# INTEGRATED REGIONAL WATER MANAGEMENT PLAN

## FOR SOUTH ORANGE COUNTY

UPDATED 2018

*Cover art courtesy of Orange County Water District*

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# LIST OF ACRONYMS

| | |
|---|---|
| § | subsection |
| AB | Assembly Bill |
| ABBRA | American Boat Builders & Repairers Association |
| AFY | Acre Feet per Year |
| ALERT | Automatic Local Evaluation on Real Time |
| AMP | Allen-McColloch Pipeline |
| AOGCM | Atmosphere Ocean General Circulation Models |
| ASBS | Areas of Special Biological Significance |
| ATM | Aufdenkamp Transmission Main |
| BLRP | Bacteria Load Reduction Plans |
| BMP | Best Management Practice |
| BOS | Board of Supervisors |
| CARB | California Air Resources Board |
| CBP | Clean Beach Project |
| CCA | Critical Coastal Area |
| CDFW | California Department of Fish and Wildlife |
| CDP | Census Designated Place |
| CEC | Constituents of Emerging Concern |
| CEDEN | California Environmental Data Exchange Network |
| CEFCAC | City Engineers Flood Control Advisory Committee |
| CEIC | California Environmental Information Catalog |
| CEQA | California Environmental Quality Act |
| CERES | California Environmental Resources Evaluation System |
| cfs | Cubic Feet per Second |
| CIP | Capital Improvement Program |
| CLRP | Comprehensive Load Reduction Plan |
| CLWC | California Latino Water Coalition |
| CRA | Colorado River Aqueduct |
| CSRM | Constantly Stirred Reactor Model |
| CTP | Coastal Treatment Plan |
| CWA | Clean Water Act |
| CWC | California Water Code |
| CWP | California Water Plan |
| CWRP | Chiquita Water Reclamation Plant |
| CUWCC | California Urban Water Conservation Council |
| DAC | Disadvantaged Communities |
| DAMP | Drainage Area Management Plan |
| DMS | Data Management System |
| DRPP | Demand, Runoff, and Pollution Prevention |
| DWR | Department of Water Resources |
| EC | Executive Committee |
| EDA | Economically Distressed Areas |

## LIST OF ACRONYMS

| | |
|---|---|
| EIR | Environmental Impact Report |
| EO | Executive Order |
| EPA | Environmental Protection Agency |
| ET | Evapotranspiration |
| ETWD | El Toro Water District |
| FACC | Funding Area Coordination Committee |
| FEMA | Federal Emergency Management Agency |
| FEIR | Final Environmental Impact Report |
| FIB | Fecal Indicator Bacteria |
| FOG | Fats, Oil and Grease |
| GAC | Granular Activated Carbon |
| GAMA | Groundwater Ambient Monitoring and Assessment |
| GCM | Global Climate Model |
| GERA | Gobernadora Ecological Resource Area |
| GIS | Geographic Information System |
| GHG | Greenhouse Gas |
| GPCD | Gallons per Capita Daily |
| GPM | Gallons per Minute |
| GRF | Groundwater Recovery Facility |
| GSWC | Golden State Water Company |
| GWFMP | Groundwater and Facilities Management Plan |
| GWRP | Groundwater Recovery Project |
| HCP | Habitat Conservation Plan |
| HECW | High Efficiency Clothes Washer |
| HET | High Efficiency Toilet |
| HMP | Hydromodification Management Plan |
| HPWQC | Highest Priority Water Quality Conditions |
| HRMP | Habitat Reserve Management Program |
| HSA | Hydrologic Subarea |
| IRP | Integrated Water Resources Plan |
| IRWD | Irvine Ranch Water District |
| IRWM | Integrated Regional Water Management |
| JRTM | Joint Regional Tri-Cities Transmission Main |
| JRTP | Joint Regional Treatment Plan |
| LAWRP | Los Alisos Water Reclamation Plant |
| LBCWD | Laguna Beach County Water District |
| LHA | Latino Health Access |
| LIP | Local Implementation Plan |
| LRP | Local Resources Program |
| MEP | Maximum Extent Practicable |
| MC | Management Committee |
| MCL | Maximum Contaminant Level |

## LIST OF ACRONYMS

| | |
|---|---|
| MGD | Million gallons per day |
| MHI | Median Household Income |
| MNWD | Moulton Niguel Water District |
| MOU | Memorandum of Understanding |
| MPA | Marine Protected Area |
| MS4 | Municipal Separate Storm Sewer System |
| MSCP | Multiple Species Conservation Program |
| MSHCP | Multi-Species Habitat Conservation Plan |
| MST | Microbial Source Tracking |
| MTBE | Methyl Tert-Butyl Ether |
| MET | Metropolitan Water District of Southern California |
| MWDOC | Municipal Water District of Orange County |
| MWRP | Michelson Water Reclamation Plant |
| NCC | Natural Communities Coalition |
| NCCP | Natural Communities Conservation Plan |
| NCI | North Coast Interceptor |
| NFIP | National Flood Insurance Program |
| NGO | Non-Government Organization |
| NHEC | National Hispanic Environmental Council |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| NRCS | Natural Resource Conservation Service |
| NROC | Nature Reserve of Orange County |
| OCFD | Orange County Flood Control District |
| OCHCA | Orange County Health Care Agency |
| OCSD | Orange County Sanitation District |
| OCSP | Orange County Stormwater Program |
| OCTA | Orange County Transportation Authority |
| OCWD | Orange County Water District |
| OPR | Office of Planning and Research |
| PEA | Program Effective Assessment |
| POTWs | Publicly Owned Treatment Works |
| QA/QC | Quality Assurance/Quality Control |
| RAC | Regional Action Committee |
| RAP | Regional Action Project |
| RCFCWCD | Riverside County Flood Control and Water Conservation District |
| RCWD | Rancho California Water District |
| RMS | Resource Management Strategies |
| RMV | Rancho Mission Viejo, LLC |
| RO | Reverse Osmosis |
| ROWD | Report of Wastewater Discharge |
| RRWRP | Robinson Ranch Water Reclamation Plant |

## LIST OF ACRONYMS

| | |
|---|---|
| RTP | Regional Treatment Plant |
| RWMG | Regional Watershed Management Group |
| RWQCB | Regional Water Quality Control Board |
| SAMP | Special Area Management Plan |
| SANDAG | San Diego Association of Governments |
| SARWQCB | Santa Ana Regional Water Quality Control Board |
| SB | Senate Bill |
| SBPAT | Structural BMP Prioritization and Analysis Tool |
| SCAG | Southern California Association of Governments |
| SCCWRP | Southern California Coastal Water Research Project |
| SCCWRRS | Southern California Comprehensive Water Reclamation and Reuse Study |
| SCWD | South Coast Water District |
| SDCWA | San Diego County Water Authority |
| SDGE | San Diego Gas and Electric |
| SDP | Seawater Desalination Program |
| SDRWQCB | San Diego Regional Water Quality Control Board |
| SEP | Supplemental Environmental Project |
| SERRA | South East Regional Reclamation Authority |
| SFHA | Special Flood Hazard Area |
| SIPP | Source Identification Protocol Project |
| SJBA | San Juan Basin Authority |
| SJHU | San Juan Hydrologic Unit |
| SJVGB | San Juan Valley Groundwater Basin |
| SmarTimer | Weather-Based Irrigation Controller |
| SMC | Stormwater Monitoring Coalition |
| SMWD | Santa Margarita Water District |
| SNMP | Salt and Nutrient Management Plan |
| SOCWA | South Orange County Wastewater Authority |
| SOCWRS | South Orange County Water Reliability Study |
| SWAMP | Surface Water Ambient Monitoring Program |
| SWRCB | State Water Resources Quality Control Board |
| SWRP | Stormwater Resource Plan |
| TAF | Thousand-Acre-Feet |
| TBA | Tert Butyl Alcohol |
| TCE | Trichloroethylene |
| TCWD | Trabuco Canyon Water District |
| TDS | Total Dissolved Solids |
| TMDL | Total Maximum Daily Load |
| USACE | United States Army Corps of Engineers (The Corps) |
| USBOR | United States Bureau of Reclamation |
| USDA | United States Department of Agriculture |
| USFWS | United States Fish and Wildlife Service |

## LIST OF ACRONYMS

| | |
|---|---|
| USGS | United States Geological Survey |
| UST | Underground Storage Tanks |
| UV | Ultraviolet |
| UWMP | Urban Water Management Plan |
| VOC | Volatile Organic Compound |
| WAP | Watershed Action Plan |
| WDL | Water Data Library |
| WEI | Wildermuth Environmental, Inc. |
| WMA | Watershed Management Area |
| WSL | Water Smart Landscape |
| WQIP | Water Quality Improvement Plan |
| WQMP | Water Quality Management Plan |
| WRCOG | Western Riverside Council of Governments |
| WUE | Water Use Efficiency |

**SOUTH ORANGE COUNTY WATERSHED MANAGEMENT AREA**
**2017 INTEGRATED REGIONAL WATER MANAGEMENT PLAN**
***An Integrated, Healthy and Balanced Watershed***

*The South Orange County Integrated Regional Water Management (IRWM) Plan has been developed from, and coordinates with, existing plans and research documents provided by the participating agencies in a manner that identifies and integrates regional projects to improve water supply, protect water quality, enhance the environment, and provide flood risk management. This Plan establishes a priority ranking to help further regional efforts to investigate the feasibility of, and identify funding for, these projects. Individual projects, however will go through the appropriate environmental review and permitting process as funding is secured.*

# 1 INTRODUCTION

Located along the scenic and temperate southern coast of California, South Orange County is rich with history. Legacies passed on from native societies, once expansive cattle ranches, and twentieth-century entrepreneurial farmers remain a part of the area's culture today. From the landmark Mission San Juan Capistrano near the stunning western coastline to the United States Department of Agriculture (USDA), Forest Service, Cleveland National Forest in the east, South Orange County continues to be a destination known for beauty and a high quality of life.

Following the national migration trends after World War II that drew citizens to Sunbelt cities, the region transitioned into one of the newest areas of urban development in the early 1960's. Several cities have been incorporated over the subsequent decades during which population increased to approximately 600,000 residents. Most of the coastline is developed and additional urbanization is anticipated in the backcountry ranch land over the next 20- years. Today, the region's social and cultural makeup includes a unique mix of equestrian lifestyle, authentic Mexican/Hispanic culture, and a progressive business industry.

The Juaneño Band of Mission Indians traditionally known as the Acjachemen nation is the indigenous Native American Indian tribe of the lands now known as Orange and San Diego Counties. The Acjachemen territory extended from Las Pulgas Creek in northern San Diego County, up into the San Joaquin Hills along the Orange County's central coast, and inland from the Pacific Ocean up into the Santa Ana Mountains. The bulk of the population occupied the outlets of two large creeks, San Juan Creek and San Mateo Creek. The Juaneño Band of Mission Indians is on the contact list maintained by the Native American Heritage Commission and they are included in this Plan as a South Orange County stakeholder; however, the Juaneño Band is not federally recognized, nor is the tribe land owning. They are headquartered in the City of San Juan Capistrano.

The region's economy has come into its own from the shadows of Los Angeles to the north and San Diego to the south with a unique technological and business infrastructure. This is demonstrated by the diversity of industries represented – from medical devices to construction – as well as intellectual resources to support this diversity. Stakeholders in the area are comprised of residents, businesses, and water agencies/Cities as described in **Section 2.3** Regional Water Management Responsibilities. **Figure 1-1** on the following page shows a map of South Orange County.


**Figure 1-1: South Orange County Map**

Water is the key element for sustaining the South Orange County economy, allowing the region to thrive. Significant local investments in water, sewer, and flood infrastructure have been made in the past to serve the area on a reliable basis. Planning and associated investments to carry the region through the next 25-year planning horizon are central to preserving the quality of life in South Orange County. Planning for flood management; surface runoff management; watershed management; water use efficiency (WUE); water supply and reliability; recycled water; habitat preservation, conservation and restoration; water quality protection and improvement; resource stewardship; and related water resource management strategies (RMSs) is critical. **Figure 1-2** shows the South Orange County IRWM Plan Goals, which are discussed in further detail below and in **Section 4** Objectives**.**

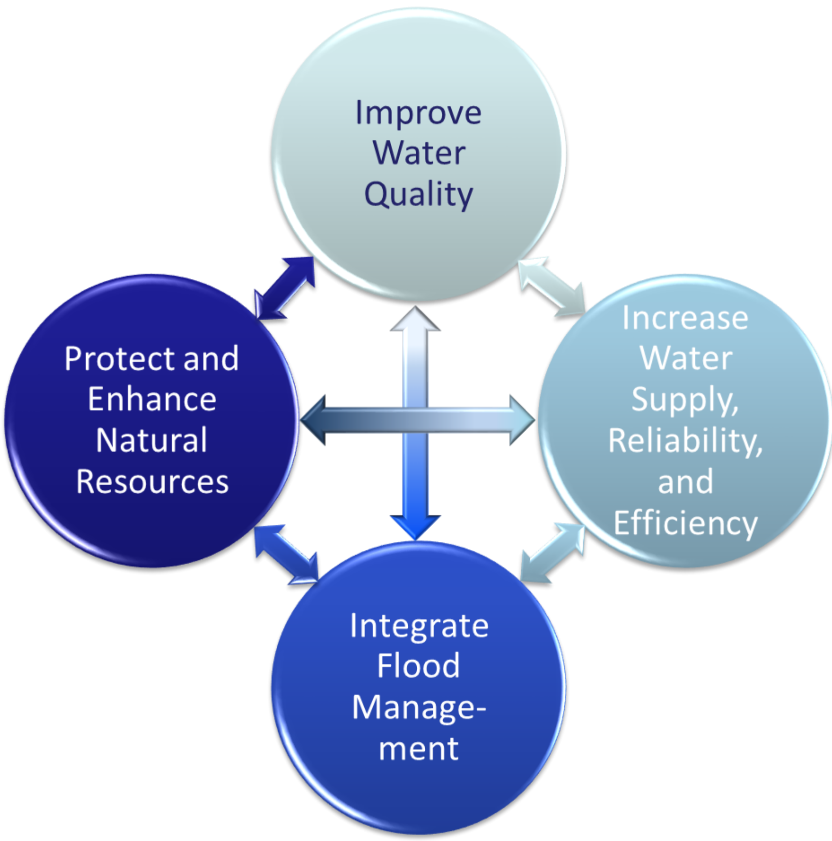


**Figure 1-2: South Orange County IRWM Plan Goals**

***Water Resource Planning in South Orange County***

Water quality improvement efforts over the last decade have resulted in significant improvements in coastal water quality along the County's beaches. The Heal the Bay Annual Report (2016) states that the County grades for year-round dry weather were excellent and wet weather grades fair, besting the five-year average for dry weather. Coastal and surface water quality remains an important component of the region's IRWM planning. Key goals for the region include reducing runoff and improving the water quality in streams and along beaches.

Another key goal of the region is expansion, protection and efficient use of local and regional water supplies, as described in **Section 4.1.2**. As a whole, South Orange County water supply is predominately from imported sources, making the region subject to outside conditions and agencies. The South Orange County IRWM Plan is aimed at diversifying water sources by developing a variety of local opportunities to decrease reliance on imported sources. For example, the local San Juan Groundwater Basin[1] has been the subject of multiple management programs for treating brackish waters and managing wet year supplies for use during dry year conditions. South Orange County agencies are leaders in implementing water recycling projects to turn wastewater into a resource. Urban water reuse projects are being developed to reduce runoff and utilize local resources. Additionally, water use efficiency projects have become a standard for water management, including Weather-Based Irrigation Controllers (SmarTimer), drip irrigation, rain barrel and landscape retrofit programs. Indeed, a clear nexus exists between projects needs for water quality and water supply. Protection of surface water quality beneficial uses can align with opportunities to enhance local supply through water reclamation, conservation, stormwater capture/treatment, and groundwater and seawater desalination.

South Orange County agencies and stakeholders place a strong emphasis on watershed planning and integration. Over the past decade, the County, cities, water and wastewater agencies and public stakeholders have participated in watershed-level studies and plans to assess and develop projects to enhance the overall health of South Orange County watersheds (Aliso Creek, Dana Point Coastal Streams, Laguna Coastal Streams, San Juan Creek, San Clemente Coastal Streams, and San Mateo Creek). Water quality efforts are described in **Sections 3.3.4, 4.3.2, 5.4.2, and 13.4**. These efforts include, but are not limited to:

- Watershed Management Plans were completed for the Aliso Creek, and San Juan Creek watersheds. These were among the first efforts to study overall watershed health and included recommendations and actions for implementation on a collective basis among the many watershed partners. Watershed Workplans[2] were developed and updated through 2014 for the watersheds in the San Diego Region to comply with Directive G of the San Diego Regional Water Quality Control Board's (SDRWQCB) Order (Regional Board Order No. R9-2009-0002). The Watershed Workplans described the Watershed Permittees' development and implementation of a collective watershed strategy to assess and prioritize the water quality challenges within the watershed's receiving waters, identify and model sources of the highest priority water quality problem(s), develop a watershed-wide Best Management Practices (BMP) implementation strategy to abate highest priority water quality problems, and a monitoring strategy to evaluate BMP effectiveness and changing water quality prioritization in the watershed.

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[1] State Department of Water Resources California's Groundwater Bulletin 118 refers to the "San Juan Valley Groundwater Basin" for the South Coast Hydrologic Region.

[2] OC Watersheds, Watershed Workplans, available online 6/28/16: http://prg.ocpublicworks.com/DocmgmtInternet/Search.aspx

- Comprehensive water quality analyses for South Orange County watersheds, including annual water quality analyses for Aliso Creek watershed[3], a San Juan Creek Watershed Bacterial Study[4], and the 2014 Report of Waste Discharge State of the Environment Report[5] which provided a comprehensive watershed-based review of TMDL and NPDES compliance over several years and utilized indices of watershed health apart from water quality exceedances.
- Watershed Infiltration Hydromodification Management Plan (WIHMP) mapping tools developed in 2014-15 provided an initial GIS screening tool for infiltration BMP site suitability at a watershed and sub-watershed level; analysis considered land use, soils, slope, ownership, channel morphology and drainage[6].
- A Water Quality Improvement Plan (WQIP) was developed by the County and South Orange County cities for all watersheds in South Orange County (the San Juan Hydrologic Unit) and submitted in April 2017 to comply with SDRWQCB Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 (CAS0109266, also referred to as the Fifth Term MS4 NPDES Permit). The WQIP establishes water quality priorities for the watershed area based upon a comprehensive watershed-based geospatial and index-based analysis of water quality, geomorphic and hydrologic data[7]. The WQIP development process provided for extensive stakeholder and public input and review; WQIP implementation will continue to involve stakeholders.
- An Orange County Stormwater Resource Plan (OC SWRP) was produced to meet functional equivalency for SB 985 and to provide watershed-based planning for stormwater projects in Orange County. The OC SWRP aligns with the South Orange County IRWM Plan in many ways, including watershed planning, identification and prioritization of projects and establishing watershed-based priorities inclusive of water quality, water supply, natural resources and flood management. The OC SWRP has been included in the IRWM Plan as **APPENDIX L**. For more information about the OC SWRP, please visit the webpage.

Another example of the region's progressive approach to water management is the Municipal Water District of Orange County (MWDOC) and the South Orange County water districts' ongoing commitment to water supply system reliability. MWDOC completed a new Orange County Reliability Study in December 2016. Phase 1 of the study completed in December 2015 estimated supply and system gaps between forecasted water demands and existing/planned water supplies, with water demand forecast and supply gap analysis, Orange County supply simulation modeling, and Orange County basin simulation modeling. Phase 2 of the study

[3] Annual water quality assessments for Aliso Creek

[4] San Juan Creek Watershed Bacterial Study

[5] 2014 Report of Waste Discharge – San Diego Region State of the Environment

[6] WIHMP mapping data available at OC Environmental Resources GIS Portal

[7] The WQIP was submitted to the SDRWQCB on April 1, 2017; the WQIP will not be in effect until receipt of SDRWQCB approval. Stakeholder and public involvement is described here.

develops and evaluates illustrative portfolios of additional supply projects that could be implemented by the Metropolitan Water District of Southern California (MET) and MET member agencies, which includes all Orange County agencies. Phase 2 was completed in August 2016 and the final report completed in December 2016. The study is highly collaborative, involving over 25 meetings of a workgroup made up of managers from MWDOC, MWDOC member agencies, Orange County Water District (OCWD), and the cities of Anaheim, Fullerton, and Santa Ana.

***IRWM Planning in South Orange County & Protection of Water Resources***

The region embraced the IRWM Planning Act of 2002 to enhance forward planning in an even more coordinated fashion. In 2008, SBX2-1 (Perata) repealed and replaced the IRWM Planning Act and appropriated funding from two initiatives passed by voters in 2006 - Proposition 84 and Proposition 1E.

The County of Orange, cities, and water and wastewater agencies of South Orange County formed the South Orange County IRWM Group in 2004 and subsequently developed and adopted the South Orange County IRWM Plan in 2005. The IRWM Group established the South Orange County IRWM region as a cooperative framework for planning and implementing water management strategies in the region.

The South Orange County IRWM Group was recognized as a region during the Proposition 50 IRWM Program Implementation Grant effort in 2005. In 2007, the South Orange County IRWM Region was awarded Proposition 50 funding. Subsequently in 2009 the South Orange County Watershed Management Area (WMA) was recognized as a region during Department of Water Resources (DWR) Regional Acceptance Process.

The South Orange County IRWM Group embraces the IRWM model because it brings together short term and long term management strategies that will protect and enhance water resources in the WMA. The South Orange County agencies maintain the belief that water management strategies can, and should be, integrated to provide a reliable water supply, protect and improve water quality, and achieve other objectives.

The IRWM Plan is designed to help local agencies and governments manage their water, wastewater, and ecological resources. The purpose of the IRWM Group in developing this Plan is to identify potential projects intended to improve water quality and supply in order to investigate their feasibility, engage in long range water planning, establish priorities among the proposals of the member entities and obtain potential funding. As the IRWM Plan is implemented, the County, as agent of the State of California, will serve as a conduit for funding to the individual agencies proposing the projects. This IRWM Plan does not commit any resources to implementation of any project nor does its creation constitute a commitment by the County or any member entity to carry out any of the proposed projects. Determinations to proceed with individual projects and required environmental review under the California Environmental Quality Act (CEQA) will be performed by the individual agencies prior to approval of funding.

Agencies within the coastal zone of South Orange County face unique environmental challenges relative to inland areas, including the protection of millions of visitors who utilize the ocean for recreation each year, as well as protection of the unique marine resources from polluted runoff. This IRWM Plan includes strategies to comply with the Porter-Cologne Act and Clean Water Act (CWA), and protect beneficial uses of receiving waters to improve water quality of the coastline. Within the South Orange County WMA, the County coastline includes one Area of Special Biological Significance (ASBS) and Heisler Park Ecological Reserve. In addition, there are three locations within the South Orange County WMA that are on the California's Critical Coastal Areas (CCA) list – San Juan Creek, Aliso Creek, and Heisler Park Ecological Reserve.

This IRWM Plan supports the state priorities that relate to the California Water Plan (CWP) Update 2013, the Delta Stewardship Council, the DWR Water Recycling Task Force Recommendations, the State Water Resources Control Board (SWRCB) Recycled Water Policy, Governor Schwarzenegger's 20x2020 Water Conservation Plan of 2010, Greenhouse Gas (GHG) emissions reduction goals of AB 32, the Water Desalination Task Force Recommendations, the California Ocean Plan, the California Watershed Action Plan, the TMDL List, the comprehensive Orange County Drainage Area Management Plan (DAMP) and subsequent Reports of Wastewater Discharge (ROWD), and the Regional Water Boards Watershed Management Initiative Chapters.

The 2018 IRWM Plan update further addresses updated Climate Change Standards, CEQA Tribal Consultation changes, amendments to the IRWM Planning Act related to IRWMs with nitrate, arsenic, perchlorate, or hexavalent chromium contamination (AB 1249), incorporation of the Orange County Stormwater Resource Plan (OC SWRP) per SB 985, and amended standards for determining Economically Distressed Areas (EDAs). The Plan considers IRWM planning concepts and aforementioned State standards/legislation through the integration of projects and programs that incorporate a wide range of water management strategies. Beneficial effects from implementation of proposed projects and programs will contribute to the goals and objectives of the local, regional and statewide priorities.

In addition to State Standards and goals, this IRWM Plan incorporates the 2016 South Orange County WMA regional priorities developed by the Executive Committee through an extensive strategic visioning process to: 1) Develop sustainable water supplies, 2) Cultivate storage for potable and recycled water, and stormwater/low flow capture, and 3) Foster regional projects to maximize water resources. These regional priorities support the Region's IRWM Plan Goals by closely aligning with the Statewide Priorities discussed in **Section 4.1.1** and the RMS discussed in **Section 5**. IRWM Plan Objectives discussed in **Section 4** also support these priorities. As the strategic visioning process was intended to capture priorities based upon known current conditions, the priorities will be updated as needs shift within WMA.

# 2 GOVERNANCE

The South Orange County IRWM Group was recognized as a region in 2005 during the Proposition 50, Chapter 8 IRWM Program Implementation Grant (Prop 50) Round 1 effort.

In January 2007, the South Orange County IRWM Plan was one of seven statewide proposals recommended for funding. In July 2007, the South Orange County IRWM Group executed a Prop 50 IRWM Implementation Grant Agreement with the SWRCB to receive grant funds in an amount of $25,000,000 for the seven highest ranking projects included in the South Orange County IRWM Plan.

In September 2009, the South Orange County WMA was recognized as a region during the RAP. The County of Orange was selected to submit the RAP materials on behalf of the South Orange County IRWM Group[8]. This section provides description of the composition and structure of the South Orange County IRWM Group, including their role in the WMA, regional watershed management responsibilities, the working relationship of the IRWM Group, and the public outreach process. In addition, this section discusses the relationship between the three IRWM regions within the San Diego Funding Area – San Diego, Upper Santa Margarita, and South Orange County – and the coordination structure within the San Diego Funding Area. The region continues to work together to plan, prioritize, and fund projects in an integrated effort.

## *2.1 South Orange County IRWM Group*

### 2.1.1 Governance Model for the County of Orange

In June 2003, per direction from the County of Orange Board of Supervisors (BOS), the Orange County Public Works (OC Public Works) Department (formerly the Resources and Development Management Department) led a task force of city managers and special district general managers to develop a countywide Water Quality Strategic Plan. The task force proposed a new governance model for water resource management programs based on three geographic sub-areas or Watershed Management Areas (WMAs) of the County: North, Central, and South Orange County.

The WMA Governance Model:

- Continues the watershed approach at a manageable scale
- Is consistent with the approach of new and future stormwater permits
- Facilitates meaningful public and private stakeholder involvement
- Allows for sub-area control of priorities
- Is similar to the Measure M structure (renewed Measure M is a local measure that is intended to provide funding for environmental projects and programs)
- Follows the successful model of the Newport Bay Watershed Executive and Management Committees (MC)
- Accommodates differences in RWQCBs (Orange County overlaps two jurisdictions)

[8] South Orange County Watershed Management Area – Region Acceptance Process, April 2009

- Accounts for differences in existing infrastructure
- Promotes partnership opportunities, especially between cities and districts
- Fits the logic of the DAMP, ROWDs, WQIP and OC SWRP
- Allows for optimum use of existing and future funding sources
- Can be accomplished through interagency agreements

From this water quality strategic planning effort, the County of Orange was designated to serve as a regional program administrator. The WMA concept formalizes a partnership between the County, the Orange County Flood Control District (OCFCD), cities, and water and wastewater agencies. It builds upon the long-term cooperative model for managing the countywide municipal stormwater program, as well as other desirable features from the partnerships that have been developed to manage Total Maximum Daily Load (TMDL) programs (e.g. Beaches and Creeks Indicator Bacteria TMDL).

### 2.1.2 Formation of South Orange County WMA

In August 2004, the County, South Orange County Cities, and special districts within the jurisdiction of the San Diego Water Board formed the South Orange County IRWM Group to continue this collaborative effort and to more efficiently coordinate their efforts through the development of an IRWM Plan.

The South Orange County IRWM Group has worked individually and collaboratively over the years to develop IRWM strategies to plan for:

- Flood management
- Surface runoff management
- Watershed management
- Water use efficiency
- Water supply and reliability
- Recycled water
- Habitat preservation
- Conservation and restoration
- Water quality protection and improvement
- Resource stewardship
- Related resource management

The South Orange County IRWM Group comprises the following jurisdictions:

- Aliso Viejo
- County of Orange (including the Orange County Flood Control District (OCFCD))
- Dana Point
- Laguna Beach
- Laguna Hills

- Laguna Niguel
- Laguna Woods
- Lake Forest
- Mission Viejo
- Rancho Santa Margarita
- San Clemente
- San Juan Capistrano

The South Orange County IRWM Group comprises the following agencies and special districts:

- City of San Clemente Utilities Divisions
- City of San Juan Capistrano Water Services Department
- El Toro Water District (ETWD)
- Irvine Ranch Water District (IRWD)
- Laguna Beach County Water District (LBCWD)
- Moulton Niguel Water District (MNWD)
- Municipal Water District of Orange County (MWDOC)
- Santa Margarita Water District (SMWD)
- South Coast Water District (SCWD)
- South Orange County Wastewater Authority (SOCWA)
- Trabuco Canyon Water District (TCWD)

Other agency and special district participants include, but are not limited to:

- California State Parks
- Natural Resources Conservation Service (NRCS)
- Natural Communities Coalition (NCC)
- Orange County Health Care Agency (OCHCA)
- San Diego Regional Water Quality Control Board (SDRWQCB)
- San Juan Basin Authority (SJBA)
- United States Army Corps of Engineers (USACE), Southern California offices
- United States Department of Agriculture (USDA), Forest Service, Cleveland National Forest

### 2.1.3 South Orange County IRWM Plan Adoption Status

The 2005 South Orange County IRWM Plan established the County as the lead agency for IRWM Plan implementation, and MWDOC and SOCWA as providers of significant resources and leadership in the South Orange County WMA. Therefore, the Board of Directors for each of these three agencies adopted or accepted the IRWM Plan by resolution as follows (refer to **APPENDIX D**): The Orange County BOS accepted on June 7, 2005, Resolution No. 05-143; the

MWDOC of Directors adopted on June 15, 2005, Resolution No. 1768; and the SOCWA Board of Directors adopted on June 2, 2005, Resolution No. 2005-07. In addition to the resolutions stated above, the following IRWM Group participants adopted, accepted, or approved the IRWM Plan in 2005 (or subsequently, where noted):

***Resolutions of Adoption***

- City of Aliso Viejo
- City of San Juan Capistrano
- County of Orange
- El Toro Water District
- Irvine Ranch Water District
- Laguna Beach County Water District (2015)
- Municipal Water District of Orange County
- San Juan Basin Authority
- Santa Margarita Water District
- South Coast Water District
- South Orange County Wastewater Authority
- Trabuco Canyon Water District

***Resolutions of Acceptance***

- City of Dana Point
- City of Laguna Beach
- City of Laguna Niguel
- City of Laguna Woods
- City of Mission Viejo
- City of San Clemente
- The County of Orange
- Moulton Niguel Water District

***Resolutions of Support***

- City of Laguna Hills
- City of Rancho Santa Margarita

***Letters of Support***

- City of Lake Forest

***Letters of Adoption***

- USDA, Forest Service, Cleveland National Forest (2015)

The South Orange County IRWM Plan was updated in 2013 to meet the Proposition 84 state guidelines; this 2018 update meets Proposition 1 state guidelines and Plan Standards. The IRWM Plan updates went through the same adoption process established for the 2005 IRWM Plan and was adopted by the IRWM Group. The resolutions adopting the IRWM Plan Adoption are included in **APPENDIX D**.

## *2.2 South Orange County WMA Structure and Process*

To further solidify this collaborative effort, the South Orange County IRWM Group has established a Cooperative Agreement (included in **APPENDIX A**) amongst its members. The Agreement provides a framework for planning and implementing water management strategies in the South Orange County WMA and executing an effective decision making process. The cooperative efforts may include but are not limited to addressing water quality impairments; establishing priorities for water resources needs; integrating water resource solutions across traditional disciplinary bounds; and jointly advocating for policies and funding that assist these goals. Through authority of this Agreement the South Orange County IRWM Group has established an Executive Committee (EC) through which the South Orange County WMA shall be governed and decision making will be effectively accomplished. A Management Committee (MC) was also formed to support the EC, and other Ad Hoc or Standing Committees, as created by the EC, may also be formed. **Figure 2-1** below shows the organizational structure of the South Orange County IRWM Group.

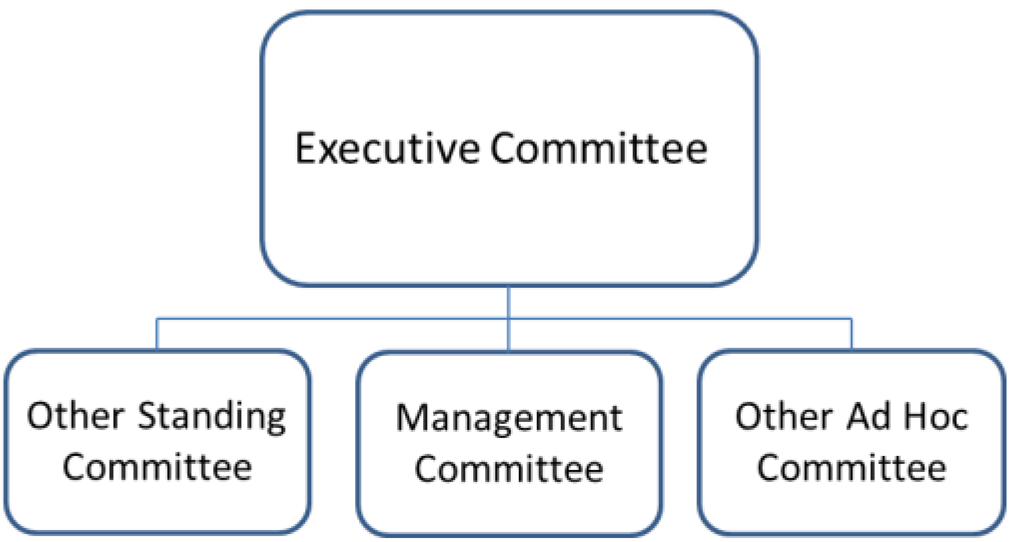



**Figure 2-1: South Orange County WMA Governance Structure**

### 2.2.1 Executive Committee

The South Orange County WMA adopted Cooperative Agreement and decision-making framework is governed by the EC of the South Orange County IRWM Group. Each of the parties shall appoint an elected or executive level official from its organization to serve as its member and alternate on the EC. Representatives will serve on the EC at the pleasure of their appointing party. Each of the parties shall designate a senior staff person as the point of contact to fulfill the intended purpose of the Agreement. Regarding matters for which the EC votes, each voting member (of the signatory agencies to the Agreement) shall have one vote. Actions of the EC shall be approved upon the affirmative vote of a majority of the representatives present. A simple majority of the EC shall constitute a quorum.

The EC will have the following duties and powers:

a. Identify and prioritize water resource issues, problems and improvement projects.

b. Establish policy direction for the South Orange County WMA and its committees.

c. Approve an annual work plan for the South Orange County WMA.

d. Approve an annual cost-shared budget for the administration and activities of the South Orange County WMA, its committees, projects, or actions, including any administrative support for the South Orange County WMA.

e. Approve significant updates of the South Orange County IRWM Plan and its prioritized lists of projects and activities.

f. Approve grant applications for funding South Orange County WMA projects or programs.

g. Allocate any new non-grant revenue sources available for South Orange County WMA projects based on capital improvement plan priorities.

h. Encourage and facilitate voluntary agreements between the parties to fund and implement South Orange County WMA projects and programs.

i. Review and report to the parties as to whether adequate and reasonable progress is being made on water quality and water resource issues in the South Orange County WMA.

j. Elect a chair and vice-chair.

k. Meet upon the request of the chair, but at least every six months unless the parties agree to meet less frequently.

l. Convene committees and workshops as deemed appropriate.

m. Establish procedures and rules of conduct for the group, as needed.

The EC cannot bind the parties' respective organizations. All recommendations of the EC requiring funding or action on behalf of any party are subject to approval by the parties' governing bodies and subject to the budget process governing those bodies.

### 2.2.2 Management Committee

The Management Committee (MC), composed of an executive level manager or executive officer from participating agencies, will meet, as appropriate, for the purpose of discussing IRWM Plan implementation and refinement issues, and to provide recommendations to the EC and South Orange County IRWM Group. The MC will implement interim and long-term updates and/or amendments to the IRWM Plan approximately every five years or as needed. The MC will perform strategic decision making, make project recommendations, coordinate project implementation, and provide program advocacy. Activities of the MC will facilitate focused and streamlined South Orange County IRWM Group meetings. These representatives have voting authority at the MC level for recommendation to the IRWM Group and EC.

The MC will have the following duties and responsibilities:

- To recommend an annual cost-shared budget for the administration and activities of the South Orange County WMA, its committees and projects or actions.
- To recommend an annual work plan for the South Orange County WMA for updates and implementation of the South Orange County IRWM Plan, including updates that may be funding source specific.
- To recommend the multi-year capital improvements plan and funding source specific prioritizations that would support implementation of the IRWM Plan.
- To make recommendations for the allocation of any revenue such as grant funding that the South Orange County WMA receives to projects and activities based on priorities articulated in the IRWM Plan.
- Where consensus exists, to authorize the County to apply for grants or seek other funds to support the implementation of the South Orange County IRWM Plan
- With staff, prepare recommendations for the allocation of any revenue that the South Orange County WMA receives for projects and activities based on priorities of the IRWM Plan.
- To initiate studies or investigations of the feasibility or appropriateness of projects or courses of action within the scope of the South Orange County IRWM Plan.
- To monitor performance of the South Orange County IRWM Plan implementation and projects to ensure quality efforts are accomplished.
- To evaluate implementation projects and efforts to recognize successful projects and efforts and to improve performance of less successful projects.
- To ensure performance, analytical and other data and information is managed in a manner that allows it to be accessed and utilized for the benefit of the South Orange County WMA and the State.

For other local, State and Federal agencies involved in the South Orange County WMA but not representing a signatory to the agreement, a representative will participate in an advisory capacity, when requested by the MC. EC meetings and other stakeholder-based workshops provide further opportunities for members of the public and other local, State and Federal agencies to participate in the South Orange County WMA planning efforts. Additionally, the Tri-FACC will conduct a Water Needs Assessment in 2018 to further identify and engage DAC, EDA and URC communities within the tri-county area. This effort will include outreach to and coordination with local stakeholders. This process is further described in **Section 3.6**.

On matters on which the MC votes, each representative shall have one vote. Actions of the MC shall be adopted upon the affirmative vote of a majority of the MC present. A simple majority of the MC shall constitute a quorum. The MC will meet as needed but no less than four times per year.

### 2.2.3 Other Standing Committees or AdHoc Committees

Other Standing or AdHoc Committees shall function solely as advisory to the MC and/or EC. These Committees may provide advice and information on plan objectives, priorities and programs. Additionally, the IRWM Group will conduct ongoing outreach to stakeholders including tribal representatives, through the Water Needs Assessment process described in **Section 3.6**. One of the goals of the Water Needs Assessment process is to form long-term engagement of DAC, EDA and URC groups, including identification of potential partnerships, projects, and opportunities for ongoing engagement with the IRWM Group, MC and EC. Stakeholder involvement is also described in **Sections 2.6.3, 2.7,** and **Section 11**.

The Committees will continue to meet, as determined appropriate, for the purpose of discussing IRWM Plan implementation and refinement issues, and to provide recommendations to the larger IRWM Group.

### 2.2.4 Overall Committee Structure and Support

The County will provide staff to support the South Orange County IRWM Group and its Committees. The Committees will continue to perform strategic decision making, project recommendations, coordination of project implementation, and provide program advocacy. Activities of the Committees will facilitate focused and streamlined IRWM Group meetings.

This three-layer method of administration will promote partnership opportunities between cities and special districts, as well as elected officials and non-elected representatives. It will also facilitate ongoing and meaningful public and private stakeholder involvement, group participation and decision making, while focusing on one administering agency for coordination and management. The administrating agency will be accountable to the IRWM Group and outside funding sources that require regional applications and agreements.

Each South Orange County IRWM Group member shall provide appropriate staff to actively participate in IRWM efforts and committees. Decisions regarding the South Orange County WMA will be determined primarily by consensus but for matters on which the EC and MC vote, each member with voting privileges shall have one vote. Actions of the EC and MC shall be adopted upon the affirmative vote of a majority of the committee present. A simple majority shall constitute a quorum.

## *2.3 Regional Water Management Responsibilities*

The following sections describe the South Orange County IRWM Group varying levels of regional water management responsibility as well as provide an overview of other groups, agencies and stakeholders involved in IRWM Plan implementation through various support roles.

### 2.3.1 Jurisdictional IRWM Group Participants (City and County)

The water management responsibilities of the cities of Aliso Viejo, Dana Point, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Mission Viejo, Rancho Santa Margarita, San Clemente and San Juan Capistrano are largely tied to surface runoff and their roles as members of the Orange County Stormwater Program (OCSP), a collaborative program between the County of Orange, all incorporated cities within the County, and the OCFCD, formed to comply with the requirements of NPDES Municipal Separate Storm Sewer System (MS4) Permits. The OCSP own and operate MS4s, therefore they are required under the Federal CWA to obtain an NPDES MS4 permit to:

- Effectively prohibit non-stormwater discharges into the MS4, and
- Develop controls to reduce the discharge of pollutants into MS4s to the Maximum Extent Practicable (MEP), including management practices, control techniques and system, design and engineering methods, and such other provisions as Administrator or the State determines appropriate for the control of such pollutants.

In response to these regulations the OCSP has obtained, renewed, and complied with NPDES MS4 permits from both the Santa Ana and SDRWQCB's since 1990. They have also developed a DAMP, subsequent ROWDs and other programmatic documents, which detail and/or summarize the specific water pollutant control program elements for the OCSP to demonstrate compliance with NPDES MS4 permit requirements. Individual cities each have a Local Implementation Plan (LIP) to implement the DAMP at a local level to direct city stormwater compliance activities.

To effectively carry out the requirements of the OCSP, the Permittees in both Regional Board areas agreed that the County would be the Principal Permittee and the OCFCD and the incorporated cities would be Permittees. As the Principal Permittee, the County has managed the overall stormwater program cost effectively by combining resources to complete activities that benefit all of the Permittees. The County, as Principal Permittee, collaborates with all Permittees by facilitating the following:

- Providing administrative and technical support for the Permittees and the committees within the management structure;
- Developing and executing inter-governmental agreements necessary for program implementation;
- Planning and implementation needed to direct and implement the program for short and long term;
- Developing BMPs;
- Developing reports and other materials required by the NPDES MS4 permits;
- Developing budgets and fiscal analyses;
- Reviewing and developing policy positions and representing the OCSP before appropriate agencies; and
- Program coordination with all affected local government agencies.

The following is a brief description of each of the IRWM Group jurisdictions[9]:

[9] Population figures in this section represent 2015 estimates (US Census Bureau)

Land use figures included in this section represent 2013 estimates (OCPW GIS Portal)

*City of Aliso Viejo:* Aliso Viejo is a 7.5 square mile planned community with a population of approximately 50,195. Land use within the city consists of 1,896 acres residential, 686 acres commercial, 65 acres industrial, and 416 acres open space. Approximately 85 percent of the city lies in the Aliso Creek Watershed. The remaining portion in the northwest part of the city drains to the Laguna Coastal Streams Watershed.

*City of Dana Point*: Dana Point lies directly on the Pacific Coast. The city covers an area of approximately 6.5 square miles with a population of approximately 34,181 people. Land uses within the city consists of: 2,537 acres residential, 370 acres commercial and office, 37 acres industrial, and 1,316 acres community, open space, and Harbor Marine Land & Transportation. The City falls within three watersheds: Dana Point Coastal Streams, San Juan Creek, and San Clemente Coastal Streams.

*City of Laguna Beach:* Laguna Beach covers an area of approximately 8.8 square miles with a population of about 23,365 people. Developed land use within the city consists of 1,985 acres residential, 321 acres' commercial uses, 14 acres industrial and institutional, and 3,337 acres open space and recreational. The majority of these areas drain into the Aliso Creek and Laguna Coastal Streams watersheds.

*City of Laguna Hills:* Laguna Hills covers an area of approximately 6.7 square miles. The City has a population of just over 31,748 people. It is located in central Southern Orange County, and does not border the coastline. Land use within the city consists of 2,514 acres residential, 604 acres' commercial uses, 78 acres' industrial uses, and 776 acres' open space and recreation. The City falls within three major watersheds: San Juan Creek, Aliso Creek, and the San Diego Creek (part of Central WMA).

*City of Laguna Niguel:* Laguna Niguel is a 14.8 square mile planned community in South Orange County. Existing and planned use of Laguna Niguel includes 4,737 acres residential, 76 acres commercial/mixed commercial and industrial, 42 acres industrial, 211 acres public/institutional facilities and 3,622 acres' open space, recreation, and vacant areas. The city has an estimated 65,806 residents. Land formations in the City of Laguna Niguel drain into three major watersheds: Aliso Creek, Dana Point Coastal Streams/Salt Creek, and San Juan Creek/Oso Creek.

*City of Laguna Woods:* Sitting on roughly 3.1 square miles, the City of Laguna Woods is home to about 16,406 residents and is primarily a residential community. Land use within the city consists of approximately; 156 acres commercial, 1,377 acres residential, 284 acres' open space, recreation, and vacant areas, and 75.9-acres of an urban activities center. The City drains into three major watersheds: Aliso Creek, Laguna Coastal Streams, and Newport Bay watersheds.

*City of Lake Forest:* The City of Lake Forest is a master-planned city located between Interstate 5 and Saddleback Mountain in the central portion of South Orange County. The City has a population of 82,492 people within 17.8 square miles. Land uses within the city include 4,207 acres of residential, 3,845 acres of open space, recreation, and vacant areas, 1,349 acres of commercial/mixed commercial, and industrial, and 620 acres of business park/light industrial. Lake Forest falls within the Aliso Creek and Newport Bay Watersheds.

*City of Mission Viejo:* The City of Mission Viejo is one of the original master planned communities in South Orange County, with the first homes being built and sold in 1966. The

City is approximately 17.7 square miles in size with a population of approximately 97,156. Land uses within the city include 6,897 acres residential, 1,464 acres commercial/mixed commercial and industrial, 48 acres industrial, and 2,400- acres open space, recreation, and vacant areas. About 80 percent of the City is within the San Juan Creek Watershed, while the remaining 20 percent lies within the Aliso Creek Watershed.

*City of Rancho Santa Margarita*: The City of Rancho Santa Margarita is a small urban community located in the eastern portion of South Orange County along the Santa Ana Mountains. The City covers approximately 13 square miles, and is home to approximately 49,324 residents. Land use within the city consists of: 2,418 acres residential, 533 acres commercial/mixed commercial and industrial, 146 acres industrial, and 4,834 acres of open space, recreation, and vacant areas. The city drains primarily into San Juan Creek Watershed, and partially into Aliso Creek Watershed.

*City of San Clemente:* The City of San Clemente covers an area of about 18.7 square miles and has a population of approximately 65,526 people. Land use in the City consists of approximately 4,489 acres residential, 760 acres commercial/mixed commercial and industrial, 128 acres industrial, and 5,475 acres' open space, recreation and vacant areas. The city drains primarily into the San Clemente Coastal Streams Watershed, with which it shares an almost identical boundary. Small portions of the city also drain to the San Mateo Creek Watershed.

*City of San Juan Capistrano:* San Juan Capistrano is home to about 36,454 people and occupies 14.1 square miles. The city land uses consist of 2,920 acres of residential, 601 acres of commercial/mixed and industrial, 54 acres industrial, 3,997 acres of open space, recreation, and vacant areas, and 1,090 acres of other uses (e.g., roadways, highways). San Juan Capistrano lies within the San Juan Creek Watershed.

*County of Orange (including the OCFCD):* The County of Orange, represented in this process primarily by OC Public Works, is active in integrated water management in various ways. The County of Orange is both a landowner and a regional planner for the area, and is engaged in various municipal operations such as roads and flood control. Furthermore, the County is partnered with each city and the OCFD to comply with NPDES MS4 permit requirements. The County of Orange has been the primary coordinator for regional water quality testing, inspection, education and report compliance. The County has jurisdiction over several County beaches, parks, and facilities including Dana Point Harbor. OCFCD is a separate political entity, governed by the County BOS and staffed by OC Public Works. OCFCD's purpose is to: (1) control flood and storm waters within the County boundary, and streams flowing into the County; (2) improve channels to remove or reduce Federal Emergency Management Agency (FEMA) Special Flood Hazard Area (SFHA) also known as the 100-year floodplain; (3) improve deficient channels in accordance with OCFCD criteria to convey the 100-year storm event;(4) mitigate the effects of tides and waves; and (5) to protect the harbors, waterways, public highways, and property in the County from such waters.

### 2.3.2 Special Districts and Agency Participants in IRWM Group

*City of San Clemente Utilities Division:* The City of San Clemente Utilities Division covers a service area of 14.2 square miles. The City's Utility Division provides water and sewer service to a population of approximately 51,000. The city maintains 210 miles of water lines and 14 storage reservoirs, 16 pump stations, 56 pressure reducing stations, and well water capacity up to 1,100-acre foot. In addition, the city maintains 180 miles of sewer lines, 12 sewer lift stations, a 6.9 million gallons per day (MGD) water reclamation plant, and 62.5 miles of storm drain lines with 1,880 catch basins run through the City.

*City of San Juan Capistrano Water Services*: The City of San Juan Capistrano's Public Works Department took over operation of the Capistrano Valley Water District in 1997. The City of San Juan Capistrano services an area of approximately 14.4 square miles. The City has a service area population of approximately 39,000. The City has ten reservoirs, eight active pump stations (three decommissioned pump stations); two imported water connections, five emergency interconnections, and one domestic well. The City also operates a 6.2 MGD Groundwater Recovery Plant (GWRP).

*El Toro Water District (ETWD):* ETWD provides water service to approximately 49,000 residents situated on 8.5 square miles. ETWD owns and operates the largest covered drinking water reservoir in the County with a capacity of 275 million-gallons. Their average annual daily water demand is 9 million gallons. Additionally, they provide sanitation services through their wastewater treatment plant. Serviced communities include Aliso Viejo, Lake Forest, Laguna Hills, Laguna Woods, and portions of Mission Viejo.

*Irvine Ranch Water District (IRWD):* IRWD provides drinking water, wastewater collection and treatment, recycled water, and surface runoff treatment to more than 381,000 residents in Central and South Orange County. Wastewater is treated at the Michelson Water Recycling Plant and the Los Alisos Water Recycling Plant (LAWRP) providing recycled water for landscape irrigation, agriculture, industrial and commercial needs. The IRWD service area encompasses nearly 181 square miles. IRWD serves the City of Irvine and portions of Tustin, Newport Beach, Costa Mesa, Orange, and Lake Forest, Santa Ana, and unincorporated Orange County. In the South Orange County WMA, IRWD provides water services to approximately 14,000 residents.

*Laguna Beach County Water District (LBCWD):* The District operates and maintains the Aufdenkamp and the Coast Supply transmission lines which provide water from the Colorado River and Northern California. LBCWD provides water services to 19,000 people within an 8.5 square mile area of Southern Orange County, including portions of the city of Laguna Beach, a portion of Crystal Cove State Park, and the unincorporated community of Emerald Bay. LBCWD services mainly residential water users. The District sells about 4,500 acre feet of water annually. In an effort to supply a reliable source of water for the community, the LBCWD is looking to resume its groundwater pumping in the Santa Ana River Basin in addition to other water supply projects.

*Moulton Niguel Water District (MNWD):* MNWD provides water, recycled water, and wastewater service to approximately 170,000 residents within its service area. MNWD's service area is located within southern Orange County encompassing approximately 37 square miles within the Cities of Laguna Niguel and Aliso Viejo and portions of the Cities of Laguna Hills, Dana Point, Mission Viejo, and San Juan Capistrano. MNWD operates and maintains nearly 1,400 miles of pipelines, 40 reservoirs, and 62 pump/lift stations, in addition to flow control facilities, pressure reducing stations, and other related facilities. Approximately 25% of MNWD's total water demand is met by recycled water. MNWD is a participant in the Baker Water Treatment Plant, Upper Chiquita Reservoir, and Upper Oso Recycled Water Reservoir, in addition to many others.

*Municipal Water District of Orange County (MWDOC):* MWDOC provides imported water to more than 2.3 million Orange County residents through 28 retail water agencies (14 city water departments, 13 water districts, one private water company). MWDOC's service area is a total of 600 square miles. In order to maintain a more reliable water supply, MWDOC continues to implement a number of projects including storage, recycling, conjunctive use with groundwater basins; ocean desalination, and groundwater development that will contribute to enhanced water reliability.

*Orange County Health Care Agency (OCHCA):* The OCHCA is dedicated to protecting and promoting the optimal health of individuals and families through partnerships, leadership, policy development and service. The agency is highly involved with water quality in the WMA, and is responsible for water quality sampling at over 150 locations along the County coastline, an activity that has been ongoing for 45 years.

*Santa Margarita Water District (SMWD):* SMWD services 62,000 acres with a population of approximately 157,000 with potable water and recycled water and operates three sewage treatment plants. Communities serviced include Rancho Santa Margarita, Los Flores, Coto de Caza, Mission Viejo, Ladera Ranch and Talega. SMWD operates 30 domestic reservoirs containing 298 million gallons of water.

*South Coast Water District (SCWD):* SCWD delivers approximately 5,100 acre feet of potable water per year, discharges approximately 3 million gallons of wastewater per day to SOCWA wastewater treatment plants (i.e., Coastal and JB Latham treatment plants) and provides recycled water to the approximately 35,000 residents within their service area. Current operational water storage capacity is 21.9 million gallons, with an additional 31.1 million gallons of emergency storage at Bradt and Upper Chiquita reservoirs. The District's potable water distribution system consists of 151-miles of pipelines, 9 pump stations, 1,580 fire hydrants, and 14 potable system reservoirs that can store 21.9 million gallons of water. The SCWD sewer collection system consists of 136-miles of gravity pipelines, 14 lift stations, approximately three-miles of force mains and approximately 3,400 maintenance holes.

*South Orange County Wastewater Authority (SOCWA):* SOCWA was created as a regional Joint Powers Authority with ten member agencies in 2001. Its mission is the collection, transmission, treatment, and disposal of wastewater; the reclamation of wastewater for beneficial reuse as recycled water on behalf of its member agencies; and the treatment, disposal and beneficial reuse of wastewater biosolids. The authority serves approximately 520,000 residents in a 220 square mile service area which is roughly co-terminus with the area of the IRWM Plan. The SOCWA operates four regional wastewater treatment plants and two ocean outfalls.

*Trabuco Canyon Water District (TCWD):* TCWD is located in the Southeastern portion of the County at the foothills of the Santa Ana Mountains and encompasses approximately 9,100 acres. It serves an estimated population of 13,000 in the City of Rancho Santa Margarita and unincorporated area of the County; specifically, the communities of Dove Canyon, Robinson Ranch, Trabuco Highlands, Walden, Rancho Cielo, Portola Hills, Santiago Canyon Estates and Fieldstone, a section of Portola Hills. TCWD supplies approximately 3,700 acre feet of potable water through imported wholesale water supplies and local ground water. TCWD also provides wastewater, reclaimed water, and recycled water service to major communities within TCWD's service area.

### 2.3.3 Other Participants in the South Orange County IRWM Activities

In addition to the IRWM Group jurisdictions, agencies and special districts signatory to the Agreement and described in **Sections 2.3.1 and 2.3.2**, several other groups and agencies have been involved with IRWM Plan activities since the group's inception. These groups are an important part of the IRWM framework and have provided and/or continue to provide valuable input on projects, IRWM planning and regional priorities. The groups listed below have either been involved in past planning, project implementation and/or outreach efforts or are currently actively engaged in IRWM processes and activities.

*Audubon Starr Ranch:* The National Audubon Society is an over 100-year old 501(c)3 nonprofit organization whose mission is to conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats for the benefit of humanity and the earth's biological diversity. Starr Ranch is a 4,000 acre Audubon California sanctuary in southeast Orange County, California. Their mission is to offer innovative approaches to land management and environmental education that will influence the way Orange County citizens appreciate, conserve, and manage wildlands.

*California Department of Fish and Wildlife (CDFW):* CDFW (formerly California Department of Fish and Game) is responsible for conserving, protecting and managing California's fish, wildlife, and native plant resources. Per Fish and Wildlife Code Section 1602, entities are required to notify DFW of any proposed activity that may substantially modify a river, stream or lake.

*California Department of Parks and Recreation:* The California Department of Parks and Recreation seek to provide for the health, inspiration and education of Californians by helping to preserve the state's biological diversity, protecting natural and cultural resources, and creating opportunities for outdoor recreation. They have jurisdiction over several natural areas in South Orange County, including Doheny State Park Beach, San Clemente State Beach and Corona Del Mar State Beach.

*California Department of Transportation (Caltrans):* Caltrans manages more than 50,000 miles of California's highway and freeway lanes and adjacent property within rights of way, provides inter-city rail services, permits more than 400 public-use airports and special-use hospital heliports, and works with local agencies.

*Clean Water Now! Coalition:* The Clean Water Now! Coalition (defunct as of January, 2013) was dedicated to the protection, restoration and preservation of aquatic and riparian systems; stakeholders representing this group continue to participate in IRWM activities.

*Juaneño Band of Mission Indians:* The Juaneño Band of Mission Indians, traditionally known as the Acjachemen nation, is the indigenous Native American Indian tribe of the lands now known as Orange and San Diego Counties. The Acjachemen territory extended from Las Pulgas Creek in northern San Diego County up into the San Joaquin Hills along the Orange County's central coast, and inland from the Pacific Ocean up into the Santa Ana Mountains. The bulk of the population occupied the outlets of two large creeks, San Juan Creek and San Mateo Creek. The Juaneño Band of Mission Indians is on the contact list maintained by the Native American Heritage Commission and they are included in this Plan as a South Orange County stakeholder; however, the Juaneño Band is not federally recognized, nor is the tribe land owning. They are headquartered in the City of San Juan Capistrano.

*Latino Health Access (LHA):* The mission of LHA is to assist in improving the quality of life and health of uninsured, under-served people through quality preventive services and educational programs, emphasizing responsibility and full participation in decisions affecting health. LHA is primarily based out of the Central Orange County WMA; however, coordination with LHA to develop watershed-based outreach to Latino communities in Orange County during early Plan implementation was essential.

*Miocean:* Miocean was a nonprofit foundation focused on reducing urban run-off pollution affecting the County's 42-miles of coastline. They raised private sector funds to contribute to and fortify local government efforts to address ocean pollution. Throughout the foundation's tenure, 15 projects were implemented to address water quality pollution issues.

*Natural Communities Coalition (NCC):* NCC is a non-profit corporation that manages the Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP) for the Central and Coastal Subregion of the County. They coordinate land management activities of public and private landowners within the 37,000-acre reserve system, conduct wildlife and habitat research and monitoring, and restore disturbed habitats. The reserve is the result of conservation planning at the natural community level by federal and state wildlife agencies, county and city governments, major landowners, and the environmental community.

*Orange County Coastkeeper (OC Coastkeeper):* OC Coastkeeper's goal is to protect and preserve all County water bodies and restore them to healthy, fully functioning systems that will protect recreational uses and aquatic life. In pursuit of this goal, Coastkeeper balances education, advocacy, research and enforcement to increase awareness of environmental issues and reduce pollution of County watersheds and coastal waters.

*San Diego Regional Water Quality Control Board (SDRWQCB):* The SDRWQCB makes critical water quality decisions for its Region, including setting standards, issuing waste discharge requirements, determining compliance with those requirements, and taking appropriate enforcement actions.

*San Juan Basin Authority (SJBA):* The SJBA was created in 1971 as a Joint Powers Authority for the purpose of carrying out water resources development of the San Juan Basin (Basin). The current members of the SJBA are the SMWD, MNWD, City of San Juan Capistrano Water Services Department, and the SCWD. These districts are the major retail water agencies within the basin.

*Sierra Club:* The Sierra Club works to protect the planet by engaging in political activity, leading trips into nature, and organizing citizen action in local community campaigns.

*South Laguna Civic Association:* The South Laguna Civic Association is an organization of South Laguna residents striving to preserve and enhance the environment, maintain the unique village character of the community, preserve open space, conserve natural resources, and protect outstanding geographical features, ensure planned and orderly growth, inform citizens on issues affecting South Laguna, and ensure the residents of South Laguna a significant, representative voice in the future of their community.

*Surfrider Foundation (South Orange County Chapter):* Surfrider Foundation is a non-profit environmental organization working to protect the ocean, waves and beaches. The South

Orange County Chapter of Surfrider Foundation has over 1000 members who reside in the communities of Laguna Beach, Aliso Viejo, Laguna Hills, Laguna Woods, Lake Forest, Laguna Niguel, Dana Point, San Juan Capistrano, Mission Viejo, Rancho Santa Margarita, and San Clemente.

*Trout Unlimited:* Trout Unlimited is a national organization with more than 140,000 volunteers organized into about 400 chapters from Maine to Montana to Alaska. This dedicated grassroots army is matched by a respected staff of lawyers, policy experts and scientists, who work out of more than 30 offices nationwide. These conservation professionals ensure that TU is at the forefront of fisheries restoration work at the local, state and national levels.

*United States Army Corps of Engineers (USACE), Southern California Area Office:* With environmental sustainability as a guiding principle, the Corps team is working diligently to strengthen the Nation's security by building and maintaining America's infrastructure and providing military facilities where our service members train, work and live. They are protecting and restoring the Nation's environment. The Corps has worked closely with the County of Orange and other stakeholders in the South Orange County WMA managing waters of the United States and natural resources.

*USDA, Forest Service, and Cleveland National Forest:* The Cleveland National Forest spans 460,000 acres intersecting parts of Orange and Riverside Counties. The agency's mission is to sustain the health, diversity, and productivity of the nation's forests and grasslands to meet the needs of present and future generations. They provide firefighting, forestry research, as well as technical and financial help to state and local government agencies, businesses, private landowners and work government-to-government with tribes to help protect and manage non-federal forest and associated range and watershed lands. They have partnerships with public and private agencies to plant trees, improve trails, educate the public, and improve conditions in wildland/urban interfaces and rural areas. The US Forest Service also promotes sustainable forest management and biodiversity conservation internationally.

## *2.4 Statutory Authority and Plan Relationship*

The South Orange County IRWM Group includes agencies that have statutory authority over water management, as defined to include water use, water delivery, natural waters, water supply, water quality, and flood waters. The agencies are listed in **Section 2.1. Table 2-1** below provides an overview of how each entity currently contributes or has in the past contributed to the IRWM Group through either jurisdictional authority/ IRWM Group membership, or in general support of IRWM projects and activities. **Table 2-1** outlines the IRWM Group participants and their relationship to the IRWM Plan development, including their authority and support.

**Table 2-1: South Orange County IRWM Group Participants**

| *Entity* | *IRWM Plan Authority or IRWM Plan Support* |
|---|---|
| **IRWM Group Jurisdictions** | **IRWM Plan Authority** |
| County of Orange/OCFCD | IRWM Plan Group Member Agency; Land use, recreational facilities, stormwater management/protection, water quality, flood control, floodplain management |
| City of Aliso Viejo | IRWM Plan Group Member Agency; Land use, recreational programs/facilities, economic and community development, stormwater management, water quality, water conservation, solid waste and recycling, habitat restoration |
| City of Dana Point | IRWM Plan Group Member Agency; Land use, cooperation with water districts on water conservation & sanitary sewer operation and maintenance, solid waste and recycling, recreational programs/facilities, economic and community development, stormwater management, ocean water quality, planning and implementation of projects and programs to protect the MPA, planning and implementation of projects and programs to protect a CCA |
| City of Laguna Beach | IRWM Plan Group Member Agency; Land use, water service, water conservation, sanitary sewer service, solid waste, groundwater management, recreational programs/facilities, economic and community development, stormwater management, water quality; planning and implementation of projects and programs to protect the CCA and ASBS habitat protection and restoration |
| City of Laguna Hills | IRWM Plan Group Member Agency; Land use, recreational programs/facilities, economic and community development, stormwater management, water quality, water conservation, solid waste and recycling, habitat restoration, green building |
| City of Laguna Niguel | IRWM Plan Group Member Agency; Land use, recreational programs/facilities, economic and community development, stormwater management, water quality |

| *Entity* | *IRWM Plan Authority or IRWM Plan Support* |
|---|---|
| **IRWM Group Jurisdictions** | **IRWM Plan Authority** |
| City of Laguna Woods | IRWM Plan Group Member Agency; Land use, recreational programs/facilities, economic and community development, and stormwater management, water quality, water conservation, solid waste and recycling, habitation restoration, green building |
| City of Lake Forest | IRWM Plan Group Member Agency; Land use, recreational programs/facilities, economic and community development, stormwater management, water quality |
| City of Mission Viejo | IRWM Plan Group Member Agency; Land use, recreational programs/facilities, economic and community development, stormwater management, water quality |
| City of Rancho Santa Margarita | IRWM Plan Group Member Agency; Land use, solid waste and recycling, recreational programs/facilities, economic and community development, stormwater management, water quality |
| City of San Clemente | IRWM Plan Group Member Agency; Land use, water service, water conservation, sanitary sewer service, solid waste, recreational programs/facilities, economic and community development, stormwater management, water quality |
| City of San Juan Capistrano | IRWM Plan Group Member Agency; Land use, water service, water conservation, sanitary sewer service, solid waste and recycling, green building program, recreational programs/facilities, economic and community development, stormwater management, water quality |
| El Toro Water District | IRWM Plan Group Member Agency; Potable and recycled water service, water conservation, wastewater collection and treatment |
| Irvine Ranch Water District | IRWM Plan Group Member Agency; Land use, potable and recycled water service, groundwater |

| *Entity* | *IRWM Plan Authority or IRWM Plan Support* |
|---|---|
| **IRWM Group Jurisdictions** | **IRWM Plan Authority** |
| | management, water conservation, wastewater collection and treatment, habitat protection and restoration, water quality |
| Laguna Beach County Water District | IRWM Plan Group Member Agency; Potable and water service and water conservation. |
| Moulton Niguel Water District | IRWM Plan Group Member Agency; Potable and recycled water service, water conservation, wastewater collection and conveyance. |
| Municipal Water District of Orange County | IRWM Plan Group Member Agency; Water resource planning, water conservation |
| Santa Margarita Water District | IRWM Plan Group Member Agency; Potable and recycled water service; water conservation; groundwater management, wastewater collection and treatment |
| South Coast Water District | IRWM Plan Group Member Agency; Potable and recycled water service, water conservation; groundwater management, wastewater collection and treatment |
| South Orange County Wastewater Authority | IRWM Plan Group Member Agency; Wastewater collection, transmission, treatment, and disposal. The reclamation of wastewater for beneficial reuse of recycled water |
| Trabuco Canyon Water District | IRWM Plan Group Member Agency; Potable and recycled water service, water conservation, groundwater management, wastewater collection and treatment |
| Audubon California | Volunteer and organization support for programs for habitat protection and restoration, public education and water quality |
| California Department of Fish and Wildlife | Organizational support for programs to conserve, protect and manage California's fish, wildlife, and native and native plant resources |

| *Entity* | *IRWM Plan Authority or IRWM Plan Support* |
|---|---|
| **IRWM Group Jurisdictions** | **IRWM Plan Authority** |
| California Department of Transportation | Landowner, funding and organization support for projects and programs related to the State's transportation facilities |
| California State Parks | Protect and preserve the state's natural and cultural resources |
| Clean Water Now! Coalition | Volunteers and organizational support for water quality, and habitat protection/restoration |
| Juaneño Band of Mission Indians | Organizational support to help engage indigenous Native American Indian tribes in the South Orange County WMA |
| Latino Health Access | Programs and facilities related to protecting the health of Disadvantaged Communities (DAC) including water quality and recreation |
| Miocean | Funding, organizational support for programs related to protecting and improving watershed and coastal water quality; organization is no longer active – individual stakeholders represent these interests |
| Natural Communities Coalition | Organizational programs designed to manage open space areas within Central/Coastal NCCP/HCP |
| Orange County Coastkeeper | Volunteer and organization support for programs for habitat protection, public education and water quality |
| OC Health Care Agency | Environmental health, ocean water protection program, water quality, ocean & beach closures. |
| Sierra Club | Volunteers and organization support for programs to protect the environment |
| South Laguna Civic Association | Volunteers and organization support for programs to protect the environment in South Laguna Beach |
| Laguna Bluebelt Coalition | Volunteers and organizational support for water quality, and habitat protection/restoration |

| *Entity* | *IRWM Plan Authority or IRWM Plan Support* |
|---|---|
| **IRWM Group Jurisdictions** | **IRWM Plan Authority** |
| Pacific Marine Mammal Center | Organizational support for programs related to ocean stewardship through research, education and collaboration |
| Surfrider Foundation- South Orange County Chapter | Funding, volunteers, and organizational support for programs related to coastal water quality, water conservation, and water recycling |
| San Juan Basin Authority | Groundwater management, water conservation, water quality |
| San Diego Regional Water Board | Provide critical water quality decisions including: setting standards, issuance of permits for discharges, and enforcement actions. |
| USACE, Southern California offices | Project planning and implementation related to waters of the United States and natural resources |
| USDA, Forest Service, Cleveland National Forest | Project planning and implementation related to forest and watershed management in partnership with the County of Orange |

## 2.5 Public Outreach and Involvement Process

### 2.5.1 Summary of Outreach and Communication

As discussed in **Section 11**, the South Orange County IRWM Group uses a variety of methods to engage the general public. The IRWM Group provides balanced access and opportunity for participation in the IRWM process. They include participating in stakeholder workshops, inclusion in the IRWM process via public EC meetings, communication via email and information sharing via the South OC WMA Data Management System (DMS) website[10]. The DMS represents both the mechanism for the South OC WMA to make available project data and the IRWM Plan and public engagement in the IRWM Plan update and project list development processes.

Since 2004, the South Orange County IRWM Group has provided informational presentations on the status and progress of the South Orange County IRWM efforts. As part of the process, in 2004 and 2005 the South Orange County IRWM Group developed goals and objectives as well

[10] The South OC WMA DMS provides project mapping, data, and resource planning tools in addition to providing general information about the WMA and IRWM Plan. The DMS provides links to other resources and contacts, where necessary.

as a prioritized list of projects. In 2010, the County started an update of the Plan and in 2011 formed an Ad Hoc Committee to lead the effort. The MC and Ad Hoc Committee updated the Plan to meet requirements in the Proposition 84 Guidelines. As a part of this effort the group defined new goals, objectives and strategies for the Region. A workshop was held to rank the goals and objectives for the Plan, which were then used for ranking projects in the Plan and grant applications.

For the 2018 IRWM Plan update, the same stakeholder-based process was utilized, whereby the MC and an Ad Hoc Committee of the MC updated the plan, a stakeholder workshop was held to solicit public and agency input and the plan was approved by the EC at the May 2018 meeting. An additional technical assistance workshop was held in February 2018 to familiarize stakeholders and IRWM Group representatives with the DMS and the online project submittal process conducted as part of this update. The 2018 IRWM Plan update meets the requirements of Proposition 1 Plan Standards and Guidelines.

### 2.5.2 Letters of Support from Non-Agency Stakeholders

The following list highlights the letters of support received from non-agency stakeholders in support of the IRWM Plan, as included in **APPENDIX E**. Please note that letters received after early June 2018 in support of the 2018 IRWM Plan will be added to **APPENDIX E** but may not be listed here. Letters of support include (but are not limited to):

- Pacific Marine Mammal Center. May 3, 2018, Keith Matassa, Executive Director; Jennifer Nevius, PE, Project Manager. Supports IRWM Plan Update and recognizes alignment between the IRWM Plan goals and Pacific Marine Mammal Center mission.
- Penny Elia. July 8, 2013. Environmental Advocate, Laguna Beach. Supports the opportunity to be part of the IRWM Group along with other important stakeholders that understand the importance of working together towards solutions.
- FluvialTech Inc. June 28, 2013. Hasan Nouri, P.E., Hoover Medalist, President. Supports development of the IRWM Plan.
- Miocean. June 28, 2013. Patrick R. Fuscoe, Chairman. Supports coastal area projects for improved coordination among local agencies with shared responsibilities for watershed management, clean water programs, water supplies, development of local resources, and protection of our natural resources.
- South Laguna Civic Association. June 26, 2013, Michael Beanan, Vice President. Supports the management of the Aliso Creek Watershed and watershed management throughout the Region.
- Surfrider Foundation. June 24, 2013, Rick Wilson, Coastal Management Coordinator. Supports watershed management, clean water programs, water supplies, development of local resources, and protection of our natural resources.
- Audubon California, Starr Ranch Sanctuary. February 5, 2013, Sandy DeSimone, Ph. D., Director – Research and Education. Supports progressive and inclusive approach to water conservation in the Region.

- Orange County Business Council. January 13, 2005, Terry Hartman, Chair, Infrastructure Committee; Julie Puentes, Executive VP Public Affairs. Supports collaborative effort for water reliability in the WMA.
- MIOCEAN. March 4, 2005, Patrick R. Fusco, P.E., Chairman. Supports organization of the South Orange County IRWM Group to prioritize and implement projects in the WMA.
- Surfrider, Laguna Beach Chapter. June 13, 2006, Rick Wilson, Chairman. Supports IRWM Plan's holistic, region-wide approach to water management and open dialogue it has facilitated in South Orange County.

## *2.6 Working Relationship of South Orange County IRWM Group*

### 2.6.1 Regional Participation and Project Coordination

As discussed earlier, participants in the South Orange County IRWM Group have worked individually and collaboratively over 30 years to develop and integrate regional strategies that address water resource issues, raise awareness for watershed management practices, and to coordinate numerous and varied water management projects.

***IRWM Plan Development & Updates***

The first meeting of the South Orange County IRWM Group was held in 2004 and was attended by multiple stakeholders in South Orange County, including County staff, local cities, and several water and wastewater agencies. The South Orange County IRWM Group identified preliminary goals, objectives, and priorities for meeting the water resource needs of the region, and set a schedule for future meetings.

Meetings were held at least twice a month through the development of the 2005 IRWM Plan. The South Orange County IRWM Group continues to inform and invite additional stakeholders to the South Orange County IRWM Group meetings, and the South Orange County IRWM Group has grown to represent 21 member agencies and several other stakeholder groups, agencies and non-profits. Stakeholders supporting the IRWM Plan represent agencies and organizations that have developed an integrated approach to addressing the objectives and water management strategies of the IRWM Plan. Refer to Section 4 for discussion on the collaborative process used to establish plan objectives. Significant progress has been made to identify the myriad of projects that are to be included in existing plans and incorporating those projects into the IRWM Plan. A comprehensive list of South Orange County IRWM Group meetings and workshops is included below.

As the 2005 South Orange County IRWM Plan was being developed, numerous iterations of the Draft South Orange County IRWM Plan were made available to the South Orange County IRWM Group and public stakeholders for review and comment. Comments were received, reviewed, and discussed by multiple participants of the South Orange County IRWM Group prior to incorporation into the Final South Orange County IRWM Plan.

In September 2009, the South Orange County WMA was recognized as a Region during the RAP. With the funding of the South Orange County IRWM Group's seven projects underway and the release of the new Proposition 84 IRWM Plan Standards, the South Orange County IRWM Group identified areas of the existing South Orange County IRWM Plan (adopted in 2005) that needed to be re-written/revised to reflect the new priority projects for the WMA and that will meet the Proposition (Prop) 84 standards.

In September 2010, the South Orange County WMA submitted a Planning Grant Proposal under DWR's IRWM Program to update the 2005 IRWM Plan to comply with recent Proposition 84 standards. In December 2010, the Planning Grant was recommended for funding and the IRWM Plan update commenced. The 2013 IRWM Plan update process followed the same steps as discussed above and described in **Section 2.6.2**. The 2013 update was finalized in June and submitted to DWR later that year.

The 2018 IRWM Plan update addresses the Proposition 1 IRWM Planning Standards. Similar to the 2005 and 2013 processes, the process described in **Section 2.6.2** was followed to provide MC, EC and stakeholder input in the process.

***IRWM Plan Meetings & Workshops***

The following is a list of South Orange County IRWM Group meeting dates by year, including work group, Ad Hoc, EC and MC meetings, held in support of the IRWM Plan[11]:

| Meeting Year | Meeting Dates |
|---|---|
| 2004 | September 14, October 11, October 25, November 8, November 22 and December 13 |
| 2005 | January 3, January 17, January 31, February 16, February 28, March 14, April 18, May 2, May 16, May 31 and July 11 |
| 2006 | January 17, February 6, March 24 and April 10 |
| 2007 | February 17, July 2 and November 15 |
| 2008 | September 18, October 15, November 20 |
| 2009 | April 15 |
| 2010 | March 30, May 4 and May 25 |
| 2011 | April 7, May 31, July 11, July 14, August 8, September 12, October 3, October 16, November 7 and December 5 |
| 2012 | January 9, February 6, February 9, March 5, April 9, May 3, May 7, June 4, August 6, September 10, October 1, November 1 and December 3 |
| 2013 | January 7, February 4, February 7, March 4, April 1, April 8, April 30, May 2, May 6, July 1, July 18, August 5, October 7, November 4 |
| 2014 | January 6, February 3, March 3, April 7, May 5, June 2, August 25, November 3, December 1 |
| 2015 | January 12, February 2, March 2, March 12, March 31, April 6, April 28, May 1, May 4, May 12, June 1, June 4, August 3, September 1, September 3, October 5, October 6, November 4, November 19 and December 7 |
| 2016 | January 27, February 1, February 4, April 4, May 2, May 12, June 6, August 29, October 3, November 10 and December 5 |
| 2017 | January 9, February 2, February 6, April 10, May 4, July 17, August 3, October 2, November 2, November 6 |

[11] Meeting/workshop list updated through May 2018, when the revised IRWM Plan was approved by the South OC WMA Executive Committee. This list will continue to be updated and posted in the DMS for reference.

| | |
|---|---|
| 2018 | January 8, February 1, February 5, March 5, March 14, May 3, May 7 |

South Orange County WMA EC, MC, and Stakeholder meetings have continued on a regular basis. Meeting information for the EC and public workshops is included on the South OC WMA DMS.

***IRWM Plan Implementation – Grant Awards***

In June 2005, the South Orange County IRWM Group submitted the South Orange County IRWM Plan for Proposition 50, Chapter 8 IRWM Program Implementation Grant funds. In January 2007, the South Orange County IRWM Plan was one of seven statewide proposals recommended for funding. In July 2007, the South Orange County IRWM Group executed a Prop 50 IRWM Plan Grant Agreement with the SWRCB to receive grant funds in an amount of $25,000,000 for the seven highest ranking projects included in the South Orange County IRWM Plan. The final list of funded projects includes:

1. **Water Use Efficiency Program Expansion:** MWDOC on behalf of 13 cities and 12 special districts in South Orange County
2. **Canada Gobernadora Multipurpose Basin:** Santa Margarita Water District
3. **Heisler Park Marine Habitat Protection:** City of Laguna Beach
4. **Recycled Water Transmission System Improvements:** City of San Juan Capistrano
5. **Recycled Water Treatment and Distribution:** City of San Clemente
6. **Aliso Creek Ecosystem Restoration Project:** County of Orange, SOCWA, and MNWD
7. **Recycled Water System Expansion:** ETWD
8. **Aliso Creek Urban Runoff Recovery, Reuse, and Conservation:** SCWD

Subsequently, the IRWM Group reviewed, selected and submitted for funding proposals for projects in Rounds 1 (2011) and 2 (2013) Proposition 84 IRWM Implementation funding. All projects submitted for funding were approved; these are listed below.

Proposition 84 – Round 1 ($2,316,780 awarded in 2011)

1. **South Orange County Water Smart Landscape (WSL) Project:** MWDOC
2. **Rockledge Ocean Protection Project:** City of Laguna Beach
3. **Shadow Rock Detention Basin Project:** Trabuco Canyon Water District

Proposition 84 – Round 2 ($1,708,647 awarded in 2014)

1. **Audubon Starr Ranch Sanctuary's Riparian Invasion Control, Restoration, Monitoring, and Education Project:** Audubon Starr Ranch
2. **Comprehensive Landscape Water Use Efficiency Program:** MWDOC
3. **Baker Water Treatment Plant:** Irvine Ranch Water District
4. **Targeted Water Conservation Program:** South Coast Water District

DWR issued a third round of grant funding under Proposition 84 in 2014 to address State-wide drought conditions, focused on water supply enhancement and potable water offset. The IRWM Group proposed, submitted and was approved funding for three projects (awarded $1,500,000 in November 2014):

1. **Califia Recycled Water Project:** Santa Margarita Water District
2. **Recycled Water Expansion Project:** South Coast Water District
3. **Recycled Water Extension:** Moulton Niguel Water District

The last round of Proposition 84 funding was issued by DWR in 2015. The IRWM Group and stakeholders selected, reviewed and approved a suite of six projects providing multiple benefits in alignment with the IRWM goals. The full suite of projects was awarded $4,949,368 in funding in 2015.

1. **Dairy Fork Wetland:** City of Aliso Viejo, Lake Forest, Laguna Hills and Laguna Woods
2. **San Juan Aquatic Passage and Habitat Improvement:** USDA Forest Service, Cleveland National Forest
3. **Crown Valley Park Channel Entry Improvements:** City of Laguna Niguel
4. **Strategic Turfgrass Removal & Design Assistance Program:** MWDOC
5. **3A Water Recycling Plant Tertiary Expansion:** Santa Margarita Water District
6. **Recycled Water Distribution Upgrade:** South Coast Water District

Project status, available data and general information is included on the South OC WMA DMS. Information is available for all projects implemented through Propositions 50 and 84 will be for future grant programs. For more information about the DMS and how to view project information, please see **Section 7**.

***IRWM Plan Project Coordination & Regional Projects***

The South Orange County WMA has implemented an aggressive approach to project coordination. The Group reviews each project included in the IRWM Plan for its multiple benefits, diversity of participants, regional impact and synergies or linkages to other projects. Projects that contain multiple elements result in tremendous added value for the WMA. Beyond the geographical linkages, the projects share synergistic benefits to achieve total watershed efficiency. This IRWM Plan demonstrates an integrated project implementation approach, which provides greater value as a regional planning tool and offers greater advantages than individual efforts due to its ability to create project linkages, incorporate multiple strategies, and leverage agency resources.

Many agencies within the South Orange County WMA have established partnerships to develop both individual and regional projects. Within the South Orange County IRWM Plan, several projects include partnerships among agencies to collaborate for regional benefits, linkages, and environmental justice. This South Orange County IRWM Plan has implemented several Regional Action Projects (RAPs); RAPs represent regional project implementing a single strategy across the entire region that would involve all participants on a phased, as-needed funding basis. One example is the Demand, Runoff, and Pollution Prevention (DRPP) Project. The DRPP encourages the structural conversion of existing landscape features that have a high impact on surface runoff quantity/quality and water demand. The DRPP RAP was divided into a public sector component targeted at converting landscaping at municipal facilities; and a private sector component encouraging private landowners to implement environmentally friendly re-landscaping projects on their properties. These projects convert portions of highway medians by removing turf, planting native drought-tolerant vegetation, and installing evapotranspiration (ET) irrigation controllers.

Furthermore, MWDOC has successfully implemented a water use efficiency program throughout the region. MWDOC collaborates with 13 cities and 12 special districts in South Orange County to encourage removal of non-functional turf; upgrade antiquated irrigation timers to weather-based self-adjusting irrigation timers, and convert high-volume overhead spray irrigation to low-volume irrigation. MWDOC implements comprehensive landscape improvement programs targeting publicly owned and other commercial landscapes properties throughout the South Orange County WMA.

Regional programs have been established that include partnerships between multiple projects to provide broad regional benefits, while maximizing resources. Most notably, South Orange County: Team Arundo was formed during the IRWM planning process. Team Arundo is an offshoot of the South Orange County IRWM Group and includes members from the County, cities, developers, regulators, non-profit organizations, and public stakeholders. This team was named after the highly invasive grass, *Arundo donax*, which can overwhelm fresh water riparian habitat areas.

Team Arundo has developed a region-wide program for the restoration of riparian habitat in the San Juan Hydrologic Unit (SJHU) through the control of invasive non-native plants (mainly *A. donax* and pampas grass) and the planting of native species. *A. donax* and pampas grass pose a serious threat to the native flora and fauna, and are a significant flood and fire risk to the community. These plants also have a severe and negative impact on biological functions within the riparian system. The plants are not utilized as a food source and have poor structure for nesting and other shelter uses by other organisms. The invasive, non-native, plant control and riparian restoration program for the SJHU is based on a systematic watershed based control of target species that provides long term ecological and resource protection benefits. This process, along with details related to restoration and exotic plant control methods have been developed in coordination with the CDFW, United States Geological Survey (USGS) Biological Resources Division and the United States Fish & Wildlife Service (USFWS). Team Arundo mapped non-native riparian plant species in the SJHU, identifying over 315 acres of targeted invasive plants in 2008. Updated information has been collected in the years since, providing valuable information for a multi-agency and multi-stakeholder approach to invasive plant removal. In addition, Team Arundo obtained all the necessary regulatory permits and environmental documents to remove non-native species in the SJHU and continues to maintain these permits for ongoing removal efforts.

### 2.6.2 IRWM Plan Updates and Sharing of Information

As discussed in **Section 2.6.1**, the South Orange County IRWM Group officially began meeting in 2004. The members of the South Orange County IRWM Group plan and execute both short-term Capital Improvement Programs (CIP) and long-term plans and management programs. The

Group's plans, reports, studies, and programs coordinate with regional plans and programs to provide the foundation for the IRWM Plan and present a coordinated integrated approach.

Many existing plans, including Master Plans, Facility Plans, Watershed Management Plans, WQIP, OC SWRP, recycled water studies, feasibility studies, and long-range plans, contain proposed projects that are instrumental in meeting the goals and objectives of the South Orange County WMA. Many projects found in the local and regional plans and studies have been incorporated into the South Orange County IRWM Plan, and will continue to be implemented in concert with those plans. **Section 10** Coordination with Existing Local/Regional Plans, identifies the plans that were reviewed and incorporated into this plan.

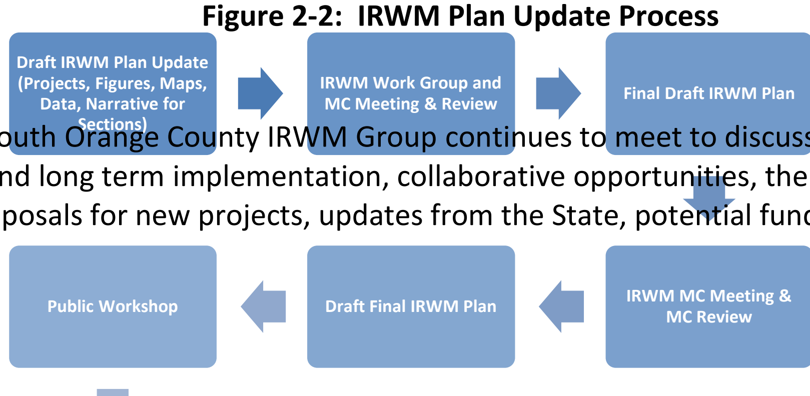
Change is anticipated within the region due to evolving considerations, issues, and planning efforts. No plan, including this IRWM Plan, should be static. Instead, the IRWM Plan is considered a living planning document and is flexible to adapt to change.

Given the high levels of interaction involved in the drafting and implementation of other regional plans in South Orange County, local agencies and groups are well prepared to modify priorities, as needed, within the IRWM Plan. In addition to the IRWM Group coordination format, member agencies also interact at watershed stakeholder workshops and various related task forces and workgroups, such as MWDOC's Water Use Efficiency (WUE) Workgroup. Through these established and intersecting networks, members of the IRWM Group have extensive access to information and one another, solidifying their ability to collectively respond to regional changes. Additionally, the IRWM Group jurisdictions are heavily involved in NPDES Permit compliance activities, including development and implementation of watershed-scale planning in the WQIP.

The IRWM Group brings issues, concerns, changes, and activities to scheduled IRWM Plan meetings. Each meeting includes an agenda item specifically for the discussion and opportunity to collectively hear, understand, and respond to points of concern, issues, and amendments. This allows the effective refinement of regional goals and objectives, as needed, for the benefit of the region and its individual stakeholders. A public workshop included in the process provides an open forum for stakeholders to provide feedback on IRWM planning in addition to discussions at public IRWM Group meetings. In this manner, all stakeholders to the IRWM Plan will be afforded the opportunity for input to amend the Plan.

As discussed in **Section 2.2**, the MC will continue to lead IRWM Plan updates. The IRWM Plan will be updated, no less than once every five years, and will be accomplished in the IRWM Group environment, affording the opportunity for input from all stakeholders. The Project List will be available at all times on the South OC WMA DMS; projects are accepted on a rolling basis and are verified at least twice annually by the MC. This process is further described in **Section 6**. **Figure 2-2** below shows the formal IRWM Plan Update Process.

**Figure 2-2: IRWM Plan Update Process**




Today, the South Orange County IRWM Group continues to meet to discuss the IRWM Plan for short term and long term implementation, collaborative opportunities, the status of existing projects, proposals for new projects, updates from the State, potential funding opportunities, and the need for plan refinements. As mentioned previously the County of Orange provides information and updates on the IRWM process through the South OC WMA DMS. Members of the IRWM Group have access to IRWM work products; committee meeting schedules, agendas, and summaries; contact information; and links to relevant web pages and information.

***IRWM Plan Coordination & Project Implementation***

Cooperation within the South Orange County IRWM Group for the development and implementation of the IRWM Plan has been exceptional. All funded projects are described in the DMS and summarized in **APPENDIX F** of this IRWM Plan; however, two projects demonstrating the regional and multi-agency coordination involved in the South Orange County IRWM Group are detailed below. These two projects were funded through Propositions 50 and 84 IRWM Grant programs and highlight the inter-region coordination involved in IRWM Plan implementation. Indeed, these are included as examples; many other projects have been implemented as a result of IRWM Plan coordination and implementation. As described in **Section 7**, the IRWM Group continues to build upon previous project tracking to provide a geospatial-based DMS [12] which will enhance project prioritization and selection based upon watershed needs and geospatial context.

*Gobernadora Multi-Purpose Basin*

One example of this cooperation is the Gobernadora Multi-Purpose Basin Project, which is approximately 36 acres, located upstream of Gobernadora Ecological Reserve Area (GERA) and just south of the Coto De Caza planned community. The Project was on the 2005 IRWM Plan project list and received funding. The Project included development of the following:

- Surface runoff water quality basin to improve water quality for downstream riparian and wetlands areas
- Storm water detention basin to protect downstream wetlands and riparian habitat from further erosion and deposition damage
- Collection system to capture and harvest drainage flows for recycled water use in the existing Portola Reservoir
- Regional trail link for overall trail connection from Thomas F. Riley Park to Caspers Wilderness Regional Park

The Basin is utilized to reduce storm peak flows by flood storage, divert and naturally treat surface runoff, and storm flows that will result with the following 1) reduce downstream erosion and sedimentation, 2) provide harvesting of excess surface water and groundwater, and 3) improve the water quality in the Gobernadora Creek and San Juan Creek, including the downstream GERA. The Project required coordination among many entities and includes facilities for water quality, drainage peak flow retarding, a Regional Riding and Hiking Trail, and non-potable water extraction/recycling. The Project was approved by the public and private stakeholders. This Project has served as a catalyst in bringing together the public and private

[12] Project information is available on the IRWM Funded Project Portal portion of the DMS. To access a current IRWM Project List, visit the IRWM Project Data Explorer portion of the DMS.

interests. The proponents for the Project are SMWD, County of Orange, and Rancho Mission Viejo, LLC (RMV) ("stakeholders").

A Memorandum of Understanding (MOU) was completed to fully address the project and the stakeholders' rights, responsibilities and obligations of the stakeholders. This MOU was intended as a precursor document for general terms for the understanding of the stakeholders concerning the funding, design, construction, operation of the project and establishes a process under which, the stakeholders will work cooperatively to develop a detailed description of the project, and sets forth the responsibilities of the stakeholders to perform the analysis of the project required by CEQA.

*Dairy Fork Wetland*

The Dairy Fork Wetland Project was awarded funding in the 2015 Proposition 84 IRWM Grant cycle and includes two phases. The first phase includes the construction of a wetland to reduce urban runoff pollutant loads from the Dairy Fork sub-watershed, which is a tributary area of Aliso Viejo Creek Watershed. The wetland will treat 325 AFY of urban runoff draining from 1,500 acres of land, covering multiple jurisdictions. This project enhances protection of Aliso Creek as well as the surrounding native species through the re-vegetation of two acres of native species, and the removal of invasive non-native plants around the wetland site.

Runoff from the Dairy Fork sub-watershed area was found to carry pollutants such as bacteria, metals, nutrients, and motor oil that impact the quality of receiving waters. This contamination has created conditions that threaten the purity of Aliso beach, riparian vegetation, and habitat, along with Aliso Creek and its tributary. The project will decrease water pollution by filtering contaminants such as total suspended solids (TSS), bacteria, metals, nutrients and motor oil found in the runoff from the Dairy Fork sub-watershed. It is anticipated that the wetland system put into place by this project will reduce pollutant load by as much as 90 percent. Two acres of native plants will replace non-native species and serve as a natural purification system; thus decreasing potential water pollution from draining into Aliso Beach.

The second phase comprises removal of approximately five acres of invasive *Arundo donax* (Arundo) stands over nine total acres of riparian corridor in the Dairy Fork sub-watershed. Previous assessments by the County of Orange as part of the Aliso Creek Invasive Mapping and Watershed Management Plan (2008), as well as studies conducted in 2012-2015 by Laguna Canyon Foundation determined the extent of Arundo in the sub-watershed, identifying approximately five acres of dense Arundo severely impacting the creek. Removal of these invasive plants will reduce stress on the riparian ecosystem and restore native habitat upstream and downstream of the wetland, while also improving biofiltration of pollutants, increasing groundwater recharge, and reducing invasive species-related bank erosion/collapse.

The Dairy Fork Wetland covers two acres of land requiring easements from Southern California Edison, OC Parks and the Aliso Viejo Community Association. Arundo removal activities associated with the project fall within Aliso and Wood Canyons Wilderness Park. Coordination between all of these agencies and the multiple benefiting jurisdictions is essential and highlights the importance of IRWM Group collaboration to meet IRWM Plan goals.

***IRWM Group Coordination with State Water Board and DWR***

In addition to sharing information and coordinating amongst themselves, the South Orange County IRWM Group met with the State Water Board, SDRWQCB and DWR staff throughout the South Orange County IRWM planning process. Local meetings in the City of Sacramento were held to discuss planning efforts, including coordination of the South Orange County IRWM Plan development, objectives, strategies, project prioritization and implementation. The South Orange County IRWM Group also coordinated with federal agencies for project implementation, as required. The Group has developed a positive working relationship with IRWM Program staff at the SWRCB while administering the Prop 50 grant funds.

The South Orange County IRWM Group continues to coordinate with DWR staff regarding Proposition 84 funding. During the RAP process, the County and members of the South Orange County IRWM Group met with DWR staff to discuss how the South Orange County WMA collaborates as a Region. Following the meeting, the South Orange County WMA was approved as a Region. DWR staff members are continuously invited to attend South Orange County IRWM Group meetings.

### 2.6.3 Native American Tribe & Stakeholder Coordination

The WMA embraces improving tribal water and natural resources for South Orange County. This includes incorporating planning measures and soliciting projects that include the Tribal consultation, collaboration, and access to funding for water programs and projects to better sustain Tribal water and natural resources. The Juaneño Band of Mission Indians, headquartered in the City of San Juan Capistrano, is on the contact list maintained by the Native American Heritage Commission and they are included in this Plan as a South Orange County stakeholder; however, the Juaneño Band is not federally recognized, nor is the tribe land owning. However, the IRWM Group recognizes that collaboration with Native American Tribal representatives is on a government to government basis, as tribes are sovereign nations.

During 2005 South Orange County IRWM Plan completion, the IRWM Group implemented a comprehensive stakeholder involvement process, which included the Juaneño Band of Mission Indians, based in South Orange County. They engaged as a stakeholder and provided a letter of support for our efforts. The South Orange County IRWM Group will continue to involve the Juaneño Band of Mission Indians to ensure their involvement and representation in the IRWM Plan process.

As part of the IRWM Plan Update process, the South Orange County IRWM Group considers ways to improve tribal water and natural resources by their involvement in the stakeholder process. The IRWM Group understands the importance of Native American Tribe Notification and incorporates this process through the IRWM Plan Update and CEQA review for each Project. Additionally, the IRWM Group will conduct ongoing outreach to tribal representatives, as part of the Water Needs Assessment described in **Section 3.6**. The Water Needs Assessment will involve extensive coordination within the San Diego Funding Area with stakeholders and Native American Tribal communities to ensure they are involved in IRWM planning. A speaker's bureau and other meetings/workshops will specifically aim to engage Tribal representatives, nonprofits and non-governmental agencies in identifying the major issues and priorities of their lands, with consideration for how projects benefiting DACs, URCs and Native American Tribal communities could be fostered within the WMA.

Equitable distribution of benefits results from educational and public outreach activities. The IRWM Group recognizes that Native American Tribes and other stakeholders should be provided mechanisms to participate in plan implementation regardless of their ability to pay as a Member Agency. Public workshops on project selection and IRWM Plan updates are made available to all stakeholders and they are encouraged to submit projects for inclusion in the IRWM Project List to foster project-based relationships within the WMA. Additionally, IRWM Group members coordinate with Native American Tribes and/or other stakeholder groups when developing projects to implement the IRWM Plan and supportive of stakeholder priorities. Additionally, the DMS includes geospatial information from other water resource planning initiatives, to serve as a tool for future project planning; this was developed in response to stakeholder requests for coordinated data availability. Refer to **Section 11**, for more detail on stakeholder involvement.

## *2.7 Adding New Members*

Participation in the South Orange County IRWM Group and its EC and MC committees, primarily comprises representatives from the IRWM Group Member Agencies: The County, South Orange County Cities, water, and wastewater agencies. It is realized that there are other parties within the South Orange County WMA that have responsibilities for water resource management, including but are not limited to, the CFDW, California Department of Transportation, Orange County Transportation Authority (OCTA), San Juan Basin Authority and Rancho Mission Viejo. These other parties will be asked to engage, as appropriate; however, participation in the South Orange County IRWM Group is open to all interested parties, should they chose to have a greater level of involvement. Organizations can also request to the IRWM Group to be added as a Member Agency; the EC will approve requests submitted to the IRWM Group for consideration.

The IRWM Group will also provide opportunities for interested parties and stakeholders to provide feedback on subject-specific topics, where warranted. Notifications of such opportunities will be provided via email and postings on the South OC WMA DMS.

## *2.8 Working Relationship of Tri-County FACC*

This section provides an overview of the WMA's commitment to inter-regional collaboration within the San Diego Funding Area via the Funding Area Coordinating Committee (Tri-County FACC).

### 2.8.1 Coordination within San Diego Funding Area

During the Proposition 50 grant cycles, three IRWM regions emerged within the San Diego Funding Area – the San Diego, Upper Santa Margarita, and South Orange County IRWM regions. The San Diego IRWM program is managed by the San Diego County Water Authority (SDCWA), City of San Diego, and County of San Diego; the Upper Santa Margarita IRWM program is managed by Riverside County Flood Control and Water Conservation District (RCFCWCD), County of Riverside, and Rancho California Water District (RCWD); and the South Orange IRWM program is managed by the County of Orange, MWDOC, and SOCWA.

The Upper Santa Margarita Regional Watershed Management Group (RWMG), San Diego RWMG, and South Orange County IRWM Group collaborate in an inter-regional body established via a MOU and known as the Tri-County Funding Area Coordinating Committee (FACC).

The Tri-County FACC enables the three RWMGs to balance the necessary autonomy of each planning region to plan at the appropriate scale with the need to improve inter-regional cooperation and efficiency. It ensures close coordination of the three planning regions to improve the quality and reliability of water and to protect and enhance natural resources in the San Diego Funding Area. The three RWMGs work together with their advisory groups to identify cross-boundary projects and common programs of value across planning regions and align project implementation.

The Tri-County FACC builds a foundation that ensures sustainable water resources planning within the San Diego Funding Area. The three RWMGs commit to coordinated planning, including watersheds that cross planning region boundaries which include the San Mateo Creek watershed area and the Santa Margarita River watershed area. This approach will capture the integration of water supply, wastewater, and watershed planning across regions in the three coordinated IRWM Plans. **Figure 2-3** shows the watershed overlap within the IRWM Regions.

Each of the Tri-County FACC members has prepared and adopted an IRWM Plan and desires close coordination to enhance the quality of planning, identify opportunities for supporting common goals and projects, and improves the quality and reliability of water in the San Diego Funding Area. The Tri-County FACC coordinates and works together with their advisory groups to address issues and conflicts across planning regions, identify common objectives and projects that address those needs, and provide general planning cooperation for shared watersheds. The Tri-County FACC has developed an agreement to improve IRWM planning in the San Diego Funding Area to coordinate across planning region lines and facilitate the appropriation of funding for IRWM projects. The following sections outline the Tri-County FACC’s governance agreements.

***Sharing of Information***

The RWMGs have agreed to share data and information to inform efforts within the San Diego Funding Area and interregional. This information sharing helps to facilitate collaboration and address interregional needs. Some of the organizations that help in this data sharing effort include MET, the SDRWQCB, and the Stormwater Monitoring Coalition (SMC). Each of the IRWM Plans in the San Diego Funding Area includes sections on data management and project selection. The Tri-County FACC serves as an advisory body in the development of projects or programs that may cross IRWM Region boundaries, which may be funded, administered, or implemented by multiple Regions. Additionally, projects of importance to the watersheds that exist in multiple IRWM Regions are identified for coordination and prioritization in each of the relevant regions’ project selection process.

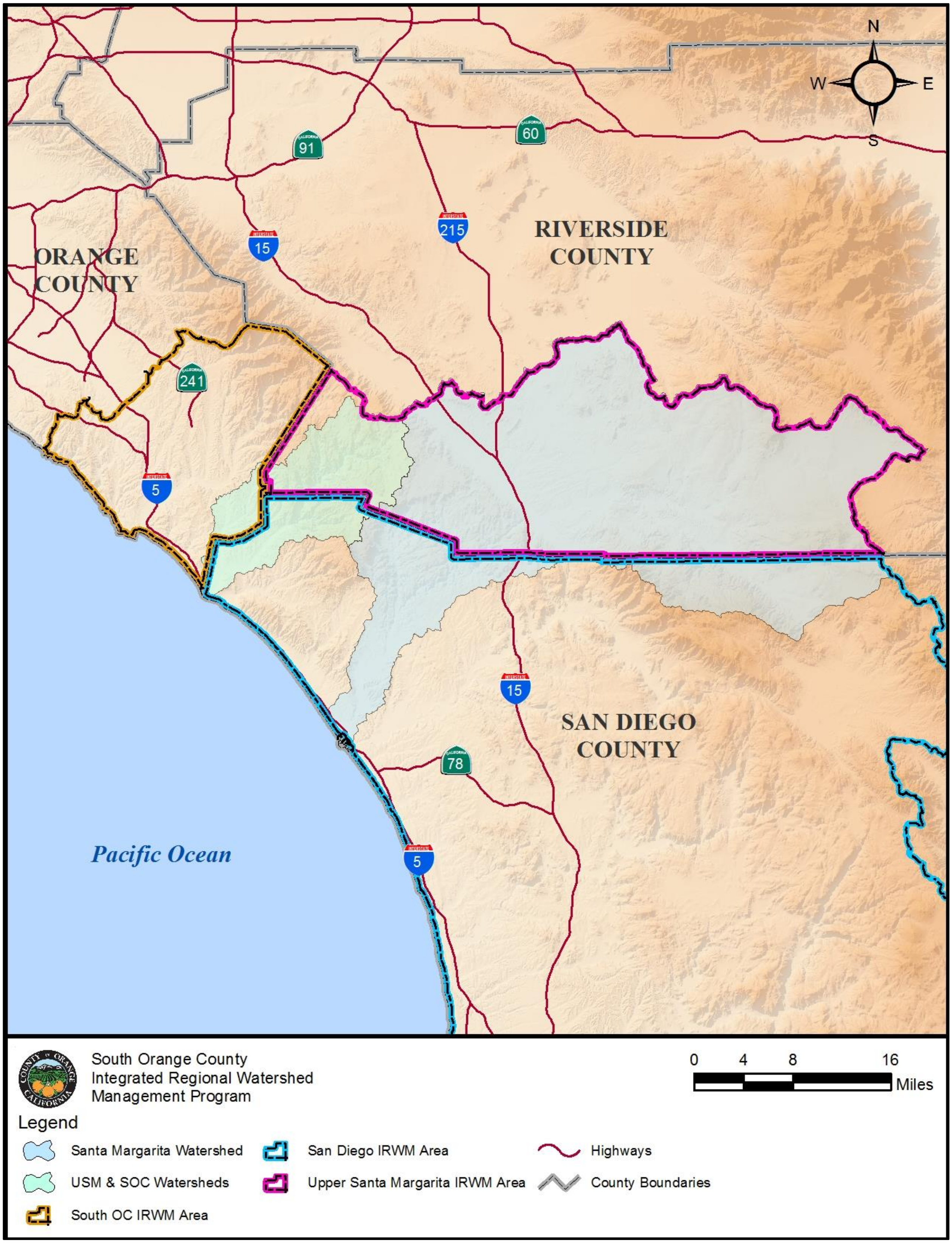



**Figure 2-3: Watershed Overlap within IRWM Areas**

Tri-County FACC members also collaborate in support of MET's drought and conservation programs. For example, in 2009 in response to three years of drought and severe water supply challenges, the MET Board of Directors (which comprises representatives of the member agencies) declared a Water Supply Alert in southern California and increased MET's water conservation efforts throughout its six-county service area. The Water Supply Alert urged cities, counties, local public water agencies and retailers to achieve extraordinary conservation by adopting and enforcing drought ordinances, accelerating public outreach and messaging, and developing additional local supplies. The Tri-County FACC continues to provide collaborative opportunities for the three IRWM regions and identifying projects or programs that may help achieve water conservation goals.

Additionally, Tri-County FACC members are collaborating to address water quality concerns via the SMC. This group is comprised of all Phase 1 municipal stormwater NPDES lead permittees and NPDES regulatory agencies in Southern California. RWMG members from each of the three planning regions are part of the SMC, including the County of Orange, RCFCWCD, and County of San Diego. SMC members have combined resources to address data gaps and cooperate on developing technical information and tools to improve stormwater decision making, as well as improve monitoring effectiveness by promoting standardization and coordination across individual NPDES municipal programs.

Another example of collaboration and information sharing among Tri-County FACC regions is in the development of TMDLs during the amendment process. RWMG members of the Upper Santa Margarita, San Diego, and South Orange County IRWM planning regions are invited to attend Regional Action Committee (RAC) meetings, in order to stay better informed of the priorities and needs of the SDRWQCB and provide feedback through the public participation process.

***Shared Infrastructure***

Each of the IRWM Regions in the Tri-County FACC are dependent on imported water, supplied through MET, and therefore share infrastructure that serves the San Diego Funding Area. Shared infrastructure includes the Colorado River Aqueduct (CRA), along with major reservoirs such as Diamond Valley Lake, Lake Skinner, and other major pipelines owned and operated by MET. Diamond Valley Lake is a reservoir located at the northernmost portion of the Upper Santa Margarita Watershed and is connected to Lake Skinner by the Southwestern Riverside County Multi-Species Reserve. Adjacent to Lake Skinner is MET's Skinner Water Treatment Plant. Within the San Diego Funding Area, more than four million residents in Riverside and San Diego counties rely on treated imported water from the Skinner Water Treatment Plant. These shared facilities serve a critical role in bringing together water management interests from all three IRWM planning regions.

In addition to MET-owned imported water infrastructure, SCWD shares the use of pipelines within the SDCWA to convey supplies to the northernmost areas of Camp Pendleton. These shared facilities ensure delivery of imported water supplies to all Tri-County FACC members and their stakeholders.

***Competing Interests***

Historically, the Tri-County FACC members have found themselves in conflict over water supply issues. However, various agreements and legal settlements have led to a cooperative management of water allocations between these entities. Currently, there is significant agreement on water allocations, and the Tri-County FACC is supporting collaborative efforts to improve the storage and management of water resources. Recently, some long-standing conflicts have been resolved. Significant funding for projects to benefit the upper and lower river areas were authorized and funded in the Federal Omnibus Lands Bill signed in March 2009. While individual areas within the Tri-County FACC have competing local interests, the recent settlements and the Tri-County FACC MOU attest to the willingness and capacity of the region to work together when fairness and certainty are documented.

### 2.8.2 Evolution of Inter-Regional Planning

The three separate IRWM planning regions – San Diego, Upper Santa Margarita, and South Orange County – were established and formalized in 2006 and 2007 during development of their IRWM Plan documents. Since that time, the three regions have developed and formalized a working relationship for joint IRWM planning in shared watershed areas. **Figure 2-4** shows the evolution of regional planning in the San Diego Funding Area.

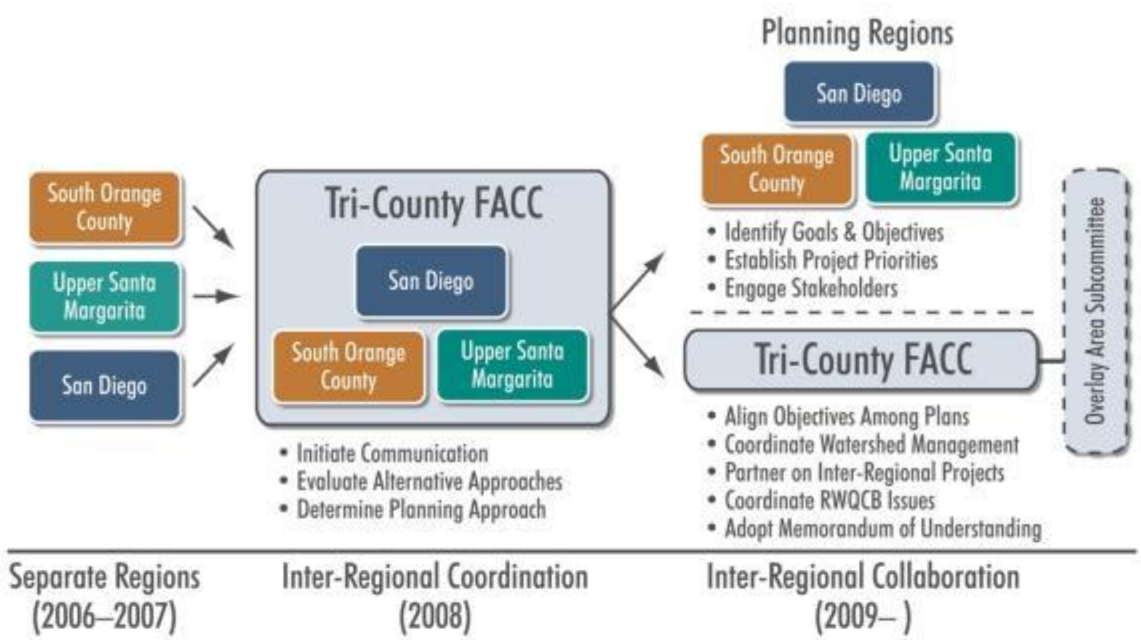



**Figure 2-4: Evolution of Regional Planning in the San Diego Funding Area**

In June 2008, the Tri-County FACC program sent a letter to DWR offering to work directly with DWR as a test of interregional collaboration. DWR staff encouraged the development of alternatives to consider governance and organization of the regions. Throughout that year, the three RWMGs undertook a coordinated evaluation of the planning region boundaries and potential alternatives for reformulation. By late 2008, the three RWMGs had determined that major differences between the three regions indicated that water management planning is better and more efficiently conducted at the local scale. However, formalizing the Tri-County FACC would allow the RWMGs to better coordinate on water management issues, objectives, and projects within watershed areas that cross regional boundaries. Moving forward, the Tri-County FACC will enable a high level of coordination for water resources management issues that are common to the three regions.

### 2.8.3 Committed Inter-Regional Process

**Figure 2-5**, Tri-County FACC Boundaries, illustrates the boundaries of the three IRWM planning regions and the Tri-County FACC. The Tri-County FACC will build a foundation that ensures sustainable water resources planning within the San Diego Funding Area by serving as an umbrella organization, allowing the three IRWM regions to coordinate water resources planning activities and pool resources. Because human-made water infrastructure systems are the key water management units in the San Diego Funding Area, the planning regions reflect this reality and cross-boundary watershed issues are addressed via a collaborative subcommittee process.

The three RWMGs will undertake coordinated planning within the Watershed Overlay Areas, which comprise the Santa Margarita River and San Mateo Creek Watersheds. A Watershed Overlay Subcommittee was organized to consider issues and develop projects pertaining to the Overlay Areas. Water resources projects and programs that may benefit from Funding Area-wide coordination, administration, funding, or support are identified by the Tri-County FACC and/or Subcommittee. One result of the Watershed Overlay Subcommittee meeting was coordination of invasive removal projects and Salt and Nutrient Management Plans (SNMP). Projects within the Watershed Overlay Areas identified as valuable and benefiting from cross-boundary coordination are considered in the three IRWM project selection processes. Tri-County FACC has also coordinated on two inter-regional IRWM projects in the Santa Margarita Watershed focused on nutrient loading and river health.

All three IRWM Plans – San Diego, Upper Santa Margarita, and South Orange County – will contain references to the entire San Diego Funding Area, to the coordination that is occurring among planning regions, and to the MOU governing the Tri-County FACC. Each IRWM Plan will identify common goals and objectives, water management strategies, issues, and challenges being addressed via inter-regional collaboration.

As described, the Tri-County FACC provides overarching facilitation of IRWM planning across the region; this framework also provides for agency, regulatory, non-profit, and public participation at the local scale. For example, public workshops for the Water Needs Assessment planned in 2018 will be hosted in different locations throughout the San Diego Funding Area to enable more convenient access by participants and DAC representatives. These workshops will both help to inform the Tri-County FACC of the DAC needs in their respective regions, and encourage workshop attendees to participate more fully in the IRWM process. The creation of larger planning regions would limit local involvement and reduce the value of the IRWM planning process to the regions, the San Diego Funding Area, and the State.

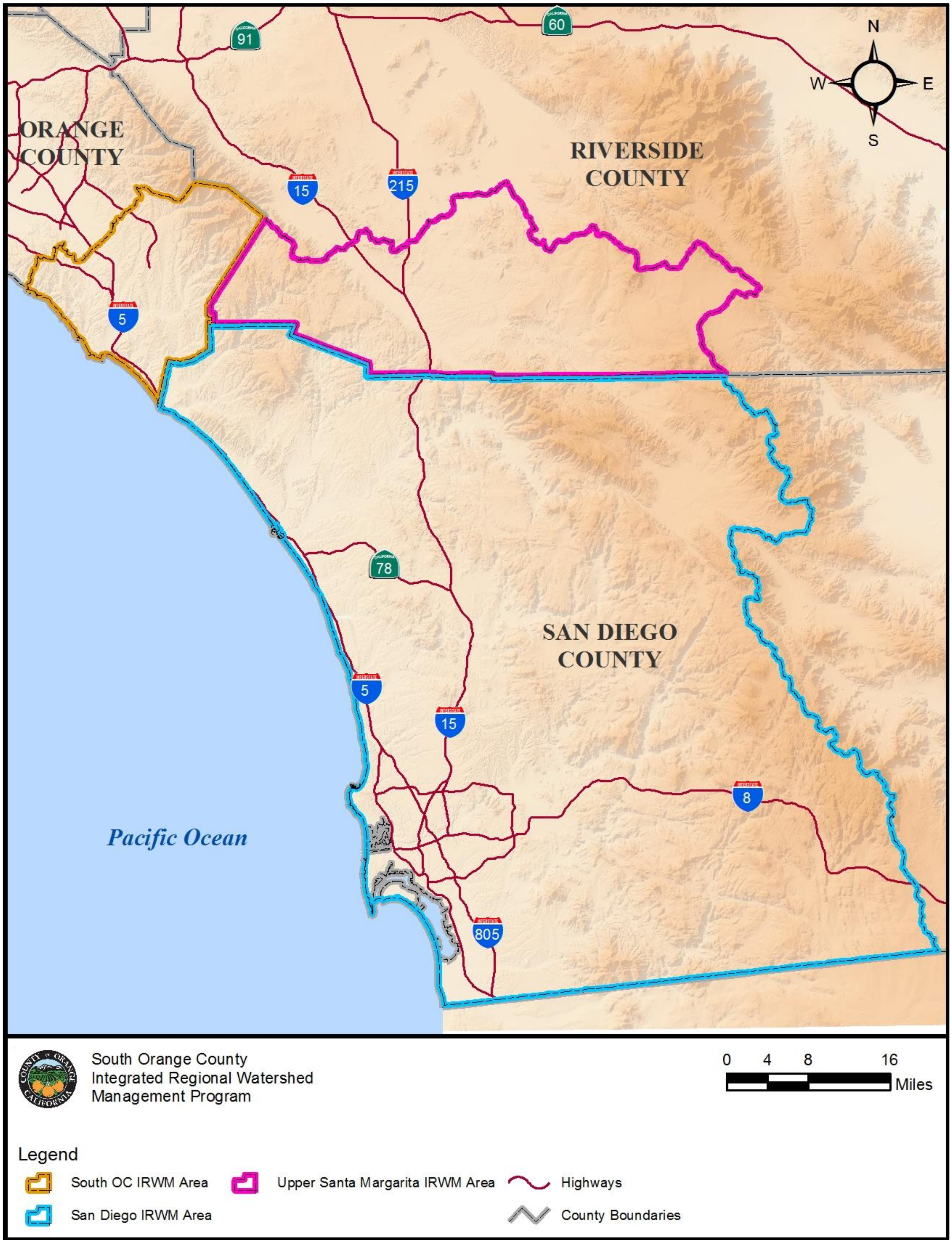



**Figure 2-5: Tri-County FACC Boundaries**

### 2.8.4 Memorandum of Understanding

In March and April 2009, the three RWMG agencies that comprise the Tri-County FACC jointly adopted an *MOU for IRWM Planning and Funding in the San Diego Funding Area* to outline their commitment to inter-regional coordination (refer to **APPENDIX B**). The efforts of the Tri-County FACC are intended to enhance the quality of water resources planning, identify opportunities for supporting common goals and projects, and to improve the quality and reliability of water in the Funding Area. **Section 2.9** contains an overview of the agreements set forth in the Tri-County FACC MOU.

### 2.8.5 Water Management Differences

As described above, the three adjacent planning regions in the San Diego Funding Area have reconsidered their governance and regional boundaries to ensure the best approach for local stakeholders. The three RWMGs began meeting in February 2008 to discuss ways to collaborate on IRWM planning. At DWR's suggestion, the group developed a matrix of five planning region alternatives and evaluated 15 factors to determine the most appropriate and productive approach. The San Diego Region presented this alternatives matrix to the RAC for discussion, and incorporated RAC suggestions into the Tri-County FACC final draft.

Through the course of this evaluation, the three RWMGs determined that the multiple regional differentiators that spurred development of three separate IRWM Plans held true. Clear division within the following water management factors warrants three separate planning regions.

***Water Supply***

Each of the three IRWM regions contains independent water supply agencies drawing from different water sources. The South Orange County WMA is comprised of MWDOC and its member agencies; the Upper Santa Margarita region is comprised of the RCWD, Elsinore Valley Municipal Water District, Eastern Municipal Water District, and Western Municipal Water District; and the San Diego Region is comprised of the San Diego Water Authority and its 24 member agencies, as well as numerous small water systems in rural areas**. Section 2.8** provides an overview of shared regional infrastructure in the San Diego Funding Area, including delivery of imported water from MET's Skinner Water Treatment Plant, a treatment facility of statewide importance. Although some infrastructure is shared, none of the water supply agency service areas overlap across the IRWM regions.

Additionally, each of the three IRWM regions depend to a varying degree on imported water supplies and receives deliveries from a different combination of sources. Because of this, the quality of water supplies and necessary treatment differs across the regions. Although supply diversification planning is underway in all three regions, development of local supplies is, by definition, conducted at the local scale.

***Wastewater/Recycled Water***

Each of the three IRWM regions contains separate wastewater agencies, reclamation plant operators, and water recycling programs. Most of South Orange County's wastewater is managed by the SOCWA, a joint powers agency whose members are all of the 10 sewer agencies in South Orange County, while Riverside and San Diego each contain multiple water and wastewater agencies. None of these wastewater agencies or their recycled water infrastructure overlaps across the IRWM regions.

Wastewater disposal practices also vary between the regions. Upper Santa Margarita exports treated wastewater to the Santa Ana River watershed and South Orange County and San Diego have aggressive recycled water projects and discharge excess effluent through deep ocean outfalls. Riverside County (unlike Orange and San Diego counties) has no connection to regional ocean outfall disposal systems. Stakeholders continue to try to resolve ongoing conflicts related to the discharge of recycled water to the Santa Margarita River. Collaboration through the Tri-County FACC provides the adjacent regions with an opportunity to find common ground and develop solutions to these water management conflicts.

***Groundwater***

Each of the three IRWM regions maintains a different level of dependence on groundwater supply. In contrast with San Diego's limited groundwater production (two percent), a larger proportion of South Riverside and Orange County supplies are obtained from groundwater. Groundwater accounts for about 15 percent of overall supplies in the South Orange County WMA. Geologic conditions preventing the subsurface movement of groundwater between the upper and lower Santa Margarita River basins limit extraction within the northern San Diego Region. Groundwater extraction and recharge facilities are localized within each region. No groundwater basins are shared across the IRWM regions.

***Land Use Planning***

Each of the three IRWM regions contains different local and regional land use planning authorities and transportation programs, as well as different development trends. The South Orange County WMA comprises the County of Orange and 12 cities. Regional coordination occurs through Southern California Association of Governments (SCAG)/Orange County Council of Governments. The Upper Santa Margarita region is comprised of Riverside County, four cities, and the regional coordination occurs through SCAG/Western Riverside Council of Governments (WRCOG). The San Diego Region is comprised of San Diego County, 18 cities, and the regional coordination occurs through the San Diego Association of Governments (SANDAG). None of these land use authorities overlap across the IRWM regions.

***Flood Protection***

Each of the three IRWM regions contains independent flood control agencies and programs. The South Orange County WMA contains OCFCD; the Upper Santa Margarita region contains RCFCWCD; and the San Diego Region contains San Diego County Flood Control District. None of these flood control agencies overlap across the IRWM regions.

***Runoff Water Quality***

Each of the three IRWM regions has obtained and complies with separate NPDES MS4 permits, surface runoff management planning, and regional pollution prevention programs. The County of Orange is the Principal Co-Permittee for the for the South Orange County Watershed Management Area, under the jurisdiction of the San Diego Regional Water Quality Control Board and associated Regional NDPES MS4 permit (Order R9-2013-0001, as amended by Order No. R9-2015-0001 and Order No. R9-2015-0100). Stormwater compliance measures, monitoring programs, and BMPs used in Orange and Riverside counties vary from those used by San Diego County.

***Environmental Resources***

Each of the three IRWM regions contains different Habitat Conservation Plan (HCP) efforts and nature reserves. The County of San Diego led development of the San Diego County Multiple Species Conservation Program (MSCP) (with the City preparing an MSCP for lands within their jurisdiction), while the County of Riverside led development of the Western Riverside Multi-Species Habitat Conservation Plan (MSHCP). None of these HCP efforts overlap across the IRWM regions. Conservation plans are being or have been prepared by the SDCWA, San Diego Gas and Electric (SDGE), SANDAG, Orange County, and Riverside County for lands adjacent to the Plan area. Preserve areas in the adjacent plan areas were integrated into the planning process to ensure that the core biological areas in the plan area were well connected with core biological areas across jurisdictional borders.

The South Orange County WMA includes a number of protected areas that form a network of interconnected and isolated biological communities. The Southern Subregion NCCP / HCP comprises 132,000 total acres, including 40,000 acres within the Cleveland National Forest and 92,000 acres within the WMA. The Southern Subregion NCCP/HCP was prepared by the County in cooperation with the CDFW and the USFWS. It focuses on long-term protection and management of multiple natural communities that provide habitat essential to the survival of a broad array of wildlife and plant species.

***Political Realities***

Each of the three IRWM regions contains separate legal (both regulatory and legislative), taxing, and funding authorities. For example, the OCTA administers Measure M (a half-cent local transportation sales tax) which includes a water quality program for transportation-related pollution; this contributes to IRWM Plan implementation in Orange County. Each of the three IRWM regions has identified an appropriate means of administering and funding integrated regional planning within their proposed regional boundary. None of these political boundaries overlap across the IRWM regions.

Following the RWMG’s determination that the existing IRWM regions are appropriate planning-level entities, the Tri-County FACC was established as a means of coordinating planning within the San Diego Funding Area. This approach allows the three RWMGs to balance the necessary autonomy of each planning region to plan at an appropriate scale with the need to improve inter-regional cooperation and efficiency. To address DWR’s concerns, the three planning regions are committed to identifying cross-boundary projects and common programs that address key challenges. This approach will capture the integration of water supply, wastewater, and watershed planning across three coordinated IRWM regions.

### 2.8.6 Relationship and Coordination with Watershed Management Areas

At its essence, the WMA is a collaborative framework for municipalities and special purpose agencies to work collaboratively and find synergies across water resource disciplines. Its purpose is to bring together a wide variety of water resource managers in order to achieve more comprehensive and cost effective solutions to Orange County’s water resources needs.

Member agencies voluntarily enter into a cooperative agreement that forms the WMA (with the exception of the North Orange County WMA). Governance includes a policy committee of elected officials to oversee each WMA. Senior staff from each member organization forms a MC to develop a joint work plan and oversee its implementation. Regular stakeholder forums are held to involve the public and share information across organizations within each WMA.

The South Orange County WMA is unique in its habitat values, open space, un-channelized creeks, reserves, parks, and forests. The South Orange County WMA is adjacent to the Central Orange County WMA (Santa Ana Watershed Funding Area), North Orange County WMA (Santa Ana Watershed Funding Area) to the north and the Upper Santa Margarita Watershed (San Diego Funding Area) to the South. Figure 2-6 shows the Orange County WMAs.

The Central Orange County WMA is located entirely in Orange County and is comprised of the San Diego Creek, and Newport Bay watersheds. It lies within the Santa Ana Regional Water Quality Control Board (SARWQCB) boundary.

The North Orange County WMA encompasses 241,000 acres (376 square miles) in northern Orange County. The northern Orange County WMA is bordered by Los Angeles County to the north and west and to the east by San Bernardino County. The three watersheds in this area are the San Gabriel River/Coyote Creek, Anaheim Bay-Huntington Harbour and the Santa Ana River. All three watersheds lie within the SARWQCB boundary.

IRWM Plans have been developed in all three Orange County WMAs; each address water issues, goals and projects applicable to local integrated planning efforts. The local North and Central IRWM Plans are likewise undergoing updates to comply with Proposition 1 Plan Standards; through this process, the IRWM Plans for the two WMAs will be combined.

In the future the ability to fund water resource projects will be challenging. With the collaborative process, Orange County continues to be a leader in meeting those challenges. WMAs and IRWM Plans are key tools to accessing federal, state and local grant opportunities to help offset the investment necessary to sustain the water resource needs of the region.

In the South Orange County WMA, integration is effectively achieved across regional boundaries by the OCWD, MWDOC and member agencies. Stormwater management and pollution control is effectively coordinated across watershed boundaries by Orange County Public Works (OC Public Works) Department as the principal National Pollutant Discharge Elimination System (NPDES) Permittee, TMDL program coordinator, and Flood Control infrastructure owner and operator of county-wide regional and subregional flood control facilities. Environmental stewardship is integrated across adjacent regions through the NCC as administrator of NCCP/HCP, environmental coalitions such as the Friends of Harbors, Beaches, and Parks, Orange County Green Vision, and the oversight and planning of regulatory agencies such as the CDFW. The Central Orange County WMA, North Orange County WMA, and the South Orange County WMA are integrated through the sharing of County Staff.

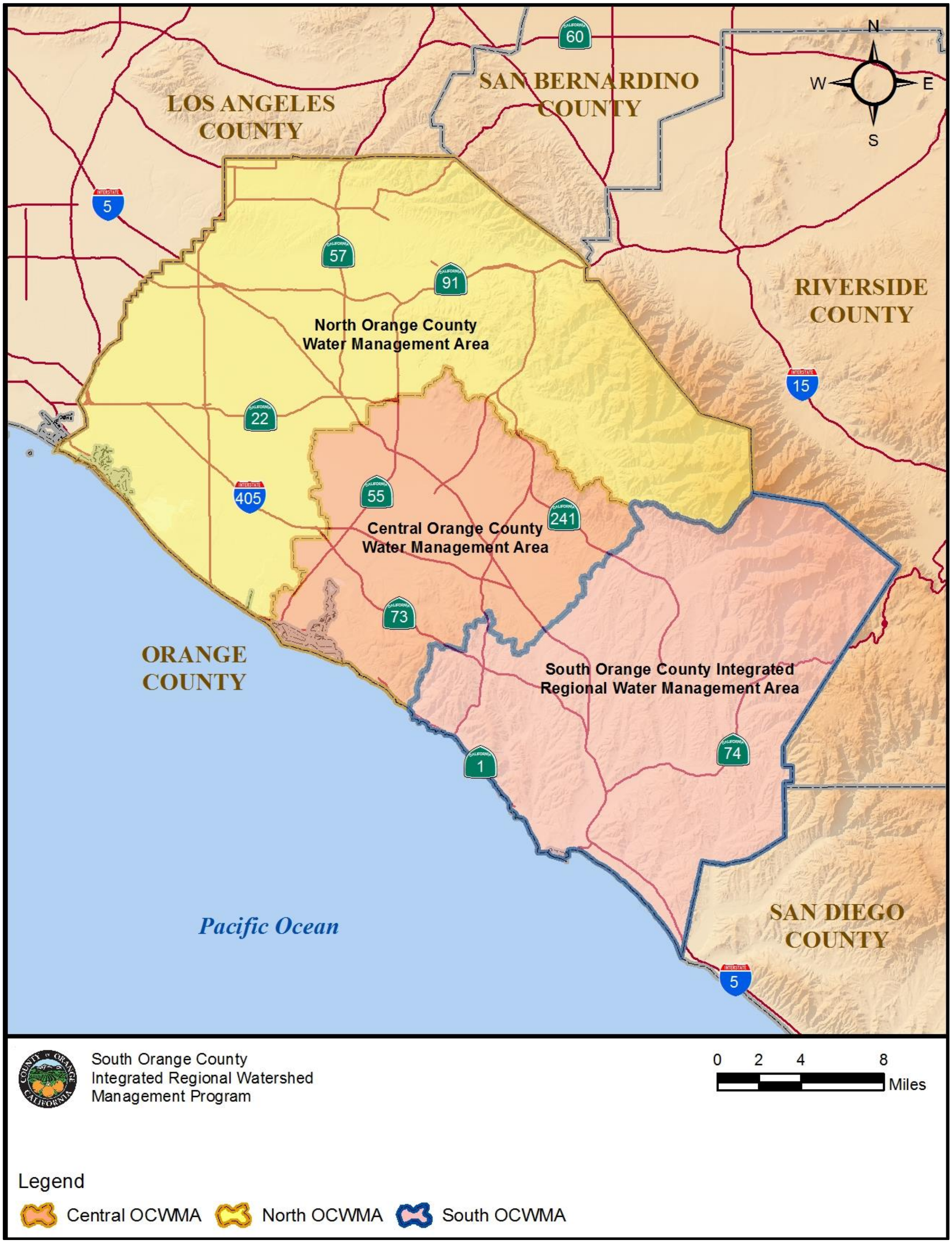



**Figure 2-6: Orange County Watershed Management Areas**

### 2.8.7 Overlapping and Void Areas

The San Diego Region does not overlap with any other proposed IRWM region. In establishing the Tri-County FACC, the three RWMGs identified one small void area between the three planning regions utilized for the Proposition 50 grant funding cycle. The Upper Santa Margarita IRWM region has incorporated that small area (a portion of the upper San Mateo Creek watershed) into its region boundary in order to ensure that all land area within the San Diego Funding Area is addressed in an IRWM planning effort. Additionally, the Tri-County FACC Overlay Subcommittee will be working collaboratively to define water management projects and programs that address common goals and objectives within the three IRWM Plans.

## *2.9 Tri-County FACC Structure and Governance*

### 2.9.1 History and Background

In February 2008, the three planning regions representing the San Diego Funding Area began coordination to identify opportunities to cooperate, share information, and determine equitable allocation of funding that allowed certainty and trust to be built. Through regular meetings over a period of 15 months, the Tri-County FACC developed the MOU, which was reviewed and approved by all RWMG agencies from each planning region. Each public agency was represented by staff, agency council, and executive management in reviewing the MOU. This process culminated in full execution of the MOU for IRWM Planning and Funding in the San Diego Funding Area on April 28, 2009, see **APPENDIX B**. Subsequent amendments to the MOU have been made to confirm allocation of Funding Area funds based upon land area and population for each bond (e.g. Proposition 1).

In June 2008, the Tri-County FACC sent a letter to DWR offering to work directly with DWR as a test pilot in interregional collaboration. DWR staff encouraged the development of alternatives to consider governance and organization of the regions. This interaction was very beneficial as it allowed FACC members to explore ways to work together and provided a timely opportunity to review progress to date with the RWMG agencies and the advisory committees of all the planning regions.

### 2.9.2 Summary of the Governance MOU

The MOU provides for a long-term stable group to coordinate current and future issues related to IRWM planning in the larger San Diego Funding Area. The coordinating role of the committee provides for MOU renewal to support the IRWM program beyond the current grant cycle. Funding allocations are specific to each bond measure allocating IRWM Program funds.

The MOU accomplishes the following for the San Diego Funding Area:

- Defines terms, which enables all parties to use a common language;
- Clearly identifies boundaries of the three planning regions covering the entire Funding Area;
- Identifies Watershed Overlay Areas to facilitate planning and coordination in cross-boundary watersheds;
- Creates an ongoing process for coordination and planning in the Funding Area and in the Overlay Areas;

- Provides for advisory committee cross membership to promote understanding, communication, and cooperation;
- Provides for IRWM Plan consistency, common references, and coordination of grant submittals to facilitate DWR's review process;
- Determines the funding allocation among the planning regions for each Proposition (updated through formal amendment of the MOU with each voter approved bond); and
- Identifies a process for identification and funding of common programs found by the Tri-County FACC to be of high value across the Funding Area.

In the unlikely event that any RWMG agency or group withdraws from the Tri-County FACC, members of the Tri-County FACC will continue to coordinate with the withdrawn agency and consider them as a stakeholder to the maximum extent possible. Additionally, the remaining members will negotiate with the withdrawn member to determine fair allocation of funding within the principles provided in the MOU agreement and will notify DWR as to the outcome of these negotiation and coordination efforts.

### 2.9.3 Future Efforts and Cooperation

The Tri-County FACC is working to identify areas of additional cooperation and to align planning efforts both to increase efficiency and to better inform each planning region about the efforts and plans of the others. The Tri-County FACC will build a foundation that ensures sustainable water resources planning within the Funding Area by serving as an umbrella organization, allowing the three IRWM regions to coordinate water resources planning activities and pool resources. Because human-made water infrastructure systems are the key water management units in the San Diego Funding Area, the planning regions reflect this reality and cross-boundary watershed issues are addressed via a collaborative subcommittee process.

The three RWMGs are undertaking coordinated planning within the Watershed Overlay Areas, one for the Santa Margarita River watershed area and one for the San Mateo Creek watershed area. The Watershed Overlay Subcommittee meets to discuss water resources projects and programs that may benefit from funding area-wide coordination, administration, funding, or support. Projects within the Watershed Overlay Areas identified as valuable and benefiting from cross-boundary coordination will be considered in the three IRWM project selection processes. A project may be proposed by a single RWMG or by several, where relevant to the Overlay Areas. However, the Tri-County FACC will coordinate to ensure that project costs are only identified once among the proposals.

# 3 REGIONAL DESCRIPTION

## *3.1 South Orange County IRWM Area*

The South Orange County IRWM Area contains a unique piece of social and cultural history as described in **Section 1**. Legacies passed on from native societies, once expansive cattle ranches, and twentieth century entrepreneurial farmers remain a part of the area's culture today. The Juaneño Band of Mission Indians, traditionally known as the Acjachemen nation, are indigenous Native American Indian tribes that were present before European settlers arrived. The landmark Mission San Juan Capistrano is emblematic of the early Spanish settlement near the western coastline to the Cleveland National Forest in the east. Subsequent waves of Americans settled in the area and south Orange County continues to be a destination known for beauty and a high quality of life. Most of the coastline is developed and additional urbanization is anticipated in the backcountry ranch land over the next 20 years. Today, the region's social and cultural makeup includes a unique mix of equestrian lifestyle, authentic Mexican/Hispanic culture, and a progressive business industry.

***Economic Conditions***

The great recession of 2008 hit the region early and particularly hard, as Orange County was home to numerous mortgage brokers, particularly in the sub-prime area. The region's high-tech sector remains a diverse and driving force of the local economy. Venture capital investment spiked 71 percent in 2015, after declining from 2011 to 2014 and sharp increases from 2009 to 2011. The pattern suggests peaks and valleys in future investment. The region's income increased to 2.4 percent between 2006 and 2007, compared with six percent between 2005 and 2006, and 5.5 percent between 2004 and 2005[13]. In 2009, the national inflation rate was negative (deflation), falling to 0.34 percent. As a result, each dollar bought marginally more, but Orange County residents were unlikely to sense the advantage since per capita income declined 5.5 percent from $51,877 in 2008 to $49,020 in 2009. In 2010, income statistics for both the state and nation indicated a rebound of approximately three percent, reflected in Orange County as well.[14] The region's unemployment rate continues to trend lower than the nation as a whole, at 4.1 percent in 2016. In April 2016, the Orange County unemployment rate decreased from the previous months' reading of 4 percent to 3.9 percent. Statewide unemployment was 5.2 percent in April 2016, which is 0.4 percentage points lower than the previous month and one percentage point lower year-over-year. The national unemployment was 4.7 percent in April 2016, a decrease of 0.4 percentage point compared to the previous month and 0.4 percentage point lower than in April 2015. This makes Orange County's unemployment rate 1.3 percentage point below the state rate and 0.8 percentage point below the national rate. The largest industry employment gains between March 2016 and April 2016 occurred in

[13] Orange County Business Council – Orange County Community Indicators Report - 2010. Available online: www.ocbc.org.

[14] Orange County Business Council – Orange County Community Indicators Report - 2012. Available online: http://cams.ocgov.com/Web_Publisher/Agenda04_03_2012_files/images/O00112-000414A.PDF

Construction (2,900 new hires), Leisure and Hospitality (2,700 new hires), and Trade, Transportation and Utilities (1,000 new hires). Orange County industries did not experience decreases during the same time period. Orange County's relative population growth increased to 10.5 percent for 2014 compared to 9.4 percent for 2013, while the state's growth in 2014 was 14.6 percent. From 2016 to 2017, Orange County population growth had slowed to 0.7% as the state rose 0.9%[15]. The California Employment Indicator Index indicates that job growth increased moderately in early 2016. Orange County industry employment is showing slight increases in all industries. Orange County population growth has recovered from a dip during the great Recession of 2009.[16]

***Hydrologic Delineation***

As shown in **Figure 3-1**, the South Orange County WMA includes the area that encompasses the SJHU in South Orange County, as defined in the Water Quality Control Plan of the San Diego Basin Plan (Basin Plan). The South Orange County IRWM Group determined that the South Orange County WMA is an appropriate region for integrated water planning because of its congruence with the natural hydrogeologic barriers of the SJHU, the furthest extents of which match the limits of the SDRWQCB boundaries and the County of Orange. The SDRWQCB boundary stretches along 85 miles of scenic coastline from South Newport Beach to the Mexican border and extends 50 miles inland to the crest of the coastal mountain range. The SDRWQCB boundary makes up the northern border of the South Orange County WMA while the southern border is consistent with the border of Orange County.

The SJHU is naturally divided by major water bodies and represents an important water resource in one of the nation's more arid regions. The SJHU comprises six major watersheds: 1) Laguna Coastal Streams, 2) Aliso Creek, 3) Dana Point Coastal Streams (Salt Creek), 4) San Juan Creek, 5) San Clemente Coastal Streams, and 6) San Mateo Creek, and two groundwater basins: 1) San Juan Valley Groundwater Basin (SJVGB) and 2) San Mateo Groundwater Basin. Refer to **Figure 3-1** for a map of the IRWM Region and **Figure 3-2** for the IRWM Region Watersheds and Surface Water Bodies.

The Mediterranean climate in South Orange County is characterized by brief, intense storms between October and March. It is not unusual for a majority of the annual precipitation to fall during a few storms in close proximity to each other. The higher elevation portions of the watershed (typically the headwater areas) typically receive significantly greater precipitation, due to orographic effects. In addition, rainfall patterns are subject to extreme variations from year to year and longer-term wet and dry cycles. The combination of steep, short watersheds, brief intense storms, and extreme temporal variability in rainfall result in "flashy" systems where stream discharge can vary by several orders of magnitude over very short periods of time.

[15] County of Orange - OC Economic Indicators Dashboard. May 2016 Metrics. Available online: http://oceconomy.org/population/ and California Department of Finance. May 2017. http://www.dof.ca.gov/Forecasting/Demographics/Estimates/E-1/

[16] County of Orange - OC Economic Indicators Dashboard. June 2016 Metrics. Available online: http://oceconomy.org/


**Figure 3-1: IRWM Regional Location**

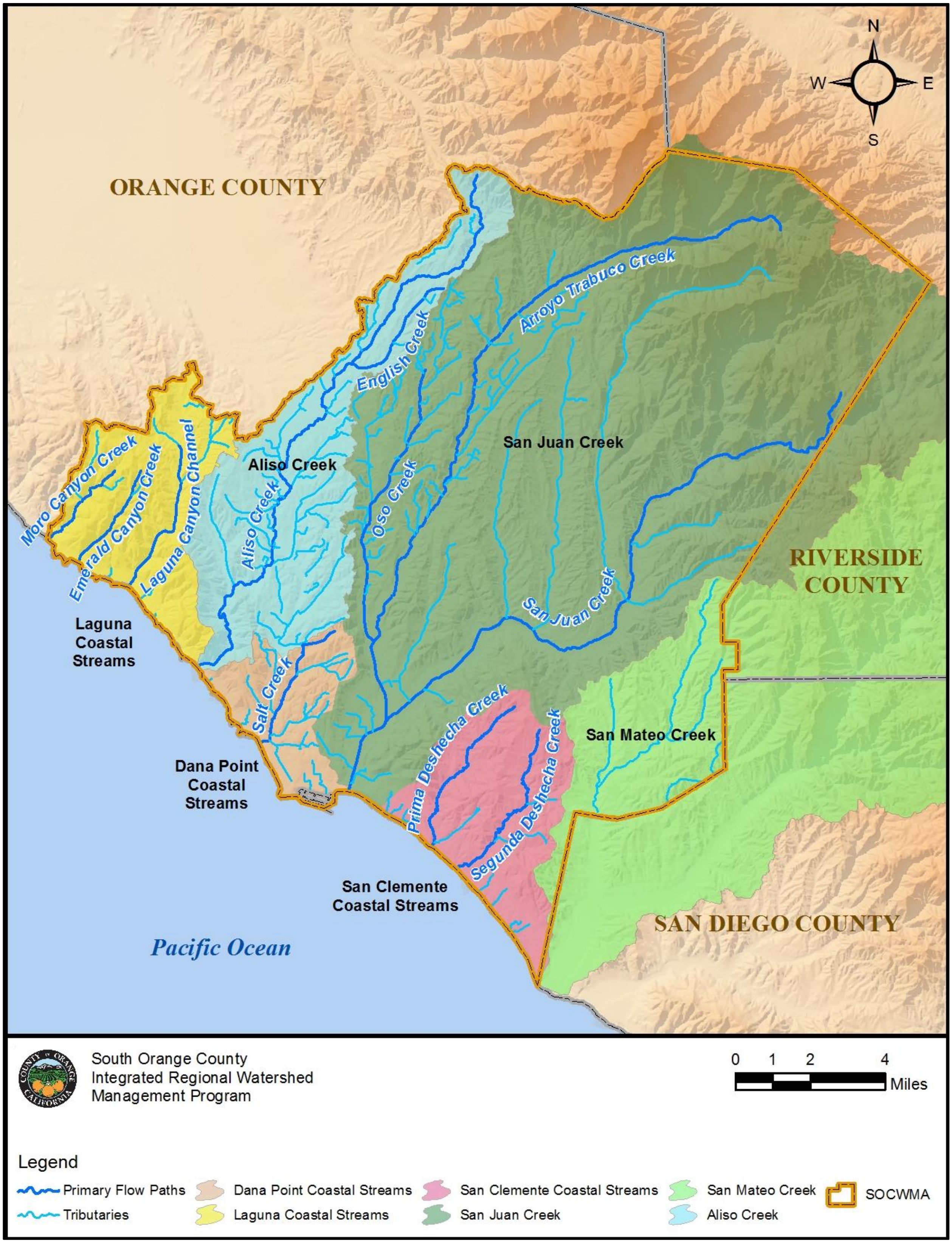



**Figure 3-2: IRWM Regional Watershed and Surface Water Bodies**

The geology, topography, and climate of the coastal watersheds of South Orange County make them unique among the watersheds in the United States. The Transverse and Peninsular Ranges are intensely sheared and steep due to ongoing uplift and tectonic activity. In addition, these ranges are located close to the coast, resulting in steeper, shorter watersheds than those found in most other portions of the country. **Figure 3-3** shows ground elevations throughout the South Orange County WMA.

Three counties and several municipalities have jurisdiction over portions of the SJHU. Riverside County includes a small portion (17.8 percent) of the SJHU, and no municipalities are found within this portion. More than half of the SJHU (51.7 percent) is located within Orange County, and the remainder (30.5 percent) is in San Diego County. In Orange County, the cities of Aliso Viejo, Mission Viejo, Laguna Beach, Laguna Woods, Laguna Niguel, Dana Point, Lake Forest, Rancho Santa Margarita, San Juan Capistrano, and San Clemente occur within the SJHU. Although a small portion (18.2 percent) of the SJHU is developed, most of this development is concentrated within the north-western portion of the SJHU. The undeveloped portion, the southern and interior portions, occupies 81.8 percent of the SJHU, based on 2013 land use patterns and aerial review. Agricultural land use occupies less than one percent of the land. Refer to **Section 10.2** for a discussion on regional land use. A very large and mostly undeveloped portion of the watershed is encompassed by the Camp Pendleton Marine Corps Base in northern San Diego County. Other large areas of open space are found within the Cleveland National Forest. Caltrans is another major landowner, and it has jurisdiction over the major freeways that traverse the watershed.


**Figure 3-3: Topographic Features**

## *3.2 Cities and Special Districts*

The IRWM Group consists of the following cities, state, county, and special districts as discussed in **Sections 2.1, 2.3, and 2.4**. **Figure 3-4** shows IRWM member cities and **Figure 3-5** shows IRWM member districts, all of which serve as the beneficiaries of the IRWM Plan. Refer to **Table 2-1** in **Section 2.4** for an overview of how each entity contributes to the IRWM Group through either jurisdictional authority and IRWM Group membership or in general support of IRWM projects and activities. The IRWM Group cities and jurisdictions include the following:

- Aliso Viejo
- County of Orange (including OCFCD)
- Dana Point
- Laguna Beach
- Laguna Hills
- Laguna Niguel
- Laguna Woods
- Lake Forest
- Mission Viejo
- Rancho Santa Margarita
- San Clemente
- San Juan Capistrano

The IRWM Group special districts and agency participants include:

- City of San Clemente Utilities Divisions
- City of San Juan Capistrano Water Services Department
- El Toro Water District (ETWD)
- Irvine Ranch Water District (IRWD)
- Laguna Beach County Water District (LBCWD)
- Moulton Niguel Water District (MNWD)
- Municipal Water District of Orange County (MWDOC)
- Santa Margarita Water District (SMWD)
- South Coast Water District (SCWD)
- South Orange County Wastewater Authority (SOCWA)
- Trabuco Canyon Water District (TCWD)

Other agency and special district participants include, but are not limited to:

- California State Parks
- Natural Resources Conservation Service (NRCS)
- Natural Communities Coalition (NCC)
- Orange County Health Care Agency (OCHCA)
- San Diego Regional Water Quality Control Board (SDRWQCB)
- San Juan Basin Authority (SJBA)
- United States Army Corps of Engineers (USACE), Southern California offices
- United States Department of Agriculture (USDA), Forest Service, Cleveland National Forest


**Figure 3-4: IRWM Plan Member Cities**


**Figure 3-5: IRWM Plan Member Districts**

## *3.3 Water Related Components of WMA*

### 3.3.1 Watersheds and Biological Significant Units

Within the WMA, there are six major watersheds and two groundwater basins; refer to **Section 3.1** for more information about the larger South Orange County IRWM Area. **Figure 3-2** shows the watershed area of major creeks and their tributaries within the WMA. Each watershed is discussed in the following sections.

Most recently, the South Orange County MS4 Permit Permittees completed preparation of the South Orange County (San Juan Hydrologic Unit) Water Quality Improvement Plan. The WQIP was prepared pursuant to requirements of a SDRWQCB Order R9-2013-0001, as amended by Order No. R9-2015-0001 and Order No. R9-2015-0100.

The WQIP covers all municipal Permittees and urbanized portions of the San Juan Hydrologic Unit and draws from the water quality findings and recommendations of the 2014 ROWD. More specifically, the WQIP applies a focus on stream system and coastal waters value and function and the ways these are affected by the MS4. The WQIP defines broader concepts of “water quality condition” that more closely relate to beneficial uses rather than focusing only on pollutants and water chemistry. A fundamental objective of the WQIP is the improvement in the form and function of receiving waters, as the associated beneficial uses are much more likely to be achieved when watersheds and receiving waters exhibit normal form and function. Further, the WQIP identifies “highest priority water quality conditions” for receiving waters based on the best available data and information. The highest priority water quality conditions (HPWQCs) identified in Section 2 of the WQIP are summarized below.

- Pathogen Health Risk: Applies to beaches during dry and wet weather, where recreational use is high and there are persistent exceedances of fecal indicator bacteria standards (limited extent during dry weather and most beaches during wet weather);
- Unnatural Water Balance/Flow Regime: Applies to inland stream reaches during dry weather where there are ponded or flowing outfalls or other observed issues exacerbated by an unnatural water balance; and
- Channel erosion/Geomorphic Impacts: Applies to inland stream reaches during wet weather where degraded channel form has become a limiting factor in channel ecology.

Section 3 of the WQIP describes water quality improvement goals for each of the HPWQCs and describes the strategies and schedules for achieving these goals. The WQIP integrates by reference many planning and guidance documents that direct strategies intended to meet water quality standards including individual jurisdictional runoff management plans (JRMPs); the Model Water Quality Management Plan (WQMP) for the San Diego Region and the associated Technical Guidance Document (TGD) for land development; and the South Orange County Hydromodification Management Plan. The OC SWRP’s regional goals for identification and prioritization of projects were drawn principally from the WQIP. Additional details pertaining to the WQIP can also be found in **Section 3.3.4**. The WQIP applies to each subsequent subwatershed description.

#### 3.3.1.1 Aliso Creek Watershed

The Aliso Creek Watershed is located in southern Orange County, approximately 50 miles south of Los Angeles and 65 miles north of San Diego. Aliso Creek drains a long, narrow coastal canyon with headwaters in the Cleveland National Forest. The Creek ultimately discharges into the Pacific Ocean at Aliso Beach. The approximately 36-square-mile watershed includes portions of the cities of Aliso Viejo, Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Mission Viejo, and County unincorporated areas including the 6 square mile Aliso and Wood Canyons Wilderness Park. Major transportation arteries through the watershed include the San Joaquin Hills Transportation Corridor and Interstate 5.

The Aliso Creek Watershed is largely developed, with the exception of the Cleveland National Forest in the upper watershed and the Aliso Wood Canyon Regional Park in the lower watershed. The Aliso Creek Watershed is within the jurisdiction of the San Diego Regional Water Quality Control Board (San Diego Regional Board). The San Diego Regional Board has placed Aliso Creek under the Laguna subunit of the San Juan Hydrologic Basin. The Water Quality Control Plan for the San Diego Region (Basin Plan) lists Aliso Creek and tributaries to Aliso Creek: English Canyon, Sulphur Creek, and Wood Canyon as receiving waters. The Basin Plan lists the English Canyon, Sulphur Creek, and Wood Canyon tributaries to Aliso Creek as receiving waters. The following existing beneficial uses are designated in the Basin Plan for the Aliso Creek watershed: agricultural supply; non-contact water recreation; warm freshwater habitat; and wildlife habitat. The following existing beneficial uses designations apply to the mouth of Aliso Creek: non-contact water recreation; warm freshwater habitat, and marine habitat.[17]

On March 2, 2001, the SDRWQCB issued a directive, by authority of California Water Code (CWC) Section 13225, to the County of Orange, the OCFCD, and the cities of Laguna Beach, Laguna Hills, Laguna Niguel, Laguna Woods, Lake Forest, Mission Viejo, and Aliso Viejo to investigate urban runoff in the Aliso Creek watershed[18]. The directive found that the Permittees may be discharging waste with high indicator bacteria concentrations from municipal storm drain outfalls into Aliso Creek and its tributaries.

The directive required the Permittees to:

- Conduct weekly monitoring at all major outfalls to Aliso Creek.
- Evaluate the effectiveness of structural and non-structural BMPs currently being implemented in the watershed and identify future measures that would eliminate levels of high bacteria from outfalls.

In 2007 the SDRWQCB adopted a TMDL for Indicator Bacteria, Project I - Beaches and Creeks in the San Diego Region, commonly referred to as the Twenty Beaches and Creeks TMDL. This TMDL include Aliso Creek and its tributaries, the Aliso Creek mouth, and Aliso Beach. In 2010

[17] County of Orange. Aliso Creek Watershed Comprehensive Load Reduction Plan. Update July 2014. OC Watersheds Document Library

[18] OC Watersheds Document Library. Available online March 2017:

the SDRWQCB revised this TMDL and on April 4, 2011, the Twenty Beaches and Creeks TMDL received final approval from the State Office of Administrative Law.

As a first step to fulfilling the requirements of the TMDLs, the County and Watershed Permittees developed a Comprehensive Load Reduction Plan (CLRP) to address bacteria impaired segments and other 303(d) listings within the Aliso Creek Watershed, as well as the San Clemente Coastal Streams and San Juan Creek Watersheds. This plan was submitted to the SDRWQCB on October 4, 2012. In addition to detailing existing and planned BMPs within the watershed, the CLRP describes a series of proposed special studies to better define and optimize future watershed efforts. In July 2014, updates were made to the CLRP based upon results from 2013-2014 Watershed Permittee efforts, the 2013 Watershed Runoff Management Plan, and ongoing CLRP assessments. A detailed description of this report may be found in **Section 3.3.4.4** below.

As noted above and outlined in the Aliso Creek Watershed Management Plan[19], the watershed suffers from a number of problems related to water resources. The Aliso Creek Watershed Management Plan groups them in four general categories: creek instability, water quality, loss of fish and wildlife habitat, and flooding damages. Based on the aforementioned challenges watershed management has become necessary to protect and restore the beneficial uses of Aliso Creek and its associated tributaries. A number of steps have been taken to address these challenges:

- The County continues to move forward with watershed planning associated with the Aliso Creek Mainstem Feasibility Study in an effort to produce a sustainable restoration plan for the project area. The original project, the Aliso Creek Water Quality SUPER Project (which combined 2005 IRWM Plan Priority A Projects 8 & 9), was integrated into the USACE feasibility study process. This process evaluates baseline conditions, future without project conditions, and conducts alternatives analysis before developing a final plan for public review. The baseline conditions report has been finalized by the USACE. USACE released for public comment an EIS/EIR in September 2017, open for a 60-day comment period. A public hearing was also held in October 2017 to receive public comments. Discussions with stakeholders are ongoing to determine the course of action that is in the best interest of the Aliso Creek watershed.
- An Annual Watershed Workplan for Aliso Creek was developed by the associated Watershed Permittees annually through 2013 to comply with SDRWQCB Order No. R9-2009-0002. The Watershed Workplan described the Watershed Permittees' development and implementation of a collective watershed strategy to assess and prioritize the water quality problems within the watershed's receiving waters, identify and model sources of the highest priority water quality problem(s), develop a watershed-wide BMP implementation strategy to abate highest priority water quality problems, and a monitoring strategy to evaluate BMP effectiveness and changing water quality prioritization in the watershed. Following the approval of the Fifth Term MS4

[19] Aliso Creek Watershed Management Plan. OC Watersheds Document Library. Available online March 2017.

NPDES Permit, annual workplans are no longer required; however, the planning contained therein assisted development of the 2014 ROWD and the WQIP.

- The Comprehensive Landscape WUE Program is a regional program which assists in meeting the water conservation and quality goals of all the watersheds throughout the region. The Project meets several objectives of the Aliso Creek Watershed Workplan and WQIP. Specifically, the Project assists agencies in meeting water quality goals by encouraging regional landscape transformation from turf-intensive to California Friendly landscapes. The WQIP emphasizes the need to reduce or eliminate dry weather flows for drains that contribute to an unnatural water balance in Aliso Creek; landscape transformation provides a source control mechanism to reduce water demands by encouraging climate-appropriate plants. The Project also meets public education goals by incorporating signage at project locations in highly visible landscapes along major streets that have non-functional turf such as street medians, intersections, and sidewalk buffers.
- Pursuant to Regional Board Order No. R9-2009-0002, an Aliso Creek Watershed Runoff Management Plan Annual Report was submitted for 2014. This report details the past status of ongoing corrective actions, monitoring, assessment, and environmental research efforts for Fecal Indicator Bacteria (FIB) in the Aliso Creek Watershed and downstream at Aliso Beach. The report focuses on six specific topics; watershed setting and BMP's, BMP monitoring, Aliso Creek monitoring, Aliso beach monitoring, drought impact, and bacteria TMDLs future direction. The Aliso Creek Watershed Runoff Management Plan Annual Report is available online for review[20].

***Sub-watershed Projects to Address Water Quality Issues***

Several projects have been implemented within the Aliso Creek watershed, including the Dairy Fork wetland project described in **Section 2.6.2**.

#### 3.3.1.2 Dana Point Coastal Streams Watershed

The Dana Point Coastal Streams Watershed covers 10.28 square miles; its main tributary is Salt Creek and the other areas consist of smaller coastal drainages. Salt Creek ultimately drains into the Pacific Ocean near the northern boundary of the City of Dana Point. Dana Point Harbor is located within this watershed. The 6-square-mile watershed is almost fully developed and includes portions of the cities of Dana Point and Laguna Niguel. Remaining undeveloped areas include open space within the Aliso and Wood Canyons Regional Park in the upper watershed and the Salt Creek Corridor Regional Park in the eastern part of the watershed. A few small, unnamed drainages and larger tributaries (Arroyo Salado Creek and San Juan Canyon Creek, both in Laguna Niguel) join Salt Creek as it makes its way through the watershed. The creek originates in the city of Laguna Niguel and flows underneath Marina Hills Drive, Niguel Road, Pacific Island Drive, and lastly, Pacific Coast Highway, before discharging into the Pacific Ocean.

[20] Aliso Creek Watershed Runoff Management Plan Annual Report. OC Watersheds Document Library. Available online March 2017.

The Dana Point Coastal Streams watershed is the smallest watershed in Orange County. The Dana Point Coastal Streams Watershed is within the jurisdiction of the San Diego Regional Water Quality Control Board (the San Diego Regional Board). The San Diego Regional Board has placed Dana Point Coastal Streams under the Laguna subunit of the San Juan Hydrologic Basin. The Water Quality Control Plan (Basin Plan) lists Arroyo Salado Creek and San Juan Canyon Creek as tributaries to Salt Creek as receiving waters.

The designated beneficial uses in the Dana Point Coastal Streams watershed for Coastal Streams, Salt Creek, San Juan Canyon, and Arroyo Salado include: agricultural supply; non-contact water recreation; warm freshwater habitat; and wildlife habitat. The following existing beneficial uses are designated in the Basin Plan for Dana Point Harbor: contact water recreation; non-contact water recreation; commercial and sport fishing; industrial; marine habitat; migration of aquatic organisms; rare, threatened or endangered species; spawning, reproduction or early development; and wildlife habitat.

In June 2008, the SDRWQCB adopted indicator bacteria TMDLs for Baby Beach in Dana Point Harbor. The TMDLs require 82.7-96.2% (dependent upon specific indicator bacteria) waste load reductions from the stormdrain system. Annual Progress Reports are prepared each year and submitted to the RWQCB. Based on the most recent report submitted in January 2018, dry weather waste load reductions and wet weather interim targets have been achieved. The comprehensive Progress Reports include a description of monitoring and investigation efforts, BMPs implemented and an extensive data analysis. Annual Progress Reports are available on www.ocwatersheds.com. Many years ago, Baby Beach has been classified as an F grade beach, with poor grades stemming from a lack of circulation as well as runoff from multiple sources. However, the Heal the Bay Beach Report Card for 2016-17 gave Baby Beach sites scores of “B” to “A+” during summer dry weather and “A” to “A+” during winter dry weather. Additionally, Baby Beach was delisted for Fecal Coliform from the 2010 303(d) list and is proposed for delisting for *Enterococcus* from the 2014/2016 303(d) list.

These documents were used to develop the WQIP summarized in **Section 3.3.1.1** and **Section 3.3.4**

***Structural Controls Implemented by IRWM Group Jurisdictions***

The Salt Creek Ozone Treatment Facility provides advanced stormwater treatment to reduce bacteria levels in the Salt Creek dry-weather flows within the 4,500-acre watershed. This project was able to significantly reduce the number of beach postings of high bacteria levels. The treatment facility has been in operation since November 2005 and operates generally from May through October/early November. The facility captures up to 1,000-Gallons per Minute (GPM) of surface flows (1.44 MGD), provides advanced filtration, and then uses ozone to treat for bacteria and other pollutants from the runoff prior to discharging to the beach. Because of the observed high population of gulls that congregate (and contribute high avian bacteria loads) at the scour pond of Salt Creek prior to the ocean, a successful pilot bird deterrent project was implemented from July – September 2016. The bird deterrent program continues again in 2017.

The City of Dana Point operates five dry weather diversions within this watershed: three (3) diversions at the Headlands Development, one (1) located in the Niguel Shores HOA and one at

Baby Beach Storm Drain Diversion (owned by the County or Orange). The dry weather diversions divert any nuisance flows that may occur during dry weather to the sanitary sewer where the water is treated at the J.B. Latham treatment plant in Dana Point and then released 2.2-miles out into the ocean. The Baby Beach project was funded by the Dana Point Headlands Reserve LLC (as were the three diversions at the Headlands Development), as conditioned by the City of Dana Point, and by the County of Orange, funded through the Proposition 40 Clean Beach Initiative Grant administered by the SWRCB.

#### 3.3.1.3 Laguna Coastal Streams Watershed

The 11-square mile Laguna Coastal Streams Watershed consists of the Laguna Canyon Creek watershed and several smaller coastal-draining watersheds adjacent to it. Laguna Canyon Creek runs north to south, directly through the middle of its watershed, and ultimately discharges into the Pacific Ocean at Laguna Beach. The lower 2.6 miles of Laguna Canyon Creek are concrete lined channel with two dry weather diversion units in place to capture nuisance flows. Several other smaller watersheds, including Boat Canyon, Blue Bird Canyon, Rim Rock Canyon, and Hobo Canyon, also drain portions of these cities. All of the smaller watersheds are channelized or piped to the discharge points on the beach and most have dry weather diversions in place. This watershed is generally bounded by the eastern boundary of the Emerald Canyon watershed on its west and the western boundary of the Aliso Creek watershed on its east. The remaining undeveloped areas are largely within the Laguna Coast Wilderness Park and the Aliso and Wood Canyons Regional Park. The Laguna Coast Wilderness Park covers most of the western half of the Laguna Canyon Creek watershed, and a small portion of the Aliso and Wood Canyons Regional Park is included in the northeastern part of the watershed. Laguna Canyon Creek runs parallel to Laguna Canyon Road, underneath the San Joaquin Hills Transportation Corridor, through the city of Laguna Beach, and underneath the Pacific Coast Highway, before emptying into the Pacific Ocean.

The Laguna Coastal Streams Watershed is within the jurisdiction of the San Diego Regional Water Quality Control Board (the San Diego Regional Board). The San Diego Regional Board has placed Laguna Coastal Streams under the Laguna subunit of the San Juan Hydrologic Basin. The Water Quality Control Plan (Basin Plan) lists Moro Canyon, Emerald Canyon, Boat Canyon, Laguna Canyon, Blue Bird Canyon, Rim Rock Canyon, Hobo Canyon as coastal streams draining to the Pacific Ocean. The Basin Plan also designates beneficial uses (the uses of water necessary for the survival and wellbeing of humanity, plants and wildlife) for inland and coastal waters, sets narrative and numerical water quality objectives that must be attained or maintained to protect the designated beneficial uses, and describes implementation programs to protect beneficial uses.

The Basin Plan lists existing designated beneficial uses for the following: Coastal Streams, Moro Canyon, Emerald Canyon, Boat Canyon, Canyon, Laguna Canyon, Bluebird Canyon, Rim Rock Canyon, and Hobo Canyon: agricultural supply, non-contact water recreation, warm freshwater habitats, and wildlife habitats.

To assist in watershed management planning, the Watershed Permittees completed an annual Watershed Workplan for Laguna Coastal Streams to comply with Directive G of SDRWQCB Order No. R9-2009-0002. The Watershed Workplan described the Watershed Permittees' development and implementation of a collective watershed strategy to assess and prioritize the water quality problems within the watershed's receiving waters, identify and model sources of the highest priority water quality problem(s), develop a watershed-wide BMP implementation strategy to abate highest priority water quality problems, and a monitoring strategy to evaluate BMP effectiveness and changing water quality prioritization in the watershed. Previous workplans are available for review on the Orange County Watersheds website[21]; however, following the approval of the Fifth Term MS4 NPDES Permit, annual workplans are no longer required.

***Sub-watershed Projects to Address Water Quality Issues***

The Heisler Park Ecological Reserve is an Area of Special Biological Significance (ASBS) located in this watershed; the ASBS was completed in 2012 and is further described in **Sections 3.3.1.8 and 3.4**. To protect Heisler Park, the City of Laguna Beach has implemented the Heisler Park Marine Habitat Protection Project Improvements project to protect the adjacent Heisler Park Ecological Reserve. The project has helped the City comply with a SWRCB mandate prohibiting runoff discharges from the urbanized watershed area to the ecological reserve. The Project is located on property owned and maintained by the City of Laguna Beach.

The following park improvements within an area of the park to reduce runoff to the ecological reserve have been completed:

1. A controlled and efficient irrigation system;
2. Bluff-top landscape grading;
3. Surface drain and pathway improvements;
4. Storm drain improvements;
5. Installation of a surface runoff diversion system; and Coastal bluff stabilization.

Projects such as the Rockledge Ocean Protection Project help to further protect the resources and beneficial uses in this watershed. The Rockledge sewer station, built more than 30 years ago, represented a significant threat to ocean water quality due to the threat of systems failure and a sewage spill. Sanitary sewer overflows into the ocean impacts all beneficial uses of the Laguna Beach coastline. Replacing the deteriorating Rockledge sewer system, located above a protected marine tide pool zone, will help local public agencies to meet long-term water supply needs, protection of water quality, and augment/restore environmental conditions. The project will help meet receiving water objectives established in the Region 9 Basin Plan as well as indicator bacteria objectives established in the Twenty Beaches and Creeks Bacteria TMDL. This project was completed in 2016.

[21] Laguna Coastal Streams Watershed Work Plan. OC Watersheds Document Library. Available online March 2017.

### 3.3.1.4 San Juan Creek Watershed

The San Juan Creek Watershed is the largest watershed in the South Orange County WMA. The 159.98 square mile watershed includes portions of the cities of Dana Point, Laguna Hills, Laguna Niguel, Mission Viejo, Rancho Santa Margarita, San Juan Capistrano and unincorporated areas within the County. The Arroyo Trabuco and Oso Creeks are smaller tributaries. A small western portion of the San Juan Creek Watershed extends into Riverside County. The creek ultimately discharges into the Pacific Ocean at Doheny Beach.

San Juan Creek falls under the Mission Viejo subunit of the San Juan Hydrologic Basin (designated Hydrologic Sub Area 1.21-1.28). The Basin Plan lists Bell Canyon Creek, Cañada Gobernadora, Arroyo Trabuco (Trabuco Creek), and Oso Creek tributaries to San Juan Creek as receiving waters. The following existing beneficial uses are designated in the Basin Plan for San Juan Creek, Morrell Canyon, Decker Canyon, Long Canyon, Lion Canyon, Hot Spring Canyon, Cold Spring Canyon, Lucas Canyon, Aliso (not Creek) Canyon, Verdugo Canyon, Bell Canyon, Fox Canyon, Dove Canyon, Crow Canyon, Trampas Canyon, Cañada Gobernadora, Cañada Chiquita, Horno Creek, Trabuco (Arroyo Trabuco) Creek, Holy Jim Canyon, Falls Canyon, Rose Canyon, Hickey Canyon, Live Oak Canyon, Tijeras Canyon, Oso Creek, and La Paz Creek: agricultural supply; cold freshwater habitat; industrial; contact water recreation; non-contact water recreation; spawning habitat; warm freshwater habitat; and wildlife habitat. The following designations apply to the mouth of San Juan Creek: rare, threatened, or endangered species; non-contact water recreation; marine habitat; migratory habitat; shellfish habitat; and wildlife habitat. The Southern California Steelhead Recovery Plan[22] identifies San Juan Creek and San Mateo creeks as critical habitat for the Southern California Steelhead. **Figure 3-6** shows the steelhead critical habitat.

San Juan Creek drains to Doheny Beach. The 2015-2016 Heal the Bay Beach Report Card, which grades shoreline water quality based on the risk of adverse health effects to swimmers and surfers, notes that Doheny State Beach has 14 points of water quality testing. The grades are based on daily and weekly FIB pollution levels in the surfzone. During the 2015-2016 assessment period, Doheny Beach experienced a range of grades with near excellent water quality during the summer dry weather, and worsening quality during wet weather.

Three regional epidemiology studies, a component of which is an effort to identify and quantify viral pathogens, began between 2007 and 2009. These studies were led by the Southern California Coastal Water Research Project (SCCWRP), UC Berkeley, Orange County Sanitation Districts (OCSD), and Heal the Bay. The overall study, which included Doheny Beach, focused on three primary questions:

1. Did water contact increase the risk of illness during the two weeks following exposure to water?

[22] National Oceanic & Atmospheric Agency (NOAA) Southwest Regional Office, National Marine Fisheries Service. *Final Southern California Steelhead Recovery Plan*. Long Beach, CA. January 2012. Available online: http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/south_central_southern_california/southern_california_steelhead_recovery_plan_executive_summary_012712.pdf

2. Among those individuals with water contact, were there associations between illness and measured levels of traditional water quality indicators?
3. Among those individuals with water contact, were there associations between illness and measured levels of non-traditional water quality indicators?

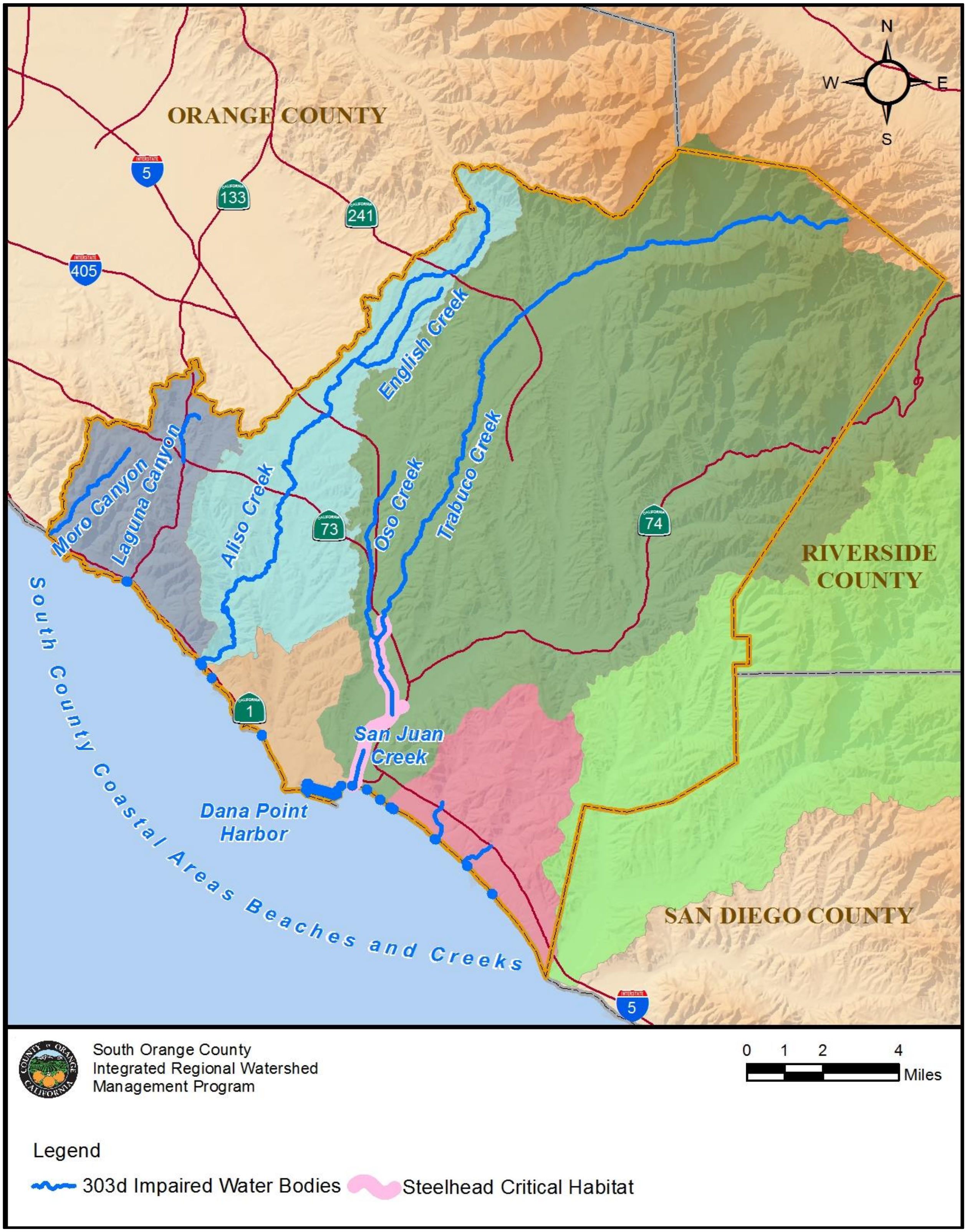



**Figure 3-6: Impaired Water Bodies and Steelhead Critical Habitat**

The study found that, of the three tested indicators (total coliform, fecal coliform, and *Enterococcus*), only associations between *Enterococcus* and health outcomes were consistent with current concentration based objectives and only under conditions when the creek flowed to the beach. These findings suggest that site specific objectives for at least total and fecal coliform bacteria indicators are warranted to accurately characterize human health risks at San Juan Creek and Doheny Beach.[23]

As a follow-up to the SCCWRP Epidemiology Study, which concluded that there was a three percent increase in health risk for gastrointestinal ailments between swimmers and non-swimmers at Doheny State Beach but could not identify the source of the increased health risk, the SWRCB's Clean Beach Task Force commissioned the *Source Identification Protocol Project* (SIPP) to develop protocols for tracking and identifying bacteria sources at beaches throughout California. SCCWRP was one of four core laboratories implementing the multi-year study, which produced a standard guidance manual for beach managers. Doheny State Beach was one site for this study. The objectives were to (1) develop protocols for source identification, (2) identify sources of beach contamination on a site-specific basis, and (3) provide recommendations for management practices that can be implemented by the local community to reduce or eliminate those sources. The City of Dana Point took on a stakeholder/facilitator role in the study with SCCWRP. Completed in 2014, the SIPP quantified specificity and sensitivity for 41 Microbial Source Tracking (MST) methods. Additionally, a guidance manual was released in December 2013 highlighting MST and identification methods that were both cost effective and high performing. This manual was adopted by the SWRCB in January 2014 as a template for source tracking.

The results of the study resulted in State Parks receiving $10 million from the unused CBI funds to help fund sanitary sewer repairs at three Parks, including Doheny State Beach which is the number one project priority. The sewer repairs are in the planning/design phase at this time.

The risk of adverse health effects to swimmers and surfers at beaches throughout South Orange County is the basis for the South Orange County WQIP specifying pathogen health risk as a HPWQC that must be addressed. As noted in **Section 3.3.1.1**, the WQIP also identifies channel erosion and associated geomorphic impacts, and unnatural water balance and flow regime, as HPWQCs. The specific goals, schedules, and strategies for addressing each HPWQC have been defined in Sections 2 and 3 of the South Orange County WQIP. In the case of pathogen health risk, interim and final numeric goals, expressed as FIB percent load reductions, have been defined for each watershed according to the goals summarized in the Twenty Beaches and Creeks TMDL. Additional details pertaining to the WQIP can also be found in **Section 3.3.4**

[23] Colford, J.M., Jr.et al., *Using rapid indicators for Enterococcus to assess the risk of illness after exposure to urban runoff contaminated marine water, Water Research* (2012), doi: 10.1016/j.watres.2012.01.033 (2012) Available online: www.elsevier.com/locate/watres

***Sub-watershed Projects to Address Water Quality Issues***

As part of the Proposition 50, IRWM Implementation Grant Program funding awarded to the South Orange County IRWM in 2007, the City of San Juan Capistrano's Recycled Water Transmission System Improvements Project was completed in 2013. The Recycled Water Transmission System Improvements Project constructed a recycled water system consisting of four reservoirs, one pump stations, and 29 pipeline projects in six segments totaling 102,000 lineal-feet. This represents the next phase of improvements to the recycled water system, and shall distribute approximately 3,268 acre feet of recycled water per year to areas in San Juan Capistrano, Dana Point, San Clemente and Mission Viejo, not currently served by a recycled water source. The Transmission System Improvements Project is a component of the J.B. Latham Treatment Plant-AWT project for distribution of recycled water produced by that plant. This project will help protect the natural resources of the watershed and expand the resources for the region.

The Gobernadora Multipurpose Basin Project, as discussed in **Section 2.6.2**, was funded under Prop 50 and will also greatly assist in protecting the beneficial uses of the San Juan Creek Watershed. The project is located along the Gobernadora Creek, which is a major tributary of San Juan Creek. The upper portion of the watershed within Coto De Caza, approximately 7.8 square miles upstream of its confluence with Wagon Wheel Creek. Wagon Wheel Creek has been developed over the past two decades primarily as Coto de Caza, a private community with over 5,000 dwelling units and two golf courses. The lower portion of the watershed, approximately 3.4 square miles, is owned by RMV and remains indigenous. The project is upstream of the 105 acre GERA; a wetlands reserve with a conservation easement. The project was completed in 2015 and restores Gobernadora Creek to protect the GERA, as well as effectively contribute to meeting the Basin Plan's objectives and beneficial uses for the San Juan Watershed within the SJHU.

A CLRP was developed for the San Juan Creek Watershed to address bacteria and other pollutants determined to be impairing San Juan Creek and associated receiving waters[24]. Similar to the Aliso Creek Watershed CLRP, the San Juan Creek Watershed CLRP was last updated in April 2015 to reflect progress made toward meeting the TMDLs. The Watershed Monitoring and Assessment Program and the CLRP Implementation strategy were assessed and structural and non-structural BMP plans updated. Additional studies were added to enhance CLRP efforts in the watershed. The analysis conducted for and the commitments made in the CLRPs for San Juan and Aliso Creeks were incorporated into the WQIP. As noted in **Section 3.3.1.1**, many of the elements and strategies included within the CLRP have been integrated into the WQIP for South Orange County. In the case of bacteria, interim and final numeric goals for addressing pathogen health risk—expressed as FIB percent load reductions—have been defined for each watershed according to the goals summarized in the Twenty Beaches and Creeks TMDL. Additional details pertaining to the WQIP can also be found in **Section 3.3.4**

[24] San Juan Creek Comprehensive Load Reduction Plan. OC Watersheds Document Library. Available online March 2017.

The City of Dana Point has constructed twelve dry weather diversions in this watershed.

#### 3.3.1.5 San Clemente Coastal Streams Watershed

The San Clemente Coastal Streams Watershed is approximately 19.16 square miles and includes portions of the cities of San Clemente, San Juan Capistrano and Dana Point. San Clemente Coastal Streams fall under the San Clemente subunit of the San Juan Hydrologic Basin (designated Hydrologic Sub Area 1.31 and 1.32). The Basin Plan lists Prima Deshecha Cañada and Segunda Deshecha Cañada as receiving waters. Prima Deshecha Cañada flows through the City of San Clemente, ultimately discharging into the Pacific Ocean at Poche Beach. Segunda Deshecha Cañada discharges into the Pacific Ocean at North Beach. The Basin Plan designates the following beneficial uses for Prima Deshecha Cañada and Segunda Deshecha Cañada: agricultural supply; contact water recreation; non-contact water recreation; warm freshwater habitat; and wildlife habitat.

Poche Beach is a County Beach located at the mouth of the Prima Deshecha Cañada Channel and lies within the City of Dana Point, with the drainage area predominantly from San Clemente. The beach was historically posted for exceedances of indicator bacteria standards, and was regularly included on Heal the Bay's list of Beach Bummers, considered to be the top 10 problem beaches in southern California. However, since 2013 Poche Beach has not been on the Beach Bummer's list, and as the 2014 ROWD indicates, Poche Beach has experienced great improvement in shoreline water quality. In fact, the 2015-2016 Heal the Bay Beach Report Card gives Poches Beach an A grade for all three assessment periods (i.e., Summery Dry, Winter Dry, and Wet Weather).

Improvements in shoreline water quality at Poche Beach are the result of a diverse set of monitoring, assessment, prevention, and treatment efforts. Regarding the latter, the Poche Clean Beach Project used state grant funds to construct a dry weather filtration/ultra violet (UV) disinfection system in 2009 that reduced input of bacterial contamination from a channel discharging to the beach. In addition, better maintenance of the Prima Deshecha landfill, combined with falconry programs at both the landfill and the beach significantly reduced the source of contaminant inputs.

Similar to the Aliso Creek and San Juan Creek Watersheds, a Watershed Workplan for San Clemente Coastal Streams was developed and updated annually by the associated Watershed Permittees from 2011-2013, to comply with Directive G of the SDRWQCB Order No. R9-2009-0002. The Watershed Workplan described the Watershed Permittees' development and implementation of a collective watershed strategy to assess and prioritize the water quality problems within the watershed's receiving waters, identify and model sources of the highest priority water quality problem(s), develop a watershed-wide BMP implementation strategy to abate highest priority water quality problems, and a monitoring strategy to evaluate BMP effectiveness and changing water quality prioritization in the watershed. The previous workplans are available for review on the Orange County Watersheds website[25]; however,

[25] San Clemente Coastal Streams Watershed Work Plan. OC Watersheds Document Library. Available online March 2017.

following the approval of the Fifth Term MS4 NPDES Permit, annual workplans are no longer required.

A CLRP was developed by the San Clemente Coastal Streams Watershed Permittees (City of San Clemente and the OCFCD collectively known as Phase 1 MS4s) in response to SDRWQCB Resolution No. R9-2010-0001 (Amending the Water Quality Control Plan for the San Diego Basin (9) to Incorporate Revised TMDLs for Indicator Bacteria, Project I – Beaches and Creeks in the San Diego Region (Including Tecolote Creek)).[26] The CLRP was developed to address bacteria and other pollutants determined to be impairing the beneficial uses of receiving waters. Key CLRP elements include: assessing watershed conditions and setting priorities including development of a Watershed Monitoring and Assessment Program; assessing BMP candidate strategies and developing a CLRP Implementation Strategy; developing BMP Action Plans, and preparing a schedule for loading reductions to be achieved. As noted in **Section 3.3.1.1**, many of the elements and strategies included within the CLRP have been integrated into the WQIP for South Orange County. In the case of bacteria, interim and final numeric goals for addressing pathogen health risk—expressed as FIB percent load reductions—have been defined for each watershed according to the goals summarized in the Twenty Beaches and Creeks TMDL. Additional details pertaining to the WQIP can also be found in **Section 3.3.4**

***Sub-watershed Projects to Address Water Needs/Issues***

The City of San Clemente's Recycled Water Treatment and Distribution Project was funded under the Proposition 50 IRWM Implementation Grant Program in 2006. Completed in 2014, the Recycled Water Treatment and Distribution Project expands the City's recycled water system, which consists of a 2.8-MGD treated recycled water treatment plant expansion, 2.0 million-gallons reservoir conversion, pump station, booster pump, interconnection, five pipeline transmission main segments totaling 12,600 linear-feet and onsite customer conversions. This project greatly enhances the local resources of the watershed.

#### 3.3.1.6 San Mateo Creek Watershed

Most of San Mateo Creek and its outlet to the Pacific Ocean, at San Onofre State Beach, is located in San Diego County. The San Mateo Creek Watershed within Orange County is largely unincorporated territory under the jurisdiction of the County. It covers approximately 20 square miles of southeastern Orange County including portions of the City of San Clemente in its downstream-most area.

San Mateo Creek falls under the San Mateo Canyon subunit of the San Juan Hydrologic Basin (designated Hydrologic Sub Area 1.40). The Basin Plan lists San Mateo Creek and its mouth as receiving waters. There are both existing and potential beneficial uses as described in the Basin Plan for the San Diego Basin. The following beneficial uses are designated in the Basin Plan for the receiving waters listed above: cold water habitat; rare species habitat; contact water

[26] San Clemente Coastal Streams Watershed Comprehensive Load Reduction Plan. City of San Clemente website. Referenced in Meeting Minutes. Available online March 2017. http://san-clemente.org/Home/ShowDocument?id=16991

recreation; non-contact water recreation; spawning habitat; warm water habitat; and wildlife habitat.

The City of San Clemente, the County of Orange, and the OCFCD (the San Mateo Creek Watershed Permittees) completed Watershed Workplans[27] for 2011-2013 that identify a schedule of management activities to be undertaken. These workplans describe the approach taken by the San Mateo Creek Watershed Permittees to maintain a responsive program in compliance with Directive G of the SDRWQCB Order No. R9-2009-0002. Following the approval of the Fifth Term MS4 NPDES Permit, annual workplans are no longer required; however, the planning contained therein assisted development of the 2014 ROWD and the WQIP.

Regional projects proposed as part of this IRWM Plan, such as the Comprehensive Landscape WUE Program, regionally assist in enhancing the water quality of beaches. Landscape irrigation is the largest demand on MWDOC's system in the South Orange County WMA. Therefore, by reducing the amount of surface runoff carrying pollutants to the beaches, the project will support meeting the beneficial uses of the San Mateo Creek Watershed.

Water quality and habitat protection are key components of the San Mateo Watershed. The Southern California Steelhead Recovery Plan identifies San Juan Creek and San Mateo creeks as critical habitat for the Southern California Steelhead.[28] **Figure 3-6** shows the steelhead critical habitat. Projects supporting water quality of creeks and the overall watershed will assist in protecting aquatic species.

Due to its largely natural condition, the San Mateo Creek Watershed essentially functions as a reference watershed for bioassessment monitoring. The San Mateo Creek Watershed is included within the WQIP; therefore, opportunities for reducing pathogen health risk, restoring natural flow regimes, and eliminating channel erosion will be pursued in the watershed where deemed a priority relative to problems identified in other watersheds. Additional details pertaining to the WQIP can be found in **Section 3.3.4.**

#### 3.3.1.7 Open Space

The NCCP program of the CDFW is an unprecedented effort by the State of California, and numerous private and public partners that takes a broad-based ecosystem approach to planning for the protection and perpetuation of biological diversity. An NCCP identifies and provides for the regional or area wide protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity.

The primary objective of the NCCP program is to conserve natural communities at the ecosystem scale while accommodating compatible land use. The program seeks to anticipate

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[27] San Mateo Creek Watershed Work Plan. OC Watersheds Document Library. Available online March 2017.

[28] National Oceanic & Atmospheric Agency (NOAA) Southwest Regional Office, National Marine Fisheries Service. Final Southern California Steelhead Recovery Plan. Long Beach, CA. January 2012. Available online: http://swr.nmfs.noaa.gov/recovery/SC_Steelhead/

and prevent the controversies and gridlock caused by species' listings and focusing on the long-term stability of wildlife and plant communities and including key interests in the process.

The Natural Communities Coalition (NCC), formerly the NROC, is a 501(c)(3) nonprofit corporation that manages the NCCP/HCP for the Central and Coastal Subregion of Orange County. It coordinates land management activities of public and private landowners within the 37,000-acre reserve system, conducts wildlife and habitat research and monitoring, and restores disturbed habitats. The South Orange County WMA includes a number of protected areas that form a network of interconnected and isolated biological communities within the Central and Coastal and Southern Subregion NCCP/HCP.

### *Central and Coastal Subregion NCCP/HCP*

The Central and Coastal Subregion NCCP/HCP consists of the following elements:

1. A 37,378-acre reserve system;
2. Special linkages and existing use areas to enhance biological connectivity within the reserve system and subregion;
3. An adaptive management program;
4. An interim management plan;
5. Funding; and
6. A mitigation option for non-participating landowners.

The South Orange County WMA is located within the boundaries of the Central and Coastal NCCP/HCP. The following areas are included in the reserve system: Laguna Coast Wilderness Park, Mason Regional Park, Peters Canyon Regional Park, Upper Newport Bay Nature Preserve, Whiting Ranch Wilderness Park, Upper Newport Bay Ecological Reserve, and the University of California Irvine Reserve. Only the Laguna Coast Wilderness Park is within the South Orange County WMA. The remaining areas are within the Central Orange County WMA.

An Annual Report and Workplan are produced annually for the NCCP/HCP. These reports highlight the workings of the NCC, progress made monitoring protected spaces and accomplishments of projects sponsored by the NCC. The most recent report was submitted in 2015 and highlights 33 projects sponsored by the NCC during 2015-2016. [29]

### *Southern Subregion NCCP/HCP*

The South Orange County WMA includes a number of protected areas that form a network of interconnected and isolated biological communities. The Southern Subregion NCCP/HCP consists of 132,000 acres, which includes 40,000 acres within the Cleveland National Forest and 92,000 acres within the Planning Area. The Southern Subregion NCCP/HCP was prepared by the County in cooperation with the CDFW and the USFWS. The Southern Subregion NCCP/HCP focuses on long-term protection and management of multiple natural communities that

[29] Natural Communities Coalition. Nature Reserve of Orange County, County of Orange Central/Coastal NCCP/HCP 2015 Annual Report. Available online 11/04/16.
https://occonservation.org/wp-content/uploads/mdocs/2015annualreport.pdf

provide habitat essential to the survival of a broad array of wildlife and plant species. In summary, the Southern Subregion NCCP/HCP consists of the following elements:

1. Creation of a permanent Habitat Reserve consisting of 11,950 acres owned by the County and contained within three existing County regional and wilderness parks (O'Neill Regional Park, Riley Wilderness Park and Casper's Wilderness Park) and 20,868 acres owned by Rancho Mission Viejo, at no cost to the public;
2. Formulation and implementation of a Habitat Reserve Management Program (HRMP);
3. Receipt of State and Federal regulatory coverage and provisions for the impacts on proposed Covered Species and CDFW Jurisdictional Areas; and
4. Execution of an Implementation Agreement and identification of funding necessary to implement the HRMP.

***The Ranch Plan Monitoring Program***

The Gobernadora Multipurpose Basin Project is included within the greater Ranch Plan as a key component to water quality protection and habitat preservation. The Ranch Plan supports the basin plan objectives of water quality enhancement and habitat protection. Since 1991, detailed scientific studies have been conducted in partnership with state and federal wildlife agencies for 23,000 acres of Rancho Mission Viejo. The Ranch Plan implements an aggressive overall monitoring program.

As part of the Ranch Plan's monitoring efforts, the SDRWQCB, USFWS, USACE, and RMV have described the baseline biology, geomorphology, hydrology, and water quality in Final Environmental Impact Statement (FEIR) 584 and 589, the FEIR for the HCP and the FEIR of the Special Area Management Plan (SAMP). Through implementation of adaptive management, the Ranch Plan seeks to maintain the net habitat values of Rancho Mission Viejo including GERA and the larger Gobernadora Creek ecosystem.

Three interrelated plans/programs form the core of the Adaptive Management Plan for the Ranch Plan, including: 1) Open space/Habitat Reserve – the HRMP, 2) Primary stream/creeks in the open space/Habitat Reserve – the Stream Monitoring Plan and 3) Developed Planning Areas – the WQMP. The HRMP monitors and manage biological resources within the Ranch Plan area. Annual compliance and effectiveness reports are written and provided to USFWS, USACE and CDFW. The Stream Monitoring Plan will monitor and manage erosion and stream stability of major tributaries within the Ranch Plan, including projects with potential to impact the water quality of the area, such as the Gobernadora Multipurpose Basin Project.

**Figure 3-7** NCCP shows the NCCP areas within the South Orange County WMA.

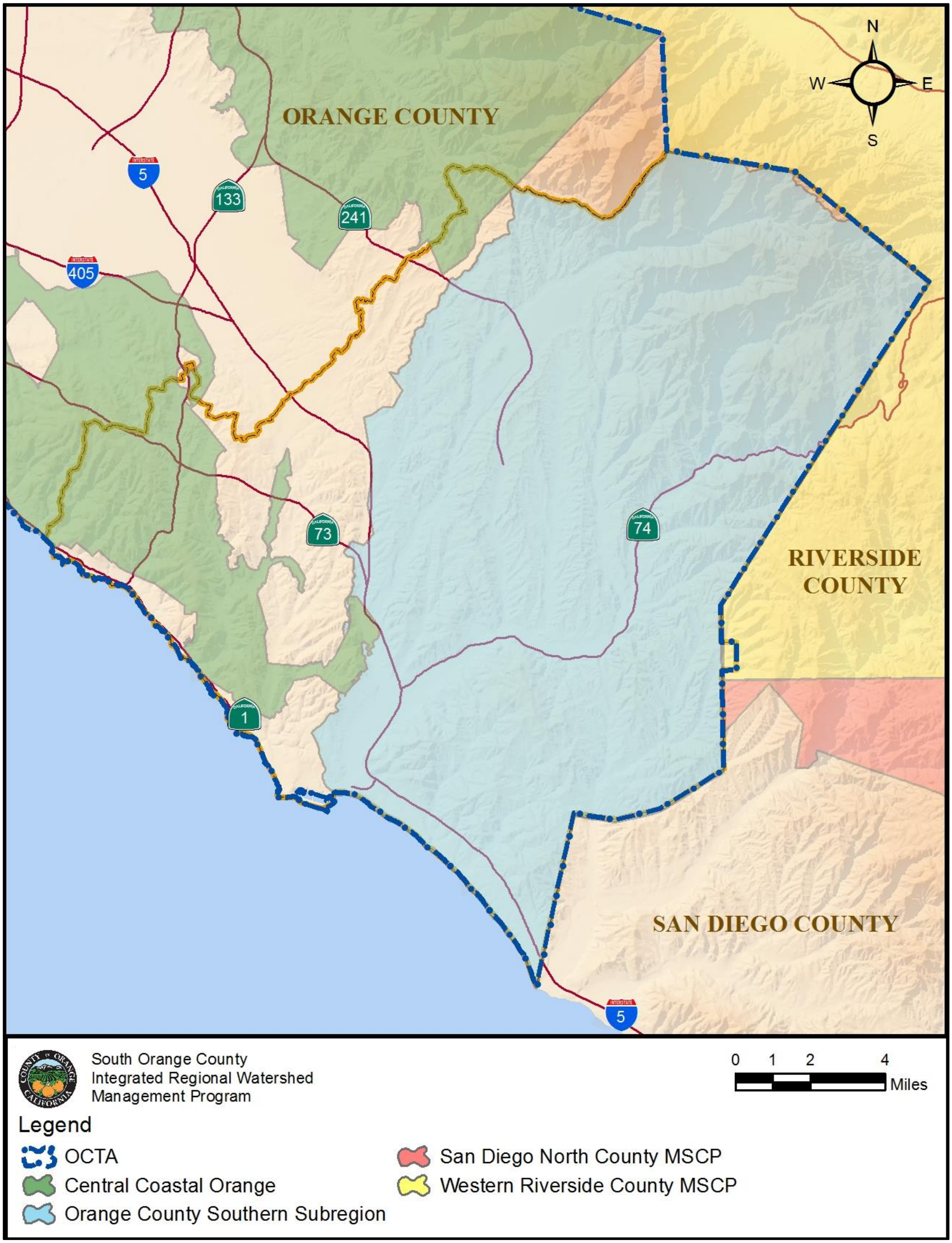


**Figure 3-7: Natural Communities Conservation Plan**

#### 3.3.1.8 Parks, Forests, Refuges and ASBS

As mentioned previously, the South Orange County WMA falls within the South Coast Region of the CDFW. Marine Protected Areas (MPAs) along the southern California coast (Point Conception to California/Mexico border) have been in effect in state waters since January 1, 2012. Within the South Orange County WMA, the following are MPAs identified for the Region: Laguna Beach State Marine Reserve, Laguna Beach State Marine Conservation Area, Dana Point State Marine Conservation Area, and Crystal Cove State Marine Conservation Area[30].

An ASBS is a protected area designated to support and protect natural marine ecosystems and heritage, improve the opportunities for human activities, and ensure a strong coastal economy. An ASBS differs from a MPA; ASBS policies are based upon attainment of water quality standards. These ASBS regulations prohibit waste from entering the protected habitat through drains and natural water outputs. The SWRCB has designated three ASBS within Orange County: the Robert E. Badham (Newport Coast) ASBS (No. 32), the Irvine Coast (Crystal Cove) ASBS (No. 33), and the Heisler Park ASBS (No. 30)[31]

The Irvine Coast (Crystal Cove) ASBS begins at Pelican Point and continues 3.4-miles along the coastline to the City of Laguna Beach. This ASBS contains the Irvine Coast State Marine Park (formerly called a Marine Life Refuge), and the overlapping Crystal Cove State Marine Conservation Area, which are administered by the CDFW. These MPAs and the adjoining beach provide excellent tidal and offshore communities featuring tide pools, kelp beds, and dolphin birthing grounds. Despite increasing urbanization, Crystal Cove State Park (administered by the California Department of Parks and Recreation) contains some of the last undeveloped Orange County coastline.

The Heisler Park ASBS in Orange County covers just 0.5-mile of coastline. The Heisler Park State Marine Reserve (formerly called an Ecological Reserve) and the overlapping Laguna Beach State Marine Park are administered by the CDFW, and the adjacent Heisler Park is owned and maintained by the City of Laguna Beach. This reserve is a popular tidepooling area and can suffer from scavenging by beach visitors. Key pollution threats are urban drainage and stormwater runoff.

The designated Marine Life Refuges in the South Orange County WMA are: Irvine Coast Marine Life Refuge, Laguna Beach Marine Life Refuge, South Laguna Beach Marine Life Refuge, Niguel Marine Life Refuge, Dana Point Marine Life Refuge, and Doheny Beach Marine Life Refuge.[32]

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[30] California Department of Fish and Wildlife. Marine Protected Areas. Available online 3/29/13. http://www.dfg.ca.gov/mlpa/scmpas_list.asp

[31] Orange County Marine protected Area Council. Water Quality- ASBS. Available online 3/29/13. http://www.ocmarineprotection.org/asbs.html

[32] Region 9 – Sand Diego Regional Water Quality Control Board Basin Plan. Available online 3/29/13. http://www.swrcb.ca.gov/rwqcb9/water_issues/programs/basin_plan/docs/update082812/Chpt_2_2012.pdf

The Region's designated State Marine Parks include: Irvine Coast State Marine Park, Laguna Beach State Marine Park, South Laguna Beach State Marine Park, Niguel State Marine Park, Dana Point State Marine Park, and Doheny Beach State Marine Park.

The following areas are designated State Marine Conservation Areas: Crystal Cove State Marine Conservation Area, and Doheny State Marine Conservation Area. In addition, the Heisler Park Ecological Reserve, and Laguna Laurel Ecological Reserve are designated Ecological Reserves by the Fish and Wildlife Commission (California Code of Regulations, Title 14, section 630).

### 3.3.2 Groundwater Basins

This section discusses the groundwater basins within the South Orange County WMA. The DWR defined Groundwater Basins in the region are shown in **Figure 3-8**.

#### 3.3.2.1 San Juan Valley Groundwater Basin

The SJVGB underlies the San Juan Creek Watershed and several tributary valleys in South Orange County. The total water storage capacity is estimated at 41,400 acre feet[33]. The groundwater basin is subdivided into three sub-basins: the upper, middle, and lower sub-basins. The San Juan Valley fill alluvium, including the three sub-basins, occupies approximately 11,700 acres. San Juan Creek drains the San Juan Valley and several other creeks drain valleys tributary to the San Juan. Average annual precipitation ranges from 11 to 15 inches. Recharge of the basin is from flow in San Juan Creek, Oso Creek, and Arroyo Trabuco and precipitation to the valley floor. Water from springs flows directly from Hot Spring Canyon into San Juan Creek, adding to recharge.

AB 1739 (Dickinson, Chapter 347, Statutes of 2014), SB 1168 (Pavley, Chapter 346), SB 1319 (Pavley, Chapter 348) collectively referred to as the Sustainable Groundwater Management Act (SGMA) allows local agencies to customize groundwater sustainability plans to their regional economic and environmental needs. SGMA creates a framework for sustainable, local groundwater management by requiring local agencies to establish a new governance structure, known as Groundwater Sustainability Agencies, prior to developing groundwater sustainability plans for groundwater basins or sub-basins. The San Juan Basin Groundwater Management and Facilities Plan, 2013 (GWFMP) (San Juan Basin Authority) serves as the groundwater management plan for the South Orange County IRWM region and meets Groundwater Management Plan Compliance. DWR has designated the San Juan Valley Groundwater Basin as a low priority in the CASGEM Final Basin Prioritization results (June 2014), available at the following link: http://www.water.ca.gov/groundwater/casgem/basin_prioritization.cfm

As discussed in several sections of this plan, drought conditions throughout the state have resulted in reduced rainfall and snowpack over the last several years; 2015 represented the fourth consecutive year of one of the worst droughts in California history, resulting in voluntary and mandatory water reductions state-wide. As a result, the region has experienced overdraft conditions in the San Juan Basin due to its limited capacity (estimated total storage of 27,000 AF), reduced rainfall and reduced potable water usage for outdoor irrigation. Due to the threat

[33] SJBA 2016 Adaptive Pumping Management Plan. August 2016.

of sea water intrusion, economic considerations and increasingly poor water quality, some storage capacity cannot be utilized. The San Juan Basin Authority developed an Adaptive Pumping Management Plan in 2016, which provided technical analysis of pumping rates and past precipitation patterns to produce a sustainable pumping curve for determination of annual sustainable pumping, based upon the volume of water in storage each spring. Though the basin is considered low priority (CASGEM), adaptive management of the basin seeks to alleviate the threat of overdraft due to ongoing drought conditions and expected changes to rainfall patterns and snowpack from climate change. Projects implemented by IRWM Group agencies seek to promote groundwater recharge, stormwater and urban runoff capture, and protection from sea water intrusion.


**Figure 3-8: Groundwater Basins**

Except for the Upper San Juan, the Total Dissolved Solids (TDS) of most groundwater stored in the main part of the groundwater basin is too high for domestic water use. Groundwater is treated by the San Juan Basin Desalter, which increases the usability of the basin in the future. In addition, shallow groundwater limits the ability to store significant supplies[34].

The San Juan Basin Authority previously performed a groundwater quality assessment of the San Juan Basin (Wildermuth Environmental Inc., 2013). The assessment considered groundwater quality data collected between 2006 and 2010 from public and private wells within the basin. A total of 21 inorganic constituents, five general physical parameters, and 35 Volatile Organic Compounds (VOCs) exceeded Primary and/or Secondary Maximum Contaminant Levels (MCLs) in at least one well during this period. The analytes with the most prevalent exceedances are discussed below.

***Total Dissolved Solids***

TDS comprise inorganic salts dissolved in water; the major ions are sodium, potassium, calcium, magnesium, bicarbonates, chlorides, and sulfates. The California secondary drinking water MCL for TDS is 500-mg/L. TDS concentrations exceeded the MCL in all 22 wells that were included in the WEI assessment. Furthermore, hydrologic sub-areas of the San Juan Basin are assigned TDS objectives that range between 500- and 1,200- mg/L. Some wells exceeded TDS sub-basin objectives.

***Sulfate***

Sulfate is an inorganic compound dissolved in water. The California secondary drinking water MCL for sulfate is 250-mg/L. Chloride concentrations exceeded the MCL in 64 of the 85 wells that were included in the WEI assessment. Furthermore, hydrologic sub-areas of the San Juan Basin are assigned TDS objectives that range between 250- and 500- mg/L. Many wells exceeded sulfate sub-basin objectives.

***Chloride***

Chloride is an inorganic constituent dissolved in water and is naturally occurring. The California secondary drinking water MCL for chloride is 250-mg/L. Chloride concentrations exceeded the MCL in 64 of the 85 wells that were included in the WEI assessment. Furthermore, hydrologic sub-areas of the San Juan Basin are assigned TDS objectives that range between 250- and 500-mg/L. Some wells exceeded chloride sub-basin objectives.

**Manganese**

Manganese is an inorganic constituent dissolved in water and is naturally occurring through the dissolution of manganese-bearing minerals. The California secondary drinking water MCL for

[34] Groundwater Basin Reports, Orange County Basins – San Juan Basin: http://www.mwdh2o.com/mwdh2o/pages/yourwater/supply/groundwater/PDFs/OrangeCountyBasins/SanJuanBasin.pdf

manganese is 0.05-mg/L. Manganese concentrations exceeded the MCL in 20 of the 26 wells that were included in the WEI assessment.

***Iron***

Iron is an inorganic constituent dissolved in water and is naturally occurring through the dissolution of iron-bearing minerals. The California secondary drinking water MCL for iron is 0.3- mg/L. Iron concentrations exceeded the MCL in 28 of the 55 wells that were included in the WEI assessment.

***Volatile Organic Compounds***

Numerous VOCs were detected above their respective MCLs in the wells included in the WEI assessment. Methyl Tert-Butyl Ether (MTBE) and Tert Butyl Alcohol (TBA) were the most prevalent VOCs, detected above MCLs in 106 and 111 wells respectively. MTBE and TBA, as well as most of the other VOCs, are generally associated with gasoline and are found in the environment as the result of leaking Underground Storage Tanks (USTs). A total of 10 potential UST point sources were identified in the WEI report.

***AB 1249 Compliance***

No groundwater bodies in the South Orange County WMA were found to include arsenic, perchlorate, or hexavalent chromium. For nitrates specifically, the GWFMP indicated exceedances occurred in only one percent of reported sample results. The SNMP (**Section 13**) concludes that nitrate (as nitrogen) concentrations in groundwater are well below the Basin Plan Objective of 10-mg/L and that nitrogen loading is not a significant issue within San Juan Creek Basin. These reports show the South Orange County WMA area is in compliance with AB 1249. A supplemental form from the 2015 IRWM Grant Solicitation Application can be found in **APPENDIX I** with additional details of compliance with AB1249.

#### 3.3.2.2 San Mateo Groundwater Basin

The San Mateo Groundwater Basin underlies San Mateo Valley and Cristianitos Canyon in the southeastern portion of Orange County and northwestern San Diego County and resides in an undeveloped and protected natural landscape. The valleys are drained westward to the ocean by San Mateo and Cristianitos Creeks. Together, the San Mateo (including San Onofre Creek) watershed is 175 square miles. The Cristianitos Creek watershed is a little over 31 square miles. The aquifer consists of unconfined alluvium and the basin is up to 100- feet in depth with an approximate storage capacity of 6,500-acre foot.

Infiltration of surface water from Cristianitos and San Mateo Creeks provides most of the recharge to the aquifer. Direct precipitation and infiltration of treated wastewater also contribute to recharge.

### 3.3.3 Surface Water Impoundments

Surface water impoundments capture flow from nearly all the major surface water streams. Many of the major surface water impoundments are a blend of natural runoff and imported water. They include:

*El Toro Reservoir:* El Toro Reservoir is an earth-filled structure owned by the ETWD. It is on a tributary of Oso Creek and is used as a seasonal and operational storage site for the ETWD's imported Colorado River Water. The impounded water is used for irrigation purposes. Construction was completed in 1967. It has a normal surface area of 21 acres. Its height is 106 feet with a length of 900 feet. Normal storage is 877 acre feet. It drains an area of 0.04 square miles.

*Laguna Lakes:* The Laguna Lakes are located in Laguna Canyon. The lakes are owned by the City of Laguna Beach and were originally formed by springs arising from a minor fault zone. Laguna Lakes are located inland along Laguna Canyon Road, approximately six miles north of Laguna Beach. The lakes are numbered one through three from upstream to downstream and are located on the east side of the road. Lakes 2 and 3 are connected. There are approximately 27 acres of open water in the three lakes, plus an un-quantified amount of riparian habitat. The lakes drain a watershed of approximately 5,600 acres. The lakes are filled by seasonal rains and natural and surface runoff. Lake 1 is a seasonal, Lake 2 is a semi-perennial and Lake 3 contains water throughout most years.

*Barbara's Lake*: This Lake is a 12-acre spring-fed lake in the James Dilley Greenbelt Preserve, a 173-acre parcel of land in the Laguna Coast Wilderness Park. Located in Laguna Canyon, just north of the Highway 73 toll road, the area forms the north boundary of the 38,000-acre South Coast Wilderness. Barbara's Lake is named in honor of conservationist Barbara Rabinowitsh and is the only natural lake in Orange County. The lake is rimmed with willows, cattails, and bulrush, offering habitat for coots, mallards, and grebes. West of Barbara's Lake, across Laguna Canyon Road, is Bubble's Pond. The pond was named for Lion Country Safari's escaped hippopotamus, who took up a temporary residence there. The trail winds through canyons and over hills en route to the south and east shores of Barbara's Lake.

*Lake Mission Viejo:* Lake Mission Viejo is a man-made located in northern Mission Viejo. The reservoir is formed by an earth-fill dam across the canyon of Oso Creek, which is part of the Trabuco Creek and San Juan Creek drainage basin. The reservoir is in the foothills of the Santa Ana Mountains, surrounded primarily by private residential communities, and is fed by surface runoff. SMWD is converting Lake Mission Viejo into California's first recreational lake to use Advanced Purified Water for refill. The new system will, for the first time ever, fill Lake Mission Viejo with 114 million gallons of Advanced Purified Water in lieu of potable water. This new system will reportedly save that potable water for other uses and make Lake Mission Viejo the largest swimmable lake in the state; perhaps the nation, to use advanced purified water.

The treatment method involves taking already highly treated wastewater and treating it further in a process that includes advanced filtration tanks, reverse osmosis and ultraviolet light. This additional purification makes it safe to supply the lake for swimming and other recreational activities.

*Upper Oso Reservoir Dam*: Upper Oso Reservoir is located in Mission Viejo and owned by the Santa Margarita Water District (SMWD). For over 30 years recycled water has been stored in winter prior to irrigation in the summer. The Upper Oso Reservoir holds up to 1.3 billion gallons of recycled water. At capacity the reservoir is 65-feet deep at its deepest point. In December

2012, the reservoir was 140 feet deep at its deepest point, based on information provided by SMWD. It is one of the largest recycled water reservoirs in the County.

*Sulphur Creek Reservoir:* Sulphur Creek Reservoir (also called the Laguna Niguel Lake) is an artificial 44 acre fishing and recreational lake in Laguna Niguel. It is fed from two sources, one of which is Sulphur Creek itself and one of which is a storm drain. In the 1950s, the creek was dammed to form Sulphur Creek Reservoir.

### 3.3.4 Water Quality

The quality of imported water is high in South Orange County. However, the WMA's continued transformation of open space to urbanized space requires ongoing protection of its local water resources. Water pollution impacts drinking water and surface waters used for fishing, swimming and other activities. Increased stream flows may lead to erosion of riparian habitats and surface runoff carries non-point source pollutants into the watersheds. Efforts to understand and mitigate the various water quality issues in the WMA are numerous.

Protection and preservation of water resources in the United States is governed by the 1972 Federal Water Pollution Control Act, commonly referred to as the CWA. Among many other amendments to the CWA, passage of the 1987 Water Quality Act mandated regulation of polluted runoff (i.e., non-point source pollution) beyond regulation of just point source pollution. Section 402(p)(2) of the 1987 regulation created the NPDES permit program to control non-point source pollution. The Environmental Protection Agency (EPA) enforces the CWA requirements; however, in California, the SWRCB and nine associated RWQCBs have been entrusted with oversight and enforcement of the federal and state law.

In Orange County, stormwater and other surface runoff is collected and conveyed via the MS4 to local water bodies or the Pacific Ocean. Runoff is often discharged untreated, except in areas where BMPs have been implemented. Since 1990, operators of the MS4 are required to develop a stormwater management program designed to prevent or reduce harmful pollutants from impacting water resources via stormwater runoff. As an MS4 operator, the County has obtained and implemented programs in compliance with NPDES permits for both the SARWQCB and SDRWQCB. The Orange County Stormwater Program (OCSP) is a cooperative of the County of Orange, OCFCD, and all 34 County cities (the Co-permittees). As the Principal Permittee on both the SARWQCB and SDRWQCB NPDES permits, the County manages the development and implementation of the program, collaborating regularly with Co-permittees to ensure compliance and mitigate ocean pollution.

MS4 NPDES permits are issued for a five-year term and have generally followed a progressive pattern. For the South Orange County WMA, the permits were first adopted in 1990 and subsequently renewed in 1996 (Second Term), 2002 (Third Term), 2009 (Fourth Term), and most recently in 2013 (Fifth Term). These permits require that the Permittees work together to effectively prohibit non-stormwater discharges to the MS4, and implement controls to reduce the discharge of pollutants in stormwater to the MEP.

To fulfill the commitment of the Permittees to develop and implement a program that satisfies permit requirements, the OCSP developed a comprehensive DAMP in 2003 that described how the Permittees would develop and implement pollutant control programs such as municipal, commercial and industrial inspections, pollutant control and spill response and public education and outreach activities. The DAMP is the Permittees' primary policy, planning and implementation document for MS4 NPDES Stormwater Permit compliance. The DAMP was prepared and is periodically updated using a consensus building process that involves public and private sector input and public review through the California Environmental Quality Act (CEQA) process. The DAMP comprises a series of Model Programs that are individually implemented by the Permittees in accordance with their respective LIPs. Model Programs provide guidance for the Permittees to ensure all municipal, existing commercial and industrial, and new/significant re-development incorporates appropriate BMPs and site design. These Model Programs have been updated to meet each iteration of the MS4 NPDES Permit and address construction, existing development and illegal discharge/illicit connection (ID/IC) programs.

Subsequent programs and activities implemented by the Permittees according to the DAMP are described in ROWDs. The ROWDs summarize Permittee accomplishments over the course of the permit term and provide planning for the next permit cycle. The ROWDs summarize data collected during the permit term, establish water quality concerns, and outline the "state of the environment" in Orange County watersheds. The ROWDs also assess program status, establish goals for future program development, and identify areas for improvement. The ROWDS are developed via a collaborative Permittee-based process, including solicitation of stakeholder input at public meetings.

The 2014 ROWD for South Orange County summarized data and accomplishments over the period of June 2009 to June 2013 for monitoring and Model Programs. The findings of this report were used in the development of the WQIP to identify and prioritize water quality concerns. Most notably, the State of the Environment Report[35] (Chapter 2 of the ROWD) provided the baseline water quality and geospatial analysis of the WQIP. The WQIP is summarized in greater detail later in this Section.

The need to address increasingly prescriptive permit requirements, while maintaining the beneficial and synergistic cohesion of a countywide program, has been addressed through separation of the DAMP's policy and planning areas. As a result of this separation, the DAMP includes Local Implementation Plans. The LIPs were created by each Permittee in implementing an increasingly complex program within its jurisdiction while maintaining a single policy document that addresses two sets of permit requirements. The LIPs were last updated by the San Diego Permittees in 2017, concurrent with completion of the WQIP.

Over the course of multiple MS4 NPDES Permit terms, and in addition to development of LIPS, the Permittees prepared a variety of other plans including, but not limited to Watershed Action Plans, Watershed Workplans, Bacteria Load Reduction Plans, and Comprehensive Load Reduction Plans. The technical rigor behind the development of these plans increased over time, as did the geospatial context of the supporting analysis and proposed solutions. Each of

[35] 2014 Report of Waste Discharge: San Diego Region State of the Environment

these plans were developed by applying a watershed-based approach to solving receiving water problems, rather than strictly adhering to jurisdictional boundaries

The WQIP for South Orange County was recently prepared pursuant to requirements of a SDRWQCB Order R9-2013-0001, as amended by Order No. R9-2015-001 and Order No. R9-2015-0100. As noted in **Section 3.3.1.1,** the WQIP address water quality improvement within urbanized portions of the San Juan Hydrologic Unit and draws from the water quality findings and recommendations of the 2014 ROWD. The WQIP defines three HPWQCs, which each have a set of goals, schedules, and strategies which are intended to correct the condition:

- Pathogen Health Risk: Applies to beaches during dry and wet weather, where recreational use is high and there are persistent exceedances of fecal indicator bacteria standards (limited extent during dry weather and most beaches during wet weather). The goals for the Pathogen Health Risk HPWQC were established to conform to the interim and final numeric goals of the Twenty Beaches and Creeks TMDL, expressed as FIB percent load reductions. To achieve these goals, the WQIP prioritizes targeted non-structural BMPs for early implementation, with emphasis on those that most directly address risks to human health (i.e., microbial source tracking). As part of a separate strategy, structural treatment BMPs (infiltration, treatment, harvest and use) to address general storm water runoff are planned;
- Unnatural Water Balance/Flow Regime: Applies to inland stream reaches during dry weather where there are ponded or flowing outfalls or other observed issues exacerbated by an unnatural water balance. The final numeric goal for this HPWQC is to effectively eliminate unnatural dry weather flows from storm drain outfalls to inland receiving waters, giving priority to locations where unnatural dry weather flow inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes. The primary strategies proposed to achieve these goals include more focused data collection and special studies to better define strategies for specific receiving waters; source control, incentives, and educational measures to promote water conservation and reduction of unnatural flows into the MS4; structural BMP retrofit strategies to divert and capture water at high priority outfalls; and optional structural BMP retrofit strategies where it is determined that source control and educational strategies have reached their limit of effectiveness and conditions remain a high priority;
- Channel erosion/Geomorphic Impacts: Applies to inland stream reaches during wet weather where degraded channel form has become a limiting factor in channel ecology. The final numeric goal and associated strategy is to restore 23,000 lineal feet of stream reach by 2042.

The WQIP also contains a monitoring and assessment program which describes the strategies and methods that Permittees will use to monitor and assess the progress toward numeric goals and schedules, as well as to monitor the conditions of receiving waters and discharges from the MS4 under wet and dry weather conditions. Finally, the WQIP contains an iterative approach and adaptive management process. The iterative approach and adaptive management process describes how the Permittees will periodically reevaluate the priority water quality conditions;

water quality improvement goals, strategies, and schedules; and the monitoring and assessment programs, and identify necessary modifications to the WQIP in order to improve its effectiveness.

#### 3.3.4.1 Ocean Desalination Quality

Product water quality goals currently being studied are based on the primary and secondary standards set by the State Water Resources Control Board. The expected treatment process at the Doheny Ocean Desalination Project, (formerly known as the South Orange Coastal Ocean Desalination Project) facility in Dana Point Orange County is Reverse Osmosis (RO), with pretreatment and post-treatment.

The proposed ocean desalination facility would likely be developed in phases, with Phase 1 producing up to 5 mgd of potable of water, with the ultimate phase producing up to 15 mgd of potable water. The proposed facility will intake water from slant wells at an estimated rate of 10 – 30 mgd from beneath the ocean floor and is expected to be designed with a recovery rate of 50 percent. Phase 1 of the facility is expected to be operational in 2021. **Table 3-1** lists projected water quality of the RO permeate based upon RO system modeling software.

**Table 3-1: Ocean Desalination RO Results**[36]

| Ion | Ocean Water Feed | Permeate | Brine Concentration |
|---|---|---|---|
| $Ca^{2+}$ (mg/L) | 408 | 0.34 | 868 |
| $Mg^{2+}$ (mg/L) | 1,298 | 1.1 | 2,760 |
| $Na^{+}$ (mg/L) | 10,768 | 53 | 22,851 |
| $K^{+}$ (mg/L) | 388 | 2.5 | 823 |
| $HCO_3^{-}$ (mg/L) | 143 | 1.8 | 34 |
| $SO_4^{2-}$ (mg/L) | 2,702 | 2 | 5,960 |
| $Cl^{-}$ (mg/L) | 19,361 | 86 | 41,097 |
| $F^{-}$ (mg/L) | 1.3 | 0 | 3 |
| TDS (mg/L) | 35,014 | 146 | 74,416 |
| PH | 7.8 | 4.6 | 5.8 |

As shown, the RO permeate will consist essentially of sodium and chloride – no hardness or alkalinity to speak of. This causes the water to be corrosive. These problems are corrected by contacting the water with limestone and carbon dioxide to add calcium bicarbonate hardness and alkalinity. Interaction of the calcium with carbon dioxide dissolved in the desalted water facilitates dissolution of calcium and provides the alkalinity necessary to buffer the water and reduce its corrosiveness. Limestone contact is supplied in a limestone bed providing approximately 15 minutes of contact time.

[36] *MWDOC, 2003, Ocean Desalination Plant Feasibility Study*

### 3.3.4.2 Groundwater Desalter Water Quality

The San Juan Basin Groundwater Recovery Plant (GWRP) operated by the City of San Juan Capistrano, completed in December 2004 and operating in the San Juan Valley Groundwater Basin, conveys brackish groundwater to a RO plant where the water is treated, micro-filtered and brought to potable water standards. The project consists primarily of RO treatment trains with iron/manganese filters and desanders, and bulk chemical storage tanks within a semi-enclosed building.

The GWRP had been impacted by MTBE, cutting production in half to about 2 MGD or less in the spring of 2008. The installation of a Granular Activated Carbon (GAC) filter allowed the full 5.1-MGD production. As of December 2015, the plant has been expanded to a capacity of 6.2 MGD.

SCWD currently owns and operates a 1-MGD Groundwater Recovery Facility (GRF) that came on-line in 2007, also known as the Capistrano Beach Desalter. The desalter operates at around 1 MGD (approx. 1,120 AFY). The plant extracts and treats brackish groundwater from the San Juan Basin using RO and iron and manganese removal technology. As of the 2015 UWMP, SCWD is seeking to expand production with an additional well to be able to produce up to SCWD's groundwater extraction permitted right of 1,300 AFY.

### 3.3.4.3 Impaired Water Bodies

A TMDL sets a limit for the total amount of a particular pollutant that can be discharged to a waterbody, such that the pollutant loads from all sources will not impair the designated beneficial uses of the waterbody. The timeframe for compliance with TMDL targets varies, but may take many years. TMDLs will often include a compliance schedule, identifying interim and final targets.

The development of a TMDL is required when a waterbody has been identified as impaired. The Section 303(d) List of the federal CWA requires states to establish a listing of all impaired waterbodies and to rank those waterbodies according to priority for TMDL development. The 303(d) list is updated every two years and is developed by the RWQCB and SWQCB and approved by the EPA.

Several streams in the South Orange County WMA are listed as impaired on the 303(d) list of water quality limited segments, affecting a total of 26.7 stream miles. **Figure 3-8** shows the Impaired Water Bodies for the WMA. The following TMDLs (**Table 3-2**) have been established or are being developed for County waterbodies (the projected adopted year is included in parentheses below)

**Table 3-2: 303(d) List and TMDL Priority Schedule**

| ALISO CREEK | | | | | | |
|---|---|---|---|---|---|---|
| **Type** | **Name** | **Calwater Watershed** | **Pollutant/Stressor** | **Source** | **Estimated Size Affected** | **Proposed TMDL Completion** |
| **2012 303(d) List** | | | | | | |
| R | Aliso Creek | 90113000 | Indicator Bacteria<br><br>*This listing for indicator bacteria applies to the Aliso Creek mainstem and all the major tributaries of Aliso Creek which are Sulphur Creek, Wood Canyon, Aliso Hills Canyon, Dairy Fork, and English Canyon.* | Source Unknown | 19 miles | 2005 |
| | | | Phosphorus<br><br>*This listing for phosphorus applies to the Aliso Creek mainstem and all the major tributaries of Aliso Creek which are Sulphur Creek, Wood Canyon, Aliso Hills Canyon, Dairy Fork, and English Canyon.* | Source Unknown | 19 miles | 2019 |
| | | | Selenium | Source Unknown | 19 miles | 2021 |
| | | | Total Nitrogen as N | Source Unknown | 19 miles | 2019 |

| ALISO CREEK | | | | | | |
|---|---|---|---|---|---|---|
| **Type** | **Name** | **Calwater Watershed** | **Pollutant/Stressor** | **Source** | **Estimated Size Affected** | **Proposed TMDL Completion** |
| | | | Toxicity<br>*This listing for toxicity applies to the Aliso Creek mainstem and all the major tributaries of Aliso Creek which are Sulphur Creek, Wood Canyon, Aliso Hills Canyon, Dairy Fork, and English Canyon.* | Source Unknown<br>Unknown Nonpoint Source<br>Unknown Point Source | 19 miles | 2019 |
| E | Aliso Creek Mouth | 90113000 | Indicator Bacteria | Source Unknown | 0.29 acre | 2019 |
| R | Arroyo Trabuco Creek | 90120000 | Diazinon | | 23 Miles | 2019 |
| | | | Phosphorus | Source Unknown<br>Urban Runoff/Storm Sewers | 23 Miles | 2019 |
| | | | Total Nitrogen as N | Source Unknown | 23 Miles | 2019 |
| | | | Toxicity | | 23 Miles | 2019 |
| R | English Canyon | 90113000 | Benzo[b]fluoranthene | Source Unknown | 3.6 miles | 2019 |
| | | | Dieldrin | Source Unknown | 3.6 miles | 2019 |

| ALISO CREEK | | | | | | |
|---|---|---|---|---|---|---|
| Type | Name | Calwater Watershed | Pollutant/Stressor | Source | Estimated Size Affected | Proposed TMDL Completion |
| | | | Sediment Toxicity | Source Unknown | 3.6 miles | 2019 |
| | | | Selenium | Source Unknown | 3.6 miles | 2019 |
| C | Pacific Ocean Shoreline, Aliso HSA, at Aliso Beach - middle | 90113000 | Enterococcus | Source Unknown | 0.03 mile | 2021 |
| | | | Total Coliform | Source Unknown | 0.03 mile | 2021 |
| C | Pacific Ocean Shoreline, Aliso HSA, at Aliso Creek mouth | 90113000 | Enterococcus | Source Unknown | 0.03 mile | 2021 |
| | | | Fecal Coliform | Source Unknown | 0.03 mile | 2021 |
| | | | Total Coliform | Source Unknown | 0.03 mile | 2012 |

Notes:

1. R – River & Stream; E – Estuary; C – Coastal & Bay Shoreline; B – Bays & Harbors

| DANA POINT COASTAL STREAMS | | | | | | |
|---|---|---|---|---|---|---|
| Type | Name | Calwater Watershed | Pollutant/ Stressor | Source | Estimated Size Affected | Proposed TMDL Completion |
| **2012 303(d) List** | | | | | | |
| C | Pacific Ocean Shoreline, Dana Point HSA, at Aliso Beach at West Street | 90114000 | Indicator Bacteria | Source Unknown | 0.03 Mile | 2005 |
| B | Dana Point Harbor | 90114000 | Copper | Marinas and Recreational Boating<br>Source Unknown<br>Unknown Nonpoint Source<br>Urban Runoff/Storm Sewers | 119.47 Acres | 2019 |
| | | | Toxicity | Source Unknown | 119.47 Acres | 2021 |
| | | | Zinc | Marinas and Recreational Boating<br>Source Unknown<br>Unknown Nonpoint Source<br>Urban Runoff/Storm Sewers | 119.47 Acres | 2019 |

| DANA POINT COASTAL STREAMS | | | | | | |
|---|---|---|---|---|---|---|
| **Type** | **Name** | **Calwater Watershed** | **Pollutant/ Stressor** | **Source** | **Estimated Size Affected** | **Proposed TMDL Completion** |
| B | Pacific Ocean Shoreline, Dana Point HSA, at Dana Point Harbor at Baby Beach | 90114000 | Enterococcus | Source Unknown | 0.03 Mile | 2012 |
| | | | Total Coliform | Source Unknown | 0.03 Mile | 2012 |
| C | Pacific Ocean Shoreline, Dana Point HSA, at Salt Creek outlet at Monarch Beach | 90114000 | Total Coliform | Unknown Nonpoint Source<br>Unknown Point Source<br>Urban Runoff/Storm Sewers | 0.03 Mile | 2021 |

Notes:

2. R – River & Stream; E – Estuary; C – Coastal & Bay Shoreline; B – Bays & Harbors

| LAGUNA COASTAL STREAMS | | | | | | |
|---|---|---|---|---|---|---|
| **Type** | **Name** | **Calwater Watershed** | **Pollutant/Stressor** | **Source** | **Estimated Size Affected** | **Proposed TMDL Completion** |
| **2012 303(d) List** | | | | | | |
| R | Laguna Canyon Channel | 90112000 | Sediment Toxicity | Source Unknown | 1.6 miles | 2019 |
| | | | Toxicity | Source Unknown | 1.6 miles | 2019 |
| C | Pacific Ocean Shoreline, Laguna Beach HSA, at Main Beach | 90112000 | Total Coliform | Source Unknown | 0.03 mile | 2021 |
| R | Moro Canyon Creek | 90111000 | Selenium | Source Unknown | 3.4 Miles | 2021 |
| | | | Toxicity | Source Unknown | 3.4 Miles | 2021 |

Notes:

3. R – River & Stream; E – Estuary; C – Coastal & Bay Shoreline; B – Bays & Harbors

| SAN CLEMENTE COASTAL STREAMS | | | | | | |
|---|---|---|---|---|---|---|
| Type | Name | CalWater Watershed | Pollutant/Stressor | Source | Estimated Size Affected | Proposed TMDL Completion |
| **2012 303(d) List** | | | | | | |
| C | Pacific Ocean Shoreline, Lower San Juan HSA, at North Doheny State Park Campground | 90130000 | Enterococcus | Natural Sources<br>Unknown Nonpoint Source<br>Source Unknown<br>Urban Runoff/Storm Sewers | 0.03 mile | 2021 |
| | | | Total Coliform | Source Unknown | 0.03 mile | 2021 |
| C | Pacific Ocean Shoreline, Lower San Juan HSA, at South Doheny State Park Campground | 90130000 | Enterococcus | Natural Sources<br>Unknown Nonpoint Source<br>Source Unknown<br>Urban Runoff/Storm Sewers | 0.03 mile | 2021 |
| C | Pacific Ocean Shoreline, San Clemente HA, at Poche Beach | 90130000 | Enterococcus | Source Unknown | 0.03 mile | 2019 |
| | | | Total Coliform | Source Unknown | 0.03 mile | 2019 |

| SAN CLEMENTE COASTAL STREAMS | | | | | | |
|---|---|---|---|---|---|---|
| **Type** | **Name** | **CalWater Watershed** | **Pollutant/Stressor** | **Source** | **Estimated Size Affected** | **Proposed TMDL Completion** |
| C | Pacific Ocean Shoreline, San Clemente HA, at San Clemente City Beach at Pier | 90130000 | Enterococcus | Source Unknown | 0.03 mile | 2019 |
| C | Pacific Ocean Shoreline, San Clemente HA, at San Clemente City Beach, North Beach | 90130000 | Total Coliform | Source Unknown | 0.03 mile | 2019 |
| C | Pacific Ocean Shoreline, San Clemente HA, at South Capistrano Beach at Beach Road | 90130000 | Enterococcus | Source Unknown | 0.03 mile | 2021 |
| C | Pacific Ocean Shoreline, San Clemente HA, at South Capistrano County Beach | 90130000 | Enterococcus | Source Unknown | 0.03 mile | 2012 |
| | | | Total Coliform | Source Unknown | 0.03 mile | 2021 |
| R | | 9013000 | Cadmium | Source Unknown | 1.2 miles | 2021 |

| SAN CLEMENTE COASTAL STREAMS | | | | | | |
|---|---|---|---|---|---|---|
| Type | Name | CalWater Watershed | Pollutant/Stressor | Source | Estimated Size Affected | Proposed TMDL Completion |
| | Prima Deshecha Creek | | Nickel | Source Unknown | 1.2 miles | 2021 |
| | | | Phosphorus | Source Unknown | 1.2 miles | 2019 |
| | | | Turbidity | Source Unknown | 1.2 miles | 2019 |
| R | Segunda Deshecha Creek | 9013000 | Phosphorus | Source Unknown | 0.92 mile | 2019 |
| | | | Toxicity | Source Unknown | 0.92 mile | 2021 |
| | | | Turbidity | Source Unknown | 0.92 mile | 2019 |

Notes:

4. R – River & Stream; E – Estuary; C – Coastal & Bay Shoreline; B – Bays & Harbors

| SAN JUAN CREEK | | | | | | |
|---|---|---|---|---|---|---|
| **Type** | **Name** | **Calwater Watershed** | **Pollutant/Stressor** | **Source** | **Estimated Size Affected** | **Proposed TMDL Completion** |
| **2012 303(d) List** | | | | | | |
| R | Arroyo Trabuco Creek | 90120000 | Diazanon | Source Unknown | 22.87 miles | 2019 |
| | | | Phosphorus | Natural Sources<br>Source Unknown<br>Urban Runoff/Storm Sewers | 22.87 miles | 2019 |
| | | | Total Nitrogen as N | Source Unknown | 22.87 miles | 2019 |
| | | | Toxicity | Source Unknown | 22.87 miles | 2019 |
| R | Oso Creek (at Mission Viejo Golf Course) | 90120000 | Chloride | Source Unknown | 1.03 miles | 2019 |
| | | | Sulfates | Source Unknown | 1.03 miles | 2019 |
| | | | Total Dissolved Solids | Source Unknown | 1.03 miles | 2019 |
| R | Oso Creek (lower) | 90120000 | Selenium | Source Unknown | 4 miles | 2021 |
| | | | Toxicity | Source Unknown | 4 miles | 2021 |

| SAN JUAN CREEK | | | | | | |
|---|---|---|---|---|---|---|
| Type | Name | Calwater Watershed | Pollutant/Stressor | Source | Estimated Size Affected | Proposed TMDL Completion |
| C | Pacific Ocean Shoreline, Lower San Juan HSA, at North Beach Creek | 90120000 | Enterococcus | Source Unknown | 0.03 mile | 2021 |
| | | | Fecal Coliform | Source Unknown | 0.03 mile | 2021 |
| | | | Total Coliform | Natural Sources<br>Source Unknown<br>Unknown Nonpoint Source<br>Urban Runoff/Storm Sewers | 0.03 mile | 2021 |
| C | Pacific Ocean Shoreline, Lower San Juan HSA, at San Juan Creek | 90120000 | Enterococcus | Natural Sources<br>Source Unknown<br>Unknown Nonpoint Source<br>Urban Runoff/Storm Sewers | 0.03 mile | 2021 |
| | | | Fecal Coliform | Natural Sources<br>Source Unknown<br>Unknown Nonpoint Source<br>Urban Runoff/Storm Sewers | 0.03 mile | 2021 |

| SAN JUAN CREEK | | | | | | |
|---|---|---|---|---|---|---|
| Type | Name | Calwater Watershed | Pollutant/Stressor | Source | Estimated Size Affected | Proposed TMDL Completion |
| | | | Total Coliform | Natural Sources<br>Source Unknown<br>Unknown Nonpoint Source<br>Urban Runoff/Storm Sewers | 0.03 mile | 2021 |
| R | San Juan Creek | 90120000 | DDE | Source Unknown | 1.02 mile | 2019 |
| | | | Indicator Bacteria | Source Unknown | 1.02 mile | 2019 |
| | | | Phosphorus | Source Unknown | 1.02 mile | 2021 |
| | | | Selenium | Source Unknown | 1.02 mile | 2021 |
| | | | Total Nitrogen as N | Source Unknown | 1.02 mile | 2021 |
| | | | Toxicity | Source Unknown | 1.02 mile | 2021 |
| E | San Juan Creek Mouth | 90120000 | Indicator Bacteria | Source Unknown | 6.29 acres | 2008 |

Notes:

5. R – River & Stream; E – Estuary; C – Coastal & Bay Shoreline; B – Bays & Harbors

During wet weather, storm runoff can convey bacteria and pathogens off of the land and deposit them into waters through the municipal separate storm sewer system (MS4). During dry weather groundwater seepage and nuisance flows from urban land use activities can provide transport through the MS4.

From 2001-2005 water samples from over 100 monitoring sites along Aliso Creek and its tributaries were tested weekly for indicator bacteria and many new BMPs were implemented by Permittees to reduce bacteria loads in the watershed. Key projects included several treatment wetland and restoration projects along tributaries to the Creek and a sand and clay filter/ultraviolet treatment system at the J01P28 storm drain outfall.

On October 12, 2005, the RWQCB approved a revised directive monitoring program as proposed by the Permittees. The new monitoring program was designed based upon improved knowledge about overall patterns of bacteria in the watershed and localized responses to specific BMPs. Current monitoring efforts focus on status and trends sites near the bottom of the watershed and BMP evaluation sites at high-priority drains throughout the watershed. Monitoring frequency increased relative to monitoring conducted in 2001-2005, but occurs only in summer when bacteria concentrations are highest. In December 2009, adoption of Directive G of SDRWQB Order No. R9-2009-0002, further incorporated the directive requirements into the South Orange County MS4 permit as a series of Aliso Creek Watershed Runoff Management Plan provisions.

On February 10, 2010 the SDRWQB adopted TMDLs for indicator bacteria to address impaired beaches and creeks in the San Diego region including Aliso Creek and its tributaries, the Aliso Creek Mouth, and Aliso Beach (Twenty Beaches and Creeks TMDL). As a first step to achieving TMDL required bacteria load reductions a draft Aliso Creek Watershed CLRP was submitted to the SDRWQCB on October 4, 2012. This plan describes the approach that will be taken by Permittees to further address watershed bacteria pollutant loads and other water quality impairments.

In 2014, the Aliso Creek CLRP was updated based upon results from 2013-2014 Watershed Permittee efforts, the 2013 Watershed Runoff Management Plan, and ongoing CLRP assessments. Monitoring for both wet weather and winter dry weather were added to CLRP monitoring procedures. Sampling of target qualifying storm events were added to existing CLRP monitoring procedures in order to capture wet weather data while additional monitoring from November through July were incorporated yearly to capture winter dry weather data. An additional sampling site upstream of the Aliso Creek mouth was incorporated into the sampling schedule for greater dry weather TMDL data.

Using *Enterococcus* data, which has the highest TMDL reduction requirements, 2003-2009 dry weather bacteria loads were reduced by 57.1 percent while wet weather loads were reduced by 5.8 percent. Current projections indicated that by 2020 dry weather load reduction goals will be exceeded by 12.4 percent while wet weather loads will need to be reduced by 7.7 percent to meet the TMDL reduction goals. However, there is limited wet weather data and progress will be continually evaluated. As of this time, the projected bacteria load reduction was considered to be within an acceptable range for this phase of planning. [37]

On May 8, 2013, the SDRWQCB adopted the Fifth Term MS4 NPDES Permit (Order No. R9-2013-0001 as amended by Order No. R9-2015-0001 on February 11, 2015). The revised permit incorporated the Waste Load Allocations for the Baby Beach TMDL and the Twenty Beaches and Creeks TMDL.

**Dana Point Harbor - Baby Beach TMDL**

Exceedance of standards for FIB (Fecal Coliform, Total Coliform and Enterococcus bacteria) at Baby Beach has led to extensive monitoring and numerous efforts by the County of Orange and City of Dana Point to meet TMDL targets for Baby Beach. In June 2008, the SDRWQCB adopted indicator bacteria TMDLs for Baby Beach in Dana Point Harbor. The TMDLs were developed in response to a 2002 CWA Section 303(d) listing of the beach. Recent monitoring data has shown that bacteria concentrations at the beach have significantly declined since that time. Baby Beach was delisted for Fecal Coliform from the 2010 303(d) list and is proposed for delisting for *Enterococcus* from the 2014/2016 303(d) list.

In December 2009, adoption of Directive I of SDRWQB Order No. R9-2009-0002 incorporated the Baby Beach indicator bacteria TMDLs requirements into the South Orange County MS4 permit. An annual water quality data assessment is provided to the SDRWQCB to assess progress toward TMDL compliance and outline existing and future BMPs and special studies needed to meet TMDL targets. On May 8, 2013, the San Diego Regional Board adopted the Fifth Term MS4 NPDES Permit (Order No. R9-2013-0001 as amended by Order No. R9-2015-0001 on February 11, 2015 and R9-2015-0001, effective January 7, 2016). The revised permit incorporated the Waste Load Allocations for the Baby Beach TMDL as well as monitoring and other requirements for Baby Beach.

Results of the efforts at Baby Beach have been positive with regards to TMDL reductions. During the 2016-17 reporting period:

- Dry weather final TMDL targets have been achieved for Total Coliform and Fecal Coliform. No dry weather exceedances of the 30-day geometric mean target occurred for both indicators during the reporting period. There was no exceedance of the single sample maximum numeric target for Total Coliform and only 2% exceedance of the numeric target for Fecal Coliform. Exceedances of the Enterococcus numeric targets in receiving waters occurred for both the 30-day geometric mean and single sample maximum. However, with the implementation of the dry weather diversion BMP, the MS4 did not discharge to the receiving water, which demonstrates compliance.
- Wet weather interim TMDL targets have been achieved for Total Coliform, Fecal Coliform and Enterococcus. There were no wet weather exceedances of the Total Coliform numeric target and only 5% exceedance of the Fecal Coliform numeric target during the reporting period. The wet weather interim TMDL compliance milestone of

[37] Aliso Creek Watershed Comprehensive Load Reduction Plan, 2014

31.1% load reduction was met for Enterococcus this reporting period, with a 44% exceedance rate reduction compared to the baseline period.

- A microbial source identification special study that began in 2012 continued in 2016-17. A subset of Baby Beach samples, which exceeded numeric targets, was tested for genetic markers. Twenty-five percent of the samples in the receiving waters tested positive for canine markers while only 5% of the samples tested positive for human markers. Human sources of bacteria from the MS4, including sewer exfiltration were eliminated as potential sources of the human markers after a number of sewer repairs were completed in November 2015.

The coordinated watershed-wide effort which include monitoring, special studies, and load reduction BMPs have resulted in reduced overall loadings of indicator bacteria by 100% and 72 % during dry weather and wet weather conditions, respectively. Load reduction efforts have exceeded the requirements of the TMDL. A comprehensive and chronological list of all the BMPs that have been implemented in the Baby Beach Watershed is provided in the Annual Progress Reports, available here.

Additionally, in 2005 & 2006 Dana Marina Inn and Dana Point Marina East & West, were designated “Clean Marinas” by the Clean Marinas California Program (www.cleanmarina.org). In 2011 the Dana Point Yacht Club received the certification while the other marinas were re-certified in 2016. Today the four facilities continue to exceed the program’s requirements. The Harbor strictly enforces the EPA’s BMP and has also increased education and awareness efforts in order to encourage boaters to take an active role in safeguarding water quality. The Dana Point Harbor continues to demonstrate its leadership role in pursuing water quality with the Dana Point Shipyard becoming one of the first two California facilities to earn the new American Boat Builders & Repairers Association (ABBRA) Clean Maritime Facility Certification. This ABBRA certification is a comprehensive certification program to recognize boatyards that pursue and achieve high standards of operation and management, including meeting and exceeding environmental and regulatory BMP. ABBRA worked with various California agencies that oversee water quality and environmental compliance to develop the certification requirements. An article on the new certification was posted in the ABBRA October 2012 Newsletter (www.abbra.org).

#### 3.3.4.4 South County Coastal Areas Beaches and Creeks

On February 10, 2010, the SDRWQCB adopted indicator bacteria TMDLs for impaired beaches and creeks in the San Diego Region (Twenty Beaches and Creeks TMDLs).[38] This includes TMDLs for over nine and a half miles of County beaches, the entire length of Aliso Creek and the lower mile of San Juan Creek.

The Beaches and Creeks TMDLs define the allowable indicator bacteria loads from the storm drain system that will still allow attainment of water quality standards. The TMDLs also require the development of watershed Bacteria Load Reduction Plans (BLRPs) focusing on indicator

[38] San Diego Region Indicator Bacteria TMDL 2010, OC Watersheds Website. Available online 1/23/2013: https://media.ocgov.com/gov/pw/watersheds/programs/waterways/tmdl/default.asp

bacteria or CLRPs addressing all watershed water quality impairments. The modeled reductions required to meet these loads in South Orange County range from 73-99 percent during dry weather to 91-100 percent during wet weather depending on the location and indicator bacteria species. A 22 percent wet weather allowable exceedance frequency of TMDL number target is also included in the TMDLs to account for natural sources of bacteria. Compliance with the TMDLs must occur by April 4, 2021 with a possible extension to April 4, 2031 for wet weather load reductions.

The impaired beaches and creeks addressed in the Twenty Beaches and Creeks TMDLs are based upon the 2002 CWA Section 303(d) list. Since 2002, water quality at many South Orange County beaches has significantly improved. This is due in part to BMPs implemented by the County, cities, non-governmental organizations, and the public in an effort to reduce bacteria and associated pathogens. These efforts have included but not limited to diversion structures, storm drain inlet filters, treatment facilities, wetlands, irrigation controllers, beach cleanups, the use of pet waste bags, and public outreach and education.

As a first step to TMDL compliance, watershed CLRPs have been developed outlining the BMPs needed to meet TMDL targets and special studies to identify sources of indicator bacteria and other listed pollutants in the watershed. In October 2012, Aliso and San Juan Creek Watershed Permittees submitted their draft CLRPs to the SDRWQCB for review. Subsequently a draft CLRP for the San Clemente Coastal Streams Watershed was submitted in December 2012.

Updated CLRP's were submitted for both the Aliso Creek Watershed and San Juan Creek in 2014 and 2015 respectively. Information on the Aliso Creek CLRP can be found in **Section 3.3.4.4**. The San Juan Creek CLRP outlines a Watershed Monitoring and Assessment Program that includes incorporation of existing monitoring plans, bacteria TMDL monitoring, and CLRP special studies. These components shall be implemented in two phases:

- Phase 1: Preparation of the Watershed Monitoring and Assessment Program, existing monitoring program implementation, and bacteria TMDL numeric target evaluation through a regional reference study
- Phase 2: Implementation of bacteria TMDL monitoring program and special studies including the completion of the regional reference study and updates to the CLRP

On May 8, 2013, the SDRWQCB adopted the Fifth Term MS4 NPDES Permit (Order No. R9-2013-0001 as amended by Order No. R9-2015-0001 on February 11, 2015 and R9-2015-0100, effective on January 7, 2016). The revised permit incorporated the Waste Load Allocations for the Twenty Beaches and Creeks TMDL, as well as monitoring and other requirements for specified beaches and creeks.

As noted in **Section 3.3.1**, the WQIP for South Orange County incorporated the CLRPs and the commitments/timelines contained therein. The WQIP will serve as the primary target-based watershed document for compliance with the TMDLs.

In addition to bacteria monitoring to comply with the TMDL, a number of special studies have been conducted and include:

- Origin of FIB Exceedances at Doheny State Beach
- Oso Creek Dissolved Solids
- Special Study: L01S03 Drainage Area Nitrogen and Phosphorus Source Investigation
- Special Study: Trash & Debris

### 3.3.5 Imported and Local Supply

South Orange County relies on two distinct water supply sources: 1) The imported water supply upon which the WMA is dependent; and 2) the local water supply, which improves the WMA's water supply and system reliability. The imported water supply accounts for approximately 97[39] percent of the WMA's potable water supply, and is obtained through MWDOC, the regional wholesale agency. The local water supply, though smaller in amount, is in many ways much more critical in that it involves not only developing a usable supply to improve overall water supply reliability but also requires maintaining and protecting the area's ecological functions dependent on the availability of high quality surface water and groundwater. **Table 3-3** shows the target levels of new supply to be developed within the WMA between 2015 and 2040 in Acre-Feet per Year (AFY).

The following discussion briefly describes the current circumstances of imported and local water resources in South Orange County.

**Table 3-3: South Orange County WMA Potential New Supplies**

| Local Supply | FY 2015 Actual (AFY) | Projection 2040 (AFY) Low | Increase 2015-2040 (AFY) |
|---|---|---|---|
| **Water Use Efficiency w/ New Conservation Efforts vs. No New Conservation post 2014 (1)** | [137,950] (4) | [125,725] (5) | 12,225 |
| **Recycling (2,6)** | 17,809 | 33,553 | 15,744 |
| **Groundwater** | 4,360 (7) | 5,215 (8) | 855 |
| **Ocean Desalination (3,9)** | | 5,600-16,800 | 5,600-16,800 |
| **Total** | 22,169 | 44,368-55,568 | 34,424- 45,624 |

1. WUE is really a demand reduction, but is presented as a supply in this comparison. Estimate by MWDOC based on SBx 7-7 compliance by 2020 and projection to 2030.
2. Recycled wastewater plus some local runoff and groundwater.
3. Approximately 16,000 AFY from South Orange Coastal Ocean Desalination project plus approximately 12,000 AFY supply delivered from Poseidon Huntington Beach desalination plant. These are preliminary planning estimates. Gross Demand is consumptive demands plus increase in WUE from 2010.

[39] MWDOC

4. OC Reliability Study TM#1 pg. 9 Table 4 (2040 Demand Forecast -No new conservation post 2014)
5. OC Reliability Study TM#1 pg. 14 Table 7 (with Additional Conservation efforts post 2014)
6. OC Reliability Study TM#1 pg. 18 Figure 9 (includes San Juan Watershed Project Phases 2 & 3)
7. 2016 San Juan Basin Adaptive Pumping Management (APM) Plan Running Average pg. 2 of 14
8. 2017 San Juan Basin Adaptive Pumping Management (APM) Plan Sustainable Pumping Curve (@33,000 AF Basin Storage) + Revised San Juan Watershed Project Phase I production of 600 AFY.
9. Doheny Ocean Desalination at 5 MGD & 15 MGD Facilities

#### 3.3.5.1 Imported Water Supply

Making the necessary investments to provide an adequate water supply to meet demand remains a critical requirement for the WMA. Population changes, economic conditions, and hydrologic conditions influence water demand in South Orange County. The WMA continues to expand its housing base and population, although successful WUE efforts and decreases in agricultural land uses are expected to abate the growth rate of water demand. Nevertheless, imported water will continue to be principal source of supply to the WMA in the foreseeable future, while efforts to develop alternative local sources will alleviate some of the WMA dependency on imported water. **Table 3-4** shows projected water demand in for South Orange County for the 20-year planning horizon.

**Table 3-4: South OC Water Demand Projections**

| Water Agency | Water Demand Projection [1,3] (AFY) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2015-16 | 2016-17 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Irvine Ranch WD[2] | 3,181 | 3,500 | 5,549 | 5,474 | 5,247 | 4,903 | 4,636 |
| El Toro WD | 7,830 | 7,420 | 8,467 | 9,054 | 9,083 | 8,975 | 8,945 |
| Laguna Beach CWD | 3,310 | 2,882 | 3,289 | 3,517 | 3,529 | 3,486 | 3,475 |
| Moulton Niguel WD | 27,349 | 27,255 | 33,502 | 33,390 | 32,927 | 32,966 | 33,076 |
| City of San Clemente | 7,658 | 7,515 | 8,576 | 9,170 | 9,200 | 9,090 | 9,060 |
| City of San Juan Capistrano | 7,456 | 6,281 | 7,167 | 7,664 | 7,689 | 7,597 | 7,571 |
| Santa Margarita WD | 28,055 | 25,269 | 28,836 | 30,835 | 30,934 | 30,566 | 30,463 |
| South Coast WD | 5,755 | 5,900 | 6,510 | 6,853 | 7,220 | 7,569 | 7,645 |
| Trabuco Canyon WD | 2,866 | 2,721 | 3,105 | 3,321 | 3,331 | 3,292 | 3,281 |
| Total | 95,972 | 87,542 | 101,454 | 108,028 | 108,131 | 106,562 | 105,952 |

1. Water that will be consumed. Includes potable water and recycled/non-potable waters.
2. Portion of IRWD within RWQCB – Region 9 Area
3. Source: MWDOC Dec 2015 Water Usage Projections.

Direct use water supply sources are in five distinct categories: imported water, groundwater, surface water, recycled water and desalted water. Existing and projected non-imported potable supply source quantities for each South Orange County water agency are listed in **Table 3-5**. Recycled (non-potable) water supply projections are shown in **Table 3-6**.

**Table 3-5: South OC Non-Imported Potable Water Supply Projects**

| Water Agency | Non-Imported Potable Water Supply Projections (AFY) | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2015-16 | 2016-17 | 2019-20 | 2024-25 | 2029-30 | 2034-35 | 2039-40 |
| Irvine Ranch WD[1] | 13,617 | 15,071 | 15,178 | 15,178 | 18,884 | 18,884 | 18,884 |
| El Toro WD | - | - | - | - | - | - | - |
| Laguna Beach CWD | - | 2,025 | 2,025 | 2,025 | 2,025 | 2,025 | 2,025 |
| Moulton Niguel WD | - | - | - | - | - | - | - |
| City of San Clemente | 433 | 300 | 500 | 500 | 500 | 500 | 500 |
| City of San Juan Capistrano | 2,021 | 7,000 | 7,450 | 7,450 | 7,450 | 7,450 | 7,450 |
| Santa Margarita WD | - | - | - | - | - | - | - |
| South Coast WD | - | 200 | 700 | 1,040 | 1,040 | 1,040 | 1,040 |
| Trabuco Canyon WD | - | - | - | - | - | - | - |
| Total | 16,071 | 24,396 | 26,278 | 26,278 | 29,984 | 29,984 | 29,984 |

Source: MWDOC Agency Projections, February 2017. Digitally provided by staff.

[1] Portion of IRWD that lies within RWQCB - Region 9 area.

**Table 3-6: South OC Non-Potable (Recycled) Supply Projections**

| Water Agency | Non-Imported Non-Potable Water Supply Projections (AFY) [1] | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2015-16 | 2016-17 | 2020 | 2025 | 2030 | 2035 | 2040 |
| Irvine Ranch WD[1] | 1,689 | 1,300 | 650 | 650 | 650 | 650 | 650 |
| El Toro WD | 862 | 1,160 | 1,160 | 1,160 | 1,160 | 1,160 | 1,160 |
| Laguna Beach CWD | 0 | 0 | 50 | 50 | 50 | 50 | 50 |
| Moulton Niguel WD | 6,430 | 6,618 | 8,500 | 8,500 | 8,500 | 8,500 | 8,500 |
| City of San Clemente | 714.6 | 1,350 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| City of San Juan Capistrano | 436.584 | 50 | 1,950 | 1,950 | 1,950 | 1,950 | 1,950 |
| Santa Margarita WD | 6,163 | 12,480 | 15,120 | 16,120 | 17,120 | 17,120 | 17,120 |
| South Coast WD | 845 | 830 | 1,050 | 1,350 | 1,350 | 1,350 | 1,350 |
| Trabuco Canyon WD | 667.6 | 850 | 1,273 | 1,273 | 1,273 | 1,273 | 1,273 |
| Total | 16,599 | 25,440 | 30,803 | 31,903 | 33,503 | 32,903 | 32,903 |

Source: MWDOC Agency Projections, February 2017. Digitally provided by staff.

[1] Portion of IRWD that lies within RWQCB - Region 9 area that has non-potable supplies of approximately 400 Acre Feet in 2005 and projected to grow to about 600 Acre Feet by 2030.

Since South Orange County imports a predominant amount of its water from outside of the area, it is not surprising that the southern part of the county is concerned about either planned or emergency outages of the import system that could be caused by natural or man-made events resulting in a disruption of water supply. Supply concerns could be caused specifically by:

- Planned shutdowns for imported delivery and treatment system maintenance and upgrades
- Emergency shutdowns or outages of facilities such as MET's Diemer Water Filtration Plant or major supply pipelines;
- Prolonged droughts on the State Water Project and/or CRA imported water systems; or
- Delays in the development of other planned local water projects.

One of the goals of the IRWM Plan is for all of the South Orange County agencies to work together to make the necessary investments to mitigate or minimize impacts from these types of events. Implementation of WUE programs and development of local supply sources, regional interconnections and lined and covered reservoir storage will help to protect the South Orange County system. Water transfers from outside of the WMA could also be beneficial to add a layer of insurance with respect to future droughts on the State Water Project or Colorado River system.

The 28.1 MGD Baker Water Treat Plant Facility, a joint regional project by El Toro WD, Irvine WD, Santa Margarita WD, Trabuco Canyon WD, and Moulton Niguel WD came on-line January 2017, providing increased water supply reliability to South Orange County by increasing local treatment capability from multiple water supply sources, including imported untreated water from MET and MWDOC through the Santiago Lateral and local surface water from Irvine Lake.

#### 3.3.5.2 Local Water Supply

MET and MWDOC have both developed complementary strategies to help insure the continued delivery of high-quality imported water supplies. Water remains a valuable resource and it is imperative that Southern California continues to develop and implement alternative strategies to meet the demands of a growing population. The IRWM Plan is consistent with the strategies of these regional water agencies, and like them, emphasizes a diversification of supplies.

- WUE practices focus on the five BMPs for urban WUE in California and include Utility Operations (Conservation Coordinator, Water Loss Control, Metering with Commodity Rates, and Retail Conservation Pricing), Education Programs (Public Information and School Education), Residential (home water surveys, low-flow showerhead and toilet retrofits), Commercial, Industrial and Institutional (Technical Assistance and Incentives, Landscape Irrigation Budgets and Incentives). These BMPs offer cost-effective opportunities to moderate the amount of imported and local water supplies required by municipal and industrial users. These programs are offered both regionally by MWDOC and MET and also locally by individual retail water agencies.
- Recycling already occurs at a significant level in South Orange County, but efforts can be extended to satisfy additional needs, particularly non-domestic demands for irrigation uses. Local recycling systems require upgrades and expansions to continue to maximize and increase supplies.
- Groundwater recovery has begun on the San Juan Valley Groundwater Basin.
- Stormwater and dry-weather runoff capture for irrigation is also being incorporated into the overall water supply portfolio that also includes ecosystem, surface and ocean water quality benefits.
- Ocean water desalination processes continue to decrease in cost, making potential use more fiscally appealing.

Surface water capture and treatment for potable and non-potable supply, groundwater basin recharge, and improved riparian habitats is also considered a minimal aspect of local water supply, and efforts to improve surface water quality are progressing through the use of BMPs.

Orange County is privileged with almost 40 miles of coastal shoreline, which means an abundant source of water, with a high salinity, is accessible to much of the county. Desalination is particularly important to South Orange County as a means to reduce dependence on imported water. The two types of processes for removing salinity from water within South Orange County include ocean desalination and groundwater desalters.

Further analysis conducted as part of the 2016 Water Reliability Study highlighted risks to supply for South Orange County. Conclusions indicated that without new supply and system investments, projected water shortages would be too great, and reliability not sustainable, by as early as 2030. Further details about the WRS conclusions can be found in **Section 3.7.2.2**.

#### 3.3.5.3 Ocean Desalination Supply

Use of newer membrane technology, energy recapture technology, and improved plant siting strategies have reduced costs for desalination, and may make seawater desalination a potential supply option for the region. In 2014, MET refined their Local Resources Program (LRP) which provides incentives for development of new local resources including seawater desalination projects in MET's service area. Under the LRP, MET provides incentives up to $340 per acre foot or $475 per acre foot for 25 and 15 years respectively, depending on unit cost of produced water for seawater desalination projects that reduce the need for imported supplies. [40] To qualify for the incentive, proposed projects must replace an existing demand or prevent a new demand on MET's imported water supplies. Desalination of ocean water provides a potentially unlimited supply of water if it can be desalinated and delivered at competitive costs.

Three desalination project sites are being considered by MWDOC studies specifically for Orange County: Huntington Beach, Doheny, and Camp Pendleton. [41] All of the sites are in close proximity to the end users in South Orange County, providing the potential for greatly improved water supply reliability. The treatment process at these desalination facilities is expected to be RO.

MWDOC and its five Project Partners – LBCWD, MNWD, City of San Clemente, City of San Juan Capistrano, and SCWD completed Phase 3 of the investigation for Doheny Ocean Desalination Project on May 24, 2017.[42] The Doheny Ocean Desalination Project would decrease the area's dependence upon imported drinking water supplies, as South Orange County agencies rely on imported water from northern California and the Colorado River to meet approximately 97 percent of their potable demands.

Currently South Coast Water District is continuing to move the project forward by investigating plant sizing and project delivery options as well as conducting additional geotechnical investigations and exploring partnering opportunities with other South Orange County water agencies.

The proposed ocean desalination facility would be located north of Doheny State Beach in Dana Point, adjacent to San Juan Creek on the inland side of Pacific Coast Highway on property being

[40] Municipal Water District of Orange County, 2016 Regional Urban Water Management Plan. FINAL.

[41] Municipal Water District of Orange County, 2016 Regional Urban Water Management Plan. FINAL.

[42] Municipal Water District of Orange County

reserved for the project by South Coast WD. Phase 1 would produce up to 5 mgd of potable water (~5300 AFY) and the ultimate expansion could produce up to 15 mgd (~16,000 AFY) of high quality drought-proof potable water. This new, local water supply would assist SCWD and the region in meeting long term water supply gaps and also benefit the area during emergencies and outages of the regional imported water delivery system. The projected net project cost is $102 million for a 5 MGD plant, and $237 million for a 15 MGD plant, with the cost of water estimated at $1,465 per acre-foot for the 5 MGD plant and at $1,240 per acre-foot for the 15 MGD plant with the cost reduction incentives from MET and Department of Water Resources grant money and State Revolving Fund (SRF) loans.[43]

The proposed ocean desalination facility would be located north of Doheny State Beach in Dana Point, adjacent to San Juan Creek on the inland side of Pacific Coast Highway on property being reserved for the project by South Coast WD. It would ultimately produce up to 5-15 MGD of high quality drought-proof water supply up to 16,000 AFY. This new, local water supply would assist SCWD and the region in meeting long term water supply gaps and also benefit the area during emergencies and outages of the regional imported water delivery system. The projected net project cost is $198 million for a 5 MGD plant, and $504 million for a 15 MGD plant, with the cost of water estimated at $1,505 per acre-foot for the 5 MGD plant and at $1,240 per acre-foot for the 15 MGD plant with the cost reduction incentives from MET and

An environmental protection element of the project is the use of slant wells to pull in filtered ocean water from the alluvial channel beneath the ocean floor which extends offshore of San Juan Creek. The slant wells avoid marine impacts such as impingement and entrainment and also protect against ocean water quality upsets such as red tides, spills and stormwater discharges. Moreover, if located near the mouth of San Juan Creek, the use of slant wells would provide seawater intrusion control to the San Juan Basin groundwater through the creation of a pumping cone of depression along the coastline. This will prevent the ocean water from moving inland, which can otherwise occur with the planned full development of the San Juan Basin brackish groundwater resource. The project could also utilize brines from the two groundwater desalters as feedwater supply to the project. This will further enhance the overall beneficial use of local water resources in the area.

Three phases of project feasibility testing have been conducted successfully at Doheny Beach since 2005. The project completed Phase 3: Extended Pumping & Pilot Plant Testing in May 2012. The Phase 3 results are promising and South Coast WD is currently reviewing options to move the project forward. Additional phases include working out the best approach for mitigation of the project impacts on the groundwater basin and conducting the pre-design steps. The pre-design work includes environmental baseline monitoring, offshore geophysics and geochemical modeling, preliminary engineering, environmental documentation and permitting. Successful adoption of the Environmental Impact Report (EIR) and the receipt of all necessary permits from all appropriate regulatory agencies as the next steps prior to project implementation and the initiation of design and construction. As planned, the project would be

[43] South Coast Water District Value-for-Money Analysis Presentation March 22, 2017 by GHD.

constructed and operational within three years after receipt of permits, and water deliveries would begin in 2021.

#### 3.3.5.4 Groundwater Desalter Water Supply

The SJBA, in conjunction with the City of San Juan Capistrano, initiated a desalter project utilizing groundwater for domestic water supply. The San Juan Basin Desalter was constructed by the City of San Juan Capistrano pursuant to the terms of the 1998 San Juan Basin Desalter Project Groundwater Recovery Program Agreement between MWD, MWDOC, and the SJBA, and as modified by First Amendment dated October 15, 2002. The San Juan Basin Desalter was completed in December 2004. The plant is currently supplied by six wells located in the Lower San Juan subbasin. The brackish water from these wells is conveyed to the plant where it is treated by RO (County of Orange, 2006). Approximately 4,800 Acre Feet were produced from the six operating wells during the period December 2004 through December 2005. Currently, the GWRP has been impacted by MTBE, cutting production in half to about 2 MGD or less since the spring of 2008. The installation of a GAC filter allows the full 5.1 MGD production, however the drought has not permitted production beyond 2 MGD. [44]

SCWD currently owns and operates a 1-MGD GRF that came on-line in 2007, also known as the Capistrano Beach Desalter. The GRF is permitted to extract 1,300 AFY of brackish groundwater, resulting in the potential treated water production of approximately 1,040 AFY. The plant extracts and treats brackish groundwater from the San Juan Basin using RO and iron and manganese removal due to high mineral content. [45] The SJBA is performing a study to evaluate the potential new well sites. SCWD will require confirmation of water rights from the SWRCB when SCWD is able to extract its permitted right of 1,300 AFY.

### 3.3.6 Water Supply Infrastructure

The resource mix for meeting South Orange County's total demand includes local groundwater, recycled water, surface water, and imported water from MET. The South Orange County WMA collaborates to develop local supplies.

Orange County as a whole depends on imported water from Northern California through the State Water Project and the Colorado River for approximately 37 percent of the County's total supply. The balance comes from several sources: a large groundwater basin underlying the northern half of the County, recycled wastewater produced by several local water agencies, and several small groundwater basins. The County anticipates that the percentage of its supply from each source will shift slightly for the next 25 years, with approximately 32 percent of its supplies from imported water and 68 percent of its supplies from local sources in 2035, even with projected growth occurring. The large groundwater basin that underlies the northern half of the County and water recycling efforts provides about 75 percent of that area's needs. South Orange County is highly dependent on imported water.

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[44] Municipal Water District of Orange County, 2016 Regional Urban Water Management Plan. FINAL.

[45] Municipal Water District of Orange County, 2016 Regional Urban Water Management Plan. FINAL.

An extensive infrastructure network makes the delivery of water possible in South Orange County. Figure 3-9 shows the Regional Imported Water Distribution System and Water Agencies. MET is the regional wholesaler of imported water for Southern California. MET is a consortium of 26 member agencies with MWDOC as its third largest agency. South Orange County purchases water from MET through MWDOC. MET's imported water system that serves South Orange County comes primarily from the Colorado River through the Colorado River Aqueduct (CRA) and from the East Branch of the California Aqueduct. South Orange County's imported water supply is treated either at the Diemer Filtration Plant in Yorba Linda and then transported through two major pipelines to the southern portion of the county the East Orange County Feeder No. 2 and the Allen McColloch Pipeline; or through the Baker Treatment Plant. Local delivery is then facilitated primarily through the Aufdenkamp Transmission Main (ATM), the Joint Regional Tri-Cities Transmission Main (JRTM), and the South County Pipeline. Water supplies then move into each local water supplier's infrastructure, which includes distribution mains, pump stations, reservoirs, wells, and other system components.

The coastal communities in South Orange County also receive a small supply from the Orange County Feeder, which is fed from MET's Weymouth Filtration Plant in the City of La Verne and at times from MET's Jensen Filtration Plant[46] in the City of Granada Hills.

IRWD Interconnection Project - This project became operational in 2009 and involved construction of a permanent interconnection and pumping facilities between the IRWD potable water distribution system and the JRTM and the ATM that conveys water into South Orange County. The project has the ability to transfer up to 30 cubic feet per second (cfs) of supplies during emergency situations only, but declines to 0 cfs by 2030 under the existing agreement.

Analysis conducted as part of the 2016 Orange County Water Reliability Study[47] highlighted risks to supply for South Orange County. Conclusions indicated that without new supply and system investments, projected water shortages would be too great, and reliability not sustainable, by as early as 2030. Further details about the WRS conclusions can be found in **Section 3.7.2.2**.

[46] South Orange County Water Reliability Study – Phase 2 System Reliability Plan, September 2004

[47] Orange County Water Reliability Study - Final Draft Executive Report, October 2016


**Figure 3-9: Regional Imported Water Distribution System & Water Agencies**

***SMWD Upper Chiquita Reservoir Project***

SMWD constructed the Upper Chiquita Reservoir with a capacity of 244-million gallons, near Oso Parkway and the 241 Toll Road. The reservoir will act as a large-scale emergency potable water supply during planned or unplanned service disruptions for South Orange County agencies. Construction began in 2009 and was completed in October 2011. The Upper Chiquita Reservoir is located on the western slope of Chiquita Canyon, just north of Oso Parkway in the City of Rancho Santa Margarita. The 241-million gallon Upper Chiquita Reservoir is the largest domestic water reservoir built in South Orange County in nearly 45 years.

***San Juan Capistrano Recycled Water***

The City of San Juan Capistrano is currently working with its neighboring agencies SMWD and MNWD to make arrangements to use recycled water, when available from these agencies. Plans for a local recycled water treatment plant at SOCWA's J.B. Latham Plant have been indefinitely delayed.

***ETWD Recycled Water Distribution Capacity Expansion***

ETWD expanded its recycled water distribution capacity, completed at the end of 2015. The project constructed a new recycled water distribution plant, producing 3.7 MGD per day, offsetting 900 AFY of potable water demand. To deliver this water, 19 miles of additional piping were laid to serve the cities of Laguna Woods and Laguna Hills. Some of the recycled water is supplied by imported tertiary treated recycled water from MNWD and IRWD.

The WMA has many projects proposed on the IRWM Priority Project List included in **APPENDIX F** of this report. **APPENDIX F** includes a Priority Project List for projects to have an opportunity for funding, and a Funded Project List for projects that have received funding and are in progress. The following provides a sample of some of the projects that would contribute to water supply.

***Baker Water Treatment Plant***

The Baker Pipeline Regional Water Treatment Plant is a 28 MGD regional project constructed at the existing IRWD Baker Filtration Plant site in the City of Lake Forest. The Plant treats untreated water from the Santiago Lateral and Irvine Lake through the Baker Pipeline. The project provides increased water supply reliability to South Orange County by increasing local treatment capability from multiple water supply sources, including imported water and local surface water from Irvine Lake. Project partners include IRWD, ETWD, MNWD, Santa Margarita Water District, and Trabuco Canyon Water District (TCWD). The project is online as of 2017.

***Cadiz Project***

The Cadiz Project is a groundwater management project that draws on an aquifer in eastern San Bernardino County that would normally discharge fresh water into a brackish aquifer that then evaporates in a dry lake bed. This project conserves fresh water that would normally be lost through natural processes and makes it available to project participants. SMWD acquired rights to 5,000 AFY from this new source that will have a pipeline that joins the Colorado River Aqueduct to reach Orange County.

***Gobernadora Basin***

The Cañada Gobernadora Multipurpose Basin project ("Gobernadora Basin") is located within an unincorporated portion of southeastern Orange County, just south of the community of Coto de Caza. The basin captures and naturally treats urban runoff and storm flows, and uses the urban return flows to help meet irrigation demands in the nearby community. It consists of a storm detention basin and a natural treatment system, a system to capture and divert flows to the wetlands, a pump station, and a pipeline to deliver flows to the Portola Reservoir, a recycled water reservoir located in Coto de Caza. The District is also connecting the Gobernadora transmission system to the Chiquita Water Reclamation Plant to deliver recycled water to the Portola Reservoir. Approximately 350 to 750 acre feet of water (114 million to 244 million gallons) is expected to be captured by the basin each year.

***Upper Oso Reservoir***

SMWD's Upper Oso Reservoir, one of the largest recycled water reservoirs in Orange County, has been in operation since 1979. It is located near the 241 Toll Road in the cities of Mission Viejo and Rancho Santa Margarita. The reservoir holds up to 1.3 billion gallons of recycled and runoff water used for outdoor irrigation in the surrounding communities, therefore conserving over a billion gallons of drinking water each year.

***SCWD Aliso Creek Streamflow Recovery Facilities Project***

SCWD has conducted a preliminary investigation of a project to intercept and treat a portion of the surface runoff flows in Aliso Creek to supplement SCWD's potable water system. This would provide a significant quantity of locally produced potable water through the existing potable water distribution system. The proposed project can be done separately or in conjunction with the Aliso Creek Harvesting Project. The project would produce up to 2 MGD of product water to SCWD's potable water distribution system or for blending with the recycled water supply.

### 3.3.7 Wastewater and Recycled Water Systems

South Orange County's wastewater is managed by the SOCWA. SOCWA serves 10 member agencies, including the majority of the cities in the WMA as well as special districts. **Figure 3-10**Wastewater Boundary & Transmission Lines shows SOCWA's service area, the agencies it serves, and the wastewater system and facilities. SOCWA's purpose it to plan for, acquire, construct, maintain, repair, manage, operate and control facilities for the collection, transmission, treatment and disposal of wastewater, the reclamation and use of wastewater for beneficial purposes, and the production, transmission, storage and distribution of non-domestic water for the mutual benefit of SOCWA's 10 member agencies and the general public in South Orange County. Specifically, SOCWA's service area encompasses the Aliso Creek, Salt Creek, Laguna Coastal Streams and San Juan Creek Watersheds (approximately 220 sq. mi) and is represented by the following member agencies:

- City of Laguna Beach
- City of San Clemente
- City of San Juan Capistrano
- El Toro Water District
- Emerald Bay Service District
- Irvine Ranch Water District

- Moulton Niguel Water District
- Santa Margarita Water District
- South Coast Water District
- Trabuco Canyon Water District

SOCWA operates three regional wastewater treatment plants, two ocean outfalls, and a treated effluent pipeline:

- Coastal Treatment Plant (CTP)
- Aliso Creek Ocean Outfall
- Regional Treatment Plant (RTP)
- San Juan Creek Ocean Outfall
- Jay B. Latham Treatment Plant
- Effluent Transmission Main

SOCWA Coastal Treatment Plant: SOCWA's CTP located in the City of Laguna Niguel has a maximum influent capacity of 6.7-MGD. Effluent has been treated to secondary or tertiary levels dependent upon disposal or reuse of the wastewater for recycling. Recycled water is treated to applicable Title 22 standards. Recycled Water Production is approximately 1.1 million gallons per day. Treated effluent that is not recycled is disposed through the Aliso Creek Outfall Ocean Outfall.

SOCWA Joint Regional Treatment Plant: The Joint Regional Treatment Plant (JRTP) with a maximum influent capacity of 12-MGD lies within the City of Laguna Niguel and is operated by SOCWA. Solid waste capacity is approximately 20 million gallons per day. Effluent has been treated to secondary or tertiary levels dependent upon disposal or reuse of the wastewater for recycling. Recycled water is treated to applicable Title 22 standards. Non-recycled effluent is conveyed to the Aliso Creek Ocean Outfall via the SOCWA Effluent Transmission Main. Average The total capacity used today is approximately 7.8 million gallons per day, while recycled water production is approximately 5 million gallons per day.


**Figure 3-10: Wastewater Boundary & Transmission Lines**

3A Wastewater Treatment Plant: The 3A Wastewater Treatment Plant (3A), located at 26801 Camino Capistrano in Mission Viejo, is a conventional activated sludge treatment facility. Wastewater generated in the service areas of the Moulton Niguel Water District and the Santa Margarita Water District is treated at the 3A Treatment Plant through a process that includes screening, grit removal, primary clarification, secondary treatment (activated sludge), secondary clarification, anaerobic digestion and solids dewatering. The design capacity of the 3A Treatment Plant is 6 million gallons per day. Approximately 2.4 million gallons of the plant's wastewater receives additional treatment each day for use as recycled water to irrigate local parks and greenbelts. Effluent that is not recycled his discharged to the Pacific Ocean through the San Juan Creek Ocean Outfall.

SOCWA J. B. Latham Treatment Plant: SOCWA's J. B. Latham Treatment Plant is the largest plant in the service area with a design capacity of 13-MGD. This plant is located in the City of Dana Point. Effluent is currently treated to secondary levels. Effluent is conveyed directly to the San Juan Creek Outfall. Average Capacity Used Today is approximately 6.7 million gallons per day. The Last Major Enhancement was in 2016. The J.B. Latham facility produces its own energy. Roughly 50 percent of the plant runs on methane gas that is a byproduct of the treatment process.

On a contract basis, two member agencies operate additional SOCWA facilities on behalf of the participating project committee members:

- North Coast Interceptor (contracted to City of Laguna Beach)
- San Clemente Land Outfall (contracted to City of San Clemente)

Collected wastewater receives full secondary treatment at the organization's four wastewater facilities, and SOCWA has active water recycling, industrial waste pretreatment, biosolids management and ocean/shoreline monitoring programs to meet the needs of its members and the requirements of the applicable regulatory permits.

Recycled water is an important part of the WMA supply system. The following projects reflect the current recycled water systems in the Region.

ETWD Water Recycling Plant: ETWD Recycling Plant is operated by ETWD and is located in the City of Laguna Woods. The plant has a maximum influent capacity of 6 MGD. Wastewater is treated to a secondary to Title 22 standards depending upon the ultimate use of the effluent. The WRP is one of the oldest water recycling plants in Orange County. In 2012, the District began a Recycled Water Expansion Project to increase the treatment and delivery of recycled water through a new tertiary treatment facility. Simultaneously, the District built a new recycled water distribution system that included 100,000 feet of recycled water pipelines beneath the roadways in portions of Laguna Woods and the northwest portion of Laguna Hills. This distribution system is completely separate from the drinking water distribution system and used for irrigation purposes only. The tertiary treatment plant is designed to produce as much as 3.7 million gallons per day with a peak hour pumping capacity of over 5,000 gallons per minute. The plant was designed with the ability to expand capacity up to the expected maximum amount of raw wastewater entering the plant.

IRWD Los Alisos Water Recycling Plant (LAWRP): LAWRP is operated by IRWD and is located in the City of Lake Forest. LAWRP has a capacity of 5.5-MGD. Wastewater is treated to a secondary or tertiary level dependent upon the ultimate use of the effluent. When excess water beyond its tertiary treatment capacity is received, it is conveyed to the SOCWA Effluent Transmission Main for disposal via the Aliso Creek Ocean Outfall.

IRWD Michelson Water Recycling Plant (MWRP): MWRP is located in the City of Irvine and is operated by IRWD. MWRP currently has a maximum influent capacity of 28 MGD after Phase 2 expansion in 2015. The expansion included state-of-the-art technology: a 10 MGD membrane bioreactor that produces water of such high clarity that the water produced is disinfected with ultraviolet lamps. These new processes operate in parallel with the existing activated sludge/dual media filtration/chlorine disinfection plant. Worker safety was enhanced by replacing chlorine gas with bleach for disinfection for the existing plant and by installing a new odor scrubbing system. Wastewater is treated to a tertiary level with advanced treatment in the form of nitrification/denitrification. All effluent meets Title 22 standards for unrestricted use, except for potable water consumption. All effluent produced by the plant is conveyed to the recycled water distribution system.

San Clemente Water Reclamation Plant: The City of San Clemente owns and operates the San Clemente Water Reclamation Plant located within the City. The San Clemente Water Reclamation Plant has a design capacity of 7 MGD and treats wastewater to secondary or tertiary levels dependent upon if the water will be recycled or disposed. In 2010, approximately 900 acre feet were recycled. Any water in excess of the plant's recycling limit is conveyed to the San Juan Creek Ocean Outfall via the San Clemente Land Outfall. Recycling capacity was expanded from 2.2 MGD to 5 MGD with the completion of the plant expansion in 2014. The expansion included nearly 9-miles of pipelines, conversion of a domestic water reservoir to recycled water storage, and a pressure reducing station. Design of this project was completed in spring 2010 and construction commenced spring 2013 with the first phase of new recycled water customers online in fall 2014.

SCWD Aliso Creek Water Reclamation Facility: SCWD constructed a project to intercept and treat a portion of the surface runoff in lower Aliso Creek to supplement the recycled water system. This improves the quality of the recycled water supply to make it more attractive for irrigation users. Treatment includes filtration and RO facilities near SOCWA's CTP. SCWD treats 300,000 to 800,000 gallons per day of urban runoff in the creek based on customer demand and the amount of creek flow. The District's permits to use water from Aliso Creek require monitoring of potential environmental impacts and a sufficient bypass flow rate (4.7 cfs) to ensure protection of fish and plants and continued flows into the lagoon at the mouth of the creek. The Water Reclamation Facility was designed, built, tested, and commissioned from January 2013 through April 2014 and operational by May 2014. It adds state-of-the-art ultrafiltration and RO treatment to the production of recycled water to lower salinity. Construction of the facility cost $2.8 million. Approximately $500,000 was funded by a State Water Resources Proposition 50 grant, and the City of Laguna Beach contributed $25,000.

SMWD Chiquita Water Reclamation Plant: Chiquita Water Reclamation Plant (CWRP) is operated by SMWD and is located in Chiquita Canyon. Wastewater is treated to a tertiary level with recycled water treated to Title 22 standards. CWRP has a maximum design capacity of 8

MGD with plans to increase its size to 10 MGD by 2025. Wastewater flows from Rancho Santa Margarita, Coto de Caza, Talega, Ladera Ranch, Sendero, Esencia, parts of IRWD and TCWD, and other areas within the District service area can be treated at the Chiquita Water Reclamation Plant (CWRP). The District owns and operates the CWRP which has a current secondary design capacity of 9 MGD and the CWRP has tertiary treatment capacity of 6 MGD which is distributed to the District's recycled water distribution system. Secondary treated wastewater is discharged to the San Juan Creek Ocean Outfall if the recycled water treatment capacity is reached, there is no recycled demand, or seasonal storage reservoirs are full. The District is planning to expand the CWRP tertiary capacity from 6 MGD to 10 MGD by 2018. The expansion would continue to reduce the District's dependency on imported water and provide additional recycled water for irrigation purposes.

<u>SMWD Nichols Institute Water Reclamation Plant:</u> The Nichols Institute Water Reclamation Plant is operated by SMWD and owned by a private company that owns property within SMWD's boundaries. This small facility treats approximately 34 AFY. No outfall is available for this facility. Therefore, all wastewater is treated to Title 22 standards for recycling purposes. Since this facility is remote from the existing water and wastewater facilities, SMWD is not obligated to provide an alternate source of water in the event the Nichols facility becomes inoperable or unusable.

<u>SMWD Oso Creek Water Reclamation Plant:</u> Oso Creek Water Reclamation Plant (OCWRP) is located along Oso Creek and is operated by SMWD The Oso Creek Water Reclamation Plant (OCWRP) is owned and operated by the District and has a design capacity of 3 MGD. OCWRP diverts wastewater from the Oso Trunk Sewer and treats it to Title 22 tertiary levels where it is conveyed to the District's recycled water system where it is beneficially reused. The solids removed during treatment are returned to Oso Trunk Sewer for handling at the J.B. Latham Treatment Plant.

<u>TCWD Robinson Ranch Water Reclamation Plant:</u> Robinson Ranch Water Reclamation Plant (RRWWTP) is operated by TCWD and is located in Trabuco Canyon, an unincorporated area of Orange County. RRWRP has a maximum capacity of 0.85 MGD. All of the wastewater is recycled as the plant is not permitted to have stream discharges, and it is unfeasible to connect to the existing outfalls in the SOCWA service area. The District owns and operates the RRWWTP that provides collection and treatment for developments on the east side of the service area. The RRWWTP is located in the Robinson Ranch development and has a treatment capacity of 0.85 MGD, and the tertiary treated water is fed into the recycled water reservoir that has a storage capacity of 130 AF.

### 3.3.8 Flood Control Infrastructure

Flood Control Infrastructure is essential for the protection of life and property. The OCFCD is tasked with the ultimate goal of protecting the County from the threat of floods by designing and constructing channels, storm drains, dams, pump stations and other drainage related facilities. The OCFCD Regional system of Flood Control facilities provides the primary flood control protection for the County and is comprised of channels, dams, retarding basins, pump stations and levees. **Figure 3-11** shows regional flood control system consisting of OCFCD, city, and privately owned reaches. The OCFCD designs, constructs, and maintains channels, storm drains, retarding basins, dams and pump stations to reduce the risk of flooding during and after seasonal and non-seasonal rain events.

The County and cities manage development in the floodplains consistent with FEMA's National Flood Insurance Program (NFIP) regulations. Building policies are enhanced to provide thresholds above NFIP regulations. This includes preserving and/or reclaiming properties in the FEMA SFHA (also known as 100-year floodplain) and beyond as open space development is prohibited in perpetuity. Additionally, OCFCD considers implementation of natural channels as an alternative to other flood control methods and incorporation of other environmental features within the flood control system, where feasible. Natural systems require much wider channels and a significant budget for future maintenance and right-of-way acquisition which may include existing development resulting in relatively high costs therefore yielding an unfeasible alternative.

There are many flood control channels and associated facilities within the South Orange County WMA. There are approximately 380 miles of concrete, rock lined, and earthen flood control facilities in the entire County that are owned, operated and maintained by OCFCD; however, some channel segments are privately owned. Flood control is provided by a system of open channels, levees, basins, culverts, and pump stations. Stormwater runoff is conveyed by gravity through a system of drainage lines and channels. Some of this water is conveyed into the suction bays of various pump stations then pumped to a higher elevation into larger levees or the ocean. The pump station operators are responsible for the operation and maintenance of seven pump stations, three UV / filtration systems and four urban runoff diversions containing 46 pumps throughout the County watershed area. The OCFCD continues to upgrade the Regional Flood Control system to provide protection from the 100-year storm event. The highest priority improvement to the flood control system in South Orange County includes the improvement programs for the San Juan Creek and Trabuco Creek channels.

***Flood Control Priorities***

In addition to meeting the FEMA 100-year flood protection designation in South Orange County channels to reduce overall flood risk, the County has placed a top priority on predicting flood events and reacting in a timely manner to areas of flooding and severe soil erosion. The Automatic Local Evaluation on Real Time (ALERT) Flood Detections System consists of a network of over 100 rainfall and flood control and reservoir water level sensors strategically located throughout the County. The ALERT system transmits data via radio transmission to the County's base station computer which allows for real time monitoring of storm conditions. The ALERT network is supported by satellite and radar storm tracking provided by the National Weather Service, the NOAA and a contract meteorologist.

Additionally, flood control facilities may at times present a great opportunity for multiple joint-uses such as recreation, water conservation, water quality improvement, and environmental enhancement.


**Figure 3-11: Flood Control Infrastructure**

### 3.3.9 Recharge Facilities

As was described in **Section 3.3.2.1**, the San Juan Basin is located within the San Juan Creek Watershed and comprises four sub-basins: Upper San Juan, Middle San Juan, Lower San Juan and Lower Trabuco. The basin is bounded on the west by the Pacific Ocean and otherwise by tertiary semi-permeable marine deposits. San Juan Creek drains the San Juan Basin and several other creeks drain valley tributaries to the San Juan. The primary water-bearing unit within the Basin is Quaternary alluvium – a heterogeneous mixture of sand, silt, and gravel in the eastern portion of the basin to coarse sand near the center to fine-grained lagoonal sediments in the western portion of the basin. Thickness of the alluvium average about 65 feet and may reach more than 125 feet. The total storage capacity has been estimated to be 41,400 AF and the net basin recharge is 2,800 to 12,700 AFY[48]. Recharge of the basin is from flow in San Juan Creek, Oso Creek, and Arroyo Trabuco, as well as rainfall infiltration and subsequent deep percolation to the water table, deep percolation of applied water from landscape and agricultural irrigation, and subsurface inflow from the tributary alluvial stream areas. Water from springs flows directly from Hot Spring Canyon into San Juan Creek adding to recharge. Work is underway to construct rubber dams and increase recharge with recycled water. [49]

San Juan Basin recharge consists of streambed percolation from the mainstream San Juan and Arroyo Trabuco Creeks. There are no spreading basins in the San Juan Basin. In the San Mateo Basin, recharge is derived from percolation of runoff derived from rainfall and effluent from a wastewater treatment plant. The infiltration is through natural reaches and five spreading areas in the stream channel of San Mateo Creek.[50]

## *3.4 Political/Jurisdictional Boundaries*

Federal, state, and local agencies have jurisdiction within the South Orange County WMA. On a federal level, Region 9 of the United States EPA includes the South Orange County WMA. The CWA requires the states or the United States EPA to set standards for surface water quality, mandate sewage treatment and regulate wastewater discharges into the nation's surface waters. Rather than operate separate state and federal water pollution control programs in California, the State assumed responsibility for implementing the CWA. The SWRCB, and its nine RWQCB assume these responsibilities. On a state level, the South Orange County WMA is within the SDRWQCB and the Southern District of the DWR. The SDRWQCB is tasked with protecting and enforcing the many uses of water within the WMA, including the needs of industry, agriculture, municipal districts, and the environment. **Figure 3-12** (RWQCB) shows the boundaries of the RWQCBs Regions 8 and 9. The DWR manages water resources of California in cooperation with other agencies, to benefit the State's people, and to protect, restore, and enhance natural and human environments.

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[48] 2016 San Juan Basin Authority Adaptive Pumping Management Plan by WEI

[49] Municipal Water District of Orange County, 2015 Regional Urban Water Management Plan. May 2016.

[50] Department of Water Resources, California's Groundwater Bulletin 118, "Hydrologic Region South Coast - San Mateo Valley Groundwater Basin" (10/1/03). Available online 1/26/13: http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/9-2.pdf


**Figure 3-12: Regional Water Quality Control Boards**

#### *Protected Ecological Areas*

The South Orange County WMA falls within the South Coast Region of the CDFW. The Mission of the CDFW is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. CDFW's Marine Region encompasses Crystal Cove State Marine Conservation Area, Laguna Beach State Marine Reserve, Laguna Beach State Marine Conservation Area, and Dana Point State Marine Conservation Area.[51]

The Irvine Coast ASBS begins at Pelican Point and continues 3.4 miles along the coastline to the City of Laguna Beach. This ASBS contains the Irvine Coast State Marine Park (formerly called a Marine Life Refuge), and the overlapping Crystal Cove State Marine Conservation Area, which are administered by the CDFW. These MPA and the adjoining beach provide excellent tidal and offshore communities featuring tide pools, kelp beds, and dolphin birthing grounds. Despite increasing urbanization, Crystal Cove State Park (administered by the California Department of Parks and Recreation) contains some of the last undeveloped Orange County coastline.

The Heisler Park ASBS in Orange County covers just 0.5 mile of coastline. The Heisler Park State Marine Reserve (formerly called an Ecological Reserve) and the overlapping Laguna Beach State Marine Park are administered by the CDFW, and the adjacent Heisler Park is owned and maintained by the City of Laguna Beach. This reserve is a popular tidepooling area and can suffer from scavenging by beach visitors. Key pollution threats are urban drainage and stormwater runoff. Protection of the reserve was completed in 2012 and included stringent coastal planning efforts between the City of Laguna Beach, City of Newport Beach, Irvine Company, the County of Orange, California State Parks, and Caltrans.

#### *Jurisdictional Authority*

On a local level, the County of Orange, eleven cities, and nine special districts have jurisdictional boundaries with authority for land use, water resources, habitat protection, water quality, flood control, and recreation facility management.

The County of Orange is governed by the Orange County BOS. The BOS oversees the management of County government and many special districts. The County is divided into five supervisorial districts with governing Boards. A BOS is elected by the voters in the five districts to four-year terms. Each district varies in geographical size; however, each has a population of approximately 600,000 residents. The South Orange County WMA is primarily within the boundaries of the Fifth District. The Supervisor for the Fifth District is the Honorable Lisa A. Bartlett. The Fifth District includes all the South Orange County Cities that make up the South Orange County WMA. Each City includes a City Council to oversee City-specific issues.

## *3.5 Regional Demographics*

South Orange County supports a major portion of Southern California's growing population. As real and projected populations continue to increase, appropriate management of the South

[51] California Department of Fish & Wildlife. *Guide to Southern California Marina Protected Areas*. Available online 3/29/13: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=43293&inline=true

Orange County WMA's water and other natural resources is essential. The IRWM Plan addresses regional demographics through effective management of its precious resources.

The South Orange County WMA includes a total population of approximately 600,000. **Table 3-7** shows the population served by the South Orange County WMA water agencies is approximately 555,924 and **Table 3-8** shows the population served by SOCWA is approximately 520,000.

**Table 3-7: Water Service Agency Population**

| Water Agency | 2015 Population Served[52] |
|---|---|
| El Toro Water District | 48,797 |
| Laguna Beach County Water District | 19,225 |
| Moulton Niguel Water District | 170,326 |
| San Clemente Utilities Division | 51,385 |
| San Juan Capistrano Water Services Department | 39,047 |
| Santa Margarita Water District | 156,949 |
| South Coast Water District | 35,004 |
| Trabuco Canyon Water District | 12,712 |
| IRWD[53] | 14,250 |
| **Total** | 547,695 |

**Table 3-8: Wastewater Service Agency Population**

| Water Agency | 2004 Population Served |
|---|---|
| South Orange County Wastewater Authority | 520,000 |
| **Total** | **520,000** |

City populations total 525,000 and are reflected in **Table 3-9**. **Figure 3-13** provides the population information by tract while **Figure 3-14** provides the Median Household Income (MHI) for the South Orange County WMA. Some areas receive water and wastewater services from agencies outside the South Orange County WMA such as the OCWD and OCSD.

[52] Information provided in each agency's 2015 Urban Water Management Plan

[53] Reflects the portion of IRWD that serves the City of Lake Forest located within South Orange County. Population is based on 4,750 dwelling units in SWRCB Region 9 that IRWD serves and assumes 3 people per unit, equaling approximately 14,250 people.

Within the South Orange County WMA there are several areas determined to be a Disadvantaged Community (DAC), which is defined as "a community with a MHI less than 80 percent of the statewide average"[54]. Of the approximately 600,000 residents in South Orange County, it is estimated that 6.7 percent of the population is disadvantaged and live at or below the poverty level. There are also Economically Disadvantaged Areas (EDA) that generally include DACs that have a state MHI between 80 and 85 percent of the statewide annual MHI along with other factors such as finical hardship, unemployment and population density. Please refer to **Section 3.6** for more discussion on DACs and EDAs.

**Table 3-9: City Populations**

| South Orange County City | 2015 Population[55] |
|---|---|
| City of Aliso Viejo | 50,195 |
| CDP of Coto de Caza | 14,866 |
| City of Dana Point | 34,181 |
| CDP of Ladera Ranch | 22,980 |
| City of Laguna Beach | 23,365 |
| City of Laguna Hills[56] | 31,748 |
| City of Laguna Niguel | 65,806 |
| City of Laguna Woods[57] | 16,406 |
| CDP of Las Flores | 5,971 |
| City of Lake Forest[58] | 82,492 |
| City of Mission Viejo | 97,156 |
| City of Rancho Santa Margarita | 49,324 |
| City of San Clemente | 65,526 |
| City of San Juan Capistrano | 36,454 |
| Total | 596,470 |

[54] US Census American Community Survey (ACS) 5-Year Data: 2010-2014 (with a median household income of $61,489. DAC are defined as households with less than 80 percent of state annual median household income.
[55]US Census Bureau 2016. CDP number published by the State Department of Finance 2010.
[56] Approximately 80 percent of total population is in South Orange County Region.
[57] Approximately 50 percent of total population is in South Orange County Region.
[58] Approximately 30 percent of total population is in South Orange County Region.

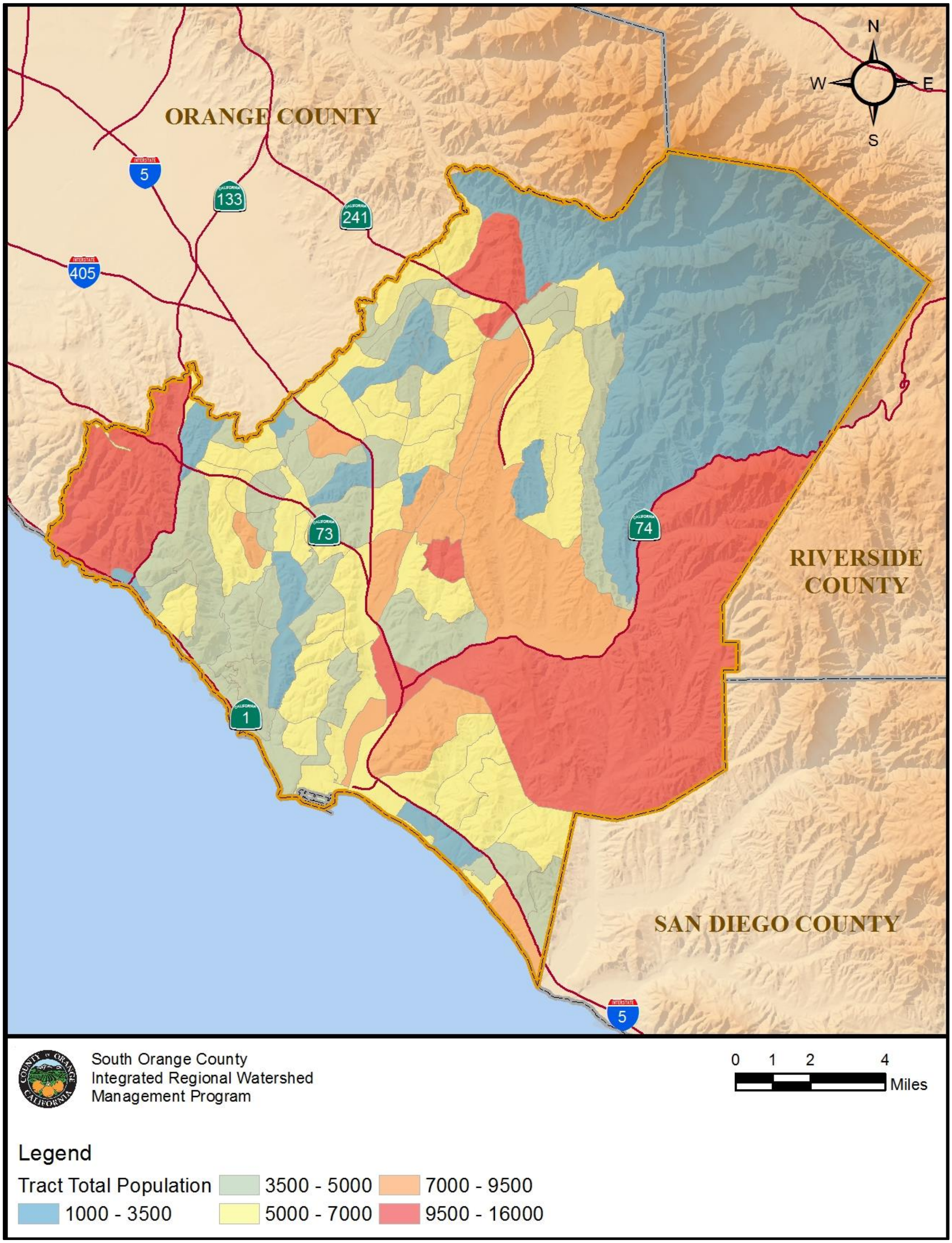


**Figure 3-13: Population Information by Census Tract**

Many factors affect future demands for water such as population growth, economic conditions, and hydrologic conditions. Historical water demand in Orange County is strongly related to land use and population. In general, as population increased, water demand increased. From 1970 to 1995, population increased 82 percent and water demand increased 55 percent. From 1995 to 2000, population increased an additional 10 percent, resulting in an overall growth from 1970 to 2000 of 101 percent. Water demand use increased 13 percent between 1995 and 2000, for an overall growth from 1970 to 2000 of 79 percent. The slower growth in water demand is primarily due to a change in land use from agriculture to urban/suburban and successful conservation efforts. **Table 3-10** reflects recent historical population growth data obtained from the US Census Bureau.

**Table 3-10: South Orange County Historical Population Growth**[59]

| South Orange County City | 2000 | 2005 | 2010 | 2015 | 2017 |
|---|---|---|---|---|---|
| City of Aliso Viejo | - | 45,302 | 47,814 | 50,195 | 50,312 |
| City of Dana Point | 35,110 | 34,550 | 33,336 | 34,181 | 33,669 |
| City of Laguna Beach | 23,727 | 23,497 | 22,718 | 23,365 | 23,505 |
| City of Laguna Hills | 31,178 | 31,421 | 30,341 | 31,748 | 31,544 |
| City of Laguna Niguel | 61,891 | 63,310 | 62,953 | 65,806 | 66,689 |
| City of Laguna Woods | 16,507 | 16,998 | 16,191 | 16,406 | 16,319 |
| City of Lake Forest | 75,997 | 76,635 | 77,257 | 82,492 | 84,931 |
| City of Mission Viejo | 93,102 | 95,427 | 93,297 | 97,156 | 96,718 |
| City of Rancho Santa Margarita | 47,214 | 47,822 | 47,849 | 49,324 | 48,602 |
| City of San Clemente | 49,936 | 62,286 | 63,494 | 65,526 | 65,975 |
| City of San Juan Capistrano | 33,826 | 34,497 | 34,567 | 36,454 | 36,262 |
| TOTAL | 468,488 | 531,745 | 529,817 | 552,653 | 554,526 |

As discussed in **Section 3.3.5**, by estimating water demands over the next 20 years, water suppliers are ensuring that reliable and economic sources of water are available to their customers while protecting the watersheds, groundwater resources, surface water, and the ocean.

[59] US Census Bureau 2016 and California Department of Finance 2017.

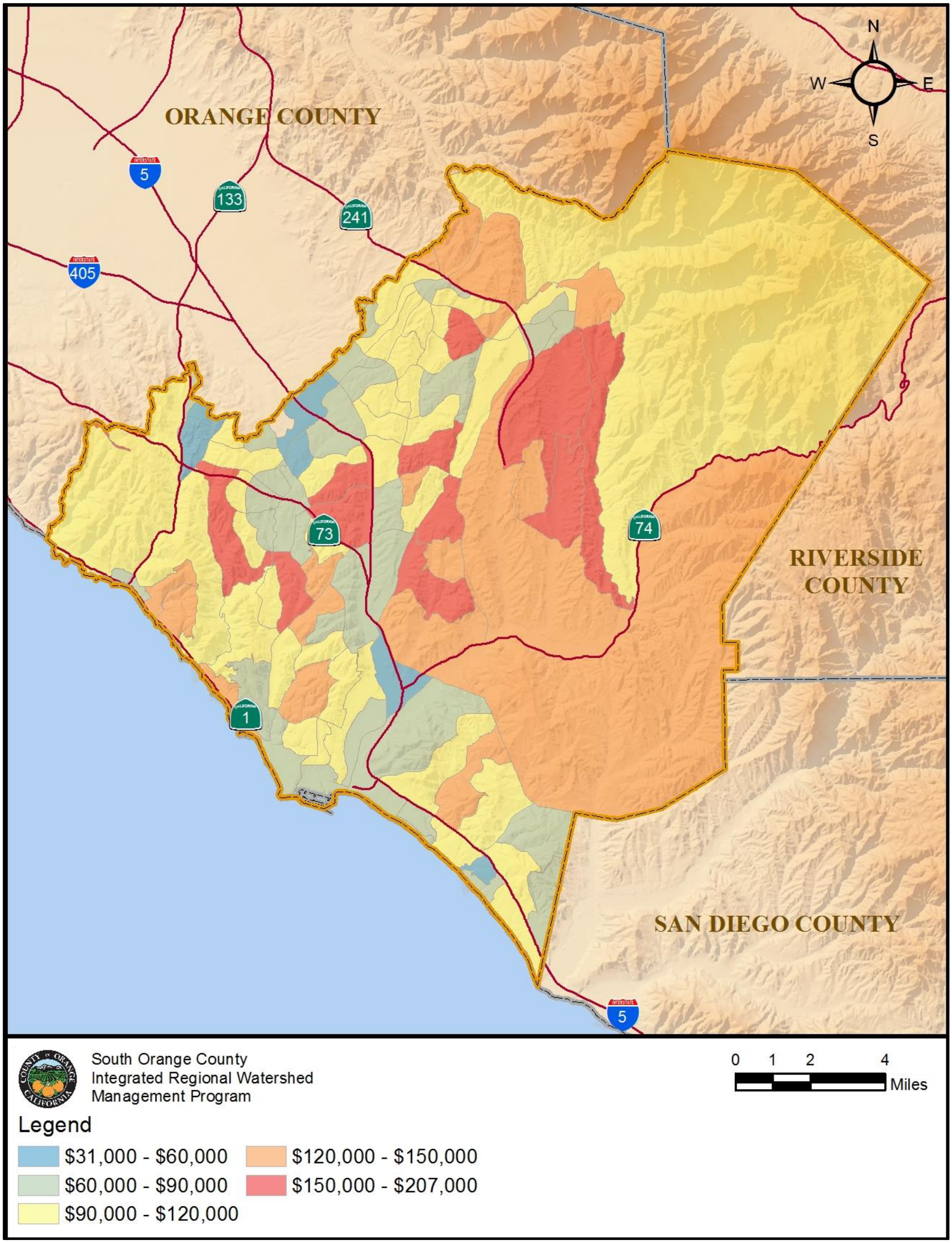


**Figure 3-14: Median Household Income**

## 3.6 Disadvantaged Communities and Economically Distressed Areas

As described in **Section 3.5** above, the South Orange County WMA includes several areas determined to be a DAC, which is defined as "a community with a MHI less than 80 percent of the statewide average"[60]. Of the approximately 600,000 residents in South Orange County, it is estimated that 6.7 percent of the population are disadvantaged and live at or below the poverty level. The Water Code §79702.(k) also identifies EDAs, which means a municipality with a population of 20,000 persons or less, a rural county, or a reasonably isolated and divisible segment of a larger municipality where the segment of the population is 20,000 persons or less, with an annual MHI that is less than 85 percent of the statewide MHI, and with one or more of the following conditions as determined by the department: (1) Financial hardship (2) Unemployment rate at least two percent higher than the statewide average or (3) Low population density. While EDA definition is similar to the DAC definition in utilizing state MHI as a determining factor, the EDA definition also includes other factors such as finical hardship, unemployment and population density. DWR's IRWM DAC and EDA Mapping Tools were used for the development of this Plan and are available at the following links:

- DWR DAC Mapping Tool: http://www.water.ca.gov/irwm/grants/resources_dac.cfm
- DWR EDA Mapping Tool: http://water.ca.gov/irwm/grants/resources_eda.cfm.

**Figure 3-15** shows the DAC and EDA locations within the WMA boundaries. DAC and EDA involvement is an important part of the South Orange County IRWM Plan process. The following cities include DACs and EDAs:

- Laguna Woods
- Laguna Hills
- Lake Forest * includes EDA
- Mission Viejo
- Rancho Santa Margarita
- Laguna Niguel
- Dana Point
- San Juan Capistrano
- San Clemente
- Unincorporated area * includes EDA

Throughout South Orange County, DACs are located within defined water agency service areas availing safe drinking water through service connections. As a result, water resources needs are generally centered on community development and surface water quality issues, rather than drinking water quality or drinking water supply issues.

[60] US Census American Community Survey (ACS) 5-Year Data: 2010-2014 (with a median household income of $61,489. DAC are defined as households with less than 80 percent of state annual median household income.


**Figure 3-15: Disadvantaged Communities and Economically Distressed Areas**

The IRWM Plan includes projects and programs aimed at protecting the population as a whole, including residents who represent the disadvantaged population of the area. For example, the ETWD Recycled Water Distribution System Expansion, completed in 2014, was funded by Proposition 84 Round 1 Implementation Grant and includes construction of a new recycled water distribution system to serve the ETWD service area, including DACs in the City of Laguna Woods. The project includes the conversion of approximately 216 existing potable water dedicated irrigation meters at 75 sites to recycled water. The conversions reduce the amount of potable water imported by the District by as much as 1,450 AFY. This Project directly benefits DACs in the water district's service area by ensuring recycled water is available for irrigation needs while potable water is available for drinking water needs. To ensure members of the public (including DACs) were involved in the project implementation process, ETWD conducted extensive community outreach, including: presentations, developing project literature, utilizing media coverage, conducting town hall meetings/open houses, issuing newsletters to residents, posting construction notices, and making available a project website and hotline.

***Environmental Justice***

Additionally, addressing water quality issues in areas of recreational use, the IRWM Plan incorporates environmental justice in a way that provides every resident an equal opportunity and fair treatment in the regional water planning process. To further substantiate the importance of including regional minority communities, the South Orange County IRWM Group has collaborated with Juaneño Band of Mission Indians and Hispanic community groups to ensure their active involvement in the IRWM Plan.

There are several areas of low cost housing and subsidized housing that service South Orange County's DAC. The majority of this socioeconomic population is Hispanic. One clear measure of this community is that the Camino Health Center in San Juan Capistrano provides affordable, quality primary medical and dental care. The Center serves over 100,600 visits annually through its medical clinic, mobile medical vans, pediatric dental clinic, and Women, Infants and Children program of which the majority were Hispanics whose income is in line with the State's formula for disadvantaged populations.

The IRWM Plan includes several projects to address the cause of water pollution for beaches within the WMA. It is particularly important to address water quality in order to protect the health and safety of the entire population in the area, especially for the disadvantaged residents that do not have the means to travel to other areas of the state or country.

**DAC Outreach & Water Needs Assessment**

The Tri-County FACC started a Water Needs Assessment process in 2017 to define DACs, EDAs, and URCs for the San Diego Funding Area and each IRWM Region. The goal of this effort will be to quantitatively identify the most critical issues for DACs, URCs, EDAs and other stakeholders in the South OC WMA. The Water Needs Assessment will continue through 2018, and result in the following for the WMA:

- Definition, mapping and characterization of DACs, EDAs and URCs;
- Identification of DAC and stakeholder contacts;

- DAC outreach, including two workshops for DACs, EDAs, URCs and local Native American Tribes to identify water-related issues within the communities that are highest priority;
- Speakers bureau presentations to gather new information from DAC stakeholders that have not traditionally been a part of the IRWM process;
- A cumulative review and analysis of the assessment, including provision of updates to the IRWM Group and other stakeholders at EC meetings.

## *3.7 Water Management Issues*

### 3.7.1 History of South Orange County IRWM Efforts

At the time of settlement, Orange County was supplied enough water from surrounding surface water bodies to meet its needs. San Juan Creek supplied the Mission at San Juan Capistrano while the Santa Ana River supplied the early cities of Anaheim and Santa Ana along with a large aquifer underlying the northern half of the County. For 200 years, South Orange County epitomized California's rancho days, with cattle on the hills and orchards in the valleys. The Mission San Juan Capistrano was a center point, flanked by a stunning coastline to the west and the Cleveland National Forest to the east.

By the early 1900s, Orange County residents understood that their water supply was limited. In 1928 the cities of Anaheim, Santa Ana, and Fullerton joined with 10 other Southern California cities to form the MET. Their objective was to build an aqueduct to the Colorado River to provide the additional water necessary to sustain the growing Southern California population.

Later, the OCWD was formed in 1933 to protect Orange County's water rights on the Santa Ana River. That mission was then expanded to manage the underground aquifer, making optimum use of local supplies and augmenting those with imported supplies provided through the County's MET member agencies.

Soon other parts of the Orange County also saw the need for supplemental supplies. A severe drought in the late 1940s further emphasized the need. In 1941, coastal communities from Newport Beach down to the San Diego county line formed the Coastal Municipal Water District as a way to join in the benefits provided by MET. In 1951, MWDOC was formed by County voters under the Municipal Water District Act of 1911. In January 2001, the Coastal Municipal Water District became a part of MWDOC, a move that streamlined local government and allowed MWDOC to more efficiently provide wholesale water services. Today, MWDOC is MET's third largest member agency, providing and managing the imported water supplies used in Orange County.

Since the early 1960s, the region has transitioned to one of the fastest growing areas of urban development in the State. The population, which once numbered a few thousand residents, now totals approximately 600,000. Homes, recreational facilities and master-planned retail areas cover the coastline. And South Orange County's last remaining portion of undeveloped inland property, still a vivid reminder of the rancho days, is slated for partial development over the next several years. Water supply reliability has allowed the area to thrive; responsible water resource management will allow it to continue. This is the basic premise on which the South Orange County IRWM Plan was developed. The entities that have developed the plan – South

Orange County cities, water and wastewater agencies, the County of Orange, and stakeholders represent half a million people working across seven major watersheds and two groundwater basins.

In June 2003, per direction from the Orange County BOS, the OCPW Department led a task force of city managers and special district general managers, to develop a countywide Water Quality Strategic Plan. The task force proposed a new governance model for water quality programs based on three geographic sub-areas of the County: The North, Central, and South Orange County WMAs.

From this water quality strategic planning effort, the County was designated to serve as a regional program administrator. The WMA concept formalizes a partnership between the County, the OCFCD, Orange County municipalities, and water and wastewater agencies and builds on years of working individually and collaboratively to develop and integrate regional water management strategies to protect communities from drought, enhance local water supply and system reliability, ensure continued water security, optimize watershed and coastal resources, improve water quality throughout the watersheds and safeguard habitat.

In August 2004, the County, South Orange County Cities and water and wastewater districts within the jurisdiction of the SDRWQCB formed the South Orange County IRWM Group (See **Section 2.1** for a complete listing) to continue this collaborative effort and to more efficiently coordinate their efforts through the development of an IRWM Plan. To further solidify this collaborative effort, the South Orange County IRWM Group has established a Cooperative Agreement amongst its members. The Agreement provides a framework for planning and implementing water management strategies in the South Orange County WMA.

### 3.7.2 Regional Water Management

The South Orange County IRWM Group focuses on identifying the long-term water supply and water quality issues facing the South Orange County WMA. All project categories within the IRWM Plan are essential for maximizing limited water resources, protecting water quality, and enhancing the environment. This integrated approach allows local agencies to access a wealth of regional resources, diversifying water supply sources over a broad range of projects. The following describes how the South Orange County IRWM Group has addressed the regional water management issues affecting the South Orange County WMA.

#### 3.7.2.1 Water Supply

Providing an adequate water supply remains a critical requirement for the South Orange County WMA. Imported water supply accounts for approximately 97 percent of the South Orange County WMA's potable water supply, and is obtained through the regional wholesale agencies. The local water supply, though smaller in amount, is in many ways much more critical in that it involves not only developing a usable supply to improve overall water supply reliability (See **Section 3.7.2.2**), but it also requires maintaining along with protection of the area's ecological functions that are dependent on the availability of high quality surface water and groundwater.

Changes in population, economic conditions, and hydrologic conditions all influence water demand in South Orange County. Furthermore, the WMA's increasing population and business growth potential will dictate future water needs. Indeed, as South Orange County is heavily reliant on imported water, the demand for imported supply is estimated to expand with the population. However, successful conservation efforts and a decrease in agricultural land uses are expected to abate the growth rate of water demand.

It is imperative that South Orange County continue to develop and implement additional strategies to meet the demands of a growing population. The South Orange County IRWM Plan supports the development and implementation of projects and programs to build diverse water supplies.

The MET imported water system that serves South Orange County is principally supplied from the Colorado River Aqueduct (CRA) and from the State Water Project (Bay Delta). MET serves South Orange County with imported water through untreated and treated water distribution systems. South Orange County receives nearly all of its MET treated supply from the Diemer Filtration Plant located in Yorba Linda. This water is delivered primarily through the Allen McColloch Pipeline and the East Orange County Feeder No. 2. Untreated MET water is supplied from the CRA through the Santiago Lateral to the Baker Water Treatment Plant located in Lake Forest for treatment by the retail agencies.

As the principal importer of water in Southern California, MET's primary goal is to provide reliable water supplies to meet the water needs of its service area at the lowest possible cost. As existing imported water supplies from the Colorado River and State Water Project face increasing climate and precipitation challenges as well as demand challenges, the reliability of deliveries from these sources will likely decrease as supply becomes constrained. To address these challenges, MET and its member agencies developed an Integrated Water Resources Plan (IRP) in 1996 which MET updates approximately every five years.

MET's IRP has helped maintain a reliable water supply for all of Southern California by anticipating needs and providing additional water resources to address changing conditions. Imported sources will remain important baseline supplies but conservation and new local supplies such as recycling and ocean desalination will provide water for growing needs. Through regional planning, education and water portfolio diversification, MET and its member agencies plan to continue to provide a reliable water system for the region.

The IRP was updated in 2010 and 2015. Updates in 2010 focused on implementing a three component approach to reduce dependence on traditional water supplies. These components are:

- Core Resource Strategy: Accelerate the levels of production of recycled water, groundwater recovery, and seawater desalination.
- Uncertainty Buffer: Implement a buffer supply equivalent to 10 percent of total retail demand in service areas and a 20 percent reduction in per capita use.
- Foundational Actions: Assess low cost, low risk options (feasibility studies, legislative action, etc.) to help develop water resources.

The 2015 IRP updated reliability targets identifying developments in imported and local water supply and in water conservation that, if successful, would provide a future without water shortages and mandatory restrictions under planned conditions. This IRP highlighted goals to achieve additional conservation savings, develop additional local water supplies (target total 2.4 million acre-feet by 2040), maintain Colorado River Aqueduct supplies (ensure a minimum of 900,000 acre-feet is available when needed), stabilize State Water Project supplies and to maximize the effectiveness of storage and transfers. The 2010 and 2015 IRP were both approved and are available. [61]

#### 3.7.2.2 Water System Reliability

Since South Orange County imports a predominant amount of its water supply from outside of the area, it is not surprising that South Orange County is concerned about either planned or emergency outages of the import system that could be caused by natural or man-made events resulting in a disruption of water supply service. To ensure continued water service reliability for South Orange County, 11 County agencies, MET and the United States Bureau of Reclamation (USBOR) joined together to fund the South Orange County Water Reliability Study (SOCWRS) - Phase 2 System Reliability Plan of 2004. A follow-up update and review of progress was completed in 2013. Heading these efforts was MWDOC.

MWDOC's purpose in studying the system reliability issues were to:

1. Identify risks, including earthquakes, that pose the greatest threat to the regional water treatment and distribution infrastructure that serves the project area
2. Identify ways to bolster source-of-supply and regional distribution systems, building on earlier engineering investigations and studies
3. Develop a list of projects that accomplish the above objectives, and identify appropriate investments
4. Allow for flexibility in phasing. Most notably project operational dates and sizing should be flexible to account for changes in local resource development through construction of LRPs.
5. Develop and implement projects to improve system reliability. The planning work took into consideration a number of prior studies, including: SOCWRS Phase 1, which served as the foundation for this effort; MET's Central Pool Augmentation Project; SMWD's Lined and Covered Reservoir investigations to increase local storage for emergency needs; IRWD's Water Resources Master Plan Update and Planning Area-6 Sub-Area Master Plan; and various OCWD plans and groundwater basin operations studies.

[61] Metropolitan Water District of Southern California Integrated Water Resources Plan 2015 Update http://www.mwdh2o.com/Reports/2.4.1_Integrated_Resources_Plan.pdf Update 8/23/2016.

The 2013 update and review documented progress in improving system reliability and reaffirmed certain conclusions regarding these issues:

- The South OC area is about 90% dependent on imported water for drinking water supply, and this dependence will continue into the future.
- Orange County will always be dependent to a large extent on supplies from the SWP and the Colorado River Aqueduct. Supplies from the SWP carry great uncertainty and dependence in SOC is higher than the rest of Orange County.
- Fixing the Bay-Delta is part of MET's IRP and will improve water source reliability but is a distant and expensive prospect.
- Imported sources of water from MET are continually under attack, although the MET IRP says that they are fully reliable out to 2035 due to a number of factors.
- Earthquakes pose a major hazard to the vital water conveyance facilities that deliver water to Orange County from hundreds of miles away.
- The South OC area in particular, can develop local water reliability projects while the Bay-Delta fix is in process.
- South OC area agencies have a variety of reliability goals.

One of the goals of the South Orange County IRWM Plan is for all of the South Orange County agencies to work together to make the necessary investments in order to mitigate or minimize impacts from water supply disruption events. Development of local supply sources, regional interconnections and lined and covered reservoir storage will help to protect the South Orange County system. Water transfers from outside of the WMA will also be beneficial for adding a layer of insurance with respect to future droughts on the State Water Project or Colorado River system.

MWDOC conducted an extensive County-wide Orange County Water Reliability Study[62] completed in December 2016 that provided a comprehensive assessment of Orange County's long term water reliability; considerations were made for reliability of imported and local supplies, population growth, water demands and conservation efforts, climate variability and development of local projects.  The study provides a 25-year projection through 2040, and noted the following for South Orange County:

- South Orange County reliability depends on local and regional investments, without which projected shortages through 2020 appear manageable only if conservation efforts continue on the part of consumers;
- Under the recommended planning scenario in the study and without new local investments in supply, shortages will worsen by 2030 and further by 2040;
- In the event of a seismic or other catastrophic outage, South Orange County will need more designated local or emergency supplies to meet a 60-day minimum demand;

[62] Orange County Water Reliability Study Executive Report (2016)

- South Orange County should develop an investment strategy aimed at the recommendations of the study and use adaptive management methods to adjust for state-wide actions or events.

The IRWM Group considers the findings of the OC Water Reliability Study through project planning and selection at the individual agency and WMA scales.

### 3.7.2.3 Water Conservation

Responsible water management must include water conservation and water use efficiency. MET defines water conservation as 'a reduction in water loss, waste, or use while still maintaining the benefits of use. Water use efficiency means that water-related tasks are accomplished with less potable water. This may be accomplished through conservation, recycled water, or other ways of extending water supplies, such as use of graywater and rainwater'.[63] This is contrasted with water conservation resulting from short-term rationing, which does not guarantee similar long-term benefits or utility. The MET IRP water use efficiency target includes conservation and recycling.

Currently, MWDOC has one of the best water efficiency programs in the country. Its program includes water use efficiency education, rebate programs for installation of hardware such as low flow toilets and shower heads, and multiple benefit landscape irrigation programs to reduce runoff and prevent pollution which are designed to maximize commercial, residential, and governmental water use efficiency. MWDOC also provides technical assistance on water use efficiency matters to all area water agencies.

***Water Use Efficiency Programming in South Orange County***

In 2006, the State legislature enacted AB1881 which requires local agencies to adopt the State Model Water Efficient Landscape Ordinance or a local ordinance that is at least effective as the State Model Ordinance by December 1, 2015. Guiding principles of the Local Ordinance are to:

1. Protect local control and mitigate the creation of increased layers of government and oversight.
2. Ensure as much simplicity, efficiency, and flexibility as possible.
3. Provide for as much consistency among County cities as possible.
4. Minimize the complexity and cost of compliance.

In 2015, the Orange County Model Water Efficient Landscape Ordinance was developed and adopted. Participants included: Orange County Division League of Cities Members, City Council Members, City and County Planners, Water Agency Directors and Staff, Building Industry Association, City Attorneys, Orange County Fire Authority and City Fire Departments, Parks and Recreation, and Green Industry.

SBx7-7, The Water Conservation Bill of 2009, was signed into law on February 3, 2010, as part of a comprehensive water legislation package. The bill sets a goal of achieving a 20 percent

[63] Metropolitan Water District of Southern California, Long-Term Conservation Plan, page 13, July 2011.

statewide reduction in urban per capita water use, and directs urban retail water suppliers to develop targets to meet a 20 percent reduction in per capita water use by 2020, and an interim 10 percent reduction by 2015. Water suppliers receive partial credit for past efforts in conservation and deductions for recycled water. As a result, not all agencies need to reduce demand by 20 percent in order to comply with the legislation.

As a wholesaler, MWDOC is committed to developing and implementing regional WUE and water conservation programs on behalf of its retail water agencies and their customers. This regional approach enables economies of scale, ensures a consistent message to the public, and assists in the acquisition of grant funding for program implementation.

To facilitate the implementation of BMPs throughout Orange County, MWDOC focuses its effort on the following three areas[64]:

- Regional Program Implementation: MWDOC develops, obtains funding for, and implements regional BMP programs on behalf of all retail water agencies in its service area.
- Local Program Assistance: Upon request, MWDOC assists retail agencies in developing and implementing local programs within their individual service areas. MWDOC provides assistance with a variety of local programs including, but not limited to: Home Water Surveys, Landscape Workshops (residential and commercial), Public Information, School Education, Conservation Pricing, and Water Waste Prohibitions.
- Research and Evaluation: An integral component of any WUE program is the research and evaluation of potential and existing programs. In the past five years, MWDOC has conducted research that allows agencies to measure the water-savings benefits of a specific program and then compare those benefits to the costs of implementing the program. This cost/benefit analysis enables individual agencies to evaluate the economic feasibility of a program prior to its implementation.

Additionally, MWDOC's WUE Department provides programs to assist residential homeowners, commercial/industrial business owners, and professional landscapers to reduce daily water consumption. Several programs are administered by the WUE Department to assist in the effort of saving water, including the rebate programs for the following: High Efficiency Clothes Washer (HECW), High Efficiency Toilet (HET), Ultra Low Flush Toilet (ULF), SmarTimer, Rotating Nozzles, Turf Removal, and Water Smart Landscape (WSL). MWDOC created a user-friendly website[65] in 2014 for residents and businesses to learn more about potential rebate and resources. A few examples of Water Use Efficiency successes: As of May 2017, over 423,000 High Efficiency and Ultra Low Flush Toilet rebates have been processed, totaling over $31

[64] Municipal Water District of Orange County. 2015 Regional Urban Water Management Plan. May 2016.

[65] http://www.ocwatersmart.com/

million. Approximately 112,000 High Efficiency Clothes Washers have been rebated, totaling over $8 million[66].

MWDOC's Residential Runoff Reduction Study and the SmarTimer and Edgescape Evaluation Study (SEEP, 2007) have both demonstrated water conservation and water quality benefits, including an 18 percent reduction in residential and 22 percent reduction in commercial landscape water use. Studies have also shown reductions in both dry-weather runoff volume and non-point source pollutants entering local creeks. The Residential Runoff Reduction Study quantified a 50 percent reduction in dry-weather runoff and non-point source pollutants with a ten percent penetration of landscape improvements. Follow-up studies, five years post installation, verified that water savings have remained persistent.

Individual water districts in the IRWM Group implement agency-specific water use efficiency and conservation programs as well. For example, SCWD's Targeted Water Conservation Program selected for funding by the IRWM Group in Proposition 84 – Round 2 focused on the largest water users (largest demand) within their service area to offer targeted rebates. The project built upon, expanded and complemented WUE programs offered by MWDOC.

***IRWM Grant Funding for Water Use Efficiency Programs***

MWDOC received funding under the Proposition 50 IRWM Grant Program for its WUE Program Expansion. This program is currently being implemented and will significantly contribute to water conservation in the South Orange County WMA by enhancing the existing rebate program for water conservation practices to the level of standard implementation for all single-family homes and commercial landscapes, and would further improve overall watershed and coastline ecosystem health.

MWDOC's South Orange County WSL Project was implemented by this IRWM Plan through Proposition 84 – Round 1. The project involved a rebate-based format to facilitate the installation of up to 960 residential smart irrigation timers, 1,104 commercial smart irrigation timers, 37,200 high efficiency irrigation rotating spray heads, resulting in the reduction of up to 300,000 square feet of high-water-using plant material with low-water-using 'California Friendly' plant material. MWDOC also received Proposition 84- Round 2 funding for its Comprehensive Landscape Water Use Efficiency Project and Proposition 84 -2015 Strategic Turfgrass Removal & Design Assistance Program. Both programs implemented water conservation and water use efficiency measures throughout their service area in South OC WMA. The Comprehensive Landscape Water Use Efficiency Project continues through implementation of Phase II with funding support from the US Bureau of Reclamation.

#### 3.7.2.4 Recycled Water

Water recycling has long been regarded as a cost-effective water supply alternative in South Orange County. Recycled water in the County is used to irrigate nursery crops, golf courses, parks, schools, business landscapes, residential lawns, and is also used for some industrial uses.

[66] Orange County Water Use Efficiency Program Savings and Implementation Report 5/30/2017. Available as part of the monthly MWDOC Planning & Operations Committee Agenda packet - http://mwdoc.com/agendas_2017.php#2

Local water recycling projects involve the collection of wastewater being discharged within the service area, treating that water to applicable standards for specific uses, and substituting the recycled water for existing or future potable water demands. The local agencies have pursued regionalization of the recycled systems to increase the use of recycled water and increase reliability.

***Recycled Water Studies & Plans***

The Bureau of Reclamation, in cooperation with eight state and local agencies, participated in the Southern California Comprehensive Water Reclamation and Reuse Study (SCCWRRS) from 1992 through 1999 (finalized in 2002). This study evaluated the feasibility of creating a long-range strategy for more effective development of water reuse programs in southern California's coastal and inland valley areas. The study covered a six county area and included over 7,300 demand points and all wastewater supplies in its databases. This data is being used to explore options to link available reclaimed water supplies with various demand points throughout southern California.

The SCCWRRS analyzed 15 geographical areas for short term project implementation, two of which were located in South Orange County. The Upper Oso short term implementation plan, as described by the study, indicates a need for regional agencies to continue to expand and connect the recycled water distribution systems as a collaborative effort. These agencies would include SMWD, ETWD, MNWD, and SOCWA. Sensitivity analyses for the Upper Oso region demonstrated that this implementation plan would result in robust benefits remaining positive across a wide range of assumptions for estimated project costs or the avoided wastewater and water supply costs. The second region identified in the study was the San Juan region, which includes the recycled water systems of the cities of San Clemente, San Juan Capistrano, the SMWD and the SOCWA. This region is also recommended to expand and connect the recycled water systems of the area to create a more reliable water supply.

The SCCWRRS also identified a long term strategy for the County. The long term analysis for the County consisted of increasing reuse at six of the wastewater treatment facilities and one of the reservoirs in the area. This increased flow is expected to satisfy approximately 52,500 AFY of new demand by 2040. This goal is being used as a guideline for implementation of the local long-term strategy described in the report to establish connections between the seven treatment facilities and reservoirs located in South Orange County to create one regional system.

From the SCCWRRS study emerged the 2004 South Orange County Water Reliability Study and its subsequent update in 2013. More details about these studies can be found in **Section 3.7.2.2.** These plans focused on water supply reliability for South Orange County and encouraged the expansion of recycled water supply, storage, and distribution to improve water reliability, offering recommendations to improve off system supply in case of extended outages.

MWDOC[67] and the IRWM Group water agencies[68] produced the 2015 Urban Water Management Plans that discuss recycled water usage within South Orange County service areas, current recycled water uses and potential recycled water uses in the region. Section 6.5 of the UWMP provides details about recycled water use optimization plans to facilitate further production and use of recycled water among and between its retail agencies and MET.

***Recycled Water Projects in the IRWM Plan***

The Project List included in **APPENDIX F** identifies several recycled water projects proposed and completed by this IRWM Plan. A list of completed projects is included below.

- San Juan Capistrano Recycled Water System: provides up to 2,900 acre feet of reclaimed water per year. The project uses water treated at the J.B. Latham Treatment Plant to meet the demand for non-potable water in the City.
- San Clemente Recycled Water Expansion Project: expanded San Clemente's reclaimed water infrastructure by doubling its production capacity. The Recycled Water Expansion project, which was completed in Fall 2014, extends pipelines and access to recycled water to over 150 new recycled water services throughout San Clemente and expand the customer base. The $25.1 million project more than doubled the amount of tertiary treated recycled water produced at the City's WRP from 2.2 to 5 MGD and construction of 9 miles of pipelines, 2 MG reservoir conversion, new 0.2 MG potable water reservoir, and new pressure reducing station.
- ETWD's Recycled Water System Expansion Project – The District is expanding its existing Water Recycling Plant to increase the treatment and delivery of recycled water from 500 acre feet to up to 1,400 acre feet per year. Simultaneously, the District is building a new recycled water distribution system. Approximately 100,000 feet or 19 miles of recycled water pipeline is being constructed beneath the roadways in portions of Laguna Woods and the northwest portion of Laguna Hills. This new distribution system is completely separate from the drinking water distribution system and used for irrigation only.
- SMWD's Califia Recycled Water Project - The District will build a new recycled water distribution system for irrigation in the Califia area. Approximately 23,000 feet (4½ miles) of recycled water pipeline ("purple pipe") will be constructed beneath the roadways. This new distribution system will be completely separate from the drinking water distribution system and used for irrigation only. The District will increase the delivery of recycled water for irrigation by approximately 72 million gallons per year.

  SCWD's Recycled Water Extension Project - Construct laterals to serve five existing potable use sites with 150 AFY from SCWD's recycled water system. Project will help alleviate drought impacts and assist local public agencies to meet long-term water supply needs, protection of water quality, and augment/restore environmental conditions.

[67] MWDOC 2015 Urban Water Management Plan (UWMP)

[68] SMWD 2015 UWMP, SCWD UWMP, TCWD UWMP, IRWD UWMP, LBCWD UWMP, MNWD UWMP

- MNWD's Recycled Water Extension Project - Convert approximately 32 irrigation meters from domestic water service to recycled water service to deliver ~102 AF recycled water for irrigation. Project will help alleviate drought impacts and assist local public agencies to meet long-term water supply needs, protection of water quality, and augment/restore environmental conditions.
- 3A Water Recycling Plant Tertiary Expansion - The 3A Water Reclamation Plant (WRP) is jointly owned by SMWD and MNWD and has been operated by SMWD since July 1, 2015. Wastewater diverted from the Oso Trunk Sewer is treated at 3A WRP to Title 22 tertiary levels prior to beneficial reuse in the MNWD and SMWD's recycled water systems. Flows exceeding the 2.4 MGD plant tertiary capacity bypass 3A and flow to the J.B. Latham Treatment Plant. Solids are treated onsite. The plant has secondary treatment capacity of 6 MGD. The current tertiary treatment capacity is 2.4 MGD. SMWD is currently in design for the expansion of the tertiary treatment capacity to 6 MGD.
- SCWD's Recycled Water Distribution Upgrade - The Project will replace an existing 6,600 feet section of 10-inch recycled distribution system supply main with a 16-inch main to eliminate a hydraulic bottleneck. A new pipeline will eliminate an existing hydraulic bottleneck and increase capacity by up to 530 gallons per minute (gpm), or approximately 850 acre-feet per year (AFY).

#### 3.7.2.5 Recycled Water Quality

Recycled water processes in the WMA are designed and operated in accordance with the requirements of Title 22 of the California Administrative Code (Water Reclamation Criteria) to treat the water to the appropriate level for the intended final use.

Agencies monitor for the amount of salts in the water (especially chlorides) to ensure continued use and efficiency of recycled water production. Salts are a natural byproduct of the reclamation process based on the salinity of the potable water. Normal wastewater treatment processes do not remove the salts. Elevated salt levels in recycled water are not deleterious to human health considerations. However, elevated salt levels (chlorides above 125 mg/l) may be harmful to certain plant materials commonly found in South Orange County, notably citrus trees, avocados, and certain turf grasses. The effects of recycled water with higher levels of salts can be mitigated through a variety of means, including: periodic flushing of soil with rain or the application of potable water, proper soil preparation to promote adequate drainage, and utilization of plant materials more tolerant of salt buildup.

Higher levels of salt content can affect the formation of disinfection byproducts. These higher levels of salt present in the potable water will also contribute to higher levels of residual salts in sewage and in the recycled water after treatment. Increased salinity in recycled water tends to be higher in areas where specific commercial or industrial processes add brines or where use of water softeners that add salt to the discharge stream or where brackish groundwater infiltrates into the sewer system. In addition, concern for the water quality in groundwater basins may lead to restrictions on the application of recycled water on lands overlying those basins.

These issues are exacerbated during times of drought, when the salinity of imported water supplies may increase, causing increased salinity in wastewater flows and recycled water. Basin management plans and recycled water customers may restrict the use of recycled water at a time when its use would be most valuable if it were of sufficient quality. For effective use of recycled water projects, therefore, it is important to control the salinity level of the Region's potable water sources and wastewater flows.

#### 3.7.2.6 Groundwater Management

With the South Orange County WMA's dependence on imported water to meet water demands, the need for local storage intensifies. One of the most effective forms of storage in a dry and arid climate is conjunctive use, wherein water is stored underground during wet periods and pumped out during dry or drought periods. Limitations to such storage include available resources such as basin storage capacity, pumping capacity, recharge capacity, water quality and institutional constraints. Despite these challenges, conjunctive use storage is a far less expensive and non-intrusive alternative to surface water storage.

The total calculated storage capacity of the San Juan Creek Groundwater Basin is estimated to be 41,400 acre feet[69]. Some of the storage capacity cannot be used because of potential sea water intrusion, environmental reasons, and poor water quality. The San Juan Basin is a shallow basin that has been categorized as an underground flowing stream which also limits storage capabilities.

Groundwater supplies are highly desirable in terms of water quality, cost, utilization of local energy resources, and they also contribute to the WMA being less dependent on imported water supplies. However, they are subject to interruption during drought conditions and, therefore projects dedicated to recharge efforts and groundwater quality measures are of particular significance to the regional water supply. The groundwater within the lower San Juan Basin generally requires treatment for potable use.

***Groundwater IRWM Plan Projects & Future Planning***

The San Juan Basin Desalter Project was initiated by the City of San Juan Capistrano and the SJBA. The desalter project is located in the City of San Juan Capistrano and provides up to 5.14 MGD of brackish groundwater treatment, although the actual annual treatment typically has been lower due to a variety of issues such as availability of water and treatment process capacity and capability. Additional details on the San Juan Basin Desalter Project may be found in **Section 3.3.4.2**. The San Juan Basin Groundwater Management and Facility Plan is included as **APPENDIX I**.

Additionally, the SJBA completed a San Juan Basin Groundwater and Desalination Optimization Program report in March 2016[70] detailing efforts to develop and expand groundwater production facilities. Key findings from the report address feasibility of recycled water recharge,

[69] 2016 Adaptive Pumping Management Plan - Spring 2016 Analysis of Storage in the San Juan Groundwater Basin by WEI.

[70] SJBA San Juan Basin Groundwater and Desalination Optimization Program Final Report

utilization of rubber dams for stormwater capture, and to promote groundwater recharge of recycled water during dry weather, incidental recharge of recycled water and recycled water treatment modifications.

### 3.7.2.7 Water Quality Management

Orange County's potable water supply consistently meets and exceeds federal and state water quality standards. The quality reflects a high standard of service among the water retailers in the county. Although surface waters in South Orange County watersheds are rarely used as sources of potable or non-potable water due to infiltration constraints, it is imperative the quality of local receiving waters and underlying groundwater basins are protected for the sake of preserving these critical resources.

The quality of surface water within the South Orange County watersheds is a significant contributor to the regional ecosystem. Pollutant loads in the watersheds resulting from surface runoff jeopardize the stability of native species, contribute to human health risks, and reduce the potential for potable and non-potable water usage. As runoff flows over urban areas, it can convey harmful pollutants such as pathogens, sediment, fertilizers, pesticides, heavy metals, and petroleum products. These pollutants often become dissolved or suspended in surface runoff and are conveyed and discharged to receiving waters such as streams, lakes, lagoons, bays and the ocean. The general status of surface water quality within the six watersheds of the SOC WMA is summarized in **Section 3.3.1**, and the associated municipal discharge permitting and planning taking place across the SOC WMA is summarized in **Section 3.3.4**.

Addressing these concerns requires a cooperative approach, education and outreach, strategic implementation of water quality improvement projects which achieve multiple benefits, and monitoring and assessing progress.

***Cooperative Approach***

The County of Orange, the cities within Orange County, and the OCFCD have cooperatively developed and implemented a comprehensive DAMP to reduce the discharge of pollutants, enhance receiving water quality, educate the public, and monitor progress. The DAMP is described in detail in **Section 3.3.4.** These same agencies recently developed a WQIP for South Orange County which, a) identifies the HPWQCs within the South Orange County WMA, b) specifies goals, strategies, and a schedule for addressing the HPWQCs, and c) defines a monitoring and assessment program that can be used to measure and demonstrate progress or improvements toward addressing the high priority water quality conditions. All of these agencies also work collaboratively to identify potential water supply augmentation projects based upon local water resource priorities and available resources. Through the framework, goals and objectives of individual plans, the County and associated stakeholders are able to prioritize a subset of projects which meet both water quality and IRWM priorities.

Projects identified through jurisdictional and collaborative efforts to comply with NPDES, TMDL and IRWM regulations and regional goals comprise the majority of prioritized projects. With regards to the WQIP, Permittees in South Orange County will identify potential projects that may improve water quality in storm drain discharges and/or receiving waters. Projects may include structural and nonstructural BMPs, utility retrofits, and stream restoration projects.

Projects will be identified and generally selected based on their ability to achieve the numeric goals and timelines specified by the WQIP, but their prioritization will also consider whether or not they provide multiple benefits to the SOC WMA. For example, prioritizing projects which address unnatural water balance, as highlighted in the WQIP, provides a nexus to addressing areas with excessive urban runoff and water usage. Additionally, the information garnered by the IRWM Group (the Permittees) through the WQIP can be utilized to prioritize projects that encourage infiltration in areas where groundwater recharge is possible. Indeed, projects that either reduce water consumption or encourage infiltration could provide dual water quality and water supply benefit for the WMA. The adaptive management approach to the WQIP allows jurisdictions the flexibility in selecting and updating strategies as needed based upon ever-changing priorities and regulatory climate.

***Education and Outreach***

Education and outreach is the foundation of the OCSP, and the WQIP highlights it as a critical non-structural BMP that will help to achieve the goals associated with HPWQCs. Changing perspectives and behaviors is not easy, especially in an area as diverse as Orange County. During the Third Term NDPES Permit, the Permittees developed and implemented an extensive public outreach campaign with brochures, PSAs, multi-outlet advertising and school-based education materials. Following on the success of the campaign as measured by public awareness surveys, the OCSP continued and built upon these efforts during the Fourth Term Permit.

Subsequent public awareness surveys and OCSP research led to a change in program structure in 2013; the Permittees maintained information campaign methods but also incorporated Community-Based Social Marketing (CBSM) techniques. The CBSM “action campaign” approach stressed behavior change techniques versus overall knowledge of issues. The action campaign topic selected for targeted behavior change was “Overwatering Is Out” focused on modifying behavior of Orange County residents to reduce runoff by adopting runoff reduction and water use efficiency BMPs. The Permittees track progress through resident commitments to reduce outdoor water usage, participation in Orange County Garden Friendly events to retrofit landscaped areas and through joint programs with MWDOC and UC Cooperative Extension.

***Water Quality Management Strategies***

To address the HPWQCs in the SOC WMA the WQIP has identified potential strategies that may result in improvements to water quality in storm drain discharges and/or receiving waters within the watershed. These potential strategies include nonstructural and structural BMPs, retrofits, and stream restoration projects, as well as those included in the Permittees’ robust jurisdictional programs (i.e., JRMPs or more commonly, Local Implementation Plans (LIPs)) that include management measures and baseline programs to reduce the discharge of pollutants in stormwater from jurisdictions’ MS4 to the maximum extent practicable.

Nonstructural BMPs considered for inclusion in the Permittees’ jurisdictional strategies to address the HPWQCs include: outreach, inspections, identification and control of sewage discharge to participating agency storm drain systems; homelessness waste management program; onsite wastewater treatment source reduction; irrigation runoff reduction and good landscaping practices; commercial, industrial, and residential good housekeeping; pet waste program; animal facilities management; WQMP implementation; street and median sweeping; storm drain cleaning; and special studies. Potential structural BMPs considered for inclusion in the Permittees' jurisdictional strategies to address the HPWQCs include watercourse rehabilitation; residential/small-scale LID incentive program; infiltration BMPs; water supply augmentation; capture and use, or rainwater harvesting; biofiltration; advanced treatment and proprietary devices; infrastructure improvement and ancillary/source control BMPs; utility retrofits; and nuisance water diversions.

The Permittees are familiar with the identification, prioritization, and implementation of non-structural and structural BMPs. For example, the Permittees have long been focused on reducing bacteria and associated pathogens and other pollutants throughout the watershed area. In addition to a comprehensive program of non-structural BMPs including, but not limited to street sweeping; creek and beach cleanups; pet waste programs; and public outreach and education efforts, appropriately sited and designed structural BMPs are also a critical component. Structural BMPs implemented within the WMA include, but are not limited to dry weather runoff diversion structures; storm drain inlet filters; trash separation units; active treatment facilities such as Dana Point Salt Creek Ozone Treatment Facility and the Poche Beach dry weather filtration/UV treatment system; and passive, biological treatment systems such as constructed wetlands (e.g., the Dairy Fork Wetland project). As a result, long-term monitoring of bacterial indicators shows that exceedances of regulatory standards are low and have been dropping over time and that the annual percentage of Heal the Bay report card grades of A has been between 93 percent and 97 percent since 2005. As described in the WQIP, focus has shifted to address human pathogens, including conducting sanitary surveys to ensure integrity of sanitary sewer infrastructure.

To address another high priority condition of concern identified in the WQIP, unnatural flow balance, as well as address water use efficiency, agencies use and promote SmarTimer and other similar irrigation controllers. These "smart" devices receive information regarding the climate and adjust the timing of irrigation controllers automatically, so the appropriate amount of water is applied to landscaping. These devices reduce water waste, but also result in less irrigation runoff that can transport sediments and pollutants into downstream receiving waters. MWDOC's SmarTimer Rebate Program promotes the use of these devices. Due to the success of SmarTimer and rebate programs, other high efficient landscape irrigation system components, such as nozzles and drip systems, as well as water–efficient landscape design concepts are also being promoted and implemented.

Although the Permittees have achieved great success at times, there are more opportunities for synergy among agencies and water resource programs relative to the selection, siting, and prioritization of projects. For example, OCSP recently completed a county-wide GIS review of hydromodification susceptibility and infiltration feasibility to identify regional opportunities for infiltration. In addition to identifying potential publicly owned and/or open space sites ideal for intercepting and treating runoff, the WIHMP maps also provided an initial screening tool for where infiltration is likely to be infeasible. County-wide, the WIHMP mapping is particularly suited to identifying areas where water infiltration and recharge projects are feasible, acting as guidance to project proponents and developers to identify these locations. The WIHMPs also work in tandem with the WQMP and TGD, which require project proponents to address source control; mapping tools assist identification of BMP locations ideal for infiltration.

***Monitoring and Assessing Progress***

An essential component of managing water quality across the region includes monitoring and assessing the progress of local and regional water quality improvement programs, projects, and activities. The WQIP contains a monitoring and assessment program which describes the strategies and methods that Permittees will use to monitor and assess the progress toward numeric goals and schedules, as well as to monitor the conditions of receiving waters and discharges from the MS4 under wet and dry weather conditions. The monitoring and assessment program adheres to the prescriptive monitoring and assessment requirements of the MS4 NPDES Permit, including specific monitoring and assessment provisions pertinent to the Baby Beach TMDL and the Twenty Beaches and Creeks TMDL. Monitoring and assessment will be performed in all six subwatersheds of the San Juan Hydrologic Unit, which are described in **Section 3.3.1**

The Monitoring Program includes five major elements:

1. The *High Priority Water Quality Condition Monitoring Program* will monitor the effectiveness of strategies, and progress towards goals and schedules associated with the HPWQCs, summarized in Section 3 of this WQIP;
2. The *Receiving Water Monitoring Program* is intended to measure the long-term health of the watersheds;
3. The *MS4 Outfall Monitoring Program* will monitor the discharges from the MS4 outfalls in order to assess the effectiveness of Permittee JRMPs at prohibiting non-storm water discharges into the MS4 and reducing pollutants in storm water discharges;
4. The *TMDL Monitoring Program* will monitor progress toward achieving compliance with interim and final numeric targets specified in the Baby Beach TMDL and the Twenty Beaches and Creeks TMDL; and
5. *Special Studies* will address pollutant and/or stressor data gaps and/or develop information necessary to more effectively address the pollutants and/or stressors that cause or contribute to the HPWQCs presented in Section 2 of the WQIP.

The Assessment Program includes both annual assessments and an integrated assessment. Annually, the Permittees will evaluate data collected as part of the aforementioned monitoring programs and special studies and information collected during the implementation of the jurisdictional runoff management programs in order to assess the progress of water quality improvement strategies. At the end of the Permit term, an integrated assessment will be performed by the Permittees. The integrated assessment will combine all previously performed assessments along with regional monitoring results and studies so that WQIP effectiveness and modifications can be considered. Integrated assessments will likely be a component of future ROWDs submitted to the SDRWQCB.

Monitoring and assessment program data will be made available via a Regional Clearinghouse administered by the Permittees. Pertinent data will also be uploaded to the California Environmental Data Exchange Network (CEDEN). Data management and dissemination is further discussed in **Section 7.2**. Updates to the monitoring and assessment program are anticipated for a variety of reasons including, but not limited to new priority water quality conditions and HPWQCs, anticipated changes to water quality objectives, and new monitoring and assessments methods and tools.

#### 3.7.2.8 Flood Management: Orange County Flood Control District

OCFCD through OC Public Works (OCPW) provides for the planning, development, operation and maintenance of OCFCD facilities within all of Orange County and for roadways within the unincorporated area of the County. OCPW staff establishes and updates the seven-year Flood Control CIP and Maintenance Improvement Projects (MIPs) annually to plan and secure funding for future flood protection construction projects. OCPW/Flood Programs staff heads the City Engineers Flood Control Advisory Committee (CEFCAC), composed of City Engineers representing cities within each of the County's five supervisorial districts. The committee meets annually to identify and prioritize construction projects to be included in the seven-year Flood Control CIP.

OC Flood establishes and accomplishes flood risk management goals through an integrated process, including: conducting feasibility, hydraulic, deficiency, floodplain and value-engineering studies, collecting and analyzing data on an on-going basis, and implementing the design and construction of projects. They also respond to citizen concerns, flood emergencies and conduct annual planned maintenance of flood control facilities. Additionally, they are responsible for reviewing development proposals in the unincorporated Orange County areas and providing construction inspection services for developer's flood control related construction projects.

Orange County (administered by OCPW) has been a participant in the National Flood Insurance Program (NFIP) since 1979. As a participant, Orange County has been eligible to be a part of the Community Rating System (CRS) program in which it completes various flood mitigation related activities every year to maintain its certification. Activities include community outreach, map information services, drainage system maintenance and others.

***Hydromodification Controls***

Hydromodification refers to changes in the magnitude and frequency of stream flows and its associated sediment load due to urbanization or other changes in the watershed land use and hydrology and the resulting impacts on receiving channels, such as erosion, sedimentation, and potentially degradation of in-stream habitat. Urbanization increases the discharge rate, amount and timing of runoff, and associated shear stress exerted on a channel by stream flows and can trigger erosion in the form of incision (channel downcutting), widening (bank erosion), or both. Where receiving stream channels are already unstable, hydromodification management can remediate or avoid exacerbating existing problems. Where receiving stream channels are in a state of dynamic equilibrium, hydromodification management may prevent the onset of erosion, sedimentation, lateral bank migration, or impacts to in-stream vegetation.

As documented within the WQIP, adverse hydromodification can affect the ability of the Permittees to effectively protect and restore the beneficial uses of receiving waters throughout the WMA. More specifically, unnatural stream form (i.e., less complexity, higher velocities, and deeper flow) will impair physical habitat, which will lower biological integrity of the stream and subsequently create aesthetic and safety issues. These issues are directly linked to the objectives associated with recreational beneficial uses. Therefore, channel erosion and associated geomorphic impacts was highlighted within the WQIP as a HPWQC.

The WQIP defines a variety of strategies for preventing future hydromodification, as well as identifying and rehabilitating existing hydromodification. With regards to rehabilitating existing hydromodification, the WQIP proposes 23,000 linear feet of rehabilitation of geomorphically unstable channels within urbanized corridors and publicly owned right-of-ways using a multi-benefit rehabilitation approach, where feasible. A key element of rehabilitation will be evaluating upstream opportunities to implement flow control. Where opportunities present, either through new facilities or retrofit of existing facilities, implementing additional upstream flow control to mitigate downstream stream energy may be a key element to allowing rehabilitation to proceed in a less “hardened” manner, i.e., more closely aligned with a geomorphically-referenced basis of design. To prevent exacerbation of existing problems and future hydromodification, the Permittees will implement the South Orange County Hydromodification Management Plan (HMP). The HMP is a primary strategy within the WQIP for controlling new impacts to streams receiving runoff from new development, and will tend to result in improvement in hydrologic conditions in existing developed areas experiencing redevelopment.

The SOC HMP was developed in 2011 pursuant to requirements of the Fourth Term MS4 NPDES Permit (Order R9-2009-0002) and updated in 2015 to comply with the Fifth Term MS4 NPDES Permit. The HMP is intended to help Permittees and development project proponents manage increases in runoff discharge rates and durations from all Priority Development Projects. Priority Development Projects include development that creates new impervious surface and significant redevelopment that adds or replaces 5,000 or more square feet of impervious area on an already developed site. To achieve this goal, the HMP contains a performance standard including a geomorphically significant flow range that ensures the geomorphic stability within the channel. Supporting analyses were based on continuous hydrologic simulation modeling, and the loss of sediment supply due to development was considered.

To aid project proponents with selecting and sizing hydromodification controls[71] the Permittees created a South Orange County Hydrology Model. In addition, a Model WQMP has been developed to aid the Permittees and development project proponents prepare a project WQMP. A project WQMP is a plan for minimizing the adverse effects of urbanization on site hydrology, runoff flow rates and pollutant loads.

[71] County of Orange. South Orange County Hydromodification Management Plan, April December 20115. Available online 3/29/13.

#### 3.7.2.9 Wastewater System: South Orange County Wastewater Authority

Through a consolidation of its governance structure, the SOCWA was created on July 1, 2001 as a Joint Powers Authority and the legal successor to the Aliso Water Management Organization (March 1972), South East Regional Reclamation Authority (March 1970) and South Orange County Reclamation Authority (1991). The principal operating revenues of the SOCWA are charges to the member agencies for services. SOCWA facilities are discussed in more detail in **Section 3.3.7**.

The mission of SOCWA is to collect, treat, beneficially reuse, and dispose of wastewater in an effective and economical manner that respects the environment, maintains the public's health and meets or exceeds all local, state and federal regulations. Collected wastewater receives full secondary treatment at one of the organization’s four wastewater facilities, and the organization also has active water recycling, industrial waste (pretreatment), biosolids management and ocean/shoreline monitoring programs to meet the needs of its members and the requirements of the applicable regulatory permits.

### 3.7.3 Competing Interests of IRWM Group

In developing the objectives further described in **Section 4**, the South Orange County IRWM Group have considered long-term regional planning conflicts and issues, such as identification of enhanced local water supplies to offset reduction of imported water to meet demands during times of drought. Though many projects are planned over the next 10 to 20 years to help achieve this goal, much more long-term planning, as well as implementation of integrated projects in all categories included in this IRWM Plan, is necessary to reach that goal.

As mentioned in **Section 2.8.4**, the IRWM Group has major water-related issues and conflicts related to water supply, water system reliability, water conservation, recycled water, groundwater management, water quality management, flood management, the wastewater management, and climate change. The IRWM Group considered these conflicts as well as the Water Quality Control Plan of the Basin Plan Objectives, the SBX7-7 Water efficiency goals, and IRWM Planning Standards.

***Groundwater Recharge, Potable Use & Surface Water Resources***

Competing interests arise with South Orange County’s effort to use and/or enhance its local groundwater resources. South Orange County has implemented several water resource projects to maximize the use of the San Juan valley groundwater basins as a potable water supply. Conflicting interests for those water resources include flood management, dry weather runoff management, natural resource preservation and land use policies. The groundwater resource could be enhanced by groundwater recharge projects; however, these competing interests must be considered.

San Juan Valley Groundwater Basin recharge consists of streambed percolation from the mainstream San Juan and Arroyo Trabuco Creeks, rainfall infiltration and subsequent deep percolation to the water table, deep percolation of applied water from landscape and agricultural irrigation, and subsurface inflow from the tributary alluvial stream areas. Since the San Juan Valley Groundwater Basin are very shallow basins, little or no treatment takes place in the soil profile before percolating surface runoff from retention/percolation facilities reaches the groundwater. Therefore, infiltration of surface runoff must be carefully considered prior to placement near shallow basins to ensure adequate retention/percolation time for treatment. As a result, regulatory-driven BMPs to treat MS4 discharges through infiltration must be carefully considered in some areas.

Natural resource and habitat preservation conflict with the potable use of groundwater by encouraging the planting and reestablishing of habitat. Deeply rooted, water table tapping, phreatophyte water use can account for as much as 25 percent of the yield of the groundwater basin during the summer months. Additionally, other projects encourage the re-establishment of fish populations. It remains to be seen how much this will reduce the amount of groundwater extractions available for potable water use.

Historical land use practices have conflicted with water resource use; portions of the San Juan Basins have been contaminated by gas stations and dry cleaners leakage or spills. Also, there are still agricultural land uses within the San Juan Creek watershed, including citrus, field crops, and livestock (horse stables). Much has been done to eliminate contamination from runoff from these activities but they still may contribute salts to the groundwater basins.

***Resolution of Water Use Conflicts – Projects & Implementation Strategies***

This IRWM Plan includes implementation strategies and projects that assist resolution to water-relates conflict within the region. The intent of implementing this IRWM Plan is to address regional conflicts and provide resolution.

Implemented projects include:

- The City of Laguna Beach's Rockledge Ocean Protection Project replaced the City's aging sewer collection system in the Rockledge neighborhood to protect residents and adjacent Laguna Beach State Marine Conservation Area (SMCA). The SMCA includes tidepools that are a complete "no take" zone. Completion of this project in 2015 provided resolution to potential conflicting wastewater and surface water quality priorities for the area and provides protection of local residents, beach goers, and water quality standards set forth by the Basin Plan. This project protects the SMCA and assists the South Orange County WMA in meeting state water quality objectives.
- The TCWD Shadow Rock Detention Basin Project Facility Urban Water Recovery Project addressed conflicts related to enhancing local water supplies to offset imported water supplies, meeting water quality requirements, and increasing recycled water. The Project captured low-flow runoff for reuse, thereby creating a less vector-prone site, increasing nutrient removal, assisting in meeting the NPDES permit requirements, and adding to the recycled water supply shared with SMWD. In addition, conflict over flood control was addressed by the Project, as the existing Shadow Rock Detention Facility Basin has long served to provide flood control and temporary storage of wet weather flows, thus mitigating the impact of storm events to the City of Rancho Santa Margarita's existing storm drain system.

## *3.8 Potential Climate Change Impacts to WMA*

Changing climate is expected to shift precipitation patterns and result in sea level rise (SLR), impacting water resources and ecosystems. The areas of concern for California include the reduction in the Sierra Nevada and Rocky Mountain snowpack, increased intensity and frequency of extreme weather events, and SLR leading to increased risk of coastal flooding and levee failure in the Sacramento-San Joaquin Delta, a major source of water supply to the planning region. Changes in global climate can affect average temperature, evaporation, and the amount, frequency, and intensity of precipitation in southern California, as well as sea temperature and level of the Pacific Ocean. The following discussion provides an overview of the Climate Change Impacts on the WMA. Refer to **Section 12** for a more detailed discussion and to **APPENDIX J** for a more extended discussion on climate change impacts specific to the South Orange County region, and to the region that provides the majority of its water (the Sacramento-San Joaquin Delta and the Colorado River basin).

Changes in hydrological conditions due to climate change most likely to affect the South Orange County WMA's water planning include:[72]

1. Sea level rise, with greater coastal erosion and potential for coastal flooding
2. Warmer temperatures leading to loss in mountain snowpack storage and snowmelt earlier in the season in the water supplying watersheds of South Orange County
3. Changes in precipitation and temperature affecting average runoff volume
4. Changes in drought persistence
5. Higher water temperatures in streams and reservoirs
6. Potential increase in in water demands for landscape use due to higher temperatures
7. Increased flood flows and flood frequencies
8. Damage to trees and increased risk of wildfire and erosion

### 3.8.1 Sea Level Rise

SLR has implications not only for coastal areas but also for the management of the Sacramento-San Joaquin Delta. The Delta region is a component of South Orange County's current water supply system. SLR may increase the potential of salt water intrusion in the Delta and will require higher freshwater outflows to sustain the present low-salinity zone standards (also known as the X2 standard in San Francisco Bay). The use of freshwater flows used for low-salinity zone maintenance may have an effect of the volume of water available for export by the State Water Project. Sea level rise, combined with winter storms, will increase the risk of levee failure and adversely affect the water quality in the Delta, particularly during extreme events. Water supply effects of sea level rise, via salt water intrusion, are also likely in some coastal aquifers, although these are not major sources of water supply in South Orange County.

[72] Adapting California's Water Management to Climate Change, November 2008, as found in California Water Plan Update 2009, Volume 4 Reference Guide.

SLR could increase coastal erosion and impact coastal infrastructure and ecological resources such as estuaries and tidal wetlands.

### 3.8.2 Changing Mountain Snowpack Runoff

Rising average temperatures throughout California and in the Colorado River drainage basin will ultimately reduce the amount of mountain snowpack as more precipitation will fall as rain instead of snow and warmer weather will cause more snowpack to melt earlier in the year. Mountain snowpack acts as natural water storage reservoir, releasing water gradually throughout the warmer periods of the year as snow melts. As a foreshadowing of future conditions, water year 2016 was an average precipitation year, but parts of the Sierras experienced what has been termed a snow drought, because of warmer conditions.[73] Reservoirs and groundwater basins that lie downstream of the mountains will likely experience inflows different from historical patterns and operational rules may need to be modified to adapt to the variability and to sustain the existing mix of streamflows and out-of-basin exports from the Delta.

### 3.8.3 Changes in Precipitation and Temperature

The effects of climate change on annual precipitation and runoff are less clear, but of great potential importance. The existing amount of surface storage on most major streams and water storage reservoir in southern California provides a fair amount of capacity to accommodate shifts in inflows for most years. However, any reduction of annual runoff volumes due to declines in precipitation or increase in ET in reservoirs or the broader watersheds would directly reduce water supplies.

### 3.8.4 Changes in Drought Persistence

Droughts differ from typical emergency events such as floods or forest fires, in that they occur slowly over a multiyear period. Drought impacts increase with the length of a drought, as carry-over supplies in reservoirs are depleted and water levels in groundwater basins decline. Droughts in the western United States are often persistent, and the recent period (2012-2016) constituted one the most severe droughts over the past millennium. The slightly warmer temperatures resulted in higher ET from the landscape and increased the severity of the drought. For example, water year 2015 was the warmest on record for California, and also coupled with one of the lowest annual rainfall quantities recorded. Between 2000-2014 record Colorado River flow reductions averaged 19.3% with approximately one-third likely due to warming. [74] See **APPENDIX J** for more details and analysis of the recent drought using models and long-term tree ring data. South Orange County's reliance on imported water from the State Water Project (aka California Aqueduct) and the Colorado River Basin makes drought awareness one of the WMA's highest concerns.

[73] http://ca.water.usgs.gov/data/drought/

[74] "The twenty-first century Colorado River hot drought and implications for the future," Bradley Udall, Johnathan Overpeck, March 24, 2017. DOI: 10.1002/2016WR019638

### 3.8.5 High Stream and Reservoir Temperatures

Higher temperatures overall will increase water temperatures throughout the system, including inflows into reservoirs, water stored within reservoirs, and water flowing downstream. Such increases will significantly affect ecosystem uses of the water system. Most species have evolved to survive within a specific temperature range. Increased water temperature can also reduce the amount of dissolved oxygen that it holds, affecting aquatic organisms. As a consequence of warmer temperatures in streams, water quality standards related to aquatic life may require greater reservoir outflows, and thus diminish the availability of stored water for other uses.

### 3.8.6 Increased Water Demands

Higher temperatures, and associated higher ET rates, are likely to also change water demands throughout the state, although this will likely be limited by available supplies. The most important effect is likely to be on agricultural water demands and landscape irrigation demands in urban areas. Statewide, average water use is roughly 50% environmental, 40% agricultural, and 10% urban.[75] Landscape irrigation accounts for about half of urban water use in California.[76]

### 3.8.7 Increased Flood Flows and Flood Frequencies

Increased intensity and frequency of major storms, another anticipated effect of climate change, would further augment flood problems in southern California. With continued increases in floodplain urbanization and the associated increase in damage potential, flooding costs from climate change could exceed those of water supply. The effects of changes in flood flows on ecosystems are less well studied but could be significant. An indirect effect of larger floods and storms could be the effect on levees in the Sacramento-San Joaquin Delta, with significant adverse effects of water quality through salinity intrusion that limits water exports for an extended time frame.

### 3.8.8 Tree Damage and Increased Wildfire and Erosion Risk

The recent drought, coupled with other actors such as pests, has significantly affected the health of forests in California, which constitute the most important watersheds throughout the state. Recent analysis of aerial imagery has shown that nearly 100 million trees may be facing mortality in the recent drought.[77] The presence of these dead trees has the potential to significantly enhance wildfire risk in the near term, and increase the risk of erosion and adverse water quality over the slightly longer term. To the degree that the recent drought is indicative of future drier and warmer conditions, it may be a significant threat to California's forests as well as its water supply.

[75] Public Policy Institute of California, http://www.ppic.org/main/publication_show.asp?i=1108

[76] California Department of Water Resources 2015 Water Efficient Landscape Ordinance website: http://www.water.ca.gov/wateruseefficiency/landscapeordinance/ accessed June 2017.

[77] http://www.fs.fed.us/news/releases/new-aerial-survey-identifies-more-100-million-dead-trees-california

### 3.8.9 Summary of Climate Change Impacts

The South Orange County IRWM Group is committed to addressing the effects of climate change on the region's water supply by incorporating climate change considerations into Resource Management Strategies (RMS). The region's water supply, flood-protection infrastructure, and aquatic habitats are affected by the amount, intensity, timing, quality, and variability of runoff and recharge, as well as on water imported from outside the region. The effects of climate change to the region and how the IRWM Group plans to address these concerns are described in more detail in **Section 12** Climate Change.

# 4 OBJECTIVES

## 4.1 Regional Vision

The South Orange County IRWM Plan focuses on the South Orange County WMA vision of total watershed efficiency. The Plan primarily builds upon the projects and plans of the member agencies, with an emphasis on water supply and water reliability. The key challenges facing the South Orange County WMA are reflected in each of the individual member agencies' responsibilities. **Figure 4-1** shows the IRWM Plan process for developing the Vision, Mission, Goals, and Objectives for the South Orange County WMA.


**Figure 4-1: IRWM Plan Process**

The regional vision was developed through a stakeholder process and evolved to include a mission and goals for the region, including:

- Vision: An Integrated, Healthy and Balanced Watershed.
- Mission: To improve water quality, increase water supply, reliability, and efficiency, integrate flood management, and protect and enhance natural resources.
- Goals: Improve Water Quality, Increase Water Supply, Reliability, and Efficiency, Integrate Flood Management, Protect and Enhance Natural Resources

### 4.1.1 Statewide Priorities

DWR compiled various Statewide Priorities based on the 2014 California Water Action Plan, issued by the California Natural Resources Agency, California Department of Food and Agriculture, and the California EPA (January, 2016). Those Statewide Priorities are shown below in **Table 4-1**.

| Table 4-1 – Statewide Priorities | |
|---|---|
| **Action #** | **Description** |
| 1. Make Conservation a California Way of Life | ◆ Building on current water conservation efforts and promoting the innovation of new systems for increased water conservation.<br>◆ Expand agricultural and urban water conservation and efficiency to exceed SB- X7-7 targets<br>◆ Provide funding for conservation and efficiency<br>◆ Increase water sector energy efficiency and GHG reduction capacity<br>◆ Promote local urban conservation ordinances and programs |
| 2. Increase Regional Self- Reliance and Integrated Water Management Across All Levels of Government | ◆ Ensure water security at the local level, where individual government efforts integrate into one combined regional commitment where the sum becomes greater than any single piece.<br>◆ Support and expand funding for Integrated Water Management planning and projects<br>◆ Improve land use and water alignment<br>◆ Provide assistance to DAC<br>◆ Encourage State focus on projects with multiple benefits<br>◆ Increase the use of recycled water |
| 3. Achieve the Co-Equal goals for the Delta | ◆ This action is directed towards State and federal agencies; however, consideration will be afforded to eligible local or regional projects that also support achieving the co-equal goals providing a more reliable water supply for California and to protect, restore, and enhance the Delta ecosystem. |
| 4. Protect and Restore Important Ecosystems | ◆ Continue protecting and restoring the resiliency of our ecosystems to support fish and wildlife populations, improve water quality, and restore natural system functions.<br>◆ Restore key mountain meadow habitat<br>◆ Manage headwaters for multiple benefits<br>◆ Protect key habitat of the Salton Sea through local partnership<br>◆ Restore coastal watersheds<br>◆ Continue restoration efforts in the Lake Tahoe Basin<br>◆ Continue restoration efforts in the Klamath Basin<br>◆ Water for wetlands and waterfowl<br>◆ Eliminate barriers to fish migration<br>◆ Assess fish passage at large dams<br>◆ Enhance water flows in stream systems statewide |
| 5. Manage and Prepare for Dry Periods | ◆ Effectively manage water resources through all hydrologic conditions to reduce impacts of shortages and lessen costs of state response actions. Secure more reliable water supplies and consequently improve drought preparedness and make California's water system more resilient.<br>◆ Revise operations to respond to extreme conditions<br>◆ Encourage healthy soils |

| Table 4-1 – Statewide Priorities | |
|---|---|
| **Action #** | **Description** |
| 6. Expand Water Storage Capacity and Improve Groundwater Management | • Increase water storage for widespread public and environmental benefits, especially in increasingly dry years and better manage our groundwater to reduce overdraft.<br>• Provide essential data to enable Sustainable Groundwater Management<br>• Support funding partnerships for storage projects<br>• Improve Sustainable Groundwater Management<br>• Support distributed groundwater storage<br>• Increase statewide groundwater recharge<br>• Accelerate clean-up of contaminated groundwater and prevent future contamination |
| 7. Provide Safe Water to all communities | • Provide all Californians the right to safe, clean, affordable and accessible water adequate for human consumption, cooking, and sanitary purposes.<br>• Consolidate water quality programs<br>• Provide funding assistance for vulnerable communities<br>• Manage the supply status of community water systems<br>• Additionally, as required by Water Code §10545, in areas that have nitrate, arsenic, perchlorate, or hexavalent chromium contamination, consideration will be given to grant proposals that included projects that help address the impacts caused by nitrate, arsenic, perchlorate, or hexavalent chromium contamination, including projects that provide safe drinking water to small DAC. |
| 8. Increase Flood Protection | • Collaboratively plan for integrated flood and water management systems, and implement flood projects that protect public safety, increase water supply reliability, conserve farmlands, and restore ecosystems.<br>• Improve access to emergency funds<br>• Better coordinate flood response operations<br>• Prioritize funding to reduce flood risk and improve flood response<br>• Encourage flood projects that plan for climate change and achieve multiple benefits |
| 9. Increase Operational and Regulatory Efficiency | • This action is directed towards State and federal agencies; however, consideration will be afforded to eligible local or regional projects that also support increased operational of the State Water Project or Central Valley Project. |
| 10. Identify Sustainable and Integrated Financing Opportunities | • This action is directed towards State agencies and the legislature. |

Efforts to meet statewide priorities and improve water quality conditions have been underway in the region for many years, and have continually advanced as new technologies and resources have become available. The South Orange County IRWM Group reviewed the statewide priorities for relevance to the region. **Figure 4-2**shows the statewide priorities that are applicable to the WMA by placing an “x” where the statewide priorities contribute to the region’s IRWM Plan Goals. Please refer to **Section 4.1.2** for more discussion on regional goals. Not all of the statewide priorities are applicable to the South Orange County WMA. The projects included on the project list in **APPENDIX F** support the statewide priorities that are applicable to the region.

| | | South Orange County IRWMP Goals | | | |
|---|---|---|---|---|---|
| | | Increase Water Supply, Reliability and Efficiency | Improve Water Quality | Integrate Flood Management | Protect and Enhance Natural Resources |
| Statewide Priorities (2014 California Water Action Plan) | **1) Make Conservation a California Way of Life** | | | | |
| | a) Expand Agricultural and Urban Water Conservation and efficiency to Exceed SBX7-7 Targets | X | | | |
| | b) Increase Water Sector Energy Efficiency and Greenhouse Gas Reduction Capacity | X | | | X |
| | C) Promote Local Urban Conservation Ordinances and Programs (Model Water Efficient Landscape Ordinance - July 2015 | X | X | | |
| | **2) Increase Regional Self-Reliance and Integrated Water Management Across All Levels of Government** | | | | |
| | a) Encourage State Focus on Projects with Multiple Benefits- directive to the administration to incentivize and co-found multiple benefit projects that promote IRWM – example: stormwater permits that emphasize stormwater capture and infiltration. State commitment to emphasize multiple benefit projects are applied to most actions in the California Water Action Plan. | X | X | X | X |
| | b) Icrease the Use of Recycled Water | X | | | |
| | **3) Achieve the Co-Equal Goals for the Delta** | | | | |
| | **4) Protect and Restore Importance Ecosystems** | | | | |
| | a) Restore Coastal Watersheds | | X | | X |
| | **5) Manage and Prepare for Dry Periods** | X | | X | X |
| | **6) Expand Water Storage Capacity and Improve Groundwater Management** | | | | |
| | a) Increase Statewide Groundwater Recharge | X | | | X |
| | **7) Provide Safe Drinking Water For All Communites** | X | | | X |
| | **8) Increase Flood Protection** | | | X | |
| | **9) Increase Operational and Regulatory Efficiency** | | | | |
| | **10) Identify Sustainable and Integrated Financing Opportunities** | | | | |

**Figure 4-2: South Orange County IRWM Plan Goals, Statewide Priorities, and Resource Management Strategies**

(Continued on the next page)

| | | South Orange County IRWMP Goals | | | |
|---|---|---|---|---|---|
| | | Increase Water Supply, Reliability and Efficiency | Improve Water Quality | Integrate Flood Management | Protect & Enhance Natural Resources |
| State Resource Management Strategies (CA Water Plan Update 2013) | Agricultural Water Use Efficiency | X | | | |
| | Urban Water Use Efficiency | X | | | |
| | Conveyance - Delta - Not Applicable | | | | |
| | Conveyance - Regional/local | X | | | |
| | System Reoperation | X | | | |
| | Water Transfers | X | | | |
| | Flood Risk Management | | | X | |
| | Agricultural Lands Stewardship | X | X | | |
| | Economic Incentives (Loans, Grants and Water Pricing) | X | | | |
| | Ecosystem Restoration | | X | | X |
| | Forest Management | X | | | X |
| | Recharge Area Protection | X | X | X | |
| | Sediment Management | | X | X | X |
| | Outreach and Engagement* | X | X | X | X |
| | Conjunctive Management and Groundwater Storage | X | | | |
| | Desalination | X | | | |
| | Precipitation Enhancement - Not Applicable | | | | |
| | Recycled Municipal Water | X | X | | |
| | Surface Storage - CALFED - Not Applicable | | | | |
| | Surface Storage - Regional/local | X | | | |
| | Drinking Water Treatment and Distribution | X | | | |
| | Groundwater Remediation/Aquifer Remediation | X | X | | |
| | Land Use Planning and Management | X | X | X | X |
| | Matching Quality to Use | X | X | X | X |
| | Pollution Prevention | X | X | | X |
| | Salt and Salinity Management | X | X | | X |
| | Urban Runoff Management | X | X | | |
| | Water-Dependent Recreation | | X | | X |
| | Watershed Management | X | X | X | X |
| | Water and Culture* | X | X | X | X |
| | Dew vaporization - Not Applicable | | | | |
| | Fog collection - Not Applicable | | | | |
| | Irrigated land retirement - Not Applicable | | | | |
| | Rainfed agriculture - Not applicable | | | | |
| | Snow fences - Not Applicable | | | | |
| | Waterbag transport/storage technology - Not Applicable | | | | |
| | Climate Change | X | X | X | X |

**Figure 4-2 cont.: South Orange County IRWM Plan Goals, Statewide Priorities, and Resource Management Strategies**

### 4.1.2 Regional Goals

In order to develop regional goals, the statewide priorities and RMS were carefully reviewed, as described above and shown in **Figure 4-2**, for relevance to the South Orange County WMA. The South Orange County IRWM Group also considered the region's major water-related issues and conflicts. The South Orange County IRWM Group Regional Goals are shown below and summarized in **Figure 4-3**:

- Integrate Flood Management
- Improve Water Quality
- Increase Water Supply, Reliability, and Efficiency
- Protect and Enhance Natural Resources

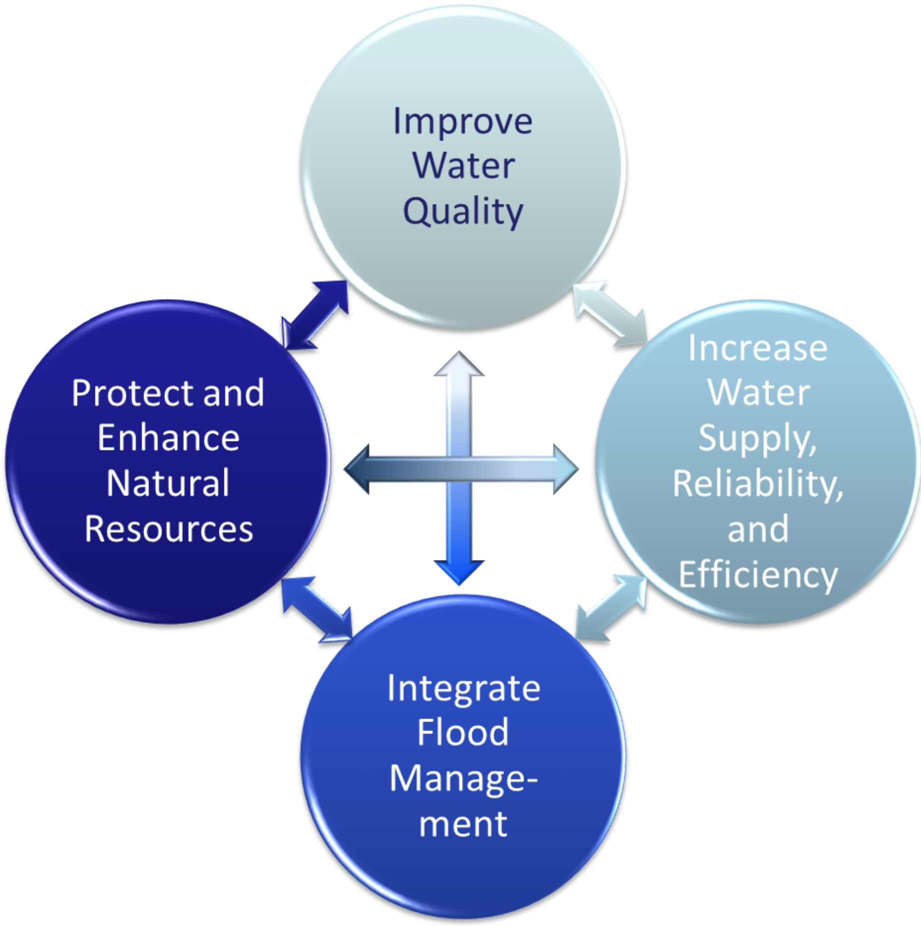


**Figure 4-3: South Orange County IRWM Plan Goals**

The regional goals were subsequently used as the foundation to develop regional objectives, which are described below.

## *4.2 Development of WMA Objectives*

The IRWM Plan considers long-term regional planning for flood management, water quality, water supply and reliability, WUE and natural resources facing the WMA over the next 20 to 50 years. These approaches to watershed planning reflect the regional goals of the South Orange County WMA, as described above, and set the foundation for developing regional objectives. This section of the IRWM Plan provides further discussion of IRWM Group efforts to meet the diverse set of watershed-scale goals, balance water needs and resolve potential water issues through development of objectives; this process considered collaboration, coordination and implementation of projects through IRWM Group planning. In addition to WMA priorities, he South Orange County IRWM Group considers the IRWM Planning Standards in developing objectives, including new requirements for climate change in the 2016 approved standards.

Through EC meetings (at least three times per year) and MC meetings (quarterly at a minimum), and stakeholders workshops the participants developed IRWM Plan objectives. In developing the objectives, the South Orange County IRWM Group considered Regional Conflicts, Basin Plan Objectives, California's 20x2020 Water Conservation Plan, climate change impacts, and WMA priorities. Measurable goals were identified for each strategy category and subsequently used to prioritize projects. The objectives are measurable milestones that will enable the community to track progress toward maintaining a natural balance in watershed resources. Additional work was performed by the IRWM Group since 2013 to further refine the strategies and objectives to develop overarching measurable goals for the objectives that can be directly associated with projects to allow for a clearer assessment of progress made and to meet new 2016 guidelines on climate change. Objectives provide the foundation for assessment of projects in the IRWM Plan; as such, the overarching metrics for the four primary goals and associated objectives (which provide detail) consider local planning priorities associated with the categories in **Figure 4-2**. The objectives and measurable goals are included in **APPENDIX K**.

### 4.2.1 Regional Issues/Challenges

In developing the objectives, the stakeholders considered long-term regional planning conflicts and issues including identification of enhanced local water supplies to offset reduction of imported water to meet demands during times of drought. Though many projects are planned over the next 10 to 20 years to help achieve this goal, much more long-term planning, as well as implementation of integrated projects in all categories included in this IRWM Plan, is necessary to reach that goal. **Section 3.7** provides greater detail of the considerations IRWM Group members make related to water-related issues/conflicts related to water supply, water system reliability, water conservation, recycled water, groundwater management, water quality management, flood management, wastewater management, and climate change.

The IRWM Plan focuses on the South Orange County WMA vision of total watershed efficiency. The Plan primarily builds upon the projects and plans of the member agencies, with an emphasis on water supply, water reliability, and WUE. The key challenges facing South Orange County are reflected in each of the individual member agencies' responsibilities. Similar to other regions, the South OC IRWM Group continues to collectively collaborate on the areas identified in **Section 3.7** and reiterated in **Table 4-2** below:

**Table 4-2: Areas of IRWM Group Collaboration**

| Areas of IRWM Group Collaboration for Establishment of Objectives | | |
|---|---|---|
| Water Supply | Recycled Water | Flood Management |
| Water System Reliability | Groundwater Management | Wastewater System |
| Water Conservation | Water Quality Management | Environmental Stewardship |

As described in **Section 3.7.3**, the South Orange County IRWM Group considers water challenges and opportunities for collaboration on projects and other efforts to address and balance issues within the region. Of note in **Section 3.7.3** is the balance of groundwater recharge of the SJVGB with surface water quality, natural resource protection/enhancement and previous land use.

### 4.2.2 Tri-County FACC Issues/Conflicts

The Tri-County FACC is a formal partnership established in April 2009 through joint adoption of an MOU outlining measures for inter-regional coordination. **Section 2.8** describes the working relationships of the Tri-County FACC and **Section 2.9** provides greater detail on Tri-FACC governance structure. The efforts of the Tri-County FACC are intended to enhance the quality of water resource planning and to improve the quality and reliability of water in the San Diego Funding Area. This partnership is a unique opportunity to collaborate with neighboring planning regions to address common objectives, issues, and conflicts. Of particular significance, the Santa Margarita River watershed has been subject to over 80 years of water rights litigation, studies, and hearings. In 1990, the “Four Party Agreement” between RCWD, Fallbrook Public Utility District, Eastern MWD, and Camp Pendleton attempted to address the conflict through discharge of recycled water to the Santa Margarita River for groundwater recharge. However, the ongoing conflict now involves uncertainty about meeting Regional Board effluent standards, which dictates the ability of RCWD to discharge into the watershed. The new partnership between San Diego and Riverside county agencies via the Tri-County FACC is helping to address those conflicts.

### 4.2.3 Basin Plan Objectives & WMA Water Quality Concerns

The Basin Plan is the Regional Board's plan for achieving the balance between competing uses of surface and groundwaters in the San Diego Region. The Basin Plan establishes or designates beneficial uses and water quality objectives for all the ground and surface waters of the Region. This South Orange County IRWM Plan incorporates the Basin Plan in its objectives to Improve Water Quality (WQ): WQ-1 - Comply with CWA and Porter-Cologne and WQ-2 - Protect beneficial uses of receiving waters. The South Orange County WMA includes the area that encompasses the SJHU in South Orange County, California, as defined in the Basin Plan.

### 4.2.4 Water Efficiency Goals

California’s 20x2020 *Water Conservation Plan* sets forth a statewide road map to maximize the state’s urban water efficiency and conservation opportunities between 2009 and 2020, and beyond. It aims to set in motion a range of activities designed to achieve the 20 percent per capita reduction in urban water demand by 2020. These activities include improving an understanding of the variation in water use across California, promoting legislative initiatives that incentivize water agencies to promote water conservation, and creating evaluation and enforcement mechanisms to assure regional and statewide goals are met.

The South Orange County IRWM Group considered California's 20x2020 Water Conservation Plan in identifying the long-term water supply and water quality issues facing the WMA over the next 20 to 50 years. All project categories within this plan are essential to maximizing limited water resources, including enhancing water efficiency and conservation. The water supply and water conservation objectives reflect the WMA's effort to meet the 20x2020 water efficiency goals.

As discussed in MWDOC's 2015 Regional Urban Water Management Plan (UWMP), MWDOC in collaboration with all of its retail agencies as well as the cities of Anaheim, Fullerton, and Santa Ana, created the Orange County 20x2020 Regional Alliance in an effort to create flexibility in meeting the per capita water use reduction targets required under SBx7-7 in 2009. This Regional Alliance allows all of Orange County to benefit from regional investments such as the GWRS, recycled water, and WUE. The members of the Orange County 20x2020 Regional Alliance are shown below:

| Members of Orange County 20x2020 Regional Alliance | |
|---|---|
| Anaheim | Moulton Niguel Water District |
| Brea | Newport Beach |
| Buena Park | Orange |
| East Orange County Water District | San Clemente |
| El Toro Water District | San Juan Capistrano |
| Fountain Valley | Santa Ana |
| Fullerton | Santa Margarita Water District |
| Garden Grove | Seal Beach |
| Golden State Water Company | Serrano WD |
| Huntington Beach | South Coast Water District |
| Irvine Ranch Water District | Trabuco Canyon Water District |
| La Habra | Tustin |
| La Palma | Westminster |
| Laguna Beach County Water District | Yorba Linda Water District |
| Mesa Water District | |

Within a Regional Alliance, each retail water supplier has an additional opportunity to achieve compliance under both an individual target and a regional water use target.

If the Regional Alliance meets its water use target on a regional basis, all agencies in the alliance are deemed compliant. If the Regional Alliance fails to meet its water use target, each individual supplier will have an opportunity to meet their water use targets individually. Individual water suppliers in the Orange County 20x2020 Regional Alliance will state their participation in the alliance, and include the regional 2015 and 2020 Urban Water Use Targets in their individual UWMPs. The Orange County 20x2020 Regional Alliance Regional Water Use target for 2015 was

176 Gallons per Capita Daily (GPCD) and for 2020 it is 158 GPCD; these targets are based on 2010 consensus data. Refer to MWDOC's 2015 Regional UWMP (Section 2.5) for individual supplier targets.

As the reporting agency for the Orange County 20x2020 Regional Alliance, MWDOC has documented the calculations for the regional urban water use reduction targets. MWDOC will also provide annual monitoring and reporting for the region on progress toward the regional per capita water use reduction targets.

### 4.2.5 Water Priorities for the WMA

As noted above, the WMA has established four primary goals for the region, balancing water priorities to holistically benefit watershed health and provide for water needs. The objectives discussed in **Section 4.3** considered water quality (**Section 3.3.4**), flood risk management (**Section 3.3.8**), water supply and wastewater management (**Section 3.3.7**) and habitat preservation/enhancement issues and priorities for the WMA. These align with State Resource Management Strategies (**Section 5**) and Statewide Priorities (**Section 4.1.1**).

## *4.3 WMA Objectives*

The Objectives Standard requires that objectives must be measurable. A measurable objective means there must be some metric the WMA can use to determine if the objective is being met as the IRWM Plan is implemented. IRWM Plans are implemented through project implementation, which are associated with relevant measurable objectives. Metrics must apply to projects which in turn relate back to Plan objectives. Objectives are measured quantitatively or qualitatively, as appropriate. The South Orange County 2018 IRWM Plan objectives were reviewed by the IRWM Group for relevance to the WMA. Input from the Cities, water and wastewater districts, and the County was instrumental in updating the objectives to reflect current watershed, land use, and natural resources management plans for the WMA. Based on feedback, appropriate refinements to the objectives were made by the MC to reflect local planning such as the WQIP and OC Water Reliability Study. Climate change context was incorporated into the existing objectives for the 2018 IRWM Plan update and approved by the MC. **APPENDIX K** shows the goals and approved objectives that help meet each goal. The objectives were presented to stakeholders through review of the IRWM Plan.

For each objective a series of strategies were developed to identify examples of appropriate ways that objective could be met. The following sections identify example strategies identified for each objective. An example unit of measure was associated with each strategy (as shown on tables in the following sections). For project prioritization purposes, a score is associated with the relative benefit attained by the strategy; if a project can quantify benefits supportive of the objective strategy, the project receives a higher score. **Section 6.1.2** and **APPENDIX K** further define the objective measures and explain the scoring process. The following sections describe the objectives and strategies for each goal. Objectives and associated measures are reviewed and iteratively revised to best reflect developments in watershed health, water quality, water supply and flood management. These refined metrics are detailed in **APPENDIX K** and may be updated more frequently than the full IRWM Plan; **APPENDIX K** will be updated, as needed.

### 4.3.1 Integrate Flood Management Objectives and Strategies

To address flood management, OC Flood implements an integrated process under which they conduct feasibility, hydraulic, deficiency, floodplain and value-engineering studies, collect and analyze data on an on-going basis, and design and construct projects. The essential purpose of the Orange County Flood Control program is to protect Orange County life and property from the threat and damage of floods.[78] Specific strategic goals include: planning, designing, constructing, operating, and maintaining flood management infrastructure; and eliminating the need for residents to pay costly flood insurance by improving flood control systems and removing properties from FEMA floodplains. With the Orange County Flood Control Division's current budget to implement its regional infrastructure to provide the current protection threshold (100-year storm event), it will take over 90 years and cost more than $2.5 billion (2010 value) to achieve this goal. Historically the budget was expended entirely on capital improvement projects; however, rising costs associated with maintenance and mitigation have shifted more budget toward those activities. Additionally, OCPW responds to citizen concerns and flood emergencies

The following objectives and supportive strategies were developed for the WMA to provide adequate flood control throughout Orange County. Units are suggested and may be applicable to multiple strategies:

***FM1: Improve conveyance and/or reliability of channelized flood control systems and related facilities and remove properties from the FEMA 100-year floodplain with consideration for climate change on flow regimes.***

| Strategy | Unit |
|---|---|
| Strategy: FM-1-S1 - Construct channel improvement projects (banks or within the channel) to convey the 100-year storm event | Conveyance Improvement Percent |
| Strategy: FM-1-S2 - Implement Local watershed improvements (e.g. raising land above base flood elevation, removing structures in floodplain) | Critical Infrastructure Protected, People per Acre, Repetitive Loss Properties Removed |
| Strategy: F-1-S3 - Remove impediments (e.g. sediment or invasive vegetation) to convey the 100-year storm event | Conveyance Maintained |

***FM2: Reduce scour and erosion to river, stream, and the channel banks***:

| Strategy | Unit |
|---|---|
| Strategy: FM-2-S1-Incorporate hydromodification retrofits to existing development | Acres Impacted |
| Strategy: FM-2-S2-Incorporate grade control structures or other improvements to reduce or eliminate scour and erosion to channel | Conveyance Maintained |
| Strategy: FM-2-S3- Minimize the potential impact of stormwater on canyon and channel stability, water quality, and habitat. | Peak Volume Detained |

[78] County of Orange, 2013: OC Public Works Business Plan: http://www.ocpublicworks.com/about/busplan

***FM3: Improve sub-regional facilities and local storm drain systems where historical flooding exists where the regional system has the capacity to accept the additional flows***

| Strategy | Unit |
|---|---|
| Strategy: FM-3-S1-Implement infrastructure improvements (e.g. storm drains, reservoirs) | Cost per Acre Protected |
| Strategy: FM-3-S2-Implement local improvements (e.g. rain gardens, cisterns, disconnect impervious areas) | Acres Impacted |

***FM4: Preserve or return floodplains as open space***

| Strategy | Unit |
|---|---|
| Strategy: FM-4-S1-Purchase land and dedicate as open space | Acres Purchased or Dedicated |
| Strategy: FM-4-S2-Implement stream channel naturalization efforts to promote riparian habitat and natural water quality treatment in concert with stable sediment transport. | Acres Restored or Protected |

***FM5: Planning, studies, research to acquire Best Data with consideration for climate change impacts***

| Strategy | Unit |
|---|---|
| Strategy: FM-5-S1-Update FEMA or other floodplain studies | Miles of Stream, or Square Miles Studied |
| Strategy: FM-5-S2-Improve OC Flood Deficiency Studies | Miles of Stream, or Square Miles Studied |
| Strategy: FM-5-S3-Obtain LiDAR within South Orange County WMA | Square Miles of Lidar Acquired |
| Strategy: FM-5-S4-Obtain new or updated discharges | Miles of Streams Updated |
| Strategy: FM-5-S5-Plan watershed improvements (e.g. raising land above flood elevation, removing structures in floodplain) | Acres Impacted |
| Strategy: FM-5-S6-Update ordinances and local plans to improve floodplain management approaches (e.g. adopt creek buffer ordinances) | YES/NO |
| Strategy: FM-5-S7-Research sea level rise coastal/estuary flooding impacts and potential mitigation efforts | Coastal or Estuary Acres protected |

### 4.3.2 Objectives and Strategies to Improve Water Quality

Under Section 303(d) of the 1972 CWA, states, territories, and authorized tribes are required to develop a list of water quality limited segments. These waters do not meet water quality standards, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for water quality impairment on the list and develop action plans, referred to as TMDLs, to improve water quality. In South Orange County, the SWRCB and the Regional Board staff have evaluated each addition, deletion, and change to Section 303(d) based on all the data and information available for each water body and pollutant.[79] **Section 3.4** provides greater detail on water quality priorities, regulations and current 303(d) listings that were considered in developing the objectives.

The following Water Quality Objectives and supportive regional strategies build upon the WMA's established goal of enhancing water quality:

***WQ1: Control anthropogenic pollutants over the developed area of the South Orange County WMA***

| Strategy | Unit |
|---|---|
| Strategy: WQ-1-S1 - Implement pollution prevention measures, including non-structural BMPs, not including educational activities | Acres Affected |
| Strategy: WQ-1-S2: Implement structural controls | Acres Affected |
| Strategy: WQ-1-S3: Implement LID strategies targeting anthropogenic pollutants | YES/NO |
| Strategy: WQ-1-S4: Retrofit soil erosion and sedimentation controls (includes hydromodification) | Cubic Yards of Erosion Prevented |
| Strategy: WQ-1-S5: Improve or protect the quality of water that may reach a receiving water | Pollution Concentration Reduction |
| Strategy: WQ-1-S6: Improve or protect the quality of recycled water | Acre Feet |
| Strategy: WQ-1-S7: Implement measures to reduce health risk/rate of illness in recreational waters, where risk has been identified | Pollution Concentration Reduction |

***WQ2: Control anthropogenic dry weather flows from the developed area within the South Orange County WMA***

| Strategy | Unit |
|---|---|
| Strategy: WQ-2-S1-Implement dry weather flow prevention measures, including non-structural BMPs (i.e. onsite / source controls) | Acres Improved |
| Strategy: WQ-2-S2-Implement dry weather flow volume reduction measures (e.g. diversions) | Acres Impacted |

***WQ3: Control wet weather flows to meet NPDES MS4 permit criteria from developed acres within the South Orange County WMA with consideration for climate change to flow regimes***

| Strategy | Unit |
|---|---|
| Strategy: WQ-3-S1-Implement storm water prevention measures, including non-structural BMPs (i.e. onsite / source controls) | Acres Improved |
| Strategy: WQ-3-S2-Implement storm water structural controls | Acres Improved |
| Strategy: WQ-3-S3-Implement hydromodification management measures | Peak Volume Reduced |

[79] County of Orange, 2003, *Drainage Area Management Plan*

***WQ4: Improve water quality regulatory framework and/or awareness and/or knowledge of water quality issues within the South Orange County WMA***

| Strategy | Unit |
|---|---|
| Strategy: WQ-4S1-Conduct studies, planning, research, evaluations, or monitoring projects | YES/NO |
| Strategy: WQ-4-S2-Pursue site specific objectives (SSOs), Use Attainability Analysis (UAA), Qualitative Microbial Risk Assessment (QMRAs), development of subcategories of Beneficial Use Designations, etc. | YES/NO |
| Strategy: WQ-4-S3-Implement programs to comply with TMDLs | YES/NO |
| Strategy: WQ-4-S4-Develop and/or implement programs to educate and/or increase awareness and knowledge | YES/NO |
| Strategy: WQ-4-S5-Address pollution issues in a holistic, integrated manner. | YES/NO |

***Water Quality Solutions Align with Objectives***

Improvement projects proposed by local agencies in the IRWM Plan suggest both direct and indirect solutions to water quality problems. The IRWM Group agencies conduct extensive water quality monitoring and plan projects to address water quality concerns within the WMA. The objectives above are reflective of these efforts. Examples of source and structural control techniques the IRWM Group employs to meet objectives for water quality are detailed in the ROWDs, WQIP, and Model WQMP/TGD for land development. Numerous projects are planned for the WMA to address the commitments of the WQIP and associated with beneficial use of stormwater and dry weather flows. Indeed, projects that accomplish multiple benefits, such as water quality improvement and potable water supply offset assist meeting multiple objectives of the WMA. In addition to the IRWM Plan Project List, projects included in the OC SWRP (**APPENDIX L**) provide examples of multi-benefit stormwater planning. **Section 6** and **APPENDIX F** provide greater detail about projects and the IRWM Plan Project List, respectively.

The objectives also consider progress made in South Orange County toward meeting the existing and proposed TMDL's, restrictions regarding ASBS's and NPDES water quality mandates. For more information about water quality improvements achieved by the County and Permittees, please reference the 2014 ROWD[80]. The ROWD analyses were referenced heavily in the development of the WQIP and will continue to inform water quality project prioritization.

### 4.3.3 Increase Water Supply, Reliability, and Efficiency Objectives and Strategies

As population and development increases in the WMA, the IRWM Group recognizes that additional investments in water supply are needed to continue providing adequate quantities of high quality water to meet demand. Water planning and development is required on a state, regional, and local level as competition for water from the Colorado River and State Water

[80] 2014 San Diego Region ROWD (http://prg.ocpublicworks.com/DocmgmtInternet/Search.aspx)

Project increases with increasing demand and climate change. WMA efforts will continue to focus efforts on increasing efficiency, conserving existing resources and increasing supply, where possible. It is noted that although the South Orange County WMA objectives do not directly impact the San Joaquin Delta and associated State Priorities or the Colorado River basin, it is vital that the WMA increase local reliability to relieve pressure on these limited resources. The 2016 OC Water Reliability Study[81] proposes planning actions to be undertaken in South Orange County to increase system reliability and meet water demands; the study considers both supply projects and efficiency-based efforts see **Section 3.7.2.2**. The following objectives and supportive regional strategies reflect the WMA's water supply, reliability, and efficiency planning. Units are suggested and may be applicable to multiple strategies:

***WS1: Increase the supply of potable water***

| Strategy | Unit |
|---|---|
| Strategy: WS-1-S1-Develop groundwater supplies through groundwater investigations, well development, treatment plant improvements, basin infiltration/retention projects, basin enhancement and protection projects | Acre Feet Developed |
| Strategy: WS-1-S2-Develop ocean desalination supplies | Acre Feet Developed |
| Strategy: WS-1-S3-Indirect Potable Reuse / Direct Potable Reuse of wastewater resources | Acre Feet Conserved |
| Strategy: WS-1-S4-Capture and reuse and/or infiltration of Urban Runoff (dry weather and storm flow) | Acre Feet Captured |
| Strategy: WS-1-S5-Mitigate the impacts of projects that increase the supply of water | YES/NO |

***WS2: Increase the supply and use of non-potable water:***

| Strategy | Unit |
|---|---|
| Strategy: WS-2-S1-Develop Urban Runoff (dry and wet weather) supplies for irrigation use | Acre-Feet Captured |
| Strategy: WS-2-S2-Utilize regional and local projects to get greater distribution and use of recycled and other non-potable water (e.g., rain water capture systems) | Acre-Feet |
| Strategy: WS-2-S3-Increase distribution of recycled and non-potable water through pipeline and conversion projects | Acre-Feet |

***WS3: Improve reliability of all water supplies with consideration for climate change on local and external sources***

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| Strategy | Unit |
|---|---|
| Strategy: WS-3-S1-Increase groundwater storage and use (e.g. recharge, basin management, etc.) | Acre-Feet |
| Strategy: WS-3-S2-Increase surface water storage and use | Acre-Feet Improved |
| Strategy: WS-3-S3-Improve and increase water treatment systems | Acre-Feet Expanded |
| Strategy: WS-3-S4-Develop interconnections and delivery systems (backup systems) to enhance the reliability of delivery of imported water | 60 Days without MET. 7 Days without power grid |
| Strategy: WS-3-S5-Develop storage in areas out of South Orange County that can be accessed to supply water under drought and emergency conditions, including water transfer facilities and agreements | Days of Emergency Supply |
| Strategy: WS-3-S6-Develop water delivery pipelines and system interconnections | YES/NO |
| Strategy: WS-3-S7-Protect aquifers from saltwater intrusion and contamination from natural or man-made sources | YES/NO |
| Strategy: WS-3-S8-Eliminate negative impacts to water resources, including removal of non-native plants (Arundo), improving water courses, runoff, storm flow systems to infiltrate, retain and reuse water | Acres Impacted |
| Strategy: WS-3-S9-Examine storage and major pipeline systems for earthquake vulnerability | YES/NO |
| Strategy: WS-3-S10-Develop an institutional operational and financial framework for sharing water in emergencies | YES/NO |

***WS4: Improve planning and awareness of water supply with consideration for climate change stresses***

| Strategy | Unit |
|---|---|
| Strategy: WS-4-S1-Complete a plan that evaluates Ocean Desalination | YES/NO |
| Strategy: WS-4-S2-Participate in Met Integrated Resources Planning and on-going evaluation /quantification of import supply and delivery vulnerability | YES/NO |
| Strategy: WS-4-S3-Complete a plan that optimizes groundwater and ocean desalination in conjunction with SJBA | YES/NO |
| Strategy: WS-4-S4-Complete a plan that assesses opportunities that maximizes local groundwater basin storage/annual yield and enhances efficiency of the groundwater basin. | YES/NO |
| Strategy: WS-4-S5-Evaluate water banking opportunities to transfer water into Orange County on a permanent and/or emergency basis | YES/NO |
| Strategy: WS-4-S6- Evaluate opportunities to develop regional recycled water seasonal storage and interagency connections to maximize the use of recycled water across individual agency service area boundaries | YES/NO |
| Strategy: WS-4-S7-Seek technical and funding assistance to support and encourage voluntary and/or mandated on-site customer recycled water conversions | YES/NO |

| | |
|---|---|
| Strategy: WS-4-S8-Advocate for local and regional (MWDOC/Met) support for participant supply and system reliability projects that translate into overall improved South Orange County reliability | YES/NO |
| Strategy: WS-4-S9- Develop a public education campaign or support local and regional collaboration to advance the value of water message and the economic benefits associated with dependable water supplies. | YES/NO |
| Strategy: WS-4-S10- Complete a study to explore the feasibility of developing institutional and financial arrangements that could be regionally employed to share water resources during an emergency. | YES |
| Strategy: WS-4-S11- Complete a study to assess the costs, benefits and issues associated with the use of rain water capture systems. | Cost Effectiveness ($/MG) |
| Strategy: WS-4-S12- Complete a study to develop a methodology to measure and quantify system/supply reliability improvements that increase the ability of individual agencies to increase days off the import system. | Days without MET |
| Strategy: WS-4-S13-Complete a study to understand potential impacts of sea level rise on water supply infrastructure near the coast. | YES/NO |

***WS5: Reduce consumption from outdoor residential, commercial, industrial, and institutional landscapes***

| Strategy | Unit |
|---|---|
| Strategy: WS-5-S1-Promote use/retrofitting of irrigation system distribution uniformity improvements | Acres or System Miles Upgraded |
| Strategy: WS-5-S2-Promote the use/retrofitting of low-volume irrigation technologies in urban landscapes | Acres Retrofitted |
| Strategy: WS-5-S3-Promote use of native and non-native California Friendly plants in urban landscapes | Acres Planted |
| Strategy: WS-5-S4-Promote the replacement of non-functional turf grass with California Friendly plantings | Acres or Square Feet Replaced |
| Strategy: WS-5-S5-Promote the use/retrofitting of smart timers in urban landscapes | Acres Retrofitted |

***WS6: Reduce consumption through enhanced water utility operations***

| Strategy | Unit |
|---|---|
| Strategy: WS-6-S1-Implement Distribution System Audit, Leak Detection and Repair programs following AWWA Standards | YES/NO |
| Strategy: WS-6-S2-Implement efficiency based rate structures | YES/NO |
| Strategy: WS-6-S3-Install Smart water metering infrastructure | YES/NO |
| Strategy: WS-6-S4-Implement meter repair and replacement programs following AWWA Standards | YES/NO |

### *WS7: Reduce consumption from indoor residential, commercial, industrial, and institutional uses*

| Strategy | Unit |
|---|---|
| Strategy: WS-7-S1-Provide technical assistance and financial incentives to single- and multi-family residential consumers | YES/NO |
| Strategy: WS-7-S2-Promote use/retrofitting of water efficient plumbing fixtures in businesses and institutions | YES/NO |
| Strategy: WS-7-S3-Provide technical assistance and financial incentives for water efficiency to industrial manufacturers | YES/NO |
| Strategy: WS-7-S4-Promote use/retrofitting of water efficient plumbing fixtures in single- and multi-family homes | YES/NO |

### *WS8: Research, evaluation, planning and education with consideration for climate change*

| Strategy | Unit |
|---|---|
| Strategy: WS-8-S1-Update water waste prevention regulations every five years | YES/NO |
| Strategy: WS-8-S2-Promote leak detection and repair | YES/NO |
| Strategy: WS-8-S3-Implement school education and public information programs to consumers | YES/NO |
| Strategy: WS-8-S4-Promote use of alternative landscape designs, including Low Impact Development, that maximize stormwater capture | YES/NO |
| Strategy: WS-8-S5-Provide technical assistance to single- and multi-family residential consumers | YES/NO |
| Strategy: WS-8-S6-Provide landscape water efficiency education to landscape owners and managers | YES/NO |
| Strategy: WS-8-S7-Update Orange County's WUE Master Plan every five years | YES/NO |
| Strategy: WS-8-S8-Other: research into efficiency factors of the technology | YES/NO |

### *Water Reliability Solutions Align with Objectives*

The IRWM Plan Project List (**APPENDIX F**) includes infrastructure improvements, desalting and recycling projects, and WUE programs that are planned for the South Orange County WMA. These projects generate not only drought year water supply, but “regular year” water supply as well. While these new water supplies may not contribute directly to long-term storage, they help reduce reliance on imported water and result in MET retaining higher levels of water in storage. Other planned projects, such as stormwater capture and treatment facilities, contribute directly to both short-term and long-term storage, but can be quite expensive. Diversion of floodwaters to recharge basins or to storage for reuse can mitigate some of the dangerous characteristics of flooding as well as augment available water supplies when cost effective. Watershed planning, including invasive species removal and other habitat restoration projects will enhance water quality and ecosystem vigor.

Water Use Efficiency

WUE programs and demand curtailment extend the availability and reliability of existing supply. Curtailment or rationing is a viable option for short-term supply shortages, which may include limiting potable water use during emergencies. As signatories to the California Urban Water Conservation Council's Memorandum of Understanding (MOU) (known now as the California Water Efficiency Partnership), which contains 5 BMP program categories for urban water conservation in California, MWDOC and South Orange County water agencies voluntarily committed to implementing low cost effective BMPs. Many South Orange County agencies voluntarily signed the MOU regarding Urban Water Conservation in the CUWCC. The California Urban Water Conservation Council was formed through adoption of this MOU and is considered the "keeper" of the BMPs, with the authority to add, change, or remove BMPs. The CUWCC also monitors implementation of the MOU. As a signatory to the MOU, MWDOC has committed to a good-faith-effort to implement all cost-effective BMPs. Examples of BMPs include Home Water Surveys, Low-Flow Showerhead and Toilet Retrofits, Clothes washer Retrofits, Landscape Irrigation Budgets, Education, Public Information, Industrial Process Water Improvements and Water Waste Prohibitions.

Water agencies throughout Orange County have provided incentives for the installation of more than 350,000 Ultra-Low-Flush Toilets, which are saving more than 11,700 AFY of water. In addition, more than 90 percent of the showerheads have been replaced with low-flow heads. As a result of these BMP implementation efforts, indoor residential water saving opportunities are maximized. Outdoor landscape irrigation water savings and plumbing fixture retrofits continue to be important BMPs for the WMA to achieve quantifiable water savings. For more information about WUE programs, projects and studies, see **Section 3.7.2.3**.

MWDOC estimates indicate that by the year 2040, water supplies made available through conservation efforts will total 35,800 AFY as illustrated in the figure below from the 2016 OC Water Reliability Study[82], an increase of about 25,300 acre feet over and above existing 10,500 WUE levels achieved in 2005.

[82] Orange County Water Reliability Study Executive Report (2016)

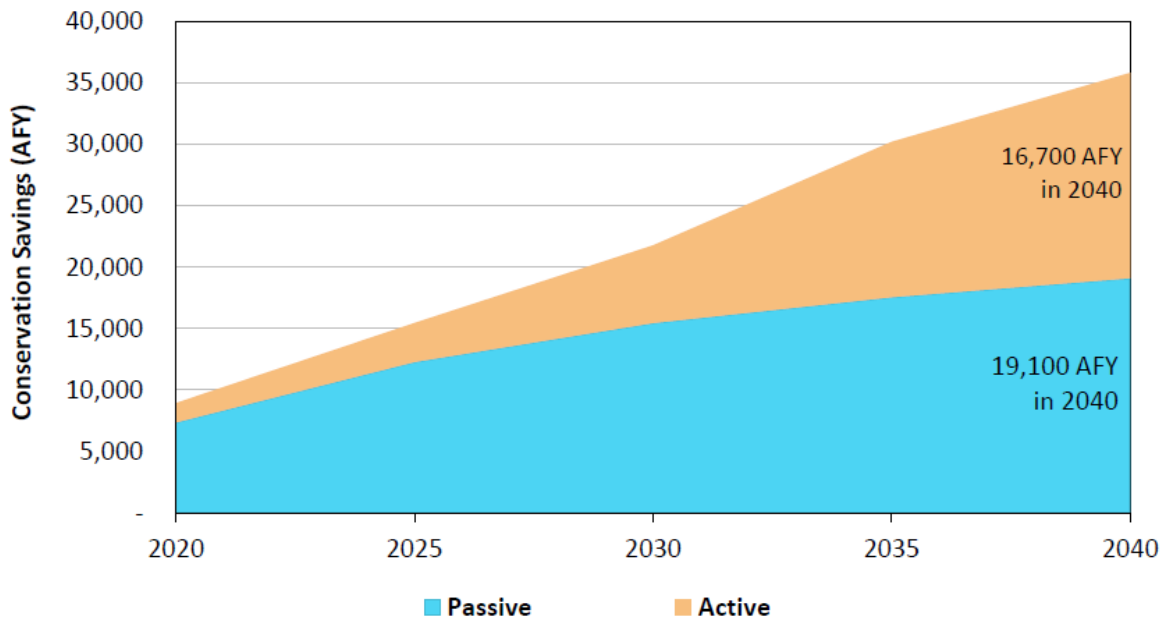


**Figure 7. Total Water Conservation in Orange County**

Water Supply

The Orange County Water Reliability Study included extensive analysis of water supply needs to increase system reliability in South Orange County (See **Section 3.7.2.2**). The overarching measure for water supply is based upon the OC Water Reliability Study, which will continue to inform the IRWM Group decision making process.

A number of water supply projects have been implemented through the IRWM Plan; indeed, even more have been implemented by the IRWM Group member agencies in addition to these efforts. Projects are discussed/summarized in **Section 2.6.1**, **Section 3.3, and Section 4.3.**

### 4.3.4 Protect Natural Resources Objectives and Strategies.

As discussed in **Section 3.3.1**, the South Orange County WMA works with the NCC, a 501(c)(3) nonprofit corporation that manages the NCCP/HCP for the Central and Coastal Subregion of Orange County California. It coordinates land management activities of public and private landowners within the 37,000-acre reserve system, conducts wildlife and habitat research and monitoring, and restores disturbed habitats. The South Orange County WMA includes a number of protected areas that form a network of interconnected and isolated biological communities within the Central and Coastal and Southern Subregion NCCP/HCP.

The following objectives and supportive regional strategies reflect the WMA's ongoing efforts for natural resources protection. Units are suggested and may be applicable to multiple strategies:

***NR1: Benefit aquatic and riparian ecosystems with consideration for climate change on water availability***

| Strategy | Unit |
|---|---|
| Strategy: NR-1-S1-Manage developed areas to minimize impacts on downstream aquatic and terrestrial ecosystems | Acres Impacted |
| Strategy: NR-1-S2-Eliminate anthropogenic impacts to marine ASBS's | Acres Impacted |
| Strategy: NR-1-S3-Construct artificial wetlands where feasible and appropriate to buffer the impacts of development on natural aquatic ecosystems | Acres Constructed |
| Strategy: NR-1-S4-Retrofit stormflow attenuation processes, devices and/or permeable surfacing into developments to restore natural hydrologic patterns (i.e. natural flow regimes) | Acres Impacted |
| Strategy: NR-1-S5-Improve water quality of runoff from developed areas | Acre-Feet Treated |
| Strategy: NR-1-S6-Eradicate non-native, harmful invasive plant and animal species | Acres Impacted |
| Strategy: NR-1-S7-Re-establish native communities along stream courses compatible with site conditions | Acres Impacted |
| Strategy: NR-1-S8-Provide opportunities for controlled recreational access and enjoyment of aquatic and terrestrial ecosystem areas to minimize the environmental impacts of uncontrolled use | YES/NO |
| Strategy: NR-1-S9-Stabilize streams and urban-impacted channels utilizing bioengineering techniques | YES/NO |
| Strategy: NR-1-S10-Restore currently restricted floodplains to a more natural/original condition, including the natural/original extent of inundated riparian vegetation during higher flows (i.e., storm events ) | Acres Impacted |
| Strategy: NR-1-S11-Removal of water diversions that preclude natural stream flow regimes to recover and maintain suitable living space for native aquatic species | YES/NO |
| Strategy: NR-1-S12-Implement "climate smart" conservation principles that consider climate projections and weather extremes. | YES/NO |
| Strategy: NR-1-S13-Reduce or eliminate fertilizer and pesticide use to improve water quality | YES/NO |

***NR2: Benefit terrestrial ecosystems***

| Strategy | Unit |
|---|---|
| Strategy: NR-2-S1- Manage developed areas to minimize impacts on terrestrial ecosystems | Acres Impacted |
| Strategy: NR-2-S2- Eradicate non-native, harmful invasive plant and animal species | Acres Impacted |
| Strategy: NR-2-S3- Provide opportunities for controlled recreational access and enjoyment of aquatic and terrestrial ecosystem areas to minimize the environmental impacts of uncontrolled use | YES/NO |
| Strategy: NR-2-S4- Manage vegetation to balance fire-safety needs with restoration and enhancement of native habitat | Acres Impacted |
| Strategy: NR-2-S5- Implement "climate smart" conservation principles that consider climate projections and weather extremes. | YES/NO |

***NR3: Benefit air, climate, and energy resources with consideration for reducing GHG emissions, carbon sequestration, and/or increased renewable energy***

| Strategy | Unit |
|---|---|
| Strategy: NR-3-S1- Recover and recycle solid waste materials collected from streets or surface drainage | Tons Removed or Recycled |
| Strategy: NR-3-S2- Reduce carbon footprint | Tons of CO2 Reduced |
| Strategy: NR-3-S3- Reduce solid waste generation | Tons Reduced |
| Strategy: NR-3-S3-Improve Energy Efficiency | YES/NO |

***NR4: Research, evaluation, monitoring, planning, recreation, and education***

| Strategy | Unit |
|---|---|
| Strategy: NR-4-S1- Promote scientific research, technology development and investigative studies | YES/NO |
| Strategy: NR-4-S2- Implement a climate-focused study to monitor and track water temperature in streams that historically support steelhead and other native aquatic species | YES/NO |
| Strategy: NR-4-S3-Promote sustainable principles within the watershed. | YES/NO |
| Strategy: NR-4-S4-Seek grants and encourage public-private financing partnerships. | YES/NO |
| Strategy: NR-4-S5-Support efforts that will enhance public recreation. | YES/NO |

***Natural Resource Solutions Align with Objectives***

As described under **Section 2.6.1**, the South Orange County Team Arundo was formed during the IRWM planning process and works to remove invasive plants and restore native riparian habitat in the watersheds of the SJHU. The invasive non-native plant control and riparian restoration program is based upon a systematic watershed based control of target species for long term ecological and resource protection benefits.

Additionally, projects implemented through the IRWM Plan have provided significant natural resource protection benefits, the most recent of which include the Dairy Fork Wetland Project and San Juan Aquatic Passage and Habitat Improvement projects approved by the IRWM Group in the 2015 Proposition 84 Grant. As shown in **Table 6-1** in **Section 6.2**, these projects provide two acres of Arundo removal and two miles of invasive plant removal within the Aliso and San Juan Creek watersheds, respectively.

### 4.3.5 Objectives and Multiple Priorities

The IRWM Group prioritizes projects that achieve multiple objectives and utilize multiple strategies. Efforts of the WMA to provide multiple, overlapping benefits is discussed in **Section 2.6.2**. As described throughout the IRWM Plan, projects meeting multiple IRWM goals and objectives illustrate both the collaborative nature of the WMA, but also efforts of the IRWM

Group and stakeholders to promote several facets of water resources in South Orange County. For example, the Dairy Fork project described in **Sections 2.6.2 and 6.2.1.1** represented a collaboration of several cities to treat a total of 1,500 watershed acres and restore habitat by removing invasive Arundo from stream banks. Similarly, the Crown Valley Park Channel Entry Improvements Project described in **Section 6.2.1.1** represents a multi-benefit project, achieving water quality, water supply and habitat restoration goals; additional local flood protection benefits also support IRWM goals.

Water quality mandates require and the NPDES Permittees seek to address unnatural dry weather flows through collaborative planning processes described in **Section 3.3.4**. Additionally, OC Flood and the other IRWM Group members work closely to implement a variety of BMPs in channel design to improve water quality, including low flow diversions in channels to divert dry weather flows to the sanitary sewer system for treatment and use as recycled water. Implementation of diversions requires coordination between the OCFCD/OC Flood, the cities and SOCWA to balance flows and ensure adequate infrastructure is in place.

## *4.4 Objective Weighting*

Consistent with the governance model, the South Orange County WMA includes an adopted Cooperative Agreement and decision-making framework for planning and implementing water management strategies. Through a series of meetings, the South Orange County IRWM Group collectively developed the objectives and prioritized them according to their water management responsibilities. The MC solicited input from the South Orange County IRWM Group. The draft priority ranking was distributed via email to the Group members and discussed at a subsequent stakeholder workshop. Together, the group:

1. Identified and weighted Objectives
2. Reviewed and evaluated the effectiveness of the objectives
3. Ensured objectives are prioritized based on regional concerns, including: Flood Management, Water Quality, Water Supply, Reliability, and Water Use Efficiency, and Natural Resources.
4. Identified and assessed weighted values for goals and objectives and for project ranking.
5. The objectives were weighted by the WMA as part of the project review process. This scoring process is described in detail in **Section 6.1**.

**Section 6.1.2** and **APPENDIX K** further describe objective weighting and measures. Goal and objective weighting expressed in the IRWM Plan may be modified on an as-needed basis, as regional priorities change and watershed health improves.

# 5 RESOURCE MANAGEMENT STRATEGIES

## *5.1 Process to Consider Resource Management Strategies*

As part of the process to develop the goals, objectives, and regional strategies for the IRWM Plan, all of the Resource Management Strategies (RMSs) as identified in **Section 4**, and Volume 3 of the CWP Update 2013 were considered and evaluated by an Ad Hoc Committee and the MC for applicability to the region. The intent of RMSs is to encourage diversification of water management approaches as a way to mitigate for uncertain future circumstances in compliance with Water Code §10541. (e)(1). An RMS, as defined in the CWP Update 2013, is a technique, program, or policy that helps local agencies and governments manage their water and related resources.

A key objective of the CWP Update 2013 is to present a diverse set of RMSs to meet the water-related resource management needs of each region statewide. The 30 strategies are organized under eight categories, which describe their primary objective and emphasis while recognizing interdependencies among many of the strategies. The RMSs that will be implemented to achieve the objectives of the South Orange County IRWMP are shown in **Figure 4-2**. The MC considered input from an Ad Hoc Committee formed to assess alignment with regional objectives and strategies. A brief explanation of how the RMSs are applicable to the region is provided in **Section 5.2**. RMSs that are not applicable are discussed in the **Section 5.3**. Regional strategies were reviewed by the IRWM Group for relevance to the WMA. Input from the Cities, water and wastewater districts, and the County was instrumental in updating the objectives to reflect current watershed, land use, and natural resources management plans for the WMA. Based upon input from the Ad Hoc Committee, the MC refined the objectives described in **Section 4**; revised objectives were included in the overall 2018 IRWM Plan update for EC and stakeholder review/approval. The following sections identify the RMSs considered, RMSs determined applicable to the region and incorporated in the objectives and strategies, and RMSs determined non-applicable to the Region.

## *5.2 Resource Management Strategies Applicability to Region*

In many cases, strategies and projects primarily targeted at one plan objective will also support other plan objectives. Strategies and projects that address multiple objectives are typically the most cost-effective and resource-efficient, and are for the most part given higher priority in this IRWM Plan.

In developing IRWM Plan goals, objectives and regional strategies, as detailed in **Section 4.3**, the IRWM Group considered the 2013 CWP RMSs. The RMSs deemed applicable to the South Orange County IRWM Region were incorporated into the development of the IRWM Plan strategies to help achieve those objectives. **Figure 4-2** summarizes the CWP Update 2013 RMSs considered and their applicability to the South Orange County IRWM Regional Goals.

### *Reduce Water Demand*

Water conservation has become a viable long-term supply option in the region because it saves considerable capital and operating cost for utilities and consumers, avoids environmental degradation, and creates multiple benefits.

Agricultural WUE RMS: Water conservation is defined by CWC Section 10817 as "the efficient management of water resources for beneficial uses, preventing waste, or accomplishing additional benefits with the same amount of water." Improvements in agricultural WUE are expressed as yield improvements for a given unit amount of water, and can be estimated over individual fields or entire regions. Direct water use in Orange County includes municipal, industrial, and agricultural use. Measures to implement agricultural WUE are implemented throughout the region, where applicable.

Urban WUE RMS: MWDOC and many other agencies in the region are signatory to the California Water Efficiency Partnership (formerly the California Urban Water Conservation Council) MOU regarding urban WUE, and are committed to implementing BMP and Demand Management Measures to support the 20x2020 Water Conservation Plan and EO B-37-16 Making Water Conservation a California Way of Life, among other local, regional and statewide water conservation goals. Alternative water sources, such as recycled water, desalinated water, gray water, and rainwater are also considered in urban water demand reduction.
Key impacts of climate change that relate to urban water supplies include:

- Warming temperatures, increasing water usage, particularly for outdoor irrigation.
- Decreasing snowfall, reducing the natural water storage found in the Sierra Nevada snowpack.
- Precipitation shifting from snow to rain, requiring a change in water supply management.
- Rising sea levels: Threatening water supply infrastructure in coastal communities, increasing seawater intrusion into coastal freshwater aquifers, reducing water exports from the Delta.
- Increasing frequency of floods, droughts, and wildfires damaging watersheds that provide water to urban communities.

### *Improve Operational Efficiency and Transfers*

California's water system responds to our need to move water from where it occurs to where it will be used.

Conveyance—Delta RMS: NOT APPLICABLE. This RMS is not applicable to the WMA because the WMA does not have conveyance facilities in the Delta.

Conveyance—Regional/Local RMS: Imported water accounts for the majority of the WMA's potable water supply, and is obtained through the regional wholesale agencies. The WMA obtains imported water supply from the State Water Project and Colorado River, through MET and MWDOC (a member of the IRWM Group). The WMA's demand on imported water indirectly impacts the conveyance system of the Delta.

System Reoperation RMS: The region considers system reoperation as it relates to increase water supply, reliability and efficiency.

Water Transfers RMS: Water transfers are a method for sharing water during emergencies or for drought protection. Interconnections with other agencies result in the ability to share water supplies during short term emergency situations or planned shutdowns of major imported water systems. Transfers of water can help with short-term outages, but can also be involved with longer term water exchanges to deal with droughts or water allocation situations. The WMA considers both local and regional transfer and exchange opportunities that promote reliability within their systems.

***Increased Water Supply***

The region's communities are finding innovative ways to generate new supplies, but as we do, we must also manage and protect existing supplies in the most efficient manner possible.

Conjunctive Management & Groundwater RMS: Conjunctive management or conjunctive use refers to the coordinated and planned use and management of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. The WMA includes conjunctive use of its groundwater supplies from the San Juan Valley Groundwater Basin and surface water supplies from the San Juan, Trabuco, and Oso Creeks.

Desalination – Brackish & Seawater RMS: The WMA works to expand its water supply portfolio by providing planning and local resource development for ocean water desalination. The Groundwater Recovery Plant (GWRP) or San Juan Basin Desalter, which came on-line in 2004, is a 5 MGD plant owned and operated by the City of San Juan Capistrano. The GWRP takes groundwater high in iron, manganese, and total dissolved solids using RO and makes it suitable for potable water uses. SCWD currently owns and operates a 1 MGD GRF that came on-line in 2007, also known as the Capistrano Beach Desalter. The plant extracts brackish groundwater from an aquifer in the San Juan Basin and goes through iron and manganese removal due to high mineral content. Additional desalination efforts include the proposed Poseidon Desalination Plant in Huntington Beach, which would have a capacity of 56,000 AFY, the Camp Pendleton plant with another 56,000 AFY, and the Doheny Beach facility at 16,000 AFY.

Precipitation Enhancement RMS: NOT APPLICABLE. Precipitation enhancement, commonly called "cloud seeding," artificially stimulates clouds to produce more rainfall or snowfall than they would produce naturally. Cloud seeding injects substances into the clouds that enable snowflakes and raindrops to form more easily. Precipitation enhancement is the one form of weather modification done in California. The WMA currently does not practice this.

Recycled Municipal Water RMS: Orange County is a water recycling leader in the State of California, in both quantity and innovation. Water supply and wastewater treatment agencies in the WMA have received well-deserved recognition in the field of water reclamation and reuse. Recycled water is widely accepted as a water supply source throughout MWDOC's service area. In the past, recycled water was mainly used for landscape irrigation but now includes Potable and Indirect Potable Reuse options for San Juan Basin. Recycled water in the WMA is treated to various levels dependent upon the ultimate end use and in accordance with Title 22 regulation.

Surface Storage—CALFED RMS: NOT APPLICABLE. The WMA does not have surface water storage in the CALFED area.

Surface Storage—Regional/Local RMS: Surface storage is the term for the use of human-made, above-ground reservoirs to collect water for later release when needed. Surface storage has played a key role in California where the quantity, timing, and location of water demand frequently does not match the natural water supply availability. Many California water agencies rely on surface storage as a part of their water distribution systems. Reservoirs also play an important role in flood control and hydropower generation throughout California. The WMA continues to develop surface storage projects for emergency and supplemental water supply purposes for example, SMWD is developing the Trampas Canyon Reservoir to function as a recycled water reservoir to supplement local water supplies and offset imported water demands. SMWD wants to expand the existing reservoir in Trampas Canyon, south of Ortega Highway off of Cristianitos Road. The 900-acre-foot reservoir was part of a sand mining operation, but is no longer used. The new reservoir's potential water storage capacity is up to 5,000 ac-ft. per year.

***Improve Water Quality***

Improved water quality can directly improve the health of Californians and our ecosystem.

Drinking Water Treatment and Distribution RMS: Providing a reliable supply of safe drinking water is the primary goal of public water systems in the WMA. To achieve this goal, public water systems must develop and maintain adequate water treatment and distribution facilities. In addition, the reliability, quality, and safety of the raw water supply are critical to achieving this goal. In general, public water systems depend greatly on the work of other entities to help protect and maintain the quality of the raw water supply. Many agencies and organizations have a role in protecting water supplies in the WMA including MET filtration plants and the Baker WTP. For example, the SDRWQCB Region 9 Basin Plan recognizes the importance of this goal and emphasize protecting water supplies — both groundwater and surface water.

Groundwater/Aquifer Remediation RMS: The WMA includes the San Mateo Groundwater Basin and the San Juan Valley Groundwater Basin, which is contaminated by both naturally occurring and anthropogenic sources. Ongoing monitoring of the water quality of the Basin is performed by the SJBA. Actions taken within the SJBA Adaptive Pumping Management (APM) Plan have been implemented to address high TDS and seawater intrusion in the Basin.

Matching Quality to Use RMS: Matching water quality to use is a management strategy recognizing that not all water uses require the same water quality. One common measure of water quality is its suitability for an intended use; a water quality constituent often is only considered a contaminant when that constituent adversely affects the intended use of the water. High-quality water sources can be used for drinking and industrial purposes that benefit from higher quality water and lesser quality water can be adequate for some uses. The WMA considers this strategy in all four of its goals as its members seek to meet the water quality requirements and beneficial uses set forth by the RWQCB. In addition, WMA efforts to increase water reuse include urban and storm water runoff treated to recycled water standards for non-potable water uses.

Pollution Prevention RMS: Non-point sources of pollution are one of the primary concerns of the SWQCB and RWQCBs. Non-point source pollutants are generated from a variety of sources, including land use activities associated with agricultural operations and livestock grazing, urban runoff, deposition of airborne pollutants, hydromodification, and discharges from marinas and recreational boating activities. The Orange County SWRP (**APPENDIX L**) identifies nonpoint source pollution control as a main water quality benefit of increasing filtration and/or treatment of runoff. The WMA implements point source and nonpoint source pollution controls through source and structural BMPs.

Salt and Salinity Management RMS: The WMA addresses salts in the form of TDS in the San Juan Valley Groundwater Basin. Seawater intrusion is impacting the Basin. SOCWA Phase 1 SNMP was prepared in response to the SWRCB adoption of the Recycled Water Policy (State Water Board Resolution No. 2009-0011) on February 3, 2009. The purpose of the Recycled Water Policy (Policy) is to protect groundwater resources and increase the beneficial use of recycled water from municipal wastewater sources in a manner consistent with state and federal water quality laws and regulations. The Policy provides direction to the RWQCB, proponents of recycled water projects, and the public regarding the appropriate criteria to be used by the SWRCB and the RWQCB in issuing permits for recycled water projects. The Policy recognizes the potential for increased salt and nutrient loading to groundwater basins as a result of increased recycled water use, and therefore, requires the development of regional or sub-regional SNMP.

Urban Stormwater Runoff Management RMS: Urban stormwater runoff management is a broad series of activities to manage both stormwater and dry-weather runoff. Dry-weather runoff occurs when, for example, excess landscape irrigation water flows to the storm drain. Traditionally, urban stormwater runoff management was viewed as a response to flood control concerns resulting from the effects of urbanization. Concerns about the water quality impacts of urban runoff have led WMA water agencies to look at watershed approaches to reduce, eliminate or divert runoff and provide other benefits.

***Practice Resource Stewardship***

The IRWM Plan recognizes the importance of protection of water resources, made available for beneficial uses.

Agricultural Lands Stewardship RMS: Agricultural land stewardship means farm and ranch landowners — the stewards of the state's agricultural land — producing public environmental benefits in conjunction with the food and fiber they have historically provided while keeping land in private ownership (CWP Update 2005, Agricultural Land Resource Management Strategy). The WMA practices this RMS. For example, Rancho Mission Viejo is an active ranch landowner in the WMA and provides recreational and educational activities on the ranch land pertaining to stewardship through its Reserve at Rancho Mission Viejo.

Ecosystem Restoration RMS: This RMS focuses on restoration of aquatic, riparian, and floodplain ecosystems because they are the natural systems most directly affected by water and flood management actions, and are particularly vulnerable to the impacts of climate change. The WMA includes ecosystem restoration in its Water Quality objective and its Protect & Enhance Natural Resources objective. Ecosystem Restoration is implemented by the IRWM Plan, as demonstrated by such projects as the Audubon Starr Ranch Sanctuary's Riparian Invasion Control, Restoration, Monitoring, and Education Project that enhances and monitors water quality and native plant and animal communities of Bell Creek, one of the last pristine riparian corridors in southern California.

Forest Management RMS: The WMA includes the Cleveland National Forest in the east. The Southern Subregion NCCP/HCP consists of 132,000 acres, including 40,000 acres within the Cleveland National Forest and 92,000 acres within the Planning Area. The Southern Subregion NCCP/HCP was prepared by the County in cooperation with the CDFW and the USFWS. The Southern Subregion NCCP/HCP focuses on long-term protection and management of multiple natural communities that provide habitat essential to the survival of a broad array of wildlife and plant species.

Land Use Planning and Management RMS: WMA local land use and water supply planning are implemented/coordinated through a patchwork of existing State laws and policies. Regional wholesalers such as MET base their water supply plans of regional growth projections developed by regional planning agencies.

Recharge Areas Protection RMS: Recharge areas provide the primary means of replenishing groundwater. Good natural recharge occurs in areas where good quality surface water is able to percolate through sediment and rock to the saturated zone, containing groundwater. If recharge areas cease to function properly, it will limit groundwater replenishment and/or groundwater quality for storage or use. The San Juan Valley Groundwater Basin is recharged by the surface water from San Juan Creek and urban runoff. Efforts to increase the amount of recharge as well as the quality of the recharge water are underway in the WMA.

Sediment Management RMS: The key to effective water-sediment management is to address excessive sediment in watersheds. The Orange County SWRP includes sediment and flow control to return to a more natural condition as an objective for protecting and enhancing natural resources & community benefits.

Watershed Management RMS: A primary objective of watershed management is to increase and sustain a watershed's ability to provide for the diverse needs of the communities that depend upon its resources, including local, regional, State, federal, and tribal stakeholders. The WMA seeks to accomplish this objective through the development and implementation of this IRWM Plan.

***Improve Flood Management***

This IRWM Plan promotes and practices integrated flood management to provide multiple benefits including better emergency preparedness and response, higher flood protection, more sustainable flood and water management systems, and enhanced floodplain ecosystems.

Flood Management RMS: This flood management RMS has been subdivided into four approaches: nonstructural, restoration of natural floodplain functions, structural, and flood emergency management. This RMS is considered in the IRWM Plan's "Integrate flood risk management" objective. The OCFCD is tasked with the ultimate goal of protecting the County from the threat of floods by designing and constructing channels, storm drains, dams, pump stations and other drainage related facilities. The OCFCD Regional Backbone Flood Control Infrastructure provides the primary flood control protection for the County and comprises channels, dams, retarding basins, pump stations and levees. Figure 3-11 shows the regional flood infrastructure, and includes more than the OCFCD owned facilities. OCFCD's goal is to provide 100-year storm event protection to its Regional Flood Control Infrastructure.

***People & Water***

Economic Incentives (Loans, Grants, & Water Pricing) RMS: Economic incentives implemented by the WMA include financial assistance, water pricing, and water market policies intended to influence water management. Economic incentives can influence the amount and time of water use, wastewater volume, and source of water supply. Examples of economic incentives include low interest loans, grants, and water rates and rate structures. Free services, rebates, and the use of tax revenues to partially fund water services also have a direct effect on the prices paid by water users.

Outreach and Engagement RMS: Outreach and engagement for water management in California is accomplished through use of tools and practices by water agencies to facilitate contributions by public individuals and groups toward good water management outcomes. Members of the WMA actively perform outreach and engagement through numerous programs. For example, MWDOC has several outreach programs for all ages, aimed at increasing awareness of rebates and water use efficiency. MWDOC promotes school education programs and sponsors MET inspection tours to educate the public about various water management issues. MWDOC member agencies also have individual outreach program; for example, SMWD has a Student Art Contest, Tours and Education, a Scholarship Program, Water Awareness Day, and California Friendly Landscape Classes offered as outreach efforts for the community.

Water and Culture RMS: Water and culture are connected in myriad ways, with subtle and complex implications for water management in California. Some cultural relationships to water are so pervasive, they may be easy to overlook. Other cultural considerations are less apparent and may be difficult to recognize. Increasing the awareness of how cultural values, uses, and practices are affected by water management, as well as how they affect water management, will help inform policies and decisions. Legacies passed on from native societies, once expansive cattle ranches, and twentieth century entrepreneurial farmers remain a part of the WMA's culture today. From the landmark Mission San Juan Capistrano near the stunning western coastline to the Cleveland National Forest in the east, South Orange County continues to be a destination known for beauty and a high quality of life.

Water-Dependent Recreation RMS: The WMA offers a variety of water-dependent recreation opportunities in any season. Each year, millions of California residents and visitors come to the WMA's lakes, rivers, and beaches seeking recreation experiences. Doheny State Beach Park, Dana Point Harbor, area beaches, and parks located along regional stream courses serve as community gathering places and are used year round. For example, Doheny state Beach continues to have millions of visitors each year. In addition, the Heisler Park State Marine Reserve (formerly called an Ecological Reserve) and the overlapping Laguna Beach State Marine Park is a popular tidepooling area and can suffer from scavenging by beach visitors.

***Other Strategies***

Crop idling, dew vaporization, fog collection, irrigated land retirement, rainfed agriculture, snow fences, and waterbag transport/storage technology RMSs: NOT APPLICABLE. These RMSs are not applicable to the region because they are not practiced in the WMA. Less than one percent of the WMA includes agricultural lands. Therefore, crop idling, irrigated land retirement, and rainfed agriculture are not considered in the IRWM Plan objectives. The WMA does not typically experience snow, therefore snow fences are not considered in the IRWMP objectives. Waterbag transport/storage technology is currently not implemented in the WMA.

Climate Change: Climate Change is considered in the IRWM Plan objectives as it impacts all facets of watershed management. All of the applicable RMSs also considered the effects of Climate Change on the IRWM region. Due to the significance of climate change on all strategies, a complete climate change analysis was completed and is included in **APPENDIX J**.

## *5.3 Resource Management Strategies (RMS) Not Applicable to Region*

Nearly all types of RMS are applicable and considered within the South Orange County IRWM Plan and proposed projects. Although most of the RMS were identified as applicable to the region, as discussed in **Section 5.2** and shown in **Figure 4-3**, some were not. The following RMSs noted as "NOT APPLICABLE" in the previous section do not apply to the WMA:

Conveyance – Delta and Surface Storage – CALFED RMS: This RMS is not directly applicable to the WMA, as most of the region's conveyance issues are related to local infrastructure and the region does not own or operate conveyance in the Delta region or surface storage facilities in the CALFED region.

Precipitation enhancement RMS: Artificial cloud seeding is not a practice within the region.

Surface Storage—CALFED RMS: The WMA does not have surface water storage in the CALFED area.

Crop idling for water transfers RMS: does not apply due to the limited agricultural land and farming that occurs in the region, where crop idling doesn't occur.

Dew vaporization RMS: This practice is not used within the WMA.

Fog collection RMS: This practice is not applicable due to the limited rainfall and precipitation within the Region.

Irrigated Land Retirement RMS: Less than one percent of the South Orange County WMA has agricultural farming; retirement of irrigated agricultural land would have little impact on water supplies in the WMA.

Rainfed Agriculture: Due to limited regional rainfall, this practice is not applicable.

Waterbag Transport/Storage Technology: This technology has not been explored in the WMA and is not an applicable practice; above ground reservoir storage facilities are utilized for storage instead.

## *5.4 Regional Strategies*

The state's RMSs were considered in the development of regional objectives and strategies for the WMA. The state's RMSs also align with strategies and guidelines found in the MET's IRP for imported water, LRP for local water source development, and Long Term Conservation Plan. The regional goals, objectives and strategies developed by the South Orange County IRWM Group are discussed in **Section 4.3**. The IRWM Plan includes multiple projects that will implement the regional strategies. Each project accomplishes several aspects of water management for the region. Strategies and projects that address multiple objectives are typically the most cost-effective and resource-efficient, and are given higher priority in the IRWM Plan. The following explains how the strategies were developed and items considered in developing the IRWM Plan goals, objectives, and regional strategies. Integration of the regional strategies discussed in this section to meet the IRWM Plan objectives enhances the benefits of project implementation throughout the South Orange County region.

### 5.4.1 Integrate Flood Management Strategies

The WMA considered Flood Management Strategies in developing the IRWM Plan goals, objectives, and strategies. Flood management practices recognized by the IRWM Plan include (but are not limited to): stabilizing streambeds impacted by development-exacerbated stormflows, conversion of hardened ditches and channels to widened soft-bottomed naturally-vegetated channels where feasible, addressing erosion and, flood control. Project performance would typically be measured by linear feet of streambed stabilized and/or converted channel; and acreage of soft-bottom channel created. This would also be accomplished by managing development through the planning process (County and cities) to reduce post-project flow to pre-project flow.

A key component of flood management is the use of Geographic Information Systems (GIS), databases and other data management tools to support data development and manage the WMA's watersheds. It promotes the development, installation, application or updating of flood control and pollutant control data, methods of measurement and management to protect waterways. Short-term per-project performance may be measured by expansion of catalogued data, confirmation of previous data conclusions, identification of erosion and sedimentation sources, and identification of accurate and rapid source tracking methods. Long-term per-project performance would typically be measured by estimated reduction in nuisance runoff volume or rate discharged to beaches; and/or estimated reduction in concentration or quantity of pathogens or indicator pollutants discharged compared to pre-project conditions.

### 5.4.2 Improve Water Quality Strategies

The WMA considered surface and groundwater quality during the development of the IRWM Plan's goals, objectives, and strategies.

***Surface Water Quality***

This management strategy will promote the region-wide utilization of centralized and decentralized structural BMPs, appropriate to non-point-source pollutants and land use types, to minimize the discharge of pollutants into or from the MS4 and into downstream aquatic ecosystems during both wet and dry weather. Per-project performance would typically be measured by the number and area of sites affected; estimated reduction in nuisance and/or storm runoff volume or rate; and/or estimated reduction in quantity of key pollutants potentially exposed to discharge to the environment, compared to pre-project or conventional conditions. Extensive discussion about the Objectives and Strategies to Improve Water Quality are found in **Section 4.3.2**.

***Groundwater Quality***

Groundwater quality protection projects and activities will help prevent contamination of aquifers by sewage, industrial or other wastes. In some cases, groundwater remediation is necessary to improve the quality of degraded groundwater for beneficial use. Drinking water supply is the beneficial use that typically requires remediation when groundwater quality is degraded.

The SJBA San Juan Basin Groundwater and Facilities Management Plan, Section 3.7.6, identifies a number of sites being monitored that may require groundwater cleanup from underground storage tanks (UST), as well as permitted facilities such as operating USTs and land disposal sites. Ten former and current UST sites are identified with potential to impact the groundwater basin, detailing where USTs were removed, existing facilities, and pollutants of concern and their monitoring as well as actions for remediation where necessary.

Implementation of this strategy also protects recharge of groundwater aquifers in a cost-effective manner consistent with minimizing socioeconomic and environmental impacts. This will include potential production from the San Clemente wells as well as possible production from the San Mateo Groundwater Basin. Arrangements with Camp Pendleton and/or the Bureau of Reclamation may need to be developed for use of San Mateo water.

### 5.4.3 Increase Water Supply, Reliability, and Efficiency Strategies

This strategy implements water savings and benefits including improvements in technology and management of water.

Through conjunctive management, the WMA coordinates use of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. Managing both resources together, rather than in isolation, allows water managers to use the advantages of both resources for maximum benefit. Implementation of conjunctive management will increase pumping and needed treatment of local groundwater for water supply, consistent with sustainability and conjunctive use with other supplies. The projection for groundwater production out of San Juan Basin is anticipated to move from 3,674 AFY in 2010- to 8,594 AFY in 2035. Additional dry-year yield may be developed through groundwater management planning, discussed in **Section 3.3.2**.

***Water Supply Reliability***

South Orange County is highly dependent on imported water resources. As a result, the WMA continues to work with MWDOC and MET on improving regional and local water conveyance facilities. Analysis conducted as part of the 2016 Orange County Water Reliability Study[83] highlighted risks to supply for South Orange County. Conclusions indicated that without new supply and system investments, projected water shortages would be too great, and reliability not sustainable, by as early as 2030. Further details about the WRS conclusions can be found in **Section 3.7.2.2**.

<u>Water Transfers</u>

A few MWDOC member agencies have also expressed interest in pursuing transfers of water from outside of the region to improve water supply reliability. MWDOC will continue to help its member agencies in developing these opportunities and ensuring their success. SMWD has actively pursued additional water supply reliability through water transfers and successfully completed water transfers in the late 1990's through the MET system. SMWD will continue to pursue water transfers as an alternative water supply and is currently working with MWDOC and other agencies to investigate possible transfers. Another example is the Cadiz Project which will draw on an aquifer in eastern San Bernardino County that would normally discharge fresh water into a brackish aquifer that then evaporates in a dry lake bed. SMWD acquired rights to 5,000 AFY from this new source that enters the CRA to reach Orange County. The Supplemental

[83] Orange County Water Reliability Study - Final Draft Executive Report, October 2016

Dry Year Agreements are triggered under specific conditions when supplies from MET are limited. Cucamonga Valley Water District and Golden State Water Company (GSWC) will utilize groundwater in lieu of taking delivery of imported water from MET. SMWD has a transfer agreement with Cucamonga Valley Water District of 4,250 AFY, both short term and long term. SMWD also has a short term transfer agreement with GSWC of 2,000 AFY. IRWD has also implemented their Strand Ranch Water Banking Program and initiated the first delivery of water under the program to their service territory in OC in June 2015 as a demonstration effort.[84]

Desalination

Desalination aligns with this strategy and was considered in the IRWM Plan goals, objectives, and regional strategies. Application of desalination technology is increasingly recognized as a component of a sustainable water portfolio for Southern California. In Orange County, there are three proposed ocean desalination projects that could serve MWDOC and its member agencies with additional water supply; the Huntington Beach Seawater Desalination Project, the South Orange Coastal Ocean Desalination Project (also known as the Doheny Ocean Desalination Project), and the Camp Pendleton Seawater Desalination Project[85]. Desalination can help meet the goals and objectives of the region. Development of potable supplies through desalination of ocean sources has the opportunity to produce 128,000 Acre Foot of supplies or possibly more, based on opportunities identified in the 2015 UWMP Section 7.4.2. Of the desalination opportunities identified, each is at a different stage of investigation and development.

Recycled Water

Recycled water was considered in the development of the IRWM Plan goals, objectives, and regional strategies. The WMA plans to increase the production and distribution capacity for recycled water. Water supply and wastewater treatment agencies in Orange County have received recognition in the field of water reclamation and reuse. Based on MWDOC's projections, expansion of recycled supplies provided by the SOC WMAs water agencies through planned projects is expected to expand production from approximately 17,800 AFY currently, to approximately 33,500 AFY by 2040.

Drinking Water Treatment

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[84] Municipal Water District of Orange County (MWDOC). 2015 Urban Water Management Plan Update. Available online March 2017: http://www.mwdoc.com/Uploads/DRAFT%20MWDOC%20UWMP_April%202016.pdf

[85] The Camp Pendleton Seawater Desalination Project would likely serve San Diego County, but would contribute to offsetting regional water supplies.

Drinking water treatment and distribution are also part of the WMA strategy to increase system sustainability and reliability. Bolstering water treatment and distribution facilities aids in the development of local potable supplies to help reduce the risk of drought exposure to South Orange County. The WMA will implement projects focused on improving reliability of the water supply system accordingly; **Section 3.7.2.2** describes this is greater detail. The WMA depends on a combination of imported and local supplies to meet its water demands and has taken numerous steps to ensure its member agencies have adequate supplies. Development of groundwater, groundwater recovery enhancement, recycled water systems, desalination opportunities, and collection of urban return flows augment the reliability of the imported water system.

The Orange County Reliability Study, Phase 2 Results, identifies the most feasible larger SOC supply projects, to mitigate both water supply shortages and system shortages. Some of these projects include:

- MWDOC Expanded Emergency Supply Program
- LBCWD Groundwater
- SJB Groundwater Expansion
- Doheny Beach Desalination
- Poseidon Desalination
- Cadiz Transfer
- Water Banking

**APPENDIX B** of the finalized version of the OC Reliability Study contains a complete listing of projects considered for Orange County. Some of the desalination projects above are discussed in **Section 3.3.4.1**. IRWM projects that benefit local storage or supply, as well as conservation, help to protect against shortages at a local and regional level.

### *Water Efficiency Strategies*

The WMA considered WUE during the development of the IRWM Plan goals, objectives, and regional strategies. The WMA considered region-wide utilization of structural and source control BMPs to conserve water and prevent potential pollutants from entering municipal storm drain systems and aquatic ecosystems. In addition to OCSP projects implemented through the WQIP to reduce urban runoff and hydromodification resulting from stormwater flows see **Section 3.7.2.8**, water agencies have prioritized projects that provide both WUE and water quality benefits. MWDOC developed a WUE Master Plan in 2012-13 that identified programs and strategies to comply with SBx7-7. Per-project performance would typically be measured by the number and area of sites affected; and estimated reduction in quantity of water discharged and key pollutants potentially exposed to discharge to the environment, compared to pre-project or conventional conditions. For more information about MWDOC’s WUE activities in the WMA, see **Section 3.7.2.3**.

To facilitate the implementation of BMPs, MWDOC focuses WUE efforts on the following three areas:

- Regional Program Implementation: MWDOC develops, obtains funding for, and implements regional BMP programs on behalf of all retail water agencies in Orange County.
- Local Program Assistance: Upon request, MWDOC assists retail agencies in developing and implementing local programs within their individual service areas. MWDOC provides assistance with a variety of local programs including, but not limited to: Home Water Surveys, Landscape Workshops (residential and commercial), Public Information, School Education, Conservation Pricing, and Water Waste Prohibitions.
- Research and Evaluation: An integral component of any WUE program is the research and evaluation of potential and existing programs. In the past five years, MWDOC has conducted research that allows agencies to measure the water-savings benefits of a specific program and then compare those benefits to the costs of implementing the program. This cost/benefit analysis enables individual agencies to evaluate the economic feasibility of a program prior to its implementation.

Surface Storage and Runoff Capture

Regional/local surface storage management also promotes WUE and includes investigation of emerging technology and regulatory actions for on-site capture, storage and re-use of rainwater for irrigation purposes, consistent with water quality and vector control needs; however, these can be extremely expensive measures. Surface water provides an additional local source to some MWDOC member agencies, including IRWD and TCWD. Surface water supplies in Orange County are captured mostly from Santiago Creek into Santiago Reservoir (a.k.a. Irvine Lake) and some reclaimed from local streams and surface runoff in South Orange County (in the SMWD service area). There are a few other dams located on the smaller streams throughout the County; however, these are generally only for flood control or local agricultural use. Effort has been made in exploring the opportunity for increasing utilization of water in San Juan Basin in South Orange County through the development of desalters and percolation basins.

### 5.4.4 Protect Natural Resources Strategies

The WMA considered protection of natural resources during the development of the IRWM Plan goals, objectives, and strategies. In particular, the WMA considers eliminating or reducing non-native surface runoff from affecting riparian eco-systems, water reuse, and protecting beneficial uses.

Protecting receiving waters and marine ASBS to the extent feasible is paramount to this strategy. Implemented projects may have a number or acreage of sites retrofitted with control measures and/or measure estimated reduction in daily or storm discharges to the receiving waters or ASBS. Protection and enhancement of natural resources will help re-establish native aquatic, riparian and transitional biotic communities along stream courses to the extent feasible. Project performance would typically be measured by linear feet of restored stream course; acreage of vegetation re-established; species diversity; and percent cover.

In addition, this strategy provides opportunities for controlled recreational access and enjoyment of aquatic ecosystem areas to minimize the environmental impacts of uncontrolled use. Per-project performance would typically be measured in linear feet or acreage of area made accessible; and estimated recreational use or capacity for use.

## *5.5 Regional and Inter-Regional Benefits*

Implementation of the IRWM Plan and its projects will lead the WMA into a future with a reliable water supply, protected and improved water quality, and achievement of the statewide priorities and program preferences for integrated regional planning. The IRWM Plan has served as an impetus to bring stakeholders together to discuss common goals, address concerns, and brainstorm solutions.

As the IRWM Plan is implemented and benefits of water supply and water quality are realized, so will the adjacent areas and regions benefit from the South Orange County regional efforts. Benefits to implementing projects with interregional benefits/advantages include increased opportunity for project implementation, collective planning to monitor regional changes and facilitate refinements for implementation, increased participation and cooperation by the public, shared costs, and cooperative land-based planning as opposed to confinement within political boundaries.

Development of South Orange County local supplies and enhancement of existing local supply also provides enhanced reliability of imported water suppliers for other regions. When dependence on imported water for the WMA is reduced, water supply to other regions will increase, enhancing their reliability.

Long-term attainment and maintenance of water quality standards within the watersheds throughout the WMA will result in enhanced local supplies, habitat restoration, pollution control, and outdoor recreational opportunities. Pollution reduction in impaired water bodies and sensitive habitat will benefit South Orange County wildlife habitat. Overall watershed health realized in the WMA provides greater opportunities for communities to enjoy the area in which they live, including beach activities, hiking, biking, bird watching, horseback riding, and other activities that thrive in this Region.

Elements of the IRWM Plan and the WMA cooperative framework present a potential model for other regions and areas of the State. Individual projects that are implemented and produce beneficial results may also be used as pilot projects that are transferable to other regions. Regional planning presents the opportunity for collective and collaborative planning in a logical and beneficial process. The prioritization of projects within the WMA provides the greatest benefit for the greater good.

Moreover, it is important to recognize that regional solutions are necessary to achieve statewide priorities and the objectives of the region for water supply reliability, groundwater management, water conservation, and water quality. In certain cases, Regional Action Projects (RAPs) have been defined where appropriate to implement a single strategy across the entire region that would involve all participants on a phased, as-needed funding basis. Regional solutions are being implemented in the objectives.

Collaboration of regional projects and priorities will achieve substantially enhanced regional benefits, increased opportunity for project implementation, collective planning to monitor regional changes and facilitate refinements for implementation, increased participation and cooperation by the public and interregional benefits to adjacent areas. Neighboring regions will experience benefits from the implementation of the South Orange County IRWM Plan.

## *5.6 DAC / Environmental Justice Benefits*

The IRWM Group has made it a priority to incorporate DACs within their projects. The DACs of South Orange County, as discussed in **Section 3.6**, predominantly utilize the waters within the region as recreational hubs. Waters within the region include area beaches, local creeks and streams, and wetland environments. Since many of these waters are accessible to the DACs of South Orange County where it is safe to provide public access, projects focused on providing safe drinking water and enhanced water quality will primarily benefit these communities. **Figure 3-15**depicts the DACs throughout the entire South Orange County IRWM Region.

Water quality of the watersheds greatly impacts the recreational opportunities for the disadvantaged community members, especially since portions of the watersheds that drain into the beach areas are impaired waters. The SDRWQCB has designated beneficial uses for many of the watershed waters for agricultural supply, contact and non-contact water recreation, warm freshwater habitat and wildlife habitat. Groundwater municipal supply is a beneficial use in the San Juan Basin and easterly portion of Aliso Creek. Projects proposed in this plan will contribute to each of these beneficial uses, enhancing the opportunity to residents in DACs.

Refer to **Section 3.6** for a description of the Water Needs Assessment, which will further define DAC, URC, URC and Native American Tribal water resource needs and potential benefits.

***Coastal Benefits***

The surrounding areas of Doheny State Beach Park, Dana Point Harbor, area beaches, and parks located along regional stream courses serve as community gathering places for DACs and are used year-round. Many of the recreational areas are accessible via public transit and often do not charge an entrance fee for walk-in visitors. Many recreational areas are also handicapped accessible. Today, Doheny State Beach continues to have millions of visitors each year.

Projects focused on improving the water quality of Aliso Creek Beach, like Aliso Viejo's Dairy Fork Wetland project, will greatly benefit DACs, especially low-income apartment complexes along the upper Aliso Creek. Aliso Creek beach is accessible through the OCTA bus system since it is a facility of the County of Orange. This beach along with beaches and parks in the region serve the DAC equally since there is no entrance fee.

The City of San Clemente's Recycled Water Treatment and Distribution project was funded under Proposition 50 IRWM Implementation Grant Program. The project reduced wastewater effluent into the ocean, accommodating DACs that utilize neighborhood parks and beaches as a weekend retreat. DACs will continue to enjoy the beach and ocean resources as a result of fewer beach closure days due to higher water quality. Water quality is a key consideration for the WMA to ensure protection of the health and safety of the entire population in the area, especially for the disadvantaged community residents that do not have the means to travel to other areas of the state or country.

***Inland Benefits***

Multiple creek restoration, wetland, and Arundo removal projects have been completed or are underway in the Region. For example, the Audubon's Starr Ranch Sanctuary project funded by Proposition 50 in the WMA restored 125 acres of the Bell Creek riparian zone, providing wildlife and habitat research education programs for kids and adults. This and other creek habitat and restoration projects will significantly benefit the continued enjoyment of the region's natural systems for low income populations.

In addition, ETWD's Recycled Water Distribution System Expansion was funded by Proposition 84 Round 1 Implementation Grant and constructed a new recycled water distribution system to serve the ETWD Service Area that includes DAC in the City of Laguna Woods. The project converted approximately 75 existing potable water dedicated irrigation meters to recycled water. The conversions reduced the amount of potable water imported by the District by as much as 300 AFY. This project directly benefits DACs.

These projects would meet multiple objectives and provide multiple benefits, including recreational and aesthetic benefits and increased water supply reliability. Expanded opportunities for recreational benefits include contact and non-contact water recreation, walking paths, bird watching, nature study, painting and photography, and other passive activities.

Recreational opportunities resulted from the implementation of the Oso Creek Multi-Use Trails Project in Laguna Niguel. This project provides and expands creek-side trail-ways for recreation and easier access to regional trails, the Metrolink station, and bus route links, as well as the opportunity for use by DACs.

Educational and public outreach activities like those found in the Audubon Starr Ranch project increase residents' understanding and appreciation of wetlands and other areas of significance, including how human interaction impacts habitat areas and other natural resources. The Audubon Starr Ranch project is designed to inspire broad implementation of water quality and water conservation improvements across the community.

Additional projects within the region continue to incorporate measures to improve infrastructure needs in DACs, such as offering catch basin insert installation to multi-family housing complexes where economically disadvantaged concentrations are significant.

***Benefits of Disadvantaged Community Participation***

Through addressing water quality issues in areas of recreational use, the IRWM Plan incorporates environmental justice in a way that provides every resident equal opportunity and fair treatment in the regional water planning process. As part of the DAC, the IRWM Group has and will continue to actively involve regional minority communities, including the Juaneño Band of Mission Indians and Hispanic community groups to ensure their active involvement in the IRWM Plan. Additionally, the IRWM Plan projects have recognized the benefits to support DAC within their areas of influence.

Since the initial IRWM Plan development, the IRWM Group has conducted outreach to DAC and Native American Tribal representatives as part of project development and IRWM Planning; however, focused outreach to these communities to better identify DAC water management needs across the San Diego Funding Area is needed. For the 2018 IRWM Plan, the Water Needs Assessment described in **Section 3.6** will be the focus of outreach efforts; the goal of the assessment is to refine DAC, URC, EDA and Native American Tribe water resource needs and to encourage participation in the IRWM Planning process on a long-term basis. The IRWM Group also seeks to identify key priorities to address any deficiencies in water, wastewater, stormwater and flood control systems that may impact these communities.

Outreach to DAC groups for IRWM Plan development has also included the following:

The Juaneño Band of Mission Indians tribe provided a letter of support for the 2005 IRWMP. In June 2012, David Belardes (Chief and Chairman of Juaneño Band of Mission Indians) was contacted and notified about the July 9, 2012 Stakeholder Workshop.

The Laguna Woods Village Professional Community Management (Homeowner's Association) was contacted and the July 9, 2012 Stakeholder Workshop announcement and OC link was provided to Professional Community Management. The invite notice and link were posted on the HOA website on in July 2012.[86]. A request was made to the Laguna Woods Village public information officer to post the March 21, 2018 Stakeholder Workshop notice by the City Deputy Clerk.

NHEC provided a letter of support for the 2005 IRWM Plan as a result of outreach efforts. In June 2012, NHEC was contacted and provided a copy of the 2005 letter of support. NHEC was invited to the July 9, 2012 Stakeholder Workshop.

LHA provided a project for inclusion in the 2005 IRWM Plan. LHA was contacted in June 2012 and invited to the July 9, 2012 Stakeholder Workshop. LHA was contacted in March 2018 for

[86] Wendy Bucknum, Professional Community Management. Laguna Woods Village HOA. 7/6/12.

assistance in outreaching to Latino communities in South Orange County for the March 21, 2018 Stakeholder Workshop.

Orange County Watersheds staff attended a California Latino Water Coalition (CLWC) event in 2010 at the OCWD. In June 2012, CLWC was contacted via phone and email and invited to attend the July 9, 2012 Stakeholder Workshop.

This South Orange County IRWM Plan aims to ensure equitable distribution of benefits to all members of the region. Environmental justice brings to light the fact that minority members of the community tend to disproportionately endure environmental pollution and unhealthy conditions. South Orange County seeks to include members of the community in the IRWM planning process to spread the benefits of IRWM Plan and project implementation to all. Specifically, the region has prioritized projects that:

- Increase the participation of DACs in the IRWM process.
- Develop multi-benefit projects with consideration of affected DAC and vulnerable populations
- Contain projects that address safe drinking water and wastewater treatment needs of DACs
- Address critical water supply or water quality needs of California Native American Tribes within the region

As previously explained, the water quality protection benefits of this IRWM Plan and its projects significantly protect the recreational beaches and waterways in the South Orange County WMA that many members of DACs from other regions frequently use. The IRWM Plan and implementation of its projects will benefit the Region’s DACs and support regional environmental justice.

## *5.7 Environmental Impacts / Benefits to Other Resources*

The regional watersheds contain a wide variety of environmental resources, extending from headwaters to ocean, and from urban landscape to forested mountaintop. These resources include water, wildlife, cultural and physical landscapes.

Currently, local watersheds are suffering from a variety of water resource and related land resource problems. Most of these are related to widespread changes in the watersheds, including changes in the hydrologic regime, channel instability, habitat loss, ecosystem degradation, urban impacts to water quality, threats to recreational resources, and others. While change is a part of the evolution of any landscape, dramatic change from a balanced historic state often results in undesirable consequences.

All proposed projects within the IRWM Plan are individually evaluated under CEQA guidelines to identify potential impacts (both negative and beneficial) to the following:

- Aesthetics
- Air Quality
- Biological Resources
- Cultural Resources
- Geology and Soils
- Hazardous Materials
- Hydrology and Water Quality
- Land Use and Planning
- Noise
- Population and Housing
- Public Services
- Recreation
- Transportation and Traffic
- Utilities and Service Systems
- Effects on Tribal cultural resources and Consultation with California Native American Tribes.

Where significant potential negative impacts are identified, the CEQA process will implement appropriate mitigation measures into the project. Responsibility for mitigation measures lies with the individual project sponsor(s). Where there are potential impacts to jurisdictional waters, habitats or species, mitigation requirements are determined within permitting processes with the RWQCB, USACE, and CDFW. Federal anti-degradation policies for surface water quality and "no net loss" policies for wetlands are typically reflected in the permit requirements. The data management methods identified in **Section 7** will work in conjunction with environmental impact analysis and ongoing project monitoring to identify potential impacts.

# 6 PROJECTS

The projects support the objectives and regional strategies described in **Section 4** of this IRWM Plan. Implementation of the projects will enable the WMA to reach its objectives, described in **Section 5** of this IRWM Plan, which reflect Statewide RMSs. This section describes the specific process for soliciting for, identifying, prioritizing, and communicating the list of water resource projects to best meet the goals and objectives of this plan.

Specific projects listed are being or have been developed by IRWM Group members and stakeholders. In certain cases, RAPs have been defined, where appropriate, to implement a single strategy across the entire region that would involve all participants on a phased, as-needed funding basis. The Project List is included in **APPENDIX F** of this report; however, the list included is for reference only. The IRWM Group has developed an extensive geospatial-based DMS as detailed in **Section 7** which provides stakeholder access to the Project List at all times, including the ability to add, amend or remove projects based upon project planning and development. As the project list is always available in the DMS, the list of projects is communicated to stakeholders on an ongoing basis. Projects included on the Project List may choose to seek IRWM Grant funding; however, projects may also be included for regional planning purposes. As a result, submittal of projects for inclusion in the plan and for IRWM Grant funding are linked, but processed in two phases. If a project proponent is prepared to and interested in seeking IRWM Grant funding, they will participate in Phase 2 see **Figure 6-1**. For projects interested in being on the list for regional planning and/or other grant programs (e.g. Storm Water Grant), they would submit projects for inclusion through Phase 1 see **Figure 6-1**.

**APPENDIX F** includes two lists: 1) a Project List for projects to have an opportunity for funding, and 2) a Funded Project List for projects that have received funding and are either completed or in progress. The Project List is available at all times; however, there are two levels of QA/QC to ensure projects listed in the IRWM Plan accurately. An initial review by County staff ensures project information is complete and accurate; the MC then provides QA/QC of the project scoresheets to ensure projects are utilizing the prioritization criteria correctly. The former review occurs as projects are submitted and the latter at least biennially or more frequent, as needed. This section provides an overview of this process and discusses projects implemented through the IRWM Plan.

## *6.1 Project Review Process*

The South Orange County IRWM Group has established a two-phase Project Review Process of solicitation and evaluation/prioritization that is driven by the Governance Structure and IRWM Plan Update process, as described in **Section 2.6.2**. **Figure 6-1**on the following page summarizes this process.

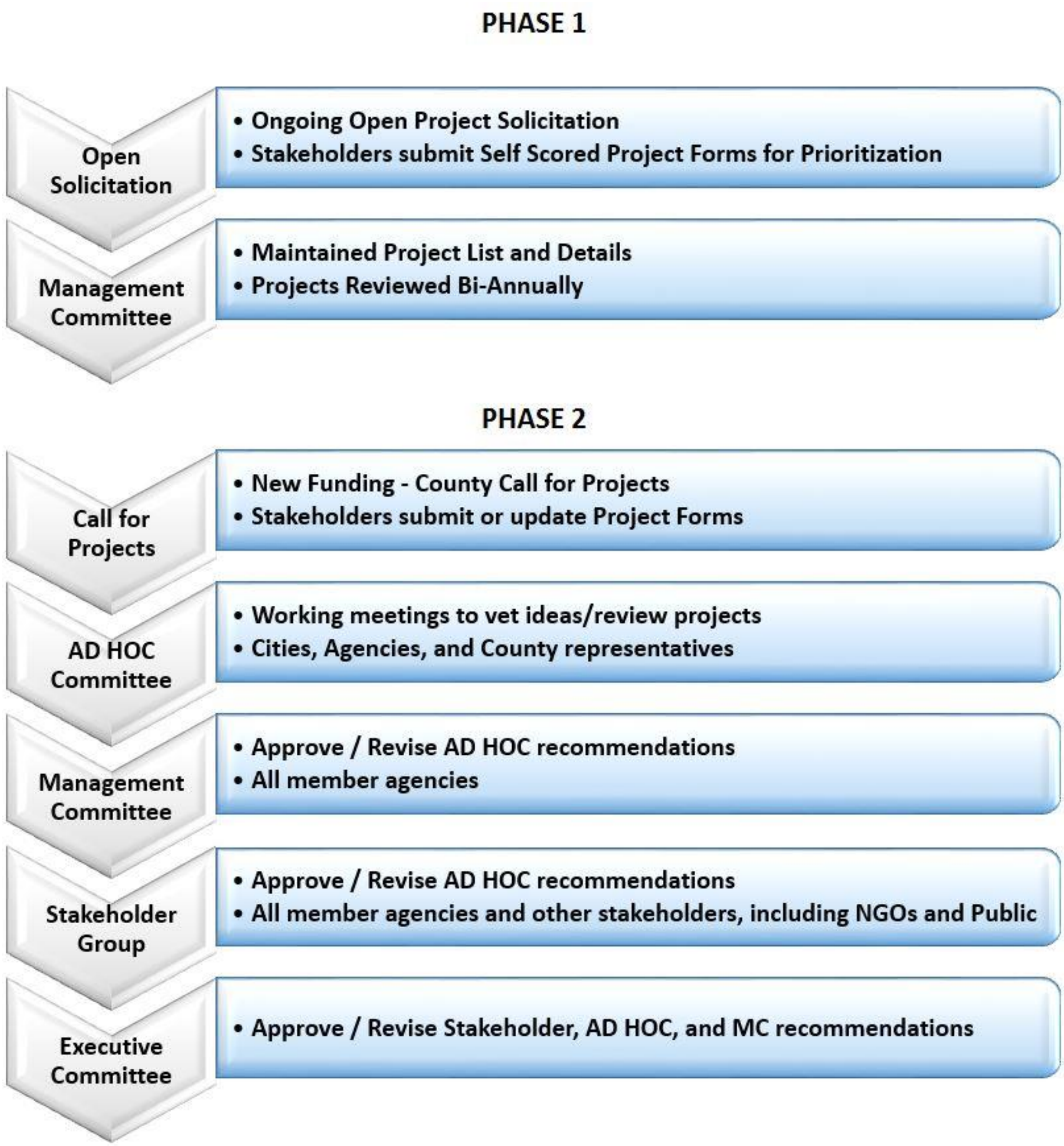


**Figure 6-1: Project Review Process**

### 6.1.1 Phase 1: Project Solicitation

As shown in **Figure 6-1**, projects are incorporated into the plan and considered for IRWM Grant funding in two phases.

The first of the two phases includes ongoing solicitation of projects and maintenance of the IRWM Plan Project List. A project form, the "IRWM Project Solicitation Score Sheet" (Project Score Sheet) was created for the 2018 IRWM Plan update and is made available to interested parties at all times through the DMS (see **APPENDIX C**)[87]. The form reflects the 2016 Plan Standards and updated priorities, objectives, and strategies to reflect considerations for climate change. Reflective of State RMSs and IRWM Plan objectives, the Project Score Sheet provides a baseline prioritization based upon South OC WMA priorities as described in **Sections 4 and 5** of this plan. Projects that complete the Project Score Sheet are included on the IRWM Plan Project List, which self-adjusts with each submittal (see **APPENDIX F**). The Project Score Sheet and accompanying online Esri ArcGIS form (to add the geospatial reference for each project) require project proponents to provide basic information about the project, including the following review factors:

- How the project contributes to the IRWM Plan objectives (emphasis placed on projects capable of quantifying project metrics that meet objectives);
- Whether or not the project can contribute to WMA goals by meeting multiple objectives (i.e. projects providing multiple benefits receive greater prioritization);
- How the project is related to RMSs selected for use in the IRWM Plan;
- Specific benefits to DAC water issues, including whether a project helps address critical water supply or water quality needs of a DAC
- Benefits to critical water issues for Native American tribal communities
- Environmental justice considerations
- Project financing;
- Project Status; Readiness to proceed;
- Contribution of the project in adapting to the effects of climate change in the region (e.g. GHG emission reduction); and
- For IRWM Group agency projects that receive water supplied from the Sacramento-San Joaquin Delta, demonstration of how the project or program will help reduce dependence on the Sacramento-San Joaquin Delta for water supply.

The above listed review factors may change, depending upon iterative review and assessment by stakeholders. The IRWM Project Solicitation Score Sheet uses a weighted additive formula for each project, summing the scores of weighted regional objectives (**Section 4.4**) within the IRWM goals (**Section 4.1.2**), and then summing the scores of each weighted goal to determine the total points a project receives. There are four goals. Each goal has four to eight objectives, and each objective has a number of suggested strategies (**Section 4.3**) by which a project can meet the objective. Weighted values were assigned to each objective as well as to each goal. **APPENDIX K** identifies the weighting of each goal and each objective.

[87] The DMS is an Esri ArcGIS StoryMap platform, which provides the mechanism for creating the IRWM Project list by auto-generating the list from stakeholder submittals through a simple online form. Project Score Sheets are then added to the geospatial reference on a map after basic QA/QC to ensure completeness. This process may be iteratively amended, based upon stakeholder input.

Goal and objective weighting expressed in the IRWM Plan may be modified on an as-needed basis, as regional priorities change. **APPENDIX K** includes a summary of the goal and objective weighting developed through the process described in **Section 4**.

To determine the score for an objective, each project proponent evaluates if a project meets a given objective, by choosing "Yes" or "No" when asked if the project achieves a given objective. The score from the "Yes" or "No" (1 or 0, respectively) is multiplied by the objective weight. These weighted objective scores are then summed together for the goal under which they fall. This total value is then multiplied by the overall goal weighting. This process determines the individual goal scores. In addition to points accumulating for the targeting of objectives and goals, if a metric will be measured, the overall score goes up by 1 point per metric. Additional points are assigned based on how well a project targets the review factors listed above. Points from those review factors are summed with those from each metric and those based on the weighted objectives and goals.

***Building a Geospatial Database for Regional Project Planning***

Project Score Sheets submitted for inclusion on the Project List are paired with a geospatial project location on a GIS map by County staff; Project Score Sheets and geospatial information are provided by the stakeholder submitting the project. The online form utilized to generate the geospatial backdrop to the Project List is a simple entry form, providing stakeholder access to the process, regardless of their ability to use GIS. This not only provides transparency in development of the Project List, it also streamlines updates to the list and provides a continuously updated map of potential projects for regional planning. The projects accumulated in the IRWM Plan Project List are then reviewed biennially (at a minimum) by the MC for adherence to IRWM priorities and objectives to provide for fairness in the prioritization across all stakeholder submittals.

To eliminate barriers to stakeholders using the DMS, the IRWM Group provided a Technical Assistance Workshop in Spring 2018 on how to use the new system and Project Score Sheet to enter projects on the Project List. Additionally, instructions on how to submit a project were discussed at public EC meetings and made available in the DMS, and County staff are available to provide additional assistance, if needed.

***Project Considerations for Climate Change Impacts***

As noted previously, the Project Score Sheet includes weighting for how projects meet the goals and objectives of the IRWM Plan. These objectives include consideration for strategies to combat climate change, reduce GHG emissions and/or increase energy efficiency. Specifically, the following review factors are considered:

- Potential effects of Climate Change on the region and consideration for whether or not adaptations to the water management system are necessary;
- The contribution of the project to adapting the identified system vulnerabilities to climate change effects on the region;

- Changes in the amount, intensity, timing, quality and variability of runoff and recharge;
- The effects of SLR on water supply conditions and identify suitable adaptation measures;
- The contribution of the project in reducing GHG emissions as compared to project alternatives;
- The project's ability to help the IRWM region reduce GHG emissions as new projects are implemented over the 20-year planning horizon; and,
- Consideration for climate change stresses (e.g. reduction in energy consumption achieved by the project, especially the energy embedded in water use, and resultant reduction in GHG emissions).

### 6.1.2 Phase 2: Evaluation and Prioritization for IRWM Grant Funding

Phase 2 begins with a formal open Call for Projects. During this solicitation, proponents either submit new projects not previously included in the Project List or notify the IRWM Group of interest in applying for grant funding for a project already Projects that previously submit forms through Phase 1 are afforded the opportunity to either keep their prioritization as-submitted or to re-evaluate and re-submit. Though this can happen any time, it is especially important that project proponents consider timing of updates to ensure their projects are considered in the Call for Projects pertinent to each grant round.

Project Score Sheets represent an initial screening tool to develop a preliminary list of projects; more detail and defined metrics are requested during Phase 2. Project proponents are asked for additional technical information regarding claimed benefits, including quantification of benefits to allow for comparison of overall benefit to the WMA from projects seeking grant funding. The following additional review factors may also be requested and considered; however, this process is flexible in nature to provide for iterative prioritization based upon grant requirements:

- Technical feasibility of the project;
- Economic feasibility, including water quality and water supply benefits and other expected benefits and costs;
- Strategic considerations for IRWM Plan implementation; and
- Whether the project proponent has adopted or will adopt the IRWM Plan.

The projects that ranked the highest are selected for further review/vetting by the MC (see **Figure 6-1**). Once approved by the MC, project rankings and recommendations are provided to stakeholders for review. At a public workshop, project proponents for the top ranked projects interested in applying for the targeted grant program present to stakeholders on the merits of the project, costs, grant funding requested, etc. Workshop attendees chose a focus group (one for each goal category) in which to participate; the projects and their associated scoring and proposed Ad Hoc and MC ranking are discussed. This stakeholder process is used to determine the final relative ranking of the top projects for funding and provides open communication with the IRWM Group on the list of selected projects for funding. The selected projects are then recommended to the EC for final approval based upon Ad Hoc, MC, then stakeholder ranking and discussion. The list of selected projects is communicated to stakeholders through the EC approval process at a publicly posted meeting; however, the IRWM Group communicates the list of projects for stakeholder input earlier in the process through the aforementioned workshop.

The IRWM Group will continue to evaluate regional goals and modify this process as needed, with stakeholder input. When a new round of IRWM grant funding is available, the projects received and prioritized during the South Orange County WMA solicitation process will be reviewed for how they meet the funding requirements of the IRWM guidelines and proposal solicitation package in addition to how they meet the South Orange County WMA IRWM goals and objectives. For examples of projects that have undergone this process and were approved for inclusion in grant applications, please refer to **Section 6.3** of this IRWM Plan for a list of Completed/Funded Projects.

### 6.1.3 Contribution to Statewide Priorities

As discussed in **Section 4.1.1,** DWR compiled various Statewide Priorities based on the 2014 California Water Action Plan, issued by the California Natural Resources Agency, California Department of Food and Agriculture, and the California EPA (January, 2016). Those Statewide Priorities are shown in **Table 4-1 – Statewide Priorities**.

Efforts to meet Statewide Priorities and improve water quality conditions have been underway in the WMA for many years, and have continually advanced as new technologies and resources have become available. All of the statewide priorities are incorporated into the IRWM Objectives and RMSs, as defined in this IRWM Plan. Refer to **Section 4.1.1** for more discussion on the Statewide and regional goals.

### 6.1.4 Project Integration of Regional Strategies

As part of the project review process, projects that integrate multiple regional strategies (discussed in **Section 5.4**) are identified and prioritized. The regional strategies were developed based on the state’s RMSs. Strategy integration includes implementing various projects that, when combined, achieve a synergistic approach to watershed management. Though projects must address at least one of the strategies targeting a regional objective, the majority incorporate several complementary strategies, often to achieve multiple objectives. For example, projects that assist with increasing water supply by offsetting imported water supply needs may also include incentive programs to enhance WUE and reduce GHG emissions through use of energy efficient technologies. The method for achieving integration is identifying projects that incorporate several complementary strategies to achieve multiple objectives.

The project review process itself allows an open exchange/dialogue of existing and future plans. As discussed in **Section 6.1.1,** projects are prioritized based on numerous review factors, specifically the accomplishment of IRWM Plan strategies and objectives. Projects are either pulled from existing plans in its entirety or created through combining projects from different plans. As a result, the most immediate needs and balanced implementation are identified.

Benefits to implementing interregional projects include increased opportunity for project implementation, collective planning to monitor regional changes and facilitation of refinements for implementation, increased participation and cooperation by the public, shared costs, and cooperative land-based planning as opposed to confinement within political boundaries. Strategies and projects that address multiple objectives are typically the most cost-effective and resource-efficient, and are for the most part given higher priority in the IRWM Plan.

## *6.2 Impacts and Benefits*

The intent of this section is to document potential impacts and benefits of implementation of the IRWM Plan and to clearly communicate those impacts and benefits to stakeholders. In the development of an IRWM Plan, it is important that participants understand the potential benefits to be gained by implementing a regional plan and some of the impacts that may occur.

The list of implementation projects will change as the IRWM planning effort matures. This impact and benefit (**Table 6-1**) analysis serves as a benchmark as the Plan is implemented and Plan performance is evaluated. The IRWM Plan implementation will result in positive impacts and benefits to the watersheds within the WMA, between regions, DAC, environmental justice concerns, and Native American Tribal communities. As discussed in **Section 4** of this IRWM Plan, the WMA has established goals, objectives, and quantitative and qualitative strategies for evaluating each project. The strategies contain suggested units of measure that will be used to assess the impacts and benefits of implemented projects. **APPENDIX F** includes a list of the projects and the anticipated impacts and benefits, as linked to qualitative and quantitative strategies. As noted, the IRWM Plan is a living document; as such the Project List, accumulation of funded projects, and benefits claimed/achieved and impacts may change over time. The IRWM Plan Project List and associated project metrics/benefits will be considered per the discussion in **Section 4** and amended, as needed by the IRWM Group.

**Table 6-1: Impacts and Benefits**

| IRWM Goal | Project Type-Sponsor | Within IRWM Region | |
|---|---|---|---|
| | | Potential Impacts | Potential Benefits |
| Protect and Enhance Natural Resources | San Juan Aquatic Passage and Habitat Improvement - USDA Forest Service, Cleveland National Forest | Protect natural resources by improving and restoring riparian areas impacted by invasive weeds, primarily treating invasive fig in Holy Jim Creek. Stabilize the stream channel through dam removal/invasive plant removal, which will help reduce anthropogenic sedimentation in the San Juan Creek Watershed. Restoring natural habitat and stream | Improvements to three stream crossings that will connect 2 miles of stream that are currently disconnected, thereby improving 145 acres of riparian habitat. Invasive weed removal along 2 miles of stream. Includes removal of a total of 16 dams. |

| Table 6-1: Impacts and Benefits | | | |
|---|---|---|---|
| IRWM Goal | Project Type-Sponsor | Within IRWM Region | |
| | | Potential Impacts | Potential Benefits |
| | | connectivity will promote a supportive setting for native species to become more sustainable and successful. | |
| Integrate Flood Management | Crown Valley Park Channel Entry Improvements – City of Laguna Niguel | Drought preparedness through enhancing water supply and improving WUE. Improving water quality in response to TMDL and 303(d) priorities. Improving flood control for public and property protection. Protection/enhancement of natural resources and habitat. | Phase 1 includes conversion of 20 acres of landscaping from potable to recycled water supply, reducing potable consumption up to 32 AFY. Phase 2 will A) replace 2.3 acres of turf with drought-tolerant plants; B) improve dry and wet weather runoff quality from 1,197 acres by implementing trash controls, a treatment wetland and bioswales; C) restore 1.54 acres of riparian habitat from hardened and grass-lined channel bed; and D) mitigate flooding by installing a culvert crossing at the park entry. |
| Protect and Enhance Natural Resources | Strategic Turfgrass Removal & Design Assistance Program - MWDOC | WUE. Protecting natural resources. Water quality enhancement. And drought preparedness. | Converts approx. 42 acres of turfgrass to California friendly landscapes. Provides technical design assistance. Saves 252 AFY of water with the use of smart timers. Constructs BMP's and prevents pollutants from entering storm drains on 1,019 acres of urban landscape. |
| Increase Water Supply, Reliability, and Efficiency | 3A Water Recycling Plant Tertiary Expansion - SMWD | Increases water supply, drought preparedness, and energy savings | Increases the local water supply/sustainability by reliably producing an additional 3,000 AFY of recycled water with reduced dependency on imported water. Saves 5,653,000 kWh of energy per year by producing and distributing recycled water in place of imported water. |

| Table 6-1: Impacts and Benefits | | | |
|---|---|---|---|
| IRWM Goal | Project Type-Sponsor | Within IRWM Region | |
| | | Potential Impacts | Potential Benefits |
| Increase Water Supply, Reliability, and Efficiency | Recycled Water Distribution Upgrade-SMWD | Increases water supply, drought preparedness, and energy savings | Replaces an existing 6,600-foot section of 10-inch recycled distribution system supply main with a 16 inch main to increase capacity by up to 530 GPM, or approximately 850 AFY. Saves a total of 1,700,000 kWh per year of energy by supplying recycled water locally in place of imported water supply. |
| Increase Water Supply, Reliability, and Efficiency | Califia Recycled Water Project - SMWD | Provide immediate regional drought preparedness, Increase water supply reliability, water conservation, and WUE | Provides 220 AFY of recycled water to the region for irrigation, thereby promoting potable water conservation, conjunctive use, and reuse and recycling. |
| Increase Water Supply, Reliability, and Efficiency | Recycled Water System Extension Project - SCWD | Provide immediate regional drought preparedness, Increase water supply reliability, water conservation, and WUE | Provides 150 AFY of recycled water to the region, thereby promoting potable water conservation, conjunctive use, and reuse and recycling. |
| Increase Water Supply, Reliability, and Efficiency | Recycled Water System Extension Project - MNWD | Provide immediate regional drought preparedness, Increase water supply reliability, water conservation, and WUE | Provides 102 AFY of recycled water to the region through 32 new recycled water services in various locations, thereby promoting potable water conservation, conjunctive use, and reuse and recycling. |
| Integrate Flood Management | Dairy Fork Wetland - Cities of Aliso Viejo, Lake Forest, Laguna Hill and Laguna Woods | Enhance Flood protection for public safety and property, Habitat Restoration, and Reduction of pollutants passing through local storm drains and into Aliso Creek | Has the capacity to contain up to 161,000 cubic feet of stormwater, restores 2 acres of land to a wetland environment and provides suitable habitat for fauna and flora, especially native plants. 90 percent reduction in TSS by treating approximately 325 acre-feet of urban runoff annually. |
| Protect and Enhance Natural Resources | Riparian Invasive Control, Restoration, | Land Management Activities, Restoration of Oak (Riparian) Woodlands, Restoration of | 125 acres of invasive control, restoration, monitoring, and education. Management and |

| Table 6-1: Impacts and Benefits | | | |
|---|---|---|---|
| IRWM Goal | Project Type-Sponsor | Within IRWM Region | |
| | | Potential Impacts | Potential Benefits |
| | Monitoring, and Education at Audubon Starr Ranch Sanctuary - Audubon Starr Ranch Sanctuary | Significant Ecosystem and Natural Landscapes, Restoration of Riparian Habitat Ecosystems, Eradication of Invasive Species, Fish Habitat | monitoring of pristine Bell Creek within the 125-acre area. Nonchemical control of riparian invasive species within the 125-acre area. Habitat enhancement for potential steelhead trout within the 125 acre area. |
| Increase Water Supply, Reliability, and Efficiency | Baker Water Treatment Plant - IRWD | Water Supply Enhancement and Water Quality Improvement | 86 acre-feet per day of water supply enhancement, Advanced treatment using modern micro-filtration membrane and ultraviolet disinfection treatment technologies. |
| Increase Water Supply, Reliability, and Efficiency | Comprehensive Landscape WUE Program - MWDOC | WUE, Water demand reduction, Water Quality Improvement, Sediment Removal, Conservation Management Plans | 8,883 acre-feet water saved over a 10-year project life. 50 percent reduction in runoff pollutant load. 50 percent reduction in dry-weather runoff volume. Helps meet SBx 7-7 water savings goal of 20 percent by 2020 |
| Increase Water Supply, Reliability, and Efficiency | Water Conservation and Implementation of Targeted Programs - SCWD | Reduced Potable water use inside businesses & homes and reduced water demands on irrigation. Builds public awareness and encourages action. Compliance with 20x2020. Compliance with CWA and Porter-Cologne | Targeted goal of 3 acre feet in water reductions over life of program. Beneficial inclusion of 20 acres of land in program. Target up to 12,000 District Water Customers. Will achieve 12 percent of region's goals by 2020 if implemented widely. Monitor participants for water use and runoff reductions. |

The projects included in the table above represent projects implemented through the IRWM Plan and funded through IRWM Grant programs. As such, this subset of projects provides a good sample of impacts and benefits of projects implemented through the IRWM Plan. Please refer to **APPENDIX F** for a comprehensive list of projects that meet IRWM goals and objectives.

Although the table above highlights positive impacts, negative impacts of implementing projects are also possible. Negative impacts are identified and assessed via the CEQA/NEPA Environmental review process, as required. Regarding water supply projects, possible negative impacts may include reduced in-stream flow, water quality degradation, habitat removal, species removal, flooding, loss of farmland, and construction related impacts.

Possible negative impacts of implementing water quality projects may include construction related impacts including short-term, site-specific impacts related to site grading and construction, and long-term impacts associated with project operation. Construction-related impacts may include: traffic, noise, biological resources, water quality, public services and utilities, cultural resources, and aesthetics. Other impacts may include surface water and ocean habitat loss from new outflow locations, and waste discharge issues associated with brine management and brine disposal. Possible benefits from improved water quality projects may include increased water supply, improved aquatic and wetland species habitat and populations, increased cropland production, creation of wetlands and riparian habitat, improved recreation opportunities, and decreased treatment costs.

Possible negative impacts of groundwater improvements may include construction related effects, changes in water quality, increased contaminant transport, increased pumping, and in-stream flow reduction. Possible benefits may include improved flood protection, decreased reliance on imported water, reduced surface water use, reduced pumping costs, and decreased or prevention of groundwater overdraft.

Possible negative impacts of water conservation and reuse projects may include construction related effects, loss of drainage flow to downstream water users, in-stream flow loss, groundwater and surface water quality effects associated with recycled water use, and reduced groundwater recharge. Benefits could be increased water saving, efficient reuse of wastewater, costs savings from reduced purchases of imported water, and saving construction of water storage facilities, and increased nutrient levels for plant and crop use from use of reclaimed wastewater.

Watershed projects' possible negative impacts such as introduction of non-native plants for erosion control and temporary increased turbidity in streams due to construction or related activities, including revegetation and forest regeneration activities and prescribed fires (to reduce undesirable trees and vegetation, etc.). Benefits may include long-term sediment reduction and temperature improvements, reduced surface water nutrient and bacteria concentrations (improved water supply quality), improved fish and wildlife habitat and passage, and enhanced public safety and recreational opportunities.

Habitat Improvement projects' possible negative impacts could include short-term, site-specific impacts related to site grading and construction, loss of agricultural land protection and urban uses and associate local revenue. Benefits may be reduced surface water nutrient and bacteria concentrations (improved water supply quality), enhanced fish habitat, increased opportunities for recreational hunting and viewing, increased numbers of native species, reduced flood risks, and education opportunities.

Flood management projects' negative impacts may include short-term, site-specific impacts related to construction, land use restrictions, development moratoriums (with potential economic effects), and loss of riparian and/or wetland acreage. Benefits could include increased aquifer recharge, runoff reduction, improved surface water quality, natural resources preservation and restoration, reduced risk to life and property, and decreased flood insurance costs.

The impacts and benefits of each project implemented will be monitored through the measurable objectives achieved by the projects. In this way, achievement of IRWM Plan Goals will be tracked. The projects collectively will have impacts and benefits throughout all the watersheds in the WMA, as described in **Section 6.2.1**.

### 6.2.1 Impacts on WMA Watersheds

The following discussion includes projects used as a sampling of the impacts and benefits for the South Orange County WMA watersheds. Other projects implemented by the IRWM Plan agencies will provide similar benefits; as noted previously, the projects described in this section highlight projects previously approved for funding by the IRWM Group because they maximize benefits and minimize impacts to the WMA. Verification of IRWM Plan implementation benefits will be measured on a project basis through evaluations that reflect water use before and after the landscape improvements. Working with local water districts, water use information for participating sites will be obtained for inclusion in project specific evaluations. The positive impacts will be carefully documented for credit in contributing to meeting basin plan objectives.

#### 6.2.1.1 Aliso Creek Watershed

As outlined in the Aliso Creek Watershed Management Plan, the watershed suffers from a number of problems related to water resources.[88] The identified problems are grouped in four general categories: creek instability, water quality, loss of fish and wildlife habitat, and flooding damages.

Human impacts have propagated water quality impairments in the Aliso Creek main-stem and tributaries, impacting designated beneficial uses. The Aliso Creek Watershed Work Plan[89] updated through 2013 identified eight watershed impairing pollutants: indicator bacteria, selenium, total nitrogen, total phosphorous, toxicity, benzo[b]fluoranthene, dieldrin, and sediment toxicity, posing a significant concern to the health of the watershed. The Aliso Creek CLRP similarly identified priorities for pollutant load reduction specific to meeting required Basin Plan objectives for Aliso Creek. Additionally, as described in **Section 3.3.1.1**, the WQIP identified source and structural control BMPs in the Aliso Creek watershed that will achieve bacteria load reduction necessary for TMDL compliance. Projects within the watershed that

[88] County of Orange. Aliso Creek Watershed Plan. 12/20/04. Available online 2/13/13: http://www.ocwatersheds.com/AlisoCreek_ReportsStudies.aspx

[89] County of Orange, OC Watersheds, “Aliso Creek Watershed Work Plan”, January 1, 2012. Available online 12/6/12: http://www.ocwatersheds.com/Documents/2012_AlisoCreekWatershedWorkplan.pdf

reduce bacteria and urban runoff flows through IRWM Plan implementation assist with meeting this goal.

The objectives in the IRWM Plan are measurable milestones that will enable the community to track progress toward maintaining a natural balance in watershed resources. Several projects implemented through the IRWM Plan are reflective of integrated water management practices and exemplify the objectives.

***Water Supply Reliability & Efficiency – MWDOC Strategic Turfgrass Removal and Design Assistance/Comprehensive Landscape WUE Programs***

The Strategic Turfgrass Removal & Design Assistance and Comprehensive Landscape WUE Programs funded in the 2015 and Round 2 Proposition 84 grant programs, respectively, assist in meeting the water conservation and water quality goals of all the entire WMA. Project goals and objectives assist in meeting several objectives of the Aliso Creek Watershed Management Plan, Aliso Creek Watershed Work Plan, CLRP and WQIP. Implementation of both programs decreases urban runoff flows, reducing opportunities for transport and growth of indicator bacteria by promoting the transformation of turf intensive landscapes to California Friendly landscapes that require less water, fertilizer and pesticides.

***Water Supply Reliability & Efficiency – IRWD's Baker Water Treatment Plant***

IRWD's Baker Water Treatment Plant project is physically located within the Newport Bay and the Santa Ana River Watershed; however, portions of the water supply produced from the project will be served in the Aliso Creek and San Juan Creek Watersheds within the South Orange County IRWM Area. The project's main purpose is to increase water supply reliability by providing 28 MGD of drinking water supply to the area. The project benefits provide improved local water treatment capability for variable supply and assist maintenance of water delivery in the event of system failures.

***Water Quality – Dairy Fork Wetland***

The City of Aliso Viejo's Dairy Fork Wetland Project funded in the 2015 Proposition 84 Grant directly benefits the Aliso Creek Watershed by improving water quality and habitat in two project phases. The first phase includes the construction of a wetland to reduce pollutant loads in urban runoff from the Dairy Fork sub-watershed. The wetland treats 325 AFY of urban runoff draining from 1,500 acres of highly urbanized land. Additionally, removal of non-native plants around the wetland provides opportunities for native plants to establish and provide habitat. Specifically, Aliso Creek will benefit from the proposed wetland as it will reduce sediment, bacteria, metals, nutrients, and motor oil found in the runoff from the Dairy Fork sub-watershed. The native plant species that replace invasive or non-native plants over the two-acre wetland area will serve as a natural purification system; thus decreasing potential water pollution from draining into Aliso Beach. The second phase is the removal of approximately five acres of invasive non-native *A. donax* (Arundo) stands over nine total acres of riparian corridor in the Dairy Fork sub-watershed. Removal of these invasive plants will reduce stress on the riparian ecosystem, restore native habitat upstream and downstream of the wetland, and complement and expand the water quality improvement goals of the constructed wetland. This will result in greater biofiltration of pollutants, lower and more natural water temperatures and increased groundwater recharge due to the removal of high water-use Arundo.

***Water Quality – Laguna Niguel Crown Valley Park Channel Entry Improvements***

The City of Laguna Niguel's Crown Valley Park Channel Entry Improvements Project represents a multi-benefit project that embodies the integrated goals of the IRWM Plan. The primary goal of the project is to remove constituents of concern (nutrients and FIB) from urban runoff draining a 1,197-acre urbanized area; a sediment forebay, trash boom, treatment wetland and bioswales provide additional surface water treatment in the park. Water quality improvements support beneficial uses downstream along lower Sulphur Creek and the 40-acre Sulphur Creek Lake. Additionally, the Project eliminates operational flooding and associated public safety impacts through installation of a new arched culvert crossing. Lastly, replacement of in-channel irrigated turfgrass and grouted rockwork with native plants restores open-water, floodplain, transitional riparian habitats and connectivity to existing riparian habitat downstream. Though the project is principally a water quality improvement project, it also offsets use of 32 AFY of potable water supply by converting 20 acres of landscaping to recycled water for irrigation and enhances WUE by 7 AFY through replacement of turfgrass with native plants and inefficient irrigation systems in upland areas with efficient devices.

#### 6.2.1.2 Dana Point Coastal Streams Watershed

The Dana Point Coastal Streams Watershed includes beneficial uses for several waterways. Priority concerns for the watershed are water quality at Salt Creek Beach, Monarch Beach and Baby Beach, and environmental issues arising from marina uses in Dana Point Harbor (anti-fouling paints, etc.).

To address high bacteria concentrations at Baby Beach and at other impaired harbor and bay beaches, the SDRWQCB adopted the TMDLs for Indicator Bacteria, Baby Beach in Dana Point Harbor and Shelter Island Shoreline Park in San Diego Bay (Resolution No. R9-2008-0027) in June 2008. The TMDLs were later incorporated into the Fifth Term MS4s Permit Order No. R9-2013-0001 as amended by No. R9-2015-0001 and R9-2015-0100. Attachment E Specific Provision 5.b.(2)(c) of Order R9-2013-0001 requires the County of Orange and the City of Dana Point to implement BMPs to achieve the interim and final TMDL compliance requirements. The Baby Beach Indicator Bacteria TMDL Workplan updated in the annual report[90] provides an overview of the BMPs and source investigation activities underway by the TMDL partners to eliminate sources of indicator bacteria to Baby Beach. The Workplan follows an established source identification protocol[91] to meet TMDL compliance. Following this protocol, the TMDL partners have conducted a structural BMP inventory and inspection, conducted more extensive GIS mapping, testing of the adjacent sanitary sewer and coordinated with SCWD to conduct repairs in response to identified system deficiencies. Additionally, as described in **Section**

[90] Baby Beach Indicator Bacteria TMDL Annual Progress Reports (OC Watersheds Document Database)

[91] The California Microbial Source Identification Manual: A Tiered Approach to Identifying Fecal Pollution Sources to Beaches (SCCWRP, 2014).

**3.3.1.2**, the WQIP identified source and structural control BMPs in the Dana Point Coastal Streams watershed that will achieve bacteria load reduction necessary for TMDL compliance. Projects within the watershed that reduce bacteria and urban runoff flows through IRWM Plan implementation assist with meeting this goal.

Although the City of Dana Point operates an ozone treatment facility at Salt Creek which is effective in treating bacteria (and viruses) to beach water quality standards. A large bird population that resides at the scour pond/creek mouth after treatment can foul beach water quality with indicator bacteria. A bird deterrent project has been piloted during summer (high beach use months) which has shown to be effective in reducing indicator bacteria inputs from gulls.

South Orange County IRWM Plan implementation positively benefits the watershed. The goals and objectives of regional projects will assist in meeting several objectives of the Dana Point Coastal Streams Watershed.

***Water Supply Reliability & Efficiency – MWDOC Strategic Turfgrass Removal and Design Assistance/Comprehensive Landscape WUE Programs***

The Strategic Turfgrass Removal & Design Assistance and Comprehensive Landscape WUE Programs described in **Section 3.7.2.3** reduce watershed irrigated landscape and improve irrigation efficiency, resulting in less pollution making its way downstream towards the beach into watersheds such as the Dana Point Coastal Streams. Projects proposed in this Plan will similarly assist in reducing overall runoff and nuisance flows.

***Water Supply Reliability & Efficiency – SCWD Targeted Water Conservation and Program***

SCWD's Water Targeted Water Conservation Program funded in Proposition 84 Round 2 (2014) provided WUE benefits to the Dana Point Coastal Streams Watershed. Complimentary to similar MWDOC programs described above, SCWD efforts added a watershed-wide education and outreach component and lent support to the analysis, planning, implementation, and measurement of program results for watershed conservation activities. The targeted program further reduces dry weather nuisance flows, improves in-stream water quality, and provides support for impaired beneficial uses.

#### 6.2.1.3 Laguna Coastal Streams Watershed

The Laguna Coastal Streams Watershed discharges into the Pacific Ocean in Laguna Beach and contains undeveloped areas largely within the Laguna Coast Wilderness Park and the Aliso and Wood Canyons Regional Park. The water quality in the Pacific Ocean along the Laguna Coastal Streams consistently ranks among the cleanest in Southern California with regard to Ocean Plan objectives.[92] In addition to open space providing natural buffers, the watershed IRWM Group

[92] County of Orange, OC Watersheds, "Laguna Coastal Streams Watershed Work Plan", January 1, 2012. Available online 12/3/12: http://www.ocwatersheds.com/Documents/2012_LagunaCoastalStreamsWatershedWorkplan.pdf

members have been proactive in implementing seventeen dry weather diversion units on the largest subwatersheds to intercept and redirect flows to SOCWA for treatment and reuse.

Receiving waters offer several beneficial uses, including agricultural supply, non-contact and contact water recreation, warm freshwater habitats, and wildlife habitats. The Heisler Park Ecological Reserve is an ASBS located in this watershed, and protection of the reserve is underway through stringent coastal planning efforts between the City of Laguna Beach, City of Newport Beach, Irvine Company, the County of Orange, California State Parks, and Caltrans.

Implementation of the IRWM Plan will provide positive impacts and benefits to this watershed. To further protect the resources and beneficial uses in this watershed, regional projects will aid in the reduction of watershed irrigated landscapes, improve irrigation efficiency, and decrease associated nuisance flows, which can carry pollutants to creeks and the ocean. The projects will also help meet receiving water objectives established in the Region 9 Basin Plan as well as indicator bacteria objectives established in the Region 9 Beaches and Creeks Bacteria TMDL described in **Section 3.3.4**.

***Water Quality – Laguna Beach Heisler Park Marine Habitat Protection Project***

The Heisler Park Marine Habitat Protection Project was implemented as part of this IRWM Plan to assist in protecting the ASBS and is further described in **Section 3.3.1.8**.

***Water Supply Reliability & Efficiency – SCWD Recycled Water Expansion Efforts***

SCWD has implemented two recycled water expansion projects in the watershed, to provide greater distribution of recycled water for irrigation and other non-potable uses. The projects, implemented through the IRWM Plan, were funded through the Drought and 2015 Proposition 84 Grant rounds. Local stakeholders participatory in the IRWM process have expressed the need for recycled water in the Laguna Beach area; these projects help to address those needs.

#### 6.2.1.4 San Juan Creek Watershed

The San Juan Creek Watershed is the largest watershed in the South Orange County WMA. A small western portion of the San Juan Creek Watershed extends into Riverside County, which is in an adjacent IRWM region. The creek ultimately discharges into the Pacific Ocean at Doheny Beach. The watershed includes the following beneficial uses: agricultural supply; cold freshwater habitat; industrial; contact water recreation; non-contact water recreation; spawning habitat; warm freshwater habitat; and wildlife habitat. The following designations apply to the mouth of San Juan Creek: rare, threatened, or endangered species; non-contact water recreation; marine habitat; migratory habitat; shellfish habitat; and wildlife habitat.

The San Juan Creek Watershed Management Plan identifies the following as the most severe problems in the watershed: Flooding and erosion, general ecosystem degradation including channel and floodplain instability, poor water quality (both in surface waters and ocean nearshore zone), and loss of habitat with associated wildlife loss.[93]

Urbanization has propagated water quality impairments in the San Juan Creek main-stem and tributaries that impact designated beneficial uses. The San Juan Creek Watershed Work Plan[94] last updated in 2013 identified eight watershed-impairing pollutants, including: indicator bacteria, chloride, sulfates, total dissolved solids, DDE, diazinon, and selenium. The San Juan Creek CLRP similarly identified priorities for pollutant load reduction specific to meeting required Basin Plan objectives for the watershed. Additionally, as described in **Section 3.3.1.4**, the WQIP identified source and structural control BMPs in the San Juan Creek watershed that will achieve bacteria load reduction necessary for TMDL compliance. Projects within the watershed that reduce bacteria and urban runoff flows through IRWM Plan implementation assist with meeting this goal.

***Water Supply Reliability & Efficiency – MWDOC Strategic Turfgrass Removal and Design Assistance/Comprehensive Landscape WUE Programs***

The Strategic Turfgrass Removal & Design Assistance and Comprehensive Landscape WUE Programs described in **Section 3.7.2.3** reduce watershed irrigated landscape and improve irrigation efficiency, resulting in less pollution making its way downstream towards the beach into watersheds such as the San Juan Creek watershed. Projects proposed in this Plan will similarly assist in reducing overall runoff and nuisance flows.

***Habitat Restoration – Audubon Starr Ranch Sanctuary Project***

The Audubon Starr Ranch Sanctuary restores 125 acres of riparian and wetland habitat in the Starr Ranch Sanctuary on Bell Creek, a major tributary to San Juan Creek in the upper watershed. Restoration of the site will ensure increased protection of water quality and sustained beneficial uses for recreation and wildlife uses on San Juan Creek.

***Habitat Restoration – USDA National Forest Service San Juan Aquatic Passage & Habitat Improvement Project***

The Cleveland National Forest San Juan Aquatic Passage and Habitat Improvement protects watershed natural resources by improving and restoring riparian areas impacted by invasive plants, including invasive fig in Holy Jim Creek and Arundo, where present. The Project includes removal of historic dams from the upper watershed, and replacement of three stream crossings that will re-connect and stabilize two miles of stream for fish passage. Overall, the project improves 145 acres of riparian habitat. Additionally, removal of water-intensive non-native

[93] County of Orange, OC Watersheds, "San Juan Creek Watershed Management Plan," September 2002. Available online 12/3/12: http://www.ocwatersheds.com/Documents/San_Juan_Creek_WMP_Sep2002.pdf

[94] County of Orange, OC Watersheds, "San Juan Creek Watershed Work Plan", January 1, 2012.

plant species from the upper watershed provides for greater flows downstream to recharge the groundwater basin. Regional climate change projections of rising temperatures will increase stresses on native plant and aquatic species as they compete for scarce resources. Invasive plant removal will enhance aquatic habitat and leave more water available for other resources. Restoring natural habitat and stream connectivity will promote a supportive setting for native species to become more sustainable and successful.

***Additional IRWM Group Projects for Water Quality and Flood Management***

The City of Dana Point's proposed San Juan Creek Storm Drain L01S02 BMPs will remove trash from runoff and infiltrate and/or divert or otherwise manage nuisance dry weather flows from the L01S02 storm drain before entering San Juan Creek, which, when flowing, discharges to the Pacific Ocean at Doheny State Beach. Subwatershed partners, including Caltrans, San Juan Capistrano and Dana Point continue to coordinate to determine source of nuisance flows and feasibility of infiltration upstream in the watershed in order to determine best management solution for this subwatershed. This project would further help support impaired beneficial uses by reducing watershed priority pollutant loadings. It also includes an Arundo removal component to further improve the watershed and habitat.

This IRWM Plan also includes flood risk management projects implemented by OCPW and funded by other sources. For example, OCFCD/OCPW has planned extensive channel improvements to San Juan Creek and Trabuco Creek Channels to fortify levees and protect homes and businesses from the threat of storms. Channel improvements are the result of a long-term planning to ensure conveyance of the 100-year storm event for the main watershed channels and reduce flood risk to neighboring properties. Where feasible, OCFCD/OCPW considers potential ecosystem restoration opportunities on the lower reaches of San Juan Creek Watershed as part of project implementation.

An ongoing study, the "San Juan Creek Invert Stabilization Study", is expected to provide recommendations for optimum channel bottom slopes and grade control structures. The first phase of the study, to assess existing geomorphology, is an engineering fluvial study needed to determine geophysical parameters of San Juan and Trabuco Creeks. Objectives of the study are to assess sediment transport data; evaluate historical vertical changes in streambed elevations to define trends in erosion and deposition; characterize floodplain hydraulics for the erosion analysis; apply different regime and geomorphic relationships for assessment of stable channel (equilibrium slope); analyze and model for general and long term conditions and perform sensitivity analysis.

The second phase will develop and study alternatives for best (optimal) stable channel. Alternatives are expected to accommodate beneficial uses such as groundwater recharge, fish passage and others. Phase 2 is underway.

#### 6.2.1.5 San Clemente Coastal Streams Watershed

The San Clemente Coastal Streams Watershed includes Prima Deshecha Canada, one of two main streams that flow through the City of San Clemente and ultimately discharge into the

Pacific Ocean at Poche Beach. The following beneficial uses are designated in the Basin Plan for the receiving waters listed above: agricultural supply; contact water recreation; non-contact water recreation; warm freshwater habitat; and wildlife habitat. The San Clemente Coastal Streams Watershed Work Plan[95] last updated in 2013, identified indicator bacteria exceedances (as determined by FIB) at beaches, and the resulting potential for human health impacts, as the most significant issue. The San Clemente Coastal Streams CLRP similarly identified priorities for pollutant load reduction specific to meeting required Basin Plan objectives for the watershed. Additionally, as described in **Section 3.3.1.5**, the WQIP identified source and structural control BMPs in the San Clemente Coastal Streams watershed that will achieve bacteria load reduction necessary for TMDL compliance. Projects within the watershed that reduce bacteria and urban runoff flows through IRWM Plan implementation assist with meeting this goal.

Poche Beach has been routinely posted for exceedances of the FIB standard in the surf zone. A dry weather filtration/UV disinfection plant at the Poche Creek outlet was completed in 2009 and as of 2013 has helped shift Heal the Bay beach Report Cards[96] for the beach from F to A or A+ (through 2016).

***Water Supply Reliability & Efficiency – MWDOC Strategic Turfgrass Removal and Design Assistance/Comprehensive Landscape WUE Programs***

The Strategic Turfgrass Removal & Design Assistance and Comprehensive Landscape WUE Programs described in **Section 3.7.2.3** reduce watershed irrigated landscape and improve irrigation efficiency, resulting in less pollution making its way downstream towards the beach into watersheds such as the San Clemente Coastal Streams. Projects proposed in this Plan will similarly assist in reducing overall runoff and nuisance flows.

***Water Supply Reliability & Efficiency – San Clemente Recycled Water Treatment and Distribution***

The City of San Clemente's Recycled Water Treatment and Distribution Project was funded under the Proposition 50 IRWM Implementation Grant Program in 2006. Completed in 2014, the Recycled Water Treatment and Distribution Project expands the City's recycled water system, which consists of a 2.8-MGD treated recycled water treatment plant expansion, 2.0 million-gallons reservoir conversion, pump station, booster pump, interconnection, five pipeline transmission main segments totaling 12,600 linear-feet and onsite customer conversions. This project greatly enhances the local resources of the watershed.

#### 6.2.1.6 San Mateo Creek Watershed

Most of San Mateo Creek and its outlet to the Pacific Ocean, at San Onofre State Beach, are located in San Diego County, in an adjacent IRWM region. There are both existing and potential

[95] County of Orange, OC Watersheds, "San Clemente Coastal Streams Watershed Work Plan," January 1, 2012. Available online 12/3/12: http://www.ocwatersheds.com/Documents/2012_SanClementeCoastalStreamsWatershedWorkplan.pdf

[96] https://healthebay.org/

beneficial uses as described in the Basin Plan for the San Diego Basin. The following existing potential beneficial uses are designated in the Basin Plan for the receiving waters listed above: cold water habitat; rare species habitat; contact water recreation; non-contact water recreation; spawning habitat; warm water habitat; and wildlife habitat. There are no 303(d) impaired waterbodies in the portion of the San Mateo Creek Watershed within Orange County, nor have any pollutants of concern been identified.[97]

There are several projects within this IRWM Plan that, once implemented, will result in water quality, water conservation, and other benefits. For example, the Strategic Turfgrass Removal & Design Assistance and Comprehensive Landscape WUE Programs, l collaboratively work to reduce the overall pollutant load transport within the South County WMA and Coastal Zone by reducing runoff from landscaped areas. This cohesive approach to regional projects is consistent with enhancing water quality in the San Mateo Creek Watershed by reducing dry weather nuisance pollutant run-off. Additionally, as described in **Section 3.3.1.6**, the WQIP identified source and structural control BMPs that will achieve bacteria load reduction necessary for TMDL compliance. Projects within the WMA that reduce bacteria and urban runoff flows through IRWM Plan implementation assist with meeting this goal.

As demonstrated, the proposed Projects within this proposal are consistent with the Basin Plan objectives for protecting beneficial uses of the waterways (and watersheds) throughout the South Orange County WMA. Collectively, the Projects will protect the South Orange County WMA's precious water resources for the greater San Diego Region.

### 6.2.2 Inter-regional Impacts

Coordination among the Tri-County FACC ensures that inter-regional benefits and impacts of proposed IRWM projects are considered. Collaboration among the San Diego, Upper Santa Margarita, and Orange County Regions through the Tri-County FACC will result in implementation of projects and programs that are mutually beneficial for water managers throughout the San Diego Funding Area. Potential negative impacts associated with this collaboration are limited to construction-related impacts associated with individual projects. However, project-specific and/or programmatic environmental compliance processes will mitigate those impacts.

### 6.2.3 DAC, Environmental Justice, Tribal Communities

DAC and EDA involvement is an important part of the South Orange County IRWMP process. DACs and EDAs in South Orange County are shown in **Figure 3-15**. The following Cities include DACs and EDAs:

- Laguna Woods
- Laguna Hills

[97] County of Orange, OC Watersheds, "San Mateo Creek Watershed Work Plan," 2013. Available online March 2017. OC Watersheds Document Library.

- Lake Forest * includes EDA
- Mission Viejo
- Rancho Santa Margarita
- Laguna Niguel
- Dana Point
- San Juan Capistrano
- San Clemente
- Unincorporated area * includes EDA

IRWM Plan projects will protect the water resources of the region and benefit all residents and businesses in the WMA, including members of DACs, which are inclusive of EDAs. Coastal resources such as Doheny State Beach Park, the Dana Point Harbor and area beaches, as well as parks located along regional stream courses serve as community gathering places for communities and are used heavily year round. Many of the recreational areas are accessible via public transit and do not charge an entrance fee for walk-in visitors.

Poor water quality can negatively impact the recreational opportunities for disadvantaged community members. Several projects within the IRWMP focus on identifying the cause of water pollution for Doheny Beach and other beaches within the region. Water quality is a key consideration for the WMA to ensure protection of the health and safety of the entire population in the area, especially for the disadvantaged community residents that do not have the means to travel to other areas of the state or country. By addressing water quality issues in areas of recreational use, the IRWM Plan incorporates environmental justice in a way that provides every resident equal opportunity and fair treatment in the regional water planning process.

DAC members use natural areas that are open and available to the public at no cost. Proposed Projects meet multiple objectives and provide recreational and aesthetic benefits, including contact and non-contact water recreation, and other passive activities available at no cost to all community members.

The Projects included in this IRWM Plan address the water quality needs of DACs. For example, MWDOC's Comprehensive Landscape WUE program directly addresses beaches recreated by DAC members by reducing dry weather runoff pollutants and protecting costal resources like marine reserves, tidepools, and beach zones. The SCWD's Water Conservation and Targeted Programs provide water conservation education and outreach to DAC members and help protect future opportunities for recreation and support established beneficial uses of the Creek and Beaches within the Dana Point and Laguna Coastal Streams watersheds.

Projects focused on improving the water quality of Aliso Creek Beach, such as Aliso Viejo's Dairy Fork Wetland project, greatly benefit DAC, especially low-income apartment complexes along upper Aliso Creek. Aliso Creek beach is accessible through the OCTA bus system since it is a facility of the County of Orange. This beach along with beaches and parks in the WMA serve the DAC equally since there is no entrance fee. The City of Laguna Niguel's Crown Valley Park Entry Channel Improvements will also help improve water quality for downstream uses.

DACs will continue to enjoy the beach and ocean resources as a result of fewer beach closure days due to higher water quality. Water quality is a key consideration for the WMA to ensure protection of the health and safety of the entire population in the area, especially for the disadvantaged community residents that do not have the means to travel to other areas of the state or country.

Projects in this IRWM Plan focus on increasing recycled water supply for the region to increase local water resource reliability. Several recycled water projects provide benefits to DACs within the WMA by providing greater reliability and sustainability, especially during times of drought or shortage; these include:

- ETWD's Recycled Water Distribution System Expansion: included construction of a recycled water distribution system to serve the ETWD Service Area that includes DAC in the City of Laguna Woods. The project resulted in the conversion of approximately 75 existing potable water dedicated irrigation meters to recycled water. The conversions reduced the amount of potable water imported by the District by as much as 300 AFY. This Project directly benefits disadvantaged community members.
- MNWD's Recycled Water Extension Project serves portions of DACs in South Orange County, as the Project is located in the Cities of Laguna Hills, Aliso Viejo and Laguna Niguel. The Project provides 102.3 acre-feet of recycled water in lieu of potable water to these communities. The project installed approximately 7,500 feet of 8-inch and 6-inch PVC with 12 recycled services in the Laguna Audubon HOA and 20 recycled services various locations in the Cities of Laguna Hills, Laguna Niguel and Aliso Viejo. Use of recycled water provides communities with additional drinking water supplies. By producing recycled water for the community, the project makes the same amount of potable drinking water supply available to serve the DAC. The South Orange County WMA relies on imported potable water supply its drinking water supply. Approximately 75 percent of MNWD's water is purchased through the MWDOC.

This South Orange County IRWM Plan aims to ensure equitable distribution of benefits to all members of the region. Environmental Justice brings to light the fact that minority members of the community tend to disproportionately endure environmental pollution and unhealthy conditions. South Orange County is a leader in including such members of the community in the IRWM Planning process to spread the benefits of IRWM Plan and Project implementation to all. See Section 3.6 for further description of DAC involvement and the Water Needs Assessment process to identify and better refine water resource needs of DACs in South Orange County.

***Tribal Communities***

The region embraces improving tribal water and natural resources for South Orange County and providing positive impacts to tribal communities. This includes incorporating planning measures and soliciting projects that include the development of Tribal consultation through the CEQA process, collaboration, and access to funding for water programs and projects to better sustain Tribal water and natural resources. Section 2.6.3 further describes efforts to involve the Juaneño Band of Mission Indians in the IRWM process and efforts to better identify water resources needs of Tribal communities and potential projects to meet those needs. Also, refer to **Section 11** for more detail on stakeholder involvement.

## *6.3 Completed/Funded Projects*

Since the launch of the South Orange County IRWM Program in 2005, the WMA has successfully implemented several projects. Project status is included in the DMS; however, as of May 2018, most projects are completed.

Prop 50 IRWM Management Implementation Grant provided $25,000,000 for the following projects:

1. **Water Use Efficiency Program Expansion:** MWDOC on behalf of 13 cities and 12 special districts in South Orange County.
2. **Canada Gobernadora Multipurpose Basin:** Santa Margarita Water District.
3. **Heisler Park Marine Habitat Protection:** City of Laguna Beach.
4. **Recycled Water Transmission System Improvements:** City of San Juan Capistrano.
5. **Recycled Water Treatment and Distribution:** City of San Clemente.
6. **Aliso Creek Ecosystem Restoration Project:** County of Orange, SOCWA, and MNWD.
7. **Recycled Water System Expansion:** ETWD.
8. **Aliso Creek Urban Runoff Recovery, Reuse, and Conservation:** SCWD.

In 2008, the OCFCD was awarded $5,000,000 under the Prop 84 LLUR Local Levee Urgent Repair Grant for the following project:

1. **San Juan Creek Channel (Facility No. L01):** From 2100-ft upstream to 6100-ft upstream Stonehill Drive (left side) Phase 1. Status: Completed in November 2009.

Subsequently, the IRWM Group reviewed, selected and submitted for funding proposals for projects in Rounds 1 (2011) and 2 (2013) of Proposition 84 IRWM Implementation funding. All projects submitted for funding were approved; these are listed below.

Proposition 84 – Round 1 ($2,316,780 awarded in 2011)

1. **South Orange County Water Smart Landscape (WSL) Project:** MWDOC.
2. **Rockledge Ocean Protection Project:** City of Laguna Beach. Completed 2016.

3. **Shadow Rock Detention Basin Project:** Trabuco Canyon Water District.
4. **County of Orange Grant Administration**

Proposition 84 – Round 2 ($1,708,647 awarded in 2014)

1. **Audubon Starr Ranch Sanctuary's Riparian Invasion Control, Restoration, Monitoring, and Education Project:** Audubon Starr Ranch.
2. **Comprehensive Landscape Water Use Efficiency Program:** MWDOC.
3. **Baker Water Treatment Plant:** Irvine Ranch Water District.
4. **Targeted Water Conservation Program:** South Coast Water District.

DWR issued a third round of grant funding under Proposition 84 in 2014 to address State-wide drought conditions, focused on water supply enhancement and potable water offset. The IRWM Group proposed, submitted and was approved funding for three projects (awarded $1,500,000 in November 2014):

1. **Califia Recycled Water Project:** Santa Margarita Water District.
2. **Recycled Water Expansion Project:** South Coast Water District.
3. **Recycled Water Extension:** Moulton Niguel Water District.
4. **County of Orange Grant Administration**

The last round of Proposition 84 funding was issued by DWR in 2015. The IRWM Group and stakeholders selected, reviewed and approved a suite of six projects providing multiple benefits in alignment with the IRWM goals. The full suite of projects was awarded $4,949,368 in funding in 2015.

1. **Dairy Fork Wetland:** City of Aliso Viejo.
2. **San Juan Aquatic Passage and Habitat Improvement:** USDA Forest Service, Cleveland National Forest.
3. **Crown Valley Park Channel Entry Improvements:** City of Laguna Niguel.
4. **Strategic Turfgrass Removal & Design Assistance Program:** MWDOC.
5. **3A Water Recycling Plant Tertiary Expansion:** Santa Margarita Water District.
6. **Recycled Water Distribution Upgrade:** South Coast Water District.
7. **County of Orange Grant Administration:** Status:

## 6.4 Plan Performance and Monitoring

As discussed under **Section 2**, the South Orange County WMA includes an IRWM Group comprising member agencies participating in the EC and MC, other agencies, non-profits and public stakeholders. Together, the groups oversee IRWM Plan Implementation through the project review process discussed in **Section 6.1**. The project review process includes evaluating and ranking each project based on the extent to which it meets the IRWM Plan objectives. As discussed in **Section 2.6.2**, the IRWM Plan will be updated no less than once every five years and will be accomplished in the IRWM Group environment affording the opportunity for input from all stakeholders. The IRWM Group performance at implementing projects will be evaluated on an ongoing basis; see **APPENDIX K** for a description of the measurable objectives utilized in the assessment of how IRWM Plan implementation of projects over time contributes to IRWM goals, objectives and regional water needs.

As described in **APPENDIX J**, climate change is anticipated to impact the South OC WMA in several ways, including more prolonged dry periods, flashier, less predictable and less frequent rainfall, and reduced snow pack resulting in fewer water supplies available state-wide. Projects included in the IRWM Plan will seek to adaptively manage resources in response to these anticipated climate change impacts; indeed, the IRWM Plan will also be amended to reflect new tools and information as more data become available and as impacts are realized. The IRWM Group agencies have similarly incorporated procedures for addressing climate change impacts through capital improvement plans and projects. **Section 10** describes coordination with existing plans.

Additionally, Section 7 describes how project data is managed and made available through the DMS. Ongoing assessment of project benefits will inform subsequent IRWM planning efforts.

***State Funded Projects***

Per state funding requirements, the lead agency of each implemented state-funded project will be responsible for developing project-specific monitoring plans and activities at the start of project operation/implementation. As applicable, projects will include a Project Monitoring and Performance Plan, for which the WMA project proponent will be responsible. For example, a Project Monitoring and Performance Plan may include water quality monitoring that will be performed and reported through CEDEN. At a minimum, each implemented Project funded by state funds will complete a Project Monitoring and Performance Plan which will evaluate and monitor the WMA's ability to meet the objectives and implement projects in the IRWM Plan on an annual basis, or as required by the state.

The following is the typically required contents of a project-specific monitoring plan including, but not limited to, the following:

- Clearly and concisely (in a table format) describe what is being monitored for each project. Examples include monitoring for water quality, water depth, flood frequency, and effects the project may have on habitat or particular species (before and after construction).
- Measures to remedy or react to problems encountered during monitoring. An example would be to coordinate with the Department of Fish and Wildlife if a species or its habitat is adversely impacted during construction or after implementation of a project.
- Location of monitoring
- Monitoring frequency
- Monitoring protocols/methodologies, including who will perform the monitoring

- DMS or procedures to keep track of what is monitored. Each project's monitoring plan will also need to address how the data collected will be or can be incorporated into statewide databases. Refer to **Section 7** for more discussion on DMS.
- Procedures to ensure the monitoring schedule are maintained and that adequate resources (including funding) are available to maintain monitoring of the project throughout the scheduled monitoring timeframe.

These performance plans will address how the project will result in measurable improvements in water supply, water quality, watershed condition, capacity for effective watershed management, and other measurable benefits. In this way, the projects will meet the objectives of the IRWM Plan. Data made available by the project proponents will be included in the DMS described in **Section 7**.

**Section 7** describes how the state-compatible data will be available to stakeholders.

***Non-state Funded Projects***

Individual projects not funded by state bond programs may establish other indicators of success as applicable. The following list shows project monitoring and performance measures that may apply to projects not funded through State IRWM Grant programs that overlap with the goals and objectives of the IRWM Plan:

- Community awareness and participation
- Watershed partnerships
- Water quality measurements
- Acres of wetland restored
- Feet of stream channel stabilization
- Photo documentation

Much of the data that currently exists for the various projects is included in existing local and regional plans, documents, and programs identified in **Section 10**. As the IRWM Plan is implemented, objectives may need to be updated based on alterations to baseline data or understanding of water management issues. In this circumstance, any amendments to the objectives will go through IRWM Group and stakeholder review to adequately identify water demand, water supply, water quality projections, environmental stewardship, and actions that may support DACs.

## 7 DATA MANAGEMENT

The proper collection, organization, storage, analysis, and dissemination of data associated with Plan implementation is essential to the continued success of South Orange County's IRWM and to the ongoing participation and support of stakeholders.

### *7.1 Data Collection & Needs within the Region*

The objective of data collection is to: 1) define existing conditions, 2) help develop water management objectives, 3) evaluate project and overall Plan effectiveness, 4) inform tools for

IRWM planning and decision making, and 5) provide better information for state agencies, stakeholders, and the general public. Data of many different types and sources is collected throughout the region by various governmental and non-governmental organizations. Collected data is associated with individual projects and programs, as well as on-going operations, maintenance, and monitoring of regional infrastructure. Both basic and advanced hydrologic and hydraulic data sets are also collected for major surface waters and groundwater basins. Additionally, physical, chemical and biological data sets associated with South Orange County watersheds are actively collected. **Sections 9.2 and 9.3**describe data gaps and monitoring efforts by the IRWM Group and other groups/agencies within the WMA that seek to fill data gaps and provide data for analysis and project development in the region.

Providing an adequate water supply remains a critical requirement for the South Orange County WMA. Imported water supply accounts for a large portion of the WMA's potable water supply, and local water maintains and protects the area's ecological functions that are dependent on the availability of high quality surface water and groundwater. The continued collection and analysis of the Region's water use data, industrial, agricultural, and domestic, will assist the IRWM Group with water needs planning and how and where to focus conservation efforts.

The urbanization of the South Orange County WMA has placed considerable stress on the quality of its local water resources. Dry and wet weather surface flows have increased due to a reduction of absorbent landscape and an increase in impermeable coverage. Increased stream flows often lead to erosion of riparian habitats. As described in **Section 3.3.4**, the WQIP and IRWM Group jurisdictional agencies seek to address the impacts of urbanization by addressing unnatural water balance and geomorphic issues resultant from urbanization. Future data collection related to addressing and tracking the status of these high priority water quality conditions is summarized in **Section 9.3**.

Streambed and overland flows carry pollutants endemic to urbanized areas, increasing pollutant loading in local water bodies. Polluted runoff is considered to be the major contributor of pollution to water bodies throughout the WMA and the leading cause of water quality impairments. Effective management will require: that data collection be focused on better characterizing the specific sources of polluted runoff; that BMPs are developed to address the pollutants generated; monitoring and assessment of water quality improvement strategy effectiveness; and continual refinement and improvement of strategies. Future data collection related to addressing coastal and inland receiving water quality is summarized in **Section 9.3**.

It is the purpose of IRWM planning to provide a regional focus, prevent duplicating data efforts, and provide access to water and land use plans, GIS data, IRWM planning information, and various technical data. The South Orange County IRWM Group shall continue to promote the collection and dissemination of data that will provide information valuable to the management, conservation, and quality of the region's limited water supply, and for the continued preservation of the region's delicate ecological resources.

## 7.2 Data Management System and Dissemination

A wide variety of water and natural resource data are collected throughout the region by various entities such as permitted dischargers, Non-Governmental Organizations (NGOs), research institutes, and government agencies. In addition, the South Orange County IRWM Group has an extensive list of studies and data sets, as included in **Table 9-1** in **Section 9** of this plan. Technical information and data sets are obtained from the extensive planning and technical studies that have been conducted for the WMA Watersheds. Projects are supported by targeted studies.

The responsibility of maintaining and managing this data is typically the responsibility of the entity collecting it. It is the intent of the South Orange County IRWM Group to support data collection throughout the region and assist with consistency, management, and dissemination of the data to support regional decision making, stakeholder interests, and public education and involvement. To achieve this goal, the IRWM Group developed a geospatial-based DMS for tracking implemented IRWM projects, proposed IRWM projects and other layers of data collected and made available by the member agencies. For example, extensive mapping was conducted for the WQIP; these data will tie into the DMS where possible to promote regional project planning and alignment of priorities.

**Figure 7-1**details the data management and dissemination system for the stakeholders and county. Primary data management functions will continue to reside with the primary data collectors (data owners). The data owners are responsible for the collection, storage, Quality Assurance/Quality Control (QA/QC), analysis, reporting in compatible formats, and dissemination of the data to any databases already receiving their data. Data owners are responsible for ensuring that the data disseminated to the existing state databases, including California Environmental Data Exchange Network (CEDEN), Surface Water Ambient Monitoring Program (SWAMP) and Groundwater Ambient Monitoring and Assessment (GAMA), is in a format compatible with those databases. Data will be made available in the DMS, where feasible.

The County shall work with stakeholders to implement a consistent QA/QC program for data collection and analysis, avoid data redundancy, work to fill data gaps, and ensure data comparability. As noted, the County hosts an IRWM GIS-based DMS, locating and identifying projects in the South Orange County WMA. The DMS will also act as a repository and dissemination site for project data provided to the county. **Figure 7-1** shows the process of data collection, storage, and dissemination to IRWM participants, stakeholders, the public, and the state.

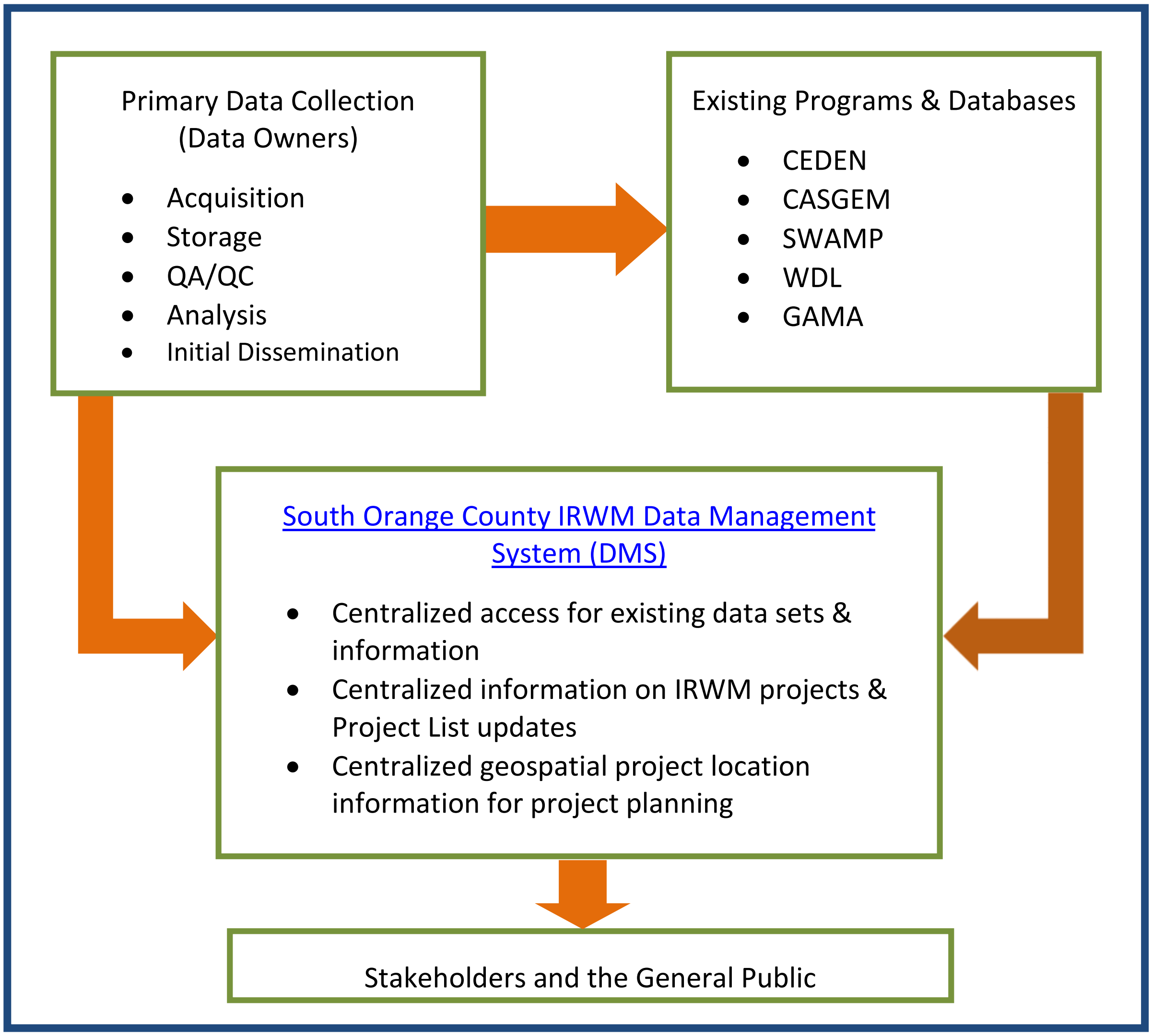


**Figure 7-1: Data Management**

Examples of data to be made available on the County's website include: project location and/or footprints, raw verified and validated data sets, project information, IRWM planning process information such as meeting schedules, meeting minutes, agendas, annual reports, Plan updates, etc. All information will be posted in user-friendly electronic formats accessible to the general public. Other monitoring websites will be identified and utilized as appropriate during implementation of the Plan.

The South Orange County IRWM DMS supports the IRWM Group's efforts to share collected data with other interested parties including local, state, and federal agencies by providing transparency of information and consistency of data. The data formats will be compatible with state data management programs to provide widespread access to the general public.

IRWM stakeholders and the general public shall be informed of updates in IRWM planning procedures and online data availability through email notifications and at public meetings and workshops. Consistent outreach with the public will encourage ongoing participation and technical assistance will be provided by the County, where needed. Technical assistance workshops will be provided to assist with use of the DMS for project submittal and data retrieval.

### 7.2.1 State Data Management Programs

To promote data reliability, the WMA will implement techniques compatible with State programs such as the CEDEN, SWAMP, the Water Data Library (WDL), and the GAMA Program. The following provides an overview of the State information and data exchange programs:

CEDEN: The CEDEN provides for state-wide coordinated data sharing. CEDEN is a growing statewide cooperative data exchange program of various groups involved in the water and environmental resources of the State of California. Most of CEDEN's data exchange services are custom developed using a robust tool set which has been used to connect scores of programs into the network. SCCWRP maintains the Southern California Regional Data Center for uploading data to CEDEN at this site. Surface water quality monitoring data is submitted to CEDEN and data is posted on the County's website from 2001 to present.

CASGEM: California Water Code §10920 *et seq*. established the California Statewide Groundwater Elevation Monitoring Program (CASGEM) to monitor, track and report seasonal and long-term groundwater elevation trends in groundwater basins statewide. Collection and evaluation of such data on a statewide scale is an important fundamental step toward improving management of California's groundwater resources. To achieve this goal, the statute requires collaboration between local monitoring entities and DWR to collect groundwater elevation data. DWR's role is to coordinate the CASGEM program, to work cooperatively with local entities, and to maintain the collected elevation data in a readily and widely available public database. The OCWD and the SJBA both notified DWR of its intent to volunteer as a "Monitoring Entity" for the Coastal Plain of Orange County. As a Monitoring Entity, the OCWD and SJBA regularly collects and uploads groundwater elevation data to the CASGEM Online System for long-term tracking and reporting. An overview of CASGEM is available on the program web site: http://www.water.ca.gov/groundwater/casgem/.

SWAMP: The SWAMP is a statewide ambient monitoring effort designed to assess the conditions of surface waters throughout the state of California. Ambient monitoring refers to any activity in which information about the status of the physical, chemical, and biological characteristics of the environment is collected to answer specific questions about the status, and trends in those characteristics. For the purposes of SWAMP, ambient monitoring refers to these activities as they relate to the characteristics of water quality. The SWAMP integrates existing water quality monitoring activities of the SWRCB and the RWQCB, and coordinates with other monitoring programs. Responsibility for implementation of monitoring activities resides with the nine RWQCBs that have jurisdiction over their specific geographical areas of the state.

In accordance with CWA section 305(b), the SWRCB and RWQCBs periodically compile an inventory of the state's major waters and the water quality condition of those waters, using monitoring data and other pertinent information. This inventory is known as the Water Quality Assessment. The Water Quality Assessment is the foundation upon which the TMDL Program is built.

To better understand the waters of the San Diego region, monitoring and assessment for both status and trends need to be planned and ongoing. The San Diego RWQCB uses SWAMP resources to ensure that monitoring is conducted in each hydrologic unit once in every five-year period. The SDRWQCB locates monitoring sites on main stem rivers and streams, just above tidal influence; main stem rivers and streams just above the confluence with major tributaries; and major tributaries just above the confluence with the main stem rivers and streams. For more information, please visit the SWRCB's SWAMP website at: http://www.waterboards.ca.gov/water_issues/programs/swamp/.

WDL: The WDL database stores data from various monitoring stations, including groundwater level wells, water quality stations, surface water stage and flow sites, rainfall/climate observers, and water well logs. The data is provided by DWR Region offices and dozens of local and federal cooperators. Information on WDL is available at: http://www.water.ca.gov/waterdatalibrary/.

GAMA: The GAMA Program is a comprehensive groundwater quality monitoring program that was created by the SWRCB in 2000. It was later expanded by Assembly Bill (AB) 599 - the Groundwater Quality Monitoring Act of 2001, resulting in a publicly accepted plan to monitor and assess groundwater quality in basins that account for 95 percent of the state's groundwater use. The GAMA Program is based on interagency collaboration with the SWRCB, DWR, Department of Pesticide Regulations, USGS, and Lawrence Livermore National Laboratory, and cooperation with local water agencies and well owners. As noted in **Section 3.3.2**, the SJBA San Juan Basin Groundwater Management and Facilities Plan, 2013 serves as the groundwater management plan for the South Orange County IRWM region and meets Groundwater Management Plan Compliance. SJBA acts as the monitoring agency.

The main goals of GAMA are to:

- Improve statewide groundwater monitoring and establish ambient groundwater quality on a basin wide scale.
- Continue periodic groundwater sampling and groundwater quality studies in order to characterize chemicals of concern and identify trends in groundwater quality.
- Centralize and increase the availability of groundwater information to the public and decision makers to better protect our groundwater resources.

The GAMA Program includes four projects to meet the statutory requirements of Groundwater Quality Monitoring Act of 2001 and GAMA Program goals. As California's most comprehensive and state of the art groundwater research program, these projects inform citizens, community water systems, environmental groups, and state and federal agencies:

Priority Basin Project. The Priority Basin Project initially focused on assessing the deep groundwater resource that accounts for over 95 percent of all groundwater used for public drinking. To date, the USGS has sampled over 2,500 public supply wells and has developed a statistically unbiased assessment of the quality of California's drinking water aquifers. In 2012, the Priority Basin Project started the second phase of the project, to assess the quality of shallow aquifers typically used for domestic and small community water supplies. Areas of the state with the greatest densities of households that rely on domestic wells are prioritized into study units for this phase of the project.

GeoTracker GAMA. The GeoTracker GAMA groundwater information system integrates and displays water quality data from various sources on an interactive Google-based map. The system centralizes and increases the availability of groundwater information to the public and decision makers, a main goal of the GAMA Program. Analytical tools and reporting features help users assess groundwater quality and identify potential groundwater issues in California.

Domestic Well Project. The Domestic Well Project samples private wells from volunteer well owners on a county level, at no cost to the well owners. Since 2002, over 1,100 of the estimated 600,000 private wells in six counties in California have been sampled for commonly detected chemicals. The well owners receive the analytical test results and fact sheets, and the water quality data is placed on GeoTracker GAMA without divulging well ownership.

Special Studies Project. The Special Studies Project focuses on specific groundwater quality studies, using state of the art scientific techniques and methods that help researchers and public policy planners to better understand how groundwater contamination occurs and behaves. Studies include sources of nitrate, wastewater indicators, groundwater recharge, detection of pharmaceutical compounds and personal care products using low-level anthropogenic compounds as tracers, and isotopic composition as a contamination source tool. Lawrence Livermore National Laboratory, the project technical lead, has pioneered the use of tritium-helium groundwater age-dating techniques, which are critical in understanding groundwater sources and flow.

Partnerships and effective coordination with the local agencies will be an important part of the GAMA Program. Thus, projects implemented as part of the South Orange County IRWM Plan that may result in information beneficial to the comprehensive analysis of groundwater resources will be coordinated with the GAMA Program. For more information please visit the State Water Resources Control Board's GAMA website at: http://waterboards.ca.gov/gama/.

# 8 FINANCE

The South Orange County IRWM Group is committed to funding IRWM Plan implementation. The IRWM Group member agencies contribute to funding and/or resources for grant application preparation, public outreach, facilitation, and other consulting services to assist in increasing public and stakeholder IRWM outreach efforts, supporting and facilitating IRWM Group meetings, coordinating with IRWM efforts of adjoining regions, assessing institutional structure options, facilitating agency and stakeholder development input and consensus on the long-term plan institutional structure, and implementing the long-term IRWM institutional structure. The funding strategy to support ongoing IRWM plan implementation and related efforts is described below. The IRWM Group develops and the EC approves an annual cost-shared budget which assists with IRWM administrative and technical support.

## *8.1 Tri-County FACC Ongoing Funding*

As described in **Section 2.9**, the Upper Santa Margarita RWMG, San Diego RWMG, and South Orange County IRWM Group collaborate in an interregional body established via a MOU and known as the Tri-County Funding Area Coordinating Committee (Tri- County FACC):

- South Orange County IRWM Group: County of Orange, MWDOC, and SOCWA.
- Riverside County Upper Santa Margarita RWMG: RCFCWCD, County of Riverside, and RCWD.
- San Diego RWMG: City of San Diego, County of San Diego, and SDCWA.

The Tri-County FACC coordinates and works together with their advisory groups to address issues and conflicts across planning regions, identify common objectives and projects that address those needs, and provide general planning cooperation for shared watersheds. The Tri-County FACC meets on an as-needed basis.

The Tri-County FACC builds a foundation that ensures sustainable water resources planning within the San Diego Funding Area. The three RWMGs commit to coordinated planning within the Watershed Overlay Areas– one comprising the San Mateo Creek watershed area and the other the Santa Margarita River watershed area, which cross planning region boundaries. This approach will capture the integration of water supply, wastewater, and watershed planning across regions in the three coordinated IRWM Plans.

Each of the Tri-County FACC members has prepared and adopted an IRWM Plan and desires close coordination to enhance the quality of planning, identify opportunities for supporting common goals and projects, and improves the quality and reliability of water in the San Diego Funding Area. The Tri-County FACC will coordinate and work together with their advisory groups to address issues and conflicts across planning regions, identify common objectives and projects that address those needs, and provide general planning cooperation for shared watersheds. Overall, the goal of the Tri-County FACC is to provide smart funding for critical watershed projects throughout the San Diego Funding Area.

By consensus, the Tri-County FACC has developed an agreement (MOU) to improve IRWM planning in the San Diego Funding Area to coordinate across planning region lines and facilitate the appropriation of funding for IRWM projects.

The MOU serves as a funding mechanism for the Tri-County FACC. It provides for a long-term stable group to coordinate current and future issues related to IRWM planning in the larger San Diego Funding Area. The coordinating role of the committee provides for MOU renewal to support the IRWM program beyond the current grant cycle.

The MOU accomplishes the following for the San Diego Funding Area:

- Defines terms, which enables all parties to use a common language;
- Clearly identifies boundaries of the three planning regions covering the entire Funding Area;
- Identifies Watershed Overlay Areas to facilitate planning and coordination in cross-boundary watersheds;
- Creates an ongoing process for coordination and planning in the Funding Area and in the Overlay Areas;
- Provides for advisory committee cross membership to promote understanding, communication, and cooperation;
- Provides for IRWM Plan consistency, common references, and coordination of grant submittals to facilitate DWR's review process;
- Determines the funding allocation among the planning regions; and
- Identifies a process for identification and funding of common programs found by the Tri-County FACC to be of high value across the Funding Area.

In the unlikely event that any RWMG agency or group withdraws from the Tri-County FACC, members of the Tri-County FACC will continue to coordinate with the withdrawn agency and consider them as a stakeholder to the maximum extent possible. Additionally, the remaining members will negotiate with the withdrawn member to determine fair allocation of funding within the principles provided in the MOU agreement and will notify DWR as to the outcome of these negotiation and coordination efforts.

The Tri-County FACC is working to identify areas of cooperation and to align planning efforts both to increase efficiency and to better inform each planning region about the efforts and plans of the others. The Tri-County FACC will build a foundation that ensures sustainable water resources planning within the San Diego Funding Area by serving as an umbrella organization, allowing the three IRWM regions to coordinate water resources planning activities and pool resources. Because man-made water infrastructure systems are the key water management units in the San Diego Funding Area, the planning regions reflect this reality and cross-boundary watershed issues are addressed via a collaborative subcommittee process.

The three RWMGs will undertake coordinated planning within the Watershed Overlay Areas, one for the Santa Margarita River watershed area and one for the San Mateo Creek watershed area. Water resources projects and programs that may benefit from Funding Area-wide coordination, administration, funding, or support will be identified by the Tri-County FACC. Projects within the Watershed Overlay Areas identified as valuable and benefiting from cross-boundary coordination will be identified in the three IRWM project selection processes. A project may be proposed by a single RWMG or by several, where relevant to the Overlay Areas. However, the Tri-County FACC will coordinate to ensure that project costs are only identified once among the proposals.

## *8.2 South OC WMA Cooperative Agreement Ongoing Funding*

As part of Orange County municipalities and special districts' effort to develop a countywide Water Quality Strategic Plan, the South Orange County WMA members developed a Cooperative Agreement based on the desire to collaborate in protecting and managing water resources in the South Orange County WMA through coordinated implementation of an integrated approach.

The purpose of the Cooperative Agreement is to establish the South Orange County WMA as a cooperative framework for planning and implementing water management strategies. As described in **Section 2.2**of this IRWM Plan, the cooperative efforts include but are not limited to: addressing water quality impairments; establishing priorities for water resource needs; integrating water resource solutions across traditional disciplinary bounds; and jointly advocating for policies and funding that assist these goals. The Cooperative Agreement serves as a funding tool to implement the projects identified in the South Orange County IRWM Plan. Refer to **APPENDIX A** for a copy of the Cooperative Agreement.

Through the EC's established duties and powers, ongoing political and financial support for the IRWM Plan shall be ensured. As part of the agreement, the EC shall approve an annual cost-shared budget for the administration and activities of the South Orange County WMA, its committees, projects, or actions, including any administrative support for the South Orange County WMA. The annual Cost-Shared Budget requires approval by 80 percent of the members of the EC. The responsibility for payment of the annual Cost Share Budget shall be distributed equally among the South Orange County IRWM Group. Each member shall include their respective share of the Annual Cost Share Budget in their agency's annual budget.

The County will provide staff support for the South Orange County WMA and its committees and will perform services including planning activities, facilitating regional planning and coordination activities related to water resources, and general administration for the implementation of the South Orange County WMA's plans and work programs, as directed by the EC. Additionally, implementation of any cost-shared programs shall be accomplished through Project Implementation Agreements. This Cooperative Agreement will ensure an ongoing funding mechanism for the South Orange County IRWM Plan Implementation.

## 8.3 South Orange County WMA Costs

The County funded the program from 2004 to 2009; during this time, costs were offset by grants (Proposition 50). Expenses for the South Orange County IRWM Plan during this time were approximately $400,000 and included the following:

- IRWM Plan Preparation, including consultant contracts.
- IRWM Plan Grant Preparation, including consultant contract.
- Grant advocacy and Prop 50 grant contract negotiation (2004 – 2009), including consultant contracts.
- Grants from the State.
- Grant administration.
- Project costs, where applicable (e.g. Team Arundo)
- Tri-FACC participation, RAP Activities and submittal

The bullet item costs above serve as an example of the costs considered for each fiscal year work plan that have been updated, considered and approved by the EC on an annual basis. The IRWM Group began reviewing and approving the Shared-Cost Budget discussed in **Section 8.2** in 2010-11. Shared costs range from $73,500 in 2010-11 to $132,500 in 2016-17. On behalf of the South Orange County WMA, the County of Orange prepares proposed work plans and budgets that are presented to the EC for approval. Approved budgets are made available to the public through EC meeting records.

## 8.4 Sources of Funding

Securing project funding is key to IRWM Plan implementation. Accordingly, implementation efforts of the South Orange County IRWM Group will, in part, focus on:

- Refining project cost estimates,
- Further evaluating potential impacts and benefits of the projects, and ensuring the
- Participation of and benefits to DAC,
- Addressing the cost-effectiveness and regional affordability of proposed projects,
- Prioritizing projects, and
- Ensuring adequate funding for IRWM Plan and project implementation.

**Section 6.3** of this IRWM Plan discusses projects that have secured funding for implementation. **Table 8-1** below identifies priority projects implemented through the IRWM Plan and the sources and certainty of funding as examples of typical approaches to funding throughout the South OC WMA for non-profit, cities and water district projects. In many cases, multiple sources of funding are used.

## Table 8-1: Project Funding Summary

| Project Name | Implementing Agency | Approximate Total Cost | Funding Sources & % of Total Cost | Funding: Certainty/Longeveity | O&M Finance Source | O&M Finance Certainty |
|---|---|---|---|---|---|---|
| Riparian Invasive Control, Restoration, Monitoring, and Education at Audubon Starr Ranch Sanctuary | Audubon Starr Ranch Sanctuary | $275,500 | Prop 84 Round 2-83%, Matching Funds - 57% So CA. Wetlands -10%, The Gimble Fund-7%, | Funding secured from So. CA Wetlands and The Gimble Fund | Non-profit grant funding efforts | Continuously funded since 2009 |
| Baker Treatment Plant | Irvine Ranch Water District | $78,500,000 | Prop 84 Round 2- 12% Local Matching Funds- 88% | Secured | IRWD Budget | Secured |
| Comprehensive Landscape Water Use Effeciency Program | Municipal Water District of Orange County (MWDOC) | $1,660,817 | Prop 84 Round 2- 43%, Local Matching Funds- 57% | MWDOC General Fund | Program Participants | Responsibility of the Participants |
| Water Conservation, Implementation of Targeted Programs | South Coast Water District | $613,000 | Prop 84 Round 2- 38%, Matching Funds-62% | SCWD Annual Operating Budget | SCWD Operating Revenue | Secured |
| Califia Recycled Water Project | Santa Margarita Water District | $3,145,000 | IRWM Drought - 16%, Matching Funds -84% | SMWD General Reserves | SMWD Operating Revenue | Secured |
| Recycled Water System Extension Project | South Coast Water District | $1,990,000 | IRWM Drought - 25%, Matching Funds - 75% | SCWD Annual Operating Budget | SCWD Operating Revenue | Secured |
| Recycled Water Extension Project | Moulton Niguel Water District | $2,060,000 | IRWM Drought - 24%, Matching Funds - 76% | MNWD General Fund | MNWD Operating Revenue | Secured |
| Dairy Fork Wetland | City of Aliso Viejo | $1,068,100 | Prop 84 IRWM 2015 - 47%, Matching Funds - 53% OCTA Measure M2 Environmental Cleanup Program | Funding secured through the City's budget | City Budget | Secured |
| San Juan Aquatic Passage and Habitat Improvement | USDA Forest Service, Cleveland National Forests | $1,518,194 | Prop 84 IRWM 2015- 46%, Matching Funds - 54% $30,000 from USFWS $784,694 from Federal ERFO funds | Funding Secured | Operating Budget | Secured |
| Crown Valley Park Entry Channel Improvements | City of Laguna Niguel | $7,198,262 | Prop 84 IRWM 2015 - 10%, Matching Funds - 90% OCTA Tier 2 Environmental Cleanup Program grant of $1,621,962 MNWD infrastructure reimbursement grant estimated at $200,000. All other funding from City of Laguna Niguel General Fund and Asset Reserves | Funding Secured | City Budget | Secured |
| Strategic Turfgrass Removal & Design Assistance Program, | MWDOC | $2,927,156 | Prop 84 IRWM 2015 - 38%, Matching Funds - 62% | Funding secured through MWDOC General Fund | Program Participants | Secured |
| 3A Water Recycling Plant Tertiary Expansion | Santa Margarita Water District | $4,000,000 | Prop 84 IRWM 2015 - 25%, Matching Funds - 75% | SMWD General Fund | SMWD Operating Revenue | Secured |
| Recycled Water Distribution Upgrade. | South Coast Water District | $2,593,053 | Prop 84 IRWM 2015- 29%, Matching Funds - 71% | SCWD Annual Operating Budget | SCWD Operating Revenue | Secured |

Consistent funding for the IRWM Plan, and projects that implement the Plan, is acquired through cooperative efforts by the South Orange County IRWM Group by working together on a regular basis to ensure priority projects are funded through the IRWM prioritization process, through the South OC WMA cooperative agreement, as well as cost share contributions. In addition, the South Orange County IRWM Group members share notifications of funding opportunities and often discuss funding successes. For example, Laguna Beach County Water District was awarded federal grant funding through the United States Bureau of Reclamation for their Advanced Metering Infrastructure Upgrade Project in 2016. As a result, other water districts in the South Orange County IRWM Group have applied or will apply for funding from the same program for similar projects.

Collaboration throughout the South OC WMA occurs due to watershed based multi-benefit projects. For examples of projects, see **Section 6** of this IRWM Plan. Federal, state, and local funding sources have funded numerous projects throughout the South OC WMA and it is anticipated this success will continue as the commitment to implementing multi-benefit projects across jurisdictions, while leveraging multiple sources of funds, proves to be a win-win for the region.

### 8.4.1 Capital Improvements Program Funding

Many of the large infrastructure projects addressed within this Plan are addressed in CIP budgets prepared and adopted by implementing agencies. The CIPs address project costs, project implementation schedules, and funding sources for implementing budgeted projects. Large-scale water and wastewater agency CIP projects are typically funded through debt (revenue bonds or general obligation bonds) serviced by water and sewer rates, capacity charges, standby charges, or agency shares of property taxes or assessments. Flood control CIP projects are typically funded through County property taxes. Smaller scale water and wastewater CIP projects may be funded by the agencies with cash on hand, short-term lines of credit, or directly from water or sewer rates. CIP projects may also be funded by outside grants or financial assistance (e.g. OCTA Measure M2 Environmental Cleanup Program).

### 8.4.2 Federal, State, and Local Funding

Several financial assistance programs are available to support local contributions by implementing governmental agencies within the Region. As described in **Section 2.6.1**, the South Orange County WMA has successfully obtained state grant funding to implement projects in the IRWM Plan. Federal, state and local programs offer funding assistance for all project phases, from initial planning and design to construction and operation. Below is a sampling of some of the federal, state and local funding programs that have been available to members of the South Orange County WMA.

***Federal and State Programs***

United States Bureau of Reclamation (USBOR)

- WaterSMART: Water and Energy Efficiency Grant Program
- WaterSMART: Title XVI Reclamation and Reuse Program Funding
- WaterSMART: Development of Feasibility Studies Under Title XVI
- Bay-Delta Restoration Program
- Conservation Field Services Program

California DWR

- Water-Energy Grant Program
- IRWM Implementation Grant Program (Rounds 1 & 2, 2015)
- IRWM Drought Grant Program (2014)
- Local Groundwater Assistance Grant Program
- CalConserve WUE Revolving Fund 2015 Loan Program
- Water Desalination Grant Program
- Sustainable Groundwater Planning Grant Program

California SWRCQB

- Water Recycling Funding Program Grants & Loans

- Drinking Water Grants & Loans (Clean, Safe and Reliable Drinking Water)
- Proposition 1 Storm Water Grant Program
- Groundwater Quality Funding Program (Proposition 1 Groundwater Sustainability)

CDFW

- Proposition 1 Watershed Restoration and Delta Water Quality and Ecosystem Restoration Grant Programs

California Water Commission

- Water Storage Investment Program

***Past Grant and Loan Programs (hyperlinked)***

Agricultural and Urban Water Use Efficiency (Proposition 50)
Drainage Funding (Proposition 204)
Flood Corridor Program (Propositions 84 and 1E)
FloodSAFE California (Proposition 84 and 1E)
Integrated Regional Water Management (Proposition 50, 84 and 1E)
Local Groundwater Assistance (Proposition 84)
Safe Drinking Water/Contaminant Removal (Proposition 50)
Stormwater Flood Management (Proposition 1E)
Urban Streams Restoration Program
Water Desalination (Proposition 50)
Watershed Restoration (Proposition 50)

Groundwater Recharge Construction (Proposition 13), Loans
Groundwater Storage (Proposition 13), Grants
Infrastructure Rehabilitation Construction (Proposition 13), Grants
Infrastructure Rehabilitation Feasibility Study (Proposition 13), Grants
Local Water Supply Project Feasibility Study (Proposition 82), Loans
New Local Water Supply Construction Loans (Prop 82)
Salton Sea Financial Assistance Program

***Loans***

Agricultural Water Conservation Program (Proposition 13)
Drinking Water State Revolving Funding Loan
Clean Water State Revolving Fund Loan

***Local Programs***

Orange County Transportation Authority (OCTA) – Measure M Funding: OCTA administers a variety of funding programs for cities to widen streets, improve intersections, coordinate signals, build Smart Streets and rehabilitate pavement. OCTA also administers the M2 Environmental Cleanup Program which seeks to help jurisdictions improve overall water quality in Orange County from transportation-generated pollution. Funds are intended to supplement, not supplant, existing transportation-related water quality programs. OCTA administers a two-tier grant funding approach for the Measure M2 Environmental Cleanup Program:

- Tier 1 – funds equipment purchases and upgrades to existing catch basins and related BMPs (e.g. catch basin inserts, screens, etc.); and
- Tier 2 – funds regional, potentially multi-jurisdictional CIPs such as constructed wetlands, detention/infiltration basins and bioswales.

MWDOC Local Programs Assistance

When requested, MWDOC assists retail agencies to develop and implement local programs within their individual service areas. This assistance includes collaboration with each retail agency to design a program to fit that agency's local needs, which may include providing staffing, targeting customer classes, acquiring grant funding from a variety of sources, and implementing, marketing, reporting, and evaluating the program. MWDOC provides assistance with a variety of local programs including, but not limited to, home water surveys, large landscape, public information, school education, conservation pricing, and water waste prohibitions. These local programs have also been structured through IRWM Planning processes in north, central and south Orange County.

MET

- On-Site Retrofit Pilot Program Incentives for Recycled Water Use
- LRP

Grant Database for IRWM Group & Stakeholders

Federal, state and local funding continues to be available to the South Orange County WMA. The County maintains a list of available grants in the DMS and on the applicable County website[98] that includes updated information on multiple funding programs and grant opportunities. Grant summaries are also archived on the website and can be found using the document database library.

### 8.4.3 Operation and Maintenance Funding

A significant majority of the operation and maintenance project costs are for water supply reliability infrastructure, including:

- Treated and raw water conveyance facilities,
- Water treatment facilities, including upgrade and expansion,
- Water storage facilities, including upgrade and expansion,
- Groundwater supply projects, including brackish groundwater demineralization, and
- Recycled water treatment, storage, and distribution projects.

Operation and maintenance of implemented water management facilities/projects will be the responsibility of implementing agencies. O&M costs may not apply to all projects, as some projects may only involve preparing studies or plans. Additionally, several project proponents

[98] http://www.ocwatersheds.com/programs/ourws/wmaareas/grant_opportunities

report no anticipated project operating costs, as existing staffing levels within the organizations are adequate to manage the proposed projects without additional costs.

For water supply, recycled water, groundwater, wastewater, and stormwater projects proposed by government agencies, maintenance budgets will primarily be funded through annual agency operating funds. Such maintenance/operating expenses may be funded by the following: water or sewer rates, flow or capacity charges, standby charges, user fees, or agency shares of tax assessments.

In addition to being used to finance capital debt for implementation, financial incentive programs may be used to offset maintenance and operation costs. Additional means of financing operation and maintenance include: special property assessments (flood control projects), groundwater assessments (groundwater management districts established per the State of California Groundwater Management Act), partnerships with in-kind services used to offset partner agency costs, private funding or endowments (conservation, habitat, or environmental projects), or membership fees (non-government agency projects).

The IRWM Planning efforts were funded by local partners via the MOU and state IRWM Planning grant funds. The certainty/longevity of funding is contingent upon continued successes in grant programs.

# 9 TECHNICAL ANALYSIS

The stakeholders within the South Orange County WMA have a long history of working collaboratively on studies, programs, and projects to address water quality, ecosystem restoration, and water supply. As a result, there is an extensive library of data and technical analysis information about the watersheds that has been created through numerous studies and project planning efforts. The WMA continues to develop science-based studies to analyze coastal water quality impacts and identify effective solutions. Not only do the unique ecological resources in this WMA provide the impetus for integrated water resource planning, but the history of collaboration and availability of the technical information make effective planning, analysis, and project implementation possible. The planning approach and framework of the South Orange County IRWM Plan ensures that solution-oriented projects are coordinated within the WMA and that funding and project benefits are leveraged to the greatest extent possible. IRWM Plan performance and monitoring is discussed in **Section 6.4**.

## *9.1 Technical Information*

Technical information and data sets are obtained from the extensive planning and technical studies that have been conducted for the WMA Watersheds. Those studies are identified in **Section 10**. In addition, numerous technical studies support projects included in the project list (**APPENDIX F**), as shown in **Table 9-1** below. Additional studies and data sets utilized specifically for the WQIP can be found at the WQIP clearinghouse website[99].

[99] SDR WQIP Clearinghouse Reports and Special Studies

**Table 9-1: WMA Technical Studies/Data Sets**

| WMA Technical Studies/Data Sets | | | | |
|---|---|---|---|---|
| **Supporting Technical Documents for Projects** | **Analysis Method** | **Results/ Derived Information** | **Use in IRWM Plan** | **Reference or Source** |
| OCTA Mitigation Funding, 2009 | Cost and Environmental Analysis | Mitigation and funding activities conducted by the OCTA | Used to consider funding opportunities | Audubon Society, OCTA |
| SCCWRP 2009 | Environmental Analysis | Regional Coastal wetland restoration grant funding and report | Used to consider wetland restoration funding | Audubon Society, SCCWRP |
| SMWD Supplemental Environmental Project (SEP), (For RWQCB), 2012 | Environmental Analysis | Implementation of a SEP | Used to consider SEP funding | Audubon Society, SMWD and RWQCB |
| USFWS, Partners for Fish and Wildlife, 2007 | Environmental Analysis | Regional Coastal wetland restoration strategies | Used to consider wetland restoration funding | Audubon Society, USFWS |
| *Arundo donax* Distribution and Impact Report, March 2011. | Impact Analysis | Arundo water consumption and habitat impacts | Used to consider San Juan Aquatic Passage and Habitat Improvement Project in Plan | California Invasive Plant Council |
| Preliminary Well Design and Site Selection Report, Domestic Non-Domestic and Brackish Water Wells Geotechnical Consultants, Inc. 2001 prepared for Capistrano Valley Water District. | Geotechnical Analysis | Domestic, Non-Domestic, and Brackish Water Data | Used to assess groundwater quality. | Capistrano Valley Water District, Geotechnical Consultants |
| Wood Canyon Emergent Wetland, City of Aliso Viejo 2010 | Environmental and Engineering Analysis | Pollutant reduction efficiency and treatment capacity | Used to consider project effectiveness | City of Aliso Viejo |

| WMA Technical Studies/Data Sets | | | | |
|---|---|---|---|---|
| **Supporting Technical Documents for Projects** | **Analysis Method** | **Results/ Derived Information** | **Use in IRWM Plan** | **Reference or Source** |
| Preliminary Identification and Prioritization of Nuisance Water Diversion Sites in Dana Point, January, 2005 | Environmental and Engineering Analysis | Identification and prioritization of feasible Dana Point nuisance water diversion sites. | Used to consider potential diversion sites | City of Dana Point |
| Dana Point LO1SO2 Diversion Feasibility Investigation, 2012 | Feasibility and Environmental Analysis | L01S02 Diversion Feasibility Study | Used to assess the feasibility of diversions sites | City of Dana Point |
| South Orange County Team Arundo: Implementation and Program Management Plan, on-going | Environmental Analysis | Management Plan for the control and eradication of Arundo | Used to consider invasive species eradication efforts | City of Dana Point, and San Juan Capistrano, Team Arundo |
| City of Laguna Beach Capital Improvement Study, 2001-2002. | Economic and Environmental Analysis | System Improvements & Costs | Used to consider IRWM Project Impacts on Laguna Beach coastline. | City of Laguna Beach |
| Multi-Agency Rocky Inter-tidal Network monitoring plan. 1996 to present. | Environmental Analysis | Current state of Orange County MPA. | Used to consider IRWM Project Impacts on Laguna Beach coastline. | City of Laguna Beach, Cal State Fullerton, Laguna Beach Marine Conservation Area, and Orange County MPA Committee. |
| Gateway Specific Plan and EIR, 2011 | Environmental Impact Analysis | Impact of the project's implementation | Used to assess Environmental impact | City of Laguna Niguel |
| On-site Geotechnical Study, 2012 | Geotechnical Analysis | Site infiltration analysis | Used to consider site infiltration capacity | City of Laguna Niguel |
| San Juan Creek Watershed Management Study, Orange County, California. USACE, Los Angeles District, August 2002. | Watershed Analysis | Watershed Management Data | Used to assess condition of watershed. | City of San Juan Capistrano, USACE |

| WMA Technical Studies/Data Sets | | | | |
|---|---|---|---|---|
| **Supporting Technical Documents for Projects** | **Analysis Method** | **Results/ Derived Information** | **Use in IRWM Plan** | **Reference or Source** |
| Recycled Water Master Plan, AKM Consulting Engineers, 2000 (revised in 2006 with the RWMP Update) prepared for the City of San Juan Capistrano. | Master Plan Analysis | Recycled Water Needs and Expansion | Used to consider IRWM Project implementation costs | City of San Juan Capistrano, AKM Consulting Engineers. |
| Revenue Requirements, Cost of Service Allocations, and Rate Design for the Water and Wastewater Utilities Report. Black & Veatch, October 2009. | Economic Analysis | Revenue & Costs | Used to consider IRWM Project implementation costs | City of San Juan Capistrano, Black & Veatch |
| Non-Domestic / Recycled Water Master Plan Update – Final Program Environmental Impact Review (Schedule No. 2006-11-11-59), Environmental Science Associates, October 2007. | Environmental Analysis | Environmental Impact | Used to consider IRWM Project Impacts | City of San Juan Capistrano, Environmental Science Associates. |
| San Juan Basin Groundwater Management and Facility Plan. Wildermuth Environmental, December 2013. | Groundwater Analysis | Groundwater Management | Used to consider Groundwater Management Facilities | City of San Juan Capistrano, NBS Lowry. |
| Aliso Creek Invasive Mapping and Watershed Management Plan, 2008 | Environmental Assessment | Approximately five acres of dense Arundo is severely impacting the creek | Used to consider Dairy Fork Wetland Project in WMA | County of Orange |
| Final EIR No. 589, General Plan Amendment/Zone Change, The Ranch Plan, approved by County of Orange November 8, 2004 | Environmental Impact Analysis | Ranch/Open space and habitat protection and restoration | Used to assess quality and quantity of open space preserved. | County of Orange, Rancho Mission Viejo |

| WMA Technical Studies/Data Sets | | | | |
|---|---|---|---|---|
| **Supporting Technical Documents for Projects** | **Analysis Method** | **Results/ Derived Information** | **Use in IRWM Plan** | **Reference or Source** |
| Planned Utilization of Water Resources in the San Juan Creek Basin Area. State of California, Resources Agency: DWR, June 1972. | Groundwater Analysis | Planned Groundwater Resources | Used to consider baseline San Juan Creek Basin area conditions | DWR |
| Baker Pipeline Regional Treatment Facility Feasibility Study Report, January 2007 | Feasibility Analysis | Baker Treatment Plant Feasibility Study | Used to consider the feasibility of the project | IRWD |
| Baker Water Treatment Plant Pilot Testing Program Final Documentation Report, August 2008 | Engineering Analysis | Baker Treatment Plant Pilot Testing to determine efficiency of proposed system | Used to consider Treatment Plant's proposed System | IRWD |
| Membrane Filtration System Procurement for the Baker Water Treatment Plant, February 2010 | Engineering Cost Analysis | Membrane Filtration System selection and procurement | Used to assess membrane filtration cost | IRWD |
| Baker Water Treatment Plant Preliminary Design Report, April 2010 | Engineering Design Analysis | Used to describe proposed design features | Used to consider Treatment Plant project | IRWD |
| Construction Plans and Project Manual for the Baker Water Treatment Plant, January 2013 | Engineering Analysis | Construction features of the proposed Treatment Plant | Used to consider Treatment Plant project | IRWD |
| Integrated Water Resources Plan, MET, 2015 | Environmental Analysis | Strategy for Managing Water Supplies | Highlight water reliability needs | MET |
| Phase 5 Preliminary Market Assessment - Recycled Water Distribution Expansion, MNWD | Environmental & Engineering Analysis | Recycled Water Needs and Expansion | Used to consider project for WMA. | MNWD |
| Recycled Water Master Plan Update, Moulton Niguel Water District | Environmental & Engineering Analysis | Recycled Water Needs and Expansion | Used to consider project for WMA. | MNWD |

| WMA Technical Studies/Data Sets | | | | |
|---|---|---|---|---|
| **Supporting Technical Documents for Projects** | **Analysis Method** | **Results/ Derived Information** | **Use in IRWM Plan** | **Reference or Source** |
| Residential Runoff and Reduction Study, MWDOC, 2004. | Environmental Analysis | Water Conservation Study | Used to assess reduction in dry-weather runoff volume and non-point source pollutants. | MWDOC |
| SmarTimer and Edgescape Evaluation Study (SEEP), MWDOC, 2008 | Environmental Analysis | Water Conservation Study | Used to assess water conservation improvements | MWDOC |
| Residential Runoff Reduction Study, July 2004 | Environmental Analysis | Effectiveness data for flow/pollutant reduction | Used to assess effectiveness water conservation | MWDOC |
| SmarTimer and Edgescape Evaluation Program, November 2008 | Environmental Analysis | Effectiveness data for flow/pollutant reduction | Used to assess effectiveness water conservation | MWDOC |
| Orange County Water Reliability Study, TM#1-4, MWDOC, 2016. | Environmental Analysis | Water Supply and Demand Reliability Forecasts | Assess water supply and infrastructure needs | MWDOC |
| Southern California Steelhead Recovery Plan, NMFS, 2012-13 | Species Recovery Analysis | Protect and Restore Ecosystem for Steelhead | Used to consider San Juan Aquatic Passage and Habitat Improvement Project in Plan | National Marine Fisheries Service |
| San Juan Creek Watershed Feasibility Study prepared by USACE for OCFCD | Environmental Analysis | Watershed Feasibility | Used to assess watershed condition | OCFD, USACE |
| San Juan Creek Watershed Stream Monitoring Program, prepared by PACE, dated March 2008. | Stream Analysis | Stream Monitoring Data | Used to assess water quality of San Juan Creek. | PACE |
| Final EIR No. 589, General Plan Amendment/Zone Change, The Ranch Plan, approved by County of Orange November 8, 2004 | Environmental Impact Analysis | Habitat Conservation Data in support of NCCP | Used to support open space Ranch Planning | Rancho Mission Viejo, County of Orange |

| WMA Technical Studies/Data Sets | | | | |
|---|---|---|---|---|
| **Supporting Technical Documents for Projects** | **Analysis Method** | **Results/ Derived Information** | **Use in IRWM Plan** | **Reference or Source** |
| Updated Rancho Mission Viejo Runoff Management Plan – Planning Level Regional Detention Basin Strategy – 100year Urbanized Peak Flow-rate Attenuation Analysis, by PACE, under contract for RMV, dated June 2009 | Attenuation Analysis | 100-Year Park Flow Rate for Regional Detention Basin | Used to consider Gobernadora Multi-Purpose Basin Project for WMA | Rancho Mission Viejo, PACE |
| Watershed Hydrology Analysis, Impacts Analysis, and Planning Level Mitigation Study, by PACE, under contract for RMV, dated April 2009 | Watershed Hydrology Analysis | Watershed Hydrology | Used to consider Multi-purpose basin in Rancho Mission Viejo | Rancho Mission Viejo, PACE |
| Annual Integrated Environmental Monitoring Report, Psomas, April 2004 (with annual updates in 2005, 2006, 2007, 2008, 2009), prepared for the SJBA. | Environmental Monitoring Analysis | San Juan Valley Groundwater Supply and Quality Data | Used to assess condition of groundwater basin. | SJBA, Psomas |
| WUE Plan, July 2014 | Water Conservation and use efficiency Analysis | Project costs and water savings | Used to support the Califia Recycled Water Project in Plan | SMWD |
| Gobernadora Multipurpose Basin, by PACE, under contract for SMWD and RMV, July 2006 | Geotechnical Analysis | Current capacity of basin | Used to consider hydrologic conditions for erosion control stabilization | SMWD and Rancho Mission Viejo, PACE |
| CEQA Certification for Gobernadora Multipurpose Basin, by Dudek & Associates, under contract for SMWD, pending | Environmental Analysis | Environmental Impact | Used to support Gobernadora Basin Project | SMWD, Dudek & Associates |

| WMA Technical Studies/Data Sets | | | | |
|---|---|---|---|---|
| **Supporting Technical Documents for Projects** | **Analysis Method** | **Results/ Derived Information** | **Use in IRWM Plan** | **Reference or Source** |
| Phase II Report on Proposed Non-Domestic Seasonal Water Storage Reservoirs prepared for SMWD by Henry Miedema & Associates dated October 19, 2004 | Environmental Analysis | Seasonal Storage Data | Used to support non-domestic seasonal water storage data | SMWD, Henry Miedema & Associates |
| Concept Plan for Gobernadora Basin, by Rivertech, under contract for SMWD, September 1999 | Geotechnical Analysis | Current capacity of basin | Used to consider hydrologic conditions for erosion control stabilization | SMWD, Rivertech |
| Impact of Regional Treatment Plant (RTP) Fats, Oils & Grease (FOG) Addition On Existing Digesters. June, 2009. | Energy Analysis | RTP FOG Waste to Energy Data | Used to consider impact on FOG to treatment plant | SOCWA |
| GHG Emissions Inventory Report – CY 2008. May, 2009. | Energy Analysis | GHG Emissions Data | Used to consider GHG emissions for WMA | SOCWA |
| RTP AQMD Rule 1110.2 Compliance. August, 2008. | Air Quality Analysis | Wastewater Treatment Plan Air Quality | Used to consider treatment plant FOG project | SOCWA |
| Alternative AWMA Access Road Alignment. 2009. | Coastal Treatment Export Sludge System Rehabilitation Analysis | Feasibility of Coastal Treatment Export Sludge Rehab | Used to consider treatment export sludge rehabilitation project | SOCWA |
| Export Sludge Equalization Basin Preliminary Design. 2005. | Coastal Treatment Export Sludge System Rehabilitation Analysis | Feasibility of Coastal Treatment Export Sludge Rehab | Used to consider treatment export sludge rehabilitation project | SOCWA |
| Miscellaneous Biological Surveys in Aliso and Wood Canyon Wilderness Park. 2000 – 2008. | Biological Analysis | Biological data | consideration of biological condition of wilderness parks | SOCWA |

| WMA Technical Studies/Data Sets | | | | |
|---|---|---|---|---|
| **Supporting Technical Documents for Projects** | **Analysis Method** | **Results/ Derived Information** | **Use in IRWM Plan** | **Reference or Source** |
| Plant 3A Aeration System Evaluation Assessment. May, 2008. | Wastewater Treatment System Analysis | Aeration System data | Used to consider project for WMA. | SOCWA |
| Nolte & Associates, South Orange County Reclamation Authority, Salt Balance Model, 1991 | Salinity Analysis | Water Reclamation Feasibility | Used to consider Salt & Nutrient Management | SOCWA, South Orange County Reclamation Authority, Nolte & Associates |
| Infrastructure Master Plan, 2008 | Infrastructure Analysis | Recycled Water System Master Plan | Used to support the Recycled Water System Extension Project | SCWD |
| Shadow Rock Detention Basin Dry Season Runoff Capture and Collection System Technical Report, 2006. | Engineering Analysis | Design and water quality analysis | Used to consider project for WMA. | TCWD, CH2MHill |
| San Juan and Trabuco Creeks Steelhead Recovery, Watershed Management Plan, TU and CDFW, 2007 | Species Recovery Analysis | Protect and Restore Ecosystem for Steelhead | Used to consider San Juan Aquatic Passage and Habitat Improvement Project in Plan | Trout Unlimited and CDFW |
| Population Growth | Statistical Analysis | Future Population | Used to calculate future water demand | United States Census Bureau 2010 |

***Overview of Plans and Studies Utilized by IRWM Plan***

As identified in **Section 10**, the plan incorporates the agencies' adopted master plans for water, wastewater, and recycled water systems, each of which includes a detailed engineering analysis of current system conditions, future service demands, and system improvements. Over the past decade, the IRWM Plan has considered extensive local planning and technical analyses in development of goals, objectives, priorities and projects. Utilizing existing planning to develop the IRWM Plan and projects has further provided opportunities for an informed stakeholder process. Because of this valuable resource, watershed management issues and conflicts have been clearly identified, the objectives directly respond to those issues, and implementation of the strategies and projects has been based on the findings and recommendations of those studies.

Planning Studies

Planning studies included in **Table 9-1** identify opportunities and constraints for watershed projects. The IRWM Group considers planning studies for project development associated with habitat protection and restoration, restoration of ecosystem processes, creek restoration for flood control and water quality, stormwater programs to protect water quality, use of water quality treatment wetlands, runoff reduction through landscape conservation programs, etc. Examples include Water Use Efficiency Plan (SMWD, July 2014) for the Califia Recycled Water Project and the San Juan and Trabuco Creeks Steelhead Recovery Watershed Management Plan (TU and CDFW, 2007).

Technical Studies

Technical studies are scientifically-based and measure watershed conditions for the sake of regulatory compliance, as well as project prioritization and development. These studies contribute considerable information to the IRWM Plan, including (but not limited to): dry and wet weather flow analysis; trends in constituents of concern; BMP effectiveness assessments; bioaccumulation studies; identification of sources and contribution to water quality degradation; effects of hydromodification in creek channels; and degree of toxicity impacts within the WMA. In addition, and as indicated in **Section 3.3.4**, annual monitoring reports are prepared for each TMDL. These reports summarize water quality results relative to the methods and effluent limitations specified in the TMDL orders issued by the SDRWQCB. A monitoring report is also prepared annually for the County's NPDES permits, which summarizes all monitoring results and data collection activities for the reporting year. Every 5 years, and as mandated by Title 23 of the California Code of Regulations and Title 40 of the Code of Federal Regulations, a ROWD is prepared for issuance of a new MS4 permit. This ROWD, summarized in greater detail within **Section 3.3.4**, addresses stormwater data and accomplishments over the past five years, which in turn is used for development of critical WMA and watershed planning documents such as the WQIP.

In the future, a significant number of technical studies and reports will be produced pursuant to the strategies documented in the WQIP (refer to **Section 3.3.4** for additional WQIP information). Finally, studies conducted by the USACE include a reconnaissance report that documents baseline conditions; these reports are made available to stakeholders for the purpose of project planning, permitting, and post-project comparisons. Each of these studies and regular reports has been used in the development of this IRWM Plan as they identify where specific actions are needed and offer science-based recommendations for strategies.

## *9.2 Technical Analyses and Methods*

The IRWM Group members perform monitoring to obtain sound technical information, based upon prescribed methods. Monitoring is intermittent surveillance carried out in order to ascertain compliance with a standard or deviation from an expected norm to:

- Determine compliance with standards,
- Construct, adjust and verify predictive models,
- Provide information to evaluate abatement measures and identify progress against control objectives, and
- Provide early warning of future problems.

Many of the WMA's monitoring programs and activities provide data that are useful to IRWM planning and management in the WMA. This section provides an overview and description of efforts thought to be of particular importance to integrated, regional planning, but is not intended as a comprehensive survey of all programs and activities. Refer to **Section 7** for further discussion of Data Management throughout the WMA.

***Water Supply Monitoring***

Operators of public water systems conduct routine monitoring to ensure that the water they produce complies with Safe Drinking Water Act standards. Results are reported to the SWRCQB Division of Drinking Water. Monitoring broadly encompasses several categories of constituents, discussed in **Section 3**.

Sampling is conducted at treatment plants, within distribution systems, and at the tap, and monitoring results are evaluated to ensure that applicable drinking water quality standards are met. For regulated constituents, results are compared to Primary and Secondary MCLs, and unregulated contaminants are evaluated against DHS Detection Limits for Purposes of Reporting (e.g., color, corrosivity, and odor).

Monitoring for constituents for water suppliers is conducted annually. Water districts publish annual water quality reports (often provided as both hard copy mailers and electronically on their websites) to provide members of their service areas information on the quality of their water, if it meets all drinking water standards, and other information the EPA would like them to know.

***Surface Water Quality Monitoring***

Numerous federal, state, and local agencies and organizations have conducted surface water quality monitoring in the WMA over the past several decades. WMA and site-specific surface water quality monitoring efforts are currently underway, including the following:

Core Monitoring

Routine, ongoing water quality monitoring within the regulatory framework of the National Pollutant Discharge Elimination System (NPDES) and TMDL monitoring programs comprises the core monitoring programs referenced in this IRWM Plan. This type of monitoring addresses clearly defined questions related to point, non-point and targeted pollutant levels with a commitment to improving our understanding of regionally-specific environmental issues. Core monitoring is additionally dictated by the WQIP's identification of areas of high priority; monitoring efforts are described in the Section 4 of the WQIP.

Unified PEAs were prepared by the County of Orange as the Principle Permittee in collaboration with the cities (Permittees) on an annual basis to comply with NPDES Permit requirements; data presented summarized core monitoring associated with NPDES and applicable TMDL compliance programs[100]. A Transitional Monitoring and Assessment Report was produced for

[100] Annual Unified PEA reports can be found in the County Document Database by year (http://prg.ocpublicworks.com/DocmgmtInternet/Search.aspx). Additional information on annual reporting can be found on the Water Quality Monitoring page of the County website, including access to the Monitoring Data Portal

the 2015-16 monitoring year while the WQIP was under development; core monitoring programs were adjusted to comply with the requirements of the interim monitoring program and are summarized in the report. Upon approval of the WQIP (anticipated in 2018), Section 4 of the plan will describe core monitoring efforts and annual WQIP updates will summarize data/findings.

Regional Monitoring

IRWM Group agencies also participate in and partner on regional monitoring programs, representing periodic, collaborative, and larger-scale multi-agency surveys. Examples include:

- Southern California Bight Studies: The Bight studies, coordinated by the SCCWRP, utilize standardized sampling and analytical methods to produce a wide range of data from both impacted and reference areas.
- Stormwater Monitoring Coalition (SMC): The SMC often use exploratory data analysis methods to investigate new measurement methods, improve basic understanding, characterize problems, or provide one-time measurements of important parameters or processes.

Unified Beach Water Quality Monitoring Program

This model monitoring program consolidates coastal receiving waters pathogenic indicator bacterial monitoring efforts for OC Public Works, OC Sanitation District, South Orange County Wastewater Authority, and OC Health Care Agency. Bacteria samples are collected once per week, year-round during dry weather conditions; sampling locations coincide with TMDL monitoring programs for both the Beaches and Creeks and Baby Beach Indicator Bacteria TMDLs.

Groundwater Monitoring

Groundwater monitoring data are collected and/or stored through a variety of monitoring efforts/organizations in the WMA; these include:

- USGS National Water Information System – The National Water Information System supports the acquisition, processing, and long-term storage of water data. This system provides real-time data on depth to groundwater.
- Waste Discharge Compliance Monitoring - NPDES permits contain monitoring requirements to verify compliance with applicable conditions. NPDES permit requirements often include groundwater monitoring. For example, the SDRWQCB has established monitoring programs for recycled water and wastewater operations that discharge to groundwater. Dischargers must periodically collect and analyze groundwater quality samples from wells representative of the receiving groundwater. The SDRWQCB has established groundwater monitoring requirements for several of the WMA's watersheds.

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and direct access to monitoring data sets (http://www.ocwatersheds.com/rainrecords/waterqualitydata/water_quality_monitoring_data).

- Underground Storage Tank Monitoring - The RWQCB and Environmental Health Division require groundwater monitoring as part of regulating compliance with underground tank regulations. Monitoring associated with UST is normally limited to the immediate vicinity of the underground tank (to check for tank leaks). At documented remediation sites where leaks have been detected, however, extensive groundwater monitoring is required to document site remediation and recovery.
- Special Studies and Projects - Groundwater quality data are also periodically collected or compiled as part of special studies, including CEQA evaluations, groundwater supply investigations, scientific studies conducted by government or research organizations.
- Geotracker (GAMA) Groundwater Information System – This is a data management system created in response to the Groundwater Quality Monitoring Act of 2001. It integrates and geographically displays groundwater information collected from multiple sources. It offers analytical tools and reporting features to assess groundwater quality and water level information to identify potential groundwater issues.

Habitat & Natural Resource Monitoring

A significant variety of habitat data has been collected within the WMA. Data have been collected as part of site-specific or project specific investigations (e.g. CEQA analyses), educational or scientific investigations, volunteer organizations, and WMA habitat conservation programs. The most significant ongoing habitat monitoring programs are conducted as part of the NCCP efforts. Refer to **Section 3.3.1.7** for more detail on the NCCP. The NCCP identifies and provides for the regional or area wide protection of plants, animals, and their habitats, while allowing compatible and appropriate economic activity.

Additional Monitoring Efforts

- Special Studies/Research – OC Watersheds along with cities, governmental agencies, NGOs and/ or universities has a strong commitment to advancements in water quality science through focused special studies to answer specific issues of concern related to Orange County. For updates on special studies, where applicable, reference annual reports, the Transitional Monitoring Program and Section 4 of the WQIP.
- Watershed Sanitary Surveys - Per the California Surface Water Treatment Rule (Title 22 of the California Code of Regulations), every public water system using surface water is required to conduct a comprehensive sanitary survey of its watersheds every five years. In the SOC WMA, this pertains to MET. The purpose of such a survey is to identify actual or potential sources of contamination or any other watershed-related factor which might adversely affect the quality of water used for domestic drinking water. Source water is analyzed for organic and inorganic constituents, microorganisms, and general physical characteristics, and results compared to the MCL and/or SMCL standards for drinking water. Potential sources of contaminants in the watersheds draining into reservoirs are examined through a review of various data sets including existing aerial photographs, GIS data, reports, water quality data and other record documents, and supplemented by field surveys. Every five years, MET is required to prepare and submit a Watershed Sanitary Survey, which examines possible sources of drinking water contamination in its State Water Project and Colorado River source waters. The Watershed Sanitary Survey includes suggestions for how to better protect these source

waters. Both source waters are exposed to stormwater runoff, recreational activities, wastewater discharges, wildlife, fires, and other watershed related factors that could affect water quality. Water from the Colorado River is considered to be most vulnerable to contamination from recreation, urban/stormwater runoff, increasing urbanization in the watershed, and wastewater. Water supplies from Northern California's State Water Project are most vulnerable to contamination from urban/storm water runoff, wildlife, agriculture, recreation, and wastewater. A copy of the most recent summary of the Watershed Sanitary Survey can be obtained by contacting MET at (800) CALL-MWD (225-5693).

- SCCWRP is a joint powers agency focusing on marine environmental research for the Southern California Bight. SCCWRP gathers scientific information so that member agencies can effectively and cost-efficiently protect the Southern California marine environment. Although SCCWRP initially focused on wastewater discharges from Publicly Owned Treatment Works (POTWs), SCCWRP has developed and refined urban runoff and surface water quality monitoring programs over the past decade. The South Orange County WMA uses scientific data and information from SCCWRP to analyze watershed conditions within the WMA.

## *9.3 Data Gaps*

Many governmental and non-governmental organizations currently collect surface water quality, surface flow, groundwater, habitat, and water use data within the WMA. Despite the extensive ongoing water resources monitoring within the WMA, opportunities exist for additional data gathering to close existing gaps. Monitoring is generally conducted to support specific organizational, regulatory, or research objectives rather than within a regional or integrated framework. As a result, many of the gaps discussed here are related to a general lack of regional, integrated planning and concomitant data support strategies. Indeed, IRWM Group agencies and other groups have extensive data available to the public for surface and groundwater as well as recycled/potable water; however, there is not one integrated analysis that assists identifying all potential data gaps for water management. Since a primary purpose of IRWM planning is to provide that regional focus, it is expected that this assessment of gaps will be updated and refined substantially over the next several years. Water supply and groundwater data are collected and publically posted on a regular basis and answer the primary questions related water sustainability (e.g. OC Water Reliability Study). The analysis of data gaps presented in this Plan are primarily from the WQIP, which sought to examine water quality on the watershed-scale, considering water quantity and changing flow regimes.

Regional stormwater runoff data collection efforts have been coordinated and managed by the MS4 Permittees, as described in **Sections 7 and 9.2**. The WQIP development process included an extensive effort to identify existing data resources and gaps; however, no central data management structure exists for all of the WMA's water management data (i.e. surface water quality, groundwater, habitat, etc.). Though the WQIP represented a significant data gathering process, data gaps still exist for how regional surface water quality, groundwater quality, groundwater availability, and habitat data overlap and interact. Filling the data gaps and coordinating data collection and management within the WMA will continue to be a priority for the IRWM Group to best assess regional water management needs and the effectiveness of implemented water management projects.

WQIP Highest Priority Water Quality Conditions

As previously noted, the WQIP development process aggregated a significant volume of data for the sake of assessing existing water quality conditions, and identifying strategies for addressing the highest priority water quality conditions. However, data gaps were identified throughout the process of developing the WQIP. These data gaps are summarized below:

- *Pathogen Impacts and Loading*

  Recreational uses are among the most important beneficial uses of many of the WMA's receiving waters. However, in recent years, Section 303(d) listings for bacterial indicators have become increasingly common. The significant number of listings for bacterial indicators (40 as of 2017) is problematic because the indicators themselves are not thought to present a threat to humans; presence is merely an indicator of the potential presence of disease organisms. For these reasons, and as noted in **Section 3.3.4**, pathogen health risk is identified as one of three highest priority water quality conditions to be addressed through implementation of the WQIP.

  To correct these conditions, Section 3 of the WQIP prioritizes targeted non-structural BMPs, with emphasis on those that most directly address risks to human health. More specifically, the MS4 Permittees will implement a Comprehensive Human Waste Source Reduction Strategy (i.e., microbial source tracking) to aggressively and comprehensively investigate and eliminate human waste sources in the watersheds. As part of a separate strategy, structural treatment BMPs intended to address general stormwater runoff are planned. The overall effectiveness of these strategies will be monitored according to the TMDLs Monitoring Program described in Section 4 of the WQIP. These programs include sampling and analysis specifically intended to address the Permittees' progress towards achieving compliance with the water quality-based effluent limitations (WQBELs) associated with applicable TMDLs. Additional monitoring will be performed by Permittees to verify the progress and effectiveness of the Comprehensive Human Waste Source Reduction Strategy and structural BMPs.

- *Unnatural Water Balance/Flow Regime*

  As discussed in **Section 3.3.4**, unnatural water balance and flow regime within inland receiving waters (i.e., flows in normally dry reaches, reduction in baseflow in normally wet reaches), is one of three highest priority water quality conditions that will be combatted through implementation of the WQIP. Pursuant to the function-based framework for stream restoration, as long as flow regime in channels is unnatural in its timing or magnitude, actions to compensate for low biologic integrity or eutrophication within inland receiving waters would likely be less efficient, less effective or would not be controllable by MS4 Permittees. Therefore, strategies have been proposed within the WQIP to effectively eliminate unnatural dry weather flows from storm drain outfalls to inland receiving waters, giving priority to locations where unnatural dry weather flow inputs arising from an unnatural urban water balance are exacerbating in-stream water quality conditions and contributing to unnatural in-stream regimes. A primary strategy proposed in the WQIP to achieve these goals include more focused data collection and special studies to better define strategies for specific receiving waters. More specifically, the WQIP Monitoring and Assessment Program specifies the need for enhanced outfall observations; detailed flow monitoring at priority outfalls; and high-resolution multispectral aerial imagery.

- *Channel Erosion/Geomorphic Impacts*

  Urbanization of the WMA has resulted in significant geomorphic impacts to inland receiving waters throughout the WMA. These impacts affect the physical habitat of a stream, and subsequently its biological integrity and recreational value. For these reasons, channel erosion and geomorphic impacts is one of three highest priority water quality conditions that will be combatted through implementation of the WQIP. Countering and rehabilitating geomorphic impacts (i.e., stream energy, stream erosion, stream form, and bed and bank material/vegetation) is expected to create physical habitats condition that are more likely to support biological and recreational beneficial uses.

  The long-term strategic vision of the WQIP includes rehabilitation of geomorphically unstable channels within urbanized corridors and publicly owned right-of-ways using a multi-benefit rehabilitation approach, where feasible. In addition to evaluating reaches for rehabilitation, an important element will be to evaluate upstream opportunities to implement flow control. The aforementioned strategies will require additional data collection for the purpose of identifying, prioritizing, and selecting restoration projects. Additionally, the WQIP Monitoring and Assessment Program describes post-restoration monitoring activities, which would be used to assess the effectiveness of restoration projects. A basic framework for assessing the effectiveness of stream restoration projects will include geomorphic characterization; high-resolution LiDAR analysis; and targeted bioassessment and California Rapid Assessment Method (CRAM).

<u>Habitat and Natural Resource Monitoring</u>

Habitat mapping efforts within the WMA are reasonably complete (e.g. NCC mapping), however, additional data collection is needed to better address habitat health and viability and to update habitat maps across the region as it relates to other water resources. Additional habitat health, species composition, and invasive species data are required in all watersheds to provide for a greater understanding of geographic-, temporal-, and water quality-related trends. Although several federal, state and local agencies collect data with respect to the quantity and quality of habitat, currently no single entity provides a comprehensive assessment of such data.

<u>Monitoring and Assessment Approaches</u>

In some instances, data gaps can be addressed through modifications to existing monitoring and assessment approaches. For instance, monitoring approaches that better focus on water quality or environmental “risk,” such as those being implanted through the ROWDs and WQIP, rather than static regulatory benchmarks such as chemical concentrations, could better and more cost efficiently focus management efforts toward solutions. Likewise, considerable benefit, including cost-savings, could be achieved through data gathering approaches that are designed to assess cumulative impacts rather than those of a single source or project. Another key issue with respect to monitoring approaches is that of linkages between media. Although the cycling of many constituents between water supply systems, surface waters, groundwater, and potentially biota, is well understood from a theoretical perspective, little real world data exist to support the development of effect management approaches. For instance, high levels of total dissolved solids (TDS) have been documented in supplied water, surface waters, and groundwater throughout the WMA. The current San Juan Basin GWFMP and SNMP are not required to target “risk” in their monitoring assessments, primarily following regulatory benchmarks. Future data collection will need to be increasingly focused on characterizing and managing this problem.

# 10 COORDINATION WITH EXISTING LOCAL/REGIONAL PLANS

As discussed in **Sections 3, 6, 7 and 9** of this IRWM Plan, implementation of integrated water planning within the WMA relies upon existing planning efforts conducted by the IRWM Group and their partners. IRWM Group agencies contribute plans, reports, studies, and programs that provide the foundation for the IRWM Plan and present a coordinated, integrated approach. In addition to the numerous planning documents listed in this section and described in **Section 9**, key planning documents integral to WMA planning are included as Appendices to this Plan, such as **APPENDIX G**: SNMP, **APPENDIX H**: Flood Management Plan, **APPENDIX I**: Groundwater Management and Facility Plan, **APPENDIX J**: Climate Change Analysis, and **APPENDIX L**: Orange County Stormwater Resources Plan (OC SWRP).

## *10.1 Local Water Planning*

It is the intent of this IRWM Plan to be congruent with local plans and to include current, relevant elements of local water planning and water management issues common to multiple local entities in the Region. The IRWM planning does not replace or supersede local planning, but rather incorporates local planning elements.

The IRWM Group shall coordinate water management activities and information with local water planners and stakeholders through IRWM Group meetings, workshops, outreach activities, and email and website updates. Additionally, IRWM Plan strategies and priority projects are planned and implemented through extensive coordination and cooperation between Group members. Planning activities addressed in this teaming process include (but are not limited to):

- Groundwater Management
- Urban Water Management
- Water Supply Management
- Wastewater Management
- Watershed Management
- City and County General Planning
- Land Development (including LID)
- Flood Protection
- Stormwater and Urban Runoff Management (including the OC SWRP)
- Ecological Resource Management
- Salt and Salinity Management
- Emergency Response/Disaster Plans

Many existing plans, including the WQIP, OC SWRP, Water Supply Master Plans, Groundwater Management Plans, Watershed Management Plans, Water Reliability Assessments, Recycled Water Studies, Desalinization Feasibility Studies, and Long-Range Plans contain proposed projects that are instrumental in meeting the goals and objectives of the Region. Projects within local and regional plans and studies have been incorporated into this IRWM Plan, and will continue to be implemented in coordination with applicable plans.

Although this IRWM Plan addresses Region-wide water management issues, local plans provide planning guidance and/or goals specific to a local water or natural resource. In the case that a stated goal or activity of a local plan conflicts with, or is inconsistent with, this IRWM Plan the IRWM Group shall organize meetings with the local governments or agencies to identify inconsistencies between the plans and resolve any issues. As IRWM planning develops and progresses, the dynamic relationships between local plans and the IRWM Plan will continue to consider and incorporate:

- Consistency and coordination regarding local plan content and the IRWM Plan content,
- Relevant, accurate, and current local plan information and references of which the IRWM Plan is based,
- Water management issues and climate change adaptation and mitigation strategies from local plans into the IRWM Plan, and
- Limits, levels, management tools or criteria relevant to water management in local plans that are applicable to the IRWM Plan.

Both local plans and this IRWM Plan will periodically be updated to reflect effective, integrated, and consistent water planning and management. Local plans will also be updated to comply with relevant compliance requirements. Updates to the IRWM Plan will consider planning changes due to compliance mandates (e.g. NPDES, TMDL or WDR) as well as increasing challenges in managing WMA water supply due to climate change, increasing population and water demand, uncertainty in the availability of water from the Sacramento-San Joaquin Delta and reduced surface flows. When the IRWM Plan is updated, the relevancy of the plans included here will be reviewed and the most updated or recent plans will be included.

**Table 10-1** demonstrates the multitude of plans and projects that the South Orange County IRWM Plan integrates into regional planning.

***Stormwater Resource Planning***

Water Code § 10562 (b)(7) (i.e. SB 985) requires the development of a SWRP to receive grants for stormwater and dry weather runoff capture projects. The RWMG is subsequently required to incorporate applicable SWRPs into IRWM Plans. Per the requirement set forth above, the Orange County SWRP (OC SWRP) is included as **APPENDIX L** of this IRWM Plan and was included in the local planning coordination efforts described above. Indeed, the OC SWRP utilizes the integrated project prioritization and selection process from this IRWM Plan as a model for stormwater projects and aligns with the goals and objectives contained herein.

**Table 10-1: Existing Local and Regional Plans, Documents and Programs**

| **GROUNDWATER MANAGEMENT** | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| San Juan Basin Groundwater and Desalination Optimization Program Final Report, March 28, 2016 | SJBA | Local groundwater management information & data. |
| Groundwater Management and Facilities Plan, 2013 | SJBA | Local groundwater management information & data |

| GROUNDWATER MANAGEMENT | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Basin Water Levels and Well Yield, Geotechnical Consultants, 11/01 | San Juan Capistrano, City of | Technical data |
| Groundwater Supply and Management Study, Boyle Engineering Corporation, 09/87 | San Clemente, City of | Technical data |
| San Juan Basin Groundwater Management and Facilities Plan, NBS Lowry, 05/94 | SJBA / MWD | Local groundwater management information & data |
| Selection of Recommended Projects for San Juan Basin Groundwater Management, SJBA, 05/95 | SJBA | Local projects information |
| Seven-Year Drought Groundwater Flow Model Results, Geotechnical Consultants, 06/02 | San Juan Capistrano, City of | Technical data |
| **URBAN WATER MANAGEMENT PLANNING** | | |
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| 2015 Regional UWMP Update, Arcadis, 5/16 | MWDOC | Regional water management information & data |
| 2010 Urban Runoff Diversion Study Report, Arcadis, 6/11 | Laguna Beach, City of | Technical information |
| 2010 Urban Runoff Management Plan, Arcadis, 6/11 | Laguna Hills, City of | Local water management information & data |
| 2010 Urban Runoff Management Plan, Arcadis, 6/11 | San Clemente, City of | Local water management information & data |
| 2015 UWMP, Arcadis, 5/16 | El Toro WD | Local water management information & data |
| 2015 UWMP, Irvine Ranch WD, 6/16 | Irvine Ranch WD | Local water management information & data |
| 2015 UWMP, Laguna Beach County WD, 6/16 | Laguna Beach County WD | Local water management information & data |
| 2015 UWMP, Moulton Niguel WD, 2016 | Moulton Niguel WD | Local water management information & data |

| URBAN WATER MANAGEMENT PLANNING | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| 2015 UWMP, Arcadis, 6/16 | San Clemente, City of | Local water management information & data |
| 2015 UWMP, Arcadis, 6/16 | Santa Margarita WD | Local water management information & data |
| 2015 UWMP, Arcadis, 7/16 | San Juan Capistrano, City of | Local water management information & data |
| 2015 UWMP, Arcadis, 6/16 | South Coast WD | Local water management information & data |
| 2015 UWMP, Arcadis, 6/16 | Trabuco Canyon WD | Local water management information & data |

| WATER SUPPLY MANAGEMENT | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Capistrano Valley Water District (now City of San Juan Capistrano Public Works) and MNWD SERRA AWT and Pipeline Project, Cathcart Garcia Von Langen Engineers, 7/94 | Moulton Niguel WD | Technical data |
| Determining the Value of Water Supply Reliability, Orange County Business Council, 8/03 | MWDOC | Technical data |
| Drinking Water Source Assessment, Geotechnical Consultants, 3/01 | San Juan Capistrano, City of | Technical data |
| ETWD, IRWD, and MNWD Recycled Water Project Study Draft, Tetra Tech, 12/03 | Moulton Niguel WD | Local project information & data |
| Evaluation of Recycled Water Supply for MNWD & ETWD, Cathcart Garcia Von Langen Engineers, 4/01 | Moulton Niguel WD | Technical data |
| Joint Regional Water Supply System Master Plan, AKM Consulting Engineers, 02/97 | South Coast WD | Water supply information |
| MNWD Master Plan for District-wide Facilities, Moulton Niguel WD, 1996 | Moulton Niguel WD | Local water facility information |

| WATER SUPPLY MANAGEMENT | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Non-Domestic Water Master Plan Financial Study, City of San Juan Capistrano, 04/00 | San Juan Capistrano, City of | Technical data |
| Ocean Desalination Plant Feasibility Study, Boyle Engineering Corporation, 1/03 | MWDOC | Project feasibility |
| Orange County Water Reliability Study, Final, CDM Smith, 12/16 | MWDOC | Water supply reliability analysis |
| Planned Utilization of Water Resources in the San Juan Creek Basin Area, DWR, 06/72 | DWR | Water resource information & data |
| Preliminary Design of MNWD Recycled Water System Expansion with ETWD, Cathcart Garcia Von Langen Engineers, 08/02 | Moulton Niguel WD | Local recycled water project |
| Preliminary Engineering MNWD AWMA-Side Water Reclamation Distribution System, Nolte and Association, 06/88 | Moulton Niguel WD | Local reclaimed water distribution information |
| Preliminary Engineering MNWD South East Regional Reclamation Authority (SERRA) -Side Water Reclamation Distribution System, Nolte and Association, 06/89 | Moulton Niguel WD | Local reclaimed water distribution information |
| Preliminary Well Design and Site Selection Report, Geotechnical Consultants, 6/01 | San Juan Capistrano, City of | Groundwater well information & data |
| Reclaimed Water Master Plan, AKM Consulting Engineers, 04/94 | San Clemente, City of | Local reclaimed water information |
| South Orange County Water Reliability Study (Phase 1&2), Boyle Engineering Corporation / MWDOC, 2001&2004 | MWDOC | Regional water reliability information |
| SCCWR and Reuse Study, CH2MHILL; USBOR, 1999 | USBOR and eight partnering agencies | Regional data |
| Strategic Plan 2003-2008, SCWD, 11/03 | SCWD | Regional planning information |
| Water and Sewer Master Plan, RBF Consulting, 12/04 | ETWD | Local planning information |

| WATER SUPPLY MANAGEMENT | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Water Master Plan, 04/94 | San Clemente, City of | Local planning information |
| Water Master Plan Update, AKM Consulting Engineers, 3/04 | San Juan Capistrano, City of | Local planning information |
| Biosolids Management Strategic Plan, Tetra Tech, Inc., 9/02 | SOCWA | Technical data |
| Enclosed Composting Facility, SOCWA, 10/02 | SOCWA | Technical data |
| J.B. Latham Wastewater Treatment Plant Preliminary Design Report, Cathcart Garcia Von Langen Engineers, 09/00 | SOCWA | Technical data |
| Sanitary Sewer Master Plan, Tetra Tech, 2003 | San Juan Capistrano, City of | Local sewer information & data |
| Sewer Collection Strategic Plan and Capital Improvements Program, City of Laguna Beach, 07/02 | Laguna Beach, City of | Local sewer information & data |
| Ten Year CIP 2010-2020, SOCWA, 3/10 | SOCWA | Technical data & planning information |

| GENERAL PLANNING | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| General Plan 2015 | City of Aliso Viejo | Local planning information |
| General Plan 1991, with various updates | City of Dana Point | Local planning information |
| General Plan/Local Coastal Program "Open Space and Conservation" Element, City of Laguna Beach, 2004 | City of Laguna Beach | Local planning information |
| General Plan, 2009 | City of Laguna Hills | Local planning information |
| General Plan, 1992 | City of Laguna Niguel | Local planning information |

| GENERAL PLANNING | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| General Plan, 2002 | City of Laguna Woods | Local planning information |
| Lake Forest General Plan 2040, 1994 | City of Lake Forest | Local planning information |
| General Plan, 2009 | City of Mission Viejo | Local planning information |
| General Plan, 2007 | City of Rancho Santa Margarita | Local planning information |
| Centennial General Plan, 2014 | City of San Clemente | Local planning information |
| General Plan, 2014. | City of San Juan Capistrano | Local planning information |
| General Plan and Draft EIR for Doheny State Beach, Department of State Parks, 12/03 | California State Parks | Local planning information |
| Long Range Plan Update, Moulton Niguel WD, 2/02 | Moulton Niguel WD | Local planning information |
| **WATERSHED MANAGEMENT** | | |
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Aliso Creek Watershed Management Plan, USACE, 9/01 | County of Orange | Local watershed management information & data |
| Laguna Coastal Streams Watershed Management Plan, Co-permittees, 2004 | Laguna Beach, City of | Local watershed management information & data |
| San Juan Creek Watershed Management Study, USACE, 09/02 | County of Orange | Local watershed management information & data |
| One Water One Watershed, SAWPA, 2/14 | SAWPA | Local watershed management information & data |
| San Mateo Creek Watershed Work Plan (2011-2013) | County of Orange | Stormwater Management Program |
| Aliso Creek Watershed Work Plan (2011-2013) | County of Orange | Stormwater Management Program |

| WATERSHED MANAGEMENT | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Dana Point Coastal Streams Watershed Work Plan (2011-2013) | County of Orange | Stormwater Management Program |
| Laguna Coastal Streams Watershed Work Plan (2011-2013) | County of Orange | Stormwater Management Program |
| San Juan Creek Watershed Work Plan (2011-2013) | County of Orange | Stormwater Management Program |
| San Clemente Coastal Streams Creek Watershed Work Plan (2011-2013) | County of Orange | Stormwater Management Program |
| **WATER QUALITY & STORMWATER/FLOOD MANAGEMENT** | | |
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| DAMP, Co-Permittees, 2003 | County of Orange | Technical data |
| Identification of Regional BMP Retrofitting Opportunities (Stormwater Program), RBF Consulting, 2004 | County of Orange | BMP data |
| Local Implementation Plan (Jurisdictional Urban Runoff Management Plan), Co-Permittees, 2017 | County of Orange & Permittees (individually) | Technical data/Local NPDES Compliance Planning |
| Aliso Creek Watershed Water Quality Data Assessment (Annual Report) | County of Orange & TMDL Permittees | Water Quality Data/TMDL compliance |
| Baby Beach Dana Point Harbor Bacterial Indicator TMDL Annual Progress Report | County of Orange & City of Dana Point | Water Quality Data/TMDL Workplan |
| Model WQMP& Technical Guidance Document (TGD) , 2013 (2017 Update submitted with WQIP) | County of Orange | Post-construction stormwater runoff requirements |
| Aliso Creek CLRP – July 2014 Update | County of Orange | Stormwater Management Program |
| South Orange County Hydromodification Plan (HMP), 2015 | County of Orange & Permittees | Hydromodification requirements for land development |
| South Orange County Hydrology Model (SOCHM), 2012 | County of Orange & Permittees | Hydrologic model to assist land development hydromodification BMP selection & sizing |

| WATER QUALITY & STORMWATER/FLOOD MANAGEMENT | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Watershed Infiltration & Hydromodification Management Plan (WIHMP) Mapping, 2016 | County of Orange & Permittees | GIS screening tool for infiltration BMP site suitability at watershed & subwatershed scales |
| Report of Waste Discharge, 2014 | County of Orange & Permittees | Watershed-based review of the State of the Environment for TMDL and NPDES monitoring and compliance |
| San Juan Creek CLRP- Draft 2012 | County of Orange & City of San Juan Capistrano | Stormwater Management Program |
| San Clemente Coastal Streams CLRP – Draft 2012 | County of Orange & City of San Clemente | Stormwater Management Program |
| Orange County SWRP (OC SWRP), 2016 | County of Orange | Stormwater Management/Project Planning, included as Appendix. |
| South Orange County (SJHU) WQIP Submittal, April 1, 2017 | County of Orange, et. al. | Water Quality Management/Watershed Planning |
| **ECOLOGICAL RESOURCE MANAGEMENT** | | |
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Heisler Park Preservation and Renovation Conceptual Plan, SFC Consultants, 07/04 | Laguna Beach, City of | Open space planning |
| Heisler Park Preservation and Renovation EIR, SFC Consultants, 12/04 | Laguna Beach, City of | Open space planning |
| Laguna Creek Initial Study and Conceptual Restoration Plan, PCR Services Corporation, 10/03 | Laguna Beach, City of | Local restoration planning |
| Southern Subregion Natural Community Conservation Plan/Habitat Conservation Plan, County of Orange, 1996 | County of Orange | Conservation planning |
| Bikeways, Trails & Open Space Master Plan, Dangermond Group, 11/01 | Laguna Hills, City of | Open space planning |

| ECOLOGICAL RESOURCE MANAGEMENT | | |
|---|---|---|
| **Document Title** | **Agency** | **Contribution to IRWM Plan** |
| Southern California Steelhead Recovery Plan, 2012 | NOAA - Southwest Regional Office, National Marine Fisheries Service Long Beach, CA | Steelhead Recovery |
| Southern California Wetlands Recovery Project 2015 | SCWRP | Cooperative wetland recovery planning and implementation |
| OCTA Mitigation Funding, 2016 | OCTA | Environmental Mitigation Planning |
| SMWD Supplemental Environmental Project (for RWQCB) 2012 | SMWD | Environmental Mitigation Planning |

***Watershed Plan Integration***

Each watershed in the WMA has unique surface water and groundwater qualities requiring localized sub-watershed and watershed-scale planning. As indicated in **Table 10-1** and described in **Section 4.2, 4.3.3, and 8.1**, watershed planning for water quality compliance has provided watershed-scale guidance for the WMA; this has included development of Watershed Work Plans, CLRPs and the WQIP. Additionally, the OC SWRP merges IRWM, WQIP, WIHMP and land use planning to prioritize watershed-level water quality and watershed concerns for project implementation. The IRWM Group and WMA will coordinate water management planning activities through incorporation of relevant plans, studies and compliance programs to balance water resources. The primary mechanism for integrating the wide breadth of water resource planning efforts is cooperation amongst the IRWM Group through the Management structure described in **Section 2.1** and through coordination with stakeholders.

Plan integration and water management coordination will also occur through implementation of projects. The Projects in this IRWM Plan are reflective of the water resource priorities described in the plans and studies included in **Sections 9 and 10** of this plan; projects address water quality, supply and reliability challenges facing the WMA. For a description of projects that integrate water resource management strategies to reflect WMA goals, see **Sections 6.1.1** to **6.2.1**.

***Groundwater Sustainability***

As noted in **Section 9**, the San Juan Basin GWFMP fulfills the SGMA requirements and provides considerable groundwater-based planning for the WMA. The IRWM Group utilizes the plan to align surface water quality, habitat restoration, water supply and groundwater management activities within the WMA. The plan provides groundwater analysis for groundwater management that is used to consider Groundwater Management Facilities. As discussed in **Section 3.3.2**, the San Juan Basin GWFMP serves as the groundwater management plan for the South Orange County IRWM region and meets Groundwater Management Plan Compliance. DWR has designated the San Juan Valley Groundwater Basin as a low priority in the CASGEM Final Basin Prioritization results (June 2014), available here.

***Climate Change Adaptation & Mitigation Strategies***

This IRWM Plan considers and incorporates water management issues and climate change adaptation and mitigation strategies from local plans into the IRWM Plan. As discussed in **Section 12**, several planning studies have been performed in South Orange County water supply regions that consider the impacts of climate change. Projected climate change conditions, typically obtained from statistical downscaling of an ensemble of models, have been used for developing plans in the region. For example, the water agencies discuss Climate Change in their UWMPs, prepared every 5 years, per DWR requirements. In addition, the GWFMP also includes climate change impacts into its analysis of groundwater for the South Orange County WMA. Climate change adaptation and mitigation strategies are discussed in the UWMPs and the GMFMP, both of which are incorporated into this IRWM Plan. **APPENDIX J** presents an assessment of the potential impacts of climate change on the water resources of South Orange County. Aspects of this analysis have been incorporated throughout the IRWM Plan per the 2016 Plan Standards.

## *10.2 Local Land Use Planning*

Land use decisions and water management decisions are often under the purview of different agencies, yet the resources each agency manages are inextricably linked. Often, the relationship among these agencies is characterized as reactive in that one agency must act to accommodate a decision the other agency has made. Early communication is vital in changing the relationship from reactive to proactive. Local land use planning, regional water issues, and water management objectives are closely related due to the overlap of issues present within the WMA. **Figure 10-1** shows land use for the region[101].

***Land Use Planning & Water Supply Reliability and Efficiency***

Local land use planning and water supply planning are coordinated through a patchwork of existing State laws and policies. Regional wholesalers such as MET base their water supply plans of regional growth projections developed by regional planning agencies.

UWMPs, as established by the Water Conservation Bill SBX7-7, must be prepared by large water purveyors (3,000 acre-foot/year or 3,000 customers), must evaluate water supplies and demands over a 20-year period, and must be updated every five years. South Orange County WMA water districts routinely submit their UWMPs to the state every five years and consider land use in their water supply and demand projections. **Table 10-1** includes references to the IRWM Group UWMPs.

Municipal water conservation efforts and landscaping programs implemented by the IRWM Group agencies integrate land use and water planning. Water use efficiency outreach and retrofit programs (e.g. MWDOC's South Orange County WSL Project) require integration of water management with land use planning by requiring careful coordination between the participating City's and land/property owners. Additionally, the UWMPs and water use

[101] Southern California Association of Governments 2008 – Land Use Data

efficiency programs implemented by the IRWM Group consider longevity of conservation measures through identification of the most appropriate locations for removing non-functional turf, upgrading antiquated irrigation timers to weather-based self-adjusting irrigation timers, and converting high-volume spray irrigation to low-volume irrigation over time.

Senate Bills 610 and 221 (2001) were enacted by the State legislature to improve coordination between land use planning and development of long-term water supplies. These laws are intended to require assessment and verification, respectively, of water supply reliability prior to approval of specified large land use projects. SB 610 applies during the CEQA process, and SB 221 applies to subdivision approvals. Both laws require a demonstration of sufficient reliable 20-year water supplies to serve both the proposed project and other water users relying on the same water supplies, during normal, single dry, and multiple dry years. To comply with these requirements, IRWM Group agencies responsible for water resource planning work with the local land use agencies to demonstrate sufficient supplies. Additionally, the IRWM Group agencies comply with SBX7-7 (Steinberg 2009) by coordinating with local jurisdictions to implement water use efficiency programs on private and public properties as well as during land development (where applicable).

***Water Quality Compliance & Land Use Planning***

IRWM Group jurisdictions – the County and cities (Permittees) – comply with NPDES requirements for land development. As indicated in **Table 10-1** and **Sections 1, 3.3.4, 3.7.2, and 10**, the Permittees have produced several guidance documents for the land development community to consider water quality BMPs and hydromodification controls protective of South Orange County water resources[102]. Development of these plans and guidance documents was conducted collaboratively with the land development, planning and NGO communities to ensure water quality is considered in land use planning throughout the WMA. Additionally, the individual jurisdictions have their own Model WQMP formats and guidance, where applicable, to provide localized guidance that aligns with agency building, construction and zoning codes. Each jurisdiction is also required to implement NPDES programs through a water quality ordinance and incorporate program elements into their general plans, where applicable.

***Land Use Planning Collaboration & Future Efforts***

Local land use plans have assisted in the development of this IRWM Plan. Refer to **Figure 10-1**for an overview of land use within the WMA. Plans and information that have contributed to the IRWM Plan include city General Plans - Land Use Elements, Storm Water Elements, and Water/Wastewater Elements; County of Orange Land Use Planning documents; and Southern California Association of Governments (SCAG) land use data. The County of Orange General Plan also played a major role in evaluating projects for consistency with planned land use.

Much of the land use data has assisted in the regional planning and projections of water demands, water use classifications, infrastructure master planning, and reliability planning into the future. The Orange County WRS uses land use as a parameter for modeling local water

[102] Land development documents and guidance is available and summarized on the OC Watersheds website: http://www.ocwatersheds.com/documents/wqmp

supply. The IRWM Plan will continue the essential link to local land use plans, and can be considered a planning document in return for many local land use plans.

To facilitate communication and coordination between water managers and land use managers in the Region, the IRWM Group includes local land use planners and agencies in meeting notices and informational emails regarding the IRWM planning process. Land use planners are encouraged to attend South Orange County IRWM Group meetings.

***Climate Change Adaptations***

Managing multiple water demands throughout the Region, adapting water management systems to the effects of climate change, and potentially offsetting climate change impacts to the water supply can be improved by a collaborative and informed relationship between land use and water planners. The WRS and UWMPs consider the impacts of climate change in their projections for water supply to the SOC WMA. Projected climate change conditions, typically obtained from statistical downscaling of an ensemble of models, have been used for developing general plans in the WMA. Information sharing and collaboration with regional land use planning is accomplished throughout the WMA through the County's website, Regional Data Clearinghouse and the DMS (see **Sections 2.5.1** and **2.8.1**). General plans are adopted by each City in the WMA and provide land use planning information specific to their City. The WMA's general plans are shown in **Table 10-1** and are available on each City's website for reference in developing this IRWM Plan and various other local and regional water management plans. Climate change is included in regional land use planning by serving as a key component in land use and population projections. For example, the City of Lake Forest will likely consider climate change during the environmental review process for the Lake Forest General Plan 2040. **Section 3.8** discusses potential climate change impacts to WMA, while Section **12.2** discusses the effects of climate change on the region. **APPENDIX J** presents an assessment of the potential impacts of climate change on the land uses of South Orange County. Aspects of this analysis have been incorporated throughout the IRWM Plan per the 2016 Plan Standards.

This IRWM Plan strives to build upon the existing working relationship between water managers and land use decision makers by achieving the following:

- Coordinate changes to the IRWM Plan with land use planners
- Improve communication mechanisms for interacting with the land use planning community
- Consider future forums, policies, and projects that could improve water management efforts, such as regular meetings between water managers and land use planners
- Consider existing and planned future land use designation when planning and managing various water supply and water quality projects.
- Apply the Ahwahnee Principles for Resource Efficient Land Use to advocate a more proactive relationship between land use and water management[103].

[103] www.lgc.org/ahwahnee/h2o_principles.html

- Utilize current land use and water issues and identify planning strategies which may be implemented, or explored in the future through the IRWM process.


**Figure 10-1: Land Use**

# 11 STAKEHOLDER INVOLVEMENT

## *11.1 Process to Identify and Involve Stakeholders*

As discussed in **Section 2.3 and 2.4**, the South Orange County IRWM Group has a diversity of stakeholders participating in the collaborative planning effort. WMA planning includes coordination of activities within the IRWM Region as well as neighboring regions. Refer to **Section 2.6.2** for more information on Project Coordination, Sharing of Information, and IRWM Plan updates. For detailed information on Coordination with San Diego Funding Area and discussion on Tri-County FACC, refer to **Section 2.8.1** of this Plan.

The South Orange County IRWM Group uses a variety of methods to engage the stakeholders and general public. They include participating in stakeholder workshops, inclusion in the IRWM project review process, communication via email and information sharing via the County's website and DMS. Additionally, the IRWM Group will conduct ongoing outreach to stakeholders and tribal representatives throughout the region through the 2018 Water Needs Assessment as described in **Sections 2.2.3**, **2.6.3**, **2.7 and 3.6**. The IRWM Group strives to make information available in various formats to reduce barriers to participation, including:

- IRWM Meetings, such as publicly posted EC meetings and other workshops (e.g. IRWM Plan, project selection and technical assistance);
- Online through the County's website and the DMS;
- In-person, at other technical or planning meetings and workshops (e.g. WQIP)

Further discussion of South Orange County WMA Structure and Process for decision making, including the EC, MC and other committees (as applicable) is included in **Section 2.2**. Stakeholders are necessary to address objectives by participating in workshops to develop the IRWMP Plan objectives, as discussed in **Section 4.2**. **Section 4.4** also discusses how stakeholders developed the objective weighting and were critical to the development of the regional objectives. The important role stakeholders played in developing the RMS is discussed in **Section 5.1**.

The South Orange County WMA has implemented a public process that provides outreach and an opportunity to participate in IRWM Plan development and implementation to the appropriate local agencies and stakeholders, including the following:

- Wholesale and retail water purveyors
- Wastewater agencies
- Flood control agencies (including those agencies who submit applications for Proposition 1E funded Stormwater Flood Management Grants)
- Municipal and county governments and special districts
- Electrical corporations
- Native American tribes
- Self-supplied water users
- Environmental stewardship organizations
- Community organizations

- Industry organizations
- State, federal, and regional agencies or universities
- DAC members
- Any other interested group or individual appropriate to the region

As discussed in **Section 2.6.1**, the first meeting of the South Orange County IRWM Group was held in 2004 and was attended by multiple stakeholders in South Orange County, including County staff, local cities, and several water and wastewater agencies. Stakeholders were generally identified as those within the SJHU, as defined in the Water Quality Control Plan of the San Diego Basin Plan (Basin Plan), which is discussed in **Section 3.1**.

The South Orange County IRWM Group identified preliminary goals, objectives, and priorities for meeting the water resource needs of the region, and set a schedule for future meetings. Meetings were held at least twice a month through the development of the 2005 IRWM Plan. The South Orange County IRWM Group continues to inform and invite additional stakeholders to the South Orange County IRWM Group meetings, and the South Orange County IRWM Group has grown to represent 21 member agencies and several other stakeholder groups, agencies and non-profits. Stakeholders supporting the IRWM Plan represent agencies and organizations that have developed an integrated approach to addressing the objectives and water management strategies of the IRWM Plan. Refer to **Section 4** for discussion on the collaborative process used to establish plan objectives. Significant progress has been made to identify the myriad of projects that are to be included in existing plans and incorporating those projects into the IRWM Plan.

The 2018 IRWM Plan update addresses the 2016 Proposition 1 IRWM Planning Standards. Similar to the 2005 and 2013 processes, the process described in **Section 2.6.2** was followed to provide MC, EC and stakeholder input in the process.

***Collaboration & Information Sharing***

The South Orange County IRWM Group continues to meet to discuss IRWM Plan implementation, collaborative opportunities, status of existing projects, proposals for new projects, updates from the State, potential funding opportunities and the need for plan refinements. As discussed in **Section 2.5.1**, the County will provide information and updates on the IRWM process through the DMS. The South Orange County IRWM Group meetings, including workshops, EC and MC meetings are described in detail in **Section 2.2.** A comprehensive list of South Orange County IRWM Group meetings and workshops is included in **Section 2.6.1.**

Through the County-led stakeholder workshops for project selection and prioritization described in **Section 6.1.2**, the South Orange County IRWM Group and regional stakeholders utilize the goals and objectives described in the IRWM Plan to select projects for implementation. This process considers the priorities of the region and provides opportunities for the IRWM Group to solicit and consider feedback from stakeholders such as local environmental non-profits, land development and planning groups (e.g. BIA), Native American tribes and members of the public. By including and inviting members of environmental-based, land use planning and other watershed stakeholders in the process of considering projects and updates to the IRWM Plan, the IRWM Group balances jurisdictional and agency-based goals with priorities expressed by the WMA stakeholders.

Technology and Information Access

As noted in **Section 7**, the IRWM Group has developed and manages a geospatial-based DMS to provide project-based information to the public. A detailed description of the DMS is available in **Section 7.2**, but in summary the IRWM Group's DMS will act as a repository and dissemination site for project data provided to the County. The DMS will serve as a portal with links to data made available to the County for individual projects, programs, and studies. **Figure 7-1** shows the process of data collection, storage, and dissemination to IRWM participants, stakeholders, the public, and the state. Examples of data to be made available include: project location and/or footprints, raw verified and validated data sets, project information, IRWM planning process information such as meeting schedules, meeting minutes, agendas, annual reports, Plan updates, etc.

***Coordination with DWR & SWRCB***

In addition to sharing information and coordinating amongst IRWM Group members, coordination with State Water Board, SDRWQCB and DWR staff throughout the South Orange County IRWM planning process has been essential. Beginning with development and approval of the original IRWM Plan in 2005-2006 and Proposition 50, the IRWM Group has met and/or coordinated with the SWRCB and DWR to ensure WMA planning aligns with State goals and objectives. Additionally, SDRWQCB staff are invited to attend EC meetings and are encouraged to engage in IRWM planning due to overlaps in planning efforts with the WQIP.

## *11.2 Disadvantaged Communities*

The IRWM Plan includes projects and programs aimed at protecting the population of South Orange County, including residents who represent the disadvantaged population of the area, as discussed in **Section 3.5** and **3.6**. For example, water recycling projects that were funded through the IRWM Program offset the use of imported potable water with recycled water, which may reduce the cost of irrigation water for DACs. Refer to

**Figure 3-15** for a map of the DACs in the South Orange County WMA. DACs are directly involved in the stakeholder process by benefitting from IRWM Plan implementation. Water reliability projects also directly benefit DACs in the water district's service area by ensuring recycled water is available for irrigation needs while potable water is available for drinking water needs. To ensure members of the public (including DACs) are involved in the project implementation process, project proponents conduct extensive community outreach, including: presentations, developing project literature, utilizing media coverage, conducting town hall meetings/open houses, issuing newsletters to residents, posting construction notices, and making available a project website and hotline.

As discussed in **Section 6.2.3**, IRWM Plan projects will protect the water resources of the region and benefit all residents and businesses in the WMA, including members of DACs, which are inclusive of EDAs. Coastal resources such as Doheny State Beach Park, the Dana Point Harbor and area beaches, as well as parks located along regional stream courses serve as community gathering places for communities and are used heavily year round. Many of the recreational areas are accessible via public transit and do not charge an entrance fee for walk-in visitors.

Poor water quality can negatively impact the recreational opportunities for disadvantaged community members. Several projects within the IRWMP focus on identifying the cause of water pollution for Doheny Beach and other beaches within the region. Water quality is a key consideration for the WMA to ensure protection of the health and safety of the entire population in the area, especially for the disadvantaged community residents that do not have the means to travel to other areas of the state or country. By addressing water quality issues in areas of recreational use, the IRWM Plan incorporates environmental justice in a way that provides every resident equal opportunity and fair treatment in the regional water planning process.

As discussed in **Section 3.5** and **3.6**, the South Orange County WMA includes several areas determined to be a DAC, which is defined as “a community with a MHI less than 80 percent of the statewide average”. Of the approximately 600,000 residents in South Orange County, it is estimated that 6.7 percent of the population are disadvantaged and live at or below the poverty level. Refer to **Section 3.5** and **3.6** for more discussion on DACs.

The San Diego Funding Area will work to better define water needs of DACs, URCs, EDAs, and Tribal communities as part of an extensive Water Needs Assessment. This effort will involve coordination within the Tri-FACC and with regional stakeholders, seek to engage these communities in IRWM planning to a greater degree, and establish the types of projects that will best meet their water resource needs. Refer to **Sections 2.6.3, 3.6 and 5.6** for further discussion on DAC and Environmental Justice integration in the IRWM Plan, and the 2018 Water Needs Assessment.

***Native American Tribes***

The South Orange County IRWM Group understands the importance of Native American Tribe Notification and incorporates this process into the IRWM Plan Update and CEQA review. The IRWM Group conducts ongoing outreach to tribal representatives throughout the region. The IRWM Group solicits to local tribes as part of the public outreach process. The public workshops aim to engage tribal representatives in identifying the major issues and priorities of their lands, and how the priority projects may impact them. Tribal notification will be a part of the CEQA process for efforts that are considered projects, as defined under CEQA.

Juaneño Band of Mission Indians: The Juaneño Band of Mission Indians have provided valuable information needed to identify the disadvantaged members of the South Orange County WMA. Previous outreach to Chief David Belardes, of the Juaneño Band of Mission Indians, provided direct inclusion of the Indians in the South Orange County IRWM Planning process. In June 2012, Chief David Belardes was contacted and notified about the July 9, 2012 Stakeholder Workshop for the IRWM Plan. The County of Orange has continued outreach to members of the Juaneño Band of Mission Indians to discuss project ideas in partnership with the City of San Juan Capistrano, for potential IRWM Plan inclusion.

Mr. Belardes passed away prior to the 2018 IRWM Plan update. The Water Needs Assessment described in **Sections 2.6.3 and 3.6** will seek to re-establish better working relationships with the Juaneno Band of Mission Indians, recognized as a sovereign entity with governance in the WMA. The San Diego Funding Area Tri-FACC has obtained two non-profit groups to assist with the Water Needs Assessment, each of which has working relationships with local Tribal communities – RCAC[104] and the Climate Science Alliance. RCAC provides technical and financial resources and advocacy for rural communities, including environmental infrastructure (i.e. water, wastewater). The Climate Science Alliance – South Coast[105] seeks to safeguard the natural and human communities of the region in the face of a changing climate by leading activities and creating partnerships to promote awareness of climate change through innovative community engagement.

The South Orange County IRWM Group will continue to actively involve regional communities, including the Juaneño Band of Mission Indians and other community groups to ensure IRWM Plan Implementation provides positive benefits and impacts to their community, as discussed in **Sections 2.3.3, 2.6.3, 3.6 and 5.6.**

[104] http://www.rcac.org/about-rcac/

[105] http://www.climatesciencealliance.org/

# 12 CLIMATE CHANGE

Climate change is a shift in the average weather that a given region experiences. This is quantified by changes in climate variables such as average temperature, average precipitation, wind patterns, and also changes in extremes in temperature and precipitation. Although the Earth's climate is always changing, the current climate change occurring today differs from previous climate changes in both its rate and its magnitude. As part of this IRWM Plan update, a climate change analysis was completed, following standards recommended by DWR in 2016. **APPENDIX J** presents an assessment of the potential impacts of climate change on the water resources of South Orange County.

## *12.1 Consideration of Effects of Climate Change to Region*

The IRWM Group is aware of the detriment and cost that inaction on climate change would have on the Region. Snowmelt, either from the Sierra Nevada or the Rockies, is a major component of the imported water supplies in the IRWM planning region. A large fraction of the precipitation in western mountain regions falls on days with temperatures just a few degrees below freezing (Bales et al., 2008). Thus, warming by even a few degrees might result in a large shift from snowfall to rainfall, a result of great consequence to the Western US and California, where snowpack represents a significant component of water storage during the year. In addition to the shift in storage, there may be impacts caused by the change in the total quantity of precipitation, and in length and severity of droughts across the large region that supplies water to South OC (**APPENDIX J, Chapter 1**). A warming California climate would also foster larger brush and forest fires, especially with the extreme tree mortality from the recent 2012-2015 drought. Continuing increases in global GHG emissions at current rates would result, by late in the century, in sea level rising by more than four feet, and a greater incidence of heat wave days (**APPENDIX J**, **Chapters 4 and 7**). These impacts will translate into real costs for California, including flood damage and flood control costs that could amount to several billion dollars in many regions. Water supply costs due to scarcity and increased operating costs would also increase.

In addition to being affected by climate change the water sector is a contributor to the greenhouse gas emissions that are a cause of climate change. The emissions arise from energy used in the transport of water through the State Water Project and Colorado River Aqueduct, in the treatment of municipal supply and in the treatment of wastewater. Therefore, any effort or specific IRWM projects that lead to reduced water imports and/or reduced water use and disposal will also have a greenhouse gas reduction, or climate mitigation benefits.

For the above reasons, and because the IRWM Plan Act, CWC §10541(e) (10), states that IRWM plans must include an evaluation of the adaptability to climate change of water management systems in the region, analysis of climate impacts was performed as part of the IRWM process and is presented in **APPENDIX J**. Although statewide efforts to address climate change are in progress, it is understood that local governments and agencies within the South Orange County WMA play an essential role in fulfilling California's emissions reduction targets and in reducing the local effects of climate change in the Region. Local governments have broad influence and, in some cases, exclusive authority over activities that contribute to significant direct and indirect GHG emissions through their planning and permitting processes, local ordinances, outreach and education efforts, and municipal operations. Land use planning and urban growth decisions are also areas where successful implementation of climate change strategies relies on local government. Local governments have primary authority to plan, zone, approve, and permit how and where land is developed to accommodate population growth and the changing needs of their jurisdictions. Decisions on how land is used will have large impacts on the GHG emissions that will result from the transportation, housing, industry, forestry, water, agriculture, electricity, and natural gas sectors.

This Section presents a high level summary of the effects of climate change in the region and ongoing adaptation efforts in the context of water supply, which is inherently a statewide issue given the inter-basin transfers of water that occur through the southwest. A brief summary of other system impacts is also discussed and derives from the vulnerability assessment presented in **APPENDIX J (Chapter 8)**. Information on greenhouse emissions associated with different elements of the water system is summarized in **APPENDIX J (Chapter 6)**, and may be used to compute the emission impacts/benefits of individual projects. Based on the body of information summarized here, it is envisioned that climate adaptation through increased water use efficiency and conservation will play a key role in the selection of future IRWM projects. Further, as understanding of the nature and impacts of climate change, especially in the South Orange County WMA, improves with time, this information will be incorporated in future versions of the IRWM plan.

## *12.2 Relationship of Climate Change Analysis to IRWM Plan Standards*

The IRWM climate change standard requirements and the information provided in this document are related for each major area of assessment below.

Regional Vulnerabilities

**IRWM Standard:** A discussion of the potential effect of climate change on the IRWM region, including an evaluation of the IRWM region's vulnerabilities to the effects of climate change and potential adaptation responses to those vulnerabilities. The evaluation of vulnerabilities must, at a minimum, be equivalent to the vulnerability assessment contained in the Climate Change Handbook for Regional Water Planning (DWR, 2011)

**Presentation in this analysis:** The pertinent information is presented in **Chapters 3, 4, 5, 7, and 8 of APPENDIX J**.

GHG Emissions

**IRWM Standard:** A process that discloses and considers GHG emissions when choosing between project alternatives and mitigation strategy.

**Presentation in this report:** GHG emissions associated with the water sector in the planning region and with specific projects are presented in **Chapter 6 of APPENDIX J**.

Vulnerability Assessment

**IRWM Standard:** A list of prioritized vulnerabilities based on the vulnerability assessment and the IRWM's decision making process.

**Presentation in this report:** Key vulnerabilities of climate change in the South OC region are discussed in **Chapter 8 of APPENDIX J**. A summary of the vulnerability assessment is presented in this section.

Future Evaluation

**IRWM Standard:** A plan, program, or methodology for further data gathering and analysis of the prioritized vulnerabilities.

**Presentation in this report:** Because of the unique situation that almost all of the region's water supply is imported, the water supply vulnerability—a key concern from the standpoint of the IRWM—is addressed through the ongoing regional efforts in California and in the Colorado Basin as discussed in **Chapter 5 of APPENDIX J**. Potential future actions are described in **Chapter 9 of APPENDIX J**.

## *12.3 Key Elements of Climate Change in IRWM Region*

Because of the importance of imported water supply to South Orange County, potential impacts of climate change to water resources must be examined over a region broader than the IRWM planning area. Changes in observed climatic variables in this larger region representing the Western United States have been examined through data collected in the $20^{th}$ century. Over this period, particularly in winter and spring, temperatures have risen significantly across western North America. In the second half of the 20th century, the warming in the mountainous western North America has led to a higher rain-to-snow ratio, lower snow water content, decline in March snow cover, and a shift toward earlier annual snowmelt timing by 5 to 30 days. These observations strongly support the need for incorporating climate change into long-term water resource planning efforts.

To estimate future climatic conditions, global climate processes are represented using Atmosphere Ocean General Circulation Models (AOGCM) or Global Climate Models (GCMs). Using these models, the projected data for the South Orange County IRWM planning region show a small decrease in precipitation of up to an inch per year by mid- to late-$21^{st}$ century periods (**Table 12-1**). The models also show an increase in temperature from about 3 to $5^{o}$F over the same periods (**Table 12-2**). In general, climate models project more adverse conditions (i.e., warmer and drier) in the latter part of the $21^{st}$ century compared to conditions observed in the second half of the $20^{th}$ century.

**Table 12-1: Average Projected Change in Precipitation in IRWM Region 16 Global Climate Models**

| Average Change in Precipitation (inches/year) | | | |
|---|---|---|---|
| Emission Scenario | 2010-2039 | 2040-2069 | 2070-2099 |
| RCP26 | -1.0 | -.07 | -0.6 |
| RCP45 | 0.02 | -0.67 | -0.94 |
| RCP60 | -1.3 | -0.9 | -0.8 |
| RCP85 | -0.9 | -0.8 | -0.7 |

**Table 12-2: Average Projected Change in Temperature in IRWM Region 16 Global Climate Models**

| Average Change in Temperature (°F) | | | |
|---|---|---|---|
| Emission Scenario | 2010-2039 | 2040-2069 | 2070-2099 |
| RCP26 | 1.4 | 3.0 | 4.3 |
| RCP45 | 1.4 | 3.0 | 4.5 |
| RCP60 | 1.4 | 3.1 | 4.5 |
| RCP85 | 1.5 | 3.2 | 4.7 |

Several planning studies have been performed in South Orange County water supply regions that consider the impacts of climate change. Projected climate change conditions, typically obtained from statistical downscaling of an ensemble of models, have been used for developing plans in the Sacramento-San Joaquin River basins and the Colorado River basin. A key feature that stands out from the comprehensive analyses that have been performed is that both California and the Colorado Basin are severely water constrained, where it will be challenging to meet current allocations in future years. In both regions, planning model projections indicate years where deliveries will sometimes fall short of allocations, over planning horizons that range from 20 to 50 years into the future, under conditions where no changes are made to the existing operational infrastructure of the system. Because the regions jointly affected by these basins are continuing to experience relatively rapid population growth, and anticipated increased in municipal demands, water planners must address the dual challenge of reduced supplies and increased demand.

GCM projections of climate change for the Sacramento-San Joaquin River Basins and the Colorado River Basin predict an increase in the frequency and duration of droughts. Precipitation is projected to have more spatial and temporal variation, and snow pack is projected to decline, mostly as a result of warming. In general, climate models project more adverse conditions (i.e., warmer and drier with greater variability) in the latter part of the 21st century compared to conditions observed in the second half of the 20th century. Planning studies using GCM estimates of precipitation and temperature also show the changes in river hydrographs for all major flows in the Delta and the Colorado River Basin (See **APPENDIX J** for additional details on these studies).

Although variable at different points along the coast due to regional factors, in general, sea levels are rising globally due to climate warming including expansion of ocean water and melting of land ice. Along the Pacific Coast, the highest values of sea level rise in southern California have been reported at Newport Beach, near the study region, where the observed increase is 2.22 mm/year. These rates are projected to accelerate over the 21st century. A recent review of different calculation approaches by the National Academy of Sciences reported that global sea level is estimated to rise 8–23 cm (3-9 inches) by 2030 relative to 2000, 18–48 cm by 2050 (7-19 inches), and 50–140 cm (20-55 inches) by 2100. This review projects that sea level in southern California is slightly higher than the global average because of land subsidence, and will rise 4–30 cm (2-12 inches) by 2030 relative to 2000, 12–61 cm (5-24 inches) by 2050, and 42–167 cm (17-66 inches) by 2100.

Maps illustrating the effects of sea level rise projected to year 2100 and a 100-year flood were developed for the South IRWM planning region to identify areas that are vulnerable. For the purpose of this analysis, we identified areas in the South OC region that are vulnerable to coastal flooding as a consequence of sea level rise at year 2100 under the conditions of a 100-year flood--the flood having a one percent chance of being equaled or exceeded in any given year--termed as the “base flood” by the Federal Emergency Management Agency (FEMA). Although geographically focused on the study area, this approach follows the methodology presented on the State of California’s decision support website, Cal-Adapt (http://www.cal-adapt.org), developed for estimations such as those presented in this report. The base flood is the national standard used by the National Flood Insurance Program (NFIP) and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development. To compute the effect of sea level rise, we took the base flood elevation (BFE) values (in feet, NAVD88 datum) for the South OC region from FEMA and added 55 inches of sea level rise corresponding to the year 2100. The 55-inch value, representing a high estimate of sea level rise, although not the highest projection of 66 inches noted above, was used for consistency with the numbers in the Cal-Adapt website. An example map is shown in **Figure 12-1** identifying areas under flooding threat due to the combined effects of a 100-year flood and sea-level rise projected to year 2100 (55 inches).


**Figure 12-1: Zoomed-in area of South OC Coastline**[106]

The effects of warming on the Sacramento-San Joaquin River Basin include increased river temperatures, increased Delta salinity due to sea level rise, and decreases in reservoir storage, water exports, and hydropower generation. The net result may be a decrease in the water available to South Orange County from the Sacramento-San Joaquin River Basins and the Colorado River without new interventions.

GHG emissions associated with the water sector were estimated for the South Orange County planning region. The General Reporting Protocol, Version 3.1, developed by the California

[106] This figure and additional maps of the coastline were developed for the IRWM climate change analysis and are shown in Chapter 7 of **APPENDIX J.**

Climate Action Registry is used to calculate indirect emissions of GHG from electricity used for the water system in South Orange County. The water sector is the largest user of electricity in the state of California. The bulk of water for southern California specifically is transported over long distances up steep gradients and is therefore more energy intensive than local sources. Energy use for water is quantified via energy intensity, or the gross energy required for the water system to use a specific amount of water at a specific location. Under baseline conditions, the water sector in the region generates GHG emissions of over 93,000 metric tons in terms of carbon dioxide equivalent.

An overall assessment of vulnerability to climate change for South Orange County following a checklist presented in the Climate Change Handbook for Regional Water Planning, and specifically recommended for IRWM climate change planning was performed and is included in **Chapter 8 of APPENDIX J**. As noted above, the major water supply system vulnerabilities in this region are not unique, but are tied to the water supply system in California and the Colorado River Basin that are being evaluated through statewide or regional efforts. Besides water supply, other areas of potential concern for this planning region are coastal flooding due to sea level rise, increase in fire risk, and impacts to ecosystems.

Climate change assessment is an integral part of the water resources related planning in the South Orange County region, as well as the larger region, spanning the Southwestern United States, that supplies its water. The best current understanding of climate change has been incorporated in the assessment of impacts, especially those relating to water supply and sea level rise. Looking forward, it is expected that the climate change analysis portion of this IRWM Plan (presented in **APPENDIX J** of this document) will be updated as better information on climate projections, including extreme events become available, and impacts to other sectors, such as water quality and habitats will be similarly evaluated.

## *12.4 Vulnerability Assessment*

The vulnerability assessment (presented in **Chapter 8 of APPENDIX J**) evaluates major climate change related sensitivities to the human and natural systems in the planning region. The following concerns are of particular importance for the topic areas in the Climate Change Handbook for Regional Water Planning (DWR and EPA, 2011, presented as Box 4-1 in the source document):

<u>Water Demand</u>

There little quantitative evaluation of the impacts of climate change on water demands in the South OC planning region. Given increased temperatures and evapotranspiration, it is expected that landscape irrigation use may tend to increase. However, this is countered by the statewide mandate to reduce per capita use by 20%, and it is likely that this mandate will override any climate-related changes. In addition, significant investments in the development of recycled water continue to be made by water agencies throughout the South OC region. These recycled water supplies are used primarily for irrigation of urban landscape further offsetting potential increased irrigation needs associated with climate change.

<u>Water Supply</u>

Climate change has the potential to impact water supplies because of the dependence on snowmelt. However, the South OC planning region is part of a much larger network of supply, storage, and delivery infrastructure that spans the Southwestern U.S. and climate change planning for water supplies is being done at this larger regional scale. Over the near to medium term (20 years), water supplies are constrained, but various management options undertaken by MET and MWDOC, including storage, banking, and water use efficiency, indicate that water supply reliability levels will be met.

Water quality

The water quality effects of climate change in the study region have not been quantified, although it is possible that larger precipitation events or longer dry periods both adversely affect stream water quality. Warmer temperatures in summer have the potential to increase wildfire risk in the region, a substantial portion of which is already considered to be at high risk.

Sea level rise

Sea level rise is a potential concern in the region, but the topography of the South OC region indicates that the areas affected by coastal flooding may be limited to a narrow strip along the coastline, without extensive flooding inland. There is a wastewater treatment plant in the region that is considered vulnerable to sea level rise (Latham Wastewater Treatment Plant). The analysis presented here is based on a preliminary assessment of coastal flooding in the context of sea level rise, although specific urban areas may need to do more detailed characterization and dynamic modeling to fully assess impacts the potential for enhanced erosion along beaches and bluffs is also a concern.

Flooding

Areas of the South OC region, particularly along the canyons are liable to flooding (http://ocflood.com). There is aging flood protection infrastructure or infrastructure that needs to be upgraded to meet current flood protection levels. The region in general may be adversely impacted by a very large flood, such as that caused by large atmospheric river events.

Ecosystems and habitat vulnerability

Changes in stream temperatures have the potential to adversely impact endangered fish species that occur in the creeks and estuaries of the South OC planning region.

Hydropower

The dependence of the region on hydropower is indirect, largely through the its use for the transport of State Water Project water to Southern California. Impacts on hydropower production will be felt statewide, and not only to the IRWM planning region.

## *12.5 Adaptation to Address Climate Change Concerns*

Because the sources of water supply in the South OC IRWM planning region are largely external to the region, adaption is focused on the larger-scale supply watersheds, related to the State

Water Project withdrawing water from the Sacramento-San Joaquin River Delta, and to the Colorado River basin.

Evaluation of climate change is one of the considerations for the development of the State Water Project Delivery Capability (Reliability) Report (http://baydeltaoffice.water.ca.gov/swpreliability/). The Delivery Capability (Reliability) Report, or DCR (DRR), is a biannual report that describes the existing and future conditions for SWP water supply that are expected if no significant changes are made to the infrastructure to convey water past the Sacramento–San Joaquin Delta (Delta). Besides climate change the DRR projections also consider constraints imposed by federal biological opinions that seek to modify SWP (and CVP) operations to minimize impacts to certain aquatic species such as the Delta smelt.

The calculations are performed for variable hydrologic conditions using an 82-year record, representing 1922-2004 conditions, and implemented through the CALSIM II model used for water planning in California. The goal of the analysis is to estimate the percentage of years where specific levels of water allocations will be met by the SWP. Water allocations are defined for each water contractor (identified in SWP Table A, (DWR, 2015)). Under the existing conditions scenario for the 2015 report, the maximum water demand for all contractors is 4,055 thousand acre feet (taf). Of this delivery, the maximum allocation for MWD—the source of water for MWDOC and then to the South OC region—is 1,912 taf. In comparison to its maximum allocation of 1,912 taf, MWD's water delivery from the SWP has recently ranged from 556 taf (2009, a dry year) to 1,720 taf (2003, an above normal year). In the most recent DCR (DWR 2015), it is estimated that under existing conditions there is a 74% likelihood that a delivery target of over 2,000 to taf, aggregated for all contractors, will be met (**Figure 12-2**). There is a 20% likelihood of water delivery of 1,000–2,000 taf, a 6% likelihood of less than 1,000 taf. The delivery capability as a function of the type of year is shown in **Table 12-3**, and ranges from 1,349 taf for a 6-year drought period to 454 taf for a single extreme dry year. Since MWD's allocations are 46% of the maximum SWP Table A allocations, MWD's allocation in dry years could be much lower than observed in the recent past. As noted in (Reclamation, 2016) "current demands for water supplies across these resource categories have already exceeded the capacity of the existing water management system to meet all the potential needs".

The seasonal component of water demands (e.g., landscape irrigation and water used for cooling processes) will likely increase with climate change as droughts become more common and more severe, increasing temperatures increase evapotranspiration rates, and growing seasons become longer. Without accounting for changes in evapotranspiration rates, agricultural crop and urban outdoor demands are expected to increase in the Sacramento Valley by as much as 6% (Chung et al., 2009). However, in urban areas such as the South OC IRWM planning region, the potential increase in water demands due to climate change is severely constrained by statewide efforts—the Water Conservation Act of 2009, or SBx7-7—to enhance water conservation and reduce water consumption on a per capita basis by 20% from current levels to the year 2020 (MWDOC 2015 Urban Water Management Plan, 2016). MWDOC, in association with its member retail agencies, has created the Orange County 20x2020 Regional Alliance to meet the water use reduction targets. As a general goal to respond to climate change with more intense droughts and to respond to statewide emission targets, California has adopted conservation and efficiency as a broad goal through the adoption of Executive Order B-37-16 (Making Water Conservation a California Way of Life, DWR, 2016). Over the longer term, i.e., in future decades in the 21st century, climate change will make all water conservation goals harder to achieve. From the standpoint of water availability over the long term, even with constrained per capita water use, water demands may continue to grow as population in the region grows. The population of Orange County is expected to grow by 0.4% annually over the next two to three decades (MWDOC, 2016).

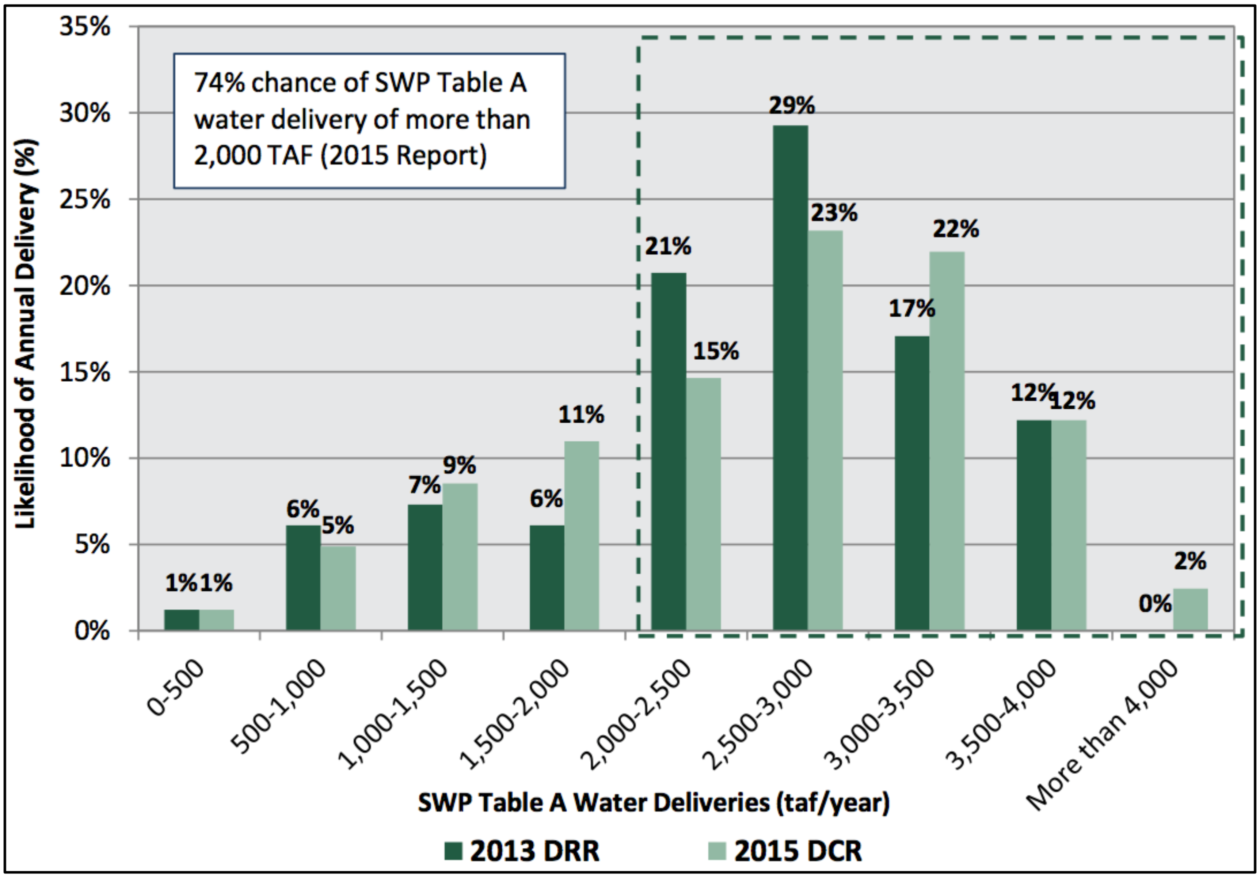


**Figure 12-2: Likelihood of specific levels of water delivery under 2015 conditions (Source: DWR, 2015).**

**Table 12-3: Estimated Average and Dry-Period Deliveries of SWP Table A Water under Conditions Existing in 2011 and 2015 (taf/year)**

| Time Period | Long-term Average (1921-2003) | Single Dry Year (1977) | 2-Year Drought (1976–1977) | 4- Year Drought (1931–1934) | 6-Year Drought (1987–1992) | 6-Year Drought (1929–1934) |
|---|---|---|---|---|---|---|
| 2011 (DWR, 2012) | 2,466 | 443 | 1,457 | 1,401 | 1,227 | 1,366 |
| 2015 (DWR, 2015) | 2,550 | 454 | 1,165 | 1,356 | 1,182 | 1,349 |

Adaptation plans for Sacramento-San Joaquin River Basins include a focus on reducing water demand in the agricultural and municipal water sectors through improvements in management and water use efficiency. The adaptation plans also consider opportunities for increasing water supply. For example, the Bureau of Reclamation has recently completed planning documents addressing needed improvements in water supply reliability and water quality (temperature and salinity) by increasing water storage in Sacramento and San Joaquin Basins. These plans are currently being reviewed prior to submission to Congress. Through the California Water Fix program (i.e., the Bay Delta Conservation Plan) the Bureau of Reclamation is coordinating with the State of California to develop a comprehensive plan addressing risks to California's current water management system, environment, and economy. Climate change adaptations, including new Delta water conveyance infrastructure, are included to address key vulnerabilities to water supply and the Delta environment from potential changes in climate and rising sea levels. The plan is currently considering public comments" (Reclamation, 2016).

In a similar manner, the Colorado River Basin Study has solicited input from stakeholders and the general public to identify options to resolve water supply and demand imbalances. Options were classified into four groups that focused on increased supply, reduced demand, modifying operations modifying governance and option implementation. Representative options to increase supply included desalination of water from the Pacific Ocean, water reuse, development of local supplies, and water imports from outside the basin. Options to reduce demand included greater conservation in municipal, agricultural, power generation sectors. Changed operations included consideration of reduced evaporation from reservoirs and aqueducts, and changed system operations. Potential volumes of water that could be generated or saved through each of these options were estimated. Many of these options are not feasible or reliable over the long term, or have technical and environmental challenges. Excluding less feasible options, an additional 3.7 MAF per year may be produced by 2035 and 7 MAFY by 2060 (Reclamation, 2012).

Multiple scenarios were assumed for the water demand in the basin states, assuming a range of population and economic growth. Based on these scenarios, the Colorado River demand for consumptive uses is projected to range between about 18.1 maf and 20.4 maf, exceeding the historical natural flows, and the reduced flows expected under climate change scenarios. The future demand as projected in the Colorado River Basin Study exhibits significant growth, and may be compared with a demand of 15.3 maf over the past decade. The largest increase in demand is projected to be for municipal and industrial uses, due to population growth.

Population within the areas supplied by the Colorado River are projected to grow from about 40 million in 2015 to between 49.3 million and 76.5 for different scenarios by 2060. A comparison of the water supply and demand projections indicates a long-term projected imbalance in future supply and demand of about 3.2 maf by 2060 (Reclamation, 2012).

There is also a projected increase in both drought frequency and duration as compared to the observed historical and long-term scenarios obtained from tree-ring records. Droughts 5 years or longer are projected to occur 50 percent of the time over the next 50 years. Projected changes in climate and hydrologic processes include continued warming across the basin, a trend towards drying, increased evapotranspiration, and decreased snowpack as a higher percentage of precipitation falls as rain (Reclamation, 2012).

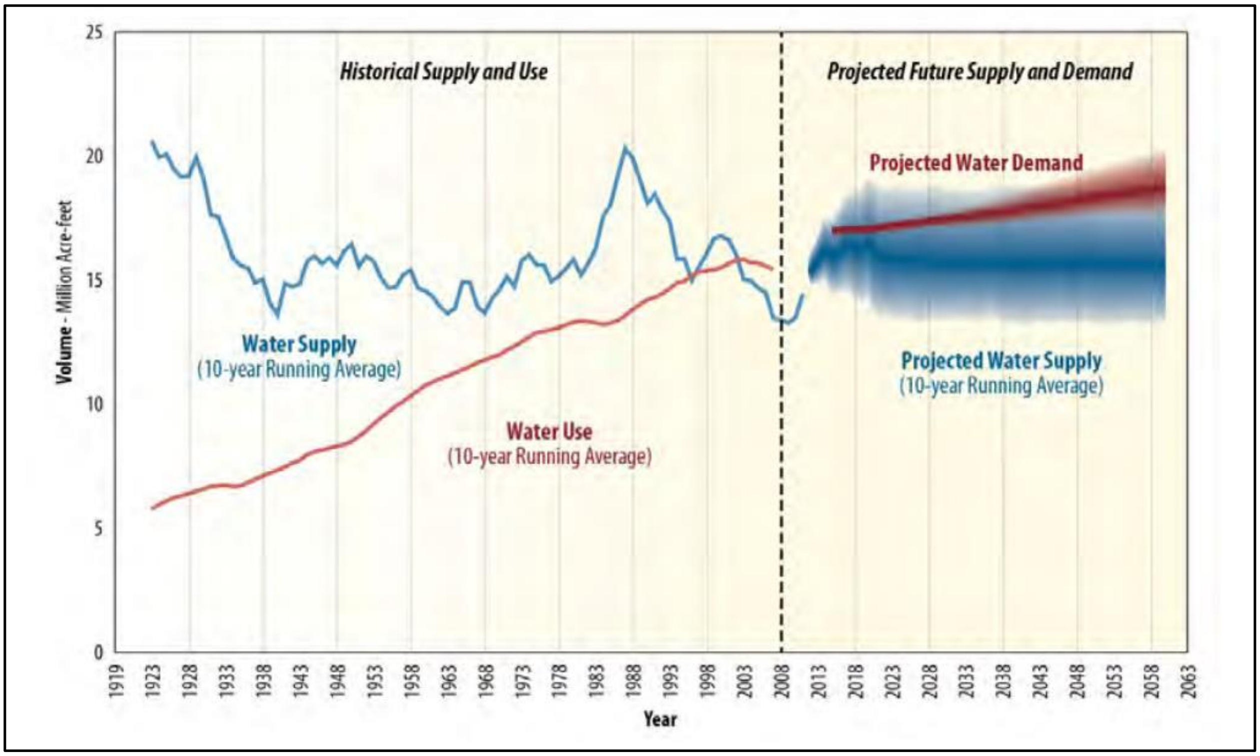


**Figure 12-3**: **Historical and projected water supply and demand on the Colorado River (Source: Bureau of Reclamation, 2012).**

The Basin Study technical evaluation presents an approach for quantifying climate change impacts in a complex system, and for developing responses through changes in supply, demand, and operations. The analysis demonstrates that it is possible for the system to adapt to conditions as they are currently understood, albeit at significant additional investment across the basin. Conservation and desalination are an important part of all portfolios considered in the basin study, and both are being considered in the South OC planning region.

## *12.6 Legislative and Policy Context*

While there are numerous pieces of policy and legislation dealing with climate change, three are particularly important resources on the State's response to climate change; these provide guidance on how IRWM planning efforts can analyze climate change on a project level. Executive Order (EO) S-3-05 and the California Global Warming Solutions Act of 2006 (AB 32; amending California Health and Safety Code Division 25.5, §38500, et seq.) laid the foundation for California's response to climate change. Senate Bill 97, signed by the Governor on August 24, 2007 initiated formal changes to the CEQA Guidelines that provide guidance for the way climate change is analyzed in CEQA documents by adding Section 21083.05 to the Public Resources Code.

EO S-3-05 made California the first state to formally establish GHG emissions reduction goals. EO S-3-05 includes the following GHG emissions reduction targets for California:

- By 2010, reduce GHG emissions to 2000 levels;
- By 2020, reduce GHG emissions to 1990 levels; and
- By 2050, reduce GHG emissions to 80 percent below 1990 levels.

The baseline emission levels are as follows: 1990 emissions were 433 million metric tons of CO2 equivalent[107]; 2000 emissions were 462.9 million metric tons of CO2 equivalent[108]. For comparison, the recent 2015 reported emissions are 440.4 million metric tons of CO2 equivalent[109]. The final emission target of 80 percent below 1990 levels would put the state's emissions in line with estimates of the required worldwide reductions needed to bring about long-term climate stabilization and avoidance of the most severe impacts of climate change (Intergovernmental Panel on Climate Change, 2007).

AB 32 further details and codifies the mid-term GHG reduction target established in EO S-3-05. AB 32 also identifies the California Air Resources Board (CARB) as the state agency responsible for the design and implementation of emissions limits, regulations, and other measures to meet the target.

SB 97 directed the Governor's OPR to develop CEQA Guideline amendments for the analysis of climate change in CEQA documents for the approval of the Natural Resources Agency.

[107] https://www.arb.ca.gov/cc/inventory/pubs/reports/staff_report_1990_level.pdf

[108] https://www.arb.ca.gov/cc/inventory/archive/tables/ghg_inventory_ipcc_all_90-04_ar4.pdf

[109] https://www.arb.ca.gov/cc/inventory/data/data.htm

# 13 SALT AND NUTRIENT MANAGEMENT PLAN

The SNMP was prepared in response to the SWRCB adoption of the Recycled Water Policy (State Water Board Resolution No. 2009-0011) on February 3, 2009. The purpose of the Recycled Water Policy (Policy) is to protect groundwater resources and increase the beneficial use of recycled water from municipal wastewater sources in a manner consistent with state and federal water quality laws and regulations. The Policy provides direction to the RWQCB, proponents of recycled water projects, and the public regarding the appropriate criteria to be used by the SWRCB and the RWQCB in issuing permits for recycled water projects. The Policy recognizes the potential for increased salt and nutrient loading to groundwater basins as a result of increased recycled water use, and therefore, requires the development of regional or sub-regional SNMPs.

In requiring such plans, the Policy acknowledges that recycled water may not be the sole cause of high concentrations of salts and nutrients in groundwater basins, and therefore regulation of recycled water alone will not address such conditions. The intent of this requirement is for salts and nutrients from all sources to be managed on a basin-wide or watershed-wide basis in a manner that ensures the attainment of water quality objectives and protection of beneficial use.

The Recycled Water Policy requires:

1. Every basin/sub-basin shall have a consistent SNMP;
2. SNMPs shall be tailored to address the water quality concerns in each basin;
3. SNMPs shall be developed or funded pursuant to the provisions of Water Code sections 10750 et seq. or other appropriate authority;
4. SNMPs shall be completed and proposed to the RWQCB within five years from the adoption date of the Policy;
5. SNMPs are not required in areas where a RWQCB has approved a functionally equivalent salt and nutrient plan; and
6. SNMPs may address constituents other than salt and nutrients that adversely affect groundwater quality.

The following sections provide a summary of the full SNMP, which is included in **APPENDIX G**.

## *13.1 Plan Focus*

The SOCWA Phase 1 SNMP effort included the following: identifying stakeholders and working groups and conducting initial interactions with them; identifying current study area projects and issues to help define ultimate water management goals; establishing definitions and concepts; compiling and performing initial analyses of data and reports; developing technical scopes of work for Phases 2 and 3; and estimating budget and schedule considerations for the Phase 2 and 3 scopes of work.

Phase 2 consisted of developing the SNMP itself, including: continuing the collaborative process; reviewing and refining Phase 1 findings, delineating groundwater management zones, computing ambient water quality and assimilative capacity, developing models and other tools to project future ambient water quality and assimilative capacity, identifying, evaluating, and recommending an SNMP program alternative, and preparing the SNMP report through the draft final stage for submittal to Region 9 of the SWQCB (Region 9). Phase 3 will involve conducting and processing required environmental analyses, preparing and processing a Basin Plan amendment, receiving and incorporating Region 9's comments to the draft final report, and preparing and submitting the final report. Refer to **APPENDIX G** for the complete SNMP.

The SNMP study area is defined geographically by SOCWA's service area. This in turn is essentially the same as that portion of Region 9 that lies in Orange County with a relatively minor exception in the northern SOCWA boundary, where a small portion of SOCWA lies in Region 8. It is defined hydrologically to include the Aliso Creek and San Juan Creek drainage areas and that portion of San Mateo Creek drainage overlain by SNMP (Cristianitos).

SOCWA is a Joint Powers Authority formed to provide regional wastewater treatment and recycled water use. SOCWA represents ten member agencies, cities and water districts, with service areas covering the southern coastal portion of Orange County. SOCWA holds two master recycled water waste discharge permit orders for portions of service area in Region 8 and Region 9. The SNMP effort focuses on the Region 9 service area covered under Region 9's Order No. 97-52.

In April 2009 SOCWA formed a Technical Advisory Committee consisting of representatives from member agencies to provide input and direction to SOCWA's SNMP efforts. The following goals of the SOCWA SNMP stakeholders were taken into consideration in the development of this SNMP:

- Offset demands for imported water from Colorado and northern California by increasing use of recycled water, stormwater, and urban runoff.
- Maximize the reuse of recycled water for irrigation in the SOCWA service area in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Maximize the capture of stormwater and urban runoff through compliance with MS4 in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Increase groundwater production yield in the Lower San Juan Basin by recharging stormwater and recycled water.
- Continue and expand existing programs to divert and use high-TDS urban surface water runoff to increase local supply and protect water quality in the Lower San Juan Basin.
- Continue and expand existing programs to desalt groundwater in the Lower San Juan Basin to increase local supply.

- Improve monitoring and management of groundwater and surface water in the San Juan Watershed to increase the understanding of salt and nutrient and transport in the watershed and to allow periodic revaluation of compliance with Basin Plan Objectives.
- Develop a long-term, adaptive SNMP that achieves the goals of the stakeholders in a reasonable and cost-effective manner.

The San Juan Valley Groundwater Basin was designated as a Tier A Basin in Region 9's SNMP Guidelines, giving the basin a high priority for this planning effort. Pumping from the San Juan Basin is managed by the SJBA, which is comprised of four SOCWA member agencies: SMWD, City of San Juan Capistrano, SCWD, and MNWD. The San Juan Basin is located entirely within the Region 9 portion of SOCWA's service area and, based on their local significance, the San Juan Basin and areas tributary to the basin are a primary focus of the SNMP.

The City of San Clemente is represented on SOCWA's Technical Advisory Committee and acts as an important stakeholder in the project, providing current and planned recycled water use information for the Prima Deshecha and Segunda Deshecha hydrologic sub areas.

A small portion of the San Mateo Canyon Hydrologic Area, Cristianitos Canyon, occupies the southeastern corner of the SOCWA service area. This portion is tributary to the Lower San Mateo Groundwater Basin. Based on historical SNMP considerations and the limited extent of planned development activity in this area, the Cristianitos sub area is given appropriate analytical consideration.

During Phase 1 an attempt was made to identify likely stakeholders and working groups with potential interest in SOCWA service area SNMP. Besides individual contacts, a general common workshop session was held to collect input and assess level of interest. No negative input was received with respect to the Phase 1 outline for SNMP.

## *13.2 Hydrologic / Hydrogeological*

Except for some very limited groundwater sources associated with geological faults and perched supplies, groundwater basins in SOCWA's service area are alluvial in character. They are intimately connected with surface water drainage courses, and range in average depth from about 25 to 135 feet. They are typically several miles long and only 100 to 200 feet wide. They are comprised of relatively tight sedimentary materials, characterized by low transmissivities and relatively small storage volumes. These characteristics must be recognized in modeling and other analyses.

Four levels of analysis were contemplated in the SNMP, whose applications depend on the nature and significance of each basin as a groundwater resource. These levels are summarized as follows (with example applications indicated):

1. No significant groundwater resources and no significant downstream concerns (e.g., Hydrologic Subarea [HSA] 1.1 and 1.3)
2. Marginally significant groundwater resources and significant downstream concerns (e.g., proposed HSA 1.42)

3. Modest groundwater resources and significant downstream concerns (e.g., HSA 1.21 – 1.25)
4. Significant groundwater resource (e.g., HSA 1.26 – 1.28)

## *13.3 Issues*

Project-Related

A summary listing of project considerations and related issues was developed. These items are shown along with their status in **Table 13-1**. These projects and issues shall be included as refined in the following analyses and program alternative development.

**Table 13-1: Phase 1 SNMP Project/Issue Listing**

| Project/Issues | Status |
|---|---|
| Groundwater Pumping | Project |
| Recycled Water Irrigation | Project |
| Recycled Water Recharge | Issue |
| Urban Return Flow[1] Reuse & Recharge | Project/Issue |
| Storm Water Capture & Recharge | Issue |
| Iron/Manganese Limits | Issue/Project |
| Brackish Water Desalting | Project |
| Seawater Desalting | Project |
| Aliso Creek Restoration | Issue |
| Habitat Conservation | Issue |
| Groundwater Monitoring | Project |
| Regional Coordination | Issue/Project |
| Other Treatment | Issue |
| Water Conservation | Issue/Project |
| Groundwater Mineralization | Issue |
| NPDES/WDR Permit Integration | Issue |

1. Includes all non-storm flows.

Water Quality

The groundwater in SOCWA's service area is naturally high in iron and manganese, which leads to levels of iron and manganese in the recycled water that frequently exceed the limits established in the Basin Plan and Order No. 97-52. The Basin Plan limits for iron and manganese were established in the early 1970s and based on Secondary Drinking Water Standards without regard to local groundwater quality. The SNMP presents management options for reducing water quality violations for iron, manganese and fluoride.

## *13.4 Water Quality*

Public input relative to water quality included regulatory as well as water agency and other stakeholder contributions. Several constituents of concern were identified during Phase 1 as listed in **Table 13-2**.

**Table 13-2: Phase 1 Constituent Summary**

| Constituent | Handling |
|---|---|
| Total dissolved solids (TDS) | Direct |
| Manganese (Mn) | Direct |
| Iron (Fe) | Direct |
| Nitrate-nitrogen ($NO_3$-N) | Direct |
| Fluoride (F) | Direct |
| Constituents of Emerging Concern (CEC) as applicable | Indirect |

The SNMP requires identification of sources of salt, nutrient and other constituents of concern and to estimate ambient groundwater quality conditions and determining assimilative capacities and WQMP. The primary constituents of focus for this effort are TDS and nitrate. However, as stated earlier this process addresses issues related to; iron, manganese, fluoride and remain open to other constituents of concern. CEC are considered in accordance with the relevant update to the State's 2009 Recycled Water Policy.

## *13.5 Plan Analyses*

Methodologies

Modeling of the hydrologic units was split between two model types, based on the significance of groundwater resources and the level of analytical focus, as described above. The areas considered having no significant groundwater resources or marginally significant groundwater resources were analyzed using computational methods without modeling. The area considered to have modest groundwater resources was modeled using a historic salt-balance model developed prior to the 1994 Basin Plan amendments. The salt-balance model was updated and expanded throughout this project. The area considered to have more significant groundwater resources was modeled using Constantly Stirred Reactor Model (CSRM). The two different types of models are integrated so the output from one model could serve as the input to the other, and vice versa.

Salt-Balance Model

The salt-balance model consisted of a series of alluvial surface/subsurface drainage elements. For each drainage element, the inputs and outputs of salt from stormwater, non-storm surface water and subsurface flow were computed. The inputs from precipitation, potable irrigation return, recycled irrigation return, urban return, and geologic leaching were considered, as well as the outputs from evaporation, well/diversion, and deep percolation.

Constantly-Stirred Reactor Model

A computational method is used for estimating the current ambient concentration of each major water quality constituent in existing subbasins and management zones based on historical groundwater level and chemistry data. All major current and future sources of salt and nutrient loading to each subbasin and management zone are identified. Loading is quantified for each source over planning period from 2011 to 2050. Then a CSRM was developed and applied to project groundwater salt and nutrient concentrations. The CSRM was formulated as an implicit finite-difference equation allowing for internal feedback from overlying land use, variable loading rates over time, and cascading interaction between subbasins and management zones. Using the current ambient water quality computation as the initial condition, the CSRM was used to project changes in the ambient concentration of major constituents for a baseline alternative and selected future water resources planning alternatives for a planning period from 2011 to 2050. Each water management alternative simulated included implementation measures that manage salt and nutrient loading in the SOCWA service area in a sustainable manner. The results were compared against Basin Plan objectives and used to rank the management alternatives and prepare a recommended management plan. **Table 13-3** shows how these methods are applied to each hydrologic area identified above.

**Table 13-3: Application of Analytical Methodologies**

| Hydrologic Area Type | Analysis Level | Ambient Concentration Determination | Loading Analysis | Projection of Salt and Nutrient Concentrations | Anti-degradation Analysis |
|---|---|---|---|---|---|
| No significant groundwater resources and no significant downstream concerns | 1 | None | None | None | None |
| Marginally significant groundwater resources and significant downstream concerns | 2 | None | Perform loading analysis | Develop salt and nutrient projections for groundwater | Make anti-degradation findings as required |
| Modest groundwater resources and significant downstream concerns | 3 | Perform ambient water quality determination | Perform loading analysis | Develop salt and nutrient projections for groundwater | Make anti-degradation findings as required |
| Significant groundwater resources | 4 | Perform ambient water quality determination | Perform loading analysis | Develop salt and nutrient projections for groundwater | Make anti-degradation findings as required |

## 13.6 Plan Outcome –Basin Plan Refinements

Existing Basin Plan

The initial study objective for realizing SOCWA's overall goal was demonstrating that increased use of recycled water for landscape irrigation could be accomplished without jeopardizing the continued or increased use of limited local groundwater supplies for beneficial purposes. This objective was satisfied when SOCWA's proposed Basin Plan amendments were approved by Region 9 and the SWRCB in 1994.

Region 9 staff agreed that TDS could be used as the indicator constituent for demonstrating projected impacts. Several TDS concentrations were considered for use as objectives to best fit the various circumstances of the hydrologic sub areas, while at the same time keeping the number of sets relatively small for the sake of administrative and operational simplicity. A concentration of 500 mg/L was selected for more pristine quality groundwater and is the general health department limit for regular direct domestic use. A concentration of 750 mg/L was selected for good but less pristine quality groundwater, where dilution or treatment may be planned to achieve general domestic use or where restricted or higher-quality direct non-potable use is planned. A concentration of 1,100 mg/L was selected for groundwater in a smaller sub area with existing and planned non-potable use. And a concentration of 1,200 mg/L was selected for all lower quality groundwater, even those whose quality was considerably poorer than the Basin Plan objective.

Implementation of planned recycled water use within the SOCWA service area is expected to further offset local demand for imported water and help the state reach its aggressive water recycling goals. Generally, the use of recycled water within the SOCWA service area complies with the State's Recycled Water and Antidegradation Policies. An adaptive management approach to the SNMP is recommended to allow for flexibility over time as knowledge is gained about current water quality and salt and nutrient transport in San Juan Creek watershed.

The SOCWA SNMP implementation measures are as follows:

1. Continue to implement Order No. 97-52 with the existing recycled water use volume and quality limitations for the Upper Trabuco, Upper San Juan, Gobernadora, Bell Canyon, Lower San Juan, Ortega and Oso sub-basins. Under current planning assumptions, recycled water use can be implemented in a manner that is protective of beneficial uses and is protective of the water quality required of those beneficial uses.
2. Immediately pursue a Basin Plan amendment for the Middle Trabuco sub-basin to increase the TDS Basin Plan Objective to 1,200 mg/L. This will ensure that up to 1,500 AFY of imported water can be offset through the use of recycled water while protecting beneficial uses within and downstream of the Middle Trabuco sub-basin.
3. Perform a salt and nutrient loading analysis, prepare salt and nutrient concentration projections and evaluate proposed recycled water project compliance with the existing Basin Plan Objective for the Middle San Juan sub-basin. This analysis must be completed before recycled water can be permitted for use in this sub-basin.

4. Improve existing monitoring efforts by developing a cooperative watershed-wide groundwater and surface water monitoring program. Report progress and data annually to the RWQCB.
5. Work in conjunction with the regional entities that are implementing potable water quality improvements and urban stormwater programs, such as the Orange County Stormwater Program, to protect and restore surface and groundwater quality, safeguard public and environmental health and secure water supplies.
6. Re-evaluate current and future Basin Plan compliance in the San Juan Basin Watershed HSAs every five years. If a significant change to the recycled water use planning assumptions used in this analysis occurs before five years is up, a reevaluation of the affected sub-basins must be presented to the RWQCB prior to approval of modified recycled water use conditions.
7. Update the SNMP implementation measures, as necessary, after each re-evaluation of Basin Plan compliance.

## 13.7 *Alignment with the San Diego Regional Water Quality Control Board's Strategic Vision*

The SNMP provides scientific management tools that enable water quality managers to achieve the strategic vision of the San Diego Regional Water Quality Control Board (RWQCB). Resolution R9-2013-0153 lays out the practical vision of the RWQCB. The following references chapters within the Strategic Vision and describe the applicable updates to the SNMP:

Chapter 1 – Strategizing for Healthy Waters.

Increased recycled water use through the basin plan amendments reduce wastewater flows and mass emissions discharged to the ocean.

Chapter 2 – Monitoring and Assessment.

As part of implementing the SNMP, SOCWA member agencies and regional stakeholders have joined together to establish and fund a long-term comprehensive effort to monitor ground and surface water quality in the San Juan Basin. This comprehensive monitoring effort will substantially increase understanding of ground and surface water quality and conditions in the San Juan Basin. Additionally, the monitoring effort is consistent with the Regional Water Board's A Framework for Monitoring within the San Diego Region.

Chapter 3 – Recovery of Stream, Wetlands, and Riparian Sections.

Through initial SNMP modeling efforts, recharge of groundwater basins has resulted in a project to capture runoff for infiltration and storage of water in the basin. The project improves surface water quality by reducing sediment loads. The project also benefits riparian habitat by reducing depth to groundwater along streams and helping to improve conditions for riparian/wetland habitat.

Chapter 4 – Proactive Public Outreach and Communication.

SOCWA's stakeholder-driven SNMP continues to bring together a variety of public and non-government stakeholders. SOCWA continues to engage regional stakeholders as part of each planned update of the SNMP and as part of the process to implement SNMP recommendations.

<u>Chapter 5 – Strategy for Achieving a Sustainable Local Water Supply.</u>

The SNMP supports increased recycled water use within the San Juan Basin in a manner consistent with protecting the quality of existing ground and surface water which reduces the demand for imported water supply.

# APPENDIX A

# APPENDIX A

# SOUTH ORANGE COUNTY IRWM GROUP COOPERATIVE AGREEMENT

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**COOPERATIVE AGREEMENT FOR THE**
**SOUTH ORANGE COUNTY WATERSHED MANAGEMENT AREA**

This AGREEMENT is made and entered into this 14th day of DECEMBER 2010, by and between the signatories, hereinafter referred to as PARTIES, all being either the County of Orange, cities, special districts, or other organizations operating in southern Orange County, California.

## RECITALS

WHEREAS, the municipalities and special districts in Orange County developed a countywide Water Quality Strategic Plan that recommends the formation of three Watershed Management Areas to better coordinate and implement collective water resource management strategies.

WHEREAS, a water resource management strategy as defined in the California Water Plan Update 2009 is a project, program, or policy that helps local agencies and governments manage their water, and related sources; and

WHEREAS, South Orange County Watershed Management Area comprises six watersheds in the San Juan Hydrologic Region: Laguna Coastal Streams, Aliso Creek, Dana Point Coastal Streams, San Juan Creek, San Clemente Coastal Streams, and San Mateo Creek, and is hereinafter referred to as the South Orange County Watershed Management Area (WMA).

WHEREAS, the PARTIES are all currently organizations operating in the South Orange County WMA and desire to collaborate in protecting and managing water resources in the South Orange County WMA through coordinated implementation of an integrated approach; and

WHEREAS, the PARTIES collectively have made significant investments in planning for flood management; urban runoff management; watershed management; water use efficiency; water supply and reliability; recycled water; habitat preservation, conservation, and restoration; water quality protection and improvement; resource stewardship; and related water resource management strategies; and

WHEREAS, the PARTIES collectively cover the planning area that contains significant need for major public infrastructure and conservation projects; and

WHEREAS, the PARTIES are willing to act in the best interest of the South Orange County WMA; and

WHEREAS, the PARTIES are committed to conduct planning efforts in an open accessible process; and

WHEREAS, the PARTIES have the institutional and fiscal capacity and systems to carry out planning and implementation efforts; and

WHEREAS, this agreement is not intended to create a financial obligation on the part of any of the PARTIES and that the financial obligations of the PARTIES will be established through the annual budget developed pursuant to this agreement, which will be approved through each PARTIES' budget adoption process; and

WHEREAS, the agreement contemplates that individual projects will be governed by separate project implementation agreements that provide funding or in-kind assistance as generally described herein; and

WHEREAS, the PARTIES expect to benefit individually and/or collectively from their participation in this AGREEMENT; and

WHEREAS, the PARTIES will have voting authority; and

WHEREAS, the PARTIES recognize that there are entities within the South Orange County WMA that have responsibilities for water resource management, including but not limited to the San Diego Regional Water Quality Control Board, California Department of Fish and Game, California Department of Transportation, and Orange County Transportation Authority; and

WHEREAS, these other interested entities may be added to this AGREEMENT with approval of the Executive Committee and

WHEREAS, the PARTIES recognize that such entities may not be required to provide funding or in-kind assistance and will, therefore, not have voting authority and will be referred to as NON VOTING PARTIES.

NOW, THEREFORE, in consideration of the foregoing, the PARTIES agree as follows:

## Section 1: Purpose

The purpose of this AGREEMENT is to establish the South Orange County WMA as a cooperative framework for planning and implementing water management strategies in the South Orange County WMA. Cooperative efforts include but are not limited to: addressing water quality impairments; establishing priorities for water resource needs; integrating water resource solutions across traditional disciplinary bounds; and jointly advocating for policies and funding that assist these goals.

## Section 2: Governance and Committees

The South Orange County WMA shall be governed through the authority of this AGREEMENT with the provisions indicated below.

### 1. <u>Executive Committee</u>

The South Orange County WMA shall act through an Executive Committee and other committees established by the Executive Committee.

Each of the PARTIES shall appoint an elected or executive level official from its organization to serve as its member and alternate on the Executive Committee. Representatives will serve on the Executive Committee at the pleasure of their appointing PARTY.

Each of the PARTIES shall designate a senior staff person as the point of contact to fulfill the intended purpose of this AGREEMENT.

For NON VOTING PARTIES, the representative will be a director or officer of the organization.

On matters on which the Executive Committee votes, each voting member shall have one vote. Actions of the Executive Committee shall be approved upon the affirmative vote of a majority of the representatives present. A simple majority of the Executive Committee shall constitute a quorum.

The Executive Committee will have the following duties and powers:

a. Identify and prioritize water resource issues, problems and improvement projects.

b. Establish policy direction for the South Orange County WMA and its committees.

c. Approve an annual work plan for the South Orange County WMA.

d. Approve an annual cost-shared budget for the administration and activities of the South Orange County WMA, its committees, projects, or actions, including any administrative support for the South Orange County WMA (Annual Budget).

e. Approve significant amendments of the South Orange County Integrated Regional Water Management Plan (hereinafter "IRWMP") and its prioritized lists of projects and activities.

f. Approve grant applications for funding South Orange County WMA projects or programs.

g. Allocate any new non-grant revenue sources available for South Orange County WMA projects based on capital improvement plan priorities.

h. Encourage and facilitate voluntary agreements between the PARTIES to fund and implement South Orange County WMA projects and programs.

i. Review and report to the PARTIES as to whether adequate and reasonable progress is being made on water quality and water resource issues in the South Orange County WMA.

j. Elect a chair and vice-chair.

k. Meet upon the request of the chair, but at least every six months unless the PARTIES agree to meet less frequently.

l. Convene committees and workshops as deemed appropriate.

m. Establish procedures and rules of conduct for the group, as needed.

PARTIES acknowledge that the Executive Committee cannot bind the PARTIES' respective organizations. All recommendations of the Executive Committee requiring funding or action on behalf of any PARTY are subject to approval by the PARTIES' governing bodies and subject to the budget process governing those bodies.

## 2. Annual Cost-Share Budget

The Executive Committee shall approve an annual cost-shared budget for the administration and activities of the South Orange County WMA, its committees, projects, or actions, including any administrative support for the South Orange County WMA. The Annual Cost-Shared Budget requires approval by 80 percent of the members of the Executive Committee. The responsibility for payment of the Annual Cost Share Budget shall be distributed equally among the PARTIES. Each PARTY shall include their respective share of the Annual Cost-Shared Budget in their agency's annual budget.

The COUNTY shall invoice each city for its annual deposit at the beginning of each fiscal year. Each PARTY shall pay the deposit within 45 days of the date of the invoice. Each PARTY's deposit shall be based on their prorated share of the approved Annual Budget, reduced for any surplus identified in the prior fiscal year end accounting.

Interest earned on the PARTIES' deposits will not be paid to the PARTIES, but will be credited against the PARTIES' share of the program costs.

The COUNTY shall prepare a fiscal year end accounting within 60 days of the end of the fiscal year. If the fiscal year end accounting results in costs (net of interest earnings) exceeding the sum of the deposits, the COUNTY shall invoice each PARTY for its prorated share of the excess cost. Each PARTY shall pay the billing within 45 days of the date of the invoice. If the fiscal year end accounting results in the sum of the deposits exceeding costs (net of interest earnings), the excess deposits will carry forward to reduce the billings for the following year.

Upon termination of the program a final accounting shall be performed by the COUNTY. If costs (net of interest earnings) exceed the sum of the deposits, the COUNTY shall invoice each PARTY for its prorated share of the excess. Each PARTY shall pay the invoice within 45 days of the date of the invoice. If the sum of the deposits exceeds the costs, the COUNTY shall reimburse to each PARTY its prorated share of the excess, within 45 days of the final accounting. Interest earnings are used to offset the PARTIES' share of program costs and will not be refunded to the PARTIES.

### 3. Administrative Support

COUNTY will provide staff support for the South Orange County WMA and its committees and will perform services including planning activities, facilitating regional planning and coordination activities related to water resources, and general administration for the implementation of the South Orange County WMA's plans and work programs, as directed by the Executive Committee.

COUNTY or other PARTY designated by the Executive Committee (Designated Party) may receive and administer any funds received on behalf of the South Orange County WMA for the administration and implementation of its projects and programs.

Designated Party may retain qualified consultants for use on South Orange County WMA matters as directed by the Executive Committee, subject to the Designated Party's normal rules and procedures for procuring such services and subject to the annual work plan and Annual Budget approved by the Executive Committee.

Designated Party may undertake efforts directly on behalf of the South Orange County WMA as directed by the Executive Committee, if necessary.

Designated Party will endeavor to apply funds received through grants or from other sources to defray the expenses in the Annual Budget where practicable. The remaining expenses in the Annual Budget will be shared by the appropriate PARTIES according to an equitable allocation approved by the South Orange County WMA.

PARTIES will provide funds for implementation of the IRWMP and for the implementation of projects and activities in furtherance of the IRWMP through specific Implementation Agreements subject to approval by the COUNTY or other applicable PARTY and PROJECT PROPONENTS.

## Section 3: Authority and Responsibilities

The PARTIES agree that the cooperative and integrated implementation of common water resource goals is in the best interests of the South Orange County WMA. The PARTIES agree to collaborate in good faith to seek funding and resources to implement the projects and activities in the South Orange County WMA and the associated work plans and programs.

The South Orange County WMA may authorize COUNTY or other designed PARTY to apply for grants or seek other funds to support the implementation of the IRWMP.

The South Orange County WMA through its Annual Budget will commit to continued IRWM planning on an appropriate annual basis to have an updated plan with a current list of projects and funding resources identified. This will ensure that the region is prepared for any funding opportunity that may arise.

## Section 4: Project Implementation Agreements

Implementation of any cost-shared programs shall be accomplished through PROJECT IMPLEMENTATION AGREEMENTS. These PROJECT IMPLEMENTATION AGREEMENTS shall designate a Managing Party responsible for managing the program that is the subject of that PROJECT IMPLEMENTATION AGREEMENT. The PARTIES to this AGREEMENT may be participants in these PROJECT IMPLEMENTATION AGREEMENTS.

## Section 5: Terms and Provisions

All information about individual projects or activities undertaken pursuant to this AGREEMENT is the responsibility of the project proponent PARTY or PARTIES. The PARTIES shall not disclose private or confidential data about the projects or activities.

The PARTIES agree that COUNTY will administer this AGREEMENT and the overall program of implementation, that COUNTY review of individual projects is discretionary, and PARTIES shall not assume that COUNTY will discover errors and/or omissions. While COUNTY may submit grant applications, factual reports, monitoring data, and the like to granting agencies on behalf of the South Orange County WMA, the PARTIES acknowledge their responsibility for the accuracy, completeness, and timely submittal of project information submitted to COUNTY for this purpose.

The PARTIES are assumed to be familiar with and shall observe and comply with all federal, state, and local laws, ordinances, rules and regulations in any manner affecting the implementation of this AGREEMENT or projects or activities hereunder.

## Section 6: Additional PARTIES

It is recognized that there are other entities within the South Orange County WMA that may have commitments to or responsibility for water quality and water resource management. The PARTIES hereto agree to engage with other entities, as appropriate, on the water quality and water resource issues described above. Additional PARTIES may be added to the AGREEMENT with approval of the Executive Committee and upon execution of the AGREEMENT by the additional PARTY. If such entity contributes funding to the South Orange County WMA, such additional Party shall be a voting PARTY with all rights and obligations of a PARTY under this Agreement. If such entity does not contribute funding but intends to participate in merely an advisory capacity, that PARTY shall be NON VOTING PARTY to this Agreement. Entities may participate in PROJECT IMPLEMENTATION AGREEMENTS without being PARTIES to this AGREEMENT.

## Section 7: Amendment

All Amendments other than the addition of Parties in accordance with Section 6 above shall be in writing with the approval of a majority of the PARTIES. Any such written modification shall be attached and incorporated hereto.

## Section 8: Assignment

Neither this AGREEMENT, nor any duties or obligations under this AGREEMENT, shall be assigned by any PARTY without the prior written consent of the Executive Committee. Should an assignment or transfer occur, whenever COUNTY, PARTY or other entity are named such reference shall be deemed to include the successor to the powers, duties and functions that are presently vested in COUNTY and the PARTY, and all agreements and covenants required hereby to be performed by or on behalf of COUNTY and PARTY shall bind and inure to the benefit of the respective successors there of whether so expressed or not.

## Section 9: Execution

This AGREEMENT may be executed in counterpart and the signed counterparts shall constitute a single instrument.

## Section 10: Withdrawal of Parties

Any PARTY or NON VOTING PARTY may withdraw its participation in this AGREEMENT upon ninety (90) days prior written notice to all of the other PARTIES, such withdrawal to be effective ninety (90) days after the notice is received or deemed received. If COUNTY withdrawals from this AGREEMENT the South Orange County WMA agrees to designate a different PARTY to assume the administrative role under this AGREEMENT who will assume all responsibilities of COUNTY. The balance of the PARTIES shall continue in the performance of the terms and conditions of this AGREEMENT unless and until the AGREEMENT is terminated.

## Section 11: Term and Termination

The term of this AGREEMENT shall commence upon the date when all PARTIES have executed this document.

This AGREEMENT is subject to termination by majority vote of the Executive Committee.

## Section 12: No Third Party Beneficiaries

Nothing in this AGREEMENT shall be construed to give any person, other than the COUNTY and PARTIES hereto, any legal or equitable right, remedy or claim under or in respect of this AGREEMENT or any provisions herein contained. This AGREEMENT and conditions and provisions hereof are intended to be and are for the sole and exclusive benefit of the COUNTY and PARTIES.

## Section 13: Liability

It is mutually understood and agreed that, merely by the virtue of entering into this AGREEMENT, each PARTY neither relinquishes any rights nor assumes any liabilities for its own actions or the actions of other PARTIES. It is the intent of the PARTIES that the rights and liabilities of each PARTY shall remain the same, while this AGREEMENT is in force, as it was before this AGREEMENT was made, except as otherwise specifically provided in this AGREEMENT.

**IN WITNESS WHEREOF**, the parties hereto have executed this Agreement on the dates opposite their respective signatures.

**COUNTY OF ORANGE**, a political subdivision of the State of California

Dated: 12-14-10 By: ____________________
Chairman of the Board of Supervisors

APPROVED AS TO FORM:
County Counsel

By: ____________________
Deputy

Dated: 10/15/2010

SIGNED AND CERTIFIED THAT A COPY OF THIS AGREEMENT HAS BEEN DELIVERED TO THE CHAIRMAN OF THE BOARD

By: ____________________
DARLENE J. BLOOM
Clerk of the Board of Supervisors of
Orange County, California

Date: 12-14-10

Signature Blocks for Each Agency Follow:

CITY OF ALISO VIEJO

By _Mark Pulone_ Date 9-15-10

Name: Mark Pulone

Title: City Manager

ATTEST:

Susan G. Ramos

City Clerk

APPROVED AS TO FORM:

Jamie L. Raymond

City Attorney

CITY OF DANA POINT

By ______________________ Date 6-15-10

Name: Douglas C. Chotkevys

Title: City Manager

ATTEST:

Kathy M. Ward

City Clerk

APPROVED AS TO FORM:

______________________

City Attorney

CITY OF LAGUNA BEACH

By ______________________ Date 7/19/10

Name: Kenneth Frank

Title: City Manager

ATTEST: APPROVED AS TO FORM:

______________________ ______________________

City Clerk City Attorney

CITY OF LAGUNA HILLS

By ______________________ Date July 13, 2010
Name: Bruce E. Channing
Title: City Manager

ATTEST:

______________________
City Clerk
Peggy J. Johns

APPROVED AS TO FORM:

______________________
City Attorney
Gregory E. Simonian

CITY OF LAGUNA NIGUEL

By ______________________ Date ____________
Name: Tim Casey
Title: City Manager

ATTEST:

______________________
City Clerk

APPROVED AS TO FORM:

______________________
City Attorney

CITY OF LAGUNA WOODS

By ______________________ Date 8/30/10

Name: Leslie A. Keane

Title: City Manager

ATTEST:

______________________

City Clerk

APPROVED AS TO FORM:

______________________

City Attorney

CITY OF LAKE FOREST

By ______________________ Date 9/22/10

Name: Robert C. Dunek

Title: City Manager

ATTEST:

APPROVED AS TO FORM:

______________________
City Clerk

______________________
City Attorney

CITY OF MISSION VIEJO

By ______________________ Date 6/23/10

Name: Dennis Wilberg

Title: City Manager

ATTEST:

APPROVED AS TO FORM:

City Clerk

City Attorney

CITY OF RANCHO SANTA MARGARITA

By _______________ Date 9/21/10
Name: Steve Hayman
Title: City Manager

ATTEST:

_______________
City Clerk

APPROVED AS TO FORM:

_______________
City Attorney

CITY OF SAN CLEMENTE

By ______________________ Date 07/06/10
Name: James Dahl
Title: Mayor

ATTEST:

APPROVED AS TO FORM:

City Clerk / Deputy

City Attorney

I, RITA MUELLER, RECORDS COORDINATOR FOR THE CITY CLERK DEPARTMENT OF THE CITY OF SAN CLEMENTE, STATE OF CALIFORNIA, HEREBY CERTIFY UNDER PENALTY OF PERJURY THE FOREGOING INSTRUMENT TO BE A FULL, TRUE AND CORRECT COPY OF THE ORIGINAL NOW ON FILE IN MY DEPARTMENT.

DATE: 9-2-10

RITA MUELLER
RECORDS COORDINATOR

BY Rita Mueller Records Coord.

CITY OF SAN JUAN CAPISTRANO

By ______________________ Date 8/18/10

Name: Joe Tait

Title: City Manager

APPROVED AS TO FORM:

ATTEST:

City Clerk

City Attorney of San Juan Capistrano

EL TORO WATER DISTRICT

By ~~Robert R. Hill~~ Date 7/15/10

Name: Robert R. Hill

Title: General Manager

APPROVED AS TO FORM:

Redwine & Sherrill

By ~~B. J. Branto~~ Date 7/15/10

Name:

Title:

MOULTON NIGUEL WATER DISTRICT

By *Robert Gumerman* Date *6-17-2010*
Name: Bob Gumerman
Title: General Manager

APPROVED AS TO FORM: *Bowie, Arneson, Wiles & Giannone*

By *Patricia B.* Date *6-17-2010*
Name: *Patricia B. Giannone*
Title: *Attorney*

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

By ______________________________ Date 9/27/2011

Name: Kevin P. Hunt

Title: General Manager

APPROVED AS TO FORM:

By ______________________________ Date______________

Name:

Title:

SANTA MARGARITA WATER DISTRICT

By ______________________ Date 9/27/10
Name: John J. Schatz
Title: General Manager

APPROVED AS TO FORM:

By ______________________ Date 9/27/10
Name:
Title:

SOUTH COAST WATER DISTRICT

By Michael Dunbar by BcB Date 9/14/2010

Name: Michael Dunbar

Title: General Manager

APPROVED AS TO FORM:

By B. Burnett Date 9/14/2010

Name: Betty Burnett

Title: District

SOUTH ORANGE COUNTY WASTEWATER AUTHORITY

By ______________________ Date 8/5/10

Name: Tom Rosales

Title: General Manager

APPROVED AS TO FORM: Bowie, Arneson, Wiles & Giannone

By Patricia B. Giannone Date 9-7-10

Name: PATRICIA B GIANNONE

Title: Legal Counsel, SOCWA

TRABUCO CANYON WATER DISTRICT

By ______________________________ Date 9/16/2010
Name: Don Chadd
Title: General Manager

APPROVED AS TO FORM:

By ______________________________ Date____________
Name:
Title:

IRVINE RANCH WATER DISTRICT

By ______________________ Date 8/5/10
Name: Paul D. Jones II
Title: General Manager

APPROVED AS TO FORM:

By ______________________ Date 8-4-10
Name: Joan Arneson
Title: Legal Counsel

LAGUNA BEACH COUNTY WATER DISTRICT

By Renae Hinchey Date 12/4/15
Name: Renae Hinchey
Title: General Manager

APPROVED AS TO FORM:

By Janet Morningstar Date 12/7/15
Name: Janet Morningstar
Title: Interim General Counsel

DEC 21 PM 1:30

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# APPENDIX B

# APPENDIX B

# TRI-COUNTY FACC MOU

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# MEMORANDUM OF UNDERSTANDING FOR INTEGRATED REGIONAL WATER MANAGEMENT PLANNING AND FUNDING IN THE SAN DIEGO SUB-REGION FUNDING AREA

**PARTIES:**

This Memorandum of Understanding (MOU) is entered into this 28th day of April 2009 (Effective Date) among the Parties listed below:

**1. San Diego County Regional Water Management Group (RWMG)**, hereinafter SDRWMG Planning Region Agencies, includes the following members:
CITY OF SAN DIEGO, hereinafter SD CITY; COUNTY OF SAN DIEGO, hereinafter SD COUNTY; and SAN DIEGO COUNTY WATER AUTHORITY, hereinafter SDCWA.

**2. Orange County RWMG**, hereinafter OCRWMG Planning Region Agencies, includes the following members: COUNTY OF ORANGE, hereinafter ORANGE COUNTY; MUNICIPAL WATER DISTRICT OF ORANGE COUNTY, hereinafter MWDOC; and SOUTH ORANGE COUNTY WASTERWATER AUTHORITY, hereinafter SOCWA.

**3. Riverside County Upper Santa Margarita RWMG,** hereinafter RCRWMG Planning Region Agencies, includes the following members: RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT, hereinafter RCFCWCD; COUNTY OF RIVERSIDE, hereinafter RIVERSIDE COUNTY; and RANCHO CALIFORNIA WATER DISTRICT, hereinafter RCWD.

Agencies acting collectively under this agreement are the TRI-COUNTY FUNDING AREA COORDINATING COMMITTEE, hereinafter called the TRI-COUNTY FACC. The agencies also are sometimes referred to in this MOU collectively as “Parties” and individually as “Party.”

**RECITALS:**

A. Proposition 84, the Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act (Public Resources Code, sections 75020-75029), authorizes the Legislature to appropriate funding for competitive grants for Integrated Regional Water Management (IRWM) projects. Funding is administered by the Department of Water Resources (DWR).
B. The intent of the Act is to encourage integrated regional strategies for management of water resources and to provide funding through competitive grants, for projects that protect communities from drought, protect and improve water quality, promote environmental stewardship, and improve local water security by reducing dependence on imported water.
C. The San Diego Sub-Region, also known as the San Diego Funding Area, comprises the three Parties – the SDRWMG, OCRWMG and RCRWMG. The boundaries of the SDRWMG, OCRWMG and RCRWMG are shown in Attachment A, and coordinated through this MOU.
D. 1. The San Diego Sub-Region has been allocated $91 million through Proposition 84.
2. For the purposes of this agreement, the formula for allocating funds among the Parties will be based on a combination of land area and population as of 2007. The division of funding shall be consistent with Attachment B.
E. DWR may establish standards to guide the selection of IRWM projects within the funding areas identified in the measure and shall defer to approved local project selection,

reviewing projects only to ensure they are consistent with Public Resources Code section 75028 (a).

F. Each Party has prepared an accepted IRWM plan and desires close coordination to enhance the quality of planning, identify opportunities for supporting common goals and projects, and improve the quality and reliability of water in the Funding Area. The Parties will coordinate and work together with their advisory groups to identify projects of value across planning regions, identify funding for highly ranked projects, and support implementation.

G. The San Diego Funding Area will balance the necessary autonomy of each planning region to plan for itself at the appropriate scale with the need to coordinate among themselves to improve inter-regional cooperation and efficiency. By consensus, the Parties have developed an agreement to improve the IRWM planning process in the Funding Area to coordinate planning across planning region lines and facilitate the appropriation of funding for IRWM projects by DWR.

H. The Parties will coordinate on grant funding requests to ensure that the sum of the total grant requests does not exceed the amount identified for the funding region.

The RECITALS are incorporated herein and the PARTIES hereby mutually agree as follows:

**1. Definitions**

The following terms and abbreviations, unless otherwise expressly defined in their context, shall mean:

A. **Funding Area –** The 11 regions and sub-regions referenced in Public Resources Code section 75027(a) and allocated a specific amount of funding to support IRWM activities. The San Diego Funding Area incorporates lands in the San Diego Regional Water Quality Control Board jurisdiction as of 2004, including portions of San Diego, Orange and Riverside counties.

B. **RWMG –**An RWMG is comprised of at least three agencies, two of which must have statutory authority over water management. An RWMG is the documented leader of IRWM planning and implementation efforts in a planning region.

C. **Planning Region –** Planning regions integrate stakeholders, agencies and projects in their regions and coordinate with other planning regions and DWR. The boundaries of the three planning regions in the San Diego Funding Area shown in attachment A.

D. **Tri-County Funding Area Coordinating Committee (Tri-County FACC) –**Will comprise at least one representative from each recognized RWMG in the Funding Area. The Tri-County FACC will meet periodically to discuss issues pertaining to the Funding Area and make recommendations to the RWMGs.

E. **Watershed Overlay Areas –** Identified areas within a watershed that cross planning region boundaries. Watershed Overlay Areas will be subject to special coordination and collaboration between the appropriate planning regions to ensure maximum watershed benefits in the IRWM plans of the Funding Area. The Santa Margarita and the San Mateo Watershed Overlays are shown in Attachment A.

F. **Watershed Overlay Subcommittee –**.The overlay subcommittee will be formed to identify projects that pertain to the watershed overlay areas and recommend them to the Tri-County FACC. The Subcommittee will comprise a representative of each Party in the watershed overlay area as well as other stakeholders agreed upon by the parties. The overlay subcommittee will meet at least twice during the update planning process to coordinate planning and project review; further meetings will occur as necessary. Meetings of the subcommittee will be open to all Tri-County FACC members.

G. **Watershed Overlay Projects –** Projects identified in an Watershed Overlay Area identified as valuable and benefiting from cross boundary coordination.

H. **Common Programs –** Programs eligible for IRWM funding that are identified by the Tri-County FACC as benefiting the entire Funding Area and have participation from at least two Planning Regions.

I. **Advisory Committee–** The recognized committee of stakeholders advising a planning region's RWMG and/or governing agencies on key issues related to IRWM planning and grant applications.

**2. General Planning Cooperation via Tri-County FACC**

All planning regions will meet at least twice per year through the Tri-County FACC. The actual number of meetings will depend on the amount and intensity of planning and coordination efforts of the Planning Regions. The efforts of the Tri-County FACC will be to enhance the quality of planning, identify opportunities for supporting common goals and projects, and to improve the quality and reliability of water in the Funding Area. The planning efforts will support the watershed-based approach through integration and coordination across planning regions in the watershed overlay areas.

**3. Mutual Plan Reference and Consistency**

Each plan prepared in the funding area will contain references to the entire Funding Area, to the coordination that is occurring among planning regions, and to this MOU. Each planning region will share its description of these matters with other planning regions to promote consistency with the goal of using common language as the IRWM plans are modified. The three RWMGs also will seek to place these common sections in the same location in their plans. Further consistency or cooperative efforts may be added with the agreement of the Parties.

**4. Coordination of Submittals and Applications**

To facilitate DWR's review process, all planning regions will coordinate their Region Acceptance Process submittals and IRWM grant applications. To the greatest extent practicable, the planning regions will develop common sections, tables and maps and place them in the same locations in their submittals and applications. The planning regions will preface their submittals and applications with information noting the common material and its location in the documents.

**5. Watershed Overlay Areas**

Through the Tri-County FACC or the overlay subcommittee, the planning regions will cooperate in identifying Overlay Projects that cross Planning Region boundaries. Overlay Projects that benefit multiple planning regions will be identified and may be jointly funded, administered, or implemented. A watershed overlay subcommittee of the Tri-County FACC will be formed for the Santa Margarita Watershed and the San Mateo Creek Watershed overlay areas as shown in Attachment A. Overlay Projects of importance to the Watershed Overlay Area planning regions would be recommended for coordination and due consideration in those Planning Regions' project selection processes.

**6. Common Programs**

The common programs found by the Tri-County FACC to be of high value for all planning regions will be identified and recommended for high priority placement in the planning regions' ranking of projects for funding. While each planning region will select projects in accordance with its own process, the regions will cooperate on the implementation of common projects programs if these efforts are selected for funding.

**7. Advisory Committee Cross Membership**
Each planning region with an advisory committee will invite the other advisory committees in the Funding Area to participate as a non-voting member in its committee to promote understanding, communication and coordination.

**8. Scope of the Agreement**
Nothing contained within this MOU binds the parties beyond the scope or term of this MOU unless specifically documented in subsequent agreements, amendments or contracts. Moreover, this MOU does not require any commitment of funding beyond that which is voluntarily committed by separate board actions, but recognizes in-kind contributions of RWMG agencies and stakeholders. Non-substantive or minor changes to this MOU that have the support of all RWMG agencies may be documented to become part of this MOU.

**9. Term of Agreement**
The term of this MOU is from its Effective Date shown above to December 31, 2014 unless extended by mutual agreement of the Parties.

**10. Modification or Termination**
This MOU may be modified or terminated with the concurrence of the RWMG agencies and effective upon execution of the modification or termination by all the RWMG agencies.

**11. Withdrawal**
Any PARTY may withdraw from the Tri-County FACC after giving a written 60-day notice to the other Parties.

**12. Notice**
Any notices sent or required to be sent to any party shall be mailed to the following addresses:

<u>SDRWMG Agencies</u>
Ken Weinberg, Director of Water Resources
San Diego County Water Authority
4677 Overland Ave., San Diego CA 92129

Marsi Steirer, Deputy Director of Water Resources and Planning
City of San Diego
600 B Street, Suite 400, San Diego CA 92101

Kathleen Flannery, CAO Project Manager
County of San Diego
1600 Pacific Highway, Room 212, San Diego CA 92101

<u>OCRWMG Agencies</u>
Mary Anne Skorpanich, Director, OC Watersheds
Orange County Public Works
333 W. Santa Ana Blvd., 5th Floor, Santa Ana, CA 92701

Karl Seckel, Assistant General Manager
Municipal Water District of Orange County
18700 Ward Street, Fountain Valley, CA 92708

Tom Rosales, General Manager
South Orange County Wastewater Authority
34156 Del Obispo Street, Dana Point, CA 92629

<u>RCRWMG Agencies</u>
Perry Louck, Director of Planning
Rancho California Water District
42135 Winchester Road, Temecula, CA 92590

Mike Shetler, Senior Management Analyst
County of Riverside
4080 Lemon Street 4th floor, Riverside, CA 92501

Warren D. Williams
Riverside County Flood Control and Water Conservation District
1995 Market St. Riverside, CA 92501

**13. Funding Uncertainties**
The RWMG agencies cannot be assured of the results of these coordination efforts and applications for funding. Nothing within this MOU should be construed as creating a promise or guarantee of future funding. No liability or obligation shall accrue to the Parties if DWR does not provide the funding. The Parties are committed to planning and coordinating notwithstanding IRWM funding. The form of such coordination may change based on the sources of funding.

**14. Indemnification**
To the fullest extent permitted by law, each Party shall defend, indemnify and hold harmless the other Parties, their consultants, and each of their directors, officers, agents, and employees from and against all liability, claims, damages, losses, expenses, and other costs including costs of defense and attorneys' fees, arising out of or resulting from or in connection with work performed pursuant to this MOU. Such obligation shall not apply to any loss, damage, or injury, as may be caused by the sole negligence or willful misconduct of a Party, its directors, officers, employees, agents, and consultants.

**15. Other Provisions**
The following provisions and terms shall apply to this agreement.

A. This MOU is to be construed in accordance with the laws of the State of California. Any action at law or in equity brought by any of the Parties shall be brought in a court of competent jurisdiction in Riverside, Orange or San Diego Counties, and the parties hereto waive all provisions of law providing for change of venue in such proceedings to any other county.
B. If any provision of this MOU is held by a court to be invalid, void or unenforceable, the remaining provisions shall be declared severable and shall be given full force and effect to the extent possible.
C. This MOU is the result of negotiations between the parties hereto and with the advice and assistance of their respective counsels. No provision contained herein shall be construed against any Party because of its participation in preparing this MOU.
D. Any waiver by a Party of any breach by the other of any one or more of the terms of this MOU shall not be construed to be a waiver of any subsequent or other breach of the same or of any other term hereof. Failure on the part of any of the respective Parties to require

from the others exact, full and complete compliance with any terms of the MOU shall not be construed to change the terms hereof or to prohibit the Party from enforcement hereof.

E. This MOU may be executed and delivered in any number of counterparts or copies, hereinafter called "Counterpart", by the parties hereto. When each Party has signed and delivered at least one Counterpart to the other parties hereto, each Counterpart shall be deemed an original and, taken together, shall constitute one and the same MOU, which shall be binding and effective as to the Parties hereto.

F. This MOU is intended by the parties hereto as their final expression with respect to the matters herein, and is a complete and exclusive statement of the terms and conditions thereof. This MOU shall not be changed or modified except by the written consent of all Parties hereto.

IN WITNESS WHEREOF, the parties hereto have executed this Agreement on the dates shown on the attached counterpart signature pages:

**San Diego County agencies**

/S/ Approved March 26th 2009
Ken Weinberg, Director of Water Resources
San Diego County Water Authority
4677 Overland Ave., San Diego CA 92129

/S/ Approved March 26th 2009
John L. Snyder, Director
Department of Public Works
County of San Diego
5555 Overland Ave, Bldg.2, Mailstop O332 San Diego, CA 92123

/S/ Approved April 7th 2009
J. M. Barrett
Director of Public Utilities
City of San Diego
600 B Street, Suite 400, San Diego CA 92101

**Orange County agencies**

/S/ Approved April 28th 2009
Chairman Pat Bates
County of Orange Board of Supervisors
Orange County Flood Control District
333 W. Santa Ana Blvd., 5th Floor
Santa Ana, CA 92701

/S/ Approved April 15th 2009
Wayne Clark, President (Maribeth Goldsby, Secretary)
Municipal Water District of Orange County
18700 Ward Street
Fountain Valley, CA 92708

/S/ Approved April 2nd 2009
Matt Disston, Chairman
South Orange County Wastewater Authority
34156 Del Obispo Street
Dana Point, CA 92629

**Riverside County agencies**

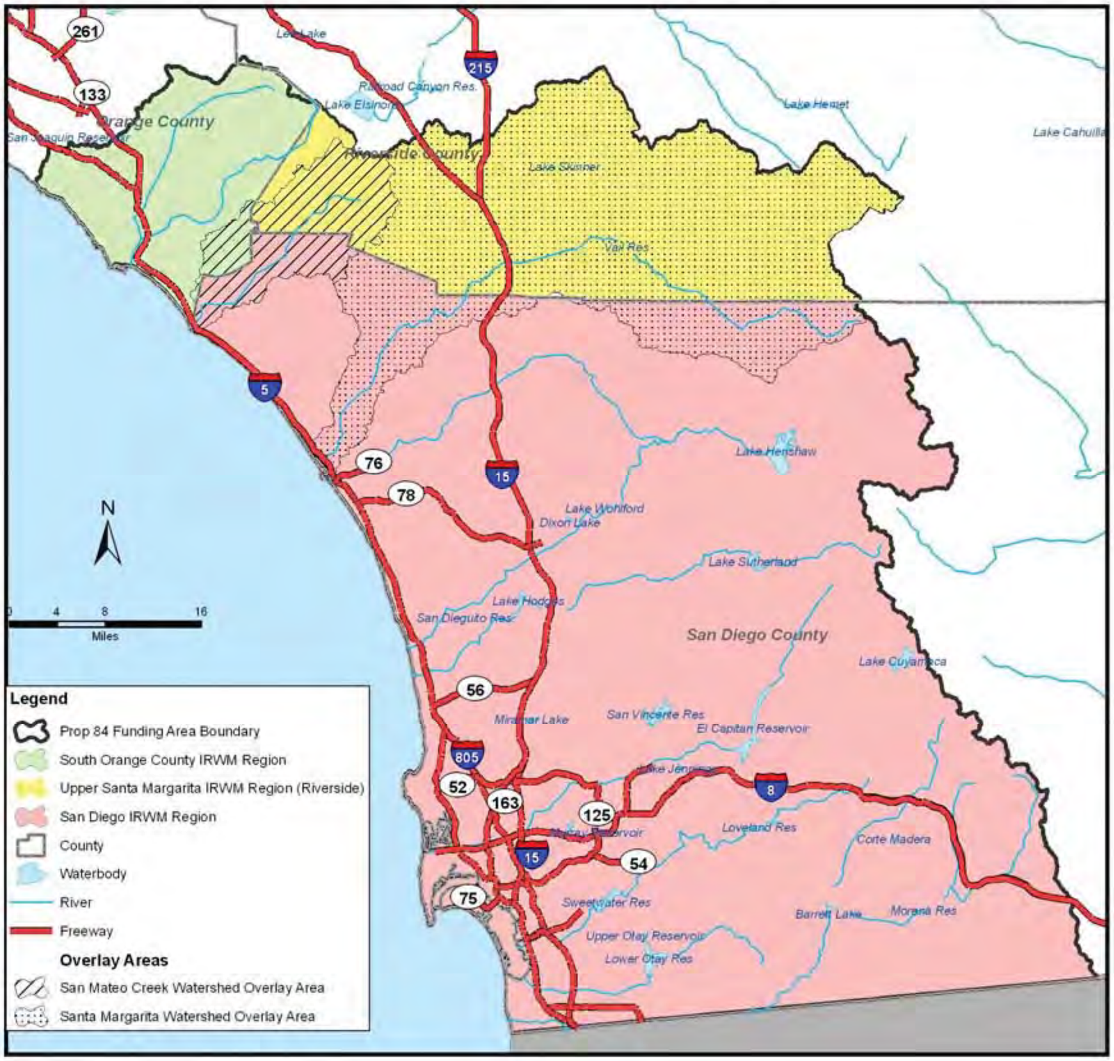
/S/ Approved April 9th 2009
Matt Stone, General Manager
Rancho California Water District
42135 Winchester Road, Temecula, CA 92590

/S/ Approved March 30th 2009
Jeff Stone, Chairman
Supervisor Third District
Riverside County Board of Supervisors
4080 Lemon St.
Riverside, CA 92501

/S/ Approved March 30th 2009
Marion Ashley, Chairman
Supervisor, Fifth District
Riverside County Flood Control & Water Conservation District
1995 Market St
Riverside, CA 92501

**Attachment A**
**Funding Area and Planning Region Boundaries with Watershed Overlay Areas**

The San Diego, Orange County and Riverside County Upper Santa Margarita planning regions are of an appropriate scale to allow integrated planning and provide for proper local interaction. The creation of planning regions larger than those outlined in the map below would limit local involvement and reduce the value of the planning to the region, the funding area, and the state.



**Attachment B**
**Allocation of Proposition 84 Funds**

Each of the three planning regions has IRWM project and program needs that far exceed the funding allocated to the funding area. Significant local match funding for selected projects is available in each planning region. Funding for planning and timing of implementation may vary among the planning regions. Because of these factors and because not all of the Proposition 84 funding will be made available at the same time, the Tri-County FACC members will cooperate and coordinate on individual funding cycle applications to ensure that the sum of the total grant requests does not exceed the amount identified for the funding region in any given cycle. Total allocations to the parties will be divided according to the schedule below. The allocations are based on a formula that is similar to that used to allocate funding in the Proposition 84 bond language. (Note: Proposition 84 allocates $91 million to the San Diego Funding Area. DWR has indicated it will spend approximately 5 percent of the funds for program delivery costs. Therefore, the allocations to the three planning regions are indicated in percentages of the total funds that will be available over the life of the program.)

| | | | Allocations (in % of $ totals) | | |
|---|---|---|---|---|---|
| **Planning Region** | **Population** | **Acres Area** | **$25 M on Land** | **$66 M on Population** | **Total** |
| Riverside Upper Santa Margarita | 253,329 | 405,233 | 16.4% | 6.4% | 9.1% |
| South Orange County | 597,348 | 168,192 | 6.8% | 15.2% | 12.9% |
| San Diego County | 3,092,351 | 1,901,203 | 76.9% | 78.4% | 78% |
| **Total** | **3,943,028** | **2,474,628** | **100%** | **100%** | **100%** |

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# APPENDIX C

# APPENDIX C

# PROJECT FORM

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## South OC Watershed Management Area IRWMP - Project Information

**Project Title:** ______

**Project Lead Agency/Organization:** ______

**Lead Agency/Organization Contact:** ______ **Lead Agency Contact phone:** ______ **Email:** ______

**Project Status:** Completed: ☐ Ongoing: ☐ Planning: ☐ Other: ______

**CEQA Complete:** Completed: ☐ In process: ☐

**Project Partners (if applicable):** ______

**Project Location:**
**(Address or Lat/Lon)** ______ (NOTE: Will need Geospatial data in GIS - To add projects to the project list, you will be asked to enter an address, Lat/Lon, or drop a point on a map.)

**Project Benefit Area:** ______ (e.g., Acres, Stream Miles, Square Miles etc.)

**Project Description:**
**(Please describe the project)**
*Up to 200 words*

(e.g. What does the project entail? Land area, construction, planning etc.)

**Description of Project Benefits:**
*Up to 200 words*

(e.g. How does it benefit the WMA? How does the project help meet local water needs and align with IRWM objectives.)

**IMPORTANT INFORMATION:**
**1). Once you have completed the project information on Tabs 1 and 2, save the workbook locally and use the file naming convention as follows: SOCWMA_OrgName_ProjectName.**
**2). Upload the workbook file to the South OC IRWM Website at:** http://arcg.is/1WWTmb

**PROJECT TOTAL SCORE:** 0.000

**Project Title:** Project Title carried over from Tab 1

**Agency:** Agency carried over from Tab 1

## PROJECT SCORING

### PROJECT CONSIDERATIONS

| Question | Response | *For County Staff Use ONLY* | |
|---|---|---|---|
| How well does your project meet the WMA Objectives listed in the dark green boxes below*? | 0 | PQ0 | |
| *Objectives reflect the WMA Goals; each coded strategy in the light green adds up to an Objective score, which is summed automatically for this cell (max point for each is 1) | | Points Per Response | 1 |
| Does your project have 50% funding match? | | PQ1 | 0 |
| Does your project have permitting complete? (i.e. NEPA, CEQA, etc.) | | PQ2 | 0 |
| When is your project capable of starting? (i.e. Time until construction start) | | PQ3 | 0 |
| What is the current percent complete with project design? | | PQ4 | 0 |
| Does your project benefit DAC areas? | | PQ5 | 0 |
| Does the project target any strategies to address climate change impacts, including but not limited to reducing energy consumption related to energy embedded in water use? | | PQ7 | 0 |
| Has the project proponent (i.e. Your agency, city, etc.) adopted the local applicable IRWMP? | | PQ8 | 0 |
| Does your project reduce dependence on the Sacramento-San Joaquin Delta for water supply? | | PQ9 | 0 |
| Does your project benefit critical water issues for any Native American Tribal Communities? | | PQ10 | 0 |
| Does your project include Environmental Justice considerations? | | PQ11 | 0 |
| Is your project currently or does it have the potential to be a regional project benefiting and involving multiple agencies/groups? | | PQ12 | 0 |

### USER NOTES

1. FILL IN THE YELLOW AREAS ONLY.
(NOTE: If a triangle appears when you click a yellow cell, select from the dropdown menu.)
2. Blue areas will be automatically calculated.
3. Additional sheets in this workbook include the local/regional objectives for reference.
4. The DUE DATE for initial list development is February 21, 2018.

There are four Objectives on this sheet, each with its own scoring area.
Score and describe all those that your project targets. Each Objective has Local and Regional priorities. They are WQ, WS, FM, and NR, and are listed under each individual objective.
Provide/Describe a metric achieved or mark an 'X' on those your project target or describe a metric achieved in yellow cells below.

### (FM) INTEGRATE FLOOD MANAGEMENT (Objective Weight 3.4)

| Does your project achieve any of the following Objectives? | Strategy Weight | Response | Code | | Provide/Describe a metric achieved |
|---|---|---|---|---|---|
| | | 0 | *FM0* | | 0 |
| | | | Points Per Response | 1 | Example: acre-feet stored/diverted, acres or linear feet protected, etc. |
| FM1: Improve conveyance and/or reliability of channelized flood control systems and related facilities and remove properties from the 100-year floodplain with consideration for climate change on flow regimes | 3.6 | | FM1 | 0 | |
| FM2: Reduce scour and erosion to river, stream, and the channel banks | 3.2 | | FM2 | 0 | |
| FM3: Improve sub-regional facilities and local storm drain systems where historical flooding exists where the regional system has the capacity to accept the additional flows | 3.2 | | FM3 | 0 | |
| FM4: Preserve or return floodplains as open space | 3.2 | | FM4 | 0 | |
| FM5: Planning, studies, research to acquire Best Data with consideration for climate change impacts | 3.2 | | FM5 | 0 | |

### (WQ) IMPROVE WATER QUALITY (Objective Weight 4.5)

| Does your project achieve any of the following Objectives? | Strategy Weight | Response | Code | | Provide/Describe a metric achieved |
|---|---|---|---|---|---|
| | | 0 | *WQ0* | | 0 |
| | | | Points Per Response | 1 | Example: kg/day reduced, mg/L target met, mgd captured, etc. |
| WQ1: Control anthropogenic pollutants over the developed area of the County | 4.4 | | WQ1 | 0 | |
| WQ2: Control anthropogenic dry weather flows from the developed area within the County | 4.1 | | WQ2 | 0 | |
| WQ3: Control wet weather flows to meet NPDES MS4 permit criteria from developed acres within the County with consideration for climate change to flow regimes | 4.1 | | WQ3 | 0 | |
| WQ4: Improve water quality regulatory framework and/or awareness and/or knowledge of water quality issues within the County | 4.1 | | WQ4 | 0 | |

### (WS) INCREASE WATER SUPPLY, RELIABILITY, and EFFICIENCY (Objective Weight 4.3)

| Does your project achieve any of the following Objectives? | Strategy Weight | Response | Code | | Provide/Describe a metric achieved |
|---|---|---|---|---|---|
| | | 0 | *WS0* | | 0 |
| | | | Points Per Response | 1 | Example: mgd produced, afy captured, $ per volume per year, etc. |
| WS1: Increase the supply of potable water | 3.5 | | WS1 | 0 | |
| WS2: Increase the supply and use of non-potable water | 3.5 | | WS2 | 0 | |
| WS3: Improve Reliability of all Water Supplies with consideration for climate change on local and external sources. | 3.5 | | WS3 | 0 | |
| WS4: Improve Planning and Awareness of Water Supply with consideration for climate change stresses | 2.7 | | WS4 | 0 | |
| WS5: Reduce consumption from outdoor residential, commercial, industrial, and institutional landscapes | 3.5 | | *WS5* | 0 | |
| WS6: Reduce consumption through enhanced water utility operations | 3.1 | | WS6 | 0 | |
| WS7: Reduce consumption from indoor residential, commercial, industrial, and institutional uses | 3.5 | | WS7 | 0 | |
| WS8: Research, Evaluation, Planning & Education with consideration for climate change | 2.7 | | WS8 | 0 | |

### (NR) PROTECT and ENHANCE NATURAL RESOURCES (Objective Weight 3.3)

| Does your project achieve any of the following Objectives? | Strategy Weight | Response | Code | | Provide/Describe a metric achieved |
|---|---|---|---|---|---|
| | | 0 | *NR0* | | 0 |
| | | | Points Per Response | 1 | Example: acres restored, megagrams carbon sequestered, people served, # jobs, etc. |
| NR1: Benefit aquatic and riparian ecosystems with consideration for climate change on water availability | 3.1 | | NR1 | 0 | |
| NR2: Benefit terrestrial ecosystems | 3.1 | | NR2 | 0 | |
| NR3: Benefit air, climate, and energy resources with consideration for reducing greenhouse gas emissions, carbon sequestration, and/or increased renewable energy | 3.1 | | NR3 | 0 | |
| NR4: Research, evaluation, monitoring, planning, recreation, and education | 3.1 | | NR4 | 0 | |

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# APPENDIX D

# APPENDIX D

## RESOLUTIONS AND/OR LETTERS OF ACCEPTANCE/ADOPTION/SUPPORT/APPROVAL FOR THE SOUTH ORANGE COUNTY IRWM PLAN

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**RESOLUTION NO. 2013 - 27**

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF ALISO VIEJO, CALIFORNIA, ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN**

**WHEREAS,** the mission of the City of Aliso Viejo includes management of water resources and environmental quality throughout its service area; and

**WHEREAS,** the City of Aliso Viejo has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

**WHEREAS,** in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

**WHEREAS,** the City of Aliso Viejo is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

**WHEREAS**, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

**WHEREAS**, in 2005, IRWM Group developed an Integrated Regional Management Plan for South Orange County Area; and

**WHEREAS,** in 2005, the City Council of the City of Aliso Viejo adopted the 2005 IRWMP by Resolution No. 2005-035; and

**WHEREAS,** Whereas, the Board of Supervisors has reviewed and accepted the said Plan with its staff and general public at its regular Board meeting on June 7, 2005; and

**WHEREAS,** in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM

Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

**WHEREAS,** on July 18, 2013, the Executive Committee for South Orange County Watershed Management Area adopted the 2013 South Orange County Integrated Regional Water Management Plan; and

**NOW, THEREFORE, BE IT RESOLVED that the City of Aliso Viejo,** hereby adopt the updated 2013 South Orange County Integrated Regional Water Management Plan.

PASSED, APPROVED AND ADOPTED this 7th day of August, 2013.

Carmen Cave
Mayor

ATTEST:

Susan A. Ramos
City Clerk

APPROVED AS TO FORM:

City Attorney

STATE OF CALIFORNIA )
COUNTY OF ORANGE ) ss.
CITY OF ALISO VIEJO )

I, SUSAN A. RAMOS, City Clerk of the City of Aliso Viejo, California, DO HEREBY CERTIFY that foregoing Resolution No. 2013-27 was duly passed and adopted by the City Council of the City of Aliso Viejo at their regular meeting held on the 7th day of August 2013, by the following vote, to wit:

| | | |
|---|---|---|
| AYES: | COUNCIL MEMBERS: | MAYOR CAVE, MAYOR PRO TEM TSUNODA, COUNCILMEMBERS CHUN, MUNZING AND PHILLIPS |
| NOES: | COUNCIL MEMBERS: | NONE |
| ABSENT: | COUNCIL MEMBERS: | NONE |

Susan A. Ramos

SUSAN A. RAMOS
CITY CLERK

(SEAL)

I hereby certify that the foregoing is the original of Resolution No. 2013-27 duly passed and adopted by the Aliso Viejo City Council at their regular meeting held August 7, 2013.

Susan A. Ramos

SUSAN A. RAMOS
CITY CLERK

(SEAL)

# ORANGE COUNTY BOARD OF SUPERVISORS
# MINUTE ORDER
## September 17, 2013

*Submitting Agency/Department:* OC PUBLIC WORKS

Adopt resolution updating South Orange County Integrated Regional Watershed Management Plan; authorizing Director or designee to accept amendments and approve minor modifications; and make California Environmental Quality Act findings - District 5

***The following is action taken by the Board of Supervisors:***

APPROVED AS RECOMMENDED ☒ OTHER ☐

**Unanimous** ☒ (1) NGUYEN: **Y** (2) MOORLACH: **Y** (3) SPITZER: **Y** (4) NELSON: **Y** (5) BATES: **Y**

*Vote Key: Y=Yes; N=No; A=Abstain; X=Excused; B.O.=Board Order*

**Documents accompanying this matter:**

☒ Resolution(s) 13-089
☐ Ordinances(s)
☐ Contract(s)

Item No. 21

Special Notes:

Copies sent to:

OCPW: Isela Martinez
Eric Swint

9-20-13

I certify that the foregoing is a true and correct copy of the Minute Order adopted by the Board of Supervisors , Orange County, State of California.
Susan Novak, Clerk of the Board

By: ______________________
Deputy

RESOLUTION OF THE BOARD OF SUPERVISORS OF
ORANGE COUNTY, CALIFORNIA

September 17, 2013

WHEREAS, the mission of the OC Public Works Department includes regional resources and environmental quality throughout Orange County; and

WHEREAS, OC Public Works has led development of the South Orange County Integrated Regional Watershed Management (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality, quantity, and reliability; and

WHEREAS, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC §79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

WHEREAS, the South Orange County IRWM Group was formed with cities and water/special districts located within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

WHEREAS, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

WHEREAS, the Board of Supervisors has reviewed and accepted said Plan with its staff and general public at its regular Board meeting on June 7, 2005 and provided for minor modifications to the Plan at its regular Board meeting on May 23, 2006; and

WHEREAS, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, River and Coastal Protection

Bond Act (PRC §75001-75130) which requires that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

WHEREAS, OC Public Works has led the update of the South Orange County IRWM Plan to Proposition 84 guidelines; and

WHEREAS the Board of Supervisors have reviewed said Plan with its staff and general public at its regular Board meeting on September 17, 2013.

NOW, THEREFORE, BE IT RESOLVED that this Board does hereby:

1. Adopt the South Orange County Integrated Regional Watershed Management Plan for the purposes of serving as a guidance document for the South Orange County Watershed Management Area, and
2. Authorize the Director of the OC Public Works Department, or his designee, to accept amendments such as appendices and updated project lists and approve minor modifications to the Plan on an annual basis.

The foregoing was passed and adopted by the following vote of the Orange County Board of Supervisors, on September 17, 2013, to wit:

| | | |
|---|---|---|
| AYES: | Supervisors: | JOHN M.W. MOORLACH, PATRICIA BATES, JANET NGUYEN TODD SPITZER, SHAWN NELSON |
| NOES: | Supervisor(s): | |
| EXCUSED: | Supervisor(s): | |
| ABSTAINED: | Supervisor(s): | |

CHAIRMAN

STATE OF CALIFORNIA )
)
COUNTY OF ORANGE )

**I, SUSAN NOVAK, Clerk of the Board of Orange County, California, hereby certify that a copy of this document has been delivered to the Chairman of the Board and that the above and foregoing Resolution was duly and regularly adopted by the Orange County Board of Supervisors .**

**IN WITNESS WHEREOF, I have hereto set my hand and seal.**

SUSAN NOVAK
Clerk of the Board
County of Orange, State of California

Resolution No: 13-089

Agenda Date: 09/17/2013

Item No: 21

I certify that the foregoing is a true and correct copy of the Resolution adopted by the Board of Supervisors , Orange County, State of California

Susan Novak, Clerk of the Board of Supervisors

By: ______________________
Deputy

## RESOLUTION NO. 13-09-17-01

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF DANA POINT, CALIFORNIA, ACCEPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN**

**WHEREAS**, the mission of the City of Dana Point includes providing a safe and healthy environment and ensuring a high quality life for our residents, businesses and visitors in a sound economical and efficient manner.

**WHEREAS**, the City of Dana Point has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWMP) pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

**WHEREAS**, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWMP; and

**WHEREAS**, the City of Dana Point is a member of the South Orange County Watershed Management Area (SOCWMA), which was formed with cities, County, and water/sewer districts located within the SOCWMA, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

**WHEREAS**, SB 1672 provides for the acceptance of said IRWMP by participants in the SOCWMA that have authority to implement the Plan; and

**WHEREAS**, in 2005, SOCWMA Group developed an Integrated Regional Management Plan (IRWMP) for South Orange County Area; and

**WHEREAS,** the Orange County Board of Supervisors reviewed and accepted the original IRMWP with its staff and general public at its regular Board meeting on June 7, 2005; and

**WHEREAS,** in 2005, the City Council of the City of Dana Point adopted the 2005 "South Orange County Integrated Regional Water Management Plan" by Resolution No. 05-06-08-03; and

**WHEREAS**, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWMPs be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

**WHEREAS**, significant changes to the Integrated Watershed Management Plan will require formal approval by the City Council, on-going addition or deletion of projects in the Plan does not require formal approval of the Plan; and,

**WHEREAS,** on July 18, 2013, the Executive Committee for SOCWMA adopted the updated 2013 South Orange County Integrated Regional Water Management Plan; and

**NOW, THEREFORE, BE IT RESOLVED** that the City of Dana Point does hereby adopt the updated 2013 South Orange County Integrated Regional Water Management Plan in continued coordination with the SOCWMA Group.

PASSED, APPROVED, AND ADOPTED this 17th day of September, 2013.

STEVEN H. WEINBERG, MAYOR

ATTEST:

KATHY M. WARD, CITY CLERK

STATE OF CALIFORNIA )
COUNTY OF ORANGE ) ss
CITY OF DANA POINT )

I, Kathy M. Ward, City Clerk of the City of Dana Point, California, DO HEREBY CERTIFY that the foregoing is a true and correct copy of Resolution No. 13-09-17-01 adopted by the City Council of the City of Dana Point, California, at a regular meeting thereof held on the 17th of September, 2013, by the following vote:

AYES: Council Members Brough, Olvera, Schoeffel, Mayor Pro Tem Bartlett, and Mayor Weinberg

NOES: None

ABSENT: None

(SEAL)

Kathy M. Ward

KATHY M. WARD, CITY CLERK

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RESOLUTION NO. 13-8-1
RESOLUTION OF THE BOARD OF DIRECTORS OF
THE EL TORO WATER DISTRICT
ADOPTING THE 2013 SOUTH ORANGE COUNTY
INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN

WHEREAS, the mission of the El Toro Water District includes management of water resources and environmental quality throughout its service area.

WHEREAS, El Toro Water District has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

WHEREAS, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

WHEREAS, the El Toro Water District is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

WHEREAS, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

WHEREAS, in 2005 the IRWMP Group developed an Integrated Regional Watershed Management Plan for South Orange County area; and

WHEREAS, in 2005, the El Toro Water District adopted the 2005 IRWMP by Resolution No. 05-6-3; and

WHEREAS, the Orange County Board of Supervisors reviewed and accepted the 2005 Plan with its staff and general public at its regular Board meeting on June 7, 2005 and provided for minor modifications to the Plan at its regular meeting on May 23, 2006; and

WHEREAS, the Orange County board of Supervisors will review and consider adoption of the 2013 Integrated Regional Watershed Management Plan at its regular meeting on September 10, 2013; and

WHEREAS, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

WHEREAS, on July 18, 2013 the Executive Committee of the South Orange County Watershed Management Area adopted the 2013 South Orange County Integrated Regional Water Management Plan; and

NOW, THEREFORE, BE IT RESOLVED that this Board does hereby adopt the 2013 South Orange County Integrated Regional Watershed Management Plan in continued coordination with the South OC IRWM Group.

ADOPTED, SIGNED AND APPROVED, this 22nd day of August 2013.

TED F. MARTIN, President
E Toro Water District and of the
Board of Directors thereof

(SEAL)

ATTEST:

ROBERT R. HILL, Secretary
El Toro Water District and of the
Board of Directors there of

STATE OF CALIFORNIA )
)
COUNTY OF ORANGE )

I, ROBERT R. HILL, Secretary of the Board of Directors of the El Toro Water District, do hereby certify that the above and foregoing is a full, true and correct copy of Resolution No. 13-8-1 of said Board, and that the same has not been amended or repealed.

DATED: August 22, 2013

ROBERT R. HILL, Secretary
El Toro Water District and of
the Board of Directors thereof

(SEAL)

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RESOLUTION NO. 2013- 33

RESOLUTION OF THE BOARD OF DIRECTORS OF THE IRVINE RANCH WATER DISTRICT, ORANGE COUNTY, CALIFORNIA ADOPTING THE SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN

WHEREAS, regional planning has become an important function in watersheds throughout California as regional stakeholders work to solve watershed challenges in a more collaborative fashion; and

WHEREAS, many stakeholders in south Orange County including the County of Orange, cities and water agencies have worked collaboratively to understand the watershed challenges in their watershed; and

WHEREAS, in 2004, those stakeholders in south Orange County formed the South Orange County Integrated Regional Watershed Management Group, prepared an Integrated Regional Watershed Management Plan (IRWMP), applied for and received $25 million in Prop. 50 grant funds to help implement several projects; and

WHEREAS, in September 2009, the California Department of Water Resources, through its "Region Acceptance Process," recognized the south Orange County as a region and the South Orange County Integrated Regional Watershed Management Group as the program administrator for the IRWMP; and

WHEREAS, in 2010, Irvine Ranch Water District became a member of the South Orange County Watershed Management Group and adopted the 2005 IRWMP; and

WHEREAS, in 2010, the SOCWMG received State Planning Grant funds to update the IRWMP and to include new elements as required by the State; and

WHEREAS, there is value in continually improving the IRWMP to reflect new projects and new priorities for the region; and

WHEREAS, Irvine Ranch Water District, which serves a portion of the south Orange County region, views the IRWMP for south Orange County as an important regional planning document for matters commonly addressed in regional watershed management plans and wants to work with the South Orange County Integrated Regional Watershed Management Group to continually improve the IRWMP.

NOW, THEREFORE, the Board of Directors of the Irvine Ranch Water District DOES HEREBY RESOLVE, DETERMINE AND ORDER as follows:

The Irvine Ranch Water District approves the South Orange County Integrated Regional Water Management Plan as the integrated watershed plan for the area referred to by the County of Orange as the South Watershed Management Area.

ADOPTED, SIGNED and APPROVED this 26th day of August, 2013.

President, IRVINE RANCH WATER DISTRICT
and of the Board of Directors thereof

Secretary, IRVINE RANCH WATER DISTRICT
and of the Board of Directors thereof

APPROVED AS TO FORM:
BOWIE, ARNESON, WILES & GIANNONE
Legal Counsel - IRWD

By________________________

STATE OF CALIFORNIA )
) SS.
COUNTY OF ORANGE )

I, Nancy Savedra, Assistant Secretary of the Board of Directors of Irvine Ranch Water District, do hereby certify that the foregoing Resolution was duly adopted by the Board of Directors of said District at a regular board meeting of said Board held on the 26th day of August 2013, and that it was so adopted by the following vote:

| | | |
|---|---|---|
| AYES: | DIRECTORS | LaMar, Matheis, Reinhart, Swan and Withers |
| NOES: | DIRECTORS | None |
| ABSTAIN: | DIRECTORS | None |
| ABSENT: | DIRECTORS | None |

(SEAL)

Nancy Savedra
Assistant Secretary of IRVINE RANCH WATER DISTRICT
and of the Board of Directors thereof

STATE OF CALIFORNIA )
) SS.
COUNTY OF ORANGE )

I, Nancy Savedra, Assistant Secretary of the Board of Directors of Irvine Ranch Water District, do hereby certify that the above and foregoing is a full, true and correct copy of Resolution No. 2013-33 of said Board, and that the same has not been amended or repealed.

Dated: 8/27/13

Nancy Savedra
Assistant Secretary of IRVINE RANCH WATER DISTRICT
and of the Board of Directors thereof

(SEAL)

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RESOLUTION NO. 2013-08-27-1

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LAGUNA HILLS, CALIFORNIA, ACCEPTING AND ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN

The City Council of the City of Laguna Hills, California, hereby finds, determines, declares, and resolves as follows:

WHEREAS, a mission of the City of Laguna Hills is the management of water resources and environmental quality throughout its service area; and

WHEREAS, the City of Laguna Hills has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWMP) pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002, to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality, quantity, and reliability of water resources; and

WHEREAS, in November 2002, California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (California Water Code §79560 to §79565), to fund competitive grants for projects consistent with an adopted IRWMP; and

WHEREAS, the City of Laguna Hills is a member of the South Orange County IRWMP Group (Group), which was formed with cities and water/special districts located within the South Orange County Watershed Management Area as adopted by the State's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County, with the County of Orange Public Works Department serving as the Group's lead; and

WHEREAS, in November 2006, California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, River and Coastal Protection Bond Act (PRC Section 75001-75130) which required that an IRWMP be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

WHEREAS, the Group has updated the IRWMP to the new guidelines required by Proposition 84 and has identified the updated IRWMP as the "2013 South Orange County Integrated Regional Water Management Plan."

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF LAGUNA HILLS, CALIFORNIA, DOES RESOLVE, DECLARE, DETERMINE, AND ORDER AS FOLLOWS:

SECTION 1. The City Council of the City of Laguna Hills does hereby accept and adopt the 2013 South Orange County Integrated Regional Water Management Plan.

PASSED, APPROVED, AND ADOPTED this 27th day of August 2013.

BARBARA D. KOGERMAN, MAYOR

ATTEST:

PEGGY J. JOHNS, CITY CLERK

STATE OF CALIFORNIA )
COUNTY OF ORANGE ) ss
CITY OF LAGUNA HILLS )

I, Peggy J. Johns, City Clerk of the City of Laguna Hills, California, DO HEREBY CERTIFY that the foregoing is a true and correct copy of Resolution No. 2013-08-27-1 adopted by the City Council of the City of Laguna Hills, California, at a Regular Meeting thereof held on the 27th day of August 2013, by the following vote:

AYES: Council Members Bressette, Carruth, Gilbert, Mayor Pro Tempore Blount, and Mayor Kogerman

NOES: None

ABSENT: None

ABSTAIN: None

(SEAL)

PEGGY J. JOHNS, CITY CLERK

RESOLUTION NO. 13.051

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LAGUNA BEACH CALIFORNIA ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN

WHEREAS, the mission of the City of Laguna Beach includes management of water resources and environmental quality throughout its service area; and

WHEREAS, the City of Laguna Beach has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWMP) pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

WHEREAS, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWMP; and

WHEREAS, the City of Laguna Beach is a member of the South Orange County Integrated Regional Watershed Management Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with Orange County Public Works serving as the Group's lead; and

WHEREAS, SB 1672 provides for the acceptance of said IRWMP by participants in the IRWM Group that have authority to implement the Plan; and

WHEREAS, in 2005, Integrated Regional Watershed Management Group developed an Integrated Regional Management Plan for South Orange County Area; and

WHEREAS, the Board of Supervisors has reviewed and accepted the said Plan with its staff and general public at its regular Board meeting on June 7, 2005; and

WHEREAS, on July 18, 2013, the Executive Committee for South Orange County

Watershed Management Area adopted the 2013 South Orange County Integrated Regional Water Management Plan; and

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF LAGUNA BEACH does further RESOLVE to adopt the updated 2013 South Orange County Integrated Regional Water Management Plan.

ADOPTED this 20th day of August 2013,

Kelly Boyd, Mayor

ATTEST:

City Clerk

I, LISETTE CHEL-WALKER, City Clerk of the City of Laguna Beach, California, do hereby certify that the foregoing Resolution No.13.051, was duly adopted at a Regular Meeting of the City Council of said City held on August 20, 2013, by the following vote:

AYES: COUNCILMEMBER(S): Whalen, Iseman, Dicterow, Boyd

NOES: COUNCILMEMBER(S): None

ABSENT: COUNCILMEMBER(S): Pearson

City Clerk of the City of Laguna Beach, CA

## RESOLUTION NO. 2013-35

## A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LAKE FOREST, CALIFORNIA, ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN

WHEREAS, the mission of the City of Lake Forest ("City") includes management of water resources and environmental quality throughout its jurisdiction; and

WHEREAS, the City has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan in accordance with Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, which encourages local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

WHEREAS, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (Wat. Code Sections 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

WHEREAS, the City is a member of the South Orange County IRWM Group, which was formed by cities, water districts, and special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board's region, which includes in the County of Orange; and

WHEREAS, SB 1672 provides for the acceptance of an IRWM plan by participants in the IRWM Group that have authority to implement an IRWM plan; and

WHEREAS, in 2005, the IRWM Group developed an Integrated Regional Management Plan for South Orange County Area; and

WHEREAS, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, River and Coastal Protection Bond Act (Pub. Resources Code Sections 75001-75090) which requires that IRWM Plans be updated with new guidelines, such as addressing flood management and climate change, in order to be eligible for Proposition 84 grant funding; and

APPROVED AS TO FORM:

SCOTT C. SMITH
CITY ATTORNEY

STATE OF CALIFORNIA )
COUNTY OF ORANGE ) SS
CITY OF LAKE FOREST )

I, Stephanie D. Smith, City Clerk of the City of Lake Forest, California, do hereby certify that the foregoing Resolution No. 2013-35 was duly passed and adopted at a regular meeting of the Lake Forest City Council on the 3rd day of September 2013, by the following vote, to wit:

| | | |
|---|---|---|
| AYES: | COUNCIL MEMBERS: | HERZOG, MCCULLOUGH, NICK, ROBINSON, VOIGTS |
| NOES: | COUNCIL MEMBERS: | NONE |
| ABSENT: | COUNCIL MEMBERS: | NONE |
| ABSTAIN: | COUNCIL MEMBERS: | NONE |

STEPHANIE D. SMITH, CMC
CITY CLERK

WHEREAS, on July 18, 2013, the Executive Committee for the South Orange County Watershed Management Area adopted the 2013 South Orange County Integrated Regional Watershed Management Plan.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF LAKE FOREST, DOES HEREBY RESOLVE, AS FOLLOWS:

SECTION 1. Incorporation of Recitals. The foregoing recitals are true and correct and are incorporated herein and made an operative part of this Resolution.

SECTION 2. Adoption of Plan. The City hereby adopts the updated 2013 South Orange County Integrated Regional Water Management Plan.

SECTION 3. CEQA. The City Council finds that this Resolution is not subject to the California Environmental Quality Act (CEQA) pursuant to Sections 15060(c)(2) (the activity will not result in a direct or reasonably foreseeable indirect physical change in the environment) and 15060(c)(3) (the activity is not a project as defined in Section 15378) of the CEQA Guidelines, California Code of Regulations, Title 14, Chapter 3, because it has no potential for resulting in physical change to the environment, directly or indirectly.

SECTION 4. Severability. If any provision of this Resolution is held invalid, the remainder of this Resolution shall not be affected by such invalidity, and the provisions of this Resolution are severable.

SECTION 5. Effective Date. This Resolution shall become effective immediately upon its adoption.

SECTION 6. Certification. The Mayor shall sign this Resolution and the City Clerk shall certify the adoption thereof.

PASSED, APPROVED AND ADOPTED this 3rd day of September, 2013.

SCOTT VOIGTS
MAYOR

ATTEST:

STEPHANIE D. SMITH, CMC
CITY CLERK

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# RESOLUTION NO. 2013-1107

## RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LAGUNA NIGUEL, CALIFORNIA, ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN

**WHEREAS,** the mission of the City of Laguna Niguel includes management of surface water resources and environmental quality throughout its jurisdiction; and

**WHEREAS,** the City of Laguna Niguel has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water resources to improve the quality, quantity, and reliability; and

**WHEREAS,** in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

**WHEREAS,** the City of Laguna Niguel is a member of the South Orange County IRWM Group, which was formed by cities and water districts in the South Orange County Watershed Management Area within the jurisdictional boundary of the San Diego Regional Water Quality Control Board, and was accepted by the State's Regional Acceptance Program, with OC Public Works serving as the Group's lead; and

**WHEREAS**, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

**WHEREAS**, in 2005, the IRWM Group developed an Integrated Regional Management Plan for the South Orange County Area; and

**WHEREAS,** in 2005, the City Council of the City of Laguna Niguel accepted the 2005 IRWM Plan in concept on June 7, 2005 by Resolution No. 2005-811; and

**WHEREAS,** the Board of Supervisors reviewed and accepted the said Plan at its regular Board meeting on June 7, 2005; and

**WHEREAS,** in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, River and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

**WHEREAS,** on July 18, 2013, the Executive Committee for South Orange County Watershed Management Area adopted the 2013 updates to the South Orange County IRWM Plan; and

**NOW, THEREFORE, BE IT RESOLVED** that the City of Laguna Niguel, hereby adopts the updated 2013 South Orange County Integrated Regional Water Management Plan.

**PASSED, APPROVED AND ADOPTED** this 3rd day of September, 2013.

Robert Ming,
Mayor

ATTEST:

Pam Lawrence
Deputy City Manager/Acting City Clerk

<u>CERTIFICATION</u>

STATE OF CALIFORNIA )
COUNTY OF ORANGE )SS
CITY OF LAGUNA NIGUEL )

I, Pam Lawrence, Deputy City Manager/Acting City Clerk of the City of Laguna Niguel, California, do hereby certify that the foregoing is Resolution No. 2013-1107 which was adopted at a regular meeting of the City Council of the City of Laguna Niguel, California, held September 3, 2013 by the following vote:

| | |
|---|---|
| AYES: | Council Members Davies, McCloskey, Slusiewicz and Mayor Pro Tem Lindholm |
| NOES: | Mayor Ming |
| ABSTENTIONS: | None |
| ABSENT: | None |

Pam Lawrence

Pam Lawrence,
Deputy City Manager/Acting City Clerk

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## RESOLUTION NO. 13-15

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF LAGUNA WOODS, CALIFORNIA ADOPTING THE SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN

**WHEREAS,** the mission of the City of Laguna Woods includes management of water resources and environmental quality throughout its jurisdiction; and

**WHEREAS,** the City of Laguna Woods has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

**WHEREAS,** in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

**WHEREAS,** the City of Laguna Woods is a member of the South Orange County IRWM Group, which was formed with cities, water, and special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

**WHEREAS,** Senate Bill 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

**WHEREAS**, the Laguna Woods City Council has reviewed and accepted the said Plan with its staff and general public at its regular City Council meeting on August 21, 2013; and

**WHEREAS**, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal

Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF LAGUNA WOODS, CALIFORNIA, DOES HEREBY RESOLVE, DECLARE, DETERMINE AND ORDER AS FOLLOWS:

SECTION 1. The City Council hereby adopts the South Orange County Integrated Regional Water Management Plan in continued coordination with the South Orange County IRWM Group.

SECTION 2. The Deputy City Clerk shall certify to the adoption of this resolution.

PASSED, APPROVED AND ADOPTED ON this 21st day of August 2013.

ROBERT B. RING, Mayor

ATTEST:

MARC DONOHUE, Deputy City Clerk

STATE OF CALIFORNIA )
COUNTY OF ORANGE ) ss.
CITY OF LAGUNA WOODS )

I, MARC DONOHUE, Deputy City Clerk of the City of Laguna Woods, do HEREBY CERTIFY that the foregoing **Resolution No. 13-15** was duly adopted by the City Council of the City of Laguna Woods at a regular meeting thereof, held on the 21st day of August 2013, by the following vote:

AYES: COUNCILMEMBERS: Conners, Hack, ~~Hatch~~, Robbins, Ring
NOES: COUNCILMEMBERS:
ABSENT: COUNCILMEMBERS: Hatch

MARC DONOHUE, Deputy City Clerk

# RESOLUTION NO. 13-19

## RESOLUTION OF THE BOARD OF DIRECTORS OF THE MOULTON NIGUEL WATER DISTRICT ADOPTING THE UPDATED "SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN"

WHEREAS, the Moulton Niguel Water District ("MNWD") includes within its mission the provision of a reliable water supply to the MNWD service area and in carrying out this particular mission over the past several years has completed considerable work with respect to improving water system reliability in South Orange County; and

WHEREAS, MNWD recognizes that on-going coordination among local agencies in South Orange County with responsibilities for managing water supplies, additional development of local resources, efficient utilization of existing resources and vigilant protection of imported water resources is necessary to maximize the quality and quantity of water available to meet the region's agricultural, domestic, industrial, and environmental needs; and

WHEREAS, MNWD has participated in the development of the South Orange County Integrated Regional Water Management Plan (IRWMP) pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002; and

WHEREAS, MNWD is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

WHEREAS, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

WHEREAS, over the past year, MNWD staff has participated in updating the IRWMP; and

WHEREAS, the MNWD Board of Directors has now reviewed the updated IRWMP with its staff and the general public at its Engineering and Operations Committee meeting on September 16, 2013, and supports the IRWMP and its goals.

**NOW, THEREFORE**, the Board of Directors of Moulton Niguel Water District does hereby **RESOLVE, DETERMINE** and **ORDER** as follows:

Section 1. The Moulton Niguel Water District Board of Directors does hereby adopt the South Orange County Integrated Regional Water Management Plan in continued coordination with the South OC IRWM Group.

**ADOPTED, SIGNED** and **APPROVED** this 19th day of September, 2013.

President/Vice President
MOULTON NIGUEL WATER DISTRICT
and of the Board of Directors thereof

Secretary
MOULTON NIGUEL WATER DISTRICT
and of the Board of Directors thereof

APPROVED AS TO FORM:

BOWIE, ARNESON, WILES & GIANNONE
Legal Counsel - Moulton Niguel Water District

By: ______________________
Patricia B. Giannone

RESOLUTION 13-48

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF MISSION VIEJO, CALIFORNIA, ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN (IRWMP)

WHEREAS, the mission of the City of Mission Viejo includes management of water resources and environmental quality throughout its service area; and

WHEREAS, the City of Mission Viejo has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWMP) pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002, to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality, quantity, and reliability; and

WHEREAS, in November 2002, California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

WHEREAS, the City of Mission Viejo is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the State's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with the County of Orange Public Works serving as the group's lead; and

WHEREAS, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

WHEREAS, in 2005, the IRWM Group developed an Integrated Regional Management Plan for South Orange County Area; and

WHEREAS, on June 6, 2005, the City Council of the City of Mission Viejo accepted the 2005 IRWMP by Resolution No. 05-057; and

WHEREAS, in November 2006, California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, River and Coastal Protection Bond Act (PRC Section 75001-75130), which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

WHEREAS, on July 18, 2013, the Executive Committee of the South Orange County Watershed Management Area adopted the 2013 South Orange County Integrated Regional Water Management Plan; and

NOW, THEREFORE, BE IT RESOLVED that the City of Mission Viejo, hereby adopts the updated 2013 South Orange County Integrated Regional Water Management Plan.

PASSED, APPROVED AND ADOPTED this 3rd day of September, 2013.

Rhonda Reardon
Mayor

I, KAREN HAMMAN, City Clerk of the City of Mission Viejo, hereby certify that the foregoing resolution was duly adopted by the City Council of the City of Mission Viejo at a regular meeting thereof, held on the 3rd day of September, 2013, by the following vote of the Council:

AYES: Kelley, Leckness, Schlicht, and Ury
NOES: None
ABSENT: Reardon

ATTEST:

Karen Hamman
City Clerk

**RESOLUTION NO. 1964**

**RESOLUTION OF THE BOARD OF DIRECTORS**
**MUNICIPAL WATER DISTRICT OF ORANGE COUNTY**
**ADOPTING THE UPDATED**
**"SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN"**

**WHEREAS,** the mission of the Municipal Water District of Orange County (MWDOC) is to provide a reliable supply of water to its service area and, in carrying out this mission, has consistently worked to improve system and supply reliability throughout Orange County; and

**WHEREAS**, MWDOC is coordinating the Orange County Regional Urban Water Management Plan, has completed the South Orange County Water Reliability Study, and is participating as an implementing entity (along with the 30 retail agencies we serve) in Metropolitan Water District of Southern California's Integrated Resources Plan, all of which will help ensure the continued reliability of supplies to Orange County; and

**WHEREAS,** MWDOC recognizes that improved coordination among local agencies with responsibilities for managing water supplies, development of additional local resources, efficient utilization of existing resources, and vigilant protection of our imported resources are necessary to maximize the supplies available to meet the region's agricultural, urban, industrial, and environmental needs; and

**WHEREAS,** a regional water management group was formed in South Orange County, facilitated by the County of Orange and in which MWDOC is participating, with the intent of developing an Integrated Regional Watershed Management Plan; and

**WHEREAS**, MWDOC staff has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWMP) in 2005, which was prepared in accordance with Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Watershed Management Planning Act of 2002; and

**WHEREAS**, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality and Supply , Flood Control, River and Coastal Protection Bond Act, which requires that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

**WHEREAS**, over the past year, MWDOC staff has participated in updating the IRWMP, and

**WHEREAS,** adopting the IRWMP does not commit MWDOC to implementation of any project; determinations to proceed with individual projects are made by the individual agencies, and

**WHEREAS,** the MWDOC Board of Directors has now reviewed the updated IRWMP with its staff and the general public at its Planning & Operations Committee meeting on

August 5, 2013, and at its regular Board meeting on August 21, 2013, and supports the IRWMP and its goals.

**NOW, THEREFORE,** be it resolved that the Board of Directors of the Municipal Water District of Orange County does hereby adopt the South Orange County Integrated Regional Watershed Management Plan for the purposes of moving forward with the proposed projects and programs included therein and in continued coordination with the IRWMP Management Committee and Executive Committee, under the coordination with the County of Orange as the Administrator of the IRWMP.

Adopted at the regular meeting of the Board of Directors held August 21, 2013, by the following roll call vote:

AYES: Directors Barbre, Clark, Dick, Hinman, Osborne and Thomas

NOES: None

ABSENT: Director Finnegan

ABSTAIN: None

I hereby certify that the foregoing is a true and correct copy of Resolution No. 1964 adopted by the Board of Directors of Municipal Water District of Orange County at its meeting held on August 21, 2013.

MUNICIPAL WATER DISTRICT OF ORANGE COUNTY

By: ______________________
Secretary

RESOLUTION NO. 13-09-11-02

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF RANCHO SANTA MARGARITA CALIFORNIA, ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN

The City Council of the City of Rancho Santa Margarita, California, hereby finds, determines, declares, and resolves as follows:

WHEREAS, the City of Rancho Santa Margarita has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWMP) pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

WHEREAS, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

WHEREAS, the City of Rancho Santa Margarita is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with Orange County Public Works serving as the Group's lead; and

WHEREAS, SB 1672 provides for the acceptance of said Plan by participants in the IRWMP Group that have authority to implement the Plan; and

WHEREAS, in 2005, IRWM Group developed an Integrated Regional Watershed Management Plan for South Orange County Area; and

WHEREAS, in 2005, the City Council of the City of Rancho Santa Margarita adopted the 2005 IRWMP by Resolution No. 05-06-22-02; and

WHEREAS, Whereas, the County Board of Supervisors has reviewed and accepted the said Plan with its staff and general public at its regular Board meeting on June 7, 2005; and

WHEREAS, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

WHEREAS, on July 18, 2013, the Executive Committee for South Orange County Watershed Management Area adopted the 2013 South Orange County Integrated Regional Water Management Plan.

NOW, THEREFORE, THE CITY COUNCIL OF THE CITY OF RANCHO SANTA MARGARITA, CALIFORNIA, DOES RESOLVE, DECLARE, DETERMINE, AND ORDER AS FOLLOWS:

SECTION 1. The City Council of the City of Rancho Santa Margarita does hereby accept and adopt the 2013 South Orange County Integrated Regional Water Management Plan.

PASSED, APPROVED AND ADOPTED THIS 11TH DAY OF SEPTEMBER, 2013.

L. ANTHONY BEALL, MAYOR

ATTEST:

MOLLY MCLAUGHLIN, CITY CLERK

State of California )
County of Orange ) ss
City of Rancho Santa Margarita)

I, Molly McLaughlin, City Clerk of the City of Rancho Santa Margarita, California, DO HEREBY CERTIFY that the foregoing is a true and correct copy of Resolution No. 13-09-11-02, adopted by the City Council of the City of Rancho Santa Margarita, California, at a regular meeting thereof, held on the 11th day of September, 2013, by the following vote:

| | | | |
|---|---|---|---|
| AYES: | 5 | COUNCIL MEMBERS: | Baric, McGirr, Petrilla, Mayor Pro Tempore Gamble and Mayor Beall |
| NOES: | 0 | COUNCIL MEMBERS: | None |
| ABSTAIN: | 0 | COUNCIL MEMBERS: | None |
| ABSENT: | 0 | COUNCIL MEMBERS: | None |

MOLLY MCLAUGHLIN, CITY CLERK

## RESOLUTION NO. 13-36

**A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SAN CLEMENTE, CALIFORNIA, ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN**

**WHEREAS,** the mission of the City of San Clemente includes management of water resources and environmental quality throughout its service area; and

**WHEREAS,** the City of San Clemente has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

**WHEREAS,** in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

**WHEREAS,** the City of San Clemente is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

**WHEREAS**, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

**WHEREAS**, in 2005, IRWM Group developed an Integrated Regional Management Plan for South Orange County Area; and

**WHEREAS,** in 2005, the City Council of the City of San Clemente adopted the 2005 IRWMP by Resolution No. 05-42; and

**WHEREAS,** Whereas, the Board of Supervisors has reviewed and accepted the said Plan with its staff and general public at its regular Board meeting on June 7, 2005; and

**WHEREAS,** in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

**WHEREAS,** on July 18, 2013, the Executive Committee for South Orange County Watershed Management Area adopted the 2013 South Orange County Integrated Regional Water Management Plan; and

**NOW, THEREFORE, BE IT RESOLVED that the City of San Clemente**, hereby adopts the updated 2013 South Orange County Integrated Regional Water Management Plan.

PASSED AND ADOPTED this 3rd day of September, 2013.

ATTEST:

City Clerk of the City of
San Clemente, California

Mayor of the City of San
Clemente, California

STATE OF CALIFORNIA )
COUNTY OF ORANGE ) §
CITY OF SAN CLEMENTE )

I, JOANNE BAADE, City Clerk of the City of San Clemente, California, do hereby certify that Resolution No. 13-36 was adopted at a regular meeting of the City Council of the City of San Clemente held on the 3rd day of September, 2013, by the following vote:

AYES: BROWN, DONCHAK, EVERT, HAMM, MAYOR BAKER

NOES: NONE

ABSENT: NONE

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the official seal of the City of San Clemente, California, this 5TH day of SEPT, 2013.

CITY CLERK of the City of
San Clemente, California

Approved as to form:

/s/ Jeff Goldfarb

City Attorney

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# SOUTH COAST WATER DISTRICT

## RESOLUTION NO. 5-13/14

### A RESOLUTION OF THE BOARD OF DIRECTORS OF SOUTH COAST WATER DISTRICT ADOPTING THE SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN

**WHEREAS,** the mission of the South Coast Water District includes management of water resources and environmental quality throughout its service area; and

**WHEREAS,** South Coast Water District has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

**WHEREAS,** in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

**WHEREAS,** the South Coast Water District is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

**WHEREAS,** SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

**WHEREAS,** the Board of Directors has reviewed and accepted the said Plan with its staff and general public at its regular Board meeting on August 8, 2013; and

**WHEREAS,** in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding.

**NOW, THEREFORE, BE IT RESOLVED** that this Board of Directors of South Coast Water District does hereby adopt the South Orange County Integrated Regional Water Management Plan in continued coordination with the South OC IRWM Group.

**PASSED AND ADOPTED** this 8th day of August 2013.

President

ATTEST:

Secretary

***SOUTH COAST WATER DISTRICT***
Serving the Public Since 1932

# Certification

I, Betty Burnett, Secretary of the SOUTH COAST WATER DISTRICT, Orange County, California, do hereby certify that the foregoing **Resolution No. 5-13/14** was duly adopted at a regular meeting of the Governing Board of said District, held on the 8th day of August 2013 by the following vote of members of the Board:

**AYES:** Erkeneff, Moore, Rayfield, Runge

**NOES:**

**ABSENT:** Dietmeier

**ABSTAIN:**

and I further certify that Wayne Rayfield, as President, and Betty Burnett, as Secretary Pro Tem, signed and approved said **Resolution No. 5-13/14** on the 8th day of August 2013.

Betty Burnett
Secretary of the Board
South Coast Water District

(District Seal)

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RESOLUTION NO. 13-09-03-02

A RESOLUTION OF THE CITY COUNCIL OF THE CITY OF SAN JUAN CAPISTRANO, CALIFORNIA ADOPTING THE SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN

WHEREAS, the Mission of the City of San Juan Capistrano includes management of water resources and environmental quality throughout its service area; and,

WHEREAS, the City of San Juan Capistrano has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and,

WHEREAS, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and,

WHEREAS, the City of San Juan Capistrano is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and,

WHEREAS, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and,

Whereas, the City Council has reviewed and accepted the said Plan with its staff and general public at its regular Council meeting on September 3rd, 2013; and,

WHEREAS, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and,

WHEREAS, changes to the Integrated Watershed Management Plan will require formal approval by the City Council, on-going addition or deletion of projects in the Plan does not require formal approval of the Plan; and, NOW THEREFORE BE IT RESOLVED, that the City Council of the City of San Juan Capistrano hereby adopt the updated 2013 South Orange County Integrated Regional Water Management Plan in continued coordination with the South OC IRWM Group.

PASSED, APPROVED AND ADOPTED this 3rd day of September 2013.

JOHN TAYLOR, MAYOR

ATTEST:

Deputy

MARIA MORRIS, CITY CLERK

STATE OF CALIFORNIA )
COUNTY OF ORANGE ) ss.
CITY OF SAN JUAN CAPISTRANO )

I, MARIA MORRIS, appointed City Clerk of the City of San Juan Capistrano, do hereby certify that the foregoing **Resolution No. 13-09-03-02** was duly adopted by the City Council of the City of San Juan Capistrano at a Regular meeting thereof, held the 3rd day of September 2013, by the following vote:

AYES: COUNCIL MEMBERS: Byrnes, Kramer, Allevato and Mayor Taylor
NOES: COUNCIL MEMBER: Reeve
ABSENT: COUNCIL MEMBER: None

Deputy

MARIA MORRIS, City Clerk

## RESOLUTION NO. 2013-09-02

**A RESOLUTION OF THE BOARD OF DIRECTORS OF SANTA MARGARITA WATER DISTRICT, COUNTY OF ORANGE, CALIFORNIA, ADOPTING THE 2013 SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATER MANAGEMENT PLAN**

**WHEREAS,** the mission of Santa Margarita Water District (District) includes management of water resources and environmental quality throughout its service area; and

**WHEREAS,** the District has participated in the development of the South Orange County Integrated Regional Watershed Management (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality, quantity, and reliability; and

**WHEREAS,** in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

**WHEREAS,** the District is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

**WHEREAS**, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

**WHEREAS**, in 2005, IRWM Group developed an Integrated Regional Management Plan for South Orange County Area; and

**WHEREAS,** in 2005, the District adopted the 2005 IRWM Plan by Resolution No. 05-05-07; and

**WHEREAS,** Whereas, the Board of Supervisors has reviewed and accepted the said Plan with its staff and general public at its regular Board meeting on June 7, 2005; and

**WHEREAS,** in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

**WHEREAS,** on July 18, 2013, the Executive Committee for South Orange County Watershed Management Area adopted the 2013 South Orange County Integrated Regional Water Management Plan; and

**NOW, THEREFORE, BE IT RESOLVED** that the Board of Directors of the Santa Margarita Water District, hereby adopt the updated 2013 South Orange County Integrated Regional Water Management Plan.

**APPROVED AND ADOPTED this 13th day of September, 2013.**

By: ______________________
Saundra Jacobs
President, Board of Directors
Santa Margarita Water District

ATTEST:

______________________
Joyce Crosthwaite
Secretary, Board of Directors
Santa Margarita Water District

STATE OF CALIFORNIA )

COUNTY OF ORANGE )

ss

I, Joyce Crosthwaite, Secretary of the Board of Directors of the Santa Margarita Water District, do hereby certify that the foregoing Resolution was duly adopted by the Board of Directors said District at a regular meeting held on the 13th day of September, 2013 and that it was so adopted by the following vote:

AYES: DIRECTORS: Wilson, Jacobs, Gibson, McCusker

NOES: DIRECTORS:

ABSENT: DIRECTORS: Olson

ABSTAIN: DIRECTORS:

Joyce Crosthwaite
Secretary, Board of Directors
Santa Margarita Water District

I, Joyce Crosthwaite, Secretary of the Board of Directors of the Santa Margarita Water District, do hereby certify that the above and forgoing is a full, true, and correct copy of Resolution No. 2013-09-02 of said Board, and that the same has not been amended or repealed.

DATED: September 13, 2013

Joyce Crosthwaite
Secretary, Board of Directors
Santa Margarita Water District

(Seal)

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**RESOLUTION NO. 2013-12**

**RESOLUTION OF THE BOARD OF DIRECTORS OF THE SOUTH ORANGE COUNTY WASTEWATER AUTHORITY ADOPTING THE SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN**

WHEREAS, the mission of the South Orange County Wastewater Authority includes management of wastewater, recycled water and the highest level of environmental stewardship throughout its service area; and

WHEREAS, the South Orange County Wastewater Authority has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

WHEREAS, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

WHEREAS, the South Orange County Wastewater Authority is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

WHEREAS, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

WHEREAS, in November 2006 California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, river and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors as follows:

Section 1. The South Orange County Wastewater Authority Board of Directors does hereby adopt the South Orange County Integrated Regional Water Management Plan in continued coordination with the South OC IRWM Group.

ADOPTED, SIGNED AND APPROVED this 1st day of August 2013.

Chairman/Vice-Chairman
SOUTH ORANGE COUNTY WASTEWATER AUTHORITY
and the Board of Directors thereof

Secretary/Assistant Secretary
SOUTH ORANGE COUNTY WASTEWATER AUTHORITY
and the Board of Directors thereof

APPROVED AS TO FORM:

BOWIE, ARNESON, WILES & GIANNONE
Legal Counsel – South Orange County Wastewater Authority

By: ______________________
Patricia B. Giannone

**RESOLUTION NO 2013-1191**

**RESOLUTION OF THE BOARD OF DIRECTORS OF TRABUCO CANYON WATER DISTRICT ADOPTING THE SOUTH ORANGE COUNTY INTEGRATED REGIONAL WATERSHED MANAGEMENT PLAN**

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**WHEREAS**, the mission of the Trabuco Canyon Water District includes management of water resources and environmental quality throughout its service area.

**WHEREAS**, Trabuco Canyon Water District has participated in the development of the South Orange County Integrated Regional Watershed Management Plan (IRWM) Plan pursuant to Senate Bill 1672 (SB 1672) of the State of California, known as the Integrated Regional Water Management Planning Act of 2002, approved by the Governor on September 20, 2002 to encourage local agencies to work cooperatively to manage local and imported water supplies to improve the quality quantity, and reliability; and

**WHEREAS**, in November 2002 California voters passed Proposition 50, the Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002 (CWC Section 79560-79565) to fund competitive grants for projects consistent with an adopted IRWM Plan; and

**WHEREAS**, the Trabuco Canyon Water District is a member of the South Orange County IRWM Group, which was formed with cities, water/special districts located within the South Orange County Watershed Management Area, adopted by the state's Regional Acceptance Program, within the San Diego Regional Water Quality Control Board boundary in Orange County with OC Public Works serving as the Group's lead; and

**WHEREAS**, SB 1672 provides for the acceptance of said Plan by participants in the IRWM Group that have authority to implement the Plan; and

**WHEREAS**, the Board of Directors has reviewed and accepted the said Plan with its staff and general public at its Regular Board Meeting on August 21, 2013; and

**WHEREAS**, in November 2006, California voters passed Proposition 84, the Safe Drinking Water, Water Quality, and Supply, Flood Control, River and Coastal Protection Bond Act (PRC Section 75001-75130) which required that IRWM Plans be updated to new guidelines in order to be eligible for Proposition 84 grant funding; and

**Now**, therefore, be it resolved that the Board of Directors of Trabuco Canyon Water District does hereby adopt the South Orange County Integrated Regional Water Management Plan in continued coordination with the South OC IRWM Group.

ADOPTED, SIGNED, and APPROVED this 21st day of August, 2013, by the Board of Directors of the Trabuco Canyon Water District.

TRABUCO CANYON WATER DISTRICT:

_______________________________
President/Vice President

_______________________________
District Secretary

STATE OF CALIFORNIA)

) ss.

COUNTY OF ORANGE )

I, Michael Perea, District Secretary of the Trabuco Canyon Water District, do hereby certify that the foregoing resolution was duly adopted by the Board of said District at a meeting of said Board held on the 21st day of August, 2013, of which meeting all of the members of the Board had due notice and at which a quorum thereof were present and acting throughout and for which notice and an agenda was prepared and posted as required by law and that at said meeting such resolution was adopted by the following vote:

AYES: Mandich, Haselton, Acosta, Dopudja, Safranski

NOES: None

ABSTAIN: None

ABSENT: None

District Secretary,
Trabuco Canyon Water District

STATE OF CALIFORNIA )
) ss.
COUNTY OF ORANGE )

I, Michael Perea, District Secretary of the Trabuco Canyon Water District, do hereby certify that the foregoing is a full, true and correct copy of Resolution No. 2013-1191 of such Board and that the same has not been amended or repealed.

Dated this 21st day of August, 2013.

District Secretary,
Trabuco Canyon Water District

USDA United States Department of Agriculture | Forest Service | Cleveland National Forest | 10845 Rancho Bernardo Road
Suite 200
San Diego, CA 92127

**File Code:** 2520
**Date:** June 30, 2015

South Orange County IRWM
c/o Mary Anne Skorpanich
Deputy Director, OC Public Works
2301 N. Glassell Street
Orange, CA 92865

Dear South Orange County IRWM,

The Cleveland National Forest is pleased that "San Juan Aquatic Passage and Habitat Improvement" project was included in the South Orange County Integrated Regional Water Management (IRWM) Plan and subsequently chosen for inclusion in the 2015 Proposition 84 IRWM Implementation application for funding from the California Department of Water Resources (DWR).

The Cleveland National Forest officially supports and adopts the current South Orange County IRWM Plan and Amended Project List to facilitate cooperation between our agencies for mutually beneficial objectives and as a requirement of Proposition 84 funding. Adoption of the plan does not hold the Federal Government to any legal action; however, the goals and objectives of the plan are in line with our National direction and Forest Land Management Plan (LMP). Because of this, by following our National direction and LMP we will meet the intent of the plan. The Cleveland National Forest intends to continue the partnership with the IRWM and participate in strategic planning to reach mutually beneficial objectives in the South Orange County IRWM area.

If you have any questions, please contact our Forest Hydrologist, Emily Fudge at (858) 674-2993.

Sincerely,

WILLIAM METZ
Forest Supervisor

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# APPENDIX E

# APPENDIX E

## SOUTH ORANGE COUNTY IRWM PLAN
## LETTERS OF SUPPORT FROM NON-AGENCY ORGANIZATIONS, COMMUNITY GROUPS, AND OTHERS

Organizations, community groups and others have provided Letters of Support in coordination, development and implementation of the South Orange County Integrated Regional Water Management Plan. Copies of the letters are included on the following pages.

» Audubon California, Starr Ranch Sanctuary
» Fluvial Tech Inc.
» MIOCEAN
» Penny Elia, Environmental Advocate
» South Laguna Civic Association
» Surfrider Foundation

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Audubon CALIFORNIA

**Starr Ranch Sanctuary**
100 Bell Canyon Road
Trabuco Canyon, CA

February 5, 2013

Marilyn Thoms,
Manager, Environmental Engineering
OC Watersheds Program
2301 N. Glassell
Orange, CA 92865
(714) 955-0610

Dear Mrs. Thoms:

I am pleased to write this letter of support for the South Orange County Integrated Regional Water Management (IRWM) projects that seek Proposition 84 funding. The National Audubon Society is an over 100 year old 501(c)3 nonprofit organization whose mission is to conserve and restore natural ecosystems, focusing on birds, other wildlife, and their habitats for the benefit of humanity and the earth's biological diversity. At Audubon Starr Ranch, we've worked to restore and monitor a 125-acre riparian corridor, Bell Creek, that is an important tributary of San Juan Creek. Thus, our strong interest in and support for the South Orange County Integrated Regional Water Management plan.

The IRWM takes a progressive and inclusive approach to water conservation in the region. Audubon Starr Ranch is proud to offer its support for the South Orange County IRWM.

Sincerely,

Sandy DeSimone

Sandra DeSimone, Ph.D.
Director – Research and Education
949-858-0309
sdesimone@audubon.org


June 26, 2013

Mrs. Marilyn Thoms,
Manager, Environmental Engineering
OC Watersheds Program
2301 N. Glassell
Orange, CA 92865
(714) 955-0610

Subject: FluvialTech Letter of Support for South Orange County IRWM Plan Adoption

Dear Mrs. Thoms:

FluvialTech Inc. supports the update and implementation of the South Orange County Integrated Regional Water Management Plan (IRWM Plan). Through participation in workshops and meetings FluvialTech contributed in the development of the IRWM Plan, and supports the IRWM Plan update in accordance with CWC §10543.

FluvialTech appreciates the opportunity to be part of the IRWM Group along with numerous South County cities, special districts, the County of Orange, and other stakeholders.

FluvialTech recognizes that improved coordination among local agencies with shared responsibilities for watershed management, clean water programs, water supplies, development of local resources, and protection of our natural resources are necessary to support our mission of Integrated, Healthy and Balanced Watersheds.

The IRWM Group, facilitated by the County of Orange, has prepared a comprehensive IRWM Plan covering the South Orange County Watershed Management Area, a Region adopted by the state in 2009. FluvialTech supports ongoing funding and implementation of the IRWM Plan and will formally adopt the 2013 IRWM Plan by May 2013.

Sincerely,

**FluvialTech Inc.**

Hasan Nouri

Hasan Nouri, P.E., Hoover Medalist

President

*FluvialTech Inc., 310 Avenida Del Mar, Suite 6, San Clemente, CA 92672, Tel: (949)633-5035, hasan.nouri@fluvialtechinc.com*

miocean

June 28, 2013

Marilyn Thoms
Manager, Environmental Engineering
OC Watersheds Program
2301 N. Glassell
Orange, CA 92865
(714) 955-0610

RE: Letter of Support for South Orange County IRWM Plan Adoption

Dear Mrs. Thoms:

The Miocean Foundation supports the update and implementation of the South Orange County Integrated Regional Water Management Plan (IRWM Plan). As you know, Miocean is a 501(c)3 non-profit foundation focused entirely on raising private sector funds to fortify local government efforts to remove ocean pollution in Orange County.

We recognize and applaud the IRWM Plan which facilitates improved coordination among local agencies with shared responsibilities for watershed management, clean water programs, water supplies, development of local resources, and protection of our natural resources. Miocean welcomes the organization that the IRWM Plan brings to prioritize and effectually implement projects that improve watersheds in South Orange County.

There are many worthy projects throughout the south coast area, we look forward to future collaborations. Thank you for your interest in Miocean.

Best Regards,

MIOCEAN

Patrick R. Fuscoe
Chairman

* * *

P.O. Box 14246 * Irvine, California * 92623-4246 * t. 949.271.4386 * t. 888.4MIOCEAN * www.miocean.org

July 8, 2013

Marilyn Thoms
Manager, Environmental Engineering
OC Watersheds Program
2301 N. Glassell
Orange, CA 92865
(714) 955-0610

Subject: Letter of Support and Encouragement for South Orange County IRWM Plan Adoption

Dear Ms. Thoms:

Please allow this letter to serve as my personal support for the update and implementation of the South Orange County Integrated Regional Water Management Plan (IRWM Plan). I participated in the development of the IRWM Plan, and support the IRWM Plan update in accordance with CWC §10543.

I appreciate the opportunity to be part of the IRWM Group along with other important stakeholders that understand the importance of working together towards solutions. It is a daunting job and our goals are not always achieved, but we must continue to work together. We may sometimes differ on the details, but we all agree that water quality and resources are a priority.

Improved coordination among local agencies with shared responsibilities for watershed management, clean water programs, water supplies, development of local resources, and protection of our natural resources are necessary to support the goal of Integrated, Healthy and Balanced Watersheds.

The IRWM Group, facilitated by the County of Orange, has prepared a comprehensive IRWM Plan covering the South Orange County Watershed Management Area, a Region adopted by the state in 2009. I support ongoing funding and implementation of the IRWM Plan and the 2013 IRWM Plan adoption.

Sincerely,

Penny Elia
Environmental Advocate
Laguna Beach, CA 92651
greenp1@cox.net

June 25, 2013

Marilyn Thoms,
Manager, Environmental Engineering
OC Watersheds Program
2301 N. Glassell
Orange, CA 92865

Subject: South Laguna Civic Association
Letter of Support for South Orange County IRWM Plan Adoption

The South Laguna Civic Association (SLCA), established in 1946, supports the update and implementation of the South Orange County Integrated Regional Water Management Plan (IRWM Plan). The SLCA has participated in the development of the IRWM Plan over several decades in a variety of iterations and supports the IRWM Plan update in accordance with CWC §10543.

As the community most impacted by shortcomings in management of the Aliso Creek Watershed, we remain dedicated to being part of the IRWM Group along with numerous South County cities, special districts, the County of Orange, and other stakeholders. SLCA input on watershed issues since the early 1970's promotes restoring creek flows to pre-development levels as guaranteed by inland development Conditions of Approval. While the IRWM is deficient in expanding recycled wastewater for regional wildland fire suppression, we look forward to improved service to all of Laguna Beach and high fire risk areas in Laguna Canyon and Aliso Canyon. More strategic use of recycled water means less ocean pollution.

The South Laguna Civic Association recognizes that improved education about impacts to coastal receiving waters and coordination among local agencies with shared responsibilities for watershed management, clean water programs, water supplies, development of local resources, and protection of our natural resources are necessary to support the mission of Integrated, Healthy and Balanced Watersheds. Allowing the flow of polluted summer urban runoff into local creeks must be aggressively abated to achieve mission objectives and to assure healthy beaches and a clean, clear ocean.

The IRWM Group, facilitated by the County of Orange, has prepared a comprehensive IRWM Plan covering the South Orange County Watershed Management Area, a Region adopted by the state in 2009. The SLCA supports ongoing funding and implementation of the IRWM Plan and the 2013 IRWM Plan adoption while advocating for restoration of natural processes in the watershed. Studies confirm restoration of natural features including the Aliso Beach Estuary Wetlands and reforestation of Aliso & Wood Canyons with native flora and fauna is the most efficacious, cost-effective, long term solution to improved bioregional watersheds.

Significant work remains to restore functioning watersheds. The support of stakeholders and sufficient funding targeted to achieve IRWD goals are central to success. Thank you for your dedicated efforts to promote healthier, natural watersheds throughout South Orange County.

Michael Beanan
Vice President
South Laguna Civic Association mike@southlaguna.org

SURFRIDER
FOUNDATION

June 24, 2013

Marilyn Thoms,
Manager, Environmental Engineering
OC Watersheds Program
2301 N. Glassell
Orange, CA 92865
(714) 955-0610

Subject: Surfrider Foundation Letter of Support for South Orange County IRWM Plan Adoption

Dear Ms. Thoms:

Surfrider Foundation and our South Orange County Chapter support the update and implementation of the South Orange County Integrated Regional Water Management Plan (IRWM Plan). Surfrider Foundation participated in the development of the IRWM Plan, and supports the IRWM Plan update in accordance with CWC §10543.

Surfrider Foundation and our South Orange County Chapter appreciate the opportunity to be part of the IRWM Group along with numerous South County cities, special districts, the County of Orange, and other stakeholders.

Surfrider Foundation recognizes that improved coordination among local agencies with shared responsibilities for watershed management, clean water programs, water supplies, development of local resources, and protection of our natural resources are necessary to support the goal of Integrated, Healthy and Balanced Watersheds.

The IRWM Group, facilitated by the County of Orange, has prepared a comprehensive IRWM Plan covering the South Orange County Watershed Management Area, a Region adopted by the state in 2009. Surfrider Foundation supports ongoing funding and implementation of the IRWM Plan and the 2013 IRWM Plan adoption.

Sincerely,

Rick Wilson
Coastal Management Coordinator
Surfrider Foundation
rwilson@surfrider.org

Global Headquarters
P.O. Box 6010
San Clemente, CA
USA 92674-6010
Phone: (949) 492 8170
Fax: (949) 492 8142

# APPENDIX F

# APPENDIX F

# IRWM PROJECTS

This Appendix includes both the Funded Project List and the 2018 IRWM Plan Project List of prioritized projects. As noted in Section 6 of the IRWM Plan, the latter represents an example of the list based upon list status in March 2018; this list is updated continually through the DMS. Please visit the DMS – IRWM Project Data Explorer tab to download the most recent IRWM Project List.

South Orange County IRWM Plan
Funded Projects

**Prop 50 Projects**

| **Prop 50 IRWM Implementation Round 1** | | |
|---|---|---|
| Project | Agency | Year Completed |
| Water Use Efficiency Program | Municipal Water District of Orange County (MWDOC) | 2013 |
| Canada Gobernadora Multipurpose Basin | Santa Margarita Water District | 2015 |
| Heisler Park Marine Habitat Protection | City of Laguna Beach | 2013 |
| Recycled Water Transmission Systems Improvements | City of San Juan Capistrano | 2013 |
| Recycled Water Treatment and Distribution | City of San Clemente | *2014* |
| Aliso Creek Habitat Restoration Project | County of Orange | 2013 |
| Recycled Water System Expansion Project | El Toro Water District | 2014 |
| Aliso Creek Urban Runoff Recovery, Reuse, and Conservation Project | South Coast Water District (SCWD) | 2014 |
| Coastal Treatment Plant Export Sludge System | South Orange County Wastewater Authority | *Project Terminated* |

| **Prop 84 Projects** | | |
|---|---|---|
| **Prop 84 Implementation Round 1** | | |
| Project | Agency | Completion Date |
| Rockledge Ocean Protection Project | City of Laguna Beach | Project Completed |
| Shadow Rock Detention Basin Facility Urban Water Recovery Project | Trabuco Canyon Water District | Project Completed |
| South Orange County Water Smart Landscape Project | MWDOC | Project Completed |
| Grant Administration | County of Orange | Anticipated 06-2018 |

South Orange County IRWM Plan
Funded Projects

| Prop 84 Implementation Round 2 | | |
|---|---|---|
| Project | Agency | Completion Date |
| Audubon Starr Ranch Sanctuary's Riparian Invasion Control, Restoration, Mon. & Ed. Project | Audubon Starr Ranch | Anticipated 04-2018 |
| Irvine Ranch Water District's Baker Water Treatment Plant | Irvine Ranch Water District | Project Completed |
| Targeted Water Conservation Programs | South Coast Water District | Project Completed |
| Comprehensive Landscape Water Use Efficiency Program | MWDOC | Project Completed |
| Grant Administration | County of Orange | Anticipated 06-2018 |

| Prop 84 IRWM 2014 Drought Grant | | |
|---|---|---|
| Project | Agency | Completion Date |
| Grant Administration | County of Orange | Anticipated 04-2018 |
| Califia Recycled Water Project | SMWD | Project Completed |
| South Coast Water District (SCWD) Recycled Water System Extension Project | South Coast Water District | Project Completed |
| Recycled Water Extension | MNWD | Project Completed |

| Prop 84 IRWM 2015 Implementation Grant | | |
|---|---|---|
| | Agency | Completion Date |
| City of Aliso Viejo’s Dairy Fork Wetland | Aliso Viejo | Anticipated 04-2018 |
| USDA Forest Service, Cleveland National Forests’ San Juan Aquatic Passage and Habitat Improvement | National Forest Service | Anticipated 03-2020 |
| City of Laguna Niguel’s Crown Valley Park Entry Channel Improvements | Laguna Niguel | Project Completed |
| MWDOC’s Strategic Turfgrass Removal & Design Assistance Program | MWDOC | Anticipated 10-2019 |
| Santa Margarita Water District’s 3A Water Recycling Plant Tertiary Expansion | SMWD | Anticipated 12-2018 |
| SCWD’s Recycled Water Distribution Upgrade. | SCWD | Project Completed |
| County of Orange Grant Administration | County of Orange | Anticipated 06-2020 |

| Project Title | Project Status | Project Description | Agency | Completion Date | Preliminary Project Ranking | Project Total Cost | Primary Project Goal | Potential Regional Project |
|---|---|---|---|---|---|---|---|---|
| AV Ranch Landscape Improvement Project | Planning | Retrofitting and improvement of existing landscape area. This includs the installation of smart and weather controled irrigation systems and planting drought resistant species | Aliso Viejo | TBD | TBD | TBD | TBD | TBD |
| AV Urban Runoff Capture and Reuse | TBD | TBD | Aliso Viejo | TBD | TBD | TBD | TBD | TBD |
| Bluebird Canyon and Diversion Structure Rehab | In Design | The City of Laguna Beach will demolish and rebuild the Bluebird Canyon Outfall and Diversion Structure, allowing increased storm water capture and recycling and providing increased regional water self-reliance. | City of Laguna Beach | 2020 | 189.4 | $ 750,000 | Improve Water Quality | Yes |
| Alicia Parkway Median Island Rehabilitation | Planning | Replacement of turf with low water use/drought tolerant landscaping to reduce water consumption and urban runoff along 3,800 lf of median island. | City of Laguna Hills | 2020 | 73.3 | $ 825,000 | Increase Water Supply, Reliability and Efficiency | No |
| La Paz Road Median Island Rehabilitation | Planning | Replacement of turf with low water use/drought tolerant landscaping to reduce water consumption and urban runoff along 1,800 lf of median island. | City of Laguna Hills | 2020 | 73.3 | $ 470,000 | Increase Water Supply, Reliability and Efficiency | No |
| Laguna Hills Drive Median Island Rehabilitation | Planning | Replacement of turf with low water use/drought tolerant landscaping to reduce water consumption and urban runoff along 3,800 lf of median island. | City of Laguna Hills | 2020 | 73.3 | $ 1,230,000 | Increase Water Supply, Reliability and Efficiency | No |
| Moulton Parkway Median Island Rehabilitation | Planning | Replacement of turf with low water use/drought tolerant landscaping to reduce water consumption and urban runoff along 1.0 mile of median island. | City of Laguna Hills | 2020 | 73.3 | $ 1,750,000 | Increase Water Supply, Reliability and Efficiency | No |
| Oso Parkway Median Island Rehabilitation | Planning | Replacement of turf with low water use/drought tolerant landscaping to reduce water consumption and urban runoff along 1.2 miles of median island. | City of Laguna Hills | 2020 | 73.3 | $ 2,125,000 | Increase Water Supply, Reliability and Efficiency | No |
| Paseo de Valencia Median Island Rehabilitation | Planning | Replacement of turf with low water use/drought tolerant landscaping to reduce water consumption and urban runoff along 1.5 mile of median island. | City of Laguna Hills | 2020 | 73.3 | $ 2,590,000 | Increase Water Supply, Reliability and Efficiency | No |
| Mission Viejo Trash and Runoff Abatement Project (TRAP): Phase 2: Los Alisos Blvd from Santa Margarita Parkway to Madero | In Design | Catch basin retrofit, irrigation efficiency/irrigation runoff prevention | City of Mission Viejo | 06/30/2020 | 137.3 | $ 1,520,000 | Improve Water Quality | No |
| City-wide Equestrian Facility LID Improvement Project | In Design | City led public-private partnership to gain a dedicated source of groundwater basin recharge from LID improvements at equestrian facilities. | City of San Juan Capistrano | 2020 | 196.2 | $ 5,000,000 | Improve Water Quality | Yes |
| L01 San Juan Creek Channel, Invert Stabilization | Planning | This project will accommodate the sheet pile walls that were inserted in 8 phases for protection against the 100-year storm event. The FEMA Special Flood Hazard Area, or 100-year floodplain will be removed and a Letter Of Map Revision (LOMR) will indicate | County of Orange, Orange County Flood Control District | June 30, 2022 | 58.7 | $ 30,000,000 | Integrate Flood Management | Yes |
| L01 San Juan Creek Channel, Pacific Ocean to Stonehill Drive | Planning | This project is downstream of the last 8 phases that were constructed with sheet pile walls and the invert stabilization will have been completed. This project is in the planning stage and may include sheet pile walls for protection against the 100-year | County of Orange, Orange County Flood Control District | June 30, 2027 | 58.7 | $ 21,500,000 | Integrate Flood Management | Yes |
| L02 Trabuco Creek Channel, Phase 8 | In Design | This project is the last phase of 8 and will implement installation of sheet pile walls for protection against the 100-year storm event. The FEMA Special Flood Hazard Area, or 100-year floodplain will be removed and a Letter Of Map Revision (LOMR) will in | County of Orange, Orange County Flood Control District | June 30, 2023 | 59.1 | $ 12,300,000 | Integrate Flood Management | Yes |
| San Juan Creek L01S02 Subwatershed Storm Drain BMPs | Planning | High priority major storm drain (11' BY 20' double box culvert) storm water BMPs (harvest, treatment and redirect and/or infiltrate), including trash removal unit in the San Juan Creek subwatershed, L01S02. Includes Arrundo removal component. | Dana Point | max. 1 year after funding acquired | 116 | $ 800,000 | Improve Water Quality | Yes |
| KelpPod Laguna | In Design | Research and develop offshore kelp forests to mitigate anthropogenic contaminates from urban runoff and secondary sewage discharges to regulated coastal receiving waters | Laguna Bluebelt Coalition | January 1, 2020 | TBD | $ 500,000 | Protect and Enhance Natural Resources | Yes |
| Aliso Creek Urban Runoff (ACWRF) | Previous Project | Remove excess urban runoff, increase recycled water , control flood management for Aliso Estuary Restoration Project | Laguna Bluebelt Coalition w/SCWD and SOCWA | January 1, 2020 | TBD | $ 2,300,000 | Protect and Enhance Natural Resources | Yes |
| South Orange County Irrigation Efficiency, Runoff Reduction, and Pollution Prevention Program | Planning | The Municipal Water District of Orange County (MWDOC) proposes the implementation of a comprehensive and holistic regional water use efficiency improvement program targeting public agency, residential, commercial, industrial, and institutional properties | Municipal Water District of Orange County (MWDOC) | 9/2024 | 250.9 | $ 5,737,034 | Increase Water Supply, Reliability and Efficiency | Yes |
| PMMC Water Treatment/Recycling System | In Design | PMMC is designing a water treatment/recycling system that will reduce its water usage by 85-90% (4 to 5 million gallons/year), provide ongoing public educational opportunities regarding water conservation, and improve facility operations and patient care. | Pacific Marine Mammal Center | 12/2019 | 207.4 | $ 2,400,000 | Increase Water Supply, Reliability and Efficiency | No |
| Joint Recycled Water Conveyance Project | Planning | The proposed Project is a regional recycled water line shared with MNWD and possibly El Toro Water District. | Santa Margarita Water District | August 2020 | 233.5 | $ 24,000,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| Recycled Water Conversions - Las Flores Improvement District No. 4B | In Design | The Project includes expanding the recycled water distribution system to allow for conversion of the dedicated irrigation systems from domestic water. | Santa Margarita Water District | June 2019 | 233.3 | $ 4,900,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| Recycled Water Conversions - Melinda Improvement District No. 3A | Planning | The Project includes expanding the recycled water distribution system to allow for conversion of dedicated irrigation systems from domestic water. | Santa Margarita Water District | June 2020 | 233.3 | $ 2,370,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| Recycled Water Conversions– Rancho Santa Margarita (RSM) Improvement District No. 4A | Planning | The Project includes expanding the recycled water distribution system to allow for conversion of the RSM dedicated irrigation systems from domestic water. | Santa Margarita Water District | June 2021 | 233 | $ 13,000,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| Recycled Water Upgrades in San Clemente | Planning | The Project includes A) Upgrade City of San Clemente Recycled Water Pumps and B) Install Recycled water pumps at Pico Lift Station Site. | Santa Margarita Water District | February 2020 | 233.3 | $ 1,200,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| San Juan Watershed Phase 1 Project | In Design | The Project includes enhancing groundwater recharge in the San Juan Basin aquifer for potable water sources. | Santa Margarita Water District | December 2019 | 259.7 | $ 23,000,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| Advanced Metering Infrastructure (AMI) Project Phase 2 | Planning | The AMI Project includes the upgrade existing Automatic Meter Reading (AMR) water meters (currently read via vehicle drive-by) with an AMI cellular base technology system that will automatically collect and store hourly consumption data. | South Coast Water District | January 2022 | 234.3 | $ 6,000,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| Doheny Ocean Desalination Plant Project including alternative energy (i.e. solar, fuel cell, battery storage, etc.) | In Design | Project includes Design, Permit & installation of Solar Energy Panels (or natural gas fuel cells, battery storage, etc.) on District property to provide alternative energy power source. Power will be utilized at the Doheny Ocean Desalination Plant. | South Coast Water District | March 2021 | 251.6 | $ 107,000,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| Golden Lantern/Stonehill Recycled Water Distribution Improvements Project (Project) (Bottleneck No. 2) | In Design | Project consists of correcting existing pressure deficiencies in the recycled water distribution system and extending the recycled water distribution system to serve targeted Tier A Conversion customers. | South Coast Water District | September 2019 | 234.2 | $ 5,500,000 | Increase Water Supply, Reliability and Efficiency | Yes |
| Recycled Water Distribution System Expansion (Construction) | Planning | Conversion of existing Potable Water irrigation customers to Recycled Water, expansion of existing Recycled Water Infrastructure to serve additional customers, and conduct ongoing public education programs. (Construction) | South Coast Water District | June 2021 | 233.7 | $ 3,000,000 | Increase Water Supply, Reliability and Efficiency | Yes |

# APPENDIX G

# APPENDIX G

## Salt and Nutrient Management Plan

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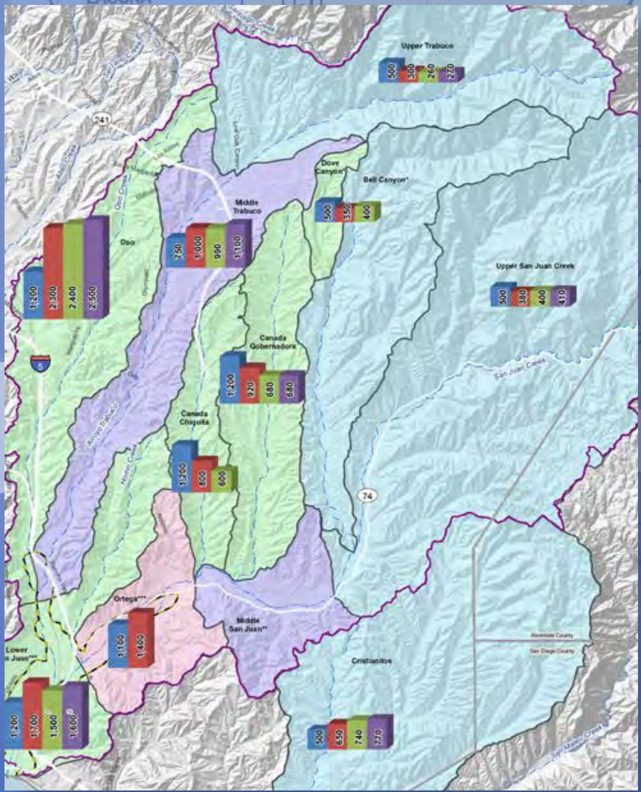
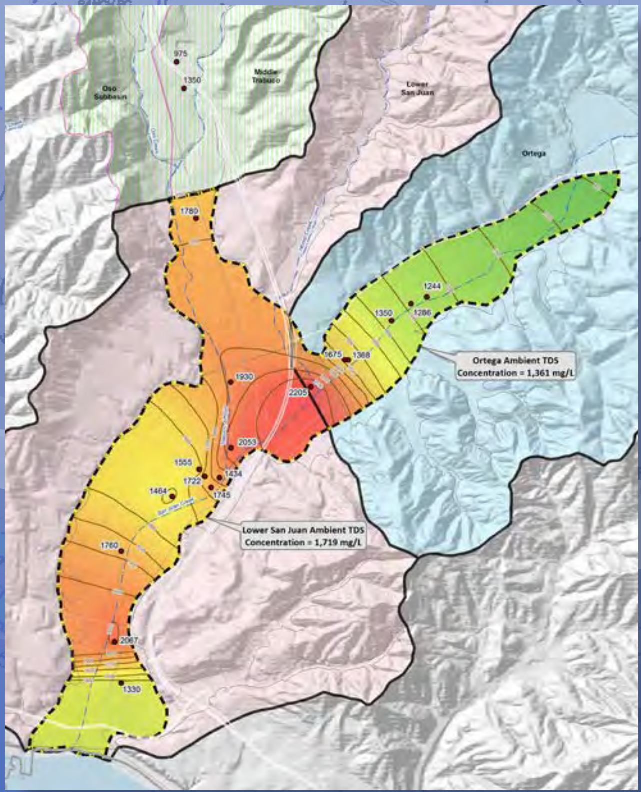
SOCWA

SOUTH ORANGE COUNTY WASTEWATER AUTHORITY

# Draft Salt and Nutrient Management Plan for the South Orange County Aliso Creek, San Juan Creek, and Portions of Other Basins

## PHASE 2 SERVICES





HDR | WILDERMUTH ENVIRONMENTAL INC.

**July 2014**

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFY | acre feet per year |
| APU | Administrate Procedure Update |
| BMP | Best Management Practice |
| CDPH | California Dept. of Public Health |
| CEC | Constituents of Emerging Concern |
| CEQA | California Environmental Quality Act |
| CRA | Colorado River Aqueduct |
| CSJC | City of San Juan Capistrano |
| CSRM | constantly-stirred reactor model |
| DEM | digital elevation model |
| DWR | Department of Water Resources (California) |
| ETo | evapotranspiration |
| GMFP | Groundwater Management and Facilities Plan |
| gpd | gallons per day |
| HA | Hydrologic Area |
| HSA | Hydrologic Subarea |
| HU | Hydrologic Unit |
| IRWMP | Integrated Regional Water Management Plan |
| LUST | Leaking Underground Storage Tank |
| MCLs | maximum contaminant levels |
| mg/L | milligrams per liter |
| MNWD | Moulton Nigel Water District |
| MS4 | Municipal Separate Stormwater Sewer System |
| MTBE | methyl-tert-butyl-ether |
| MWD | Metropolitan Water District of Southern California |
| MWDOC | Metropolitan Water District of Orange County |
| MWDSC | Metropolitan Water District of Southern California |
| NGO | Non Governmental Organization |
| NPDES | National Pollutant Discharge Elimination System |
| Policy | Recycled Water Policy |
| Regional Boards | Regional Water Quality Control Boards |
| RMV | Rancho Mission Viejo |
| RO | reverse osmosis |
| RWQCB | Regional Water Quality Control Boards |
| SCAG | Southern California Association of Governments |
| SCWD | South Coast Water District |
| SJBA | San Juan Basin Authority |
| SJBGFMP | San Juan Basin Groundwater Management and Facilities Plan |
| SNMPs | Salt and Nutrient Management Plans |
| SOCWA | South Orange County Wastewater Authority |
| SWP | State Water Project |
| SWRCB | State Water Resources Control Board |
| TAC | Technical Advisory Committee |
| TDS | Total Dissolved Solids |
| UOCB | Upper Oso Creek Barrier |
| USGS | United States Geological Survey |

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# EXECUTIVE SUMMARY

The California State Water Resources Control Board's (SWRCB) 2009 Recycled Water Policy (Policy) was developed ". . . *to increase the use of recycled water from municipal wastewater sources…in a manner that implements State and Federal water quality laws*." The Policy recognizes that some groundwater basins in the State contain salts and nutrients that exceed or threaten to exceed water quality objectives established in the applicable Water Quality Control Plans (Basin Plans), which are overseen by the local Regional Water Quality Control Boards (Regional Boards). The presence of salt and nutrients in groundwater are affected by a variety of naturally occurring and anthropogenic activities. Rather than imposing requirements solely on individual recycled water projects to rectify potentially degrading conditions, the Policy requires that salt and nutrient issues be addressed through the development of regional salt and nutrient management plans (SNMPs). Specifically, the SWRCB Policy states that "*local water and wastewater entities, together with local salt/nutrient contributing stakeholders, will fund locally-driven and locally-controlled, collaborative processes open to all stakeholders that will prepare salt and nutrient management plans for each basin/sub-basin in California, including compliance with CEQA and participation by Regional Board staff*." The Policy establishes a deadline of May 14, 2014 for submittal of all SNMPs to the Regional Boards for approval and adoption.

To provide a framework for developing SNMPs for San Diego groundwater basins, the San Diego Regional Board developed a guidance document: *Proposed Guidelines for Salt/Nutrient Management Planning in the San Diego Region*. The guidelines prioritize the need to develop SNMPs based on the groundwater basin size, complexity, use, source loads, hydrodynamics and degree of prior study. **The San Juan groundwater basin, which lies beneath the San Juan Creek watershed within the South Orange County Wastewater Authority (SOCWA) service area was identified in the Guidelines as a Tier A Basin,** giving it a high priority based on its size, its degraded water quality in the lower basin and the availability of local groundwater studies and modeling data. Prior planning within this basin includes the *SOCWA Basin Plan Amendments Final Report* (Nolte, 1993), the *San Juan Groundwater Basin Groundwater Management and Facilities Plan* (WEI, 2013) and the *South Orange County Watershed Management Area Integrated Regional Water Management Plan* (Orange County Department of Public Works, 2013).

In April 2009 SOCWA formed a Technical Advisory Committee (TAC) consisting of representatives from member agencies to provide stakeholder input and direction to SOCWA's salt and nutrient management planning efforts. The following goals of the SOCWA SNMP stakeholders were taken into consideration in the development of this SNMP:

- Offset demands for imported water from Colorado and northern California by increasing use of recycled water, stormwater, and urban runoff.
- Maximize the reuse of recycled water for irrigation in the SOCWA service area in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Maximize the capture of stormwater and urban runoff through compliance with MS4 in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Increase groundwater production yield in the Lower San Juan Basin by recharging stormwater and recycled water.
- Continue and expand existing programs to divert and use high-TDS urban surface water runoff to increase local supply and protect water quality in the Lower San Juan Basin.

- Continue and expand existing programs to desalt groundwater in the Lower San Juan Basin to increase local supply.
- Improve monitoring and management of groundwater and surface water in the San Juan Watershed to increase the understanding of salt and nutrient and transport in the watershed and to allow periodic revaluation of compliance with Basin Plan Objectives.
- Develop a long-term, adaptive SNMP that achieves the goals of the stakeholders in a reasonable and cost-effective manner.

Implementation of planned recycled water beneficial use projects in the SOCWA service area alone will offset an additional 10,000 AFY of demand for imported water, helping the state reach its water recycling goals in accordance with the Policy.

**Findings**

The San Juan Hydrologic Unit is comprised of four major watersheds and each was reviewed to determine the appropriate level of SNMP analysis:

- The coastal stream watersheds, including the **Laguna and San Clemente Hydrologic Areas**, are not within any groundwater basin identified by the State and therefore, in accordance with the Guidelines, are defined as Tier D Basins and do not require the preparation of a SNMP.
- The **Mission Viejo Hydrologic Area** is divided into eight subbasins, five of which lie within the Upper San Juan Basin and are tributary to the three subbasins in the Middle and Lower San Juan Basins. The San Juan Basin Authority has defined the active groundwater basin to be within the Lower San Juan Basin. Because the total dissolved solids (TDS) concentration is too high for domestic water use in the Lower San Juan Basin, groundwater is treated at two desalter (RO) plants, which increases usability; however the small storage capacity of the basin will require aggressive groundwater supply management to meet future water supply demands. As a Tier A Basin, a detailed SNMP analysis was conducted.
- The **San Mateo Canyon Hydrologic Area** is located outside of the SOCWA service area except for the Cristianitos subarea, which lies within the Orange County boundary, upstream of Camp Pendleton Marine Corp Base.  There is currently no recycled water use in the Cristianitos subarea and little data regarding groundwater quality.  Further analysis of this basin should be coordinated with Camp Pendleton's efforts to prepare an SNMP for the San Mateo Basin.

A review of historical water quality data for the Mission Viejo Hydrologic Area resulted in the following observations:

- The highest quality surface water and groundwater is in the upper reaches of the watershed and degrades downstream.  Downstream degradation of water quality is commonly attributed to irrigation return flows, the dissolution of salts from regional geologic deposits, and the concentration of TDS in surface water as slow-flowing creeks lose water to evaporation and transpiration.
- Nitrate-N concentrations in groundwater and surface water are well below the Basin Plan objectives, all of which are 10 mg/L as nitrogen. Therefore it was determined that nutrient loading is not a significant issue within the basin.

An analysis of salt loading within each of the subbasins of the Mission Viejo Hydrologic Area was conducted and resulted in the following findings of existing and anticipated future compliance with the Basin Plan objective for TDS:

- The Basin Plan objectives for TDS are being met, and assimilative capacity exists, in the uppermost basins of the Mission Viejo Hydrologic Area (Upper Trabuco, Upper San Juan, Bell Canyon, Gobernadora/Chiquita subbasins). Existing and planned recycled water projects in these basins use less than 20% of the available assimilative capacity and therefore no further antidegradation analysis is required.
- The Basin Plan objectives for TDS are not being met and no assimilative capacity exists in the Middle and Lower Basins (Oso, Lower San Juan and Ortega subbasins); however, the TDS concentration of recycled water being used in these basins is lower than the objective and therefore no further antidegradation analysis is required. **It should be noted that the water quality objectives for TDS in these basins were purposefully set in 1993 to be lower than ambient water quality as a monitoring parameter focused on conjunctive water use, not as a quality goal to be met by the groundwater itself. Therefore, these findings are in alignment with the intent of the prior Basin Plan Amendment.**

While the available (albeit limited) data show compliance with the Basin Plan TDS objective within the Middle San Juan HSA, salt load and planning conditions assessed in the 1993 Study may no longer be current, as development is currently underway. Prior to using recycled water within the Middle San Juan HSA, an antidegradation analysis will be performed to demonstrate if recycled water use will use up more than 20% assimilative capacity or threaten to exceed water quality objectives. If water quality objectives are threatened, but beneficial uses can be protected, a Basin Plan amendment may be proposed to raise the TDS objective based on considerations in CA Water Code §13241.

An analysis of salt loading within the Middle Trabuco subbasin of the Mission Viejo Hydrologic Area was conducted and resulted in the following findings of existing and anticipated future non compliance with the Basin Plan objective for TDS:

- The current ambient TDS for Middle Trabuco is 1,000 mg/L, which exceeds the Basin Plan objective of 750 mg/L. With increased recycled water use the TDS quality improves, but still exceeds the Basin Plan objective, which was set in 1993 to protect municipal wells in San Juan Capistrano. Degraded water quality (iron, manganese, radionuclides, TDS) has resulted in the discontinuation of well use for domestic purposes in the subbasin, therefore no existing beneficial uses are protected by this objective. It is recommended that a Basin Plan Amendment be pursued to increase the objective to 1,200 mg/L, which aligns with the objectives set for neighboring subbasins and protects continued beneficial use of the groundwater for private irrigation wells.

**Next Steps**

Implementation of planned recycled water use within the SOCWA service area is expected to increase from 13,000 AFY to 23,000 AFY, offsetting local demand for imported water and helping the state reach its aggressive water recycling goals. Generally, the use of recycled water within the SOCWA service area complies with the State's Recycled Water and Antidegradation Policies. However, the current understanding of spatial and temporal water quality trends and salt transport in much of the service area is insufficient to identify and commit funding to specific salt and nutrient Best Management Practices (BMPs). Thus, an adaptive management approach to the SNMP is recommended to allow for flexibility over time as knowledge is gained about current water quality and salt and nutrient transport in San Juan Creek watershed.

To better assess future compliance with the Basin Plan objectives, a coordinated, basin-wide water quality monitoring program is recommended to augment existing monitoring efforts. This effort will especially support the groundwater management program being proposed by the San Juan Basin Authority in the Lower Basins that could increase recycled water use by another 2,000 to 10,000 AFY.

The SOCWA SNMP implementation measures are as follows:

1. Continue to implement Order No. 97-52 with the existing recycled water use volume and quality limitations for the Upper Trabuco, Upper San Juan, Gobernadora, Bell Canyon, Lower San Juan, Ortega and Oso sub-basins. Under current planning assumptions, recycled water use can be implemented in a manner that is protective of beneficial uses and is protective of the water quality required of those beneficial uses.

2. Immediately pursue a Basin Plan amendment for the Middle Trabuco sub-basin to increase the TDS Basin Plan Objective to 1,200 mg/L. This will ensure that up to 1,500 AFY of imported water can be offset through the use of recycled water while protecting beneficial uses within and downstream of the Middle Trabuco sub-basin.

3. Perform a salt and nutrient loading analysis, prepare salt and nutrient concentration projections and evaluate proposed recycled water project compliance with the existing Basin Plan Objective for the Middle San Juan sub-basin. This analysis must be completed before recycled water can be permitted for use in this sub-basin.

4. Improve existing monitoring efforts by developing a cooperative watershed-wide groundwater and surface water monitoring program. Report progress and data annually to the Regional Board.

5. Work in conjunction with the regional entities that are implementing potable water quality improvements and urban stormwater programs, such as the County of Orange Drainage Area Management Plan, to protect and restore surface and groundwater quality, safeguard public and environmental health and secure water supplies.

6. Re-evaluate current and future Basin Plan compliance in the San Juan Basin Watershed HSAs every five years. If a significant change to the recycled water use planning assumptions used in this analysis occurs before five years is up, a reevaluation of the affected sub-basins must be presented to the Regional Board prior to approval of modified recycled water use conditions.

7. Update the SNMP implementation measures, as necessary, after each re-evaluation of Basin Plan compliance.

# 1.0 INTRODUCTION

California is facing an unprecedented uncertainty in its water supply reliability. This uncertainty stems from the potential collapse of the State Water Project system due to earthquakes and/or catastrophic levee failures, climate change, continued population growth, severe drought in the Colorado River Basin, and the need to preserve the Bay-Delta ecosystem. This new reality is challenging California to rethink the development of water supply portfolios that are adequate, reliable, secure, affordable, sustainable, and of suitable quality for beneficial uses to protect, preserve, and enhance watersheds, communities, and environmental and agricultural resources. Sustainable management of local surface waters and groundwater, together with enhanced water conservation, water reuse and the use of stormwater is necessary to increase our independence from relying on the vagaries of annual precipitation and imported water delivery systems.

In Southern California, where imported water from the SWP and Colorado River comprise the majority of water supplies in many cities, the need to enhance and protect local water supplies such as groundwater and recycled water is incontrovertible. For over 40 years the South Orange County Wastewater Authority (SOCWA) and its member agencies have been collaborating to implement projects that are protective of water quality and help to ensure the sustainability of water supply. Since the early 1990's, the use of recycled water, in particular, has played a vital role in increasing the reliability and sustainability of the overall water supply within the SOCWA service area.

To provide further understanding of the relationship between groundwater availability, quality, and recycled water use, this report provides a salt and nutrient management plan for the groundwater basins underlying the SOCWA service area. Required under the State of California's 2009 Recycled Water Policy and supported by the South Orange County Integrated Regional Water Management Program, this report focuses on groundwater quality and use in the San Juan Groundwater Basin. This effort was partially funded through the Proposition 84 grant program, which matches 25 percent of the total project cost.

## 1.1 REGULATORY FRAMEWORK

The State Water Resources Control Board's (SWRCB) 2009 Recycled Water Policy (Policy) identifies an "*unparalleled opportunity for California to move aggressively towards a sustainable water future*" and encourages the "*local and regional water agencies to move toward clean, abundant, local water for California by emphasizing appropriate water recycling, water conservation, maintenance of supply infrastructure, and the use of stormwater (including dry-weather urban runoff).*"

The Policy, which became effective on May 14, 2019[1] establishes:

- State-wide recycled water reuse objectives and goals and the mandates for achieving these goals (Sections 1, 2, 3, and 4 of the Policy);
- The roles and responsibilities of state agencies in implementing the Policy (Section 5 of the Policy);
- The requirement and criteria for developing salt and nutrient management plans (SNMPs) for every groundwater basin in California (Section 6 of the Policy);

[1] The SWRCB's adopted Recycled Water Policy can be found at www.waterboards.ca.gov/board_decisions/adopted_orders/resolutions/2013/rs2013_0003_a.pdf

- The criteria for permitting landscape irrigation and recycled water recharge projects (Sections 7, 8, and 9 of the Policy);
- The criteria and research programs to evaluate potential environmental and public health impacts from constituents of emerging concern (CECs) in water supplies (Section 10 of the Policy); and
- Incentives for the use of recycled water (Section 11 of the Policy).

The Policy mandates increasing recycled water reuse to the extent economically practicable without threatening to degrade water quality in such a way that public health, environmental health, or beneficial uses are impaired. The Policy recognizes that some groundwater basins in the State contain salts and nutrients that exceed or threaten to exceed water quality objectives established in the applicable Water Quality Control Plans (Basin Plans), which were developed and have been implemented by the various Regional Water Quality Control Boards (Regional Boards). Such conditions could limit the ability of local agencies to maximize recycled water use. Regulation of recycled water alone will not address these conditions.

Recognizing that not all Basin Plans include the adequate implementation procedures for achieving or ensuring compliance with the water quality objectives for salt or nutrients, the purpose of the Policy is to provide direction to the Regional Boards, proponents of recycled water projects, and the public regarding the appropriate criteria to be used by the SWRCB and the Regional Boards in issuing permits for recycled water projects (refer to Section 2.a of the Policy). To this end, the Policy requires that an SNMP be developed for every groundwater basin or sub-basin in California and that the Regional Boards develop implementation procedures for permitting recycled water projects and ensuring compliance with groundwater quality objectives based on the SNMPs.

The Policy recognizes that the degree of specificity within each SNMP will be dependent on a variety of site-specific factors, including but not limited to the size and complexity of a basin, aquifer characteristics, hydrogeology, historical groundwater quality, source water quality, beneficial uses, and recycled water and stormwater goals. Each SNMP must:

- Characterize the groundwater resources of the study area to determine the complexity of salt and nutrient management planning needed, if any
- Identify current recycled water reuse, future groundwater and stormwater projects, and establish recycled water and stormwater goals
- Evaluate existing groundwater quality and assimilative capacity (if not already established by the Regional Board)
- Identify and quantify sources of salt and nutrient loading
- Demonstrate how much assimilative capacity will be used up in meeting the recycled water and stormwater goals.
- Include an antidegradation analysis, the complexity of which is based on the criteria set forth in Section 9 of the Policy.
- Include provisions for a basin or sub-basin wide monitoring program that is designed to determine water quality in the basin, assess compliance with water quality objectives, and includes provisions for annual monitoring of CECs pursuant to the criteria set forth in Section 10 of the Policy.

Specifically, the Policy states that "*local water and wastewater entities, together with local salt/nutrient contributing stakeholders, will fund locally-driven and locally-controlled, collaborative processes open to all stakeholders that will prepare salt and nutrient management plans for each basin/sub-basin in California, including compliance with CEQA and participation by Regional Water Board staff.*" The Policy establishes a deadline of May 14, 2014 for submittal of all SNMPs to the Regional Boards for approval and adoption. However, the Regional Boards may grant a two-year extension if it finds that the stakeholders are making substantial progress towards completion of a SNMP.

## 1.2 SNMP GUIDELINES AND OBJECTIVES

These regional or sub-regional SNMPs are intended to provide a roadmap for management of salt and nutrient loadings on a basin or watershed-wide basis to ensure protection of beneficial uses. In an effort to provide a framework for the SNMPs, the San Diego Regional Water Quality Control Board (Regional Board) collaborated with major stakeholders, including the Southern California Salt Coalition, San Diego County Water Authority and SOCWA in the development of *Proposed Guidelines for Salt/Nutrient Management Planning in the San Diego Region* (Region 9 SNMP Guidelines)[2].

There are six large alluvial groundwater basins located in Region 9. The Guidelines prioritized the need to develop SNMPs for these basins based on the groundwater basin size, complexity, use, source loads, hydrodynamics and degree of prior study. Recognizing that the level of effort for salinity/nutrient assessment should be proportional to the size and complexity of the basin, a tiered approach was used to allow for flexibility while ensuring a level of consistency in planning efforts within the region. The San Juan Groundwater Basin, which lies beneath the San Juan Creek Watershed within the SOCWA service area was identified in the Region 9 SNMP Guidelines **as a Tier A Basin, giving it a high priority for this planning effort based on its size, its degraded water quality in the lower basin and the potential for groundwater management alternatives to improve water quality in the basin.**

This SNMP was prepared in alignment with the Guidelines. In addition, the SOCWA Planning Area SNMP shall comply, or be consistent, with the following regulatory documents:

- Water Quality Control Plan for the San Diego Basin (Basin Plan)
- California Department of Water Resources Water Plan Update 2009 – Bulletin 160-09
- SWRCB Antidegradation Policy – Resolution No. 68-16
- California Environmental Quality Act (CEQA) regulations.

## 1.3 SNMP STUDY AREA

The SOCWA SNMP study area is defined geographically by SOCWA's service area, located in southern Orange County, approximately 55 miles south of Los Angeles and 60 miles north of San Diego. The study area covers approximately 210 square miles and includes portions of the cities of Dana Point, Laguna Hills, Laguna Niguel, Mission Viejo, Rancho Santa Margarita, and San Juan Capistrano.

[2] Proposed SNMP Guidelines can be found at http://www.waterboards.ca.gov/sandiego/board_info/agendas/2010/oct/item6/Item6_Doc2.pdf

SOCWA is represented by the following ten member agencies:

- City of Laguna Beach
- City of San Clemente
- City of San Juan Capistrano
- El Toro Water District
- Emerald Bay Service District
- Irvine Ranch Water District
- Moulton Niguel Water District
- Santa Margarita Water District
- South Coast Water District
- Trabuco Canyon Water District


The study area encompasses the Aliso Creek, Salt Creek, Laguna Canyon Creek and San Juan Creek watersheds, and a portion of the San Mateo Creek watershed. The SOCWA service area lies within the jurisdiction of Region 9 of the SWRCB with a relatively minor exception in the northern SOCWA boundary, where a small portion of SOCWA lies in Region 8. This SNMP study area focuses on the part of SOCWA that lies within Region 9.

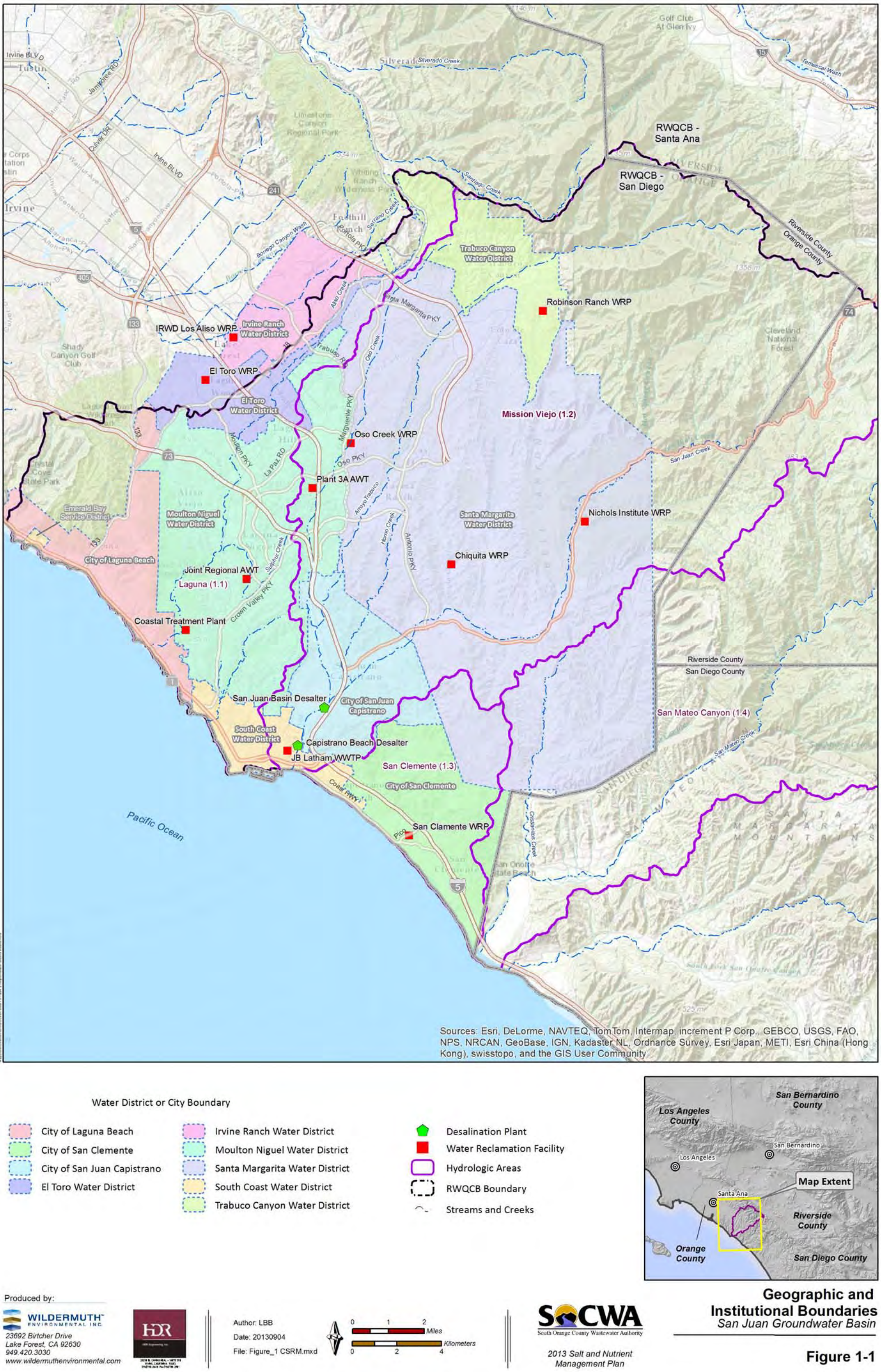
**Figure 1-1** illustrates the extent of the SNMP study area and its relationship to the San Juan Hydrologic Unit (HU) and Hydrologic Subareas (HSAs) within the San Diego Basin (Region 9) which include Laguna (1.1), Mission Viejo (1.2), San Clemente (1.3) and Cristianitos (1.42).

## 1.4 SNMP APPROACH OVERVIEW

A successful SNMP establishes technical and regulatory common ground, where recycled water projects and groundwater management programs can flourish together without undue additional complexities and uncertainties, while doing so to stakeholder satisfaction. The SNMP for the SOCWA service area is being conducted in three phases:

**Phase 1** was completed in the fall of 2012 and included identifying likely Stakeholders and working groups and conducting initial interactions with them; identifying current study area projects and issues to help define ultimate water management goals; establishing definitions and concepts; compiling and performing initial analyses of data and reports; developing technical scopes of work for Phases 2 and 3; and estimating budget and schedule considerations for the Phase 2 and 3 scopes of work.

**Phase 2** is the development of this SNMP, which includes: continuing the collaborative process; reviewing and refining Phase 1 findings; delineating groundwater management zones; computing ambient water quality and assimilative capacity; developing models and other tools to project future ambient water quality and assimilative capacity; identifying, evaluating, and recommending an SNMP program alternative; and preparing the SNMP report through the draft final stage for submittal to Region 9.




**Geographic and Institutional Boundaries**
*San Juan Groundwater Basin*

**Figure 1-1**

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**Phase 3** will involve conducting and processing required environmental analyses, preparing and processing a Basin Plan amendment, receiving and incorporating Region 9's comments to the draft final report, and preparing and submitting the final report.

## 1.5 STAKEHOLDER ROLES AND RESPONSIBILITIES

In April 2009 SOCWA formed a Technical Advisory Committee (TAC) consisting of representatives from member agencies to provide input and direction to SOCWA's salt and nutrient management planning efforts. The City of San Clemente is represented on SOCWA's TAC and is an important stakeholder in this project, providing current and planned recycled water use information for the Prima Deshecha and Segunda Deshecha hydrologic sub areas. These representatives provided input to the development of the Region 9 SNMP Guidelines.

Through 2011, additional stakeholders with potential interest in SOCWA service area SNMP were identified and contacted. A general common workshop session was held to collect input and assess level of interest. Positive feedback was received regarding SOCWA's planned approach to development of an SNMP for its service area and willingness of the participants to continue their stakeholder involvement. **Table 1-1** lists those entities with whom contact was made and the nature of each entity.

**Table 1-1. SNMP Stakeholder Listing**

| Agency Name | Entity Type |
|---|---|
| Audubon Society | Non Governmental Organization (NGO) |
| California Dept. of Public Health | Regulatory |
| City of San Clemente | SOCWA member |
| City of San Juan Capistrano | SOCWA & SJBA member |
| Coastkeepers | NGO |
| County of Orange | Storm Water & Run Off |
| El Toro Water District | SOCWA member |
| Irvine Ranch Water District | SOCWA member |
| Moulton Niguel Water District | SOCWA & SJBA member |
| Municipal Water District of Orange County | Overlapping & Desalination |
| Other MS4 Holders | Storm Water & Run Off |
| Rancho Mission Viejo | Land Developer |
| San Diego RWQCB (Region 9) | Regulatory |
| San Juan Basin Authority (SJBA) | Overlapping Regional |
| Santa Margarita Water District | SOCWA & SJBA member |
| Sierra Club | NGO |
| South Coast Water District | SOCWA & SJBA member |
| Southern California Salinity Coalition | NGO |
| Surfrider Foundation | NGO |
| Trabuco Canyon Water District | SOCWA member |
| USMC Camp Pendleton | Land Holder |

Stakeholders and other interested parties were included in the SNMP process through a variety of methods throughout the development of this SNMP. A web portal, provided by SOCWA, was used to disseminate information including meeting agendas and minutes, meeting presentations, project schedules, contact information, and deliverables. Draft SNMP documents were distributed to the stakeholders and posted on the SNMP portal for review before they were finalized. A review period was scheduled for submittal of comments, questions, and suggested edits. Comments and questions were submitted to SOCWA by email. Meetings and/or workshops were held throughout the process, as documented in **Appendix A**, to update the stakeholders on progress of the SNMP and to receive feedback on the information presented.

In December 2012, a workshop was held to provide an overview of the objectives and approach for the SNMP, emphasizing that the overall focus of this project is groundwater quality. The goals of the SOCWA SNMP stakeholders are to:

- Offset demands for imported water from Colorado and northern California by increasing use of recycled water, stormwater, and urban runoff.
- Maximize the reuse of recycled water for irrigation in the SOCWA service area in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Maximize the capture of stormwater and urban runoff through compliance with MS4 in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Increase groundwater production yield in the Lower San Juan Basin by recharging stormwater and recycled water.
- Continue and expand existing programs to divert and use high-TDS urban surface water runoff to increase local supply and protect water quality in the Lower San Juan Basin.
- Continue and expand existing programs to desalt groundwater in the Lower San Juan Basin to increase local supply.
- Improve monitoring and management of groundwater and surface water in the San Juan Watershed to increase the understanding of salt and nutrient and transport in the watershed and to allow periodic revaluation of compliance with Basin Plan Objectives.
- Develop a long-term, adaptive SNMP that achieves the goals of the stakeholders in a reasonable and cost-effective manner.

Implementation of planned recycled water beneficial use projects in the SOCWA service area alone will offset an additional 10,000 AFY of demand for imported water, helping the state reach its water recycling goals in accordance with the Policy.

With input from the stakeholders, the SNMP would attempt to answer the following three questions:

1. *Are the current Basin Plan ground water quality objectives appropriate or do they need to be amended?*
2. *Can the beneficial use objectives be maintained?*
3. *Are there regional management strategies, either project or operations based, that can improve water quality for the stated beneficial use?*

## 1.6 REPORT ORGANIZATION

The approach to completing this SNMP is adapted from the 5-step approach recommended in the Region 9 SNMP Guidelines:

- Step 1: Initial basin characterization and prioritization of analysis
- Step 2: Identify and quantify source loads
- Step 3: Assess assimilative capacity and perform antidegradation analysis
- Step 4: Identify supplemental monitoring needs and basin management strategies
- Step 5: Prepare implementation plan
- Step 6: Assess plan effectiveness

The SOCWA SNMP Phase 2 addresses Steps 1 through 5, with a draft SNMP deliverable for stakeholder and Regional Board review.

This report is organized to follow the steps outlined above:

- Chapter 2 provides an overview of the institutional framework for the development of the SNMP.
- Chapter 3 provides an initial characterization of the groundwater basins, including a summary of the work that was completed as part of Phase 1. This chapter prioritizes the level of analysis for each of the hydrologic subareas within the study area.
- Chapter 4 characterizes the local water resources and activities that influence water quality within the basin.
- Chapter 5 and Chapter 6 describe the modeling methodology and results of the analyses performed to evaluate current and future water quality in each of the hydrologic subareas. An assessment of assimilative capacity and sensitivity analysis of the various parameters used in the analysis are also addressed in this chapter.
- Chapter 7 identifies potential amendments to the Basin Plan and provides an antidegradation analysis associated with those amendments.
- Chapter 8 identifies supplemental monitoring needs and outlines a proposed salt and nutrient management plan and implementation schedule.

For the reader's convenience, Table 2-1 provides a checklist to specifically identify where in the report the elements of the SNMP Guidelines are addressed.

**Table 1-2. Summary of Required SNMP Elements and Tasks**

| SNMP Element | SNMP Task | Desired SNMP Feature | Section |
|---|---|---|---|
| 1. Initial Basin Characterization and Stakeholder Input Process | 1.1. Identify and delineate study area | 1.1.a Clearly identify the SNMP study area | 1.3 and Figure 1-1 |
| | | 1.1.b Identify the basis for selecting the SNMP study area | 1.3 |
| | | 1.1.c Identify the basin category within the SNMP Guidelines (e.g. Tier A, B, C) | 1.2 |
| | | 1.1.d Identify the aquifer(s) that exist within the SNMP area and the watershed(s) that contribute to the aquifers | 1.3 and 3.1 |
| | 1.2. Identify prior groundwater studies | 1.2.a Identify prior studies of the SNMP aquifer(s) | 2.1.1 and 4.1 |
| | | 1.2.b Summarize aquifer characteristics, hydrogeology, and hydrology of the basin | 3.1 |
| | | 1.2.c Identify whether prior Basin Plan studies or Basin Plan modifications have occurred in the study area | 2.1.1 |
| | 1.3. Stakeholder outreach and communication | 1.3.a Identify stakeholders who were contacted and involved in the SNMP effort | 1.5 |
| | | 1.3.b Identify the process for receiving stakeholder input | 1.5 |
| | | 1.3.c Identify constituents of concern or water quality issues that have been cited in prior studies | 2.1.1 and 4.1 |
| | 1.4. Document beneficial uses | 1.4.a Identify beneficial uses of the aquifer(s) designated in the Basin Plan | 2.1.1 |
| | | 1.4.b Identify known municipal and private groundwater wells and identify the use of the extracted groundwater | 4.2.3.2 |
| | | 1.4.c Identify groundwater dependent habitat | 4.2.3.2 |
| | 1.5. Characterize groundwater quality and occurrence | 1.5.a Identify applicable Basin Plan groundwater quality objectives | 2.1.1 and Table 2-2 |
| | | 1.5.b Identify sources of applicable groundwater quality data | 4.1.1 and Appendix B |
| | | 1.5.c Identify known time-dependent, geographic, or depth-dependent groundwater quality trends | 4.1.1 and Appendix B |
| | | 1.5.d Present conclusions on whether data are sufficient to assess compliance with Basin Plan objectives | 5.1 and 6.1 |
| | | 1.5.e Identify methodology used to compute water quality averages | 5.1 and 6.1 |
| | | 1.5.f Determine the degree to which Basin Plan objectives are being achieved | 7.2 and Table 7-1 |
| | 1.6. Identify SNMP constituents of concern | 1.6.a Identify the process for selecting salt or nutrient constituents of concern | 4.1 and 6.1 |
| | | 1.6.b Identify selected salt/nutrient constituents of concern | 4.1 and 6.1 |

| SNMP Element | SNMP Task | Desired SNMP Feature | Section |
|---|---|---|---|
| 2. Identify and quantify salt loads | 2.1. Identify salt/nutrient sources | 2.1.a Identify prior studies or modeling efforts that have estimated salt/nutrient loads within the basin | 2.2 |
| | | 2.1.b Identify potential sources of salt/nutrient loads within the basin | 4.2 |
| | | 2.1.c Identify potential salt/nutrient sinks (exports) within the basin | 4.2 |
| | | 2.1.d Identify the system boundaries for which salt/nutrient loads are estimated | 3.2 |
| | 2.2 Quantify salt/nutrient loads | 2.2.a Identify assumptions and bases for quantifying salt/nutrient loads and sinks | 5.1 and 6.1 |
| | | 2.2.b Estimate basin water balance terms (inputs/outputs) | 5.1 and 6.1 |
| | | 2.2.c Quantify existing salt/nutrient loads for each identified source or sink that is determined to be significant | 5.1 and 6.1 |
| | | 2.2.d Identify salt/nutrient sources/sinks that appear to be most significant or important | 5.1 and 6.1 |
| | 2.3 Salt/nutrient load assessment tools | 2.3.a Identify the type of model used for evaluating salt load impacts and trends (e.g. spreadsheet mass balance model or groundwater flow model) | 3.2 |
| | | 2.3.b Present the rationale for selecting the chosen model (e.g. conformance to SNMP guidelines, existing model is available, etc.) | 5.0 and 6.0 |
| | | 2.3.c Use the model to evaluate current salt/nutrient load trends (e.g. increasing or decreasing basin mineralization) | 5.1 and 6.1 |
| | | 2.3.d Use the model to evaluate projected future salt/nutrient loads under projected future conditions (e.g. projected development, projected stormwater runoff changes, etc.) | 5.1 and 6.2 |
| | | 2.3.e Rank the importance of the identified salt load/sink terms in affecting water quality | Figure 6-7 |
| | | 2.3.f Identify key source load quantification assumptions that appear to have the most significant effect on projected water quality | 6.2 |
| 3. Data Availability and Monitoring Plan | 3.1 Identify data gaps | 3.1.a Identify whether available data are current and/or are geographically representative | 4.1 |
| | | 3.1.b Identify additional data needs to characterize existing groundwater quality, use, or salt/nutrient loads | NA |
| | | 3.1.c Assess relative importance of supplemental data collection needs | NA |
| | 3.2 Identify additional required monitoring | 3.2.a Identify ongoing data collections programs | 4.1 |
| | | 3.2.b Identify recommended supplemental monitoring program, responsible parties, and schedule | 8.4 |

| SNMP Element | SNMP Task | Desired SNMP Feature | Section |
|---|---|---|---|
| 4. SNMP Management Strategies | 4.1 Identify management goals | 4.1.a Identify stakeholders active in groundwater management and identify known stakeholder conflicts | 1.5 |
| | | 4.1.b Identify selected management goals and describe the process for selecting the management goals | 8.1 |
| | 4.2 Available management strategies | 4.2.a Identify any known groundwater quality improvement projects/strategies and stakeholders proposing to implement the projects | 8.2 |
| | | 4.2.b Identify any additional potential water quality management strategies that could be considered in the basin and identify potential responsible parties associated with the potential management strategies | 8.2 |
| | | 4.2.c Identify water quality management strategies that are excluded from consideration within the SNMP and present the rationale for why the strategies are not considered | NA: Management Strategy is already in place |
| | 4.3 Effects of management strategies on water quality | 4.3.a Evaluate the effects of the identified potential management strategies on groundwater quality using the groundwater assessment tool (spreadsheet or groundwater model) | NA: Management Strategy is already in place |
| | | 4.3.b Identify salt/nutrient load reductions and water quality improvements/changes associated with each considered management strategy | NA: Management Strategy is already in place |
| | | 4.3.c Identify consistency of each strategy in achieving Basin Plan water quality objectives | NA: Management Strategy is already in place |
| | | 4.3.d Rank the strategies with respect to load reduction effects | NA: Management Strategy is already in place |
| | 4.4 Evaluate alternative management strategies | 4.4.a Describe the process for evaluating management strategies | NA: Management Strategy is already in place |
| | | 4.4.b Identify implementability considerations and constraints associated with each strategy | NA: Management Strategy is already in place |
| | | 4.4.c Identify any management strategies that are concluded as being required (essential) for achieving compliance with Basin Plan water quality objectives | 8.2 |
| | | 4.4.d Identify any management strategies that are desired (but not required) for enhancing groundwater quality | NA: Management Strategy is already in place |

| SNMP Element | SNMP Task | Desired SNMP Feature | Section |
|---|---|---|---|
| | 4.5 Basin Plan modification needs | 4.5.a Present conclusions on whether current numerical Basin Plan groundwater quality objectives can be achieved under existing and projected salt/nutrient load conditions | 7.2 |
| | | 4.5.b Present conclusions on whether existing numerical Basin Plan groundwater quality objectives are appropriate and warranted for protecting beneficial uses and reflecting achievable groundwater quality, and identify proposed modified Basin Plan numerical objectives that are appropriate and achievable | 7.2 |
| | | 4.5.c Identify required modifications in Basin Plan implementation provisions to accommodate required (essential) basin management strategies | 7.3 |
| | | 4.5.d For any proposed relaxation of Basin Plan groundwater quality objectives, assess compliance with the State Non-degradation Policy | TBD as part of Implementation Plan |
| | | 4.5.e If current Basin Plan compliance cannot be reliability assessed using existing data, identify a proposed approach for data collection and reassessment | NA |
| | 4.6 CEQA/NEPA | 4.6.a Identify whether any required management strategies are subject to CEQA/NEPA review | TBD as part of Implementation Plan |
| | | 4.6.b Identify the responsible (governing) body for any required CEQA/NEPA review | TBD as part of Implementation Plan |
| | | 4.6.c Identify the proposed schedule for CEQA/NEPA review of the required projects | TBD as part of Implementation Plan |
| 5. Plan Effectiveness | 5.1 Identify metrics and responsible agencies | 5.1.a If applicable, identify specific water quality improvements targeted by management strategies required to ensure Basin Plan compliance | 8.2 |
| | | 5.1.b If applicable, present a plan for gathering additional data to assess Basin Plan compliance | 8.3 |
| | | 5.1.c If applicable, parties responsible for collecting additional data and evaluating plan metrics | 8.4 |
| | | 5.1.d If applicable, identify metrics to be used to assess the effectiveness of the targeted water quality improvements | 8.3 |
| | 5.2 SNMP audit | 5.2.a Identify responsible parties for conducting SNMP audits | 8.4 |
| | | 5.2.b Present a schedule for future plan audits or update | 8.4 |

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# 2.0 INSTITUTIONAL FRAMEWORK

The institutional framework that governs the development of this SNMP includes both state and regional basin management agencies. A brief description of those agencies and their role in the SNMP are provided below.

## 2.1 STATE AGENCIES

The SWRCB has jurisdiction throughout California to protect water quality by setting statewide policy, coordinating and supporting the Regional Board efforts, and reviewing petitions that contest Regional Board actions. There are nine regional water quality control boards that exercise rulemaking and regulatory activities by basins. Pertinent to this SNMP, the San Diego Regional Water Quality Control Board (Regional Board) is responsible for executing the State Recycled Water Policy in the southernmost portion of the state (Region 9) and promoting recycled water use in a manner consistent with protecting existing and potential groundwater uses. As such, the Regional Board regulates local surface and groundwaters by establishing requirements for nearly any source of waste discharge, including recycled water use. To fulfill the requirement to complete salt/nutrient management plans, the Regional Board has sought cooperative assistance of interested local agencies, water users, source contributors and other interested stakeholders, particularly the agencies that hold permits for the production and distribution of recycled water.

For this SNMP, it is anticipated that the Regional Board staff will participate in the stakeholder process, review the SNMP documents, provide input on proposed Basin Plan modification alternatives associated with any recommendations from the SNMP, and participate in the California Environmental Quality Act (CEQA) review process.

### 2.1.1 Basin Plan Objectives

The San Diego Basin Plan designates existing and potential beneficial uses of groundwater so that appropriate water quality objectives can be established and programs that maintain or enhance water quality can be implemented to ensure the protection of the designated beneficial uses. The Basin Plan establishes numerical groundwater quality concentration objectives for a number of salinity constituents including total dissolved solids (TDS), chloride, sulfate, percent sodium, boron and fluoride. These objectives vary from watershed to watershed reflecting the ambient conditions within each basin. Nutrient parameters of concern are addressed with water quality objectives for nitrate, iron, manganese, and phosphorous.

In the 1980s and 1990s, the San Diego Regional Board implemented numerous modifications to numerical Basin Plan groundwater quality objectives in coastal and urbanized areas to promote recycled water use while reflecting existing groundwater sources loads and water quality. In some cases, the objectives were set as a management parameter, focused on conjunctive water use and not a quality goal to be met by the groundwater itself, as the natural occurring salts in some parts of the basin can greatly exceed these objectives.

In the early 1990s, SOCWA successfully demonstrated that increased use of recycled water for landscape irrigation could be accomplished throughout its service area without jeopardizing the continued or increased use of limited local groundwater supplies. SOCWA's analysis included proposed modifications to the hydrologic areas and subareas beneficial use designations and water quality objectives for the modified subareas. SOCWA's proposed Basin Plan amendments were approved by Region 9 and the

SWRCB in 1994. Although modeled, the recommended subdivision of the Cristianitos Canyon HSA within the San Mateo Canyon HA, with a proposed TDS objective of 1,200 milligrams per liter (mg/L), was not adopted by the Regional Board. The beneficial uses and numerical water quality objectives for each HA or HSA of the San Juan Hydrologic Unit, are listed in **Tables 2-1 and 2-2** below.

**Table 2-1. Beneficial Uses of Groundwater in the San Juan Basin**

| Subareas within the San Juan Hydrologic Unit (901.00) | Basin Number | Designated Beneficial Use for Groundwater | | | | | |
|---|---|---|---|---|---|---|---|
| | | Municipal Supply | Agricultural Supply | Industrial Service Supply | Industrial Process Supply | Freshwater Replenishment | Groundwater Recharge |
| Laguna HA | 1.10 | | | | | | |
| San Joaquin Hills[1] | 1.11 | ● | ● | | | | |
| Laguna Beach[1] | 1.12 | ● | ● | | | | |
| Aliso Creek[2] | 1.13 | ● | ● | | | | |
| Dana Point[1] | 1.14 | + | ● | | | | |
| Mission Viejo HA | 1.20 | | | | | | |
| Oso | 1.21 | ● | ● | ● | | | |
| Upper Trabuco | 1.22 | ● | ● | ● | | | |
| Middle Trabuco | 1.23 | ● | ● | ● | | | |
| Gobernadora | 1.24 | ● | ● | ● | | | |
| Upper San Juan | 1.25 | ● | ● | ● | | | |
| Middle San Juan | 1.26 | ● | ● | ● | | | |
| Lower San Juan[3] | 1.27 | ● | ● | ● | | | |
| Ortega | 1.28 | ● | ● | ● | | | |
| San Clemente HA | 1.30 | | | | | | |
| Prima Deshecha[4] | 1.31 | ● | ● | | | | |
| Secunda Deshecha | 1.32 | + | | | | | |
| San Mateo Canyon HA[4] | 1.40 | ● | ● | ● | | | |
| San Onofre HA[4] | 1.50 | ● | ● | | | | |

Notes: ● Existing Beneficial Use
+ Excepted from Municipal

1 These beneficial uses do not apply to all lands on the coastal side of the inland boundary of the right-of-way of Pacific Coast Highway 1, and this area is excepted from the sources of drinking water policy. The beneficial uses for the remainder of HA 1.10 are as shown.

2 These beneficial uses do not apply westerly of the right-of-way of Interstate 5 and this area is excepted from the sources of drinking water policy. The beneficial uses for the remainder of the hydrologic area are as shown.

3 These beneficial uses do not apply to all lands on the coastal side of the inland boundary of the right-of-way of Pacific Coast Highway 1 west of the San Juan Creek channel and this area is excepted from the sources of drinking water policy. The beneficial uses for the remainder of HA 1.20 are as shown.

4 These beneficial uses do not apply westerly of the easterly boundary of the right-of-way of Interstate 5 and this area is excepted from the sources of drinking water policy. The beneficial uses for the remainder of the hydrologic area are as shown.

**Table 2-2. Groundwater Quality Objectives in the San Juan Basin**

| Subareas within the San Juan Hydrologic Unit (901.00) | Basin Number | Constituent (mg/L or as noted) Concentrations not to be exceeded more than 10% of the time during any one year period. | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | TDS | Cl | $SO^4$ | %Na | $NO^3$ | Fe | Mn | MBAS | B | Odor | Turb NTU | Color Units | F |
| Laguna HA | 1.10 | | | | | | | | | | | | | |
| San Joaquin Hills | 1.11 | 1200 | 400 | 500 | 60 | 10 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Laguna Beach | 1.12 | 1200 | 400 | 500 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Aliso Creek | 1.13 | 1200 | 400 | 500 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Dana Point | 1.14 | 1200 | 400 | 500 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Mission Viejo HA | 1.20 | | | | | | | | | | | | | |
| Oso | 1.21 | 1200 | 400 | 500 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Upper Trabuco | 1.22 | 500 | 250 | 250 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Middle Trabuco | 1.23 | 750 | 375 | 375 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Gobernadora | 1.24 | 1200 | 400 | 500 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Upper San Juan | 1.25 | 500 | 250 | 250 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Middle San Juan | 1.26 | 750 | 375 | 375 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Lower San Juan | 1.27 | 1200 | 400 | 500 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Ortega | 1.28 | 1100 | 375 | 450 | 60 | 45 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| San Clemente HA | 1.30 | | | | | | | | | | | | | |
| Prima Deshecha | 1.31 | 1200 | 400 | 500 | 60 | 10 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| Secunda Deshecha | 1.32 | 1200 | 400 | 500 | 60 | 10 | 0.3 | 0.05 | 0.5 | 0.75 | None | 5 | 15 | 1.0 |
| San Mateo Canyon HA[a] | 1.40 | 500[b] | 250 | 250[b] | 60 | 45[b] | 0.3[b] | 0.05 | 0.5[b] | 0.75[b] | None | 5 | 15 | 1.0 |
| San Onofre HA[a] | 1.50 | 500[b] | 250 | 250[b] | 60 | 45[b] | 0.3[b] | 0.05 | 0.5[b] | 0.75[b] | None | 5 | 15 | 1.0 |

Notes: [a] The water quality objectives do not apply westerly of the easterly boundary of Interstate 5. The objectives for the remainder of the Hydrologic Area (Subarea) are as shown.

[b] Detailed salt balance studies are recommended for this area to determine limiting mineral concentration levels for discharge. On the basis on existing data, the tabulated objectives would probably be maintained in most areas. Upon completion of the salt balance studies, significant water quality objective revisions may be necessary. In the interim period of time, projects of ground water recharge with water quality inferior to the tabulated numerical values may be permitted following individual review and approval by the Regional Board if such projects do not degrade existing ground water quality to the aquifers affected by the recharge.

In adopting the revised numerical water quality objectives, shown in **Table 1-2**, Region 9 staff established that TDS could be used as the indicator constituent for demonstrating projected impacts of recycled water use in the basin. In the 1993 SOCWA Basin Plan Amendments Final Report[3], the following statements were included in the recommendations:

> *Several TDS concentrations were considered for use as objectives to best fit the various circumstances of the hydrologic sub areas, based on existing data and modeling forecasts. A concentration of 500 mg/L was selected for more pristine quality groundwater and is the general health department limit for regular direct domestic use. A concentration of 750 mg/L was selected for good but less pristine quality groundwater, where dilution or treatment may be planned to achieve general domestic use or where*

[3] Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993, pp 1-9 and 1-13.

*restricted or higher-quality direct non-potable use is planned. A concentration of 1,100 mg/L was selected for groundwater in a smaller sub area with existing and planned non-potable use. And a concentration of 1,200 mg/L was selected for all lower quality groundwater, even those whose existing quality was considerably poorer than the Basin Plan objective.*

*The 1,200 mg/L objective is based upon horticultural TDS concentration limits for the irrigation of general landscape plants over the entire study area. Also, this value allows the direct use of study area reclaimed water without the need for any demineralization treatment; it allows adequate quality local groundwater to be used directly for irrigation without demineralization or dilution; and it provides a blending limit for reclaimed water (or domestic water) and higher-TDS local groundwater and surface water.* ***As applied to groundwaters whose quality has not been or never will be at the objective, the (1,200 mg/L TDS) objective becomes a monitoring parameter – focused on conjunctive water use – and not a quality goal to be met in the groundwater itself. This value thereby accommodates the cost-effective use of local water resources, both reclaimed water and surface/groundwater, while respecting use quality impacts.***

Note, this last statement is an important consideration in evaluating salt and nutrient management within the San Juan basin, and will be referenced later in this document regarding the antidegradation analysis.

## 2.2 REGIONAL BASIN MANAGEMENT AGENCIES

There are two regional agencies that oversee water and wastewater management within the study area: SOCWA oversees wastewater collection and water reclamation and the San Juan Basin Authority oversees the management of the San Juan Creek groundwater basin. Each of these agencies are described below.

### 2.2.1 SOCWA

SOCWA facilitates and manages the transmission, treatment and disposal of wastewater for more than 500,000 homes and businesses across South Orange County. SOCWA operates under San Diego Regional Board (Region 9) Order No. 97-52, which permits over 52,000 acre feet per year (AFY) of recycled water use within its service area and saves approximately six billion gallons of domestic water each year that otherwise would be used for those purposes. This order, adopted in 1997, and its predecessor were founded on regional salt-balance modeling in the early 1990s[4] and takes into consideration existing and contemplated basin pumping and treatment projects, as well as urban water recovery facilities and groundwater recharge projects.

SOCWA was created on July 1, 2001 as a joint powers authority with ten member agencies, and is the legal successor to the Aliso Water Management Agency, South East Regional Reclamation Authority and South Orange County Reclamation Authority. It operates four treatment plants and two ocean outfalls, in addition to multiple programs to meet the needs of its member agencies and the requirements of the Clean Water Act and applicable National Pollutant Discharge Elimination System (NPDES) and other permits. SOCWA is the lead agency in the development of this SNMP for the SOCWA service area. Substantial portions of the SOCWA SNMP are subject to funding under a State Proposition 84 planning grant which affects the both the scope and schedule of this work effort.

[4] Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993.

### 2.2.2 San Juan Basin Authority

The San Juan Basin Authority (SJBA) is a joint powers authority created in 1971 for the purpose of managing water resources development in the lower San Juan Basin. The mission of the SJBA is:

> *To develop and maintain a reliable, high quality economical local water supply for the residents in the San Juan Basin by maximizing water use through management of local ground and surface water of San Juan Creek and its tributaries, with due consideration for preservation, enhancement, and conservation of the environment, including, but not limited to, the natural resources, fish and wildlife, infrastructure improvements, and the cultural heritage of the area.*

The San Juan Groundwater Basin is characterized by the SWRCB as flow of an underground stream. As such, water rights in in the basin are permitted and regulated by the SWRCB. The SJBA diverts groundwater from the San Juan Groundwater Basin pursuant to Water Rights Permit 21074, which currently allows up to 8,026 acre-feet (acre-ft) of production per year. Due to high-TDS concentrations in the basin, all water extracted is first treated by reverse osmosis to reduce the TDS concentration to municipal drinking water standards. In compliance with Permit 21074, the SJBA implements a groundwater, surface water, and vegetation monitoring program to collect the data needed to demonstrate the water supply, water quality, and environmental impacts to the basin that result from their diversions. The SJBA coordinates their monitoring and reporting efforts with the South Coast Water District (SCWD), who also diverts and treats groundwater for municipal use pursuant to a water rights permit from the SWRCB.

Today, the members of the SJBA include: the City of San Juan Capistrano (CSJC), the Moulton Nigel Water District (MNWD), the Santa Margarita Water District (SMWD), and SCWD. All member agencies of the SJBA are highly dependent on imported water from the Metropolitan Water District of Southern California (MWDSC). MWDSC supplies consist primarily of State Water Project (SWP) water and Colorado River Aqueduct (CRA) water, both of which have been permanently reduced and are now less reliable. MWDSC's water rates to retail agencies have increased dramatically in the last several years and are projected to continue to increase into the future. Because of this, the SJBA recognized the need to develop more local supplies and local storage to improve supply reliability, reduce their demands on MWDSC, mitigate temporary interruptions of supply from MWDSC, and minimize their exposure to penalties in the drought allocation plan. Thus, in 2010 the SJBA engaged Wildermuth Environmental, Inc. (WEI) to update their San Juan Basin Groundwater Facilities and Management Plan (SJBGFMPP). The draft SJBGFMP was released for public review by the SJBA in July 2013. The report documents the current state of the San Juan Basin, the conceptual model of the hydrologic system, the environmental and infrastructure resources in the investigation area, the management goals of the SJBA member agencies, the impediments to achieving the goals, the range of potential management alternatives, the recommended management plan(s), and a monitoring and reporting plan. The final report is expected to be adopted in December 2013. This SJBA made all of the data and analysis from the SJBGFMP available to SOCWA for the development of this SNMP.

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# 3.0 INITIAL BASIN CHARACTERIZATION

The initial basin characterization of the watersheds within the SOCWA service area was conducted as part of the SOCWA SNMP Phase 1 evaluation. This chapter provides an overview of the basin hydrology and a summary of the Phase 1 findings.

## 3.1 SAN JUAN BASIN HYDROLOGY

The San Juan Hydrologic Unit is comprised of four major watersheds and two major groundwater basins. The basins include the San Juan and San Mateo Groundwater Basins. The Basin Plan defines ground water as subsurface water that occurs beneath the water table in soils and geologic formations that are fully saturated. Ground water bearing formations sufficiently permeable to transmit and yield significant quantities of water are called aquifers. A ground water basin is defined as a hydrogeologic unit containing one large aquifer or several connected and interrelated aquifers. The term "ground water" for basin planning and regulatory purposes, includes all subsurface waters that occur in fully saturated zones within soils, and other geologic formations. Subsurface waters are considered ground water even if the waters do not occur in an aquifer or an identified ground water basin.

In the San Diego Region 9 SNMP Guidelines the San Juan Basin was identified as a Tier A Basin, giving the basin a high priority based on its size, its degraded quality in the lower basin and potential for groundwater management alternatives to improve water quality in the basin. The San Juan Basin is the only groundwater basin within the SOCWA service area that is described in California Department of Water Resources (DWR) Bulletin 118, which defines the groundwater basins within the State of California.

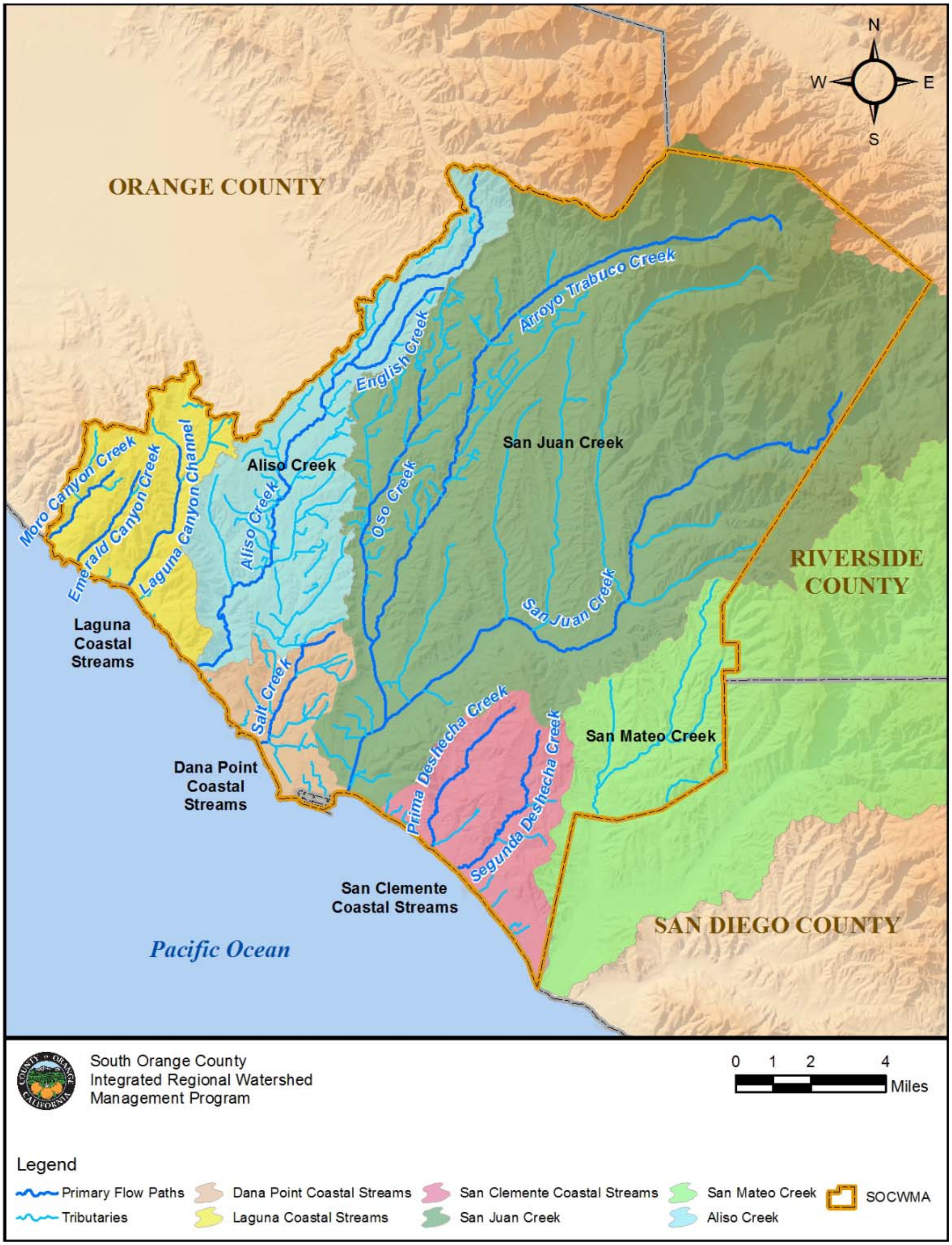
In the Basin Plan the San Juan Hydrologic Unit is divided into Hydrologic Areas (HAs) and Subareas (HSAs), as shown previously in **Figure 1-1**, with beneficial uses and water quality objectives, as described in **Tables 2-1 and 2-2**. The watersheds lie within the Laguna HA; the Mission Viejo HA; the San Clemente HA; and the San Mateo Canyon HA.

The physical attributes of these watershed and basin areas, defined on the following map, are described in the South Orange County Watershed Management Area Integrated Regional Water Management Plan (IRWMP) dated July 2013[5]. The following sections provide an overview of the hydrology and associated groundwater management practices within each watershed.

### 3.1.1 Laguna Coastal Streams Watershed

The Laguna Coastal Streams watershed lies within the Laguna subunit of the San Juan Hydrologic Unit (designated HSAs 1.11 and 1.12). The watershed consists of the Laguna Canyon Creek watershed and several smaller coastal-draining watersheds adjacent to it. Laguna Canyon Creek runs north to south, directly through the middle of its watershed, and ultimately discharges into the Pacific Ocean at Laguna Beach.

[5] South Orange County Watershed Management Area Integrated Regional Water Management Plan, July 2013. https://media.ocgov.com/gov/pw/watersheds/programs/ourws/wmaareas/wmasouthoc/default.asp




**Source:** South Orange County IRWMP, July 2013.

The 11-square-mile watershed includes portions of the cities of Aliso Viejo, Laguna Beach, and Laguna Woods. Undeveloped areas include the Laguna Coast Wilderness Park and the Aliso and Wood Canyons Regional Park. Currently, no potable water supply is drawn from these surface waters, and no groundwater resources are associated with this watershed. Therefore, in accordance with criteria established in the Region 9 Salt and Nutrient Management Plan Guidelines, this sub-basin is defined as "Tier D" groundwater basins where recycled water use is in compliance with existing Basin Plan groundwater quality objectives and, as such, do not require the preparation of salt and nutrient management plans.

### 3.1.2 Aliso Creek Watershed

The Aliso Creek watershed falls under the Laguna subunit of the San Juan Hydrologic Unit (designated HSA 1.13). The watershed encompasses a drainage area of approximately 30 square miles, extending 19 miles from the foothills of the Santa Ana Mountains to the Pacific Ocean south of Laguna Beach. The watershed includes tributaries from Wood Canyon, Sulphur Creek, Aliso Hills Channel, Dairy Fork, Munger Creek, and English Canyon. Residential developments within the watershed include portions of Lake Forest, Laguna Beach, Foothill Ranch, Portola Hills, Mission Viejo, Laguna Hills, Aliso Viejo, and Laguna Niguel. As the region became heavily urbanized, Aliso Creek flows were by significant increases in upstream urban runoff.

As reported in the 1993 SOCWA Basin Plan Amendment Final Report, the Aliso Creek watershed has limited water-bearing formations, and has historically been a poor and unreliable source of groundwater. The groundwater quality objective for this basin at that time was 3,500 mg/L, reflecting the historic poor water quality. Three aquifers exist, a shallow alluvial aquifer in the upper basin above I-5, a deeper aquifer in the upper basin, and a shallow alluvial aquifer in the lower basin downstream of I-5. The two alluvial aquifers are separated by a shale formation in the vicinity of I-5. The upper aquifer has formed in alluvial deposits that average about 50 feet in depth under the Aliso Creek bed. The lower aquifer is very shallow and almost reaches the surface in many locations, likely because of the restricted canyon outlet to the ocean.

Groundwater pumping is limited in the Aliso Creek Watershed as withdrawals run the risk of allowing saltwater intrusion into the aquifer. Therefore, in accordance with criteria established in the Region 9 Salt and Nutrient Management Plan Guidelines, this subbasin is defined as "Tier D" groundwater basins where recycled water use is in compliance with existing Basin Plan groundwater quality objectives and, as such, do not require the preparation of salt and nutrient management plans.

### 3.1.3 Dana Point Coastal Streams Watershed

Dana Point Coastal Streams watershed falls under the Laguna subunit of the San Juan Hydrologic Unit (designated HSA 1.14). The main tributary of the Dana Point Coastal Streams Watershed is Salt Creek, which ultimately drains to the Pacific Ocean. The six-mile square watershed is almost entirely developed, and therefore highly influenced by stormwater flows. Currently, no potable water supply is drawn from these surface waters, and no groundwater resources are associated with this watershed. Therefore, in accordance with criteria established in the Region 9 Salt and Nutrient Management Plan Guidelines, this subbasin is defined as "Tier D" groundwater basins where recycled water use is in compliance with existing Basin Plan groundwater quality objectives and, as such, do not require the preparation of salt and nutrient management plans.

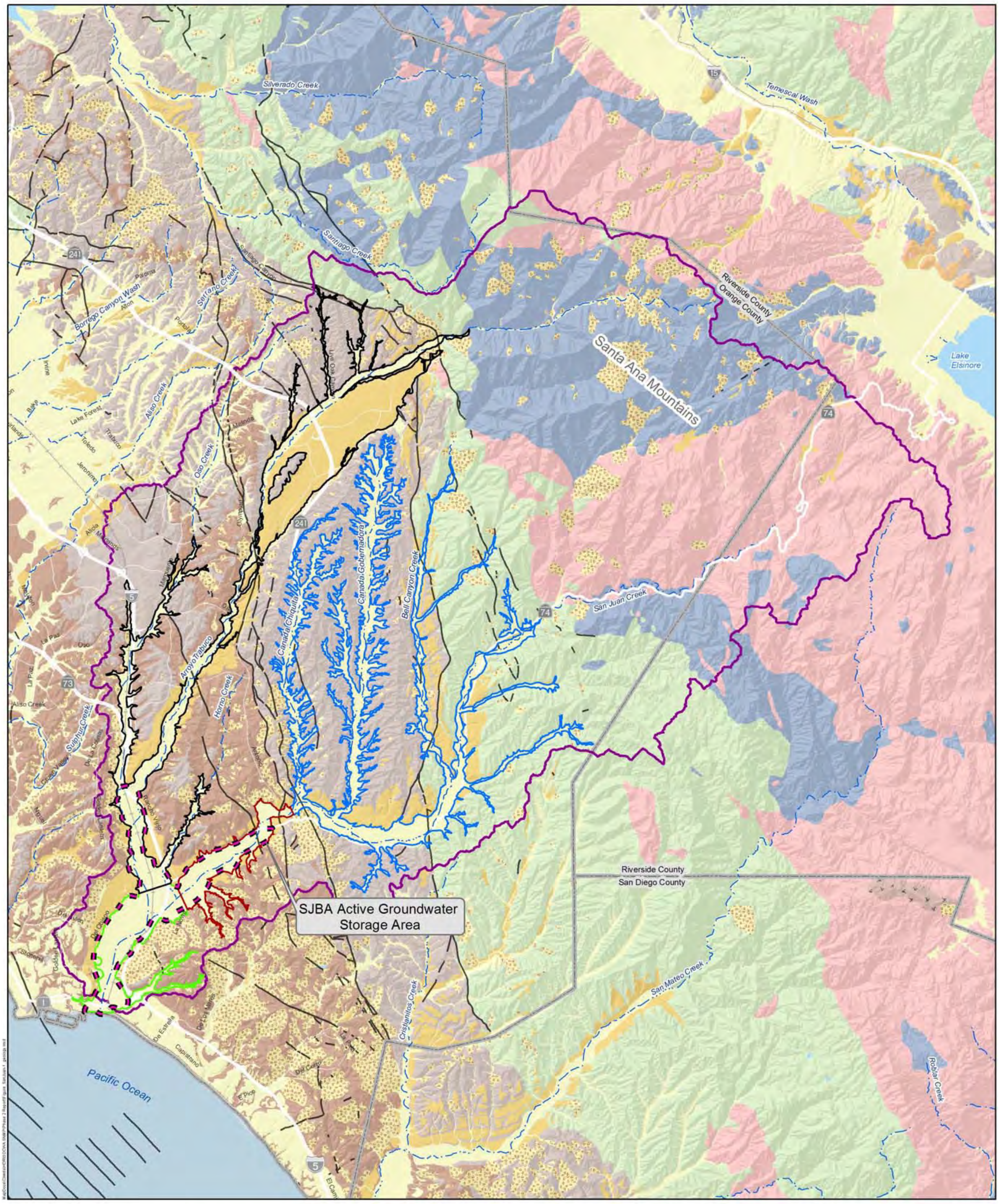
### 3.1.4 San Juan Creek Watershed

San Juan Creek falls under the Mission Viejo subunit of the San Juan Hydrologic Unit (designated HSAs 1.21-1.28). The San Juan Creek watershed is located on the western flank of the Santa Ana Mountains (**Figure 3-1**). The headwaters originate in the Cleveland National Forest near the Orange/Riverside County border at an elevation of approximately 3,300 feet above sea level and flow approximately 29 miles south-southwest to the Pacific Ocean at Doheny State Beach in Dana Point. The total watershed drainage area covers approximately 175 square miles. The upper third of the watershed is extremely rugged with steep slopes and deep cutting narrow canyons with minor tributaries from these areas flowing out from sharp canyons. The center third is dominated by rolling hills, and the downstream third is a highly developed floodplain. As the streams come out of the canyon mouth, they widen out into several alluvial floodplains. These floodplains comprise the alluvial sediments that are the San Juan groundwater basin. Land rises from sea level, where San Juan Creek discharges to the Pacific Ocean, to 5,687 feet at Santiago Peak. There are three principal creeks that drain the watershed: Oso Creek, the Arroyo Trabuco and San Juan Creek. These sub watersheds were recently described in the San Juan Creek Watershed Hydrology Study by PACE (2008), and are summarized below.

***San Juan Creek***. The mainstem channel originates at an elevation of approximately 3,300 feet above sea level in the Santa Ana Mountains and flows approximately 29 miles southwesterly into the Pacific Ocean. The drainage area, excluding Trabuco and Oso Creeks, is approximately 122 square miles. The major tributaries to San Juan Creek (from upstream to downstream, respectively) include Decker Canyon, Long Canyon, Bear Canyon, Lion Canyon, Hot Spring Canyon, Cold Spring Canyon, Lucas Canyon, Bell Canyon, Verdugo Canyon, Cañada Gobernadora, Cañada Chiquita, Horno Creek, and Arroyo Trabuco.

The main channel of San Juan Creek remains mostly in a natural condition except the downstream 2½ miles which is an improved trapezoidal channel with concrete side slopes and an earthen bottom. In non-storm conditions, surface flows in San Juan Creek are predominantly from dry-weather urban runoff and rising groundwater. Upstream of its confluence with Arroyo Trabuco, San Juan Creek typically dries up in the late summer months in the reach.

***Arroyo Trabuco.*** The Arroyo Trabuco Watershed, excluding the Oso Creek Watershed, originates from the Cleveland National Forest in the Santa Ana Mountains at an elevation of approximately 5,600 feet above sea level. Arroyo Trabuco flows approximately 23 miles to join San Juan Creek and has a drainage area, excluding Oso Creek, of approximately 38 square miles. This entire watershed is long and narrow. The headwaters originate within the steep and mountainous terrain, and the basin typically tilts from east to west. As the mountains gradually give way to ridges and moderately steep hillsides, the canyons yield to a wider floodplain, and the streambed gradually turns northeast to southwest. The downstream portion of Arroyo Trabuco meanders through the developed floodplain area and flows mainly in a north to south direction. The main channel of Arroyo Trabuco remains mostly in a natural condition. In non-storm conditions, surface flows in Arroyo Trabuco are predominately from dry-weather urban runoff.




### Hydrologic Features

- San Juan Creek Watershed Boundary
- SJBA Active Groundwater Storage Area
- Streams and Creeks

*San Juan Sub-Basins as Delineated by DWR (1972)*

- Arroyo Trabuco
- Lower Basin
- Middle Basin
- Upper Basin

### Geologic Features

*Late Holocene to Early Pleistocene Surficial Deposits*

- Younger Alluvial Deposits
- Landslide Deposits
- Older Alluvial Deposits

*Tertiary Bedrock Units*

- Fine-grained Formations (Capistrano and Monterey Formations)
- Coarse-grained Formations (Santiago,Sespe, and Niguel Formations)

Source: CGS Special Report 217.

*Mesozoic and Older Bedrock Units*

- Cretaceous Age Formations of Sedimentary Origin (Williams and Trabuco Formations)
- Pre-Cretaceous Metamorphic Formations of Sedimentary and Volcanic Origins (Menifee Valley and Bedford Canyon Formations)
- Granitic and other intrusive crystalline rocks

*Faults*

- Location Certain
- Location Approximate

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Author: LBB
Date: 20130726
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SOCWA
South Orange County Wastewater Authority
2013 Salt and Nutrient Management Plan

**Generalized Geology and Groundwater Sub-Basins in the San Juan Creek Watershed**

Figure 3-1

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***Oso Creek***. Oso Creek originates in the foothills of the Santa Ana Mountains at an elevation of 1,600 feet above sea level. Oso Creek flows for a distance of 13 miles to enter Arroyo Trabuco with a drainage area of 16 square miles. The entire channel flows through the low, rolling foothills west of the Santa Ana Mountains in a north to south direction. Most of the Oso Creek Watershed is developed. In non-storm conditions, the surface flows in Oso Creek are predominately from dry-weather urban runoff, which is captured and diverted by the SMWD at the Oso Creek Barrier.

### 3.1.5 San Juan Groundwater Basin

Groundwater within the San Juan Creek watershed primarily occurs in the relatively thin alluvial deposits along the valley floors and within the major stream channels (**Figure 3-1**). The SWRCB has characterized this groundwater, from a water rights perspective, as flow of an underground stream. The groundwater basin is bound to the north by the Santa Ana Mountains, composed of impermeable granitic and metamorphic bedrock, and to the south by the Pacific Ocean. Sedimentary bedrock formations form the sides of the water bearing canyons of the Upper Basin and Arroyo Trabuco (i.e., Cañada Chiquita, Cañada Gobernadora, and Bell Canyon). Four principal groundwater basins have been identified in the San Juan Creek watershed: (1) Lower Basin, (2) Middle Basin, (3) Upper Basin, and (4) Arroyo Trabuco. These sub-basins, shown in **Figure 3-1**, were first delineated by the California Department of Water Resources (DWR) in 1972 based on water quality differences.

In its 1972 Bulletin 104 report on water resources in the San Juan Creek Basin, DWR estimated the storage capacity of the entire San Juan Basin to be about 90,000 AF, noting that some of this storage capacity cannot be utilized due to poor water quality (DWR, 1972). This storage estimate is commonly referenced in reports that describe the San Juan Basin, including the San Diego Basin Plan (see for example: Stetson/Boyle 1998; County of Orange, 2006; MWDSC 2007; SMWD, 2010). In more detailed studies relating to groundwater resources management, CDM (1987), NBS Lowery (1994), PSOMAS (2004-2010), and others, have modified the DWR delineations and storage estimates. The most common modification to the DWR work is to exclude the upper reaches of the basin where the alluvial aquifer is narrow, shallow, and is functionally an underground stream as opposed to a groundwater reservoir. Groundwater storage estimates from these studies range from about 26,000 AF to about 42,000 AF.

Most recently, as part of its SJBGFMP update (WEI, 2013), the San Juan Basin Authority studied the storage capacity of the San Juan Basin. The SJBGFMP defines the active groundwater storage area (e.g., the management area) as the areas within the Lower Basin, Middle Basin, and lower Arroyo Trabuco that are bounded by the Ortega Highway on San Juan Creek, the confluence of the Arroyo Trabuco and Oso Creek, and the Pacific Ocean. The SJBA's active groundwater storage area is shown relative to the DWR sub-basins in **Figure 3-1**. The Upper Basin, which underlies the Canada Chiquita, Canada Gobernadora, Bell Canyon, Dove Canyon and Upper San Juan Creek watersheds, was excluded by the SJBA because: (1) the groundwater resource is insignificant; and (2) a majority of the land overlying the Upper Basin is privately owned and managed by the Rancho Mission Viejo (RMV), who would not make their data available to the SJBA. The upper Arroyo Trabuco was excluded by the SJBA because the groundwater resource is insignificant. The SJBA active groundwater storage area contains approximately 6 square miles of water bearing alluvium and with a storage capacity of about 38,000 AF. Recharge of the basin is from streambed infiltration in San Juan Creek, Oso Creek, and Arroyo Trabuco; surface inflow from beneath these stream reaches; and deep infiltration of precipitation and applied water. Discharge from the basin in from groundwater production and subsurface outflow to the Pacific Ocean.

### 3.1.6 San Clemente Watershed

San Clemente Coastal Streams watershed falls under the San Clemente subunit of the San Juan Hydrologic Unit (designated HSAs 1.31 and 1.32). Within the watershed there are two main streams that flow through the City of San Clemente, ultimately discharging into the Pacific Ocean. The Prima Deshecha originates near the Prima Deshecha landfill and flows along Camino de los Mares, underneath the I-5 and N. El Camino Real, before discharging into the Pacific Ocean at Poche Beach. The Segunda Deshecha Canada, the second main stream draining the watershed, flows through the Talega development, along Avenido Pico, under I-5 and N. El Camino Real, before discharging into the Pacific Ocean at North Beach. The 18-square-mile watershed is almost fully developed and includes parts of the cities of San Clemente, San Juan Capistrano and Dana Point.

In the San Clemente Master Reclamation Permit, as amended in March of 2012, it was established that this watershed is not within any groundwater basin identified by the DWR in Bulletin No. 118. Therefore, in accordance with criteria established in the Region 9 Salt and Nutrient Management Plan Guidelines, the Prima Deshecha and Segunda Deshecha subbasins are defined as "Tier D" groundwater basins where recycled water use is in compliance with existing Basin Plan groundwater quality objectives and, as such, do not require the preparation of salt and nutrient management plans.

### 3.1.7 San Mateo Creek Watershed

San Mateo Creek falls under the San Mateo Canyon subunit of the San Juan Hydrologic Unit (designated HSA 1.40). The portion of the San Mateo Creek Watershed covers 20 square miles of southeastern Orange County and is largely unincorporated territory under the jurisdiction of the County of Orange, but includes parts of the City of San Clemente in its downstream-most area. Tributaries to San Mateo Creek, the largest creek in the watershed, are Gabino Canyon, Paz Canyon and Blind Canyon, which combine and flow into Cristianitos Creek. The entire San Mateo Creek watershed is approximately 132 square miles and lies upstream of the Camp Pendleton Marine Corp Base. The Donna O’Neill Land Conservancy is located toward the southwestern side of the watershed at Rancho Mission Viejo. The portion of San Mateo Creek within Orange County flows through unincorporated Orange County before entering the City of San Clemente. It then reenters San Diego County, ultimately discharging into the Pacific Ocean at San Onofre State Beach. As the majority of this watershed is undeveloped, minimal watershed management has been implemented and very little water quality data has been collected.

### 3.1.8 San Mateo Groundwater Basin

As reported in the 2006 South Orange County IRWMP*,* the San Mateo Groundwater Basin is a small basin that underlies San Mateo Valley and Cristianitos Canyon. Together, the San Mateo (including San Onofre Creek) watershed is 175 square miles. The Cristianitos Creek watershed is a little over 31 square miles. The aquifer consists of unconfined alluvium and the basin is up to 100 feet in depth with an approximate storage capacity of 6,500 AF. Recharge is derived from percolation of runoff from rainfall and effluent from a wastewater treatment plant. The infiltration is through natural reaches and five spreading basins in the stream channel of the San Mateo Creek. Water levels vary with wet and dry weather cycles, and low levels generally recover during wet periods.

Pumping from this aquifer is thought to be met in part from increased deep percolation of runoff in San Mateo Creek and its tributaries, decreasing the length of channel available to sustain riparian vegetation. San Clemente utilizes water from the northern portion of the basin, pumping up to 1,100 AF per year for potable sources. The City of San Clemente has extracted water from their local sub-basin since the 1950s, and has historically found excessive iron and manganese, which is removed at a water treatment plant before entering the City’s supply. The City of San Clemente’s sub-basin is located in the northern flank of the main San Mateo groundwater basin and, therefore, the groundwater quality of its sub-basin is not entirely indicative of the water quality for the larger San Mateo groundwater basin. Camp Pendleton Marine Corps Base also pumps from the basin, which is currently the only water resource for domestic, municipal, industrial, and agricultural water demand in the northern part of Camp Pendleton.

## 3.2 SNMP PHASE 1 - INITIAL BASIN CHARACTERIZATION FINDINGS

Except for some very limited groundwater sources associated with geological faults and perched supplies, groundwater basins in SOCWA's service area are alluvial in character. They are intimately connected with surface water drainage courses, and range in average depth from about 25 to 135 feet. The alluvium is typically several miles long and only 100 to 200 feet wide. They are comprised of relatively tight sedimentary materials, characterized by low transmissivities and relatively small storage volumes. As part of Phase 1, the study area for the SNMP was defined hydrologically to include the Aliso Creek and San Juan Creek drainage areas and that portion of San Mateo Creek drainage overlain by Santa Margarita Water District (Cristianitos).

In keeping with the Region 9 SNMP Guidelines, a tiered approach utilizing four levels of analysis are proposed for the Phase 2 SNMP, ranging from Level 1 (no significant analysis) to Level 4 (ambient concentration determinations, source and load estimates, salt/nutrient water quality projections, and Basin Plan conformance/modification/antidegradation analyses). Levels of SNMP evaluation are being assigned to service area subbasins on the basis of the significance of the groundwater resource within and downstream of each of the subbasins, as follows:

- Level 1 - no significant groundwater resources and no significant downstream concerns.
- Level 2 - marginal groundwater resources and significant downstream concerns.
- Level 3 - modest groundwater resources and significant downstream concerns.
- Level 4 - significant groundwater resources.

**Table 3-1** lists the level of analysis to be undertaken for each of the subbasins in the study area.

**Table 3-1. Current Hydrologic Areas and SNMP Level of Analysis**

| San Juan Hydrologic Subunit | Unit No. | SNMP Level of Analysis |
|---|---|---|
| Laguna | 1.10 | -- |
| San Joaquin Hills | 1.11 | Level 1 |
| Laguna Beach | 1.12 | Level 1 |
| Aliso | 1.13 | Level 1 |
| Dana Point | 1.14 | Level 1 |
| Mission Viejo | 1.20 | -- |
| Oso | 1.21 | Level 3 |
| Upper Trabuco | 1.22 | Level 3 |
| Middle Trabuco | 1.23 | Level 3 |
| Gobernadora | 1.24 | Level 3 |
| Upper San Juan | 1.25 | Level 3 |
| Middle San Juan | 1.26 | Level 4 |
| Lower San Juan | 1.27 | Level 4 |
| Ortega | 1.28 | Level 4 |
| San Clemente | 1.30 | -- |
| Prima Deshecha | 1.31 | Level 1 |
| Segunda Deshecha | 1.32 | Level 1 |
| San Mateo Canyon | 1.40 | -- |
| Cristianitos (Proposed) | 1.42 | Level 2 |

Key issues identified by stakeholders during Phase 1 of the SOCWA SNMP development process included:

- Stormwater influence on groundwater quality and availability is important, and the SNMP effort should incorporate and evaluate stormwater management strategies being implemented as part of the MS4 (Municipal Separate Stormwater Sewer System) permits.
- Groundwater evaluations should be consistent with surface water data and groundwater infiltration load estimates and data from the MS4 program.
- The SOCWA SNMP should reflect the fact that existing or potential groundwater use could occur within the proposed Level 1 zones of the basin.
- Opportunities for salt credits should be taken into account as a management strategy.
- Influences of septic tank discharges on groundwater should be quantified and considered.
- Influences of riparian habitat on groundwater, such as significant uptake by invasive Arundo vegetation, should be quantified and considered.
- Seawater intrusion can represent a significant salinity load, and should be evaluated as part of the SNMP.
- Dumpsites and toxic "hot spots" (or other sources of potential contaminants) should be identified and assessed as part of the SNMP.
- Evaluating the interaction between surface flow and groundwater will be an important component in the SNMP assessment.
- Moving forward, data management will be an important component of management strategies in terms of keeping track of projects within the basin that may affect groundwater use and/or quality.

Per Phase 1 recommendations, groundwater quality constituents to be addressed as part of the SOCWA service area SNMP include TDS, iron, manganese, nitrate, and constituents of emerging concern. TDS and nitrate will receive the primary focus in the SNMP effort. Constituents of emerging concern (CECs) will be considered in accordance with the relevant update to the State's 2009 Recycled Water Policy. Stakeholders indicated support for the proposed tiered work approach, noting that this approach ensures consistency between the level of effort and the significance (both quality and quantity) of SOCWA service area groundwater resources.

As noted in the initial basin characterization of the Laguna and San Clemente HAs, no further analysis is required for these Level 1subbasins (HSAs 1.11, 1.12, 1.13, 1.14, 1.31, and 1.32). These watersheds are not within any groundwater basin identified by the DWR in Bulletin No. 118 and are not considered to have significant groundwater resources, nor any significant downstream concerns. Therefore, in accordance with criteria established in the San Diego Region 9 Salt and Nutrient Management Plan Guidelines, these subbasins are defined as "Tier D" groundwater basins where recycled water use is in compliance with existing Basin Plan groundwater quality objectives and, as such, do not require the preparation of salt and nutrient management plans.

In Phase 2, the SNMP focuses on the Level 2, 3 and 4 subbasins, located in the Mission Viejo HA and the San Mateo HA. This analysis requires identification of sources of salt, nutrient and other constituents of concern and to estimate ambient groundwater quality conditions and determining assimilative capacities and water quality management planning. The primary constituents of focus for this effort will be TDS and nitrate. However as stated earlier this process will address issues related to iron, manganese, fluoride, and remain open to other constituents of concern. Phase 2 also includes identifying the type of model required and using that model to assess pollutant transport and impacts to groundwater quality.

Assessment and modeling of the hydrologic units will be performed based on the significance of groundwater resources and the level of analytical focus identified in the basin characterization. The areas considered having no significant groundwater resources or marginally significant groundwater resources will be analyzed using computational methods without modeling. The area considered to have modest groundwater resources will be modeled using a historic salt-balance model developed prior to the 1994 Basin Plan amendments. The salt-balance model will be updated and expanded during this project. The area considered to have more significant groundwater resources will be modeled using constantly-stirred reactor model. The two different types of models will be integrated so the output from one model can serve as the input to the other, and vice versa.

**Table 3-2** shows how these methods will be applied to each hydrologic subarea identified above and **Figure 3-1** indicates the level of analysis proposed for each hydrologic subarea.

**Table 3-2. Application of Analytical Methodologies**

| Hydrologic Area Type | Analysis Level | Type of Analytic Approach | | | |
|---|---|---|---|---|---|
| | | Ambient Concentration Determination | Loading Analysis | Projection of Salt and Nutrient Concentrations | Anti-degradation Analysis |
| No significant groundwater resources and no significant downstream concerns | 1 | None | None | None | None |
| Marginally significant groundwater resources and significant downstream concerns | 2 | None | Perform loading analysis | Develop salt and nutrient projections for groundwater | Make antidegradation findings as required |
| Modest groundwater resources and significant downstream concerns | 3 | Perform ambient water quality determination | Perform loading analysis | Develop salt and nutrient projections for groundwater | Make antidegradation findings as required |
| Significant groundwater resources | 4 | Perform ambient water quality determination | Perform loading analysis | Develop salt and nutrient projections for groundwater | Make antidegradation findings as required |

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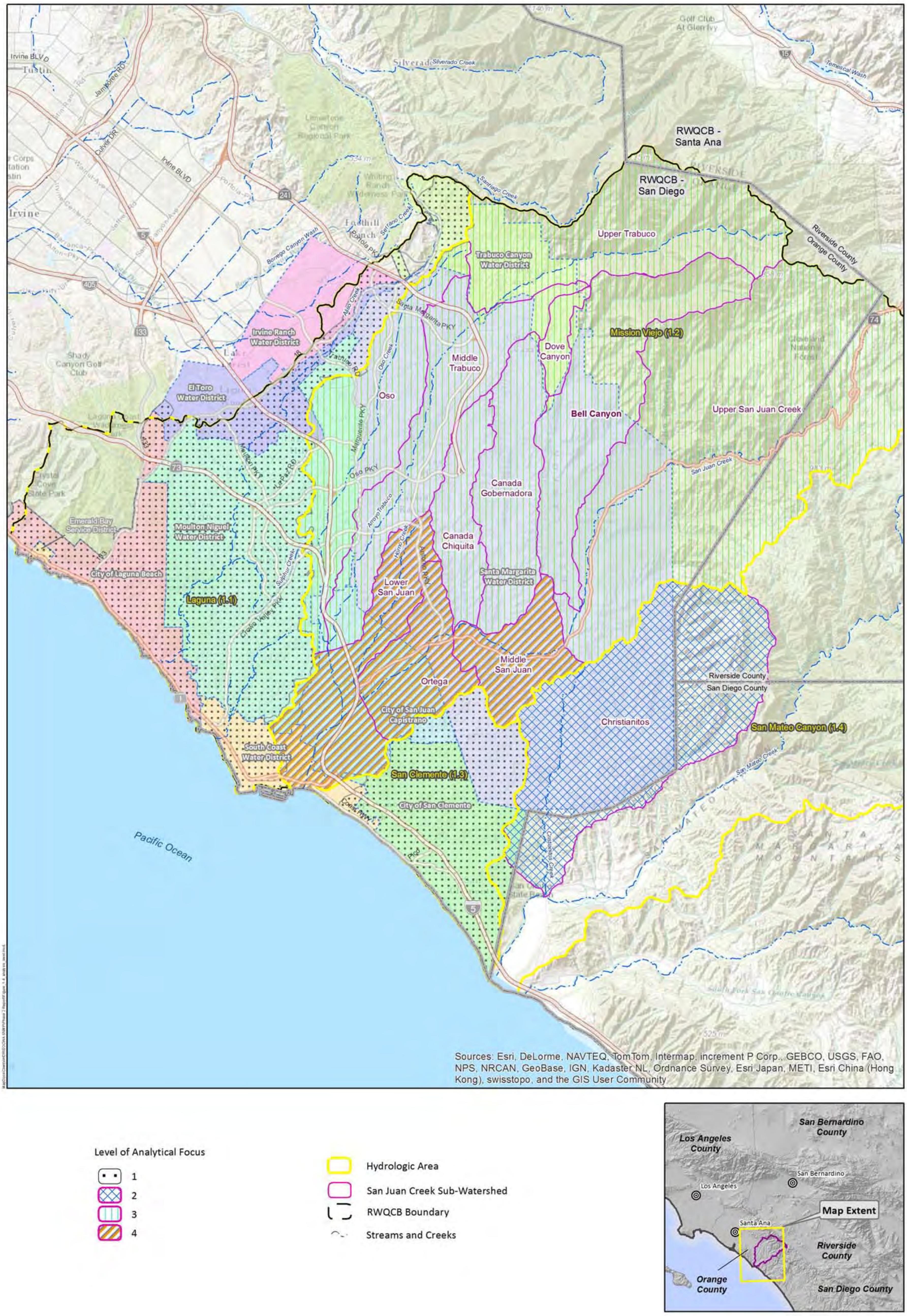


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**Level of Analytical Focus**
*SOCWA Service Area*

**Figure 3-2**

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# 4.0 CHARACTERIZATION OF WATER QUALITY AND SOURCE LOADS

This section provides a summary of the water monitoring programs within the study area, and a description of the contributing water sources, projects and activities that impact water quality in the basin. These factors will be taken into account in evaluating assimilative capacity and projecting future water quality of the groundwater basins in this study.

## 4.1 CHARACTERIZATION OF WATER RESOURCES AND WATER QUALITY

Contributing sources to the San Juan Groundwater Basin include streambed percolation from the tributary creeks, rainfall infiltration and subsequent deep percolation to the water table, deep percolation of applied water from landscape and agricultural irrigation, and subsurface inflow from the tributary alluvial stream areas. Imported water and recycled water are the main sources of applied water for irrigation.

As part of its SJBGFMP update, the SJBA prepared a comprehensive state of the basin assessment of the San Juan Basin (WEI, 2013), including an inventory of the surface and groundwater hydrology, geologic conditions, groundwater storage and water quality, water infrastructure and interpretation of groundwater modeling work conducted by the Municipal Water District of Orange County in support of the South Orange County Desalter Project. The analysis emphasized the surface and groundwater resources in the basin area bounded by the Ortega Highway on San Juan Creek, the confluence of the Arroyo Trabuco and Oso Creek, and the Pacific Ocean, but data collected by the SJBA covered most of the San Juan Creek Watershed. The SJBA made its database available to SOCWA for the SNMP. Additional data for the SNMP study area that was not available from the SJBA's database was collected from SMWD and TCWD.

### 4.1.1 Historical and Current Water Quality

In its 1972 Bulletin 104 report on water resources in the San Juan Creek Basin, DWR characterized the general mineral quality of the basin's water resources based on samples collected in the 1960s. In general, the highest quality surface water and groundwater is in the upper reaches of the watershed and degrades as you move downstream towards the coast. DWR attributed the downstream degradation of water quality to irrigation return flows, the dissolution of salts from regional geologic deposits, and the concentration of TDS in surface water as slow-flowing creeks lose water to evaporation and transpiration. Surface water TDS concentrations at individual monitoring locations fluctuated greatly based on surface water discharge: the lower the flow, the higher the TDS concentration. Oso Creek had the poorest surface water and groundwater quality in the watershed. **Table 4-1** summarizes the TDS and nitrate-N concentrations observed in surface water and groundwater throughout the San Juan Creek Watershed during the 1960's, as reported by DWR.

The most comprehensive assessment of current surface water and groundwater quality in the San Juan Creek Watershed was performed as part of the SJBGFMP update (WEI, 2013). In this assessment, surface water quality was characterized across the entire San Juan Watershed and groundwater quality was characterized for the SJBA groundwater storage area (see **Figure 3-1**). The current state of water quality was assessed by comparing the maximum constituent concentrations observed in surface water and groundwater to two types of water quality criteria: drinking water maximum contaminant levels (MCLs) and Basin Plan objectives.

**Table 4-1. Historical Surface Water and Groundwater Quality in the San Juan Creek Watershed (as reported by DWR, 1972)**

| Surface Water Monitoring Location | TDS (mg/L) | Nitrate-N (mg/L as N) |
|---|---|---|
| Oso Creek | 331 - 12,880 | Not reported |
| *Arroyo Trabuco* | | |
| above confluence with Oso Creek | < 500 | Not reported |
| below confluence with Oso and above confluence with San Juan Creek | 294 - 3,940 | Not reported |
| *San Juan Creek* | | |
| above confluence with Bell Canyon | < 250 | ND |
| Canada Gobernadora | 452 - 1,807 | Not reported |
| Canada Chiquita | 598 - 1,562 | Not reported |
| Horno | 1,327 | 3.8 |
| at Ortega Highway | 121 - 611 | Not reported |
| Below confluence with Arroyo Trabuco | 440 - 1,241 | Not reported |
| **Groundwater Sub-basin Monitoring Location** | **TDS (mg/L)** | **Nitrate-N (mg/L as N)** |
| Oso | 1,176 - 5,758 | ND - 15 |
| Upper Trabuco | 336 - 804 | ND - 2.7 |
| Lower Trabuco | 506 - 2,869 | 2 - 5 |
| Upper San Juan | 298 - 515 | ND - 2.5 |
| Canada Gobernadora and Canada Chiquita | 296 - 378 | Not reported |
| Middle San Juan (including Ortega) | 582 - 1,823 | ND - 1.7 |
| Lower San Juan | 811 - 2,070 | ND - 9.3 |

ND = not detected above the laboratory reporting limit

Current trends in groundwater quality were analyzed for the five-year period from 2006-2010 and trends in surface water quality were analyzed for the period from 1986-2010. A longer period of record was used to characterize current surface water quality because there was little overlap in the periods of record available for the majority of surface water monitoring sites. The following conclusions can be drawn from the SJBA assessment:

- All wells in the SJBA groundwater storage area had a maximum TDS concentration that exceeded the secondary MCL for TDS of 500 mg/L. And, the maximum TDS concentration measured at the majority of wells exceeded the Basin Plan groundwater objectives in their respective HSAs.
- The maximum TDS concentration measured at surface water monitoring sites was generally greater than the secondary MCL and the Basin Plan surface water objective, both of which are 500 mg/L.
- TDS concentrations in surface water are lowest in the upper reaches of the watershed and increase downstream towards the coast. The highest TDS concentrations in surface water were observed in the Oso and Lower San Juan HSAs.

- Nitrate-N concentrations in groundwater and surface water are well below the primary MCL and the Basin Plan objectives, all of which are 10 mg/L as nitrogen.
- The majority of wells had maximum iron concentrations that exceeded the secondary MCL and Basin Plan groundwater objective of 0.30 mg/L. The wells exceeded these criteria by as much as 60 times the regulatory standards.
- With the exception of the Arroyo Trabuco and the upper reaches of San Juan Creek, the maximum observed iron concentrations in surface water were generally greater than the MCL and Basin Plan objectives, all of which are 0.30 mg/L.
- The majority of wells had maximum manganese concentrations that exceed the secondary MCL and Basin Plan groundwater objective of 0.05 mg/L. The wells exceeded these criteria by as much as 40 times the regulatory standards.
- Manganese concentrations of surface water in Oso Creek and the lower reaches of San Juan Creek generally exceeded the secondary MCL and Basin Plan groundwater objective of 0.05 mg/L.

The tables and figures characterizing the surface water and groundwater conditions described above are included as **Appendix B** of this report[6].

## 4.2 CHARACTERIZATION OF LAND USE AND ACTIVITIES IMPACTING WATER QUALITY

A number of factors influence the quality and quantity of groundwater in the San Juan basin. These factors include land use, climate, water supply sources, stormwater management and septic system use, each of which are discussed in more detail in the following paragraphs.

### 4.2.1 Land Use

Since the early 1960s, this area has become one of the fastest growing areas of urban development in California. From the coastline, development has expanded eastward, as shown in **Figure 4-1**. Although only 25 percent of the 134,000-acre SOCWA study area is developed, most of this development is concentrated within the north-western portion of the basin. Developed land use is primarily urban residential with commercial shopping centers, with parks and golf courses interspersed. The undeveloped portion, the Southern and interior portions, occupies 75 percent of the basin. Agricultural land use occupies less than 1 percent of the land. A very large and mostly undeveloped portion of the watershed is encompassed by the Camp Pendleton Marine Corps Base in northern San Diego County. Other large areas of open space are found within local regional parks and the Cleveland National Forest. Caltrans is major landowner, and it has jurisdiction over the major freeways that traverse the watershed.[7]

Land use coverage information from Southern California Association of Governments (SCAG) provides information regarding the amount of each type of vegetation that is prevalent within each of the hydrologic subareas. General Plans for the area project a 7 percent increase in development within the San Juan Hydrologic Unit through 2050.

[6] Note that in the SJBA's analysis, surface water quality was only compared against surface water quality criteria; it was not compared against the underlying groundwater quality objectives.
[7] Gobernadora Multipurpose Basin Project *South Orange County IRWM Prop 1E Grant Proposal, April 2011*

### 4.2.2 Climate

The climate across the study area is mild, based on its close proximity to the Maritime Fringe Climatic Region of Southern California. The area has several microclimates based on its topography and the elevation change, which influences the amount of rainfall within each watershed. Precipitation data was captured for each of the watersheds using the PRISM model (Parameter-elevation Regression on Independent Slopes Model (PRISM) Climate Group), which is a GIS-based hybrid statistical-geographic approach to mapping climate data. PRISM uses point data, a digital elevation model (DEM), and other spatial data sets to generate estimates of annual, monthly, and event-based climatic elements that are gridded and GIS-compatible.

The average annual rainfall across the study area is approximately 14 inches, however precipitation within the San Juan Creek watershed ranged from 15 inches per year at the lower basin, to 22 inches per year in the upper basin. The average evapotranspiration (ETo) is two to four times the annual average rainfall, at almost 50 inches per year. As a result, there is a high demand for landscape irrigation for homes, commercial properties, parks, and golf courses and a propensity for drought conditions.

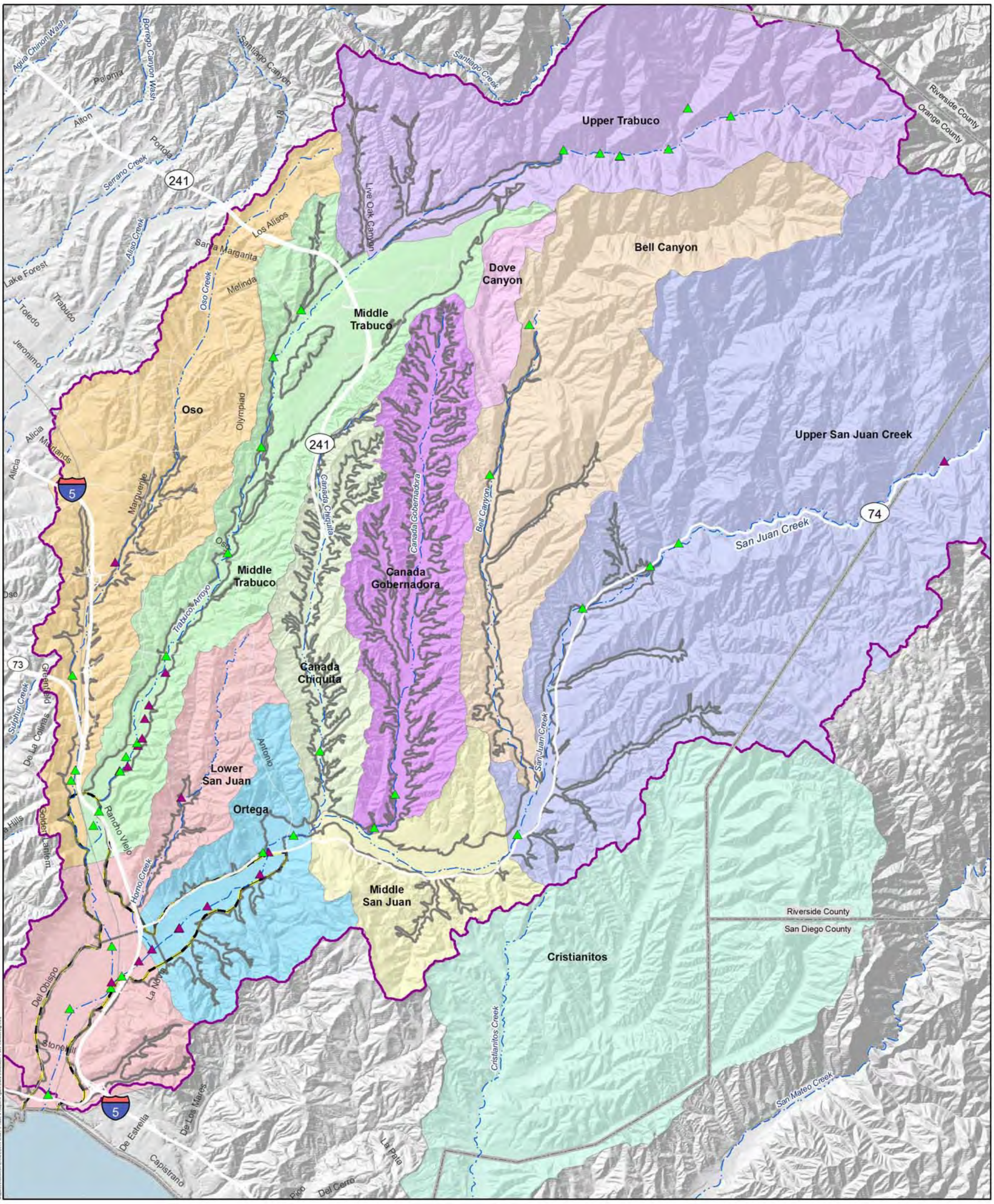
### 4.2.3 Water Supply Sources

The majority of the study area relies heavily on imported water wholesaled by MWD through Metropolitan Water District of Orange County (MWDOC) for domestic supply. To reduce their dependence on imported water, local water agencies use local groundwater, recycled water, and dry weather runoff diversions to augment their supply portfolios. Potential projects that may impact available local resources include ocean desalination, aquifer storage and recovery, and stormwater management projects. The impacts of the quality and quantity of these water supply sources on salt and nutrient management within the study area are discussed in the following paragraphs.

#### *4.2.3.1 Imported Water Supply*

Metropolitan Water District of Southern California (MWD) is responsible for providing water of a high quality throughout its service area. The water that MWD delivers is tested both for currently regulated contaminants and for additional contaminants of concern as over 300,000 water quality tests are conducted each year to regulate the safety of its waters. MWD's principal sources of water originate from two sources - the Colorado River via the CRA and the Lake Oroville watershed in Northern California through the State Water Project (SWP). This water is treated at the Robert B. Diemer Filtration Plant located north of Yorba Linda. Typically, the Diemer Filtration Plant receives a blend of Colorado River water from Lake Mathews through the Metropolitan Lower Feeder and SWP water through the Yorba Linda Feeder. The Allen-McColloch Pipeline and the East Orange County Feeder No.2 extend south to deliver domestic water from the Diemer Plant to the study area water agencies for distribution. MWA's goal is to deliver domestic water with a TDS value of less than 500 mg/L.

MWD's primary sources face individual water quality issues of concern. The CRA water source contains a higher level of total dissolved solids (TDS) and a lower level of organic material while the SWP contains a lower TDS level while its level or organic materials is much higher, lending to the formation of disinfection byproducts. To remediate the CRA's high level of salinity and the SWP's high level of organic materials, MWD has been blending CRA water with SWP supplies, as well as implementing updated treatment processes to decrease the disinfection byproducts.




## Main Features

▲ Surface Water Location with TDS Samples from 2008 to 2012

▲ Surface Water Location with TDS Samples from 1982 to 2007

## Hydrologic Features

Active Groundwater Storage Area

San Juan Creek Watershed Boundary

San Juan Basin

Streams and Creeks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HDR

Author: LBB
Date: 20130509
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0 1,000 2,000 Feet
0 0.25 0.5 Miles

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South Orange County Wastewater Authority
2013 Salt and Nutrient Management Plan

**Surface Water Monitoring Sites with TDS Data**

Figure 4-1

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TDS values associated with imported domestic water supplies from the Diemer Plant are shown in **Figure 4-2,** below. While TDS increased through the 1990s, the blended water quality saw improvement in TDS concentrations through the 2000's. Current annual average values of TDS from the Diemer Plant are in the range of 470 to 500 mg/L.

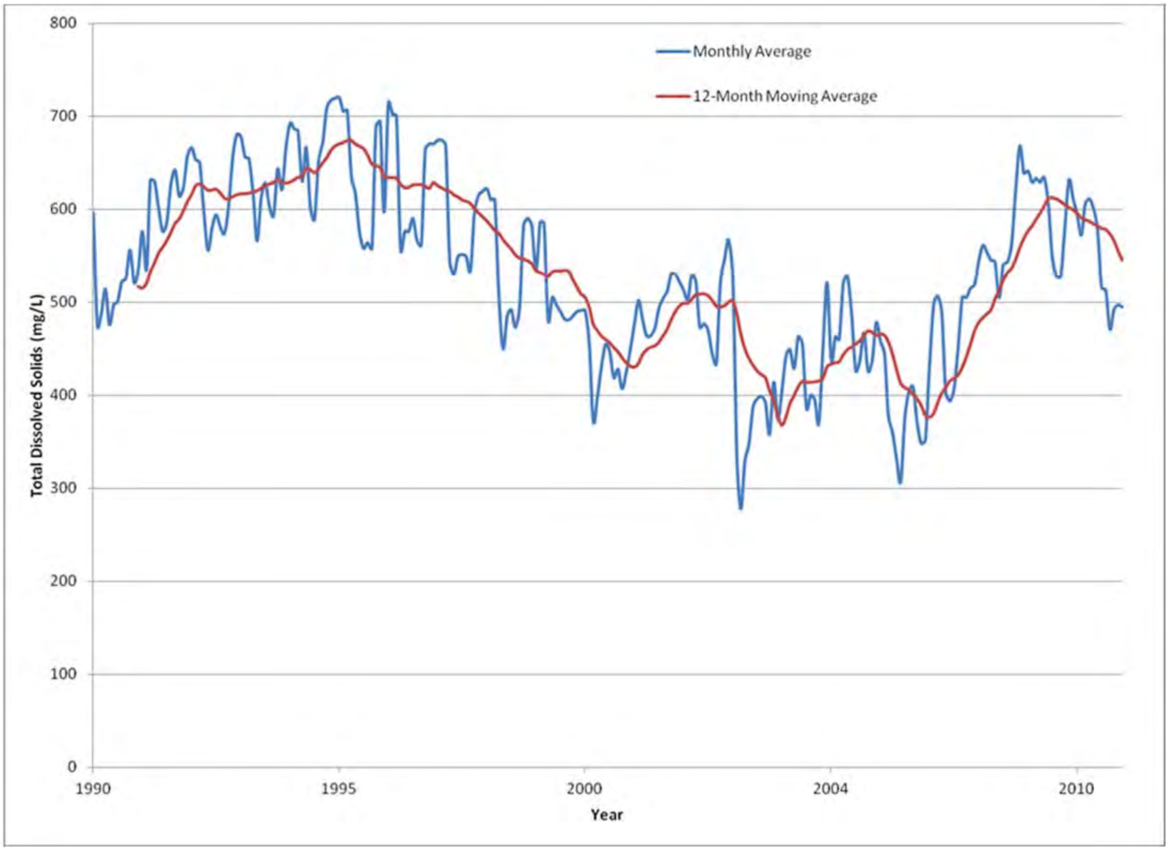



**Figure 4-2. Diemer Plant TDS in mg/L (1990 to 2010)**

In addition, MWD has been engaged in efforts to protect its Colorado River supplies from threats of uranium, perchlorate, and chromium VI while also investigating the potential water quality impact of emerging contaminants, N-nitrosodimethylamine (NDMA) and pharmaceuticals and personal care products (PPCPs). MWD has assured its ability to overcome the above mentioned water quality concerns through its protection of source waters, implementation of renovated treatment processes, and blending of its two sources.

### *4.2.3.2 Groundwater*

Within the SOCWA service area, the San Juan Basin has historically been the predominant source of groundwater supply. In the 1960's, agricultural demands accounted for approximately 85 percent of the total water demand of 6,500 AF. As the area rapidly converted to urban land uses in the 1970s, demands shifted towards the domestic sector, making up 50 percent of the total groundwater usage of about 9,500 AF (DWR, 1972). Today, municipal and commercial uses make up the majority of groundwater demands in the San Juan Basin. The entities producing groundwater in the San Juan Basin include Trabuco Canyon Water District (TCWD), City of San Juan Capistrano (CSJC), South Coast Water District (SCWD), and various private entities, including Rancho Mission Viejo (RMV). Based on the most recent planning projections, the total groundwater demand (potable and non-potable use) is projected to increase from about 8,800 AFY in 2011 to about 13,600 AFY in 2035. A majority of this demand is produced from the Lower San Juan Basin. These projections do not include the demands of most private entities in the basin, including the RMV, as these data were not available. **Figure 4-3** is a map showing the location of known active groundwater production wells in the San Juan Basin. Note that the majority of wells are located in the Lower San Juan Basin.

Total groundwater pumping from the Lower San Juan Basin has declined over the years due to poor water quality. The primary water quality concerns in the Lower San Juan Basin are TDS, iron, manganese and methyl-tert-butyl-ether (MTBE). High concentrations of TDS, iron, and manganese in groundwater primarily result from the dissolution of naturally occurring geologic deposits (DWR, 1972), whereas contamination from MTBE, and other gasoline byproducts, is a result of numerous leaking underground storage tank (LUST) sites across the basin.

To put groundwater to beneficial municipal use, it must first be treated. Both the CSJC and SCWD have groundwater desalination facilities to treat groundwater for potable use. These facilities are identified in **Figure 4-3**, and are described below.

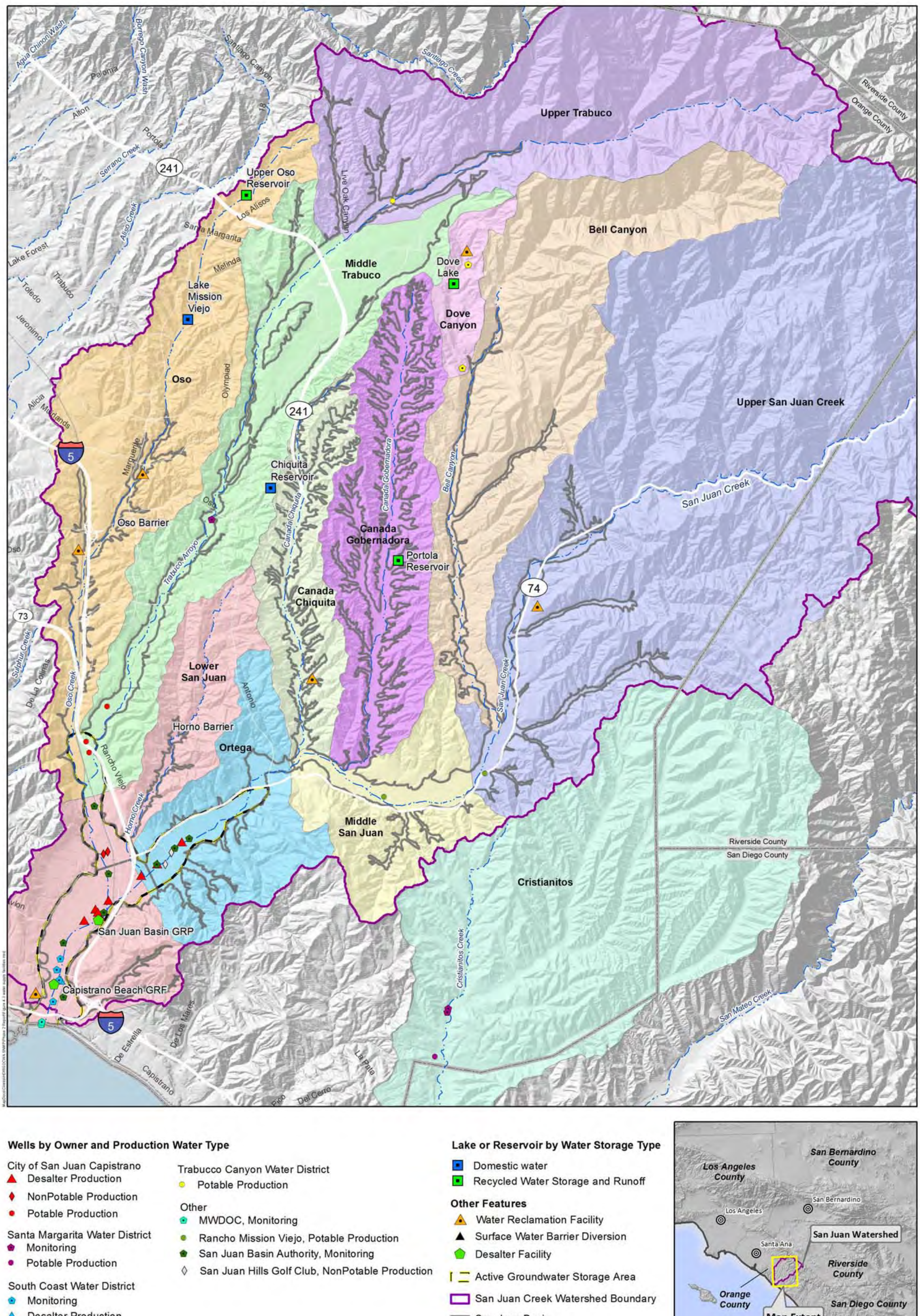
***San Juan Basin Groundwater Recovery Plant (GRP).*** The San Juan Basin GRP was constructed in 2005 and is operated by CSJC. The treatment process consists of iron and manganese removal, MTBE removal via granular activated carbon filtration, and TDS removal via reverse osmosis (RO). The plant is fed by eight groundwater production wells and has the capacity to produce up to 5.1 mgd of potable water. Groundwater influent to the plant has a TDS concentration of about 1,700 mg/L. Product water from the plant has a TDS concentration of about 440 mg/L, iron and manganese concentrations that comply with public drinking water standards, and no detectable levels of MTBE, or other gasoline byproducts.

***Capistrano Beach Groundwater Recovery Facility (GRF).*** The GRF was constructed in 2007 and is operated by the SCWD. The treatment facility is fed by a single groundwater well and consists of RO treatment and iron and manganese removal. A second groundwater well is planned in the future. A portion of the influent groundwater to the GRF is sent to an RO treatment process to remove TDS. Another portion by-passes the RO train and is treated to remove iron and manganese. Groundwater influent to the plant has a TDS concentration of about 2,000 mg/L. The RO permeate and by-pass trains are recombined to produce 0.71 MGD of potable water. Product water from the plant has a TDS concentration of about 360 mg/L and iron and manganese concentrations that comply with public drinking water standards.

Groundwater is also produced to meet non-potable demands. The City of San Juan Capistrano supplements its non-potable supply system with untreated groundwater. And private golf courses use untreated groundwater for landscape irrigation. Groundwater used for landscape irrigations ranges in quality from around 900 mg/L to 1,500 mg/L.

#### *4.2.3.3 Recycled Water Supply*

Within the SOCWA service area recycled water use is governed by Region 9's Order No. 97-52, which includes numerical limits based on recycled water production sources and use areas, the former delineated by various agency water reclamation plants and the latter delineated by current Region 9 hydrologic sub areas (HSA). The Order's total production limit is 52.36 million gallons per day (MGD); the total use limit is 46,150 AFY. The TDS limit for recycled water is 1,000 mg/L; however, most of the treatment facilities produce recycled water with a TDS component between 600 and 900 mg/L.




**Location of Groundwater, Surface Water and Wastewater Facilities**

**Figure 4-3**

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**Coastal Treatment Plant**

Constructed originally in 1950, SOCWA operates the Coastal Treatment Plant (CTP) located in the lower portion of Aliso Canyon, approximately 1.5 miles from the Pacific Ocean. The plant treats wastewater from homes and business in the city of Laguna Beach, Emerald Bay Services District, South Coast Water District. The plant treats wastewater through a process that includes screening, grit removal, primary clarification, secondary treatment (activated sludge), and secondary clarification. The Wastewater solids are pumped to the Regional Treatment Plant for anaerobic digestion and solids dewatering. The CTP is designed to treat up to 6.7 MGD, but currently averages approximately 3. 28 MGD. About twenty percent of the plant's effluent receives additional tertiary treatment to produce recycled water, which is utilized for landscape irrigation.

**3A Wastewater Treatment Plant**

SOCWA also operates the 3A Wastewater Treatment Plant (3A). Constructed in 1993, it is located in Mission Viejo and is a conventional activated sludge treatment facility. Wastewater generated in the service areas of the Moulton Niguel Water District and the Santa Margarita Water District is treated at the 3A Treatment Plant through a process that includes screening, grit removal, primary clarification, secondary treatment (activated sludge), secondary clarification, anaerobic digestion and solids dewatering. The design capacity of the 3A Treatment Plant is 6 MGD, the plant treats approximately 2.0 million gallons of wastewater each day with about 0.68 MGD of recycled water production for irrigation of local parks and greenbelts.

**Regional Treatment Plant**

The SOCWA Regional Treatment Plant (RTP) was constructed in 1982 and is located in Laguna Niguel. It treats wastewater generated in the Moulton Niguel Water District (MNWD) service area. The RTP is a conventional activated sludge treatment facility with a liquid handling capacity of 12 MGD and an equivalent of 24.6 MGD of solids handling capacity. Wastewater treatment unit operations and processes include screening, grit removal, primary clarification, secondary treatment (activated sludge), secondary clarification, anaerobic digestion and solids dewatering. Besides managing its own solids from the treatment process, the RTP also treats solids trucked to the plant from the El Toro Water Reclamation Plant and additional solids transported through a force main from the SOCWA Coastal Treatment Plant. A portion of the plant's secondary effluent receives tertiary treatment and is used as recycled water in landscape irrigation. The current capacity of the existing tertiary treatment facility is 11.4 MGD and an average of close to 5.20 MGD of recycled water is produced for irrigation purposes. The remaining effluent is discharged to the Pacific Ocean through the Aliso Creek Ocean Outfall.

**Additional Reclamation Facilities**

Within the SOCWA service area, there are seven additional treatment plants that produce recycled water including:

- Los Alisos Water Reclamation Plant (WRP) operated by Irvine Ranch Water District (IRWD)
- El Toro WRP operated by El Toro Water District (ETWD)
- Robinson Ranch WRP operated by Trabuco Canyon Water District (TCWD)
- Oso Creek WRP operated by Santa Margarita Water District (SMWD)
- Chiquita WRP operated by SMWD

- Nichols Institute WRP operated by SMWD
- San Clemente WRP operated by the City of San Clemente (SC)

The locations of these facilities are shown in **Figure 4-3**. Under Regional Board Order 97-52, these reclamation facilities have operational parameters, as listed in **Table 4-2**, below:

**Table 4-2. SOCWA Reclamation Treatment Facilities Operational Parameters**

| Reclamation Plant | Agencies with Capacity Rights | Permitted Capacity (MGD) | Planned Capacity (MGD) | 2011 Recycled Water Production (MGD) |
|---|---|---|---|---|
| Coastal TP | City of Laguna Beach, MNWD, South Coast Water District | 4.20 | 4.04 | 0.56 |
| 3A TP | MNWD, SMWD | 5.20 | 2.40 | 0.74 |
| Joint Regional TP | MNWD | 11.40 | 11.40 | 4.92 |
| Los Alisos WRP | IRWD, SMWD | 5.50 | 5.50 | 0.66 |
| El Toro WRP | ETWD | 2.60 | 0.60 | 0.43 |
| Robinson Ranch WRP | TCWD | 1.10 | 1.10 | 0.62 |
| Oso Creek WRP | SMWD | 3.00 | 2.00 | 1.69 |
| Chiquita WRP | SMWD | 7.50 | 5.00 | 2.40 |
| Nichols WRP | SMWD | 0.08 | 0.08 | 0.03 |
| San Clemente WRP | City of San Clemente | 2.2[1] | 4.4 | 0.70 |

[1]City of San Clemente holds a separate permit from SOCWA (Regional Board Oder 2003-0123)

Specific use volume limits per watershed were based on water quality modeling performed in support of the 1994 Basin Plan amendments and later refinements performed to support the Order's adopted numerical requirements. Annual monitoring of the two types of limits is reported with comparisons for each plant and HSA among permitted volume, planned volume, and actual latest annual production and use volume. Currently planned recycled water use under the Order totals 22,970 AFY. Although annual use in recent years has approached 18,000 AFY, actual use for 2011, representing both economic and water conservation cut-backs, is 13,245 AFY shown in **Table 4-3**.

The San Mateo Basin is a principal drinking water aquifer of the US Marine Corps (USMC) Base, Camp Pendleton. Per the San Clemente Master Reclamation Permit, dated March 2012, to prevent recycled water with potentially elevated total dissolved solids concentration from impacting the lower San Mateo basin, the Pacific Golf Course has installed a brine interception and disposal system along the border of the San Mateo basin at the Pacific Golf Course. The captured brine is pumped to a lined decorative lake (brine disposal pond) located in the Segunda Deshecha drainage area at the Pacific Golf Course. Overflow from the lake is discharged to an area in the Segunda Deshecha HSA.

**Table 4-3. 2011 Recycled Water Use in the SOCWA Study Area**

| Hydrologic Areas and Sub Areas | Basin No. | Permitted RW Use Under Order 97-52 (AFY) | Planned RW Use (AFY) | Current RW Use (AFY) |
|---|---|---|---|---|
| Laguna HA | | | | |
| San Joaquin Hills | 1.11 | 0 | 0 | 0 |
| Laguna Beach | 1.12 | 1,026 | 253 | 92 |
| Aliso | 1.13 | 10,494 | 6,826 | 4,002 |
| Dana Point | 1.14 | 5,804 | 2,952 | 1,547 |
| Mission Viejo HA | | | | |
| Oso | 1.21 | 7,168 | 5,290 | 2,548 |
| Upper Trabuco | 1.22 | 420 | 23 | 0 |
| Middle Trabuco | 1.23 | 4,232 | 1,487 | 924 |
| Gobernadora | 1.24 | 4,148 | 4,000 | 1,634 |
| Upper San Juan | 1.25 | 977 | 91 | 31 |
| Middle San Juan | 1.26 | 0 | 0 | 0 |
| Lower San Juan | 1.27 | 4,396 | 3 ,349 | 1,433 |
| Ortega | 1.28 | 2,758 | 65 | 13 |
| San Clemente HA | | 3890 | | |
| Prima Deshecha | 1.31 | - | 0 | 0 |
| Segunda Deshecha | 1.31 | - | 1,650 | 1,021 |
| San Mateo Canyon HA | 1.40 | 837 | | |
| San Mateo | | - | 0 | 0 |
| Cristianitos | | - | 333 | 0 |
| Total | N/A | 46,150 | 22,970 | 13,245 |

### *4.2.3.4 Surface Water Diversions*

There are currently three urban runoff barriers in operation and one under development within the SJBA service area as shown on Figure 4-3. The barriers are designed to intercept and reuse urban runoff before impacting sensitive environmental areas.

The Oso Creek Barrier was constructed in the late 1970s and is designed to collect dry-weather urban-runoff within Oso Creek. The barrier consists of a water diversion structure, pump station, pressure discharge pipeline, and a gravity pipeline. The captured runoff is pumped to the Upper Oso Reservoir and blended with seasonally stored recycled water. The Upper Oso Reservoir holds up to 1.3 billion gallons of recycled water.

The Dove Canyon Barrier is designed to collect urban runoff from the Dove Canyon community before entering the environmentally sensitive Starr Ranch Sanctuary. The collected runoff is used for irrigation of nearby golf courses and parks. The Trabuco Canyon Water District (TCWD) owns and operates the barrier and the reclaimed water is shared by TCWD and SMWD.

Horno Creek Barrier treats urban runoff from the Ladera Ranch community in a constructed wetland. The barrier provides reclaimed water to the SMWD.

SCWD is proposing to construct a diversion structure designed to collect and reuse urban runoff in Aliso Creek. It is estimated that the barrier will collect approximately 560 AFY. The collected water will be treated with reverse osmosis (RO), and combined with the irrigation water from the Advanced Wastewater Treatment System at the Costal Treatment Plant, increasing the supply and quality of reclaimed water for the SCWD.

#### *4.2.3.5 Ocean Desalination*

The MWDOC and its five Project Partners – Laguna Beach County Water District, MNWD, City of San Clemente, and SCWD – are working diligently to improve local water reliability in south Orange County through the investigation and development of the Doheny Desalination Project.This project would decrease the area's dependence upon imported drinking water supplies, as the South Orange County participating agencies rely on imported water from northern California and the Colorado River to meet approximately 95 percent of their potable demands.

The proposed ocean desalination facility would be located north of Doheny State Beach in Dana Point, adjacent to San Juan Creek on the inland side of Pacific Coast Highway on property being reserved for the project by the South Coast Water District. It would produce approximately 15 MGD (16,000 AFY) of high quality, drought-proof water supply or about 30 percent of the potable water demand of the participating agencies.

Two phases of project feasibility testing have been conducted successfully at Doheny Beach since 2005. The project entered Phase 3: Extended Pumping & Pilot Plant Testing in early 2010 and was completed in May 2012. The Phase 3 results are promising and the participating agencies are reviewing options to move the project forward. The next phase in the implementation of the project is working out the best approach for mitigation of the project impacts on the groundwater basin and conducting the pre-design steps over the next 3 to 4 years. As planned, the project would be constructed and operational within three years after receipt of permits, and water deliveries would begin in 2020.

### 4.2.4 Storm Water Management

Within the SOCWA service area storm water provides incidental recharge of groundwater basins. Storm water is also beneficial to the service area and its recycled water use practice for flushing salts retained in the upper soil profile from irrigation and for conveying those salts to the ocean, typically in wet years.

In addition to being within the SOCWA study area, these watersheds also comprise the study area of the South Orange County Watershed Management Area Integrated Regional Water Management Plan (IRWMP).  The San Juan Creek watershed is approximately 30 percent developed, with ongoing future development of most remaining privately held land. The San Juan Creek Watershed Workplan (Workplan) identifies a schedule of management activities addressing priority constituents of concern to be undertaken in 2012 by the cities of Dana Point, Laguna Hills, Laguna Niguel, Mission Viejo, Rancho Santa Margarita, and San Juan Capistrano, the County of Orange, and the Orange County Flood Control District (the San Juan Creek Watershed Permittees or Watershed Permittees).

The County of Orange, in conjunction with the San Juan Creek Watershed Permittees, have developed a comprehensive framework for stormwater management, described in the Drainage Area Management Plan (DAMP)[8], which is updated as appropriate in conjunction with the Report of Waste Discharge (ROWD)[9] and each new Municipal Permit's findings and requirements. The DAMP sets forth a model programmatic countywide approach for urban stormwater management to protect and restore surface water and groundwater quality, safeguard public and environmental health, and secure water supplies.

### 4.2.5 Septic Systems

Septic systems have proven to be a relatively inexpensive and effective method of wastewater treatment when a centralized wastewater collection system is unavailable. However, if systems fail, poorly treated effluent may surface and drain to nearby storm drain systems and receiving waters. Septic systems can also prematurely leach into the groundwater system, increasing TDS and nitrates. In 2003, a study was conducted to develop an inventory/database of the septic systems in Orange County and to estimate the potential impact of septic systems on the quality of selected receiving waters. Septic systems throughout the County were inventoried, and placed in a GIS layer for ease of viewing and inventory maintenance. (RBF, 2003) **Figure 4-4** illustrates the location of the inventoried septic systems within the study area of this SNMP, primarily in the lower San Juan and the Upper Trabuco subareas.

The final inventory/database lists over 2,776 active septic systems in Orange County. The failure rate for septic systems in Orange County was estimated through field investigation. Based on a field survey of eighty systems, one failed system was noted; representing a failure rate of 1.25 percent. An analysis was performed to determine the extent septic systems may impact water quality in Orange County based on the results from the field survey findings. A spreadsheet model was developed to estimate the loading of pathogen indicators and total Kjeldahl nitrogen (TKN) from the failed systems. The results of the analysis show that the load from the failed septic systems in any given year is a very marginal contributor for pathogen indicators and is insignificant for TKN.

On June 19, 2012, the State Water Resources Control Board (State Water Board) adopted Resolution No. 2012-0032, adopting the Water Quality Control Policy for Siting, Design, Operation, and Maintenance of Onsite Wastewater Treatment Systems (OWTS Policy). This Policy establishes a statewide, risk-based, tiered approach for the regulation and management of OWTS installations and replacements and sets the level of performance and protection expected from OWTS. The Regional Board is required to incorporate the standards established in the OWTS Policy, or standards that are more protective of the environment and public health, into their water quality control plans by May 2014. The policy does not identify any impaired water bodies within the study area of this SNMP; however, septic systems in the area will be required to conform to the other requirements outlined in the policy.

[8] The Drainage Area Management Plan (DAMP) is available online at: http://www.ocwatersheds.com/DAMP_MapPlan.aspx

[9] The Report of Waste Discharge (ROWD) is available online at: http://www.ocwatersheds.com/ReportsDocuments.aspx#ROWD

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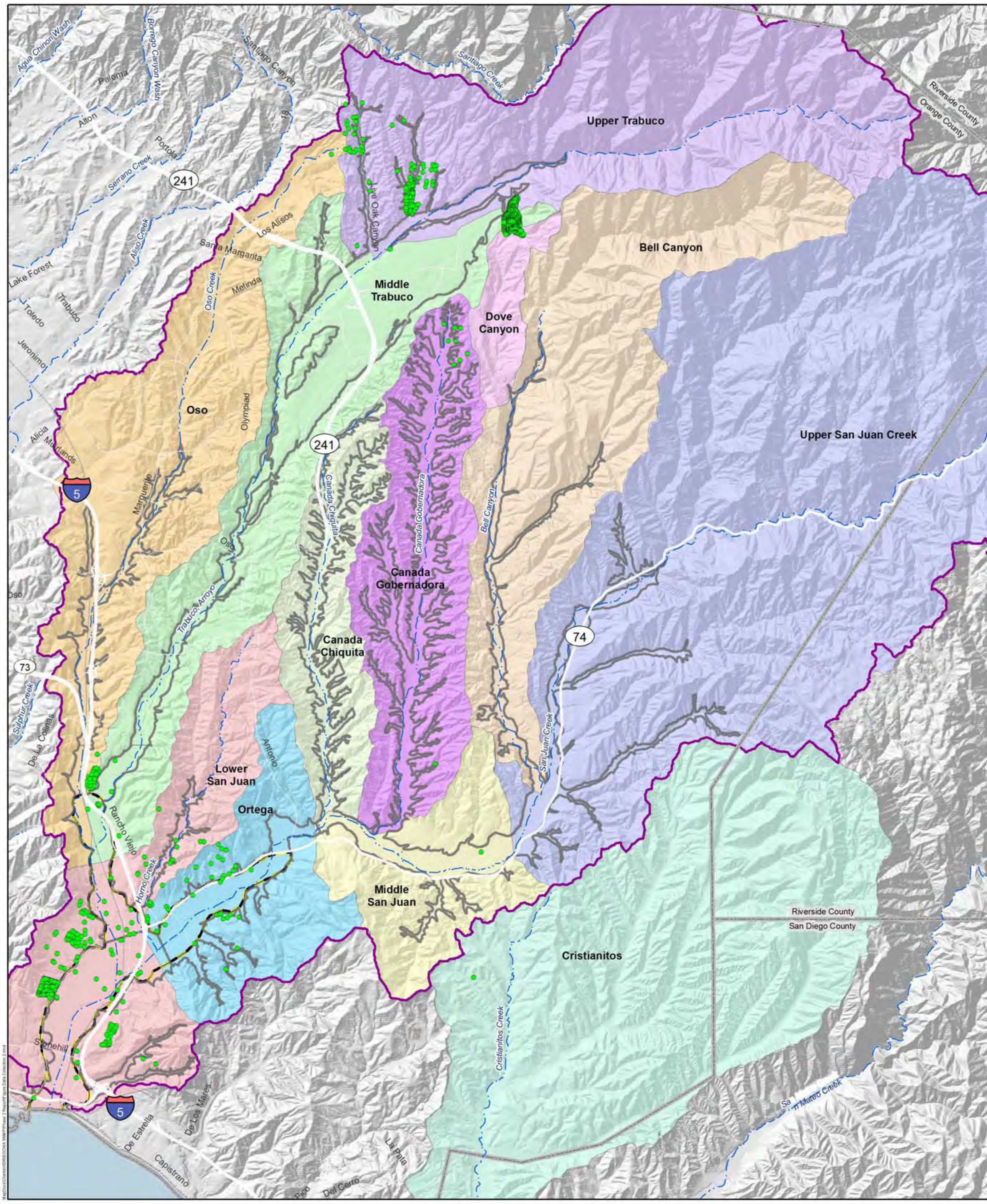


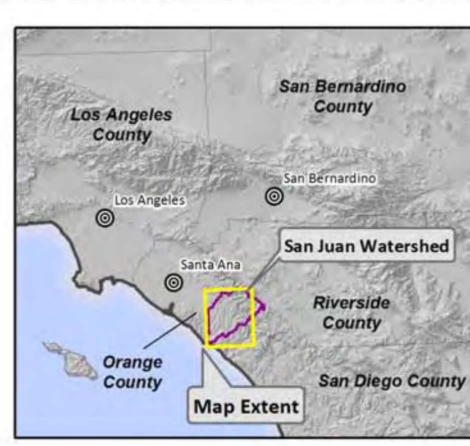


**Main Features**

- Septic Tank

**Hydrologic Features**

- Active Groundwater Storage Area
- San Juan Creek Watershed Boundary
- San Juan Basin
- Streams and Creeks

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Author: LBB
Date: 20130509
File: figure 4-4 septic.mxd

0 4,000 8,000 Feet
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2013 Salt and Nutrient Management Plan

**Locations of Septic Tanks**

**Figure 4-4**

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# 5.0 GROUNDWATER BASIN EVALUATION

The Regional Boards manage salt and nutrients, in part, by regulating the discharge and reuse of recycled water. Constituent concentration limitations for recycled water discharge and reuse are based on the water quality objectives established by each region's Basin Plan. In general, permitting and establishing concentration limitations for a given recycled water project requires an assessment of current ambient groundwater quality, a comparison of the ambient quality to the relevant Basin Plan objectives, and a determination of whether the project will result in an exceedance of a Basin Plan objective.

As the measure of compliance with water quality objectives, the San Diego Basin Plan establishes that constituent concentrations in groundwater should not exceed the constituent objective more than 10 percent of the time during any one-year period (see Table 3-3 of the San Diego Basin Plan). There is no further specification as to where or how often compliance data should be collected, or how to estimate ambient constituent concentrations to compute assimilative capacity for a hydrologic area or sub-area.

To clarify such ambiguities, which are not uncommon in the various Regional Basin Plans, the Recycled Water Policy outlines the criteria which the Regional Boards should use to evaluate and permit recycled water projects (see Sections 7, 8, and 9 of the Policy).The criteria are based directly on findings of current assimilative capacity and projected future assimilative capacity. The Policy identifies how to make these findings when the Regional Board, or its Basin Plan, has not already done so:

> *"...For those basins/sub-basins where the Regional Water Boards have not determined the baseline assimilative capacity, the baseline assimilative capacity shall be calculated by the initial project proponent...For compliance with this subparagraph, the available assimilative capacity shall be calculated by comparing the mineral water quality objective with the average concentration of the basin/sub-basin, either over the most recent five years of data available or using a data set approved by the Regional Water Board Executive Officer. In determining whether the available assimilative capacity will be exceeded by the project or projects, the Regional Water Board shall calculate the impacts of the project or projects over at least a ten year time frame."* [Section 9.c.(1) of The Policy][10]

As presented in Section 3.2 of this report, four levels of analysis were proposed for the development of an SNMP:

- **Level 1 -** No significant groundwater resources and no significant downstream concerns.
- **Level 2 -** Marginally significant groundwater resources and significant downstream concerns.
- **Level 3 -** Modest groundwater resources and significant downstream concerns.
- **Level 4 -** More significant groundwater resource.

These levels are applied to the watersheds within the study area, as noted in **Table 5-1**, below.

10 Section 9.c.(2) of The Policy refers specifically to permitting of recycled water recharge projects. Given that comparisons of current and future assimilative capacity are also criteria for permitting landscape irrigation projects (as discussed in section 9.d of The Policy, it is assumed that guidelines provided in Section 9.c.(2). are applicable to the evaluation of all types of recycled water projects proposed for implementation.

**Table 5-1. Current Hydrologic Areas and SNMP Level of Analysis**

| San Juan Hydrologic Subunit | Unit No. | SNMP Level of Analysis |
|---|---|---|
| Laguna | 1.10 | -- |
| San Joaquin Hills | 1.11 | Level 1 |
| Laguna Beach | 1.12 | Level 1 |
| Aliso | 1.13 | Level 1 |
| Dana Point | 1.14 | Level 1 |
| Mission Viejo | 1.20 | -- |
| Oso | 1.21 | Level 3 |
| Upper Trabuco | 1.22 | Level 3 |
| Middle Trabuco | 1.23 | Level 3 |
| Gobernadora | 1.24 | Level 3 |
| Upper San Juan | 1.25 | Level 3 |
| Middle San Juan | 1.26 | Level 4 |
| Lower San Juan | 1.27 | Level 4 |
| Ortega | 1.28 | Level 4 |
| San Clemente | 1.30 | -- |
| Prima Deshecha | 1.31 | Level 1 |
| Segunda Deshecha | 1.32 | Level 1 |
| San Mateo Canyon | 1.40 | - |
| Cristianitos (Proposed) | 1.42 | Level 2 |

Sections 5 and 6 of this SNMP describe the groundwater basin evaluations performed to determine current ambient water quality, current assimilative capacity, and future assimilative capacity for the Levels 2 and 3 (Section 5), and Level 4 (Section 6) HSAs. The results of these evaluations will be used in the Antidegradation Analysis presented in Section 7 of this SNMP. As previously noted, the areas with no significant groundwater resources and no significant downstream concerns (Level 1) were determined in the Phase I initial basin characterization findings (Section 3.2) to not require any additional analysis with regard to salt and nutrient management.

## 5.1 LEVEL 3 — SALT BALANCE MODEL ANALYSIS

The salt balance is a theoretical concept where the total mass of dissolved minerals entering a ground water basin system from all sources is equal to the total mass of dissolved minerals leaving the system, either through extraction or natural outflow. It is preferable to have a balance of the salt inflows and outflows to maintain water quality in a basin. The salt-balance model consists of a series of alluvial surface/subsurface drainage elements. For each drainage element, the inputs and outputs of salt from stormwater, non-storm surface water and subsurface flow are computed. The inputs from precipitation, potable irrigation return, recycled irrigation return, urban return, and geologic leaching are considered, as well as the outputs from evaporation, well/diversion, and deep percolation. This form of mass balance analysis is used here to assess Level 2 and 3 basins, as outlined in the San Diego Guidelines for Salinity/Nutrient Management Planning.

### 5.1.1 Data Sources and Assumptions

The usefulness of any groundwater model in predicting actual conditions is limited to the accuracy of the assumptions and data used in the development and application of the model. The models presented and described herein were developed with full recognition that many of the parameters are based on factors such as geological conditions, current and future development plans, landscaping/hard surface mixture, and runoff coefficients that are difficult to accurately measure. Bases for estimates and assumptions are noted in the following paragraphs.

#### *5.1.1.1 Watershed Boundaries/Area*

The study area is contained within Region 9 and is further divided into hydrologic areas, subareas, and drainages. The boundaries of the watersheds are unchanged from previous modeling for the most part, although some watersheds were updated based on recent GIS data. The boundaries are based on the most recent Basin Plan and were collected from the RWQCB. These updated boundaries changed the area inputs for some watersheds; the magnitude of this change for the total study area was less than four percent. These new inputs replaced area values calculated from hand drawn boundaries on maps in the models developed for the previous basin plan amendment[11]. The watershed boundaries match those available through the RWQCB for all areas except for the Oso/La Paz boundary. The Oso/La Paz boundary available through the RWQCB did not match the boundary that was developed during the previous basin plan amendment. The Oso/La Paz boundary that was previously used was carried forward for the current modeling. The calculated areas for each of the hydrologic basins are provided in Table 5-2.

**Table 5-2. Acreages of Hydrologic Subareas**

| Subarea | Area (Acres) |
|---|---|
| Oso/La Paz | 10,544 |
| Middle Trabuco | 10,704 |
| Upper San Juan | 37,739 |
| Upper Trabuco | 13,339 |
| Gobernadora | 7,116 |
| Chiquita | 4,085 |
| Dove/Bell | 13,083 |
| Cristianitos | 20,487 |

#### *5.1.1.2 Land Use and Land Cover*

Land uses are consistent with current conditions and future projections. Land uses were obtained from 2008 GIS data obtained from SCAG information and compared to the information in the General Plan. The land use by type for each HSA is provided in **Table 5-3**. This information provided the basis for future projections of land use and development.

Land cover data was obtained from United States Geological Survey (USGS) National Gap Analysis Program (GAP) information published in 2001. Current land cover acreages, separated by land cover type are provided in **Table 5-4**. Development projections are provided in **Table 5-5**.

Future land use was obtained from the General Plan. The future “Open Space and Recreation” was subtracted from the total HSA area to determine the future human development.

*Example: Total HSA Area – Future Open Space and Recreation = Future Human Development*

[11] Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993.

**Table 5-3. Land Use by Type**

| Land Use Type | Oso/ La Paz | Upper Trabuco | Middle Trabuco | Chiquita | Gobernadora | Dove/ Bell | Upper San Juan | Cristianitos |
|---|---|---|---|---|---|---|---|---|
| | Acres | | | | | | | |
| Agriculture | 123 | 116 | 186 | 0 | 59 | 0 | 203 | 57 |
| Commercial and Services | 1,205 | 82 | 902 | 79 | 94 | 0 | 320 | 357 |
| Fire/Police Station | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Industrial | 121 | 7 | 132 | 0 | 25 | 0 | 101 | 413 |
| Military Training | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,986 |
| Military Use | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 82 |
| Mixed Commercial and Industrial | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 27 |
| Open Space and Recreation | 2,186 | 186 | 3,165 | 1,153 | 1,360 | 3,968 | 990 | 561 |
| Residential | 3,958 | 263 | 2,395 | 2 | 2,012 | 277 | 471 | 1,243 |
| Transportation, Communications, and Utilities | 586 | 1 | 626 | 173 | 6 | 11 | 0 | 135 |
| Under Construction | 0 | 0 | 26 | 0 | 1 | 0 | 0 | 29 |
| Unknown | 1,732 | 56 | 1,041 | 15 | 42 | 31 | 702 | 822 |
| Urban Vacant | 6 | 3 | 280 | 0 | 18 | 98 | 0 | 0 |
| Vacant | 423 | 12,625 | 1,925 | 2,664 | 3,468 | 8,677 | 34,952 | 13,046 |
| Vacant and Undeveloped Land | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 726 |
| Water | 205 | 0 | 26 | 0 | 33 | 21 | 0 | 0 |
| Total | 10,544 | 13,339 | 10,704 | 4,085 | 7,116 | 13,083 | 37,739 | 20,487 |

**Table 5-4. Existing Land Cover**

| Land Cover Type | Oso/ La Paz | Middle Trabuco | Upper San Juan | Upper Trabuco | Gobernadora | Chiquita | Dove/ Bell | Cristianitos |
|---|---|---|---|---|---|---|---|---|
| | Acres | | | | | | | |
| Agricultural Vegetation | 0 | 0 | 134 | 0 | 2 | 0 | 0 | 23 |
| Developed & Other Human Use | 9,221 | 7,336 | 1,425 | 950 | 2,795 | 499 | 954 | 1,886 |
| Forest & Woodland | 152 | 1,003 | 3,601 | 2,329 | 1,154 | 629 | 1,902 | 4,510 |
| Nonvascular & Sparse Vascular Rock Vegetation | 0 | 2 | 60 | 0 | 55 | 2 | 8 | 29 |
| Open Water | 135 | 1 | 0 | 0 | 13 | 0 | 10 | 3 |
| Semi-Desert | 0 | 1 | 73 | 22 | 5 | 3 | 4 | 5 |
| Shrubland & Grassland | 1,037 | 2,361 | 32,445 | 10,038 | 3,092 | 2,952 | 10,205 | 14,031 |
| Total | 10,544 | 10,704 | 37,739 | 13,339 | 7,116 | 4,085 | 13,083 | 20,486 |

**Table 5-5. Developed and Other Human Use Area Projections**

| Basin | Current Developed & Other Human Use[1] | Future Human Development[2] | Additional Development |
|---|---|---|---|
| | Acres | | |
| Oso | 9,221 | 9,221 | 0 |
| Middle Trabuco | 7,336 | 7,336 | 0 |
| Upper San Juan | 1,425 | 1,461 | 36 |
| Upper Trabuco | 950 | 2,789 | 1,839 |
| Gobernadora | 2,795 | 4,966 | 2,171 |
| Chiquita | 499 | 1,126 | 627 |
| Bell | 954 | 954 | 0 |
| Cristianitos | 1,886 | 4,233 | 2,347 |

1. SCAG Lang Use 2008
2. Future Human Development determined by subtracting Future Open Space and Recreation (derived from General Plan) from Total HSA area.

Land cover is an important characteristic of each drainage area because it impacts the amount of applied water that is evapotranspired by vegetation or evaporated from water surfaces. Future land use and land cover were developed from the General Plan, which provides information and planned future development. Future development data were used to update the future Developed and Other Human Use information, and the additional development areas were subtracted from the other types of land cover. The changes in land use were used to project the amount of acreage assigned to "lawn/landscape" for and project future evapotranspiration estimates.

Extrapolations of the current data in to the future are provided in **Table 5-6**; the land use numbers in ***bold italics*** are the only ones that were changed from the current land cover. The "Developed & Other Use" value was increased based on increases in human development demonstrated in the General Plan. The acreages that were added to the "Developed & Other Use" category were subtracted from "Shrubland and Grassland", because in many cases, it was the largest land cover type and it also was the most reasonable land cover type from which to subtract the area.

**Table 5-6. Future Land Cover**

| Land Cover Type | Upper San Juan | Upper Trabuco | Gobernadora | Chiquita | Cristianitos |
|---|---|---|---|---|---|
| | Acres | | | | |
| Agricultural Vegetation | 134 | 0 | 2 | 0 | 23 |
| Developed & Other Human Use | *1,461* | *2,789* | *4,966* | *1,126* | *2,336* |
| Forest & Woodland | 3,601 | 2,329 | 1,154 | 629 | 4,510 |
| Nonvascular & Sparse Vascular Rock Vegetation | 60 | 0 | 55 | 2 | 29 |
| Open Water | 0 | 0 | 13 | 0 | 3 |
| Semi-Desert | 73 | 22 | 5 | 3 | 5 |
| Shrubland & Grassland | *32,409* | *8,199* | *921* | *2,325* | *13,551* |
| Total | 37,739 | 13,339 | 7,116 | 4,085 | 20,486 |

### *5.1.1.3 Precipitation and Evapotranspiration*

Long-term average annual precipitation for each HSA was computed using the Gridded Map tool in HydroDaVE Explorer[SM]. HydroDaVE Explorer exports monthly minimum, maximum, and average precipitation and temperature records generated by the Parameter-elevation Regression on Independent Slopes Model (PRISM) Climate Group. PRISM is a GIS-based hybrid statistical-geographic approach to mapping climate data (Daly and Neilson, 1992; Daly, et al., 1994; Daly, et al., 1997). PRISM uses point data, a digital elevation model (DEM), and other spatial data sets to generate estimates of annual, monthly, and event-based climatic elements that are gridded and GIS-compatible. HydroDaVE Explorer exports PRISM grid-cell data sets with a resolution of 800 square meters (30 arc-seconds) for a user-defined period of record within specified polygon areas. For this study, GIS polygons of the HSAs were loaded to HydroDaVE Explorer to export monthly average precipitation for the 1895 to 2011 period. From this export, average annual precipitation was computed for each individual HSA. The values used in the models are provided in **Table 5-7**.

**Table 5-7. Precipitation Values**

| Basin | The long-term (1895-2010), Annual Average Precipitation | |
|---|---|---|
| | inches | feet |
| Upper Trabuco | 22.05 | 1.84 |
| Bell Canyon | 18.33 | 1.53 |
| Upper San Juan | 18.01 | 1.50 |
| Dove Canyon | 17.89 | 1.49 |
| Middle Trabuco | 15.70 | 1.31 |
| Cristianitos | 16.06 | 1.34 |
| Gobernadora | 15.49 | 1.29 |
| Chiquita | 15.27 | 1.27 |
| Oso / La Paz | 14.90 | 1.24 |

Research conducted for the RWQCB, San Diego Region showed a range of TDS values for rainfall to be 10 to 15 mg/L (UCI, 1975). The precipitation was modeled with a TDS of 15 mg/L, based on the high end of this range.

Land cover data described above were evaluated to determine appropriate evapotranspiration rates. Evapotranspiration rates were derived based on values used in previous modeling from the second edition of The Water Encyclopedia (Frits von der Leeden, Fred L. Troise, and David Keith Todd) and are provided in **Table 5-8**. Evapotranspiration rates are based on type of vegetation, availability of water, and climatic conditions. Availability of water depends on climatic rainfall as well as runoff. Ranges were used based on observed runoff values. The range of evapotranspiration rates applied to each basin is provided in **Table 5-8**.

**Table 5-8. Evapotranspiration Rates**

| Land Cover Type | Evapotranspiration Rate, Feet per Year |
|---|---|
| Agricultural | 4.40 |
| Developed – not lawn/landscape | 0 |
| Lawn/Landscape | 4.21 |
| Forest & Woodland | 1.50 to1.90 |
| Nonvascular & Sparse Vascular Rock Vegetation | 0.88 |
| Semi-Desert | 0.88 |
| Shrubland & Grassland | 0.88 to 1.32 |
| Open Water | 3.70 |

#### *5.1.1.4 Surface Water and Groundwater Quality*

Surface water and stormwater data were analyzed to characterize the stormwater TDS and non-storm TDS for each of the HSAs. However, complete data were not necessarily available for each of the HSAs. In addition, some HSAs had surface water data and stormwater data; some had one or the other, and some and neither surface water nor stormwater data. Two methods of analysis were employed to determine the stormwater TDS: one method was based on surface water TDS and a second method used only stormwater TDS. Non-storm TDS quality was determined from the surface water data only, for each HSA for which surface water data were available.

Surface water data were accessed from the San Juan Basin Authority's relational database, which is accessed through HydroDaVE[sm], for each of the hydrologic areas and used as one method to determine the TDS of the storm and non-storm flows. The HSA for the available sample locations, number of samples, and date ranges are provided in **Table 5-9**. The location of these sample sites are shown in **Figure 5-1**. Raw data is provided in **Appendix C**.

**Table 5-9. Surface Water Data**

| HSA | Sample Sites[1] | Total Samples | Date Range |
|---|---|---|---|
| Upper Trabuco | 7 | 13 | 1998 |
| Dove/Bell Canyon | 2 | 0 | N/A |
| Upper San Juan | 6 | 5 | 1987-2009 |
| Middle Trabuco | 17 | 126 | 1986-2010 |
| Cristianitos | 0 | 0 | N/A |
| Gobernadora | 2 | 13 | 1986-1987 |
| Chiquita | 1 | 8 | 1986-1987 |
| Oso/La Paz | 4 | 95 | 1997-2010 |

1. Some sample sites do not have any samples.

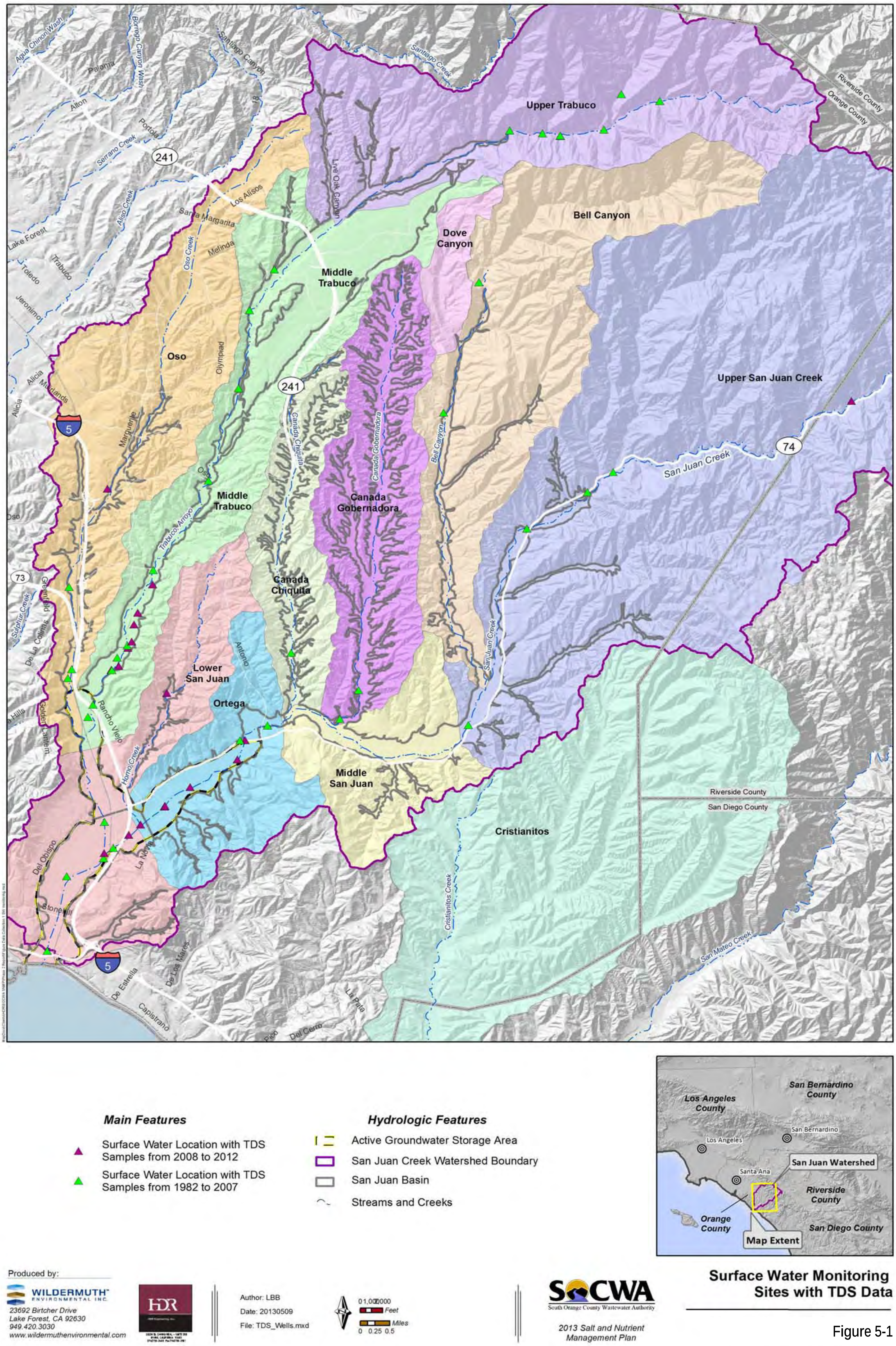
Daily rainfall data were collected at Lake Mission Viejo from 2001 through 2011. In **Table 5-10**, dates of surface water sample collection were compared to daily rainfall data at Lake Mission Viejo to determine if the sample TDS concentration was indicative of storm or non-storm flows. Volume of rainfall on the day of the sample and the days preceding the sample were considered.

**Table 5-10. Surface Water Characterization of TDS for Storm and Non-Storm**

| HSA | TDS Non-Storm (mg/L) | TDS Storm (mg/L) | Comments |
|---|---|---|---|
| Upper Trabuco | 300 | N/A | Limited data available in 1998 only. Data from the Tin Mine area were disregarded because they were much higher than the rest of the HSA data. |
| Dove/Bell Canyon | N/A | N/A | No surface water data were available |
| Upper San Juan | 400 | N/A | Four samples taken in 1987 (average TDS = 329); one sample taken in 2009 (383 mg/L). Higher result taken more recently was deemed more representative. |
| Middle Trabuco | 800 | 600 | Relatively consistent data sets were available for the period from 2005 to 2010 for three of the 17 sample sites. These three were used for characterization. |
| Cristianitos | N/A | N/A | No surface water data were available |
| Gobernadora | 1000 | N/A | Only data available are from 1986 to 1987. Average TDS of sample results was 917 mg/L. |
| Chiquita | 800 | N/A | Only data available are from 1986 to 1987. Average TDS of sample results was 813 mg/L. |
| Oso/La Paz | 2,315 | 1,200 | Samples available at Oso Creek regularly from 2005 to 2010. Only three samples taken were considered to be characteristic of storm TDS. |

1. N/A: no samples were available

Stormwater data came from stormwater sampling done from 2001-2003 for the Rancho Mission Viejo Conceptual Water Quality Management Plan (GeoSyntech Consultants, Inc., 2004). Data were not available for each of the HSAs. Those data that were available are provided in **Table 5-11** and the data used in the models is provided in **Table 5-12**.




**Surface Water Monitoring Sites with TDS Data**

Figure 5-1

**Table 5-11. Stormwater Data and Storm TDS**

| HSA | Sample Sites | Total Samples | TDS Storm (mg/L) |
|---|---|---|---|
| Upper Trabuco | N/A | N/A | N/A |
| Dove/Bell Canyon | 1 | 2 | 215 |
| Upper San Juan | N/A | N/A | N/A |
| Middle Trabuco | 3 | 9 | 250 |
| Cristianitos | 2 | 6 | 417 |
| Gobernadora | 2 | 6 | 400 |
| Chiquita | N/A | N/A | N/A |
| Oso/La Paz | N/A | N/A | N/A |

1. Note: Samples taken in February and March of 2003

**Table 5-12. TDS Storm and Non-Storm Used in Models**

| HSA | TDS Storm (mg/L) | TDS Non-Storm (mg/L) |
|---|---|---|
| Upper Trabuco | 175 | 300 |
| Dove/Bell Canyon | 216 | 350 |
| Upper San Juan | 150 | 383 |
| Middle Trabuco | 600 | 1,000 |
| Cristianitos | 200 | 619 |
| Gobernadora | 410 | 916 |
| Chiquita | 200 | 800 |
| Oso/La Paz | 600 | 2,315 |

### *5.1.1.5 Groundwater flow and quality*

Data were available on the flow of groundwater across boundaries of the Lower Trabuco and Oso/La Paz drainage areas considered in this analysis. These data are currently unpublished and were provided by Geoscience Support Services Inc. Well water data were available from the San Juan Basin Authority's relational database, which is accessed through HydroDaVE$^{sm}$. The locations of the wells with TDS data are shown in **Figure 5-2**. Raw data is provided in **Appendix C**.

***Dove Canyon Wells Water Quality***

A summary of the available data for wells in the Dove Canyon HSA is provided in **Table 5-13**.

**Table 5-13. TDS of Upper and Lower Monitoring Wells**

| Well Name | Number of Samples | Date Range | Average TDS (mg/L) |
|---|---|---|---|
| Upper Monitoring Well | 4 | 2009 to 2012 | 1,813 |
| Lower Monitoring Well | 4 | 2009 to 2012 | 2,008 |

***Cristianitos Wells Water Quality***

A summary of the available data for wells in the Cristianitos HSA is provided in **Table 5-14.**

**Table 5-14. TDS of Cristianitos Wells**

| Well Name | Number of Samples | Date Range | Average TDS (mg/L) |
|---|---|---|---|
| Northrup 1 | 4 | 2012 to 2013 | 548 |
| Northrup 2 | 1 | 2012 | 456 |
| Pico Well | 7 | 2009 to 2010 | 740 |

***Upper San Juan Creek Wells Water Quality***

A summary of the available data for wells in the Upper San Juan HSA is provided in **Table 5-15.**

**Table 5-15. TDS of San Juan Creek Wells**

| Well Name | Number of Samples | Date Range | Average TDS (mg/L) |
|---|---|---|---|
| RMV Nichols Well | 35 | 1994-2010 | 532 |
| Main Well | 1 | 1993 | 230 |

***Upper Trabuco Water Quality***

A summary of the available data for wells in the Upper Trabuco HSA is provided in **Table 5-6**.

**Table 5-16. TDS of Upper Trabuco Wells**

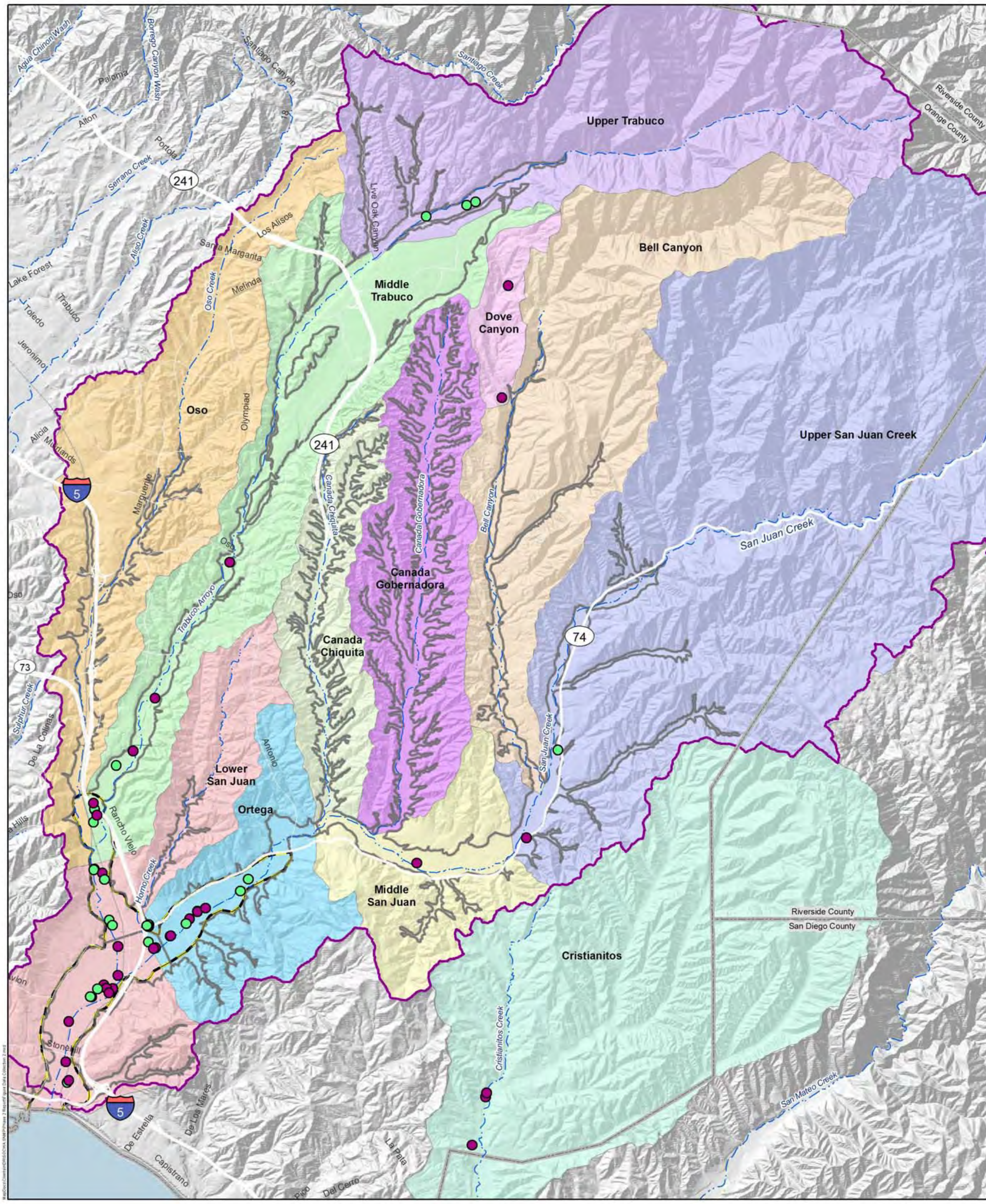
| Well Name | Number of Samples | Date Range | Average TDS (mg/L) |
|---|---|---|---|
| Rose | 2 | 1998 | 353 |
| Sakaida | 2 | 1998 | 435 |
| T-Y Nursery | 2 | 1998 | 385 |

***Middle Trabuco Water Quality***

A summary of the available data for wells in the Middle Trabuco HSA is provided in **Table 5-7.**

**Table 5-17. TDS of Middle Trabuco Wells**

| Well Name | Number of Samples | Date Range | Average TDS (mg/L) |
|---|---|---|---|
| IW 1 | 21 | 2005 to 2010 | 946 |
| P-6 | 17 | 2005 to 2010 | 1,041 |
| Rosenbaum 1 | 24 | 1966 to 2010 | 735 |
| Rosenbaum 2 | 11 | 1961 to 1997 | 580 |
| Christmas Tree Farm 1 | N/A | 1962 to 1966 | 525 |
| Egan Tract 1 | 2 | 1996 to 1998 | 755 |
| North Open Space | 11 | 1999 to 2008 | 1,041 |
| Christmas Tree Farm 2 | 2 | 1966 to 1967 | 538 |




**Main Features**

- Well with TDS Samples from 2008 to 2012
- Well with TDS Samples from 1982 to 2007

**Hydrologic Features**

- Active Groundwater Storage Area
- San Juan Creek Watershed Boundary
- San Juan Basin
- Streams and Creeks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Date: 20130509
File: TDS_Wells.mxd

0 1,000 2,000 Feet
0 0.25 0.5 Miles

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South Orange County Wastewater Authority
2013 Salt and Nutrient Management Plan

**Wells with TDS Data**

**Figure 5-2**

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#### 5.1.1.6 Recycled Water Quality, Production, and Use

Recycled water TDS quality and production data were available for each of the recycled water treatment plants in the study area from before 2007 through 2011. Data were provided by SOCWA. Each watershed considered the contributing treatment plants using both 2011 flow-weighted average values and 5-year (2007–2011) flow-weighted values. These two different approaches were taken to understand the differences between very recent and longer-term trends in recycled water quality. Recycled water TDS and production are provided in **Table 5-18** and **Table 5-19**.

**Table 5-18. Recycled Water Quality**

| Year | Recycled Water TDS (mg/L) by Treatment Plant | | | | | |
|---|---|---|---|---|---|---|
| | TCWD | SMWD Oso | SMWD Chiquita | SMWD Nichols | MNWD-3A | MNWD-RTP |
| 2007 | 970 | 690 | 638 | 830 | 869 | 795 |
| 2008 | 916 | 828 | 834 | 926 | 986 | 848 |
| 2009 | 990 | 991 | 920 | 1,019 | 965 | 936 |
| 2010 | 930 | 845 | 794 | 1,006 | 881 | 841 |
| 2011 | 888 | 630 | 647 | 694 | 872 | 736 |
| Average | 939 | 797 | 766 | 895 | 915 | 831 |

**Table 5-19. Recycled Water Production**

| Year | Recycled Water Production (MGD) by Treatment Plant | | | | | |
|---|---|---|---|---|---|---|
| | TCWD | SMWD Oso | SMWD Chiquita | SMWD Nichols | MNWD-3A | MNWD-RTP |
| 2007 | 0.63 | 1.47 | 2.81 | 0.02 | 1.25 | 5.98 |
| 2008 | 0.92 | 1.54 | 2.14 | 0.02 | 0.63 | 6.24 |
| 2009 | 0.61 | 1.23 | 2.48 | 0.02 | 0.96 | 6.30 |
| 2010 | 0.64 | 1.10 | 1.83 | 0.03 | 0.96 | 5.47 |
| 2011 | 0.62 | 1.69 | 2.40 | 0.03 | 0.74 | 4.92 |
| Average | 0.68 | 1.41 | 2.33 | 0.02 | 0.91 | 5.78 |

The resulting flow-weighted averages for all recycled water produced in the SOCWA service area are provided in **Table 5-20**. The 2011 average, 717 mg/L, was deemed to be more representative of current recycled water production and use, and was therefore used in the modeling. Sensitivity analyses were performed on this and other parameters. That evaluation is provided below.

**Table 5-20. Flow-Weighted Average of Recycled Water TDS**

| Period | Average TDS[1] (mg/L) |
|---|---|
| 2007 to 2011 | 827 |
| 2011 | 717 |

1. Average TDS calculated from by flow-weighting water reclamation plant TDS.

Recycled water use data for 2010 and 2011 was provided by SOCWA. **Table 5-21** shows how that use is distributed among the HSAs, and **Table 5-22** shows how that use is distributed among the recycled water purveyors. Planned use refers to projected use, based on the plans of each recycled water purveyor in 1997, as documented in the SOCWA permit, Regional Board Order 97-52. Permitted use generally exceeds the planned value.

**Table 5-21. Recycled Water Use By Drainage Area**

| HSA | SOCWA 2011 Actual | SOCWA Planned | Order 97-52 Permitted |
|---|---|---|---|
| | (AFY) | | |
| Oso | 2,548 | 5,290 | 7,168 |
| Middle Trabuco | 924 | 1,487 | 4,232 |
| Upper San Juan | 31 | 91 | 977 |
| Upper Trabuco | 0 | 23 | 420 |
| Gobernadora | 1,634 | 4,000 | 4,148 |
| Chiquita | 0 | n/a | n/a |
| Bell | 0 | n/a | n/a |
| Cristianitos | 0 | 333 | n/a |
| Middle San Juan | 0 | 0 | 0 |
| Lower San Juan | 1,433 | 3,349 | 4,396 |
| Aliso | 4,002 | 6,826 | 10,494 |
| Dana Point | 1,547 | 2,952 | 5,804 |
| Total | 12,119 | 24,351 | 37,639 |

**Table 5-22. Recycled Water Use by Water District (AFY)**

| Parameter | SMWD | MNWD | TCWD | CSJC | Total |
|---|---|---|---|---|---|
| 2010 RW Use | 6,027 | 7,120 | 751 | 430 | 14,328 |
| 2011 RW Use | 5,363 | 5,578 | 645 | 125 | 11,711 |
| Future Use | 12,860 | 9,000 | 1,035 | 1,950 | 24,845 |

### *5.1.1.7 Potable Water Quality and Use*

Where recycled water is unavailable for irrigation, potable water is used. In addition, there is a potential for agencies to use potable water to compliment recycled water in groundwater replenishment projects. Potable water quality data were available from water quality reports provided by the individual water districts within the project area. The majority of the potable water used in the study area comes from the MWD Water District of Southern California. The MWD Water District of Southern California regularly provides data to water suppliers, and the water agencies that provide the water to users also publish annual Water Quality Confidence Reports. Potable water quality was gathered from these reports, and listed in **Table 5-23**.

In addition to water supplied by the MWD Water District of Southern California, some of the agencies in the study area have local sources. Data on these local sources is also available in the Water Quality Confidence Reports.

**Table 5-23. Potable Water Quality and Sources, 2011**

| Source | Average TDS (mg/L) |
|---|---|
| MWD Water District of Southern California Treated Surface Water | 470 |
| Trabuco Canyon Water District Dimension Water Treatment Plant | 640 |
| Trabuco Canyon Water District Trabuco Creek Wells Facility | 370 |

### 5.1.1.8 Irrigation Demands and Return Flows

The irrigated areas were developed in one of two ways based on modeling the current scenario and future projections. For areas that were essentially unchanged since the prior modeling[12], those areas of lawn/landscape that were determined in the past were kept in the current model. The determinations in the past were made according to known places of irrigation (e.g., golf courses, schools, open spaces, parks) or by known areas of irrigation based on data provided by the water supplier. Typically these areas were 35 percent to 45 percent of the developed or urban areas. To project future areas of irrigation based on future development, 60 percent of the future development was assumed to be impervious, leaving 40 percent as lawn/landscape to be irrigated. Once the irrigated areas were determined, recycled water use and the irrigation rate were used to determine the area irrigated by recycled water. The area irrigated by recycled water was then subtracted from the total area irrigated to determine the area irrigated by potable water. The irrigation rate was then used to determine the potable irrigation volume. Evapotranspiration rates were applied and the remainder of the water was assumed to percolate into the groundwater.

### 5.1.1.9 Urban Runoff Diversion/Pumping

A number of projects have been developed or are planned to be developed within the project area that affect the salt balance within the watersheds. These projects have been incorporated into the models and include:

**Upper Oso Creek Barrier**

Urban runoff in Oso Creek is captured at the Upper Oso Creek Barrier (UOCB) and pumped from the barrier to the Upper Oso Reservoir for blending with recycled water stored in the reservoir. This diversion impacts Oso/La Paz HSA and this feature has been included in that model. Pumped flow from the barrier to the reservoir is metered, and samples are regularly taken for water quality monitoring of constituents, including TDS. This monitoring data is provided in **Table 5-24**.

**Table 5-24. Upper Oso Creek Barrier Flow and Quality**

| Year | Total Flow (MG) | Average TDS (mg/L) |
|---|---|---|
| 2007 | 546 | 1,867 |
| 2008 | 785 | 2,200 |
| 2009 | 392 | 2,503 |
| 2010 | 919 | 2,034 |
| 2011 | 425 | 2,508 |
| Average | 613 | 2,222 |

### 5.1.1.10 Model Assumptions

In addition to the data provided in the previous sections, some assumptions were made in the model based on referenced data. These assumptions include:

[12] Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993.

- Natural TDS concentrations in sandstone formations were assumed to range from 3,000 to 5,000 mg/L as referenced from Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, a 1967 report created by Engineering Science, Inc.
- The TDS concentration of rainfall was assumed to be in the range of 10 to 15 mg/L per the 1975 San Diego RWQCB Basin Plan and the 1979 UCI Final Report for Newport-Irvine Waste-Management Planning Agency.
- Salt loading from urban runoff was assumed to be 400 pounds per acre per year, as referenced from the 1997 San Diego RWQCB Basin Plan.

### 5.1.2 Baseline Conceptual Model and Calibration

In the previous basin plan amendment, performed in 1993[13], several watersheds within the study area required the development of an alluvial groundwater model to predict the affects on groundwater quality due to the subsequent increase in the use of reclaimed water in those watersheds. A groundwater quality model based on a salt balance was developed, calibrated and verified for the Oso Creek watershed, and then modified as necessary and transferred to other basins, as appropriate. These previously developed models have been used as the baseline conceptual models for the current basin plan amendment and have been updated to be representative of the current conditions within the study area.

This salt balance concept consists of a relatively simple method of treating a watershed, or a portion thereof, as a “free body” and accounting for all salt and flow inputs and outputs from the system. The models are developed in spreadsheets and track all inputs to the system, such as precipitation and irrigation, and all outputs, such as evapotranspiration, pumping, diversion, and outflow. Water pumped, diverted, or flowing out of the watershed carries salts out of the watershed. As water is lost from evapotranspiration, the salt is left behind in the watershed and the salt concentration increases. Conversely, precipitation dilutes the salt concentration in the basin. In some cases water is “recycled” within a watershed with a water reclamation plant. Reclaimed water can also be exported from a watershed or imported to a watershed. **Figure 5-3** shows a graphical representation of the hydrologic elements used as a basis for the models. The models represent the surface/subsurface elements shown in **Figure 5-3**.

The models are developed on an annual basis, recognizing that monthly or even seasonal data is more prone to error than annual data, and furthermore the level of sophistication of the model does not necessarily warrant analysis on a monthly or seasonal basis. Annual averages for precipitation, evapotranspiration, irrigation rates, water quality, etc. can generally be found as measured data from previous studies or estimates from a literature search. These annual averages were used to estimate multi-year trends.

The models developed for Oso/La Paz Creek, Upper/Middle Arroyo Trabuco, Chiquita, Gobernadora, Dove/Bell Canyon, Upper San Juan Creek, and Cristianitos Canyon are all similar in the respect that these watersheds are generally shallow, narrow, ribbon-like alluvial aquifers which lie directly beneath surface drainage channels. As shown in **Table 5-25**, the average annual precipitation in each basin is equal to or greater than the estimated groundwater storage capacity of each basin. In one case the annual precipitation is as much as 13 times the basin groundwater storage capacity. Much of the precipitation that falls is lost to direct runoff and evapotranspiration. The relatively small storage capacity of these basins in relation to annual volume of precipitation (and more so irrigation) suggest the likelihood that these aquifers could, if depleted, turn over (replace old water in storage with new) very quickly. Quick turnover of these aquifers

[13] Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993.

implies that they can be degraded quickly, but also restored quickly using appropriate management practices. Hence, management plans become critical and the concept of assimilative capacity not very meaningful.

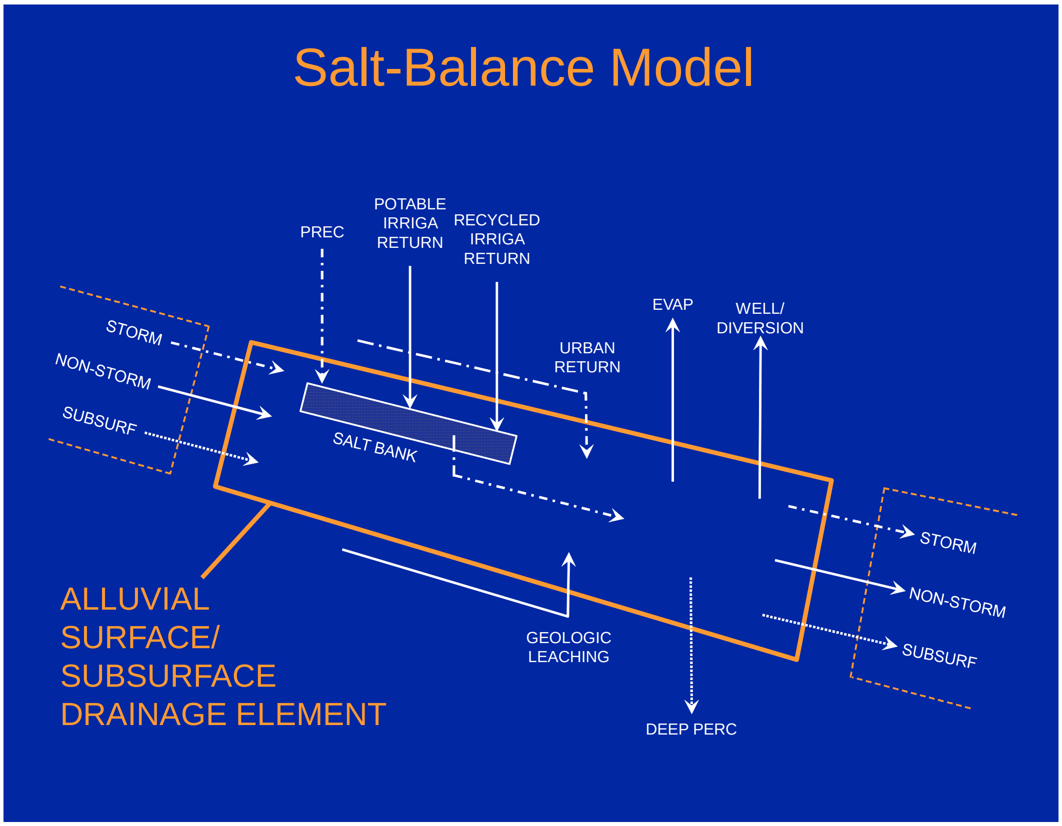


**Figure 5-3. Salt Balance Model Diagram**

**Table 5-25. Storage Capacity and Rainfall Volume**

| Watershed | Storage Capacity (AF)[1] | Drainage Area (acres) | Annual Average Rainfall (ft.) | Rainfall Volume (AF) | Ratio of Rainfall Volume to Storage Capacity |
|---|---|---|---|---|---|
| Oso/La Paz | 6,550 | 10,544 | 1.24 | 13,075 | 2.00 |
| Upper Trabuco | 6,200 | 13,339 | 1.84 | 24,544 | 3.96 |
| Middle Trabuco | 4,980 | 10,704 | 1.31 | 14,022 | 2.82 |
| Chiquita | 4,850 | 4,085 | 1.27 | 5,188 | 1.07 |
| Gobernadora | 9,180 | 7,116 | 1.29 | 9,180 | 1.00 |
| Dove/Bell | 3,490 | 13,083 | 1.53 | 20,017 | 5.74 |
| Upper San Juan | 4,190 | 37,739 | 1.5 | 56,609 | 13.51 |
| Cristianitos | 10,500 | 20,487 | 1.34 | 27,453 | 2.61 |

1. Bulletin No. 104-7, Planned Utilization of Water Resources in the San Juan Creek Basin Area, State of California, Department of Water Resources, 1972 (Resources, 1972).

The concentrated dissolved salts seeping into the groundwaters from geologic formations flanking the alluvium are diluted by the increased flows generated by development and associated water imported into the area. **Since the groundwater bearing strata in each basin generally consists of shallow alluvial deposits directly connected to an overlying surface drainage, the model treats the surface water quality and groundwater quality as being one and the same during non-storm periods, which is the majority of the time during a year.** The presumption, based on observed but limited data, is that the majority of non-storm surface flow is comprised of "rising water" from the alluvial aquifer. Storm runoff is transitory in nature and is highly dependent on the antecedent conditions, as well as stage, duration, and intensity of the storm.

Salts and other constituents are continually flushed out of any basin through the natural hydrologic process. Weather cycles in the study area are typically comprised of several relatively dry years interspersed with wet years. Salts stored in the soil profile during average and dry years are flushed out of the basin during wet years.

The baseline model was originally calibrated for Oso Creek as part of the 1993 Basin Plan Amendment. It is assumed that the previous calibration is still valid since the actual basins haven't experienced any significant changes. For details on the original calibration refer to Section 3.3.1 of the 1993 Basin Plan Amendment Final Report.

### 5.1.3 Salt Source Identification

Salt inputs are the most important parameters considered by the models. The parameters used in the determination and quantification of salt sources include:

- Storm flow, Q(storm): Storm flow tributary to study area
- Upper storm flow: storm flow that comes from upstream drainage areas (e.g., Upper Trabuco storm flow into Middle Trabuco)
- Non-storm flow, Q(non-storm): Non-storm flow tributary to study area
- Upper non-storm flow: non-storm flow that comes from upstream drainage areas (e.g., Upper Trabuco non-storm flow into Middle Trabuco)
- Storm flow quality
- Non-storm flow quality
- Subsurface flow: flow beneath the earth's surface
- Precipitation: the quantity of water deposited on the earth in the form of rain, hail, mist, sleet, or snow.
- Potable irrigation return flow
- Recycled irrigation return flow
- Urban return flow
- Geologic leaching

Other processes affecting the exporting of salt loadings within the study area include:

- Well pumping
- Deep percolation

- Evaporation
- Storm
- Transport

### 5.1.4 Assimilative Capacity

Assimilative capacity specifically refers to the capacity for a water body to absorb constituents without exceeding a specific concentration, such as a water quality objective. For example, if the irrigation water quality objective for salt is 750 mg/L of total dissolved solids, the assimilative capacity of a water body would be the amount of salt that could be added to the water such that its concentration would not exceed 750 mg/L. When the ambient constituent concentration of groundwater within an HSA is greater than the Basin Plan objective for that HSA, the HSA has no assimilative capacity.

The following sections provide an evaluation of ambient conditions and assimilative capacity for TDS in the Level 3 basins. The evaluation for each basin includes a minimum of four scenarios. These scenarios include: (1) a natural condition (pre-development, based on the 1993 Basin Plan Amendment Final Report[14]); (2) the current conditions (assuming 2011 recycled water use); (3) future development based on the General Plan development projections and planned recycled water use; and (4) future development based on the General Plan development projections and permitted recycled water use. In some basins, an evaluation of future development without recycled water use was performed. The model runs for these evaluations are provided in **Appendix D**.

#### *5.1.4.1 Oso/La Paz Results*

Four separate conditions were modeled for the Oso/La Paz HSA, which include:

- Natural Condition
- Current with Reclamation
- Developed with Reclamation (planned use), and
- Developed with Reclamation (permitted use)

The modeling results for the Oso/La Paz HSA are provided in **Table 5-26**. The Oso/La Paz HSA is already considered to be “built-out”; therefore, there is no change in the amount of development between the current model and future projections. Two future projections were modeled based on planned recycled water use (5,290 AFY) and permitted recycled water use (7,168 AFY). The recycled water use is the main difference between the current condition and the future projection. As recycled water use increases from the current condition to the planned use condition and again to the permitted use condition, the TDS of the non-storm flow increases from 2,315 mg/L to 2,447 mg/L to 2,538 mg/L, respectively. The TDS of the storm flow also increases from 600 mg/L to 634 mg/L to 658 mg/L respectively. The value for the TDS of the non-storm flow in the current condition is already greater than the basin objective of 1,200 mg/L. The increased recycled water use in the future conditions exacerbates this condition, but is still within the realm of natural conditions without recycled water use.

[14] Nolte and Associates, SOCWA Basin Plan Amendments Final Report, July 1993.

**Table 5-26. Oso/La Paz Modeling Results**

| Scenario | Nonstorm | | Storm | | Basin Objective TDS (mg/L) | Assimilative Capacity TDS (mg/L) |
|---|---|---|---|---|---|---|
| | Flow (AFY) | TDS Concentration (mg/L) | Flow (AFY) | TDS Concentration (mg/L) | | |
| Natural Condition | 146 | 2,500 | 2,618 | 300 | 1,200 | -1,300 |
| Current with Reclamation | 2,669 | 2,315 | 4,795 | 600 | 1,200 | -1,115 |
| Developed with Reclamation (Planned use) | 2,669 | 2,447 | 4,795 | 634 | 1,200 | -1,247 |
| Developed with Reclamation (Permitted use) | 2,669 | 2,538 | 4,795 | 658 | 1,200 | -1,338 |

### *5.1.4.2 Middle Trabuco Results*

Five separate conditions were modeled for the Middle Trabuco HSA, which include:

- Natural Condition
- Current with Reclamation
- Developed without Reclamation
- Developed with Reclamation (Planned Use), and
- Developed with Reclamation (Permitted Use)

The modeling results for the Middle Trabuco HSA are provided in **Table 5-27**. The Middle Trabuco HSA is already considered to be “built-out”; therefore, there is no change in the amount of development between the current model and future projections. Three future projections were modeled based on no recycled water use, planned recycled water use (1,487 AFY) and permitted recycled water use (4,232 AFY). The recycled water use is the main difference between the current condition and the future projection. The TDS of the non-storm flow is 1,000 mg/L and is already greater than the basin objective of 750 mg/L. Removing recycled water use from the model reduces the TDS of the non-storm flow to 942 mg/L. As recycled water use increases from the current condition to the planned use condition, the TDS of the non-storm flow decreases from 1,000 mg/L to 991 mg/L. As the recycled water use increases from the planned use condition to the permitted use condition, the TDS of the non-storm flow increases from 991 mg/L to 1,082 mg/L. The TDS of the storm flow also increases from 524 mg/L to 552 mg/L to 602 mg/L as the recycled water use increases from no use to the planned use to the permitted use, respectively. The value for the TDS of the non-storm flow in the current condition is already greater than the basin objective. The increased recycled water use in the future conditions exacerbates this condition.

**Table 5-27. Middle Trabuco Modeling Results**

| Scenario | Nonstorm | | Storm | | Basin Objective TDS (mg/L) | Assimilative Capacity TDS (mg/L) |
|---|---|---|---|---|---|---|
| | Flow (AFY) | TDS Concentration (mg/L) | Flow (AFY) | TDS Concentration (mg/L) | | |
| Natural Condition | 1,030 | 450 | 7,713 | 200 | 750 | 300 |
| Current with Reclamation | 2,506 | 1,000 | 6,470 | 600 | 750 | -250 |
| Developed without Reclamation | 2,708 | 942 | 7,536 | 524 | 750 | -192 |
| Developed with Reclamation (Planned Use) | 2,708 | 991 | 7,536 | 552 | 750 | -241 |
| Developed with Reclamation (Permitted Use) | 2,708 | 1,082 | 7,536 | 602 | 750 | -332 |

### 5.1.4.3 Gobernadora Results

Five separate conditions were modeled for the Gobernadora HSA, which include:

- Natural Condition
- Current with Reclamation
- Developed without Reclamation
- Developed with Reclamation (Planned Use), and
- Developed with Reclamation (Permitted Use)

The modeling results for the Gobernadora HSA are provided in **Table 5-28**. The Gobernadora HSA is not fully "built-out." There is and increase in the amount of development between the current model and future projections. Three future projections were modeled based on additional development: no recycled water use, planned recycled water use (4,000 AFY) and permitted recycled water use (4,148AFY). The additional development and recycled water use are the main differences between the current condition and the future projections. The current TDS of the non-storm flow is 916 mg/L and is less than the basin objective (1,200 mg/L), allowing for an assimilative capacity of 284 mg/L. Removing recycled water use from the model reduces the TDS of the non-storm flow to 546 mg/L. With additional development, as recycled water use increases from no use to the planned use condition and then the permitted use condition, the TDS of the non-storm flow increases from 546 mg/L to 677 mg/L and 682 mg/L, respectively. The TDS of the storm flow also increases from 383 mg/L to 475 mg/L to 479 mg/L as the recycled water use increase from no use to the planned use to the permitted use, respectively. The projected concentrations of TDS in both the non-storm and storm flows are below the basin objective for TDS, allowing for assimilative capacity in the basin.

**Table 5-28. Gobernadora Modeling Results**

| Scenario | Nonstorm | | Storm | | Basin Objective TDS (mg/L) | Assimilative Capacity TDS (mg/L) |
|---|---|---|---|---|---|---|
| | Flow (AFY) | TDS Concentration (mg/L) | Flow (AFY) | TDS Concentration (mg/L) | | |
| Natural Condition | 251 | 500 | 1,836 | 200 | | |
| Current with Reclamation | 839 | 916 | 1,823 | 410 | 1,200 | 284 |
| Developed without Reclamation | 1,962 | 546 | 2,718 | 383 | 1,200 | 654 |
| Developed with Reclamation (Planned Use) | 1,962 | 677 | 2,718 | 475 | 1,200 | 523 |
| Developed with Reclamation (Permitted Use | 1,962 | 682 | 2,718 | 479 | 1,200 | 518 |

#### *5.1.4.4 Chiquita Results*

Four separate conditions were modeled for the Chiquita HSA, which include:

- Natural Condition
- Current without Reclamation
- Developed without Reclamation
- Developed with Reclamation (Planned Use), and
- Developed with Reclamation (Permitted Use)

The modeling results for the Chiquita HSA are provided in **Table 5-29**. The Chiquita HSA is not fully "built-out" and there is currently no application of recycled water within the basin. The additional development and recycled water use are the main differences between the current condition and the future projections. The current TDS of the non-storm flow is 800 mg/L, which is below the basin objective (1,200 mg/L) allowing for an assimilative capacity of 400 mg/L. For the first future projection, additional development was considered without reclamation. This resulted in a decreased TDS of the non-storm flow (544 mg/L). A second future projection was modeled based on additional development and recycled water use (676 AFY). Removing recycled water use from the model reduces the TDS of the non-storm flow to 546 mg/L. With additional development, as recycled water use increases from no use to the planned use condition, the TDS of the non-storm flow increases from 544 mg/L to 604 mg/L. The TDS of the storm flow also increases from 211 mg/L to 234 mg/L. The projected concentrations of TDS in both the non-storm and storm flows are below the basin objective for TDS, allowing for assimilative capacity in the basin.

**Table 5-29. Chiquita Modeling Results**

| Scenario | Nonstorm | | Storm | | Basin Objective TDS (mg/L) | Assimilative Capacity TDS (mg/L) |
|---|---|---|---|---|---|---|
| | Flow (AFY) | TDS Concentration (mg/L) | Flow (AFY) | TDS Concentration (mg/L) | | |
| Natural Condition | 104 | 800 | 1,039 | 800 | | |
| Current without Reclamation | 436 | 800 | 590 | 200 | 1,200 | 400 |
| Developed without Reclamation | 963 | 544 | 839 | 211 | 1,200 | 657 |
| Developed with Reclamation (Planned Use) | 963 | 604 | 839 | 234 | 1,200 | 598 |

#### *5.1.4.5 Cristianitos Results*

Five separate conditions were modeled for the Cristianitos HSA, which include:

- Natural Condition
- Current without Reclamation
- Developed without Reclamation
- Developed with Reclamation (Planned Use), and
- Developed with Reclamation (Permitted Use)

The modeling results for the Cristianitos HSA are provided in **Table 5-30**. The Cristianitos HSA is not fully "built-out" and there is currently no application of recycled water within the basin. The additional development and recycled water use are the main differences between the current condition and the future projections. The current TDS of the non-storm flow is 652 mg/L, which is below the basin objective

(750 mg/L) allowing for an assimilative capacity of 98 mg/L. For the first future projection, additional development was considered without reclamation. This resulted in an increased TDS of the non-storm flow (723 mg/L). Additional future projections were modeled based on additional development and two future recycled water use scenarios: planned use (333 AFY) and permitted use (837 AFY). With additional development, as recycled water use increases from no use to the planned use and permitted use conditions, the TDS of the non-storm flow increases from 723 mg/L to 743 mg/L to 773 mg/L, respectively. The TDS of the storm flow also increases from 211 mg/L to 216 mg/L to 225 mg/L, respectively. The projected concentrations of TDS in both the non-storm and storm flows are below the basin objective for TDS for the future development scenario without reclamation and with the planned use reclamation, allowing for assimilative capacity in the basin. However, the projection for future development with permitted recycled water use resulted in a TDS value for the non-storm flow of 773 mg/L, which is greater than the basin objective.

**Table 5-30. Cristianitos Modeling Results**

| Scenario | Nonstorm | | Storm | | Basin Objective TDS (mg/L) | Assimilative Capacity TDS (mg/L) |
|---|---|---|---|---|---|---|
| | Flow (AFY) | TDS Concentration (mg/L) | Flow (AFY) | TDS Concentration (mg/L) | | |
| Natural Condition | 383 | 600 | 5,479 | 200 | | |
| Current without Reclamation | 1,224 | 652 | 2,852 | 200 | 750 | 98 |
| Developed without Reclamation | 1,244 | 723 | 3,054 | 211 | 750 | 27 |
| Developed with Reclamation (Planned Use) | 1,245 | 743 | 3,054 | 216 | 750 | 7 |
| Developed with Reclamation (Permitted Use) | 1,245 | 773 | 3,054 | 225 | 750 | -23 |

#### *5.1.4.6 Dove/Bell Results*

Four separate conditions were modeled for the Dove/Bell HSA, which include:

- Natural Condition
- Current without Reclamation
- Developed without Reclamation
- Developed with Reclamation

The modeling results for the Dove/Bell HSA are provided in **Table 5-31**. The Dove/Bell HSA is considered fully "built-out" and there is currently no application of recycled water within the basin. Recycled water use is the main differences between the current condition and the future projections. The current TDS of the non-storm flow is 350 mg/L, which is below the basin objective (500 mg/L) allowing for an assimilative capacity of 150 mg/L. For the first future projection, there was no additional development and no reclamation. This resulted in no change to the TDS of the non-storm flow. The additional future projection was modeled based on a future recycled water use scenario (889 AFY). As recycled water use increases from no use to planned use, the TDS of the non-storm flow increases from 350 mg/L to 408 mg/L. The TDS of the storm flow also increases from 215 mg/L to 250 mg/L. The projected concentrations of TDS in both the non-storm and storm flows are below the basin objective for TDS for the future recycled water use scenario, allowing for assimilative capacity in the basin.

**Table 5-31. Dove/Bell Modeling Results**

| Scenario | Nonstorm | | Storm | | Basin Objective TDS (mg/L) | Assimilative Capacity TDS (mg/L) |
|---|---|---|---|---|---|---|
| | Flow (AFY) | TDS Concentration (mg/L) | Flow (AFY) | TDS Concentration (mg/L) | | |
| Natural Condition | 305 | 300 | 4,003 | 150 | | |
| Current without Reclamation | 963 | 350 | 1,961 | 215 | 500 | 150 |
| Developed without Reclamation | 963 | 350 | 1,961 | 215 | 500 | 150 |
| Developed with Reclamation | 963 | 408 | 1,961 | 250 | 500 | 92 |

### *5.1.4.7 Upper San Juan Results*

Four separate conditions were modeled for the Upper San Juan HSA, which include:

- Natural Condition
- Current with Reclamation
- Developed with Reclamation (Planned Use), and
- Developed with Reclamation (Permitted Use)

The modeling results for the Upper San Juan HSA are provided in **Table 5-32**. The Upper San Juan HSA is not fully "built-out," although the difference in development between the current figure (1,425 acres) and the future projection (1,461 acres) is minimal. Three future projections were modeled based on additional development: planned recycled water use (91 AFY) and permitted recycled water use (977 AFY). The additional development and recycled water use are the main differences between the current condition and the future projections. The current TDS of the non-storm flow is 383 mg/L and is less than the basin objective (500 mg/L), allowing for an assimilative capacity of 117 mg/L. With additional development, as recycled water use increases from current use (31 AFY) to the planned use condition and then the permitted use condition, the TDS of the non-storm flow increases from 383 mg/L to 387 mg/L and 414 mg/L, respectively. The TDS of the storm flow also increases from 150 mg/L to 151 mg/L to 162 mg/L as the recycled water use increases from no use to the planned use to the permitted use, respectively. The projected concentrations of TDS in both the non-storm and storm flows are below the basin objective for TDS, allowing for assimilative capacity in the basin.

**Table 5-32. Upper San Juan Modeling Results**

| Scenario | Nonstorm | | Storm | | Basin Objective TDS (mg/L) | Assimilative Capacity TDS (mg/L) |
|---|---|---|---|---|---|---|
| | Flow (AFY) | TDS Concentration (mg/L) | Flow (AFY) | TDS Concentration (mg/L) | | |
| Natural Condition | 1,636 | 275 | 11,322 | 150 | | |
| Current with Reclamation | 3,812 | 383 | 4,919 | 150 | 500 | 117 |
| Developed with Reclamation (Planned Use) | 3,817 | 387 | 4,936 | 151 | 500 | 113 |
| Developed with Reclamation (Permitted Use) | 3,817 | 414 | 4,936 | 162 | 500 | 86 |

#### *5.1.4.8 Upper Trabuco Results*

Five separate conditions were modeled for the Upper Trabuco HSA, which include:

- Natural Condition
- Current without Reclamation
- Developed without Reclamation
- Developed with Reclamation (Planned Use), and
- Developed with Reclamation (Permitted Use)

The modeling results for the Upper Trabuco HSA are provided in **Table 5-33**. The Upper Trabuco HSA is not fully "built-out" and there is currently no application of recycled water within the basin. The additional development and recycled water use are the main differences between the current condition and the future projections. The current TDS of the non-storm flow is 300 mg/L, which is below the Basin Objective (500 mg/L) allowing for an assimilative capacity of 200 mg/L. For the first future projection, additional development was considered without reclamation. This resulted in a decreased TDS of the non-storm flow (263 mg/L) and increased TDS of the storm flow from 175 mg/L to 207 mg/L. Additional future projections were modeled based on additional development and two recycled water use scenarios: planned use (23 AFY) and permitted use (420 AFY). With additional development, as recycled water use increases from no use to the planned use and permitted use conditions, the TDS of the non-storm flow increases from 263 mg/L to 264 mg/L to 273 mg/L, respectively. The TDS of the storm flow does not increase from for the planned use condition (207 mg/L), but increases from 207 mg/L to 215 mg/L as recycled water use is increased for the permitted use condition. The projected concentrations of TDS in both the non-storm and storm flows are below the basin objective for TDS, allowing for assimilative capacity in the basin.

**Table 5-33. Upper Trabuco Modeling Results**

| Scenario | Nonstorm | | Storm | | Basin Objective TDS (mg/L) | Assimilative Capacity TDS (mg/L) |
|---|---|---|---|---|---|---|
| | Flow (AFY) | TDS Concentration (mg/L) | Flow (AFY) | TDS Concentration (mg/L) | | |
| Natural Condition | 686 | 400 | 4,909 | 150 | | |
| Current without Reclamation | 212 | 300 | 2,391 | 175 | 500 | 200 |
| Developed without Reclamation | 415 | 263 | 3,457 | 207 | 500 | 237 |
| Developed with Reclamation (Planned Use) | 415 | 264 | 3,457 | 207 | 500 | 236 |
| Developed with Reclamation (Permitted Use) | 415 | 273 | 3,457 | 215 | 500 | 227 |

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# 6.0 LOWER SAN JUAN GROUNDWATER BASIN EVALUATION

The Lower San Juan Basin is that portion of the SJBA groundwater storage area that falls within the boundaries of the Level 4 HSAs. **Figure 6-1** is a map of the active groundwater storage area boundary relative to the boundaries of the Lower San Juan Basin.

A computational method for estimating the current ambient groundwater TDS and nitrate concentration in the Level 4 HSAs (Lower San Juan and Ortega) was developed based on historical groundwater level and water quality data. Then, a constantly-stirred reactor model (CSRM) was developed to project groundwater quality changes over time based on all known sources of salt and nutrient loading. The use of the CSRM allows for the internal feedback from overlying land use, variable loading rates over time, and cascading interaction with the upstream HSA's. Using the current ambient determination as the initial condition, the CSRM was used to project changes in the water quality for a baseline alternative and selected future water resources planning alternatives through the year 2050. The results were then compared against Basin Plan objectives in order to evaluate regulatory compliance issues. This section summarizes the development, use, and results of the computation methods to project water quality changes over time.

## 6.1 ESTIMATION OF AMBIENT WATER QUALITY AND ASSIMILATIVE CAPACITY – LEVEL 4 HYDROLOGIC SUB AREAS

The defining characteristic of the groundwater basin with the Lower San Juan is groundwater storage. Compared to the rapid turnover in the shallow, narrow alluvial aquifers in the upper San Juan Basin (Oso, Middle Trabuco Upper Trabuco, Gobernadora, Upper San Juan), changes in groundwater quality in the Lower San Juan Basin generally occur more slowly and are dependent on the volume and quality of water in storage. The methodology defined by the Basin Plan for evaluating compliance with groundwater quality objectives is impractical for the Level 4 groundwater storage area because it cannot account for the spatial, temporal, or depth-specific variability of constituent concentrations that may exist within a basin. Thus, a basin-wide, volume-averaged approach was developed to make TDS and nitrate-N ambient water quality determinations for the Lower San Juan Basin groundwater storage area. The general steps to estimate ambient water quality with this approach were as follows:

1. Define the groundwater basin storage area and aquifer properties.
2. Review data and select a time period that is representative of a time of interest.
3. Estimate the volume of water in storage.
4. Develop point-statistics of TDS and nitrate-N.
5. Develop contours of TDS and nitrate-N concentrations.
6. Compute the volume-weighted ambient concentration.

Each step is described in detail below.

***Define the groundwater basin storage area and aquifer properties***. The active groundwater storage area managed by the San Juan Basin Authority was used to delineate the boundaries of the groundwater storage area for the ambient water quality analysis.

For the purpose of this analysis, the Lower San Juan Basin is treated as a single-layer, unconfined aquifer. The aquifer properties needed to estimate the volume of water in storage include the effective base of the alluvial aquifer and specific yield (a parameter that describes the quantity of water which a unit volume of aquifer, after being saturated, will yield by gravity, expressed either as a ratio or as a percentage of a unit volume of aquifer sediments).

The effective base of the alluvial aquifer was recently defined as part of the SJBGFMP update (WEI, 2013). And, a numerical groundwater-flow model of the San Juan Basin was recently developed by the Municipal Water District of Orange County in support of the proposed South Orange County Ocean Desalination project (GEOSCIENCE Support Services, Inc. [GSSI], 2013). The groundwater model uses a 15x15 meter grid to assign aquifer properties, including specific yield, to the San Juan Basin. Using the aquifer properties defined by WEI and GSSI, a 15-by-15 meter grid of the groundwater storage area was developed and assigned properties.

Note that although the Middle San Juan HSA is identified as a Level 4 HSA, it was excluded from the projected water quality assessment. The majority of the land overlying this sub-area is privately owned and is managed by the Rancho Mission Viejo (RMV) development company, which would not make its water consumption or water quality data available to the SJBA or MWDOC. Thus, the GSSI model boundary does not extend across the HSA and no aquifer properties could be defined to extend the analysis to include Middle San Juan. A discussion of the Middle San Juan HSA is included in Section 6.3.

***Review data and select a time period of analysis***. To select a time period of analysis, the following data were reviewed and considered: the location of wells with TDS or nitrate-N sample results, the time-history and trends in TDS and nitrate-N concentrations, precipitation patterns, and groundwater production and storage patterns. Based on this review, the five-year time period of January 1, 2007 to December 31, 2011 was selected to represent current ambient water quality of the groundwater storage area. This time period incorporates the maximum number of wells and data points into the analysis and includes wet and dry years. In addition, the basin experienced minimal changes in storage during this time period. Accordingly, the groundwater storage condition at the end of the time period (fall 2011) is considered representative of the entire five-year period. **Figure 6-1** is a map of all wells located in close proximity to the Lower San Juan Basin with TDS or nitrate-N data for the selected time period. Time-history plots of measured TDS and nitrate-N concentrations for the 2007 to 2011 time period are included in **Appendix E** of this report.

***Estimate the volume of water in storage***. All wells in the Lower San Juan Basin with groundwater-level elevation data during the fall 2011 period were mapped and each location was assigned a representative fall 2011 elevation value. Contours of equal-elevation were hand-drawn, digitized, and brought into a Geographic Information System (GIS). The 15x15 meter grids were draped over the basin and groundwater-level elevations were estimated for each grid cell using a topo-to-raster interpolation scheme in the Geospatial Analyst extension to ArcGIS. The volume of groundwater in each grid cell was calculated using the following formula:

$$V_i = A_i \cdot (WL_i - B_i) \cdot SY_i$$

where,

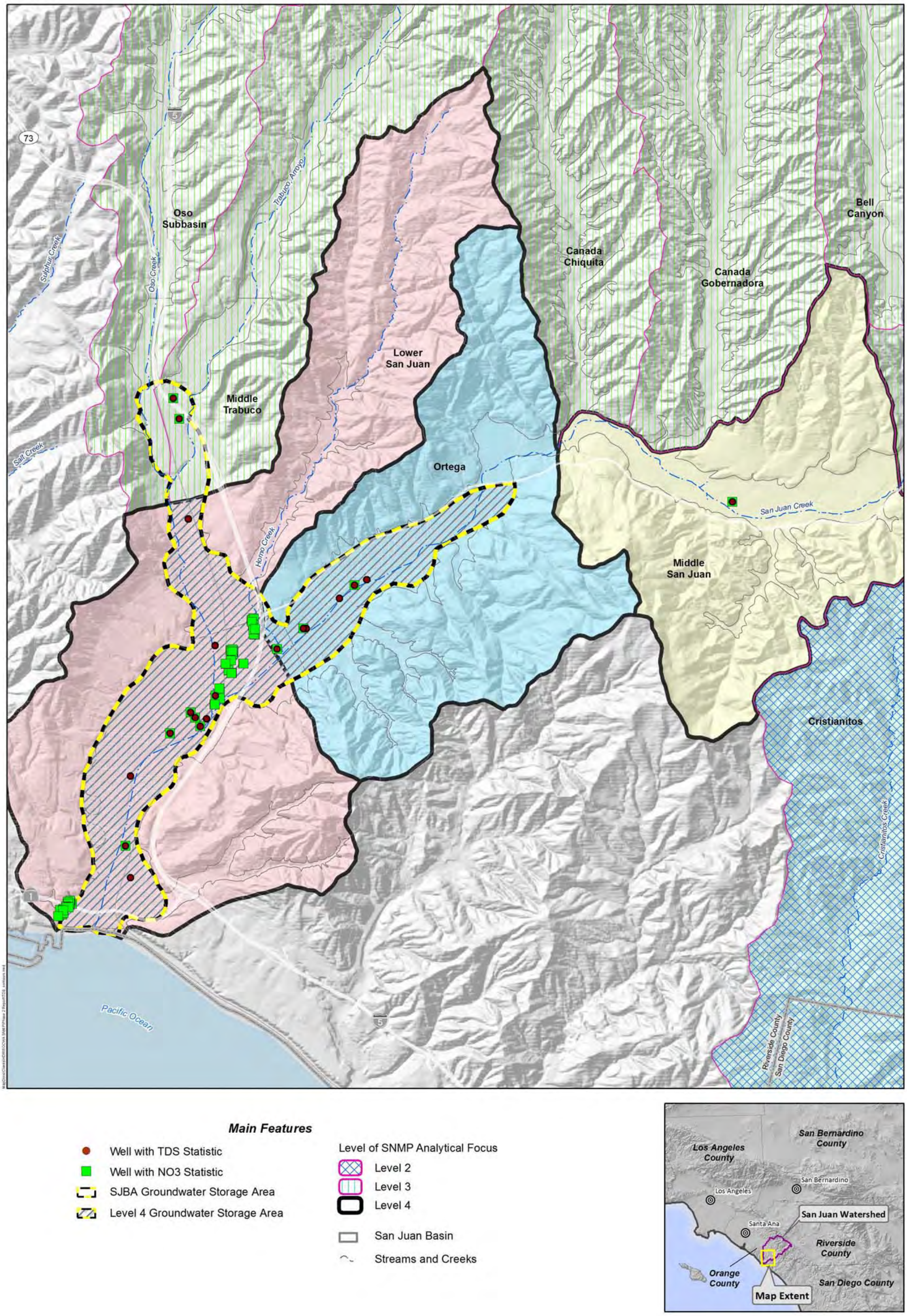
$V_i$ = volume of groundwater in $i^{th}$ grid cell (cubic meters)

$A_i$ = area of the $i^{th}$ grid cell

$WL_i$ = average elevation of groundwater in $i^{th}$ grid cell (meters above mean sea level [MSL])

$B_i$ = average elevation of the effective base of aquifer in $i^{th}$ grid cell (meters above MSL)

$SY_i$ = specific yield assigned the $i^{th}$ grid cell

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Author: LBB
Date: 20130509
File: TDS_contours.mxd

0 1,000 2,000 Feet
0 0.25 0.5 Miles

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South Orange County Wastewater Authority
2013 Salt and Nutrient Management Plan

**Wells With Data in Level 4 Storage Area (2007-2011)**

Figure 6-1

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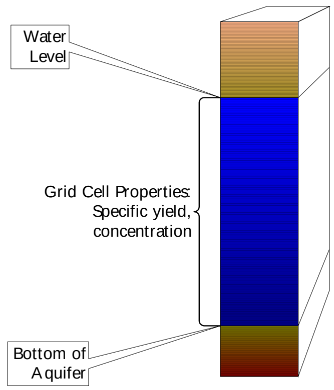



The total volume of groundwater within the storage area of each HSA was calculated by summing the volume of groundwater in all grid cells with the HSA. Where a grid cell is split by an HSA boundary, storage was calculated based on the part of the grid cell area within each HSA.

***Develop point statistics of TDS and nitrate-N***. Groundwater from wells in the study area is sampled at varying frequencies depending on the well owner, well type, and the respective sampling program objectives. In the dataset available for the Lower San Juan Basin, sampling frequencies observed for TDS or nitrate-N included one-time, weekly, monthly, quarterly, annual, and triennial. In some cases, wells were sampled at different frequencies from one year to the next. To eliminate bias towards values and wells which are sampled more than once per year, an annualized average statistic was developed to represent the ambient condition. The annualized statistic for each well was computed in two steps:

1. For each calendar year of the analysis time period (2007-2011), compute the average constituent concentration of all samples collected during that year[15]. For any given well included in the analysis, the minimum number of annualized averages was one and the maximum was five.
2. Compute the average of the annualized averages.

***Develop contours of TDS and nitrate-N concentration***. All wells with point statistics for TDS and nitrate-N were mapped and each location was annotated with the computed statistic[16]. Contours of equal-concentration were developed by hand, digitized, and brought into a GIS. **Figure 6-2** is a map showing wells with a TDS statistic for the 2007 to 2011 period and the resultant concentration contours.

**Figure 6-3** is a location map of all wells with a nitrate-N statistic for the 2007 to 2011 period. Although 82 wells had nitrate-N statistics, the majority of the wells are multi-depth casings located in tight clusters around LUST contamination sites. Contours that describe the spatial distribution of nitrate-N were not

[15] Nitrate-N results that were reported as non-detect were included in the analysis by setting the concentration equal to the detection limit divided by the square root of 2. This results in a more conservative estimate than setting the non-detect values equal to zero.

[16] For nested monitoring wells with multiple-depth casings, a statistic was computed for each casing. Then, the statistics were averaged to obtain a single statistic contour point for that location. For example, a nested monitoring well with two casings had five-year statistics of 1,340 mg/L and 1,321 mg/L. These to values were averaged to obtain one statistic value of 1,330 mg/L.

developed herein as the spatial distribution of the point nitrate-N statistics was judged to be insufficient to scientifically characterize the spatial distribution of nitrate-N.

***Compute volume-weighted ambient concentration***. The 15x15 meter grids were draped over the basin and TDS concentrations were estimated for each grid cell using a topo-to-raster interpolation scheme in the Geospatial Analyst extension to ArcGIS. **Figure 6-2** is map showing the interpolated TDS concentrations of groundwater across the storage area. Ambient water quality was then calculated using the following formula:

$$C_{avg} = ( 1/V_T ) \cdot \sum C_i \cdot V_i$$

where,

$C_{avg}$ = the ambient concentration of TDS in the Lower San Juan Basin

$V_T$ = the total volume of groundwater within the Lower San Juan Basin ( $\sum V_i$ )

$C_i$ = the concentration in grid cell *i*

$V_i$ = the volume of water stored in grid cell *i*

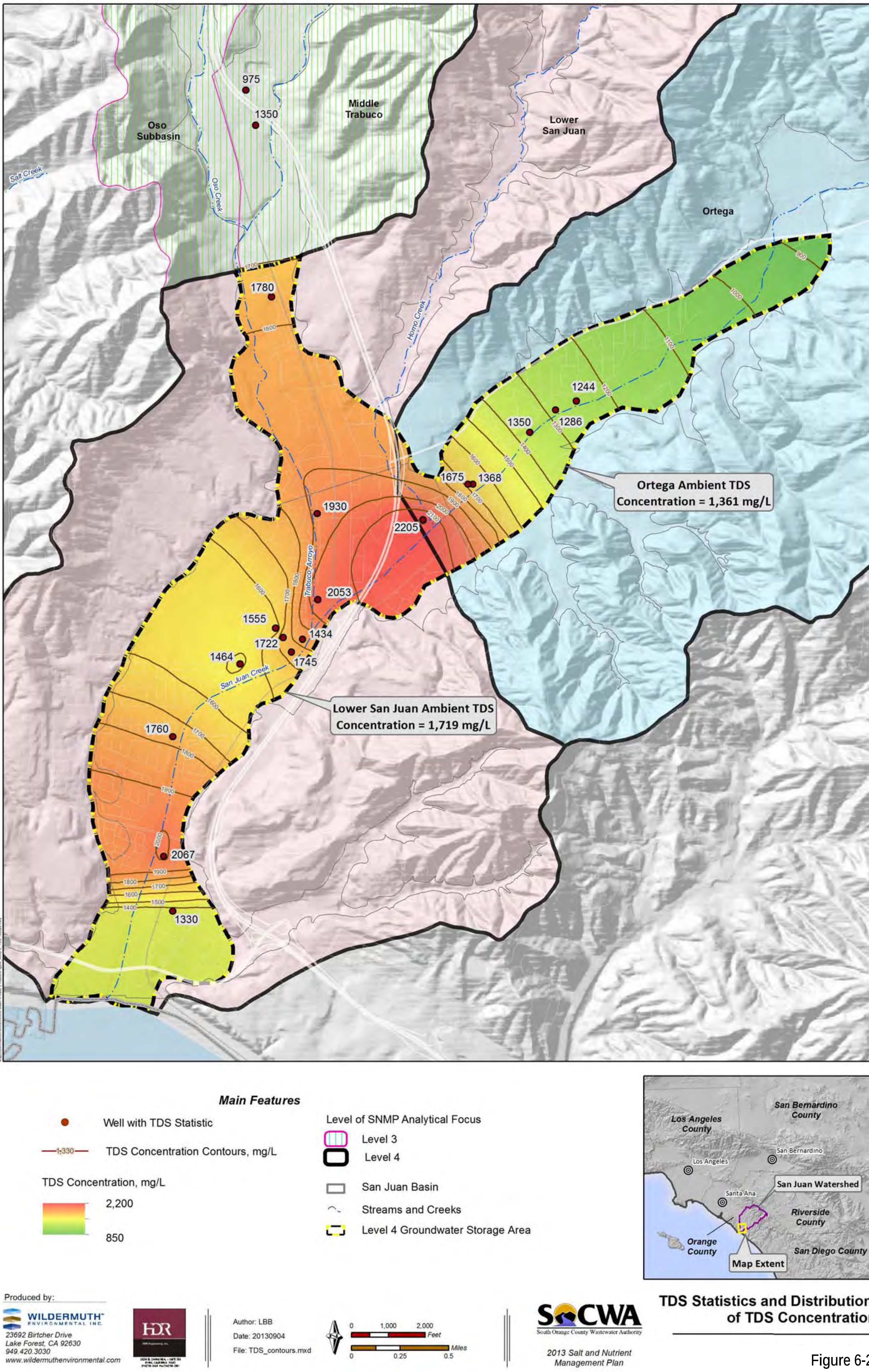
**Results**

***Total Dissolved Solids.*** The 2011 ambient TDS concentration of the entire Lower San Juan Basin averages about 1,600 mg/L. The storage area was further broken down by HSA to compare the volume-weighted ambient TDS concentration with the water quality objectives of the Basin Plan (see **Figure 6-2**).

*Lower San Juan HSA.* The water quality objective of the Lower San Juan HSA is 1,200 mg/L. The ambient TDS concentration of groundwater in the Lower San Juan HSA is about 1,700 mg/L. Thus, there is no assimilative capacity for TDS.

*Ortega HSA.* The water quality objective of the Ortega HSA is 1,100 mg/L. The ambient TDS concentration of groundwater in the Ortega HSA is about 1,400 mg/L. Thus, there is no assimilative capacity for TDS.

***Nitrate as Nitrogen.*** There was an insufficient distribution of wells with nitrate-n statistics to draw isoconcentration contours of nitrate-N in the Lower San Juan Basin as was done for TDS. Thus, no HSA-wide ambient nitrate-N concentration was computed. The 2011 nitrate-N statistic values at wells ranged between 0.04 mg/L and 17 mg/L and the median value is 0.57 mg/L. Only 1 well exceeded the Basin Plan objective of 10 mg/L. This well was associated with a leading underground storage tank (LUST) contamination site and may have been influenced by conditions at the LUST. The spatial distribution of the nitrate-N statistics at wells suggests that the ambient concentration is much less than the nitrate-N objective of 10 mg/L and therefore there is assimilative capacity for nitrate-N in the Lower San Juan Basin.




**TDS Statistics and Distribution of TDS Concentration**

Figure 6-2

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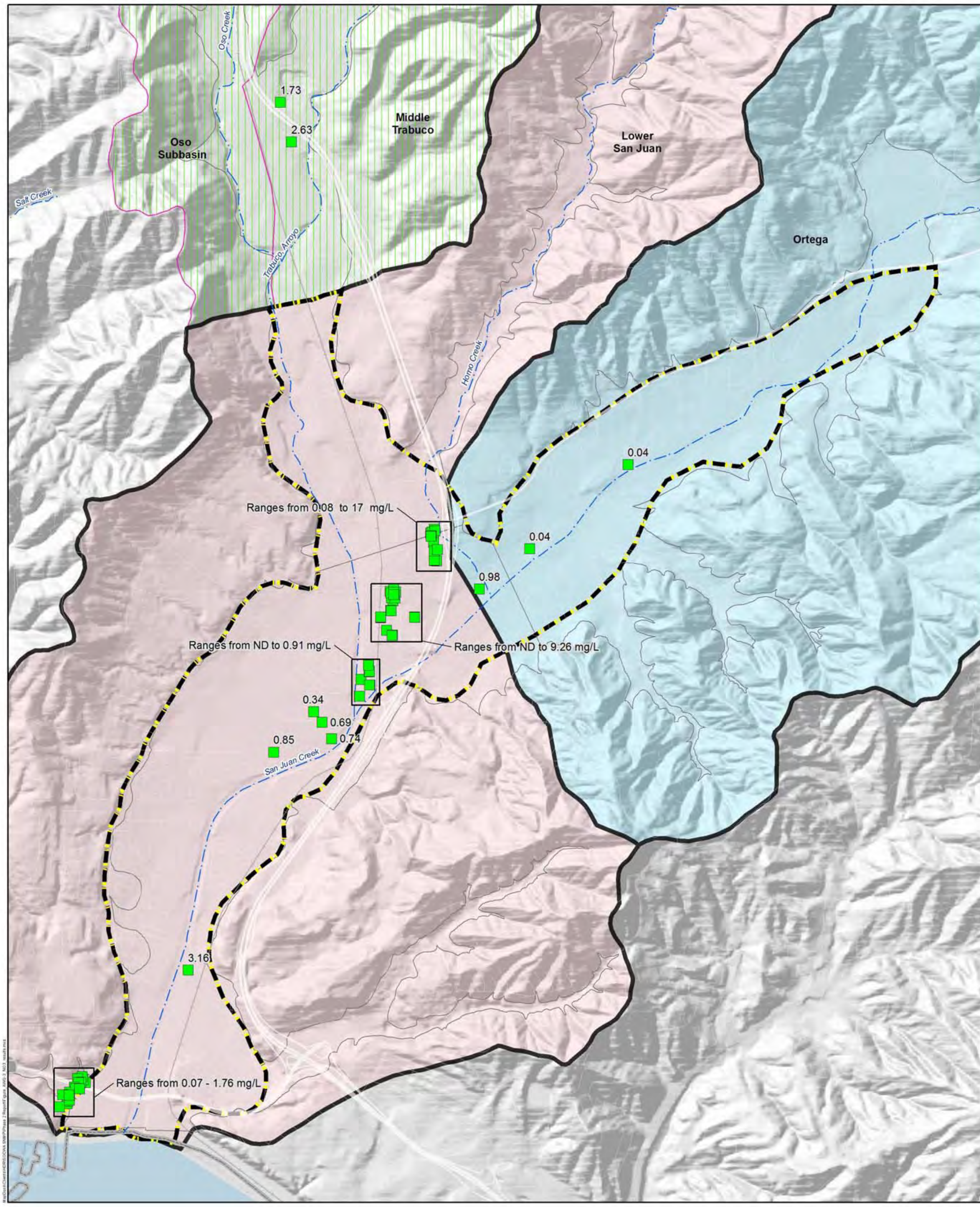


***Main Features***

- Well with NO3 Statistic

Level of SNMP Analytical Focus

- Level 3
- Level 4
- San Juan Basin
- Streams and Creeks
- Level 4 Groundwater Storage Area


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Date: 20130904
File: TDS_contours.mxd

0 1,000 2,000 Feet

0 0.25 0.5 Miles

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2013 Salt and Nutrient Management Plan

**Nitrate - Nitrogen Statistics**

**Figure 6-3**

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## 6.2 TOTAL DISSOLVED SOLIDS PROJECTIONS

A CSRM was developed to project TDS concentration changes in the groundwater storage area within the Lower San Juan and Ortega HSAs through the year 2050. A CSRM is a mass balance model that accounts for TDS (or other conservative constituents) added or removed through inflows and outflows. In a CSRM, fluid particles enter the reactor and are instantaneously dispersed throughout the reactor volume. This approximation is used to study lakes and reservoirs with continuous inputs and outputs (see, for example, *Water Quality: Characteristics*, *Modeling and Modification*, Tchobanoglous & Schroeder, 1987). The extension of this approach to a groundwater basin provides a first-order approximation of the time scale of TDS concentration changes. This approach produces a conservative projection of TDS concentrations because the salt loads from all sources are assumed to enter the saturated zone of the groundwater basin and instantaneously mix with the water in storage in the year the sources are applied to the groundwater basin (reactor). As outlined in the San Diego Guidelines for Salinity/Nutrient Management Planning, this is an appropriate approach for projecting future TDS concentrations in a basin.

The approach is as follows:

- Estimate the volume of water in storage and volume-weighted TDS concentrations of the reactor at the start of the simulation period (initial condition).
- For each time step, the following are performed:
    - Estimate inflow and outflow volumes.
    - Estimate the change in storage.
    - Estimate the TDS concentration for each inflow component.
    - Estimate the TDS concentration in the reactor at the end of the time step.

The water volume and constituent mass balance for a groundwater basin (reactor) is:

Inflow – Outflow = Change in Storage

To estimate the TDS concentration of the reactor, an implicit finite-difference approximation is used:

$$\sum [I_j \times C_j] + M - \sum [O_k \times CGW_t] = VGW_{t+1} \times CGW_{t+1} - VGW_t \times CGW_t$$

Where:

| | |
|---|---|
| $I_j$ | is the j[th] inflow component during the period t to t+1, |
| $C_j$ | is the concentration for the j[th] inflow component during the period t to t+1, |
| $M$ | is the TDS added through the leaching or dissolution of salts from aquifer sediments, |
| $O_k$ | is the k[th] outflow component from the groundwater basin during the period t to t+1, |
| $CGW_t$ | is the concentration of groundwater at time t, |
| $VGW_t$ | is the volume of groundwater in storage at time t, |
| $VGW_{t+1}$ | is the volume of groundwater in storage at time t+1, and |
| $CGW_{t+1}$ | is the concentration of groundwater at time t+1. |

The mass balance is solved for $CGW_{t+1}$ after the hydrologic or water volume mass balance is solved. The steps to develop and implement a CSRM are:

1. Delineate the CSRM boundary and identify the water supply and management entities that overly the watershed that is tributary to and overlying the groundwater basin.
2. Define the hydrologic components (inflow and outflow components) and, where appropriate, the associated TDS concentration.
3. Define the water supply plans of the water supply agencies that overly the CSRM.
4. Define the water supply and recycled water planning alternatives.
5. Quantify the hydrologic components for each planning alternative.

***Define CSRM Boundary and Identify Overlying Agencies***. The boundary of the CSRM model reactor is the Lower San Juan Basin area. The watershed area directly tributary to and impacting inflows to CSRM is the area bounded by the Lower San Juan and Ortega HSAs. There are two municipal water supply agencies and one significant private water user that directly overly the Lower San Juan Basin[17]: the City of San Juan Capistrano, the South Coast Water District, and the San Juan Hills Golf Course. The San Juan Basin Authority is responsible for managing groundwater supply and quality within the study area. **Figure 6-4** shows the boundaries of the water supply agencies relative to the Lower San Juan Basin.

***Define the hydrologic components***. **Figure 6-5** is a graphical representation of the conceptual model of the CSRM. The inflow components consist of the deep infiltration of precipitation, streambed infiltration, subsurface inflow from upstream HSAs (Middle Trabuco/Oso, Horno, and Middle San Juan), the deep infiltration of applied water, enhanced stormwater recharge, and recycled water recharge. The outflow components consist of groundwater production, evapotranspiration, and rising groundwater. There is also a flow boundary between the groundwater basin and the Pacific Ocean, the direction of which is dependent upon groundwater-level elevation and production patterns. In addition to these inflows and outflows, historical groundwater quality trends suggest that the TDS concentration of the groundwater basin is impacted by a natural loading source (e.g. the leaching or dissolution of salts from aquifer sediments).

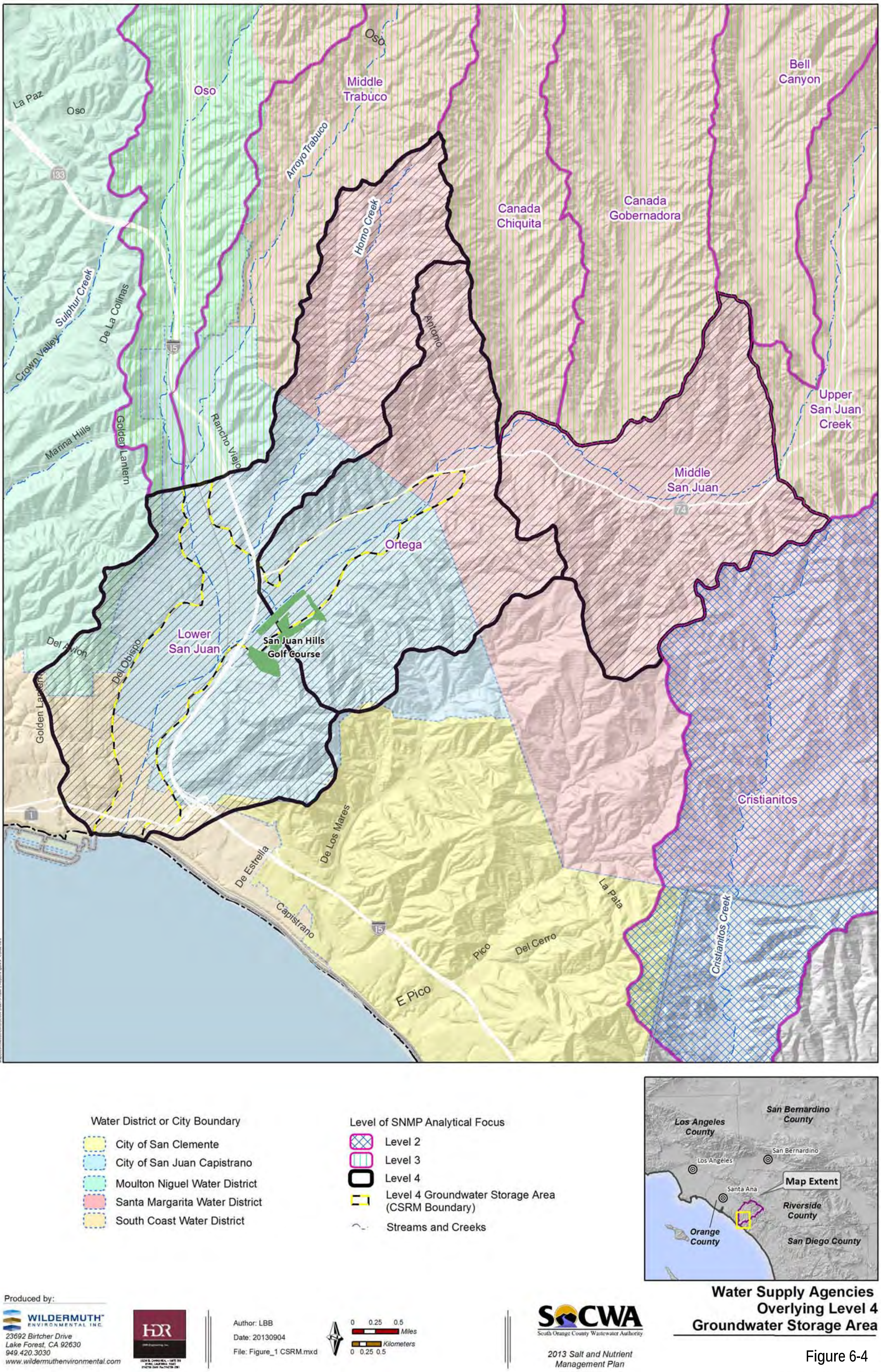
***Water Supply Plans***. The water supply plans of the agencies that overly the area tributary to the Lower San Juan Basin are important to the TDS projections because they are the basis for computing the volume and quality of the deep infiltration of applied water, which is typically a significant contributor to TDS loading. Applied water is water that is used outdoors for landscape irrigation. The volume of deep infiltration of applied water is derived from the portion of demand that is used for irrigation. The TDS concentration of applied water is a function of the water supply TDS concentration, the fraction of the water supply consumptively used by landscape vegetation, and the mass increments added through the use of fertilizers and soil amendments. This can be expressed as:

$$V_{rf} \times C_{rf} = (V_{sw} \times C_{sw}) + M_{incr} - M_{decr}$$
$$V_{rf} = V_{sw} \times (1 - FC)$$

Combining these equations yields:

$$C_{rf} = [(V_{sw} \times C_{sw}) + M_{incr} - M_{decr}]/[V_{sw} \times (1 - FC)]$$
$$C_{rf} = [C_{sw} / (1 - FC)] + [M_{incr} - M_{decr}]/[V_{sw} \times (1 - FC)]$$

[17] Although the Santa Margarita Water District also overlies portions of the Lower San Juan and Ortega HSAs, the applied water inflows to the CSRM generated in the Santa Margarita Water District are accounted for in the model as a part of the boundary inflows at Horno Creek. These inflow components were estimated from MWDOC's San Juan Basin groundwater model.




**Water Supply Agencies Overlying Level 4 Groundwater Storage Area**

Figure 6-4

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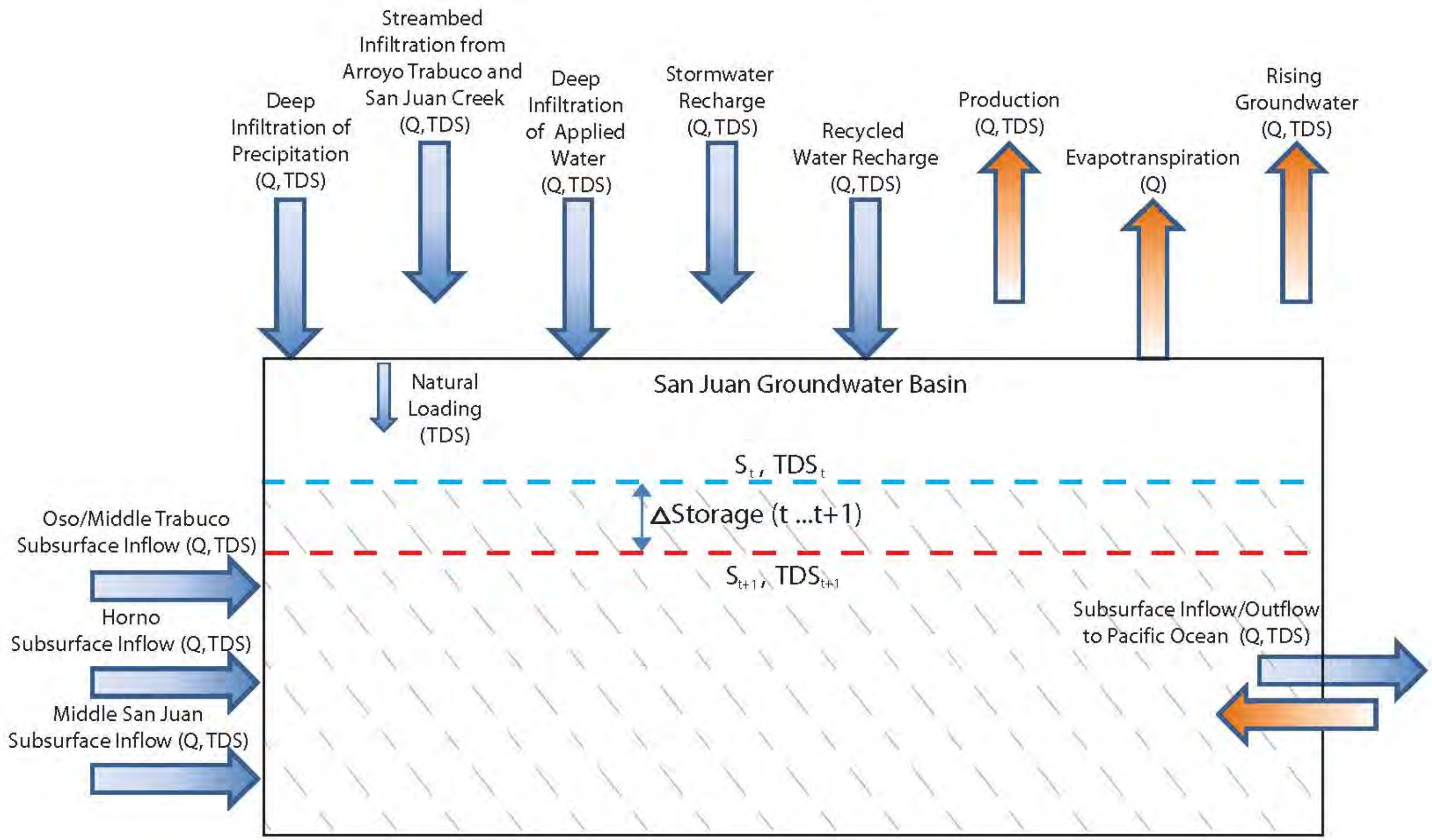
**Figure 6-5. CSRM Conceptual Model of Level 4 Groundwater Storage Area**

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Where:

$V_{rf}$ is the volume of applied water that returns to the groundwater basin ,
$C_{rf}$ is the constituent concentration of the applied water that returns to the groundwater basin,
$V_{sw}$ is the volume of the source water,
$C_{sw}$ is the constituent concentration in the source water,
$M_{incr}$ is the mass added by a specific water use,
$M_{decr}$ is the mass taken out by consumptive use and degradation processes within a specific water use, and
$C$ is the fraction of water consumed.

To compute the deep infiltration of applied water, water supply plans were developed for the City of San Juan Capistrano, South Coast Water District, and San Juan Hills Golf Course. The total water demands and supplies of each entity was derived from San Juan Basin GWFMP (WEI, 2013). The portion of demand that is satisfied with San Juan Basin groundwater was reduced relative to the demands reported in the GWFMP to ensure the CSRM projects groundwater storage conditions that do not induce seawater intrusion over time. The results of the MWDOC groundwater model were used to refine the groundwater production projections. Imported water supplies were increased to compensate for any reductions in groundwater production relative to the GWFMP. The water supply plans developed for this analysis are summarized in **Table 6-1**.

**Table 6-1. Water Supply Plans Used to Compute the Deep Infiltration of Applied Water to the CSRM (in acre-feet)**

| | 2015 | 2020 | 2025 | 2030 | 2035 |
|---|---|---|---|---|---|
| City of San Juan | | | | | |
| Imported Water | 2,566 | 2,816 | 3,066 | 3,964 | 4,214 |
| Groundwater - Treated | 4,424 | 4,424 | 4,424 | 4,424 | 4,424 |
| Groundwater - Potable | 627 | 627 | 627 | 627 | 627 |
| Groundwater - Non-Potable | 310 | 310 | 310 | 310 | 310 |
| Recycled Water | 623 | 623 | 623 | 825 | 825 |
| *Total Water Supply* | *8,550* | *8,800* | *9,050* | *10,150* | *10,400* |
| South Coast Water District | | | | | |
| Imported Water | 5,896 | 6,083 | 6,093 | 6,124 | 6,124 |
| Groundwater - Treated | 1,212 | 1,212 | 1,212 | 1,212 | 1,212 |
| Recycled Water | 1,100 | 1,200 | 1,300 | 1,400 | 1,400 |
| *Total Water Supply* | *8,208* | *8,495* | *8,605* | *8,736* | *8,736* |
| San Juan Hills Golf Course | | | | | |
| Groundwater - Non-Potable | 322 | 322 | 322 | 322 | 322 |
| *Total Water Supply* | *322* | *322* | *322* | *322* | *322* |
| Total Water Supply | | | | | |
| Imported Water | 8,462 | 8,899 | 9,159 | 10,088 | 10,338 |
| Groundwater - Treated | 5,636 | 5,636 | 5,636 | 5,636 | 5,636 |
| Groundwater - Potable | 627 | 627 | 627 | 627 | 627 |
| Groundwater - Non-Potable | 632 | 632 | 632 | 632 | 632 |
| Recycled Water | 1,723 | 1,823 | 1,923 | 2,225 | 2,225 |
| Total | 17,080 | 17,617 | 17,977 | 19,208 | 19,458 |

Detailed supply plans, including the derivation of outdoor water supply and returns from use are included as Tables B1, B2, and B3 of **Appendix E**. Key assumptions made in the development of the water supply plans and the derivation of the deep infiltration of applied water are summarized in **Table 6-2**.

**Table 6-2. Assumptions Used in the Derivation of Volume and TDS Concentration of the Deep Infiltration of Applied Water**

| Water Supply Plan Component | Assumed Value | Basis of Assumption |
|---|---|---|
| TDS concentration of imported water | 470 mg/L | 2012 Consumer Confidence Reports; Assumption used for Level 3 Salt Balance models. |
| TDS concentration of treated (desalinated) groundwater | 470 mg/L | Assumes that agencies will only treat groundwater down to a concentration that is comparable to their imported water. Currently, actual TDS concentration of treated water ranges between 360 and 440 mg/L, so this is a conservative assumption. |
| TDS concentration of untreated groundwater | Estimated by CSRM | In each time step, untreated groundwater is assumed to equal the concentration estimated by the model reactor for each time step. |
| TDS concentration of recycled water used by the City of San Juan Capistrano | 1,000 | This is the permit limit for the recycled water purchased by the City. |
| TDS concentration of recycled water used by the South Coast Water District | 1,200 | This is the permit limit for the recycled water used by the SCWD. |
| Fraction of potable water supply used outdoors | 60% | Consistent with assumptions made in MWDOC's San Juan Groundwater Basin Model (GSSI, 2013) |
| Fraction of non-potable water supply used outdoors | 100% | All non-potable water in the study area is used for landscape irrigation. |
| The mass of TDS consumed by irrigated landscape | 0% | The mass of TDS uptake by irrigated landscape is assumed to be negligible. |
| Fraction of applied water consumed by irrigated landscape | 85% | Consistent with assumptions made in MWDOC's San Juan Groundwater Basin Model (GSSI, 2013) |
| Fraction of applied water not consumed by irrigated landscape | 15% | Consistent with assumptions made in MWDOC's San Juan Groundwater Basin Model (GSSI, 2013) |
| Fraction of applied water that is not consumed by irrigated landscape that infiltrates to groundwater | 25% (of 15%) | Consistent with assumptions made in MWDOC's San Juan Groundwater Basin Model (GSSI, 2013) |
| Fraction of applied water that is not consumed by irrigated landscape that becomes surface water flow | 75% (of 15%) | Consistent with assumptions made in MWDOC's San Juan Groundwater Basin Model (GSSI, 2013) |

**Recycled Water Planning Alternatives**

Two types of recycled water reuse activities are proposed in the Lower San Juan Basin: direct reuse for irrigation and groundwater recharge. The direct reuse of recycled water for irrigation by the City of San Juan Capistrano and the South Coast Water District is already permitted under SOCWA's permit. The indirect reuse of recycled water through groundwater recharge is proposed by the SJBA as part of the SJBGFMP update (WEI, 2013). Although the recharge project is in the very early stages of planning, it was analyzed herein so that the project could be considered a part of the Salt and Nutrient Management Plan if it is constructed. The recycled water planning alternatives modeled in this analysis are described in detail below.

***Baseline Alternative.*** The baseline alternative represents the status quo in terms of recycled water reuse. In this alternative, only permitted recycled water reuse activities in SOCWA's service area are simulated. Two sub alternatives for the Baseline Alternative were prepared:

- *Baseline – Current:* In this sub alternative, the CSRM is used to project the future TDS concentration of the Lower San Juan Basin assuming current levels of recycled water reuse in the upper watershed do not change. The inflow TDS concentrations at the boundaries of the CSRM are based on the results of the Level 3 salt balance models in the upstream HSAs that represent current ambient quality.
- *Baseline – Future:* In this sub alternative, the CSRM used to project the future TDS concentration of the Lower San Juan Basin assuming the upstream HSAs is increased to the maximum permitted limits. The inflow TDS concentrations at the boundaries of the CSRM are based on the results of the Level 3 salt balance models that represent future ambient quality when recycled water reuse is maximized.

The purpose of running current and future baseline sub alternatives is to bracket the projected TDS concentration at the end of the planning period. The *Baseline—Future* sub alternative represents the highest TDS loading scenario such that all upstream recycled water users began using the maximum permitted recycled water volumes staring in the first year of the model simulation.

*San Juan Basin Groundwater Management and Facilities Plan Alternative 6.* The SJBGFMP evaluated 10 groundwater management plan alternatives to achieve the goals of the member agencies (see Sections 5 and 6 of WEI, 2013). Each alternative was evaluated based on its consistency with the SJBGFMP goals, the new yield generated, cost, and implementation difficulty (see Section 7 of WEI, 2013). Based on the management goals of the SJBGFMP and the ability of the alternatives to attain the goals, the SJBA Technical Advisory Committee recommended the phased implementation of Alternative 6. The key physical features of Alternative 6 include:

- Construct a coastal extraction barrier to increase basin yield by 4,000 AFY and prevent seawater intrusion.
- Construct and operate in-stream recharge facilities to enhance the recharge of stormwater from October through April. The yield increase will be up to 2,000 AFY.
- Construct and operate recycled water recharge facilities. Yield increase will be up to 10,000 AFY.

- Expand existing or construct new desalting facilities to enable the recovery of storm and recycled water recharge.
- Site and construct new wells to increase production capacity to enable the recovery of storm and recycled water recharge.

For this analysis, three sub alternatives of Alternative 6 were developed to evaluate the TDS concentration impacts of increasing levels of recycled water recharge. All three subalternatives will include a seawater extraction barrier that extracts 2,000 AFY of groundwater from the basin, enhanced stormwater recharge of 1,000 AFY, and will assume that recycled water reuse in the upstream HSAs is maximized. The sub alternatives will simulate the following recycled water recharge and production patterns:

- ***SJBA Alternative 6a***: 2,000 AFY recycled water recharge; 11,205 AFY total production.
- ***SJBA Alternative 6b:*** 5,000 AFY recycled water recharge; 14,205 AFY total production.
- ***SJBA Alternative 6c:*** 10,000 AFY recycled water recharge; 19,205 AFY total production.

Each physical feature of Alternative 6 was assumed implemented per the schedule defined in Section 8 of the SJBGFMP (WEI, 2013), assuming that Year 1 of the implementation plan is 2014.

*No recycled Water Reuse.* In this alternative, no recycled water is used for direct or indirect uses in the SOCWA service area.

***Planning Hydrology***. For each planning alternative, the basin was defined in terms of its initial conditions with regards to the volume and TDS concentration of water in storage as well as the volume and TDS concentration of the inflows and outflows that will change these conditions over time. Exclusive of the inflow and outflow components for the SJBGFMP program elements described above, the inflow and outflow components assumed for the future projections derived from the results of Model Run 2h of MWDOC's San Juan Basin Groundwater Model (GSSI, 2013). A planning period of 2011 to 2050 was selected for this analysis to evaluate the projected TDS impacts on the basin after the SJBGFMP projects have been online for about 25 years.

**Table 6-3** summarizes the volume of each inflow and outflow component over the planning period and includes a description of the data sources and assumptions that were used to estimate the values **Table 6-3** also describes how the inflows and outflows vary between the recycled water planning alternatives (*Baseline (Current and Future)*[18], *SJBA Alternative 6a, 6b, and 6c,* and *No Recycled Water Reuse*).

**Table 6-4** summarizes the TDS concentration of each inflow and outflow component over the planning period and includes a description of the data sources and assumptions that were used to estimate the TDS values. **Table 6-4** also shows how the TDS concentrations vary between the recycled water planning alternatives. (*Baseline—Current*, *Baseline—Future*[19], *SJBA Alternative 6*[20] and *No Recycled Water Reuse*).

[18] The inflow and outflow volumes do not vary in the two Baseline alternatives.
[19] The TDS concentration of the inflow and outflow components do not vary between *Baseline—Future* and *SJBA Alternative 6*.
[20] The TDS concentration of the inflow and outflow components do not vary between *SJBA Alternative 6a*, *6b*, and *6c*.

**Results**

***TDS Concentration Projections.*** **Figure 6-6** is a time-history plot of the TDS projections for the Lower San Juan Basin for the six recycled water planning alternatives analyzed. **Table 6-5** summarizes the CSRM results for each planning alternative. The detailed CSRM results for each planning alternative are provided in **Appendix F**.

In all planning alternatives, the TDS concentration is projected to decrease over time. In each scenario, the TDS concentration decreases in the first 10 years of the projection and then asymptotically approaches a constant value over the remainder of the planning period. These TDS concentration trajectories result from the use of long-term average values to represent hydrologic inflow and outflow components that will actually fluctuate from year-to-year depending on climate conditions (e.g. streambed infiltration). Long-term average values are used herein because it is unknown when wet or dry years will occur during the planning period. In reality, wet and dry years will result in TDS concentrations that fluctuate around the projected TDS concentration. TDS concentrations will decrease over time, just not exactly in the pattern estimated by the CSRM. Thus, these TDS concentration trajectories can be interpreted as the central tendency of the projected TDS concentration of the Lower San Juan Basin over time.

If recycled water reuse for irrigation in the entire SNMP study area remains the same, or increases to planned or permitted levels, the TDS concentration of the Lower San Juan Basin will remain about the same as it is today at 1,600 mg/L. Alternative 6 of the SJBGFMP is projected to improve the TDS concentration of the basin relative to the baseline alternative. The TDS concentration decreases in this scenario relative to the baseline because greater volumes of high-TDS groundwater are pumped and treated and are subsequently replaced with lower-TDS sources of water (stormwater and recycled water). Each increase of the volume of recycled water recharge to the Lower San Juan Basin results in a further decrease (improvement) in TDS concentration in the basin over time.

Although TDS concentrations decrease in all planning alternatives, the concentration never approaches the basin plan objective of 1,200 mg/L. Even if recycled water was not used in the SOCWA service area, TDS concentrations in the Lower San Juan Basin would still be well above the objective at about 1,400 mg/L. Thus, regardless of recycled water reuse in the SNMP study area based on current basin objectives (1,200 mg/L), there will never be assimilative capacity for TDS in the Lower San Juan Basin. Despite this, the municipal water supply agencies are still able to put the groundwater to beneficial use through the use of groundwater desalters.

***TDS Mass Loading.*** **Figure 6-7** illustrates the relative TDS contribution of each loading source to the Lower San Juan Basin as a percent of the average mass loading over the planning period for each planning alternative. Based purely on tons of TDS, the top five contributors to mass loading in the Lower San Juan Basin are streambed infiltration, subsurface inflow from the Middle Trabuco and Oso HSAs, natural loading, deep infiltration of applied water, and recycled water recharge.

**Table 6-3. Summary of Inflow and Outflow Volumes to the CSRM by Recycled Water Reuse Planning Alternative**

| CSRM Flux Terms | Inflow and Outflow Volumes by Planning Alternative *(afy, unless otherwise noted)* | | | Data Sources and Assumptions |
|---|---|---|---|---|
| | Baseline (Current and Future) | SJBA GWMFP Alternative 6 | No Recycled Water Reuse | |
| **Initial Conditions** | | | | |
| Groundwater in storage | 25,528 af | 25,528 af | 25,528 af | Computed based on fall 2011 groundwater-level elevation and aquifer properties delineated by WEI (2013) and GSSI (2013). See Section 6.1 of this report for a detailed description of how the volume of water in storage was calculated. |
| **Inflows** | | | | |
| Deep infiltration of precipitation | 179 | 179 | 179 | Represents the long-term average value of GSSI model Run 2h results for the 1947-2010 period. The value was adjusted to account for the reduced size of the Lower San Juan Basin study area relative to the GSSI model boundary. The Lower San Juan Basin study area covers 55% of the GSSI model boundary, which had a long-term average precipitation value of 325 afy. This inflow to the CSRM does not change across planning alternatives. |
| Streambed infiltration - stormflow: *Arroyo Trabuco* | 977 | 977 | 977 | Total streambed infiltration, by reach, for the Lower San Juan Basin study area were provided by GSSI (unpublished data). The GSSI data did not break down the relative volumes of streambed infiltration attributable to stormflow versus baseflow. It was desirable to estimate this breakdown in order to assign TDS concentrations for the two types of flow. The breakdown of stormflow versus baseflow was computed based on the results of GSSI model Run 2h for the 1947-2010 period. The total volume of streambed infiltration over the study area is 4,349 afy. This inflow to the CSRM does not change across planning alternatives. |
| Streambed infiltration - baseflow: *Arroyo Trabuco* | 1,707 | 1,707 | 1,707 | |
| Streambed infiltration - stormflow: *San Juan Creek* | 888 | 888 | 888 | |
| Streambed infiltration - baseflow: *San Juan Creek* | 777 | 777 | 777 | |
| Subsurface inflow: *Oso and Middle Trabuco HSAs* | 2,625 | 2,625 | 2,625 | Represents the long-term average value of GSSI model Run 2h results for the 1947-2010 period (unpublished data). This inflow to the CSRM does not change across planning alternatives. |
| Subsurface inflow: *Horno Creek* | 90 | 90 | 90 | Represents the long-term average value of GSSI model Run 2h results for the 1947-2010 period (unpublished data). This inflow to the CSRM does not change across planning alternatives. |
| Subsurface inflow: *Middle San Juan HSA* | 1,170 | 1,170 | 1,170 | Represents the long-term average value of GSSI model Run 2h results for the 1947-2010 period (unpublished data). This inflow to the CSRM does not change across planning alternatives. |
| Deep infiltration of applied water (See Appendix F for values on an annual basis) | 205 to 259 | 205 to 259 | 205 to 259 | The deep infiltration of applied water is variable over time and changes with total water demands. The infiltration volume was computed based on the water supply plans of overlying water users. Consistent with GSSI modeling work, this analysis assumes the following: 60% of potable water and 100% of non-potable water is used outdoors; 85% irrigation efficiency (e.g. 85% of water applied outdoors is used by plants), and of the 15% of water not used by plants, 86% of return flow becomes runoff to streams and 14% infiltrates to groundwater (GSSI, 2013). This inflow to the CSRM does not change across planning alternatives. |
| Enhanced stormwater recharge | 0 | 1,000 | 0 | Based on Alternative 6 of the San Juan Basin Authority's Groundwater Management and Facilities Plan (WEI, 2013). |
| Recycled water recharge | 0 | **Alt 6a:** 2,000<br>**Alt 6b:** 5,000<br>**Alt 6c:** 10,000 | 0 | Based on Alternative 6 of the San Juan Basin Authority's Groundwater Management and Facilities Plan (WEI, 2013). The SJBA identified that up to 10,000 afy of recycled water is available for supplemental recharge. This study simulated three levels of recycled water recharge because actual project size has not been evaluated. |
| Natural loading | 0 | 0 | 0 | This term represents the mass of TDS added by the leaching or dissolution of salts from unsaturated and/or saturated aquifer sediments as inflows infiltrate to the water table and/or as water in storage flows through the basin. There is no volume associated with this term. |
| **Outflows** | | | | |
| Production - Actual (2011 and 2012) | 5,189 and 6,304 | 5,189 and 6,304 | 5,189 and 6,304 | Represents actual production provided by water suppliers for 2011-2012. |
| Production - Projections (2013-2050) | 8,127 | **Alt 6a:** 8,127 to 11,185<br>**Alt 6b:** 8,127 to 14,185<br>**Alt 6c:** 8,127 to 19,185 | 8,127 | Baseline production values were adapted from the long-term average GSSI model Run 2h results for the 1947-2010 period (unpublished data). Production values were reduced to approximate a net zero flow between the groundwater basin and the Pacific Ocean because seawater intrusion is not permissible by the State Water Resources Control Board under the terms of the SJBA's and SCWD's water rights permits. Alternative 6 production ramps up according the implementation schedule in the SJBA GWMPF. As the total volume of groundwater recharge increases from Alternative 6a to 6c, the total production is increased to recover the recharged water. |
| Evapotranspiration | 286 | 286 | 286 | Represents the long-term average value of GSSI model Run 2h results for the 1947-2010 period. The value was adjusted to account for the reduced size of the Lower San Juan Basin study area relative to the GSSI model boundary. The Lower San Juan Basin study area covers 55% of the GSSI model boundary, which had a long-term average evapotranspiration value of 520 afy. This outflow from the CSRM does not change across planning alternatives. |
| Rising groundwater | 132 | 132, then 0 | 132 | Represents the long-term average value of GSSI model Run 2h results for the 1947-2010 period, and assumes all outflows occur within the study area boundary. Once the SJBA Alternatives 6a-6c projects begin to come online, it is assumed that rising groundwater will cease. |
| Subsurface inflow/outflow to the Pacific Ocean | 0 | 0 | 0 | Per the water rights permits held by the SJBA and SCWD, seawater intrusion into the basin is not permissible. GSSI model Run 2h results for the 1947-2010 simulated a net annual inflow of seawater of about 369 afy. Average production from GSSI model Run 2h was reduced to obtain a net zero flux from the Pacific Ocean. |

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**Table 6-4. Summary of TDS Concentrations Assigned to the Inflows to and Outflows from the CSRM by Recycled Water Reuse Planning Alternative**

| CSRM Flux Terms | TDS Concentration by Planning Alternative (mg/L, unless otherwise noted) | | | Data Source/Assumptions |
|---|---|---|---|---|
| | Baseline -- Current | Baseline -- Future and SJBA Alternative 6 | No Recycled Water Reuse | |
| **Initial Conditions** | | | | |
| Groundwater in storage | 1,618 | 1,618 | 1,618 | The initial condition is the ambient water quality computation for 2007-2011. See Section 6 .2 of thisreportfor a detailed description of how the volume-weighted, ambient TDS concentration of water in storage was calculated. |
| **Inflows** | | | | |
| Deep infiltration of precipitation | 400 | 400 | 400 | Assumed to equal the lowest observed stormflow TDS concentration in the Watershed. Set the value equal the average of peak stormflow water quality sampling results reported in Appendix C of the *RANCHO MISSION VIEJO CONCEPTUAL WATER QUALITY MANAGEMENT PLAN* (GeoSyntec, 2003). |
| Streambed infiltration - stormflow: *Arroyo Trabuco* | 460 | 460 | 460 | Estimated from measured data during wet-weather and dry-weather flows at surface water monitoring stations in the Lower San Juan Basin during the last ten years. The total volume-weighted TDS concentration of streambed infiltration for each alternative is:<br>**Baseline -- Current:** 1,115 mg/L<br>**Baseline -- Future and SJBA Alternative 6:** 1,170 mg/L<br>**No Recycled Water Reuse:** 1,000 mg/L |
| Streambed infiltration - baseflow: *Arroyo Trabuco* | 1,600 | 1,700 | 1,400 | |
| Streambed infiltration - stormflow: *San Juan Creek* | 740 | 740 | 740 | |
| Streambed infiltration - baseflow: *San Juan Creek* | 1,300 | 1,390 | 1,100 | |
| Subsurface inflow: *Oso and Middle Trabuco HSAs* | 1,450 | 1,500 | 1,300 | **Baseline -- Current:** Equal to the volume-weighted concentration of outflow from the Oso and Middle Trabuco HSAs as estimated by the Level 3 Salt Balance models for the current use model run.<br>**Baseline -- Future and SJBA Alternative 6:** Equal to the volume-weighted concentration of outflow from the Oso and Middle Trabuco HSAs as estimated by the Level 3 Salt Balance models for the permitted use model run.<br>**No Recycled Water Reuse:** Equal to the volume-weighted concentration of outflow from the Oso and Middle Trabuco HSAs as estimated by the Level 3 Salt Balance models for no recycled water use model run. |
| Subsurface inflow: *Horno Creek* | 1,800 | 1,980 | 1,620 | **Baseline -- Current:** Assumed to equal the average TDS concentration of water diverted from the SMWD's Horno Creek Barrier for the 2009-2011 period.<br>**Baseline -- Future and SJBA Alternative 6:** To account for degradation due to increased recycled water reuse, assumed a similar degradation rate to that estimated by the Level 3 Salt Balance model for Middle Trabuco/Oso of about 10%.<br>**No Recycled Water Reuse:** To account for improve due to decreased recycled water reuse, assumed a similar improvement rate to that estimated by the Level 3 Salt Balance model for Middle Trabuco/Oso of about 10%. |
| Subsurface inflow: *Middle San Juan HSA* | 700 | 750 | 580 | **Baseline--Current:** Assumed equal to average TDS concentration sampled from RMV Well #7 for the 2007-2011 period.<br>**Baseline -- Future and SJBA Alternative 6:** To account for degradation due to increased recycled water reuse, assumed TDS concentration will degrade at the same rate observed for Upper San Juan, about 10%.<br>**No RW reuse:** To account for improvements due to decreased recycled water reuse, assumed TDS concentration will improve at a similar rate observed for Upper San Juan, about 17%. |
| Deep infiltration of water applied | 3,782 to 4,516 | 3,790 to 4,555 | 3,723 to 4,042 | Variable based on source water quality, which changes over time. Assumes that the consumptive use of TDS by landscape irrigation is 0% and that return flows carry away 100 percent of the TDS mass of applied water. See Appendix F for concentration values on an annual basis. |
| Enhanced stormwater recharge | 740 | 740 | 740 | TDS concentration of stormwater recharge was assumed equal the TDS concentration assigned to stormflow in San Juan Creek (see above). |
| Recycled water recharge | 1,200 | 1,200 | 1,200 | TDS concentration of recycled water recharge was assumed to equal the Lower San Juan HSA basin plan objective of 1,200 mg/L, where the proposed recycled water recharge project will be located. |
| Natural loading | 3,000 tons/yr | 3,000 tons/yr | 3,000 tons/yr | This term represents the mass of TDS added by the leaching or dissolution of salts from unsaturated and/or saturated aquifer sediments as inflows infiltrate to the water table and/or as water in storage flows through the basin. This value was estimated by simulating a range of values from 0 to 5,000 tons mass loading per year. 3,000 tons/yr was selected because it buffered the basin from rapid degradation or improvement over time, which is the trend observed at wells in the Lower San Juan Basin. |
| **Outflows** | | | | |
| Production - Actual (2011-2012) | Computed by CSRM | | | |
| Production - Projections (2013-2050) | | | | |
| Evapotranspiration | 0 | 0 | 0 | Water lost through evapotranspiration leaves behind 100 percent of the TDS content. |
| Rising groundwater | Computed by CSRM | | | |
| Subsurface inflow/outflow to the Pacific Ocean | n/a | n/a | n/a | Per the water rights permits held by the SJBA and SCWD, seawater intrusion into the basin is not permissible. No exchange between the groundwater basin and Pacific Ocean is simulated, so no TDS concentration was assigned. |

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Figure 6-6
Total Dissolved Solids Projections for the Lower San Juan Basin

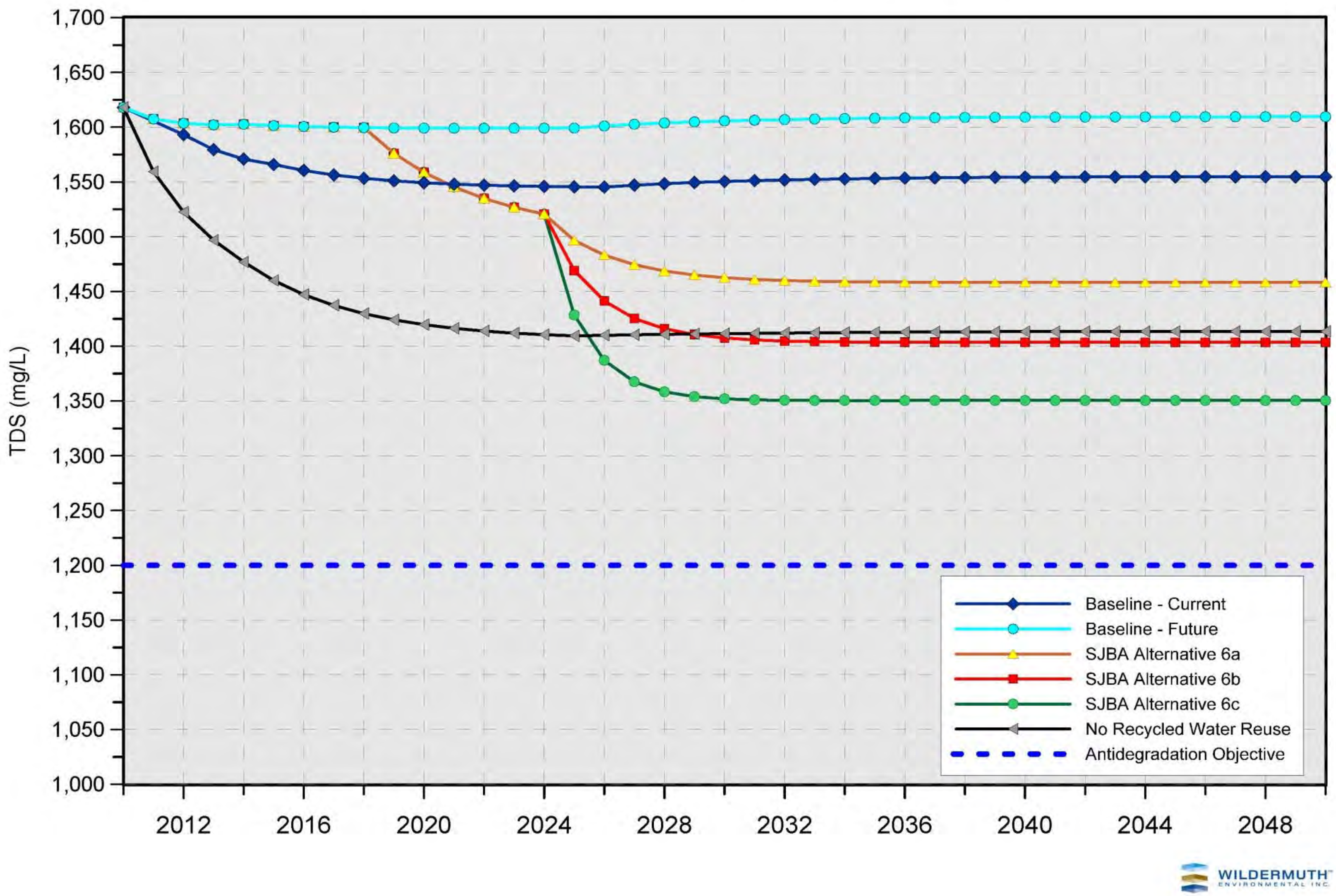


**Table 6-5. Summary of TDS Concentration Changes and Mass Loading and Export in the Lower San Juan Basin for each Recycled Water Planning Alternative**

| Recycled Water Planning Alternative | TDS Concentration in 2050 | Increase/ (Decrease) Relative to Current Ambient | Average Annual TDS Mass Loading | Average Annual TDS Mass Export | Assimilative Capacity in 2050? |
|---|---|---|---|---|---|
| | *mg/L* | *mg/L* | *tons/yr* | *tons/yr* | |
| Baseline – Current | 1,555 | - 63 | 17,666 | 17,005 | No |
| Baseline – Future | 1,610 | -8 | 18,289 | 17,540 | No |
| SJBA Alternative 6a | 1,458 | -160 | 21,267 | 21,136 | No |
| SJBA Alternative 6b | 1,404 | -214 | 24,602 | 24,609 | No |
| SJBA Alternative 6c | 1,350 | -268 | 30,254 | 30,423 | No |
| No Recycled Water Reuse | 1,414 | -204 | 16,079 | 15,640 | No |

Analyzing the impact of loading sources to the basin solely in terms of mass is misleading. Given that the Basin Plan objectives are based on TDS concentrations, the loading terms should be analyzed in terms of their contribution to degradation or dilution relative to the objective concentration. For example, an inflow to the basin at a volume of 1,000 AFY and a concentration of 1,200 mg/L would contribute 1,633 tons of TDS, but it would have a net zero impact on the basin in terms of degrading the basin or improving the basin relative to the objective. A loading source of the same volume at a TDS concentration of 1,000 mg/L would contribute 1,361 tons of TDS, but would improve the basin from a concentration standpoint. Such a loading term can be said to provide 273 tons of TDS dilution relative to the objective. Similarly, a loading source of 1,000 AFY at 1,400 mg/L would contribute 273 tons of TDS degradation relative to the objective.

**Figure 6-8** is stacked bar chart showing the average annual dilution or degradation provided by each loading source, by planning alternative, measured as tons of TDS less than or greater than the objective. **Figure 6-8** shows that:

- Loading sources contributing to TDS degradation relative to the TDS objective are natural loading, deep infiltration of applied water for irrigation, subsurface inflow from Oso and Middle Trabuco, and subsurface inflow from Horno.
- Natural loading is by far the largest contributor to TDS degradation relative to the objective.
- Loading sources contributing to TDS dilution relative to the TDS objective are deep infiltration of precipitation, streambed infiltration, subsurface inflow from Middle San Juan, and enhanced stormwater recharge.
- Recycled water recharge has no TDS concentration impact.

**Figure 6-9** is a similar chart showing the average annual dilution or degradation provided by each loading source by planning alternative, measured as tons of TDS less than or greater than the current ambient TDS concentration of 1,600 mg/L. **Figure 6-9** shows that:

- Loading sources contributing to TDS degradation relative to the current ambient TDS concentration are natural loading, deep infiltration of applied water for irrigation, and subsurface inflow from Horno.
- Natural loading is the largest contributor to TDS degradation relative to the current ambient TDS concentration.
- Loading sources contributing to TDS dilution relative to the current ambient TDS concentration are deep infiltration of precipitation, streambed infiltration, subsurface inflow from Middle San Juan, subsurface inflow from Oso and Middle Trabuco, enhanced stormwater recharge, and recycled water recharge.

**Figure 6-7. Dilution and Degradation by TDS Loading to the Lower San Juan Basin Relative to the Basin Plan Objective**

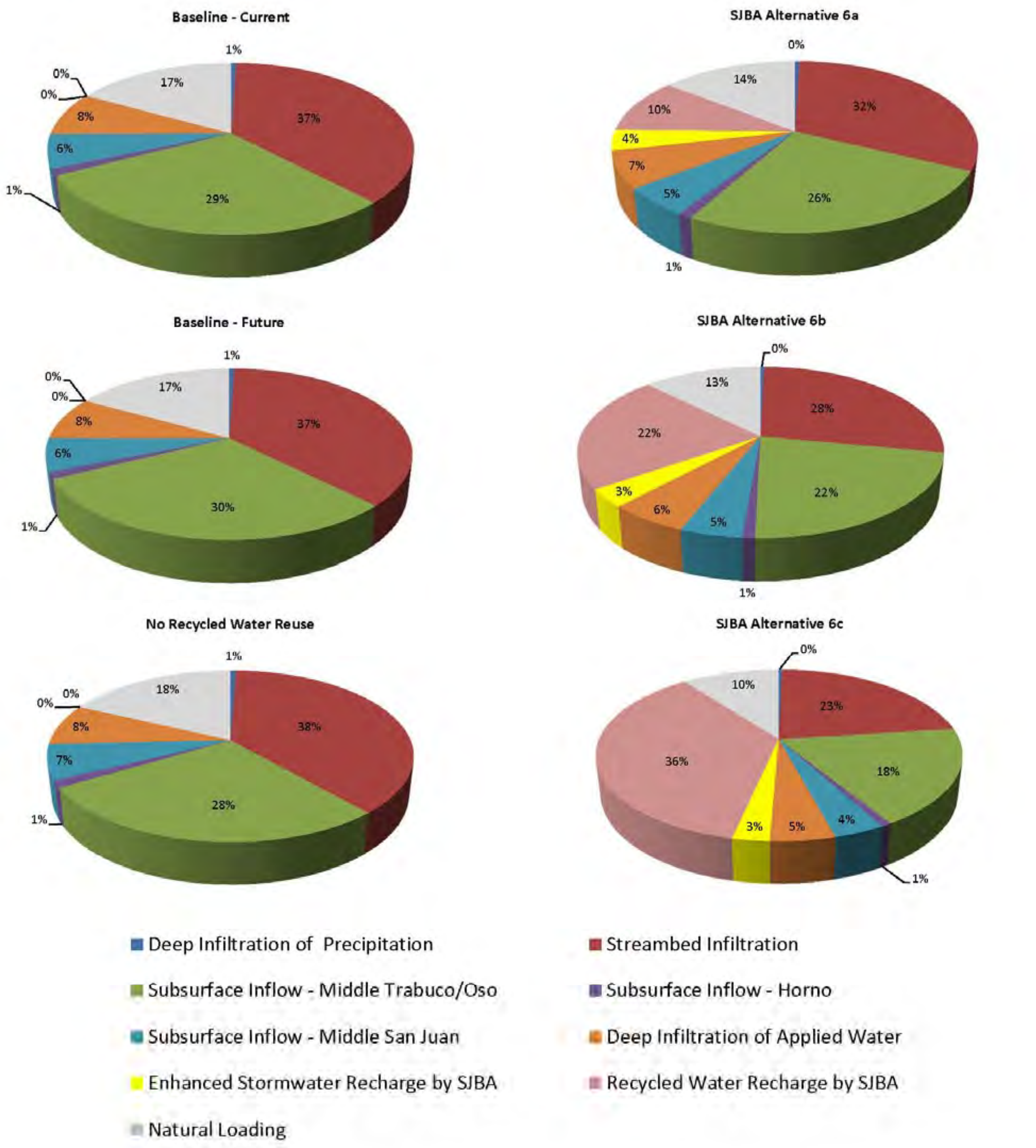


**Figure 6-8**
**Dilution and Degradation by TDS Loading to the Lower San Juan Basin Relative to the Basin Plan Objective**

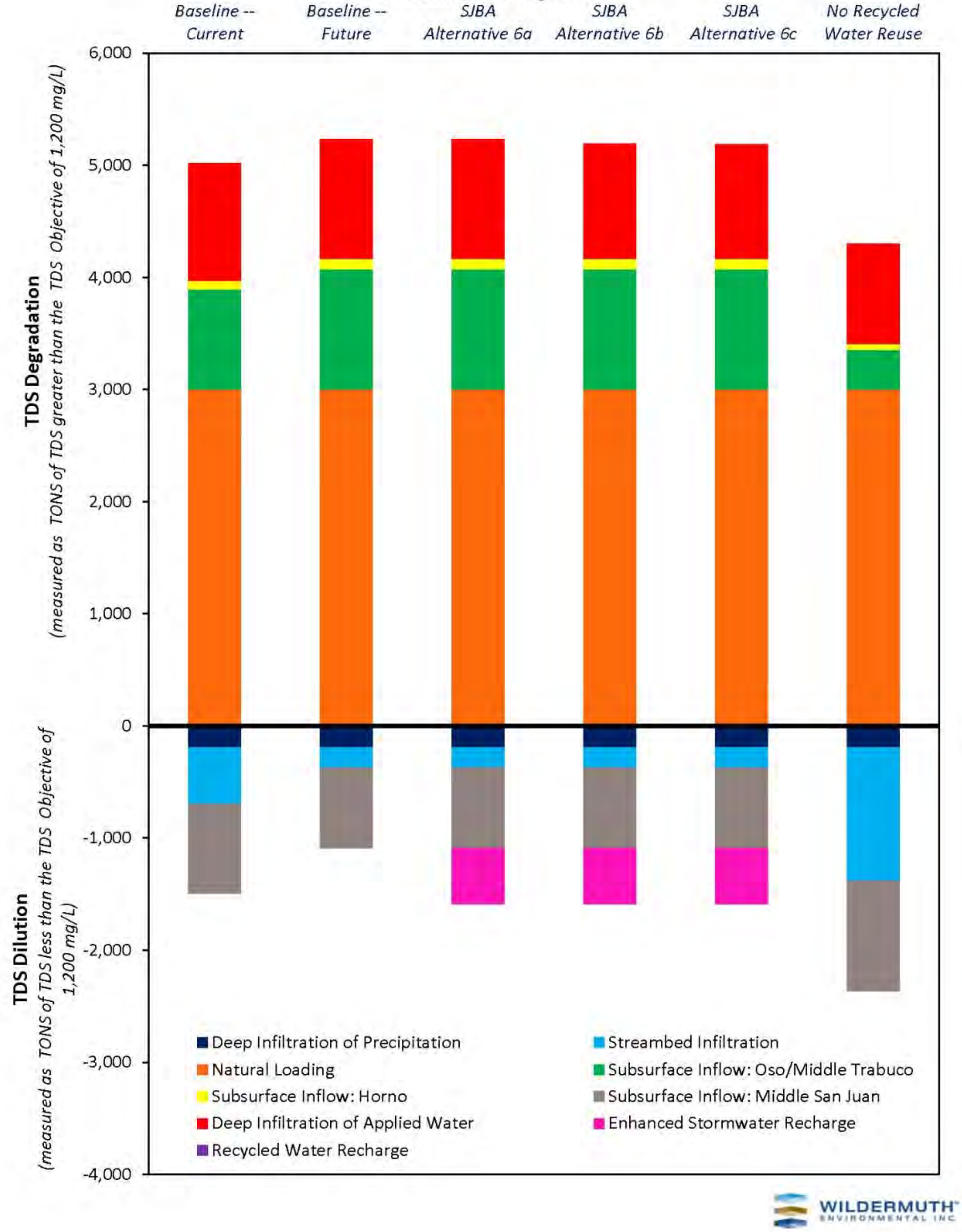
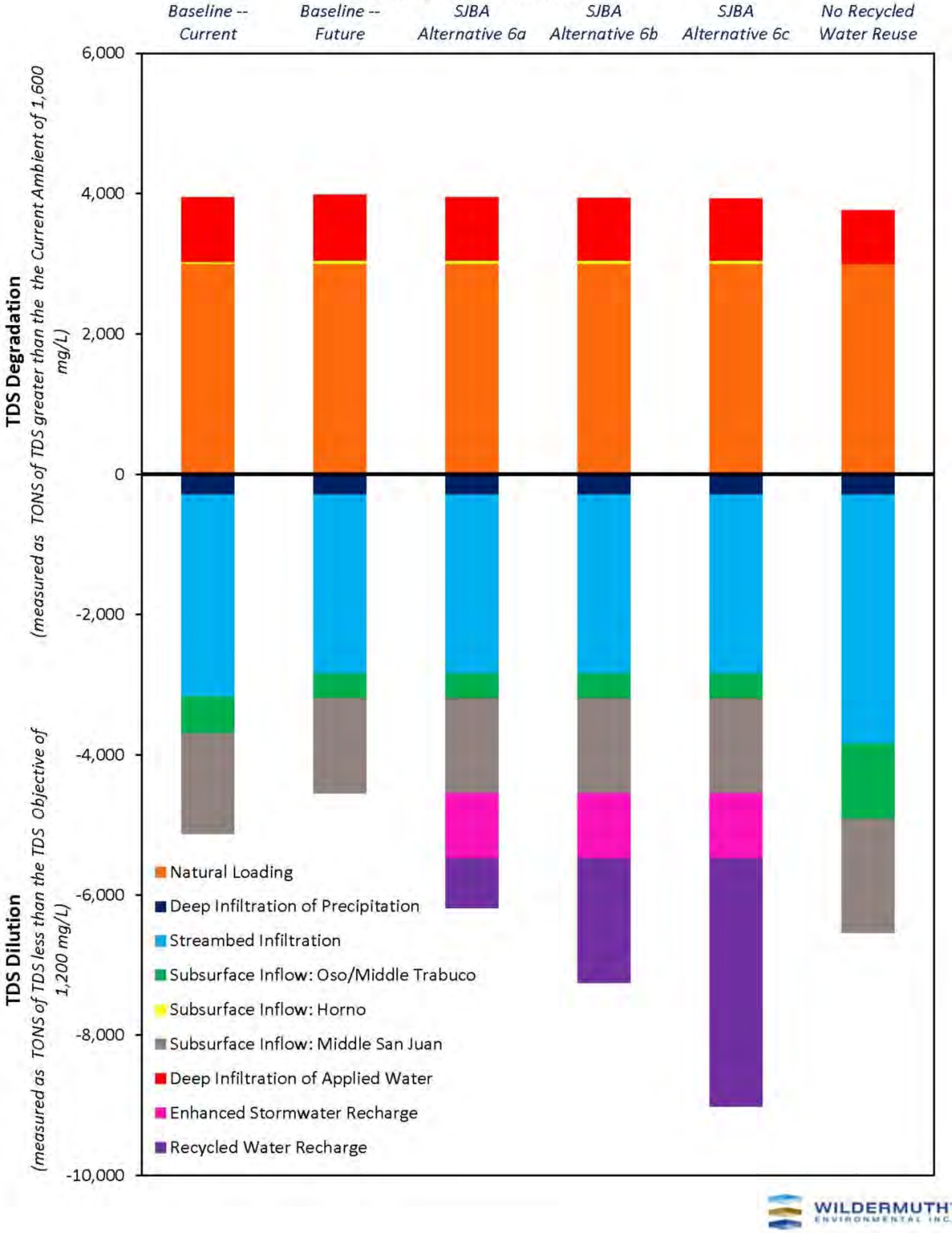


**Figure 6-9**
**Dilution and Degradation by TDS Loading to the Lower San Juan Basin Relative to the Current Ambient**



**Sensitivity Analysis**

An analysis was performed to test the sensitivity of the CSRM results to various assumptions or inputs to the model. The parameters tested for the sensitivity analysis included: natural TDS mass loading, the TDS concentration of subsurface inflow from Oso and Middle Trabuco, the TDS concentration of subsurface inflow from Middle San Juan, the TDS concentration of streambed infiltration, and the TDS concentration of imported water. The magnitude of each parameter was increased and decreased relative to the respective value used in the *Baseline—Future* planning alternative. The *Baseline—Future* planning alternative was selected for the sensitivity analysis because it resulted in the highest future TDS concentration in the Lower San Juan Basin. The sensitivity of the CSRM was tested for changes to each individual parameter as well as for changes to all parameters at the same time. **Table 6-6** summarizes the adjusted parameter values input to the model for the sensitivity analysis, the resultant TDS concentration in 2050, and the percent change in TDS concentration in 2050 relative to the *Baseline—Future* planning alternative. **Figure 6-10** shows the results of the sensitivity analysis as a TDS concentration time-history plot. The 2050 TDS concentration projections from the sensitivity analyses ranged from 1,340 mg/L to 1,790 mg/L. **Figure 6-10** shows that:

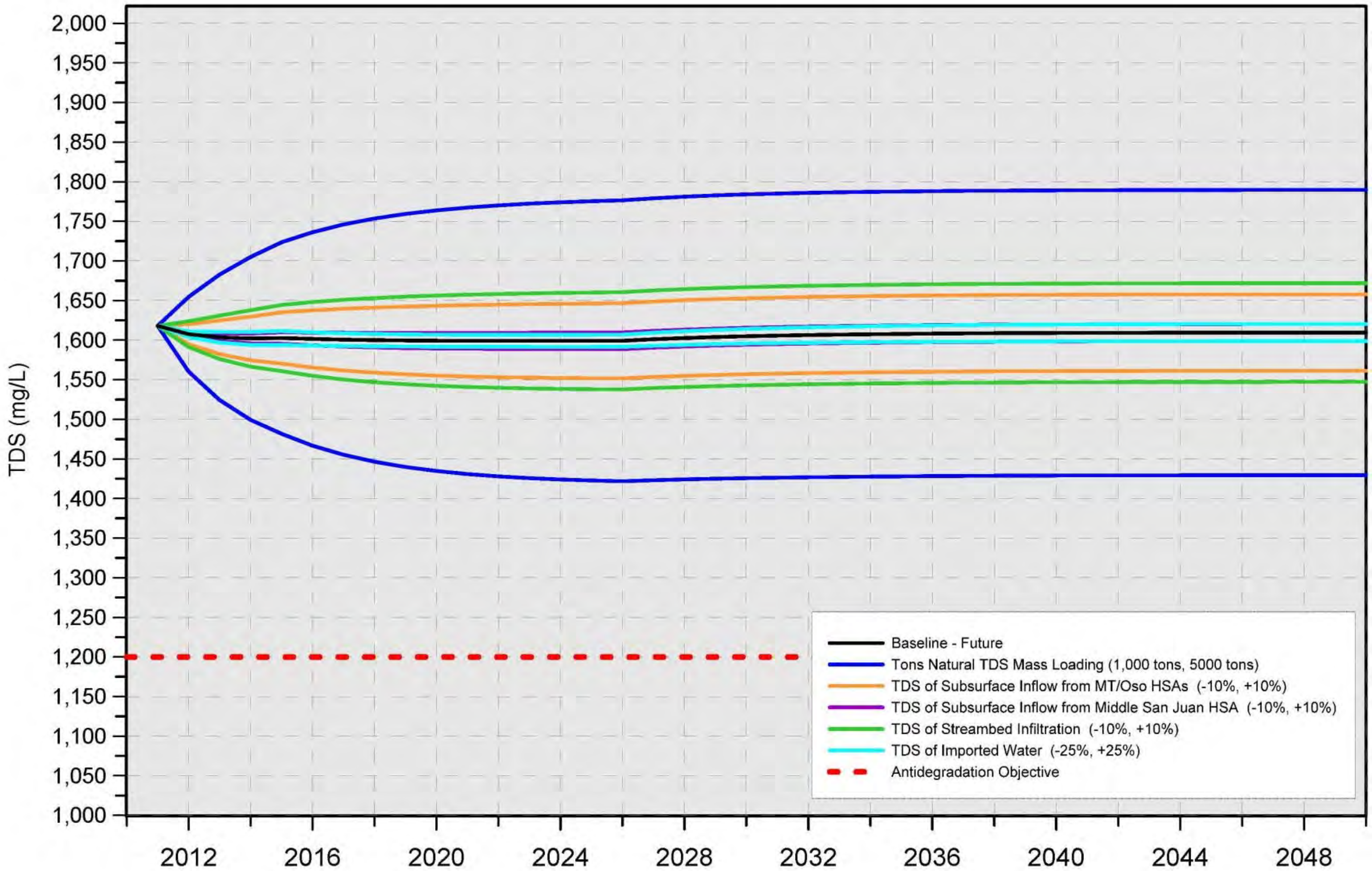
- The model is most sensitive to the natural TDS mass loading value.
- The model is least sensitive to the concentration of imported water.
- Even if all model parameters were over-estimated, the TDS concentration of the Lower San Juan Basin would remain above the TDS objective.
-

**Table 6-6. Summary of Sensitivity Analysis Parameter Values and Results**

| Parameters Tested | Baseline – Future Parameter Input Value | Sensitivity of CSRM to Reduced Parameter Vales | | | | Sensitivity of CSRM to Increased Parameter Vales | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Adjusted Parameter Value* | *% Change in Parameter Value* | *TDS concentration in 2050 (mg/L)* | *% Change Relative to Baseline--Future* | *Adjusted Parameter Value* | *% Change in Parameter Value* | *TDS concentration in 2050 (mg/L)* | *% Change Relative to Baseline--Future* |
| Natural TDS Mass Loading | 3,000 tons | 0 tons | -100% | 1,339 | -17% | 5,000 tons | 67% | 1,790 | 11% |
| TDS Concentration of Subsurface Inflow - Middle Trabuco/Oso | 1,500 mg/L | 1,350 mg/L | -10% | 1,561 | -4% | 1,650 mg/L | 10% | 1,658 | 2% |
| TDS Concentration of Subsurface Inflow - Middle San Juan | 750 mg/L | 675 mg/L | -10% | 1,599 | -1% | 825 mg/L | 10% | 1,620 | 0% |
| TDS Concentration of Streambed Infiltration | 1,170 mg/L | 1,053 mg/L | -10% | 1,547 | -4% | 1,287 mg/L | 10% | 1,672 | 3% |
| TDS Concentration of Imported Water Supply | 470 mg/L | 353 mg/L | -25% | 1,600 | -1% | 588 mg/L | 25% | 1,620 | 0% |

If all model parameters were under-estimated, the TDS concentration of the Lower San Juan Basin would degrade over time, but would still asymptotically approach a constant value.

**Figure 6-10. Total Dissolved Solids Projections for the Lower San Juan Basin Sensitivity Analysis of CSRM Results to TDS Loading Inputs**



## 6.3 MIDDLE SAN JUAN HSA EVALUATION

As previously described there is insufficient hydrologic and water quality data in the Middle San Juan HSA to make a determination regarding assimilative capacity or to project future TDS concentrations using the Level 4 analysis methodologies. However, a comparison with past analysis projections and current limited datasets for TDS concentrations in the HSA are consistent. The Middle San Juan HSA was analyzed in the 1993 SOCWA Basin Plan Amendments Final Report based on projected recycled water use in the watershed, and it was recommended that the TDS objective be increased from 500 to 750 mg/L. That amendment was approved. The 1993 Report noted that the groundwater quality in this basin was "marginal" and that "[d]omestic use in this basin is permitted by California State Board of Health if no other suitable water is available. Groundwater quality is adversely affected by irrigation return water and percolation through sediments which contribute to high TDS concentrations." At that time no development of this area was anticipated and no recycled water use within the HSA was projected for the planning period of the study.

The land overlying the Middle San Juan HSA is privately owned by the Rancho Mission Viejo (RMV) development company. No recycled water is currently being used within this basin. Groundwater is being used for non-domestic purposes, such as irrigation. RMV collects groundwater quality data at wells within their jurisdiction. Although requested from RMV, RMV to date has not agreed to make their data publicly available. There is one RMV well that is used for potable purposes in Middle San Juan, and therefore the data is publicly available. That well has a calculated point-statistic value for TDS of 703 mg/L (see description of point-statistic calculation method earlier in Section 6.1). A time-history plot of measured values in the last five years, consisting of only two data points, shows that concentrations remain below the objective of 750 mg/L (refer to Figure E-11 of **Appendix E**). This is consistent with what was found in the 1993 Study – where historic concentrations ranged from 500 to 800 mg/L. Although there was insufficient data to provide a Level 4 volume-weighted analysis of the ambient TDS concentration for this basin, a Level 3 analysis based on these two data points supports an indication that assimilative capacity does exist in the HSA today.

While the available (albeit limited) data show compliance with the Basin Plan TDS objective within the Middle San Juan HSA, salt load and planning conditions assessed in the 1993 Study may no longer be current, as development is currently underway. At the start of the SOCWA SNMP study, plans for use of recycled water were not anticipated until 2020. However, since the completion of the first draft of this SNMP, a need to serve recycled water to RMV has developed due to prolonged drought conditions. RMV's data and plans for future recycled water use will need to be assessed to evaluate current and potential future Basin Plan compliance issues before recycled water use can be permitted. To address this future need, the implementation plan presented within this SNMP identifies tasks required for finalizing agency responsibilities, conducting a Level 4 analysis, updating existing and projected salt load analyses, and (if applicable) reassessing Basin Plan modification recommendations within the Middle San Juan HSA.

# 7.0 ANTIDEGRADATION ANALYSIS

The Antidegradation Policy defines the State of California's regulatory approach to maintaining existing high quality waters of the state. The requirements of the policy must be applied in the interpretation of the water quality analysis findings provided in the previous chapters, particularly where the water quality objective is not being met, or may not be met in the future. This section summarizes the regulatory framework for the antidegradation analysis, and describes the development of a flow chart in alignment with the Antidegradation and Recycled Water policies, to interpret the water quality findings and determine if planned recycled water reuse can be permitted or if a basin plan amendment may be needed to continue or initiate recycled water use within the individual San Juan Basin HSAs.

## 7.1 REGULATORY FRAMEWORK FOR ANTIDEGRADATION POLICY

In 1968, the SWRCB adopted the Antidegradation Policy, Resolution No. 68-16, as a policy statement to implement the California Legislature's intent that waters of the state shall be regulated to achieve the highest water quality consistent with the maximum benefit to the people of the State of California. Specifically, the antidegradation policy states that:

> *"Whenever the existing quality of water is better than the quality established in policies…such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies."* (Resolution No. 68-16)

In 1990, the SWRCB issued Administrate Procedure Update (APU) 90-004 to provide guidance to the Regional Boards for performing antidegradation analyses. APU 90-004 establishes when an antidegradation analysis is required, and how to determine the level of analysis required (simple versus complete), and what components should be included as part of the antidegradation analysis and subsequent antidegradation findings by the Regional Boards. In general, a complete antidegradation analysis must establish the following:

1. Will the proposed discharge activity lower existing water quality?
2. Will the proposed discharge activity result in water quality that exceeds or threatens to exceed established water quality objectives in the applicable Basin Plan?
3. If the proposed discharge activity will lower existing water quality, or will result in water quality that exceeds or threatens to exceed water quality objectives, is such degradation permissible when balanced against the benefit to the people of the state?

The 2012 Recycled Water Policy establishes additional guidelines as to the level of antidegradation analysis required for permitting recycled water reuse and recharge projects (see Section 9 of the Policy). Section 9 of the Policy first establishes that reuse of recycled water for landscape irrigation or recharge is in accordance with the Policy and is to the benefit of the people of the State of California. The Policy outlines the following antidegradation criteria for landscape irrigation projects:

> *"A project that meets the criteria for a streamlined irrigation permit and is within a basin where a salt/nutrient management plan satisfying the provisions of paragraph 6(b) is being prepared may be approved by the Regional Water Board by demonstrating through a salt/nutrient mass balance or similar analysis that the project uses less than*

*10 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin (or multiple projects using less than 20 percent of the available assimilative capacity as estimated by the project proponent in a basin/sub-basin).”* [21] [Section 9.d.(2)]

The Policy outlines the following antidegradation criteria for recycled water recharge projects:

*“A project that utilizes less than 10 percent of the available assimilative capacity in a basin/sub-basin (or multiple projects utilizing less than 20 percent of the available assimilative capacity in a basin/sub-basin) need only conduct an antidegradation analysis verifying the use of the assimilative capacity…In the event a project or multiple projects utilize more than the fraction of the assimilative capacity designated in subparagraph (1), then a Regional Water Board-deemed acceptable antidegradation analysis shall be performed to comply with Resolution No. 68-16. The project proponent shall provide sufficient information for the Regional Water Board to make this determination.”* [Section 9.c]

These criteria will be used to determine the level of antidegradation analysis needed for evaluating and eventually permitting the various recycled water reuse projects in the SOCWA service area. However, these criteria do not provide guidelines for the complete set of potential water quality outcomes that could result from an analysis of current and projected future ambient water quality. The Policy is silent as to the level of analysis required if a landscape irrigation project utilizes more than 10 percent of the available assimilative capacity (or 20% for multiple projects).

For the purpose of this SNMP, it is assumed that the same antidegradation analysis criteria established for recycled water recharge projects apply to those landscape irrigation projects that utilize more than 10 percent of available assimilative capacity (or 20% for multiple projects). The Policy is also silent as to the permitting process for those basins or sub-basins that currently have no assimilative capacity (e.g., the current ambient water quality is greater than the water quality objective). If a basin has no assimilative capacity today, it is assumed that the Regional Board has the following options for permitting recycled water projects (subject to implementation of an SNMP):

1. Write permits that limit the constituent concentration of recycled water to a concentration that is equal to or less than the Basin Plan objective.
2. Write permits that require a salt offset program to mitigate loading from use of recycled water that has a concentration in excess of the constituent objective.
3. Modify the Basin Plan to raise the water quality objectives and create assimilative capacity. If a project proponent requests a modification of Basin Plan objectives, the project proponent must demonstrate that beneficial uses will be protected, that the lowering of water quality standards is to the maximum benefit of the people of the state of California, and use the criteria established in California Water Code Section §13241 to propose alternative water quality objectives.

[21] The criteria for streamlined permitting are outlined in Section 7.b of the Policy and it is assumed that all new irrigation projects in SOCWA’s service area will satisfy this criteria.

In the case where an HSA currently has no assimilative capacity, the SOCWA SNMP stakeholders will only propose amendments to the Basin Plan objectives where the existing TDS concentration will prevent "current" levels of recycled water reuse from being permitted. Current, as defined in this assumption, is the present plus five years into the future. It is assumed that a current project cannot be permitted if there is a finding of no assimilative capacity in the HSA where the project is proposed and the TDS concentration of the recycled water used for the project is greater than the Basin Plan TDS objective.

## 7.2 INTERPRETATION OF GROUNDWATER BASIN ANALYSES

The groundwater basin analyses developed in Sections 5 and 6 of this report provide the information needed to determine the level of antidegradation analysis required for each HSA. **Figure 7-1** summarizes the results of these evaluations. For each HSA in the study area, **Figure 7-1** shows the Basin Plan TDS objective, the current ambient TDS concentration, and the projected future TDS concentration of groundwater within the HSA. The TDS concentration results shown in **Figure 7-1** represent the projected change in TDS concentrations due to all sources of TDS loading in the study area, including planned recycled water reuse projects. **Table 7-1** summarizes the relative contribution to changes in the TDS concentration caused by the planned recycled water projects in each HSA and the percent of available assimilative capacity, if any, that is used up by the projects. These values were calculated as part of the model runs, included in **Appendices D and F**. Note that the modeled TDS values presented in **Figure 7-1** and **Table 7-1** are rounded to two significant digits, which is in line with the level of accuracy expected from these models.

A detailed flow-chart was developed to organize the interpretation of the range of TDS results and assimilative capacity outcomes and establish the level of antidegradation analysis required for each sub-basin. The decision flow-chart is shown in **Figure 7-2**. Also shown in **Figure 7-2** is the regulatory end-point for each sub-basin evaluated in this study. The following sections describe the appropriate antidegradation analyses for each HSA based on this interpretation of the regulatory guidelines established in the Policy and any additional assumptions made to address situations not characterized in the Policy itself.

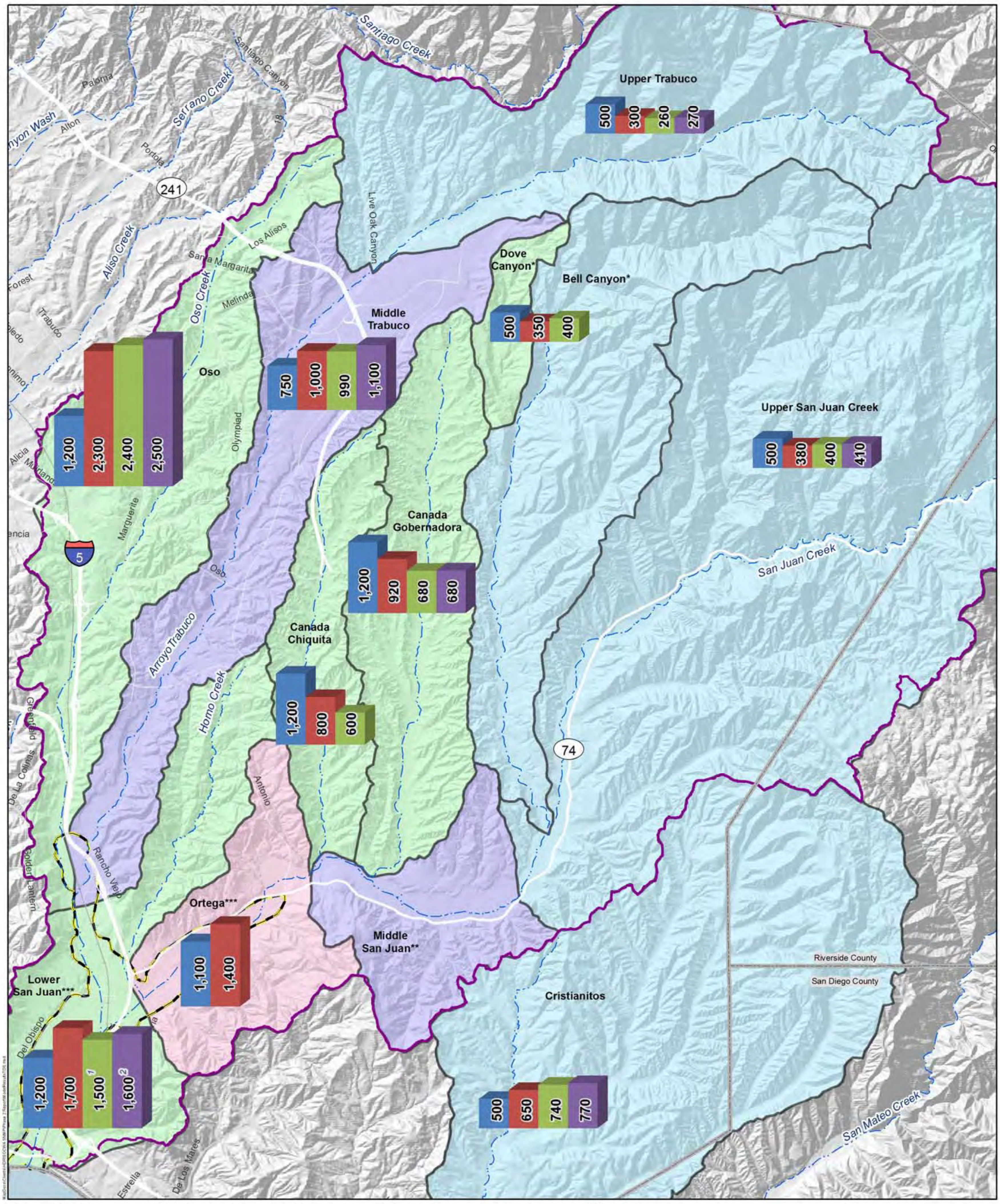
**Table 7-1 Recycled Water Contribution to TDS Concentrations within the San Juan Basin (in mg/L)**

| Sub-Basin | TDS Objective | Current TDS | Available Assimilative Capacity | Projected TDS Concentration from Planned Recycled Water Projects Scenario | Assimilative Capacity Gained or Lost | TDS Contribution Associated with Recycled Water Reuse Projects | % of Available Assimilative Capacity used by Recycled Water Projects |
|---|---|---|---|---|---|---|---|
| Oso | 1,200 | 2,300 | None | 2,400 | None | 181 | None Available |
| Middle Trabuco | 750 | 1,000 | None | 990 | None | 18 | None Available, but TDS Improves |
| Upper Trabuco | 500 | 300 | 200 | 260 | +40 | 0 | Assimilative Capacity Improves |
| Canada Gobernadora | 1,200 | 920 | 280 | 680 | +240 | 34 | Assimilative Capacity Improves |
| Canada Chiquita | 1,200 | 800 | 400 | 600 | +200 | 36 | Assimilative Capacity Improves |
| Dove/Bell Canyon* | 500 | 350 | 150 | 400 | -50 | 15 | 10% |
| Upper San Juan | 500 | 380 | 120 | 400 | -20 | 7 | 6% |
| Cristianitos | 500 | 650 | None | 740 | None | 6 | None Available |
| Ortega** | 1,000 | 1,400 | None | -- | -- | -- | -- |
| Lower San Juan | 1,200 | 1,700 | None | 1,600 | None | 0 | None Available, but TDS Improves |
| Middle San Juan | 750 | 700*** | 50 | Unknown | Unknown | Unknown | Unknown |

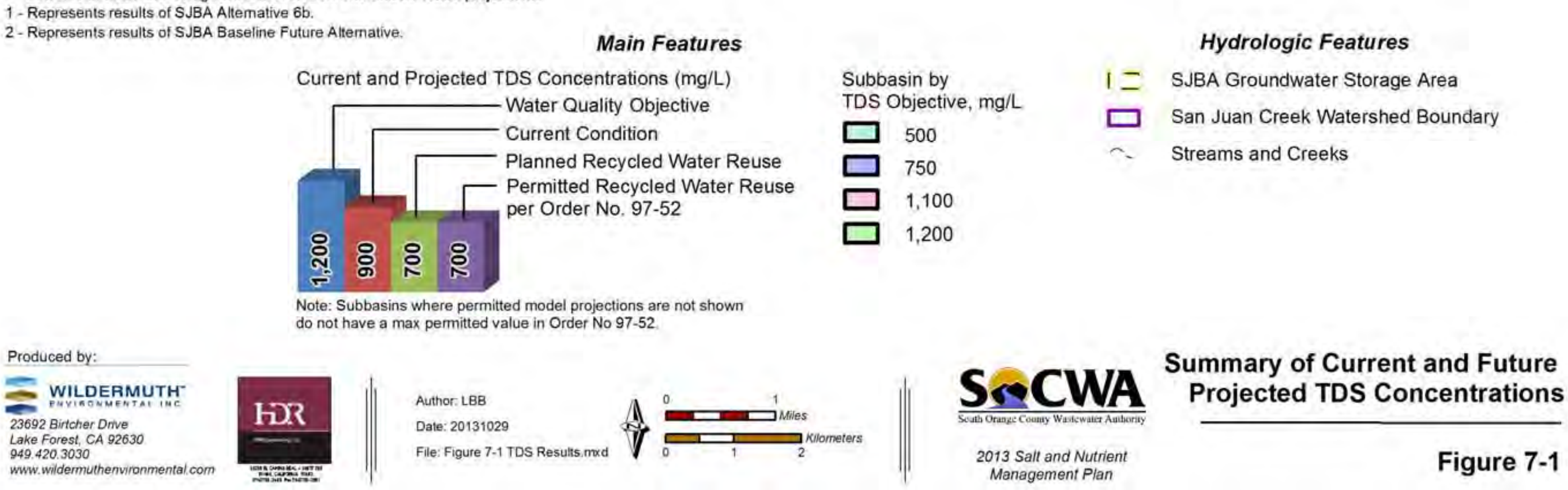
* Dove Canyon and Bell Canyon were modeled as one unit, but have different TDS objectives (1,200 mg/L and 500 mg/L, respectively). To be conservative, the results of the groundwater basin analysis were compared to the lower objective of 500 mg/L for Bell Canyon.

** Ortega and Lower San Juan were modeled as one unit, the projected TDS concentration is for Lower San Juan and Ortega combined, and is representative of the Baseline Future model alternative, which results in the worst case future TDS concentration in the basin.

*** Although there was insufficient data to provide a Level 4 volume-weighted analysis of the ambient TDS concentration for the Middle San Juan HSA, a Level 3 analysis based on limited data points supports an indication that assimilative capacity does exist in the HSA today.




* Dove and Bell Canyons were modeled as one unit for current and future projections. The model results are compared to Bell Canyons TDS objective.
** Data not available to determine current and future TDS concentrations.
*** Lower San Juan and Ortega were modeled as one unit for future projections.
1 - Represents results of SJBA Alternative 6b.
2 - Represents results of SJBA Baseline Future Alternative.



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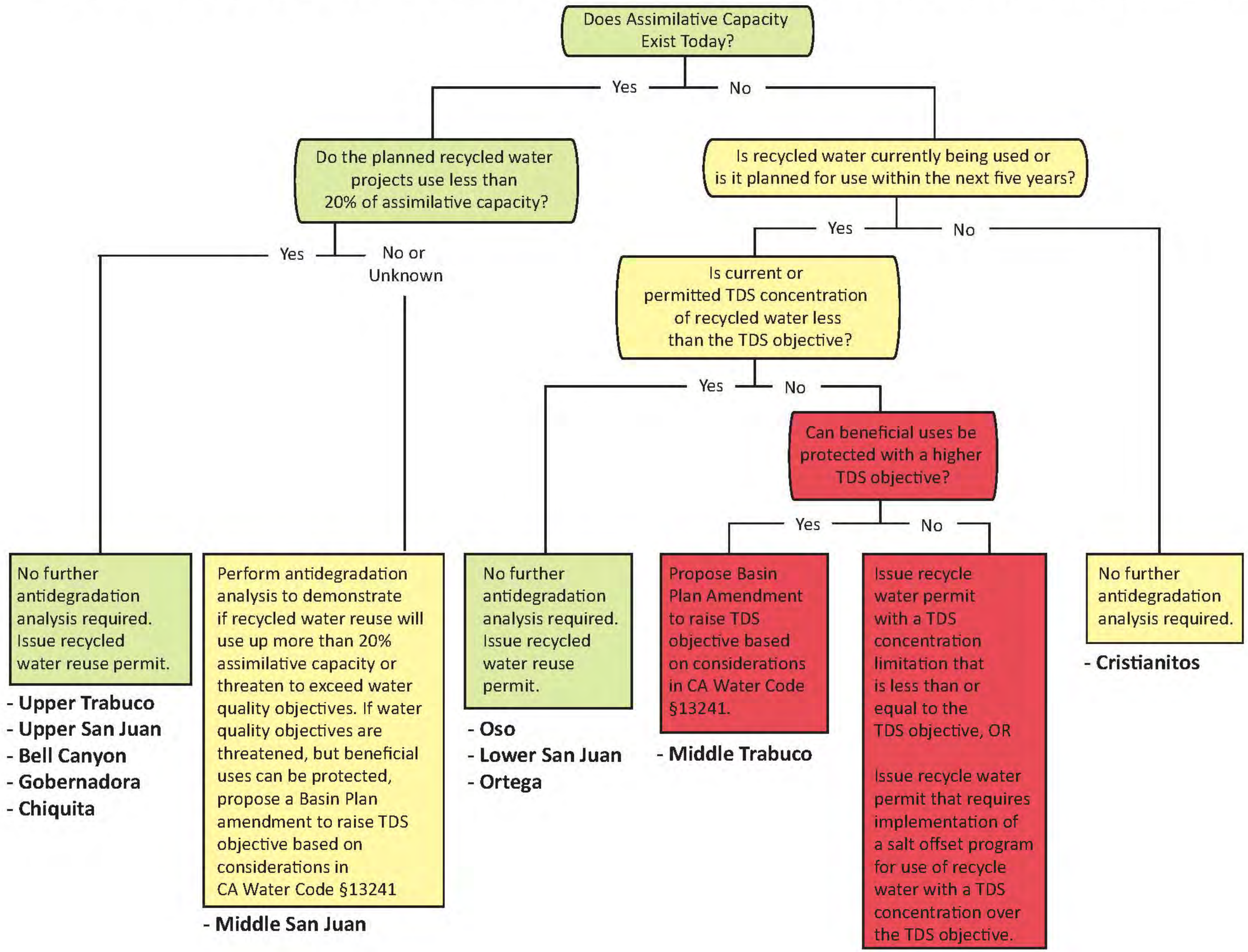
# Figure 7-2 Decision Flow Chart to Identify Antidegradation Analysis Requirements



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***Does Assimilative Capacity exist today?***

Based on our Level 3 and Level 4 analyses of TDS concentrations in the study area, assimilative capacity currently exists within each of the HSAs, with the exception of Middle Trabuco and Cristianitos.

If yes, the second question asks,

***Do the planned recycled water projects use less than 20% of the available assimilative capacity?***

In accordance with the State Recycled Water Policy, no further antidegradation analysis is required if the answer is yes. The following basins fall under this category. In some of these basins, the assimilative capacity actually improves with planned recycled water use.

- *Upper Trabuco*
- *Upper San Juan*
- *Dove/Bell Canyon*
- *Canada Gobernadora*
- *Canada Chiquita*

For Middle San Juan, the answer to this question is unknown. At the start of the SOCWA SNMP study, plans for use of recycled water in the Middle San Juan HSA were not anticipated within the current planning period and therefore, no use of available assimilative capacity was anticipated by planned recycled water projects in the basin. However, since the completion of the first draft of this SNMP, a need to serve recycled water to RMV has developed due to prolonged drought conditions in the area. RMV's data and plans for future recycled water use will need to be assessed to evaluate current and potential future Basin Plan compliance issues before recycled water use can be permitted. Therefore, it is currently unknown whether the available assimilative capacity will be reduced by proposed future recycled water projects.

In order to make this determination prior to using recycled water within the Middle San Juan HSA, an antidegradation analysis will be performed to demonstrate if recycled water reuse will use up more than 20% assimilative capacity or threaten to exceed water quality objectives. If water quality objectives are threatened, but beneficial uses can be protected, a Basin Plan amendment may be proposed to raise the TDS objective based on considerations in CA Water Code §13241.

If there is no existing available assimilative capacity, the flow chart asks:

***Is recycled water currently being used or planned for use within the next five years?***

If not, then an antidegradation analysis is not required at this time. Given that the SOCWA SNMP implementation plan will allow for re-evaluation of Basin Plan compliance on a five-year schedule (see Section 8), an antidegradation analysis will be more appropriate during the next evaluation, when there will be greater certainty about "current" land use and recycled water plans and additional water quality data from which to make a baseline assessment. The Cristianitos HSA falls into this category.

*Cristianitos*

Recycled water projects are not anticipated to start until 2020 and thus no antidegradation finding is needed for Cristianitos at this time. Existing data is insufficient to scientifically establish a basin plan objective that accommodates recycled water reuse in accordance with the Policy and is protective of beneficial uses. Antidegradation analyses to accommodate future recycled water reuse should be made during the next evaluation of Basin Plan compliance (five years after adoption of this SNMP). At that time compliance with Basin Plan objectives can be assessed and the regulatory actions necessary to permit recycled water reuse, protect beneficial uses, and manage salt and nutrients in the basin can be established. Consideration of the beneficial uses within the lower San Mateo watershed, outside of the SOCWA study area, should also be considered at that time.

If recycled water is currently being used or planned for use in the next five years but no assimilative capacity exists, the flow chart asks:

***Is the current or permitted TDS concentration of recycled water less than the TDS objective?***

If current and permitted TDS concentration is less than the basin plan objective then no further antidegradation analysis is required. Allowable TDS concentration for recycled water, per the SOCWA permit, is 1,000 mg/L (1,200 mg/L for the Coastal Plant) and the current annual average is 717 mg/L. Based on these criteria, the Oso and Ortega/Lower San Juan HSAs fall into this category.

*Oso*

Actual and permitted TDS concentration of recycled water used and planned for use in the Oso sub-basin is lower than the TDS objective of 1,200 mg/L. No further antidegradation analysis is needed.

*Ortega and Lower San Juan*

Actual and permitted TDS concentration of recycled water used and planned for use in Ortega and Lower San Juan sub-basins is lower than the TDS objectives of 1,100 and 1,200 mg/L, respectively. And, recycled water recharge is projected to improve the basin relative to management scenarios that do not implement recycled water recharge. Thus, subject to DPH approval, recycled water recharge is permissible under the guidelines of the Antidegradation and Recycled Water policies. No further antidegradation analysis is needed.

One final question remains:

***If the permitted TDS concentration is not less than the basin objective, can beneficial uses be protected with a higher basin objective?***

If the answer is yes, then a basin amendment can be proposed based on considerations included in the California Water Code, as follows:

*California Water Code §13241*

Each regional board shall establish such water quality objectives in water quality control plans as in its judgment will ensure the reasonable protection of beneficial uses and the prevention of nuisance; however, it is recognized that it may be possible for the quality of water to be changed to some degree without unreasonably affecting beneficial uses. Factors to be considered by a regional board in establishing water quality objectives shall include, but not necessarily be limited to, all of the following:

(a) Past, present, and probable future beneficial uses of water.

(b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.

(c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.

(d) Economic considerations.

(e) The need for developing housing within the region.

(f) The need to develop and use recycled water.

*Middle Trabuco*

Middle Trabuco falls into this category for a potential basin plan amendment. The current TDS objective for the Middle Trabuco HSA is 750 mg/l. The existing TDS is 1,000 mg/L, which improves with planned recycled water use to 990 mg/L, but still exceeds the basin objective. Approximately 900 AFY of recycled water is currently used within the basin, and up to 1,500 AFY is planned.

Historically, the Rosenbaum wells at the downstream end of the basin provided municipal water to the CSJC (formerly Capistrano Valley Water District). The CSJC, however, has not used these wells in recent years due to degrading quality associated with radionuclides, arsenic, iron, and manganese. Private wells were, and are, used for the irrigation of local golf courses. Prior modeling indicated that the groundwater basin would degrade even without implementation of recycled water projects, but it was assumed that by limiting the pumping and reuse of the groundwater for irrigation, which could concentrate the salts in the groundwater, a water quality objective of 750 mg/L could be maintained. So the basin objective for TDS was raised from 500 mg/L to 750 mg/L. At the time, the basin was thought to be almost 80 percent built out, and ultimately 8,000 acres of the 11,000-acre watershed would be left unimproved. Today, however, the basin is considered built out, with less than 4,000 acres left unimproved. This means that there has been much more development in this watershed than was previously forecasted, resulting in a negative impact on the groundwater TDS concentration.

Alternative actions to continue to permit recycled water use in the Middle Trabuco HSA are as follows:

1. Restrict recycled water quality within this HSA to a concentration that is less than the basin objective of 750 mg/L. Although the current recycled water quality of 717 mg/L falls below the 750 mg/L objective, it may be problematic to maintain this level of quality. Variances in potable water quality alone could greatly affect the water reclamation plants' ability to consistently achieve TDS concentrations below 750 mg/L. If restriction of recycled water quality is pursued by the Regional Board, then recycled water use in the basin may have to be suspended and up to

1,500 AFY of additional imported water will be required to meet those irrigation water demands in the SOCWA service area.

2. Implement a salt offset program to mitigate the loading from the use of recycled water with a TDS concentration greater than 750 mg/L. There are no current or planned municipal uses of groundwater in Middle Trabuco HSA, and subsequently there is no need for water quality to meet an objective of 750 mg/L.  Downstream impacts would be mitigated by desalters that are already needed to put naturally high-TDS water to beneficial use. A salt offset program might consist of a water softener control program, increasing stormwater infiltration projects, eliminating septic systems in the downstream end of the Middle Trabuco basin, and/or demineralization of recycled water prior to use within the basin.  These efforts may help the groundwater meet the current objective, but no additional beneficial uses would be achieved and the expense of these efforts would not be justifiable.

3. Modify the Basin Plan objective to 1,200 mg/L to create assimilative capacity and continue/expand recycled water reuse. If recycled water were not used, approximately 1,500 AFY of imported water will have to be brought into the region to replace recycled water. By amending the objective to 1,200 mg/L, the current assimilative capacity would be 200 mg/L.  With planned recycled water use, assimilative capacity would improve to 210 mg/L, so no assimilative capacity is lost due to recycled water use under a modified objective. Middle Trabuco would then affirmatively fall into the category of the second question *Does Assimilative Capacity exist today?  If yes, do the planned recycled water projects use less than 20% of the available assimilative capacity?*  And as such, recycled water use in this basin could continue to be permitted.

## 7.3 SUMMARY OF REQUIRED ACTIONS

In summary, the following actions are required to continue to permit recycled water reuse in the San Juan Basin HSA's in a manner that maximizes recycled water reuse, offsets imported water demand, and protects beneficial uses in a cost-effective manner:

Recycled water can continue to be permitted as defined in Regional Board Order No. 97-52 in the Upper Trabuco, Upper San Juan, Bell Canyon, Gobernadora, Oso. Lower San Juan, and Ortega HSA's.

Modify the Basin Plan objective for Middle Trabuco to 1,200 mg/L to create assimilative capacity and continue/expand recycled water reuse. This allows maximum reuse of recycled water without harming beneficial uses within or downstream of the Middle Trabuco sub-basin. The sensitivity studies performed in the analysis of Lower San Juan sub-basin (see Section 6-2) demonstrated that an increased TDS concentration at the boundary of Middle Trabuco and Lower San Juan would not result in compliance issues in the Lower San Juan sub-basin.

If plans for recycled water use in the Middle San Juan HSA move forward an antidegredation analysis must be performed to demonstrate if the project will use more than 20% of the available assimilative capacity or if recycled water use threatens to exceed the current water quality objectives in the basin. If water quality objectives are threatened but beneficial uses can be protected, a Basin Plan amendment may be proposed to raise the TDS objective, based on considerations in CA Water Code §13241.The results of the analyses will be evaluated in a manner consistent with this SNMP to determine how to proceed with permitting recycled water use in the Middle San Juan HSA.

# 8.0 SALT AND NUTRIENT MANAGEMENT PLAN IMPLEMENTATION

The Recycled Water Policy establishes that each salt and nutrient management plan (SNMP) shall include the following components:

1. Establish recycled water and stormwater capture goals [see Section 6.b(3).c of the Policy]
2. Salt and nutrient source identification, basin/sub-basin assimilative capacity and loading estimates, together with fate and transport of salts and nutrients. [see Section 6.b(3).d of the Policy]
3. An antidegradation analysis demonstrating that the projects included within the plan will, collectively, satisfy the requirements of Resolution No. 68-16 [see Section 6.b(3).f of the Policy]
4. A monitoring plan, which includes annual monitoring of CEC's, for ongoing evaluation of compliance with Basin Plan Objectives for salts and nutrients [see Section 6.b(3).a and 6.b(3).b of the Policy]Implementation measures to manage salt and nutrient loading in the basin on a sustainable basis. [see Section 6.b(3).e of the Policy]

Sections 4, 5, 6, and 7 of this report cover existing monitoring efforts and available data, the identification and quantification of salt and nutrient loading sources, planned recycled water reuse projects in compliance with Regional Board Order No. 97-52 and planned stormwater capture projects within the SNMP study area, the analysis of current and future assimilative capacity with and without these projects, and the antidegradation analysis to assess compliance with SWRCB Resolution No. 68-16 and the Recycled Water Policy.

This section summarizes the SOCWA Salt and Nutrient Management Plan and implementation schedule, including: restatement of the recycled water reuse and stormwater recharge goals of the SOCWA SNMP stakeholders, the implementation measures to control salt and nutrients in the San Juan Basin Watershed, the recommended approach to address the compliance issues in Middle Trabuco and Middle San Juan as identified by the basin evaluations and antidegradation analyses, and the proposed plan for developing a comprehensive, watershed-wide SNMP monitoring program.

## 8.1 RECYCLED WATER REUSE AND STORMWATER RECHARGE GOALS

The goals of the SOCWA SNMP stakeholders are to:

- Offset demands for imported water from Colorado and northern California by increasing use of recycled water, stormwater, and urban runoff.
- Maximize the reuse of recycled water for irrigation in the SOCWA service area in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Maximize the capture of stormwater and urban runoff through compliance with MS4 in a manner that is protective of beneficial uses of local groundwater and surface water resources.
- Increase groundwater production yield in the Lower San Juan Basin by recharging stormwater and recycled water.
- Continue and expand existing programs to divert and use high-TDS urban surface water runoff to increase local supply and protect water quality in the Lower San Juan Basin.

- Continue and expand existing programs to desalt groundwater in the Lower San Juan Basin to increase local supply.
- Improve monitoring and management of groundwater and surface water in the San Juan Watershed to increase the understanding of salt and nutrient and transport in the watershed and to allow periodic revaluation of compliance with Basin Plan Objectives.
- Develop a long-term, adaptive SNMP that achieves the goals of the stakeholders in a reasonable and cost-effective manner.

Implementation of planned recycled water beneficial use projects in the SOCWA service area alone will offset an additional 10,000 AFY of demand for imported water, helping the state reach its water recycling goals in accordance with the Policy.

## 8.2 SALT AND NUTRIENT MANAGEMENT IMPLEMENTATION MEASURES

As a result of the 1993 SOCWA Basin Plan Amendments Final Report, the Regional Board developed a comprehensive recycled water reuse permit (Order No. 97-52) that was designed to limit recycled water reuse to amounts that were appropriate for ensuring long-term compliance with Basin Plan Objectives in the San Juan Watershed. Order 97-52 was the SOCWA service area's first salt and nutrient management plan. The approach developed by SOCWA and the Regional Board was unique in that it accounted for the spatial variability of land use and water quality (both ground and surface water) across the San Juan Watershed to set appropriate Basin Plan Objectives and recycled water reuse limits, by sub-watershed. And, rather than setting Basin Plan Objectives that were consistent with the naturally high TDS concentrations in the region, several sub-watersheds—Oso, Lower San Juan, Ortega—were designated with TDS objectives that were far less than existing TDS concentrations. As applied to groundwater whose quality had never been or never would be at the recommended objectives, the objective became a management parameter – focused on conjunctive water use – and not a quality goal to be met in the groundwater itself. The value of this strategy was that it accommodated the cost-effective use of local water resources, both recycled water and surface/groundwater, while respecting limitations required for beneficial use.

The analyses performed for this study demonstrated that by and large, the recycled water reuse limitations developed in 1993 were successful at maximizing recycled water use, protecting beneficial uses, and complying with Basin Plan Objectives. Two exceptions were Middle Trabuco and Middle San Juan. In both cases, the ultimate land-use development plans of the sub-basins changed relative to the assumptions made in the 1993 analysis. The current ambient concentration of TDS in the Middle Trabuco HSA is 1,000 mg/L, which exceeds the Basin Plan objective of 750 mg/L set in 1993 to protect municipal wells in San Juan Capistrano. Degraded water quality (iron, manganese, radionuclides, TDS) has resulted in the discontinuation of well use for domestic purposes in the subbasin; therefore no existing beneficial uses are protected by this objective. It is recommended that a Basin Plan Amendment be pursued to increase the objective to 1,200 mg/L, which aligns with the objectives set for neighboring subbasins and protects continued beneficial use of the groundwater for private irrigation wells.

At the start of the SOCWA SNMP study, plans for use of recycled water were not anticipated until 2020. However, since the completion of the first draft of this SNMP, a need to serve recycled water to RMV has developed due to prolonged drought conditions. RMV's data and plans for future recycled water use will need to be assessed to evaluate current and potential future Basin Plan compliance issues before recycled water use can be permitted. To address this future need, the implementation plan presented within this SNMP identifies tasks required for finalizing agency responsibilities, conducting a Level 4 analysis, updating existing and projected salt load analyses, and (if applicable) reassessing Basin Plan modification recommendations within the Middle San Juan HSA.

An important outcome of these results is the understanding that the planning environment is neither static nor certain and that compliance with Basin Plan Objectives needs to occur more frequently than every twenty years. Including a more frequent schedule of water quality compliance evaluation as part of an SNMP will ensure that salt and nutrient management measures are working and will continue to be effective in the future, and if not, the salt and nutrient management measures can be modified accordingly. And, while existing data was sufficient to evaluate compliance with Basin Plan Objectives, future monitoring efforts need to be improved to address water quality compliance questions.

The SOCWA SNMP implementation measures are as follows:

1. Continue to implement Order No. 97-52 with the existing recycled water use volume and quality limitations for the Upper Trabuco, Upper San Juan, Gobernadora, Bell Canyon, Lower San Juan, Ortega and Oso sub-basins. Under current planning assumptions, recycled water use can be implemented in a manner that is protective of beneficial uses and is protective of the water quality required of those beneficial uses.
2. Immediately pursue a Basin Plan amendment for the Middle Trabuco sub-basin to increase the TDS Basin Plan Objective to 1,200 mg/L. This will ensure that up to 1,500 AFY of imported water can be offset through the use of recycled water while protecting beneficial uses within and downstream of the Middle Trabuco sub-basin.
3. Perform a salt and nutrient loading analysis, prepare salt and nutrient concentration projections and evaluate proposed recycled water project compliance with the existing Basin Plan Objective for the Middle San Juan sub-basin. This analysis must be completed before recycled water can be permitted for use in this sub-basin.
4. Improve existing monitoring efforts by developing a cooperative watershed-wide groundwater and surface water monitoring program. Report progress and data annually to the Regional Board.
5. Work in conjunction with the regional entities that are implementing potable water quality improvements and urban stormwater programs, such as the County of Orange Drainage Area Management Plan, to protect and restore surface and groundwater quality, safeguard public and environmental health and secure water supplies.
6. Re-evaluate current and future Basin Plan compliance in the San Juan Basin Watershed HSAs every five years. If a significant change to the recycled water use planning assumptions used in this analysis occurs before five years is up, a reevaluation of the affected sub-basins must be presented to the Regional Board prior to approval of modified recycled water use conditions.
7. Update the SNMP implementation measures, as necessary, after each re-evaluation of Basin Plan compliance.

The proposed monitoring program is described in greater detail in Section 8.3. The overall SNMP implementation schedule, including reference to responsible parties, is provided in Section 8.4.

## 8.3 SALT AND NUTRIENT MANAGEMENT MONITORING AND REPORTING PROGRAM

As described in Section 4 of this SNMP, there are numerous stakeholders collecting groundwater and surface water data throughout the San Juan Basin Watershed. The current groundwater and surface water monitoring entities include the County of Orange, CSJC, MNWD, SJBA, SCWD, SMWD, SOCWA, TCWD, and numerous private entities. Currently, the individual monitoring efforts are targeted at answering regulatory or water quality management issues specific to the monitoring entity. While these data collection efforts could continue to be sufficient for future evaluations of water quality compliance assuming they continue into the future, there is no guarantee that they will continue into the future, or that the constituents of interest will be collected at a frequency that furthers the understanding of the spatial and temporal impacts of recycled water reuse in the San Juan Basin Watershed. Therefore, a watershed-wide monitoring program is proposed to more efficiently and comprehensively meet the monitoring plan requirements of the Recycled Water Policy.

The Policy outlines the following monitoring plan requirements:

> "*A basin/sub-basin wide monitoring plan that includes an appropriate network of monitoring locations. The scale of the basin/sub-basin monitoring plan is dependent upon the site-specific conditions and shall be adequate to provide a reasonable, cost-effective means of determining whether the concentrations of salt, nutrients, and other constituents of concern as identified in the salt and nutrient plans are consistent with applicable water quality objectives. Salts, nutrients, and the constituents identified in paragraph 6(b)(1)(f) shall be monitored. The frequency of monitoring shall be determined in the salt/nutrient management plan and approved by the Regional Water Board pursuant to paragraph 6(b)(2)*."

And, the monitoring plan shall include:

> *"A provision for annual monitoring of Constituents of Emerging Concern (e.g., endocrine disrupters, personal care products or pharmaceuticals) (CECs) consistent with recommendations by CDPH and consistent with any actions by the State Water Board taken pursuant to paragraph 10(b) of this Policy*."

Given the size of the watershed, the number of monitoring entities involved, and the varied frequencies required for existing and future monitoring, it will take approximately one year to develop the comprehensive, watershed-wide monitoring program. The SJBA has included a line-item within their Fiscal Year 2014-2015 budget to develop the monitoring program. The following subsections describe the key questions that need to be answered by the San Juan Watershed monitoring program and the general monitoring components that will be included in the final monitoring plan, in alignment with the Recycled Water Policy.

### 8.3.1 Key Monitoring and Data Collection Program Design Questions

The following is the preliminary list of questions the monitoring and data collection program should be designed to answer. For each question, there is a notation as to how the data can be obtained. This list will be refined during the first few tasks of SNMP implementation (see Section 8.4).

1. What is the impact to the constituent concentrations in groundwater and non-storm surface water flow caused by recycled water reuse in the upper watershed HSA's?
    a) What is the quality of non-storm fluxes (groundwater and surface water) at the HSA boundaries? (requires field monitoring)
    b) Where in the basin is recycled water applied (parcel-level analysis)? (data provided by water agencies)
    c) What is the volume and quality of recycled water used in each HSA? (data provided by water agencies)
    d) What is the volume and quality of other water used for irrigation in the upper watershed HSAs? (calculation based on data provided by water agencies)

2. What is the impact to the constituent concentrations in stormwater recharged in the lower watershed HSAs caused by increasing recycled water reuse in the upper watershed HSAs?
   a) What is the volume and quality of stormwater flowing over and recharging groundwater in the lower watershed HSAs? (requires monitoring)
3. What is the impact to the constituent concentrations in groundwater in the lower watershed HSAs caused by recycled water reuse for irrigation and recharge?
   a) What is the change in groundwater quality over time? (requires monitoring)
   b) Where in the basin is recycled water applied (parcel-level analysis)? (data provided by water agencies)
   c) What is the volume and quality of recycled water used for irrigation in the lower watershed HSAs? (data provided by water agencies)
   d) What is the volume and quality of other water used for irrigation in the lower watershed HSAs? (monitoring provided by water agencies and subsequent calculations)
   e) What is the relative impact of recycled and other waters used for irrigation in the lower watershed HSAs? (calculation based on monitoring data)
   f) What is the volume and quality of recycled water recharged in the lower watershed HSAs? (requires monitoring)
4. What is the impact to the constituent concentrations of groundwater in the lower watershed HSAs caused by leaching from natural aquifer materials?
   a) What is the volume and quality of each recharge component to the basin? (new monitoring, existing monitoring provided by water agencies and subsequent calculations)
   b) What is the change in groundwater quality over time? (requires monitoring)
5. Are the CECs identified by the California Department of Public Health's (CDPH's) Blue Ribbon Panel present in detectible concentrations in the San Juan Watershed?

### 8.3.2 General Monitoring Program and Data Collection Components

The complete monitoring program will be developed during the first few tasks of SNMP implementation (see Section 8.4). The following bullets describe the type of data that will be collected and the minimum frequency of monitoring during initial program implementation.

- *Recycled water use*: develop a GIS database of recycled water reuse sites, water sources, water volume served, and water quality.
- *Other water use*: develop a database of water sources, supply volumes, and water quality in the San Juan Watershed.
- *Surface water (non-storm flow)*: quarterly sampling during non-storm periods for the first two years and potentially reduced frequency sampling thereafter based on chemical constituent variability and amounts of recycled water used in the watershed tributary to the measuring point. CEC's will be sampled at least once per year.
- *Surface water (storm flow)*: two to three storm events per drainage area (Oso, Arroyo Trabuco, San Juan, Horno, Chiquita, Gobernadora, Bell Canyon, Cristianitos); target 2 to 3 drainage areas per year. Modify stormwater monitoring frequency after all drainage areas evaluated based on chemical constituent variability and amounts of recycled water used in the drainage area.

- *Groundwater*: quarterly sampling at wells for the first two years and potentially reduced frequency thereafter based on chemical constituent variability and amounts of recycled water used in the watershed tributary to the well. CEC's will be sampled at least once per year.

## 8.4 SALT AND NUTRIENT MANAGEMENT IMPLEMENTATION PLAN AND SCHEDULE

The SNMP implementation steps are described below and include an annotation of the stakeholder responsible for implementing the task, the estimated duration of the task, and when the task would be completed relative to notice to proceed with the implementation plan. **Figure 8-1** is a graphical representation of the proposed components of the implementation plan and schedule.

**Continued compliance with Recycled Water Limitations in Order 97-52, and subsequent revisions.**

**Middle Trabuco Basin Plan Amendment**. Provide assistance and prepare the necessary documentation to support the Regional Board in amending the Basin Plan to raise the TDS objective in the Middle Trabuco HSA. This task will be implemented by the SJBA, whose member agencies represent the majority of recycled water users in the Middle Trabuco HSA (CSJC, MNWD, and SMWD). The SJBA will work with the additional recycled water users (TCWD), as necessary, to implement this task. Duration: up-to one year from the submittal of the SNMP to the Regional Board.

**Middle San Juan Analysis**. Work with private entities to obtain existing groundwater data and perform a salt loading and antidegradation analysis in support of permitting recycled water use in the Middle San Juan HSA. This task will be implemented by the SMWD, whose service area encompasses the entire HSA and will serve recycled water to the private entities. Duration: the timing of this task will be coordinated with plans for recycled water use in the area.

**Continue to implement individual groundwater and surface water monitoring programs**. During the year it will take to develop the cooperative, watershed-wide monitoring program, each individual agency will continue to implement their individual monitoring programs. Duration: until new monitoring program is complete and being implemented (see following steps).

**Monitoring Program Development**

**Step 1**. Perform comprehensive survey of existing groundwater and surface water monitoring efforts in the entire watershed. This task will be implemented by the SJBA. Duration: three months.

**Step 2**. Develop a GIS database of recycled water reuse sites in the SNMP study area. This task will be implemented by the SJBA. Duration: three months.

**Step 3**. Identify spatial and temporal data gaps and canvass the watershed for sites that should be monitored, but that are not currently a part of an existing monitoring program. This task will be implemented by the SJBA. Duration: two months, after development steps (1) and (2) completed; cumulatively five months from notice to proceed.

**Step 4**. Recommend a comprehensive monitoring plan that answers the SNMP questions and that does not duplicate efforts of other agencies. This may include recommendations to add new surface water monitoring locations or construct new groundwater monitoring wells. Submit the plan to the Regional Board for approval. This task will be implemented by the SJBA. Duration: two months, after development step (3) completed; cumulatively seven months from notice to proceed.

**Step 5**. Work with participating agencies to finalize monitoring program, which incorporates comments from the Regional Board. This task will be implemented by the SJBA. Duration: two months, after development step (4) completed; cumulatively nine months from notice to proceed.

**Step 6**. Execute agreements among agencies to finance and implement the final monitoring program. Submit final plan to the Regional Board. This task will be implemented by the SJBA.Duration: three months, after development step (5) completed; cumulatively 12 months from notice to proceed].

**Monitoring Program Implementation**

**Step 1**. Implement monitoring program at existing monitoring sites. This task will be coordinated by the SJBA. Duration: ongoing, after development step (6) completed.

**Step 2**. Construct new monitoring wells, only if necessary. This task will be implemented by the responsible party identified in the final monitoring program plan. Duration: one year, concurrent with start of monitoring program implementation step (1); cumulatively two years from notice to proceed.

**Step 3**. Implement monitoring program at new monitoring sites, if constructed. This task will be coordinated by the SJBA. Duration: ongoing, after monitoring implementation step (2) completed.

**Annual Reporting to the Regional Board**. After each 12-month monitoring period, an annual progress report will be prepared and submitted to the Regional Board. Each progress report will summarize the monitoring efforts for the year, include a database of data collected, and report on any proposed changes to the monitoring program to ensure the questions defined during monitoring plan development are adequately being addressed. This task will be implemented by the SJBA. Duration: six months, annually after each 12-month monitoring period.

**Re-evaluate Compliance with Basin Plan Objectives.** Compute ambient water quality and evaluate compliance with Basin Plan Objectives , perform anti-degradation analyses, evaluate and revise SNMP implementation measures as appropriate, and update SNMP, including revisions to the monitoring program, implementation plans for projects to manage salt and nutrients in areas where compliance is problematic, and any proposed revisions to the process and schedule to reevaluate compliance with Basin Plan objectives in the future. Submit complete analysis and updated SNMP to the Regional Board. This task will be implemented by the SJBA. Duration: 18 months, to be started five years after the adoption of the current SNMP.

**Implement updated SNMP**. Duration: ongoing.

**Table 8- 1**
**SNMP Implementation Schedule**

| Implementation Tasks Outlined in Section 8.4 of SNMP | Duration of Implementation Tasks Relative to the Notice to Proceed with the SNMP | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Year 1 (months) | | | | | | | | | | | | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Years 7 and later |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | | | | | | |
| **Continued compliance with Recycled Water Limitations in Permit 97-52, and subsequent revisions** | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| **Middle Trabuco Basin Plan Amendment.** Provide assistance and prepare the necessary documentation to support the Regional Board in amending the Basin Plan to raise the TDS objective in the Middle Trabuco HAS. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ ◆ | | | | | | |
| **Middle San Juan Analysis** Work with private entities to obtain existing groundwater data and perform a salt loading and antidegradation analysis in support of permitting recycled water reuse in the Middle San Juan HSA. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ ◆ | | | | | |
| **Continue to Implement Individual Groundwater and Surface Water Monitoring Programs.** During the year it will take to develop the cooperative, watershed-wide monitoring program, each individual agency will continue to implement their individual monitoring programs. | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | | | | | | |
| **Monitoring Program Development - Step 1.** Perform comprehensive survey of existing groundwater and surface water monitoring efforts in the entire watershed. | ■ | ■ | ■ | | | | | | | | | | | | | | | |
| **Monitoring Program Development - Step 2.** Develop a GIS database of recycled water reuse sites in the SNMP study area. | ■ | ■ | ■ | | | | | | | | | | | | | | | |
| **Monitoring Program Development - Step 3.** Identify spatial and temporal data gaps and canvass the watershed for sites that should be monitored, but that are not currently a part of an existing monitoring program. | | | | ■ | ■ | | | | | | | | | | | | | |
| **Monitoring Program Development - Step 4.** Recommend a comprehensive monitoring plan that answers the SNMP questions and that does not duplicate efforts of other agencies. This may include recommendations to add new surface water monitoring locations or construct new groundwater monitoring wells. | | | | | | ■ | ■ | | | | | | | | | | | |
| **Monitoring Program Development - Step 5.** Work with participating agencies to finalize monitoring program, which incorporates comments from the Regional Board. | | | | | | | | ■ | ■ | | | | | | | | | |
| **Monitoring Program Development - Step 6.** Execute agreements among agencies to finance and implement the final monitoring program. Submit final plan to the Regional Board. | | | | | | | | | | ■ | ■ | ■ ◆ | | | | | | |
| **Monitoring Program Implementation - Step 1.** Implement monitoring program at existing monitoring sites. | | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ | ■ |
| **Monitoring Program Implementation - Step 2.** Construct new monitoring wells, only if necessary. | | | | | | | | | | | | | ■ | | | | | |
| **Monitoring Program Implementation - Step 3.** Implement monitoring program at new monitoring sites, if constructed. | | | | | | | | | | | | | | ■ | ■ | ■ | ■ | ■ |
| **Annual Reporting to the Regional Board.** After each 12-month monitoring period, an annual progress report will be prepared and submitted to the Regional Board. Each progress report will summarize the monitoring efforts for the year, include a database of data collected, and report on any proposed changes to the monitoring program to ensure the questions defined during monitoring plan development are adequately being addressed. | | | | | | | | | | | | | | ◆ | ◆ | ◆ | ◆ | ◆ |
| **Re-evaluate Compliance with the Basin Plan Objectives.** Develop methodology to compute ambient water quality and evaluate compliance with Basin Plan Objectives, perform antidegradation analysis, evaluate and revise SNMP implementation measures as appropriate, and update SNMP, including revisions to the monitoring program, implementation plans for projects to manage salt and nutrients in areas where compliance is problematic, and any proposed revisions to the process and schedule to re-evaluate compliance with Basin Plan Objectives in the future. Submit complete analysis and updated SNMP to the Regional Board. | | | | | | | | | | | | | | | | | ■ | ■ ◆ |
| **Implement Updated SNMP.** | | | | | | | | | | | | | | | | | | ■ |

◆ Indicates deliverable due to the Regional Board

# APPENDICES

# APPENDIX A
# Stakeholder Workshops

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# Meeting Summary

## Stakeholder Meeting No. 1
## SOCWA Salt & Nutrient Management Plan – Phase 2

**Date/Time:** December 11, 2012, 10:00 am

**Location:** Moulton Niguel Water District
27500 La Paz Road, Laguna Niguel

## 1. Introductions/Objectives Meeting

Brennon Flahive presented a brief overview of the three-phased effort to develop a Salt and Nutrient Management Plan (SNMP) for the SOCWA service area. He thanked attending stakeholders for their prior input in helping to complete Phase 1 of the SNMP effort, which involved preparing a scope of work for the proposed Phase 2 SNMP. He noted that this December 11 workshop represented an initial element in soliciting stakeholder input to the Phase 2 effort, which will culminate in the development and submittal of a SNMP to the Regional Water Quality Control Board (Regional Board). He welcomed the following stakeholders to the workshop.

| Name | Organization | Email |
|---|---|---|
| Jaime Aguilar | Santa Margarita Water District | jaimea@smwd.com |
| Ted on Bittner | Orange County Public Works | theodorevonbittner@rdmd.com |
| Don Bunts | San Juan Basin Authority | dbunts@smwd.com |
| Roger Butow | Clean Water Now | rogerbutow@me.com |
| Dennis Cafferty | El Toro Water District | dcafferty@etwd.com |
| Matt Collings | Moulton Niguel Water District | mcollings@mnwd.com |
| William Curry | City of San Juan Capistrano | wcurry@sanjuancapistrano.org |
| Steve Dishon | South Coast Water District | sdishon@scwd.org |
| Jennifer Duffy | HDR | jennifer.duffy@hdrinc.com |
| Jay Elston | City of San Clemente | elstonj@san-clemente.org |
| Brennon Flahive | South Orange County Wastewater Authority | bflaihve@socwa.org |
| Ziad Mazboudi | City of San Juan Capistrano | zmazboudi@sanjuancapistrano.org |
| Fisayo Osibodu | Regional Water Quality Control Board | oosibodu@waterboards.ca.gov |
| Oliver Pacifico | California Department of Public Health | oliver.pacifico@cdph.ca.gov |
| Dave Roohk | HDR | dave.roohk@hdrinc.com |
| Hector Ruiz | Trabuco Canyon Water District | hruiz@tcwd.ca.gov |
| Michael Welch | Consultant w/HDR | mwelch1@san.rr.com |
| Rick Wilson | Surfrider Foundation | rwilson@surfrider.org |

## 2. Proposed SNMP Technical Approach

M. Welch summarized the State of California Water Recycling Policy which requires the preparation of SNMPs. He noted that:

- Key objectives of the SNMPs include (1) assessing whether existing groundwater quality objectives established in the Regional Board's Basin Plan are appropriate for protecting beneficial uses of groundwater, and (2) evaluating groundwater quality management strategies for ensuring compliance with applicable Basin Plan groundwater quality objectives.

- The SNMPs focus on groundwater beneficial uses and groundwater quality, but evaluating the interaction between groundwater and surface water will be an important aspect of evaluating Basin Plan groundwater quality objectives and assessing groundwater management strategies.
- An assessment of Basin Plan groundwater quality objectives in the SOCWA service area occurred in the early 1990s, and resulted in modification of Basin Plan groundwater quality objectives in several portions of the San Juan Basin to encourage recycled water use.
- San Diego Region stakeholders and the Regional Board cooperated to develop recommended guidelines for preparing SNMPs within the San Diego Region. The guidelines, adopted by the Regional Board in 2011, identify a tiered approach that tailors the level of SNMP effort to the size and significance of the groundwater basin.
- The Regional Board initially encouraged stakeholders to develop SNMPs within their respective areas of interest, but is now requiring the development of SNMPs by recycled water agencies. The Regional Board recently modified SOCWA's recycled water permit to require SOCWA to assume a lead role in the development of a SNMP within the San Juan Basin.

D. Roohk presented an overview of the proposed technical approach for the SOCWA SNMP effort. He noted that:

- The geographic area of the study encompasses the portion of the SOCWA service area that is within the San Diego Region.
- Per Phase 1 recommendations, groundwater quality constituents to be addressed as part of the SOCWA service area SNMP include total dissolved solids (TDS), iron, manganese, nitrate, and constituents of emerging concern. TDS and nitrate will receive the primary focus in the SNMP effort.
- A roster of potential stakeholders developed as part of the Phase 1 effort is being updated as part of the SNMP Phase 2 effort.
- A list of service area groundwater-related projects and groundwater issues is being updated as part of Phase 2.
- In keeping with the approach utilized within the SNMP Guidelines, a tiered approach utilizing four levels of analysis are proposed for the Phase 2 SNMP, ranging from Level 1 (no significant analysis) to Level 4 (ambient concentration determinations, source and load estimates, salt/nutrient water quality projections, and Basin Plan conformance/modification/antidegradation analyses). Levels of SNMP evaluation are being assigned to service area subbasins on the basis of the significance of the groundwater resource within and downstream of each of the subbasins, as follows:
    - Level 1 - no significant groundwater resources and no significant downstream concerns.
    - Level 2 - marginal groundwater resources and significant downstream concerns.
    - Level 3 - modest groundwater resources and significant downstream concerns.
    - Level 4 - significant groundwater resources.

# 3. Group Discussion

Fisayo Osibodu of the Regional Board briefed the stakeholders on the Regional Board SNMP perspective, noting that the SNMP process should be stakeholder-driven. He also noted that the tiered work approach proposed as part of the SOCWA SNMP is in keeping with the adopted SNMP guidelines and Regional Board expectations. He also noted the importance of maintaining flexibility throughout the SNMP process to respond to stakeholder issues and concerns. One of the benefits of the State Policy and the SNMP initiative is to streamline permitting for recycled water projects.

M. Welch asked for stakeholder input on the proposed technical approach or input on stakeholder issues/concerns that need to be incorporated in the SNMP effort. Key issues identified by stakeholders included:

- Stormwater influence on groundwater quality and availability is important, and the SNMP effort should incorporate and evaluate stormwater management strategies being implemented as part of the MS4 (Municipal Separate Stormwater Sewer System) permits.
- Groundwater evaluations should be consistent with surface water data and groundwater infiltration load estimates and data from the MS4 program.
- Prior NGO participation in the SNMP effort may have been limited by uncertainty on (1) how the SNMP process integrated with surface water evaluations, and (2) whether SNMPs were required or "encouraged".
- The SOCWA SNMP should reflect the fact that existing or potential groundwater use could occur within the proposed Level 1 zones of the basin.
- Opportunities for salt credits should be taken into account as a management strategy.
- Influences of septic tank discharges on groundwater should be quantified and considered.
- Influences of riparian habitat on groundwater, such as significant uptake by invasive Arundo vegetation, should be quantified and considered.
- Seawater intrusion can represent a significant salinity load, and should be evaluated as part of the SNMP.
- Dumpsites and toxic "hot spots" (or other sources of potential contaminants) should be identified and assessed as part of the SNMP.
- Evaluating the interaction between surface flow and groundwater will be an important component in the SNMP assessment.
- Moving forward, data management will be an important component of management strategies in terms of keeping track of projects within the basin that may affect groundwater use and/or quality.

Stakeholders indicated support for the proposed tiered work approach, noting that this approach ensures consistency between the level of effort and the significance (both quality and quantity) of SOCWA service area groundwater resources.

# 4. Summary and Action Items

M. Welch and D. Roohk summarized the key stakeholder input received during the meeting, and noted that the SNMP technical team will incorporate the stakeholder suggestions and input into the Phase 2 analysis of salinity and nutrient sources, loads, beneficial use needs, management constraints, and management opportunities.

In closing the meeting, Brennon Flahive thanked the participants for their input. He noted that the presentation and other documents can be found on the SOCWA Dropbox web site for stakeholders, and if access has lapsed, please let him know so he can rectify it. He also noted that a second SNMP workshop would be scheduled in the future to provide the stakeholders an opportunity to

- review SNMP progress in assessing groundwater quality conditions, loads, and management opportunities within the SOCWA service area, and
- provide guidance on groundwater management strategies and options within the study area.

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# APPENDIX B
# Initial Basin Characterization Maps and Graphics

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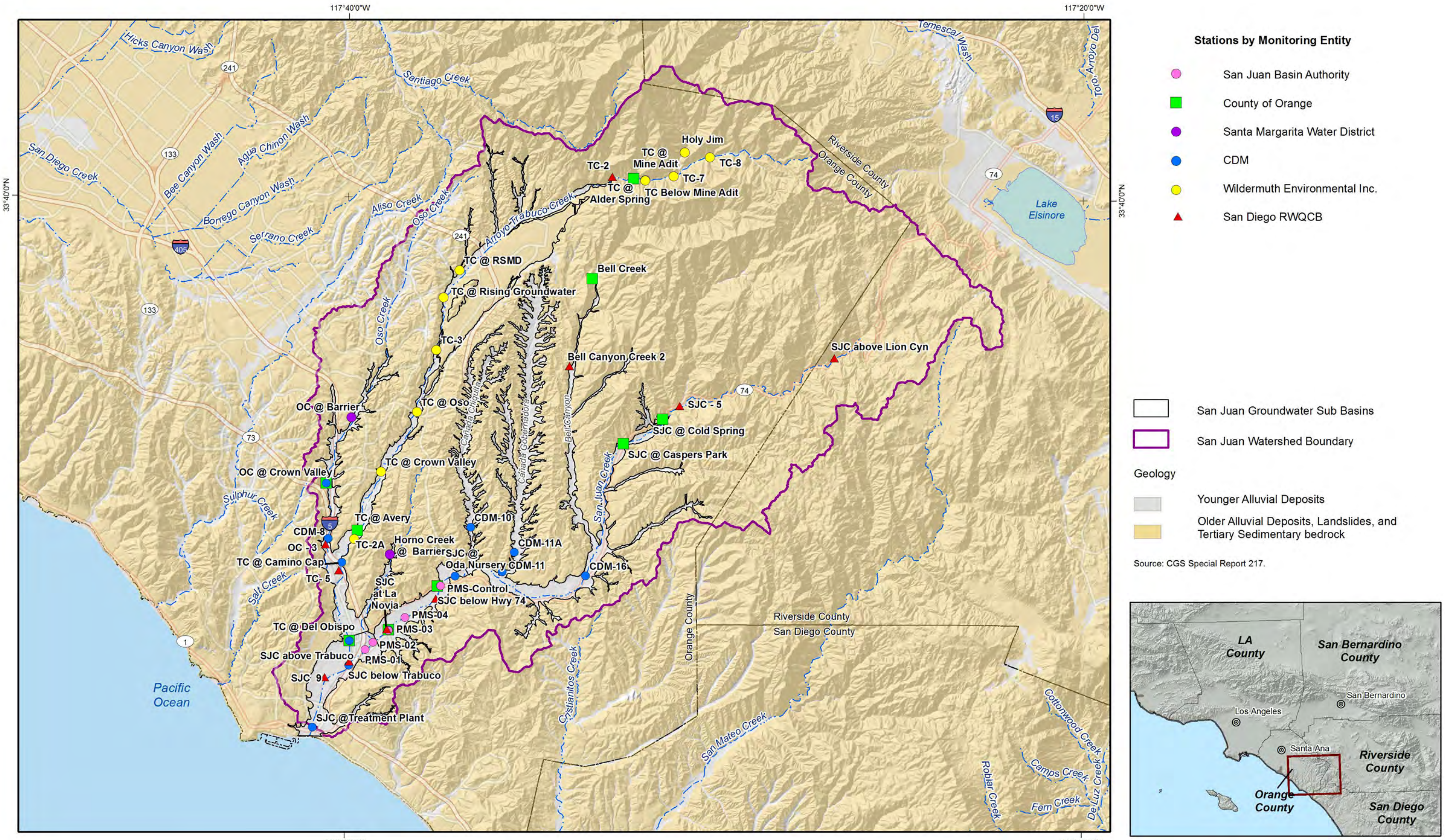


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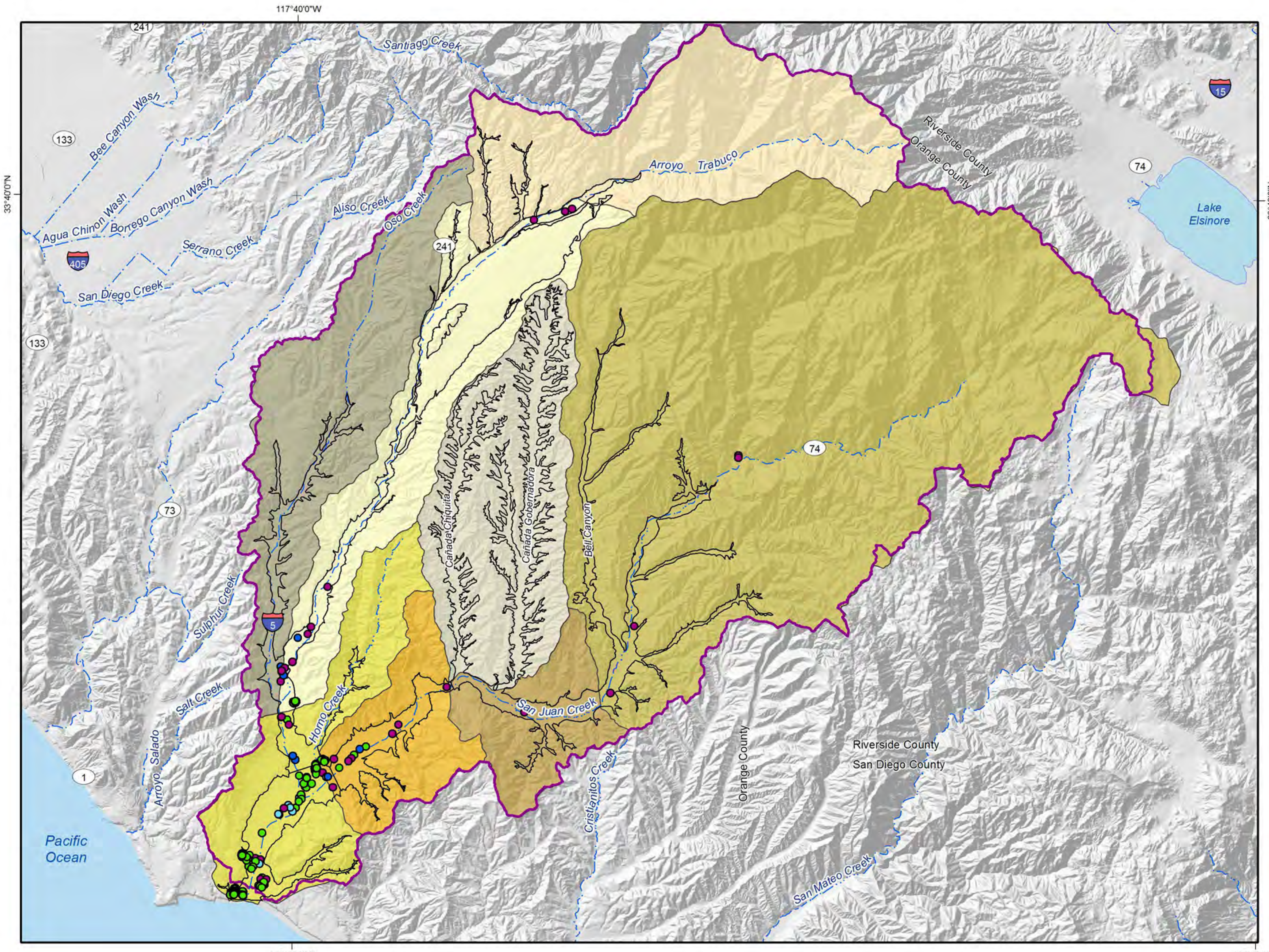
SAN JUAN BASIN AUTHORITY

075-003
004

**San Juan Watershed**
**Surface Water Quality Monitoring Stations**

**Figure 3-27**




## Well Type

- Monitoring
- Municipal - Desalter
- Municipal - Non Potable
- Private

## Hydrologic Sub Areas

- Upper Trabuco
- Upper San Juan
- Oso
- Middle Trabuco
- Gobernadora
- Middle San Juan
- Ortega
- Lower San Juan

- San Juan Groundwater Sub Basins
- San Juan Watershed Boundary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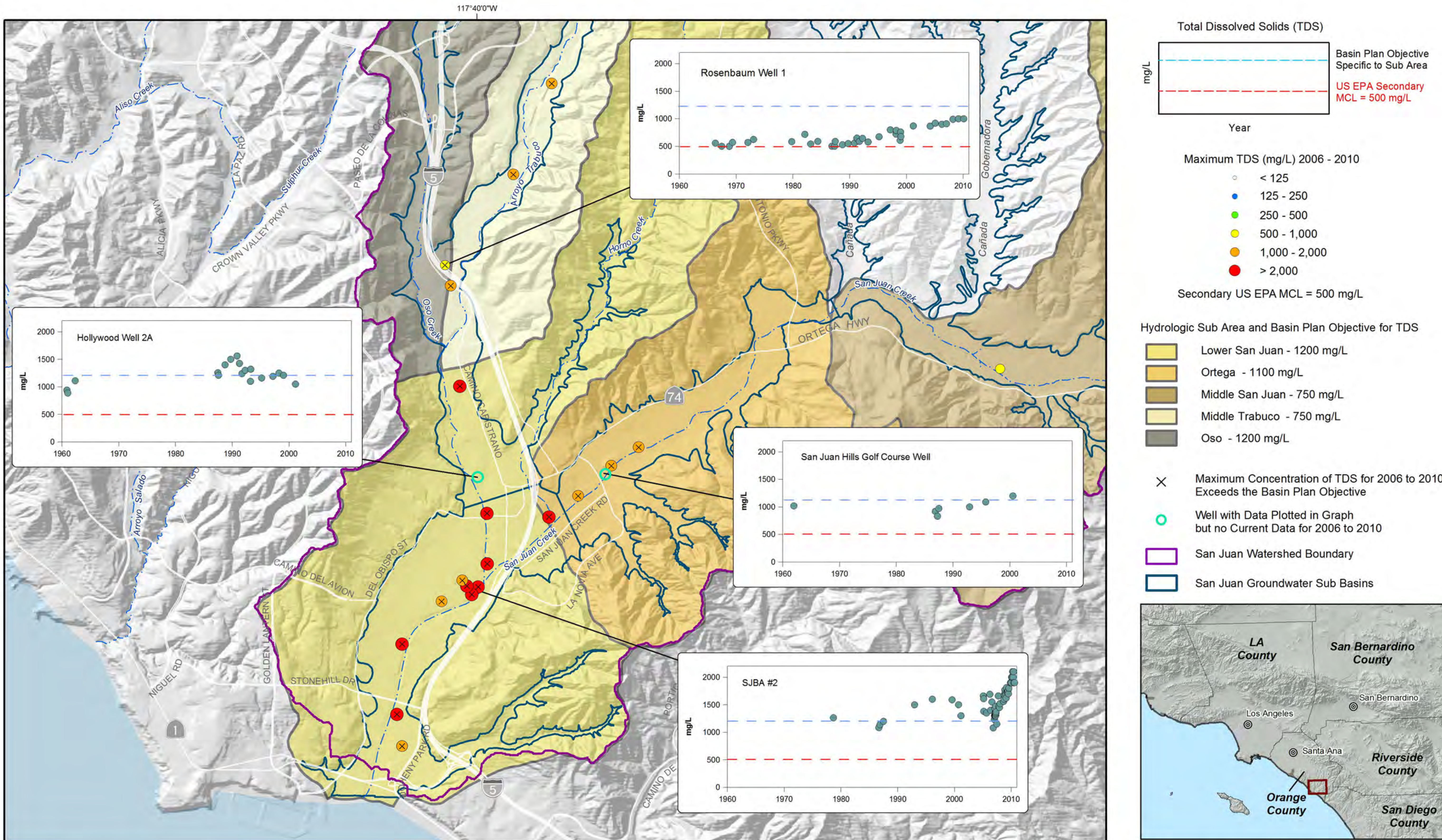
0 1 2 3 4 Miles
0 2 4 6 KM

SAN JUAN BASIN AUTHORITY

075-003
004

**San Juan Watershed**
**Wells with Water Quality Data**

**Figure 3-28**

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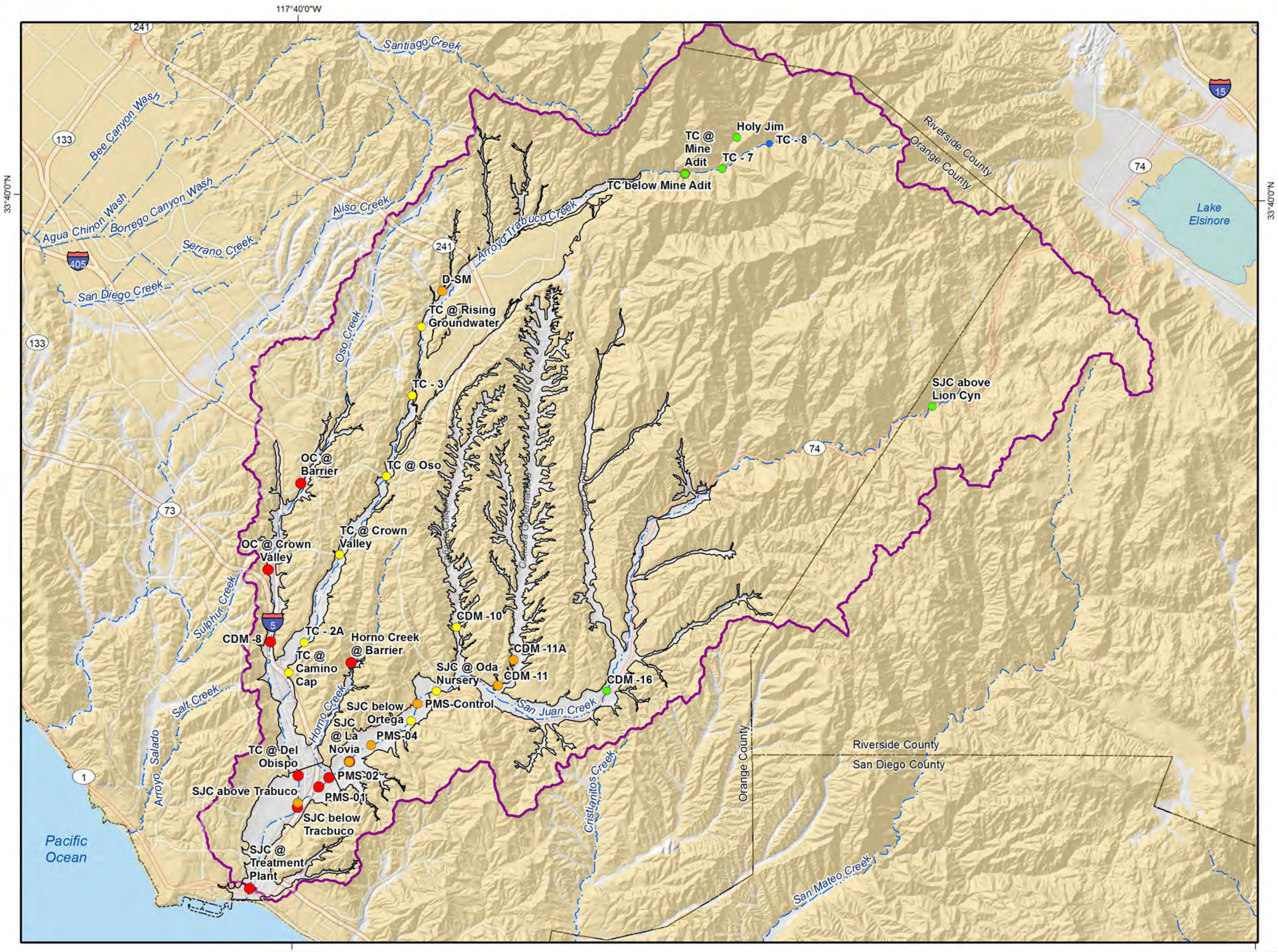
0 2,500 5,000 7,500 10,000 Feet
0 1,000 2,000 3,000 Meters

SAN JUAN BASIN AUTHORITY

075-003
004

**Total Dissolved Solids in Groundwater**
*Maximum Concentration 2006 - 2010 and Historical Trends*

**Figure 3-29**




Maximum TDS (mg/L)

- < 125
- 125 - 250
- 250 - 500
- 500 - 1,000
- 1,000 - 2,000
- > 2,000

Secondary US EPA MCL = 500 mg/L

Basin Plan Surface Water Objective = 500 mg/L

** Maximum concentration is based on all available data from the historical record. All surface water sites are monitored at different time periods and for different analytes. Refer to Table 3-5 in this report for a summary of the monitoring at the surface water stations.*

San Juan Groundwater Sub Basins

San Juan Watershed Boundary

Geology

Younger Alluvial Deposits

Older Alluvial Deposits, Landslides, and Tertiary Sedimentary bedrock

Source: CGS Special Report 217.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0 1 2 3 4 Miles
0 2 4 6 KM

SAN JUAN BASIN AUTHORITY

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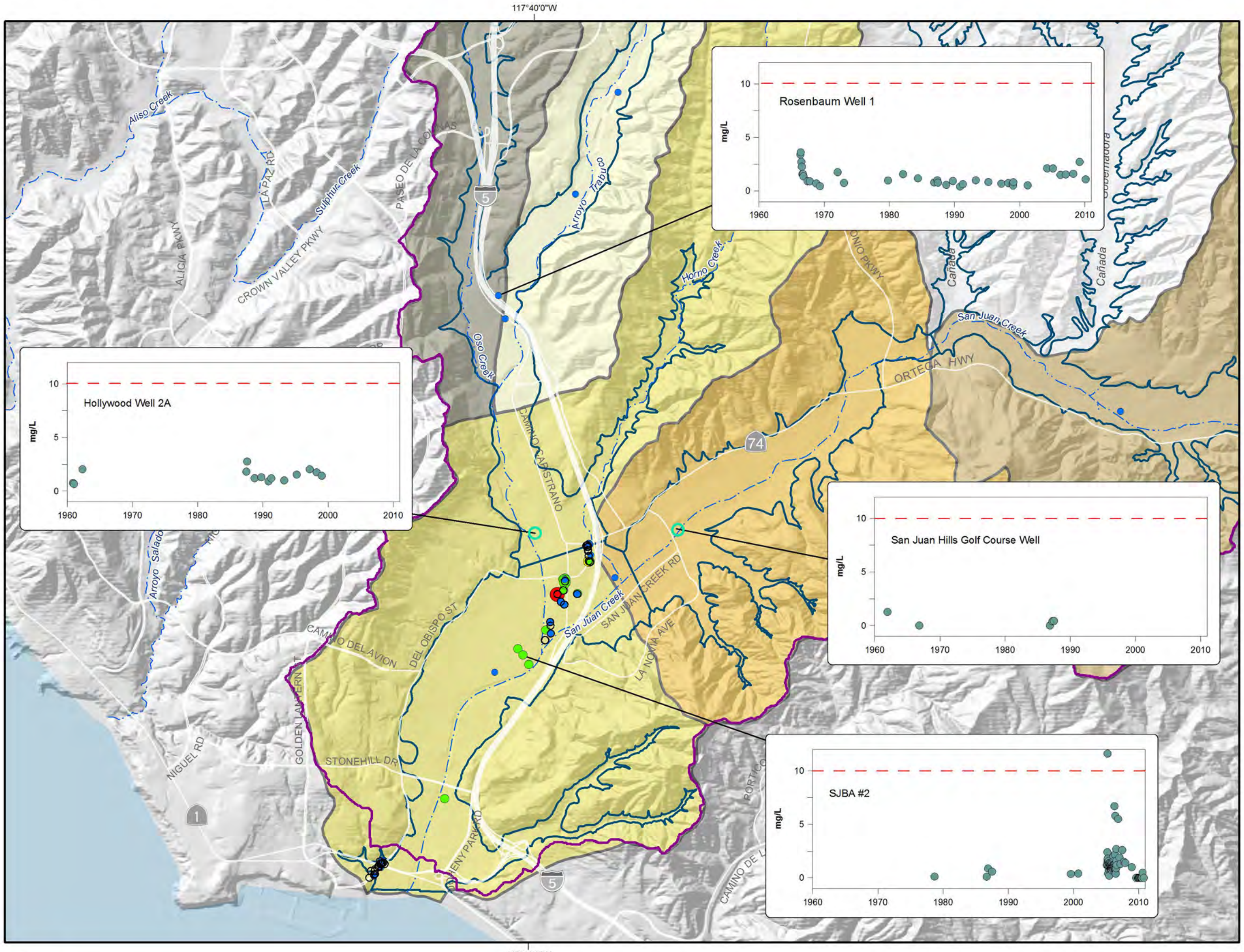
**Total Dissolved Solids in Surface Water**

*Maximum Concentration for Historical Record*

**Figure 3-30**




Nitrate as Nitrogen (NO3-N)

mg/L | Year

Basin Plan Objective = 10 mg/L

Primary US EPA & CA MCL = 10 mg/L

Maximum NO3-N (mg/L) 2006 - 2010

- ND
- < 5
- 5 - 10
- 10 - 20
- 20 - 40
- > 40

Primary US EPA MCL = 10 mg/L
Primary CA MCL = 10 mg/L

Hydrologic Sub Area and Basin Plan Objective for NO3-N

- Lower San Juan - 10 mg/L
- Ortega - 10 mg/L
- Middle San Juan - 10 mg/L
- Middle Trabuco - 10 mg/L
- Oso - 10 mg/L

- Well with Data Plotted in Graph but no Current Data for 2006 to 2010
- San Juan Watershed Boundary
- San Juan Groundwater Sub Basins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Path: N:\MapDocs\Clients\SJBA\2011 GWMP\Figure 3-31.mxd

0 2,500 5,000 7,500 10,000 Feet
0 1,000 2,000 3,000 Meters

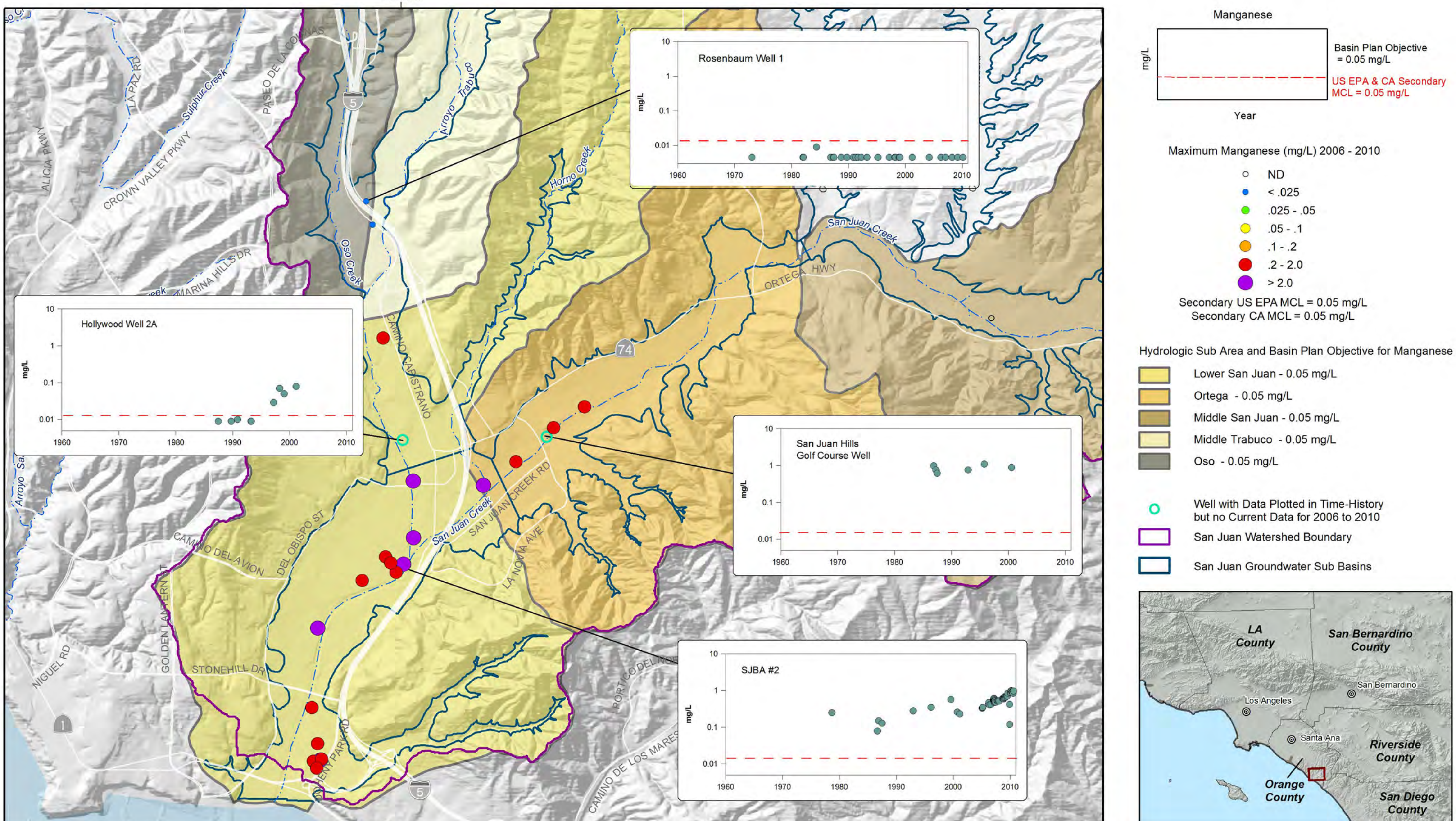
SAN JUAN BASIN AUTHORITY

075-003
004

## Nitrate as Nitrogen in Groundwater

*Maximum Concentration 2006 - 2010 and Historical Trends*

**Figure 3-31**

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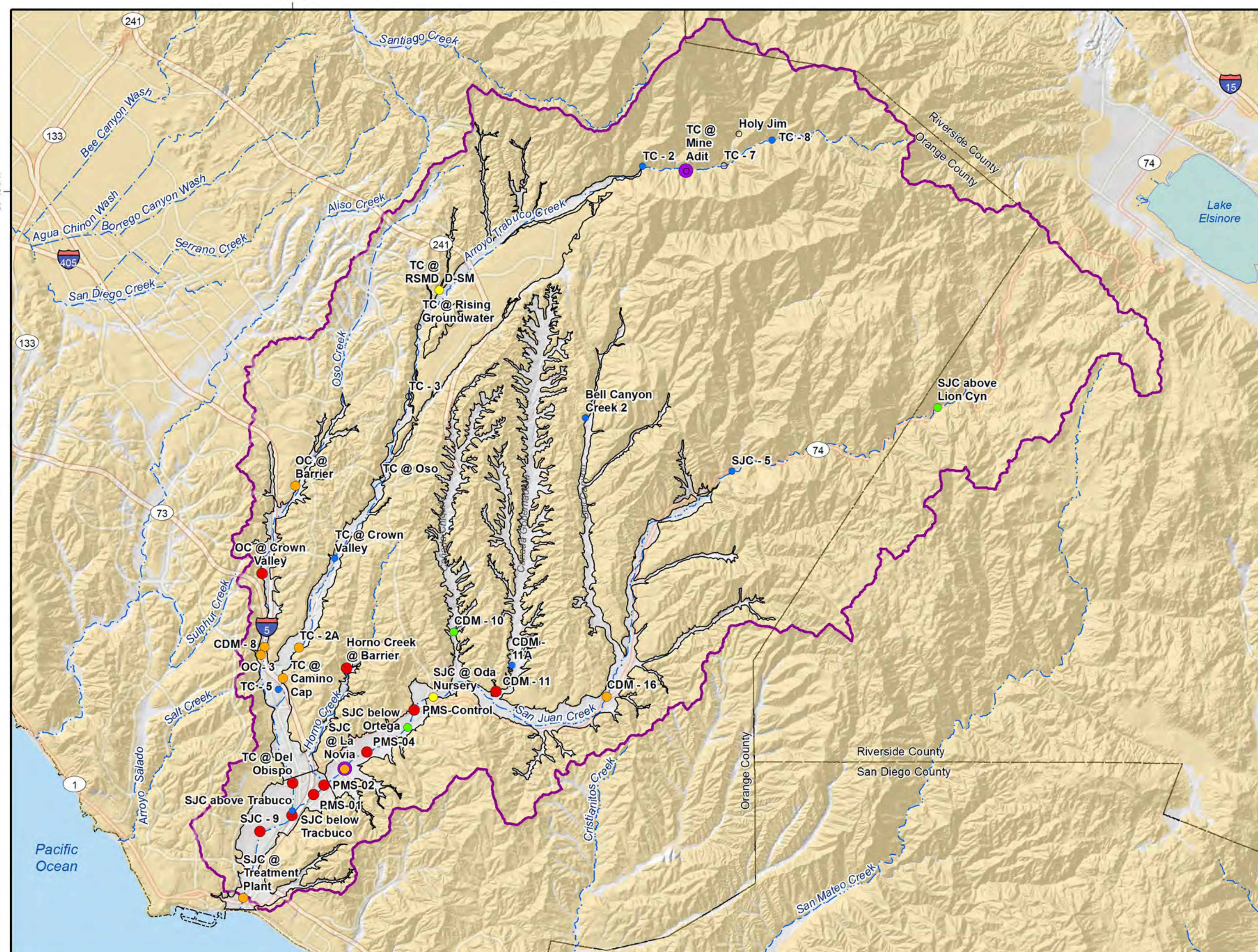
**Manganese in Groundwater**

*Maximum Concentration 2006 - 2010*
*and Historical Trends*

**Figure 3-36**




Maximum Manganese (mg/L)

- ND
- < .025
- .025 - .05
- .05 - .1
- .1 - .2
- .2 - 2.0
- > 2.0

Secondary US EPA MCL = 0.05 mg/L
Secondary CA MCL = 0.05 mg/L

Basin Plan Surface Water Objective = 0.05 mg/L

** Maximum concentration is based on all available data from the historical record. All surface water sites are monitored at different time periods and for different analytes. Refer to Table 3-5 in this report for a summary of the monitoring at the surface water stations.*

San Juan Groundwater Sub Basins

San Juan Watershed Boundary

Geology

Younger Alluvial Deposits

Older Alluvial Deposits, Landslides, and Tertiary Sedimentary bedrock

Source: CGS Special Report 217.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0 1 2 3 4 Miles
0 2 4 6 KM

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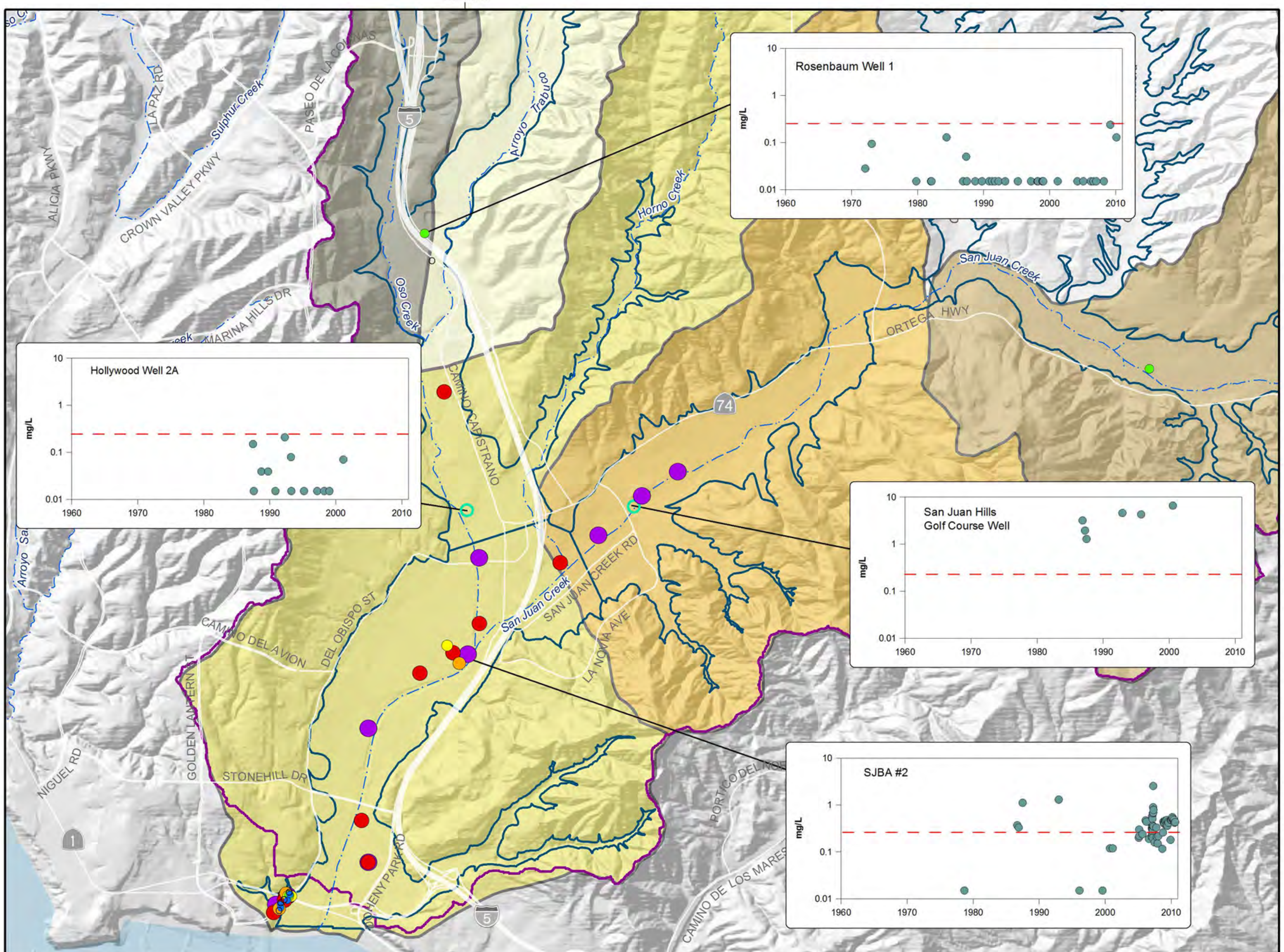
004

## Manganese in Surface Water

*Maximum Concentration for Historical Record*

**Figure 3-37**




Iron

Basin Plan Objective = 0.3 mg/L

US EPA & CA Secondary MCL = 0.3 mg/L

mg/L

Year

Maximum Iron (mg/L) 2006 - 2010

- ND
- < .15
- .15 - .3
- .3 - .6
- .6 - 1.2
- 1.2 - 20
- > 20

Secondary US EPA MCL = 0.3 mg/L
Secondary CA MCL = 0.3 mg/L

Hydrologic Sub Area and Basin Plan Objective for Iron

- Lower San Juan - 0.3 mg/L
- Ortega - 0.3 mg/L
- Middle San Juan - 0.3 mg/L
- Middle Trabuco - 0.3 mg/L
- Oso - 0.3 mg/L

Well with Data Plotted in Graph but no Current Data for 2006 to 2010

San Juan Watershed Boundary

San Juan Groundwater Sub Basins


117°40'0"W

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Path: N:\MapDocs\Clients\SJBA\2011 GWMP\Figure 3-38.mxd

0 2,500 5,000 7,500 10,000 Feet

0 1,000 2,000 3,000 Meters

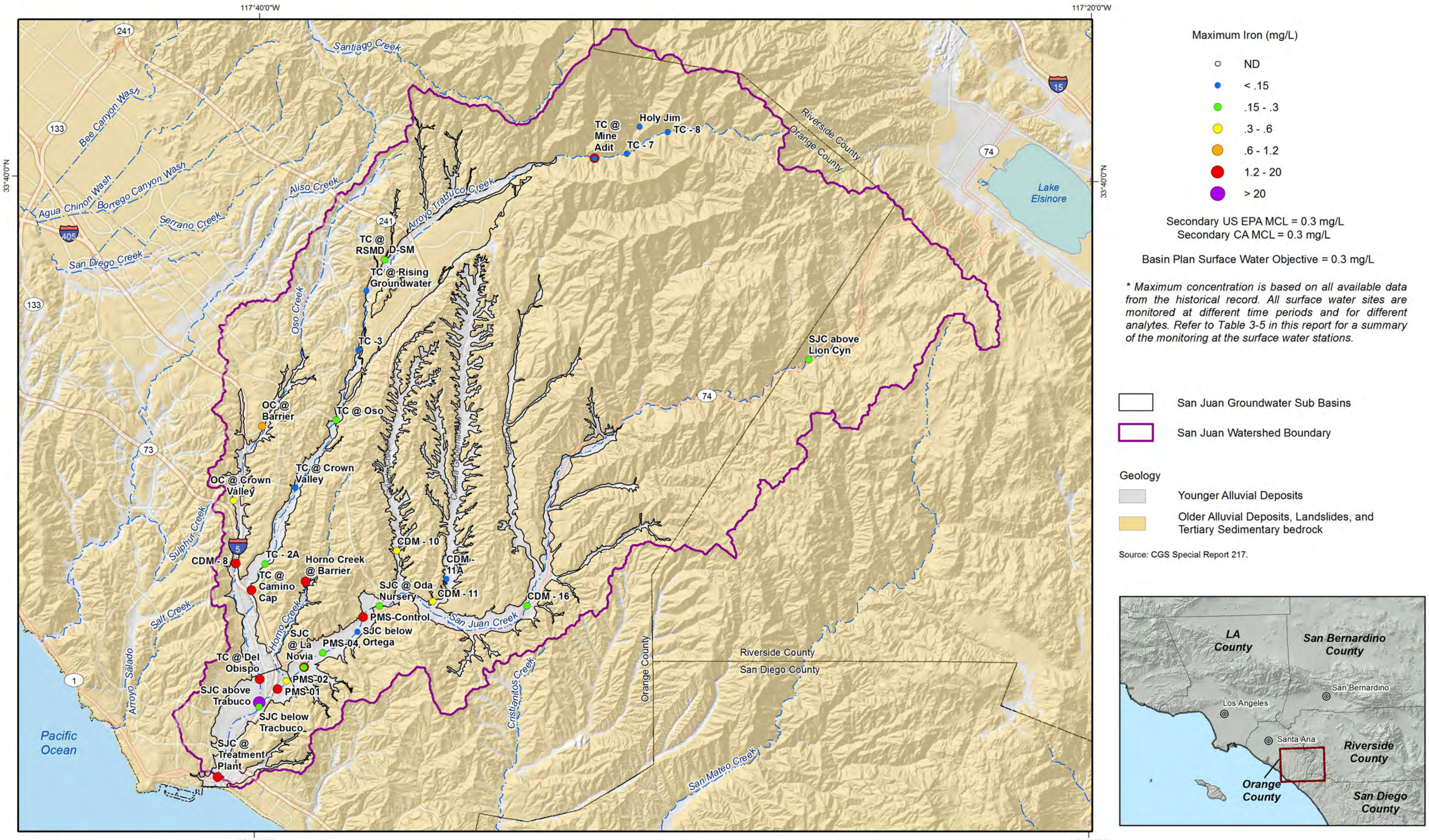
SAN JUAN BASIN AUTHORITY

075-003
004

# Iron in Groundwater

*Maximum Concentration 2006 - 2010 and Historical Trends*

**Figure 3-38**

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**Iron in Surface Water**

*Maximum Concentration for Historical Record*

**Figure 3-39**

Table 3-5
Surface Water Quality Sampling Sites in the San Juan Basin Watershed

| Monitoring Entity | Surface Water Body | Station Name | Station Abbreviation | Station Alias | Monitoring Program | Sampling Time Period | Analytes |
|---|---|---|---|---|---|---|---|
| County | Bell Creek | Bell Creek | Bell Creek | REF-BC | Bioassessment Program | 2003 - 2009 | General Physical, Metals, Pesticides |
| County | San Juan Creek | San Juan Creek at Cold Spring | SJC @ Cold Spring | REF-CS | Bioassessment Program | 2002 - 2009 | General Physical, Metals, Pesticides |
| County | San Juan Creek | San Juan Creek at Ortega Highway | SJC @ Ortega | SJC-74 | Bioassessment Program | 2003 - 2009 | General Physical, Metals, Pesticides |
| County | San Juan Creek | San Juan Creek at Caspers Park | SJC @ Caspers Park | SJOL01 | Mass Emissions Monitoring Program | 1993 - 2001 | General Physical, Metals, Pesticides |
| County | San Juan Creek | San Juan Creek at Camino Capistrano | SJC @ Camino Capistrano | SJC-CC | Bioassessment Program | 2002 - 2009 | General Physical, Metals, Pesticides |
| County | Trabuco Creek | Trabuco Creek alder Spring | TC @ Alder Spring | REF-TCAS | Bioassessment Program | 2003 - 2009 | General Physical, Metals, Pesticides |
| County | Trabuco Creek | Trabuco Creek at Avery Parkway | TC @ Avery | TC-AP | Bioassessment Program | 2002 - 2008 | General Physical, Metals, Pesticides |
| County/CDM | Oso Creek | Oso Creek at Crown Valley Parkway | OC @ Crown Valley | OSOLO3/CDM-SW-9 | Bioassessment Program | 1986 - 1999 | General Physical, Metals, Pesticides |
| County/CDM/RWQCB | San Juan Creek | San Juan Creek at La Novia | SJC @ La Novia | SJNL01/CDM-SW-4 | Mass Emissions Monitoring Program | 1987 - 2009 | General Physical, Metals, Pesticides |
| County/CDM | Trabuco Creek | Trabuco Creek at Del Obispo | TC @ Del Obispo | TCOL02/CDM-SW-6 | Mass Emissions Monitoring Program | 1986 - 2009 | General Physical, Metals, Pesticides |
| CDM | Oso Creek | CDM-SW-8 | CDM-8 | CDM-8 | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| CDM | San Juan Creek | San Juan Creek at Treatment Plant | SJC @ Treatment Plant | CDM-1 | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| CDM | San Juan Creek | CDM_SW-10 (Tributary to San Juan Creek) | CDM-10 | CDM-10 | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| CDM | San Juan Creek | CDM_SW-11 | CDM-11 | CDM-11 | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| CDM | San Juan Creek | CDM_SW-11A (Tributary to San Juan Creek) | CDM-11A | CDM-11A | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| CDM | San Juan Creek | CDM_SW-16 | CDM-16 | CDM-16 | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| CDM | San Juan Creek | San Juan Creek below Trabuco Creek | SJC below Trabuco | CDM-2 | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| CDM | San Juan Creek | San Juan Creek at Oda Nursery | CDM-5 | CDM-5 | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| CDM | Trabuco Creek | Trabuco Creek At Camino Capistrano | CDM-7 | TC @ Camino Cap | Monitoring Program | 1986 - 1987 | General Physical, Fe, Mn |
| RWCQB | San Juan Creek | San Juan Creek ~1mi above Lion Cyn. Cr. | SJC above Lion Cyn | 901S00313 | Ambient SW Monitoring Program | 2009 - 2010 | General Physical, Metals, Pesticides |
| RWCQB | San Juan Creek | San Juan Creek above Arroyo Trabuco | SJC above Trabuco | 901S39498 | Ambient SW Monitoring Program | 2009 - 2010 | General Physical, Metals, Pesticides |
| RWCQB | San Juan Creek | San Juan Creek ~0.3mi below Hwy 74 | SJC below Ortega | 901S45253 | Ambient SW Monitoring Program | 2009 - 2010 | General Physical, Metals, Pesticides |
| RWCQB | Trabuco Creek | Trabuco Creek 2 | TC -2 | 901SJATC2 | Ambient SW Monitoring Program | 2002 - 2003 | General Physical, Metals, Pesticides |
| RWCQB | Trabuco Creek | Trabuco Creek 5 | TC - 5 | 901SJATC5 | Ambient SW Monitoring Program | 2002 - 2003 | General Physical, Metals, Pesticides |
| RWCQB | Bell Creek | Bell Canyon Creek 2 | Bell Canyon Creek 2 | 901SJBEL2 | Ambient SW Monitoring Program | 2002 - 2003 | General Physical, Metals, Pesticides |
| RWCQB | Oso Creek | Oso Creek 3 | OC - 3 | 901SJOSO3 | Ambient SW Monitoring Program | 2002 - 2003 | General Physical, Metals, Pesticides |
| RWCQB | San Juan Creek | San Juan Creek 5 | SJC - 5 | 901SJSJC5 | Ambient SW Monitoring Program | 2002 - 2003 | General Physical, Metals, Pesticides |
| RWCQB | San Juan Creek | San Juan Creek 9 | SJC - 9 | 901SJSJC9 | Ambient SW Monitoring Program | 2002 - 2003 | General Physical, Metals, Pesticides |
| SJBA | San Juan Creek | PMS-Control | PMS-Control | PMS-Control | Integrated Environmental Sampling | 2009 - 2010 | General Mineral, Physical, and Metals |
| SJBA | San Juan Creek | PMS-01 | PMS-01 | PMS-01 | Integrated Environmental Sampling | 2009 - 2010 | General Mineral, Physical, and Metals |
| SJBA | San Juan Creek | PMS-02 | PMS-02 | PMS-02 | Integrated Environmental Sampling | 2009 - 2010 | General Mineral, Physical, and Metals |
| SJBA | San Juan Creek | PMS-03 | PMS-03 | PMS-03 | Integrated Environmental Sampling | 2009 - 2010 | General Mineral, Physical, and Metals |
| SJBA | San Juan Creek | PMS-04 | PMS-04 | PMS-04 | Integrated Environmental Sampling | 2009 - 2010 | General Mineral, Physical, and Metals |
| SMWD | Oso Creek | Oso Creek at Oso Barrier | OC @ Barrier | Oso Barrier | Surface Water Diversion Monitoring | 2009 - 2010 | General Mineral, Physical, and Metals |
| SMWD | Horno Creek | Horno Creek at Horno Barrier | Horno Creek @ Barrier | Horno Barrier | Surface Water Diversion Monitoring | 2009 - 2010 | General Mineral, Physical, and Metals |
| WEI | Trabuco Creek | Trabuco Creek-8 | TC - 8 | TC-8 | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Drainage Tributary from RSM Development | TC @ RSMD | D-SM | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Trabuco Creek at Rising Groundwater | TC @ Rising Groundwater | TC-RG | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Trabuco Creek-7 | TC-7 | TC-7 | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Tin Mine Adit (SN-1A) | TC @ Mine Adit | SN-1A | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Trabuco Creek Below Tin Mine Adit (SN-1) | TC below Mine Adit | SN-1 | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Holy Jim Creek-1 | Holy Jim | HJC-1 | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Trabuco Creek-2A | TC-2A | TC-2A | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Trabuco Creek at Oso Parkway | TC @ Oso | TC-OSO | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Trabuco Creek-3 | TC-3 | TC-3 | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |
| WEI | Trabuco Creek | Trabuco Creek at Crown Valley Parkway | TC @ Crown Valley | TC-CV | Arroyo Trabuco Study | 1998 | General Mineral, Physical, Metals, Trace Constituents |


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Table 3-6
Groundwater Quality Data Sources for Wells in the San Juan Basin

| WQ Data Source | Time Period | # of Wells | Description |
|---|---|---|---|
| DWR, 1972 | 1952 - 1969 | 19 | Private and Public Wells in San Juan Basin |
| NBS Lowry, 1994 | 1970 - 1992 | 10 | Private and Public Wells in San Juan Basin |
| CDM, 1987 | 1986 - 1987 | 15 | Private and Public Wells in San Juan Basin |
| CA DPH Database - RMV | 1986 - 1999 | 1 | Non Private RMV Wells (RMV 7) |
| GTC, 2001 | 1988 - 2001 | 15 | Private and Public Wells in San Juan Basin |
| CA DPH Database - City of San Juan | 1991 - 2010 | 10 | City of San Juan Production Wells |
| CA State GeoTracker Website | 2001 - 2010 | 272 | Monitoring Wells for 10 Point Source Contamination Sites |
| SJBA | 2003 - 2010 | 9 | SJBA Monitoring Wells |
| City of San Juan Capistrano | 2005 - 2008 | 6 | City of San Juan Desalter Production Wells |
| CA DPH Database - SJBA | 2005 - 2010 | 6 | City of San Juan Desalter Production Wells |
| CA DPH Database - SCWD | 2006 - 2010 | 1 | Stonehill Well |
| Santa Margarita Water District | 2006 - 2010 | 1 | Nichols Well |

Table 3-7
Surface Water Quality Data in Exceedance of Drinking Water Maximum Contaminant Levels

| Analyte Group/ Constituent | Maximum Contaminant Levels[1] | | | | | 1987 - 2005 | | | | | | | | Last Five Years (2006-2010) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Exceedance | | | | Non-Exceedance | | | | Exceedance | | | | Non-Exceedance | | | |
| | Primary | Secondary | Notification Level | Units | Notes | # of Sites | % of Sites Exceeding MCLs | Count | % of Samples Exceeding MCLs | # of Sites | % of Sites Not Exceeding MCLs | Count | % of Samples Not Exceeding MCLs | # of Sites | % of Sites Exceeding MCLs | Count | % of Samples Exceeding MCLs | # of Sites | % of Sites Not Exceeding MCLs | Count | % of Samples Not Exceeding MCLs |
| Inorganic Constituents | | | | | | | | | | | | | | | | | | | | | |
| Total Dissolved Solids | | 500 | | mg/L | | 19 | 66% | 192 | 88% | 10 | 34% | 27 | 12% | 10 | 91% | 90 | 99% | 1 | 9% | 1 | 1% |
| Sulfate | | 250 | | mg/L | | 16 | 38% | 143 | 62% | 26 | 62% | 88 | 38% | 9 | 82% | 89 | 98% | 2 | 18% | 2 | 2% |
| Chloride | | 250 | | mg/L | | 6 | 20% | 115 | 53% | 24 | 80% | 102 | 47% | 6 | 38% | 57 | 66% | 10 | 63% | 30 | 34% |
| Manganese | | 0.05 | 0.5 | mg/L | | 15 | 38% | 67 | 44% | 24 | 62% | 87 | 56% | 8 | 50% | 40 | 62% | 8 | 50% | 25 | 38% |
| Iron | | 300 | | mg/L | | 10 | 31% | 26 | 19% | 22 | 69% | 109 | 81% | 7 | 41% | 30 | 46% | 10 | 59% | 35 | 54% |
| Aluminum | 1 | 0.2 | | mg/L | 2 | 1 | 6% | 1 | 2% | 17 | 94% | 51 | 98% | 1 | 14% | 1 | 2% | 6 | 86% | 46 | 98% |
| Arsenic | 10 | | | ug/L | | 0 | 0% | 0 | 0% | 17 | 100% | 51 | 100% | 2 | 25% | 22 | 45% | 6 | 75% | 27 | 55% |
| Boron | | | 1000 | ug/L | | 0 | 0% | 0 | 0% | 12 | 100% | 115 | 100% | 1 | 33% | 7 | 10% | 2 | 67% | 60 | 90% |
| Cadmium | 5 | | | ug/L | | 4 | 13% | 26 | 5% | 27 | 87% | 537 | 95% | 4 | 24% | 12 | 5% | 13 | 76% | 233 | 95% |
| Lead | 15 | | | ug/L | | 4 | 20% | 34 | 6% | 16 | 80% | 498 | 94% | 3 | 19% | 5 | 2% | 13 | 81% | 240 | 98% |
| Chromium | 50 | | | ug/L | 3 | 2 | 7% | 7 | 1% | 27 | 93% | 556 | 99% | 2 | 13% | 2 | 1% | 13 | 87% | 243 | 99% |
| Nickel | 100 | | | ug/L | | 3 | 10% | 6 | 1% | 26 | 90% | 557 | 99% | 1 | 8% | 1 | 0% | 11 | 92% | 203 | 100% |
| Nitrate-N | 10 | | | mg/L | | 10 | 25% | 32 | 16% | 30 | 75% | 165 | 84% | 0 | 0% | 0 | 0% | 6 | 100% | 60 | 100% |
| General Physical | | | | | | | | | | | | | | | | | | | | | |
| Specific Conductance | | 900 | | umhos/cm | | 8 | 26% | 86 | 19% | 23 | 74% | 367 | 81% | 11 | 52% | 68 | 49% | 10 | 48% | 71 | 51% |
| Turbidity | 1 | | | NTU | | 8 | 44% | 262 | 66% | 10 | 56% | 138 | 35% | 8 | 35% | 60 | 39% | 15 | 65% | 92 | 61% |
| Color | | 15 | | Units | | 0 | NA | 0 | NA | 0 | NA | 0 | NA | 5 | 83% | 13 | 81% | 1 | 17% | 3 | 19% |
| Odor | | 3 | | Threshold Units | | 0 | NA | 0 | NA | 0 | NA | 0 | NA | 5 | 50% | 7 | 44% | 5 | 50% | 9 | 56% |
| pH | | 6.5<pH<8.5 | | Units | | 3 | 12% | 13 | 3% | 23 | 88% | 442 | 97% | 0 | 0% | 0 | 0% | 13 | 100% | 111 | 100% |

1 The California MCL was used for exceedance analysis unless otherwise noted.
2 The Primary California MCL is used for this analysis because the lower Secondary limit of 0.2 mg/L is the same as the US EPA Threshold 2 limit.
3 MCL is for total chromium.

Table 3-8
Surface Water Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Surface Water Quality Objectives

| Station | Analyte | Unit | Objective | Time Period | # of Years in Time Period | # of Years not Sampled | # of Years Above | # of Years Below |
|---|---|---|---|---|---|---|---|---|
| ***Bell Creek - Upstream to Downstream*** | | | | | | | | |
| Bell Creek | Turbidity | NTU | 20 | 2003-2009 | 7 | 0 | 0 | 7 |
| Bell Canyon Creek 2 | SO4 | mg/L | 250 | 2003-2003 | 1 | 0 | 0 | 1 |
| Bell Canyon Creek 2 | Mn | mg/L | 0.05 | 2003-2003 | 1 | 0 | 0 | 1 |
| ***San Juan Creek - Upstream to Downstream*** | | | | | | | | |
| SJC above Lion Cyn. | TDS | mg/L | 500 | 2009-2009 | 1 | 0 | 0 | 1 |
| SJC above Lion Cyn. | SO4 | mg/L | 250 | 2009-2009 | 1 | 0 | 1 | 0 |
| SJC above Lion Cyn. | Cl | mg/L | 250 | 2009-2009 | 1 | 0 | 0 | 1 |
| SJC above Lion Cyn. | Fe | mg/L | 0.3 | 2009-2009 | 1 | 0 | 0 | 1 |
| SJC above Lion Cyn. | Mn | mg/L | 0.05 | 2009-2009 | 1 | 0 | 0 | 1 |
| SJC above Lion Cyn. | %Na | % | 60 | 2009-2009 | 1 | 1 | 0 | 0 |
| SJC - 5 | SO4 | mg/L | 250 | 2002-2003 | 2 | 0 | 0 | 2 |
| SJC - 5 | Mn | mg/L | 0.05 | 2002-2003 | 2 | 0 | 0 | 2 |
| SJC @ Cold Spring | Turbidity | NTU | 20 | 2002-2009 | 8 | 0 | 1 | 7 |
| SJC @ Caspers Park | Turbidity | NTU | 20 | 1993-2001 | 9 | 0 | 4 | 5 |
| CDM-16 | TDS | mg/L | 500 | 1987-1987 | 1 | 0 | 0 | 1 |
| CDM-16 | SO4 | mg/L | 250 | 1987-1987 | 1 | 0 | 0 | 1 |
| CDM-16 | Cl | mg/L | 250 | 1987-1987 | 1 | 0 | 0 | 1 |
| CDM-16 | Fe | mg/L | 0.3 | 1987-1987 | 1 | 0 | 0 | 1 |
| CDM-16 | Mn | mg/L | 0.05 | 1987-1987 | 1 | 0 | 1 | 0 |
| CDM-11A | TDS | mg/L | 500 | 1987-1987 | 1 | 0 | 1 | 0 |
| CDM-11A | SO4 | mg/L | 250 | 1987-1987 | 1 | 0 | 1 | 0 |
| CDM-11A | Cl | mg/L | 250 | 1987-1987 | 1 | 0 | 0 | 1 |
| CDM-11A | Fe | mg/L | 0.3 | 1987-1987 | 1 | 0 | 0 | 1 |
| CDM-11A | Mn | mg/L | 0.05 | 1987-1987 | 1 | 0 | 0 | 1 |
| CDM-11 | TDS | mg/L | 500 | 1986-1987 | 2 | 0 | 2 | 0 |
| CDM-11 | SO4 | mg/L | 250 | 1986-1987 | 2 | 0 | 0 | 2 |
| CDM-11 | Cl | mg/L | 250 | 1986-1987 | 2 | 0 | 0 | 2 |
| CDM-11 | Fe | mg/L | 0.3 | 1986-1987 | 2 | 0 | 2 | 0 |
| CDM-11 | Mn | mg/L | 0.05 | 1986-1987 | 2 | 0 | 1 | 1 |
| CDM-10 | TDS | mg/L | 500 | 1986-1987 | 2 | 0 | 2 | 0 |
| CDM-10 | SO4 | mg/L | 250 | 1986-1987 | 2 | 0 | 0 | 2 |
| CDM-10 | Cl | mg/L | 250 | 1986-1987 | 2 | 0 | 0 | 2 |
| CDM-10 | Fe | mg/L | 0.3 | 1986-1987 | 2 | 0 | 1 | 1 |
| CDM-10 | Mn | mg/L | 0.05 | 1986-1987 | 2 | 0 | 0 | 2 |
| SJC @ Oda Nursery | TDS | mg/L | 500 | 1986-1987 | 2 | 0 | 2 | 0 |
| SJC @ Oda Nursery | SO4 | mg/L | 250 | 1986-1987 | 2 | 0 | 1 | 1 |
| SJC @ Oda Nursery | Cl | mg/L | 250 | 1986-1987 | 2 | 0 | 0 | 2 |
| SJC @ Oda Nursery | Fe | mg/L | 0.3 | 1986-1987 | 2 | 0 | 0 | 2 |
| SJC @ Oda Nursery | Mn | mg/L | 0.05 | 1986-1987 | 2 | 0 | 1 | 1 |
| PMS-Control | TDS | mg/L | 500 | 2009-2011 | 3 | 0 | 3 | 0 |
| PMS-Control | SO4 | mg/L | 250 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-Control | Cl | mg/L | 250 | 2009-2011 | 3 | 0 | 1 | 2 |
| PMS-Control | Fe | mg/L | 0.3 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-Control | Mn | mg/L | 0.05 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-Control | Turbidity | NTU | 20 | 2009-2011 | 3 | 0 | 0 | 3 |
| PMS-Control | Color | units | 20 | 2009-2011 | 3 | 0 | 0 | 3 |
| PMS-Control | MBAS | mg/L | 0.5 | 2009-2011 | 3 | 0 | 0 | 3 |
| PMS-Control | %Na | % | 60 | 2009-2011 | 3 | 0 | 0 | 3 |
| SJC @ Ortega | Turbidity | NTU | 20 | 2003-2009 | 7 | 0 | 1 | 6 |
| SJC Below Ortega | TDS | mg/L | 500 | 2010-2010 | 1 | 0 | 1 | 0 |
| SJC Below Ortega | SO4 | mg/L | 250 | 2010-2010 | 1 | 0 | 0 | 1 |
| SJC Below Ortega | Cl | mg/L | 250 | 2010-2010 | 1 | 0 | 0 | 1 |

Table 3-8
Surface Water Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Surface Water Quality Objectives

| Station | Analyte | Unit | Objective | Time Period | # of Years in Time Period | # of Years not Sampled | # of Years Above | # of Years Below |
|---|---|---|---|---|---|---|---|---|
| SJC Below Ortega | Fe | mg/L | 0.3 | 2010-2010 | 1 | 0 | 0 | 1 |
| SJC Below Ortega | Mn | mg/L | 0.05 | 2010-2010 | 1 | 0 | 0 | 1 |
| SJC Below Ortega | %Na | % | 60 | 2010-2010 | 1 | 1 | 0 | 0 |
| PMS-04 | TDS | mg/L | 500 | 2010-2011 | 2 | 0 | 2 | 0 |
| PMS-04 | SO4 | mg/L | 250 | 2010-2011 | 2 | 0 | 1 | 1 |
| PMS-04 | Cl | mg/L | 250 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-04 | Fe | mg/L | 0.3 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-04 | Mn | mg/L | 0.05 | 2010-2011 | 2 | 0 | 1 | 1 |
| PMS-04 | Turbidity | NTU | 20 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-04 | Color | units | 20 | 2010-2011 | 2 | 0 | 1 | 1 |
| PMS-04 | MBAS | mg/L | 0.5 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-04 | %Na | % | 60 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-03 | TDS | mg/L | 500 | 2010-2011 | 2 | 0 | 2 | 0 |
| PMS-03 | SO4 | mg/L | 250 | 2010-2011 | 2 | 0 | 1 | 1 |
| PMS-03 | Cl | mg/L | 250 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-03 | Fe | mg/L | 0.3 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-03 | Mn | mg/L | 0.05 | 2010-2011 | 2 | 0 | 1 | 1 |
| PMS-03 | Turbidity | NTU | 20 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-03 | Color | units | 20 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-03 | MBAS | mg/L | 0.5 | 2010-2011 | 2 | 0 | 0 | 2 |
| PMS-03 | %Na | % | 60 | 2010-2011 | 2 | 0 | 0 | 2 |
| SJC @ La Novia | TDS | mg/L | 500 | 1987-2009 | 23 | 18 | 5 | 0 |
| SJC @ La Novia | SO4 | mg/L | 250 | 1987-1992 | 6 | 2 | 4 | 0 |
| SJC @ La Novia | Cl | mg/L | 250 | 1987-2009 | 23 | 19 | 0 | 4 |
| SJC @ La Novia | Fe | mg/L | 0.3 | 1987-2009 | 23 | 18 | 2 | 3 |
| SJC @ La Novia | Mn | mg/L | 0.05 | 1987-2009 | 23 | 18 | 3 | 2 |
| SJC @ La Novia | Turbidity | NTU | 20 | 1992-2009 | 18 | 0 | 15 | 3 |
| SJC @ La Novia | %Na | % | 60 | 2009-2009 | 1 | 1 | 0 | 0 |
| PMS-02 | TDS | mg/L | 500 | 2009-2011 | 3 | 0 | 3 | 0 |
| PMS-02 | SO4 | mg/L | 250 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-02 | Cl | mg/L | 250 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-02 | Fe | mg/L | 0.3 | 2009-2011 | 3 | 0 | 1 | 2 |
| PMS-02 | Mn | mg/L | 0.05 | 2009-2011 | 3 | 0 | 1 | 2 |
| PMS-02 | Turbidity | NTU | 20 | 2009-2011 | 3 | 0 | 0 | 3 |
| PMS-02 | Color | units | 20 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-02 | MBAS | mg/L | 0.5 | 2009-2011 | 3 | 0 | 0 | 3 |
| PMS-02 | %Na | % | 60 | 2009-2011 | 3 | 0 | 0 | 3 |
| PMS-01 | TDS | mg/L | 500 | 2009-2011 | 3 | 0 | 3 | 0 |
| PMS-01 | SO4 | mg/L | 250 | 2009-2011 | 3 | 0 | 3 | 0 |
| PMS-01 | Cl | mg/L | 250 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-01 | Fe | mg/L | 0.3 | 2009-2011 | 3 | 0 | 1 | 2 |
| PMS-01 | Mn | mg/L | 0.05 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-01 | Turbidity | NTU | 20 | 2009-2011 | 3 | 0 | 1 | 2 |
| PMS-01 | Color | units | 20 | 2009-2011 | 3 | 0 | 2 | 1 |
| PMS-01 | MBAS | mg/L | 0.5 | 2009-2011 | 3 | 0 | 0 | 3 |
| PMS-01 | %Na | % | 60 | 2009-2011 | 3 | 0 | 0 | 3 |
| SJC above Trabuco Creek | TDS | mg/L | 500 | 2010-2010 | 1 | 0 | 1 | 0 |
| SJC above Trabuco Creek | SO4 | mg/L | 250 | 2010-2010 | 1 | 0 | 0 | 1 |
| SJC above Trabuco Creek | Cl | mg/L | 250 | 2010-2010 | 1 | 0 | 1 | 0 |
| SJC above Trabuco Creek | Fe | mg/L | 0.3 | 2010-2010 | 1 | 0 | 1 | 0 |
| SJC above Trabuco Creek | Mn | mg/L | 0.05 | 2010-2010 | 1 | 0 | 0 | 1 |
| SJC above Trabuco Creek | %Na | % | 60 | 2010-2010 | 1 | 1 | 0 | 0 |
| SJC below Trabuco Creek | TDS | mg/L | 500 | 1986-1987 | 2 | 0 | 2 | 0 |
| SJC below Trabuco Creek | SO4 | mg/L | 250 | 1986-1987 | 2 | 0 | 2 | 0 |

Table 3-8
Surface Water Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Surface Water Quality Objectives

| Station | Analyte | Unit | Objective | Time Period | # of Years in Time Period | # of Years not Sampled | # of Years Above | # of Years Below |
|---|---|---|---|---|---|---|---|---|
| SJC below Trabuco Creek | Cl | mg/L | 250 | 1986-1987 | 2 | 0 | 2 | 0 |
| SJC below Trabuco Creek | Fe | mg/L | 0.3 | 1986-1987 | 2 | 0 | 0 | 2 |
| SJC below Trabuco Creek | Mn | | 0.05 | 1986-1987 | 2 | 0 | 2 | 0 |
| SJC - 9 | SO4 | mg/L | 250 | 2002-2008 | 7 | 4 | 3 | 0 |
| SJC - 9 | Mn | mg/L | 0.05 | 2002-2003 | 2 | 0 | 1 | 1 |
| SJC @ Treatment Plant | TDS | mg/L | 500 | 1986-1987 | 2 | 0 | 2 | 0 |
| SJC @ Treatment Plant | SO4 | mg/L | 250 | 1986-1987 | 2 | 0 | 2 | 0 |
| SJC @ Treatment Plant | Cl | mg/L | 250 | 1986-1987 | 2 | 0 | 2 | 0 |
| SJC @ Treatment Plant | Fe | mg/L | 0.3 | 1986-1987 | 2 | 0 | 1 | 1 |
| SJC @ Treatment Plant | Mn | mg/L | 0.05 | 1986-1987 | 2 | 0 | 2 | 0 |
| SJC @ Camino Capistrano | Turbidity | NTU | 20 | 2002-2009 | 8 | 1 | 1 | 6 |
| ***Horno Creek - Upstream to Downstream*** | | | | | | | | |
| Horno Creek @ Barrier | TDS | mg/L | 500 | 1997-2010 | 14 | 0 | 14 | 0 |
| Horno Creek @ Barrier | SO4 | mg/L | 250 | 1997-2010 | 14 | 0 | 14 | 0 |
| Horno Creek @ Barrier | Cl | mg/L | 250 | 1997-2010 | 14 | 0 | 14 | 0 |
| Horno Creek @ Barrier | Fe | mg/L | 0.3 | 2009-2010 | 2 | 0 | 2 | 0 |
| Horno Creek @ Barrier | Mn | mg/L | 0.05 | 2009-2010 | 2 | 0 | 1 | 1 |
| Horno Creek @ Barrier | B | mg/L | 0.75 | 1997-2010 | 14 | 0 | 0 | 14 |
| Horno Creek @ Barrier | F | mg/L | 1 | 1997-2010 | 14 | 0 | 1 | 13 |
| Horno Creek @ Barrier | Turbidity | NTU | 20 | 2009-2010 | 2 | 0 | 0 | 2 |
| Horno Creek @ Barrier | MBAS | mg/L | 0.5 | 2009-2010 | 2 | 0 | 0 | 2 |
| Horno Creek @ Barrier | %Na | % | 60 | 1997-2010 | 14 | 14 | 0 | 0 |
| ***Trabuco Creek - Upstream to Downstream*** | | | | | | | | |
| TC - 8 | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 8 | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 8 | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 8 | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 8 | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 8 | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 8 | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 8 | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| Holy Jim | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 0 | 1 |
| Holy Jim | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| Holy Jim | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| Holy Jim | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| Holy Jim | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 0 | 1 |
| Holy Jim | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| Holy Jim | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| Holy Jim | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 7 | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 7 | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 7 | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 7 | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 7 | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 7 | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 7 | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 7 | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Mine Adit | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Mine Adit | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Mine Adit | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Mine Adit | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Mine Adit | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Mine Adit | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |

Table 3-8
Surface Water Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Surface Water Quality Objectives

| Station | Analyte | Unit | Objective | Time Period | # of Years in Time Period | # of Years not Sampled | # of Years Above | # of Years Below |
|---|---|---|---|---|---|---|---|---|
| TC @ Mine Adit | F | mg/L | 1 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Mine Adit | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC Below Mine Adit | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC Below Mine Adit | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC Below Mine Adit | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC Below Mine Adit | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC Below Mine Adit | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC Below Mine Adit | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC Below Mine Adit | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC Below Mine Adit | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Alder Spring | Turbidity | NTU | 20 | 2003-2009 | 7 | 0 | 0 | 7 |
| TC - 2 | SO4 | mg/L | 250 | 2003-2003 | 1 | 0 | 0 | 1 |
| TC - 2 | Mn | mg/L | 0.05 | 2003-2003 | 1 | 0 | 0 | 1 |
| TC @ RSMD | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ RSMD | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ RSMD | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ RSMD | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ RSMD | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ RSMD | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ RSMD | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ RSMD | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Rising Groundwater | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Rising Groundwater | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Rising Groundwater | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Rising Groundwater | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Rising Groundwater | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Rising Groundwater | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Rising Groundwater | F | mg/L | 1 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Rising Groundwater | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 3 | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC - 3 | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC - 3 | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 3 | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 3 | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 3 | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 3 | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 3 | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Oso | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Oso | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Oso | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Oso | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Oso | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Oso | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Oso | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Oso | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Crown Valley | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC @ Crown Valley | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Crown Valley | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Crown Valley | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Crown Valley | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Crown Valley | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Crown Valley | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Crown Valley | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Avery | Turbidity | NTU | 20 | 2002-2008 | 7 | 0 | 0 | 7 |

Table 3-8
Surface Water Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Surface Water Quality Objectives

| Station | Analyte | Unit | Objective | Time Period | # of Years in Time Period | # of Years not Sampled | # of Years Above | # of Years Below |
|---|---|---|---|---|---|---|---|---|
| TC - 2A | TDS | mg/L | 500 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC - 2A | SO4 | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 2A | Cl | mg/L | 250 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 2A | Fe | mg/L | 0.3 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 2A | Mn | mg/L | 0.05 | 1998-1998 | 1 | 0 | 1 | 0 |
| TC - 2A | B | mg/L | 0.75 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 2A | F | mg/L | 1 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC - 2A | %Na | % | 60 | 1998-1998 | 1 | 0 | 0 | 1 |
| TC @ Camino Cap | TDS | mg/L | 500 | 1986-1992 | 7 | 2 | 3 | 2 |
| TC @ Camino Cap | SO4 | mg/L | 250 | 1986-1992 | 7 | 2 | 1 | 4 |
| TC @ Camino Cap | Cl | mg/L | 250 | 1986-1992 | 7 | 2 | 0 | 5 |
| TC @ Camino Cap | Fe | mg/L | 0.3 | 1986-1992 | 7 | 2 | 4 | 1 |
| TC @ Camino Cap | Mn | mg/L | 0.05 | 1986-1992 | 7 | 2 | 5 | 0 |
| TC - 5 | SO4 | mg/L | 250 | 2002-2003 | 2 | 0 | 0 | 2 |
| TC - 5 | Mn | mg/L | 0.05 | 2002-2003 | 2 | 0 | 0 | 2 |
| TC @ Del Obispo | TDS | mg/L | 500 | 1986-1991 | 6 | 2 | 4 | 0 |
| TC @ Del Obispo | SO4 | mg/L | 250 | 1986-1991 | 6 | 2 | 4 | 0 |
| TC @ Del Obispo | Cl | mg/L | 250 | 1986-1991 | 6 | 2 | 3 | 1 |
| TC @ Del Obispo | Fe | mg/L | 0.3 | 1986-1991 | 6 | 2 | 2 | 2 |
| TC @ Del Obispo | Mn | mg/L | 0.05 | 1986-1991 | 6 | 2 | 2 | 2 |
| TC @ Del Obispo | Turbidity | NTU | 20 | 1994-2009 | 16 | 5 | 10 | 1 |
| **Oso Creek - Upstream to Downstream** | | | | | | | | |
| OC @ Barrier | TDS | mg/L | 500 | 1997-2010 | 14 | 0 | 14 | 0 |
| OC @ Barrier | SO4 | mg/L | 250 | 1997-2010 | 14 | 0 | 14 | 0 |
| OC @ Barrier | Cl | mg/L | 250 | 1997-2010 | 14 | 0 | 14 | 0 |
| OC @ Barrier | Fe | mg/L | 0.3 | 2009-2010 | 2 | 0 | 2 | 0 |
| OC @ Barrier | Mn | mg/L | 0.05 | 2009-2010 | 2 | 0 | 2 | 0 |
| OC @ Barrier | B | mg/L | 0.75 | 1997-2010 | 14 | 0 | 0 | 14 |
| OC @ Barrier | F | mg/L | 1 | 1997-2010 | 14 | 0 | 1 | 13 |
| OC @ Barrier | Turbidity | NTU | 20 | 2009-2010 | 2 | 0 | 0 | 2 |
| OC @ Barrier | MBAS | mg/L | 0.5 | 2009-2010 | 2 | 0 | 0 | 2 |
| OC @ Barrier | %Na | % | 60 | 1997-2010 | 14 | 14 | 0 | 0 |
| OC @ Crown Valley | TDS | mg/L | 500 | 1986-1987 | 2 | 0 | 2 | 0 |
| OC @ Crown Valley | SO4 | mg/L | 250 | 1986-1987 | 2 | 0 | 2 | 0 |
| OC @ Crown Valley | Cl | mg/L | 250 | 1986-1987 | 2 | 0 | 2 | 0 |
| OC @ Crown Valley | Fe | mg/L | 0.3 | 1986-1987 | 2 | 0 | 1 | 1 |
| OC @ Crown Valley | Mn | mg/L | 0.05 | 1986-1987 | 2 | 0 | 2 | 0 |
| OC @ Crown Valley | Turbidity | NTU | 20 | 1991-1999 | 9 | 1 | 7 | 1 |
| CDM-8 | TDS | mg/L | 500 | 1986-1992 | 7 | 2 | 5 | 0 |
| CDM-8 | SO4 | mg/L | 250 | 1986-1992 | 7 | 2 | 5 | 0 |
| CDM-8 | Cl | mg/L | 250 | 1986-1992 | 7 | 2 | 5 | 0 |
| CDM-8 | Fe | mg/L | 0.3 | 1986-1992 | 7 | 2 | 3 | 2 |
| CDM-8 | Mn | mg/L | 0.05 | 1986-1992 | 7 | 2 | 4 | 1 |
| OC - 3 | SO4 | mg/L | 250 | 2002-2003 | 2 | 0 | 2 | 0 |
| OC - 3 | Mn | mg/L | 0.05 | 2002-2003 | 2 | 0 | 2 | 0 |

Table 3-9
Groundwater Quality Data in Exceedance of Drinking Water Maximum Contaminant Levels
2006 to 2010

| Analyte Group/Constituent | Maximum Contaminant Levels[1] | | | | | Exceedance | | | | Non-Exceedance | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Secondary | Notification Level | Units | Notes | # of Wells | % of Wells Exceeding MCL | Count | % of Samples Exceeding MCL | # of Wells | % of Wells Not Exceeding MCL | Count | % of Samples Not Exceeding MCL |
| **Inorganic Constituents** | | | | | | | | | | | | | |
| Total Dissolved Solids | | 500 | | mg/L | | 22 | 100% | 424 | 100% | 0 | 0% | 0 | 0% |
| Manganese | | 0.05 | 0.5 | mg/L | | 20 | 77% | 422 | 95% | 6 | 23% | 21 | 5% |
| Iron | | 300 | | mg/L | | 28 | 51% | 398 | 73% | 27 | 49% | 144 | 27% |
| Sulfate | | 250 | | mg/L | | 98 | 89% | 375 | 88% | 12 | 11% | 52 | 12% |
| Chloride | | 250 | | mg/L | | 64 | 75% | 162 | 55% | 21 | 25% | 132 | 45% |
| Arsenic | 10 | | | ug/L | | 35 | 40% | 64 | 20% | 52 | 60% | 249 | 80% |
| Chromium | 50 | | | ug/L | 2 | 8 | 13% | 14 | 6% | 54 | 87% | 223 | 94% |
| Aluminum | | 0.05 | | mg/L | 3,4 | 1 | 8% | 1 | 2% | 11 | 92% | 48 | 98% |
| Nitrate-Nitrogen | 10 | | | mg/L | | 3 | 3% | 5 | 1% | 86 | 97% | 439 | 99% |
| Lead | 0.015 | | | mg/L | | 2 | 10% | 2 | 7% | 19 | 90% | 26 | 93% |
| Vanadium | | | 0.05 | mg/L | | 2 | 9% | 2 | 8% | 20 | 91% | 24 | 92% |
| Barium | 1 | | | mg/L | | 1 | 4% | 1 | 2% | 26 | 96% | 63 | 98% |
| Cadmium | 5 | | | ug/L | | 1 | 2% | 1 | 1% | 46 | 98% | 167 | 99% |
| Copper | 1.3 | 1 | | mg/L | | 1 | 2% | 1 | 0% | 55 | 98% | 349 | 100% |
| Foaming Agents | | 0.5 | | mg/L | | 1 | 5% | 1 | 1% | 20 | 95% | 183 | 99% |
| Mercury | 0.002 | | | mg/L | | 1 | 4% | 1 | 2% | 26 | 96% | 63 | 98% |
| Nitrite-Nitrogen | 1 | | | mg/L | | 1 | 2% | 1 | 1% | 65 | 98% | 82 | 99% |
| Silver | | 0.1 | | mg/L | | 1 | 1% | 1 | 4% | 72 | 99% | 26 | 96% |
| Mercury | 0.002 | | | mg/L | | 1 | 4% | 1 | 2% | 26 | 96% | 63 | 98% |
| Nickel | 0.1 | | | mg/L | | 1 | 2% | 1 | 1% | 45 | 98% | 167 | 99% |
| Zinc | | 5 | | mg/L | | 1 | 2% | 1 | 0.3% | 55 | 98% | 348 | 99.7% |
| **General Physical** | | | | | | | | | | | | | |
| Specific Conductance | | 900 | | umhos/cm | | 18 | 58% | 344 | 87% | 13 | 42% | 52 | 13% |
| Turbidity | | 5 | | NTU | | 15 | 52% | 145 | 59% | 14 | 48% | 100 | 41% |
| Color | | 15 | | Units | | 13 | 41% | 73 | 29% | 19 | 59% | 178 | 71% |
| Odor | | 3 | | Threshold Units | | 11 | 35% | 38 | 18% | 20 | 65% | 179 | 82% |
| pH | | 6.5<pH<8.5 | | Units | | 2 | 8% | 2 | 1% | 22 | 92% | 342 | 99% |
| **Chlorinated VOCs** | | | | | | | | | | | | | |
| Methyl Tert-Butyl Ether | 13 | 5 | | ug/L | | 106 | 29% | 632 | 21% | 260 | 71% | 2349 | 79% |
| Tert-Butyl Alcohol | | | 12 | ug/L | | 111 | 30% | 567 | 20% | 256 | 70% | 2263 | 80% |
| Benzene | 1 | | | ug/L | | 59 | 17% | 386 | 13% | 283 | 83% | 2495 | 87% |
| Ethylbenzene | 300 | | | ug/L | | 15 | 5% | 121 | 4.2% | 290 | 95% | 2760 | 96% |
| Naphthalene | | | 17 | ug/L | | 16 | 6% | 96 | 6% | 241 | 94% | 1426 | 94% |
| 1,2-Dichloroethane | 0.5 | | | ug/L | | 27 | 10% | 85 | 6% | 238 | 90% | 1456 | 94% |
| Toluene | 150 | | | ug/L | | 12 | 4% | 82 | 3% | 292 | 96% | 2798 | 97% |
| 1,2,4-Trimethylbenzene | 5 | | | ug/L | | 12 | 5% | 66 | 4% | 245 | 95% | 1465 | 96% |
| Total Xylene | 1750 | | | ug/L | | 12 | 4% | 61 | 2% | 267 | 96% | 2573 | 98% |
| 1,3,5-Trimethylbenzene | | | 330 | ug/L | | 9 | 4% | 32 | 2% | 247 | 96% | 1499 | 98% |
| n-Propylbenzene | | | 260 | ug/L | | 6 | 2% | 24 | 2% | 247 | 98% | 1507 | 98% |

Table 3-9
Groundwater Quality Data in Exceedance of Drinking Water Maximum Contaminant Levels
2006 to 2010

| Analyte Group/Constituent | Maximum Contaminant Levels[1] | | | | | Exceedance | | | | Non-Exceedance | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Primary | Secondary | Notification Level | Units | Notes | # of Wells | % of Wells Exceeding MCL | Count | % of Samples Exceeding MCL | # of Wells | % of Wells Not Exceeding MCL | Count | % of Samples Not Exceeding MCL |
| 1,2-Dibromo-3-chloropropane | 0.2 | | | ug/L | | 16 | 6% | 23 | 2% | 246 | 94% | 1488 | 98% |
| **Chlorinated VOCs - continued** | | | | | | | | | | | | | |
| Ethylene Dibromide | 0.05 | | | ug/L | | 13 | 5% | 21 | 1% | 246 | 95% | 1491 | 99% |
| 1,2,3-Trichloropropane | | | 0.005 | ug/L | | 13 | 5% | 20 | 1% | 248 | 95% | 1508 | 99% |
| Dichloromethane | 5 | | | ug/L | | 13 | 5% | 20 | 1% | 248 | 95% | 1520 | 99% |
| Tetrachloroethene | 5 | | | ug/L | | 6 | 2% | 14 | 1% | 247 | 98% | 1522 | 99% |
| 1,2-Dichloropropane | 5 | | | ug/L | | 4 | 2% | 10 | 1% | 248 | 98% | 1530 | 99% |
| Methyl Isobutyl Ketone | | | 120 | ug/L | | 4 | 2% | 10 | 1% | 225 | 98% | 1045 | 99% |
| Trichloroethene | 5 | | | ug/L | | 3 | 1% | 10 | 1% | 248 | 99% | 1530 | 99% |
| 1,1,2,2-Tetrachloroethane | 1 | | | ug/L | | 3 | 1% | 6 | 0% | 248 | 99% | 1534 | 100% |
| 1,1,2-Trichloroethane | 5 | | | ug/L | | 4 | 2% | 6 | 0% | 248 | 98% | 1534 | 100% |
| Carbon Tetrachloride | 0.5 | | | ug/L | | 3 | 1% | 6 | 0% | 248 | 99% | 1534 | 100% |
| Vinyl Chloride | | | | ug/L | | 3 | 1% | 6 | 0% | 248 | 99% | 1534 | 100% |
| 1,1-Dichloroethane | 5 | | | ug/L | | 3 | 1% | 5 | 0% | 248 | 99% | 1535 | 100% |
| 1,1-Dichloroethene | 6 | | | ug/L | | 3 | 1% | 5 | 0% | 248 | 99% | 1535 | 100% |
| 1,2,4-Trichlorobenzene | 5 | | | ug/L | | 3 | 1% | 5 | 0% | 248 | 99% | 1535 | 100% |
| 1,4-Dichlorobenzene | 5 | | | ug/L | | 3 | 1% | 5 | 0% | 248 | 99% | 1535 | 100% |
| Cis-1,2-Dichloroethene | 6 | | | ug/L | | 3 | 1% | 5 | 0% | 248 | 99% | 1535 | 100% |
| Styrene | 100 | | | ug/L | | 3 | 1% | 3 | 0% | 248 | 99% | 1537 | 100% |
| Trans-1,2-Dichloroethene | 10 | | | ug/L | | 2 | 1% | 3 | 0% | 248 | 99% | 1537 | 100% |
| Trichlorofluoromethane | 150 | | | ug/L | | 2 | 1% | 3 | 0% | 248 | 99% | 1537 | 100% |
| Chlorobenzene | 70 | | | ug/L | | 2 | 1% | 2 | 0% | 248 | 99% | 1538 | 100% |
| n-Butylbenzene | | | 260 | ug/L | | 1 | 0% | 1 | 0% | 247 | 100% | 1530 | 100% |
| Sec-Butylbenzene | | | 260 | ug/L | | 1 | 0% | 1 | 0% | 248 | 100% | 1530 | 100% |
| Tert-Butylbenzene | | | 260 | ug/L | | 1 | 0% | 1 | 0% | 248 | 100% | 1530 | 100% |

1 The California MCL was used for exceedance analysis unless otherwise noted.
2 MCL is for total chromium
3 US EPA Secondary MCL Threshold 1
4 The US EPA Secondary MCL was used to compute counts and percentages of exceedances because it is a lower than the California MCL. The counts and percentages of exceedances were calculated for the US EPA Secondary MCL Threshold 2 (0.2 mg/L),California Secondary MCL (0.2 mg/L), and California Primary MCL (1 mg/L) and were determined to be zero.

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Lower San Juan Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| 08S08W01F001 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W01K003 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W01Q005 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W01Q01 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W12A001 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W12B002 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W12C002 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W14H003 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W14Q001 (Rancho SJ) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W23A007 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S08W23A05 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| AMW-01(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| Capistrano Beach CWD-4 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-7(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-7-1 (T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-7-1R(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-7-2(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-7-3(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-7-4(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-7-5(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-8(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-8-1(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-8-2(t0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-8-3(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-8-4(t0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-8-5(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-8-6(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9-1(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9-2(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9-3(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9-4(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9-5(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9-6(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9-7 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMT-9-7(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CMW-09(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| CMW-11(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| Crean Well | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CVWD #2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CVWD-1 | 1 | 4 | 0 | 2 | 0 | 3 | 2 | 3 | 0 | 2 | 0 | 3 | 1 | 0 | 4 | 1 | 1 | 3 | 1 | 4 | 0 | 3 | 0 | 2 | 3 | 0 | 2 | 1 | 0 | 4 | 1 | 0 | 4 | 2 | 0 | 3 |
| Dance Hall | 0 | 5 | 0 | 1 | 0 | 4 | 1 | 4 | 0 | 1 | 0 | 4 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 3 | 0 | 3 | 4 | 0 | 1 | 0 | 5 | 0 | 0 | 3 | 2 | 1 | 0 | 4 |
| Hollywood 2A | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Kinoshita | 0 | 5 | 0 | 1 | 0 | 4 | 1 | 3 | 1 | 1 | 0 | 4 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 3 | 0 | 2 | 4 | 0 | 1 | 1 | 4 | 0 | 1 | 2 | 2 | 1 | 0 | 4 |
| Mission Street | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-01(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-02(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-02A(T0605902510) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-02B(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-03(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Lower San Juan Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| MW-03(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-03R(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-04(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-04(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-05(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-05(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-06(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW07 (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 3 | 0 | 2 | 5 | 0 | 0 | 3 | 0 | 2 | 3 | 1 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-07(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW08 (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 | 5 | 0 | 0 | 4 | 0 | 1 | 3 | 0 | 2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-08(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-08A(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-08B(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW09 (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 3 | 2 | 0 | 5 | 0 | 0 | 3 | 0 | 2 | 3 | 0 | 2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-09A(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-09B(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW1 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW10 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 3 | 0 | 2 | 5 | 0 | 0 | 4 | 0 | 1 | 3 | 0 | 2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10A(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-10B(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW11 (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 | 5 | 0 | 0 | 4 | 0 | 1 | 3 | 2 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-11(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-11(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-11A(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-11B(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-12(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-12A(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-12A(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-12B(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-12B(T0605902510) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-12C(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-12D(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-13(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-13A(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-13A(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-13B(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-13B(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-13C(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-14(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-14A(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-14A(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-14B(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-14B(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-14C(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Lower San Juan Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| MW-15(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-15A(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-15A(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-15B(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-15B(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-15C(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-15D(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-16(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-16(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-16A(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-16B(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-16C(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-16D(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-17(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-18(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-19A(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-19B(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-19C(T0605902379) | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW2 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-20A(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 1 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 |
| MW-20B(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 |
| MW-20C(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 |
| MW-20D(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 |
| MW-21(T0605902379) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-21A(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-21B(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-22A(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-22B(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-23A(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-23B(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-24(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-24A(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-24B(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-25(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-25A(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-25B(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-26(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-27(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-28(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW3 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-30(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-31(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-32(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-34(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-35(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-36(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |



WILDERMUTH ENVIRONMENTAL INC.

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Lower San Juan Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| MW37(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW38(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW4 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW5 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW6 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW7 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-7(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-7(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-7A(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-7B(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW-7C(T0605902379) | 5 | 0 | 0 | 4 | 1 | 0 | 4 | 1 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 |
| MW8 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW9 (T0605902575) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-12(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-13(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-14(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-15(T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-22/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-22/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-23/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-23/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-24/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-24/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-25/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-25/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-26/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-26/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-27/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-27/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-28/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-28/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-29/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-29/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Lower San Juan Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| OZ-30/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-30/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-31/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-31/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-32/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-32/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-33/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-33/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-34/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-34/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-35/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-35/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-36/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-36/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-37/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-37/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-38/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-38/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-39/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-39/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-40/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-40/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-41/A (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| OZ-41/B (T0605902573) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Rosan Ranch-1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Rosan Ranch-2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| RP-1(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| RP-2(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| RP-3(T0605902526) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| RW-15(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| RW-16(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| RW-2(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| RW-3(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Schuller | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SJBA #1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SJBA MW-01N | 0 | 2 | 3 | 0 | 0 | 5 | 0 | 2 | 3 | 0 | 4 | 1 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 4 | 1 | 0 | 1 | 4 | 5 | 0 | 0 |
| SJBA MW-01S | 0 | 2 | 3 | 0 | 0 | 5 | 0 | 1 | 4 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 2 | 5 | 0 | 0 |
| SJBA MW-02 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 1 | 4 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 2 | 5 | 0 | 0 |
| SJBA MW-03 | 0 | 2 | 3 | 0 | 1 | 4 | 0 | 2 | 3 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 5 | 0 | 0 |
| SJBA MW-07 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 2 | 5 | 0 | 0 |
| SJBA MW-08 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 2 | 3 | 5 | 0 | 0 |
| SJBA-2 | 0 | 5 | 0 | 1 | 0 | 4 | 1 | 4 | 0 | 1 | 0 | 4 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 3 | 0 | 2 | 4 | 0 | 1 | 0 | 0 | 5 | 0 | 0 | 5 | 1 | 0 | 4 |
| SJBA-4 | 0 | 5 | 0 | 1 | 0 | 4 | 1 | 4 | 0 | 1 | 0 | 4 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 3 | 0 | 2 | 4 | 0 | 1 | 0 | 4 | 1 | 0 | 0 | 5 | 1 | 0 | 4 |
| SP-1(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SP-2(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SP-3(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SP-4(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SP-5(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SP-6(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SP-7(T0605902362) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Lower San Juan Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| Stonehill | 1 | 4 | 0 | 2 | 3 | 0 | 2 | 3 | 0 | 2 | 0 | 3 | 1 | 3 | 1 | 1 | 4 | 0 | 1 | 4 | 0 | 2 | 0 | 3 | 3 | 0 | 2 | 4 | 1 | 0 | 2 | 3 | 0 | 4 | 0 | 1 |
| SW-16A(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Sycamore Stables | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| TCW-1(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| TCW-2(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| TW-1 (SJC) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Vermulean Well | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-12(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-13(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-14(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-15(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-16(T0605902502) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VW-2(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VW-3(T0605902524) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

| ***Middle San Juan Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 750 mg/L | | | 375 mg/L | | | 375 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| RMV 7 | 4 | 0 | 1 | 4 | 0 | 1 | 4 | 0 | 1 | 4 | 0 | 1 | 0 | 0 | 5 | 4 | 0 | 1 | 4 | 0 | 1 | 4 | 0 | 1 | 5 | 0 | 0 | 4 | 0 | 1 | 4 | 0 | 1 | 4 | 0 | 1 |

| ***Middle Trabuco Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 750 mg/L | | | 375 mg/L | | | 375 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| 07S08W25B004 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 07S08W25K002 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 07S08W25L001 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 07S08W36L01 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Christmas Tree Farm 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Egan Tract-2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| IW-1 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-01(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-02(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-04(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-05(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-06(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-07(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-08(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-09(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605902366) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW1(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW10(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW11(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-11(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Middle Trabuco Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 750 mg/L | | | 375 mg/L | | | 375 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| MW12(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-12(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW13(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW14(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-15(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605902366) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW2(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW2U(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605902366) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW3(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605933373) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW3U(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902366) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW4(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW4U(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902366) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW5(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW5U(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW6(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW7(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-7(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW8(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW9(T0605902555) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605952809) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| North Open Space(NOS) | 2 | 3 | 0 | 2 | 0 | 3 | 2 | 2 | 1 | 2 | 0 | 3 | 2 | 0 | 3 | 2 | 0 | 3 | 2 | 0 | 3 | 2 | 0 | 3 | 4 | 0 | 1 | 2 | 1 | 2 | 2 | 0 | 3 | 2 | 0 | 3 |
| P-6 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 4 | 0 | 1 | 5 | 0 | 0 | 5 | 0 | 0 |
| Rosenbaum 2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

| ***Ortega Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,100 mg/L | | | 375 mg/L | | | 450 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| 07S07W33B01 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S07W06K001 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S07W06K03 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S07W06P001 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| 08S07W07C03 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Cerritos Ranch 3 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CVWD # 5 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CVWD #4 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| CVWD #5A | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| La Couague | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-03R(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Ortega Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,100 mg/L | | | 375 mg/L | | | 450 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| MW-1(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-11(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-12(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-13(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-14(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-15(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-16(T0605902510) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-16(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-7(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902561) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Orange County Water Works #4 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SJBA MW-04 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 3 | 2 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 2 | 5 | 0 | 0 |
| SJBA MW-05 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 4 | 1 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 2 | 5 | 0 | 0 |
| SJBA MW-06 | 0 | 2 | 3 | 0 | 0 | 5 | 0 | 1 | 4 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 2 | 5 | 0 | 0 |
| SJHGC-Large | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| SJHGC-Small | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| South Cooks | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| The Oaks | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Tirador | 0 | 5 | 0 | 1 | 0 | 4 | 1 | 4 | 0 | 1 | 0 | 4 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 3 | 0 | 3 | 4 | 0 | 1 | 0 | 5 | 0 | 0 | 5 | 0 | 1 | 2 | 2 |
| TW-2 (SJC) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| W-2(T0605902592) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

| ***Oso Sub Area*** | **TDS** | | | **Cl** | | | **SO4** | | | **%Na** | | | **NO3-N** | | | **Fe** | | | **Mn** | | | **MBAS** | | | **B** | | | **Turbidity** | | | **Color** | | | **F** | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| 07S08W25L001 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 |
| B-11(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-12(T0605902620) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-13(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-13(T0605902620) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-14(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 2 | 1 | 2 | 2 | 0 | 3 | 2 | 0 | 3 |
| B-15(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-16(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-17(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| ***Oso Sub Area*** | TDS | | | Cl | | | SO4 | | | %Na | | | NO3-N | | | Fe | | | Mn | | | MBAS | | | B | | | Turbidity | | | Color | | | F | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| B-20(T0605902620) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-28(T0605902620) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-30(T0605902620) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-31(T0605902620) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-36(T0605902620) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| B-37(T0605902620) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Christmas Tree Farm 1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Christmas Tree Farm 2 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-1(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-11(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-13(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-14(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-16(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-17(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-18(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-19(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-20(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-21(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-22(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-4(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-5(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| E-7(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Egan Tract-1 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Egan Tract-3 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| GW-1(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605902475) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1(T0605940201) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW1(T0605991301) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902568) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-10(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-11(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-11(T0605902568) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-12(T0605902568) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-1A(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW1C(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-2(T0605940201) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW2(T0605991301) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-24(T0605902454) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-25(T0605902454) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-26(T0605902454) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-27(T0605902454) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-28(T0605902454) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

Table 3-10
Groundwater Quality Data in Exceedance of San Diego Regional Water Quality Control Board Basin Plan Groundwater Quality Objectives - 2006 to 2010

| *Oso Sub Area* | TDS | | | Cl | | | SO4 | | | %Na | | | NO3-N | | | Fe | | | Mn | | | MBAS | | | B | | | Turbidity | | | Color | | | F | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Objective: | 1,200 mg/L | | | 400 mg/L | | | 500 mg/L | | | 60% | | | 10 mg/L | | | 0.3 mg/L | | | 0.05 mg/L | | | 0.5 mg/L | | | 0.75 mg/L | | | 5 NTU | | | 15 units | | | 1 mg/L | | |
| | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | | # of Years | | |
| Well Name | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below | Not Samp | Above | Below |
| MW-3(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-3(T0605940201) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW3(T0605991301) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-4(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-5(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-6(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-7(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-7(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-7(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW7A(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW7B(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-8(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW8A(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW8B(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902381) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902472) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902568) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| MW-9(T0605902574) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Rosenbaum 1 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 1 | 0 | 4 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| Shaw | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| TCW(T0605902580) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-1(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-2(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-3(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-4(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-5(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-6(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |
| VEW-7(T0605902455) | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 |

# APPENDIX C
# Salt Balance Model Data

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**Oso/La Paz HSA Dry Weather Surface Water Samples**

| Sample Location | | Date | TDS (mg/L) |
|---|---|---|---|
| ID | Name | | |
| 5000056 | Oso Creek at Oso Barrier | 4/5/05 | 2,670 |
| 5000056 | Oso Creek at Oso Barrier | 7/12/05 | 2,350 |
| 5000056 | Oso Creek at Oso Barrier | 10/4/05 | 2,160 |
| 5000056 | Oso Creek at Oso Barrier | 4/3/06 | 2,310 |
| 5000056 | Oso Creek at Oso Barrier | 8/9/06 | 2,170 |
| 5000056 | Oso Creek at Oso Barrier | 11/7/06 | 2,380 |
| 5000056 | Oso Creek at Oso Barrier | 4/19/07 | 2,170 |
| 5000056 | Oso Creek at Oso Barrier | 7/17/07 | 1,900 |
| 5000056 | Oso Creek at Oso Barrier | 10/1/07 | 2,200 |
| 5000056 | Oso Creek at Oso Barrier | 1/14/08 | 2,520 |
| 5000056 | Oso Creek at Oso Barrier | 4/7/08 | 2,430 |
| 5000056 | Oso Creek at Oso Barrier | 7/16/08 | 2,275 |
| 5000056 | Oso Creek at Oso Barrier | 9/24/08 | 2,300 |
| 5000056 | Oso Creek at Oso Barrier | 9/25/08 | 2,240 |
| 5000056 | Oso Creek at Oso Barrier | 9/26/08 | 2,350 |
| 5000056 | Oso Creek at Oso Barrier | 11/7/08 | 2,050 |
| 5000056 | Oso Creek at Oso Barrier | 1/20/09 | 2,530 |
| 5000056 | Oso Creek at Oso Barrier | 2/4/09 | 2,490 |
| 5000056 | Oso Creek at Oso Barrier | 3/11/09 | 2,680 |
| 5000056 | Oso Creek at Oso Barrier | 4/15/09 | 2,475 |
| 5000056 | Oso Creek at Oso Barrier | 5/6/09 | 2,630 |
| 5000056 | Oso Creek at Oso Barrier | 6/8/09 | 2,550 |
| 5000056 | Oso Creek at Oso Barrier | 7/14/09 | 2,540 |
| 5000056 | Oso Creek at Oso Barrier | 8/18/09 | 2,785 |
| 5000056 | Oso Creek at Oso Barrier | 9/1/09 | 2,340 |
| 5000056 | Oso Creek at Oso Barrier | 10/20/09 | 2,380 |
| 5000056 | Oso Creek at Oso Barrier | 11/3/09 | 2,520 |
| 5000056 | Oso Creek at Oso Barrier | 12/1/09 | 2,335 |
| 5000056 | Oso Creek at Oso Barrier | 1/28/10 | 2,170 |
| 5000056 | Oso Creek at Oso Barrier | 3/10/10 | 2,023 |
| 5000056 | Oso Creek at Oso Barrier | 5/11/10 | 2,710 |
| 5000056 | Oso Creek at Oso Barrier | 6/24/10 | 2,420 |
| 5000056 | Oso Creek at Oso Barrier | 7/21/10 | 2,390 |
| 5000056 | Oso Creek at Oso Barrier | 8/12/10 | 2,520 |
| 5000056 | Oso Creek at Oso Barrier | 9/8/10 | 2,380 |

**Middle Trabuco HSA Dry Weather Surface Water Samples**

| | Sample Location | | Sample Location | | Sample Location | |
|---|---|---|---|---|---|---|
| | ID | Name | ID | Name | ID | Name |
| | 1208352 | TC1 | 1208354 | TC2 | 1208355 | TC3 |
| Date | TDS (mg/L) | | TDS (mg/L) | | TDS (mg/L) | |
| 2/16/05 | 500 | | 520 | | 500 | |
| 5/17/05 | 630 | | 650 | | 650 | |
| 8/24/05 | 720 | | 760 | | 760 | |
| 4/27/06 | 668 | | 658 | | 642 | |
| 6/29/06 | 688 | | 690 | | 686 | |
| 9/5/06 | 862 | | 836 | | 852 | |
| 12/4/06 | 776 | | 806 | | 802 | |
| 4/12/07 | 772 | | 780 | | 794 | |
| 7/12/07 | 1030 | | 1000 | | 1020 | |
| 10/4/07 | 996 | | 1010 | | 1000 | |
| 7/22/08 | 930 | | 916 | | 912 | |
| 9/30/08 | 1150 | | 1170 | | 976 | |
| 3/24/09 | 838 | | 846 | | 838 | |
| 6/23/09 | 970 | | 970 | | 950 | |
| 10/1/09 | 1100 | | 1100 | | 1100 | |
| 3/22/10 | 810 | | 760 | | 830 | |
| 6/28/10 | 920 | | 900 | | | |
| 6/29/10 | - | | 840 | | - | |

## Upper San Juan HSA Dry Weather Surface Water Samples

| Sample Location | | Date | TDS (mg/L) |
|---|---|---|---|
| ID | Name | | |
| 5000058 | San Juan Creek about 1mi above Lion Cyn. Cr. | 4/30/09 | 383 |

### Upper Trabuco HSA Dry Weather Surface Water Samples

| Date | Sample Location | | Sample Location | | Sample Location | | Sample Location | |
|---|---|---|---|---|---|---|---|---|
| | ID | Name | ID | Name | ID | Name | ID | Name |
| | 5000034 | Holy Jim Creek-1 | 5000035 | Trabuco Creek Below Tin Mine adit (SN-1) | 5000037 | Trabuco Creek-7 | 5000040 | Trabuco Creek-8 |
| | TDS (mg/L) | | TDS (mg/L) | | TDS (mg/L) | | TDS (mg/L) | |
| 11/17/98 | 340 | | 340 | | 340 | | 240 | |
| 12/1/98 | 310 | | - | | 315 | | 230 | |
| 12/15/98 | 299 | | - | | 295 | | 230 | |

## Gobernadora HSA Dry Weather Surface Water Samples

| Sample Location | | Date | TDS (mg/L) |
|---|---|---|---|
| ID | Name | | |
| 5000041 | CDM_SW-11A (Tributary to San Juan Creek) | 5/5/87 | 968 |
| 5000041 | CDM_SW-11A (Tributary to San Juan Creek) | 7/7/87 | 1014 |
| 5000041 | CDM_SW-11A (Tributary to San Juan Creek) | 8/6/87 | 1042 |
| 5000049 | CDM_SW-11 | 10/31/86 | 874 |
| 5000049 | CDM_SW-11 | 12/4/86 | 940 |
| 5000049 | CDM_SW-11 | 1/6/87 | 696 |
| 5000049 | CDM_SW-11 | 1/26/87 | 880 |
| 5000049 | CDM_SW-11 | 2/23/87 | 750 |
| 5000049 | CDM_SW-11 | 3/25/87 | 732 |
| 5000049 | CDM_SW-11 | 5/5/87 | 994 |
| 5000049 | CDM_SW-11 | 7/7/87 | 952 |
| 5000049 | CDM_SW-11 | 8/6/87 | 1022 |
| 5000049 | CDM_SW-11 | 9/14/87 | 1046 |

## Chiquita HSA Dry Weather Surface Water Samples

| Sample Location | | Date | TDS (mg/L) |
|---|---|---|---|
| ID | Name | | |
| 5000043 | CDM_SW-10 (Tributary to San Juan Creek) | 10/31/86 | 876 |
| 5000043 | CDM_SW-10 (Tributary to San Juan Creek) | 12/04/86 | 786 |
| 5000043 | CDM_SW-10 (Tributary to San Juan Creek) | 01/06/87 | 772 |
| 5000043 | CDM_SW-10 (Tributary to San Juan Creek) | 01/26/87 | 834 |
| 5000043 | CDM_SW-10 (Tributary to San Juan Creek) | 02/23/87 | 720 |
| 5000043 | CDM_SW-10 (Tributary to San Juan Creek) | 03/25/87 | 744 |
| 5000043 | CDM_SW-10 (Tributary to San Juan Creek) | 04/30/87 | 916 |
| 5000043 | CDM_SW-10 (Tributary to San Juan Creek) | 07/07/87 | 850 |

## Oso/La Paz HSA Wet Weather Surface Water Samples

| Sample Location | | Date | TDS (mg/L) |
|---|---|---|---|
| ID | Name | | |
| 5000056 | Oso Creek at Oso Barrier | 2/26/07 | 1,000 |
| 5000056 | Oso Creek at Oso Barrier | 4/13/10 | 1,400 |

## Middle Trabuco HSA Wet Weather Surface Water Samples

| Date | Sample Location | | | | | |
|---|---|---|---|---|---|---|
| | ID | Name | ID | Name | ID | Name |
| | 1208352 | TC1 | 1208354 | TC2 | 1208355 | TC3 |
| | TDS (mg/L) | | TDS (mg/L) | | TDS (mg/L) | |
| 10/18/05 | 400 | | 470 | | 410 | |
| 1/29/08 | 558 | | 548 | | 572 | |
| 12/17/08 | 734 | | 758 | | 422 | |
| 12/8/09 | 750 | | 740 | | 740 | |

| Date | Sample Location | | |
|---|---|---|---|
| | Trabuco Creek Upstream of Crown | Trabuco Creek Upstream of ATGC | Trabuco Creek Downstream of ATGC |
| | TDS (mg/L) | TDS (mg/L) | TDS (mg/L) |
| 2/12/2003 | 360 | 400 | 440 |
| 2/25/2003 | 210 | 220 | 280 |
| 3/15/2003 | 180 | 250 | 24 |

## Gobernadora HSA Wet Weather Surface Water Samples

| Date | Sample Location | |
|---|---|---|
| | Gobernadora Downstream of Cote De Coza | Gobernadora Upstream of Confluence with San Juan |
| | TDS (mg/L) | TDS (mg/L) |
| 2/12/2003 | 460 | 540 |
| 2/25/2003 | 500 | 350 |
| 3/15/2003 | 230 | 380 |

## Bell Canyon Wet Weather Surface Water Samples

| Date | Sample Location<br>San Juan Creek at Caspers<br>TDS (mg/L) |
|---|---|
| 2/25/2003 | 310 |
| 3/15/2003 | 120 |

## Cristianitos Well Data

| Well Name | Date | TDS (mg/L) |
|---|---|---|
| Northrup 1 | 4/19/2012 | 456 |
| Northrup 1 | 7/26/2012 | 440 |
| Northrup 1 | 10/18/2012 | 650 |
| Northrup 1 | 1/24/2013 | 644 |
| Northrup 2 | 4/19/2012 | 456 |
| Pico Well | 2/3/2009 | 815 |
| Pico Well | 4/15/2009 | 1000 |
| Pico Well | 7/14/2009 | 690 |
| Pico Well | 10/20/2009 | 740 |
| Pico Well | 2/9/2010 | 760 |
| Pico Well | 5/17/2010 | 600 |
| Pico Well | 7/21/2010 | 574 |

## Upper San Juan Well Data

| Well ID | Well Name | Date | TDS (mg/L) |
|---|---|---|---|
| 1221746 | RMV Nichols Well 29 | 2/10/1994 | 418 |
| 1221746 | RMV Nichols Well 29 | 4/20/1994 | 516 |
| 1221746 | RMV Nichols Well 29 | 8/9/1994 | 434 |
| 1221746 | RMV Nichols Well 29 | 7/5/1995 | 404 |
| 1221746 | RMV Nichols Well 29 | 10/5/1995 | 400 |
| 1221746 | RMV Nichols Well 29 | 1/10/1996 | 410 |
| 1221746 | RMV Nichols Well 29 | 4/2/1996 | 400 |
| 1221746 | RMV Nichols Well 29 | 7/8/1996 | 410 |
| 1221746 | RMV Nichols Well 29 | 10/2/1996 | 460 |
| 1221746 | RMV Nichols Well 29 | 12/4/1996 | 472 |
| 1221746 | RMV Nichols Well 29 | 1/23/1997 | 430 |
| 1221746 | RMV Nichols Well 29 | 4/3/1997 | 450 |
| 1221746 | RMV Nichols Well 29 | 7/1/1997 | 450 |
| 1221746 | RMV Nichols Well 29 | 1/30/1998 | 510 |
| 1221746 | RMV Nichols Well 29 | 2/12/1998 | 560 |
| 1221746 | RMV Nichols Well 29 | 7/10/1998 | 400 |
| 1221746 | RMV Nichols Well 29 | 1/6/1999 | 420 |
| 1221746 | RMV Nichols Well 29 | 7/10/1999 | 500 |
| 1221746 | RMV Nichols Well 29 | 1/10/2000 | 430 |
| 1221746 | RMV Nichols Well 29 | 7/5/2000 | 460 |
| 1221746 | RMV Nichols Well 29 | 3/5/2001 | 610 |
| 1221746 | RMV Nichols Well 29 | 8/8/2001 | 580 |
| 1221746 | RMV Nichols Well 29 | 4/17/2002 | 640 |
| 1221746 | RMV Nichols Well 29 | 7/8/2002 | 740 |
| 1221746 | RMV Nichols Well 29 | 1/6/2003 | 930 |
| 1221746 | RMV Nichols Well 29 | 7/8/2003 | 726 |
| 1221746 | RMV Nichols Well 29 | 1/12/2004 | 700 |
| 1221746 | RMV Nichols Well 29 | 7/12/2005 | 450 |
| 1221746 | RMV Nichols Well 29 | 1/10/2006 | 570 |
| 1221746 | RMV Nichols Well 29 | 7/11/2006 | 560 |
| 1221746 | RMV Nichols Well 29 | 4/3/2007 | 550 |
| 1221746 | RMV Nichols Well 29 | 7/9/2007 | 650 |
| 1221746 | RMV Nichols Well 29 | 1/28/2008 | 670 |
| 1221746 | RMV Nichols Well 29 | 7/7/2008 | 705 |
| 1221746 | RMV Nichols Well 29 | 12/8/2010 | 622 |

## Upper Trabuco Well Data

| Well ID | Well Name | Date | TDS (mg/L) |
|---|---|---|---|
| 1223023 | T-Y Nursery | 11/18/1998 | 360 |
| 1223023 | T-Y Nursery | 12/18/1998 | 410 |
| 1223024 | Sakaida | 12/10/1998 | 450 |
| 1223024 | Sakaida | 12/21/1998 | 420 |
| 1223025 | Rose | 11/25/1998 | 320 |
| 1223025 | Rose | 12/29/1998 | 385 |

**Middle Trabuco Well Data**

| Well ID | Well Name | Date | TDS (mg/L) |
|---|---|---|---|
| 1221138 | IW 1 | 2/16/2005 | 860 |
| 1221138 | IW 1 | 5/17/2005 | 810 |
| 1221138 | IW 1 | 8/24/2005 | 850 |
| 1221138 | IW 1 | 11/3/2005 | 890 |
| 1221138 | IW 1 | 4/27/2006 | 942 |
| 1221138 | IW 1 | 6/29/2006 | 848 |
| 1221138 | IW 1 | 9/5/2006 | 854 |
| 1221138 | IW 1 | 12/4/2006 | 876 |
| 1221138 | IW 1 | 4/12/2007 | 952 |
| 1221138 | IW 1 | 7/12/2007 | 976 |
| 1221138 | IW 1 | 10/4/2007 | 920 |
| 1221138 | IW 1 | 1/29/2008 | 968 |
| 1221138 | IW 1 | 7/22/2008 | 916 |
| 1221138 | IW 1 | 9/30/2008 | 1150 |
| 1221138 | IW 1 | 12/17/2008 | 964 |
| 1221138 | IW 1 | 3/24/2009 | 1000 |
| 1221138 | IW 1 | 6/23/2009 | 990 |
| 1221138 | IW 1 | 10/1/2009 | 1000 |
| 1221138 | IW 1 | 12/8/2009 | 1100 |
| 1221138 | IW 1 | 3/22/2010 | 1000 |
| 1221138 | IW 1 | 6/28/2010 | 990 |
| 1221139 | P-6 | 11/3/2005 | 980 |
| 1221139 | P-6 | 4/27/2006 | 882 |
| 1221139 | P-6 | 6/29/2006 | 914 |
| 1221139 | P-6 | 12/4/2006 | 938 |
| 1221139 | P-6 | 4/12/2007 | 908 |
| 1221139 | P-6 | 7/12/2007 | 998 |
| 1221139 | P-6 | 10/4/2007 | 996 |
| 1221139 | P-6 | 1/29/2008 | 990 |
| 1221139 | P-6 | 7/22/2008 | 938 |
| 1221139 | P-6 | 9/30/2008 | 1370 |
| 1221139 | P-6 | 12/17/2008 | 1070 |
| 1221139 | P-6 | 3/24/2009 | 1010 |
| 1221139 | P-6 | 6/23/2009 | 1100 |
| 1221139 | P-6 | 10/1/2009 | 1200 |
| 1221139 | P-6 | 12/8/2009 | 1100 |
| 1221139 | P-6 | 3/22/2010 | 1100 |
| 1221139 | P-6 | 6/29/2010 | 1200 |
| 1222435 | Rosenbaum 1 | 5/3/1966 | 558 |
| 1222435 | Rosenbaum 1 | 6/13/1967 | 502 |
| 1222435 | Rosenbaum 1 | 10/14/1968 | 500 |
| 1222435 | Rosenbaum 1 | 5/8/1969 | 572 |
| 1222435 | Rosenbaum 1 | 9/29/1989 | 550 |
| 1222435 | Rosenbaum 1 | 4/12/1991 | 650 |
| 1222435 | Rosenbaum 1 | 9/17/1991 | 590 |
| 1222435 | Rosenbaum 1 | 4/9/1992 | 645 |

| Well ID | Well Name | Date | TDS (mg/L) |
|---|---|---|---|
| 1222435 | Rosenbaum 1 | 4/5/1993 | 580 |
| 1222435 | Rosenbaum 1 | 3/8/1995 | 674 |
| 1222435 | Rosenbaum 1 | 3/6/1997 | 800 |
| 1222435 | Rosenbaum 1 | 3/3/1998 | 722 |
| 1222435 | Rosenbaum 1 | 3/26/1998 | 789 |
| 1222435 | Rosenbaum 1 | 11/24/1998 | 610 |
| 1222435 | Rosenbaum 1 | 12/28/1998 | 760 |
| 1222435 | Rosenbaum 1 | 1/12/1999 | 679 |
| 1222435 | Rosenbaum 1 | 3/20/2001 | 870 |
| 1222435 | Rosenbaum 1 | 3/15/2004 | 867 |
| 1222435 | Rosenbaum 1 | 2/4/2005 | 920 |
| 1222435 | Rosenbaum 1 | 3/31/2006 | 900 |
| 1222435 | Rosenbaum 1 | 1/24/2007 | 910 |
| 1222435 | Rosenbaum 1 | 3/18/2008 | 990 |
| 1222435 | Rosenbaum 1 | 3/9/2009 | 1000 |
| 1222435 | Rosenbaum 1 | 2/11/2010 | 1000 |
| 1222436 | Rosenbaum 2 | 10/30/1961 | 557 |
| 1222436 | Rosenbaum 2 | 4/25/1962 | 557 |
| 1222436 | Rosenbaum 2 | 1/8/1964 | 532 |
| 1222436 | Rosenbaum 2 | 6/30/1966 | 481 |
| 1222436 | Rosenbaum 2 | 9/29/1989 | 560 |
| 1222436 | Rosenbaum 2 | 4/12/1991 | 636 |
| 1222436 | Rosenbaum 2 | 9/17/1991 | 585 |
| 1222436 | Rosenbaum 2 | 4/9/1992 | 585 |
| 1222436 | Rosenbaum 2 | 4/5/1993 | 545 |
| 1222436 | Rosenbaum 2 | 3/8/1995 | 609 |
| 1222460 | Christmas Tree Farm 1 | 12/13/1962 | 506 |
| 1222460 | Christmas Tree Farm 1 | 5/6/1966 | 543 |
| 1222461 | Egan Tract-1 | 2/8/1996 | 730 |
| 1222461 | Egan Tract-1 | 3/3/1998 | 780 |
| 1222485 | North Open Space(NOS) | 12/14/1999 | 708 |
| 1222485 | North Open Space(NOS) | 9/22/2000 | 940 |
| 1222485 | North Open Space(NOS) | 9/22/2000 | 940 |
| 1222485 | North Open Space(NOS) | 9/27/2001 | 940 |
| 1222485 | North Open Space(NOS) | 10/21/2003 | 1080 |
| 1222485 | North Open Space(NOS) | 12/17/2003 | 987 |
| 1222485 | North Open Space(NOS) | 9/14/2004 | 1180 |
| 1222485 | North Open Space(NOS) | 8/29/2005 | 1100 |
| 1222485 | North Open Space(NOS) | 8/15/2006 | 880 |
| 1222485 | North Open Space(NOS) | 8/27/2007 | 1400 |
| 1222485 | North Open Space(NOS) | 9/17/2008 | 1300 |
| 1223028 | Christmas Tree Farm 2 | 5/5/1966 | 551 |
| 1223028 | Christmas Tree Farm 2 | 5/1/1967 | 525 |

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# APPENDIX D
# Salt Balance Model Results

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# SALT BALANCE
# OSO/LA PAZ
# NATURAL TDS COMPONENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 10,544 | acres |
| RAIN= | 1.24 | ft/yr |
| TDS(rain)= | 15 | mg/l |
| FOREST & WOODLAND EVAPOTRANSP= | 228 | af/yr |
| OPEN WATER EVAPOTRANSP= | 163 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 9,934 | af/yr |
| STORM RUNOFF COEF= | 0.2 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 2,618 | af/yr |
| Q(non-storm)= | 146 | af/yr |
| Q= | 2,764 | af/yr |
| T(rain)= | 267 | tons/yr |
| **T(natural)=** | **1,297** | **tons/yr** |
| **TOTAL INPUT=** | **1,564** | **tons/yr** |

OUTPUT SUMMARY:

| | | |
|---|---|---|
| T(non-storm)= | 496 | tons/yr |
| **TDS(non-storm)=** | **2,500** | **mg/l** |
| T(storm)= | 1,068 | tons/yr |
| **TDS(storm)=** | **300** | **mg/l** |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-20
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
5) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
6) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
7) Length of Oso Creek drainage = 51,700 ft. length of La Paz Creek drainage = 22,000 ft.
8) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 0 | 0.00 | 0 | | |
| Forest & Woodland | 152 | 1.50 | 228 | | |
| Open Water | 44 | 3.70 | 163 | A | AFY |
| Shrubland & Grassland | 10,348 | 0.96 | 9,934 | 10,544 | 10,325 |

11/4/2013

# SALT BALANCE
# OSO/LA PAZ
# CURRENT DEVELOPMENT - AVERAGE (2007-2011)
# (WITH RECLAMATION)

| CONDITIONS | VALUE | UNITS | CALCULATIONS | 105 | 311 | 4378 |
|---|---|---|---|---|---|---|
| A(watershed)= | 10,544 | acres | Q(storm)= | 4,795 | af/yr | |
| A(lawns/landscaping)= | 3,342 | acres | Q(non-storm)= | 2,669 | af/yr | |
| A(reservoirs)= | 190 | acres | Q= | 7,464 | af/yr | |
| A(impervious)= | 5,879 | acres | TDS(nondom)= | 1,395 | mg/l | |
| A(unimproved)= | 1,133 | acres | Q(dom)= | 6,968 | af/yr | |
| A(irr/nd)= | 1,299 | acres | Q(nondom)= | 4,428 | af/yr | |
| A(irr/d)= | 2,043 | acres | T(nondom)= | 8,407 | tons/yr | |
| A(urban)= | 9,221 | acres | T(dom)= | 4,456 | tons/yr | |
| R(irr)= | 3.41 | ft/yr | T(rain)= | 267 | tons/yr | |
| RAIN= | 1.24 | ft/yr | T(urbanrunoff)= | 1,176 | tons/yr | |
| Q(rw)= | 2,548 | af/yr | **TOTAL INPUT=** | **16,109** | **tons/yr** | |
| Q(uocb)= | 1,880 | af/yr | | | | |
| Q(dwblend)= | 0 | af/yr | | | | |
| Q(MNWDndblend)= | 0 | af/yr | OUTPUT SUMMARY: | | | |
| TDS(wrp)= | 717 | mg/l | | | | |
| TDS(uocb)= | 2,315 | mg/l | T(non-storm)= | 8,406 | tons/yr | 52.2% |
| TDS(dom)= | 470 | mg/l | **TDS(non-storm)=** | **2,315** | **mg/l** | |
| TDS(rain)= | 15 | mg/l | | | | |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | T(storm)= | 3,914 | tons/yr | 24.3% |
| T(natural)= | 1,297 | tons/yr | **TDS(storm)=** | **600** | **mg/l** | |
| SP(lmv)= | 362 | tons/yr | | | | |
| Q(lmv)= | 151 | af/yr | **Salt Bank=** | **3,788** | **tons/yr** | 23.5% |
| SP(uor)= | 144 | tons/yr | | | | |
| Q(uor)= | 127 | af/yr | T(pump)= | 5,921 | tons/yr | |
| DEVELOPED EVAPOTRANSP= | 14,070 | af/yr | TDS(pump)= | 2,315 | mg/l | |
| FOREST & WOODLAND EVAPOTRANSP= | 228 | af/yr | Q(pump)= | 1,880 | af/yr | |
| OPEN WATER EVAPOTRANSP= | 498 | af/yr | | | | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 996 | af/yr | T(stream)= | 2,485 | tons/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | TDS(stream)= | 2,315 | mg/l | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | Q(stream)= | 789 | af/yr | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | Q(stream)= | 1.08976919 | cfs | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | | | | |
| Global ET Adjiustment Factor = | 1.081 | | | | | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Oso Creek drainage = 51,700 ft. length of La Paz Creek drainage = 22,000 ft.
7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) |
|---|---|---|---|
| Developed & Other Human Use | 5,879 | 0.00 | 0 |
| Lawn/Landscape | 3,342 | 4.21 | 14,070 |

| | | | | | |
|---|---|---|---|---|---|
| Forest & Woodland | 152 | 1.50 | 228 | | |
| Open Water | 135 | 3.70 | 498 | A | AFY |
| Shrubland & Grassland | 1,037 | 0.96 | 996 | 4,666 | 15,791 |

8) Recycled water use for 2011 as reported by SOCWA

9) Upper Oso Creek Barrier Flow based on 5-year average (2007-2011) reported by SMWD

10) WQ data from agency Water Quality Confidence Reports 2011

11) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/4/2013

# SALT BALANCE
# OSO/LA PAZ
# BUILDOUT YEAR 2035
# WITH RECLAMATION (PLANNED USE)

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 10,544 | acres | Q(storm)= | 4,795 | af/yr | |
| A(lawns/landscaping)= | 3,342 | acres | Q(non-storm)= | 2,669 | af/yr | |
| A(reservoirs)= | 190 | acres | Q= | 7,464 | af/yr | |
| A(impervious)= | 5,879 | acres | TDS(nondom)= | 1,136 | mg/l | |
| A(unimproved)= | 1,133 | acres | Q(dom)= | 4,226 | af/yr | |
| A(irr/nd)= | 2,103 | acres | Q(nondom)= | 7,170 | af/yr | |
| A(irr/d)= | 1,239 | acres | T(nondom)= | 11,082 | tons/yr | |
| A(urban)= | 9,221 | acres | T(dom)= | 2,702 | tons/yr | |
| R(irr)= | 3.41 | ft/yr | T(rain)= | 267 | tons/yr | |
| RAIN= | 1.24 | ft/yr | T(urbanrunoff)= | 1,176 | tons/yr | |
| Q(rw)= | 5,290 | af/yr | **TOTAL INPUT=** | **17,030** | **tons/yr** | 100.0% |
| Q(uocb)= | 1,880 | af/yr | | | | |
| Q(dwblend)= | 0 | af/yr | | | | |
| Q(MNWDndblend)= | 0 | af/yr | OUTPUT SUMMARY: | | | |
| TDS(wrp)= | 717 | mg/l | | | | |
| TDS(uocb)= | 2,315 | mg/l | T(non-storm)= | 8,887 | tons/yr | 52.2% |
| TDS(dom)= | 470 | mg/l | **TDS(non-storm)=** | **2,447** | **mg/l** | |
| TDS(rain)= | 15 | mg/l | | | | |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | T(storm)= | 4,138 | tons/yr | 24.3% |
| T(natural)= | 1,297 | tons/yr | **TDS(storm)=** | **634** | **mg/l** | |
| SP(lmv)= | 362 | tons/yr | | | | |
| Q(lmv)= | 151 | af/yr | **Salt Bank=** | **4,005** | **tons/yr** | 23.5% |
| SP(uor)= | 144 | tons/yr | | | | |
| Q(uor)= | 127 | af/yr | T(pump)= | 4,604 | tons/yr | 27.0% |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | TDS(pump)= | 1,800 | mg/l | |
| LAWN/LANDSCAP EVAPOTRANSP= | 14,070 | af/yr | Q(pump)= | 1,880 | af/yr | |
| FOREST & WOODLAND EVAPOTRANSP= | 228 | af/yr | | | | |
| OPEN WATER EVAPOTRANSP= | 498 | af/yr | | | | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 996 | af/yr | T(stream)= | 4,283 | tons/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | TDS(stream)= | 2,447 | mg/l | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | Q(stream)= | 789 | af/yr | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | Q(stream)= | 1.08976919 | cfs | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | | | | |
| Global ET Adjiustment Factor = | 1.081 | | | | | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
   San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report

for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Oso Creek drainage = 51,700 ft. length of La Paz Creek drainage = 22,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 5,879 | 0.00 | 0 | | |
| Lawn/Landscape | 3,342 | 4.21 | 14,070 | | |
| Forest & Woodland | 152 | 1.50 | 228 | | |
| Open Water | 135 | 3.70 | 498 | A | AFY |
| Shrubland & Grassland | 1,037 | 0.96 | 996 | 4,666 | 15,791 |

8) Recycled water use based on planned use as reported by SOCWA

9) Upper Oso Creek Barrier Flow based on 5-year average (2007-2011) reported by SMWD

10) WQ data from agency Water Quality Confidence Reports 2011

11) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# OSO/LA PAZ
# BUILDOUT YEAR 2035
# WITH RECLAMATION (PERMITTED USE)

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 10,544 | acres |
| A(lawns/landscaping)= | 3,342 | acres |
| A(reservoirs)= | 190 | acres |
| A(impervious)= | 5,879 | acres |
| A(unimproved)= | 1,133 | acres |
| A(irr/nd)= | 2,653 | acres |
| A(irr/d)= | 689 | acres |
| A(urban)= | 9,221 | acres |
| R(irr)= | 3.41 | ft/yr |
| RAIN= | 1.24 | ft/yr |
| Q(rw)= | 7,168 | af/yr |
| Q(uocb)= | 1,880 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| Q(MNWDndblend)= | 0 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(uocb)= | 2,315 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 1,297 | tons/yr |
| SP(lmv)= | 362 | tons/yr |
| Q(lmv)= | 151 | af/yr |
| SP(uor)= | 144 | tons/yr |
| Q(uor)= | 127 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| LAWN/LANDSCAP EVAPOTRANSP= | 14,070 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 228 | af/yr |
| OPEN WATER EVAPOTRANSP= | 498 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 996 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.081 | |

| CALCULATIONS | | | |
|---|---|---|---|
| Q(storm)= | 4,795 | af/yr | |
| Q(non-storm)= | 2,669 | af/yr | |
| Q= | 7,464 | af/yr | |
| TDS(nondom)= | 1,049 | mg/l | |
| Q(dom)= | 2,348 | af/yr | |
| Q(nondom)= | 9,048 | af/yr | |
| T(nondom)= | 12,914 | tons/yr | |
| T(dom)= | 1,502 | tons/yr | |
| T(rain)= | 267 | tons/yr | |
| T(urbanrunoff)= | 1,176 | tons/yr | |
| **TOTAL INPUT=** | **17,662** | **tons/yr** | 100.0% |
| OUTPUT SUMMARY: | | | |
| T(non-storm)= | 9,217 | tons/yr | 52.2% |
| **TDS(non-storm)=** | **2,538** | **mg/l** | |
| T(storm)= | 4,291 | tons/yr | 24.3% |
| **TDS(storm)=** | **658** | **mg/l** | |
| **Salt Bank=** | **4,154** | **tons/yr** | 23.5% |
| T(pump)= | 4,604 | tons/yr | 26.1% |
| TDS(pump)= | 1,800 | mg/l | |
| Q(pump)= | 1,881 | af/yr | |
| T(stream)= | 4,612 | tons/yr | |
| TDS(stream)= | 2,538 | mg/l | |
| Q(stream)= | 788 | af/yr | |
| Q(stream)= | 1.0880546 | cfs | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
5) Length of Oso Creek drainage = 51,700 ft. length of La Paz Creek drainage = 22,000 ft.

6) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | | |
|---|---|---|---|---|---|---|
| Developed & Other Human Use | 5,879 | 0.00 | 0 | | | |
| Lawn/Landscape | 3,342 | 4.21 | 14,070 | | | |
| Forest & Woodland | 152 | 1.50 | 228 | | | |
| Open Water | 135 | 3.70 | 498 | A | AFY | |
| Shrubland & Grassland | 1,037 | 0.96 | 996 | 4,666 | | 15,791 |

7) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

8) Recycled water use based on permitted use as reported by SOCWA

9) Upper Oso Creek Barrier Flow based on 5-year average (2007-2011) reported by SMWD

10) WQ data from agency Water Quality Confidence Reports 2011

11) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# UPPER ARROYO TRABUCO
# NATURAL TDS COMPONENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 13,339 | acres |
| RAIN= | 1.84 | ft/yr |
| TDS(rain)= | 15 | mg/l |
| FOREST & WOODLAND EVAPOTRANSP= | 4,425 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 19 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 14,504 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 0 | af/yr |
| STORM RUNOFF COEF= | 0.2 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 4,909 | af/yr |
| Q(non-storm)= | 686 | af/yr |
| Q= | 5,595 | af/yr |
| T(rain)= | 501 | tons/yr |
| **T(natural)=** | **874** | **tons/yr** |
| **TOTAL INPUT=** | **1,375** | **tons/yr** |

OUTPUT SUMMARY:

| | | |
|---|---|---|
| T(non-storm)= | 373 | tons/yr |
| **TDS(non-storm)=** | **400** | **mg/l** |
| T(storm)= | 1,002 | tons/yr |
| **TDS(storm)=** | **150** | **mg/l** |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-:
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
5) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
6) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
7) Length of Upper Trabuco drainage = 38,000 ft.
8) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | |
|---|---|---|---|---|
| Developed & Other Human Use | 0 | 0.00 | 0 | |
| Forest & Woodland | 2,329 | 1.90 | 4,425 | |
| Semi-Desert | 22 | 0.88 | 19 | |
| Shrubland & Grassland | 10,988 | 1.32 | 14,504 | |
| Lawn/Landscape | 0 | 4.21 | 0 | 13,339 |

# SALT BALANCE
# UPPER ARROYO TRABUCO
# CURRENT DEVELOPMENT-AVERAGE
# (NO RECLAMATION)

| 1710 | 52 | 629 |
|---|---|---|

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 13,339 | acres |
| A(lawns/landscaping)= | 380 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious)= | 570 | acres |
| A(unimproved)= | 12,389 | acres |
| A(irr/nd)= | 0 | acres |
| A(irr/d)= | 380 | acres |
| A(urban)= | 950 | acres |
| R(irr)= | 2.81 | ft/yr |
| RAIN= | 1.84 | ft/yr |
| Q(rw)= | 0 | af/yr |
| Q(ndpumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| Q(tcwdpumping)= | 212 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(ndpumping)= | 300 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(tcwdpumping)= | 300 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 874 | tons/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 4,425 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 19 | af/yr |
| IRUBLAND & GRASSLAND EVAPOTRANSP= | 13,250 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 1,600 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.192 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 2,391 | af/yr |
| Q(non-storm)= | 212 | af/yr |
| Q= | 2,604 | af/yr |
| TDS(nondom)= | 717 | mg/l |
| Q(dom)= | 1,068 | af/yr |
| Q(nondom)= | 0 | af/yr |
| T(nondom)= | 0 | tons/yr |
| T(dom)= | 683 | tons/yr |
| T(rain)= | 501 | tons/yr |
| T(urbanrunoff)= | 114 | tons/yr |
| **TOTAL INPUT=** | **2,172** | **tons/yr** |

OUTPUT SUMMARY:

| | | | |
|---|---|---|---|
| T(non-storm)= | 87 | tons/yr | 4.0% |
| **TDS(non-storm)=** | **300** | **mg/l** | |
| T(storm)= | 569 | tons/yr | 26.2% |
| **TDS(storm)=** | **175** | **mg/l** | |
| **Salt Bank=** | **1,516** | **tons** | 69.8% |
| T(pump)= | 87 | tons/yr | 4.0% |
| TDS(pump)= | 300 | mg/l | |
| Q(pump)= | 212 | af/yr | |
| T(stream)= | 0 | tons/yr | |
| TDS(stream)= | 300 | mg/l | |
| Q(stream)= | 0 | af/yr | |

where pump + stream = non-storm.

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-20

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Upper Trabuco = 38,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 570 | 0.00 | 0 | | |
| Forest & Woodland | 2,329 | 1.90 | 4,425 | | |
| Semi-Desert | 22 | 0.88 | 19 | | |
| Shrubland & Grassland | 10,038 | 1.32 | 13,250 | | |
| Lawn/Landscape | 380 | 4.21 | 1,600 | 13,339 | 19,295 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

9) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Developed & Other Human Use Total = | 950 |
| Impervious Area = | 570 |

10) Recycled water use for 2011 as reported by SOCWA

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/4/2013

# SALT BALANCE
# UPPER ARROYO TRABUCO
# DEVELOPED AT YEAR 2035
# WITHOUT RECLAMATION

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 13,339 | acres |
| A(lawns/landscaping)= | 1,116 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious)= | 1,673 | acres |
| A(unimproved)= | 10,549 | acres |
| A(irr/nd)= | 0 | acres |
| A(irr/d)= | 1,116 | acres |
| A(urban)= | 2,789 | acres |
| R(irr)= | 2.8 | ft/yr |
| RAIN= | 1.84 | ft/yr |
| Q(rw)= | 0 | af/yr |
| Q(ndpumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| Q(tcwdpumping)= | 212 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(ndpumping)= | 263 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(tcwdpumping)= | 263 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 874 | tons/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 4,425 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 19 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 10,823 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 4,698 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.192 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 3,457 | af/yr |
| Q(non-storm)= | 415 | af/yr |
| Q= | 3,872 | af/yr |
| TDS(nondom)= | 717 | mg/l |
| Q(dom)= | 3,136 | af/yr |
| Q(nondom)= | 0 | af/yr |
| T(nondom)= | 0 | tons/yr |
| T(dom)= | 2,005 | tons/yr |
| T(rain)= | 501 | tons/yr |
| T(urbanrunoff)= | 335 | tons/yr |
| **TOTAL INPUT=** | **3,715** | **tons/yr** |

OUTPUT SUMMARY:

| | | | |
|---|---|---|---|
| T(non-storm)= | 148 | tons/yr | 4.0% |
| **TDS(non-storm)=** | **263** | **mg/l** | |
| T(storm)= | 974 | tons/yr | 26.2% |
| **TDS(storm)=** | **207** | **mg/l** | |
| **Salt Bank=** | **2,593** | **tons** | 69.8% |
| T(pump)= | 76 | tons/yr | 2.0% |
| TDS(pump)= | 263 | mg/l | |
| Q(pump)= | 212 | af/yr | |
| T(stream)= | 72 | tons/yr | |
| TDS(stream)= | 263 | mg/l | |
| Q(stream)= | 203 | af/yr | |

where pump + stream = non-storm.

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Upper Trabuco = 38,000 ft.
7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | |
|---|---|---|---|---|
| Developed & Other Human Use | 1,673 | 0.00 | 0 | |
| Forest & Woodland | 2,329 | 1.90 | 4,425 | |
| Semi-Desert | 22 | 0.88 | 19 | |
| Shrubland & Grassland | 8,199 | 1.32 | 10,823 | |
| Lawn/Landscape | 1,116 | 4.21 | 4,698 | 13,339 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.
9) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 2,789 |
| Impervious Area = | 1,673 |

10) WQ data from agency Water Quality Confidence Reports 2011
11) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# UPPER ARROYO TRABUCO
# DEVELOPED AT YEAR 2035
# WITH RECLAMATION (PLANNED USE)

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 13,339 | acres |
| A(lawns/landscaping)= | 1,116 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious)= | 1,673 | acres |
| A(unimproved)= | 10,549 | acres |
| A(irr/nd)= | 8 | acres |
| A(irr/d)= | 1,108 | acres |
| A(urban)= | 2,789 | acres |
| R(irr)= | 2.81 | ft/yr |
| RAIN= | 1.84 | ft/yr |
| Q(rw)= | 23 | af/yr |
| Q(ndpumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| Q(tcwdpumping)= | 212 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(ndpumping)= | 264 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(tcwdpumping)= | 264 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 874 | tons/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 4,425 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 19 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 10,823 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 4,698 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.192 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 3,457 | af/yr |
| Q(non-storm)= | 415 | af/yr |
| Q= | 3,872 | af/yr |
| TDS(nondom)= | 717 | mg/l |
| Q(dom)= | 3,113 | af/yr |
| Q(nondom)= | 23 | af/yr |
| T(nondom)= | 22 | tons/yr |
| T(dom)= | 1,991 | tons/yr |
| T(rain)= | 501 | tons/yr |
| T(urbanrunoff)= | 335 | tons/yr |
| **TOTAL INPUT=** | **3,723** | **tons/yr** |

OUTPUT SUMMARY:

| | | | |
|---|---|---|---|
| T(non-storm)= | 149 | tons/yr | 4.0% |
| **TDS(non-storm)=** | **264** | **mg/l** | |
| T(storm)= | 976 | tons/yr | 26.2% |
| **TDS(storm)=** | **207** | **mg/l** | |
| **Salt Bank=** | **2,598** | **tons** | 69.8% |
| T(pump)= | 76 | tons/yr | 2.0% |
| TDS(pump)= | 264 | mg/l | |
| Q(pump)= | 212 | af/yr | |
| T(stream)= | 73 | tons/yr | |
| TDS(stream)= | 264 | mg/l | |
| Q(stream)= | 203 | af/yr | |

where pump + stream = non-storm.

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%

San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Upper Trabuco = 38,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | |
|---|---|---|---|---|
| Developed & Other Human Use | 1,673 | 0.00 | 0 | |
| Forest & Woodland | 2,329 | 1.90 | 4,425 | |
| Semi-Desert | 22 | 0.88 | 19 | |
| Shrubland & Grassland | 8,199 | 1.32 | 10,823 | |
| Lawn/Landscape | 1,116 | 4.21 | 4,698 | 13,339 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

9) Impervious = 60% of Developed & Other Human Use total

Total Developed & Other Human Use = 2,789

Impervious Area = 1,673

10) Recycled water use based on Planned Use as reported by SOCWA

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# UPPER ARROYO TRABUCO
# DEVELOPED AT YEAR 2035
# WITH RECLAMATION (PERMITTED USE)

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 13,339 | acres | Q(storm)= | 3,457 | af/yr | |
| A(lawns/landscaping)= | 1,116 | acres | Q(non-storm)= | 415 | af/yr | |
| A(reservoirs)= | 0 | acres | Q= | 3,872 | af/yr | |
| A(impervious)= | 1,673 | acres | TDS(nondom)= | 717 | mg/l | |
| A(unimproved)= | 10,549 | acres | Q(dom)= | 2,716 | af/yr | |
| A(irr/nd)= | 149 | acres | Q(nondom)= | 420 | af/yr | |
| A(irr/d)= | 967 | acres | T(nondom)= | 410 | tons/yr | |
| A(urban)= | 2,789 | acres | T(dom)= | 1,737 | tons/yr | |
| R(irr)= | 2.81 | ft/yr | T(rain)= | 501 | tons/yr | |
| RAIN= | 1.84 | ft/yr | T(urbanrunoff)= | 335 | tons/yr | |
| Q(rw)= | 420 | af/yr | **TOTAL INPUT=** | **3,856** | **tons/yr** | |
| Q(ndpumping)= | 0 | af/yr | | | | |
| Q(dwblend)= | 0 | af/yr | | | | |
| Q(tcwdpumping)= | 212 | af/yr | OUTPUT SUMMARY: | | | |
| TDS(wrp)= | 717 | mg/l | | | | |
| TDS(ndpumping)= | 273 | mg/l | T(non-storm)= | 154 | tons/yr | 4.0% |
| TDS(dom)= | 470 | mg/l | **TDS(non-storm)=** | **273** | **mg/l** | |
| TDS(tcwdpumping)= | 273 | mg/l | | | | |
| TDS(rain)= | 15 | mg/l | T(storm)= | 1,011 | tons/yr | 26.2% |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | **TDS(storm)=** | **215** | **mg/l** | |
| T(natural)= | 874 | tons/yr | | | | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | **Salt Bank=** | **2,692** | **tons** | 69.8% |
| FOREST & WOODLAND EVAPOTRANSP= | 4,425 | af/yr | | | | |
| SEMI-DESERT EVAPOTRANSP= | 19 | af/yr | T(pump)= | 79 | tons/yr | 2.0% |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 10,823 | af/yr | TDS(pump)= | 273 | mg/l | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 4,698 | af/yr | Q(pump)= | 212 | af/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | | | | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | | | | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | T(stream)= | 75 | tons/yr | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | TDS(stream)= | 273 | mg/l | |
| Global ET Adjiustment Factor = | 1.192 | | Q(stream)= | 203 | af/yr | |

where pump + stream = non-storm.

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%

San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Upper Trabuco = 38,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | |
|---|---|---|---|---|
| Developed & Other Human Use | 1,673 | 0.00 | 0 | |
| Forest & Woodland | 2,329 | 1.90 | 4,425 | |
| Semi-Desert | 22 | 0.88 | 19 | |
| Shrubland & Grassland | 8,199 | 1.32 | 10,823 | |
| Lawn/Landscape | 1,116 | 4.21 | 4,698 | 13,339 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

9) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 2,789 |
| Impervious Area = | 1,673 |

10) Recycled water use based on Permitted Use (Order 97-52)

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# MIDDLE ARROYO TRABUCO
# NATURAL TDS COMPONENT

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | |
|---|---|---|---|---|---|
| A(watershed)= | 10,704 | acres | Q(storm)= | 7,713 | af/yr |
| RAIN= | 1.31 | ft/yr | Q(non-storm)= | 1,030 | af/yr |
| Q(upperstorm)= | 4909 | af/yr | Q= | 8,744 | af/yr |
| Q(uppernonstorm)= | 686 | af/yr | T(upperstorm)= | 1,002 | tons/yr |
| TDS(upperstorm)= | 150 | mg/l | T(uppernonstorm)= | 373 | tons/yr |
| TDS(uppernonstorm)= | 400 | mg/l | T(rain)= | 286 | tons/yr |
| TDS(rain)= | 15 | mg/l | **T(natural)=** | **1,068** | **tons/yr** |
| FOREST & WOODLAND EVAPOTRANSP= | 2,091 | af/yr | **TOTAL INPUT=** | **2,730** | **tons/yr** |
| ɔNVASCULAR & SAPRSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 2 | af/yr | | | |
| OPEN WATER EVAPOTRANSP= | 104 | af/yr | OUTPUT SUMMARY: | | |
| SEMI-DESERT EVAPOTRANSP= | 1 | af/yr | | | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 8,676 | af/yr | T(non-storm)= | 631 | tons/yr |
| STORM RUNOFF COEF= | 0.2 | | **TDS(non-storm)=** | **450** | **mg/l** |
| | | | T(storm)= | 2,099 | tons/yr |
| | | | **TDS(storm)=** | **200** | **mg/l** |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
5) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
6) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
7) Length of Middle Trabuco drainage = 24,000 ft. Length of Tijeras Canyon = 29,000 ft. Length of Live Oak Canyon = 10,000 ft.
8) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 0 | 0.00 | 0 | | |
| Forest & Woodland | 1,394 | 1.50 | 2,091 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 2 | 0.88 | 2 | | |
| Open Water | 28 | 3.70 | 104 | | |
| Semi-Desert | 1 | 0.88 | 1 | | |
| Shrubland & Grassland | 9,279 | 0.94 | 8,676 | 10,704 | 10,873 |

11/4/2013

# SALT BALANCE
# MIDDLE ARROYO TRABUCO
# CURRENT DEVELOPMENT
# (WITH RECLAMATION)

| 331 | 288 | 3460 |
|---|---|---|

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 10,704 | acres | Q(storm)= | 6,470 | af/yr | |
| A(lawns/landscaping)= | 2,934 | acres | Q(non-storm)= | 2,506 | af/yr | |
| A(reservoirs)= | 0 | acres | Q= | 8,976 | af/yr | |
| A(impervious)= | 4,402 | acres | TDS(nondom)= | 717 | mg/l | |
| A(unimproved)= | 3,369 | acres | Q(dom)= | 8,876 | af/yr | |
| A(irr/nd)= | 277 | acres | Q(nondom)= | 924 | af/yr | |
| A(irr/d)= | 2,657 | acres | T(nondom)= | 901 | tons/yr | |
| A(urban)= | 7,336 | acres | T(dom)= | 5,676 | tons/yr | |
| R(irr)= | 3.3 | ft/yr | T(upperstorm)= | 569 | tons/yr | |
| RAIN= | 1.31 | ft/yr | T(uppernonstorm)= | 0 | tons/yr | |
| Q(upperstorm)= | 2,391 | af/yr | T(rain)= | 286 | tons/yr | |
| Q(uppernonstorm)= | 0 | af/yr | T(urbanrunoff)= | 880 | tons/yr | |
| Q(rw)= | 924 | af/yr | **TOTAL INPUT=** | **9,381** | **tons/yr** | |
| Q(ndpumping)= | 0 | af/yr | | | | |
| Q(dwblend)= | 0 | af/yr | | | | |
| Q(pumping)= | 630 | af/yr | OUTPUT SUMMARY: | | | |
| TDS(upperstorm)= | 175 | mg/l | | | | |
| TDS(uppernonstorm)= | 300 | mg/l | T(non-storm)= | 3,409 | tons/yr | 36.3% |
| TDS(wrp)= | 717 | mg/l | **TDS(non-storm)=** | **1,000** | **mg/l** | |
| TDS(ndpumping)= | 0 | mg/l | | | | |
| TDS(dom)= | 470 | mg/l | T(storm)= | 5,282 | tons/yr | 56.3% |
| TDS(pumping)= | 1,000 | mg/l | **TDS(storm)=** | **600** | **mg/l** | |
| TDS(rain)= | 15 | mg/l | | | | |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | **Salt Bank=** | **691** | **tons/yr** | 7.4% |
| T(natural)= | 1,068 | tons/yr | | | | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | T(pump)= | 857 | tons/yr | |
| FOREST & WOODLAND EVAPOTRANSP= | 1,304 | af/yr | TDS(pump)= | 1,000 | mg/l | |
| NONVASCULAR & SAPRSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 2 | af/yr | Q(pump)= | 630 | af/yr | |
| OPEN WATER EVAPOTRANSP= | 5 | af/yr | | | | |
| SEMI-DESERT EVAPOTRANSP= | 1 | af/yr | T(stream)= | 2,552 | tons/yr | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 2,007 | af/yr | TDS(stream)= | 1,000 | mg/l | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 12,352 | | Q(stream)= | 1,876 | af/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | Q(stream)= | 2.59 | cfs | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | | | | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | | | | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | | | | |
| Global ET Adjustment Factor = | 1.100 | | | | | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
   San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Middle Trabuco = 38,000 ft. Length of Tijeras Canyon = 29,000 ft. Length of Live Oak Canyon = 10,000 ft.
7) Phreatophyte consumption: acres rate (ft/yr) volume (ac-ft)

| | | | | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 4,402 | 0.00 | 0 | | |
| Forest & Woodland | 1,003 | 1.30 | 1,304 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 2 | 0.88 | 2 | | |
| Open Water | 1 | 3.70 | 5 | | |
| Semi-Desert | 1 | 0.88 | 1 | | |
| Shrubland & Grassland | 2,361 | 0.85 | 2,007 | | |
| Lawns/Landscape | 2,934 | 4.21 | 12,352 | 10,704 | 15,670 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

9) Impervious = 60% of Developed & Other Human Use total

Developed & Other Human Use Total = 7,336

Impervious Area = 4401.6

10) Recycled water use for 2011 as reported by SOCWA

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/4/2013

# SALT BALANCE
# MIDDLE ARROYO TRABUCO
# DEVELOPED AT YEAR 2035
# WITHOUT RECLAMATION
# WITHOUT NONDOMESTIC WELLFIELD DEVELOPMENT

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 10,704 | acres | Q(storm)= | 7,536 | af/yr | |
| A(lawns/landscaping)= | 2,934 | acres | Q(non-storm)= | 2,708 | af/yr | |
| A(reservoirs)= | 0 | acres | Q= | 10,245 | af/yr | |
| A(impervious)= | 4,402 | acres | TDS(nondom)= | 717 | mg/l | |
| A(unimproved)= | 3,368 | acres | Q(dom)= | 9,800 | af/yr | |
| A(irr/nd)= | 0 | acres | Q(nondom)= | 0 | af/yr | |
| A(irr/d)= | 2,934 | acres | T(nondom)= | 0 | tons/yr | |
| A(urban)= | 7,336 | acres | T(dom)= | 6,266 | tons/yr | |
| R(irr)= | 3.34 | ft/yr | T(upperstorm)= | 974 | tons/yr | |
| RAIN= | 1.31 | ft/yr | T(uppernonstorm)= | 73 | tons/yr | |
| Q(upperstorm)= | 3,457 | af/yr | T(rain)= | 286 | tons/yr | |
| Q(uppernonstorm)= | 203 | af/yr | T(urbanrunoff)= | 880 | tons/yr | |
| Q(rw)= | 0 | af/yr | **TOTAL INPUT=** | **9,548** | **tons/yr** | |
| Q(smwdpumping)= | 0 | af/yr | | | | |
| Q(ndpumping)= | 0 | af/yr | | | | |
| Q(dwblend)= | 0 | af/yr | OUTPUT SUMMARY: | | | |
| Q(pumping)= | 630 | af/yr | | | | |
| TDS(upperstorm)= | 207 | mg/l | T(non-storm)= | 3,470 | tons/yr | 36.3% |
| TDS(uppernonstorm)= | 263 | mg/l | **TDS(non-storm)=** | **942** | **mg/l** | |
| TDS(wrp)= | 717 | mg/l | | | | |
| TDS(ndpumping)= | 942 | mg/l | T(storm)= | 5,375 | tons/yr | 56.3% |
| TDS(dom)= | 470 | mg/l | **TDS(storm)=** | **524** | **mg/l** | |
| TDS(pumping)= | 942 | mg/l | | | | |
| TDS(rain)= | 15 | mg/l | **Salt Bank=** | **703** | **tons/yr** | 7.4% |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | | | | |
| T(natural)= | 1,068 | tons/yr | T(pump)= | 807 | tons/yr | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | TDS(pump)= | 942 | mg/l | |
| FOREST & WOODLAND EVAPOTRANSP= | 1,304 | af/yr | Q(pump)= | 630 | af/yr | |
| CULAR ROCK VEGETATION EVAPOTRANSP= | 2 | af/yr | | | | |
| OPEN WATER EVAPOTRANSP= | 5 | af/yr | T(stream)= | 2,663 | tons/yr | |
| SEMI-DESERT EVAPOTRANSP= | 1 | af/yr | TDS(stream)= | 942 | mg/l | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 2,007 | af/yr | Q(stream)= | 2,078 | af/yr | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 12,352 | af/yr | Q(stream)= | 2.87094927 | cfs | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | | | | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | | | | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | | | | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | | | | |
| Global ET Adjustment Factor = | 1.100 | | | | | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report

6) Length of Middle Trabuco = 38,000 ft. Length of Tijeras Canyon = 29,000 ft. Length of Live Oak Canyon = 10,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 4,402 | 0.00 | 0 | | |
| Forest & Woodland | 1,003 | 1.30 | 1,304 | | |
| Nonvascular & Sparse Vascular Rock Vegeta | 2 | 0.88 | 2 | | |
| Open Water | 1 | 3.70 | 5 | | |
| Semi-Desert | 1 | 0.88 | 1 | | |
| Shrubland & Grassland | 2,361 | 0.85 | 2,007 | | |
| Lawns/Landscape | 2,934 | 4.21 | 12,352 | 10,704 | 15,670 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

9) Impervious = 60% of Developed & Other Human Use total

Developed & Other Human Use Total = 7,336

Impervious Area = 4401.6

10) Recycled water use for 2011 as reported by SOCWA

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/4/2013

# SALT BALANCE
# MIDDLE ARROYO TRABUCO
# DEVELOPED AT YEAR 2035
# WITH RECLAMATION (PLANNED USE)
# WITHOUT NONDOMESTIC WELLFIELD DEVELOPMENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 10,704 | acres |
| A(lawns/landscaping)= | 2,934 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious)= | 4,402 | acres |
| A(unimproved)= | 3,368 | acres |
| A(irr/nd)= | 445 | acres |
| A(irr/d)= | 2,489 | acres |
| A(urban)= | 7,336 | acres |
| R(irr)= | 3.34 | ft/yr |
| RAIN= | 1.31 | ft/yr |
| Q(upperstorm)= | 3,457 | af/yr |
| Q(uppernonstorm)= | 203 | af/yr |
| Q(rw)= | 1,487 | af/yr |
| Q(smwdpumping)= | 0 | af/yr |
| Q(ndpumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| Q(pumping)= | 630 | af/yr |
| TDS(upperstorm)= | 207 | mg/l |
| TDS(uppernonstorm)= | 263 | mg/l |
| TDS(wrp)= | 717 | mg/l |
| TDS(ndpumping)= | 991 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(pumping)= | 991 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 1,068 | tons/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 1,304 | af/yr |
| SCULAR ROCK VEGETATION EVAPOTRANSP= | 2 | af/yr |
| OPEN WATER EVAPOTRANSP= | 5 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 1 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 2,007 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 12,352 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjustment Factor = | 1.100 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 7,536 | af/yr |
| Q(non-storm)= | 2,708 | af/yr |
| Q= | 10,245 | af/yr |
| TDS(nondom)= | 717 | mg/l |
| Q(dom)= | 8,313 | af/yr |
| Q(nondom)= | 1,487 | af/yr |
| T(nondom)= | 1,451 | tons/yr |
| T(dom)= | 5,316 | tons/yr |
| T(upperstorm)= | 974 | tons/yr |
| T(uppernonstorm)= | 73 | tons/yr |
| T(rain)= | 286 | tons/yr |
| T(urbanrunoff)= | 880 | tons/yr |
| **TOTAL INPUT=** | **10,047** | **tons/yr** |

OUTPUT SUMMARY:

| | | | |
|---|---|---|---|
| T(non-storm)= | 3,651 | tons/yr | 36.3% |
| **TDS(non-storm)=** | **991** | **mg/l** | |
| T(storm)= | 5,657 | tons/yr | 56.3% |
| **TDS(storm)=** | **552** | **mg/l** | |
| **Salt Bank=** | **740** | **tons/yr** | 7.4% |
| T(pump)= | 849 | tons/yr | |
| TDS(pump)= | 991 | mg/l | |
| Q(pump)= | 630 | af/yr | |
| T(stream)= | 2,802 | tons/yr | |
| TDS(stream)= | 991 | mg/l | |
| Q(stream)= | 2,078 | af/yr | |
| Q(stream)= | 2.87078283 | cfs | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Middle Trabuco = 38,000 ft. Length of Tijeras Canyon = 29,000 ft. Length of Live Oak Canyon = 10,000 ft.

| 7) Phreatophyte consumption: | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 4,402 | 0.00 | 0 | | |
| Forest & Woodland | 1,003 | 1.30 | 1,304 | | |
| Nonvascular & Sparse Vascular Rock Vegetat | 2 | 0.88 | 2 | | |
| Open Water | 1 | 3.70 | 5 | | |
| Semi-Desert | 1 | 0.88 | 1 | | |
| Shrubland & Grassland | 2,361 | 0.85 | 2,007 | | |
| Lawns/Landscape | 2,934 | 4.21 | 12,352 | 10,704 | 15,670 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

9) Impervious = 60% of Developed & Other Human Use total

Developed & Other Human Use Total = 7,336

Impervious Area = 4401.6

10) Recycled water use based on planned use as reported by SOCWA

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/4/2013

# SALT BALANCE
# MIDDLE ARROYO TRABUCO
# DEVELOPED AT YEAR 2035
# WITH RECLAMATION (PLANNED USE)
# WITHOUT NONDOMESTIC WELLFIELD DEVELOPMENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 10,704 | acres |
| A(lawns/landscaping)= | 2,934 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious)= | 4,402 | acres |
| A(unimproved)= | 3,368 | acres |
| A(irr/nd)= | 898 | acres |
| A(irr/d)= | 2,036 | acres |
| A(urban)= | 7,336 | acres |
| R(irr)= | 3.34 | ft/yr |
| RAIN= | 1.31 | ft/yr |
| Q(upperstorm)= | 3,457 | af/yr |
| Q(uppernonstorm)= | 203 | af/yr |
| Q(rw)= | 3,000 | af/yr |
| Q(smwdpumping)= | 0 | af/yr |
| Q(ndpumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| Q(pumping)= | 630 | af/yr |
| TDS(upperstorm)= | 207 | mg/l |
| TDS(uppernonstorm)= | 263 | mg/l |
| TDS(wrp)= | 717 | mg/l |
| TDS(ndpumping)= | 1,041 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(pumping)= | 1,041 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 1,068 | tons/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 1,304 | af/yr |
| APRSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 2 | af/yr |
| OPEN WATER EVAPOTRANSP= | 5 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 1 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 2,007 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 12,352 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjustment Factor = | 1.100 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 7,536 | af/yr |
| Q(non-storm)= | 2,708 | af/yr |
| Q= | 10,245 | af/yr |
| TDS(nondom)= | 717 | mg/l |
| Q(dom)= | 6,800 | af/yr |
| Q(nondom)= | 3,000 | af/yr |
| T(nondom)= | 2,927 | tons/yr |
| T(dom)= | 4,348 | tons/yr |
| T(upperstorm)= | 974 | tons/yr |
| T(uppernonstorm)= | 73 | tons/yr |
| T(rain)= | 286 | tons/yr |
| T(urbanrunoff)= | 880 | tons/yr |
| **TOTAL INPUT=** | **10,556** | **tons/yr** |

OUTPUT SUMMARY:

| | | | |
|---|---|---|---|
| T(non-storm)= | 3,836 | tons/yr | 36.3% |
| **TDS(non-storm)=** | **1,041** | **mg/l** | |
| T(storm)= | 5,943 | tons/yr | 56.3% |
| **TDS(storm)=** | **580** | **mg/l** | |
| **Salt Bank=** | **777** | **tons/yr** | 7.4% |
| T(pump)= | 892 | tons/yr | |
| TDS(pump)= | 1,041 | mg/l | |
| Q(pump)= | 630 | af/yr | |
| T(stream)= | 2,944 | tons/yr | |
| TDS(stream)= | 1,041 | mg/l | |
| Q(stream)= | 2,078 | af/yr | |
| Q(stream)= | 2.87078283 | cfs | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
   San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Middle Trabuco = 38,000 ft. Length of Tijeras Canyon = 29,000 ft. Length of Live Oak Canyon = 10,000 ft.

| 7) Phreatophyte consumption: | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 4,402 | 0.00 | 0 | | |
| Forest & Woodland | 1,003 | 1.30 | 1,304 | | |
| Nonvascular & Sparse Vascular Rock Vegetat | 2 | 0.88 | 2 | | |
| Open Water | 1 | 3.70 | 5 | | |
| Semi-Desert | 1 | 0.88 | 1 | | |
| Shrubland & Grassland | 2,361 | 0.85 | 2,007 | | |
| Lawns/Landscape | 2,934 | 4.21 | 12,352 | 10,704 | 15,670 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

9) Impervious = 60% of Developed & Other Human Use total

Developed & Other Human Use Total = 7,336

Impervious Area = 4401.6

10) Recycled water use based on planned use as reported by SOCWA

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/4/2013

# SALT BALANCE
# MIDDLE ARROYO TRABUCO
# DEVELOPED AT YEAR 2035
# WITH RECLAMATION (PERMITTED USE)
# WITHOUT NONDOMESTIC WELLFIELD DEVELOPMENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 10,704 | acres |
| A(lawns/landscaping)= | 2,934 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious)= | 4,402 | acres |
| A(unimproved)= | 3,368 | acres |
| A(irr/nd)= | 1,267 | acres |
| A(irr/d)= | 1,667 | acres |
| A(urban)= | 7,336 | acres |
| R(irr)= | 3.3 | ft/yr |
| RAIN= | 1.31 | ft/yr |
| Q(upperstorm)= | 3,457 | af/yr |
| Q(uppernonstorm)= | 203 | af/yr |
| Q(rw)= | 4,232 | af/yr |
| Q(smwdpumping)= | 0 | af/yr |
| Q(ndpumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| Q(cvwdpumping)= | 630 | af/yr |
| TDS(upperstorm)= | 207 | mg/l |
| TDS(uppernonstorm)= | 263 | mg/l |
| TDS(wrp)= | 717 | mg/l |
| TDS(ndpumping)= | 1,082 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(pumping)= | 1,082 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 1,068 | tons/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 1,304 | af/yr |
| ;CULAR ROCK VEGETATION EVAPOTRANSP= | 2 | af/yr |
| OPEN WATER EVAPOTRANSP= | 5 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 1 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 2,007 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 12,352 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjustment Factor = | 1.100 | |

| CALCULATIONS | | | |
|---|---|---|---|
| Q(storm)= | 7,536 | af/yr | |
| Q(non-storm)= | 2,708 | af/yr | |
| Q= | 10,245 | af/yr | |
| TDS(nondom)= | 717 | mg/l | |
| Q(dom)= | 5,568 | af/yr | |
| Q(nondom)= | 4,232 | af/yr | |
| T(nondom)= | 4,128 | tons/yr | |
| T(dom)= | 3,560 | tons/yr | |
| T(upperstorm)= | 974 | tons/yr | |
| T(uppernonstorm)= | 73 | tons/yr | |
| T(rain)= | 286 | tons/yr | |
| T(urbanrunoff)= | 880 | tons/yr | |
| **TOTAL INPUT=** | **10,970** | **tons/yr** | |
| OUTPUT SUMMARY: | | | |
| T(non-storm)= | 3,986 | tons/yr | 36.3% |
| **TDS(non-storm)=** | **1,082** | **mg/l** | |
| T(storm)= | 6,176 | tons/yr | 56.3% |
| **TDS(storm)=** | **602** | **mg/l** | |
| **Salt Bank=** | **807** | **tons/yr** | 7.4% |
| T(pump)= | 927 | tons/yr | |
| TDS(pump)= | 1,082 | mg/l | |
| Q(pump)= | 630 | af/yr | |
| T(stream)= | 3,059 | tons/yr | |
| TDS(stream)= | 1,082 | mg/l | |
| Q(stream)= | 2,078 | af/yr | |
| Q(stream)= | 2.87078283 | cfs | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Middle Trabuco = 38,000 ft. Length of Tijeras Canyon = 29,000 ft. Length of Live Oak Canyon = 10,000 ft.

| 7) Phreatophyte consumption: | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 4,402 | 0.00 | 0 | | |
| Forest & Woodland | 1,003 | 1.30 | 1,304 | | |
| Nonvascular & Sparse Vascular Rock Vegetat | 2 | 0.88 | 2 | | |
| Open Water | 1 | 3.70 | 5 | | |
| Semi-Desert | 1 | 0.88 | 1 | | |
| Shrubland & Grassland | 2,361 | 0.85 | 2,007 | | |
| Lawns/Landscape | 2,934 | 4.21 | 12,352 | 10,704 | 15,670 |

8) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

9) Impervious = 60% of Developed & Other Human Use total

Developed & Other Human Use Total = 7,336

Impervious Area = 4401.6

10) Recycled water use based on permitted use as reported by SOCWA

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# CHIQUITA
# NATURAL TDS COMPONENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 4,085 | acres |
| RAIN= | 1.27 | ft/yr |
| TDS(rain)= | 15 | mg/l |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 943 | af/yr |
| NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 1 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 3 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 3,107 | af/yr |
| STORM RUNOFF COEF= | 0.2 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 1,039 | af/yr |
| Q(non-storm)= | 104 | af/yr |
| Q= | 1,143 | af/yr |
| T(rain)= | 106 | tons/yr |
| **T(natural)=** | **290** | **tons/yr** |
| **TOTAL INPUT=** | **396** | **tons/yr** |

OUTPUT SUMMARY:

| | | |
|---|---|---|
| T(non-storm)= | 113 | tons/yr |
| **TDS(non-storm)=** | **800** | **mg/l** |
| T(storm)= | 283 | tons/yr |
| **TDS(storm)=** | **200** | **mg/l** |

References:
1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
3) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Canada Chiquita drainage = 33,000 ft.
7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | |
|---|---|---|---|---|
| Developed & Other Human Use | 0 | 0.00 | 0 | |
| Forest & Woodland | 629 | 1.50 | 943 | |
| Nonvascular & Sparse Vascular Rock Vegetation | 2 | 0.88 | 1 | |
| Semi-Desert | 3 | 0.88 | 3 | |
| Shrubland & Grassland | 3,452 | 0.90 | 3,107 | 4,085 |

# SALT BALANCE
# CHIQUITA
# CURRENT TDS COMPONENT (AVERAGE)
# (NO RECLAMATION)

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 4,085 | acres | Q(storm)= | 590 | af/yr | |
| A(lawns/landscaping)= | 200 | acres | Q(non-storm)= | 436 | af/yr | |
| A(reservoirs)= | 0 | acres | Q= | 1,026 | af/yr | |
| A(impervious)= | 299 | acres | TDS(nondom)= | 717 | mg/l | |
| A(unimproved)= | 3,585 | acres | Q(dom)= | 676 | af/yr | |
| A(irr/nd)= | 0 | acres | Q(nondom)= | 0 | af/yr | |
| A(irr/d)= | 200 | acres | T(nondom)= | 0 | tons/yr | |
| A(urban)= | 499 | acres | T(dom)= | 432 | tons/yr | |
| R(irr)= | 3.38 | ft/yr | T(rain)= | 106 | tons/yr | |
| RAIN= | 1.27 | ft/yr | T(urbanrunoff)= | 60 | tons/yr | |
| Q(rw)= | 0 | af/yr | **TOTAL INPUT=** | **1,039** | **tons/yr** | |
| TDS(wrp)= | 717 | mg/l | | | | |
| TDS(dom)= | 470 | mg/l | | | | |
| TDS(rain)= | 15 | mg/l | OUTPUT SUMMARY: | | | |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | | | | |
| T(natural)= | 290 | tons/yr | T(non-storm)= | 475 | tons/yr | 45.7% |
| SP(chiquita)= | 362 | tons/yr | **TDS(non-storm)=** | **800** | **mg/l** | |
| Q(chiquita)= | 151 | af/yr | | | | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | T(storm)= | 160 | tons/yr | 15.4% |
| FOREST & WOODLAND EVAPOTRANSP= | 943 | af/yr | **TDS(storm)=** | **200** | **mg/l** | |
| NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 1 | af/yr | | | | |
| SEMI-DESERT EVAPOTRANSP= | 3 | af/yr | **Salt Bank=** | **403** | **tons** | 38.8% |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 2,657 | af/yr | | | | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 842 | af/yr | T(pump)= | 0 | tons/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | TDS(pump)= | 800 | mg/l | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | Q(pump)= | 0 | af/yr | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | | | | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | T(stream)= | 475 | tons/yr | |
| Global ET Adjiustment Factor = | 1.124 | | TDS(stream)= | 800 | mg/l | |
| | | | Q(stream)= | 436 | af/yr | |

where pump + stream = non-storm.

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Upper Trabuco = 38,000 ft.
7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 299 | 0.00 | 0 | | |
| Lawn/landscape | 200 | 4.21 | 842 | | |
| Forest & Woodland | 629 | 1.50 | 943 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 2 | 0.88 | 1 | | |
| Semi-Desert | 3 | 0.88 | 3 | | |
| Shrubland & Grassland | 2,952 | 0.90 | 2,657 | 4,085 | 4,446 |

(Lawn evapotranspiration rate from Oso Creek developed model)

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Trabuco | Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.
10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Developed & Other Human Use Total = | 499 |
| Impervious Area = | 299.4 |

11) Recycled water use for 2011 as reported by SOCWA
12) WQ data from agency Water Quality Confidence Reports 2011
13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/5/2013

# SALT BALANCE
# CHIQUITA
# DEVELOPED AT YEAR 2035
# WITHOUT RECLAMATION

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 4,085 | acres | Q(storm)= | 839 | af/yr | |
| A(lawns/landscaping)= | 450 | acres | Q(non-storm)= | 963 | af/yr | |
| A(reservoirs)= | 25 | acres | Q= | 1,801 | af/yr | |
| A(impervious)= | 676 | acres | TDS(rw)= | 0 | mg/l | |
| A(unimproved)= | 2,935 | acres | Q(dom)= | 1,521 | af/yr | |
| A(irr/nd)= | 0 | acres | Q(nondom)= | 0 | af/yr | |
| A(irr/d)= | 450 | acres | T(nondom)= | 0 | tons/yr | |
| A(urban)= | 1,126 | acres | T(dom)= | 973 | tons/yr | |
| R(irr)= | 3.38 | ft/yr | T(rain)= | 106 | tons/yr | |
| RAIN= | 1.27 | ft/yr | T(urbanrunoff)= | 135 | tons/yr | |
| Q(rw)= | 0 | af/yr | **TOTAL INPUT=** | **1,560** | **tons/yr** | |
| Q(pumping)= | 0 | af/yr | | | | |
| TDS(wrp)= | 0 | mg/l | | | | |
| TDS(pumping)= | 0 | mg/l | OUTPUT SUMMARY: | | | |
| TDS(dom)= | 470 | mg/l | | | | |
| TDS(rain)= | 15 | mg/l | T(non-storm)= | 713 | tons/yr | 45.7% |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | **TDS(non-storm)=** | **544** | **mg/l** | |
| T(natural)= | 290 | tons/yr | | | | |
| SP(Chiquita)= | 56 | tons/yr | T(storm)= | 241 | tons/yr | 15.4% |
| Q(Chiquita)= | 49 | af/yr | **TDS(storm)=** | **211** | **mg/l** | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | | | | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 1,895 | af/yr | **Salt Bank=** | **606** | **tons** | 38.8% |
| FOREST & WOODLAND EVAPOTRANSP= | 943 | af/yr | | | | |
| ULAR ROCK VEGETATION EVAPOTRANSP= | 1 | af/yr | T(pump)= | 0 | tons/yr | |
| SEMI-DESERT EVAPOTRANSP= | 3 | af/yr | TDS(pump)= | 544 | mg/l | |
| IRUBLAND & GRASSLAND EVAPOTRANSP= | 2,093 | af/yr | Q(pump)= | 0 | af/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | | | | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | T(stream)= | 713 | tons/yr | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | TDS(stream)= | 544 | mg/l | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | Q(stream)= | 963 | af/yr | |
| Global ET Adjiustment Factor = | 1.124 | | | | | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-20

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Canada Chiquita drainage = 33,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 676 | 0.00 | 0 | | |
| Lawn/landscape | 450 | 4.21 | 1,895 | | |
| Forest & Woodland | 629 | 1.50 | 943 | | |
| Nonvascular & Sparse Vascular Rock Veget | 2 | 0.88 | 1 | | |
| Semi-Desert | 3 | 0.88 | 3 | | |
| Shrubland & Grassland | 2,325 | 0.90 | 2,093 | 4,084 | 4,934 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz m

| | Trabuco | Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 1,126 |
| Impervious Area = | 676 |

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/5/2013

# SALT BALANCE
# CHIQUITA
# DEVELOPED AT YEAR 2035
# WITH RECLAMATION (PLANNED USE)

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 4,085 | acres | Q(storm)= | 839 | af/yr | |
| A(lawns/landscaping)= | 450 | acres | Q(non-storm)= | 963 | af/yr | |
| A(reservoirs)= | 25 | acres | Q= | 1,801 | af/yr | |
| A(impervious)= | 676 | acres | TDS(nondom)= | 717 | mg/l | |
| A(unimproved)= | 2,935 | acres | Q(dom)= | 845 | af/yr | |
| A(irr/nd)= | 200 | acres | Q(nondom)= | 676 | af/yr | |
| A(irr/d)= | 250 | acres | T(nondom)= | 659 | tons/yr | |
| A(urban)= | 1,126 | acres | T(dom)= | 540 | tons/yr | |
| R(irr)= | 3.38 | ft/yr | T(rain)= | 106 | tons/yr | |
| RAIN= | 1.27 | ft/yr | T(urbanrunoff)= | 135 | tons/yr | |
| Q(rw)= | 676 | af/yr | **TOTAL INPUT=** | **1,731** | **tons/yr** | |
| Q(pumping)= | 0 | af/yr | | | | |
| TDS(wrp)= | 717 | mg/l | | | | |
| TDS(pumping)= | 0 | mg/l | OUTPUT SUMMARY: | | | |
| TDS(dom)= | 470 | mg/l | | | | |
| TDS(rain)= | 15 | mg/l | T(non-storm)= | 791 | tons/yr | 45.7% |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | **TDS(non-storm)=** | **604** | **mg/l** | |
| T(natural)= | 290 | tons/yr | | | | |
| SP(Chiquita)= | 56 | tons/yr | T(storm)= | 267 | tons/yr | 15.4% |
| Q(Chiquita)= | 49 | af/yr | **TDS(storm)=** | **234** | **mg/l** | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | | | | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 1,895 | af/yr | | | | |
| FOREST & WOODLAND EVAPOTRANSP= | 943 | af/yr | **Salt Bank=** | **672** | **tons** | 38.8% |
| :ULAR ROCK VEGETATION EVAPOTRANSP= | 1 | af/yr | | | | |
| SEMI-DESERT EVAPOTRANSP= | 3 | af/yr | T(pump)= | 0 | tons/yr | |
| HRUBLAND & GRASSLAND EVAPOTRANSP= | 2,093 | af/yr | TDS(pump)= | 0 | mg/l | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | Q(pump)= | 0 | af/yr | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | | | | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | T(stream)= | 604 | tons/yr | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | TDS(stream)= | 0 | mg/l | |
| Global ET Adjiustment Factor = | 1.124 | | Q(stream)= | 1,801 | af/yr | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-201

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

3) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas, 0.7 - 0.95 for hard surfaces, and 0.18 - 0.22 for for poor draining lawns @ 2% to 7% slope. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Canada Chiquita drainage = 33,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 676 | 0.00 | 0 | | |
| Lawn/landscape | 450 | 4.21 | 1,895 | | |
| Forest & Woodland | 629 | 1.50 | 943 | | |
| Nonvascular & Sparse Vascular Rock Veget: | 2 | 0.88 | 1 | | |
| Semi-Desert | 3 | 0.88 | 3 | | |
| Shrubland & Grassland | 2,325 | 0.90 | 2,093 | 4,084 | 4,934 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz moc

| | Trabuco | Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 1,126 |
| Impervious Area = | 676 |

11) Recycled water use based on planned use as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# GOBERNADORA
# NATURAL TDS COMPONENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 7,116 | acres |
| RAIN= | 1.29 | ft/yr |
| TDS(rain)= | 15 | mg/l |
| AGRICULTURAL EVAPOTRANSP= | 7 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 1,627 | af/yr |
| CULAR ROCK VEGETATION EVAPOTRANSP= | 49 | af/yr |
| OPEN WATER EVAPOTRANSP= | 48 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 4 | af/yr |
| 3HRUBLAND & GRASSLAND EVAPOTRANSP= | 5,358 | |
| STORM RUNOFF COEF= | 0.2 | af/yr |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 1,836 | af/yr |
| Q(non-storm)= | 251 | af/yr |
| Q= | 2,087 | af/yr |
| T(rain)= | 187 | tons/yr |
| **TOTAL INPUT=** | **671** | **tons/yr** |
| OUTPUT SUMMARY: | | |
| T(non-storm)= | 171 | tons/yr |
| **TDS(non-storm)=** | **500** | **mg/l** |
| T(storm)= | 500 | tons/yr |
| **TDS(storm)=** | **200** | **mg/l** |
| **T(natural)=** | **483** | **tons/yr** |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
5) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
   San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
6) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
7) Length of Canada Gobernadora drainage = 44,000 ft. Length of Wagon Wheel drainage = 11,000 ft.
8) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 2 | 4.40 | 7 | | |
| Developed & Other Human Use | 0 | 0.00 | 0 | | |
| Forest & Woodland | 1,154 | 1.41 | 1,627 | | |
| Nonvascular & Sparse Vascular Rock Vegeta | 55 | 0.88 | 49 | | |
| Open Water | 13 | 3.70 | 48 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 5,888 | 0.91 | 5,358 | 7,116 | 7,093 |

# SALT BALANCE
# GOBERNADORA
# CURRENT DEVELOPMENT (AVERAGE)
# (WITH RECLAMATION)
# (NO WELLFIELD DEVELOPMENT)

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 7,116 | acres |
| A(lawns/landscaping)= | 1,118 | acres |
| A(reservoirs)= | 25 | acres |
| A(impervious)= | 1,677 | acres |
| A(unimproved)= | 4,297 | acres |
| A(irr/nd)= | 486 | acres |
| A(irr/d)= | 632 | acres |
| A(urban)= | 2,795 | acres |
| R(irr)= | 3.36 | ft/yr |
| RAIN= | 1.29 | ft/yr |
| Q(rw)= | 1,634 | af/yr |
| Q(pumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(pumping)= | 916 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 483 | tons/yr |
| SP(Portola)= | 56 | tons/yr |
| Q(Portola)= | 49 | af/yr |
| AGRICULTURAL EVAPOTRANSP= | 7 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 4,707 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 1,627 | af/yr |
| NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 49 | af/yr |
| OPEN WATER EVAPOTRANSP= | 48 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 4 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 2,721 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| CALCULATIONS | | | |
|---|---|---|---|
| Q(storm)= | 1,823 | af/yr | |
| Q(non-storm)= | 839 | af/yr | |
| Q= | 2,662 | af/yr | |
| TDS(nondom)= | 717 | mg/l | |
| Q(dom)= | 2,122 | af/yr | |
| Q(nondom)= | 1,634 | af/yr | |
| T(nondom)= | 1,594 | tons/yr | |
| T(dom)= | 1,357 | tons/yr | |
| T(rain)= | 188 | tons/yr | |
| T(urbanrunoff)= | 335 | tons/yr | |
| **TOTAL INPUT=** | **4,013** | **tons/yr** | 100.0% |

OUTPUT SUMMARY:

| | | | |
|---|---|---|---|
| T(non-storm)= | 1,046 | tons/yr | 26.1% |
| **TDS(non-storm)=** | **916** | **mg/l** | |
| T(storm)= | 1,017 | tons/yr | 25.3% |
| **TDS(storm)=** | **410** | **mg/l** | |
| **Salt Bank=** | **1,950** | **tons/yr** | 48.6% |
| T(pump)= | 0 | tons/yr | |
| TDS(pump)= | 916 | mg/l | |
| Q(pump)= | 0 | af/yr | |
| T(stream)= | 1,046 | tons/yr | |
| TDS(stream)= | 916 | mg/l | |
| Q(stream)= | 839 | af/yr | |
| Q(stream)= | 1.1589756 | cfs | |

=References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Canada Gobernadora drainage = 44,000 ft. Length of Wagon Wheel drainage = 11,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 2 | 4.40 | 7 | | |
| Developed & Other Human Use | 1,677 | 0.00 | 0 | | |
| Lawn/Landscape | 1,118 | 4.21 | 4,707 | | |
| Forest & Woodland | 1,154 | 1.41 | 1,627 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 55 | 0.88 | 49 | | |
| Open Water | 13 | 3.70 | 48 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 3,092 | 0.88 | 2,721 | 7,116 | 9,163 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Developed & Other Human Use Total = | 2,795 |
| Impervious Area = | 1677 |

11) Recycled water use for 2011 as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/5/2013

# SALT BALANCE
# GOBERNADORA
# DEVELOPED AT YEAR 2035
# WITHOUT RECLAMATION
# WITHOUT NONDOMESTIC WELLFIELD DEVELOPMENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 7,232 | acres |
| A(lawns/landscaping)= | 1,986 | acres |
| A(reservoirs)= | 25 | acres |
| A(impervious)= | 2,980 | acres |
| A(unimproved)= | 2,241 | acres |
| A(irr/nd)= | 0 | acres |
| A(irr/d)= | 1,986 | acres |
| A(urban)= | 4,966 | acres |
| R(irr)= | 3.36 | ft/yr |
| RAIN= | 1.29 | ft/yr |
| Q(rw)= | 0 | af/yr |
| Q(pumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(pumping)= | 546 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 483 | tons/yr |
| SP(Portola)= | 56 | tons/yr |
| Q(Portola)= | 49 | af/yr |
| AGRICULTURAL EVAPOTRANSP= | 7 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 8,361 | af/yr |
| ARSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 1,627 | af/yr |
| OPEN WATER EVAPOTRANSP= | 49 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 48 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 4 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| CALCULATIONS | | | |
|---|---|---|---|
| Q(storm)= | 2,718 | af/yr | |
| Q(non-storm)= | 1,962 | af/yr | |
| Q= | 4,679 | af/yr | |
| TDS(nondom)= | 717 | mg/l | |
| Q(dom)= | 6,673 | af/yr | |
| Q(nondom)= | 0 | af/yr | |
| T(nondom)= | 0 | tons/yr | 0% |
| T(dom)= | 4,267 | tons/yr | 76% |
| T(rain)= | 191 | tons/yr | 3% |
| T(urbanrunoff)= | 596 | tons/yr | 11% |
| **TOTAL INPUT=** | **5,593** | **tons/yr** | |
| OUTPUT SUMMARY: | | | |
| T(non-storm)= | 1,457 | tons/yr | 26.1% |
| **TDS(non-storm)=** | **546** | **mg/l** | |
| T(storm)= | 1,417 | tons/yr | 25.3% |
| **TDS(storm)=** | **383** | **mg/l** | |
| **Salt Bank=** | **2,718** | **tons/yr** | 48.6% |
| T(pump)= | 0 | tons/yr | |
| TDS(pump)= | 546 | mg/l | |
| Q(pump)= | 0 | af/yr | |
| T(stream)= | 1,457 | tons/yr | |
| TDS(stream)= | 546 | mg/l | |
| Q(stream)= | 1,962 | af/yr | |
| Q(stream)= | 2.70940419 | cfs | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Canada Gobernadora drainage = 44,000 ft. Length of Wagon Wheel drainage = 11,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 2 | 4.40 | 7 | | |
| Developed & Other Human Use | 2,980 | 0.00 | 0 | | |
| Lawn/Landscape | 1,986 | 4.21 | 8,361 | | |
| Forest & Woodland | 1,154 | 1.41 | 1,627 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 55 | 0.88 | 49 | | |
| Open Water | 13 | 3.70 | 48 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 921 | 0.88 | 811 | 7,116 | 10,907 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 4,966 |
| Impervious Area = | 2,980 |

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# GOBERNADORA
# DEVELOPED AT YEAR 2035
# WITH RECLAMATION (PLANNED USE)
# WITHOUT NONDOMESTIC WELLFIELD DEVELOPMENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 7,232 | acres |
| A(lawns/landscaping)= | 1,986 | acres |
| A(reservoirs)= | 25 | acres |
| A(impervious)= | 2,980 | acres |
| A(unimproved)= | 2,241 | acres |
| A(irr/nd)= | 1,190 | acres |
| A(irr/d)= | 796 | acres |
| A(urban)= | 4,966 | acres |
| R(irr)= | 3.36 | ft/yr |
| RAIN= | 1.29 | ft/yr |
| Q(rw)= | 4,000 | af/yr |
| Q(pumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(pumping)= | 677 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 483 | tons/yr |
| SP(Portola)= | 56 | tons/yr |
| Q(Portola)= | 49 | af/yr |
| AGRICULTURAL EVAPOTRANSP= | 7 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 8,361 | af/yr |
| 'ARSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 1,627 | af/yr |
| OPEN WATER EVAPOTRANSP= | 49 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 48 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 4 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 2,718 | af/yr |
| Q(non-storm)= | 1,962 | af/yr |
| Q= | 4,679 | af/yr |
| TDS(nondom)= | 717 | mg/l |
| Q(dom)= | 2,673 | af/yr |
| Q(nondom)= | 4,000 | af/yr |
| T(nondom)= | 3,902 | tons/yr |
| T(dom)= | 1,709 | tons/yr |
| T(rain)= | 191 | tons/yr |
| T(urbanrunoff)= | 596 | tons/yr |
| **TOTAL INPUT=** | **6,937** | **tons/yr** |

OUTPUT SUMMARY:

| | | | |
|---|---|---|---|
| T(non-storm)= | 1,808 | tons/yr | 26.1% |
| **TDS(non-storm)=** | **677** | **mg/l** | |
| T(storm)= | 1,758 | tons/yr | 25.3% |
| **TDS(storm)=** | **475** | **mg/l** | |
| **Salt Bank=** | **3,371** | **tons/yr** | 48.6% |
| T(pump)= | 0 | tons/yr | |
| TDS(pump)= | 677 | mg/l | |
| Q(pump)= | 0 | af/yr | |
| T(stream)= | 1,808 | tons/yr | |
| TDS(stream)= | 677 | mg/l | |
| Q(stream)= | 1,962 | af/yr | |
| Q(stream)= | 2.70940419 | cfs | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
   San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Canada Gobernadora drainage = 44,000 ft. Length of Wagon Wheel drainage = 11,000 ft.
7) Phreatophyte consumption:

| 7) Phreatophyte consumption: | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 2 | 4.40 | 7 | | |
| Developed & Other Human Use | 2,980 | 0.00 | 0 | | |
| Lawn/Landscape | 1,986 | 4.21 | 8,361 | | |
| Forest & Woodland | 1,154 | 1.41 | 1,627 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 55 | 0.88 | 49 | | |
| Open Water | 13 | 3.70 | 48 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 921 | 0.88 | 811 | 7,116 | 10,907 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.
10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 4,966 |
| Impervious Area = | 2,980 |

11) Recycled water use based on planned use as reported by SOCWA
12) WQ data from agency Water Quality Confidence Reports 2011
13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/5/2013

# SALT BALANCE
# GOBERNADORA
# DEVELOPED AT YEAR 2035
# WITH RECLAMATION (PERMITTED USE)
# WITHOUT NONDOMESTIC WELLFIELD DEVELOPMENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 7,232 | acres |
| A(lawns/landscaping)= | 1,986 | acres |
| A(reservoirs)= | 25 | acres |
| A(impervious)= | 2,980 | acres |
| A(unimproved)= | 2,241 | acres |
| A(irr/nd)= | 1,235 | acres |
| A(irr/d)= | 751 | acres |
| A(urban)= | 4,966 | acres |
| R(irr)= | 3.36 | ft/yr |
| RAIN= | 1.29 | ft/yr |
| Q(rw)= | 4,148 | af/yr |
| Q(pumping)= | 0 | af/yr |
| Q(dwblend)= | 0 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(pumping)= | 682 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 483 | tons/yr |
| SP(Portola)= | 56 | tons/yr |
| Q(Portola)= | 49 | af/yr |
| AGRICULTURAL EVAPOTRANSP= | 7 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 8,361 | af/yr |
| CULAR ROCK VEGETATION EVAPOTRANSP= | 1,627 | af/yr |
| OPEN WATER EVAPOTRANSP= | 49 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 48 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 4 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 2,718 | af/yr |
| Q(non-storm)= | 1,962 | af/yr |
| Q= | 4,679 | af/yr |
| TDS(nondom)= | 717 | mg/l |
| Q(dom)= | 2,525 | af/yr |
| Q(nondom)= | 4,148 | af/yr |
| T(nondom)= | 4,046 | tons/yr |
| T(dom)= | 1,615 | tons/yr |
| T(rain)= | 191 | tons/yr |
| T(urbanrunoff)= | 596 | tons/yr |
| **TOTAL INPUT=** | **6,987** | **tons/yr** |

OUTPUT SUMMARY:

| | | | |
|---|---|---|---|
| T(non-storm)= | 1,820 | tons/yr | 26.1% |
| **TDS(non-storm)=** | **682** | **mg/l** | |
| T(storm)= | 1,771 | tons/yr | 25.3% |
| **TDS(storm)=** | **479** | **mg/l** | |
| **Salt Bank=** | **3,396** | **tons/yr** | 48.6% |
| T(pump)= | 0 | tons/yr | |
| TDS(pump)= | 682 | mg/l | |
| Q(pump)= | 0 | af/yr | |
| T(stream)= | 1,820 | tons/yr | |
| TDS(stream)= | 682 | mg/l | |
| Q(stream)= | 1,962 | af/yr | |
| Q(stream)= | 2.70940419 | cfs | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Canada Gobernadora drainage = 44,000 ft. Length of Wagon Wheel drainage = 11,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 2 | 4.40 | 7 | | |
| Developed & Other Human Use | 2,980 | 0.00 | 0 | | |
| Lawn/Landscape | 1,986 | 4.21 | 8,361 | | |
| Forest & Woodland | 1,154 | 1.41 | 1,627 | | |
| Nonvascular & Sparse Vascular Rock Vegeta | 55 | 0.88 | 49 | | |
| Open Water | 13 | 3.70 | 48 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 921 | 0.88 | 811 | 7,116 | 10,907 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 4,966 |
| Impervious Area = | 2,980 |

11) Recycled water use based on permitted use as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# DOVE/BELL
# NATURAL TDS COMPONENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 13,083 | acres |
| RAIN= | 1.53 | ft/yr |
| TDS(rain)= | 15 | mg/l |
| WETLANDS EVAPOTRANSP= | 3,392 | af/yr |
| GRASSLANDS EVAPOTRANSP= | 37 | af/yr |
| CHAPARRAL EVAPOTRANSP= | 4 | af/yr |
| SAGEBRUSH EVAPOTRANSP= | 12,275 | af/yr |
| WOODLANDS EVAPOTRANSP= | 0 | af/yr |
| MIXED CONIFERS EVAPOTRANSP= | 0 | |
| STORM RUNOFF COEF= | 0.2 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 4,003 | af/yr |
| Q(non-storm)= | 305 | af/yr |
| Q= | 4,309 | af/yr |
| T(rain)= | 409 | tons/yr |
| **T(natural)=** | **533** | **tons/yr** |
| **TOTAL INPUT=** | **942** | **tons/yr** |

OUTPUT SUMMARY:

| | | |
|---|---|---|
| T(non-storm)= | 125 | tons/yr |
| **TDS(non-storm)=** | **300** | **mg/l** |
| T(storm)= | 817 | tons/yr |
| **TDS(storm)=** | **150** | **mg/l** |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
5) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
6) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
7) Length of Bell Canyon = 37,500 ft. Length of Dove Canyon = 15,000 ft.
8) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 0 | 0.00 | 0 | 15,709 | |
| Forest & Woodland | 1,902 | 1.78 | 3,385 | | |
| Nonvascular & Sparse Vascular Rock Veg. | 8 | 0.88 | 7 | | |
| Open Water | 10 | 3.70 | 37 | | |
| Semi-Desert | 4 | 0.88 | 4 | | |
| Shrubland & Grassland | 11,159 | 1.10 | 12,275 | | |
| Lawn/Landscape | 0 | 4.21 | 0 | 13,083 | 15,709 |

# SALT BALANCE
# DOVE/BELL
# CURRENT DEVELOPMENT
# (WITHOUT RECLAMATION)

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 13,083 | acres | Q(storm)= | 1,961 | af/yr | |
| A(lawns/landscaping)= | 382 | acres | Q(non-storm)= | 963 | af/yr | |
| A(reservoirs)= | 0 | acres | Q= | 2,924 | af/yr | |
| A(impervious)= | 572 | acres | TDS(nondom)= | 717 | mg/l | |
| A(unimproved)= | 12,129 | acres | Q(dom)= | 1,192 | af/yr | |
| A(irr/nd)= | 0 | acres | T(rw)= | 0 | tons/yr | |
| A(irr/d)= | 382 | acres | T(dom)= | 762 | tons/yr | |
| A(urban)= | 954 | acres | T(rain)= | 408 | tons/yr | |
| R(irr)= | 3.12 | ft/yr | T(urbanrunoff)= | 114 | tons/yr | |
| RAIN= | 1.53 | ft/yr | **TOTAL INPUT=** | **1,818** | **tons/yr** | 100.0% |
| Q(rw)= | 0 | af/yr | | | | |
| Q(pumping)= | 0 | af/yr | OUTPUT SUMMARY: | | | |
| Q(dwblend)= | 0 | af/yr | | | | |
| Q(pumping)= | 0 | af/yr | T(non-storm)= | 459 | tons/yr | 25.2% |
| TDS(wrp)= | 717 | mg/l | **TDS(non-storm)=** | **350** | **mg/l** | |
| TDS(pumping)= | 350 | mg/l | | | | |
| TDS(dom)= | 470 | mg/l | T(storm)= | 574 | tons/yr | 31.5% |
| TDS(rain)= | 15 | mg/l | **TDS(storm)=** | **215** | **mg/l** | |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | | | | |
| T(natural)= | 533 | tons/yr | **Salt Bank=** | **786** | **tons/yr** | 43.2% |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | | | | |
| FOREST & WOODLAND EVAPOTRANSP= | 1,608 | af/yr | T(pump)= | 0 | tons/yr | |
| NONVASCULAR & SAPRSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 3,385 | | | | | |
| OPEN WATER EVAPOTRANSP= | 7 | af/yr | TDS(pump)= | 350 | mg/l | |
| SEMI-DESERT EVAPOTRANSP= | 37 | af/yr | Q(pump)= | 0 | af/yr | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 4 | af/yr | | | | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 11,225 | af/yr | T(stream)= | 459 | tons/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | TDS(stream)= | 350 | mg/l | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | Q(stream)= | 963 | af/yr | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | | | | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | | | | |
| Global ET Adjiustment Factor = | 1.124 | | | | | |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Bell Canyon = 37,500 ft. Length of Dove Canyon = 15,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 572 | 0.00 | 0 | 16,267 | |
| Lawn/Landscape | 382 | 4.21 | 1,608 | | |
| Forest & Woodland | 1,902 | 1.78 | 3,385 | | |
| Nonvascular & Sparse Vascular Rock Veg. | 8 | 0.90 | 7 | | |
| Open Water | 10 | 3.70 | 37 | | |
| Semi-Desert | 4 | 0.88 | 4 | | |
| Shrubland & Grassland | 10,205 | 1.10 | 11,225 | 13,083 | 16,267 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Developed & Other Human Use Total = | 954 |
| Impervious Area = | 572.4 |

11) Recycled water use for 2011 as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/5/2013

# SALT BALANCE
# DOVE/BELL
# DEVELOPED AT YEAR 2035
# WITHOUT RECLAMATION

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 13,083 | acres | Q(storm)= | 1,961 | af/yr | |
| A(lawns/landscaping)= | 382 | acres | Q(non-storm)= | 963 | af/yr | |
| A(reservoirs)= | 0 | acres | Q= | 2,924 | af/yr | |
| A(impervious)= | 572 | acres | TDS(rw)= | 717 | mg/l | |
| A(unimproved)= | 12,128 | acres | Q(dom)= | 1,192 | af/yr | |
| A(irr/nd)= | 0 | acres | T(rw)= | 0 | tons/yr | |
| A(irr/d)= | 382 | acres | T(dom)= | 762 | tons/yr | |
| A(urban)= | 954 | acres | T(rain)= | 408 | tons/yr | |
| R(irr)= | 3.12 | ft/yr | T(urbanrunoff)= | 114 | tons/yr | |
| RAIN= | 1.53 | ft/yr | **TOTAL INPUT=** | **1,818** | **tons/yr** | 100.0% |
| Q(rw)= | 0 | af/yr | | | | |
| Q(pumping)= | 0 | af/yr | OUTPUT SUMMARY: | | | |
| TDS(wrp)= | 717 | mg/l | | | | |
| TDS(pumping)= | 0 | mg/l | T(non-storm)= | 459 | tons/yr | 25.2% |
| TDS(dom)= | 470 | mg/l | **TDS(non-storm)=** | **350** | **mg/l** | |
| TDS(rain)= | 15 | mg/l | | | | |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | T(storm)= | 574 | tons/yr | 31.5% |
| T(natural)= | 533 | tons/yr | **TDS(storm)=** | **215** | **mg/l** | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | | | | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 1,608 | | | | | |
| FOREST & WOODLAND EVAPOTRANSP= | 3,385 | af/yr | **Salt Bank=** | **786** | **tons/yr** | 43.2% |
| NONVASCULAR & SAPRSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 7 | af/yr | | | | |
| OPEN WATER EVAPOTRANSP= | 37 | af/yr | T(pump)= | 0 | tons/yr | |
| SEMI-DESERT EVAPOTRANSP= | 4 | af/yr | TDS(pump)= | 350 | mg/l | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 11,225 | | | | | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | Q(pump)= | 0 | af/yr | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | | | | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | T(stream)= | 350 | tons/yr | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | TDS(stream)= | 350 | mg/l | |
| Global ET Adjiustment Factor = | 1.124 | | Q(stream)= | 963 | af/yr | |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Bell Canyon = 37,500 ft. Length of Dove Canyon = 15,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 572 | 0.00 | 0 | 16,267 | |
| Lawn/Landscape | 382 | 4.21 | 1,608 | | |
| Forest & Woodland | 1,902 | 1.78 | 3,385 | | |
| Nonvascular & Sparse Vascular Rock Veg. | 8 | 0.90 | 7 | | |
| Open Water | 10 | 3.70 | 37 | | |
| Semi-Desert | 4 | 0.88 | 4 | | |
| Shrubland & Grassland | 10,205 | 1.10 | 11,225 | 13,083 | 16,267 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Developed & Other Human Use Total = | 954 |
| Impervious Area = | 572.4 |

11) WQ data from agency Water Quality Confidence Reports 2011

12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# DOVE/BELL
# DEVELOPED AT YEAR 2035 (PLANNED USE)
# WITH RECLAMATION

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 13,083 | acres | Q(storm)= | 1,961 | af/yr | |
| A(lawns/landscaping)= | 382 | acres | Q(non-storm)= | 963 | af/yr | |
| A(reservoirs)= | 0 | acres | Q= | 2,924 | af/yr | |
| A(impervious)= | 572 | acres | TDS(nondom)= | 717 | mg/l | |
| A(unimproved)= | 12,129 | acres | Q(dom)= | 303 | af/yr | |
| A(irr/nd)= | 285 | acres | Q(nondom)= | 889 | af/yr | |
| A(irr/d)= | 97 | acres | T(nondom)= | 867 | tons/yr | |
| A(urban)= | 954 | acres | T(dom)= | 194 | tons/yr | |
| R(irr)= | 3.12 | ft/yr | T(rain)= | 408 | tons/yr | |
| RAIN= | 1.53 | ft/yr | T(urbanrunoff)= | 114 | tons/yr | |
| Q(rw)= | 889 | af/yr | **TOTAL INPUT=** | **2,117** | **tons/yr** | 100.0% |
| Q(pumping)= | 0 | af/yr | | | | |
| TDS(wrp)= | 717 | mg/l | OUTPUT SUMMARY: | | | |
| TDS(pumping)= | 408 | mg/l | | | | |
| TDS(dom)= | 470 | mg/l | T(non-storm)= | 534 | tons/yr | 25.2% |
| TDS(rain)= | 15 | mg/l | **TDS(non-storm)=** | **408** | **mg/l** | |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | | | | |
| T(natural)= | 533 | tons/yr | T(storm)= | 668 | tons/yr | 31.5% |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | **TDS(storm)=** | **250** | **mg/l** | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 1,608 | af/yr | | | | |
| FOREST & WOODLAND EVAPOTRANSP= | 3,385 | af/yr | **Salt Bank=** | **915** | **tons/yr** | 43.2% |
| NONVASCULAR & SAPRSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 7 | af/yr | | | | |
| OPEN WATER EVAPOTRANSP= | 37 | af/yr | T(pump)= | 0 | tons/yr | |
| SEMI-DESERT EVAPOTRANSP= | 4 | af/yr | TDS(pump)= | 408 | mg/l | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 11,225 | af/yr | Q(pump)= | 0 | af/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | | | | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | T(stream)= | 534 | tons/yr | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | TDS(stream)= | 408 | mg/l | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | Q(stream)= | 963 | af/yr | |
| Global ET Adjiustment Factor = | 1.124 | | | | | |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Bell Canyon = 37,500 ft. Length of Dove Canyon = 15,000 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Developed & Other Human Use | 572 | 0.00 | 0 | 16,267 | |
| Lawn/Landscape | 382 | 4.21 | 1,608 | | |
| Forest & Woodland | 1,902 | 1.78 | 3,385 | | |
| Nonvascular & Sparse Vascular Rock Veg. | 8 | 0.90 | 7 | | |
| Open Water | 10 | 3.70 | 37 | | |
| Semi-Desert | 4 | 0.88 | 4 | | |
| Shrubland & Grassland | 10,205 | 1.10 | 11,225 | 13,083 | 16,267 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

Developed & Other Human Use Total = 954

Impervious Area = 572.4

11) Recycled water use based on planned use as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# UPPER SAN JUAN CREEK
# NATURAL TDS COMPONENT

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 37,739 | acres |
| RAIN= | 1.50 | ft/yr |
| TDS(rain)= | 15 | mg/l |
| AGRICULTURAL EVAPOTRANSP= | 590 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 6,470 | af/yr |
| NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 53 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 65 | af/yr |
| HRUBLAND & GRASSLAND EVAPOTRANSP= | 36,474 | |
| STORM RUNOFF COEF= | 0.2 | |

| CALCULATIONS | | |
|---|---|---|
| Q(storm)= | 11,322 | af/yr |
| Q(non-storm)= | 1,636 | af/yr |
| Q= | 12,957 | af/yr |
| T(rain)= | 1,155 | tons/yr |
| **TOTAL INPUT=** | **2,923** | **tons/yr** |
| T(non-storm)= | 612 | tons/yr |
| **TDS(non-storm)=** | **275** | **mg/l** |
| T(storm)= | 2,311 | tons/yr |
| **TDS(storm)=** | **150** | **mg/l** |
| **T(natural)=** | **1,767** | **tons/yr** |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
5) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
6) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
7) Length of Upper San Juan Creek = 70,000 ft
8) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 134 | 4.40 | 590 | | |
| Developed & Other Human Use | 0 | 4.21 | 0 | | |
| Forest & Woodland | 4,313 | 1.50 | 6,470 | | |
| Nonvascular & Sparse Vascular Rock Vegeta | 60 | 0.88 | 53 | | |
| Semi-Desert | 73 | 0.88 | 65 | | |
| Shrubland & Grassland | 33,158 | 1.10 | 36,474 | 37,739 | 43,651 |

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# SALT BALANCE
# UPPER SAN JUAN CREEK
# CURRENT DEVELOPMENT
# WITH RECLAMATION

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 37,739 | acres |
| A(lawns/landscaping)= | 570 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious surfaces)= | 855 | acres |
| A(unimproved)= | 36,314 | acres |
| A(irr/nd)= | 10 | acres |
| A(irr/d)= | 560 | acres |
| A(urban)= | 1,425 | acres |
| R(irr)= | 3.15 | ft/yr |
| RAIN= | 1.50 | ft/yr |
| Q(rw)= | 31 | af/yr |
| Q(pumping)= | 279 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(pumping)= | 495 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 1,767 | tons/yr |
| AGRICULTURAL EVAPOTRANSP= | 590 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 2,394 | |
| FOREST & WOODLAND EVAPOTRANSP= | 5,401 | af/yr |
| NONVASCULAR & SPARSE VASCULAR ROCK VEGETATION EVAPOTRANSP= | 53 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 65 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 35,690 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| CALCULATIONS | | | |
|---|---|---|---|
| Q(storm)= | 4,919 | af/yr | |
| Q(non-storm)= | 3,812 | af/yr | |
| Q= | 8,731 | af/yr | |
| TDS(rw)= | 517 | mg/l | |
| Q(dom)= | 1,486 | af/yr | |
| T(rw)= | 218 | tons/yr | |
| T(dom)= | 950 | tons/yr | |
| T(rain)= | 1,155 | tons/yr | |
| T(urbanrunoff)= | 171 | tons/yr | |
| TOTAL INPUT= | 4,262 | tons/yr | |
| T(non-storm)= | 1,986 | tons/yr | 46.6% |
| **TDS(non-storm)=** | **383** | **mg/l** | |
| T(storm)= | 1,004 | tons/yr | 23.6% |
| **TDS(storm)=** | **150** | **mg/l** | |
| **Salt Bank=** | **1,271** | **tons/yr** | 29.8% |
| T(pump)= | 145 | tons/yr | |
| TDS(pump)= | 383 | mg/l | |
| Q(pump)= | 279 | af/yr | |
| T(stream)= | 1,841 | tons/yr | |
| TDS(stream)= | 383 | mg/l | |
| Q(stream)= | 3,533 | af/yr | |

11/5/2013

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

3) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas, 0.7 - 0.95 for hard surfaces, and 0.18 - 0.22 for poor draining lawns @ 2% to 7% slope. Civil Engineeing Review Manual, 3rd edition, Michael R. Lindeburg.

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering-Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Upper San Juan Creek = 37,500 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 134 | 4.40 | 590 | | |
| Developed & Other Human Use | 855 | 0.00 | 0 | | |
| Lawn/Landscape | 570 | 4.20 | 2,394 | | |
| Forest & Woodland | 3,601 | 1.50 | 5,401 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 60 | 0.88 | 53 | | |
| Semi-Desert | 73 | 0.88 | 65 | | |
| Shrubland & Grassland | 32,445 | 1.10 | 35,690 | 37,739 | 44,193 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Developed & Other Human Use Total = | 1,425 |
| Impervious Area = | 855 |

11) Recycled water use for 2011 as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/5/2013

# SALT BALANCE
# UPPER SAN JUAN CREEK
# FUTURE (2035)
# WITH ADDITIONAL RECLAMATION (PLANNED USE)

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 37,739 | acres |
| A(lawns/landscaping)= | 584 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious surfaces)= | 877 | acres |
| A(unimproved)= | 36,278 | acres |
| A(irr/nd)= | 29 | acres |
| A(irr/d)= | 555 | acres |
| A(urban)= | 1,461 | acres |
| R(irr)= | 3.15 | ft/yr |
| RAIN= | 1.50 | ft/yr |
| Q(rw)= | 91 | af/yr |
| Q(pumping)= | 279 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(pumping)= | 495 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 1,767 | tons/yr |
| AGRICULTURAL EVAPOTRANSP= | 590 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 2,453 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 5,401 | af/yr |
| ;ULAR ROCK VEGETATION EVAPOTRANSP= | 53 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 65 | af/yr |
| HRUBLAND & GRASSLAND EVAPOTRANSP= | 35,650 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| CALCULATIONS | | | |
|---|---|---|---|
| Q(storm)= | 4,936 | af/yr | |
| Q(non-storm)= | 3,817 | af/yr | |
| Q= | 8,753 | af/yr | |
| TDS(rw)= | 550 | mg/l | |
| Q(dom)= | 1,470 | af/yr | |
| T(rw)= | 277 | tons/yr | |
| T(dom)= | 940 | tons/yr | |
| T(rain)= | 1,155 | tons/yr | |
| T(urbanrunoff)= | 175 | tons/yr | |
| TOTAL INPUT= | 4,314 | tons/yr | |
| T(non-storm)= | 2,011 | tons/yr | 46.6% |
| **TDS(non-storm)=** | **387** | **mg/l** | |
| T(storm)= | 1,016 | tons/yr | 23.6% |
| **TDS(storm)=** | **151** | **mg/l** | |
| **Salt Bank=** | **1,287** | **tons/yr** | 29.8% |
| T(pump)= | 147 | tons/yr | |
| TDS(pump)= | 387 | mg/l | |
| Q(pump)= | 279 | af/yr | |
| T(stream)= | 1,864 | tons/yr | |
| TDS(stream)= | 387 | mg/l | |
| Q(stream)= | 3,538 | af/yr | |

11/5/2013

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering-Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Upper San Juan Creek = 37,500 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 134 | 4.40 | 590 | | |
| Developed & Other Human Use | 877 | 0.00 | 0 | | |
| Lawn/Landscape | 584 | 4.20 | 2,453 | | |
| Forest & Woodland | 3,601 | 1.50 | 5,401 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 60 | 0.88 | 53 | | |
| Semi-Desert | 73 | 0.88 | 65 | | |
| Shrubland & Grassland | 32,409 | 1.10 | 35,650 | 37,739 | 44,212 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 1,461 |
| Impervious Area = | 877 |

11) Recycled water use based on planned use as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/5/2013

# SALT BALANCE
# UPPER SAN JUAN CREEK
# FUTURE (2035)
# WITH FURTHER ADDITIONAL RECLAMATION (Planned Use)

| CONDITIONS | VALUE | UNITS |
|---|---|---|
| A(watershed)= | 37,739 | acres |
| A(lawns/landscaping)= | 584 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious surfaces)= | 877 | acres |
| A(unimproved)= | 36,278 | acres |
| A(irr/nd)= | 162 | acres |
| A(irr/d)= | 422 | acres |
| A(urban)= | 1,461 | acres |
| R(irr)= | 3.15 | ft/yr |
| RAIN= | 1.50 | ft/yr |
| Q(rw)= | 511 | af/yr |
| Q(pumping)= | 279 | af/yr |
| TDS(wrp)= | 717 | mg/l |
| TDS(pumping)= | 495 | mg/l |
| TDS(dom)= | 470 | mg/l |
| TDS(rain)= | 15 | mg/l |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr |
| T(natural)= | 1,767 | tons/yr |
| AGRICULTURAL EVAPOTRANSP= | 590 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 2,453 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 5,401 | af/yr |
| CULAR ROCK VEGETATION EVAPOTRANSP= | 53 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 65 | af/yr |
| HRUBLAND & GRASSLAND EVAPOTRANSP= | 35,650 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| CALCULATIONS | | | |
|---|---|---|---|
| Q(storm)= | 4,936 | af/yr | |
| Q(non-storm)= | 3,817 | af/yr | |
| Q= | 8,753 | af/yr | |
| TDS(rw)= | 639 | mg/l | |
| Q(dom)= | 1,050 | af/yr | |
| T(rw)= | 686 | tons/yr | |
| T(dom)= | 671 | tons/yr | |
| T(rain)= | 1,155 | tons/yr | |
| T(urbanrunoff)= | 175 | tons/yr | |
| TOTAL INPUT= | 4,455 | tons/yr | |
| T(non-storm)= | 2,077 | tons/yr | 46.6% |
| **TDS(non-storm)=** | **400** | **mg/l** | |
| T(storm)= | 1,050 | tons/yr | 23.6% |
| **TDS(storm)=** | **156** | **mg/l** | |
| **Salt Bank=** | **1,329** | **tons/yr** | 29.8% |
| T(pump)= | 152 | tons/yr | |
| TDS(pump)= | 400 | mg/l | |
| Q(pump)= | 279 | af/yr | |
| T(stream)= | 1,925 | tons/yr | |
| TDS(stream)= | 400 | mg/l | |
| Q(stream)= | 3,538 | af/yr | |

Ranch RW use of 481 afy plus existing of 31 afy

11/5/2013

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering-Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Upper San Juan Creek = 37,500 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 134 | 4.40 | 590 | | |
| Developed & Other Human Use | 877 | 0.00 | 0 | | |
| Lawn/Landscape | 584 | 4.20 | 2,453 | | |
| Forest & Woodland | 3,601 | 1.50 | 5,401 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 60 | 0.88 | 53 | | |
| Semi-Desert | 73 | 0.88 | 65 | | |
| Shrubland & Grassland | 32,409 | 1.10 | 35,650 | 37,739 | 44,212 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

Total Developed & Other Human Use = 1,461

Impervious Area = 877

11) Recycled water use based on permitted use as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

11/5/2013

# SALT BALANCE
# UPPER SAN JUAN CREEK
# FUTURE (2035)
# WITH ADDITIONAL RECLAMATION (PERMITTED USE)

| CONDITIONS | VALUE | UNITS | CALCULATIONS | | | |
|---|---|---|---|---|---|---|
| A(watershed)= | 37,739 | acres | Q(storm)= | 4,936 | af/yr | |
| A(lawns/landscaping)= | 584 | acres | Q(non-storm)= | 3,817 | af/yr | |
| A(reservoirs)= | 0 | acres | Q= | 8,753 | af/yr | |
| A(impervious surfaces)= | 877 | acres | TDS(rw)= | 668 | mg/l | |
| A(unimproved)= | 36,278 | acres | Q(dom)= | 584 | af/yr | |
| A(irr/nd)= | 310 | acres | T(rw)= | 1,141 | tons/yr | |
| A(irr/d)= | 274 | acres | T(dom)= | 373 | tons/yr | |
| A(urban)= | 1,461 | acres | T(rain)= | 1,155 | tons/yr | |
| R(irr)= | 3.15 | ft/yr | T(urbanrunoff)= | 175 | tons/yr | |
| RAIN= | 1.50 | ft/yr | TOTAL INPUT= | 4,612 | tons/yr | |
| Q(rw)= | 977 | af/yr | | | | |
| Q(pumping)= | 279 | af/yr | | | | |
| TDS(wrp)= | 717 | mg/l | T(non-storm)= | 2,150 | tons/yr | 46.6% |
| TDS(pumping)= | 495 | mg/l | **TDS(non-storm)=** | **414** | **mg/l** | |
| TDS(dom)= | 470 | mg/l | | | | |
| TDS(rain)= | 15 | mg/l | T(storm)= | 1,086 | tons/yr | 23.6% |
| URBAN TDS RUNOFF= | 400 | lbs/acre-yr | **TDS(storm)=** | **162** | **mg/l** | |
| T(natural)= | 1,767 | tons/yr | | | | |
| AGRICULTURAL EVAPOTRANSP= | 590 | af/yr | **Salt Bank=** | **1,376** | **tons/yr** | 29.8% |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | | | | |
| LAWN/LANDSCAPE EVAPOTRANSP= | 2,453 | af/yr | T(pump)= | 157 | tons/yr | |
| FOREST & WOODLAND EVAPOTRANSP= | 5,401 | af/yr | TDS(pump)= | 414 | mg/l | |
| CULAR ROCK VEGETATION EVAPOTRANSP= | 53 | af/yr | Q(pump)= | 279 | af/yr | |
| SEMI-DESERT EVAPOTRANSP= | 65 | af/yr | | | | |
| HRUBLAND & GRASSLAND EVAPOTRANSP= | 35,650 | af/yr | T(stream)= | 1,993 | tons/yr | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | TDS(stream)= | 414 | mg/l | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | Q(stream)= | 3,538 | af/yr | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | | | | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | | | | |
| Global ET Adjiustment Factor = | 1.124 | | | | | |

11/5/2013

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/l. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.

2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)

3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).

4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering-Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%

5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.

6) Length of Upper San Juan Creek = 37,500 ft.

7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 134 | 4.40 | 590 | | |
| Developed & Other Human Use | 877 | 0.00 | 0 | | |
| Lawn/Landscape | 584 | 4.20 | 2,453 | | |
| Forest & Woodland | 3,601 | 1.50 | 5,401 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 60 | 0.88 | 53 | | |
| Semi-Desert | 73 | 0.88 | 65 | | |
| Shrubland & Grassland | 32,409 | 1.10 | 35,650 | 37,739 | 44,212 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.

10) Impervious = 60% of Developed & Other Human Use total

Total Developed & Other Human Use = 1,461

Impervious Area = 877

11) Recycled water use based on permitted use as reported by SOCWA

12) WQ data from agency Water Quality Confidence Reports 2011

13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# CRISTIANITOS CANYON
# NATURAL TDS COMPONENT

| CONDITIONS | VALUES | UNITS | CALCULATIONS | | UNITS |
|---|---|---|---|---|---|
| A(watershed)= | 20,467 | acres | Q(storm)= | 5,479 | af/yr |
| RAIN= | 1.34 | ft/yr | Q(non-storm)= | 383 | af/yr |
| TDS(rain)= | 15 | mg/L | Q(total)= | 5,862 | af/yr |
| AGRICULTURAL EVAPOTRANSP= | 103 | af/yr | T(rain)= | 559 | tons/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | T(total)= | 1,803 | tons/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 6,765 | af/yr | | | |
| NONVASCULAR & SPARSE VASCULAR ROCK EVAPOTRANSP= | 25 | af/yr | T(non-storm)= | 313 | tons/yr |
| OPEN WATER EVAPOTRANSP= | 10 | af/yr | TDS(non-storm)= | 600 | mg/L |
| SEMI-DESERT EVAPOTRANSP= | 4 | | | | |
| RUBLAND & GRASSLAND EVAPOTRANSP= | 14,625 | | T(storm)= | 1,491 | tons/yr |
| UNIMPROVED RUNOFF COEF= | 0.2 | | TDS(storm)= | 200 | mg/L |
| | | | **T(natural)=** | **1,244** | **tons/yr** |

References:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/L. Conservation of Water and Soil in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
5) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
6) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Repor Newport-Irvine Waste-Management Planning Agency, 1979.
7) Length of Cristianitos Canyon = 40,000 ft. Length of Gabino Canyon = 42,000 ft. Length of Talega Canyon = 50,000
8) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 23 | 4.40 | 103 | (5-ft width) | |
| Developed & Other Human Use | 0 | 0.00 | 0 | (10-ft width) | |
| Forest & Woodland | 4,510 | 1.50 | 6,765 | | |
| Nonvascular & Sparse Vascular Rock Vege | 29 | 0.88 | 25 | | |
| Open Water | 3 | 3.70 | 10 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 15,897 | 0.92 | 14,625 | | 20,467 |

# SALT BALANCE
# CRISTIANITOS CANYON
# CURRENT DEVELOPMENT (AVERAGE)

| CONDITIONS | VALUES | UNITS | CALCULATIONS | | UNITS | |
|---|---|---|---|---|---|---|
| A(watershed)= | 20,487 | acres | Q(storm)= | 2,852 | af/yr | |
| A(lawns/landscaping)= | 754 | acres | Q(non-storm)= | 1,224 | af/yr | |
| A(reservoirs)= | 0 | acres | Q(total)= | 4,076 | af/yr | |
| A(impervious)= | 1,132 | acres | TDS(rw)= | 717 | mg/L | |
| A(unimproved)= | 18,601 | acres | Q(irr/pw)= | 2,496 | af/yr | |
| A(irr/rw)= | 0 | acres | Q(irr/rw)= | 0 | af/yr | |
| A(irr/pw)= | 754 | acres | T(irr/rw)= | 0 | tons/yr | |
| A(urban)= | 1,886 | acres | T(irr/pw)= | 1,596 | tons/yr | |
| R(irr)= | 3.31 | ft/yr | T(rain)= | 560 | tons/yr | |
| RAIN= | 1.34 | ft/yr | T(urbanrunoff)= | 226 | tons/yr | |
| Q(irr/rw)= | 0 | af/yr | T(total)= | 3,626 | tons/yr | **100.0%** |
| Q(pumping)= | 0 | af/yr | | | | |
| TDS(wrp)= | 717 | mg/L | T(non-storm)= | 1,085 | tons/yr | **29.9%** |
| TDS(dom)= | 470 | mg/L | TDS(non-storm)= | 652 | mg/L | |
| TDS(rain)= | 15 | mg/L | | | | |
| URBAN TDS RUNOFF= | 400 | lbs/ac-yr | T(storm)= | 776 | tons/yr | **21.4%** |
| T(natural)= | 1,244 | tons/yr | TDS(storm)= | 200 | mg/L | |
| AGRICULTURAL EVAPOTRANSP= | 103 | af/yr | | | | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | **T(saltbank)=** | **1,765** | **tons/yr** | **48.7%** |
| LAWN/LANDSCAPE EVAPOTRANSP= | 3,174 | af/yr | | | | |
| FOREST & WOODLAND EVAPOTRANSP= | 6,765 | af/yr | T(pump)= | 0 | tons/yr | |
| NONVASCULAR & SPARSE VASCULAR ROCK EVAPOTRANSP= | 25 | af/yr | TDS(pump)= | 652 | mg/L | |
| OPEN WATER EVAPOTRANSP= | 10 | af/yr | Q(pump)= | 0 | af/yr | |
| SEMI-DESERT EVAPOTRANSP= | 4 | af/yr | | | | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 12,909 | af/yr | | | | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | | | | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | T(stream)= | 1,085 | tons/yr | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | TDS(stream)= | 652 | mg/l | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | Q(stream)= | 1,224 | af/yr | |
| Global ET Adjiustment Factor = | 1.124 | | | | | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/L. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering-Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Cristianitos Canyon = 40,000 ft. Length of Gabino Canyon = 42,000 ft. Length of Talega Canyon = 50,000 ft.
7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 23 | 4.40 | 103 | | |
| Developed & Other Human Use | 1,132 | 0.00 | 0 | | |
| Lawn/landscape | 754 | 4.21 | 3,174 | | |
| Forest & Woodland | 4,510 | 1.50 | 6,765 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 29 | 0.88 | 25 | | |
| Open Water | 3 | 3.70 | 10 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 14,031 | 0.92 | 12,909 | 20,487 | 22,991 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz mode

| | Upper Trabuco | Middle Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.
10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 1,886 |
| Impervious Area = | 1,132 |

11) Recycled water use for 2011 as reported by SOCWA
12) WQ data from agency Water Quality Confidence Reports 2011
13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.
14) TDS non-storm value based on average TDS of well samples taken from Northrup 1, Northrup 2, and the Pico wells from 2009-2012.

# SALT BALANCE
# CRISTIANITOS CANYON
# DEVELOPED AT YEAR 2035
# WITHOUT RECYCLED WATER

| CONDITIONS | VALUES | UNITS |
|---|---|---|
| A(watershed)= | 20,487 | acres |
| A(lawns/landscaping)= | 946 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious)= | 1,420 | acres |
| A(unimproved)= | 18,121 | acres |
| A(irr/rw)= | 0 | acres |
| A(irr/pw)= | 946 | acres |
| A(urban)= | 2,366 | acres |
| R(irr)= | 3.31 | ft/yr |
| RAIN= | 1.34 | ft/yr |
| Q(irr/rw)= | 0 | af/yr |
| Q(pumping)= | 0 | af/yr |
| TDS(wrp)= | 0 | mg/L |
| TDS(dom)= | 470 | mg/L |
| TDS(rain)= | 15 | mg/L |
| URBAN TDS RUNOFF= | 400 | lbs/ac-yr |
| T(natural)= | 1,244 | tons/yr |
| AGRICULTURAL EVAPOTRANSP= | 103 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| LAWN/LANDSCAPE EVAPOTRANSP= | 3,983 | |
| FOREST & WOODLAND EVAPOTRANSP= | 6,765 | af/yr |
| NONVASCULAR & SPARSE VASCULAR ROCK EVAPOTRANSP= | 25 | af/yr |
| OPEN WATER EVAPOTRANSP= | 10 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 4 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 12,467 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| | CALCULATIONS | UNITS | |
|---|---|---|---|
| Q(storm)= | 3,054 | af/yr | |
| Q(non-storm)= | 1,244 | af/yr | |
| Q(total)= | 4,299 | af/yr | |
| TDS(rw)= | 0 | mg/l | |
| Q(irr/pw)= | 3,131 | af/yr | |
| Q(irr/rw)= | 0 | af/yr | |
| T(irr/rw)= | 0 | tons/yr | |
| T(irr/pw)= | 2,002 | tons/yr | |
| T(rain)= | 560 | tons/yr | |
| T(urbanrunoff)= | 284 | tons/yr | |
| T(total)= | 4,090 | tons/yr | 100.0% |
| T(non-storm)= | 1,224 | tons/yr | 29.9% |
| **TDS(non-storm)=** | **723** | **mg/L** | |
| T(storm)= | 875 | tons/yr | 21.4% |
| **TDS(storm)=** | **211** | **mg/L** | |
| T(saltbank)= | 1,991 | tons/yr | 48.7% |
| T(pump)= | 0 | tons/yr | |
| TDS(pump)= | 723 | mg/L | |
| Q(pump)= | 0 | af/yr | |
| T(stream)= | 1,224 | tons/yr | |
| TDS(stream)= | 723 | mg/l | |
| Q(stream)= | 1,244 | af/yr | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/L. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas, 0.7 - 0.95 for hard surfaces, and 0.18 - 0.22 for poor draining lawns @ 2% to 7% slope. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering-Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Cristianitos Canyon = 37,500 ft. Length of Gabino Canyon = 15,000 ft. Length of Talega Canyon = 50,000 ft.
7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 23 | 4.40 | 103 | | |
| Developed & Other Human Use | 1,420 | 0.00 | 0 | | |
| Lawn/landscape | 946 | 4.21 | 3,983 | | |
| Forest & Woodland | 4,510 | 1.50 | 6,765 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 29 | 0.88 | 25 | | |
| Open Water | 3 | 3.70 | 10 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 13,551 | 0.92 | 12,467 | 20,487 | 23,357 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Trabuco | Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.
10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 2,366 |
| Impervious Area = | 1,420 |

11) WQ data from agency Water Quality Confidence Reports 2011
12) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# CRISTIANITOS CANYON
# DEVELOPED AT YEAR 2035
# WITH RECYCLED WATER (PLANNED USE)

| CONDITIONS | VALUES | UNITS |
|---|---|---|
| A(watershed)= | 20,487 | acres |
| A(lawns/landscaping)= | 946 | acres |
| A(reservoirs)= | 0 | acres |
| A(impervious)= | 1,420 | acres |
| A(unimproved)= | 18,121 | acres |
| A(irr/rw)= | 101 | acres |
| A(irr/pw)= | 845 | acres |
| A(urban)= | 2,366 | acres |
| R(irr)= | 3.31 | ft/yr |
| RAIN= | 1.34 | ft/yr |
| Q(irr/rw)= | 333 | af/yr |
| Q(pumping)= | 0 | af/yr |
| TDS(wrp)= | 717 | mg/L |
| TDS(pw)= | 470 | mg/L |
| TDS(rain)= | 15 | mg/L |
| URBAN TDS RUNOFF= | 400 | lbs/ac-yr |
| T(natural)= | 1,244 | tons/yr |
| AGRICULTURAL EVAPOTRANSP= | 103 | af/yr |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr |
| LAWN/LANDSCAEP EVAPOTRANSP= | 3,983 | af/yr |
| FOREST & WOODLAND EVAPOTRANSP= | 6,765 | af/yr |
| NONVASCULAR & SPARSE VASCULAR ROCK EVAPOTRANSP= | 25 | af/yr |
| OPEN WATER EVAPOTRANSP= | 10 | af/yr |
| SEMI-DESERT EVAPOTRANSP= | 4 | af/yr |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 12,467 | af/yr |
| UNIMPROVED RUNOFF COEF= | 0.075 | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | |
| Global ET Adjiustment Factor = | 1.124 | |

| CALCULATIONS | | UNITS | |
|---|---|---|---|
| Q(storm)= | 3,054 | af/yr | |
| Q(non-storm)= | 1,245 | af/yr | |
| Q(total)= | 4,299 | af/yr | |
| TDS(rw)= | 717 | mg/l | |
| Q(irr/pw)= | 2,798 | af/yr | |
| Q(irr/rw)= | 333 | af/yr | |
| T(irr/rw)= | 325 | tons/yr | |
| T(irr/pw)= | 1,789 | tons/yr | |
| T(rain)= | 560 | tons/yr | |
| T(urbanrunoff)= | 284 | tons/yr | |
| T(total)= | 4,202 | tons/yr | 100.0% |
| T(non-storm)= | 1,258 | tons/yr | 29.9% |
| **TDS(non-storm)=** | **743** | **mg/L** | |
| T(storm)= | 899 | tons/yr | 21.4% |
| **TDS(storm)=** | **216** | **mg/L** | |
| T(saltbank)= | 2,045 | tons/yr | 48.7% |
| T(pump)= | 0 | tons/yr | |
| TDS(pump)= | 743 | mg/L | |
| Q(pump)= | 0 | af/yr | |
| T(stream)= | 1,258 | tons/yr | |
| TDS(stream)= | 743 | mg/l | |
| Q(stream)= | 1,245 | af/yr | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/L. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
3) Storm runoff coefficients range from 0.1 - 0.3 for unimproved areas, 0.7 - 0.95 for hard surfaces, and 0.18 - 0.22 for poor draining lawns @ 2% to 7% slope. Civil Engineering Review Manual, 3rd edition, Michael R. Lindeburg.
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering-Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Cristianitos Canyon = 37,500 ft. Length of Gabino Canyon = 15,000 ft. Length of Talega Canyon = 50,000 ft.
7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 23 | 4.40 | 103 | | |
| Developed & Other Human Use | 1,420 | 0.00 | 0 | | |
| Lawn/landscape | 946 | 4.21 | 3,983 | | |
| Forest & Woodland | 4,510 | 1.50 | 6,765 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 29 | 0.88 | 25 | | |
| Open Water | 3 | 3.70 | 10 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 13,551 | 0.92 | 12,467 | 20,487 | 23,357 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Trabuco | Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.
10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 2,366 |
| Impervious Area = | 1,420 |

11) Recycled water use based on planned use as reported by SOCWA
12) WQ data from agency Water Quality Confidence Reports 2011
13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# SALT BALANCE
# CRISTIANITOS CANYON
# DEVELOPED AT YEAR 2035
# WITH RECYCLED WATER (PERMITTED USE)

| CONDITIONS | VALUES | UNITS | CALCULATIONS | | UNITS | |
|---|---|---|---|---|---|---|
| A(watershed)= | 20,487 | acres | Q(storm)= | 3,054 | af/yr | |
| A(lawns/landscaping)= | 946 | acres | Q(non-storm)= | 1,245 | af/yr | |
| A(reservoirs)= | 0 | acres | Q(total)= | 4,299 | af/yr | |
| A(impervious)= | 1,420 | acres | TDS(rw)= | 717 | mg/l | |
| A(unimproved)= | 18,121 | acres | Q(irr/pw)= | 2,294 | af/yr | |
| A(irr/rw)= | 253 | acres | Q(irr/rw)= | 837 | af/yr | |
| A(irr/pw)= | 693 | acres | T(irr/rw)= | 817 | tons/yr | |
| A(urban)= | 2,366 | acres | T(irr/pw)= | 1,467 | tons/yr | |
| R(irr)= | 3.31 | ft/yr | T(rain)= | 560 | tons/yr | |
| RAIN= | 1.34 | ft/yr | T(urbanrunoff)= | 284 | tons/yr | |
| Q(irr/rw)= | 837 | af/yr | T(total)= | 4,371 | tons/yr | 100.0% |
| Q(pumping)= | 0 | af/yr | | | | |
| TDS(wrp)= | 717 | mg/L | T(non-storm)= | 1,308 | tons/yr | 29.9% |
| TDS(pw)= | 470 | mg/L | **TDS(non-storm)=** | **773** | **mg/L** | |
| TDS(rain)= | 15 | mg/L | | | | |
| URBAN TDS RUNOFF= | 400 | lbs/ac-yr | T(storm)= | 936 | tons/yr | 21.4% |
| T(natural)= | 1,244 | tons/yr | **TDS(storm)=** | **225** | **mg/L** | |
| AGRICULTURAL EVAPOTRANSP= | 103 | af/yr | | | | |
| DEVELOPED EVAPOTRANSP= | 0 | af/yr | T(saltbank)= | 2,128 | tons/yr | 48.7% |
| LAWN/LANDSCAEP EVAPOTRANSP= | 3,983 | af/yr | | | | |
| FOREST & WOODLAND EVAPOTRANSP= | 6,765 | af/yr | | | | |
| NONVASCULAR & SPARSE VASCULAR ROCK EVAPOTRANSP= | 25 | af/yr | T(pump)= | 0 | tons/yr | |
| OPEN WATER EVAPOTRANSP= | 10 | af/yr | TDS(pump)= | 773 | mg/L | |
| SEMI-DESERT EVAPOTRANSP= | 4 | af/yr | Q(pump)= | 0 | af/yr | |
| SHRUBLAND & GRASSLAND EVAPOTRANSP= | 12,467 | af/yr | | | | |
| UNIMPROVED RUNOFF COEF= | 0.075 | | T(stream)= | 1,308 | tons/yr | |
| LAWN/LANDSCAPE RUNOFF COEF= | 0.075 | | TDS(stream)= | 773 | mg/l | |
| IMPERVIOUS SURFACE RUNOFF COEF= | 0.600 | | Q(stream)= | 1,245 | af/yr | |
| Dry/Wet-Yr ET Adjustment Factor= | 1.000 | | | | | |
| Global ET Adjiustment Factor = | 1.124 | | | | | |

References/assumptions:

1) Natural TDS concentrations in sandstone formations range from 3,000 - 5,000 mg/L. Conservation of Water and Soil Resources in Trabuco and San Juan Creek Watersheds, Engineering-Science, 1967.
2) Average annual rainfall calculated using the PRISM 800m dataset. The calculation is based on long-term precipitation data (1895-2010)
3) Average annual evaporation of 3.7 ft based on records at Lake Mission Viejo (1979-91).
4) Rainfall-Runoff relationships. Conservation of Water and Soil Resources Trabuco and San Juan Creek Watersheds, Engineering-Science, Inc., 1967. Trabuco Canyon average runoff to rainfall ratio (1930-62) = 9.3%
San Juan Creek watershed average runoff to rainfall ratio (1928-62) = 8.4%
5) TDS concentration of rainfall based on range of 10 - 15 mg/l. San Diego RWQCB Basin Plan, 1975. UCI Final Report for Newport-Irvine Waste-Management Planning Agency, 1979.
6) Length of Cristianitos Canyon = 37,500 ft. Length of Gabino Canyon = 15,000 ft. Length of Talega Canyon = 50,000 ft.
7) Phreatophyte consumption:

| | acres | rate (ft/yr) | volume (ac-ft) | | |
|---|---|---|---|---|---|
| Agricultural Vegetation | 23 | 4.40 | 103 | | |
| Developed & Other Human Use | 1,420 | 0.00 | 0 | | |
| Lawn/landscape | 946 | 4.21 | 3,983 | | |
| Forest & Woodland | 4,510 | 1.50 | 6,765 | | |
| Nonvascular & Sparse Vascular Rock Vegetation | 29 | 0.88 | 25 | | |
| Open Water | 3 | 3.70 | 10 | | |
| Semi-Desert | 5 | 0.88 | 4 | | |
| Shrubland & Grassland | 13,551 | 0.92 | 12,467 | 20,487 | 23,357 |

8) Global ET Adjiustment Factor for all subsequent models is based on average of Upper Trabuco, Middle Trabuco, and Oso/La Paz models

| | Trabuco | Trabuco | Oso/La Paz | Average |
|---|---|---|---|---|
| Global ET Adjiustment Factor = | 1.19243 | 1.100 | 1.0805 | 1.124 |

9) Salt loading from urban runoff is 400 lbs/acre-yr. San Diego RWQCB Basin Plan - 1975.
10) Impervious = 60% of Developed & Other Human Use total

| | |
|---|---|
| Total Developed & Other Human Use = | 2,366 |
| Impervious Area = | 1,420 |

11) Recycled water use based on permitted use as reported by SOCWA
12) WQ data from agency Water Quality Confidence Reports 2011
13) WRP TDS determined by a flow-weighted average for the following treatment plants: TCWD, SMWD Oso Creek, SMWD Chiquita, SMWD Nichols, MNWD Plant 3A, and MNWD Regional Treatment Plant.

# APPENDIX E
# CSRM Water Quality Data

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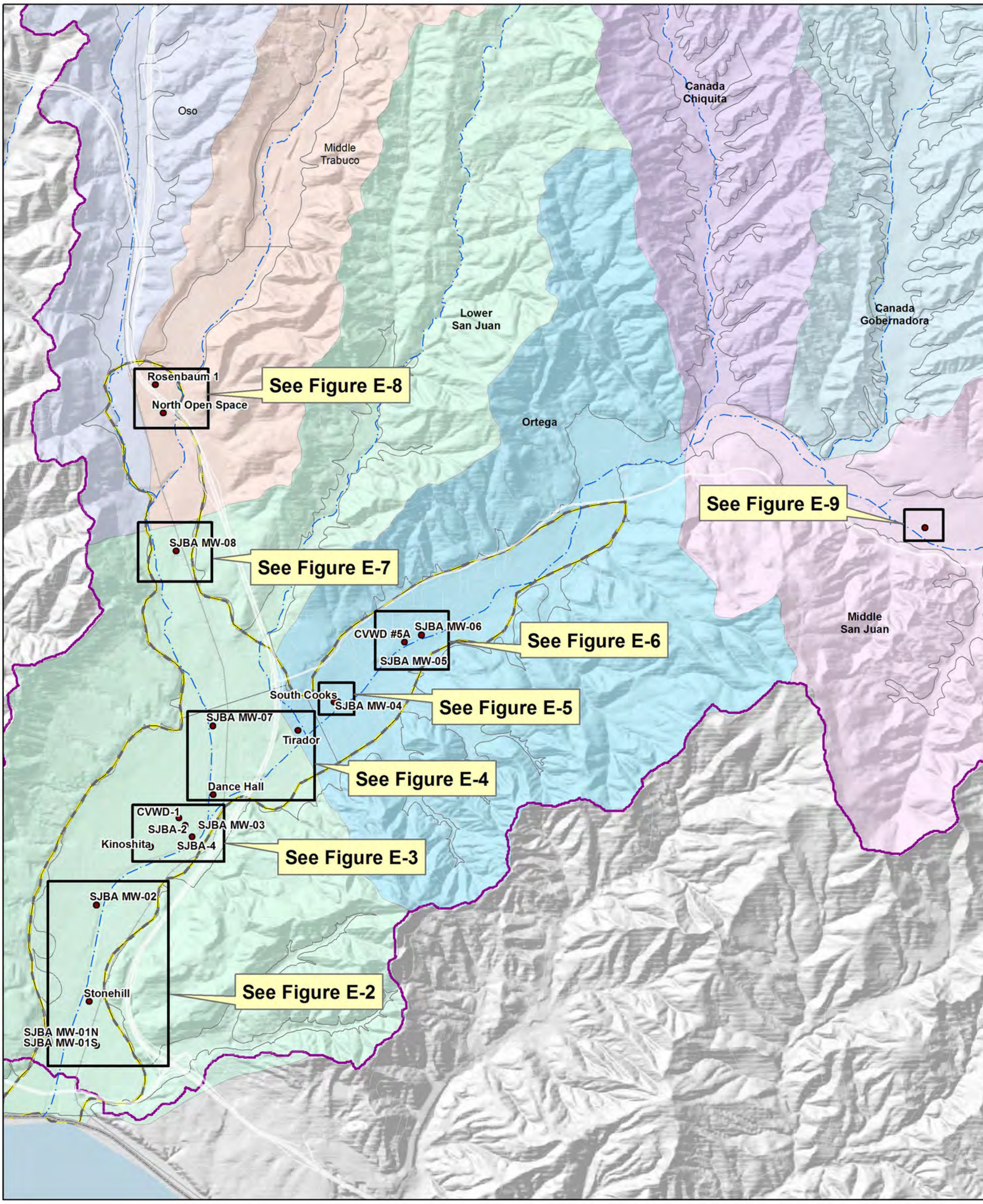


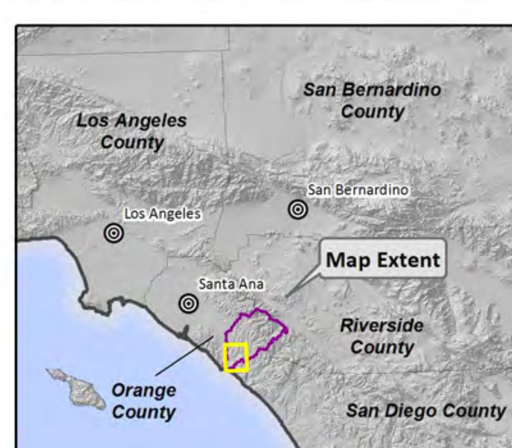


**Main Features**

- Well with TDS Statistic

**Hydrologic Features**

- Active Groundwater Storage Area
- San Juan Creek Watershed Boundary
- San Juan Basin
- Streams and Creeks


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www.wildermuthenvironmental.com
HDR


Author: LBB
Date: 20130530
File: Figure E_1_TDS Map.mxd

0 1,000 2,000 Feet
0 0.25 0.5 Miles

SOCWA South Orange County Wastewater Authority
2013 Salt and Nutrient Management Plan

**TDS Time Series Well Locations**
*San Juan Groundwater Basin*

**Figure E-1**

Figure E-2: Time History of TDS Concentrations at Wells in the San Juan Basin

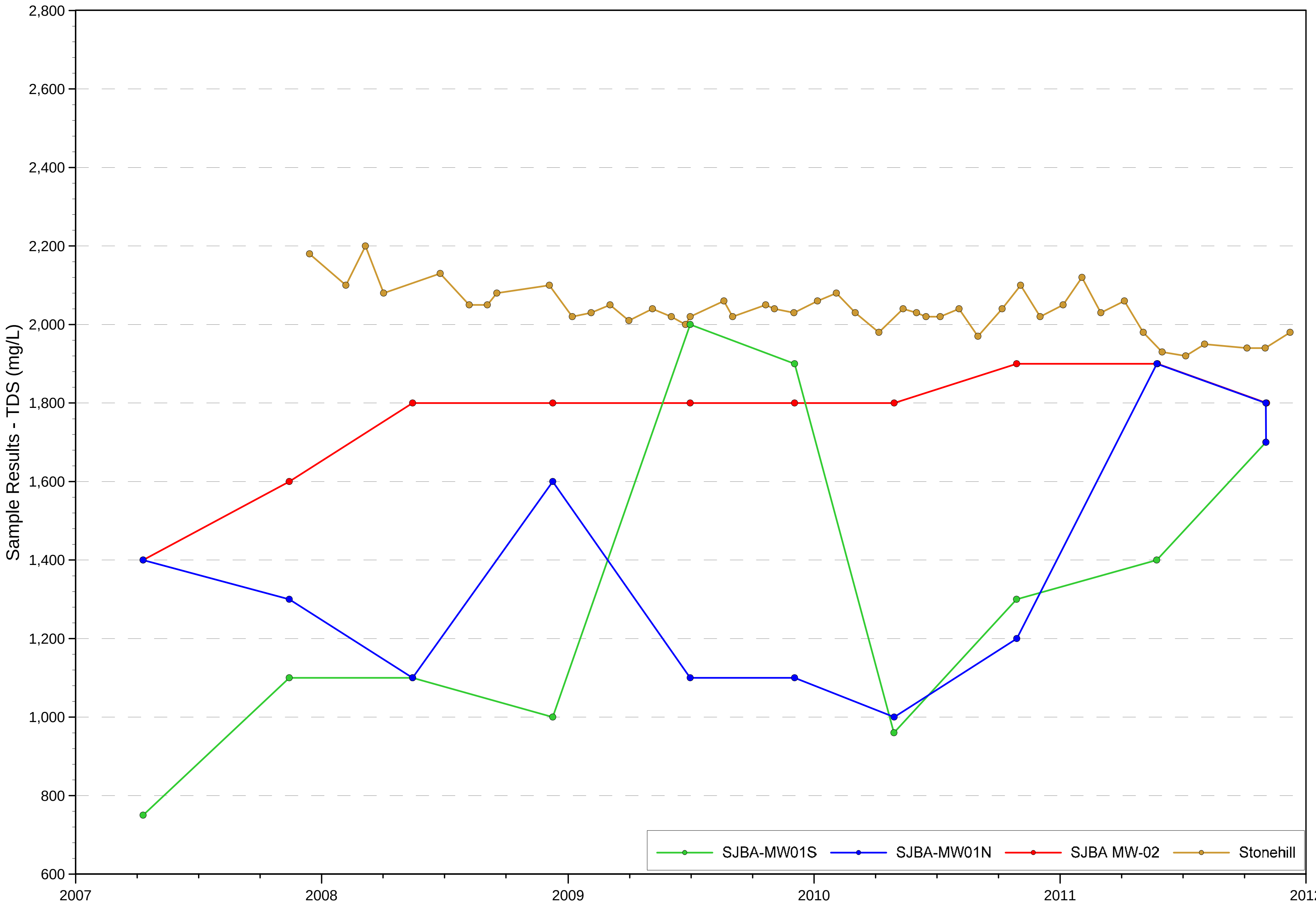
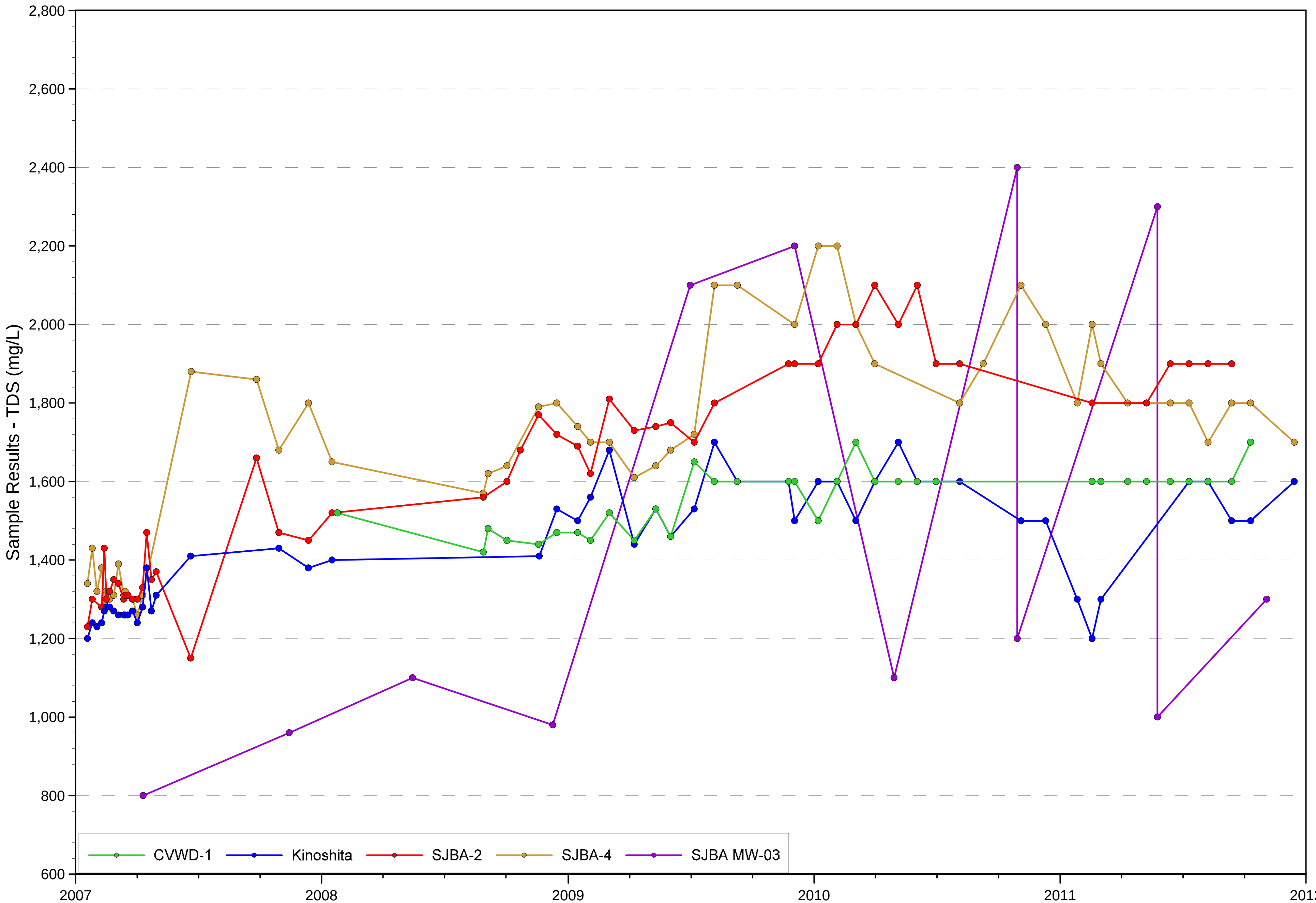


**Figure E-3: Time History of TDS Concentrations at Wells in the San Juan Basin**

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## Figure E-4: Time History of TDS Concentrations at Wells in the San Juan Basin

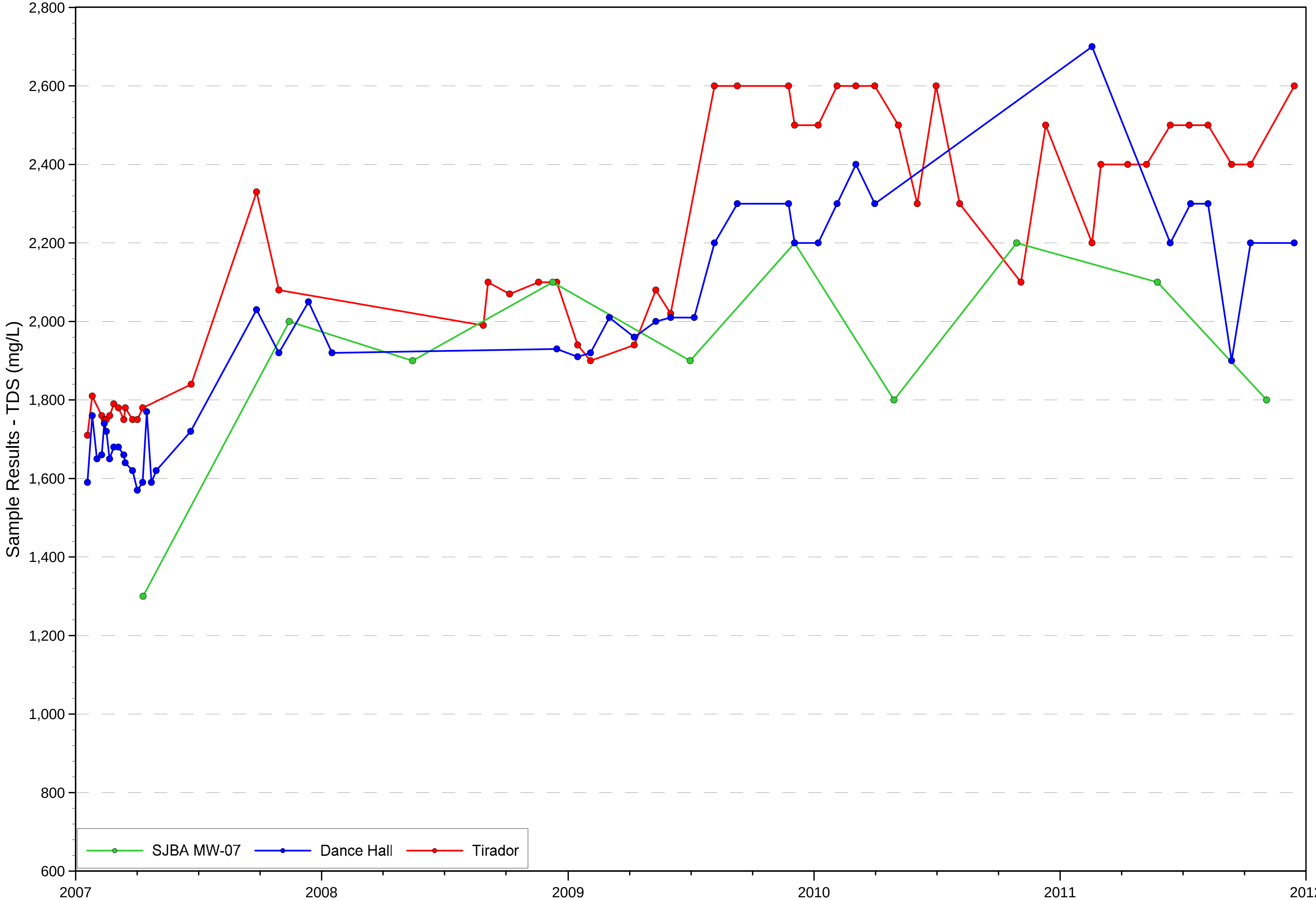


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**Figure E-5: Time History of TDS Concentrations at Wells in the San Juan Basin**

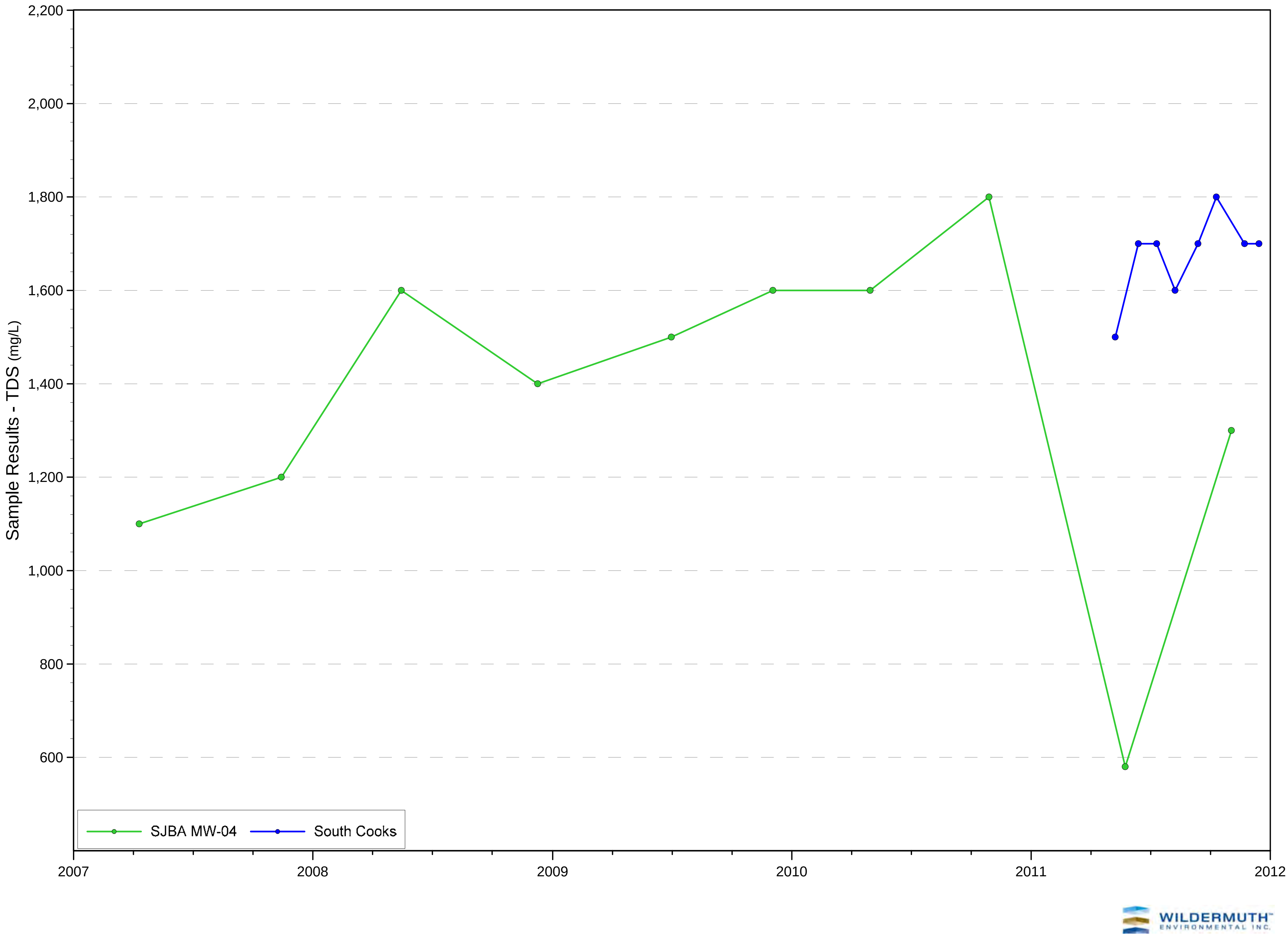

**Figure E-6: Time History of TDS Concentrations at Wells in the San Juan Basin**

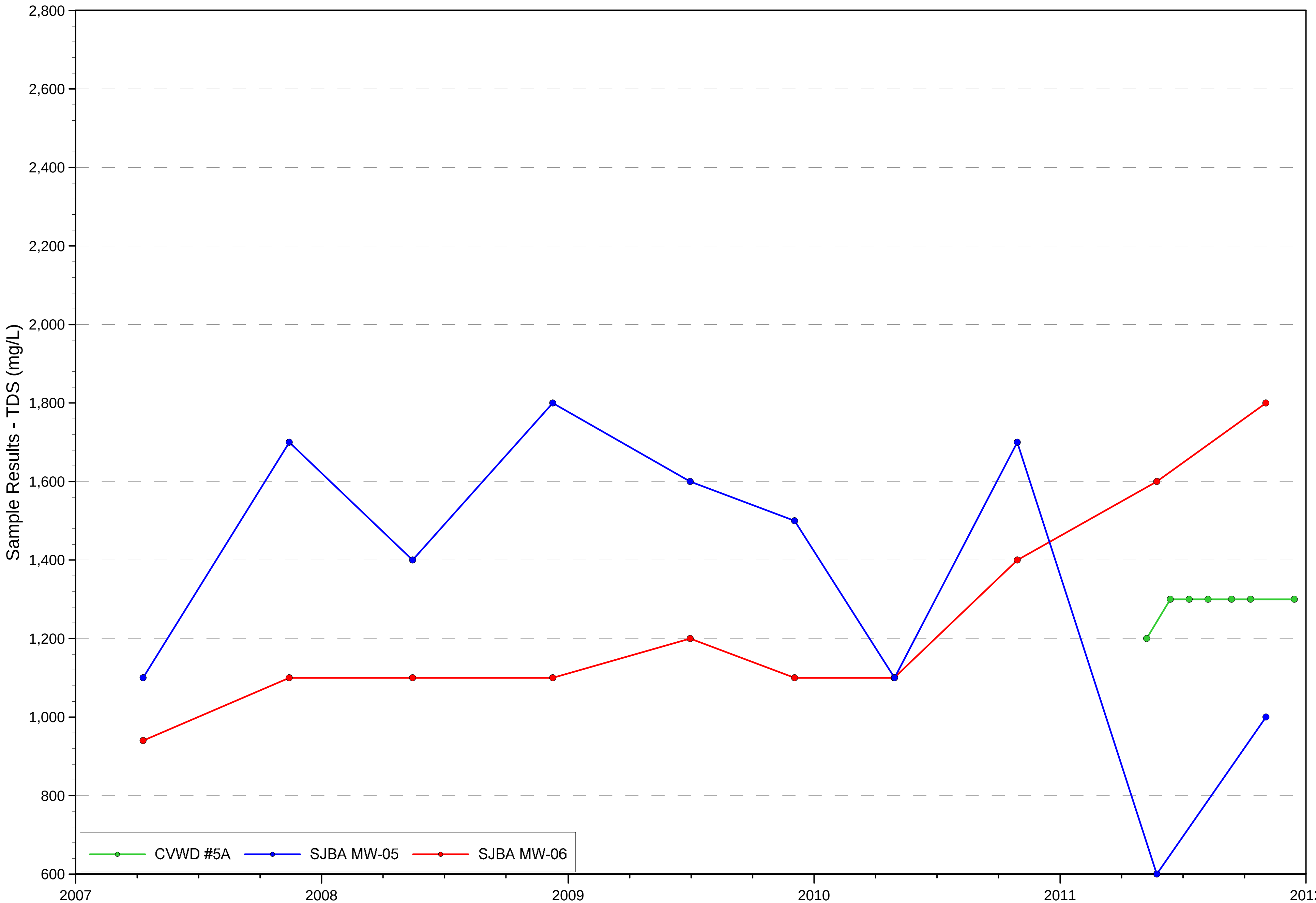


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**Figure E-7: Time History of TDS Concentrations at Wells in the San Juan Basin**

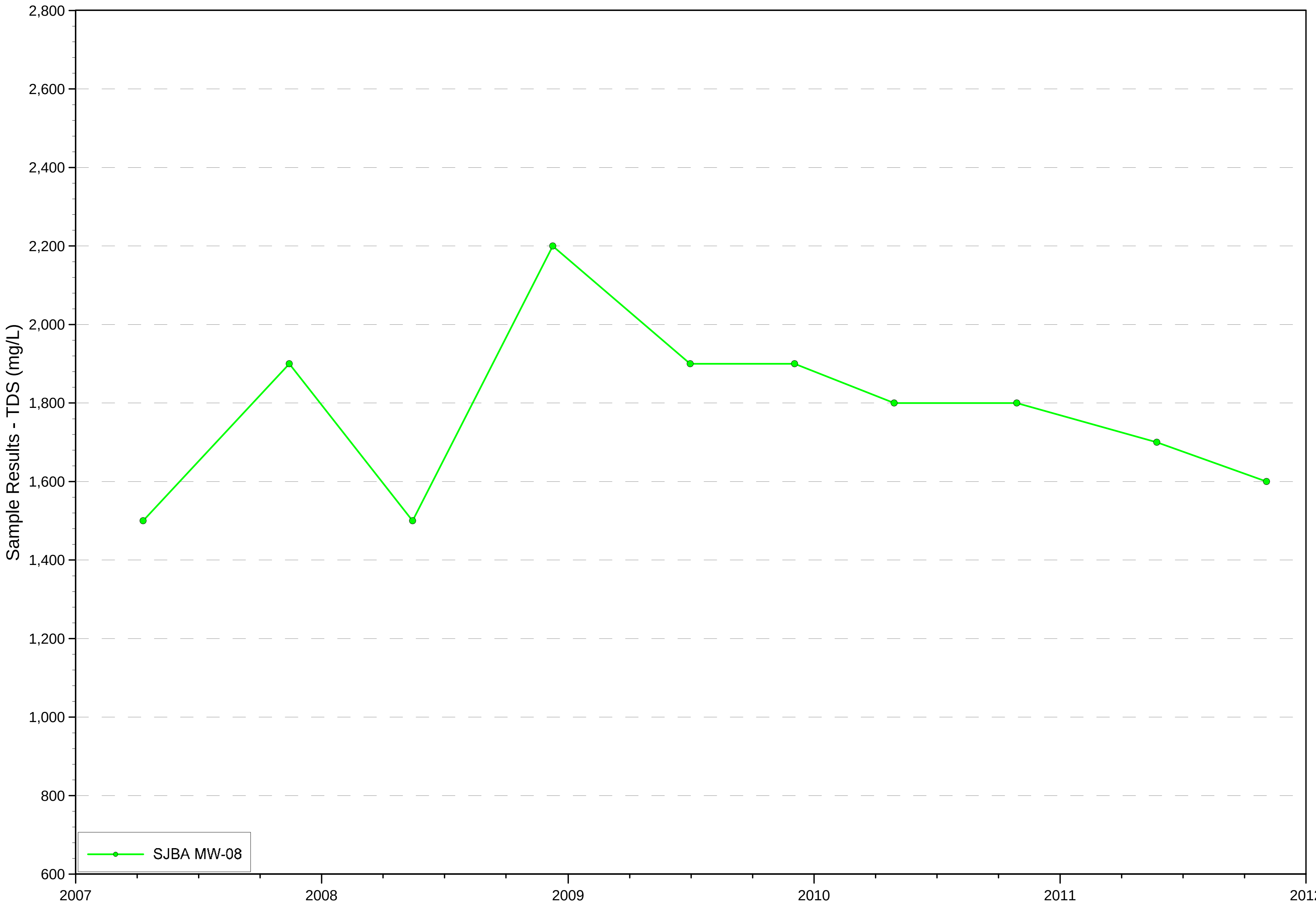


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**Figure E-8: Time History of TDS Concentrations at Wells in the San Juan Basin**

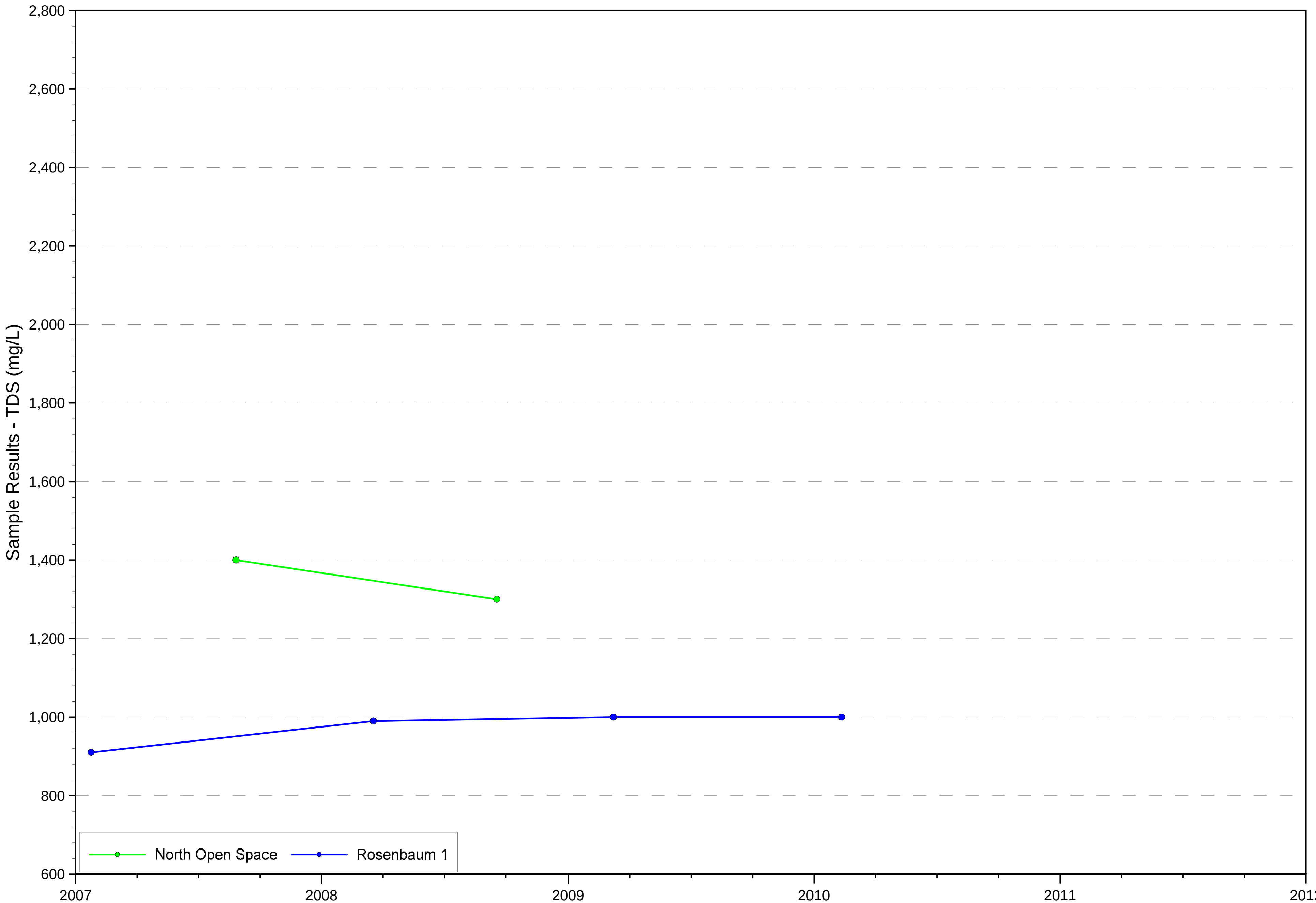


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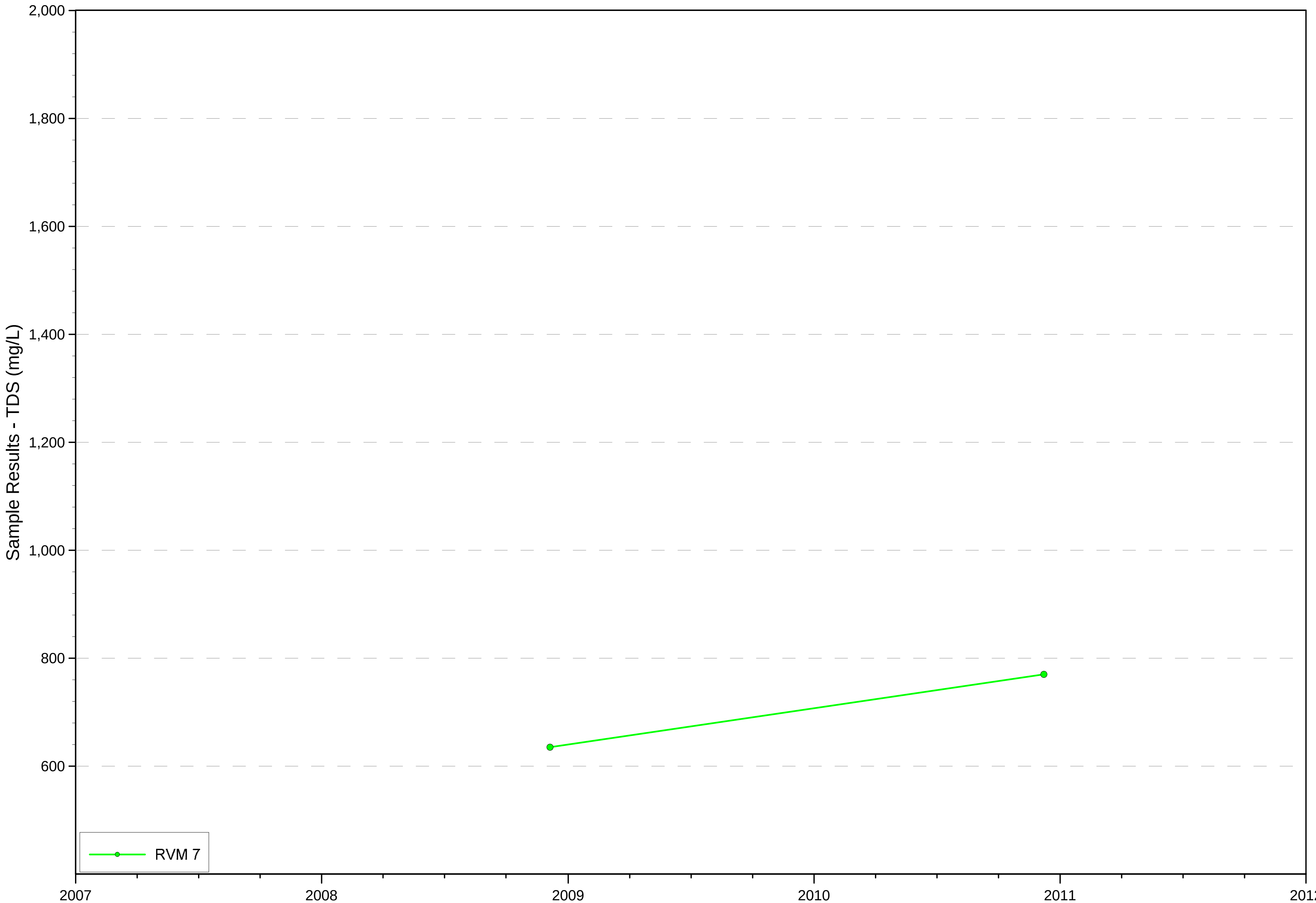
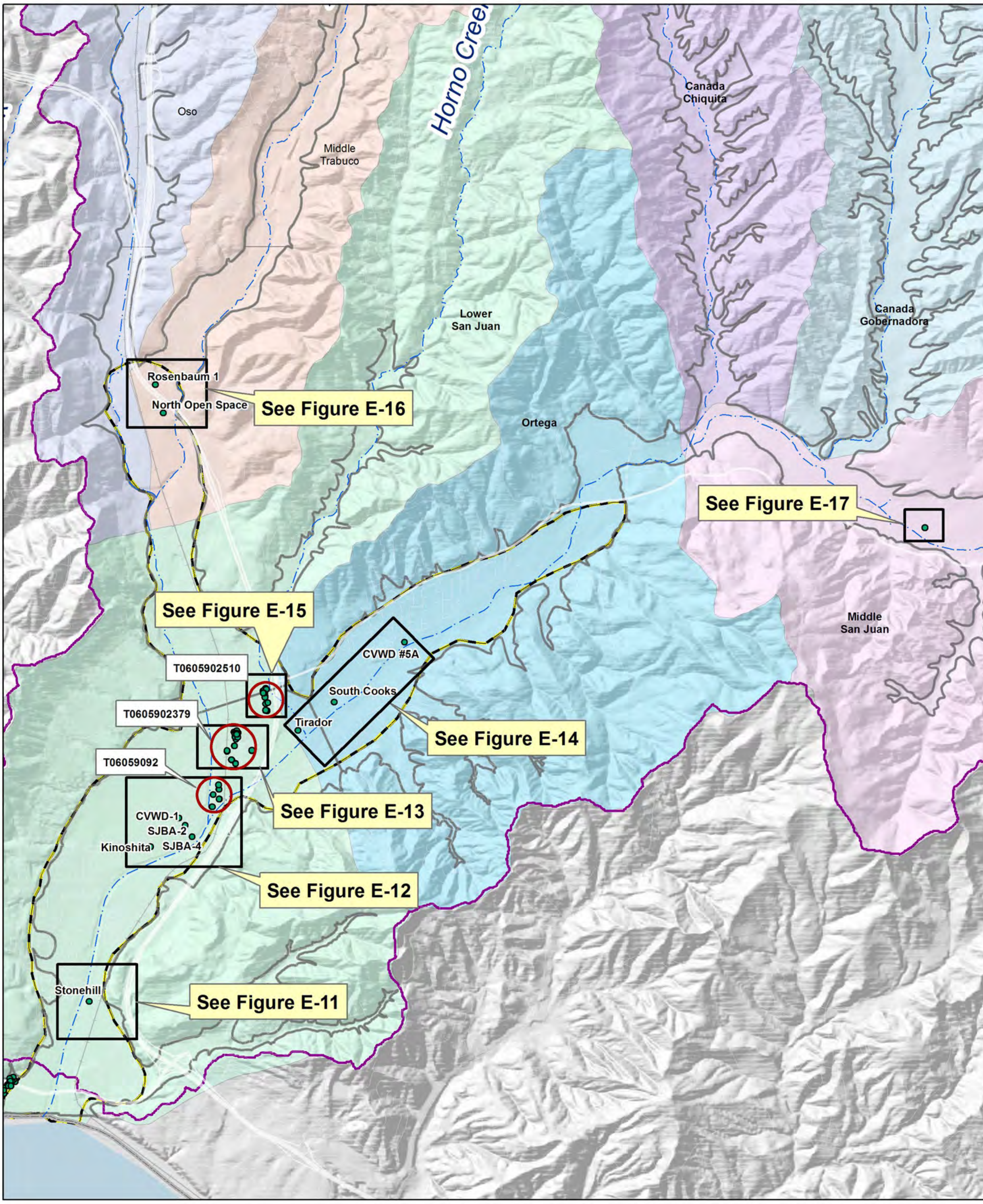
Figure E-9: Time History of TDS Concentrations at Wells in the San Juan Basin






**Main Features**

Well with Nitrogen Statistic

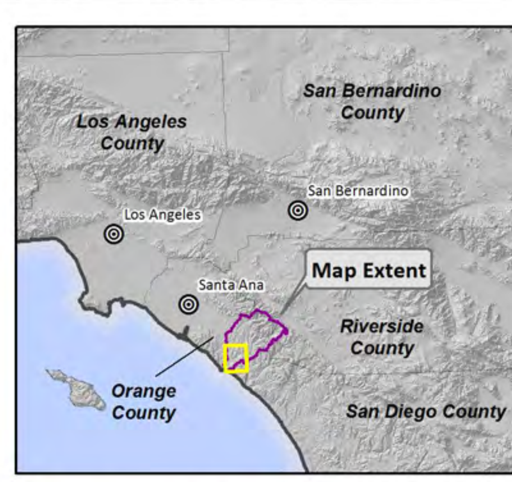
**Hydrologic Features**

Active Groundwater Storage Area

San Juan Creek Watershed Boundary

San Juan Basin

Streams and Creeks





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HDR


Author: LBB

Date: 20130530

File: Figure X_9_N Map.mxd

0 1,000 2,000 Feet

0 0.25 0.5 Miles

SOCWA
South Orange County Wastewater Authority

2013 Salt and Nutrient Management Plan

**NO3 Time Series Well Locations**

*San Juan Groundwater Basin*

**Figure E-10**

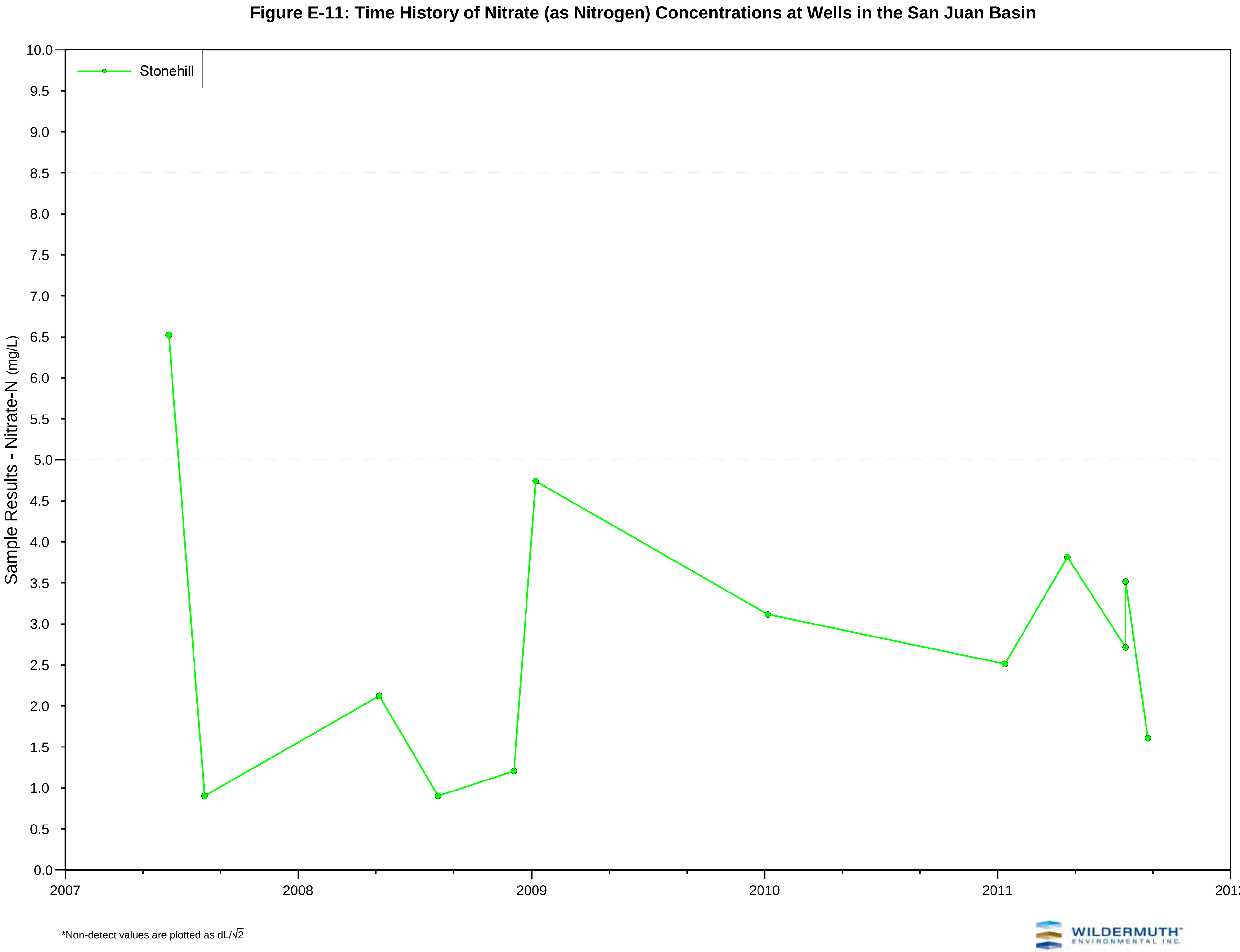

Figure E-11: Time History of Nitrate (as Nitrogen) Concentrations at Wells in the San Juan Basin
Stonehill
Sample Results - Nitrate-N (mg/L)
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
2007
2008
2009
2010
2011
2012
*Non-detect values are plotted as dL/√2
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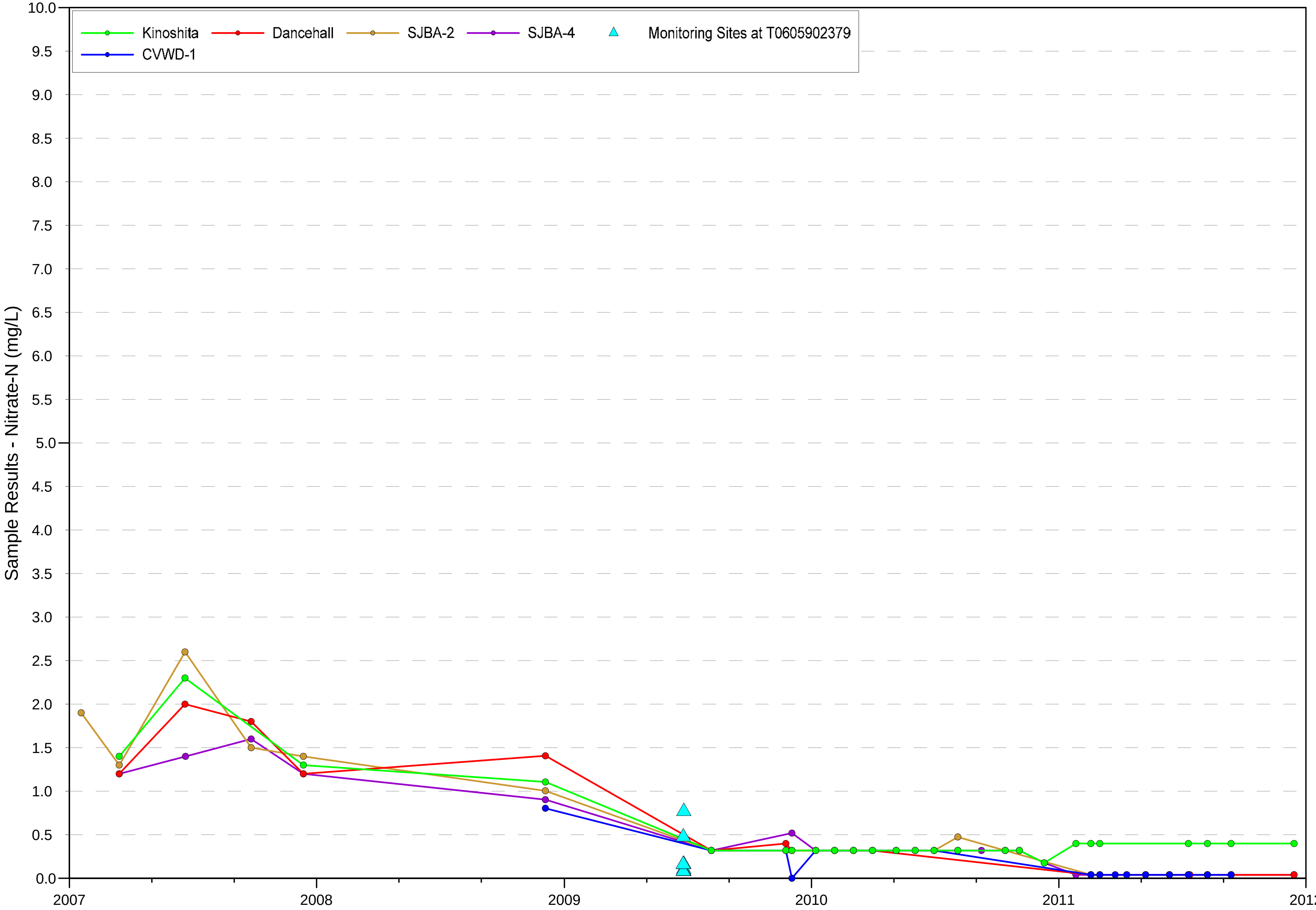
**Figure E-12: Time History of Nitrate (as Nitrogen) Concentrations at Wells in the San Juan Basin**




*Non-detect values are plotted as dL/√2

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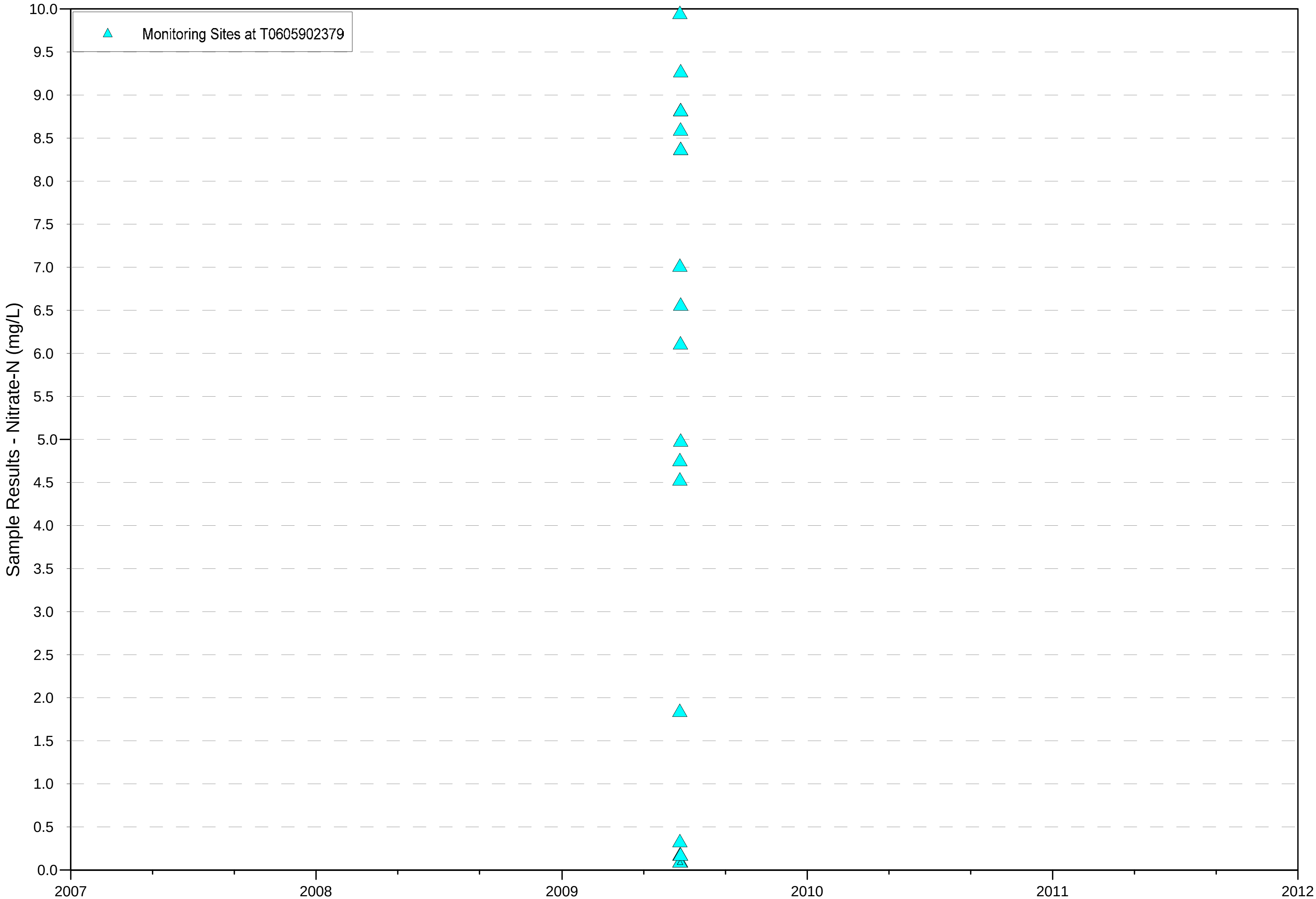
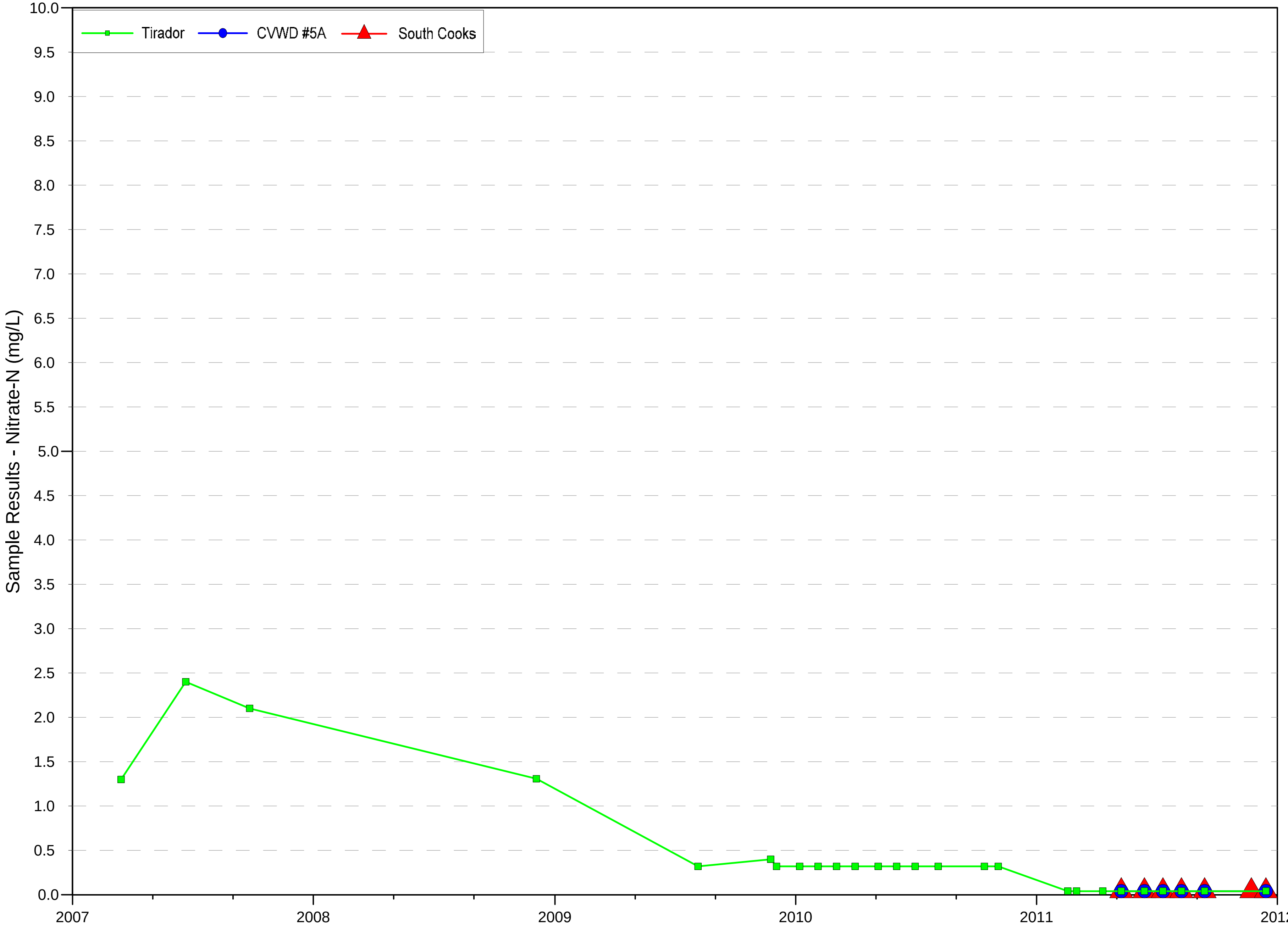
**Figure E-13: Time History of Nitrate (as Nitrogen) Concentrations at Wells in the San Juan Basin**




*Non detect values are plotted as dL/$\sqrt{2}$

Figure E-14: Time History of Nitrate (as Nitrogen) Concentrations at Wells in the San Juan Basin




*Non-detect values are plotted as DL/√2

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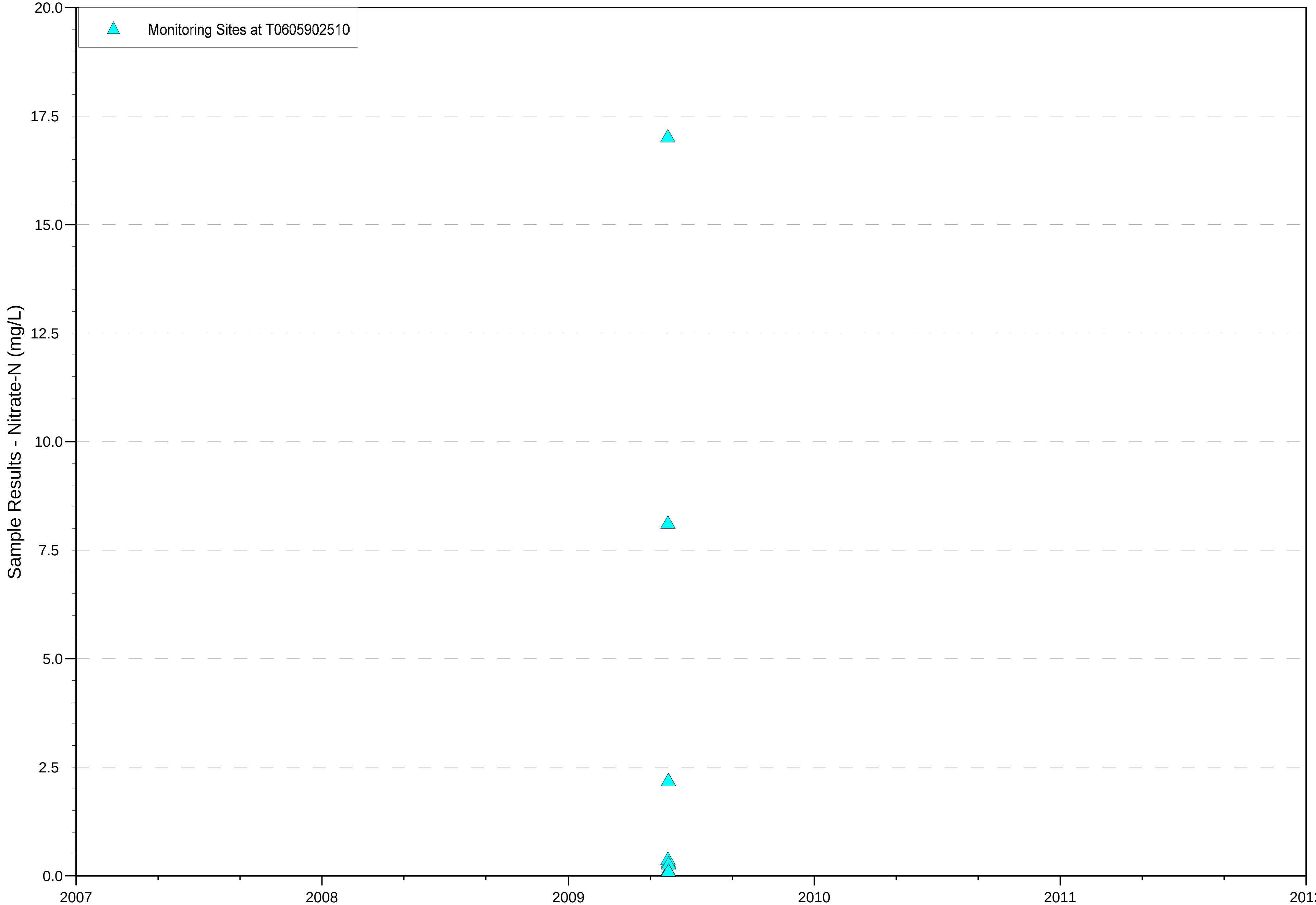
## Figure E-15: Time History of Nitrate (as Nitrogen) Concentrations at Wells in the San Juan Basin




*Non-detect values are plotted as dL/√2

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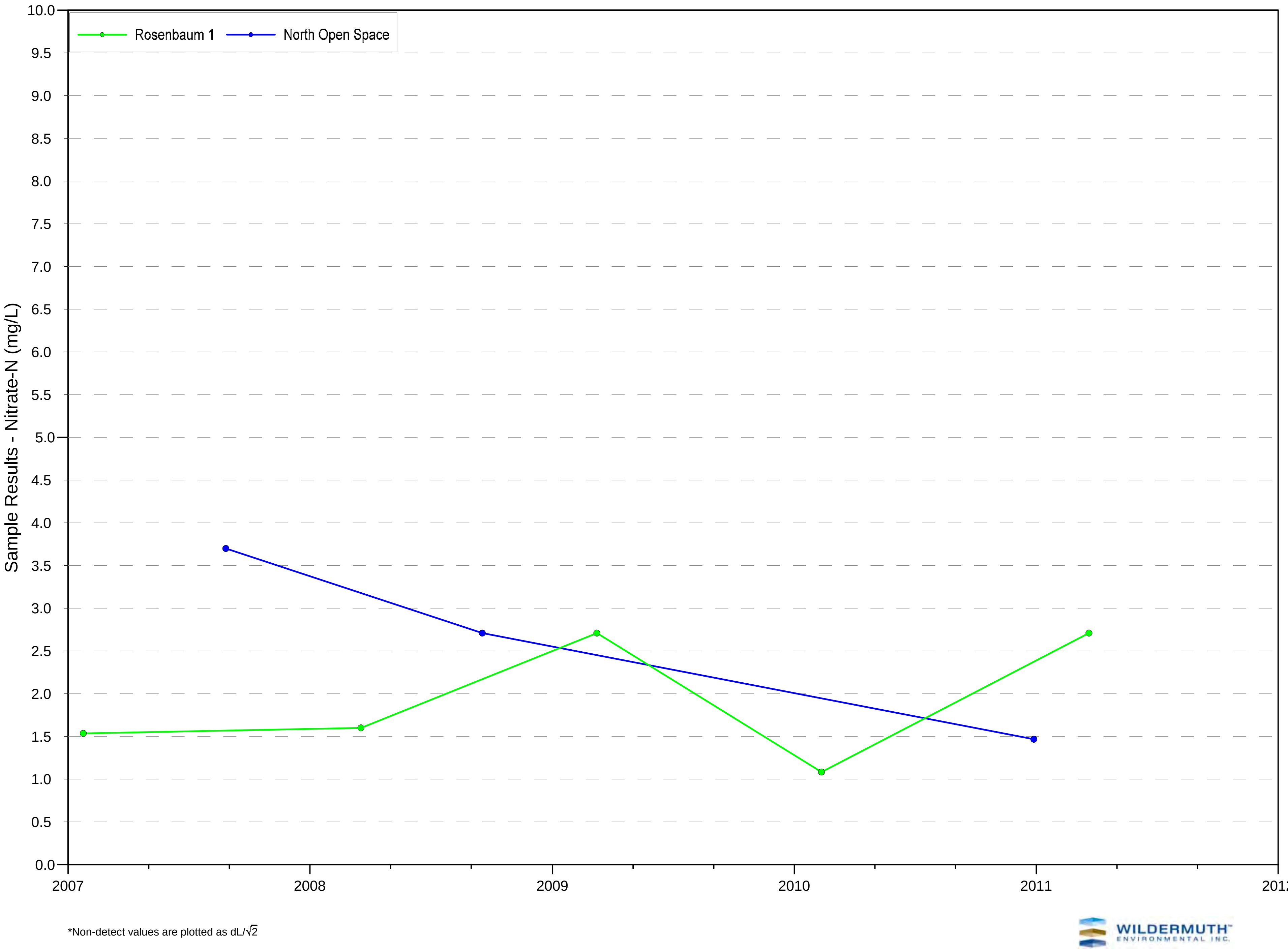
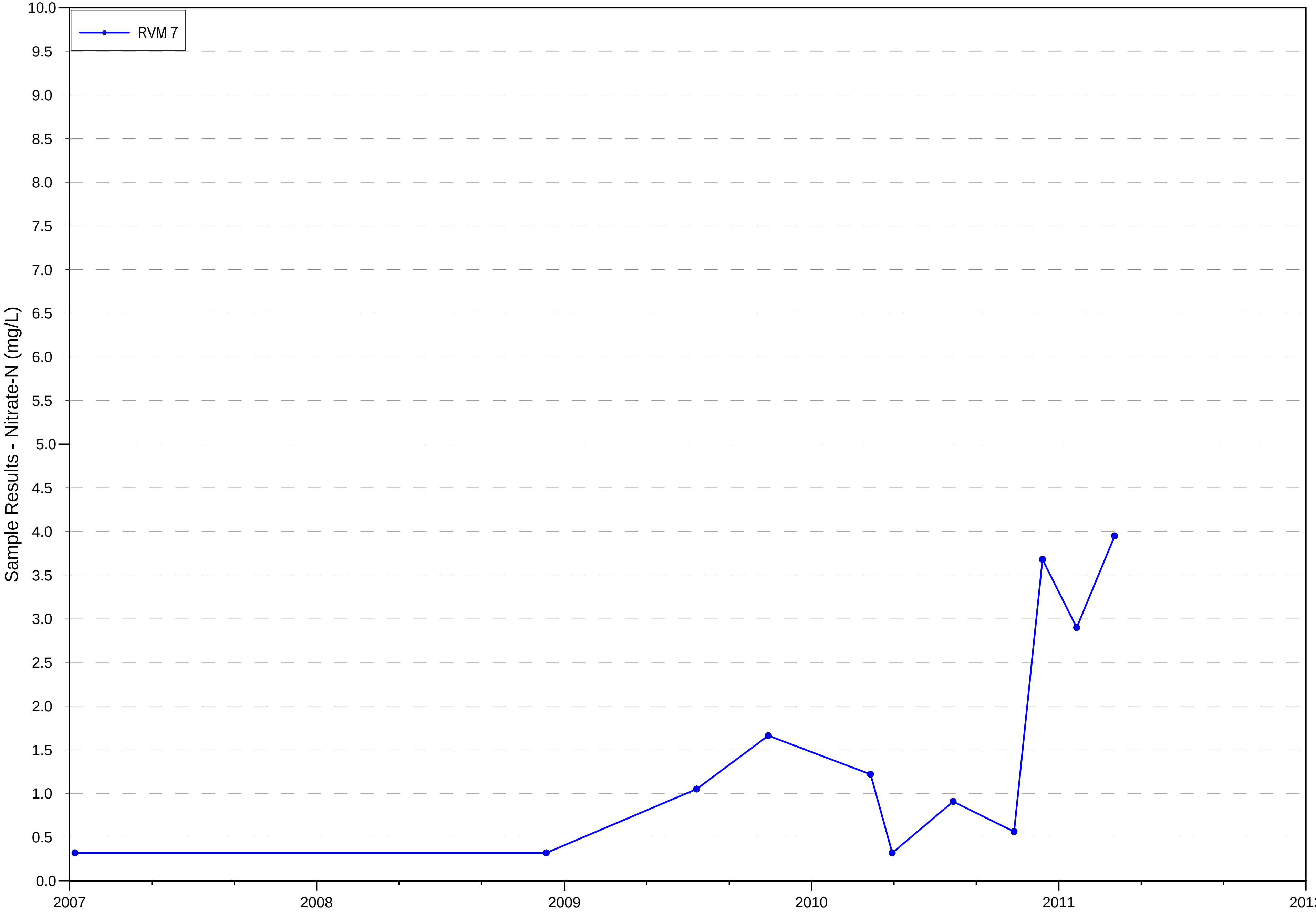
## Figure E-16: Time History of Nitrate (as Nitrogen) Concentrations at Wells in the San Juan Basin



## Figure E-17: Time History of Nitrate (as Nitrogen) Concentrations at Wells in the San Juan Basin




*Non-detect values are plotted as dL/√2

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# APPENDIX F
# CSRM Model Results

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# Table F-1 Baseline Water Supply Plan - City of San Juan Capistrano

| Year | Demand | | | Supply | | | | | | | | | | | | | | | | | Derivation of Outdoor Water Supply and Deep Infiltration of Applied Water | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Potable System Supply | | | | | | | | Non-Potable System Supply | | | | | | | | Total Supply | Total Outdoor Supply in City Service Area | | Total Outdoor Supply in CSRM Model Boundary | | Fate of Water Applied for Irrigation | | | | Fate of Water Not Consumptively Used by Plants | | | |
| | Potable | Non-Potable | Total Demand | GWRP Groundwater | | Potable Groundwater | | Imported Water | | Total Potable Supply | | Non-Potable Groundwater | | Imported Water | | Recycled water | | Total Non-Potable Supply | | | | | | | Water Consumptively Used by Plants | | Water Not Consumptively Used by Plants | | Deep Infiltration to Groundwater | | Becomes Surface Water Flow | |
| | Q | Q | Q | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS |
| | *afy* | *afy* | *afy* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* |
| 2011 | 9,209 | 1,100 | 10,309 | 2,577 | 470 | 31 | 1,163 | 6,601 | 470 | 9,209 | 472 | 290 | 1,618 | 773 | 470 | 37 | 1,000 | 1,100 | 790 | 10,309 | 6,625 | 525 | 5,355 | 531 | 4,552 | 0 | 803 | 3,541 | 201 | 3,541 | 602 | 3,541 |
| 2012 | 10,502 | 1,100 | 11,602 | 3,437 | 470 | 9 | 1,138 | 7,055 | 470 | 10,502 | 471 | 272 | 1,593 | 781 | 470 | 47 | 1,000 | 1,100 | 771 | 11,602 | 7,401 | 515 | 5,968 | 520 | 5,073 | 0 | 895 | 3,469 | 224 | 3,469 | 671 | 3,469 |
| 2013 | 10,062 | 1,100 | 11,162 | 4,424 | 470 | 627 | 1,125 | 5,011 | 470 | 10,062 | 511 | 310 | 1,580 | 740 | 470 | 50 | 1,000 | 1,100 | 807 | 11,162 | 7,137 | 556 | 5,759 | 562 | 4,896 | 0 | 864 | 3,744 | 216 | 3,744 | 648 | 3,744 |
| 2014 | 9,622 | 1,100 | 10,722 | 4,424 | 470 | 627 | 1,116 | 4,571 | 470 | 9,622 | 512 | 310 | 1,571 | 167 | 470 | 623 | 1,000 | 1,100 | 1,080 | 10,722 | 6,873 | 603 | 5,551 | 613 | 4,718 | 0 | 833 | 4,090 | 208 | 4,090 | 624 | 4,090 |
| 2015 | 7,450 | 1,100 | 8,550 | 4,424 | 470 | 627 | 1,111 | 2,399 | 470 | 7,450 | 524 | 310 | 1,566 | 167 | 470 | 623 | 1,000 | 1,100 | 1,079 | 8,550 | 5,570 | 634 | 4,521 | 645 | 3,843 | 0 | 678 | 4,303 | 170 | 4,303 | 509 | 4,303 |
| 2016 | 7,500 | 1,100 | 8,600 | 4,424 | 470 | 627 | 1,106 | 2,449 | 470 | 7,500 | 523 | 310 | 1,561 | 167 | 470 | 623 | 1,000 | 1,100 | 1,078 | 8,600 | 5,600 | 632 | 4,545 | 644 | 3,863 | 0 | 682 | 4,293 | 170 | 4,293 | 511 | 4,293 |
| 2017 | 7,550 | 1,100 | 8,650 | 4,424 | 470 | 627 | 1,101 | 2,499 | 470 | 7,550 | 522 | 310 | 1,556 | 167 | 470 | 623 | 1,000 | 1,100 | 1,076 | 8,650 | 5,630 | 631 | 4,569 | 642 | 3,883 | 0 | 685 | 4,283 | 171 | 4,283 | 514 | 4,283 |
| 2018 | 7,600 | 1,100 | 8,700 | 4,424 | 470 | 627 | 1,098 | 2,549 | 470 | 7,600 | 522 | 310 | 1,553 | 167 | 470 | 623 | 1,000 | 1,100 | 1,075 | 8,700 | 5,660 | 629 | 4,592 | 641 | 3,904 | 0 | 689 | 4,275 | 172 | 4,275 | 517 | 4,275 |
| 2019 | 7,650 | 1,100 | 8,750 | 4,424 | 470 | 627 | 1,096 | 2,599 | 470 | 7,650 | 521 | 310 | 1,551 | 167 | 470 | 623 | 1,000 | 1,100 | 1,075 | 8,750 | 5,690 | 628 | 4,616 | 640 | 3,924 | 0 | 692 | 4,267 | 173 | 4,267 | 519 | 4,267 |
| 2020 | 7,700 | 1,100 | 8,800 | 4,424 | 470 | 627 | 1,094 | 2,649 | 470 | 7,700 | 521 | 310 | 1,549 | 167 | 470 | 623 | 1,000 | 1,100 | 1,074 | 8,800 | 5,720 | 627 | 4,640 | 639 | 3,944 | 0 | 696 | 4,260 | 174 | 4,260 | 522 | 4,260 |
| 2021 | 7,750 | 1,100 | 8,850 | 4,424 | 470 | 627 | 1,093 | 2,699 | 470 | 7,750 | 520 | 310 | 1,548 | 167 | 470 | 623 | 1,000 | 1,100 | 1,074 | 8,850 | 5,750 | 626 | 4,664 | 638 | 3,964 | 0 | 700 | 4,253 | 175 | 4,253 | 525 | 4,253 |
| 2022 | 7,800 | 1,100 | 8,900 | 4,424 | 470 | 627 | 1,092 | 2,749 | 470 | 7,800 | 520 | 310 | 1,547 | 167 | 470 | 623 | 1,000 | 1,100 | 1,074 | 8,900 | 5,780 | 625 | 4,687 | 637 | 3,984 | 0 | 703 | 4,246 | 176 | 4,246 | 527 | 4,246 |
| 2023 | 7,850 | 1,100 | 8,950 | 4,424 | 470 | 627 | 1,091 | 2,799 | 470 | 7,850 | 520 | 310 | 1,546 | 167 | 470 | 623 | 1,000 | 1,100 | 1,074 | 8,950 | 5,810 | 625 | 4,711 | 636 | 4,004 | 0 | 707 | 4,240 | 177 | 4,240 | 530 | 4,240 |
| 2024 | 7,900 | 1,100 | 9,000 | 4,424 | 470 | 627 | 1,091 | 2,849 | 470 | 7,900 | 519 | 310 | 1,546 | 167 | 470 | 623 | 1,000 | 1,100 | 1,073 | 9,000 | 5,840 | 624 | 4,735 | 635 | 4,024 | 0 | 710 | 4,234 | 178 | 4,234 | 533 | 4,234 |
| 2025 | 7,950 | 1,100 | 9,050 | 4,424 | 470 | 627 | 1,091 | 2,899 | 470 | 7,950 | 519 | 310 | 1,546 | 167 | 470 | 623 | 1,000 | 1,100 | 1,073 | 9,050 | 5,870 | 623 | 4,758 | 634 | 4,045 | 0 | 714 | 4,229 | 178 | 4,229 | 535 | 4,229 |
| 2026 | 8,000 | 1,950 | 9,950 | 4,424 | 470 | 627 | 1,090 | 2,949 | 470 | 8,000 | 519 | 310 | 1,545 | 815 | 470 | 825 | 1,000 | 1,950 | 865 | 9,950 | 6,750 | 619 | 5,547 | 628 | 4,715 | 0 | 832 | 4,188 | 208 | 4,188 | 624 | 4,188 |
| 2027 | 8,050 | 1,950 | 10,000 | 4,424 | 470 | 627 | 1,092 | 2,999 | 470 | 8,050 | 518 | 310 | 1,547 | 815 | 470 | 825 | 1,000 | 1,950 | 865 | 10,000 | 6,780 | 618 | 5,571 | 628 | 4,735 | 0 | 836 | 4,185 | 209 | 4,185 | 627 | 4,185 |
| 2028 | 8,100 | 1,950 | 10,050 | 4,424 | 470 | 627 | 1,093 | 3,049 | 470 | 8,100 | 518 | 310 | 1,548 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,050 | 6,810 | 618 | 5,594 | 627 | 4,755 | 0 | 839 | 4,182 | 210 | 4,182 | 629 | 4,182 |
| 2029 | 8,150 | 1,950 | 10,100 | 4,424 | 470 | 627 | 1,095 | 3,099 | 470 | 8,150 | 518 | 310 | 1,550 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,100 | 6,840 | 617 | 5,618 | 627 | 4,775 | 0 | 843 | 4,178 | 211 | 4,178 | 632 | 4,178 |
| 2030 | 8,200 | 1,950 | 10,150 | 4,424 | 470 | 627 | 1,095 | 3,149 | 470 | 8,200 | 518 | 310 | 1,550 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,150 | 6,870 | 617 | 5,642 | 626 | 4,796 | 0 | 846 | 4,174 | 212 | 4,174 | 635 | 4,174 |
| 2031 | 8,250 | 1,950 | 10,200 | 4,424 | 470 | 627 | 1,096 | 3,199 | 470 | 8,250 | 518 | 310 | 1,551 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,200 | 6,900 | 616 | 5,666 | 626 | 4,816 | 0 | 850 | 4,170 | 212 | 4,170 | 637 | 4,170 |
| 2032 | 8,300 | 1,950 | 10,250 | 4,424 | 470 | 627 | 1,097 | 3,249 | 470 | 8,300 | 517 | 310 | 1,552 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,250 | 6,930 | 616 | 5,689 | 625 | 4,836 | 0 | 853 | 4,166 | 213 | 4,166 | 640 | 4,166 |
| 2033 | 8,350 | 1,950 | 10,300 | 4,424 | 470 | 627 | 1,097 | 3,299 | 470 | 8,350 | 517 | 310 | 1,552 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,300 | 6,960 | 615 | 5,713 | 624 | 4,856 | 0 | 857 | 4,163 | 214 | 4,163 | 643 | 4,163 |
| 2034 | 8,400 | 1,950 | 10,350 | 4,424 | 470 | 627 | 1,098 | 3,349 | 470 | 8,400 | 517 | 310 | 1,553 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,350 | 6,990 | 614 | 5,737 | 624 | 4,876 | 0 | 860 | 4,159 | 215 | 4,159 | 645 | 4,159 |
| 2035 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,098 | 3,399 | 470 | 8,450 | 517 | 310 | 1,553 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,155 | 216 | 4,155 | 648 | 4,155 |
| 2036 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,099 | 3,399 | 470 | 8,450 | 517 | 310 | 1,554 | 815 | 470 | 825 | 1,000 | 1,950 | 866 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,155 | 216 | 4,155 | 648 | 4,155 |
| 2037 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,099 | 3,399 | 470 | 8,450 | 517 | 310 | 1,554 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,155 | 216 | 4,155 | 648 | 4,155 |
| 2038 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,099 | 3,399 | 470 | 8,450 | 517 | 310 | 1,554 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,155 | 216 | 4,155 | 648 | 4,155 |
| 2039 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,099 | 3,399 | 470 | 8,450 | 517 | 310 | 1,554 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,155 | 216 | 4,155 | 648 | 4,155 |
| 2040 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,099 | 3,399 | 470 | 8,450 | 517 | 310 | 1,554 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,155 | 216 | 4,155 | 648 | 4,155 |
| 2041 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,155 | 216 | 4,155 | 648 | 4,155 |
| 2042 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |
| 2043 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |
| 2044 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |
| 2045 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |
| 2046 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |
| 2047 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |
| 2048 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |
| 2049 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |
| 2050 | 8,450 | 1,950 | 10,400 | 4,424 | 470 | 627 | 1,100 | 3,399 | 470 | 8,450 | 517 | 310 | 1,555 | 815 | 470 | 825 | 1,000 | 1,950 | 867 | 10,400 | 7,020 | 614 | 5,760 | 623 | 4,896 | 0 | 864 | 4,156 | 216 | 4,156 | 648 | 4,156 |

## Table F-2 Baseline Water Supply Plan - South Coast Water District

| Year | Demands | | | Potable Supplies | | | | | | Non-Potable Supplies | | | | | | Total Supply | Derivation of Outdoor Water Supply and Deep Infiltration of Applied Water | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Potable | Non-Potable | Total | Groundwater - GRF | | Imported Water | | Total Potable | | Groundwater | | Recycled Water | | Total Non-Potable | | | Total Outdoor Supply in City Service Area | | Total Outdoor Supply in CSRM Model Boundary | | Fate of Water Applied for Irrigation | | | | Fate of Water Not Consumptively Used by Plants | | | |
| | | | | | | | | | | | | | | | | | | | | | Water Consumptively Used by Plants | | Water Not Consumptively Used by Plants | | Deep Infiltration to Groundwater | | Becomes Surface Water Flow | |
| | Q | Q | Q | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS |
| | *afy* | *afy* | *afy* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* |
| 2011 | 5,919 | 881 | 6,800 | 924 | 470 | 4,995 | 470 | 5,919 | 470 | 0 | 1,618 | 881 | 1,200 | 881 | 1,200 | 6,800 | 4,433 | 615 | 666 | 499 | 566 | 0 | 100 | 3,327 | 25 | 3,327 | 75 | 3,327 |
| 2012 | 6,418 | 936 | 7,353 | 913 | 470 | 5,505 | 470 | 6,418 | 470 | 0 | 1,593 | 936 | 1,200 | 936 | 1,200 | 7,354 | 4,787 | 613 | 721 | 498 | 613 | 0 | 108 | 3,323 | 27 | 3,323 | 81 | 3,323 |
| 2013 | 6,623 | 990 | 7,613 | 1,195 | 470 | 5,428 | 470 | 6,623 | 470 | 0 | 1,580 | 990 | 1,200 | 990 | 1,200 | 7,613 | 4,964 | 616 | 745 | 499 | 633 | 0 | 112 | 3,327 | 28 | 3,327 | 84 | 3,327 |
| 2014 | 6,828 | 1,045 | 7,873 | 1,195 | 470 | 5,633 | 470 | 6,828 | 470 | 0 | 1,571 | 1,045 | 1,200 | 1,045 | 1,200 | 7,873 | 5,141 | 618 | 769 | 500 | 653 | 0 | 115 | 3,332 | 29 | 3,332 | 86 | 3,332 |
| 2015 | 7,108 | 1,100 | 8,208 | 1,195 | 470 | 5,913 | 470 | 7,108 | 470 | 0 | 1,566 | 1,100 | 1,200 | 1,100 | 1,200 | 8,208 | 5,365 | 620 | 801 | 500 | 681 | 0 | 120 | 3,334 | 30 | 3,334 | 90 | 3,334 |
| 2016 | 7,145 | 1,120 | 8,265 | 1,195 | 470 | 5,950 | 470 | 7,145 | 470 | 0 | 1,561 | 1,120 | 1,200 | 1,120 | 1,200 | 8,265 | 5,407 | 621 | 805 | 500 | 685 | 0 | 121 | 3,336 | 30 | 3,336 | 91 | 3,336 |
| 2017 | 7,183 | 1,140 | 8,323 | 1,195 | 470 | 5,988 | 470 | 7,183 | 470 | 0 | 1,556 | 1,140 | 1,200 | 1,140 | 1,200 | 8,323 | 5,450 | 623 | 810 | 501 | 688 | 0 | 121 | 3,339 | 30 | 3,339 | 91 | 3,339 |
| 2018 | 7,220 | 1,160 | 8,380 | 1,195 | 470 | 6,025 | 470 | 7,220 | 470 | 0 | 1,553 | 1,160 | 1,200 | 1,160 | 1,200 | 8,380 | 5,492 | 624 | 815 | 501 | 692 | 0 | 122 | 3,341 | 31 | 3,341 | 92 | 3,341 |
| 2019 | 7,258 | 1,180 | 8,438 | 1,195 | 470 | 6,062 | 470 | 7,258 | 470 | 0 | 1,551 | 1,180 | 1,200 | 1,180 | 1,200 | 8,438 | 5,535 | 626 | 819 | 502 | 696 | 0 | 123 | 3,344 | 31 | 3,344 | 92 | 3,344 |
| 2020 | 7,295 | 1,200 | 8,495 | 1,195 | 470 | 6,100 | 470 | 7,295 | 470 | 0 | 1,549 | 1,200 | 1,200 | 1,200 | 1,200 | 8,495 | 5,577 | 627 | 824 | 502 | 700 | 0 | 124 | 3,346 | 31 | 3,346 | 93 | 3,346 |
| 2021 | 7,297 | 1,220 | 8,517 | 1,195 | 470 | 6,102 | 470 | 7,297 | 470 | 0 | 1,548 | 1,220 | 1,200 | 1,220 | 1,200 | 8,517 | 5,598 | 629 | 825 | 502 | 701 | 0 | 124 | 3,349 | 31 | 3,349 | 93 | 3,349 |
| 2022 | 7,299 | 1,240 | 8,539 | 1,195 | 470 | 6,104 | 470 | 7,299 | 470 | 0 | 1,547 | 1,240 | 1,200 | 1,240 | 1,200 | 8,539 | 5,619 | 631 | 825 | 503 | 702 | 0 | 124 | 3,353 | 31 | 3,353 | 93 | 3,353 |
| 2023 | 7,301 | 1,260 | 8,561 | 1,195 | 470 | 6,106 | 470 | 7,301 | 470 | 0 | 1,546 | 1,260 | 1,200 | 1,260 | 1,200 | 8,561 | 5,641 | 633 | 826 | 503 | 702 | 0 | 124 | 3,356 | 31 | 3,356 | 93 | 3,356 |
| 2024 | 7,303 | 1,280 | 8,583 | 1,195 | 470 | 6,108 | 470 | 7,303 | 470 | 0 | 1,546 | 1,280 | 1,200 | 1,280 | 1,200 | 8,583 | 5,662 | 635 | 827 | 504 | 703 | 0 | 124 | 3,359 | 31 | 3,359 | 93 | 3,359 |
| 2025 | 7,305 | 1,300 | 8,605 | 1,195 | 470 | 6,110 | 470 | 7,305 | 470 | 0 | 1,546 | 1,300 | 1,200 | 1,300 | 1,200 | 8,605 | 5,683 | 637 | 828 | 504 | 704 | 0 | 124 | 3,363 | 31 | 3,363 | 93 | 3,363 |
| 2026 | 7,311 | 1,320 | 8,631 | 1,195 | 470 | 6,116 | 470 | 7,311 | 470 | 0 | 1,545 | 1,320 | 1,200 | 1,320 | 1,200 | 8,631 | 5,707 | 639 | 829 | 505 | 705 | 0 | 124 | 3,366 | 31 | 3,366 | 93 | 3,366 |
| 2027 | 7,317 | 1,340 | 8,657 | 1,195 | 470 | 6,122 | 470 | 7,317 | 470 | 0 | 1,547 | 1,340 | 1,200 | 1,340 | 1,200 | 8,657 | 5,730 | 641 | 830 | 505 | 706 | 0 | 125 | 3,369 | 31 | 3,369 | 93 | 3,369 |
| 2028 | 7,324 | 1,360 | 8,684 | 1,195 | 470 | 6,128 | 470 | 7,324 | 470 | 0 | 1,548 | 1,360 | 1,200 | 1,360 | 1,200 | 8,684 | 5,754 | 643 | 832 | 506 | 707 | 0 | 125 | 3,372 | 31 | 3,372 | 94 | 3,372 |
| 2029 | 7,330 | 1,380 | 8,710 | 1,195 | 470 | 6,135 | 470 | 7,330 | 470 | 0 | 1,550 | 1,380 | 1,200 | 1,380 | 1,200 | 8,710 | 5,778 | 644 | 833 | 506 | 708 | 0 | 125 | 3,375 | 31 | 3,375 | 94 | 3,375 |
| 2030 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,550 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2031 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,551 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2032 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,552 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2033 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,552 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2034 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,553 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2035 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,553 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2036 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,554 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2037 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,554 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2038 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,554 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2039 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,554 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2040 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,554 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2041 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2042 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2043 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2044 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2045 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2046 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2047 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2048 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2049 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |
| 2050 | 7,336 | 1,400 | 8,736 | 1,195 | 470 | 6,141 | 470 | 7,336 | 470 | 0 | 1,555 | 1,400 | 1,200 | 1,400 | 1,200 | 8,736 | 5,802 | 646 | 834 | 507 | 709 | 0 | 125 | 3,378 | 31 | 3,378 | 94 | 3,378 |

## Table F-3 Baseline Water Supply Plan - Private Users

| Year | Demands | | | Non-Potable Supplies | | | | Total Supply | Derivation of Outdoor Water Supply and Deep Infiltration of Applied Water | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Potable | Non-Potable | Total | GC wells | | Recycled water | | | Total Outdoor Supply in City Service Area | | Total Outdoor Supply in CSRM Model Boundary | | Fate of Water Applied for Irrigation | | | | Fate of Water Not Consumptively Used by Plants | | | |
| | | | | | | | | | | | | | Water Consumptively Used by Plants | | Water Not Consumptively Used by Plants | | Deep Infiltration to Groundwater | | Becomes Surface Water Flow | |
| | Q | Q | Q | Q | TDS | Q | TDS | Q | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS | Q | TDS |
| | *afy* | *afy* | *afy* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* | *afy* | *mg/L* |
| 2011 | 0 | 322 | 322 | 322 | 1,618 | 0 | 1,200 | 322 | 322 | 1,618 | 322 | 1,618 | 274 | 0 | 48 | 10,787 | 12 | 10,787 | 36 | 10,787 |
| 2012 | 0 | 322 | 322 | 322 | 1,593 | 0 | 1,200 | 322 | 322 | 1,593 | 322 | 1,593 | 274 | 0 | 48 | 10,621 | 12 | 10,621 | 36 | 10,621 |
| 2013 | 0 | 322 | 322 | 322 | 1,580 | 0 | 1,200 | 322 | 322 | 1,580 | 322 | 1,580 | 274 | 0 | 48 | 10,530 | 12 | 10,530 | 36 | 10,530 |
| 2014 | 0 | 322 | 322 | 322 | 1,571 | 0 | 1,200 | 322 | 322 | 1,571 | 322 | 1,571 | 274 | 0 | 48 | 10,473 | 12 | 10,473 | 36 | 10,473 |
| 2015 | 0 | 322 | 322 | 322 | 1,566 | 0 | 1,200 | 322 | 322 | 1,566 | 322 | 1,566 | 274 | 0 | 48 | 10,440 | 12 | 10,440 | 36 | 10,440 |
| 2016 | 0 | 322 | 322 | 322 | 1,561 | 0 | 1,200 | 322 | 322 | 1,561 | 322 | 1,561 | 274 | 0 | 48 | 10,404 | 12 | 10,404 | 36 | 10,404 |
| 2017 | 0 | 322 | 322 | 322 | 1,556 | 0 | 1,200 | 322 | 322 | 1,556 | 322 | 1,556 | 274 | 0 | 48 | 10,376 | 12 | 10,376 | 36 | 10,376 |
| 2018 | 0 | 322 | 322 | 322 | 1,553 | 0 | 1,200 | 322 | 322 | 1,553 | 322 | 1,553 | 274 | 0 | 48 | 10,356 | 12 | 10,356 | 36 | 10,356 |
| 2019 | 0 | 322 | 322 | 322 | 1,551 | 0 | 1,200 | 322 | 322 | 1,551 | 322 | 1,551 | 274 | 0 | 48 | 10,340 | 12 | 10,340 | 36 | 10,340 |
| 2020 | 0 | 322 | 322 | 322 | 1,549 | 0 | 1,200 | 322 | 322 | 1,549 | 322 | 1,549 | 274 | 0 | 48 | 10,329 | 12 | 10,329 | 36 | 10,329 |
| 2021 | 0 | 322 | 322 | 322 | 1,548 | 0 | 1,200 | 322 | 322 | 1,548 | 322 | 1,548 | 274 | 0 | 48 | 10,320 | 12 | 10,320 | 36 | 10,320 |
| 2022 | 0 | 322 | 322 | 322 | 1,547 | 0 | 1,200 | 322 | 322 | 1,547 | 322 | 1,547 | 274 | 0 | 48 | 10,314 | 12 | 10,314 | 36 | 10,314 |
| 2023 | 0 | 322 | 322 | 322 | 1,546 | 0 | 1,200 | 322 | 322 | 1,546 | 322 | 1,546 | 274 | 0 | 48 | 10,309 | 12 | 10,309 | 36 | 10,309 |
| 2024 | 0 | 322 | 322 | 322 | 1,546 | 0 | 1,200 | 322 | 322 | 1,546 | 322 | 1,546 | 274 | 0 | 48 | 10,306 | 12 | 10,306 | 36 | 10,306 |
| 2025 | 0 | 322 | 322 | 322 | 1,546 | 0 | 1,200 | 322 | 322 | 1,546 | 322 | 1,546 | 274 | 0 | 48 | 10,304 | 12 | 10,304 | 36 | 10,304 |
| 2026 | 0 | 322 | 322 | 322 | 1,545 | 0 | 1,200 | 322 | 322 | 1,545 | 322 | 1,545 | 274 | 0 | 48 | 10,302 | 12 | 10,302 | 36 | 10,302 |
| 2027 | 0 | 322 | 322 | 322 | 1,547 | 0 | 1,200 | 322 | 322 | 1,547 | 322 | 1,547 | 274 | 0 | 48 | 10,314 | 12 | 10,314 | 36 | 10,314 |
| 2028 | 0 | 322 | 322 | 322 | 1,548 | 0 | 1,200 | 322 | 322 | 1,548 | 322 | 1,548 | 274 | 0 | 48 | 10,323 | 12 | 10,323 | 36 | 10,323 |
| 2029 | 0 | 322 | 322 | 322 | 1,550 | 0 | 1,200 | 322 | 322 | 1,550 | 322 | 1,550 | 274 | 0 | 48 | 10,331 | 12 | 10,331 | 36 | 10,331 |
| 2030 | 0 | 322 | 322 | 322 | 1,550 | 0 | 1,200 | 322 | 322 | 1,550 | 322 | 1,550 | 274 | 0 | 48 | 10,337 | 12 | 10,337 | 36 | 10,337 |
| 2031 | 0 | 322 | 322 | 322 | 1,551 | 0 | 1,200 | 322 | 322 | 1,551 | 322 | 1,551 | 274 | 0 | 48 | 10,342 | 12 | 10,342 | 36 | 10,342 |
| 2032 | 0 | 322 | 322 | 322 | 1,552 | 0 | 1,200 | 322 | 322 | 1,552 | 322 | 1,552 | 274 | 0 | 48 | 10,346 | 12 | 10,346 | 36 | 10,346 |
| 2033 | 0 | 322 | 322 | 322 | 1,552 | 0 | 1,200 | 322 | 322 | 1,552 | 322 | 1,552 | 274 | 0 | 48 | 10,349 | 12 | 10,349 | 36 | 10,349 |
| 2034 | 0 | 322 | 322 | 322 | 1,553 | 0 | 1,200 | 322 | 322 | 1,553 | 322 | 1,553 | 274 | 0 | 48 | 10,352 | 12 | 10,352 | 36 | 10,352 |
| 2035 | 0 | 322 | 322 | 322 | 1,553 | 0 | 1,200 | 322 | 322 | 1,553 | 322 | 1,553 | 274 | 0 | 48 | 10,355 | 12 | 10,355 | 36 | 10,355 |
| 2036 | 0 | 322 | 322 | 322 | 1,554 | 0 | 1,200 | 322 | 322 | 1,554 | 322 | 1,554 | 274 | 0 | 48 | 10,357 | 12 | 10,357 | 36 | 10,357 |
| 2037 | 0 | 322 | 322 | 322 | 1,554 | 0 | 1,200 | 322 | 322 | 1,554 | 322 | 1,554 | 274 | 0 | 48 | 10,359 | 12 | 10,359 | 36 | 10,359 |
| 2038 | 0 | 322 | 322 | 322 | 1,554 | 0 | 1,200 | 322 | 322 | 1,554 | 322 | 1,554 | 274 | 0 | 48 | 10,361 | 12 | 10,361 | 36 | 10,361 |
| 2039 | 0 | 322 | 322 | 322 | 1,554 | 0 | 1,200 | 322 | 322 | 1,554 | 322 | 1,554 | 274 | 0 | 48 | 10,362 | 12 | 10,362 | 36 | 10,362 |
| 2040 | 0 | 322 | 322 | 322 | 1,554 | 0 | 1,200 | 322 | 322 | 1,554 | 322 | 1,554 | 274 | 0 | 48 | 10,363 | 12 | 10,363 | 36 | 10,363 |
| 2041 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,363 | 12 | 10,363 | 36 | 10,363 |
| 2042 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,364 | 12 | 10,364 | 36 | 10,364 |
| 2043 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,364 | 12 | 10,364 | 36 | 10,364 |
| 2044 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,365 | 12 | 10,365 | 36 | 10,365 |
| 2045 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,365 | 12 | 10,365 | 36 | 10,365 |
| 2046 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,365 | 12 | 10,365 | 36 | 10,365 |
| 2047 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,365 | 12 | 10,365 | 36 | 10,365 |
| 2048 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,366 | 12 | 10,366 | 36 | 10,366 |
| 2049 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,366 | 12 | 10,366 | 36 | 10,366 |
| 2050 | 0 | 322 | 322 | 322 | 1,555 | 0 | 1,200 | 322 | 322 | 1,555 | 322 | 1,555 | 274 | 0 | 48 | 10,366 | 12 | 10,366 | 36 | 10,366 |

## Table F-4: CSRM Results for Baseline -- Current

| Year | Storage and TDS at Start of Year | | Inflows | | | | | | | | | | | | | | | | | | | | Outflows | | | | | Change in Storage | Storage and TDS at End of Year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Deep Infiltration of Precipitation | | Streambed Infiltration | | Subsurface Inflow - Middle Trabuco and Oso | | Subsurface Inflow - Horno | | Subsurface Inflow - Middle San Juan | | Deep Infiltration of Applied Water | | Enhanced Stormwater Recharge by SJBA | | Recycled Water Recharge by SJBA | | Total Inflow | | Total Inflow TDS after Natural Loading | | Production | Evapo-transpiration | Rising Groundwater | Subsurface Outflow to Pacific Ocean | Total | | | |
| | Storage af | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | TDS tons | TDS mg/L | Q afy | Q afy | Q afy | Q afy | Q afy | Q af | Storage af | TDS mg/L |
| 2011 | 25,528 | 1,618 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 205 | 3,886 | 0 | 740 | 0 | 1,200 | 8,618 | 1,219 | 3,000 | 1,475 | 5,189 | 286 | 132 | 0 | 5,607 | 3,011 | 28,539 | 1,593 |
| 2012 | 28,539 | 1,593 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 263 | 3,782 | 0 | 740 | 0 | 1,200 | 8,676 | 1,233 | 3,000 | 1,488 | 6,304 | 286 | 132 | 0 | 6,722 | 1,954 | 30,492 | 1,580 |
| 2013 | 30,492 | 1,580 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 256 | 4,019 | 0 | 740 | 0 | 1,200 | 8,669 | 1,238 | 3,000 | 1,493 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 30,736 | 1,571 |
| 2014 | 30,736 | 1,571 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 249 | 4,311 | 0 | 740 | 0 | 1,200 | 8,662 | 1,245 | 3,000 | 1,499 | 8,007 | 286 | 132 | 0 | 8,425 | 237 | 30,974 | 1,566 |
| 2015 | 30,974 | 1,566 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 212 | 4,516 | 0 | 740 | 0 | 1,200 | 8,625 | 1,236 | 3,000 | 1,492 | 8,007 | 286 | 132 | 0 | 8,425 | 200 | 31,173 | 1,561 |
| 2016 | 31,173 | 1,561 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 213 | 4,504 | 0 | 740 | 0 | 1,200 | 8,626 | 1,236 | 3,000 | 1,492 | 8,007 | 286 | 132 | 0 | 8,425 | 201 | 31,374 | 1,556 |
| 2017 | 31,374 | 1,556 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 214 | 4,493 | 0 | 740 | 0 | 1,200 | 8,627 | 1,237 | 3,000 | 1,492 | 8,007 | 286 | 132 | 0 | 8,425 | 202 | 31,576 | 1,553 |
| 2018 | 31,576 | 1,553 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 215 | 4,484 | 0 | 740 | 0 | 1,200 | 8,628 | 1,237 | 3,000 | 1,492 | 8,007 | 286 | 132 | 0 | 8,425 | 203 | 31,779 | 1,551 |
| 2019 | 31,779 | 1,551 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 216 | 4,475 | 0 | 740 | 0 | 1,200 | 8,629 | 1,237 | 3,000 | 1,492 | 8,007 | 286 | 132 | 0 | 8,425 | 204 | 31,982 | 1,549 |
| 2020 | 31,982 | 1,549 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 217 | 4,467 | 0 | 740 | 0 | 1,200 | 8,630 | 1,237 | 3,000 | 1,493 | 8,007 | 286 | 132 | 0 | 8,425 | 205 | 32,187 | 1,548 |
| 2021 | 32,187 | 1,548 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 218 | 4,461 | 0 | 740 | 0 | 1,200 | 8,631 | 1,237 | 3,000 | 1,493 | 8,007 | 286 | 132 | 0 | 8,425 | 206 | 32,393 | 1,547 |
| 2022 | 32,393 | 1,547 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 219 | 4,455 | 0 | 740 | 0 | 1,200 | 8,632 | 1,237 | 3,000 | 1,493 | 8,007 | 286 | 132 | 0 | 8,425 | 207 | 32,600 | 1,546 |
| 2023 | 32,600 | 1,546 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 220 | 4,449 | 0 | 740 | 0 | 1,200 | 8,633 | 1,238 | 3,000 | 1,493 | 8,007 | 286 | 132 | 0 | 8,425 | 208 | 32,808 | 1,546 |
| 2024 | 32,808 | 1,546 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 221 | 4,444 | 0 | 740 | 0 | 1,200 | 8,634 | 1,238 | 3,000 | 1,493 | 8,007 | 286 | 132 | 0 | 8,425 | 209 | 33,016 | 1,546 |
| 2025 | 33,016 | 1,546 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 222 | 4,438 | 0 | 740 | 0 | 1,200 | 8,635 | 1,238 | 3,000 | 1,493 | 8,007 | 286 | 132 | 0 | 8,425 | 210 | 33,226 | 1,545 |
| 2026 | 33,226 | 1,545 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 251 | 4,381 | 0 | 740 | 0 | 1,200 | 8,664 | 1,247 | 3,000 | 1,502 | 8,007 | 286 | 132 | 0 | 8,425 | 239 | 33,465 | 1,547 |
| 2027 | 33,465 | 1,547 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 252 | 4,378 | 0 | 740 | 0 | 1,200 | 8,665 | 1,248 | 3,000 | 1,502 | 8,007 | 286 | 132 | 0 | 8,425 | 240 | 33,705 | 1,548 |
| 2028 | 33,705 | 1,548 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 253 | 4,375 | 0 | 740 | 0 | 1,200 | 8,666 | 1,248 | 3,000 | 1,502 | 8,007 | 286 | 132 | 0 | 8,425 | 241 | 33,946 | 1,550 |
| 2029 | 33,946 | 1,550 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 254 | 4,372 | 0 | 740 | 0 | 1,200 | 8,667 | 1,248 | 3,000 | 1,502 | 8,007 | 286 | 132 | 0 | 8,425 | 242 | 34,188 | 1,550 |
| 2030 | 34,188 | 1,550 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 255 | 4,368 | 0 | 740 | 0 | 1,200 | 8,668 | 1,248 | 3,000 | 1,503 | 8,007 | 286 | 132 | 0 | 8,425 | 243 | 34,431 | 1,551 |
| 2031 | 34,431 | 1,551 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 256 | 4,365 | 0 | 740 | 0 | 1,200 | 8,669 | 1,249 | 3,000 | 1,503 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 34,675 | 1,552 |
| 2032 | 34,675 | 1,552 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 257 | 4,361 | 0 | 740 | 0 | 1,200 | 8,670 | 1,249 | 3,000 | 1,503 | 8,007 | 286 | 132 | 0 | 8,425 | 245 | 34,920 | 1,552 |
| 2033 | 34,920 | 1,552 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 258 | 4,357 | 0 | 740 | 0 | 1,200 | 8,671 | 1,249 | 3,000 | 1,503 | 8,007 | 286 | 132 | 0 | 8,425 | 246 | 35,165 | 1,553 |
| 2034 | 35,165 | 1,553 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 258 | 4,354 | 0 | 740 | 0 | 1,200 | 8,671 | 1,249 | 3,000 | 1,503 | 8,007 | 286 | 132 | 0 | 8,425 | 246 | 35,412 | 1,553 |
| 2035 | 35,412 | 1,553 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,350 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 35,659 | 1,554 |
| 2036 | 35,659 | 1,554 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,350 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 35,907 | 1,554 |
| 2037 | 35,907 | 1,554 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,350 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,154 | 1,554 |
| 2038 | 36,154 | 1,554 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,350 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,401 | 1,554 |
| 2039 | 36,401 | 1,554 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,649 | 1,554 |
| 2040 | 36,649 | 1,554 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,896 | 1,555 |
| 2041 | 36,896 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,143 | 1,555 |
| 2042 | 37,143 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,391 | 1,555 |
| 2043 | 37,391 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,638 | 1,555 |
| 2044 | 37,638 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,886 | 1,555 |
| 2045 | 37,886 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,133 | 1,555 |
| 2046 | 38,133 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,380 | 1,555 |
| 2047 | 38,380 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,628 | 1,555 |
| 2048 | 38,628 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,875 | 1,555 |
| 2049 | 38,875 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 39,122 | 1,555 |
| 2050 | 39,122 | 1,555 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 259 | 4,351 | 0 | 740 | 0 | 1,200 | 8,672 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 39,370 | 1,555 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| min | 25,528 | 1,545 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 205 | 3,782 | 0 | 740 | 0 | 1,200 | 8,618 | 1,219 | 3,000 | 1,475 | 5,189 | 286 | 132 | 0 | 5,607 | 200 | 28,539 | 1,545 |
| max | 39,122 | 1,618 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 263 | 4,516 | 0 | 740 | 0 | 1,200 | 8,676 | 1,249 | 3,000 | 1,504 | 8,007 | 286 | 132 | 0 | 8,425 | 3,011 | 39,370 | 1,593 |
| average | 34,279 | 1,556 | 179 | 400 | 4,349 | 1,115 | 2,625 | 1,450 | 90 | 1,800 | 1,170 | 700 | 245 | 4,353 | 0 | 740 | 0 | 1,200 | 8,658 | 1,244 | 3,000 | 1,499 | 7,894 | 286 | 132 | 0 | 8,312 | 346 | 34,625 | 1,555 |
| **average tons TDS** | | | | **97** | | **6,600** | | **5,182** | | **221** | | **1,115** | | **1,452** | | **0** | | **0** | | **14,665** | **3,000** | **17,666** | | | | | | | | |
| **% of average** | | | | **0.6%** | | **37.4%** | | **29.3%** | | **1.2%** | | **6.3%** | | **8.2%** | | **0.0%** | | **0.0%** | | | **17.0%** | **100.0%** | | | | | | | | |

## Table F-5: CSRM Results for Baseline -- Future

| Year | Storage and TDS at Start of Year | | Inflows: Deep Infiltration of Precipitation | | Streambed Infiltration | | Subsurface Inflow - Middle Trabuco and Oso | | Subsurface Inflow - Horno | | Subsurface Inflow - Middle San Juan | | Deep Infiltration of Applied Water | | Enhanced Stormwater Recharge by SJBA | | Recycled Water Recharge by SJBA | | Total Inflow | | Total Inflow TDS after Natural Loading | | Outflows: Production | Evapo-transpiration | Rising Groundwater | Subsurface Outflow to Pacific Ocean | Total | Change in Storage | Storage and TDS at End of Year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Storage af | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | TDS tons | TDS mg/L | Q afy | Q afy | Q afy | Q afy | Q afy | Q af | Storage af | TDS mg/L |
| 2011 | 25,528 | 1,618 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 205 | 3,886 | 0 | 740 | 0 | 1,200 | 8,618 | 1,270 | 3,000 | 1,526 | 5,189 | 286 | 132 | 0 | 5,607 | 3,011 | 28,539 | 1,608 |
| 2012 | 28,539 | 1,608 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 263 | 3,790 | 0 | 740 | 0 | 1,200 | 8,676 | 1,285 | 3,000 | 1,539 | 6,304 | 286 | 132 | 0 | 6,722 | 1,954 | 30,492 | 1,604 |
| 2013 | 30,492 | 1,604 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 256 | 4,040 | 0 | 740 | 0 | 1,200 | 8,669 | 1,291 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 30,736 | 1,602 |
| 2014 | 30,736 | 1,602 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 249 | 4,340 | 0 | 740 | 0 | 1,200 | 8,662 | 1,297 | 3,000 | 1,551 | 8,007 | 286 | 132 | 0 | 8,425 | 237 | 30,974 | 1,603 |
| 2015 | 30,974 | 1,603 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 212 | 4,555 | 0 | 740 | 0 | 1,200 | 8,625 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 200 | 31,173 | 1,602 |
| 2016 | 31,173 | 1,602 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 213 | 4,547 | 0 | 740 | 0 | 1,200 | 8,626 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 201 | 31,374 | 1,601 |
| 2017 | 31,374 | 1,601 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 214 | 4,540 | 0 | 740 | 0 | 1,200 | 8,627 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 202 | 31,576 | 1,600 |
| 2018 | 31,576 | 1,600 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 215 | 4,532 | 0 | 740 | 0 | 1,200 | 8,628 | 1,290 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 203 | 31,779 | 1,600 |
| 2019 | 31,779 | 1,600 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 216 | 4,526 | 0 | 740 | 0 | 1,200 | 8,629 | 1,290 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 204 | 31,982 | 1,599 |
| 2020 | 31,982 | 1,599 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 217 | 4,519 | 0 | 740 | 0 | 1,200 | 8,630 | 1,290 | 3,000 | 1,546 | 8,007 | 286 | 132 | 0 | 8,425 | 205 | 32,187 | 1,599 |
| 2021 | 32,187 | 1,599 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 218 | 4,514 | 0 | 740 | 0 | 1,200 | 8,631 | 1,290 | 3,000 | 1,546 | 8,007 | 286 | 132 | 0 | 8,425 | 206 | 32,393 | 1,599 |
| 2022 | 32,393 | 1,599 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 219 | 4,508 | 0 | 740 | 0 | 1,200 | 8,632 | 1,291 | 3,000 | 1,546 | 8,007 | 286 | 132 | 0 | 8,425 | 207 | 32,600 | 1,599 |
| 2023 | 32,600 | 1,599 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 220 | 4,503 | 0 | 740 | 0 | 1,200 | 8,633 | 1,291 | 3,000 | 1,546 | 8,007 | 286 | 132 | 0 | 8,425 | 208 | 32,808 | 1,599 |
| 2024 | 32,808 | 1,599 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 221 | 4,498 | 0 | 740 | 0 | 1,200 | 8,634 | 1,291 | 3,000 | 1,546 | 8,007 | 286 | 132 | 0 | 8,425 | 209 | 33,016 | 1,599 |
| 2025 | 33,016 | 1,599 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 222 | 4,493 | 0 | 740 | 0 | 1,200 | 8,635 | 1,291 | 3,000 | 1,547 | 8,007 | 286 | 132 | 0 | 8,425 | 210 | 33,226 | 1,599 |
| 2026 | 33,226 | 1,599 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 251 | 4,429 | 0 | 740 | 0 | 1,200 | 8,664 | 1,300 | 3,000 | 1,555 | 8,007 | 286 | 132 | 0 | 8,425 | 239 | 33,465 | 1,601 |
| 2027 | 33,465 | 1,601 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 252 | 4,426 | 0 | 740 | 0 | 1,200 | 8,665 | 1,301 | 3,000 | 1,555 | 8,007 | 286 | 132 | 0 | 8,425 | 240 | 33,705 | 1,603 |
| 2028 | 33,705 | 1,603 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 253 | 4,423 | 0 | 740 | 0 | 1,200 | 8,666 | 1,301 | 3,000 | 1,555 | 8,007 | 286 | 132 | 0 | 8,425 | 241 | 33,946 | 1,604 |
| 2029 | 33,946 | 1,604 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 254 | 4,420 | 0 | 740 | 0 | 1,200 | 8,667 | 1,301 | 3,000 | 1,555 | 8,007 | 286 | 132 | 0 | 8,425 | 242 | 34,188 | 1,605 |
| 2030 | 34,188 | 1,605 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 255 | 4,416 | 0 | 740 | 0 | 1,200 | 8,668 | 1,301 | 3,000 | 1,556 | 8,007 | 286 | 132 | 0 | 8,425 | 243 | 34,431 | 1,606 |
| 2031 | 34,431 | 1,606 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 256 | 4,413 | 0 | 740 | 0 | 1,200 | 8,669 | 1,301 | 3,000 | 1,556 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 34,675 | 1,606 |
| 2032 | 34,675 | 1,606 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 257 | 4,409 | 0 | 740 | 0 | 1,200 | 8,670 | 1,302 | 3,000 | 1,556 | 8,007 | 286 | 132 | 0 | 8,425 | 245 | 34,920 | 1,607 |
| 2033 | 34,920 | 1,607 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 258 | 4,405 | 0 | 740 | 0 | 1,200 | 8,671 | 1,302 | 3,000 | 1,556 | 8,007 | 286 | 132 | 0 | 8,425 | 246 | 35,165 | 1,607 |
| 2034 | 35,165 | 1,607 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 258 | 4,401 | 0 | 740 | 0 | 1,200 | 8,671 | 1,302 | 3,000 | 1,556 | 8,007 | 286 | 132 | 0 | 8,425 | 246 | 35,412 | 1,608 |
| 2035 | 35,412 | 1,608 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,397 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 35,659 | 1,608 |
| 2036 | 35,659 | 1,608 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,397 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 35,907 | 1,609 |
| 2037 | 35,907 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,154 | 1,609 |
| 2038 | 36,154 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,401 | 1,609 |
| 2039 | 36,401 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,649 | 1,609 |
| 2040 | 36,649 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,896 | 1,609 |
| 2041 | 36,896 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,143 | 1,609 |
| 2042 | 37,143 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,391 | 1,609 |
| 2043 | 37,391 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,638 | 1,609 |
| 2044 | 37,638 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,886 | 1,609 |
| 2045 | 37,886 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,133 | 1,609 |
| 2046 | 38,133 | 1,609 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,380 | 1,610 |
| 2047 | 38,380 | 1,610 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,628 | 1,610 |
| 2048 | 38,628 | 1,610 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,875 | 1,610 |
| 2049 | 38,875 | 1,610 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 39,122 | 1,610 |
| 2050 | 39,122 | 1,610 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,398 | 0 | 740 | 0 | 1,200 | 8,672 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 39,370 | 1,610 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| min | 25,528 | 1,599 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 205 | 3,790 | 0 | 740 | 0 | 1,200 | 8,618 | 1,270 | 3,000 | 1,526 | 5,189 | 286 | 132 | 0 | 5,607 | 200 | 28,539 | 1,599 |
| max | 39,122 | 1,618 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 263 | 4,555 | 0 | 740 | 0 | 1,200 | 8,676 | 1,302 | 3,000 | 1,557 | 8,007 | 286 | 132 | 0 | 8,425 | 3,011 | 39,370 | 1,610 |
| average | 34,279 | 1,605 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 245 | 4,397 | 0 | 740 | 0 | 1,200 | 8,658 | 1,297 | 3,000 | 1,552 | 7,894 | 286 | 132 | 0 | 8,312 | 346 | 34,625 | 1,605 |
| average tons TDS | | | | 97 | | 6,927 | | 5,360 | | 243 | | 1,195 | | 1,467 | | 0 | | 0 | | 15,288 | 3,000 | 18,289 | | | | | | | | |
| % of average | | | | 0.5% | | 37.9% | | 29.3% | | 1.3% | | 6.5% | | 8.0% | | 0.0% | | 0.0% | | | 16.4% | 100.0% | | | | | | | | |

**Table F-6: CSRM Results for SJBA GWMFP Alternative 6a**

| Year | Storage and TDS at Start of Year | | Inflows | | | | | | | | | | | | | | | | | | | | Outflows | | | | | Change in Storage | Storage and TDS at End of Year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Deep Infiltration of Precipitation | | Streambed Infiltration | | Subsurface Inflow - Middle Trabuco and Oso | | Subsurface Inflow - Horno | | Subsurface Inflow - Middle San Juan | | Deep Infiltration of Applied Water | | Enhanced Stormwater Recharge by SJBA | | Recycled Water Recharge by SJBA | | Total Inflow | | Total Inflow TDS after Natural Loading | | Production | Evapo-transpiration | Rising Groundwater | Subsurface Outflow to Pacific Ocean | Total | | | |
| | Storage af | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | TDS tons | TDS mg/L | Q afy | Q afy | Q afy | Q afy | Q afy | Q af | Storage af | TDS mg/L |
| 2011 | 25,528 | 1,618 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 205 | 3,886 | 0 | 740 | 0 | 1,200 | 8,618 | 1,270 | 3,000 | 1,526 | 5,189 | 286 | 132 | 0 | 5,607 | 3,011 | 28,539 | 1,608 |
| 2012 | 28,539 | 1,608 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 263 | 3,790 | 0 | 740 | 0 | 1,200 | 8,676 | 1,285 | 3,000 | 1,539 | 6,304 | 286 | 132 | 0 | 6,722 | 1,954 | 30,492 | 1,604 |
| 2013 | 30,492 | 1,604 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 256 | 4,040 | 0 | 740 | 0 | 1,200 | 8,669 | 1,291 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 30,736 | 1,602 |
| 2014 | 30,736 | 1,602 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 249 | 4,340 | 0 | 740 | 0 | 1,200 | 8,662 | 1,297 | 3,000 | 1,551 | 8,007 | 286 | 132 | 0 | 8,425 | 237 | 30,974 | 1,603 |
| 2015 | 30,974 | 1,603 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 212 | 4,555 | 0 | 740 | 0 | 1,200 | 8,625 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 200 | 31,173 | 1,602 |
| 2016 | 31,173 | 1,602 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 213 | 4,547 | 0 | 740 | 0 | 1,200 | 8,626 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 201 | 31,374 | 1,601 |
| 2017 | 31,374 | 1,601 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 214 | 4,540 | 0 | 740 | 0 | 1,200 | 8,627 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 202 | 31,576 | 1,600 |
| 2018 | 31,576 | 1,600 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 215 | 4,532 | 0 | 740 | 0 | 1,200 | 8,628 | 1,290 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 203 | 31,779 | 1,600 |
| 2019 | 31,779 | 1,600 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 216 | 4,526 | 1,000 | 740 | 0 | 1,200 | 9,629 | 1,233 | 3,000 | 1,462 | 8,007 | 286 | 132 | 0 | 8,425 | 1,204 | 32,982 | 1,576 |
| 2020 | 32,982 | 1,576 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 217 | 4,495 | 1,000 | 740 | 0 | 1,200 | 9,630 | 1,232 | 3,000 | 1,461 | 9,007 | 286 | 132 | 0 | 9,425 | 205 | 33,187 | 1,559 |
| 2021 | 33,187 | 1,559 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 218 | 4,472 | 1,000 | 740 | 0 | 1,200 | 9,631 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,662 | 31,525 | 1,545 |
| 2022 | 31,525 | 1,545 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 219 | 4,453 | 1,000 | 740 | 0 | 1,200 | 9,632 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,661 | 29,864 | 1,535 |
| 2023 | 29,864 | 1,535 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 220 | 4,437 | 1,000 | 740 | 0 | 1,200 | 9,633 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,660 | 28,204 | 1,527 |
| 2024 | 28,204 | 1,527 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 221 | 4,424 | 1,000 | 740 | 0 | 1,200 | 9,634 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,659 | 26,544 | 1,521 |
| 2025 | 26,544 | 1,521 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 222 | 4,413 | 1,000 | 740 | 2,000 | 1,200 | 11,635 | 1,227 | 3,000 | 1,416 | 10,685 | 286 | 0 | 0 | 10,971 | 664 | 27,208 | 1,497 |
| 2026 | 27,208 | 1,497 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 251 | 4,337 | 1,000 | 740 | 2,000 | 1,200 | 11,664 | 1,233 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 193 | 27,401 | 1,483 |
| 2027 | 27,401 | 1,483 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 252 | 4,321 | 1,000 | 740 | 2,000 | 1,200 | 11,665 | 1,233 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 194 | 27,595 | 1,475 |
| 2028 | 27,595 | 1,475 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 253 | 4,309 | 1,000 | 740 | 2,000 | 1,200 | 11,666 | 1,233 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 195 | 27,790 | 1,469 |
| 2029 | 27,790 | 1,469 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 254 | 4,300 | 1,000 | 740 | 2,000 | 1,200 | 11,667 | 1,233 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 196 | 27,986 | 1,465 |
| 2030 | 27,986 | 1,465 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 255 | 4,293 | 1,000 | 740 | 2,000 | 1,200 | 11,668 | 1,233 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 197 | 28,183 | 1,463 |
| 2031 | 28,183 | 1,463 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 256 | 4,287 | 1,000 | 740 | 2,000 | 1,200 | 11,669 | 1,233 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 198 | 28,381 | 1,461 |
| 2032 | 28,381 | 1,461 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 257 | 4,282 | 1,000 | 740 | 2,000 | 1,200 | 11,670 | 1,233 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 199 | 28,580 | 1,460 |
| 2033 | 28,580 | 1,460 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 258 | 4,277 | 1,000 | 740 | 2,000 | 1,200 | 11,671 | 1,233 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 200 | 28,779 | 1,459 |
| 2034 | 28,779 | 1,459 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 258 | 4,272 | 1,000 | 740 | 2,000 | 1,200 | 11,671 | 1,234 | 3,000 | 1,422 | 11,185 | 286 | 0 | 0 | 11,471 | 200 | 28,980 | 1,459 |
| 2035 | 28,980 | 1,459 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 29,181 | 1,459 |
| 2036 | 29,181 | 1,459 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 29,383 | 1,459 |
| 2037 | 29,383 | 1,459 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 29,584 | 1,459 |
| 2038 | 29,584 | 1,459 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 29,785 | 1,458 |
| 2039 | 29,785 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 29,987 | 1,458 |
| 2040 | 29,987 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 30,188 | 1,458 |
| 2041 | 30,188 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 30,389 | 1,458 |
| 2042 | 30,389 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 30,591 | 1,458 |
| 2043 | 30,591 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 30,792 | 1,458 |
| 2044 | 30,792 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 30,994 | 1,458 |
| 2045 | 30,994 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 31,195 | 1,458 |
| 2046 | 31,195 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 31,396 | 1,458 |
| 2047 | 31,396 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 31,598 | 1,458 |
| 2048 | 31,598 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,268 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 31,799 | 1,458 |
| 2049 | 31,799 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,267 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 32,000 | 1,458 |
| 2050 | 32,000 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,267 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,234 | 3,000 | 1,423 | 11,185 | 286 | 0 | 0 | 11,471 | 201 | 32,202 | 1,458 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| min | 25,528 | 1,458 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 205 | 3,790 | 0 | 740 | 0 | 1,200 | 8,618 | 1,227 | 3,000 | 1,416 | 5,189 | 286 | 0 | 0 | 5,607 | -1,662 | 26,544 | 1,458 |
| max | 33,187 | 1,618 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 263 | 4,555 | 1,000 | 740 | 2,000 | 1,200 | 11,672 | 1,297 | 3,000 | 1,551 | 11,185 | 286 | 132 | 0 | 11,471 | 3,011 | 33,187 | 1,608 |
| average | 29,856 | 1,507 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 245 | 4,310 | 800 | 740 | 1,300 | 1,200 | 10,758 | 1,244 | 3,000 | 1,452 | 10,272 | 286 | 33 | 0 | 10,591 | 167 | 30,022 | 1,503 |
| **average tons TDS** | | | | **97** | | **6,927** | | **5,360** | | **243** | | **1,195** | | **1,438** | | **806** | | **2,124** | | **18,218** | **3,000** | **21,267** | | | | | | | | |
| **% of average** | | | | **0.5%** | | **32.6%** | | **25.2%** | | **1.1%** | | **5.6%** | | **6.8%** | | **3.8%** | | **10.0%** | | | **14.1%** | **100.0%** | | | | | | | | |

**Tbale F-7: CSRM Results for SJBA GWMFP Alternative 6b**

| Year | Storage and TDS at Start of Year | | Inflows | | | | | | | | | | | | | | | | | | | | Outflows | | | | | Change in Storage | Storage and TDS at End of Year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Deep Infiltration of Precipitation | | Streambed Infiltration | | Subsurface Inflow - Middle Trabuco and Oso | | Subsurface Inflow - Horno | | Subsurface Inflow - Middle San Juan | | Deep Infiltration of Applied Water | | Enhanced Stormwater Recharge by SJBA | | Recycled Water Recharge by SJBA | | Total Inflow | | Total Inflow TDS after Natural Loading | | Production | Evapo-transpiration | Rising Groundwater | Subsurface Outflow to Pacific Ocean | Total | | | |
| | Storage af | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | TDS tons | TDS mg/L | Q afy | Q afy | Q afy | Q afy | Q afy | Q af | Storage af | TDS mg/L |
| 2011 | 25,528 | 1,618 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 205 | 3,886 | 0 | 740 | 0 | 1,200 | 8,618 | 1,270 | 3,000 | 1,526 | 5,189 | 286 | 132 | 0 | 5,607 | 3,011 | 28,539 | 1,608 |
| 2012 | 28,539 | 1,608 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 263 | 3,790 | 0 | 740 | 0 | 1,200 | 8,676 | 1,285 | 3,000 | 1,539 | 6,304 | 286 | 132 | 0 | 6,722 | 1,954 | 30,492 | 1,604 |
| 2013 | 30,492 | 1,604 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 256 | 4,040 | 0 | 740 | 0 | 1,200 | 8,669 | 1,291 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 30,736 | 1,602 |
| 2014 | 30,736 | 1,602 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 249 | 4,340 | 0 | 740 | 0 | 1,200 | 8,662 | 1,297 | 3,000 | 1,551 | 8,007 | 286 | 132 | 0 | 8,425 | 237 | 30,974 | 1,603 |
| 2015 | 30,974 | 1,603 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 212 | 4,555 | 0 | 740 | 0 | 1,200 | 8,625 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 200 | 31,173 | 1,602 |
| 2016 | 31,173 | 1,602 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 213 | 4,547 | 0 | 740 | 0 | 1,200 | 8,626 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 201 | 31,374 | 1,601 |
| 2017 | 31,374 | 1,601 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 214 | 4,540 | 0 | 740 | 0 | 1,200 | 8,627 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 202 | 31,576 | 1,600 |
| 2018 | 31,576 | 1,600 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 215 | 4,532 | 0 | 740 | 0 | 1,200 | 8,628 | 1,290 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 203 | 31,779 | 1,600 |
| 2019 | 31,779 | 1,600 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 216 | 4,526 | 1,000 | 740 | 0 | 1,200 | 9,629 | 1,233 | 3,000 | 1,462 | 8,007 | 286 | 132 | 0 | 8,425 | 1,204 | 32,982 | 1,576 |
| 2020 | 32,982 | 1,576 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 217 | 4,495 | 1,000 | 740 | 0 | 1,200 | 9,630 | 1,232 | 3,000 | 1,461 | 9,007 | 286 | 132 | 0 | 9,425 | 205 | 33,187 | 1,559 |
| 2021 | 33,187 | 1,559 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 218 | 4,472 | 1,000 | 740 | 0 | 1,200 | 9,631 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,662 | 31,525 | 1,545 |
| 2022 | 31,525 | 1,545 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 219 | 4,453 | 1,000 | 740 | 0 | 1,200 | 9,632 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,661 | 29,864 | 1,535 |
| 2023 | 29,864 | 1,535 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 220 | 4,437 | 1,000 | 740 | 0 | 1,200 | 9,633 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,660 | 28,204 | 1,527 |
| 2024 | 28,204 | 1,527 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 221 | 4,424 | 1,000 | 740 | 0 | 1,200 | 9,634 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,659 | 26,544 | 1,521 |
| 2025 | 26,544 | 1,521 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 222 | 4,413 | 1,000 | 740 | 5,000 | 1,200 | 14,635 | 1,221 | 3,000 | 1,372 | 14,185 | 286 | 0 | 0 | 14,471 | 164 | 26,708 | 1,469 |
| 2026 | 26,708 | 1,469 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 251 | 4,312 | 1,000 | 740 | 5,000 | 1,200 | 14,664 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 193 | 26,901 | 1,441 |
| 2027 | 26,901 | 1,441 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 252 | 4,284 | 1,000 | 740 | 5,000 | 1,200 | 14,665 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 194 | 27,095 | 1,425 |
| 2028 | 27,095 | 1,425 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 253 | 4,266 | 1,000 | 740 | 5,000 | 1,200 | 14,666 | 1,225 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 195 | 27,290 | 1,416 |
| 2029 | 27,290 | 1,416 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 254 | 4,254 | 1,000 | 740 | 5,000 | 1,200 | 14,667 | 1,225 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 196 | 27,486 | 1,411 |
| 2030 | 27,486 | 1,411 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 255 | 4,245 | 1,000 | 740 | 5,000 | 1,200 | 14,668 | 1,225 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 197 | 27,683 | 1,408 |
| 2031 | 27,683 | 1,408 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 256 | 4,239 | 1,000 | 740 | 5,000 | 1,200 | 14,669 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 198 | 27,881 | 1,406 |
| 2032 | 27,881 | 1,406 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 257 | 4,233 | 1,000 | 740 | 5,000 | 1,200 | 14,670 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 199 | 28,080 | 1,405 |
| 2033 | 28,080 | 1,405 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 258 | 4,229 | 1,000 | 740 | 5,000 | 1,200 | 14,671 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 200 | 28,279 | 1,404 |
| 2034 | 28,279 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 258 | 4,224 | 1,000 | 740 | 5,000 | 1,200 | 14,671 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 200 | 28,480 | 1,404 |
| 2035 | 28,480 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 28,681 | 1,404 |
| 2036 | 28,681 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 28,883 | 1,404 |
| 2037 | 28,883 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 29,084 | 1,404 |
| 2038 | 29,084 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 29,285 | 1,404 |
| 2039 | 29,285 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 29,487 | 1,404 |
| 2040 | 29,487 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 29,688 | 1,404 |
| 2041 | 29,688 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 29,889 | 1,404 |
| 2042 | 29,889 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 30,091 | 1,404 |
| 2043 | 30,091 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 30,292 | 1,404 |
| 2044 | 30,292 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 30,494 | 1,404 |
| 2045 | 30,494 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 30,695 | 1,404 |
| 2046 | 30,695 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 30,896 | 1,404 |
| 2047 | 30,896 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 31,098 | 1,404 |
| 2048 | 31,098 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 31,299 | 1,404 |
| 2049 | 31,299 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 31,500 | 1,404 |
| 2050 | 31,500 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,220 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,226 | 3,000 | 1,376 | 14,185 | 286 | 0 | 0 | 14,471 | 201 | 31,702 | 1,404 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| min | 25,528 | 1,404 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 205 | 3,790 | 0 | 740 | 0 | 1,200 | 8,618 | 1,221 | 3,000 | 1,372 | 5,189 | 286 | 0 | 0 | 5,607 | -1,662 | 26,544 | 1,404 |
| max | 33,187 | 1,618 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 263 | 4,555 | 1,000 | 740 | 5,000 | 1,200 | 14,672 | 1,297 | 3,000 | 1,551 | 14,185 | 286 | 132 | 0 | 14,471 | 3,011 | 33,187 | 1,608 |
| average | 29,543 | 1,474 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 245 | 4,281 | 800 | 740 | 3,250 | 1,200 | 12,708 | 1,239 | 3,000 | 1,422 | 12,235 | 286 | 33 | 0 | 12,554 | 154 | 29,697 | 1,468 |
| average tons TDS | | | | 97 | | 6,927 | | 5,360 | | 243 | | 1,195 | | 1,428 | | 806 | | 5,309 | | 21,435 | 3,000 | 24,602 | | | | | | | | |
| % of average | | | | 0.4% | | 28.2% | | 21.8% | | 1.0% | | 4.9% | | 5.8% | | 3.3% | | 21.6% | | | 12.2% | 100.0% | | | | | | | | |

## Table F-8: CSRM Results for SJBA GWMFP Alternative 6c

| Year | Storage and TDS at Start of Year | | Inflows | | | | | | | | | | | | | | | | | | | | Outflows | | | | | Change in Storage | Storage and TDS at End of Year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Deep Infiltration of Precipitation | | Streambed Infiltration | | Subsurface Inflow - Middle Trabuco and Oso | | Subsurface Inflow - Horno | | Subsurface Inflow - Middle San Juan | | Deep Infiltration of Applied Water | | Enhanced Stormwater Recharge by SJBA | | Recycled Water Recharge by SJBA | | Total Inflow | | Total Inflow TDS after Natural Loading | | Production | Evapo-transpiration | Rising Groundwater | Subsurface Outflow to Pacific Ocean | Total | | | |
| | Storage af | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | TDS tons | TDS mg/L | Q afy | Q afy | Q afy | Q afy | Q afy | Q af | Storage af | TDS mg/L |
| 2011 | 25,528 | 1,618 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 205 | 3,886 | 0 | 740 | 0 | 1,200 | 8,618 | 1,270 | 3,000 | 1,526 | 5,189 | 286 | 132 | 0 | 5,607 | 3,011 | 28,539 | 1,608 |
| 2012 | 28,539 | 1,608 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 263 | 3,790 | 0 | 740 | 0 | 1,200 | 8,676 | 1,285 | 3,000 | 1,539 | 6,304 | 286 | 132 | 0 | 6,722 | 1,954 | 30,492 | 1,604 |
| 2013 | 30,492 | 1,604 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 256 | 4,040 | 0 | 740 | 0 | 1,200 | 8,669 | 1,291 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 30,736 | 1,602 |
| 2014 | 30,736 | 1,602 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 249 | 4,340 | 0 | 740 | 0 | 1,200 | 8,662 | 1,297 | 3,000 | 1,551 | 8,007 | 286 | 132 | 0 | 8,425 | 237 | 30,974 | 1,603 |
| 2015 | 30,974 | 1,603 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 212 | 4,555 | 0 | 740 | 0 | 1,200 | 8,625 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 200 | 31,173 | 1,602 |
| 2016 | 31,173 | 1,602 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 213 | 4,547 | 0 | 740 | 0 | 1,200 | 8,626 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 201 | 31,374 | 1,601 |
| 2017 | 31,374 | 1,601 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 214 | 4,540 | 0 | 740 | 0 | 1,200 | 8,627 | 1,289 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 202 | 31,576 | 1,600 |
| 2018 | 31,576 | 1,600 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 215 | 4,532 | 0 | 740 | 0 | 1,200 | 8,628 | 1,290 | 3,000 | 1,545 | 8,007 | 286 | 132 | 0 | 8,425 | 203 | 31,779 | 1,600 |
| 2019 | 31,779 | 1,600 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 216 | 4,526 | 1,000 | 740 | 0 | 1,200 | 9,629 | 1,233 | 3,000 | 1,462 | 8,007 | 286 | 132 | 0 | 8,425 | 1,204 | 32,982 | 1,576 |
| 2020 | 32,982 | 1,576 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 217 | 4,495 | 1,000 | 740 | 0 | 1,200 | 9,630 | 1,232 | 3,000 | 1,461 | 9,007 | 286 | 132 | 0 | 9,425 | 205 | 33,187 | 1,559 |
| 2021 | 33,187 | 1,559 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 218 | 4,472 | 1,000 | 740 | 0 | 1,200 | 9,631 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,662 | 31,525 | 1,545 |
| 2022 | 31,525 | 1,545 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 219 | 4,453 | 1,000 | 740 | 0 | 1,200 | 9,632 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,661 | 29,864 | 1,535 |
| 2023 | 29,864 | 1,535 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 220 | 4,437 | 1,000 | 740 | 0 | 1,200 | 9,633 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,660 | 28,204 | 1,527 |
| 2024 | 28,204 | 1,527 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 221 | 4,424 | 1,000 | 740 | 0 | 1,200 | 9,634 | 1,232 | 3,000 | 1,461 | 11,007 | 286 | 0 | 0 | 11,293 | -1,659 | 26,544 | 1,521 |
| 2025 | 26,544 | 1,521 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 222 | 4,413 | 1,000 | 740 | 10,000 | 1,200 | 19,635 | 1,216 | 3,000 | 1,328 | 19,185 | 286 | 0 | 0 | 19,471 | 164 | 26,708 | 1,428 |
| 2026 | 26,708 | 1,428 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 251 | 4,276 | 1,000 | 740 | 10,000 | 1,200 | 19,664 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 193 | 26,901 | 1,387 |
| 2027 | 26,901 | 1,387 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 252 | 4,235 | 1,000 | 740 | 10,000 | 1,200 | 19,665 | 1,218 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 194 | 27,095 | 1,368 |
| 2028 | 27,095 | 1,368 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 253 | 4,214 | 1,000 | 740 | 10,000 | 1,200 | 19,666 | 1,218 | 3,000 | 1,330 | 19,185 | 286 | 0 | 0 | 19,471 | 195 | 27,290 | 1,358 |
| 2029 | 27,290 | 1,358 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 254 | 4,203 | 1,000 | 740 | 10,000 | 1,200 | 19,667 | 1,218 | 3,000 | 1,330 | 19,185 | 286 | 0 | 0 | 19,471 | 196 | 27,486 | 1,354 |
| 2030 | 27,486 | 1,354 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 255 | 4,195 | 1,000 | 740 | 10,000 | 1,200 | 19,668 | 1,218 | 3,000 | 1,330 | 19,185 | 286 | 0 | 0 | 19,471 | 197 | 27,683 | 1,352 |
| 2031 | 27,683 | 1,352 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 256 | 4,190 | 1,000 | 740 | 10,000 | 1,200 | 19,669 | 1,218 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 198 | 27,881 | 1,351 |
| 2032 | 27,881 | 1,351 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 257 | 4,185 | 1,000 | 740 | 10,000 | 1,200 | 19,670 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 199 | 28,080 | 1,351 |
| 2033 | 28,080 | 1,351 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 258 | 4,181 | 1,000 | 740 | 10,000 | 1,200 | 19,671 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 200 | 28,279 | 1,350 |
| 2034 | 28,279 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 258 | 4,178 | 1,000 | 740 | 10,000 | 1,200 | 19,671 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 200 | 28,480 | 1,350 |
| 2035 | 28,480 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 28,681 | 1,350 |
| 2036 | 28,681 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 28,883 | 1,350 |
| 2037 | 28,883 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 29,084 | 1,350 |
| 2038 | 29,084 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 29,285 | 1,350 |
| 2039 | 29,285 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 29,487 | 1,350 |
| 2040 | 29,487 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 29,688 | 1,350 |
| 2041 | 29,688 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 29,889 | 1,350 |
| 2042 | 29,889 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 30,091 | 1,350 |
| 2043 | 30,091 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 30,292 | 1,350 |
| 2044 | 30,292 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 30,494 | 1,350 |
| 2045 | 30,494 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 30,695 | 1,350 |
| 2046 | 30,695 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 30,896 | 1,350 |
| 2047 | 30,896 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 31,098 | 1,350 |
| 2048 | 31,098 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 31,299 | 1,350 |
| 2049 | 31,299 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 31,500 | 1,350 |
| 2050 | 31,500 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 259 | 4,174 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,219 | 3,000 | 1,331 | 19,185 | 286 | 0 | 0 | 19,471 | 201 | 31,702 | 1,350 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| min | 25,528 | 1,350 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 205 | 3,790 | 0 | 740 | 0 | 1,200 | 8,618 | 1,216 | 3,000 | 1,328 | 5,189 | 286 | 0 | 0 | 5,607 | -1,662 | 26,544 | 1,350 |
| max | 33,187 | 1,618 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 263 | 4,555 | 1,000 | 740 | 10,000 | 1,200 | 19,672 | 1,297 | 3,000 | 1,551 | 19,185 | 286 | 132 | 0 | 19,471 | 3,011 | 33,187 | 1,608 |
| average | 29,543 | 1,440 | 179 | 400 | 4,349 | 1,170 | 2,625 | 1,500 | 90 | 1,980 | 1,170 | 750 | 245 | 4,252 | 800 | 740 | 6,500 | 1,200 | 15,958 | 1,234 | 3,000 | 1,393 | 15,485 | 286 | 33 | 0 | 15,804 | 154 | 29,697 | 1,433 |
| **average tons TDS** | | | | **97** | | **6,927** | | **5,360** | | **243** | | **1,195** | | **1,418** | | **806** | | **10,618** | | **26,817** | **3,000** | **30,254** | | | | | | | | |
| **% of average** | | | | **0.3%** | | **22.9%** | | **17.7%** | | **0.8%** | | **3.9%** | | **4.7%** | | **2.7%** | | **35.1%** | | | **9.9%** | **100.0%** | | | | | | | | |

## Table F-9: CSRM Results for No Recycled Water Reuse

| Year | Storage and TDS at Start of Year | | Inflows | | | | | | | | | | | | | | | | | | | | | Outflows | | | | | Change in Storage | Storage and TDS at End of Year | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Deep Infiltration of Precipitation | | Streambed Infiltration | | Subsurface Inflow - Middle Trabuco and Oso | | Subsurface Inflow - Horno | | Subsurface Inflow - Middle San Juan | | Deep Infiltration of Applied Water | | Enhanced Stormwater Recharge by SJBA | | Recycled Water Recharge by SJBA | | Total Inflow | | Total Inflow TDS after Natural Loading | | Production | Evapo-transpiration | Rising Groundwater | Subsurface Outflow to Pacific Ocean | Total | | | |
| | Storage af | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | Q afy | TDS mg/L | TDS tons | TDS mg/L | Q afy | Q afy | Q afy | Q afy | Q afy | Q af | Storage af | TDS mg/L |
| 2011 | 25,528 | 1,618 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 205 | 3,848 | 0 | 740 | 0 | 1,200 | 8,618 | 1,096 | 3,000 | 1,352 | 5,189 | 286 | 132 | 0 | 5,607 | 3,011 | 28,539 | 1,559 |
| 2012 | 28,539 | 1,559 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 263 | 3,723 | 0 | 740 | 0 | 1,200 | 8,676 | 1,111 | 3,000 | 1,365 | 6,304 | 286 | 132 | 0 | 6,722 | 1,954 | 30,492 | 1,523 |
| 2013 | 30,492 | 1,523 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 256 | 3,925 | 0 | 740 | 0 | 1,200 | 8,669 | 1,115 | 3,000 | 1,369 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 30,736 | 1,497 |
| 2014 | 30,736 | 1,497 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 249 | 3,923 | 0 | 740 | 0 | 1,200 | 8,662 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 237 | 30,974 | 1,477 |
| 2015 | 30,974 | 1,477 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 212 | 4,042 | 0 | 740 | 0 | 1,200 | 8,625 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 200 | 31,173 | 1,460 |
| 2016 | 31,173 | 1,460 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 213 | 4,020 | 0 | 740 | 0 | 1,200 | 8,626 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 201 | 31,374 | 1,447 |
| 2017 | 31,374 | 1,447 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 214 | 4,002 | 0 | 740 | 0 | 1,200 | 8,627 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 202 | 31,576 | 1,437 |
| 2018 | 31,576 | 1,437 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 215 | 3,987 | 0 | 740 | 0 | 1,200 | 8,628 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 203 | 31,779 | 1,430 |
| 2019 | 31,779 | 1,430 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 216 | 3,975 | 0 | 740 | 0 | 1,200 | 8,629 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 204 | 31,982 | 1,424 |
| 2020 | 31,982 | 1,424 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 217 | 3,965 | 0 | 740 | 0 | 1,200 | 8,630 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 205 | 32,187 | 1,420 |
| 2021 | 32,187 | 1,420 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 218 | 3,957 | 0 | 740 | 0 | 1,200 | 8,631 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 206 | 32,393 | 1,416 |
| 2022 | 32,393 | 1,416 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 219 | 3,950 | 0 | 740 | 0 | 1,200 | 8,632 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 207 | 32,600 | 1,414 |
| 2023 | 32,600 | 1,414 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 220 | 3,944 | 0 | 740 | 0 | 1,200 | 8,633 | 1,103 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 208 | 32,808 | 1,412 |
| 2024 | 32,808 | 1,412 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 221 | 3,939 | 0 | 740 | 0 | 1,200 | 8,634 | 1,104 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 209 | 33,016 | 1,411 |
| 2025 | 33,016 | 1,411 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 222 | 3,934 | 0 | 740 | 0 | 1,200 | 8,635 | 1,104 | 3,000 | 1,359 | 8,007 | 286 | 132 | 0 | 8,425 | 210 | 33,226 | 1,409 |
| 2026 | 33,226 | 1,409 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 251 | 3,839 | 0 | 740 | 0 | 1,200 | 8,664 | 1,111 | 3,000 | 1,365 | 8,007 | 286 | 132 | 0 | 8,425 | 239 | 33,465 | 1,410 |
| 2027 | 33,465 | 1,410 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 252 | 3,836 | 0 | 740 | 0 | 1,200 | 8,665 | 1,111 | 3,000 | 1,365 | 8,007 | 286 | 132 | 0 | 8,425 | 240 | 33,705 | 1,410 |
| 2028 | 33,705 | 1,410 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 253 | 3,834 | 0 | 740 | 0 | 1,200 | 8,666 | 1,111 | 3,000 | 1,366 | 8,007 | 286 | 132 | 0 | 8,425 | 241 | 33,946 | 1,411 |
| 2029 | 33,946 | 1,411 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 254 | 3,832 | 0 | 740 | 0 | 1,200 | 8,667 | 1,111 | 3,000 | 1,366 | 8,007 | 286 | 132 | 0 | 8,425 | 242 | 34,188 | 1,411 |
| 2030 | 34,188 | 1,411 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 255 | 3,830 | 0 | 740 | 0 | 1,200 | 8,668 | 1,112 | 3,000 | 1,366 | 8,007 | 286 | 132 | 0 | 8,425 | 243 | 34,431 | 1,412 |
| 2031 | 34,431 | 1,412 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 256 | 3,828 | 0 | 740 | 0 | 1,200 | 8,669 | 1,112 | 3,000 | 1,366 | 8,007 | 286 | 132 | 0 | 8,425 | 244 | 34,675 | 1,412 |
| 2032 | 34,675 | 1,412 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 257 | 3,825 | 0 | 740 | 0 | 1,200 | 8,670 | 1,112 | 3,000 | 1,366 | 8,007 | 286 | 132 | 0 | 8,425 | 245 | 34,920 | 1,412 |
| 2033 | 34,920 | 1,412 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 258 | 3,823 | 0 | 740 | 0 | 1,200 | 8,671 | 1,112 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 246 | 35,165 | 1,412 |
| 2034 | 35,165 | 1,412 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 258 | 3,821 | 0 | 740 | 0 | 1,200 | 8,671 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 246 | 35,412 | 1,413 |
| 2035 | 35,412 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,819 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 35,659 | 1,413 |
| 2036 | 35,659 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,819 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 35,907 | 1,413 |
| 2037 | 35,907 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,819 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,154 | 1,413 |
| 2038 | 36,154 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,819 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,401 | 1,413 |
| 2039 | 36,401 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,649 | 1,413 |
| 2040 | 36,649 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 36,896 | 1,413 |
| 2041 | 36,896 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,143 | 1,413 |
| 2042 | 37,143 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,391 | 1,413 |
| 2043 | 37,391 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,638 | 1,413 |
| 2044 | 37,638 | 1,413 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 37,886 | 1,414 |
| 2045 | 37,886 | 1,414 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,133 | 1,414 |
| 2046 | 38,133 | 1,414 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,380 | 1,414 |
| 2047 | 38,380 | 1,414 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,628 | 1,414 |
| 2048 | 38,628 | 1,414 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 38,875 | 1,414 |
| 2049 | 38,875 | 1,414 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 39,122 | 1,414 |
| 2050 | 39,122 | 1,414 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 259 | 3,820 | 0 | 740 | 0 | 1,200 | 8,672 | 1,113 | 3,000 | 1,367 | 8,007 | 286 | 132 | 0 | 8,425 | 247 | 39,370 | 1,414 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| min | 25,528 | 1,409 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 205 | 3,723 | 0 | 740 | 0 | 1,200 | 8,618 | 1,096 | 3,000 | 1,352 | 5,189 | 286 | 132 | 0 | 5,607 | 200 | 28,539 | 1,409 |
| max | 39,122 | 1,618 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 263 | 4,042 | 0 | 740 | 0 | 1,200 | 8,676 | 1,115 | 3,000 | 1,369 | 8,007 | 286 | 132 | 0 | 8,425 | 3,011 | 39,370 | 1,559 |
| average | 34,279 | 1,431 | 179 | 400 | 4,349 | 1,000 | 2,625 | 1,300 | 90 | 1,620 | 1,170 | 580 | 245 | 3,868 | 0 | 740 | 0 | 1,200 | 8,658 | 1,109 | 3,000 | 1,364 | 7,894 | 286 | 132 | 0 | 8,312 | 346 | 34,625 | 1,426 |
| **average tons TDS** | | | | **97** | | **5,923** | | **4,646** | | **198** | | **924** | | **1,290** | | **0** | | **0** | | **13,077** | **3,000** | **16,079** | | | | | | | | |
| **% of average** | | | | **0.6%** | | **36.8%** | | **28.9%** | | **1.2%** | | **5.7%** | | **8.0%** | | **0.0%** | | **0.0%** | | | **18.7%** | **100.0%** | | | | | | | | |

WILDERMUTH ENVIRONMENTAL INC

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SOUTH ORANGE COUNTY WASTEWATER AUTHORITY

HDR

3230 El Camino Real, Suite 200
Irvine, CA 92602 | www.hdrinc.com

# APPENDIX H

# APPENDIX H

## Orange County Local Hazard Mitigation Plan (Flood Management Plan Replacement)

# County of Orange

# &

# Orange County Fire Authority

# Local Hazard Mitigation Plan November 2015

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## Record of Changes

| Date of Revision | Revision Description | Section/Component | Revision Completed By |
|---|---|---|---|
| | | | |
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## Board of Supervisors Resolution

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## State OES Formal Review Letter

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## FEMA Letter of Acceptance

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# Table of Contents

# Chapter 1 Introduction

## Introduction

The County of Orange operates a comprehensive emergency management program of which mitigation is a key component. Responsibility for mitigation planning and implementation rests with multiple agencies and departments. The mitigation theory postulates that money spent reducing a community's exposure to hazards is more cost effective than the money spent to respond to and recover from the impacts of those hazards.

The Disaster Mitigation Act of 2000 (Public Law 106-390) amended the Robert T. Stafford Disaster and Emergency Assistance Act (42 USC 5121 et seq.) to describe a set of requirements for local mitigation planning. Local jurisdictions are required to maintain a Local Hazard Mitigation Plan (LHMP) under the Disaster Mitigation Act of 2000 to be eligible to receive FEMA mitigation project grants (42 USC 5165).

The mission of the County of Orange and Orange County Fire Authority Hazard Mitigation Plan is to promote sound public policy designed to protect residents, critical facilities, infrastructure, key resources, private property, and the environment from natural hazards in County unincorporated area, fire hazards in the Fire Authority service area, and County and Fire Authority owned facilities.

Hazard mitigation will result in increased public awareness, documentation of resources for risk reduction and loss-prevention, and identifying activities to guide the County toward building a safer, more sustainable community.

## Scope

This Local Hazard Mitigation Plan (LHMP) is a multi-jurisdiction plan developed jointly between the County of Orange, a local government, and the Orange County Fire Authority, a Joint Powers Authority. This collaborative plan was developed to ensure that each participating agency has met the requirements of 44 CFR §201.6. The plan is also written to meet requirements of Activity 510 – Floodplain Management Planning under the National Insurance Program Community Rating System. The current approved Local Hazard Mitigation Plan is adopted as an element of The County of Orange General Plan under Chapter IX – Safety Element as required under California Government Code §8685.9 and §65302.6.

As a multi-jurisdiction plan, the document focuses on mitigating all natural hazards impacting unincorporated areas of the County as well as County and Orange County Fire Authority owned facilities. The Orange County Fire Authority provides fire suppression and prevention services to the County unincorporated areas, as well as a variety of other jurisdictions and contracts under their Joint Powers Authority. As a result, fire mitigation strategies in this plan are inclusive of all areas served by the Fire Authority.

## Planning Process

| |
|---|
| ***Requirement §201.6(b):*** *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process **shall** include:* |

*(1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;*

*(2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and*

***Requirement §201.6(c)(1):*** *[The plan **shall** document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.*

In order to develop a comprehensive Local Hazard Mitigation Plan (LHMP) it was necessary to enlist participation from County agencies as well as the Fire Authority. This plan was developed through the work of the Orange County Hazard Mitigation Planning Task Force (Task Force), the County Emergency Management Council, the County Emergency Management Council Subcommittee, and the Orange County Emergency Management Organization. The Task Force consisted of representatives from the following agencies, departments, and jurisdictions:

| County of Orange | |
|---|---|
| Sheriff's Department, Emergency Management Division | |
| Michelle Anderson | Deputy Director of Emergency Management |
| Donna Boston | Director of Emergency Management |
| Ethan Brown | Senior Emergency Management Program Coordinator |
| Raymond Cheung | Assistant Emergency Manager |
| Bryan Hovde | Senior Emergency Management Program Coordinator |
| Victoria Osborn | Assistant Emergency Manager |
| Public Works Department | |
| Brian Anderson | Supervising Engineering Technician II, GIS Applications |
| Mike Granada | Civil Engineering Assistant, Capital Programs |
| Penny Lew | Senior Civil Engineer, Flood Plain Management |
| Ruby Maldonado | Manager, Planning, Land Use Development |
| Mehdi Sobhani | Manager, Infrastructure Programs, Flood Program Support |
| Health Care Agency | |
| Michele Cheung | Public Health Medical Officer |
| Lydia Mikhail | Manager, Health Disaster Management |
| Mike Steinkraus | Emergency Medical Services Coordinator |
| Social Services Agency | |
| Diana LaRusso | Emergency Services Support Manager |
| Sheriff's Department | |
| Robert Beaver | Director, Research and Development Division |
| Delia Kraft | Emergency Communications Manager, Communications Division |

| | |
|---|---|
| John Wayne Airport | |
| Jim Ellis | Emergency Preparedness Manager |
| Andrew Harsh | Emergency Preparedness Manager |
| Dana Point Harbor | |
| David Rocha, P.E. | Engineering Manager |
| Orange County Community Resources | |
| Janet Hamlin-Clinkscales | Administrative Manager, Organizational Development |
| Orange County Fire Authority | |
| Randy Black | Battalion Chief, Emergency Planning and Coordination |
| Brian Norton | Battalion Chief, Community Risk Reduction |

The Task Force was responsible for leading the plan update process. During the revision, members reviewed and updated the County's mitigation strategy, evaluated changes to the threat landscape, updated disaster histories to reflect recent incidents, analyzed impacts to unincorporated areas and County owned infrastructure, and updated, added, and reprioritized mitigation action items. The County of Orange held responsibility for evaluating the majority of the hazards while the Orange County Fire Authority was responsible for evaluating fire threats, history, and mitigation action items across its service area. Both jurisdictions provided data on critical infrastructure to assist in evaluating risk.

In addition to the work done by the Task Force, additional agencies, jurisdictions, and organizations were provided an opportunity to provide comments, input, and feedback on the plan. Entities who were invited

to participate include:

**County of Orange**

- Assessor
- Auditor-Controller
- Board of Supervisors
- Child Support Services
- Clerk of the Board
- Clerk-Recorder
- County Counsel
- County Executive Office
- District Attorney
- Health Care Agency
- Human Resources
- John Wayne Airport
- OC Community Resources (OCCR)
- OCCR – Animal Care Services
- OCCR – Dana Point Harbor
- OC Public Works
- OC Waste & Recycling
- Orange County Sheriff's Department
(OCSD)
- OCSD – Communications
- Orange County Fire Authority
- Probation
- Public Defender
- Registrar of Voters
- Social Services Agency
- Superior Courts of California, County of
Orange
- Treasurer-Tax Collector

In addition to County agencies represented through the Emergency Management Council and the Emergency Management Council Subcommittee, comments on the plan were solicited from the Orange

County Emergency Management Organization (OCEMO). OCEMO is a standing subcommittee of the Orange County Operational Area Executive Board, tasked with developing and reviewing plans across the County to ensure consistency. Membership in the organization consists of representatives from each of the County's 34 cities along with members from special districts, school districts, and affiliated nongovernmental organizations. OCEMO meetings are also often attended by interested members of the public. OCEMO member agencies include:

**OCEMO – Plan Participants**

- County of Orange
- Orange County Fire Authority

**OCEMO -- Cities**

- Aliso Viejo
- Anaheim
- Brea
- Buena Park
- Costa Mesa
- Cypress
- Dana Point
- Fountain Valley
- Fullerton
- Garden Grove
- Huntington Beach
- Irvine
- La Habra
- La Palma
- Laguna Beach
- Laguna Hills
- Laguna Niguel
- Laguna Woods
- Lake Forest
- Los Alamitos
- Mission Viejo
- Newport Beach
- Orange
- Placentia
- Rancho Santa Margarita
- San Clemente
- San Juan Capistrano
- Santa Ana
- Seal Beach
- Stanton
- Tustin
- Villa Park

- Westminster
- Yorba Linda

**OCEMO – School Districts**

- Anaheim City School District
- Anaheim Union H.S. District
- Brea-Olinda Unified School District
- Capistrano Unified School District
- Centralia School District
- Coast Community College
- Cypress School District
- Fountain Valley School District
- Fullerton Joint Union High School District
- Fullerton School District
- Garden Grove Unified School District
- Huntington Beach School District
- Huntington Beach Union High School District
- Irvine Unified School District
- La Habra City School District
- Laguna Beach Unified School District
- Los Alamitos Unified School District
- Lowell Joint School District
- Magnolia School District
- Newport-Mesa Unified School District
- North Orange County Community College District
- Orange County Department of Education
- Ocean View School District
- Orange Unified School District
- Placentia-Yorba Linda Unified School District  Rancho Santiago Community College District
- Saddleback Valley Unified School District
- Santa Ana Unified School District
- Savanna School District
- South Orange County Community College District
- Tustin Unified School District
- Westminster School District

**OCEMO – Special Districts**

- Buena Park Library District
- Capistrano Bay Community Services District
- Costa Mesa Sanitary District
- East Orange County Water District
- El Toro Water District
- Emerald Bay Community Services District
- Garden Grove Sanitary District
- Irvine Ranch Water District

- Laguna Beach County Water District
- Mesa Consolidated Water District
- Midway City Sanitary District
- Moulton Niguel Water District
- Municipal Water District of Orange County
- Orange County Transportation Authority
- Orange County Cemetery District
- Orange County Sanitation District
- Orange County Vector Control
- Orange County Water District
- Placentia Library District of Orange County
- Rossmoor Community Services District
- Santa Margarita Water District
- Serrano Water District
- South Coast Water District
- Sunset Beach Sanitary District
- Trabuco Canyon Water District
- Yorba Linda Water District

### Disabilities and Access and Functional Needs Working Group

Members of the Orange County Disabilities, Access and Functional Needs Working Group were given an opportunity to review and comment on the plan. This working group is composed of people with disabilities, the organizations that serve them, emergency planners, and community advocates. The group works to ensure that all plan documents address the needs of the whole community.

### Public Review

In addition to members of the public who reviewed the plan through other open meetings and committees, the Hazard Mitigation Plan was also distributed for public review on the Orange County Sheriff's Department Emergency Management Division's website and the County of Orange website. To publicize the plan's review, messages were sent through the Emergency Management Division's Twitter and Facebook accounts to more than 9,000 followers as well as through the Orange County Sheriff Department's Twitter account to more than 18,000 followers. On the website, visitors were also encouraged to participate in a survey regarding hazard and risk perception as well as steps they have taken to prepare themselves, their families, and their homes.

After closing the survey and public comment period, a Hazard Mitigation page is maintained on the Emergency Management Division website providing a resource for members of the public on the County's mitigation strategy, plan documents, and opportunities to provide feedback and comments for consideration during each annual plan review.

## Online Survey Results

The online survey received 164 responses from Orange County residents. Survey-takers were asked a variety of questions, including which, if any, hazards had impacted them in the past, their level of concern on different hazards, their preparedness level, and their knowledge of hazards in their area. The complete text of the survey is available in Attachment A.

The most intriguing results of the survey included:

- Almost all respondents (or their families) had experienced a disaster. Of those, 85.71% were impacted by earthquake and 72.05% by drought.
- Respondents ranked earthquake as the natural disaster that poses the greatest threat to their neighborhood, with wildland/urban Fire, flood/storm and drought close behind. Nearly 50% of respondents ranked earthquake as the greatest natural threat.
- Only 26.50% of respondents ranked themselves as prepared or very prepared for a disaster. 73.49% of respondents ranked themselves as somewhat prepared or not prepared at all.
- Less than 50% of respondents reported they use social media as a source for emergency preparedness information, with most opting to use traditional sources like television, web sites and radio.
- Only 14.56% of respondents reported carrying flood insurance, while 41.14% of respondents reported carrying earthquake insurance.
- Almost 90% of respondents were signed up for AlertOC or another emergency mass notification system.

These survey results were used to validate the hazard risk assessment as well as the prioritization of mitigation action items.

## Plan Meetings

As the planning process was executed, a number of in-person meetings were held to facilitate a thorough review and update of the plan (see Attachment A for planning meeting documentation). Between meeting dates, Task Force members were responsible for obtaining data, reviewing, and updating content. Below are the meetings and their purpose:

| Date | Location | Purpose |
|---|---|---|
| September 9, 2014 | Silverado, CA | Kick-off and task schedule |
| October 28, 2014 | Santa Ana, CA | Hazard profile review and update assignment |
| March 18, 2015 | Santa Ana, CA | Mitigation strategy review and project update |
| July 15, 2015 | Santa Ana, CA | Mitigation action item final review (STAPLEE/prioritization) |
| August 6, 2015 | Santa Ana, CA | OCEMO plan briefing |
| August 12, 2015 | Santa Ana, CA | Agency capability and resource review/update |
| August 12, 2015 | Santa Ana, CA | Emergency Management Council plan briefing |
| September 3, 2015 | Remote | Draft plan review – internal |
| September 3, 2015 | Orange, CA | OCEMO plan brief |

| | | |
|---|---|---|
| October 1, 2015 | Santa Ana, CA | OCEMO plan brief |
| October 13, 2015 | Laguna Niguel, CA | Disabilities, Access, and Functional Needs Working Group review |
| November 5, 2015 | Anaheim, CA | OCEMO plan brief and review |
| November 18, 2015 | Santa Ana, CA | Emergency Management Council Plan Approval |
| November 19, 2015 | Remote | Plan Submission to Cal OES/FEMA |
| January 2016 (Tentative) | Santa Ana, CA/ Irvine, CA | Plan adoption pending approval |

## Related Documents and Resources

***Requirement §201.6(b):*** *In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process* ***shall*** *include:*

*(3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.*

During the plan review, update, and development, several other documents were reviewed to ensure consistency in planning efforts. Information from these documents has been incorporated throughout this plan. Both the County Emergency Operations Plan and the Urban Area Security Initiative Threat and Hazard Identification and Risk Assessment include hazard analysis of threats impacting the County.
Reviewing the various methodologies used in these plans compared to the methodology in the Hazard Mitigation Plan was useful in evaluating the risk and impact associated with each hazard included. Other plans and documents provided base level data either for statistical purposes or based on scientific research surrounding potential hazard impacts in the County. Finally, State and Local Hazard Mitigation Plans were reviewed to evaluate format and content. Documents, reports, and studies reviewed included:

- County of Orange Emergency Operations Plan, 2015
- County of Orange General Plan, 2005
- County of Orange Comprehensive Annual Financial Report, 2014
- Orange County Essential Facilities Risk Assessment Project Report, 2009
- Anaheim/Santa Ana UASI THIRA, 2014
- California Multi-Hazard Mitigation Plan, 2013
- Southern California Catastrophic Earthquake Response Plan, 2010
- The ShakeOut Scenario (USGS Open File Report 2008-1150), 2008
- Overview of the ARkStorm Scenario (USGS Open File Report 210-1312), 2010
- City of Huntington Beach Hazard Mitigation Plan, 2012
- City of Berkeley Local Hazard Mitigation Plan, 2014
- City of Simi Valley Local Hazard Mitigation Plan, 2015
- National Flood Insurance Program Community Rating System Coordinator's Manual, 2013
- Local Mitigation Plan Review Guide, 2011
- Local Mitigation Planning Handbook, 2013

# Chapter 2 Community Profile

## History

### The Formation and of Orange County

The State of California, created from a territory, was ceded to the United States by Mexico in 1848 and admitted into the Union as a free state in 1850. The population at that time was 92,597, located in a few small cities and mining camps scattered over grazing lands adjacent to watercourses. With the formation of the state, each principal town formed a county. The first counties were large with small populations, due to the vast amounts of territory between towns. As the county settled, additional centers of population formed. Efforts to form new counties by cutting off portions of the already established counties took place with some being successful, while others failed.

The growth of communities in the southeastern portion of Los Angeles County produced a desire for a smaller county with a county seat nearer home. The desire became reality with an appeal for autonomy to the legislature in 1889. The City of Santa Ana, which had outgrown the other cities in the proposed new county, took the lead in the struggle for county division. Throughout the winter, lobbyists remained in Sacramento at considerable expense, without success in overcoming the influence of Los Angeles against the bill for the new county. The bill, titled "An Act to Create the County of Orange," selected Orange as its name. Late in the session, W.H. Spurgeon and James McFadden were successful in the legislature, skillfully handling various interests and antagonisms. The legislature passed the bill and Governor Waterman signed it on March 11, 1889.

### The Formation of the Orange County Fire Authority

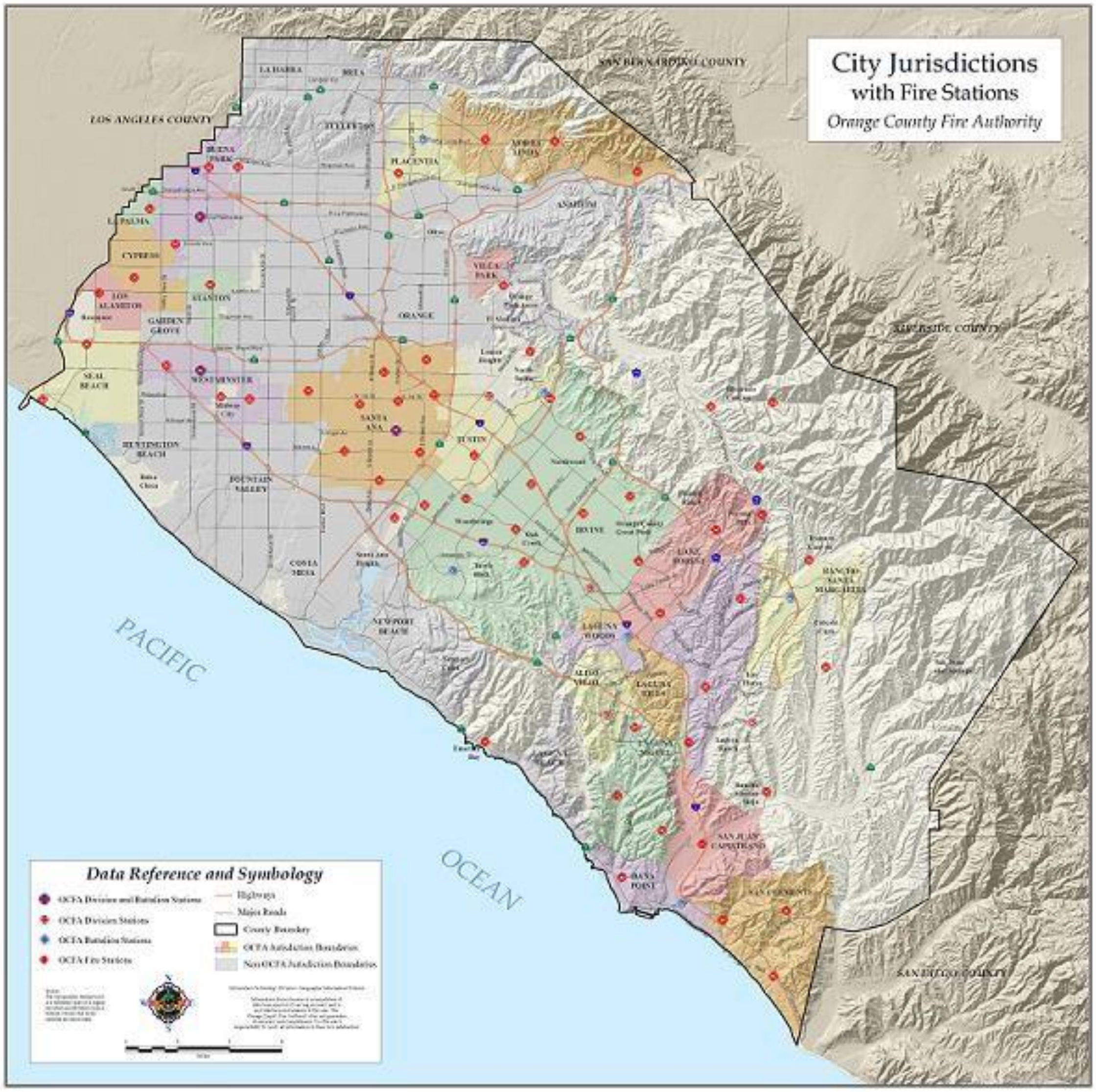
Prior to May, 1980, fire service for the cities of Cypress, Irvine, La Palma, Los Alamitos, Placentia, San Juan Capistrano, Tustin, Villa Park, and Yorba Linda along with the County unincorporated areas was provided by the California Department of Forestry (CDF)*. However, on May 16, 1980, the Orange County Fire Department (OCFD) was formed as a county department reporting to the Board of Supervisors. Fifty-two percent of the 518,483 residents served by the OCFD lived in unincorporated areas of the County.

However, over the course of the next decade, five new cities were formed from unincorporated territory and two additional cities decided to contract with OCFD for fire service. As a result, by January 1, 1991, over 80% of OCFD's service population of 808,139 lived within these sixteen cities.

During 1991, the OCFD was on its way exploring the possibility of forming a special district as an independent entity governed by a board of directors representing the member cities and the County. The California Government Code dealing with special districts was studied, other fire protection districts were contacted, and services the new agency would need to provide were identified (i.e. investment services, employee benefits, payroll, and purchasing). Discussions had begun with the County about transferring title of the fire stations to the new organization.

A new governance structure, a Joint Powers Authority (JPA), was selected. Much of the previous work was used in this endeavor. By 1994 the plans and structure of the new agency were well underway. The County Board of Supervisors, the various City Councils, the OCFD labor groups, and management were all pulling together to launch the new JPA. The Orange County Fire Authority (OCFA) was formed on March 1, 1995.


☐ **Map 1 - Orange County Base Map (Unincorporated Area in Gray)**

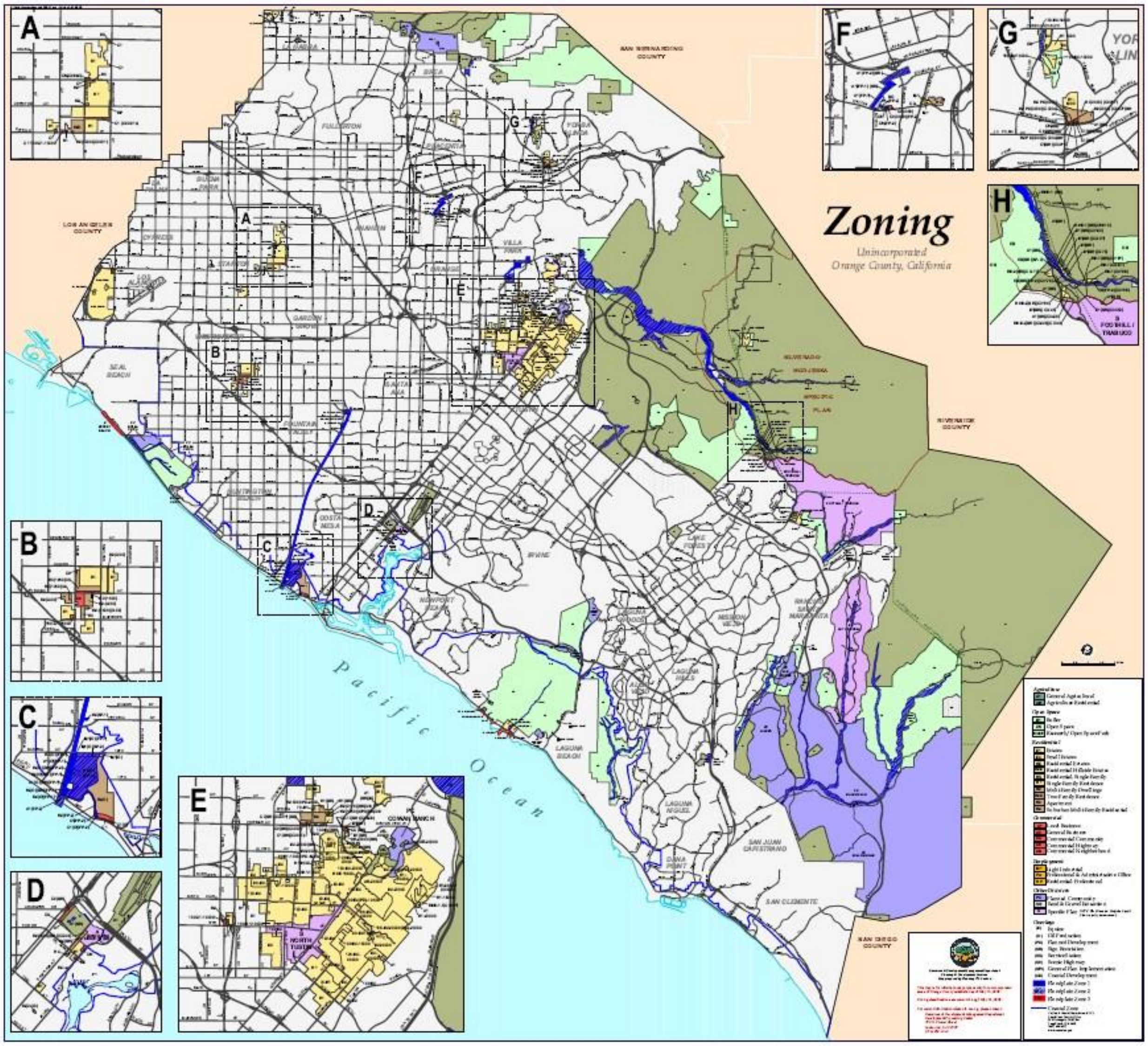



☐ **Map 2 – Orange County Fire Authority Service Area**

## Geography and the Environment

Orange County has an area of 948 square miles, of which 791 square miles is land and 157 square miles is water. It is located in the southwestern portion of California and is bordered by Los Angeles County to the north, San Diego County to the south, Riverside and San Bernardino Counties to the east and the Pacific Ocean to the west. Orange County has 42 miles of coastline and three harbors. Thirty-four incorporated cities in the County are responsible for hazard mitigation planning within their jurisdictions. The County is responsible for hazard mitigation planning in the approximately 276 square miles of unincorporated area and all County owned facilities and properties.

The geography of Orange County is dominated by 3 major features: the vast coastal plain of the Los Angeles basin in the north and west, the Santa Ana Mountains and foothills in the south and east, and the coastline of the Pacific Ocean to the southwest. Elevations in the County are as high as 5,689 feet at Santiago Peak down to sea level.




☐ **Map 3 - Zoning for Orange County**

## Land Use

***Requirement §201.6(c)(2)(ii)(C):*** *[The plan **should** describe vulnerability in terms of] providing a general description of land uses and development trends within the community so that mitigation options can be considered in future land use decisions.*

***Requirement §201.6(d)(3)):*** *A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities.*

Residential housing comprises Twenty-five percent of the County's land area. Commercial, industrial, and public institutional uses account for thirteen percent of the County's land area. Twenty-five percent of the County is classified as uncommitted, meaning it is either vacant or there is no data available for that land. Sixteen percent of the land is dedicated to open space and recreation.

Forty-six percent of the County unincorporated area is designated open space, with an additional twentyeight percent designated for agricultural use. Only four percent of the unincorporated area is zoned residential, but an additional fifteen percent is designated as planned communities. Less than one percent of the land is zoned for commercial use.

Orange County maintains approximately 60,000 acres of parkland, open space and shoreline. Orange County's city, state, and federal agencies also maintain local parks and open space, adding an additional 65,000 acres to the county total.

Housing growth in unincorporated Orange County includes both infill within existing neighborhoods and new construction on vacant land.

Since 2010, infill has consisted of construction of second units within residential areas and multi-unit developments on commercially zoned land. This has occurred mainly in the northern and central portions of the county. Also new single family unit construction is continuing and will soon complete the Ladera Ranch Planned Community. The net housing gain in unincorporated areas over the last five years is 214 units.

Recent new housing construction is now beginning on vacant undeveloped land in the southern and eastern parts of the county.

Over the last two years, construction has begun on the 14,000 unit Rancho Mission Viejo Planned Community (RMV PC) in unincorporated Orange County. Over one thousand units are completed and construction is ongoing. Over the next two decades, development will occur on 6,000 acres with 17,000 acres to remain as a permanent protected open space preserve. RMV PC follows the countywide trend toward higher density single family housing and more attached/multi-unit structures.

The 340 unit Esperanza Hills and 112 unit Rancho Cielo developments east of Yorba Linda and the 65 unit Saddle Crest development east of Santiago Canyon Road are in various planning approval/preconstruction stages. Construction within these single family home developments will likely begin within the 2015-2020 planning period.

## Population and Demographics

As of January 2015, the California Department of Finance estimates Orange County's population as 3,114,209. Of those, about 121,458 live in the unincorporated areas of the County.[1]

[1] E-1 Current Population Estimates - California Department of Finance. Retrieved October 15, 2015, from http://www.dof.ca.gov/research/demographic/reports/estimates/e-1/view.php

The latest data depicts a diverse community, as shown in Table 1 below.

☐ **Table 1 – Orange County Population By Race**

| Percentage of Total Orange County Population | |
|---|---|
| **White alone, Not Hispanic or Latino** | 42% |
| **Hispanic or Latino** | 35% |
| **Asian, Not Hispanic or Latino** | 19% |
| **Other** | 4% |

Source: California Department of Finance

This diversity of the Orange County community emphasizes the need for effective communication during disasters for non-English speaking people. Roughly 45% of Orange County residents (over age 5) speak a language other than English at home, 20% speak English less than "very well" and 29.7% were born outside of the United States.[23] In 2012, widely spoken languages other than English spoken in Orange County households included Spanish, Vietnamese, Korean, Chinese, Tagalog, Persian, Arabic and Japanese.[4]

In 2014, the U.S. Census Bureau estimated that 8.6% of the noninstitutionalized population in Orange County was living with a disability. This percentage increases among the older population, with nearly 31% of the population 65 and older having some type of disability.

☐ **Table 2 – Orange County Disability Demographics**

| Population | 0-4 years 191,517 | | 5-17 years 529,348 | | 18-64 years 2,000,063 | | 65 + years 407,850 | |
|---|---|---|---|---|---|---|---|---|
| **Disability** | Count | Rate | Count | Rate | Count | Rate | Count | **Rate** |
| **Hearing Difficulty** | 1,130 | 0.7% | 2,625 | 0.5% | 23,185 | 1.2% | 50,483 | 12.4% |
| **Vision Difficulty** | 723 | 0.4% | 4,480 | 0.8% | 24,639 | 1.2% | 22,366 | 5.5% |
| **Cognitive Difficulty** | - | - | 12,506 | 2.4% | 49,374 | 2.5% | 33,807 | 8.3% |
| **Ambulatory Difficulty** | - | - | 2,336 | 0.4% | 50,081 | 2.5% | 78,443 | 19.2% |
| **Self-Care Difficulty** | - | - | 4,504 | 0.9% | 21,304 | 1.1% | 33,886 | 8.3% |
| **Independent Living Difficulty** | **-** | **-** | **-** | **-** | 62,606 | 2.2% | 62,606 | 15.4% |

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[2] American Community Survey - SDC - Demographic Research - California Department of Finance. Retrieved August [3] , 2015, from http://www.dof.ca.gov/research/demographic/state_census_data_center/american_community_survey/

[4] Languages Other Than English Spoken at Home (Orange County, 2012). Retrieved October 15, 2015, from http://cpehn.org/chart/languages-other-english-spoken-home-orange-county-2012

Source: U.S. Census Bureau, Disability Characteristics, 2014 American Community Survey 1-Year Estimates

### Employment and Industry

As of February 2015, roughly 50% of the Orange County workforce was employed by service industries (including Information, Professional and Business Services, Educational and Health Services, Leisure and Hospitality, and Other Services). Approximately 10% of the workforce was employed by the manufacturing sector and 10% were employed in the retail trades. The top employers in Orange County were the Walt Disney Company, The University of California, the County of Orange, St. Joseph's Health, Kaiser
Permanente, and Boeing.[5] As of July [6], the unemployment rate in Orange County was 4.7%.[7]

Orange County hosts 42 million visitors annually.[8]

82% of the workforce commutes alone, 10% carpool and 3% use public transportation.[9] The high mobility of employees commuting from surrounding areas to industrial and business centers creates a greater dependency on roads, communications, accessibility and emergency plans.

### History of Disasters

Since 1953 Orange County has received 29 federal disaster proclamations including 21 Presidential Disaster Declarations, 3 Presidential Emergency Proclamations, and 5 Fire Management Assistance declarations (shown in the table below). While the greatest recurring threat is flood and fire, the earthquake risk is ever-present.

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[5] County of Orange Comprehensive Annual Financial Report - Principal Employers (2014). Retrieved October 15,
[6] , from http://ac.ocgov.com/civicax/filebank/blobdload.aspx?BlobID=41026

[7] Labor Market Information. Retrieved August 15, 2015, from http://www.labormarketinfo.edd.ca.gov/

[8] About OCVA. Retrieved September 15, 2015, from http://www.visittheoc.com/maps-and-information/about-ovca/

[9] County of Orange. (2015). OC Community Indicators: 2015. Retrieved October 15, 2015, from http://ocgov.com/civicax/filebank/blobdload.aspx?BlobID=45210

| Federal Disaster Declarations for Orange County | | | |
|---|---|---|---|
| Disaster Number | Year | Incident Type | Incident Title |
| DR-1952 | 2011 | Flood | SEVERE WINTER STORMS, FLOODING, AND DEBRIS AND MUD FLOWS |
| FM-2792 | 2008 | Fire | FREEWAY FIRE COMPLEX |
| DR-1810 | 2008 | Fire | WILDFIRES |
| FM-2737 | 2007 | Fire | SANTIAGO FIRE |
| FM-2683 | 2007 | Fire | 241 FIRE |
| EM-3279 | 2007 | Fire | WILDFIRES |
| DR-1731 | 2007 | Fire | WILDFIRES, FLOODING, MUD FLOWS, AND DEBRIS FLOWS |
| FM-2630 | 2006 | Fire | SIERRA FIRE |
| DR-1585 | 2005 | Severe Storm | SEVERE STORMS, FLOODING, LANDSLIDES, AND MUD AND DEBRIS FLOWS |
| EM-3248 | 2005 | Hurricane | HURRICANE KATRINA EVACUATION |
| DR-1577 | 2005 | Severe Storm | SEVERE STORMS, FLOODING, DEBRIS FLOWS, AND MUDSLIDES |
| FS-2405 | 2002 | Fire | ANTONIO FIRE |
| DR-1203 | 1998 | Severe Storm | SEVERE WINTER STORMS AND FLOODING |
| EM-3120 | 1996 | Fire | SEVERE FIRESTORMS |
| DR-1046 | 1995 | Severe Storm | SEVERE WINTER STORMS, FLOODING LANDSLIDES, MUD FLOW |
| DR-1044 | 1995 | Severe Storm | SEVERE WINTER STORMS, FLOODING, LANDSLIDES, MUD FLOWS |
| DR-1008 | 1994 | Earthquake | NORTHRIDGE EARTHQUAKE |
| DR-1005 | 1993 | Fire | FIRES, MUD/LANDSLIDES, FLOODING, SOIL EROSION |
| DR-979 | 1993 | Flood | SEVERE WINTER STORM, MUD & LAND SLIDES, & FLOODING |
| DR-935 | 1992 | Flood | RAIN/SNOW/WIND STORMS, FLOODING, MUDSLIDES |
| DR-812 | 1988 | Flood | SEVERE STORMS, HIGH TIDES & FLOODING |
| DR-799 | 1987 | Earthquake | EARTHQUAKE & AFTERSHOCKS |
| DR-677 | 1983 | Coastal Storm | COASTAL STORMS, FLOODS, SLIDES & TORNADOES |
| DR-657 | 1982 | Fire | URBAN FIRE |
| DR-635 | 1980 | Fire | BRUSH & TIMBER FIRES |
| DR-615 | 1980 | Flood | SEVERE STORMS, MUDSLIDES & FLOODING |

| | | | |
|---|---|---|---|
| DR-547 | 1978 | Flood | COASTAL STORMS, MUDSLIDES & FLOODING |
| DR-566 | 1978 | Flood | LANDSLIDES |
| DR-253 | 1969 | Flood | SEVERE STORMS & FLOODING |

Since the Local Hazard Mitigation Plan was last revised in 2010, the County of Orange received a disaster declaration for the 2011 winter storms and flooding. In March of 2014, the County of Orange proclaimed a local state of emergency following the 5.1 magnitude La Habra earthquake. Despite more than 10.5 million dollars in damage and costs related to this earthquake, no State Emergency Proclamation was received. On January 17, 2014 the Governor of California proclaimed a State of Emergency related to the State's extended drought. While the proclamation did not direct specific actions for counties, it was an important step in working towards reducing the overall impact of the drought across the state.

# Chapter 3 Risk and Vulnerability Assessment

## Overview of the Risk Assessment Process

A risk assessment provides information on the location of hazards, the value of existing land and property in hazard locations, and an analysis of risk to life, property, and the environment resulting from a natural hazard event. Specifically, the levels of a risk assessment are as follows:

### 1) Hazard Identification

Through an established hazard analysis process, the County of Orange regularly identifies its major hazards during the revision of its Emergency Operations Plan (complete list of identified hazards available in the "Hazard Identification" section below). In addition to its man-made hazards, Orange County has identified nine major natural hazards to be specifically addressed in its Hazard Mitigation plan: flood/storm, wildland/urban fire, earthquake, dam failure, landslide/mud flow/debris flow, tsunami, drought, climate change, and epidemic. Other natural hazards, such as high wind, extreme temperatures and tornado are not specifically described or assessed in this document as the related impacts to the County's unincorporated areas are minimal compared to the major hazards. Many agencies and jurisdictions worked together to identify these hazards, including the Orange County Emergency Management Organization, the Emergency Management Council Subcommittee, emergency management personnel from cities, special districts and school districts, and the Hazard Mitigation Planning Task Force. The process used the best available data to balance historical occurrence, probability and potential impact.

### 2) Profiling Hazard Events

This process describes the cause and characteristic of each hazard, the effect on the County in the past, and the historical vulnerability specific to Orange County's population, infrastructure, and environment. Each hazard section provides a profile for the hazards discussed in this plan.

### 3) Vulnerability Assessment/Inventorying Assets

This is a combination of hazard identification with an inventory of the existing (or planned) property development(s) owned by Orange County. Critical facilities are of particular concern. These entities provide essential products and services to the public, preserving the welfare and quality of life in the County and fulfill important public safety, emergency response, and/or disaster recovery functions. Map 4 of this section identifies critical facilities in the County with a description provided.

### 4) Risk Analysis

Estimating potential losses involves assessing the likely damage, injuries, and financial cost sustained in a geographic area over a given period. This analysis involves mathematical models with two measurable components of risk analysis: magnitude of the harm that may result expressed in monetary terms and the likelihood of the harm occurring. Describing vulnerability in terms of dollar loss provides the community and the state with a common framework to measure the effects of hazards on assets. At this time, quantitative estimates on losses have been calculated on flood, wildland fire, earthquake, dam failure, landslide, and tsunami hazards, and are available in the Quantitative Exposure Analysis section at the end of this chapter. The remaining hazards (drought, climate change, epidemic) lack an easily definable spatial extent or are compounding factors for other hazards. In these situations, impact descriptions are qualitative in nature.

### 5) Assessing Vulnerability/Analyzing Development Trends

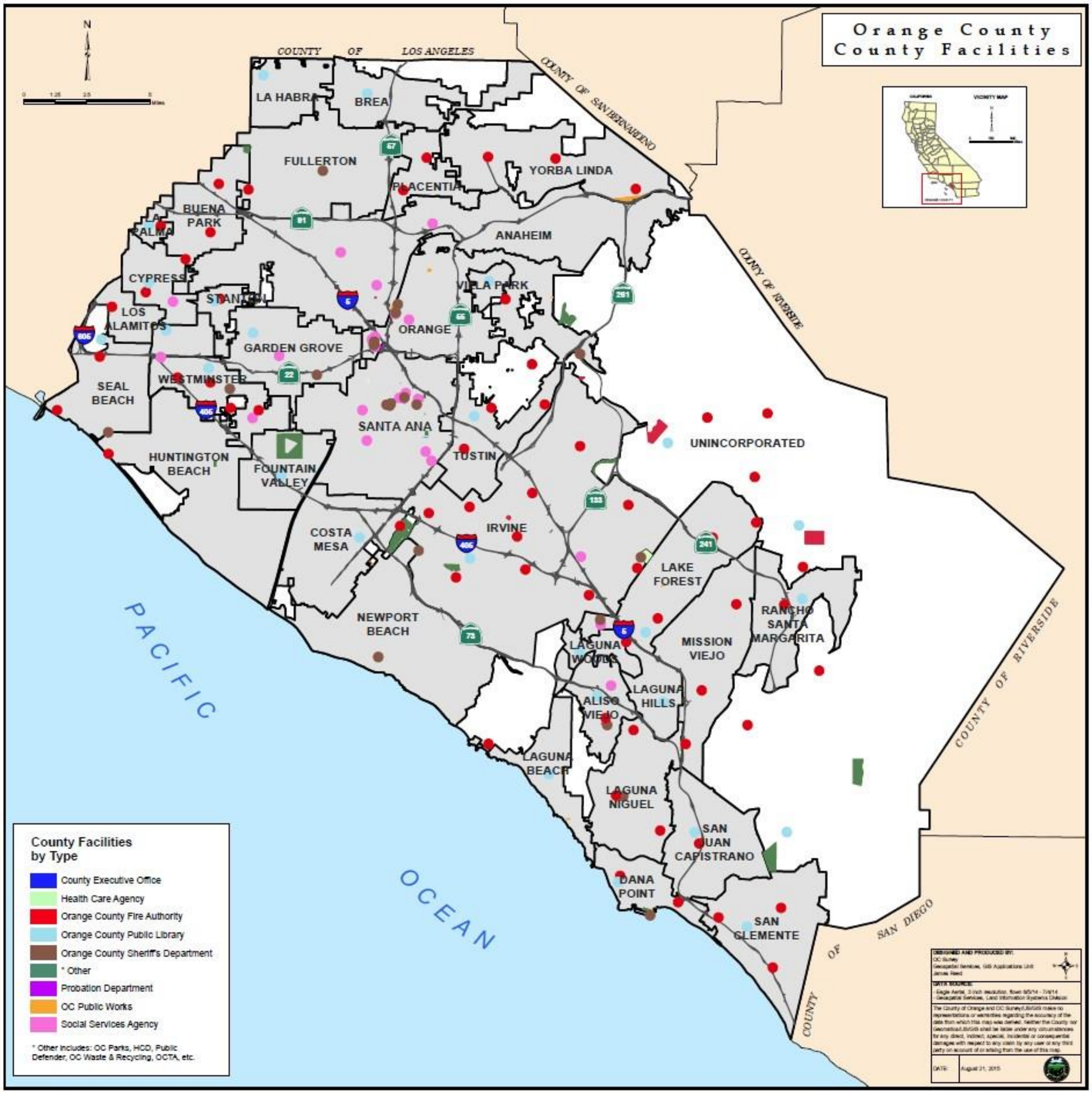
This step provides a general description of land uses and development trends within the community. This plan provides a comprehensive description of the character of the unincorporated area of Orange County in the Community Profile, Chapter 2. Analyzing the components of Orange County assists in identifying potential problem areas and serves as a guide for incorporating goals and ideas contained in this mitigation plan into other community development plans.

Hazard assessments are subject to the availability of hazard-specific data. Each hazard-specific section of the plan includes a section on hazard identification using data and information from the County or State agency sources.

Using the data available for hazard assessments, the County has numerous strategies available for reducing risk (described in Action Items, Chapter 4). Mitigation strategies further reduce disruption of critical services, risk to human life, and damage to personal and public property, and infrastructure. Action items throughout the hazard sections provide recommendations to improve data collection, hazard mapping and hazard assessments.

## Critical Facilities and Infrastructure

Facilities critical to government response and recovery activities (i.e., life safety and property and environmental protection) include 911 centers, emergency operations centers, police and fire stations, public works facilities, communications centers, sewer and water facilities, hospitals, bridges and roads, and shelters. Critical and essential facilities are those facilities vital to the continued delivery of key government services or having significant impact on the public's ability to recover from an emergency. Map 4 below gives an overview of County-owned facilities. For a complete list, see Attachment C.




☐ **Map 4 – Orange County Critical Facilities**

## Hospitals

The County of Orange does not own and/or operate hospitals. With the exception of the University of California, Irvine Medical Center, owned and operated by the University of California, all hospitals within Orange County are privately owned and operated. There are no hospitals in the unincorporated area of Orange County.

## Hazard Identification

| |
|---|
| ***Requirement §201.6(c)(2)(i):*** *[The risk assessment **shall** include a] description of the type … of all natural hazards that can affect the jurisdiction.* |

A hazard analysis has indicated that the County of Orange is at risk from numerous hazards associated with natural disasters and technological incidents. Many of the hazards that exist in or adjacent to Orange County have the potential for causing disasters exceeding any one jurisdiction's capabilities to successfully respond, making centralized command and control and the support of the County and its department's essential functions. The County will review and update the hazard analysis in conjunction with the review of the County of Orange Emergency Operations Plan (EOP). The hazard analysis in Figure 1 below was last approved in 2014.

Human-caused hazards listed in the table below are in County of Orange and Orange County Fire Authority Hazard Mitigation Plan documents such as the Orange County Emergency Operations Plan. Specifically, hazardous materials preparedness and mitigation measures addressed in the Orange County Operational Area Plan focus on hazardous materials throughout the County. The Orange County Emergency Operations Plan and the Orange County Sheriff's Department Policy Manual address issues related to riot and civil unrest. The Orange County Emergency Operations Plan Aviation Annex addresses aircraft incidents. The Office of Oil Spill Prevention and Response addresses oil spill mitigation. The Operational Area Rail Annex covers train and rail accidents. The Orange County Emergency Operations Plan addresses train accidents and other transportation issues. Although the San Onofre Nuclear Generating Station (SONGS) resides outside of Orange County, mitigation issues surrounding it are in the SONGS Plans, coordinated by the SONGS Interjurisdictional Planning Committee. Regarding terrorism, the Operational Area Executive Board manages the Terrorism Working Group, actively mitigating issues surrounding terrorism. The Orange County Intelligence Assessment Center addresses terrorism indicators and warnings issues. The Orange County Emergency Operations Plan addresses mitigation measures for Power Failures.

Climate change was not included as a hazard in the last County Emergency Operations Plan revision so it is not specifically called out in the table below, but it is evident that it will be a major component of Orange County's hazard analysis process moving forward. Since many of the effects of climate change will serve to worsen the severity and frequency of other hazards (wildfire, flood/storm, tsunami (through sea level rise)), the hazard analysis process will increase in complexity. The Hazard Mitigation Planning Task Force discussed this issue and decided the current hazard analysis did reflect the impact of climate change on other hazards, but will revisit the issue in 2020. In addition, other specific climate change hazards such as sea level rise may be added during future hazard analysis update cycles.

The following criteria were used to establish each potential hazard rating, based upon historical and recent events to validate frequency and impacts:

- What are the hazard threats facing the community.
    - Natural disaster
    - Manmade disasters
- What is the probability of occurrence?

  - Likely
  - Possible
  - Unlikely
- What is the effect to lives and property?
  - High
  - Average
  - Low
- What are the hazard ratings – multiply probability of occurrence by the effects.

☐ **Figure 1 - Hazard Identification and Analysis**

| HAZARD THREAT | PROBABILITY OF OCCURRENCE | | | EFFECT | | | HAZARD RATING (Probability x Effect) |
|---|---|---|---|---|---|---|---|
| | Likely 10 | Possible 5 | Unlikely 1 | High 10 | Average 5 | Low 1 | |
| Flood and Storm | X | | | | X | | 50 |
| Hazardous Materials | X | | | | X | | 50 |
| Wildland Fire | X | | | | X | | 50 |
| Earthquake | | X | | X | | | 50 |
| Civil Disturbance and Riot | | X | | | X | | 25 |
| Aircraft Incident | | X | | | X | | 25 |
| Oil Spill (Coastal) | | X | | | X | | 25 |
| Drought | | X | | | X | | 25 |
| Train Accident | | X | | | X | | 25 |
| Dam and Reservoir Failure | | | X | X | | | 10 |
| Epidemic | | | X | X | | | 10 |
| SONGS | | | X | X | | | 10 |
| Terrorism | | | X | X | | | 10 |
| High Wind (Santa Ana Winds) | X | | | | | X | 10 |
| Extreme Temperatures | X | | | | | X | 10 |
| Urban Fire | | X | | | | X | 5 |
| HAZARD THREAT | PROBABILITY OF OCCURRENCE | | | EFFECT | | | HAZARD RATING |

| | Likely 10 | Possible 5 | Unlikely 1 | High 10 | Average 5 | Low 1 | (Probability x Effect) |
|---|---|---|---|---|---|---|---|
| Landslide, Mud Flow and Debris Flow | | X | | | | X | 5 |
| Power Failure | | X | | | | X | 5 |
| Tornado | | X | | | | X | 5 |
| Tsunami | | | X | | | X | 1 |

## Profile of Hazard Events

***Requirement §201.6(c)(2)(i):*** *[The risk assessment **shall** include a] description of the … location and extent of all natural hazards that can affect the jurisdiction. The plan **shall** include information on previous occurrences of hazard events and on the probability of future hazard events.*

The following information details each of the nine natural hazards addressed in the Hazard Mitigation Plan, their effect on Orange County in the past, and the portion of the County's population, infrastructure, and environment that has been historically vulnerable to each specific hazard, based on available data. Other natural hazards, such as high wind, extreme temperatures and tornado are not specifically described or assessed in this document as the related impacts to the County's unincorporated areas are minimal compared to the major hazards.

## 3.1 Flood/Storm

The following discussion addresses the threat of storm-related flooding updated from material found in the Safety Element of the County's General Plan.

Orange County's 510,000 acres are mainly mountainous terrain (on the northeast and southeast) and floodplain (in the central and western section). The County's rapid growth and transformation from an agricultural community to an urban community has changed flood control of large flows from mountains and hills to include control of additional runoff produced by development of the plains. Although there is a countywide system of flood control facilities, the majority of these are inadequate for conveying runoff from major storms, such as the Standard Project Flood or the 100-year flood.

The infrequency of very large floods further obscures the County's flood hazard. Storms labeled "severe" have occurred in less than 10 of the past 175 years. In particularly disastrous storms, a false sense of security prevailed following long periods of mild semi-arid years.

Map 5 provides locations of the various watersheds throughout Orange County. Orange County worked closely with Region IX in the FEMA Flood Map Modernization process which resulted in digital Federal Insurance Rate Maps (FIRM) dated December 3, 2009. The County facilitated FEMA to reach other cities within Orange County. The County is working with FEMA in transitioning the Flood Map Modernization (Map Mod) to Risk Mapping, Assessment, and Planning (Risk Map) for multi-hazard risk management.


**A = Coyote Creek**

**B = Carbon Canyon**

**C = Westminster**

**D = Talbert**

**E = Santa Ana River**

**F = San Diego Creek**

**G = Newport Bay**

**H = Los Trancos/Muddy Creek**

**I = Laguna Canyon**

**J = Aliso Creek**

**K = Salt Creek**

**L = San Juan Creek**

**M = Prima Deshecha/Segunda Deshecha**

☐ **Map 5 - Watersheds of Orange County**

(Source: Orange County Public Works, Watershed & Coastal Resources Division)

To provide quantitative information for flood warning and detection, Orange County began installing its ALERT (Automated Local Evaluation in Real Time) system in 1983. Operated by the Environmental Resources group at OC Public Works in cooperation with the National Weather Service, ALERT uses remote sensors located in rivers, channels and creeks to transmit environmental data to a central computer in real time. Sensors are installed along the Santa Ana River, San Juan Creek, Arroyo Trabuco Creek, Oso Creek, Aliso Creek, as well as flood control channels and basins. The field sensors transmit hydrologic and other data (e.g., precipitation data, water levels, temperature, wind speed, etc.) to base station computers for display and analysis. In addition, seven pump stations (Huntington Beach, Cypress, Seal Beach, Los Alamitos, Rossmoor, Harbor-Edinger, and South Park) regulating storm water discharge to flood control channels are also instrumented. Their monitoring system includes automated call-out of operations personnel in the event of a crisis.

Activation of the OC Public Works Department Operations Center (DOC) takes place when heavy rainfall occurs or is predicted, and/or when storm runoff conditions indicate probable flood damage. The DOC monitors the situation on a 24-hour basis. Response may include patrols of flood control channels and deployment of equipment and personnel to reinforce levees when needed. DOC activation and various emergency response actions are based on the following Emergency Readiness Stages:

- Stage I - Mild rainfall (watch stage).

- Stage II - Heavy rainfall or potential thereof. OC Public Works Department Operations Center activated and surveillance of flood control facilities in effect.
- Stage III - Continued heavy rainfall or deterioration of facilities. County Public Works Director in charge. County's personnel assume assigned emergency duties.
- Stage IV - Conditions are or are likely to be beyond County control. Board of Supervisors, or Director of Emergency Services when the Board is not in session, proclaims Local Emergency and assumes special powers. Mutual Aid requested.
- Stage V - Damage beyond control of all local resources. State forces are required. Governor requested to proclaim State of Emergency.
- Stage VI - Damage beyond control of local and State resources. Federal forces are required. President requested to declare Major Disaster. **References:**

Gold, Scott, "Disaster Prompted $1.3 billion Effort to Tame Santa River, Protect Basin," Los Angeles Times, October 3, 1999.

United States Army Corps of Engineers, Standard Project Flood Determinations, U.S. Army Corps of Engineers, Publication number EM 1110-2-141 (1965).

### ***Floods as a Threat to Orange County***

The Santa Ana River, flowing through the heart of Orange County to the Pacific Ocean, is the county's greatest flood threat. Research of flooding in Orange County illustrates these flood hazard issues, citing loss of life as well as damage to personal and public property.

One such flood occurred in 1938, wiping out roads, bridges, and railroads near the river when an 8-foot wall of water swept out of the Santa Ana Canyon. Anaheim, Santa Ana, and Garden Grove were hardest hit and 34 lives were lost because of the flood. The flood and its damage were a catalyst for construction of Prado Dam, developed as part of the Army Corps of Engineers flood control protection plan. Government officials estimate that today without the protection of Prado Dam, a flood of this magnitude would cause as many as 3,000 deaths and top $40 billion in damages.

The Army Corps of Engineers, tasked with the project of increasing the level of protection at Prado Dam from the current 70-year level to a 190-year level of protection, started the final phase of construction in 2012 for the area of the River downstream of Prado Dam (called Reach 9). It is anticipated that the construction of all phases of Reach 9 will be completed in 2018. Overall completion of the Prado Dam project, which includes dikes within the Prado Basin and raising of the spillway, is anticipated to be completed in 2021. Further, portions of the County not inundated by river overflow during a 100-year event could be subject to flooding from overflow of water drainage facilities currently inadequate for carrying the 100-year discharge.

Other areas subject to flooding during severe storms include areas adjacent to Bolsa Chica Channel, Anaheim-Barber, Stanton Storm Channel, Santa Ana-Santa Fe, Cañada, Paularino, Westminster, Trabuco, Borrego, Serrano, Laguna Canyon, Atwood Channel, Brea Creek Channel, Fullerton Creek Channel, Carbon Creek Channel, San Juan Creek Channel, and East Garden Grove-Wintersburg Channel. Areas adjacent to Santiago Creek and Collins Channel in the central portion of the County and large portions of the San Diego Creek watershed in the City of Irvine and unincorporated areas of the County are also subject to inundation. In the southern portion of the county, canyon areas are subject to flooding. However, with increased development in these areas the flood hazard becomes even greater.

Flood damages within the Westminster-East Garden Grove Watershed, along the East Garden GroveWintersburg Channel and Westminster Channel affect residential, commercial, and industrial development within the cities of Westminster, Garden Grove, Santa Ana, Huntington Beach, Seal Beach, and Fountain Valley. The East Garden Grove-Wintersburg Channel was originally constructed in the early 1960s as a mixture of earthen, riprap, and concrete-lined trapezoidal section with short reaches of concrete rectangular and covered box facilities. It was designed to carry 25-year peak discharge which was the design standard at the time the channels were constructed. With urbanization growth throughout Orange County and congressional approval of the 1968 National Flood Insurance Program and 1973 amendment, the existing capacity has become deficient and needs to be improved to convey a 100-year peak discharge. The hundreds of homes in the downstream segment of the channel system would be subjected to an estimated 8-foot depth of flooding if a 100-year storm event occurred today. The winter storms of 2005 in this area severely eroded the maintenance roads and levee banks. Constructing this channel system to its ultimate condition will alleviate the floodplain and mitigate 100-year storm events to containment within the channel thus relieving mandatory flood insurance and will create potential environmental enhancements for the watershed.

Portions of the downstream channel have been improved; however continuing work on portions of the channel includes, but is not limited to: removing and hauling existing riprap lining, excavating material from the channel sides, constructing and improving maintenance roadways, and reinforcing the levee with soil-cement mixed columns in combination with sheet pile installations.

San Juan Creek and Trabuco Creek Channels over the years have sustained numerous damages caused by heavy storms, with the most recent damage occurring in January 2005 and December 2010. The damaged portions of the creek’s levees were promptly repaired following the storms. However, despite these repairs, significant portions of the levees remain vulnerable to failure during major storm events while the creek’s capacity remained deficient to convey the 100-year storm. OC Public Works focused its resources on devising an eight phase levee fortification program which will install steel sheet pile walls behind existing deficient channel lining. This multi-phase program will provide immediate protection against catastrophic levee failure once completed. The levee reinforcement program includes creek improvements on San Juan Creek Channel from Stonehill Drive to the I-5 Freeway and on Trabuco Creek Channel from its confluence with San Juan Creek Channel to 1,600 feet upstream of the Del Obispo Bridge. To date, four of the eight phases have been completed. The remaining segments, to be constructed in the next few years, have been prioritized based on the District’s funding allocation. Following these improvements, another phase will begin which includes additional construction needed to raise the level of protection to the desired 100-year level including improvements between Pacific Coast Highway and Stonehill Drive and remove adjacent areas out of the Federal Emergency Management Agency’s (FEMA) floodplain designation.

### *Historic Data for Orange County*

Residents reported damaging floods caused by the Santa Ana River, known as "Great Floods," as early as 1770. A massive flood recorded on January 7, 1770 is in the Notes of Father John Crespi. Major floods in Orange County on the Santa Ana River have occurred in 1810, 1815, 1825, 1884, 1891, 1916, 1927, 1938, 1969, 1983, 1993 and 1997. The greatest flood in terms of water flow was in 1862 with an estimated flow rate of 317,000 cubic feet per second (cfs). This was three times greater than the Great Flood of 1938 estimated at 110,000 cfs. The most damaging flood in terms of cost was the Great Flood of 1969. The County's population had significantly increased by this time creating greater potential for loss.

**Great Flood of 1862**- The storm and flood of January 1862, called the Noachian deluge of California, were unusual in two ways: 1) the storm occurred during the very severe drought of 1856-1864 and 2) the flooding was extremely long, lasting 20 days. Under normal circumstances, major floods last no longer than a few days. The only structure left standing was a chapel called Aqua Mansa on high ground above the river. The priest rang the chapel bell and the settlers fled the rising waters. Small villages along the Santa Ana River were completely destroyed. Miraculously, there were no recorded deaths.

**Great Flood of 1916** – The flood on January 27, 1916 inundated a large area in Santa Ana, flooding Main Street with water 3 feet deep. The farming area, today known as City of Westminster, was also flooded.

A total of six bridges, three traffic bridges and three railroad bridges washed away and four people drowned.

**Great Flood of 1938** – The flood of 1938 considered the most devastating of all County floods in the 20th Century, affected all of Southern California. The storm began on February 27 and lasted until March 3. In the Santa Ana Basin, 34 people died and 182,300 acres were flooded. All buildings in Anaheim were damaged or destroyed. Two major railroad bridges, seven traffic bridges, and the little town of Atwood were completely destroyed. As the Santa Ana River inundated the northwestern portion of Orange County, train service to and from Santa Ana was cancelled and communication with the outside world was essentially nonexistent. Damage exceeded $50 million.

**Great Flood of 1969** – The floods of January and February were the most destructive on record in Orange County. Previous floods had greater potential for destruction, but the County was then relatively undeveloped. The intensity of the 1938 flood was greater, but of shorter duration. A drought that began in 1945 was relieved by only two wet years until the floods in 1969. An annual overdraft of 100,000 acrefeet brought the average groundwater level to 15 feet below sea level, and ocean water moved into the aquifers. Some wells along the coast began producing brackish water and had to be abandoned. http://www.ocwd.com/html/history.htm Rainfall was continuous from January 18-25 resulting in widespread flooding January 25-26. Orange County was declared a national disaster area on February 5. A storm on February 21-25 once again brought rain to the already saturated ground, culminating in a disastrous flood on February 25. The largest peak outflow from Santiago Reservoir since its inception in 1933 occurred in February. On February 25, the reservoir at Villa Park Dam reached its capacity. This was the first time since its construction in 1963 with a maximum outlet inflow of 11,000 cfs. Even though the outlet conduit was discharging up to 4,000 cfs, spillway overflow occurred at 1:30 p.m. on February 25 and continued 36 hours. The maximum peak outflow from the dam reached 6,000 cfs. The safety of the dam was never threatened. However, the outflow caused serious erosion downstream in Orange and Santa Ana and in portions of parks and golf courses. Trees and debris inundated the streambed. Houses, apartments, gardens, swimming pools, and bridges eroded away. Numerous residents and volunteers, worked around the clock to remove debris, sandbag eroding embankments, cordon off danger zones, issue warnings, and make temporary repairs. U.S. Marine Corps helicopters dropped junked cars along the banks of the creek below Bristol Street in an effort to prevent further undermining of homes. A Southern Pacific Railroad bridge, water and sewer lines, a pedestrian overcrossing, and three roads washed out. Approximately 2,000 Orange and Santa Ana residents were evacuated from houses bordering Santiago Creek.

**Great Flood of 1983** – The presence of El Nino spawned the flood of 1983. The intense downpour concentrated in a local area and also resulted in the highest waves to crest onshore in 10 years. Meanwhile, the Santa Ana River crested at the mouth of the ocean, creating a disaster for the low-lying areas of Huntington Beach with floodwaters three to five feet deep. In addition, the pounding surf destroyed a section of the Huntington Beach Pier, resulting in a complete renovation of the pier.

**Great Floods of 1993** – In 1993, El Nino spawned a storm and flood. This storm was concentrated in the Laguna Canyon Channel area from Lake Forest to downtown Laguna Beach. In spite of a valiant effort to save downtown merchants by sandbagging, the stores were flooded anyway. Laguna Canyon Road was damaged extensively as well as homes and small businesses in the Laguna Canyon Channel. There were no fatalities reported.

☐ **Figure 2 - Great Floods in the past in Orange County**

| | |
|---|---|
| ▪ 1770, Jan. | ▪ Information regarding this flood is gathered from Father Juan Crespi's diary |
| ▪ 1780, Dec. | ▪ Information regarding gathered from Father Junipero Serra's diary. |
| ▪ 1825 | ▪ Greatest flood of previous 100 years.<br>▪ Santa Ana River changed main course from Anaheim Bay to Newport Bay. |
| ▪ 1862, Jan. | ▪ The greatest flood in California's history.<br>▪ The rain began on Christmas Eve 1861 continuing for 30 days. The sun shone a total of 45 minutes in that thirty day period.<br>▪ Fifty inches of rain fell during December and January.<br>▪ Water ran four feet deep through downtown Anaheim. |

| | |
|---|---|
| ▪ 1862 | Agua Mansa Story<br>▪ The entire population of Agua Mansa survived the great flood in a small church. Granite monuments were placed on the steps of the church to mark the place where waters stopped rising.<br>▪ In 1967, archeologists and the Riverside County Surveyor located the ruined foundation of the Agua Mansa Mission near the present day Route 60 bridge in Riverside.<br>▪ The water surface established by the mission monuments and other data from old irrigation works enabled the calculation of flow at Agua Mansa to be 315,000 CFS. Nearly 700 square miles are tributary to Prado Dam downstream of Agua Mansa, estimated flow in the Santa Ana Canyon was 400,000 CFS.<br>▪ Current Santa Ana River capacity in Orange County is 20,000 to 40,000 CFS.<br>▪ NOTE: the enormous magnitude of the 1862 flood was unknown in 1939-1941 at the time of the design and building of Prado Dam.<br>▪ Santa Ana River Basin parameters.<br>▪ 2253 square miles tributary to Prado (768 square miles behind Lake Elsinore).<br>▪ The fall of the Santa Ana River from Orange County line to the Pacific Ocean (30 miles) is greater than the fall in the Mississippi River from Cairo, Illinois to the Gulf of Mexico (600 miles). The steep watercourse makes hydraulic design difficult. The rapid response of the watershed to rainfall makes warning of over bank flow difficult.<br>▪ Computer based radio telemetry is used to gather data for flood warnings.<br>▪ Sediment deposits near the ocean chokes channel capacity.<br>▪ Scour around bridges and channel lining caused by high velocity flows.<br>▪ Drop structures (small dams) are required to slow the water and stabilize the soft bottom portions of the channel.<br>▪ Villa Park Dam impounds the flow from 81 square miles. |
| ▪ 1884 Feb. | ▪ The Santa Ana River created a new ocean outlet |
| ▪ 1888-1891 | ▪ Annual floods |
| ▪ 1914 | ▪ Heavy flooding |
| ▪ 1916 | ▪ Hundreds of square miles inundated Orange County. The flow in the Santa Ana River was about 75,000 cfs., overflowing into Anaheim Bay.<br>▪ Santiago Creek overflowed into El Modena and Tustin. |
| ▪ 1921 | ▪ Flooding |
| ▪ 1927 | ▪ Moderate flood |
| ▪ 1938 Mar | Devastation to all of Orange County.<br>▪ Greatest flood since 1862 – about 100,000 cfs in Santa Ana River.<br>▪ 22" of rain fell in 5 days in the San Bernardino Mountains.<br>▪ Santa Ana River levees failed in many places and waters flowed into Anaheim Bay.<br>▪ 34 lives lost in Orange County.<br>▪ Damage reached $14 million (1938). |

| | |
|---|---|
| ▪ 1969 | Great damage, especially to governmental infrastructure.<br>▪ The January storm was the greatest since 1938. There was one heavy flood after 9 day storm and another moderate flood.<br>▪ February storm greater than January but both were moderate intensity, long duration (i.e., large volume) events. 1-hour intensity and 24-hour volume.<br>▪ Prado Dam inflow : 77,000 cfs, outflow 6,000 cfs.<br>▪ Maximum Santa Ana river capacity is 40,000 cfs.<br>▪ 1 ½ million cubic yards of sediment carried by Santa Ana River nearly caused levee failure due to the invert rising over five feet near the river mouth.<br>▪ Prado Dam was 60% filled.<br>▪ Villa Park Dam inflow – 11,000 cfs, outflow – 6,000 cfs.<br>▪ $5 million – private property damage.<br>▪ $2.6 million – district property damage.<br>▪ $9 million – other public property damage (roads and parks).<br>▪ Federal Dams in and near Orange County cost $640 million over a 30 year period.<br>▪ The Federal dams prevented $1 million in damage during one week in February 1969. Smaller but more numerous local facilities by district, cities and county had a comparable cost-benefit effect.<br>▪ 1969 was a wakeup call to flood protection engineers from the Corps of Engineers to City Engineer level in Orange County. |
| ▪ 1974 | ▪ 100-year rainfall along the coast of Orange County. Damage limited by substantial flood control improvements and 3-hour duration of high intensity rainfall. |
| ▪ 1983 | A very damaging record-breaking storm.<br>▪ 6-hours in duration covering about 100 square miles of western Orange County.<br>▪ Severe property damage in Huntington Beach, Fountain Valley, and Costa Mesa.<br>▪ The storm influenced the criteria published in the 1986 Orange County Hydrology Manual. |
| ▪ 1995 | ▪ A very damaging storm with record breaking intensities for 2 and 3 hour duration. Flooded homes in Los Alamitos, Seal Beach, and Garden Grove. |
| ▪ 1997 | The most severe storm ever measured in Orange County.<br>▪ New records set for 30 minutes, 1 hour, 2 hour, 3 hour, 6 hour, 12 hour, and 24-hour rainfall.<br>▪ There was severe damage to Laguna Beach, Lake Forest, Irvine, and to the I-5 Freeway.<br>▪ 100-year rainfall covered over 200 square miles of our 800 square mile county.<br>▪ This storm and the similar, but slightly less severe 1983 and 1995 events, revealed vulnerability of older flood control facilities built. It was thought this type of intense storm was too rare to consider protective measures.<br>▪ Too many record-breaking storms hit in too short a period. |
| ▪ 2005 | ▪ A series of "Pineapple Express" storms in January and February were the most significant since El Nino of 1998 causing mud flows and flooding throughout Orange County. Both state proclamations and federal declarations of disaster were made for these storms. |
| ▪ 2010 | ▪ Significant storms occurring in January and December resulted in damage from flooding and mud flows in Laguna Beach. Levee damage occurred in San Juan Capistrano along Trabuco Creek. |
| **Sources: Santa Ana River Mainstream Project – OC Public Works/Santa Ana River Division** | |

Flooding during the 1997/1998 El Niño Storm Season affected Orange County. Extensive storm damage to private property and public infrastructure (County and cities) reached approximately $50 million.

Storm conditions caused numerous countywide mud flows, road closures, and channel erosion. Hillside erosion and mud flows forced continual clearing of County roads of fallen trees and debris. Protective measures, such as stabilizing hillside road slopes with rock or K-rail at the toe of slopes, were taken to keep the normal flow of transportation on the County's road system. County harbors, beaches, parks, and trails also sustained substantial storm damage.

High ocean waves and storm activity forced the closure of Aliso Beach Pier when it was declared unsafe to the public and as a result, eventually required demolition. The high ocean waves also severely damaged the Laguna Beach boardwalk. Flooding occurred in the city, causing injuries and two deaths as a result of water and mud flow. Lateral erosion occurred to the natural banks of Serrano Creek and Aliso Creek. Storm flows destroyed portions of San Juan Creek and Trabuco Creek levees and channel linings. The U.S. Army Corps of Engineers assumed responsibility for the channel restoration following initial emergency response repairs made by the County. Substantial silt and sedimentation deposits at Santa Ana-Delhi and San Diego Creek Channels contributed to severe dredging problems at the Upper Newport Bay Regional Park, with costs estimated in excess of $2 million. Major landslides in Laguna Niguel caused millions of dollars in damage. Deterioration and collapse of a culvert 25 feet beneath the asphalt forced closure of Santiago Canyon Road for three weeks.

Assistance from resources such as the Army Corps of Engineers and the Federal Highway Administration minimized the overall reimbursement from FEMA (P.L. 93-288, Stafford Act for Public Assistance). Still, the reimbursement to the County unincorporated area alone still reached approximately $4 million.

Although the 1997/1998 floods resulted in substantial damage to Orange County, it was not unprecedented. In January 1995, a disaster was declared in the County as extremely heavy and intense rains quickly exceeded the storm runoff capacity of local drainage systems in many Orange County cities and regional Flood Control District systems. As a result, widespread flooding of homes and businesses occurred throughout these cities. There were approximately 1000 people evacuated and extensive damage sustained to both private and public property. Unincorporated areas of the county received $12.5 million in reimbursement through Public Assistance programs.

A series of storms battered Southern California in January and February 2005. These storms were the most significant to hit Southern California since the El Niño of 1998 and caused mud flows and flooding throughout Orange County. Both state proclamations and federal declarations of disaster were made for these storms.

Orange County is in close proximity to Los Angeles, San Bernardino, Riverside, and San Diego Counties. Heavy rain affecting any one of these counties can easily affect Orange County. In addition, the towering mountains trap eastern-moving winter storms and draw out the rain. The rainwater moves rapidly down the steep slopes and across the coastal plains on its way to the ocean. Orange County averages about thirteen inches of rain a year, yet some mountain peaks in the County receive more than forty inches of precipitation annually.

Naturally, this rainfall moves rapidly downstream, often with severe consequences for anything in its path. Flood-generated debris flows roared down canyons at speeds near 40 miles per hour carrying with them walls of mud, debris, and water many feet high.

## *Factors Creating Flood Risk*

Flooding occurs when climate, geology, and hydrology combine to create conditions of water flow outside its usual course.

**Seasonal Rainfall**

Over the last 100 years, the average annual rainfall in Orange County is 13.03 inches. However, the term “average” means very little as the annual rainfall during this period has ranged from 2.19 inches in 20062007 to 38.2 inches in 1883-1884. This makes Orange County a land of extremes in terms of annual precipitation. Orange County is in the southern section of the Los Angeles Basin fringing the border of the Saddleback Range on the east, increasing the possibility of collection of rainwater within the county.

Another relatively regular source for heavy rainfall, particularly in the mountains and adjoining cities, is from summer tropical storms. Figure 3 lists tropical storms with significant rainfall in the past century, and the general areas affected by these storms. These tropical storms usually coincide with El Niño years.

**El Niño**

Like many weather patterns, El Niño is one of those systems that nearly everyone has heard of, but whose origins are not so widely known. An elixir of unusual trade wind patterns and warming waters, the weather event can dominate climatic conditions across the world. El Nino is a disruption of the ocean-atmosphere system in the tropical Pacific having important consequences for weather around the globe.

Nineteenth century anglers coined the name "El Niño.” Anglers plying the waters off the coast of Peru in the late 1800s were the first to notice an occasional seasonal invasion of warm, southward ocean current that displaced the north-flowing, cold stream in which they normally fished. Typically, it happened around Christmas, or the first of the year – hence the name "El Niño," which means "little boy" or "Christ child" in Spanish.

An El Niño occurs when the ocean-atmosphere system in the tropical Pacific Ocean is disrupted. Normally, trade winds blow toward the west across the tropical Pacific Ocean, piling up warm surface water in the western Pacific. In a classic El Niño, the trade winds relax in the central and western Pacific, leaving warm water in the eastern Pacific. Heavy rainfall follows the warm water eastward, leading to flooding in Peru and California. Meanwhile, areas farther west, such as Indonesia and Australia, suffer droughts.

An El Niño event occurred in 1997-98 and mild occurrences in 2004-2005 and 2009-2010. The 1983-84 El Niño is considered the strongest and most devastating on record, responsible for more than 1,000 deaths, causing weather-related disasters on nearly every continent and totaling $10 billion in damages to property and livestock. El Niño conditions typically last one or two years, and are followed by "La Niña," or "little girl," in which a cooling of the same mid-Pacific waters triggers a reverse in climate impacts.

☐ **Figure 3 – Select Tropical storms or cyclones that affected Southern California**

| **Month-Year** | **Date(s)** | **Area(s) Affected** | **Rainfall** |
|---|---|---|---|
| July 1902 | 20th & 21st | Deserts & Southern Mountains | up to 2" |
| Aug. 1906 | 18th & 19th | Deserts & Southern Mountains | up to 5" |
| Sept. 1910 | 15th | Mountains of Santa Barbara County | 2" |
| Aug. 1921 | 20th & 21st | Deserts & Southern Mountains | up to 2" |
| Sept. 1921 | 30th | Deserts | up to 4" |
| Sept. 1929 | 18th | Southern Mountains & Deserts | up to 4" |
| Sept. 1932 | 28th to Oct 1st | Mountains & Deserts, 15 Fatalities | up to 7 |
| Aug. 1935 | 25th | Southern Valleys, Mountains & Deserts | up to 2" |
| Sept. 1939 | 4th - 7th | Southern Mountains, Southern & Eastern Deserts | up to 7 |
| | 11th & 12th | Deserts, Central & Southern Mountains | up to 4" |
| | 19th - 21st | Deserts, Central & Southern Mountains | up to 3" |
| | 25th | Long Beach, W/ Sustained Winds of 50 Mph | 5" |
| | | Surrounding Mountains | 6 to 12" |
| Sept. 1945 | 9th & 10th | Central & Southern Mountains | up to 2” |
| Sept. 1946 | 30th - Oct 1st | Southern Mountains | up to 4" |
| Aug. 1951 | 27th - 29th | Southern Mountains & Deserts | 2 to 5" |
| Sept. 1952 | 19th - 21st | Central & Southern Mountains | up to 2" |
| July 1954 | 17th - 19th | Deserts & Southern Mountains | up to 2" |
| July 1958 | 28th & 29th | Deserts & Southern Mountains | up to 2" |
| Sept. 1960 | 9th & 10th | Julian | 3.40" |
| Sept. 1963 | 17th - 19th | Central & Southern Mountains | up to 7" |

| | | | |
|---|---|---|---|
| Sept. 1967 | 1st - 3rd | Southern Mountains & Deserts | 2" |
| Oct. 1972 | 6th | Southeast Deserts | up to 2" |
| Sept. 1976 | 10th & 11th | In Central and Southern Mountains. Ocotillo, CA was destroyed and there were 3 fatalities | 6 to 12" |
| Aug. 1977 | n/a | Los Angeles | 2" |
| | | Mountains | up to 8" |
| Oct. 1977 | 6th & 7th | Southern Mountains & Deserts | up to 2 |
| **Month-Year** | **Date(s)** | **Area(s) Affected** | **Rainfall** |
| Sept. 1978 | 5th & 6th | Mountains | 3" |
| Sept. 1982 | 24th - 26th | Mountains | up to 4" |
| Sept. 1983 | 20th & 21st | Southern Mountains & Deserts | up to 3" |
| Oct. 1987 | 5th-12th | Southern California | 2.14” |
| June 1990 | 5th – 7th | Southern California and Western U.S. | Up to 3.28” |
| Sept. 2001 | 3rd | Southern California, Strong Thunderstorm Activity | Less than 1” |
| Oct. 2009 | 14th | Southern and Central California, High winds | Up to 10” |
| Sept. 2014 | 8th | Southern Deserts | Up to 3” |
| July 2015 | 18th – 20th | Southern California | Up to 4” |
| http://www.fema.gov/nwz97/eln_scal.shtm & other sources | | | |

**Geography and Geology**

Southern California is the product of rainstorms and erosion for millennia. Most of the mountains surrounding the valleys and coastal plain are deeply fractured faults. As the mountains grew taller, their brittle slopes eroded. Rivers and streams carried boulders, rocks, gravel, sand, and silt down these slopes to the valleys and coastal plain. Today, much of the coastal plain rests on the ancient rock debris and sediment washed down from the mountains.

This sediment acts like a sponge, absorbing vast quantities of rain in years when heavy rains follow a dry period. Like a sponge near saturation, the same soil fills up rapidly when heavy rain follows a period of relatively wet weather. Even so, in some years of heavy rain, flooding is minimal because the ground is relatively dry, yet the same amount of rain following a wet period can cause extensive flooding.

Essentially all of Orange County is built out leaving little open land to absorb rainfall. The lack of open land forces water to remain on the surface rapidly accumulating. If it were not for the massive flood control system with its concrete lined river and streambeds, flooding would be a much more common occurrence. In addition, the tendency is toward less and less open land. In-fill building is becoming a much more common practice in many areas. Developers tear down an older home, typically covering up to 40% of the lot, replacing the single home with three or four town homes or apartments covering 90-95% of the lot.

Another potential source of flooding is “asphalt creep.” The street space between the curbs of a street is a part of the flood control system. When water leaves property and accumulates in the street, it is directed toward the underground portion of the flood control system. The carrying capacity of the street is determined by the width of the street and the height of the curbs along the street. Often, when resurfacing streets, a one to two inch layer of asphalt is laid over the existing asphalt. This added layer of asphalt subtracts from the rated capacity of the street to carry water. Thus, the original engineered capacity of the entire storm drain system is marginally reduced over time. Subsequent re-paving of the street will further reduce the engineered capacity even more.

**Bridges**

In flood events, bridges are key points of concern because of their importance in the transportation network for the movement of goods, travel, and emergency services. During flood events, scouring of bed material supporting their foundation can occur. Historically, this is the most common cause of bridge failures. Bridges in and of themselves may also be obstructions in a watercourse, restrict flows, and cause stream instability.

Bridges in the County are Federal, State, County, Flood Control District, City, or privately owned property. County owned bridges that are on the public roadway system are inspected by the California Department of Transportation (CalTrans) in accordance with National Bridge Inspection Standards. Inspections are performed at regular intervals not to exceed two years unless justification to do otherwise is approved by the Federal Highway Administration. Bridges that are not a part of the public roadway system or listed in the States Inventory of Bridges will not be subject to inspection and are consequently a reason for concern.

The following bridges owned and maintained by the County have been retrofitted to address scour and/or seismic concerns:

- Hamilton Street-Victoria Street at Santa Ana River Channel (Bridge No. 55C-0103)
- Adams Avenue Bridge at Santa Ana River Channel (Bridge No. 55C-0344)
- Edinger Avenue Bridge at Santa Ana River Channel (Bridge No. 55C-0154) ▪ Warner Avenue Bridge at Santa Ana River Channel (Bridge No. 55C-0148)

- Harbor Boulevard Bridge at Santa Ana River Channel (Bridge No. 55C-0631)
- Lincoln Avenue Bridge at Santa Ana River Channel (Bridge No. 55C-0017)
- Glassell Street Bridge at Santa Ana River Channel (Bridge No. 55C-0130)
- Santiago Canyon Road Bridge at Santiago Creek (Bridge No. 55C-0038)
- Santiago Canyon Road Bridge at Santiago Creek (Bridge No. 55C-0049)
- Island Way Bridge at Harbor Waterway (Bridge No. 55C-0561)
- Brea Boulevard Bridge at Brea Creek (Bridge No. 55C-0122)
- Brea Boulevard Bridge at Brea Creek (Bridge No. 55C-0123)
- Santa Margarita Parkway Bridge at Arroyo Trabuco (Bridge No. 55C-0520)
- Slater Avenue-Segerstrom Avenue Bridge at Santa Ana River Channel (Bridge No. 55C-0371)

The County plans to replace Edinger Bridge at Bolsa Chica Channel (Bridge No. 55C-0400) in Fiscal Year 2017/2018. The new bridge is designed to current seismic design standards.

### *Flood Terminology*

#### Floodplain

A floodplain is a land area adjacent to a river, stream, lake, estuary, or other water body that is subject to flooding. This area, if left undisturbed, stores excess floodwater. The floodplain is made up of two sections: the floodway and the flood fringe.

#### 100-Year Flood

A 100-year flooding event is a flood having a one percent chance of being equaled or exceeded in magnitude in any given year. Contrary to popular belief, it is not a flood occurring once every 100 years. The 100-year floodplain is the area adjoining a river, stream, or watercourse covered by water in the event of a 100-year flood. Map 6 illustrates the 100-year floodplain in Orange County.

#### Floodway

The floodway is one of two main sections creating the floodplain. Regulatory purposes require floodways be defined. Unlike floodplains, floodways do not reflect a recognizable geologic feature. For National Flood Insurance Program (NFIP) purposes, floodways are defined as the channel of a river or stream, and the over bank areas adjacent to the channel. The Orange County Zoning Code defines a “Floodway” as “the channel of a river or other watercourse and that part of the floodplain reasonably required to discharge the base flood without cumulatively increasing the water surface elevation more than one (1) foot.” In the Orange County Zoning Code, the “FP-1” Zoning District is intended to be applied to areas shown as “floodway” on the December 3, 2009 or most current federal Flood Insurance Rate Maps and Flood Boundary and Floodway Maps and areas in which the County has determined that a floodway exists.

The floodway carries the bulk of the floodwater downstream and is usually the area where water velocities and forces are the greatest. NFIP regulations require the floodway be open and free from development or other structures that can obstruct or divert flood flows onto other properties.


☐ **Map 6 - 100-Year Floodplain in Orange County**

### Flood Fringe

The flood fringe refers to outer portions of the floodplain, beginning at the edge of the floodway and continuing outward. It is generally defined as "the land area, which is outside of the stream floodway, but is subject to periodic inundation by regular flooding." This is the area where development is most likely to occur, and where precautions to protect life and property must be taken. In Section 7-9-113-1 of the Orange County Zoning Code (Zoning Ordinance), the flood fringe encompasses the FP-2 and FP-3 Districts.

The FP-2 is intended to be applied to areas shown as "A," "A1", "AO," "AE," "AH," and "A99" on the December 3, 2009 or most current federal Flood Insurance Rate Maps and areas in which the County has determined to be a "Special Flood Hazard Area" (SFHA).

The FP-3 is intended to be applied to areas shown as "V", "VE," "AH," and "A99," on the December 3, 2009 or most current federal Flood Insurance Rate Maps and areas in which the County has determined to be a coastal high hazard area.

**Development**

For floodplain ordinance purposes, development is broadly defined as "any human caused change to improved or unimproved real estate, including but not limited to buildings or other structures, mining, dredging, filling, grading, paving, excavation, or drilling operations located within the area of special flood hazard." The definition of development for floodplain purposes is generally broader and includes more activities than the definition of development used in other sections of local land use ordinances.

**Uses permitted** within the FP-1 District include agriculture, public flood control facilities and devices, public utility facilities, public parks and recreation areas. Specifically prohibited within all Floodplain Zones (FP-1, FP-2, and FP-3) are structures and uses increasing flood elevations during the course of a base flood discharge. Landfills, excavations and grading or the storage of materials and equipment resulting in the diversion or increase in erosion, flood elevations, or related hazards to people or property and storage or disposal of floatable substances and materials or of chemicals, explosives, and toxic materials are also prohibited. The "Base Flood" is defined in the Zoning Code as "the flood having a one percent chance of being equaled or exceeded in any given year, a.k.a. 100-year flood."

**Base Flood Elevation (BFE)**

The term "Base Flood Elevation" refers to the expected elevation (normally measured in feet above sea level) of a base flood. Base flood elevations can be set at levels other than a 100-year flood. Some communities choose to use higher frequency flood events as a base flood elevation for certain activities, while using lower frequency events for others. For example, for the purpose of storm water management, a 25-year flood event might serve as the base flood elevation; while a 500-year flood event may serve as base flood elevation for the tie down of mobile homes. The regulations of the NFIP focus on development in the 100-year floodplain.

**Characteristics of Flooding**

Two types of flooding primarily affect Orange County: riverine flooding and urban flooding (see descriptions below). In addition, any low-lying area has the potential to flood. The flooding of developed areas may occur when the amount of water generated from rainfall and runoff exceeds a storm water system's capability to remove it.

**Riverine Flooding**

Riverine flooding is the over bank flooding of rivers and streams. The natural process of riverine flooding adds sediment and nutrients to fertile floodplain areas. Flooding in large river systems typically results from large-scale weather systems generating prolonged rainfall over a wide geographic area. Flooding occurs in hundreds of smaller streams, which then drain into the major rivers.

Shallow area flooding is a special type of riverine flooding. FEMA defines shallow flood hazards as areas that are inundated by the 100-year flood with flood depths of only one to three feet. These areas are generally flooded by low velocity sheet flows of water.

**Urban Flooding**

As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization of a watershed changes the hydrologic systems of the basin. Heavy rainfall collects and flows faster on impervious concrete and asphalt surfaces. The water moves from the clouds, to the ground, and into streams at a much faster rate in urban areas. Adding these elements to the hydrological systems can result in floodwaters that rise very rapidly, peaking with violent force.

**Dam Failure Flooding**

Loss of life and damage to structures, roads, and utilities may be the result of a dam failure. Economic loss can result in a lowered tax base and lack of utility profits. The failure of one of the major dams in Orange County would certainly have this effect. FEMA requires all dam owners to develop Emergency Action Plans (EAP) for warning, evacuation, and post-flood actions because dam failure can have severe consequences. Although there may be coordination with county officials in the development of the EAP, the responsibility for developing potential flood inundation maps and facilitation of emergency response is the responsibility of the dam owner.

Since the 19th century, 45 dam failures have occurred in California. The two most significant dam failures are St. Francis Dam in 1928 and the Baldwin Hills Dam in 1963 that occurred in Los Angeles County.

For more detailed information regarding dam failure flooding, and potential flood inundation zones for a particular dam in the county, refer to the Orange County Emergency Action Plan. Also see Hazard Profile for Dam Failure in Chapter 3, Section 3.4 of this document.

**Mud Flows**

Another flood related hazard that can affect certain parts of the Southern California region are debris flows. Typically, debris flows occur in mountain canyons and the foothills. However, any hilly or mountainous area with intense rainfall and the proper geologic conditions may experience one of these very sudden and devastating events.

Mud flows, sometimes referred to as debris flows, lahars, or debris avalanches, are common types of fastmoving landslides. These flows generally occur during periods of intense rainfall or rapid snow melt. They usually start on steep hillsides as shallow landslides that liquefy, accelerating to speeds that are typically about 10 miles per hour, but can exceed 35 miles per hour. The consistency of debris flows ranges from watery mud to thick, rocky mud and can carry items as large as boulders, trees, and cars. Debris flows from many different sources can combine in channels, greatly increasing their destructive power. As the flow reaches flatter ground, debris spreads causing damage in developed areas.

The canyon areas within Orange County are susceptible to flooding and landslides following fire events.

The 2007 Santiago Fire, torching more than 28,000 acres, and the 2014 Silverado Canyon Fire, burning 960 acres, left burned trees and shrubs on steep slopes, exposing soil to be washed away by rain. It usually takes a few years for burned areas to recover vegetation.

**Coastal Flooding**

Low-lying coastal communities of Southern California also contend with coastal flooding. This occurs most often during storms with higher than normal tides. Storms, the time of year, and the tidal cycle can bring much higher than normal tides, causing flooding in low-lying coastal areas. This hazard however is limited to those areas.

**Effect of Development on Floods**

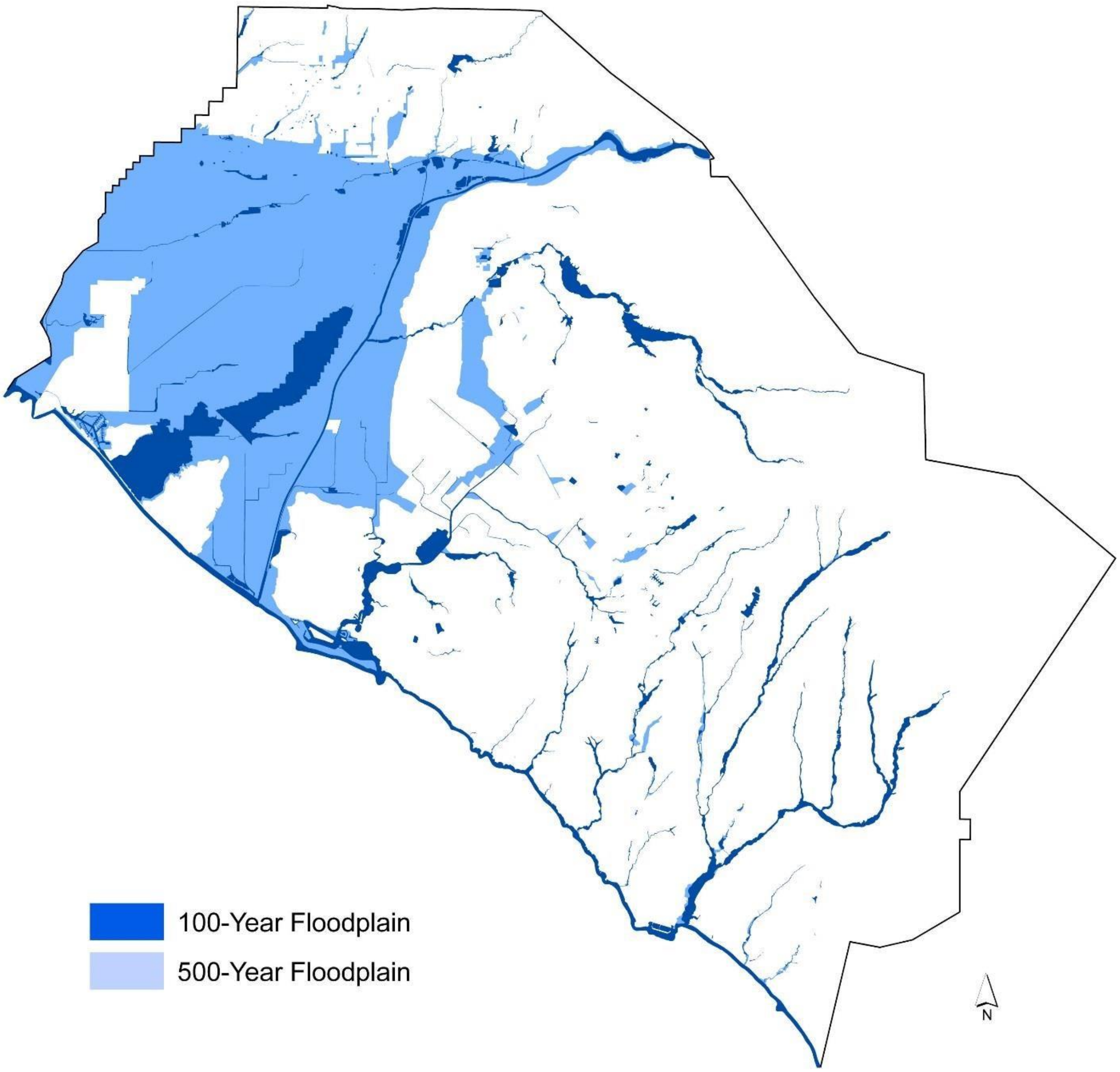
Development raises the river levels by forcing the river to compensate for the flow space obstructed by the inserted structures and/or fill. Serious problems arise with structures or a material added to floodways or floodplains and there is no removal of fill to compensate. Flood waters may be forced away from historic floodplain areas. As a result, other existing floodplain areas may experience floodwaters that rise above historic levels. Displacement of only a few inches of water can mean the difference between no structural damage occurring in a given flood event, and the inundation of many homes, businesses, and other facilities. Careful attention should be given to development occurring within the floodplain to ensure structures are prepared to withstand base flood events. In highly urbanized areas, increased paving can lead to an increase in volume and velocity of runoff after a rainfall event, exacerbating the potential flood hazards. Consideration taken in the development and the implementation of storm-water management systems ensures effective displacement of runoff waters.

**Identification of Flood-Prone Areas**

Flood maps and Flood Insurance Studies (FIS) are often used to identify flood-prone areas. The NFIP was established in 1968 to provide low-cost flood insurance to the nation's flood-prone communities. The NFIP also reduces flood losses through regulations focusing on building codes and sound floodplain management. Although NFIP regulations (44 Code of Federal Regulations (CFR) Chapter 1, Section 60, 3) require all new construction in floodplains be elevated at or above the base flood level, the Orange County Ordinance (09-008) requires that new construction be elevated at least one foot above the BFE.

Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies (FIS) Floodplain maps are the basis for implementing floodplain regulations and for delineating flood insurance purchase requirements. A Flood Insurance Rate Map (FIRM) is the official map produced by FEMA delineating Special Flood Hazard Areas (SFHA) in communities where NFIP regulations apply. FIRMs are also used by insurance agents and mortgage lenders to determine flood insurance requirements and applicable rates.

FIRMs are developed by combining water surface elevations with topographic data. Information derived through this process illustrates areas with the potential for inundation during a 100-year flood. They may also include base flood elevations (BFEs) and areas located within the 500-year floodplain. Flood Insurance Studies and FIRMs produced for the NFIP provide assessments of the probability of flooding in a specific location. Flood Insurance Studies conducted in the late 1970's and early 1980's by FEMA show flood risk in specific areas. FEMA recently updated these floodplain maps during the Digital Flood Insurance Rate Map update. Human caused and natural changes to the environment continue to change the dynamics of storm water run-off.




☐ **Map 7 - FEMA 100 and 500-Year Floodplains (December 2009)**

**Flood Mapping Methods and Techniques**

Although many communities rely exclusively on FIRMs to characterize the risk of flooding in their area, some flood-prone areas are unmapped, but remain susceptible to flooding. These areas include locations next to small creeks, local drainage areas, and human-caused flooding.

To address this lack of data, Orange County, as well as other jurisdictions, has taken efforts to develop more localized flood hazard maps. One method includes using high water marks from flood events or aerial photos, in conjunction with the FEMA maps, to better reflect the true flood risk. The use of GIS (Geographic Information System) is becoming an important tool for flood hazard mapping. FIRM maps can be imported directly into GIS, which allows for GIS analysis of flood hazard areas.

Flood hazard areas on tax assessment parcel maps are particularly useful to communities, allowing evaluation of the flood hazard risk for specific parcels during review of a development request. Coordination between FEMA and local planning jurisdictions is key to making a strong connection with GIS technology for flood hazard mapping.

FEMA and the Environmental Systems Research Institute (ESRI), a private company, have formed a partnership providing multi-hazard maps and information to the public via the Internet. The online FEMA GeoPlatform site assists communities in evaluating geospatial information regarding natural hazards. The hazard maps provided on the site are available at http://fema.maps.arcgis.com. The FEMA Map Service Center (MSC) is the official public source for flood hazard information providing centralized GIS downloadable data and maps at http://www.msc.fema.gov.

## *Hazard Assessment*

### Hazard Identification

Hazard identification is the first phase of flood-hazard assessment. Identification is the process of estimating: (1) the geographic extent of the floodplain (i.e., the area at risk from flooding), (2) the intensity of the flooding that can be expected in specific areas of the floodplain, and (3) the probability of occurrence of flood events. This process results in the creation of a floodplain map providing detailed information to assist jurisdictions when making policies and land-use decisions.

### Data Sources

FEMA mapped the 100-year and 500-year floodplains through the Flood Insurance Study (FIS) in conjunction with the United States Army Corps of Engineers (USACE) in August of 1987. A map of the floodplain completed in March of 1978 included the Housing and Urban Development (HUD) study when Orange County entered into the NFIP. The county has updated smaller drainage studies on the USACE and FEMA maps since this time and has access to the latest updated DFIRM (Digital Flood Insurance Rate Map) maps that followed the December 2009 FIRMs from FEMA. Map changes are expected from the upcoming Risk Map updates.

## *Community Flood Issues*

### Susceptibility to Damage during a Flood Event

The largest impact to communities in a flood event is the loss of life and property to both private and public entities. Development in the floodplains of Orange County increases the risk of extensive property loss resulting in flooding and flood damage.

**Property Loss Resulting from Flooding Events**

The type of property damage resulting from flood events is dependent upon the depth and velocity of the floodwaters. Fast moving floodwaters can wash buildings off their foundations and sweep cars downstream. High waters combined with flood debris can damage infrastructure, pipelines, and bridges. Landslide damage related to soil saturation can cause extensive damage. Water saturation of materials susceptible to loss (i.e., wood, insulation, wallboard, fabric, furnishings, floor coverings, and appliances), in many cases, renders a home unlivable.

**Mobile Homes**

The 1996 floods destroyed 156 housing units in the State. Of those units, 61% were mobile or manufactured homes. Many older manufactured home parks are located in floodplain areas. A manufactured home has a lower level of structural stability during a flood event. Because of confusion in the late 1980's resulting from multiple changes in NFIP regulations, some communities do not actively enforce anchoring requirements. The lack of enforcement of manufactured home construction standards in floodplains contributes to severe damage. In the unincorporated area of Orange County, the Orange County Zoning Code specifies that each mobile home installed on its own building site shall comply with the requirements of Section7-9-149.5 (et. al.). Each mobile home installation shall comply with the site development standards for a single-family dwelling in the applicable zoning district and be placed on a foundation system.

The Orange County Planning Division states there are currently no mobile home parks within the unincorporated area that have some portion of their property in the 100-year floodplain. However, the Orange County Zoning Code does permit "Manufactured Homes" within the FP-2 and FP-3 "Floodplain" district subject to a site development permit per Section 7-9-113.5 of the Zoning Code. Such uses may also be subject to appropriate approvals from FEMA if a subject property is also included within a floodplain on a Flood Insurance Rate Map or a Flood Boundary and Floodway Map.

**Business/Industry**

Flooding impacts businesses when damaged property interrupts operation, forcing closure for repairs, and customer access is cut off. A community maintains economic vitality in the face of flood damage with quick response to the needs of businesses affected by the flood. Response to business damages can include funding to assist owners in elevating or relocating flood-prone business structures.

**Public Infrastructure**

Publicly owned facilities are a key component of the daily lives of all residents in the county. Damage to public water and sewer systems, transportation networks, flood control facilities, emergency facilities, and offices hinder the government in delivering services. By taking action to create public policy, government can reduce risk to public infrastructure and private property resulting from flood events.

**Roads**

During a natural hazard event, or any type of emergency or disaster, dependable road connections are critical for providing emergency services. Orange County road systems often traverse floodplain and floodway areas. Federal, state, county, and city governments all have a stake in protecting roads from flood damage. Transportation agencies responsible for road maintenance are typically aware of roads at risk from flooding.

**Bridges**

Bridges are key points of concern during flood events. They are important links in road networks and river crossings and can be obstructions in watercourses, inhibiting the flow of water. A state-designated inspector must inspect all public bridges every two years, looking at everything from seismic capability to erosion and scour. Private bridges, not inspected, can be very dangerous. Five of the highest priority bridges in Orange County are currently being upgraded by replacing earthquake resistant bearing pads.

**Storm Water Systems**

Local drainage problems are common throughout the County and most of the local systems are owned and operated by the cities. A drainage master plan of the county is updated as needed. The staff of Orange County Public Works is aware of local drainage threats. The problems are often present where storm water runoff enters culverts or goes underground into storm sewers. Inadequate maintenance also contributes to the flood hazard in urban areas.

**Water/Wastewater Treatment Facilities**

There are ten utilities in Orange County with facilities located in local jurisdictions. There are 28 retail water utilities and 2 regional water utilities within the county.

**Water Quality**

Environmental quality problems include bacteria, toxins, and pollution. In 1990, the California Regional Water Quality Control Board, Santa Ana, and San Diego Regions issued municipal separate storm sewer system (MS4) permits under the National Pollution Discharge and Elimination System (NPDES) regulating the discharge of urban storm water runoff. Fourth term MS4 permits for Orange County were issued in 2009 and fifth term permits will be adopted in 2015. Each jurisdiction, including Orange County must comply with the MS4 permit provision, which have increased in complexity each time they have been reissued. Procedures established assist OC Public Works staff in implementing NPDES requirements designed for reducing and eliminating the discharge of pollutants into the waters of Orange County from urban sources. Orange County has invested heavily in efforts to implement a watershed approach to address water quality as well as habitat restoration, recreation, and flood control.

### *Existing Flood Mitigation Activities*

Flood mitigation activities include current mitigation programs and activities that are being implemented by Orange County agencies or organizations.

**Orange County Codes**

Orange County uses building codes, zoning codes, and various planning strategies to address the goals aimed at restricting development in areas of known hazards, and applying the appropriate safeguards.

**Acquisition and Protection of Open Space in the Floodplain**

Current efforts to increase public open space in Orange County coupled with the need to restore and preserve natural systems providing a wildlife habitat also help to mitigate flood events. Publicly owned parks and open spaces provide a buffer linking flood hazards and private property.

**Riparian Areas**

Riparian areas are important transitional areas linking water and land ecosystems. Vegetation in riparian areas is dependent on stream processes and is composed of plants requiring large amounts of water, such as willows and cottonwood trees. Healthy vegetation in riparian buffers can reduce streamside erosion during flood events normally affected by the high water. The community has supported various improvement projects addressing issues caused by population growth and development and strained by land and water resources.

**Wetlands**

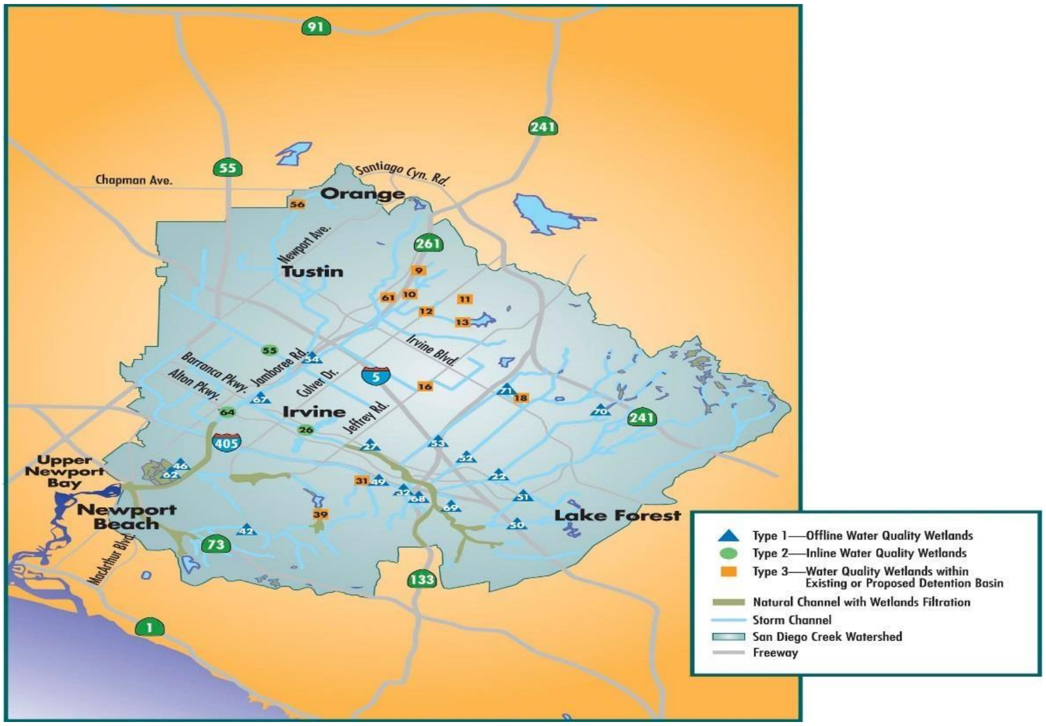
Many floodplain and stream-associated wetlands absorb and store storm water flows, reducing flood velocities and stream bank erosion. Preserving the wetlands reduces flood damage and the need for expensive flood control devices such as levees. When the storms are over, many wetlands augment summer stream flows by slowly releasing the stored water back to the stream system. Wetlands are highly effective in removing nitrogen, phosphorous, heavy metals, and other pollutants from the water. For this reason, artificial wetlands are often constructed for cleaning storm water runoff and for tertiary treatment (polishing) of wastewater.

The only wetlands located in Orange County are listed below. These areas are under the jurisdictions noted with each site.

- **Bolsa Chica** – Responsible Party: California State Fish & Game.
- **Upper Newport Bay** – Responsible Party: California State Fish & Game (Orange County Public Works, Harbors, Parks & Beaches operates a regional facility adjacent to the bay).
- **Seal Beach Wetlands** – Responsible Party: Federal Government/ Seal Beach Weapons Station.
- **Huntington Beach Wetlands** – Responsible Party: Huntington Beach Conservancy.

The Natural Treatment System is a wetlands project initiated by the Irvine Ranch Water District. With the support of Orange County and the Cities of Irvine, Lake Forest, Orange, Newport Beach and Tustin, construction of 31 water quality wetlands to clean urban runoff within the San Diego Creek Watershed and to improve water quality in Upper Newport Bay is underway.

The Natural Treatment System (NTS) is a cost effective, environmentally sound alternative for handling dry weather runoff. Low-flow natural and urban run-off is diverted into manmade wetlands throughout the San Diego Creek Watershed. Contaminants are removed preventing them from reaching the Upper Newport Bay. As the system provides a natural resource, riparian habitat, wildlife and water quality benefits throughout the watershed.




☐ **Map 8 - Irvine Ranch Water District's Natural Treatment System (NTS)**

### *Storm Water Systems*

Orange County, the Orange County Flood Control District, and the Cities of Orange County (collectively referred to as Permittees) received their first National Pollutant Discharge Elimination System (NPDES) MS4 permits in 1990 from the Santa Ana Regional Water Quality Control Board. These permits authorize the discharge of runoff from the municipally owned and operated storm drain system provided pollutants be prevented or minimized to the Maximum Extent Practicable (MEP). MS4 permits for Orange County Permittees were renewed in 1996, 2002, 2009 and 2015. Each subsequent MS4 permit renewal has increased the responsibility of Orange County Permittees to manage storm water runoff discharged to receiving waters from the municipal storm drain system.

To achieve compliance with MS4 permit requirements, Orange County Permittees drafted a Drainage Area Management Plan (DAMP) in 1993. The DAMP was updated in 2000, 2003 and again in 2011, reflecting the increased requirements of the MS4 permits. The main objectives of the DAMP are to present a plan that satisfies NPDES permit requirements and to reduce and prevent the impacts of urban storm water discharges on receiving waters.

The DAMP is the principal policy document for Orange County Permittees, with each jurisdiction documenting how they are implementing the DAMP in a document called the Local Implementation Plan (LIP).

The DAMP describes the programs that serve to:

1. Provide the framework for the program management activities and plan development (**Section 2.0** and **Section 3.0**);

2. Provide the legal authority for prohibiting unpermitted discharges into the storm drain system and for requiring Best Management Practices (BMP) in new development and significant redevelopment (**Section 4.0**);

3. Improve existing municipal pollution prevention and removal BMPs to further reduce the amount of pollutants entering the storm drain system. (**Section 5.0**);

4. Educate the public about the issue of urban storm water and non-storm water pollution and obtain their support in implementing pollution prevention BMPs (**Section 6.0**);

5. Ensure all new development and significant redevelopment incorporates appropriate Site Design, Source Control and Treatment Control BMPs to address specific water quality issues. (**Section 7.0**);

6. Ensure construction sites implement control practices that address control of construction related pollutants discharges including erosion and sediment control and on-site hazardous materials and waste management (**Section 8.0**);

7. Ensure existing development will address discharges from industrial facilities, selected commercial businesses, residential development and common interest areas/homeowner associations. (**Section 9.0**);

8. Detect and eliminate illegal discharges/illicit connections to the municipal storm drain system (**Section 10.0**);

9. Conduct a storm water monitoring program to identify impacted receiving waters to assist in the prioritization of watersheds for analysis and planning, and to assist in the prioritization of pollutants to facilitate the development of specific controls to address these problems (**Section 11.0**); and

10. Assess watersheds and manage urban runoff on a watershed basis (**Section 12.0**).

**Flood Management Projects**

Flood management structures assist in regulating flood levels by adjusting water flows upstream of floodprone areas. There are 32 dams in Orange County holding millions of gallons of water in reservoirs. The County of Orange/Orange County Flood Control District owns three of these dams, while the U.S. Army Corps of Engineers (USACE), water districts and other entities own the majority. Release of reservoir water from flood control dams is designed to protect the County from floods. Projects by the

County of Orange/OCFCD focus on the removal of large floodplains and are included in its Capital Improvement
Program. These floodplains are located in the watersheds referred to by USACE as the Westminster Watershed (Huntington Beach, Westminster, Fountain Valley, Garden Grove, Unincorporated Orange County and Santa Ana) and the San Juan Creek Watershed (San Juan Capistrano and Dana Point). Also, participation in the Community Rating System keeps the county active in implementing and maintaining mitigation measures to manage flood where possible.

**Community Issues Summary**

Orange County works to mitigate flood issues as they arise. However, funding, time, and resources are often challenging to obtain. Areas within the county are more susceptible to flooding issues than others are and have incurred repetitive loss. Orange County Public Works and the Orange County Sheriff's Department Emergency Management Division have documented the problem areas in the community.

The USACE is engaged in helping Orange County Public Works to identify problem areas and is partnered with property owners to mitigate flooding and associated stream bank issues. However, as the USACE moves away from in-stream stabilization projects, many projects are not maintained. The USACE will continue to assist Orange County in appropriate mitigation projects.

*Source: Orange County Emergency Operations Plan, 2014.*

**Vulnerability Assessment**

Vulnerability assessment is the second phase of flood-hazard assessment, combining the floodplain boundary, generated through hazard identification, with an inventory of the property in the floodplain. Understanding the population and property exposed to natural hazards assists in reducing risk and preventing loss from future events. FEMA provides a tool called HAZUS which uses Geographic Information Systems (GIS) technology to estimate physical, economic and social impacts of disasters. Sitespecific inventory data for a particular flood event (10-year, 25-year, 50-year, 100-year, and 500-year) are generally available within HAZUS to calculate a community's vulnerability to flood events. The amount of property in the floodplain, as well as the type and value of structures on those properties, are calculated within HAZUS to provide a working estimate for potential flood losses.

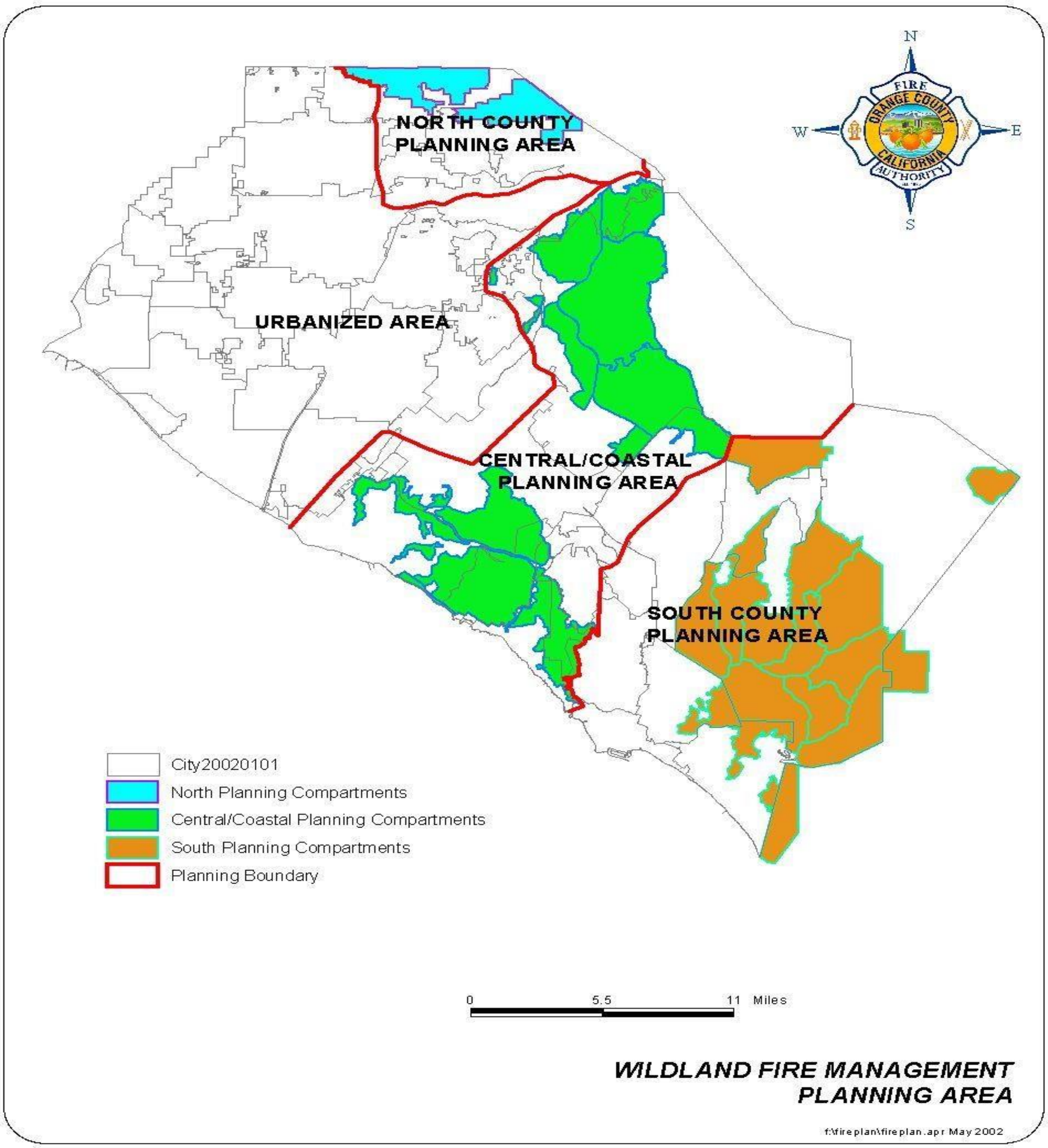
**Risk Analysis**

Risk analysis is the third and most advanced phase of a hazard assessment. It builds upon the hazard identification and vulnerability assessment. A flood risk analysis for Orange County includes two components: (1) the life and value of property that may incur losses from a flood event (defined through the vulnerability assessment), and (2) the number and type of flood events expected to occur over time. Within the broad components of a risk analysis, it is possible to predict the severity of damage from a range of events. Flow velocity models can assist in predicting the amount of damage expected from different magnitudes of flood events. The data used to develop these models is based on hydrological analysis of landscape features. Changes in the landscape, often associated with human development, can alter the flow velocity and the severity of damage that can be expected from a flood event.

The Orange County Essential Facilities Risk Assessment project ran detailed models for three flood scenarios (1% Annual Chance Flood Event (with levees), 100 Year Flood (without levees), and 500 Year Flood) in Orange County. That data can be found in Attachment B – OCEFRA HAZUS Report. In addition, assessments were performed using updated data in ArcGIS and are available at the end of this chapter in the Quantitative Exposure Analysis section.

## 3.2 Wildland/Urban Fire

A variety of fire protection challenges exist within Orange County, including structure, urban fires, wildland fires, and fires in the Wildland Urban Interface (WUI). This hazard analysis focuses on wildland fires, but also addresses issues specifically related to the Wildland Urban Interface and structure issues. Map 9 shows the Wildland Fire Management Planning Areas for Orange County.




☐ **Map 9 - Wildland Fire Management Planning Areas**

**Wildland Urban Interface**

In an effort to alleviate the dangers from wildland fires in or near the interface with urban development (Wildland Urban Interface or WUI), the construction of fuel modification zones (firebreak, fuel break, or greenbelt) are required in unincorporated County areas. The application of this method does have limitations and is therefore only a part of the solution. Fire prevention measures that reduce the level of risk to the structures located in the WUI must be further studied and developed in order to "harden the structure/home" and prevent the spread of wildland fire due to flying embers and radiant heat.

Much of the following, which addresses the threat of fire to urban areas, wildlands and the Wildland Urban Interface, has been extracted from the information prepared by the Orange County Fire Authority (OCFA) for the Safety Element of the County's General Plan.

Some of the most difficult fire protection problems in the urban area are:

- Multiple story, wood frame, high-density developments.
- Large contiguous built up areas with combustible roof covering materials.
- Transportation of hazardous materials by air, rail, road, water and pipeline.  Natural disasters.

Other factors contributing to major fire losses are:

- Delayed detection of emergencies.
- Delayed notification to the fire agency.
- Response time of emergency equipment.
- Street structure – private, curvilinear and dead-end, street widths.
- Inadequate water supply for wildland fire suppression.
- Inadequate code enforcement and code revisions, which lag behind fire prevention knowledge.

Fire Prevention is the major fire department activity in urban areas; the objective is to prevent fires from starting. Once a fire starts, the objective is to minimize the damage to life and property. Urban fire prevention programs that are designed to achieve this fire prevention objective are:

- Adoption and aggressive enforcement of the most recent Fire and Building Codes with state and local amendment addressing wildland fire hazards.
- Development of a comprehensive master plan to ensure that staffing and facilities keep pace with growth.
- Enforcement of Hazardous Materials Disclosure Ordinance.
- Active participation in planning committees and other planning activities.

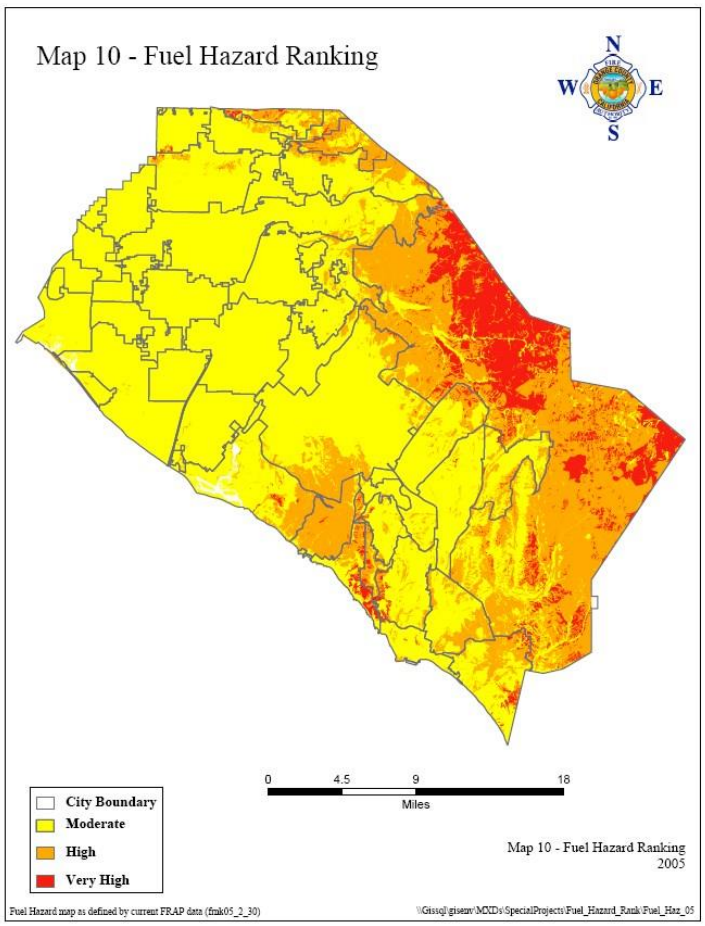
The character of the existing built-up area and future land use determines the location of fire stations, the number of fire companies, staffing of such companies, and future fire protection facility needs. Structural conditions also influence the quantity of water needed for fire protection (fire flow) and hydrant distribution.

Features of structural conditions that affect fire control are:

- Type of construction, construction features, and use of buildings.
- Area of building (ground floor area).
- Number of stories.
- Type of roof covering material.
- Exposures to the building.

**Wildland Fires**

California experiences large, destructive wildland fires almost every year and Orange County is no exception. Wildland fires have occurred within the county, particularly in the fall of the year, ranging from small, localized fires to disastrous fires covering thousands of acres. The most severe fire protection problem in the unincorporated areas is wildland fire during Santa Ana wind conditions. Map 10 shows the current fuel hazard ranking as of 2015 for the County.




☐ **Map 10 - Fuel Hazard Ranking, 2005 (Current as of 2015)**

Reasons for control difficulty associated with wildland fires are:

- Adverse weather conditions.

- Large quantities of contiguous combustible fuelbeds.
- Inaccessible terrain.
- Nonexistent or very limited water supply.
- Large fire fronts requiring dispersal of fire forces.

For these reasons, it is usually necessary for the firefighting force to meet the advancing fire front in an accessible area containing a minimum amount of combustible vegetation, and preferably located close to a water source.

The major objective of wildland fire defense planning is to prevent wildland fires from starting and, if unsuccessful, to minimize the damage to natural resources and structures. Some of the more successful programs currently in effect which contribute to the success of wildland fire prevention activities are:

- Closure of public access to land in hazardous fire areas.
- Building Code prohibition of most combustible roof covering materials (still allows Class C).
- Local amendments requiring "special construction features," e.g. boxed eaves, Class A roof, dual paned or tempered glass windows.
- Construction and maintenance of community and private fuel modification zones.
- Vegetative Management Program (controlled burning).
- Weed Abatement Program.
- Fire Prevention Education Programs.

There are a number of natural conditions which dictate the severity of a wildland fire when it occurs. Three such conditions are weather elements, the topography of the area, and the type and condition of wildland vegetation.

**Weather**

Weather conditions have many complex and important effects on fire intensity and behavior. Wind is of prime importance; as wind increases in velocity, the rate of fire spread also increases. Relative humidity (i.e., relative dryness of the air) also has a direct effect; the drier the air, the drier the vegetation and the more likely the vegetation will ignite and burn. Precipitation (annual total, seasonal distribution and storm intensity) further affects the moisture content of both dead and living vegetation, which influences fire ignition and behavior.

Many wildland fires have been associated with adverse weather conditions. In recent years, Orange County has experienced numerous wildland fires that have destroyed, damaged or threatened an extensive number of homes and businesses that relates to millions of dollars in property damage and loss of business revenue. The Sierra Incident in CY2006 burned 10,584 acres; the Santiago Incident in CY2007 burned 28,476 acres and either damaged or destroyed 23 residences and the Freeway Complex in CY2008 that burned 30,305 acres and either damaged or destroyed 300+ residences; are just a few examples of the devastation caused by wildland fires. At the onset of these fires, the Santa Ana winds were exceeding 50 mph, making quick containment impossible.

Additionally, the extreme fire weather conditions of 1993, aided the devastating firestorms that swept the County during the period of October 24 through November 4. During this period, a total of 20 major fires in six Southern California counties burned out of control, of which three of these fires occurred in Orange County: the Stagecoach fire burned 750 acres and destroyed 9 buildings, the Laguna Beach fire burned 14,337 acres, destroyed 441 homes and caused approximately $528 million in damage, and the Ortega fire burned 21,384 acres and destroyed 19 buildings

In 1997, the Baker Canyon fire by Irvine Lake burned 6,317 acres of vegetation, followed by two additional fires in 1998: The Blackstar/Santiago Canyons fire destroyed 8,800 acres, and the Carbon Canyon fire burned 733 acres of brush.

In addition to winds, structural development exposures within or adjacent to wildland represents an extreme fire protection problem due to flying embers and the predominance of combustible roof coverings.

**Topography**

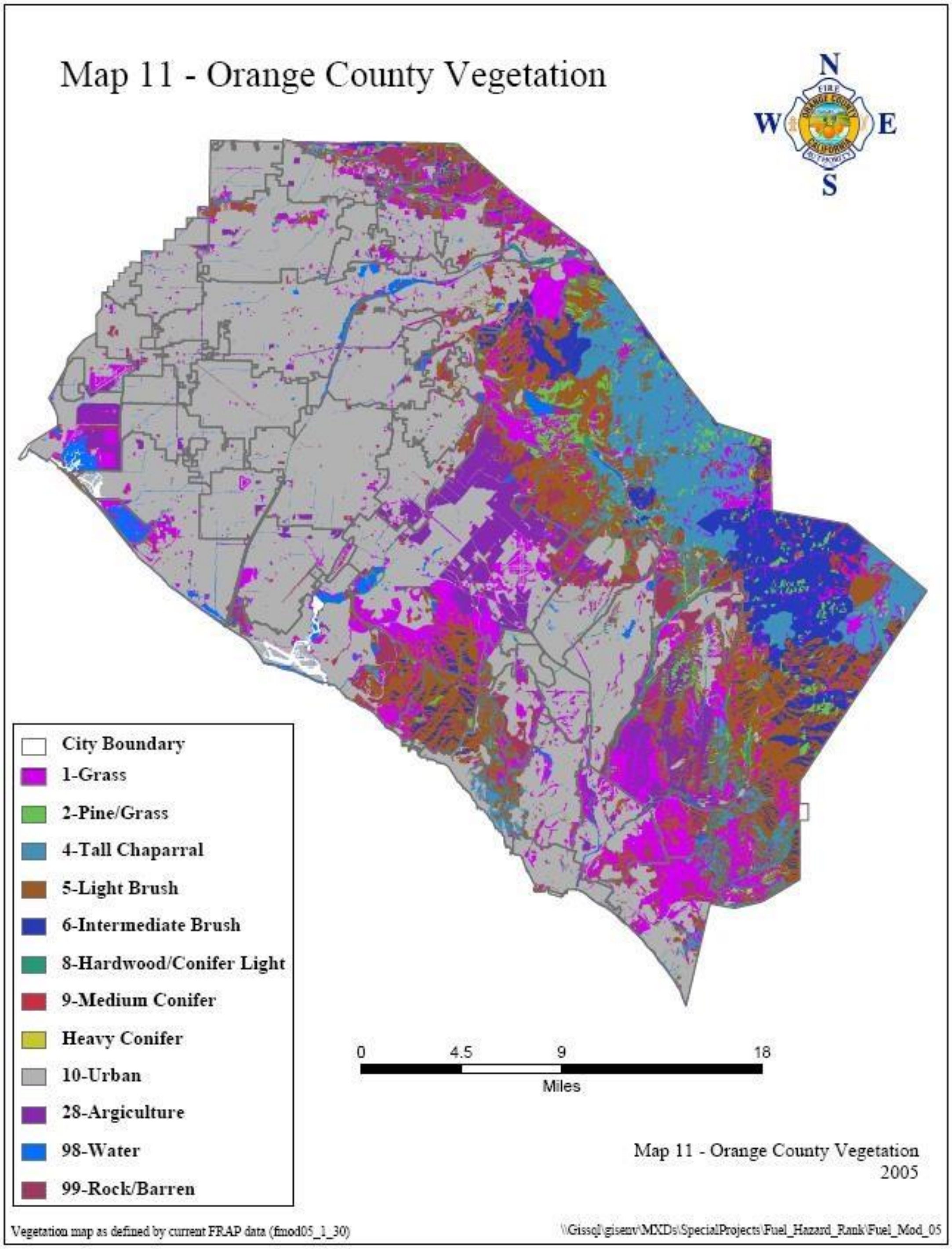
Topography has considerable effect on wildland fire behavior and, depending on the topography, may limit the ability of firefighters and their equipment to take adequate action to suppress or contain wildland fires. Simply said, a wildland fire starting in a canyon bottom will quickly spread to the ridge top before initial attack forces arrive. Rough topography greatly limits fireline construction, road construction, road standards, and accessibility by ground firefighting resources. Steep topography also channels airflow, creating extremely erratic winds on leeward slopes, canyons and passes. Water supply, intended for protecting structures located at higher elevations, is frequently dependent on water pump stations and utilities. The source of power for such stations is usually from overhead electrical power distribution lines, which are subject to destruction by wildland fires.

**Vegetation**

A key to effective fire control and the successful accommodation of fire in wildland management is the understanding of fire and its environment. The fire environment is the combination of combustible fuels, topography, and air mass and the complexity of these factors play an important role to influence the inception, growth, and behavior of a fire. The topography and weather components are, for all practical purposes, beyond human control, but it is a different story with fuels, which can be controlled before the outbreak of fires. In terms of future urban expansion, finding new ways to control and understand these fuels can lead to possible fire reduction.

A relatively large portion of the county is covered by natural (though modified) vegetation as indicated on the Composite Vegetation Map 11 provided by the Orange County Fire Authority. Of these different vegetation types, coastal sage scrub, chaparral, and grasslands become the most hazardous, with a high probability of ignition, during the dry summer months and, under certain conditions, during the winter months. For example, as chaparral gets older, twigs and branches within the plants die and are held in place. A stand of brush 10- to 20-years of age will contain dried and cured dead material that can produce a rate of spread comparable to grass fires. In severe drought years, additional plant material may die, contributing to the fuel load. There will normally be enough dead fuel accumulated in 20- to

30-year old brush to give rates of spread approximately twice as fast as in a grass fire. For example, under moderate weather conditions in a grass vegetation type a rate of spread of one-half foot per second can be expected. Conversely, a vegetation type of 20- to 30-year old stand of chaparral may have a rate of fire spread of about one foot per second. Fire spread in old brush (40 years or older) has been measured at eight times as fast as in grass, about four feet per second. Under extreme weather conditions, the fastest fire spread in grass is 12 feet per second or about eight miles per hour. Fuel Hazard Ranking for 2005 (Current as of 2015) is shown on Map 10 provided by OCFA.




☐ **Map 11 - Orange County Vegetation**

### *Wildland Fires as a Threat to Southern California*

Wildland fire is a natural part of the ecosystem in Southern California. However, wildland fire presents a substantial hazard to life and property in communities built in or adjacent to the open spaces of Orange

County. There is a huge potential for losses due to Wildland Urban Interface fires in Southern California. The fall of 2007 marked one of the most destructive wildland fire season in California history. In a four day period from 10/20/07 thru 10/23/07, 20 separate fires started and raged across Southern California in Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, Orange and San Diego counties. The massive Witch Incident in San Diego County alone consumed of 1,218 homes and burned over 197,990 acres.

☐ **Figure 4 - October 2007 Firestorm Statistics**

| County | Fire Name | Began | Acres Burned | Homes Lost | Homes Damaged | Lives Lost |
|---|---|---|---|---|---|---|
| San Diego | Ammo | 10/23/07 | 21,004 | 0 | 0 | 0 |
| San Diego | Harris | 10/21/07 | 90,440 | 253 | 12 | * 5 |
| San Diego | Witch | 10/21/07 | 69,894 | 1,141 | 77 | * 2 |
| San Diego | Rice | 10/22/07 | 9,472 | 206 | 0 | 0 |
| San Diego | Poomacha | 10/23/07 | 49,410 | 138 | 5 | 0 |
| Orange | Santiago | 10/21/07 | 28,400 | 15 | 8 | 0 |
| Riverside | Rosa | 10/22/07 | 411 | 0 | 0 | 0 |
| Riverside | Roca | 10/21/07 | 270 | 1 | 0 | 0 |
| San Diego | Coronado Hills | 10/22/07 | 250 | 0 | 0 | 0 |
| San Diego | McCoy | 10/21/07 | 353 | 2 | 0 | 0 |
| Santa Barbara | Cajon | 10/22/07 | 250 | 0 | 0 | 0 |
| Santa Barbara | Slide | 10/22/07 | 12,759 | 271 | 43 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Santa Barbara | Grass Valley | 10/22/07 | 1,247 | 178 | 22 | 0 |
| Los Angeles | October | 10/21/07 | 20 | 0 | 0 | 0 |
| Los Angeles | Canyon | 10/21/07 | 4,521 | 6 | 9 | 0 |
| Los Angeles | Magic | 10/22/07 | 2,824 | 0 | 0 | 0 |
| Los Angeles | Buckweed | 10/21/07 | 38,356 | 21 | 13 | 0 |
| Angeles NF | Ranch | 10/20/07 | 58,401 | 1 | 0 | 0 |
| Ventura | Nightsky | 10/21/07 | 30 | 0 | 0 | 0 |
| Los Padres NF | Sedgewick | 10/21/07 | 710 | 0 | 0 | 0 |
| **County** | **Fire Name** | **Began** | **Acres Burned** | **Homes Lost** | **Homes Damaged** | **Lives Lost** |
| **Total Losses** | | | 517,122 | 2,233 | 189 | |

Source: http://www.fire.ca.gov/php/fire_er_content/downloads/2003LargeFires.pdf

***** Civilian Fatalities

### *Wildland Fire Characteristics*

There are three categories of Wildland Urban Interface (WUI): (1) the classic WUI exists where welldefined urban and suburban development presses up against open expanses of wildland areas, (2) the mixed WUI is characterized by isolated homes, subdivisions and small communities situated predominantly in wildland settings, (3) and the occluded WUI existing where islands of wildland vegetation occur inside a largely urbanized area. Certain conditions must be present for significant interface fires to occur. The most common conditions include: hot, dry and windy weather, the inability of firefighting forces to contain or suppress the fire, the occurrence of multiple fires that overwhelm committed resources, and a large fuel load (dense vegetation). Once a fire has started, several conditions influence its behavior, including fuel, topography, weather, drought, and development.

Southern California has two distinct areas of risk for wildland fire. The foothills and lower mountain areas are most often covered with scrub brush or chaparral. The higher elevations of mountains also have heavily forested terrain.

The higher elevations of Southern California's mountains are typically heavily forested. The magnitude of the 2003, 2007 and 2008 fires is the result of three primary factors: (1) weather conditions including severe drought, a series of storms that produce thousands of lightning strikes and windy conditions; (2) infestations of a variety of beetles and other pests that has killed thousands of mature trees; and (3) the cumulative effects of wildland fire suppression over the past century that has resulted in an overabundance of brush and small diameter trees in the forests.

At the beginning of the 1900s, forests were relatively open, with 20 to 25 mature trees per acre. Periodically, lightning would start fires that would clear out underbrush and small trees, renewing the forests.

Today's forests are completely different, with as many as 400 trees crowded onto each acre, along with thick undergrowth. This density of growth makes forests susceptible to disease, drought and severe wildland fires. Instead of restoring forests, these wildland fires destroy them and it can take decades to recover. This radical change in our forests is the result of nearly a century of well-intentioned but misguided management[10].

**The Interface**

One challenge Southern California faces regarding the wildland fire hazard is from the increasing number of houses being built in the Wildland Urban Interface. Every year the growing population expands further and further into the hills and mountains, including forest lands. The increased "interface" between urban/suburban areas and the open spaces created by this expansion has produced a significant increase in threats to life and property from fires and has pushed existing fire protection systems beyond original or current design and capability. Many property owners in the interface are not aware of the problems and threats they face. Therefore, many owners must do more to manage or offset fire hazards or risks on their own property. Furthermore, human activities increase the incidence of fire ignition and potential damage.

**Fuel**

Fuel is the material that feeds a fire and is a key factor in wildland fire behavior. Fuel is classified by volume and by type.

Fuel volume is described in terms of "fuel loading," or the amount of available vegetative fuel.

Fuel type is an identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause a predictable rate of spread or resistance to control under specified

[10] "Overgrown Forests Require Prevention Measures" by Gale A. Norton, Secretary of the Interior, USA Today, Editorial, August 21, 2002.

weather conditions. Chaparral is a primary fuel type in Southern California and the basis of the extreme conditions associated with wildland fires. Chaparral habitat ranges in elevation from near sea level to over 5,000 feet in Southern California. Chaparral communities experience long dry summers and receive most of their annual precipitation from winter rains.

Fire has been important in the life cycle of chaparral communities for over 2 million years; however, the true nature of the "fire cycle" has been subject to interpretation. In a period of 750 years, it is generally thought that fire occurs once every 65 years in coastal drainages and once every 30 to 35 years inland.

The vegetation of chaparral communities has evolved to a point it requires fire to spawn regeneration. Many species invite fire through the production of plant materials with large surface-to-volume ratios, volatile oils and through periodic die-back of vegetation. These species have further adapted to possess special reproductive mechanisms following fire. Several species produce vast quantities of seeds which lie dormant until fire triggers germination. The parent plant which produces these seeds defends itself from fire by a thick layer of bark which allows enough of the plant to survive so that the plant can crown sprout following the blaze. In general, chaparral community plants have adapted to fire through the following methods: a) fire induced flowering, b) bud production and sprouting subsequent to fire, c) in-soil seed storage and fire stimulated germination, and d) on plant seed storage and fire stimulated dispersal.

An important element in understanding the danger of wildland fire is the availability of diverse fuels in the landscape, such as natural vegetation, manmade structures and combustible materials. A house surrounded by brushy growth rather than cleared space allows for greater continuity of fuel and increases the fire’s ability to spread. After decades of fire suppression, “dog-hair" thickets have accumulated, which enable high intensity fires to flare and spread rapidly.

**Topography**

Topography influences the movement of air, thereby directing a fire course. For example, if the percentage of uphill slope doubles, the rate of spread in wildland fire will likely double. Gulches and canyons can funnel air and act as chimneys, which intensify fire behavior and cause the fire to spread faster. Solar heating of dry, south-facing slopes produces up slope drafts that can complicate fire behavior. Unfortunately, hillsides with hazardous topographic characteristics are also desirable residential areas in many communities. This underscores the need for wildland fire hazard mitigation and increased education and outreach to homeowners living in interface areas.

**Weather**

Weather patterns combined with certain geographic locations can create a favorable climate for wildland fire activity. Areas where annual precipitation is less than 30 inches per year are extremely fire susceptible. High-risk areas in Southern California share a hot, dry season in late summer and early fall when high temperatures and low humidity favor fire activity. The so-called “Santa Ana” winds, which are heated by compression as they flow down to Southern California from the Great Basin Region, create a particularly high risk, as they can rapidly spread what might otherwise be a small fire.

**Drought**

Recent concerns about the effects of climate change, particularly drought, are contributing to concerns about wildland fire vulnerability. The term drought is applied to a period in which an unusual scarcity of rain causes a serious hydrological imbalance. Unusually dry winters, or significantly less rainfall than normal, can lead to relatively drier conditions and leave reservoirs and water tables lower. Drought leads to problems with irrigation and may contribute to additional fires, or additional difficulties in fighting fires. **Development**

Growth and development in scrubland and forested areas is increasing the number of human-made structures in Southern California interface areas. Wildland fire has an effect on development, yet development can also influence wildland fire. Owners often prefer homes that are private, have scenic views, are nestled in vegetation and use natural materials. A private setting may be far from public roads, or hidden behind a narrow, curving driveway. These conditions, however, make evacuation and firefighting difficult. The scenic views found along mountain ridges can also mean areas of dangerous topography. Natural vegetation contributes to scenic beauty, but it may also provide a ready trail of fuel leading a fire directly to the combustible fuels of the home itself.

### *Wildland Fire Hazard Assessment*

**Wildland Fire Hazard Identification**

Wildland fire hazard areas are commonly identified in regions of the Wildland Urban Interface. Ranges of the wildland fire hazard are further determined by the ease of fire ignition due to natural or human conditions and the difficulty of fire suppression. The wildland fire hazard is also magnified by several factors related to fire suppression/control such as the surrounding fuel load, weather, and topography and property characteristics. Generally, hazard identification rating systems are based on weighted factors of fuels, weather and topography.

Figure 5 - Illustrates a rating system to identify wildland fire hazard risk (with a score of 3 equaling the most danger and a score of 1 equaling the least danger.

**☐ Figure 5 - Sample Hazard Identification Rating System**

| Category | Indicator | Rating |
|---|---|---|
| Roads and Signage | Steep, narrow, poorly signed | 3 |
| | One or two of the above | 2 |
| | Meets all requirements | 1 |
| Water Supply | None, except domestic | 3 |
| | Hydrant, tank, or pool over 500 feet away | 2 |

| | | |
|---|---|---|
| | Hydrant, tank, or pool within 500 feet | 1 |
| Structure Location | Top of steep slope with brush/grass below | 3 |
| | Mid-slope with clearance | 2 |
| | Level with lawn, or watered groundcover | 1 |
| Exterior Construction | Combustible roofing, open eaves, combustible siding | 3 |
| | One or two of the above | 2 |
| | Non-combustible roof, boxed eaves, non-combustible siding | 1 |

In order to determine the "base hazard factor" of specific wildland fire hazard sites and interface regions, several factors must be taken into account. Categories used to assess the base hazard factor include:

Topographic location, characteristics and fuels
Site/building construction and design
Site/region fuel profile (landscaping)
Defensible space
Accessibility
Fire protection response
Water availability

The use of Geographic Information System (GIS) technology in recent years has been a great asset to fire hazard assessment, allowing further integration of fuels, weather and topography data for such ends as fire behavior prediction, watershed evaluation, mitigation strategies, and hazard mapping.

**Vulnerability and Risk**

Orange County residents are served by a variety of local fire departments as well as county, state and federal fire resources. Data that includes the location of interface areas in the county can be used to assess the population and total value of property at risk from wildland fire and direct these fire agencies in fire prevention and response.

Key factors included in assessing wildland fire risk include ignition sources, building materials and design, community design, structural density, slope, vegetative fuel, fire occurrence and weather, as well as occurrences of drought. An assessment of Orange County's exposure to high wildfire hazard areas is available in the Quantitative Exposure Analysis section at the end of this chapter.

The National Wildland Urban Fire Protection Program has developed the Wildland Urban Fire Hazard Assessment Methodology tool for communities to assess their risk to wildland fire. For more information on wildland fire hazard assessment refer to http://www.Firewise.org.

## *Community Wildland Fire Issues*

### Susceptibility to Wildland fire

Orange County has an extensive history with wildland fire, as described in Figure 6 below.

☐ **Figure 6 - Large Fires in Orange County 1914-2015**

| Year | Fire Name | Acreage | Year | Fire Name | Acreage |
|---|---|---|---|---|---|
| 1914 | Unknown | 18,754 | 1976 | Pendleton | 2,111 |
| 1915 | Unknown | 1,794 | 1977 | Mine | 4,956 |
| 1917 | Unknown | 3,164 | 1978 | Soquel | 5,428 |
| 1919 | Unknown | 2,225 | 1979 | Paseo | 3,644 |
| 1920 | Unknown | 2,724 | 1980 | Owl | 18,332 |
| **Year** | **Fire Name** | **Acreage** | **Year** | **Fire Name** | **Acreage** |
| 1923 | Unknown | 2,150 | 1980 | Carbon Canyon | 14,613 |
| 1925 | Unknown | 8,650 | 1980 | Indian | 28,938 |
| 1926 | Unknown | 9,934 | 1982 | Gypsum | 19,986 |
| 1927 | Unknown | 1,837 | 1985 | Shell | 1,635 |
| 1929 | Unknown | 1,085 | 1986 | Bedford 1 | 2,956 |
| 1937 | Unknown | 4,916 | 1987 | Bedford | 4,070 |
| 1943 | Unknown | 1,930 | 1987 | Silverado | 6,018 |
| 1943 | Unknown | 2,727 | 1988 | Ortega | 2,471 |
| 1948 | Green River | 53,079 | 1989 | Ortega | 8,170 |
| 1952 | Indian Potrero | 5,604 | 1989 | Assist 108 | 13,478 |
| 1954 | Weigand | 4,956 | 1990 | Carbon Canyon | 6,664 |
| 1954 | Jameson | 7,881 | 1990 | Yorba | 7,884 |

| | | | | | |
|---|---|---|---|---|---|
| 1955 | Niger | 1,606 | 1993 | Laguna Fire | 14,337 |
| 1956 | Cornwall | 3,173 | 1993 | Ortega | 21,010 |
| 1958 | Unknown | 11,774 | 1997 | Baker | 6,320 |
| 1958 | Kelly | 2,380 | 1998 | Santiago Canyon | 7,760 |
| 1958 | Steward | 69,444 | 2002 | Green | 2,234 |
| 1959 | Talega | 3,187 | 2002 | Antonio | 1,480 |
| 1961 | Unknown | 5,273 | 2006 | Sierra Peak | 10,505 |
| 1961 | Outside Origin #2 | 5,019 | 2007 | 241 | 1,618 |
| 1966 | Indian | 1,405 | 2007 | Santiago | 28,517 |
| 1967 | Paseo Grande | 51,075 | 2008 | Freeway Complex | 30,305 |
| 1970 | Nelson | 3,586 | 2014 | Silverado | 968 |
| 1975 | Grundy | 1,915 | | | |

**Growth and Development in the Interface** The hills and mountainous areas of Southern California are considered to be interface areas. The development of homes and other structures is encroaching onto the wildlands and is expanding the Wildland Urban Interface. The interface neighborhoods are characterized by a diverse mixture of varying housing structures, development patterns, ornamental and natural vegetation and natural fuels.

In the event of a wildland fire, vegetation, structures and other flammables can merge into unwieldy and unpredictable events. Factors important to the fighting of such fires include access, fire and fuel breaks, proximity of water sources, distance from a fire station and available firefighting personnel and equipment. Reviewing past Wildland Urban Interface fires shows that many structures are destroyed or damaged for one or more of the following reasons:

- Combustible roofing material.
- Open eaves and vents.
- Combustible siding, window and door frames.
- Structures with no defensible space.
- Poor fire crew access to structures.
- Subdivisions located in heavy natural fuel types.
- Structures located on steep slopes covered with flammable vegetation.
- Limited water supply.

- Winds over 30 miles per hour.

**Road Access**

Road access is a major issue for all emergency service providers. As development encroached into the rural areas of the county, the number of houses without adequate turn-around space increased. In many older areas, there is not adequate space for emergency vehicle turnarounds in single-family residential neighborhoods, causing emergency workers to have difficulty accessing houses. As fire trucks are large, firefighters are challenged by narrow roads and limited access. When there is inadequate turn around space, the fire fighters can only work to remove the occupants, but cannot safely remain to save the threatened structures.

**Water Supply**

Firefighters in remote and rural areas are faced by limited water supply and lack of hydrant taps. Rural areas are characteristically outfitted with small diameter pipe water systems, inadequate for providing sustained firefighting flows.

**Interface Fire Education Programs and Enforcement**

Fire protection in Wildland Urban Interface areas may rely more heavily on the landowner's personal initiative to take measures to protect his or her own property. Therefore, public education and awareness may play a greater role in interface areas. In those areas with strict fire codes, property owners who resist maintaining the minimum brush clearances may be cited for failure to clear brush.

**The Need for Mitigation Programs**

Continued development into the interface areas will have growing impacts on the Wildland Urban Interface. Periodically, the historical losses from wildland fires in Southern California have been catastrophic, with deadly and expensive fires going back decades. The continued growth and development increases the public need for natural hazard mitigation planning in Southern California.

### *Wildland Fire Mitigation Activities*

Existing mitigation activities include current mitigation programs and activities that are being implemented by county, regional, state, or federal agencies or organizations.

**Local Programs**

In Orange County there are independent local fire departments as well as a countywide consolidated fire district. Although each district or department is responsible for fire related issues in specific geographic areas, they work together to keep Orange County residents safe from fire. Although fire agencies work together to fight Wildland Urban Interface fires, each separate agency may have a somewhat different set of codes to enforce for mitigation activities.

The fire departments and districts provide essential public services in the communities they serve and their duties far surpass extinguishing fires. Most of the districts and departments provide other services to their jurisdictions including Emergency Medical Services who can begin treatment and stabilize sick and injured patients in emergency situations. All of the fire service providers in the county are dedicated to fire prevention and use their resources to educate the public to reduce the threat of the fire hazard, especially in the Wildland Urban Interface. Fire prevention professionals throughout the county have taken the lead in providing many useful and educational services to Orange County residents, such as:

- Home fire safety inspection.
- Assistance developing home fire escape plans.
- Business Inspections.
- Community Emergency Response Team (CERT) training.
- Fire cause determination.
- Counseling for juvenile fire-setters.
- Teaching fire prevention in schools.
- Coordinating educational programs with other agencies, hospitals and schools.
- Answering residents' questions regarding fire hazards.

**The Threat of Urban Conflagration**

Although communities without Wildland Urban Interface are much less likely to experience a catastrophic fire, in Orange County there is a scenario where any community might be exposed to an urban conflagration similar to the fires that occurred following the 1906 San Francisco earthquake.

Large fires following an earthquake in an urban region are relatively rare phenomena, but have occasionally been of catastrophic proportions. The two largest peacetime urban fires in history, 1906 San Francisco and 1923 Tokyo, were both caused by earthquakes.

The fact that fire following earthquake has been little researched or considered in the United States is particularly surprising when one realizes that the conflagration in San Francisco after the 1906 earthquake was the single largest urban fire, and the single largest earthquake loss, in U.S. history. The loss over three days of more than 28,000 buildings within an area of nearly 5 square miles was staggering: $250 million in 1906 dollars, or about $5 billion at today’s prices.

The 1989 Loma Prieta Earthquake, the 1991 Oakland Hills Fire, and Japan’s recent Hokkaido Nansei-oki Earthquake all demonstrate the current, real possibility of a large fire, such as a fire following an earthquake, developing into a conflagration. In the United States, all the elements that would hamper firefighting capabilities are present: density of wooden structures, limited personnel and equipment to address multiple fires, debris blocking the access of fire-fighting equipment, and a limited water supply.

Finally, the April 21, 1982 Anaheim apartment fires in Anaheim illustrated the capability for urban conflagration in Orange County. The fire broke out shortly before dawn and, fueled by Santa Ana winds, quickly swept through a four-block area near Cerritos Avenue and Euclid Street, ultimately destroying 393 apartment units, one house and one business.  This incident resulted in both a state proclamation of emergency and a federal disaster declaration.  It also led many Orange County cities to enact ordinances restricting the use of flammable shake roofs.

These scenarios highlight the need for fire mitigation activity in all sectors of the region, Wildland Urban Interface or not.

**Fire Codes**

**Local Fire and Building Codes**

The State Fire and Building Codes currently contain few regulations for protection of structures from wildland fires. An Appendix to the California Fire Code, which must be locally adopted in order to have enforcement authority, contains extracts from the Public Resource Code relative to minimum brush clearances (30 to 100 feet) and safety in interface areas. Many local jurisdictions develop local amendments that more specifically address risks within their communities. The Orange County Fire Authority, through its partner cities and the County, adopt fuel modification standards (170 feet minimum) and building construction requirements (Class A roofs, boxed eaves, protected vents, dual paned windows, etc.) applicable in identified fire hazard areas.

**County Fire Codes**

Most of key sections of county codes are local amendments to the State Fire Code, including brush clearance (fuel modification) and construction features (roofs, eaves, etc.) that apply to Wildland Urban Interface areas are covered in the State Fire Code.

**State Fire Codes**

**California Fire Code 2001**

(For fuel modification and enforcement of hazardous fuels within populated areas.)

Section 27, Appendix 2-A-1

Article 11, Section 1103.2.4

**CALIFORNIA PUBLIC RESOURCES CODE**

### Federal Programs

The role of the federal land management agencies in the Wildland Urban Interface is to: reduce fuel hazards on the lands they administer, cooperating in prevention and education programs; providing technical and financial assistance; and developing agreements, partnerships and relationships with property owners, local protection agencies, states and other stakeholders in Wildland Urban Interface areas. These relationships focus on activities before a fire occurs, which render structures and communities safer and better able to survive a fire occurrence.

### Federal Emergency Management Agency (FEMA) Programs

FEMA is directly responsible for providing fire suppression assistance grants and, in certain cases, major disaster assistance and hazard mitigation grants in response to fires. The role of FEMA in the Wildland Urban Interface is to encourage comprehensive disaster preparedness plans and programs, increase the capability of state and local governments and provide for a greater understanding of FEMA programs at the federal, state and local levels.

### Fire Management Assistance Grants

This type of grant may be provided to a state with an approved hazard mitigation plan for the suppression of a forest or grassland fire that threatens to become a major disaster on public or private lands. These grants are provided to protect life and improved property, encourage the development and implementation of viable multi-hazard mitigation measures, and provide training to clarify FEMA's programs. The grant may include funds for equipment, supplies and personnel. A Fire Suppression

Assistance Grant is the form of assistance most often provided by FEMA to a state for a fire. The grants are cost-shared with states. FEMA's US Fire Administration (USFA) provides public education materials addressing Wildland Urban Interface issues and the USFA's National Fire Academy provides training programs.

**Hazard Mitigation Grant Program**

Following a major disaster declaration, the FEMA Hazard Mitigation Grant Program provides funding for long-term hazard mitigation projects and activities to reduce the possibility of damages from all future fire hazards and to reduce the costs to the nation for responding to and recovering from the disaster.

**National Wildland Urban Interface Fire Protection Program**

Federal agencies can use the National Wildland Urban Interface Fire Protection Program to focus on Wildland Urban Interface fire protection issues and actions. The Western Governors' Association (WGA) can act as a catalyst to involve state agencies, as well as local and private stakeholders. The objective is to develop an implementation plan to achieve a uniform, integrated national approach to hazard and risk assessment using fire prevention and protection in the Wildland Urban Interface. The program helps states develop viable and comprehensive wildland fire mitigation plans and performance-based partnerships.

**U.S. Forest Service**

The U. S. Forest Service (USFS) is involved in a fuel-loading program implemented to assess fuels and reduce hazardous buildup on National Forest lands. The USFS is a cooperating agency and, while it has little to no jurisdiction in the lower valleys, it has an interest in preventing fires in the forested lands in the interface, due to the likelihood that a wildland fire can spread from either jurisdiction onto the adjoining jurisdiction.

**Other Mitigation Programs and Activities**

Some areas of the country are facing Wildland Urban Interface issues collaboratively. These are model programs that include local solutions. Summit County, Colorado, has developed a hazard and risk assessment process that mitigates hazards through zoning requirements. In California, the Los Angeles County Fire Department and Orange County Fire Authority have retrofitted more than 150 fire engines with fire retardant foam capability and Orange County is developing a rating schedule specific to the Wildland Urban Interface to determine areas and structures susceptible to wildland fire. All are examples of successful programs that demonstrate the value of pre-suppression and prevention efforts when combined with property owner support to mitigate hazards within the Wildland Urban Interface.

**Prescribed Burning**

The health and condition of a forest will determine the magnitude of wildland fire. If fuels--slash, dry or dead vegetation, fallen limbs and branches--are allowed to accumulate over long periods of time without being methodically cleared, fire can move more quickly and destroy everything in its path. Prescribed burning is the most efficient method to get rid of these fuels. In California during 2003, various fire agencies conducted over 200 prescribed fires and burned over 33,000 acres to reduce the wildland fire hazard.

**Firewise**

Firewise is a program developed within the National Wildland/ Urban Interface Fire Protection Program and it is the primary federal program addressing interface fire. It is administered through the National Wildfire Coordinating Group whose extensive list of participants includes a wide range of federal agencies. The program is intended to empower planners and decision makers at the local level. Through conferences and information dissemination, Firewise increases support for interface wildland fire mitigation by educating professionals and the general public about hazard evaluation and policy implementation techniques. Firewise offers online wildland fire protection information and checklists, as well as listings of other publications, videos and conferences. The interactive home page allows users to ask fire protection experts questions and to register for new information as it becomes available.

**Wildland Fire Mitigation Action Items**

As stated in the Federal Wildland Fire Policy, located at www.fs.fed.us **"The problem is not one of finding new solutions to an old problem but of implementing known solutions;** deferred decision making is as much a problem as the fires themselves. If history is to serve us in the resolution of the Wildland Urban Interface problem, we must take action on these issues now. To do anything less is to guarantee another review process in the aftermath of future catastrophic fires."

## 3.3 Earthquake

Earthquakes are considered a major threat to the County due to the proximity of several fault zones, notably including the San Andreas Fault Zone and the Newport-Inglewood Fault Zone. A significant earthquake along one of the major faults could cause substantial casualties, extensive damage to buildings, roads and bridges, fires, and other threats to life and property. The effects could be aggravated by aftershocks and by secondary effects such as fire, landslide and dam failure. A major earthquake could be catastrophic in its effect on the population, and could exceed the response capability of the local communities and even the State.

Following major earthquakes, extensive search and rescue operations may be required to assist trapped or injured persons. Emergency medical care, food and temporary shelter would be required for injured or displaced persons. In the event of a truly catastrophic earthquake, identification and burial of the dead would pose difficult problems. Mass evacuation may be essential to save lives, particularly in areas below dams. Many families could be separated, particularly if the earthquake should occur during working hours, and a personal inquiry or locator system would be essential to maintain morale. Emergency operations could be seriously hampered by the loss of communications and damage to transportation routes within, to and out of the disaster area and by the disruption of public utilities and services.

Extensive federal assistance could be required and could continue for an extended period. Efforts would be required to remove debris and clear roadways; demolish unsafe structures; assist in reestablishing public services and utilities; and provide continuing care and welfare for the affected population including temporary housing for displaced persons.

In general, the population is less at risk during non-work hours (if at home) as wood-frame structures are relatively less vulnerable to major structural damage than are typical commercial and industrial buildings. Transportation problems are intensified if an earthquake occurs during work hours, as significant numbers of Orange County residents commute to work in Los Angeles County. Similarly, a somewhat smaller number of Los Angeles residents commute to work in Orange County. An earthquake occurring during work hours would clearly create major transportation problems for those displaced workers.

Hazardous materials could present a major problem in the event of an earthquake. Orange County, one of the largest industrial and manufacturing areas in the state, has several thousand firms that handle hazardous materials, and are estimated to produce more than 100 million gallons of hazardous waste per year. The County’s highways and railways serve as hazardous materials transportation corridors, and Interstate 5 is the third busiest highway corridor in the country. The Orange County Fire Authority coordinates the Hazardous Materials Area Plan which serves as a guide for emergency response and operations for hazardous materials incidents.

Large faults as shown in Map 12 that could affect Orange County include the San Andreas Fault, the Newport-Inglewood Fault, the Whittier Fault, the Elsinore Fault, and the San Jacinto Fault. Smaller faults include the Norwalk Fault, and the El Modena and Peralta Hills Faults. In addition, newly studied thrust faults, such as the San Joaquin Hills Fault and the Puente Hills Fault (not shown on map) could also have a significant impact on the County. Each of the major fault systems is described briefly below.


☐ **Map 12 - Earthquake Faults**

**San Andreas Fault Zone:** The dominant active fault in California, it is the main element of the boundary between the Pacific and North American tectonic plates. The longest and most publicized fault in California, it extends from Cape Mendocino in northern California to east of San Bernardino in southern California, and is approximately 35 miles northeast of Orange County. This fault was the source of the 1906 San Francisco earthquake, which resulted in some 700 deaths and millions of dollars in damage. It is the southern section of this fault that is currently of greatest concern to the scientific community. Geologists can demonstrate that at least eight major earthquakes (Richter magnitude 7.0 and larger) have occurred along the Southern San Andreas Fault in the past 1200 years with an average spacing in time of 140 years, plus or minus 30 years. The last such event on the Southern San Andreas occurred in 1857 (the Fort Tejon earthquake). Based on that evidence and other geophysical observations, the

Working Group on California Earthquake Probabilities (Southern California Earthquake Center (SCEC), 1995) has estimated the probability of a similar rupture (Magnitude 7.8) in the next 30 years (1994 through 2024) to be about 50%. The range of probable magnitudes on the San Andreas Fault Zone is reported to be 6.8 - 8.0.

**Newport-Inglewood Fault Zone:** Extends from the Santa Monica Mountains southeastward through the western part of Orange County to the offshore area near Newport Beach and was the source of the destructive 1933 Long Beach earthquake (magnitude 6.4), which caused 120 deaths and considerable property damage. During the past 60 years, numerous other shocks ranging from magnitude 3.0 to 5+ have been recorded. SCEC reports probable earthquake Magnitudes for the Newport-Inglewood fault to be in the range of 6.0 to 7.4.

**Elsinore Fault Zone:** Located in the northeast part of the county, this fault follows a general line east of the Santa Ana Mountains into Mexico. The main trace of the Elsinore Fault zone is about 112 miles long. The last major earthquake on this fault occurred in 1910 (M 6.0), and the interval between major ruptures is estimated to be about 250 years. SCEC reports probable earthquake magnitudes for the main trace of the Elsinore fault to be in the range of 6.5 to 7.5. At the northern end of the Elsinore Fault zone, the fault splits into two segments: the 25 mile long Whittier Fault (probable magnitudes between 6.0 and 7.2), and the 25 mile long Chino Fault (probable magnitudes between 6.0 and 7.0).

**San Jacinto Fault Zone:** Located approximately 30 miles north and east of the county. The interval between ruptures on this 130 mile long fault zone has been estimated by SCEC to be between 100 and 300 years, per segment. The most recent event (1968 M6.5) occurred on the southern half of the Coyote Creek segment. SCEC reports probable earthquake magnitudes for the San Jacinto fault zone to be in the range of 6.5 to 7.5.

**San Joaquin Hills Fault:** A recently discovered southwest-dipping blind thrust fault originating near the southern end of the Newport-Inglewood Fault close to Huntington Beach, at the western margins of the San Joaquin Hills. Rupture of the entire area of this blind thrust fault could generate an earthquake as large as M 7.3. In addition, a minimum average recurrence interval of between about 1650 and 3100 years has been estimated for moderate-sized earthquakes on this fault (Grant and others, 1999).

**Puente Hills Thrust Fault**: This is another recently discovered blind thrust fault that runs from northern Orange County to downtown Los Angeles. This fault is now known to be the source of the 1987 Whittier Narrows earthquake. Recent studies indicate that this fault has experienced four major earthquakes ranging in magnitude from 7.2 to 7.5 in the past 11,000 years, but that the recurrence interval for these large events is on the order of several thousand years.

In addition to the major faults described above, rupture of a number of smaller faults could potentially impact Orange County, including the Norwalk Fault (located in the north of the county in the Fullerton area), the El Modena Fault (located in the Orange area), and the Peralta Hills Fault in the Anaheim Hills area.

As indicated, there are a large variety of earthquake events that could affect Orange County. (The earliest recorded earthquake in California occurred in Orange County in 1769.) Predicted ground shaking patterns throughout Southern California for hypothetical scenario earthquakes are available from the United States Geological Survey as part of their on-going "ShakeMap" program. These maps are provided in terms of Instrumental Intensity, which is essentially Modified Mercalli Intensity (see Figure 7 for the Modified Mercalli Intensity Scale) estimated from instrumental ground motion recordings.

Maps depicting strong ground shaking patterns for eight hypothetical scenario events potentially impacting Orange County are provided in Maps 13 through 20, as follows:

- M 7.8 repeat of the 1857 Fort Tejon Earthquake on the San Andreas Fault (Map 13)
- M 7.8 event on the Southern San Andreas Fault – "ShakeOut Scenario" (Map 14)
- M 6.9 earthquake on the Newport-Inglewood Fault (Map 15)
- M 6.8 earthquake on the Whittier Fault (Map 16)
- M 6.8 earthquake on the Elsinore Fault (Map 17)
- M 7.1 earthquake on the Palos Verdes Fault (Map 18)
- M 6.6 earthquake on the San Joaquin Hills Fault (Map 19)
- M 7.1 earthquake on the Puente Hills Fault (Map 20)

☐ **Figure 7 - Modified Mercalli Intensity (MMI) Scale (Richter, 1958)**

| **Value** | **Description** |
|---|---|
| I | Not felt. Marginal and long period effects of large earthquakes. |
| II | Felt by persons at rest, on upper floors, or favorably placed. |
| III | Felt indoors. Hanging objects swing. Vibration like passing of light trucks. Duration estimated. May not be recognized as an earthquake. |
| IV | Hanging objects swing. Vibration like passing of heavy trucks; or sensation of a jolt like a heavy ball striking the walls. Standing motorcars rock. Windows, dishes, doors rattle. Glasses clink. Crockery clashes. In the upper range of IV, wooden walls and frame creak. |
| V | Felt outdoors; direction estimated. Sleepers wakened. Liquids disturbed, some spilled. Small unstable objects displaced or upset. Doors swing, close, open. Shutters, pictures move. Pendulum clocks stop, start, change rate. |
| VI | Felt by all. Many frightened and run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books, etc., off shelves. Pictures off walls. Furniture moved or overturned. Weak plaster and masonry D cracked. Small bells ring (church, school). Trees, bushes shaken (visibly, or heard to rustle) |

| | |
|---|---|
| VII | Difficult to stand. Noticed by drivers of motor cars. Hanging objects quiver. Furniture broken. Damage to masonry D, including cracks. Weak chimneys broken at roof line. Fall of plaster, loose bricks, stones, tiles, cornices (also unbraced parapets and architectural ornaments). Some cracks in masonry C. Waves on ponds; water turbid with mud. Small slides and caving in along sand or gravel banks. Large bells ring. Concrete irrigation ditches damaged. |
| VIII | Steering of motor cars affected. Damage to masonry C; partial collapse. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting, fall of chimneys, factory stacks, monuments, towers, elevated tanks. Frame houses moved on foundations if not bolted down; loose panel walls thrown out. Decayed piling broken off. Branches broken from trees. Changes in flow or temperature of springs and wells. Cracks in wet ground and on steep slopes. |
| **Value** | **Description** |
| IX | General panic. Masonry D destroyed; masonry C heavily damaged, sometimes with complete collapse; masonry B seriously damaged. (General damage to foundations.) Frame structures, if not bolted, shifted off foundations. Frames racked. Serious damage to reservoirs. Underground pipes broken. Conspicuous cracks in ground. In alluvial areas sand and mud ejected, earthquake fountains, sand craters. |
| X | Most masonry and frame structures destroyed with their foundations. Some well-built wooden structures and bridges destroyed. Serious damage to dams, dikes, embankments. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and flat land. Rails bent slightly. |
| XI | Rails bent greatly. Underground pipelines completely out of service. |
| XII | Damage nearly total. Large rock masses displaced. Lines of sight and level distorted. Objects thrown into the air. |

***Masonry A:*** Good workmanship, mortar, and design; reinforced, especially laterally, and bound together by using steel, concrete, etc.; designed to resist lateral forces.

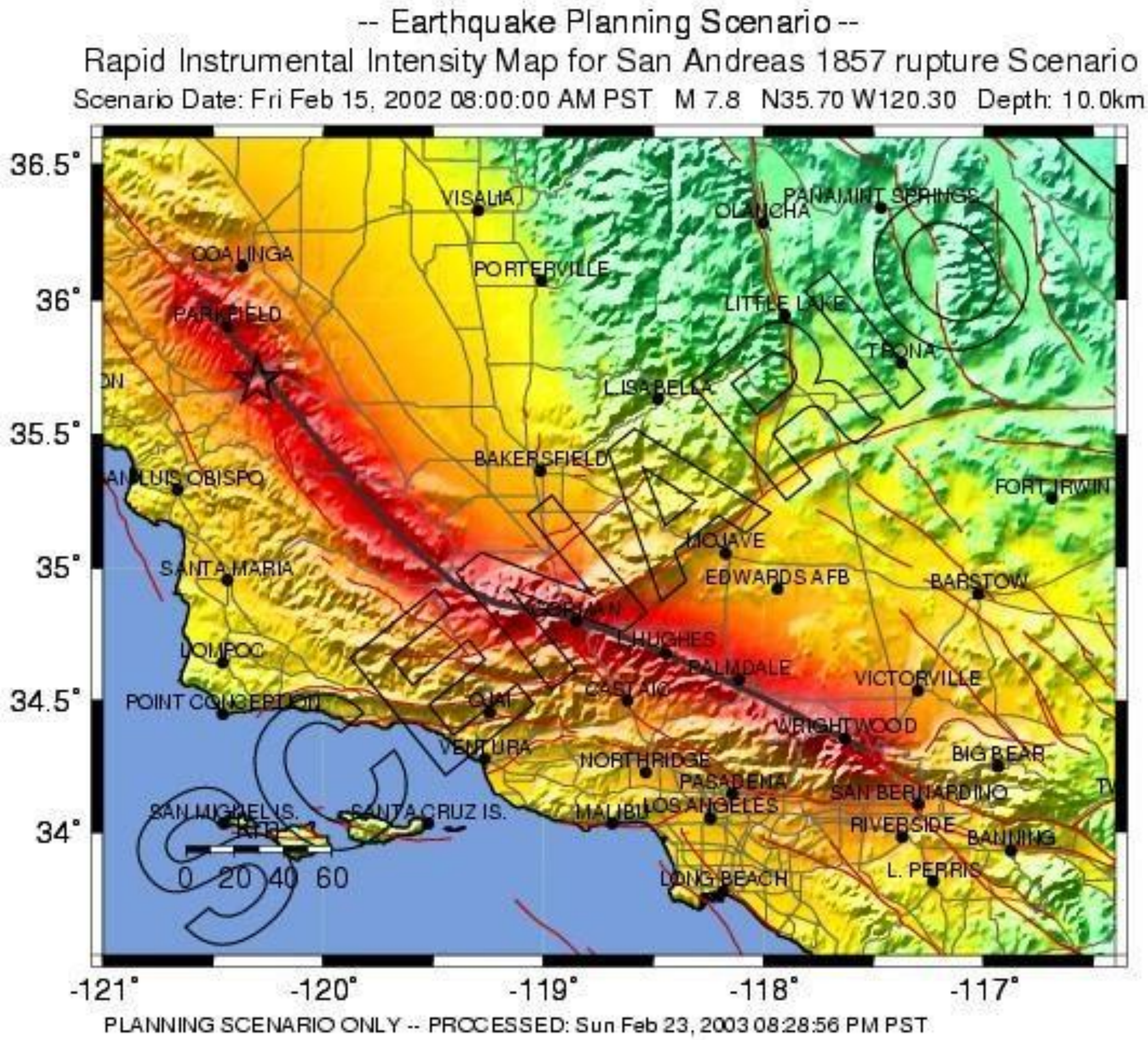
***Masonry B:*** Good workmanship and mortar; reinforced, but not designed in detail to resist lateral forces.

***Masonry C:*** Ordinary workmanship and mortar; no extreme weaknesses like failing to tie in at corners, but neither reinforced nor designed against horizontal forces.

***Masonry D:*** Weak materials, such as adobe; poor mortar; low standards of workmanship; weak horizontally.

**Map -**

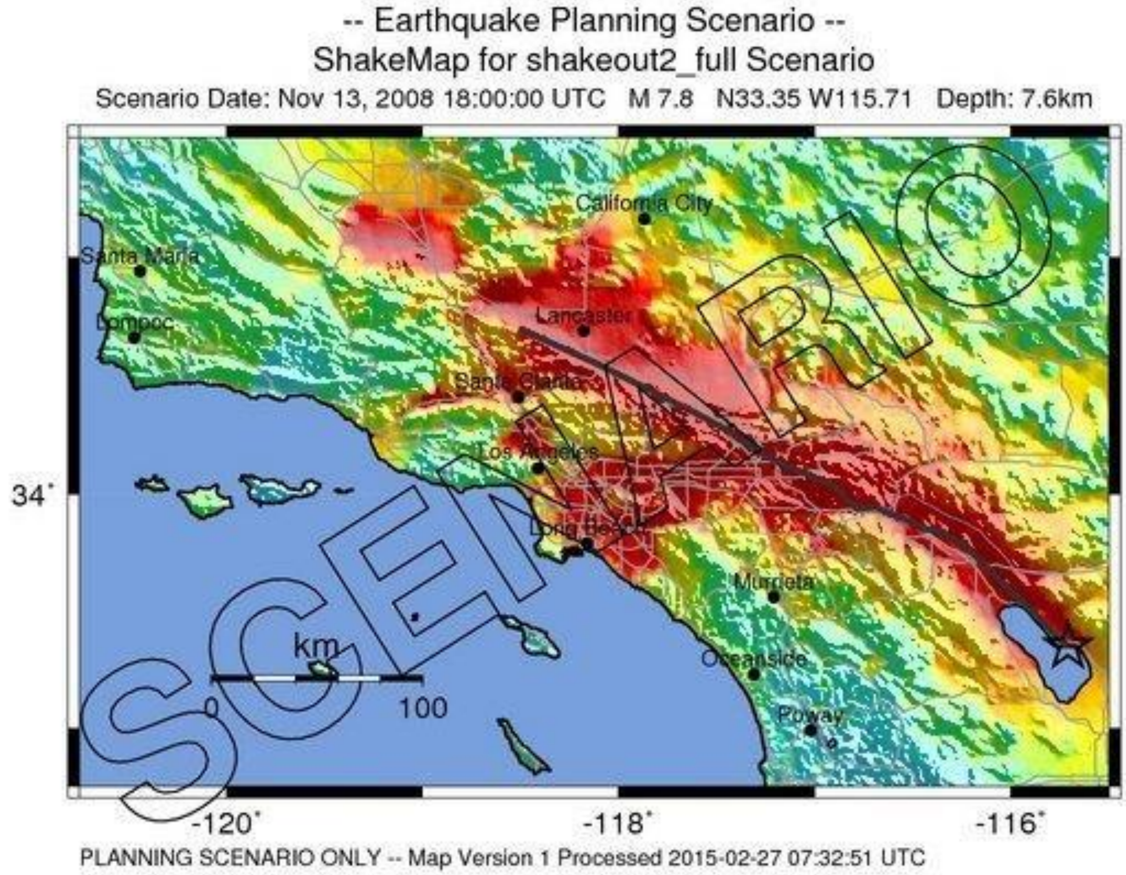
☐ **13 Scenario ShakeMap for a M 7.8 Earthquake on the San Andreas Fault: Repeat of 1857 Fort Tejon Earthquake (USGS)**




| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

☐ **14 Scenario ShakeMap for a M 7.8 Earthquake on the Southern San Andreas Fault – "ShakeOut" Scenario (USGS, 2008)**

**Map -**

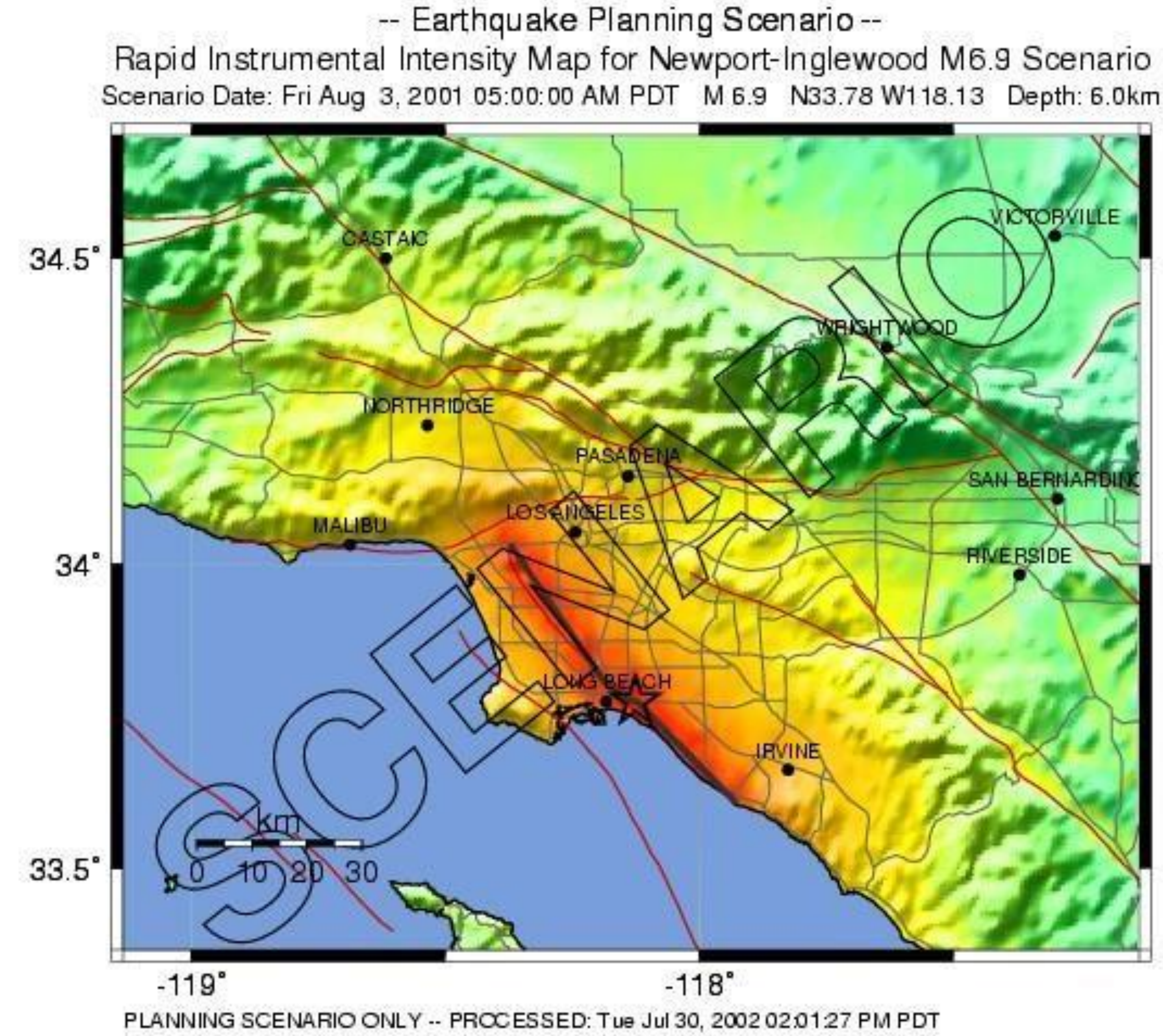



| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Mod./Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <0.05 | 0.3 | 2.8 | 6.2 | 12 | 22 | 40 | 75 | >139 |
| PEAK VEL.(cm/s) | <0.02 | 0.1 | 1.4 | 4.7 | 9.6 | 20 | 41 | 86 | >178 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

Scale based upon Worden et al. (2012)

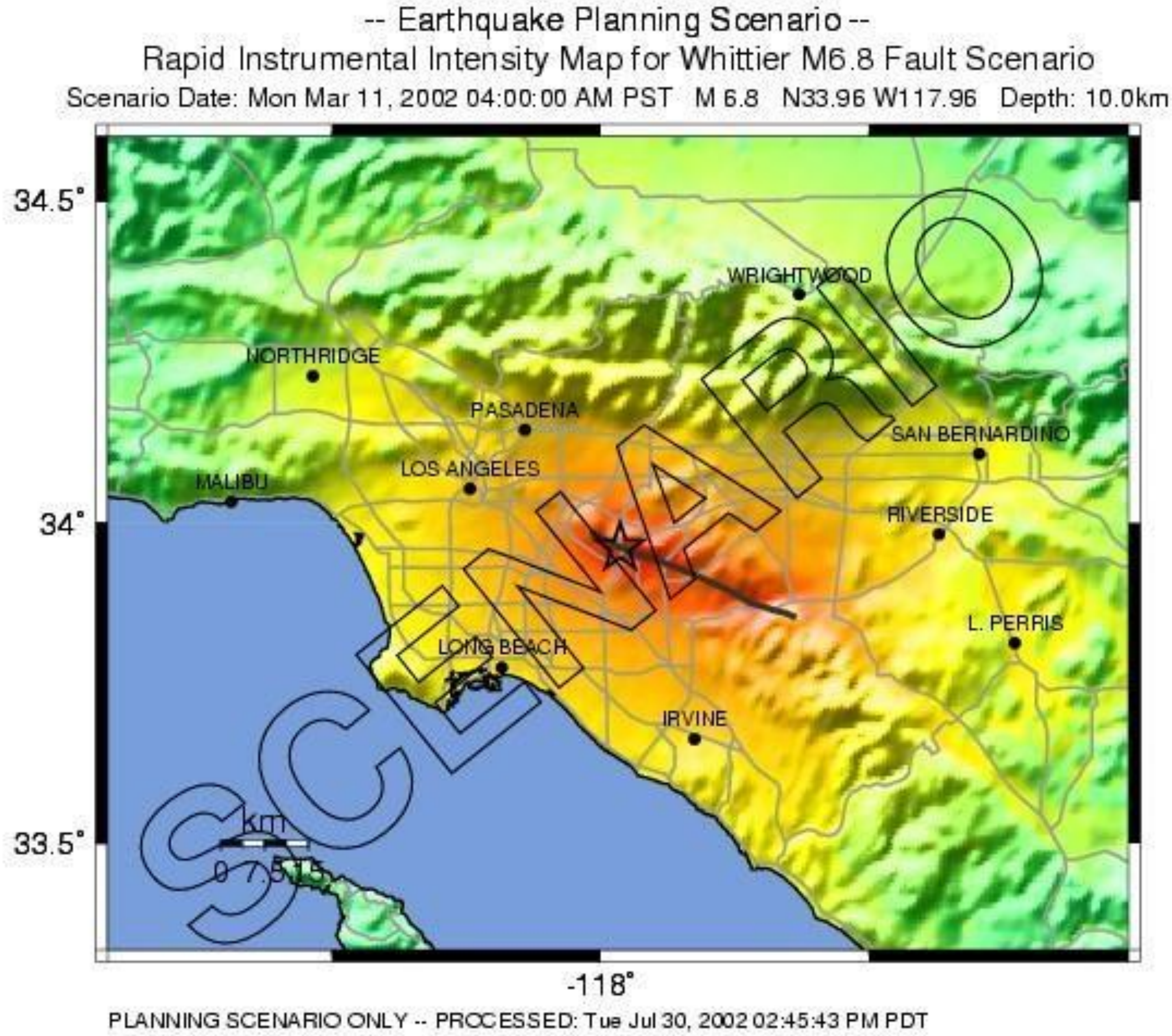
☐ **15 Scenario for a M 6.9 Earthquake on the Newport-Inglewood Fault (USGS, 2001)**

**Map -**



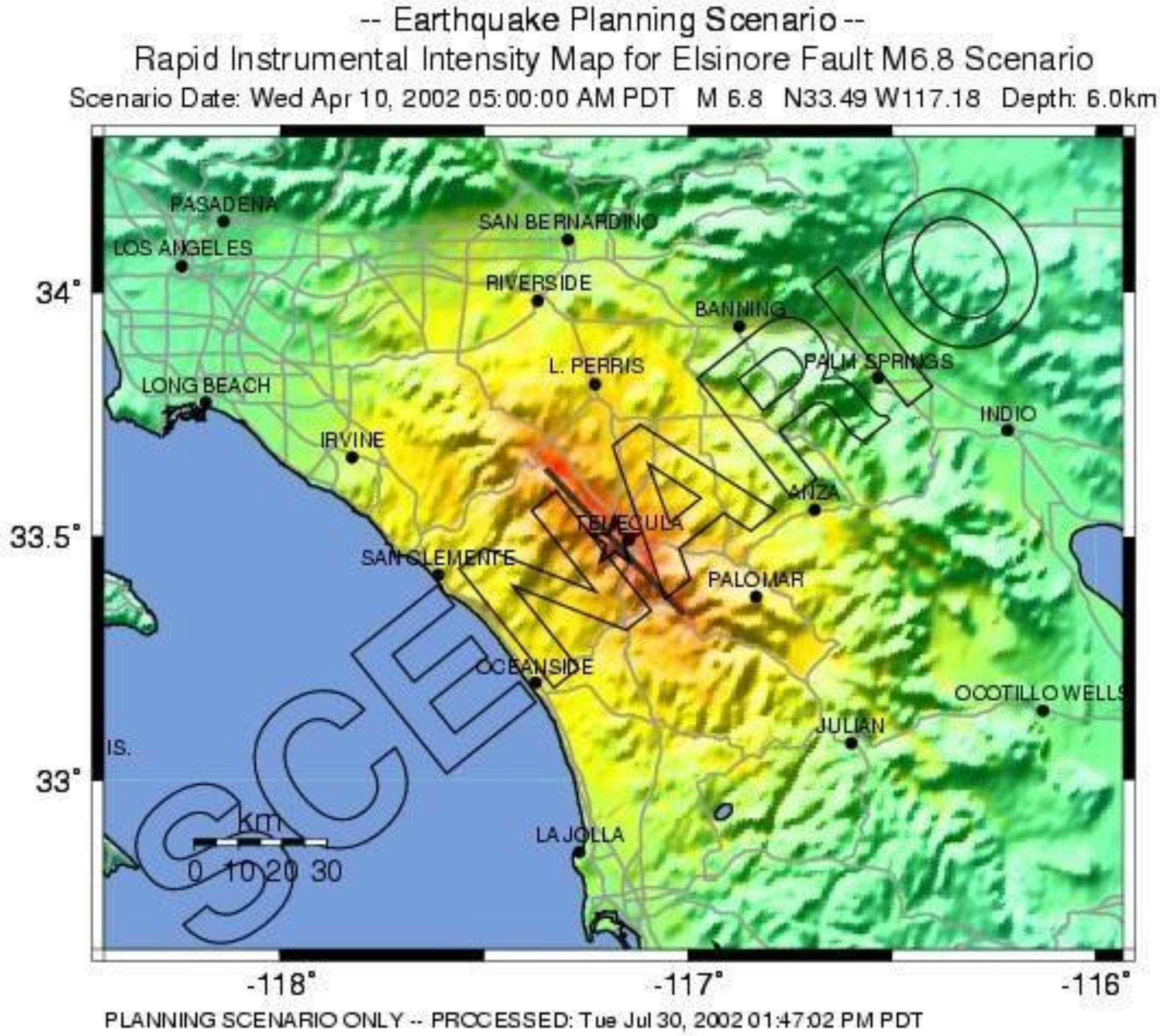

| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

☐ **Map - 16 Scenario ShakeMap for a M 6.8 Earthquake on the Whittier Fault (USGS, 2002)**




| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

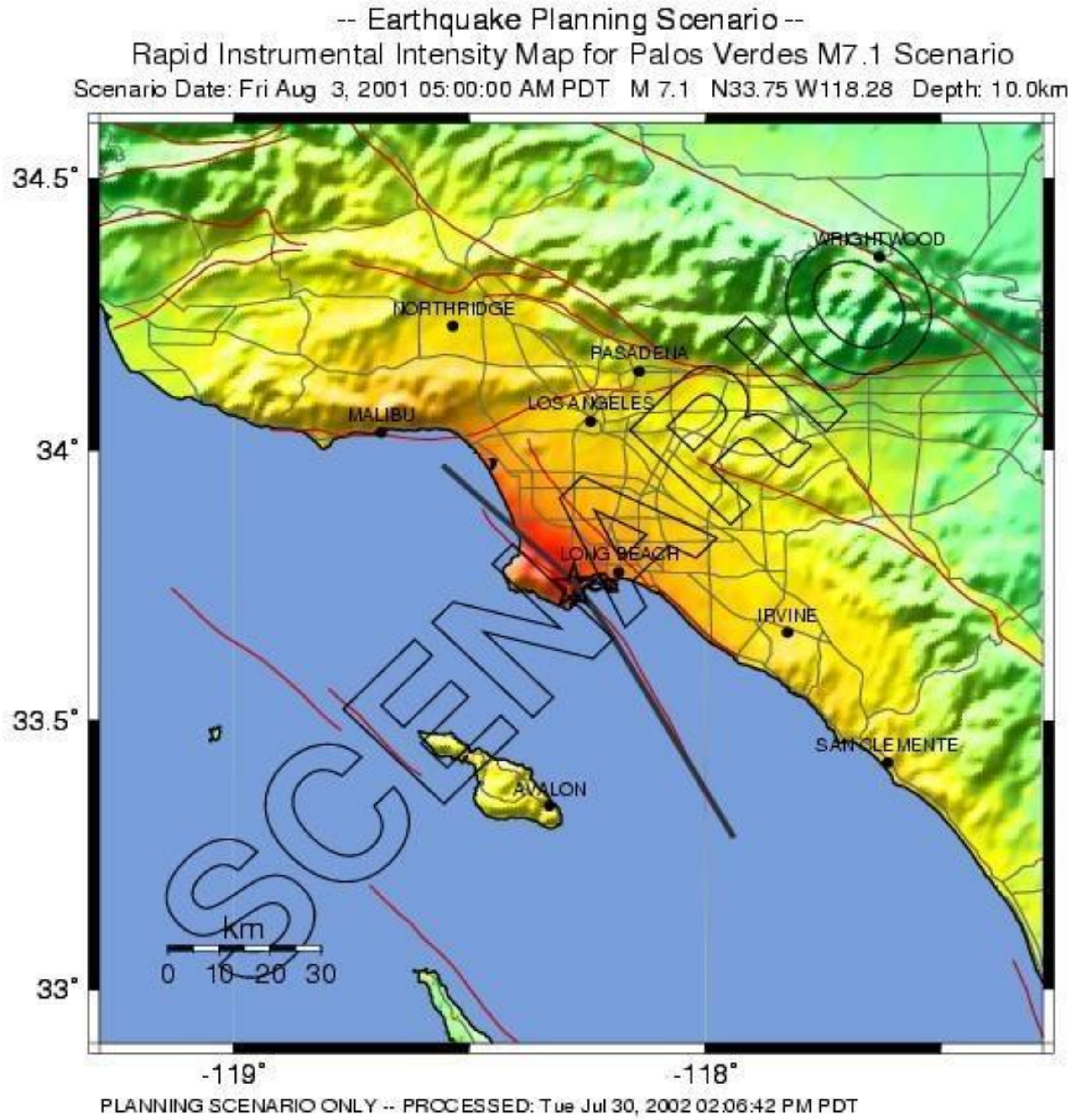
☐ **Map -**
**17 Scenario ShakeMap for a M 6.8 Earthquake on the Elsinore Fault (USGS, 2002)**




| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

**18- Scenario ShakeMap for a M 7.1 Earthquake on the Palos Verdes Fault (USGS, 2001)**

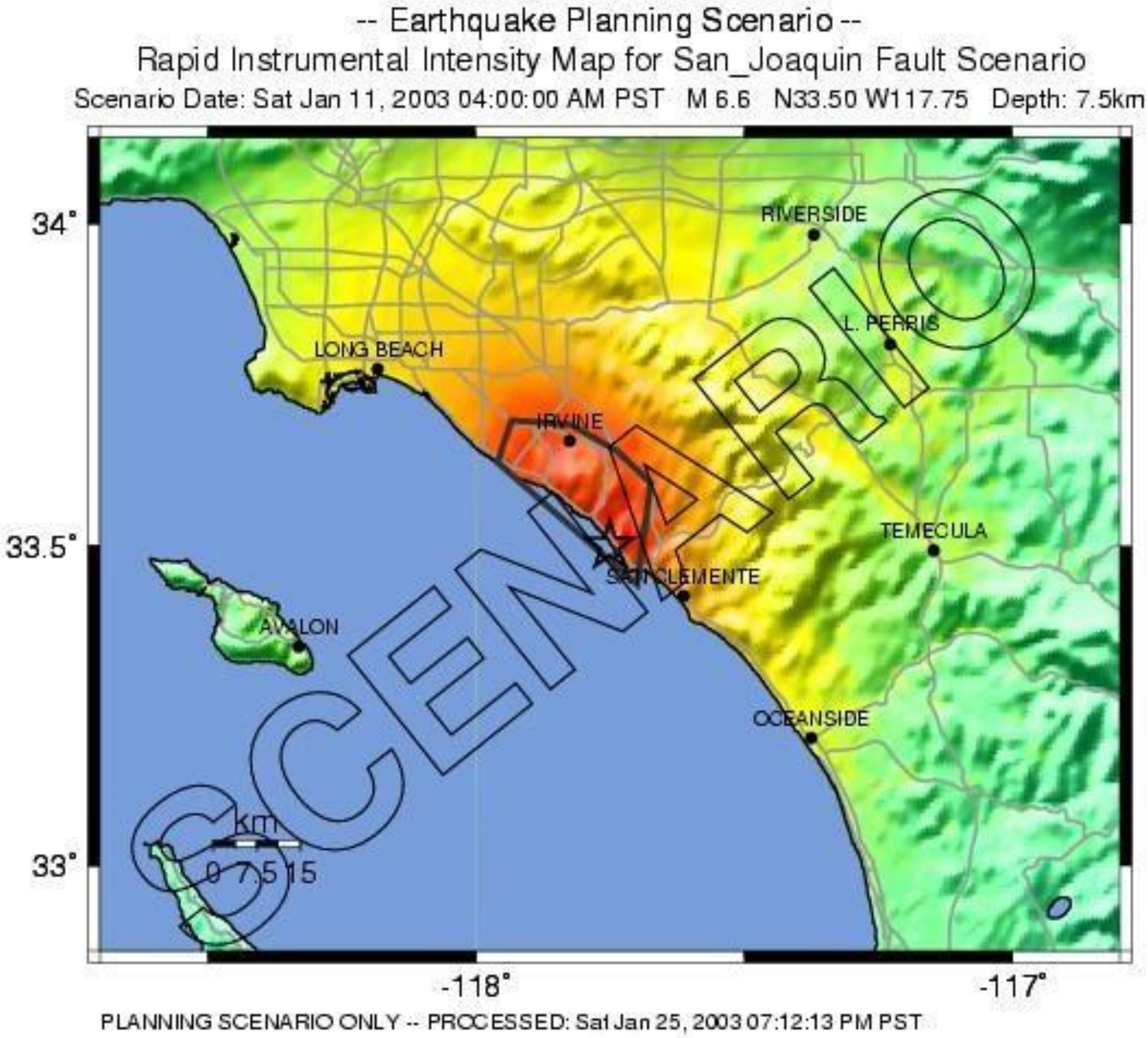
☐ **Map**




| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

☐ **Map**

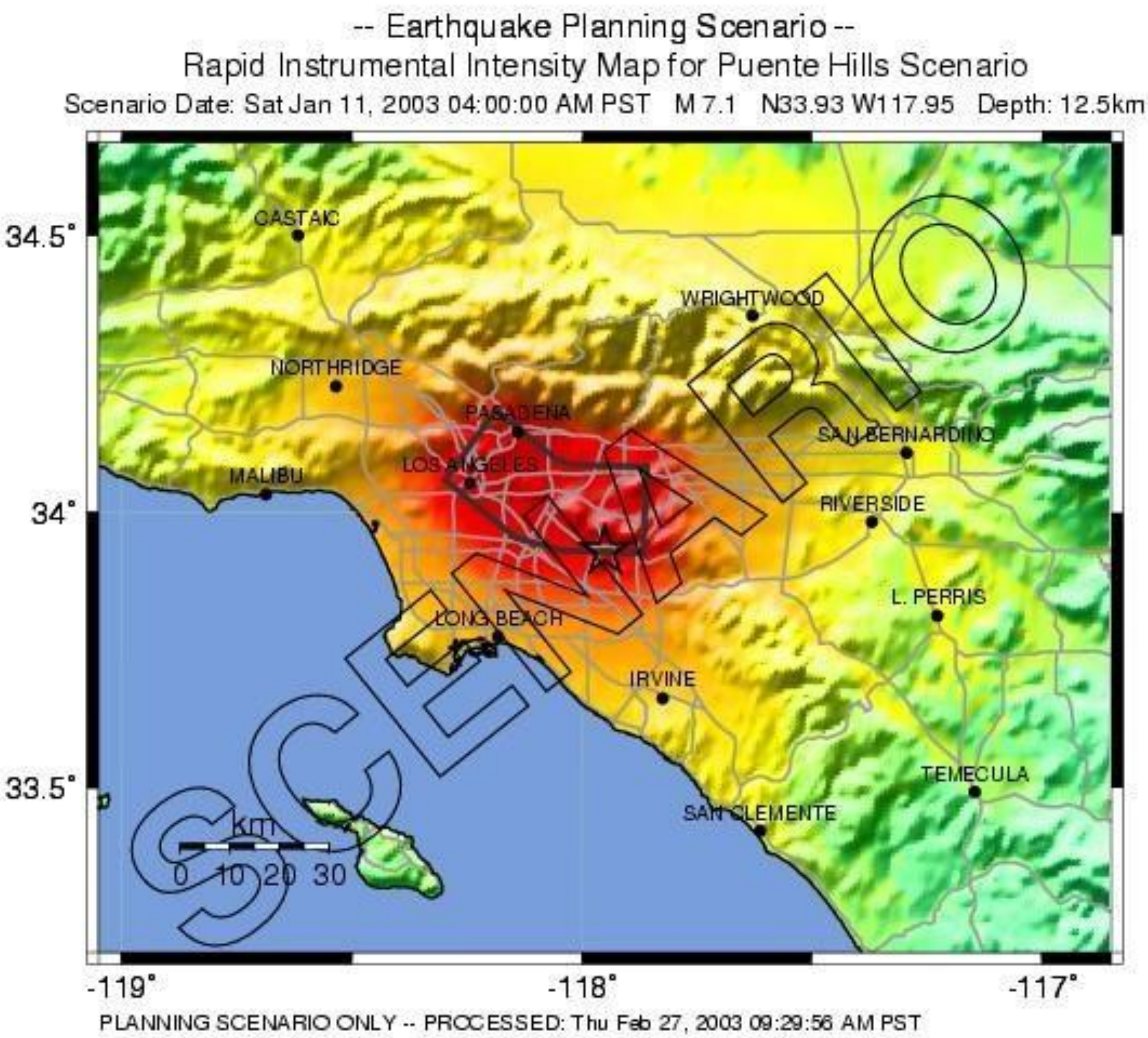
**19- - Scenario ShakeMap for a M 6.6 Earthquake on the San Joaquin Hills Fault (USGS)**




| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

☐ **20 - Scenario ShakeMap for a M 7.1 Earthquake on the Puente Hills Fault (USGS, 2003)**

**Map**




| PERCEIVED SHAKING | Not felt | Weak | Light | Moderate | Strong | Very strong | Severe | Violent | Extreme |
|---|---|---|---|---|---|---|---|---|---|
| POTENTIAL DAMAGE | none | none | none | Very light | Light | Moderate | Moderate/Heavy | Heavy | Very Heavy |
| PEAK ACC.(%g) | <.17 | .17-1.4 | 1.4-3.9 | 3.9-9.2 | 9.2-18 | 18-34 | 34-65 | 65-124 | >124 |
| PEAK VEL.(cm/s) | <0.1 | 0.1-1.1 | 1.1-3.4 | 3.4-8.1 | 8.1-16 | 16-31 | 31-60 | 60-116 | >116 |
| INSTRUMENTAL INTENSITY | I | II-III | IV | V | VI | VII | VIII | IX | X+ |

## *Earthquake as a Threat to Orange County*

The most recent damaging earthquake event affecting Southern California was the 1994 Northridge Earthquake. At 4:31 A.M. on Monday, January 17, a moderate, but very damaging earthquake with a magnitude of 6.7 struck the San Fernando Valley. In the following days and weeks, thousands of aftershocks occurred, causing additional damage to affected structures.

Fifty-seven people were killed and more than 1,500 people seriously injured. For days afterward, thousands of homes and businesses were without electricity, tens of thousands had no gas, and nearly 50,000 had little or no water. Approximately 15,000 structures were moderately to severely damaged, which left thousands of people temporarily homeless. Of the 66,500 buildings were inspected, nearly 4,000 were severely damaged and over 11,000 were moderately damaged. Several collapsed bridges and overpasses created commuter havoc on the freeway system. Extensive damage was caused by ground shaking, but earthquake triggered liquefaction and dozens of fires also caused additional severe damage. This extremely strong ground motion felt in large portions of Los Angeles County resulted in record economic losses.

Historical and geological records show that California has a long history of seismic events. Southern California is probably best known for the San Andreas Fault, a fault running from the Mexican border to a point offshore, west of San Francisco. Geologic studies show that over the past 1,400 to 1,500 years large earthquakes have occurred at about 130 year intervals on the Southern San Andreas Fault. As the last large earthquake on the Southern San Andreas occurred in 1857, that section of the fault is considered a likely location for an earthquake within the next few decades according to www.data.scec.org/.

Yet, the San Andreas is only one of dozens of known earthquake faults that crisscross Southern California. Some of the better known faults include the Newport-Inglewood, Whittier, Chatsworth, Elsinore, Hollywood, Los Alamitos, and Palos Verdes faults. Beyond the known faults, there are a potentially large number of "blind" faults that underlie the surface of Southern California. One such blind fault was involved in the Whittier Narrows earthquake in October 1987.

Although the most famous of the faults, the San Andreas, is capable of producing an earthquake with a magnitude of 8+ on the Richter scale, some of the "lesser" faults have the potential to inflict greater damage on the urban core of the Los Angeles Basin which includes Orange County. Seismologists believe that a 6.0 earthquake on the Newport-Inglewood would result in far more death and destruction than a "great" quake on the San Andreas, because the San Andreas is relatively remote from the urban centers of Southern California.

For decades, partnerships have flourished between the USGS, Cal Tech, the California Geological Survey and universities to share research and educational efforts with Californians. Tremendous earthquake mapping and mitigation efforts have been made in California in the past two decades, and public awareness has risen remarkably during this time. Major federal, state, and local government agencies and private organizations support earthquake risk reduction. These partners have made significant contributions in reducing the adverse impacts of earthquakes. Despite the progress, the majority of

California communities remain unprepared because there is a general lack of understanding regarding earthquake hazards among Californians.

To better understand the earthquake hazard, the scientific community has looked at historical records and accelerated research on those faults that are the sources of the earthquakes occurring in the Southern California region. Historical earthquake records can generally be divided into records of the preinstrumental period and the instrumental period. In the absence of instrumentation, the detection of earthquakes is based on observations and felt reports, and is dependent upon population density and distribution. Since California was sparsely populated in the 1800s, the detection of pre-instrumental earthquakes is relatively difficult. However, two very large earthquakes, the Fort Tejon in 1857 (7.9) and the Owens Valley in 1872 (7.6) are evidence of the tremendously damaging potential of earthquakes in Southern California. In more recent times two 7.3 earthquakes struck Southern California, in Kern County (1952) and Landers (1992). The damage from these four large earthquakes was limited because they occurred in areas which were sparsely populated at the time they happened. The seismic risk is much more severe today than in the past because the population at risk is in the millions, rather than a few hundred or a few thousand persons.

**History of Earthquake Events in Southern California**

Since seismologists started recording and measuring earthquakes, there have been tens of thousands of recorded earthquakes in Southern California, most with a magnitude below three. No community in Southern California is beyond the reach of a damaging earthquake. Figure 8 describes the historical earthquake events that have affected Southern California.

☐ **Figure 8 - Earthquake Events in the Southern California Region**

| **Southern California Region Earthquakes with a Magnitude 5.0 or Greater** | |
|---|---|
| 1769 Los Angeles Basin | 1918 San Jacinto |
| 1800 San Diego Region | 1923 San Bernardino Region |
| 1812 Wrightwood | 1925 Santa Barbara |
| 1812 Santa Barbara Channel | 1933 Long Beach |
| 1827 Los Angeles Region | 1941 Carpenteria |
| 1855 Los Angeles Region | 1952 Kern County |
| 1857 Great Fort Tejon Earthquake | 1954 W. of Wheeler Ridge |
| 1858 San Bernardino Region | 1971 San Fernando |

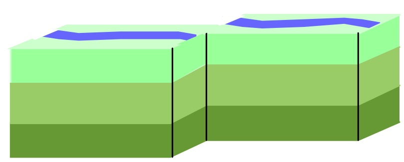
| | |
|---|---|
| 1862 San Diego Region | 1973 Point Mugu |
| 1892 San Jacinto or Elsinore Fault | 1986 North Palm Springs |
| 1893 Pico Canyon | 1987 Whittier Narrows |
| 1894 Lytle Creek Region | 1992 Landers |
| 1894 E. of San Diego | 1992 Big Bear |
| 1899 Lytle Creek Region | 1994 Northridge |
| 1899 San Jacinto and Hemet | 1999 Hector Mine |
| 1907 San Bernardino Region | 2004 San Luis Obispo |
| 1910 Glen Ivy Hot Springs | 2008 Chino Hills |
| 1916 Tejon Pass Region | 2010 Baja California |
| | 2014 La Habra |

Source: US Geological Survey

**Causes and Characteristics of Earthquakes in Southern California**

**Earthquake Faults**

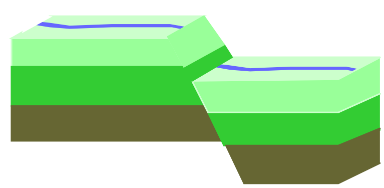
A fault is a fracture along between blocks of the earth's crust where either side moves relative to the other along a parallel plane to the fracture.



**Strike Slip Fault**

**Strike-slip**

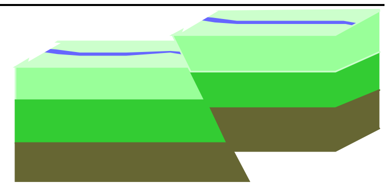
Strike-slip faults are vertical or almost vertical rifts where the earth's plates move mostly horizontally. From the observer's perspective, if the opposite block looking across the fault moves to the right, the slip style is called a right lateral fault; if the block moves left, the shift is called a left lateral fault.



**Normal Fault**

**Dip-slip**

Dip-slip faults are slanted fractures where the blocks mostly shift vertically. If the earth above an inclined fault moves down, the fault is called a normal fault, but when the rock above the fault moves up, the fault is called a reverse fault. Thrust faults have a reverse fault with a dip of 45 degrees or less.



**Thrust Fault**

### *Earthquake Related Hazards*

Ground shaking, landslides, liquefaction, and amplification are the specific hazards associated with earthquakes. The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, earthquake magnitude, and the type of earthquake.

#### Ground Shaking

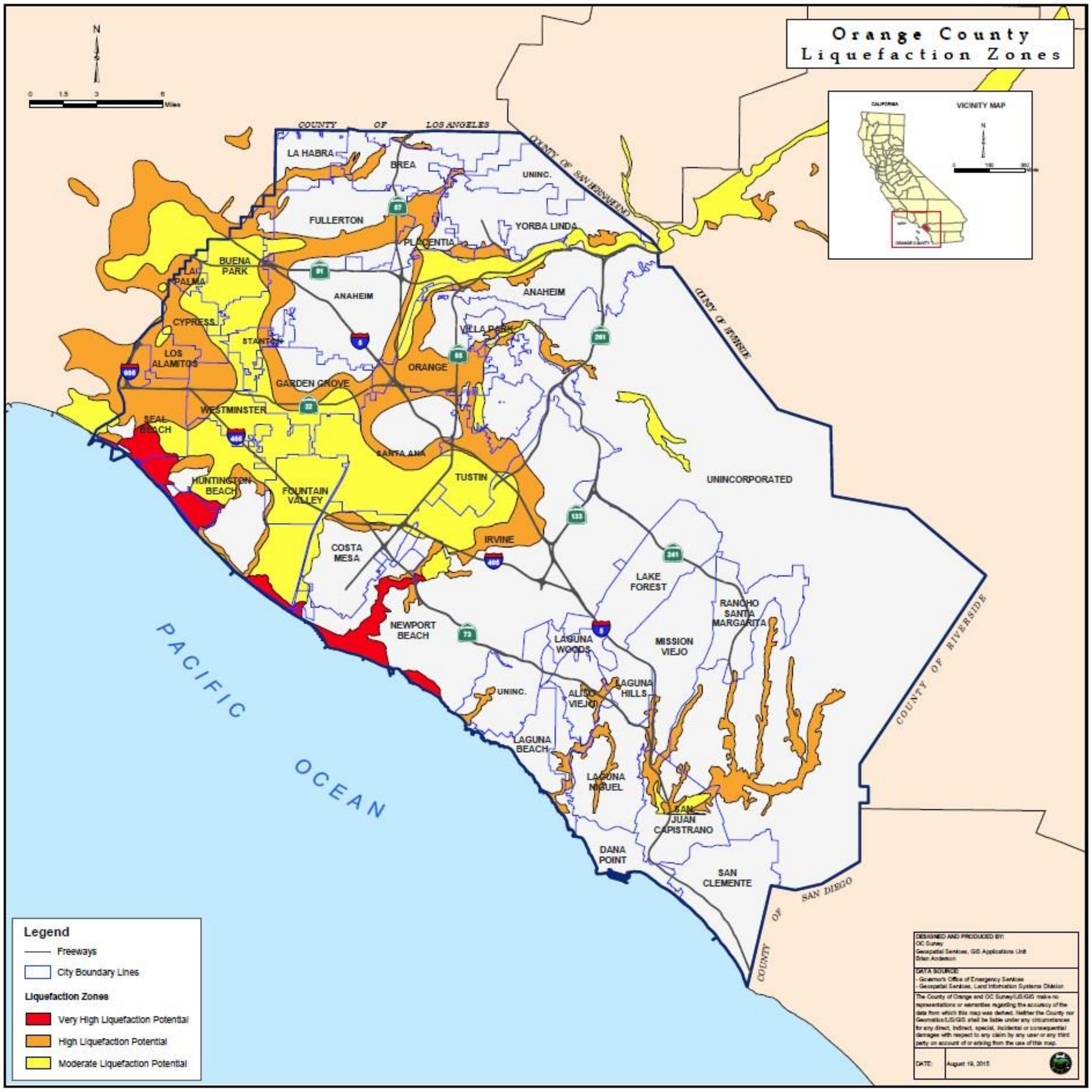
Ground shaking is the motion felt on the earth's surface caused by seismic waves generated by the earthquake. It is the primary cause of earthquake damage. The strength of ground shaking depends on the magnitude of the earthquake, the type of fault, and distance from the epicenter (where the earthquake originates). Buildings on poorly consolidated and thick soils will typically see more damage than buildings on consolidated soils and bedrock.

#### Earthquake Induced Landslides

Earthquake induced landslides are secondary earthquake hazards that occur from ground shaking. They can destroy the roads, buildings, utilities, and other critical facilities necessary to respond and recover from an earthquake. Many communities in Southern California have a high likelihood of encountering such risks, especially in areas with steep slopes.

#### Liquefaction

Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures. Many communities in Southern California are built on ancient river bottoms and have sandy soil. In some cases this ground may be subject to liquefaction, depending on the depth of the water table. Map 22 shows the areas of Orange County that may are susceptible to liquefaction. See also the California Geological Survey website at http://gmw.consrv.ca.gov/shmp/html/pdf_maps_so.html.




☐ **Map 21 - Liquefaction Map, Orange County**

### Amplification

Soils and soft sedimentary rocks near the earth's surface can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the magnitude of the seismic waves generated by the earthquake. The amount of amplification is influenced by the thickness of geologic materials and their physical properties. Buildings and structures built on soft and unconsolidated soils can face greater risk. Amplification can also occur in areas with deep sediment filled basins and on ridge tops.

### *Earthquake Hazard Assessment*

In California, many agencies are focused on seismic safety issues: the State's Seismic Safety Commission, the Applied Technology Council, California Office of Emergency Services, United States Geological Survey, Cal Tech, the California Geological Survey, as well as a number of universities and private foundations.

These organizations, in partnership with other state and federal agencies, have undertaken a rigorous program in California to identify seismic hazards and risks including active fault identification, bedrock shaking, tsunami inundation zones, ground motion amplification, liquefaction, and earthquake induced landslides. Seismic hazard maps have been published and are available for many communities in California through the State Division of Mines and Geology. Map 22 illustrates the known seismic zones in Southern California.

In California, each earthquake is followed by revisions and improvements in the Building Codes.

The 1933 Long Beach resulted in the Field Act, affecting school construction. The 1971 Sylmar earthquake brought another set of increased structural standards. Similar re-evaluations occurred after the 1989 Loma Prieta and 1994 Northridge earthquakes. These code changes have resulted in stronger and more earthquake resistant structures.

The Alquist-Priolo Earthquake Fault Zoning Act was passed in 1972 to mitigate the hazard of surface faulting to structures for human occupancy. This state law was a direct result of the 1971 San Fernando Earthquake, which was associated with extensive surface fault ruptures that damaged numerous homes, commercial buildings, and other structures. Surface rupture is the most easily avoided seismic hazard.

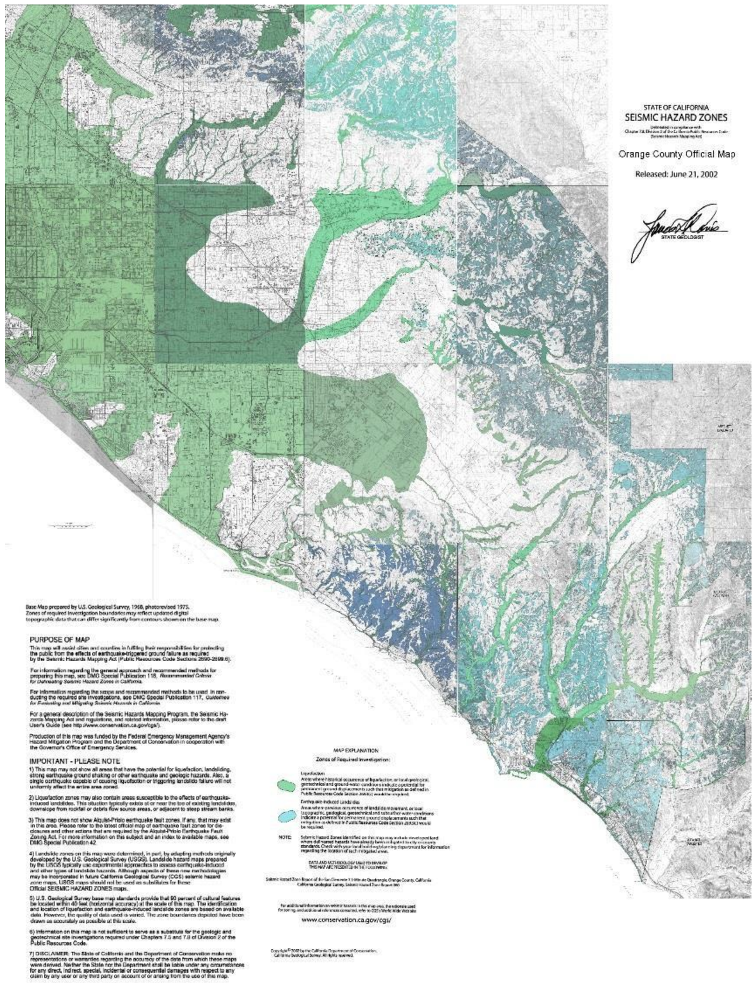
The Seismic Hazards Mapping Act, passed in 1990, addresses non-surface fault rupture earthquake hazards, including liquefaction and seismically induced landslides. The State Department of Conservation operates the Seismic Mapping Program for California. Extensive information is available at their website: http://gmw.consrv.ca.gov/shmp/index.htm.

**Vulnerability Assessment**

The effects of earthquakes span a large area, and large earthquakes occurring in many parts of the Southern California region would probably be felt throughout Orange County. However, the degree to which the earthquakes are felt, and the damages associated with them may vary. At risk from earthquake damage are large stocks of old buildings and bridges; many high tech and hazardous materials facilities; extensive sewer, water, and natural gas pipelines; earth dams; petroleum pipelines; and other critical facilities and private property located in the county. The relative or secondary earthquake hazards, which are liquefaction, ground shaking, amplification, and earthquake-induced landslides can be just as devastating as the earthquake.

The California Geological Survey has identified areas most vulnerable to liquefaction. Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Buildings and their occupants are at risk when the ground can no longer support these buildings and structures.

Orange County has many active landslide areas, and a large earthquake could trigger accelerated movement in these slide areas, in addition to jarring loose other unknown areas of landslide risk.




☐ **Map 22 – OC Seismic Hazard Map (Liquefaction in Green, Landslides in Aqua)**

***Community Earthquake Issues*** **Susceptibility**

**to Earthquakes**

Earthquake damage occurs because humans have built structures that cannot withstand severe shaking. Buildings, airports, schools, and lifelines (highways and utility lines) suffer damage in earthquakes and can cause death or injury to humans. The welfare of homes, major businesses, and public infrastructure is very important. Addressing the reliability of buildings, critical facilities, and infrastructure, and understanding the potential costs to government, businesses, and individuals as a result of an earthquake, are challenges faced by the County.

**Dams**

There are a total of 44 dams in Orange County. The ownership ranges from the federal government to Homeowner Associations. These dams hold billions of gallons of water in reservoirs. The major reservoirs are designed to protect Southern California from flood waters and to store domestic water. Seismic activity can compromise the dam structures resulting in catastrophic flooding.

**Buildings**

The built environment is susceptible to damage from earthquakes. Buildings that collapse can trap and bury people. Lives are at risk and the cost to clean up the damage is great. In most California communities, including Orange County, many buildings were built before 1993 when building codes were not as strict. In addition, retrofitting is not required except under certain conditions and can be expensive. Therefore, the number of buildings at risk remains high. The California Seismic Safety Commission makes annual reports on the progress of the retrofitting of unreinforced masonry buildings.

**Infrastructure and Communication**

Residents in Orange County commute frequently by automobiles and public transportation such as buses and light rail. An earthquake can greatly damage bridges and roads, hampering emergency response efforts and the normal movement of people and goods. Damaged infrastructure strongly affects the economy of the community because it disconnects people from work, school, food, and leisure, and separates businesses from their customers and suppliers.

Lifelines are the connections between communities and outside services. They include water and gas lines, transportation systems, electricity and communication networks. Ground shaking and amplification can cause pipes to break open, power lines to fall, roads and railways to crack or move, and radio and telephone communication to cease. Disruption to transportation makes it especially difficult to bring in supplies or services. Lifelines need to be usable after earthquakes to allow for rescue, recovery, and rebuilding efforts and to relay important information to the public.

**Bridge Damage**

Even modern bridges can sustain damage during earthquakes, leaving them unsafe for use. Some bridges have failed completely due to strong ground motion. Bridges are a vital transportation link as even minor damages can make some areas inaccessible. Because bridges vary in size, materials, location and design, any given earthquake will affect them differently. Bridges built before the mid-1970's have a significantly higher risk of suffering structural damage during a moderate to large earthquake compared with those built after 1980 when design improvements were made.

Much of the interstate highway system was built in the mid to late 1960's. The bridges in Orange County are state, county or privately owned (including railroad bridges). Cal Trans has retrofitted most bridges on the freeway systems; however, there are still some county maintained bridges that are not retrofitted. The Federal Highway Administration requires that bridges on the National Bridge Inventory be inspected every 2 years. CalTrans checks when the bridges are inspected because they administer the Federal funds for bridge projects.

**Disruption of Critical Services**

Critical facilities include police stations, fire stations, hospitals, shelters, and other facilities that provide important services to the community. These facilities and their services need to be functional after an earthquake event. **Businesses**

Seismic activity can cause great loss to businesses, both large-scale corporations and small retail shops. When a company is forced to stop production for just a day, the economic loss can be tremendous, especially when its market is at a national or global level. Seismic activity can create economic loss that presents a burden to large and small shop owners who may have difficulty recovering from their losses.

Forty percent of businesses do not reopen after a disaster and another twenty-five percent fail within one year according to the Federal Emergency Management Agency (FEMA). Similar statistics from the United States Small Business Administration indicate that over ninety percent of businesses fail within two years after being struck by a disaster.

The Institute of Business and Home Safety has developed “Open for Business,” which is a disaster planning toolkit to help guide businesses in preparing for and dealing with the adverse effects of natural hazards. The kit integrates protection from natural disasters into the company's risk reduction measures to safeguard employees, customers, and the investment itself. The guide helps businesses secure human and physical resources during disasters and helps to develop strategies to maintain business continuity before, during, and after a disaster occurs.

**Individual Preparedness**

Because the potential for earthquake occurrence and earthquake related property damage is relatively high in Orange County, increasing individual preparedness is a significant need. Strapping down heavy furniture, water heaters, and expensive personal property, as well as being earthquake insured, and anchoring buildings to foundations are just a few steps individuals can take to mitigate earthquake hazards.

**Death and Injury**

Death and injury can occur both inside and outside of buildings due to collapsed buildings and falling equipment, furniture, debris, and structural materials. Downed power lines and broken water and gas lines can also endanger human life.

**Fire**

Downed power lines or broken gas mains can trigger fires. When fire stations suffer building or lifeline damage, quick response to extinguish fires is less likely. Furthermore, major incidents will demand a larger share of resources, and initially smaller fires and problems will receive little or insufficient resources in the initial hours after a major earthquake event. Loss of electricity may cause a loss of water pressure in some communities, further hampering firefighting ability.

**Debris**

After damage to a variety of structures, a considerable amount of time is spent cleaning up brick, glass, wood, steel or concrete building elements, office and home contents, and other materials. Developing a strong debris management strategy is essential in post-disaster recovery. Occurrence of a disaster does not exempt Orange County from compliance with AB 939 regulations which require recycling debris. In addition, Orange County is developing a Debris Management Plan.

### *Existing Mitigation Activities*

Existing mitigation activities include current mitigation programs and activities that are being implemented by county, regional, state, or federal agencies or organizations.

**Orange County Codes**

Implementation of earthquake mitigation policies most often takes place at the local government level. OC Public Works enforces zoning ordinances, land use regulations and building codes related to earthquake hazards.

Generally, these codes seek to discourage development in areas that could be prone to flooding, landslide, wildfire and/or seismic hazards. Where development is permitted, the applicable construction standards are met. Developers in hazard-prone areas may be required to retain a qualified professional engineer to evaluate level of risk on the site and recommend appropriate mitigation measures.

**Hospitals**

The Alfred E. Alquist Hospital Seismic Safety Act (Hospital Act) was enacted in 1973 in response to the moderate magnitude 6.6 Sylmar Earthquake in 1971 when four major hospital campuses were severely damaged and evacuated. Two hospital buildings collapsed killing forty seven people. Three others were killed in another hospital that nearly collapsed.

In approving the Act, the Legislature noted that: "Hospitals that house patients who have less than the capacity of normally healthy persons to protect themselves, and that must be reasonably capable of providing services to the public after a disaster, shall be designed and constructed to resist, insofar as practical, the forces generated by earthquakes, gravity and winds." (Health and Safety Code Section 129680)

When the Hospital Act was passed in 1973, the State anticipated that, based on the regular and timely replacement of aging hospital facilities, the majority of hospital buildings would be in compliance with the Act's standards within 25 years. However, hospital buildings are not being replaced at that anticipated rate. In fact, the great majority of the State's urgent care facilities are now more than 40 years old.

The moderate magnitude 6.7 Northridge Earthquake in 1994 caused $3 billion in hospital-related damage and evacuations. Twelve hospital buildings constructed before the Act were cited (red tagged) as unsafe for occupancy after the earthquake. Those hospitals built in accordance with the 1973 Hospital Act were very successful in resisting structural damage. However, nonstructural damage (for example, plumbing and ceiling systems) was still extensive in those post-1973 buildings.

Senate Bill 1953 (SB 1953), enacted in 1994 after the Northridge Earthquake, expanded the scope of the 1973 Hospital Act. Under SB 1953, all hospitals are required, as of January 1, 2008, to survive earthquakes without collapsing or posing the threat of significant loss of life. The 1994 Act further mandates that all existing hospitals be seismically evaluated and retrofitted, if needed, by 2030. SB 1953 applies to all urgent care facilities (including those built prior to the 1973 Hospital Act) and affects approximately 2,500 buildings on 475 campuses.

SB 1953 directed the Office of Statewide Health Planning and Development (OSHPD), in consultation with the Hospital Building Safety Board, to develop emergency regulations including "…earthquake performance categories with sub gradations for risk to life, structural soundness, building contents, and nonstructural systems that are critical to providing basic services to hospital inpatients and the public after a disaster." (Health and Safety Code Section 130005 - The Seismic Safety Commission Evaluation of the State's Hospital Seismic Safety Policies).

In 2001, recognizing the continuing need to assess the adequacy of policies, and the application of advances in technical knowledge and understanding, the California Seismic Safety Commission created an ad hoc committee to re-examine the compliance with the Alquist Hospital Seismic Safety Act. The formation of the Committee was also prompted by the recent evaluations of hospital buildings reported to the Office of Statewide Health Planning and Development revealing a large percentage (40%) of California's operating hospitals are in the highest category of collapse risk.

Orange County is currently home to 38 hospitals, but none are located in the unincorporated areas. All hospitals sit within one of the two highest seismic risk zones, according to USGS. There are no Countyowned hospitals.

**California Earthquake Mitigation Legislation**

California officials are painfully aware of the threats the state faces from earthquakes. Dating back to the th century, Californians have been killed, injured, and lost property as a result of earthquakes. As the
19
state's population continues to grow, and urban areas become even more densely built up, the risk will continue to increase. For decades, the Legislature has passed laws to strengthen the built environment and protect the residents. Figure 9 provides a sample of State Codes related to earthquakes.

☐ **Figure 9- Partial List of the Over 200 California Laws on Earthquake Safety**

| | |
|---|---|
| Government Code Section 8870-8870.95 | Creates Seismic Safety Commission. |

| | |
|---|---|
| Government Code Section 8876.1-8876.10 | Established the California Center for Earthquake Engineering Research. |
| Public Resources Code Section 2800-2804.6 | Authorized a prototype earthquake prediction system along the central San Andreas fault near the City of Parkfield. |
| Public Resources Code Section 2810-2815 | Continued the Southern California Earthquake Preparedness Project and the Bay Area Regional Earthquake Preparedness Project. |
| Health and Safety Code Section 16100-16110 | The Seismic Safety Commission and State Architect will develop a state policy on acceptable levels of earthquake risk for new and existing state-owned buildings. |
| Government Code Section 8871-8871.5 | Established the California Earthquake Hazards Reduction Act of 1986. |
| Health and Safety Code Section 130000-130025 | Defined earthquake performance standards for hospitals. |
| Public Resources Code Section 2805-2808 | Established the California Earthquake Education Project. |
| Government Code Section 8899.10-8899.16 | Established the Earthquake Research Evaluation Conference. |
| Public Resources Code Section 2621-2630 2621. | Established the Alquist-Priolo Earthquake Fault Zoning Act. |
| Government Code Section 8878.50-8878.52 8878.50. | Created the Earthquake Safety and Public Buildings Rehabilitation Bond Act of 1990. |
| Education Code Section 3529535297 35295. | Established emergency procedure systems in kindergarten through grade 12 in all the public or private schools. |
| Health and Safety Code Section 19160-19169 | Established standards for seismic retrofitting of unreinforced masonry buildings. |
| Health and Safety Code Section 1596.80-1596.879 | Required all child day care facilities to include an Earthquake Preparedness Checklist as an attachment to their disaster plan. |
| **Source: http://www.leginfo.ca.gov/calaw.html** | |

**Earthquake Education** Earthquake research and education activities are conducted at several major universities in the Southern California region, including the California Institute of Technology, the University of Southern California, the University of California – Los Angeles, the University of California – Santa Barbara, the University of California – Irvine, and the University of California – San Diego. The local clearinghouse for earthquake information is the Southern California Earthquake Center located at the University of Southern California. The Southern California Earthquake Center (SCEC) is a community of scientists and specialists who actively coordinate research on earthquake hazards at nine core institutions, and communicate earthquake information to the public. SCEC is a National Science Foundation Science and Technology Center and is cofunded by the United States Geological Survey (USGS).

**Risk Analysis**

Risk analysis is the third phase of a hazard assessment. Risk analysis involves estimating the damage and costs likely to be experienced in a geographic area over a period of time. Factors in assessing earthquake risk include population and property distribution in the hazard area, the frequency of earthquake events, landslide susceptibility, buildings, infrastructure, and disaster preparedness of the region. This type of analysis can generate estimates of the damages to the region due to an earthquake event in a specific location. FEMA's software program, HAZUS, uses mathematical formulas and information about building stock, local geology and the location and size of potential earthquakes, economic data, and other information to estimate losses from a potential earthquake. The HAZUS software is available from FEMA at no cost.

For greater Southern California there are multiple worst case scenarios, depending on which fault might rupture, and which communities are in proximity to the fault. But damage will not necessarily be limited to immediately adjoining communities. Depending on the hypocenter of the earthquake, seismic waves may be transmitted through the ground to unsuspecting communities. In the 1994 Northridge earthquake, Santa Monica suffered extensive damage, even though there was a range of mountains between it and the origin of the earthquake.

Damages for a large earthquake almost anywhere in Southern California are likely to run into the billions of dollars. Although current building codes are some of the most stringent in the world, tens of thousands of older existing buildings were built under much less rigid codes. California has laws affecting unreinforced masonry buildings (URM's) and although many building owners have retrofitted their buildings, hundreds of pre-1933 buildings still have not been brought up to current standards.

Non-structural bracing of equipment and contents is often the most cost-effective type of seismic mitigation. Inexpensive bracing and anchoring may be the most effective way to protect expensive equipment and furnishings and will also reduce the chance of injury for the occupants of a building.

The Orange County Essential Facilities Risk Assessment project ran detailed models on two earthquake scenarios (M6.9 Newport-Inglewood Earthquake and M6.6 San Joaquin Hills Earthquake) in Orange County. That data can be found in Attachment B – OCEFRA HAZUS Report. An additional assessment was performed using the ShakeOut scenario and is available in the Quantitative Exposure Analysis section at the end of this chapter.

## 3.4 Dam Failure

Dam failures can result from a number of natural or human caused threats such as earthquakes, erosion of the face or foundation, improper siting, rapidly rising flood waters, and structural/design flaws.

A dam failure will cause loss of life, damage to property, and other ensuing hazards, as well as the displacement of persons residing in the inundation path. Damage to electric generating facilities and transmission lines could also impact life support systems in communities outside the immediate hazard areas.

Governmental assistance could be required and may continue for an extended period. These efforts would be required to remove debris and clear roadways, demolish unsafe structures, assist in reestablishing public services and utilities, and provide continuing care and welfare for the affected population including, as required, temporary housing for displaced persons.

The dams in Orange County are considered potential terrorist targets. The weapon most likely to be used would be explosives with the goal of collapsing the dam. Such an event would result in a dam inundation event with little or no warning. The potential of using other types of weapons such as chemical or biological are considered low due to the large amount of material that would be required to contaminate the reservoirs. This scenario would only apply to those dams where the reservoirs are used for drinking water.

Currently, there are 44 dams and reservoirs registered within or immediately adjacent to Orange County. They include reservoirs which normally contain water from flood control facilities which may be dry most of the time. Their capacity range from 18 acre-feet (Deimer No. 8) to 314,400 acre-feet (Prado Dam) holding capacity.

The County of Orange owns and operates 16 dams and reservoirs, the smallest facility is Harbor View with a capacity of 28 acre-feet and is located in Corona Del Mar to the Villa Park Dam with a capacity of 15,600 acre-feet and is located in Orange.

The following is a list of all registered dams and reservoirs in Orange County along with their owners and/or operators[11] and locations.

| Dam or Reservoir Name | Owner | Year built | Capacity by acre-feet | Location |
|---|---|---|---|---|
| 30 MG Central Reservoir | City of Brea | 1924 | 92 | Brea |
| Agua Chinon | County of Orange | 1998 | 256 | Irvine |

[11] http://www.water.ca.gov/damsafety/damlisting/index.cfm

| | | | | |
|---|---|---|---|---|
| Bee Canyon Retention Basin | County of Orange | 1994 | 243 | Irvine |

| Dam or Reservoir Name | Owner | Year built | Capacity by acre-feet | Location |
|---|---|---|---|---|
| Big Canyon | City of Newport Beach | 1959 | 600 | Newport Beach |
| Brea Dam | Army Corps of Engineers | 1942 | 4,018 | Fullerton |
| Carbon Canyon Dam | Army Corps of Engineers | 1961 | 7,033 | Yorba Linda |
| Diemer No. 8 | Metropolitan Water District of So. California | 1968 | 18 | Yorba Linda |
| Diemer Ozone Contact Basin | Metropolitan Water District of So. California | 2011 | 23 | Yorba Linda |
| Diemer Reservoir | Metropolitan Water District | 1963 | 80 | Yorba Linda |
| Dove Canyon | Dove Canyon Master Association | 1989 | 415 | Dove Canyon |
| East Hicks Canyon Retarding Basin | County of Orange | 1997 | 75 | Irvine |
| Eastfoot Retarding Basin | City of Irvine | 2007 | 213 | Irvine |
| El Toro Reservoir | El Toro Water District | 1967 | 877 | Mission Viejo |
| Fullerton Dam | Army Corps of Engineers | 1941 | 706 | Fullerton |
| Galivan Retarding Basin | County of Orange | 2000 | 169 | Newport Beach |
| Harbor View | County of Orange | 1964 | 28 | Corona Del Mar |
| Hicks Canyon Retention Basin | County of Orange | 1997 | 110 | Irvine |
| Lake Mission Viejo | Lake Mission Viejo Association, Inc. | 1976 | 4,300 | Mission Viejo |
| Lower Peters Canyon Retarding Basin | County of Orange | 1990 | 206 | North Tustin |
| Marshburn Retarding Basin | County of Orange | 1998 | 424 | Irvine |
| Orange County (Humble) Reservoir | Metropolitan Water District | 1941 | 217 | Brea |
| Orchard Estates Retarding Basin | County of Orange | 1999 | 138 | Irvine |
| Palisades Reservoir | South Coast Water District | 1963 | 147 | San Clemente |
| Peters Canyon | County of Orange | 1932 | 1,090 | North Tustin |

| | | | | |
|---|---|---|---|---|
| Portola | Santa Margarita Water District | 1980 | 586 | Coto de Caza |
| Prado Dam | Army Corps of Engineers | 1941 | 314,400 | Corona |
| Rattlesnake Canyon | Irvine Ranch Water District | 1959 | 1,480 | Irvine |
| Rossmoor No. 1 | El Toro Water District | 1964 | 43 | Laguna Woods |
| Rossmoor Retarding Basin | County of Orange | 2002 | 175 | Rossmoor |
| Round Canyon Retarding Basin | County of Orange | 1994 | 286 | Irvine |
| San Joaquin Reservoir | Irvine Ranch Water District | 1966 | 3,036 | Newport Beach |
| Sand Canyon | Irvine Ranch Water District | 1912 | 960 | Sand Canyon |
| **Dam or Reservoir Name** | **Owner** | **Year built** | **Capacity by acre-feet** | **Location** |
| Santiago Creek (Irvine Lake) | Serrano and Irvine Ranch Water Districts | 1933 | 25,000 | Silverado |
| Sulphur Creek | County of Orange | 1966 | 520 | Laguna Niguel |
| Syphon Canyon | Irvine Ranch Water District | 1949 | 500 | Irvine |
| Trabuco | Trabuco Canyon Water District | 1984 | 138 | Rancho Santa Margarita |
| Trabuco Retarding Basin | County of Orange | 1996 | 390 | Irvine |
| Trampas Canyon | Premier Silica LLC | 1975 | 5,700 | San Juan Capistrano |
| Upper Chiquita | Santa Margarita Water District | 2012 | 753.5 | Rancho Santa Margarita |
| Upper Oso | Santa Margarita Water District | 1979 | 3,700 | Mission Viejo |
| Villa Park Dam | County of Orange | 1963 | 15,600 | Orange |
| Veeh Reservoir | Lake Hills Community Church | 1936 | 185 | Laguna Hills |
| Walnut Canyon | City of Anaheim | 1968 | 2,570 | Anaheim |
| Yorba | County of Orange | 1907 | 1,200 | Anaheim |

### *Historical Failure Flooding*

**Westminster Water Tank Failure – Westminster, Orange County**

On September 21, 1998, at 5:47am, a 5 million gallon precast concrete above ground water storage tank ruptured, sending a 6 foot high wave of water through a nearby fire station and the Hefley Square Townhomes in the City of Westminster. Six people were injured and 30 were left temporarily homeless after the tidal wave gushed from the 22 foot high rupture in the tank. The fire station, 70 homes, 32 outbuildings, 2 businesses and 25 vehicles sustained damages or were destroyed. Gas, electric and telephone services were disrupted.


*This 31-year-old storage tank ruptured in Westminster, California, sending a 6-foot wave of water through the city that damaged or destroyed about 50 buildings and over a dozen vehicles. Storage tanks should be replaced or periodically rehabilitated to preserve their structural integrity.*

**Prado Dam Seepage**

In January 2005, due to preceding storm activity which produced near record water levels behind Prado Dam, the reservoir water surface elevation behind the dam peaked at 527.4 feet above sea level. On January 13, the U.S. Army Corps of Engineers discovered minor seepage on the downstream face of Prado Dam. The seepage was located in an area that was under construction to build new outlet works as part of the overall flood control improvement to Prado Dam. As a precautionary measure Corona city officials evacuated over 800 homes below the dam and Orange County officials relocated campers in the Canyon RV Park because of their proximity to the adjacent floodplain.

To decrease the amount of water behind Prado dam the release of water was increased from 5,000 cubic feet per second (cfs) to 10,000 cfs to reduce the level of water being held to 505 feet. In addition to the increase in water release, the U.S. Army Corps began holding back floodwaters upstream at both the San Antonio Dam in Los Angeles County and Seven Oaks Dam near Redlands to reduce the inflow of water to Prado Dam. As the water level was lowered, the hydraulic pressure on the dam abutment subject to seepage was reduced. When the water was reduced to 505 feet (25,750 acre feet of water) on Monday, January 17, 2005 the USACE was able to start the reconditioning of the cofferdam in order to be ready for subsequent flood inflows to the dam.

### *Vulnerability Assessment*

Loss of life and damage to structures, roads, and utilities may result from a dam failure. Economic losses can also result from a lowered tax base and lack of utility profits. These effects would certainly accompany the failure of one of the major dams in Orange County. Because dam failure can have severe consequences, FEMA and the California Office of Emergency Services require all dam owners to develop Emergency Action Plans (EAP) for warning, evacuation, and post-flood actions. Although there may be coordination with county officials in the development of the EAP, the responsibility for developing potential flood inundation maps and facilitation of emergency response is the responsibility of the dam owner. For more detailed information regarding dam failure flooding, and potential flood inundation zones for a particular dam in the county, refer to the Orange County Operational Area Emergency Operations Plan – Dam / Reservoir Failure Annex.

**Life and Property**

Based on the number of dams in Orange County and utilizing the dam failure inundation maps, we can conclude that a large portion of the County is vulnerable to dam failure. The largest impact on the community from a dam failure is the loss of life and property.

**Residential and Commercial**

Vulnerable properties are those located closest to the dam inundation area. These properties would experience the largest, most destructive surge of water. Low-lying areas are also vulnerable since this is where the dam waters would collect.

Residential property in low-lying areas in an inundation zone would be heavily impacted. Orange County is an affluent community, where the median price of a home on the coastline is $800,000 to well over $1,000,000. The failure of a large dam could potentially destroy or damage hundreds of homes spreading debris for miles.

A dam failure event would impact businesses by damaging property and by interrupting business and services. Any residential or commercial structure with weak reinforcement would be susceptible to damage.

**Infrastructure**

Dam failure can damage buildings, power lines, and other property and infrastructure due to flooding.

Transportation routes are vulnerable to dam inundation and have the potential to be severely damaged or literally swept away, creating isolation issues. This includes all roads, railroads and bridges in the path of the dam inundation. Those that are most vulnerable are those that are already in poor condition and would not be able to withstand a large water surge. Utilities such as overhead power lines, cable and phone lines could also be vulnerable. Loss of these utilities could create additional isolation issues for the inundation areas. Dam failure can result in collapsed or damaged buildings or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Damage to public water and sewer systems, transportation networks, and flood channels would greatly impact daily life for residents.

Roads blocked by objects during or after a dam failure may have severe consequences to people who are attempting to evacuate or who need emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric services and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from dam failure related to both physical damages and interrupted services.

**Additional Vulnerability Analysis**

While all 44 dams in Orange County would have some impact on infrastructure, by far the greatest threat is from Prado Dam on the Santa Ana River just east of the County boundary. With more than ten times the capacity of the next largest dam on the list, it is the primary concern when it comes to dam and reservoir failure planning in Orange County. The U.S. Army Corps of Engineers, who manages the dam site, does not release information on dam inundation areas, but, using old paper maps, a basic analysis has been performed to assess the vulnerability of the County's unincorporated areas and the County of Orange and the Orange County Fire Authority's facilities. This assessment is available in the quantitative exposure analysis section at the end of this chapter. In addition, a mitigation action item exists the address the lack of more current inundation maps for Prado Dam and other dams in Orange County.

## 3.5 Landslide/Mud Flow/Debris Flow

Landslide is a general term for a falling mass of soil or rocks; vertical movement of small pieces of soil. Mud flow is a flow of very wet rock and soil. The primary effects of mud flows/landslides can include:

- Abrupt depression and lateral displacement of hillside surfaces over distances of up to several hundreds of feet.
- Disruption of surface drainage.
- Blockage of flood control channels and roadways.
- Displacement or destruction of improvements such as roadways, buildings, and water wells.

Orange County also uses the term debris flow, usually in regard to risk of surface soil movement in areas recently burned by wildfire. Since this term is used in our official planning documents for such occurrences, it is included here.

**Landslide Characteristics**

A landslide is defined as, the movement of a mass of rock, debris or earth down a slope. Landslides are a type of 'mass wasting' which denotes any down slope movement of soil and rock under the direct influence of gravity. The term 'landslide' encompasses events such as rock falls, topples, slides, spreads, and flows. Landslides can be initiated by rainfall, earthquakes, volcanic activity, changes in groundwater, disturbance and change of a slope by man-made construction activities, or any combination of these factors. Landslides can also occur underwater, causing tidal waves and damage to coastal areas. These landslides are called submarine landslides.

The size of a landslide usually depends on the geology and the initial cause of the landslide. Landslides vary greatly in their volume of rock and soil, the length, width, and depth of the area affected, frequency of occurrence, and speed of movement. Some characteristics that determine the type of landslide are slope of the hillside, moisture content, and the nature of the underlying materials. Landslides are given different names, depending on the type of failure and their composition and characteristics.

Slides move in contact with the underlying surface. These movements include rotational slides where sliding material moves along a curved surface and translational slides where movement occurs along a flat surface. These slides are generally slow moving and can be deep. Slumps are small rotational slides that are generally shallow. Slow-moving landslides can occur on relatively gentle slopes and can cause significant property damage, but are far less likely to result in serious injuries than rapidly moving landslides.

Failure of a slope occurs when the force that is pulling the slope downward (gravity) exceeds the strength of the earth materials that compose the slope. They can move slowly, (millimeters per year) or can move quickly and disastrously, as is the case with debris-flows. Debris-flows can travel down a hillside of speeds up to 200 miles per hour (more commonly, 30 – 50 miles per hour), depending on the slope angle, water content, and type of earth and debris in the flow. These flows are initiated by heavy, usually sustained, periods of rainfall, but sometimes can happen as a result of short bursts of concentrated rainfall in susceptible areas. Burned areas charred by wildfires are particularly susceptible to debris flows, given certain soil characteristics and slope conditions.

**Mud Flow**

A mud or debris flow is a river of rock, earth and other materials, including vegetation, that is saturated with water. This high percentage of water gives the debris flow a very rapid rate of movement down a slope. Debris flows can attain speeds greater than 20 miles per hour, and can often move much faster. This high rate of speed makes debris flows extremely dangerous to people and property in their path.

Earth flows are plastic or liquid movements in which land mass (e.g. soil and rock) breaks up and flows during movement. Earthquakes often trigger flows. Debris flows normally occur when a landslide moves down-slope as a semi-fluid mass scouring, or partially scouring soils from the slope along its path. Flows are typically rapid moving and also tend to increase in volume as they scour out the channel. Flows often occur during heavy rainfall, can occur on gentle slopes, and can move rapidly for large distances.

**Landslide Events and Impacts**

Landslides are a common hazard in California. Weathering and the decomposition of geologic materials produces conditions conducive to landslides and human activity further exacerbates many landslide problems. Many landslides are difficult to mitigate, particularly in areas of large historic movement with weak underlying geologic materials. As communities continue to modify the terrain and influence natural processes, it is important to be aware of the physical properties of the underlying soils as they, along with climate, create landslide hazards. Even with proper planning, landslides will continue to threaten the safety of people, property, and infrastructure, but without proper planning, landslide hazards will be even more common and more destructive.

The increasing scarcity of buildable land, particularly in urban areas, increases the tendency to build on geologically marginal land. Additionally, hillside housing developments in Southern California are prized for the view lots that they provide.

Rock falls occur when blocks of material come loose on steep slopes. Weathering, erosion, or excavations, such as those along highways, can cause falls where the road has been cut through bedrock. They are fast moving materials free falling or bouncing down a slope. In falls, material is detached from a steep slope or cliff. The volume of material involved is generally small, but large boulders or blocks of rock can cause significant damage.

**Landslide Conditions**

Landslides are often triggered by periods of heavy rainfall. Earthquakes, subterranean water flow and excavations may also trigger landslides. Certain geologic formations are more susceptible to landslides than others. Human activities, including locating development near steep slopes, can increase susceptibility to landslide events. Landslides on steep slopes are more dangerous because movements can be rapid.

"Although landslides are a natural geologic process, the incidence of landslides and their impacts on people can be exacerbated by human activities. Grading for road construction and development can increase slope steepness. Grading and construction can decrease the stability of a hill slope by adding weight to the top of the slope, removing support at the base of the slope, and increasing water content. Other human activities effecting landslides include: excavation, drainage and groundwater alterations, and changes in vegetation."[12]

Wildland fires in hills covered with chaparral are often a precursor to debris flows in burned out canyons. The extreme heat of a wildfire can create a soil condition in which the earth becomes impervious to water by creating a waxy-like layer just below the ground surface. Since the water cannot be absorbed into the soil, it rapidly accumulates on slopes, often gathering loose particles of soil in to a sheet of mud and debris. Debris flows can often originate miles away from unsuspecting persons, and approach them at a high rate of speed with little warning.

**Natural Conditions**

Natural processes can cause landslides or re-activate historical landslide sites. The removal or undercutting of shoreline-supporting material along bodies of water by currents and waves produces countless small slides each year. Seismic tremors can trigger landslides on slopes historically known to have landslide movement. Earthquakes can also cause additional failure (lateral spreading) that can occur on gentle slopes above steep streams and riverbanks.

**Particularly Hazardous Landslide Areas**

Locations at risk from landslides or debris flows include areas with one or more of the following conditions:

- On or close to steep hills.
- Steep road-cuts or excavations.
- Existing landslides or places of known historic landslides (such sites often have tilted power lines, trees tilted in various directions, cracks in the ground, and irregular-surfaced ground).
- Steep areas where surface runoff is channeled, such as below culverts, V-shaped valleys, canyon bottoms, and steep stream channels.
- Fan-shaped areas of sediment and boulder accumulation at the outlets of canyons.
- Canyon areas below hillside and mountains that have recently (within 1-6 years) been subjected to a wildland fire.

Although landslides are a natural occurrence, human impacts can substantially affect the potential for landslide failures in Orange County. Proper planning and geotechnical engineering can be exercised to reduce the threat of safety of people, property, and infrastructure.

[12] "Planning for Natural Hazards: The Oregon Technical Resource Guide, Department of Land Conservation and Development, (2000), Chapter 5.

**Excavation and Grading**

Slope excavation is common in the development of home sites or roads on sloping terrain. Grading these slopes can result in some slopes that are steeper than the pre-existing natural slopes. Since slope steepness is a major factor in landslides, these steeper slopes can be at an increased risk for landslides. The added weight of fill placed on slopes can also result in an increased landslide hazard. Small landslides can be fairly common along roads, in either the road cut or the road fill. Landslides occurring below new construction sites are indicators of the potential impacts stemming from excavation.

**Drainage and Groundwater Alterations**

Water flowing through or above ground is often the trigger for landslides. Any activity that increases the amount of water flowing into landslide-prone slopes can increase landslide hazards. Broken or leaking water or sewer lines can be especially problematic, as can water retention facilities that direct water onto slopes. However, even lawn irrigation in landslide prone locations can result in damaging landslides. Ineffective storm water management and excess runoff can also cause erosion and increase the risk of landslide hazards. Drainage can be affected naturally by the geology and topography of an area. Development that results in an increase in impervious surface impairs the ability of the land to absorb water and may redirect water to other areas. Channels, streams, ponding, and erosion on slopes all indicate potential slope problems.

Road and driveway drains, gutters, downspouts, and other constructed drainage facilities can concentrate and accelerate flow. Ground saturation and concentrated velocity flow are major causes of slope problems and may trigger landslides. Information gathered from the "Homeowners Guide for Landslide Control, Hillside Flooding, Debris Flows, Soil Erosion (March 1997).

**Changes in Vegetation**

Removing vegetation from very steep slopes can increase landslide hazards. Areas that experience wildfire and land clearing for development may have long periods of increased landslide hazard. Also, certain types of ground cover have a much greater need for constant watering to remain green. Changing from native ground cover plants may increase the risk of landslide.

There are multiple areas within Orange County that are susceptible to landslides and mud flows. An example of an Orange County landslide was in Anaheim Hills following the floods of 1992. Most, but not all, landslides in southern California begin to move when the soils have become saturated during heavy rains. In Anaheim Hills several homes located at the crest of the hill began to slide and had to be evacuated. These structures were deemed unsafe for continued habitation.

Almost all sites with potential for mud flows/landslides lie within the hillside and coastal areas of Orange County. Many slopes in the County are only marginally stable and landslides could occur. OC Public Works enforces Orange County Grading Code to ensure that areas of landslide or hillside areas are adequately identified and investigated prior to development.

### *Landslides as a Threat to Orange County*

Landslides are a serious geologic hazard in almost every state in America. Nationally, landslides cause 25 to 50 deaths each year. The best estimate of direct and indirect costs of landslide damage in the United States range between $1 and $2 billion annually as noted in Dennis Miletti's Disasters by Design: A Reassessment of Natural Hazards in the United States. As a seismically active region, California has had a significant number of locations impacted by landslides. Some landslides result in private property damage; other landslides impact transportation corridors, fuel and energy conduits, and communication facilities. They can also pose a serious threat to human life.

**Historic Southern California Landslides**

The following landslide accounts comprise only a fraction of the Southern California landslide history. These are provided as a sample for mitigation planning

**1978 Bluebird Canyon, Orange County**

Cost, $52.7 million (2000 dollars) 60 houses destroyed or damaged. Unusually heavy rains in March of 1978 may have contributed to initiation of the landslide. Although the 1978 slide area was approximately 3.5 acres, it is suspected to be a portion of a larger, ancient landslide.

**1980 Southern California Slides**

$1.1 billion in damage (2000 dollars). Heavy winter rainfall in 1979-80 caused damage in six Southern California counties. In 1980, the rainstorm started on February 8th. A sequence of 5 days of continuous rain and 7 inches of precipitation fell by February 14th. Slope failures were beginning to develop by February 15th and then very high-intensity rainfall occurred on February 16. As much as 8 inches of rain fell in a 6 hour period in many locations.

**1983 San Clemente, California, Orange County**

Cost, $65 million in 2000 dollars on California Highway 1. Litigation at that time involved approximately $43.7 million (2000 dollars).

**1994 Northridge, California earthquake landslides**

As a result of the magnitude 6.7 Northridge, California, earthquake, more than 11,000 landslides occurred over an area nearly 4,000 square miles. Most were in the Santa Susana Mountains and in mountains north of the Santa Clara River Valley. They destroyed dozens of homes, blocked roads, and damaged oilfield infrastructure. It also caused deaths from Coccidioidomycosis (valley fever) the spore of which was released from the soil and blown toward the coastal populated areas. It is postulated the spore was released from the soil by the landslide activity.

**March 1995 Los Angeles and Ventura Counties, Southern California**

Above normal rainfall triggered damaging debris flows, deep-seated landslides, and flooding. Several deep-seated landslides were triggered by the storms, the most notable was the La Conchita landslide, which in combination with a local debris flow, destroyed or badly damaged 11 to 12 homes in the small town of La

Conchita, about 12 miles west of Ventura. There also was widespread debris-flow and flood damage to homes, commercial buildings, and roads and highways in areas along the Malibu coast that had been devastated by wildfire 2 years before.

**1998 Laguna Niguel, Orange County, Landslide**

During the 1997/1998 El Nino Season heavy rainfall increased movement on the site of an ancient landslide in Laguna Niguel. The storms in December 1997 had accelerated its movement and in early 1998, a crumbling hillside forced the evacuation of 10 hilltop homes and more than 10 condominium units resting below. Ultimately four of the hilltop homes collapsed, falling down hillside into the void created by the slide area. The condominium complex has since been demolished and the site sits as open space as shown below.

**Before**

**After**

**Other 1997-1998 Landslides**

On December 6, 1997, four homes were condemned and evacuated due to a mud flow and rockfall in Silverado Canyon. Floods and mud flows were reported in Costa Mesa, Irvine, Lake Forest, San Juan Capistrano, and Laguna Beach. mud flows occurred in Black Star, Baker, and Santiago Canyons. Many road closures were reported along the Santa Ana Freeway at Laguna Freeway, Laguna Canyon Road, Pacific Coast Highway in Newport Beach and in Huntington Beach.

On December 23, 1997, movement of an active landslide in the Anaheim Hills accelerated. This "Vista Summit Way" landslide damaged two to three houses and affected three city blocks.

On February 6, 1998, a mud flow crushed two cars in Newport Beach. On February 8, high tide and rain caused damage to shoreline properties; nine homes at a mobile home park were damaged in San Clemente. One of these houses was condemned. In Dana Point, the Holiday Inn Express was evacuated when a mud flow flowed into the underground parking structure. Cars flowed out of the building into the street with the mud. In Brea a rock and mud flow closed the Carbon Canyon Road. Other road closures occurred at Pacific Coast Highway, Laguna Canyon Road, and El Toro Road.

On On February 23, 1998, the storm forced the evacuation of eight to ten residents in Holy Jim Canyon near the Orange - Riverside County line; a half-dozen other residents declined to move despite the growing slide threat. One home was endangered in Silverado Canyon. On February 24, Carbon Canyon Road was closed in Brea, after a hillside slid across half of the road at the La Vida Hot Springs Resort. On March 3, a landslide forced the evacuation of four homes in the 300 block of Paseo de Cristobal in San Clemente, piled dirt and large boulders onto the railroad tracks and cut off rail service.

**2004-2005 Anaheim Hills**

Three new multi-million dollar homes along Ramsgate Drive were destroyed by this slow-moving landslide in 2004-05.

**2005 Bluebird Canyon Landslide**

In the early morning of June 1, 2005, a landslide began moving in the Bluebird Canyon area of Laguna Beach, California. No rainfall or earthquake activity occurred during or immediately before the landslide movement. This movement is almost certainly related to the extremely heavy winter rains that occurred from December through February.

On February 15, 2005, USGS issued an advisory that landslides could continue to occur long after the winter rainfall ended: "An additional consequence of the above-normal rainfall in January in southern California is the potential for activation of deep-seated, slow-moving landslides. Rainfall is moving slowly through soil and bedrock, and over time (days to months), may result in destabilization of some hillslopes."

**2007-2008 Post-Santiago Fire and 2014-2015 Post-Silverado Fire Debris Flows**

After the Santiago Fire stripped the vegetation bare in the canyon communities of Orange County, a debris flow task force was convened to address the potential impact that post-fire winter storms could have on the slopes in the burn areas. There were several cases of mud flows that damaged homes in the Modjeska Canyon area.

Following the Silverado Fire in 2014, similar conditions were generated in the Silverado Canyon area of Orange County. While no major debris flows have been recorded in the year following the event, the threat will remain for several more years.

**2010 Winter Storm Mud flows**

In December 2010, a series of storms passed over Orange County, dropping several inches of rain and triggering a series of mud and debris flows in Orange County canyon and coastal areas. While not specifically associated with a fire or other event, these slides tended to occur in areas already identified as being prone to such activity.

### *Vulnerability and Risk*

Vulnerability assessment for landslides will assist in predicting how different types of property and population groups will be affected by a hazard. Data that includes specific landslide-prone and debris flow locations in the county can be used to assess the population and total value of property at risk from future landslide occurrences.

Past landslide events have caused major property damage or significantly impacted county residents, and continuing to map landslide and debris flow areas will help in preventing future loss.

Factors included in assessing landslide risk include population and property distribution in the hazard area, the frequency of landslide or debris flow occurrences, slope steepness, soil characteristics, and precipitation intensity. The California Geological Survey produces a dataset that depicts where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements throughout all of Orange County. Using this dataset, it is possible to assess the County of Orange and Orange County Fire Authority's total exposure to the landslide hazard. This assessment is available in the Quantitative Exposure Analysis section at the end of this chapter.

### *Community Landslide Issues*

#### Susceptibility to Landslides

Landslides can affect utility services, transportation systems, and critical lifelines. Communities may suffer immediate damages and loss of service. Disruption of infrastructure, roads, and critical facilities may also have a long-term effect on the economy. Utilities, including potable water, wastewater, telecommunications, natural gas, and electric power are all essential to service community needs. Loss of electricity has the most widespread impact on other utilities and on the whole community. Natural gas pipes may also be at risk of breakage from landslide movements as small as an inch or two.

#### Lifelines and critical facilities

Lifelines and critical facilities should remain accessible, if possible, during a natural hazard event. The impact of closed transportation arteries may be increased if the closed road or bridge is critical for hospitals and other emergency facilities. Therefore, inspection and repair of critical transportation facilities and routes is essential and should receive high priority. Losses of power and phone service are also potential consequences of landslide events. Due to heavy rains, soil erosion in hillside areas can be accelerated, resulting in loss of soil support beneath high voltage transmission towers in hillsides and remote areas. Flood events can also cause landslides, which can have serious impacts on gas lines that are located in vulnerable soils.

Losses incurred from landslide hazards in Orange County have usually been associated with roads. The Orange County Public Works, Operations & Maintenance Division is responsible for responding to slides that inhibit the flow of traffic or are damaging a road or a bridge. The Division does its best to communicate with residents impacted by landslides, but can usually only repair the road itself, as well as the areas adjacent to the slide where the county has the right of way.

It is not cost effective to mitigate all slides because of limited funds and the fact that some historical slides are likely to become active again even with mitigation measures. The County alleviates problem areas by grading slides, and by installing new drainage systems on the slopes to divert water from the landslides.

This type of response activity is often the most cost-effective in the short-term, but is only temporary.

**Additional Vulnerability Analysis**

While a basic assessment of the total landslide threat is available, the lack of high-resolution hazard data and parcel-level replacement values make a more in-depth analysis not feasible at this time. A mitigation action item was created to address this data limitation and it is hoped that funds will be available to correct for this in the next plan update.

## 3.6 Tsunami

The phenomenon we call "tsunami" is a series of traveling ocean waves of extremely long length generated primarily by earthquakes occurring below or near the ocean floor. Underwater volcanic eruptions and landslides can also generate tsunamis. In the deep ocean, the tsunami waves move across the deep ocean with a speed exceeding 500 miles per hour, and a wave height of only a few inches. Tsunami waves are distinguished from ordinary ocean waves by their great length between wave crests, often exceeding 60 miles or more in the deep ocean, and by the time between these crests, ranging from 10 minutes to an hour.

As they reach the shallow waters of the coast, the waves slow down and the water can pile up into a wall of destruction up to 30 feet or more in height. The effect can be amplified where a bay, harbor or lagoon funnels the wave as it moves inland. Large tsunamis have been known to rise over 100 feet. Even a tsunami 1-3 feet high can be very destructive and cause many deaths and injuries.

**Causes of a Tsunami**

There are many causes of tsunamis, but the most prevalent is earthquakes. In addition, landslides, volcanic eruptions, explosions, and even the impact of cosmic bodies, such as meteorites, can generate tsunamis.

**Earthquakes and Tsunamis**

An earthquake can be caused by volcanic activity, but most are generated by movements along fault zones associated with plate boundaries. Most strong earthquakes, representing 80% of the total energy released worldwide by earthquakes, occur in subduction zones where an oceanic plate slides under a continental plate or another younger oceanic plate.

Not all earthquakes generate tsunamis. To generate a tsunami, the fault where the earthquake occurs must be underneath or near the ocean, and cause vertical movement of the sea floor over a large area, hundreds or thousands of square miles. By far, the most destructive tsunamis are generated from large, shallow earthquakes with an epicenter or fault line near or on the ocean floor. The amount of vertical and horizontal motion of the sea floor, the area over which it occurs, the simultaneous occurrence of slumping of underwater sediments due to the shaking, and the efficiency with which energy is transferred from the earth's crust to the ocean water are all part of the tsunami generation mechanism. The sudden vertical displacements over such large areas disturb the ocean's surface, displace water, and generate destructive tsunami waves. Although all oceanic regions of the world can experience tsunamis, the most destructive and repeated occurrences of tsunamis are in the Pacific Rim region.

The September 2, 1992 earthquake (magnitude 7.2) was barely felt by residents along the coast of Nicaragua. Located well off-shore, the severity of shaking on a scale of I to XII, was mostly II along the coast, and reached III at only a few places. A tsunami struck the coast of Nicaragua 20 to 70 minutes after the earthquake occurred with wave amplitudes up to 13 feet above normal sea level in most places and a maximum run-up height of 35 ft. The waves caught coastal residents by complete surprise, causing many casualties and considerable property damage.

This tsunami was caused by a tsunami earthquake, an earthquake that produces an unusually large tsunami relative to the earthquake magnitude. Tsunami earthquakes are characterized by a very shallow focus, fault dislocations greater than several meters, and fault surfaces that are smaller than for a normal earthquake.

Tsunami earthquakes are also slow earthquakes, with slippage along the fault beneath the sea floor occurring more slowly than it would in a normal earthquake. The only known method to quickly recognize a tsunami earthquake is to estimate a parameter called the seismic moment using very long period seismic waves (more than 50 seconds/cycle). Two other destructive and deadly tsunamis from tsunami earthquakes have occurred in recent years in Java, Indonesia (June 2, 1994) and Peru (February 21, 1996).

**Landslides and Tsunamis**

Less frequently, tsunami waves can be generated from displacements of water resulting from rock falls, icefalls and sudden submarine landslides or slumps. Such events may be caused impulsively from the instability and sudden failure of submarine slopes, which are sometimes triggered by the ground motions of a strong earthquake. For example in the 1980's, earth moving and construction work of an airport runway along the coast of Southern France, triggered an underwater landslide, which generated destructive tsunami waves in the harbor of Thebes.

### *Tsunami Characteristics*

**Speed**

Unnoticed tsunami waves can travel at the speed of a commercial jet plane, over 500 miles per hour. They can move from one side of the Pacific Ocean to the other in less than a day. This great speed makes it important to be aware of the tsunami as soon as it is generated. Scientists can predict when a tsunami will arrive at various places by knowing the source characteristics of the earthquake that generated the tsunami and the characteristics of the sea floor along the paths to those places. Tsunamis travel much slower in more shallow coastal waters where their wave heights begin to increase dramatically.

**Size**

Offshore and coastal features can determine the size and impact of tsunami waves. Reefs, bays, entrances to rivers, undersea features and the slope of the beach all help to modify the tsunami as it attacks the coastline. When the tsunami reaches the coast and moves inland, the water level can rise many feet. In extreme cases, water level has risen to more than 50 feet for tsunamis of distant origin and over 100 feet for tsunami waves generated near the earthquake’s epicenter. The first wave may not be the largest in the series of waves. One coastal community may see no damaging wave activity while in another nearby community destructive waves can be large and violent. The flooding can extend inland by 1000 feet or more, covering large expanses of land with water and debris.

**Frequency**

Since scientists cannot predict when earthquakes will occur, they cannot determine exactly when a tsunami will be generated. However, by looking at past historical tsunamis and run-up maps, scientists know where tsunamis are most likely to be generated. Past tsunami height measurements are useful in predicting future tsunami impact and flooding limits at specific coastal locations and communities.

**Types of Tsunamis**

**Pacific-wide and Regional Tsunamis**

Tsunamis can be categorized as Pacific-wide and "local." Typically, a Pacific-wide tsunami is generated by major vertical ocean bottom movement in offshore deep trenches. A "local" tsunami can be a component of the Pacific-wide tsunami in the area of the earthquake or a wave that is confined to the area of generation within a bay or harbor and caused by movement of the bay itself or landslides.

In 1960, a large tsunami generated by an earthquake located off the coast of Chile caused loss of life and property damage not only along the Chile coast but also in Hawaii and as far away as Japan. The Great Alaskan Earthquake of 1964 killed 106 people and produced deadly tsunami waves in Alaska, Oregon and California.

In July 1993, a tsunami generated in the Sea of Japan killed over 120 people in Japan. Damage also occurred in Korea and Russia but spared other countries since the tsunami wave energy was confined within the Sea of Japan. The 1993 Japan Sea tsunami is known as a "regional event" since its impact was confined to a relatively small area. For people living along the northwestern coast of Japan, the tsunami waves followed the earthquake within a few minutes.

During the 1990s, destructive regional tsunamis also occurred in Nicaragua, Indonesia, the Philippines, Papua New Guinea, and Peru, killing thousands of people. Others caused property damage in Chile and Mexico. Some damage also occurred in the Marquesas Islands (French Polynesia) from the July 30, 1995, Chilean and February 21, 1996 Peruvian tsunamis.

In less than a day, tsunamis can travel from one side of the Pacific to the other. However, people living near areas where large earthquakes occur may find that the tsunami waves will reach their shores within minutes of the earthquake. For these reasons, the tsunami threat to many areas such as Alaska, the Philippines, Japan and the United States West Coast can be immediate (for tsunamis from nearby earthquakes which take only a few minutes to reach coastal areas) or delayed (for tsunamis from distant earthquakes which take from three to 22 hours to reach coastal areas).

All of the coastal areas in Orange County are susceptible to tsunamis. A tsunami from the South Pacific or from South America could strike the County coastal areas from the south to southwest. The Channel Islands do not provide adequate protection.

The worst recorded tsunami to hit California was in 1812. A landslide occurred in the Santa Barbara Channel, and the resulting waves are reported by some disputed sources to have been up to 15 feet above sea level in Ventura. Widespread damage and some loss of life occurred in 1964 following the

Alaskan earthquake. Tsunamis from the earthquake also destroyed a number of towns in Alaska and damaged the Los Angeles-Long Beach harbors, as well as harbors in Ventura County.

## *Tsunami as a Threat to Southern California*

History has shown that the probability of a tsunami in Orange County is an extremely low threat. However, if a tsunami should occur, the consequences could be great. As shown on the tsunami run-up map (Map 23), the entire 42 miles of Orange County coastline could be impacted. Approximately 89,000 residents would have to be evacuated. The impact could cause loss of life, destroy thousands of high priced homes and greatly affect coastal businesses and impact tourism. Even if all residents and visitors were safely evacuated, the damage to property in this densely populated, high property value area would still be tremendous.

**California's Tsunamis**

Since 1812, the California coast has had 14 tsunamis with wave heights higher than three feet; six of these were destructive. The Channel Islands were hit by a tsunami in the early 1800s. The worst tsunami resulted from the 1964 Alaskan earthquake and caused 12 deaths and at least $17 million in damages in northern California.

## *History of Regional Tsunamis*

**Local**

The local tsunami may be the most serious threat as it strikes suddenly, sometimes before the earthquake shaking stops. Alaska has had six serious local tsunamis in the last 80 years and Japan has had many more.

**Local History of Tsunamis**

Tsunamis have been recorded since ancient times. They have been documented extensively in California since 1806. Although the majority of tsunamis have occurred in Northern California, Southern California has been impacted as well. In the 1930's, four tsunamis struck the LA, Orange County, and San Diego coastal areas. In Orange County the tsunami wave reached heights of 20 feet or more above sea level. In 1964, following the Alaska 8.2 earthquake, tidal surges of approximately 4 feet to 5 feet hit the Huntington Harbor area causing moderate damage. The run-up is the height the tsunami reached above a reference level such as mean sea level. It is not always clear which reference level was used.

On February 27$^{th}$, 2010, a magnitude 8.8 earthquake off Chile that literally made the planet vibrate generated a tsunami that produced 3 foot high waves in Orange County 13 hours later, including breakers that hit storm runoff in the Santa Ana River, briefly producing small, frothy rapids.

The tsunami, which traveled about 6,000 miles to get here, led officials to close virtually every beach in Orange County as well as most piers. Newport Beach sent automated phone calls to residents warning them to stay away from the ocean. Parts of Dana Point Harbor were closed. The bait barge in Dana Point Harbor was broken roughly in half. The new $1 billion destroyer USS Dewey was sent out to sea from the Seal Beach Naval Weapons Station to avoid being damaged.

A 9.0 earthquake on March 11, 2011 that occurred near Tohoku, Japan caused a two foot run up in Huntington Beach and Dana Point and a one foot run up in Newport Beach. Damages were minor with a boat pulled off its mooring and a pylon damaged when hit by a boat.

**Tsunami Hazard Assessment**

**Hazard Identification**

A tsunami threat to Orange County is considered low to moderate**.**

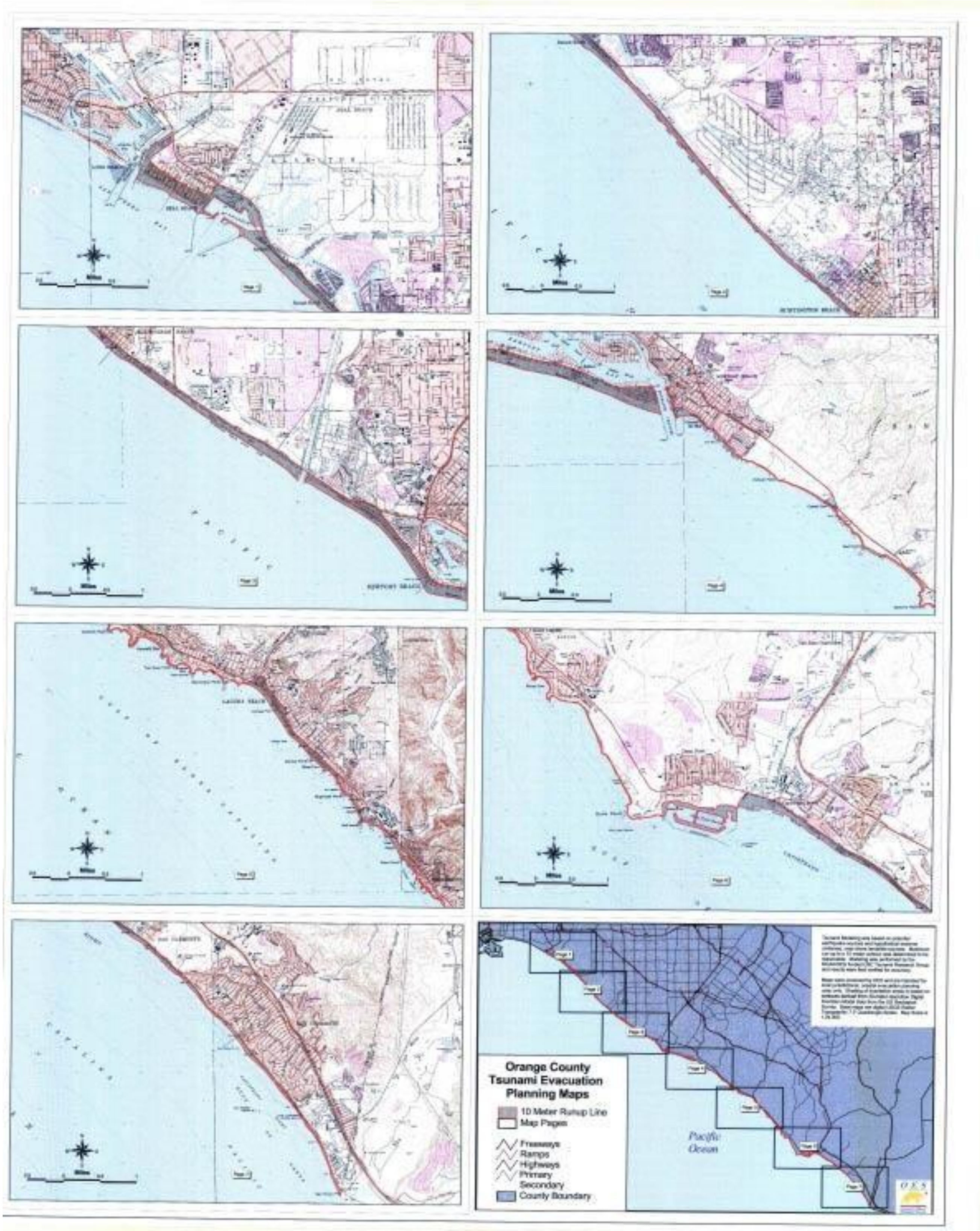
Damage factors of tsunamis:

Tsunamis cause damage in three ways: inundation, wave impact on structures, and erosion. Orange County has southwestern facing beaches that are vulnerable to tsunamis or tidal surges from the south and from the west.

Strong, tsunami-induced currents lead to the erosion of foundations and the collapse of bridges and sea walls. Flotation and drag forces move houses and overturn railroad cars. Considerable damage is caused by the resultant floating debris, including boats and cars that become dangerous projectiles that may crash into buildings, break power lines, and may start fires. Fires from damaged ships in ports or from ruptured coastal oil storage tanks and refinery facilities can cause damage greater than that inflicted directly by the tsunami. Of increasing concern is the potential effect of tsunami draw down, when receding waters uncover cooling water intakes of nuclear power plants.

Predicted wave heights, exclusive of tide and storm generated wave heights are:

| For a 100 year occurrence | For a 500 year occurrence |
|---|---|
| 4.0 feet minimum | 6.8 feet minimum |
| 6.6 feet average | 11.4 feet average |
| 9.2 feet maximum | 16.0 feet maximum |




☐ **Map 23 - Tsunami Run Up Map for Orange County**

### *Community Tsunami Issues*

**Susceptibility to Tsunami**

**Life and Property**

Based on the "local" history events of tsunamis we can conclude that approximately 16% of the County would be heavily impacted utilizing the Tsunami Run-up Maps. The largest impact on the community from a tsunami event is the loss of life and property.

Known risk areas include, but are not limited to:

- City, County and State Beaches.
- All buildings and apartments on the water side of Pacific Coast Highway (PCH).
- Vehicles and pedestrians on PCH in low lying areas.
- Buildings that are on the inland side of PCH facing the ocean.
- Harbor areas.
- Low lying areas adjacent to the coast.

The use of the Tsunami Warning, Watch, and Advisory Bulletins would provide time to allow coastal residents to evacuate and seek higher ground for shelter. This would greatly reduce injuries and loss of life.

**Residential**

Property along the coast could be devastated. A large tsunami could potentially destroy or damage hundreds of homes spreading debris for miles. Orange County is an affluent community, with a median housing price of $629,500 in 2015 with coastal properties worth millions (or tens of millions) of dollars.

**Commercial**

The coastline of Orange County is world famous. During summer months hundreds of thousands of people a day come into the community to stay in the beautiful hotels and shop at the unique boutiques. Local governments rely heavily on tourism and sales tax. A tsunami event would impact businesses by damaging property and by interrupting business and services.

**Infrastructure**

Tsunamis (and earthquakes) can damage buildings, power lines, and other property and infrastructure due to flooding. Tsunamis can result in collapsed or damaged buildings or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Damage to public water and sewer systems, transportation networks, and flood channels would greatly impact daily life for residents.

Roads blocked by objects during a tsunami may have severe consequences to people who are attempting to evacuate or who need emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric services and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from tsunamis related to both physical damages and interrupted services.

### *Existing Mitigation Activities*

Orange County has implemented a number of tsunami mitigation activities over the years. Some of the current mitigation programs include:

1. Public Information Plan for Emergency Alerting System (EAS).

2. Disaster Preparedness Public Education.

### *Vulnerability and Risk*

The 2009 Orange County Essential Facilities Risk Assessment project ran detailed models on a tsunami coastal flood hazard affecting Orange County. That data can be found in Attachment B – OCEFRA HAZUS Report. In addition, an updated assessment of the total tsunami threat is available in the Quantitative Exposure Analysis section at the end of this chapter.

County facilities with greatest exposure to tsunami hazards are affiliated with the three harbor areas maintained by County agencies. A land annexation by the City of Huntington Beach in 2011 greatly reduced the unincorporated county area's exposure to the tsunami threat.

## 3.7 Drought

Unlike most other natural hazards, drought is not a sudden, catastrophic occurrence. It is often referred to as a "creeping phenomenon" and its impacts vary from region to region. Drought can therefore be difficult for people to understand. Because drought can occur over several years, it is almost impossible to determine when a drought begins and ends. Many government agencies, the National Oceanic and Atmospheric Administration (NOAA) and the California Department of Water Resources, as well as academic institutions, such as the University of Nebraska-Lincoln's National Drought Mitigation Center, generally agree that there is no clear definition of drought. Drought is highly variable depending on what part of a state or the country one is situated. In the most general sense, drought originates from a deficiency of precipitation over an extended period of time--usually a season or more--resulting in a water shortage for some activity, group, or environmental sector. Its impacts result from the interplay between the natural event (less precipitation than expected) and the demand people place on water supply, and human activities can exacerbate the impacts of drought.

Droughts may be measured by a number of indicators, including:

- Levels of precipitation
- Soil conditions (moisture)
- Temperature

There are four ways in which droughts can be viewed:

**Meteorological** – a measure of departure of precipitation from normal. Due to climatic differences, what may be considered a drought in one location of the country might not be a drought in another location.

**Agricultural** – refers to a situation where the amount of moisture in the soil no longer meets the needs of a particular crop.

**Hydrologica**l – occurs when surface and subsurface water supplies are below normal.

**Annual Indicators** – the California Department of Water Resources uses three indicators to evaluate water conditions in California. These are Snowpack, Precipitation, and Reservoir Storage as percentages of the annual average.

### *Disaster History*

A significant drought, reported by many of the ranchers in southern California, occurred in 1860. The great drought of the 1930s, coined the "Dust Bowl," was geographically centered in the Great Plains yet ultimately caused water shortages in California. The drought conditions in the Plains resulted in a large influx of people to the West Coast. Approximately 350,000 people from Arkansas and Oklahoma immigrated mainly to the Great Valley of California. As more people moved into California, increases in intensive agriculture led to overuse of Santa Ana River watershed and groundwater resulting in regional water shortages.

Historically, California has experienced severe drought conditions. The approved 2013 State Hazard Mitigation Plan (SHMP) states that from 1972 to 2009, there have been eight drought-related State Emergency Proclamations in California. Through 2012, the California Office of Emergency Services administered costs due to drought totaling $2,686,858,480.

Beginning in 2009, California entered into another drought situation. Water years 2012 and 2013 were dry statewide, and the 2013 record-low precipitation has worsened California's conditions for the 2014 water year (started October of 2013). Statewide reservoir storage is down significantly and impacts of two (possibly three) dry years in a row has caused significant water delivery issues in California. In January 2014, a statewide Gubernatorial State of Emergency Proclamation was issued for the drought emergency and remains in effect until further notice. There are no indicators when this situation may improve, or if it will continue to worsen. Allocations for contractors of Department of Water Resources State Water Project (SWP) and the U.S. Bureau of Reclamation's (USBR's) Central Valley Project (CVP) are dependent upon snowpack accumulation in the Cascades and Sierra Nevada mountains. In April 2015, DWR announced an initial allocations lower than the SWP contractors' requested amounts. In Orange County, MWDOC has been subject to these decreased allocations. For more information on current drought conditions in California, visit: http://www.water.ca.gov/waterconditions/droughtinfo.cfm.

### *Regulatory Environment*

Several bills have been introduced into Congress in an effort to mitigate the effects of drought. In 1998, President Clinton signed into law the National Drought Policy Act, which called for the development of a national drought policy or framework that integrates actions and responsibilities among all levels of government. In addition it established the National Drought Policy Commission to provide advice and recommendations on the creation of an integrated federal policy. The most recent bill introduced into Congress was the National Drought Preparedness Act of 2003, which established a comprehensive national drought policy and statutorily authorized a lead federal utility for drought assistance. Currently there exists only an ad-hoc response approach to drought unlike other disasters (e.g., hurricanes, floods, and tornadoes) which are under the purview of FEMA.

The 2015 California Drought Contingency Plan was prepared in conjunction with the California Water Plan and both documents are updated every five years. The purpose of the plan is to minimize drought impacts by improving agency coordination, enhancing monitoring and early warning capabilities, conducting water shortage impact assessments, and implementing preparedness, response, and recovery programs. The California Water Plan presents strategic plan elements including a vision, mission, goals, guiding principles, and recommendations for current water conditions, challenges, and activities. The plan includes future uncertainties and climate change impacts, scenarios for 2050, and a roadmap for improving data and analytical tools.

Localized regulations for drought are mentioned in local municipal codes. The County of Orange, Code of Ordinances Section 3 provides the definition of a drought emergency. Section 7 defines use of water and landscaping during conservation times under the state model, and Article 1 outlines water conservation and the governance over well water use in Orange County.  All retail water utilities have drought ordinances that specify use of drinking water during the various phases of drought.

On a statewide basis, a number of regulatory requirements and documents address planning for drought in California, most notably the 2015 California Drought Contingency Plan.

### *Magnitude/Severity*

Drought severity depends on numerous factors, including duration, intensity, and geographic extent, as well as regional water supply demands by humans and vegetation. The severity of drought can be aggravated by other climatic factors, such as prolonged high winds and low relative humidity. The magnitude of drought is usually measured in time and the severity of the hydrologic deficit. Drought can also be further affected by environmental restrictions.

Drought is one of the few hazards that has the potential to directly or indirectly impact each and every person within Orange County, as well as adversely affect the local economy. The impacts would be water restrictions associated with domestic supplies, agricultural losses and economic impacts associated with those losses, economic impacts to tourism and recreation industries, hydroelectric power reductions, increased wildland firefighting costs, and increased costs for water. The magnitude of the drought’s impact will be directly related to the severity and length of the drought. Secondary effects include increased susceptibility to wildfires and pine beetle infestations which can weaken pine trees and make them more susceptible to drought conditions. Increased groundwater pumping during times of drought can contribute to land subsidence problems. However, the basins in Orange County are managed basins, restricting over-pumping and managing recharge operations.

Several resources are available to evaluate drought status and estimate future expected conditions. The National Integrated Drought Information System (NIDIS) Act of 2006 (Public Law 109-430) prescribes an interagency approach for drought monitoring, forecasting, and early warning. The NIDIS maintains the U.S. Drought Portal (www.drought.gov), a web-based access point to several drought related resources.

A number of indices measure how much precipitation for a given period has deviated from historically established norms.

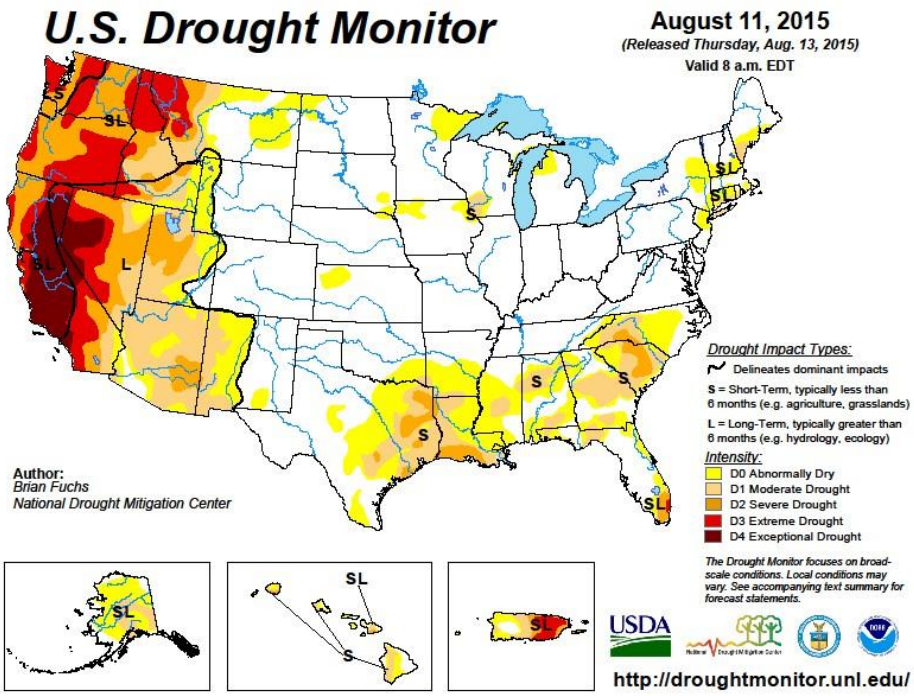
The primary indicator for the U.S. Drought Monitor and U.S Seasonal Drought Outlook for the western United States is the Palmer Drought Severity Index (PDSI). PDSI is a commonly used index that measures the severity of drought for agriculture and water resource management. It is calculated from observed temperature and precipitation values, and estimates soil moisture. While U.S. Department of Agriculture uses the PDSI to determine when to grant emergency drought assistance, it is not considered consistent enough to characterize the risk of drought on a nationwide basis (FEMA, 1997) nor is it well suited to the dry, mountainous areas in the western U.S.

For western states with mountainous terrain and complex regional microclimates, it is useful to supplement the PDSI values with other indices such as Surface Water Supply Index and Standardized Precipitation Index (SPI). The Surface Water Supply Index takes snowpack and other unique conditions into account. The National Drought Mitigation Center (NDMC) uses the SPI to identify emerging drought months sooner than the PDSI. It is computed on various time scales to monitor moisture supply conditions.

The SPI is the number of standard deviations that precipitation value would deviate from the long-term mean.

The Vegetation Drought Response Index, or VegDRI, is a bi-weekly depiction of vegetation stress across the contiguous United States. VegDRI is a fine resolution index based on remote sensing data, and incorporates climate and biophysical data to determine the cause of vegetation stress. Development of the VegDRI map and associated products is a joint effort by the NDMC, the USGS National Center for Earth Resources Observation and Science (EROS), and the High Plains Regional Climate Center (HPRCC).

The graphic below from the National Weather Service Prediction Center provides updates regarding the drought impacts both long and short term for the United States. As seen below, in 2015, majority of California, is in an extreme drought situation, and the County of Orange is no exception.




**Source: http://droughtmonitor.unl.edu/**

### *Vulnerability Assessment*

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to our ability to produce goods and provide services.

Impacts are commonly referred to as direct or indirect. Reduced crop, rangeland, and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in crop, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs. Direct or primary impacts are usually biophysical. Conceptually speaking, the more removed the impact from the cause, the more complex the link to the cause. In fact, the web of impacts becomes so diffuse that it is very difficult to come up with financial estimates of damages. The impacts of drought can be categorized as economic, environmental, or social.

Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in both crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and diseases to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.

Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a ripple effect. Retailers and others who provide goods and services to farmers face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue for local, state, and federal government. Less discretionary income affects the recreation and tourism industries. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in the need to import these goods from outside the stricken region.

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Social impacts mainly involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social components as well. Population out-migration is a significant problem in California's Central Valley, as agricultural jobs are reduced. Migration is usually to urban areas within the stressed area or to regions outside the drought area. However, when the drought has abated, these persons seldom return home, depriving agricultural areas of valuable human resources necessary for economic development. For the urban area to which they have immigrated, they place ever-increasing pressure on the social infrastructure, possibly leading to greater poverty and social unrest.

In the long-term, the County of Orange must continue to focus on mitigation actions to enhance local water storage, recycle water projects, increased water conservation programs, and looking at environmental erosion control projects without causing a significant economic disruption. Drought mitigation has a cascading effect and impact on other natural hazards including flooding and wildland fire.

Other economic losses occur for water utilities and small groundwater well owners. Income loss for water retail agencies can result in the need to increase water rates in order to cover fixed operational costs. As groundwater becomes unavailable, agencies or properties are required to drill deeper wells or identify alternate sources that are often more expensive and sometimes limited.  Some water utilities are having to adjust their treatment processes or supply based on availability, resulting in higher operating costs and, at times, damage to their filters over long periods of time.

## 3.8 Climate Change

According to the U.S. Environmental Protection Agency (EPA), Earth's average temperature has risen by 1.4°F over the past century, and is projected to rise another 2 to 11.5°F over the next hundred years. Small changes in the average temperature of the planet can result in large and potentially dangerous shifts in climate and weather.

With increases in temperature, Earth’s climate is changing. Snow and rainfall patterns are shifting, and more extreme climate events like heavy rainstorms and record high temperatures are already occurring. Scientists are highly confident that many of these observed changes can be linked to the climbing levels of carbon dioxide and other greenhouse gases in our atmosphere, which are caused by human activities.

Many places have seen changes in rainfall, resulting in more floods, droughts, or intense rain, as well as more frequent and severe heat waves. The planet's oceans and glaciers have also experienced some big changes - oceans are warming and becoming more acidic, ice caps are melting, and sea levels are rising. As these and other changes become more pronounced in the coming decades, they will likely present challenges to our society and our environment.

Data from National Oceanic and Atmospheric Administration (NOAA) shows increases in observed sea level rise around the United States and globally. Climate models provide data and projections using atmosphere-ocean general circulation models (GCM) that drive climate models. They are showing an increase in carbon dioxide concentrations where multiple GCMs have been run to project 21$^{st}$ century climate.

### ***Community Climate Change Issues***

**Water Supply & Demand**

Drinking water supply for Orange County is approximately half local and half imported. The Metropolitan Water District (MWD) of Southern California provides Orange County with its import water, which is obtained from the State Water Project (SWP) and from the Colorado River Aqueduct. Water from both sources is purified and tested at the Diemer Filtration Plant in Yorba Linda then piped to the various water districts in Orange County. The groundwater basin is recharged with recycled water, natural recharge, Santa Ana River base flows, and storm flow. According to data from the Orange County Water District (OCWD), the demand for groundwater has more than doubled in the last 60 years; however, basin storage must be managed within limits or risk adverse impacts.

Because of the importance of imported water supply to Orange County, potential impacts of climate change to water resources must be considered over a region broader than the Orange County area. Changes in observed climatic variables in this larger region representing the Western U.S. have been studied through data collected over the past 100 years. Within this period it has been observed, particularly in winter and spring, temperatures have risen significantly across western North America. Data collected over the past 50 years indicate warming in the mountainous western North America that has led to a higher rain-to-snow ratio, lower snow water content, a decline in March snow cover, and a shift toward earlier annual snowmelt. These observations strongly support the need for incorporating climate change into long-term water resources planning efforts.

An overall assessment of vulnerability to climate change for Orange County following a checklist presented in the DWR Climate Change Handbook for Regional Water Planning, and specifically recommended for climate change planning was performed and is available from Orange County Public Works. As noted, the major water supply system vulnerabilities are tied to the water supply system in California and the Colorado River Basin that are being evaluated through statewide or regional efforts.

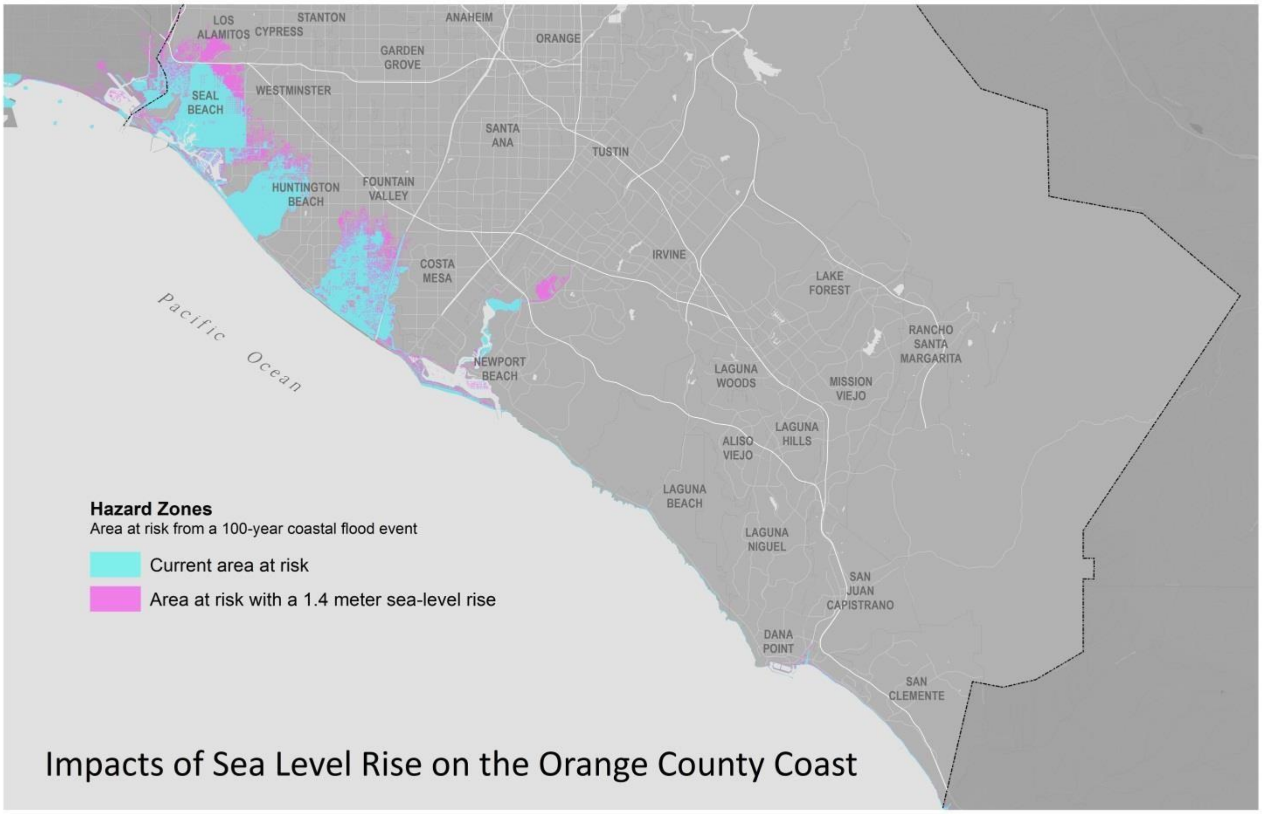
The best current understanding of climate change has been incorporated in the assessment of impacts, especially those relating to water supply and sea level rise. Several major planning studies have been performed for Orange County water supply regions that consider the impacts of climate change. Based on projected climate change conditions for the region, comprehensive analyses for both the California and the Colorado basins are severely water constrained indicating it will be challenging to meet current allocations in future years. The planning model projections indicate there will be years where deliveries will sometimes fall short of allocations, over planning horizons that range from 20 to 50 years into the future with assumptions that no changes are made to the existing operational infrastructure of the system. Population growth and anticipated increases in municipal demands must be addressed in the dual challenge of reduced supplies and increased demand. Looking forward, it is expected that these plans will be updated as better information on climate projections, including extreme events become available, and impacts to other sectors, such as water quality and habitats will be similarly evaluated.

**Sea Level Rise**

Although variable at different points along the coast due to regional factors, sea levels are rising globally due to climate warming including expansion of ocean water and melting of land ice. Along the Pacific Coast, the highest values of sea level rise in Southern California have been reported at Newport Beach near the study region, where the observed increase is 2.22 mm per year. These rates are projected to accelerate over the 21$^{st}$ century.

A recent review of different calculation approaches by the National Academy of Sciences reported estimated global sea level rise. This review also projected that sea level in Southern California, which is slightly higher than the global average because of land subsidence, and will be approximately (relative to year 2000) 2 to 12 inches by 2030, 5 to 24 inches by 2050 and 17 to 66 inches by 2100. Numerous studies have been done that will report different results as each are based on different methodologies. Future sea level rise estimates will vary based on future greenhouse gas emissions and projections.

Maps illustrating the effects of sea level have been developed for California to identify approximate vulnerable areas. An example is shown for Orange County in Map 24.




☐ **Map 24 - Impacts of Sea Level Rise on the California Coast-(Pacific Institute, 2009 (Projections still current as of 2015))**

Much of the damage from this accelerated sea level rise will be likely caused by an increase in the frequency and intensity of coastal flooding and erosion associated with extreme weather events and storm surges. In addition to sea-level rise, California's coastal and ocean resources are expected to experience dramatic changes. These include more severe atmospheric events (e.g. El Nino events); changes in ocean chemistry (e.g. temperature and pH) and estuarine chemistry (temperature, pH, and salinity); and changes to ecosystem processes (e.g. nutrient upwelling). The outlook and future of the coast is uncertain; however, we will need to change the way we manage our natural assets. Existing laws such as the California Coastal Act, provides state and local governments with tools for addressing the effects of climate change but also impose some significant limitations.

**Water Quality**

Less frequent but more intense rainfall patterns could have serious consequences on water quality at our beaches. Lower precipitation in summertime may also leave contaminants more concentrated in stream flows. Heavy runoff offers a medium for infectious disease vectors to spread and multiply. Large amounts of runoff could overwhelm the capacity of infrastructure including storm drains, flood control channels and pump stations.

**Flooding**

Past El Nino events have resulted in significant financial damages and exposed large numbers of people to flooding hazards. Flooding having a significant impact in the Canyon areas and along flood control channels also creates challenges for wastewater utilities as they receive increased flows in their systems. Climate change will likely exacerbate these impacts with larger waves and higher water levels. Coastal erosion and sediment transport patterns will be impacted by larger and longer duration of winter waves and increased exposure to tropical weather systems.

**Property**

The largest impact on the community from gradual sea water inundation is the loss of property, if plans are not made to mitigate for sea level rise and protection from storm surges and other flood related events. Known risk areas include, but are not limited to: City, county and state Beaches; buildings and other types of structures, in harbors and along the coastal inundation areas. In coastal areas where topography is relatively flat, the risk would include low-lying areas adjacent to but further away from the coast. As sea levels continue to rise, structures on the inland side of Pacific Coast Highway will be affected. Although sea level rise would be a gradual, planning and implementation would greatly reduce impacts to lives.

Orange County has many communities along its coastline with high to very high-priced homes. The results of sea level rise due to climate change could potentially destroy or damage thousands of homes and businesses over time resulting in displacement and relocation of people and businesses.

**Infrastructure**

Over time, if infrastructure is not relocated outside possible inundation areas, damage to roads, bridges, water infrastructure, power lines, vital equipment, and other property and facilities could occur due to flooding. Damage to public water and sewer systems, and transportation networks would greatly impact residents.

Consideration and planning for the protection of infrastructure will be very challenging as coastal Orange County is completely developed; however, there would be direct consequences to the local economy resulting from non-action to protect infrastructure.

**Services**

Planning considerations and efforts of local agencies and community entities whose facilities and offices are located within the possible inundation areas should include the possibility of relocation. While some time allows for planning, locations of public offices, schools, senior homes and emergency serviceshospitals, fire and police stations should all be studied.

**Ecosystem and Habitat Vulnerability**

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Environmental effects are likely to become permanent. Wildlife habitat, for example, may be degraded through the loss of their habitat; however, many species could relocate, survive and maybe recover adjusting to new environments, resulting in the entry of invasive species crowding out already stressed native species and the local appearance of tropical disease vectors. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Earth's oceans have maintained a relatively stable acidity level for tens of millions of years. But research shows that this balance is being undone by a recent and rapid drop in surface pH that could have devastating global consequences.

Since the early 1800s, fossil fuel-powered machines have driven human industry and advancement. Unfortunately the consequence has been the emission of billions of tons of carbon dioxide (CO2) and other greenhouse gases into Earth's atmosphere. Scientists know that about half of this man-made CO2 has been absorbed over time by the oceans. Relatively new research is finding that the introduction of massive amounts of CO2 into the seas is altering water chemistry and affecting the life cycles of many marine organisms, particularly those at the lower end of the food chain.

### *Mitigation Activities*

More detailed analysis of the effects of sea level rise in specific areas along the coastline is recommended. These analyses need to consider the dynamics of storm surges and the existing protective infrastructure. We also need to consider the occurrence of extreme precipitation events for planning emergency response.

A new set of projections are expected in 2013-14 (the fifth assessment) and may provide more current information for planners. Similarly, there is an ongoing effort to develop detailed dynamically downscaled climate projections for North America that may provide better information on future climate in the region.

Along with other counties in California, Orange County has been working with FEMA on remapping California Coastal areas through the CCAMP and FEMA Open Pacific Coast Study to complete coastal analysis to be included in the next version of the FEMA FIRM maps (“Flood Risk”). As mapping is a necessary step in assessing potential adverse conditions, Orange County needs to implement more climate change mitigation activities over the next few years. However, in bringing the subject to the forefront and to familiarize businesses and the general public, some of the mitigation activities could include:

1. Public information plan for sea level rise
2. Disaster preparedness public education for climate change
3. Estimates for the value of potential loss

### *Vulnerability and Risk*

Climate change has the possibility of producing impacts that span many sectors of the economy and reaches well beyond the area of experiencing physical sea level rise or long term temperature rise. The impacts would be complex and can be direct or indirect. A few examples of direct impacts are productivity from agriculture could decrease; fire hazard could increase; drinking water levels could decrease; wildlife mortality rates and damage to wildlife and fish habitat could increase. The consequences of these impacts may result in reduced income for businesses, increased prices for food and resources, unemployment, reduced tax revenues due to reduced expenditures, increased crime, foreclosures on bank loans to businesses, and migration. The web of impacts would be complex making it challenging to come up with financial estimates of damages. The impacts of climate change can be categorized as economic, environmental, or social.

Social impacts involve public safety, health, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social components as well. We could see migration out of the coastal areas where increasing pressure on the social infrastructure could result.

Municipalities will have to make decisions about which critical assets to protect, relocate, or remove and what is economically feasible. It will be challenging to achieve multiple goals such as protection of critical infrastructure, sustained coastal recreation, and ecosystem protection. Agencies need to recognize there could be conflicts and develop priorities while working with the regulatory agencies.

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## 3.9 Epidemic

Vaccines, antibiotics, and improved living conditions resulted in dramatic declines in communicable diseases in the latter part of the 20$^{th}$ Century. However, infectious diseases have become an increasing threat to all persons in Orange County over the past decades due to a variety of factors such as: population growth (crowding, aging, migration), methods of food production (large scale, wide distribution, importation), environmental changes (drought, encroachment of humans on wild areas, global warming), microbial adaptation (resistance to antibiotics, re-assortment of genetic material), changes in health care (drugs causing immunosuppression, widespread use of antibiotics), and human behavior (travel, diet, sexual behavior, compromised immune systems, immunization rates).

Orange County has programs within the Health Care Agency (HCA) that monitor the occurrence of communicable diseases and work to prevent their occurrence. Under California law, certain communicable diseases are required to be reported to local health departments. An on-call system utilizing Orange County Sheriff's Department (OCSD) Communications Control One allows urgent reports to be received 24 hours per day, 7 days a week. HCA staff investigates individual cases of reported communicable diseases and outbreaks, analyzes trends in disease occurrence, and makes recommendations to prevent spread. More information is available at http://ochealthinfo.com/phs/about/dcepi/.

Although transmission of communicable diseases occurs on a daily basis in every community, most instances are not of the severity or magnitude to be considered a county-wide hazard. However, an outbreak, epidemic, or pandemic, or the introduction of a novel disease, could pose a large threat to the health of the community. An **outbreak** is an increase, usually sudden, of occurrences of a particular disease over the baseline occurrence, for a specific time period and place. An **epidemic** is an outbreak that spreads quickly and widely through a given community or location over a relatively short period of time. A **pandemic** is a widespread outbreak or epidemic that spreads to other geographic areas, countries or continents.

Current epidemic threats include:

- Foodborne illness, including norovirus;
- Influenza, including seasonal, novel, and/or pandemic influenza strains;
- Childhood vaccine-preventable diseases, such as measles and pertussis;
- West Nile Virus and other vector-borne diseases;
- Emerging pathogens such as Middle East Respiratory Syndrome Coronavirus (MERS-CoV) or Ebola

### *General Public Health Response to an Outbreak/Epidemic*

Once an outbreak is suspected by HCA Public Health, an investigation is launched which includes the following steps:

1. Confirmation of the outbreak.
2. Investigation of the epidemic to determine its etiology, source, mode of transmission and persons affected and at risk.
3. Determining and recommending control measures to prevent further spread.
4. Health professional and public notification and education as needed.

Coordination of response to large outbreaks and epidemics is outlined in the HCA Emergency Operations Plan Disease Outbreak Response Annex and other supporting agency plans. In addition, HCA has developed policies and procedures for the use, implementation and enforcement of health officer orders for isolation and quarantine as part as the response to communicable diseases and outbreaks/epidemics. In the event of a vector-borne disease outbreak or emerging vector-borne disease, HCA collaborates with the Orange County Mosquito and Vector Control District (OCMVCD).

### *Foodborne Illness, including Norovirus*

The Centers for Disease Control and Prevention (CDC) estimates that every year approximately one (1) in 6 Americans (or 48 million people) gets sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases in the United States. Extrapolated to the Orange County population, that would suggest approximately 500,000 people get sick with foodborne illness each year. Examples of reportable infections that may potentially be food-borne include bacteria such as *Salmonella, Campylobacter,* and shiga-toxin producing *Escherichia coli* (STEC). In Orange County, on average approximately 400 cases of *Salmonella,* 400 *Campylobacter*, and 40 STEC are reported each year. Not all foodborne illness is reportable and even the diseases that are reportable are under-reported and under-diagnosed. We do not have exact numbers of how many people are affected.

In general, foodborne illnesses cause symptoms such as diarrhea, vomiting, and/or abdominal cramps. Some people may also have fever. Complications of foodborne illnesses include dehydration, and spread of the infection to the blood or other parts of the body, especially if a bacteria is involved.

Foodborne illnesses can result from exposure to contaminated food prepared at home or at a restaurant or market, from contaminated food sources and/or human error in preparation or storage. Each year, the Orange County HCA receives 800-1,000 reports of foodborne illness, and investigates 20-40 foodborne outbreaks. Most foodborne illnesses can be prevented with proper handling and preparation of food and avoiding having ill persons handle and serve food.

**Mitigation Measures for Foodborne Illness**

To mitigate the hazard of foodborne illness, HCA conducts the following activities:

- Operation of a Foodborne Illness Hotline to receive reports of foodborne illness from the public.
- Receipt and review of all communicable disease reports.
- Outreach and education of local medical providers and healthcare facilities about the importance of timely reporting of reportable diseases and potential outbreaks.
- Prompt review and assessment of all reported disease events that could be associated with foodborne illness outbreaks.
- Investigation of potential foodborne illness to determine the source and decrease transmission.
- Laboratory testing to identify specific pathogens and determine if individual infection reports are linked to a community outbreak.
- Conducting *Risk-Based Inspections* that focus on the five identified CDC risk-based factors that are mostly identified in foodborne illness outbreaks (based on FDA 1998-2008 study). This includes regular audits of inspectors to ensure their focus during routine inspections remains on the major risk factors.
- Utilization of the Food and Drug Administration's Oral Culture Learning format to better communicate food safety measures for non-traditional written base cultures, such as the Hispanic culture. These training guides utilize stories or pictures to better communicate food safety practices.

- Provision of routine trainings relative to foodborne illness investigations through town hall meetings and an annual Council to Improve Foodborne Outbreak Response (CIFOR) training for all field inspectors to focus their attention on preventing or eliminating CDC Risk Factor violations.
- Provision of written and web-based materials to educate food workers to stay home when ill.
- Implementation of restaurant education programs that address education about food handling and staying home when ill.
- Collaboration with the Orange County Department of Education to provide safe food handling information to children.
- Coordination with HCA and community partners to distribute educational materials about safe food handling.

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### *Influenza, including Seasonal, Novel, and/or Pandemic Influenza Strains*

Influenza is a contagious respiratory illness caused by influenza viruses. Although many illnesses are selflimited and mild, complications of seasonal influenza cause on average more than 200,000 hospitalizations and up to 49,000 deaths each year in the United States. In Orange County, severe influenza cases (defined as persons who have influenza and are admitted to the intensive care unit or die) in persons less than 65 years of age are reportable. Since 2010 (not including the H1N1 pandemic year), Orange County has had up to 57 severe influenza cases, with 21 deaths, in one season during the annual epidemic period.

A pandemic occurs when a new (novel) virus that humans have not encountered before, and therefore have no immunity to, begins circulating, causes infections and spreads quickly from person to person, causing substantial morbidity and mortality across geographic areas. Orange County HCA routinely does surveillance for seasonal influenza as well as enhanced surveillance for novel strains and human infections with bird (avian) or pig (swine) influenza strains that are circulating in other parts of the country and the world.

In 2009, an H1N1 influenza pandemic spread quickly and led to over 200 severe influenza cases and 50 deaths in Orange County. The 2009 H1N1 influenza virus quickly established itself as a seasonal influenza strain and was the predominant virus in the 2013-2014 influenza season. Although the mortality rate from H1N1 Influenza during this pandemic was low, other strains may cause more severe illness with case fatality rates over 3%.

An influenza pandemic is likely to occur in "waves" of infection, each lasting approximately 8 to 12 weeks and separated by weeks of inactivity. In total, it could last from 18 months to several years. An influenza pandemic is likely to affect everyone in Orange County at some point and can greatly impact "business as usual" in any sector of society or government. A pandemic will place a great strain on existing health care resources and may exceed available resources. Personnel, supplies, equipment, and pharmaceutical responses (e.g., vaccination and antivirals) may be in short supply and/or unavailable. If transportation is compromised in the region or country, food and other essentials may be unavailable as well. Outbreaks are expected to occur simultaneously throughout much of the County and the State, which may limit the availability of mutual aid assistance and resources from other areas.

**Mitigation Measures for Influenza (including Seasonal, Novel, and/or Pandemic Influenza Strains)**

To mitigate the hazard of seasonal, novel and/or pandemic influenza, HCA conducts the following activities:

- Maintenance of routine influenza surveillance and a network of sentinel outpatient care providers.
- Investigation and reporting of severe influenza cases (defined above).
- Education of health care providers and the public about the importance of annual influenza vaccination and prompt treatment of suspect influenza cases at high risk for complications with antiviral medication
- Laboratory testing to identify circulating viruses causing influenza-like illness, and monitor influenza strains
- Investigation of outbreaks of respiratory illness in the community and institutional settings.
- Provision of publicly funded influenza vaccine through HCA clinics and community partners.
- Annual exercising of mass vaccination clinics (Point of Dispensing [POD] sites) using influenza vaccine.
- Maintenance of an *Eye on Influenza* newsletter and distribution list to provide influenza updates to healthcare and community partners.
- Maintenance of current information on the HCA website and issuing of press releases as needed with important updates.
- Collaboration with school nurses, local medical societies and other community healthcare partners as well as emergency management to provide uniform up-to-date recommendations and messaging to the public.
- Enhanced surveillance for novel or pandemic influenza strains using Centers for Disease Control and Prevention (CDC) and California Department of Public Health (CDPH) guidelines to support early detection.
- Utilization of health officer orders for isolation and quarantine as needed early in a pandemic or after introduction of a novel influenza strain to limit further spread in the community.

- Provision of recommendations for infection control, treatment, prophylaxis, and nonpharmaceutical community mitigation measures such as strict adherence to respiratory hygiene and cough etiquette, hand washing, self-isolation, and social distancing.

### *Childhood Vaccine-Preventable Diseases, such as Measles and Pertussis*

Before the middle of the last century, life-threatening diseases such as *Haemophilus influenzae*, diphtheria, polio, measles and rubella affected hundreds of thousands of infants, children, and adults in the United States, with thousands dying every year. Since the advent and widespread use of vaccines, these diseases have declined dramatically and nationally, vaccine-preventable disease levels are at or near record lows. Vaccinations for chickenpox, diphtheria, *Haemophilus influenzae* type B, hepatitis A, hepatitis B, influenza, measles, mumps, pertussis, polio, pneumococcus, rotavirus, and rubella are now routinely available for infants and children. However, this is not the case throughout the world and outbreaks of diseases such as polio and measles still occur regularly. Even though most children in the U.S. have received the recommended vaccines by age 2 years, many under-immunized children remain, leaving the community vulnerable to outbreaks of these diseases. The California Department of Public Health compiles data annually on immunization rates at kindergarten entry by school and makes it available on an interactive website (http://www.shotsforschool.org/k-12/how-doing/). For Orange County-specific data on vaccination rates for the MMR (measles, mumps, rubella) vaccine by school district, see https://media.ocgov.com/civicax/filebank/blobdload.aspx?BlobID=41625.

**Measles –** Measles is one of the most contagious of all infectious diseases with over 90% of exposed people developing infection if they are not already immune, either by previous infection or immunization. In the pre-vaccination era, there were on average over 500,000 cases in the U.S. and almost 500 deaths reported annually. Cases dropped dramatically after vaccination against measles was introduced in the 1960’s and a second dose of vaccine was routinely recommended in 1989. In 2000, measles was declared eliminated in the U.S., meaning there was no ongoing transmission, but cases and outbreaks continue to occur from visitors or returning travelers from countries were measles is still common introducing the virus into unvaccinated or under-vaccinated communities. In the U.S. there have been between 37 to 644 cases of measles reported each year, with multiple outbreaks reported in 2013, 2014, and now 2015. In Orange County, 0-1 cases of measles were reported annually between 2010 and 2013, but large outbreaks resulted in 23 cases reported in 2014, and 35 cases reported in the first few months of 2015.

**Pertussis –** Pertussis (whooping cough) is a highly contagious respiratory infection caused by a bacteria *Bordetella pertussis*. Although symptoms may be mild and resemble an ordinary “cold” in some people, the infection may become more serious, particularly in infants, and cause hospitalizations and even death. Infections in the U.S. decreased dramatically with the advent of the whole-cell DTP (diphtheria, tetanus, pertussis) vaccine in the 1940’s, but have increased over the past 20-30 years, partially because of increased awareness, improved testing, better reporting, and waning immunity from the acellular pertussis vaccine (DTaP) used since the 1990’s. California has had particularly large outbreaks since 2010 with numbers as high as those in the 1940’s. Over 9,000 pertussis cases and 10 infant deaths were reported with disease onset in 2010 and over 11,000 cases and 3 infant deaths were reported with disease onset in 2014. In Orange County, 467 pertussis cases were reported in 2010 and 397 in 2014.

**Mitigation Measures for Childhood Vaccine-Preventable Diseases, such as Measles and Pertussis**

To mitigate the hazard of childhood vaccine-preventable diseases in Orange County, HCA conducts the following activities:

- Case investigation and contact tracing to monitor incidence of diseases and limit further transmission in the community.
- Maintenance of adequate vaccine supply for publicly funded vaccine and outbreak response.
- Coordination of Vaccines for Children (VFC) vaccine supply and distribution through the Immunization Action Program.
- Collaboration with multiple community partners to educate the public and healthcare about the importance of vaccination ○ Coordination of Orange County Immunization Coalition, with monthly meetings and a newsletter
    - Quarterly attendance at school nurse meetings to provide immunization updates ○ Provision of immunization updates in the local American Academy of Pediatrics newsletter and at the Orange County Medical Association meetings
    - Outreach to California Health and Disability Prevention (CHDP) providers ○ Participation in community forums
    - Outreach to obstetricians, perinatal service providers and pharmacist associations to improve vaccination rates in pregnant women—especially for pertussis and influenza.
- Collaboration with community-based organizations to address low vaccination rates ○ Orange County Children's partnership ○ Social Services Agency ○ Children's and Families Commission
- Publication of an annual Conditions of Children report summarizing immunization rates and mapping State data on immunization rates of incoming kindergarteners by school district.
- Maintenance of current information on the HCA website, including links to the Immunization Action Coalition and Shots for Schools website, and issuing of press releases as needed with vaccinepreventable disease instances in the community prompting immunization reminders.

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### *Emerging Pathogens such as Middle East Respiratory Syndrome Coronavirus (MERS-CoV) or Ebola*

With advances in travel, diseases can quickly spread throughout the world. Orange County with its diverse population and large tourism industry is particularly at risk for importation of diseases that may previously have been localized to other countries or continents. These diseases pose a significant hazard if they are highly transmissible from person to person and if they have significant morbidity or mortality. In the past decade, we have prepared to respond to multiple such diseases such as Severe Acute Respiratory Syndrome (SARS), avian influenza H5N1, MERS-CoV and Ebola. Although these diseases may have different modes of transmission, symptoms, and natural history, the approach to handling the threat of an emerging or novel communicable disease is similar.

**Mitigation Measures for Emerging Pathogens such as Middle East Respiratory Syndrome Coronavirus (MERS-CoV) or Ebola**

To mitigate the hazard of emerging or novel pathogens in Orange County, HCA conducts the following activities:

- Maintenance of a network of sentinel outpatient care providers for surveillance.
- Enhanced surveillance for emerging or novel pathogens using CDC and CDPH guidelines to support early detection.
- Investigation of suspect cases meeting surveillance criteria and confirmation through laboratory testing.
- Contact tracing and monitoring to limit transmission in the community.
- Utilization of health officer orders for isolation and quarantine as needed to limit transmission in the community.
- Education of health care providers and the public about the signs and symptoms of the disease, risk factors, treatment and prevention.
- Maintenance of a newsletter and alert distribution list to provide updates to healthcare and community partners.
- Maintenance of current information on the HCA website and issuing of press releases as needed with important updates.
- Collaboration with school nurses, local medical societies and other community healthcare partners as well as emergency management to provide uniform up-to-date recommendations and messaging to the public.

### *Vector-Borne Diseases*

According to the Centers for Disease Control and Prevention (CDC), vector-borne diseases are among the most complex of all infectious diseases to prevent and control due to the difficulty of predicting habits of vectors like mosquitoes, fleas, and ticks. These vectors transmit viruses, bacteria, or other pathogens that infect animals as well as humans. For example, West Nile virus, which is primarily a disease of birds, can be transmitted to humans and other animals by the bite of a mosquito and has been responsible for causing 532 reported infections, including 18 deaths, in Orange County since its introduction to the county in 2004.

The Orange County Mosquito and Vector Control District (OCMVCD) is an independent special district charged with protecting the citizens of Orange County from vectors and vector-borne disease under the California Health and Safety Code (CAL. HSC. § 2000-2910). OCMVCD operates year-round to provide service to all 34 cities within Orange County as well as unincorporated areas, federal, and state lands.

OCMVCD utilizes an Integrated Vector Management (IVM) Program strategy to control populations of mosquitoes, filth flies and black flies, red imported fire ants (RIFA), and rats. The IVM Program consists of the following activities:

1) Surveillance for vectors, vector habitats, and associated pathogens/diseases, including field and laboratory analysis of vectors in order to evaluate populations and emerging disease threats;

2) Source reduction to limit breeding by vectors, including management of vegetation, land, and water with appropriate landowners to minimize vector production and harborage;

3) Education and outreach efforts targeted toward the public and private landowners in ways to facilitate source reduction and minimize disease-carrying vectors;

4) Distribution of mosquito fish (*Gambusia affinis*), a biological control measure used to reduce mosquito production in isolated aquatic features, such as neglected residential swimming pools; and

5) Application of pesticides to minimize vector populations and reduce the threat of potential vector-borne disease transmission to humans.

The vector-borne diseases currently of major public health threat in Orange County include:

- West Nile Virus and other mosquito-borne infections;
- Flea-borne typhus and other flea-borne infections;
- Other vector-borne diseases with the potential to emerge or re-emerge in Orange County.

### *West Nile Virus (WNV) and other Mosquito-Borne Infections*

**West Nile Virus -** West Nile virus was first detected in Orange County in 2003. This virus is spread by mosquitoes and has become well-established in Orange County since its introduction. Epidemics of West Nile virus infections are expected every year. Although only a small proportion of persons infected develop symptoms, which can include fever, body aches, headaches, and/or rash, infection can also be very severe, resulting in meningitis or encephalitis (inflammation of the brain) and serious sequelae. HCA works closely with the OCMVCD to monitor the presence of the virus in the County.

**Other mosquito-borne diseases potentially transmitted by locally abundant Orange County mosquitoes include Saint Louis Encephalitis (SLE), Western equine encephalitis (WEE), and malaria.** Although SLE was considered the most important mosquito-borne virus in North America until the arrival of WNV in 1999, SLE virus activity has not been detected in Orange County since the introduction of WNV into the County in late 2003. WEE was a significant cause of death and disease in humans and horses in the United States prior to the establishment of organized vector control programs in the late 1940s. However, WEE has not been detected in mosquitoes, or host animals such as birds in Orange County in many years and is unlikely to pose a threat in the future. Malaria is a serious infection caused by a parasite called

Plasmodium. Although malaria is thought to be eradicated in the United States, imported malaria cases among travelers returning home have the potential to spark a reintroduced of locally-transmitted malaria among the

County's *Anopheles* mosquitoes, which are largely restricted to wetland habitats in Orange County. The last confirmed outbreak of locally transmitted malaria in Southern California occurred in 1991 along the San Diego County/Orange County border. HCA works closely with the OCMVCD to monitor the presence of imported cases of malaria in the County.

**Mosquito-borne diseases transmitted by Aedes mosquitoes not currently known to be present in Orange County but in other areas of California include dengue and chikungunya.** With recent introductions of several species of non-native mosquitoes from the genus *Aedes* in southern California, including the Asian tiger mosquito (*Aedes albopictus*) and the yellow fever mosquito (*Aedes aegypti*), there is potential for diseases like chikungunya and dengue to become established in Orange County. In 2015, *Aedes aegypti* was detected in Anaheim and believed to be locally eradicated. *Aedes albopictus* has been collected several times in Orange County following small, focal introductions in 2001 and 2004 and successfully eradicated. These mosquitoes are known vectors of dengue and chikungunya viruses. Although local transmission of these viruses is not known from Orange County, human cases of dengue and chikungunya are regularly reported to HCA from travelers returning from known endemic disease areas. Therefore, traveling humans infected with the virus could spread the disease once in areas of Orange County with established populations of these mosquitoes.

- **Dengue** –The World Health Organization reports that dengue is the most rapidly spreading mosquito-borne viral disease in the world. Dengue is transmitted by the bite of a mosquito infected with one of the four dengue virus serotypes. Unlike other mosquitoes, *Aedes aegypti*, the main vector for dengue, bites during the day. *Aedes albopictus*, a secondary dengue vector, can survive in cooler temperate regions. Similar to chikungunya, dengue would likely enter Orange County via an infectious person returning from an area of the world where these diseases are endemic. Symptoms of dengue include fever, severe headache, pain behind the eyes, muscle and joint pain, swollen glands and rash. There is no vaccine or any specific medicine to treat dengue. The only method to reduce the transmission of dengue virus is to control vector mosquitoes and protect against mosquitoes bites. HCA works closely with the OCMVCD to monitor the presence of imported cases of dengue of in the County.
- **Chikungunya** - Chikungunya is a viral tropical disease transmitted by *Aedes* mosquitoes. In recent years the virus has been regularly detected in parts of Mexico and the Caribbean. Typical symptoms are an acute illness with fever, skin rash and incapacitating joint pains that can last for weeks. The latter distinguishes chikungunya virus from dengue, which otherwise shares the same vectors, symptoms and geographical distribution. Most patients recover fully but, in some cases, joint pain may persist for several months or even years. The spread of disease via movement of infected humans is specifically relevant for a pathogen such as chikungunya virus. As with dengue, the only method to reduce transmission of chikungunya is to control vector mosquitoes and protect against mosquitoes bites. HCA works closely with the OCMVCD to monitor the presence of imported cases of chikungunya in the County.

**Mitigation Measures for Mosquito-Borne Diseases**

To mitigate the hazard of West Nile virus and other mosquito-borne diseases, HCA conducts the following activities:

- Case investigation and collaboration with OCMVCD about potential areas of mosquito exposure.
- Laboratory testing for confirmation of suspect cases especially early in the season.
- Education of health care providers and the public about the signs and symptoms of the disease, testing, risk factors, treatment and prevention.
- Maintenance of a newsletter and alert distribution list to provide updates to healthcare and community partners.
- Maintenance of current information on the HCA website and issuing of press releases as needed with important updates.
- Education of persons with recently acquired dengue or chikungunya infections to avoid mosquito exposure for the seven days after symptom onset.

To mitigate the hazard of West Nile virus and other mosquito-borne diseases, OCMVCD conducts the following activities:

- Extensive larval and adult mosquito control activities throughout Orange County to suppress mosquito populations.
- Education and outreach to the public on source reduction (elimination of vector breeding sources and vector favorable conditions) and personal protection measures.
- Conduct mosquito exposure investigations of WNV human cases.
- Provision of training and consultation to private firms, municipal staff, and other interests to reduce and eliminate vector breeding sources.
- Coordination with regional vector control districts to respond quickly to the detection of new invasive mosquito species and diseases.
- Provision of education materials in multiple languages to the public.
- Coordination with OCMVCD public health, municipal, and community partners in the event of a mosquito-borne disease outbreak or epidemic

Since the detection of mosquitoes carrying human pathogens may result in area-wide application of pesticides by truck or aircraft, OCMVCD will work closely with HCA and the County Agricultural Commissioner for application notification.

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### *Flea-Borne Diseases*

**Flea-borne typhus -** Orange County has experienced a resurgence of flea-borne typhus over the last ten years. Since 2006, 132 human cases have been reported to HCA. Flea-borne typhus is a bacterial (rickettsial) infection transmitted by fleas found on backyard wildlife and domestic pets. The transmission cycle in Orange County involves cat fleas, cats, opossums, and other backyard wildlife. Symptoms include fever, muscle aches, rash, and sometimes vomiting and headache. Approximately 85% of cases reported to HCA are hospitalized. HCA works closely with Orange County Mosquito and Vector Control District to investigate exposure sites with large populations of fleas and host animals. Flea-borne typhus exposure sites with large populations of host animals may be referred to local animal care agencies for assistance.

**Plague -** Plague is a zoonotic disease caused by the bacterium *Yersinia pestis*. In its sylvatic cycle, it is transmitted by fleas found on locally abundant ground squirrels, rodents and rabbits. Humans usually get plague after being bitten by a rodent flea that is carrying the plague bacterium or by handling an animal infected with plague. Most persons with plague develop fever and swollen lymph nodes. Plague bacteria can also migrate to the lungs causing a pneumonic presentation where respiratory droplets may serve as the source of person-to-person transfer that can lead to localized outbreaks or devastating epidemics. According to CDPH, plague is rare among humans but is found each year among squirrels, chipmunks, and other rodents in California and the southwestern U.S. Plague epizootics can be detected by large die-offs of naturally infected hosts such as rabbits and ground squirrels. Domestic cats are also susceptible to plague and can pass the infection to their owners.

The California Department of Public Health (CDPH) Vector-Borne Disease Section lists the Santa Ana Mountains as a plague endemic area. Plague has occurred in Orange County sporadically, including instances in ground squirrels during 1982 in the Anaheim Hills and in a roof rat from the City of Orange in 1998. Pneumonic plague transmission last occurred along the Orange County and Los Angeles County border in 1988 and involved a pet cat. HCA works closely with the OCMVCD to monitor the presence of plague in the County.

**Mitigation Measures for Flea-Borne Diseases**

To mitigate the hazard of flea-borne typhus and other flea-borne diseases, HCA conducts the following activities:

- Case investigation and collaboration with OCMVCD about potential areas of exposure.
- Laboratory testing for confirmation of suspect cases.
- Education of health care providers and the public about the signs and symptoms of the disease, testing, risk factors, treatment and prevention.
- Maintenance of a newsletter and alert distribution list to provide updates to healthcare and community partners.

- Maintenance of current information on the HCA website and issuing of press releases as needed with important updates.

To mitigate the hazard of flea-borne typhus and other flea-borne diseases, OCMVCD conducts the following activities:

- Routine monitoring of fleas and host animals for the presence of flea-borne typhus and plague.  Inspection of potential exposure sites for the presence of fleas and host animals  Investigation of animal die-offs in Orange County.
- In collaboration with the Orange County Agricultural Commissioner and CDPH, application of pesticides to control fleas.
- Education and outreach to the public on source reduction (elimination of vector breeding sources and vector favorable conditions) and personal protection measures.
- Conduct vector investigations surrounding human cases.
- Provision of training and consultation to private firms, municipal staff, and other interests to reduce and eliminate vector breeding sources.
- Coordination with OCMVCD partners.
- Provision of education materials in multiple languages to the public.
- Coordination with OCMVCD public health, municipal, and community partners in the event of an epidemic.
- Coordination with local animal care agencies in the event of a flea-borne typhus outbreak or epidemic.

**References**

California Department of Public Health (CDPH). *Plague*. State of California 2015. Web (http://www.cdph.ca.gov/HealthInfo/discond/Pages/Plague.aspx). 9 July 2015.

### *Other Vector-Borne Diseases*

Although less prevalent than West Nile virus and flea-borne typhus, other vector-borne diseases have the potential to re-emerge or emerge in Orange County should environmental conditions change or new competent vector species successfully become established. These diseases are not considered a major health hazard in Orange County at this time, but include tick-borne diseases such as Lyme disease, Pacific Coast tick fever, and tularemia, and rodent-borne diseases such as Hantavirus. OCMVCD is constantly monitoring local vector populations in order to detect the presence of these diseases and mitigate the potential for these hazards.

## Vulnerability Assessment

| |
|---|
| **Requirement §201.6(c)(2)(ii):** [The risk assessment **shall** include a] description of the jurisdiction's vulnerability to the hazards described in paragraph (c)(2)(i) of this section. This description **shall** include an overall summary of each hazard and its impact on the community. |

### Estimating Potential Losses

The FEMA HAZUS program was used to estimate losses due to the following potential hazards in Orange County: earthquake, flood, and tsunami. Thanks to a FEMA sponsored pilot project called the Orange County Essential Facilities Risk Assessment project, enhanced data was collected and utilized to run improved HAZUS loss estimation modeling. The results of these models are described in the 2009 HAZUS report attachment.

For other hazards, what data and maps that were available are used to demonstrate the vulnerability of that hazard to the surrounding communities. For more information, see the Exposure Analysis section below.

### Analyzing Development Trends

Development trends are included in Chapter 2 of this Hazard Mitigation Plan under Land Use and Formation and Development of Orange County, including a Zoning Map.

### Identifying Structures

Using an inventory list provided by the County Executive Office, Office of Risk Management the Hazard Mitigation Task Force has identified County owned or leased properties and buildings (See Attachment C). The list includes the property or building name, address, city or county, operating organization, year built, gross area, real and personal property value, and any pertinent notes on the property/building. Included in these figures are critical facilities since the County maintains numerous critical facilities vital to the safety and operation of the county area.

Current data indicates that Orange County owns or leases 698 properties or buildings with an estimated replacement value of $2,520,347,802. The County‘s property insurance schedule was used to provide values for real property (building). Maintaining the County‘s property inventory is an ongoing process and the County is continuously working on updates and improvements with the involvement of multiple County agencies. A current updated list is maintained by the County Executive Office, Office of Risk Management.

### Quantitative Exposure Analysis

Based on data availability, a quantitative exposure analysis is possible most hazards. The County parcel layer, as well as County of Orange and OCFA property inventories were used to assess the potential impact of flood events, wildfires, landslides, tsunami, the failure of Prado Dam, and an earthquake on the San Andreas Fault defined by the USGS ShakeOut scenario. Census blocks from the 2010 Census were used to approximate exposed population estimated. The tables below display the results of these assessments. Not included in these assessments are drought, climate change and epidemic, as their spatial and quantitative components are considerably more difficult to model and analyze, based on available data. For these hazards, the vulnerability assessments are more qualitative in nature. As additional information becomes available, the County of Orange and the Orange County Fire Authority hope to expand exposure analysis and assessment efforts.

☐ **Table 3 – Vulnerability Analysis for Unincorporated Orange County**

| Hazard Type | Exposed Population Estimate (2010) | Number of Residential Parcels | Number of Commercial/Industrial Parcels | Number of County Properties | Potential Exposure for County Properties |
|---|---|---|---|---|---|
| **Prado Dam Inundation*** | 20,812 | 7,228 | 162 | 195 | $1,369,667,342 |
| **Landslide**** | 29,118 | 6,748 | 163 | 11 | $1,993,082 |
| **100 Year Flood Event** | 10,723 | 713 | 58 | 79 | $14,967,640 |
| **500 Year Flood Event** | 31,299 | 9,043 | 175 | 218 | $1,948,211,714 |
| **Wildland Fire (Very High Hazard Area)** | 40,805 | 15,354 | 230 | 181 | $34,819,674 |
| **7.8 Earthquake on San Andreas Fault ("ShakeOut" Scenario)***** | 52042 | 22118 | 453 | 477 | $2,311,481,267 |
| **Tsunami** | 0 | 62 | 2 | 70 | $101,127,067 |

*Based on digitizing of inundation area from print USACE maps prepared in 1985. USACE does not provide inundation maps to local emergency planners due to terrorism fears.

**Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

*** Based on exposure to ground movement equivalent to an MMI rating of VI or greater.

**☐ Table 4 – Vulnerability Analysis for OCFA Facilities**

| Hazard Type | Exposed OCFA Facilities | Potential Exposure for OCFA Properties |
|---|---|---|
| **Prado Dam Inundation*** | 21 | $37,161,200 |
| **Landslide**** | 3 | $5,848,100 |
| **100 Year Flood Event** | 3 | $2,223,800 |
| **500 Year Flood Event** | 19 | $38,516,400 |
| **Wildland Fire (Very High Hazard Area)** | 10 | $15,839,050 |
| **7.8 Earthquake on San Andreas Fault ("ShakeOut" Scenario)***** | 43 | $138,701,150 |

| | | |
|---|---|---|
| **Tsunami** | 1 | $795,000 |

*Based on digitizing of inundation area from georeferenced print USACE maps prepared in 1985. USACE does not provide inundation maps to local emergency planners due to terrorism fears.

**Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.
*** Based on exposure to ground movement equivalent to an MMI rating of VI or greater.

# Chapter 4 Hazard Mitigation Strategy

***Requirement §201.6(c)(3):*** *[The hazard mitigation strategy* ***shall*** *include a] mitigation strategy that provides the jurisdiction's blueprint for reducing the potential losses identified in the risk assessment, based on existing authorities, policies, programs and resources, and its ability to expand on and improve these existing tools.*

## Multi-Hazard Goals and Action Items

Hazard mitigation strategies can reduce the impacts concentrated at large employment and industrial centers, public infrastructure, and critical facilities. This section provides information on the process used to develop the mitigation strategy, based on goals and action items that pertain to the hazards addressed in this mitigation plan. It also describes the framework that focuses the plan on developing successful mitigation strategies.

***Requirement §201.6(c)(3)(i):*** *[The hazard mitigation strategy* ***shall*** *include a] description of mitigation goals to reduce or avoid long-term vulnerabilities to the identified hazards.*

The plan goals describe the overall direction that Orange County agencies, organizations, and residents can take to minimize the impacts of natural hazards. The goals serve as stepping-stones between the broad direction of the mission statement and the specific recommendations outlined in the action items and help to guide direction of future activities aimed at reducing risk and preventing loss from natural hazards. The goals listed here serve as checkpoints as agencies and organizations begin implementing mitigation action items. For the 2015 revision, the Hazard Mitigation Planning task force reviewed these goals and reaffirmed they reflect the intended direction of hazard mitigation planning for the County of Orange.

-  **Protect Life and Property**
    - Implement activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to natural hazards.
    - Reduce losses and repetitive damage for chronic hazard events, while promoting insurance coverage for catastrophic hazards.
    - Improve hazard assessment information to make recommendations for discouraging new development and encouraging preventative measures for existing development in areas vulnerable to natural hazards.
-  **Public Awareness**
    ○ Develop and implement education and outreach programs to increase public awareness of the risks associated with natural hazards. ○ Provide information on tools, partnership opportunities, and funding resources to assist in implementing mitigation activities.
- **Natural Systems** ○ Balance watershed planning, natural resource management, and land use planning with natural hazard mitigation to protect life, property, and the environment.

  - Preserve, rehabilitate, and enhance natural systems to serve natural hazard mitigation functions.
- **Partnerships and Implementation** ○ Strengthen communication and coordinate participation among and within public agencies, residents, non-profit organizations, business, and industry to gain a vested interest in implementation.
  - Encourage leadership within public and private sector organizations to prioritize and implement local, county, and regional hazard mitigation activities.
- **Emergency Services** ○ Establish policy to ensure mitigation projects for critical facilities, services, and infrastructure.
  - Strengthen emergency operations by increasing collaboration and coordination among public agencies, non-profit organizations, business, and industry.
  - Coordinate and integrate natural hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

## Hazard Mitigation Plan Action Items

The action items are a listing of activities in which County agencies and residents can be engaged to reduce risk. The mitigation plan identifies short- and long-term action items developed through data collection and research, and the public participation process. Mitigation plan activities may be considered for funding through Federal and State grant programs, and when other funds are made available through the County. Action items address multi-hazard and hazard specific issues. To help ensure activity implementation, each action item includes information on the time line and coordinating organizations. Upon implementation, the coordinating organizations may look to partner organizations for resources and technical assistance. A description of the partner organizations is provided in the Resource Directory of this plan.

**Identification**

The process to identify mitigation initiatives for the original plan and this plan update were prepared in a similar manner. Each Task Force member represented their agency and was responsible for gathering and coordinating the information required for their initiatives. Emergency management staff provided planning partners a variety of data to support the development of their mitigation initiatives:

- County of Orange Emergency Operations Plan, 2015
- County of Orange General Plan, 2005
- County of Orange Comprehensive Annual Financial Report, 2014
- Orange County Essential Facilities Risk Assessment Project Report, 2009
- Anaheim/Santa Ana UASI THIRA, 2014
- California Multi-Hazard Mitigation Plan, 2013
- Southern California Catastrophic Earthquake Response Plan, 2010
- The ShakeOut Scenario (USGS Open File Report 2008-1150), 2008
- Overview of the ARkStorm Scenario (USGS Open File Report 210-1312), 2010
- City of Huntington Beach Hazard Mitigation Plan, 2012
- City of Berkeley Local Hazard Mitigation Plan, 2014

- City of Simi Valley Local Hazard Mitigation Plan, 2015
- National Flood Insurance Program Community Rating System Coordinator's Manual, 2013
- Local Mitigation Plan Review Guide, 2011
- Local Mitigation Planning Handbook, 2013
- Benefit cost review worksheets and instructions
- Local mitigation initiative template with instructions

The process for evaluating vulnerabilities and identifying a range of alternative mitigation actions to reduce actual and potential hazard exposures varied among agencies depending upon their capabilities and resources. In general, Task Force members collaborated with staff and or committees within their jurisdictions that were most familiar with their infrastructural systems, facilities, assets, services, or the geographic area being addressed. Local planning partners referenced a variety of materials such as their risk assessment, comprehensive plans, strategic plans, emergency management plans, capital facility plans, after action review debriefings, and other planning documents. The planning partners' identification processes considered existing initiatives from the original hazards mitigation plan, new and original initiatives identified in this plan update process, and initiatives that have already been identified or documented in a different planning process such as a storm water utility capital facilities plan.

**Previous Action Items**

***Requirement §201.6(d)(3)):*** *A local jurisdiction must review and revise its plan to reflect changes in development, progress in local mitigation efforts, and changes in priorities.*

Many of the items listed in the 2010 plan have been completed, removed or continued due to various reasons. Some continuing projects, particularly where the Orange County Fire Authority is the lead agency, have also been shifted due to changing priorities. 2010 projects and their statuses are listed below.

| 2010 Plan Project Number | 2015 Plan Project Number | Action Item | Coordinating Organization | Status |
|---|---|---|---|---|
| **OCPW1** | **OCPW1** | Santa Ana River Channel Project | Orange County Public Works | **Ongoing**, The U.S. Army Corps of Engineers has completed construction of the Lower Santa Ana River from the Pacific Ocean to Prado Dam to convey the 190year storm event and the Seven Oaks Dam. Currently the Orange County Flood Control District is acquiring land necessary to accommodate the increase in reservoir capacity with the Prado Dam spillway elevation being raised by the USACE. |

| 2010 Plan Project Number | 2015 Plan Project Number | Action Item | Coordinating Organization | Status |
|---|---|---|---|---|
| **OCPW2** | **OCPW2** | East Garden Grove-Wintersburg Channel (Facility No. C05) Project | Orange County Public Works | **Ongoing**, Five flood control capital improvement projects completed, (1995 thru 2013) upstream and downstream of the I-405 Freeway totaling 1.3 miles at a cost of $15,000,000. Three capital improvement projects are currently under construction. An additional seven projects, totaling 6.5 miles at an estimated cost of $110,000,000 (2010 dollars) within the 7-Year Flood Control Capital Improvement Project Plan are currently undergoing the design process. |
| **OCPW3** | **OCPW3** | San Juan Creek Channel (Facility No. L01) Project, Lower Reach | Orange County Public Works | **Ongoing**, Four flood control capital improvement projects completed (2008 thru current) and four projects in the design phase which includes obtaining regulatory permits. |
| **OCPW4** | **OCPW4** | Trabuco Creek Channel (Facility No. L02) Project | Orange County Public Works | **Ongoing**, Four flood control capital improvement projects completed, One project under construction and one in the design phase |
| **OCPW5** | **OCPW5** | Westminster Channel (Facility No. C04) Project | Orange County Public Works | **Ongoing**, One flood control capital improvement project completed and two projects in the design phase |
| **OCPW6** | **OCPW6** | Santa Ana-Delhi Channel (Facility No. F01) Project, Lower Reach | Orange County Public Works | **Ongoing**, One flood control capital improvement project completed and one project in 7-Year Flood Control Capital Improvement Project Plan. |

| 2010 Plan Project Number | 2015 Plan Project Number | Action Item | Coordinating Organization | Status |
|---|---|---|---|---|
| **OCPW7** | **OCPW7** | Oceanview Channel (Facility No. C06) Project | Orange County Public Works | **Ongoing**, One flood control capital improvement project completed and two projects in the preliminary design phase |
| **OCPW8** | **OCPW8** | San Diego Creek Channel (Facility No. F05) Project | Orange County Public Works | **Ongoing**, In the process of designing and obtaining regulatory permits to rehabilitate this channel segment to previous conditions and to restore flood capacity, the Regulatory agencies conditioned two (2) offsite mitigation projects. In the process of obtaining permits. Additional time was added for the design and construction process for the offsite mitigation projects. |
| **OCPW9** | **OCPW9** | Lane Channel (Facility No. F08) Project | Orange County Public Works | **Ongoing**, Two projects totaling nearly 10,000 linear feet are scheduled in the 7-Year Flood Control Capital Improvement Project Plan. The beginning reach starting at the confluence with San Diego Creek and ending at Von Karman, is currently undergoing the design process for repair and construction to convey the 100-year storm event. The upstream segment from Von Karman to 1,000' downstream of Red Hill Avenue was recently selected into the 7-Year Flood Control Capital Improvement Project Plan. |

| 2010 Plan Project Number | 2015 Plan Project Number | Action Item | Coordinating Organization | Status |
|---|---|---|---|---|
| **OCPW10** | **OCPW10** | Carbon Creek Channel (Facility No. B01) Project | Orange County Public Works | **Ongoing**, There are six projects (including Cypress Pump Station) listed on the 7-Year Flood Control Capital Improvement Project Plan. The projects located in the middle of the channel system within the City of Anaheim total 2 miles (11,500 linear feet). |
| **OCPW11** | **OCPW11** | Brea Creek Channel (Facility No. A02) Project | Orange County Public Works | **Ongoing**, There is one project listed on the 7-Year Flood Control Capital Improvement Project Plan. The project is located near the beginning of the channel system within the City of Buena Park totaling 1 mile (5,900 linear feet). |
| **OCPW12** | **OCPW12** | Fullerton Creek Channel (Facility No. A03) Project | Orange County Public Works | **Ongoing**, There are three projects listed on the 7-Year Flood Control Capital Improvement Project Plan. |
| **OCPW13** | **OCPW13** | Santa Ana-Santa Fe Channel (Facility No. F10) Project | Orange County Public Works | **Ongoing**, A 2-mile reach starting at the confluence with Peters Canyon Channel to upstream Red Hill Avenue is a qualified future project to be included in the 7-Year Flood Control Capital Improvement Project Plan. |

| 2010 Plan Project Number | 2015 Plan Project Number | Action Item | Coordinating Organization | Status |
|---|---|---|---|---|
| **OCPW14** | **OCPW14** | Santa Ana Gardens Channel (Facility No. F02) Project | Orange County Public Works | **Ongoing**, The project listed in the 7-Year Flood Control Capital Improvement Project Plan includes this segment. The project is located near the downstream end of the channel system within the City of Costa Mesa totaling 1/3 mile. |
| **OCPW15** | **OCPW15** | Bolsa Chica Channel (Facility No. C02) Project | Orange County Public Works | **Ongoing**, There is one project listed in the 7-Year Flood Control Capital Improvement Project Plan. The project, a retarding basin and channel, is located near the upstream end of the channel system within the U.S. Joint Armed Forces Reserve Center. |
| **OCPW16** | **N/A** | Huntington Beach Channel (Facility No. D01) Project | Orange County Public Works | **Completed** |
| **OCPW17** | **N/A** | Talbert Channel (Facility No. D02) Project | Orange County Public Works | **Completed** |
| **OCPW18** | **N/A** | Fountain Valley Channel (Facility No. D05) Project | Orange County Public Works | **Completed** |

| | | | | |
|---|---|---|---|---|
| **OCPW19** | **OCPW16** | Peters Canyon Channel (Facility No. F06) Project | Orange County Public Works | **Ongoing**, A segment of the channel, upstream and downstream of Barranca Parkway has been constructed to ultimate conditions to convey the 100-year storm event. This project was partially funded from Assessment Districts through the City of Irvine. There is one project on the 7-Year Flood Control Capital Improvement Project Plan starting from the confluence with San Diego Creek Channel and ending at Barranca Parkway totaling 3,600 linear feet. |
| **OCPW20** | **OCPW17** | Laguna Canyon Channel (Facility No. I02) Project | Orange County Public Works | **Ongoing**, There is one project listed in the 7-Year Flood Control Capital Improvement Project Plan. The project requires acquiring real estate for construction of flood control facilities for a 1 mile reach. |
| **OCFA1** | **OCFA3** | Reduce the amount of combustible fuels within 14 atrisk communities | Orange County Fire Authority | **Ongoing**, The OCFA Pre-Fire Management Section continues to develop and expand the READY! SET! GO! Program which is the single point comprehensive wildfire prevention program to accomplish this effort. |

| 2010 Plan Project Number | 2015 Plan Project Number | Action Item | Coordinating Organization | Status |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **OCFA2** | **OCFA6** | Enhance outreach and education programs aimed at mitigating wildland/urban hazards and reducing and preventing the exposure of residents, public agencies, private property owners and business to these hazards. | Orange County Fire Authority | **Ongoing**, This program has been implemented but is under continual evaluation/expansion. Currently restructuring and reorganizing the Pre-Fire Management section to better identify and focus on the hazards and methods to minimize exposure to residents, government, and business. The identification and assigning of resources and training needs are in progress. |
| **OCFA3** | **OCFA2** | Increase communication, coordination and collaboration between wildland/urban interface property owners, local and county planners and fire prevention crews and officials to address risks, existing mitigation measures and federal assistance programs. | Orange County Fire Authority | **Ongoing**, While there has been great progress in involving property owners and officials alike, OCFA is constantly seeking new partners to further the process. This includes increased involvement at the homeowner level through city councils to continue improvement to the educational process and strategy associated with wildland fire safety. |
| **OCFA4** | **OCFA11** | Inventory alternative firefighting water sources and encourage the development of additional sources. | Orange County Fire Authority | **Ongoing,** OCFA is working with MWDOC to identify all helicopter accessible water points and is working with GIS Unit on a layer in new mapping system. Working to create additional water sources at Rancho Mission Viejo. Exploring building water points into new park designs. |

| **2010 Plan Project Number** | **2015 Plan Project Number** | **Action Item** | **Coordinating Organization** | **Status** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| **OCFA5** | **OCFA8** | Enhance efficiency of wildfire/urban response and recover activities.<br><br>Installation of additional fire reporting stations. provide for improved coverage and access. A need has been identified to develop a County call list that includes all at-risk wildland/urban interface residents within the unincorporated area of Orange County in order to contact them during evacuations. | Orange County Fire Authority | **Modified and Ongoing,** There is now the Red Flag Firewatch program established and operational throughout the county. OCFA assists with the training and provides notification to the groups based on weather forecasts from the National Weather Service. **Alert OC is in place but is not coordinated by OCFA. Evacuation is a Law Enforcement function.** |
| **OCFA6** | **OCFA7** | Establish a “County Wide” Fire Safe Council | Orange County Fire Authority | **Ongoing**, This has been implemented but is continually being assessed and evaluated. The Countywide Fire Safe Council is established and functioning. |
| **OCFA7** | **OCFA9** | Development and dissemination of maps relating to the fire hazard to help educate and assist builders and home owners in being engaged in wildland/urban mitigation activities and to help guide emergency services during response. | Orange County Fire Authority | **Ongoing,** OCFA is in the process of developing and testing a mapping and inspection application to fulfill this mission. |
| **OCFA8** | **OCFA12** | Educate agency personnel on federal cost-share and grant programs, Fire Protection Agreements and other related federal programs. | Orange County Fire Authority | **Ongoing,** Efforts currently underway. Several meetings held with OCFA staff to identify, coordinate and prioritize grant programs and cost-share options. |
| **OCFA9** | **OCFA4** | Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability. | Orange County Fire Authority | **Ongoing**, OCFA has entered into work agreements, partnerships and MOU’s with landowners (both public and private) to improve access and reduce hazardous fuel loading. COAST (County of Orange Area Safety Task Force) has been formed to address these topics on a countywide level. |

| 2010 Plan Project Number | 2015 Plan Project Number | Action Item | Coordinating Organization | Status |
|---|---|---|---|---|
| **CEO1** | **OCSD19** | Mass Notification | County Executive Office | **Ongoing** (Program transferred to Orange County Sheriff's Department) |
| **OCSD1** | **OCSD17** | Geographic Information Systems Data and Analysis | Orange County Sheriff's Department | **Ongoing**, Parcel data now freely available due to CA Supreme Court decision, assessor data still unavailable |
| **OCSD2** | **OCSD18** | Dam Inundation Mapping | Orange County Sheriff's Department | **Ongoing**, efforts to secure inundation data from USACE and CalOES continue. One alternative will be to secure firm to produce new inundation maps and data |
| **OCWR1** | **N/A** | Frank R. Bowerman Landfill – Phase 8 East Flank/Heat Vents Excavation Project | Orange County Waste and Recycling | **Completed** |
| **OCWR2** | **N/A** | Olinda Alpha Landfill – Middle East Channel Improvements | Orange County Waste and Recycling | **Completed** |
| **OCWR3** | **N/A** | Disaster Debris Disposal Guidelines for Residents | Orange County Waste and Recycling | **Completed** |
| **OCCR1** | **OCCR1** | Niguel Shores Revetment Rehabilitation | Orange County Community Resources | **Ongoing**, On hold due to lack of consensus with the public and adjacent property owners. |
| **DPH1** | **DPH1** | Quay Wall | Dana Point Harbor | **Ongoing**, currently not implemented due to changing priorities but listed in Capital Improvement Plan |

| 2010 Plan Project Number | 2015 Plan Project Number | Action Item | Coordinating Organization | Status |
|---|---|---|---|---|
| **PARKS1** | **OCCR2** | Drought Mitigation - Develop a water management plan in the County park and facility system to conserve and efficiently manage water usage. | Orange County Parks | **Ongoing**, Work on this program is in progress. OC Parks continues to implement water-saving measures, but has not yet finalized a comprehensive water management plan. |

## National Flood Insurance Program

***Requirement: §201.6(c)(3)(ii):*** *[The mitigation strategy] must also address the jurisdiction's participation in the National Flood Insurance Program (NFIP), and continued compliance with NFIP requirements, as appropriate.*

In 1968, the US Congress created the National Flood Insurance Program (NFIP). Community participation is voluntary; however, in order to receive funding from the Federal Emergency Management Agency (FEMA), it is a requirement for all communities to participate in the program. The Orange County Flood Control District (OCFCD) is a long time participant in the program and administers the floodplains within the unincorporated areas of the County. Within the incorporated areas, Orange County cities administer their floodplains. Since the creation of NFIP, OCFCD has worked cooperatively with cities in Orange County to reduce the floodplain within the County of Orange by constructing flood control facilities that provide 100-year flood protection. Such facilities typically traverse through the cities and ultimately outlet into the Pacific Ocean.

The County participates in the National Flood Insurance Program (NFIP) that is conducted under the auspices of Federal Emergency Management Agency (FEMA).

Ordinance No. 09-008, of the County of Orange, California, amending sections 7-9-113 through 7-9-113.10 and adding sections 7-9-113.11 and 7-9-113.12 of the codified ordinances of the County of Orange regarding floodplain district regulations was adopted on November 24, 2009.

Orange County worked closely with Region IX in the FEMA Map Modernization process which resulted in digital Federal Insurance Rate Maps (FIRM) dated December 3, 2009. The County worked with FEMA to reach other cities within Orange County.

The Community Rating System (CRS) is an NFIP program that governs the rate of flood insurance for the unincorporated areas of Orange County and consists of certain flood prevention activities. As a condition of membership in good standing, OC Public Works is required to be certified each year that it continues to conduct those activities as part of the CRS program by signing of Form AW-214, CRS Annual recertification of the following activities:

1. Activity 310 – Elevation Certificates
2. Activity 320 – FIRM Information
3. Activity 330 – Outreach Projects
4. Activity 350 – Flood Protection Information
5. Activity 360 – Flood Protection Assistance
6. Activity 410 – Additional Flood Data
7. Activity 420 – Open Space Preservation
8. Activity 430 – Higher Regulatory Standard
9. Activity 450 – Stormwater Management
10. Activity 440 – Flood Data Maintenance
11. Activity 502 – Repetitive Losses
12. Activity 510 – Floodplain Management Plan
13. Activity 540 – Drainage System Maintenance
14. Activity 610 – Flood Threat Recognition System

Recertification requires certain documentation from Operations and Maintenance Section in order to complete annual recertification for the CRS activities.

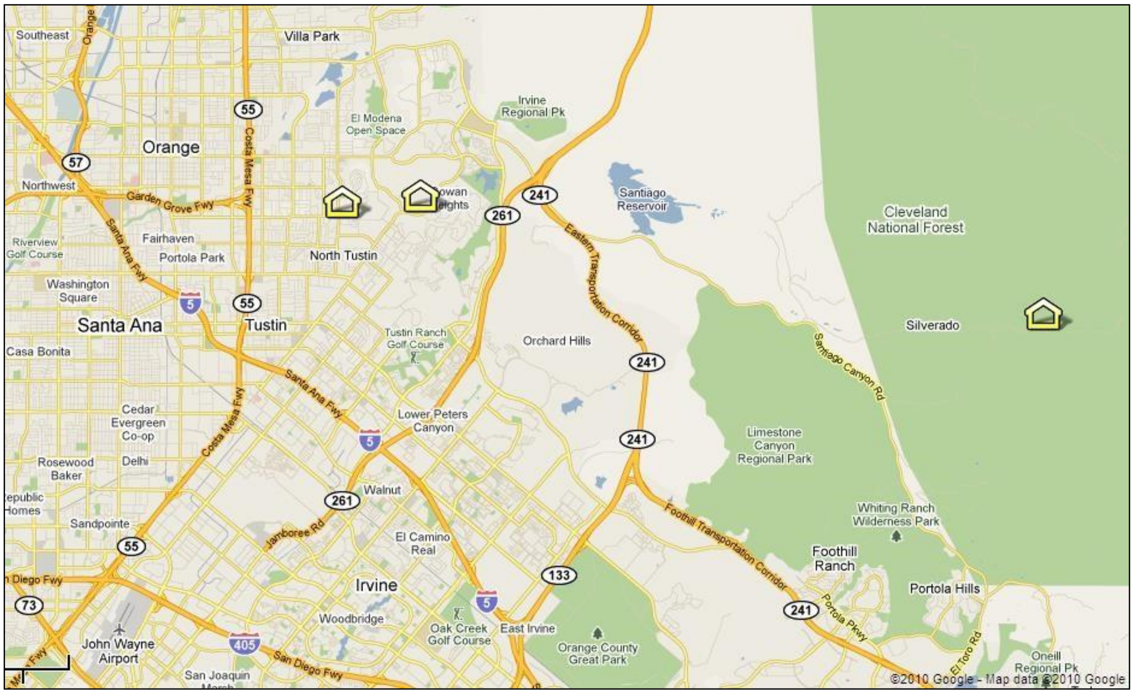
Orange County (unincorporated) as a community is in full compliance with the minimum National Flood Insurance Program requirements as specified in Title 44, Code of Federal Regulations, Section 59, 60.3 through 60.6. Projects that maintain continued compliance with NFIP were also given heavy weight during the prioritization process.

For more information on Orange County's exposure to the flood threat, see the Quantitative Exposure Analysis section in Chapter 3.

### Repetitive Loss Structures

| |
|---|
| ***Requirement §201.6(c)(2)(ii):*** *[The risk assessment]* ***must*** *also address National Flood Insurance Program (NFIP) insured structures that have been repetitively damaged by floods.* |

According to the National Flood Insurance Program (NFIP), a repetitive loss structure is an insured building that has had two or more losses of at least $1,000 each being paid under the NFIP within any 10-year period since 1978. Within unincorporated Orange County, there are only three structures that currently fit this definition: one in Silverado, one in North Tustin, and one in Cowan Heights. These locations are highlighted on the map below (Map 25).




☐ **Map 25 - Repetitive Loss Structures**

## Prioritization

***Requirement: §201.6(c)(3)(iii):*** *[The mitigation strategy section **shall** include] an action plan describing how the actions identified in section (c)(3)(ii) will be prioritized, implemented, and administered by the local jurisdiction. Prioritization **shall** include a special emphasis on the extent to which benefits are maximized according to a cost benefit review of the proposed projects and their associated costs.*

The mitigation action items were prioritized by the Task Force. The members utilized a numerical ranking process to sort the initiatives. All of the initiatives were listed on a voting sheet. The workgroup discussed the benefits and the significance of each initiative as they related to the plan's goals and objectives and the most pressing needs of the region. Actions related to the protection of life and property and NFIP projects were given the highest weight. Each workgroup member assigned a numerical ranking to each action. The ranks were summed for each action. The action with the lowest value received the highest priority and so forth.

## Benefit Cost Review

FEMA requires local governments to analyze the benefits and costs of range of mitigation actions that can reduce the effects of each hazard within their community. A hazard mitigation plan must demonstrate that a process was employed that emphasized a review of benefits and costs when prioritizing the mitigation actions. The benefit-cost review must be comprehensive to the extent that it can evaluate the monetary as well as the non-monetary benefits and costs associated with each action. The benefit-cost review should at least consider the following questions:

- How many people will benefit from the action?
- How large an area is impacted?

- How critical are the facilities that benefit from the action (which is more beneficial to protect, the fire station or the administrative building)?
- Environmentally, does it make sense to do this project for the overall community?

The severity of hazards and their impacts vary among the county's agencies due to the varying range of resources and services that they are responsible for providing their customers. As such, their range of mitigation actions for the same hazard will differ substantially. Each plan partner has to consider their agency's exposure, their capabilities, their resources, and select an appropriate process to evaluate the benefits and costs of various mitigation actions.

For the plan update process, the Task Force selected a benefit-cost review method known as STAPLEE. STAPLEE is an acronym for the following criteria that are scored according to benefits or costs of any proposed initiative: social, technical, administrative, political, legal, economic, and environmental. The STAPLEE method is outlined in FEMA's how-to guide, *Developing the Mitigation Plan (FEMA 386-3, 2003).* Task Force members were provided a worksheet and instructions for conducting this process. The worksheet provided general criteria but agencies could elect to modify the criteria to fit their needs. Agency staff scored each mitigation initiative or alternative action according to its benefit (positive score) or cost (negative score) as follows:

| **Benefit** | | | **Cost** | | |
|---|---|---|---|---|---|
| Low, +1 | Moderate, +2 | High, +3 | Low, -1 | Moderate, -2 | High, -3 |

The worksheet allowed members to score multiple alternatives mitigation actions to address a particular vulnerability or a hazard, and compare the relative benefits and costs of each of the alternative actions. A final score is tallied for each alternative mitigation initiative by summing the score assigned to each alternative across the criteria. The greater the score, the greater the project benefit. Agencies could use this rating to select a preferred alternative and/or prioritize mitigation actions.

## Mitigation Action Items

***Requirement §201.6(c)(3)(ii):*** *[The mitigation strategy* ***shall*** *include a] section that identifies and analyzes a comprehensive range of specific mitigation actions and projects being considered to reduce the effects of each hazard, with particular emphasis on new and existing buildings and infrastructure.*

| Priority | Status | Project Number | Hazard | Mitigation Action | Responsible Agency | Time to Completion | Funding Source(s) |
|---|---|---|---|---|---|---|---|
| 1 | Existing | OCPW1 | Flood | Santa Ana River Channel Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/Infrastructure Programs | 25 years | Federal and local sponsorship |
| 2 | Existing | OCPW2 | Flood | East Garden Grove-Wintersburg Channel (Facility No. C05) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/Infrastructure Programs | 1995 to 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/state grants. |
| 3 | Existing | OCPW3 | Flood | San Juan Creek Channel (Facility No. L01) Project, Lower Reach - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/Infrastructure Programs | 2005-2025 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/state grants. |
| 4 | Existing | OCPW4 | Flood | Trabuco Creek Channel (Facility No. L02) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2005-2025 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/state grants. |
| 5 | Existing | OCPW5 | Flood | Westminster Channel (Facility No. C04) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2005 to 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/state grants. |
| 6 | Existing | OCPW6 | Flood | Santa Ana-Delhi Channel (Facility No. F01) Project, Lower Reach - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2015 to 2020 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/state grants. |
| 7 | Existing | OCPW7 | Flood | Oceanview Channel (Facility No. C06) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 1995 to 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/state grants. |

| Priority | Status | Project Number | Hazard | Mitigation Action | Responsible Agency | Time to Completion | Funding Source(s) |
|---|---|---|---|---|---|---|---|
| **8** | Existing | OCPW8 | Flood | San Diego Creek Channel (Facility No. F05) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2010 to 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/state grants. |
| **9** | Existing | OCPW9 | Flood | Lane Channel (Facility No. F08) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2010 to 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **10** | Existing | OCPW10 | Flood | Carbon Creek Channel (Facility No. B01) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2010 to 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **11** | Existing | OCPW11 | Flood | Brea Creek Channel (Facility No. A02) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | To Be Determined | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **12** | Existing | OCPW12 | Flood | Fullerton Creek Channel (Facility No. A03) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 1985 to 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **13** | Existing | OCPW13 | Flood | Santa Ana-Santa Fe Channel (Facility No. F10) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2010 thru 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **14** | Existing | OCPW14 | Flood | Santa Ana Gardens Channel (Facility No. F02) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2010 thru 2035 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |

| Priority | Status | Project Number | Hazard | Mitigation Action | Responsible Agency | Time to Completion | Funding Source(s) |
|---|---|---|---|---|---|---|---|
| **15** | Existing | OCPW15 | Flood | Bolsa Chica Channel (Facility No. C02) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | 2015 thru 2040 | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **16** | Existing | OCPW16 | Flood | Peters Canyon Channel (Facility No. F06) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | To Be Determined | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **17** | Existing | OCPW17 | Flood | Laguna Canyon Channel (Facility No. I02) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | To Be Determined | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **18** | New | OCPW18 | Flood | Greenville-Banning Channel (Facility No. D03) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | To Be Determined | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **19** | New | OCPW19 | Flood | Barranca Channel (Facility No. F09) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | To Be Determined | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **20** | New | OCPW20 | Flood | Los Alamitos Channel (Facility No. C01) Project - Design and Construction of Flood Control Improvements | Orange County Flood Control District/Orange County Public Works/ Infrastructure Programs | To Be Determined | Orange County Flood Fund is mainly acquired from a portion of Orange County property taxes, and Federal/State grants. |
| **21** | New | OCSD1 | Drought | Replace Cooling Towers at Theo Lacy Jail Facility | Orange County Sheriff's Department | 12 months / Construction 14 months | Grants and/or Annual Budgets |
| **22** | New | OCSD2 | Multi-Hazard | Replace Emergency Generator at Sheriff Headquarters Facility | Orange County Sheriff's Department | Design: 12 months / Construction 14 months | Grants and/or Annual Budgets |
| **23** | New | OCSD3 | Multi-Hazard | Replace Emergency Generator at Brad Gates Facility | Orange County Sheriff's Department | Design: 12 months / Construction 14 months | Grants and/or Annual Budgets |

| Priority | Status | Project Number | Hazard | Mitigation Action | Responsible Agency | Time to Completion | Funding Source(s) |
|---|---|---|---|---|---|---|---|
| **24** | New | OCSD4 | Multi-Hazard | Seismic retrofit, ADA compliance upgrade and hazardous material abatement and remediation renovation to HQ | Orange County Sheriff's Department | Design: 16 months / Construction 20 months | Grants and/or Annual Budgets |
| **25** | New | OCSD5 | Multi-Hazard | Replace Fire Pumps – Loma Ridge Emergency Operations Center | Orange County Sheriff's Department | Design: 10 months / Construction 7 months | Grants and/or Annual Budgets |
| **26** | New | OCSD6 | Multi-Hazard | Brad Gates Building: Replace and Upgrade the Existing and UPS System | Orange County Sheriff's Department | Design: 11 months / Construction 11 months | Grants and/or Annual Budgets |
| **27** | New | OCSD7 | Multi-Hazard | Emergency Operations Center Communications Redundancy Project | Orange County Sheriff's Department | Design: 10 months / Construction 8 months | Grants and/or Annual Budgets |
| **28** | New | OCSD8 | Multi-Hazard | Emergency Operations Center Uninterruptible Power Supply capabilities and coverage | Orange County Sheriff's Department | Design: 12 months / Construction 14 months | Grants and/or Annual Budgets |
| **29** | New | OCSD9 | Drought | Replace Screw Type Chillers at the Coroner Facility | Orange County Sheriff's Department | Design: 6 months / Construction 9 months | Grants and/or Annual Budgets |
| **30** | New | OCSD10 | Multi-Hazard | Replace Emergency Generator at Theo Lacy Facility | Orange County Sheriff's Department | Design: 10 months / Construction 9 months | Grants and/or Annual Budgets |
| **31** | New | OCSD11 | Drought | Install Waterless Urinals in all Administrative Areas | Orange County Sheriff's Department | Design: 4 months / Construction 3 months (per facility) | Grants and/or Annual Budgets |
| **32** | New | OCSD12 | Drought | Install Electro-Mechanical Valves in all Jail Facility Showers and Lavatories | Orange County Sheriff's Department | Design: 10 months / Construction 6 months (per facility) | Grants and/or Annual Budgets |
| **33** | New | OCSD13 | Wildland Fire | Replace Skins on the JAMF North Compound Inmate Housing Tents | Orange County Sheriff's Department | Design: 12 months / Construction 10 months | Grants and/or Annual Budgets |
| **34** | New | OCSD14 | Multi-Hazard | Emergency Operations Access Road Widening | Orange County Sheriff's Department | Design: 16 months / Construction 10 months | Grants and/or Annual Budgets |
| **35** | New | OCSD15 | Earthquake | Complete Seismic Assessments for Sheriff Facilities | Orange County Sheriff's Department | Assessment: To Be Determined | Grants and/or Annual Budgets |
| **36** | New | OCSD16 | Earthquake | Bring Sheriff-Coroner Essential Facilities up to Current Essential Building Standards | Orange County Sheriff's Department | To Be Determined | Grants and/or Annual Budgets |

| Priority | Status | Project Number | Hazard | Mitigation Action | Responsible Agency | Time to Completion | Funding Source(s) |
|---|---|---|---|---|---|---|---|
| **37** | Existing | OCSD17 | Multi-Hazard | Geographic Information Systems Data and Analysis | Orange County Sheriff's Department | 5 years | Grants |
| **38** | Existing | OCSD18 | Dam Failure | Dam Inundation Mapping | Orange County Sheriff's Department | 5 years | Not identified |
| **39** | Existing | OCSD19 | Multi-Hazard | Mass Notification | Orange County Sheriff's Department | 2011 | Grants and/or Annual Budgets |
| **40** | Existing | OCCR1 | Flood Hazard | Niguel Shores Revetment Rehabilitation | OC Parks | 2 years | Annual Budgets |
| **41** | Existing | DPH1 | Flooding, Tsunami, Earthquake, Climate Change | Quay Wall | Dana Point Harbor | 1-2 years for 5:1 Repair to Replacement Ratio. 58 years for 100% Full Replacement | Grants and/or Annual Budgets |
| **42** | Existing | OCCR2 | Drought | Drought Mitigation - Develop a water management plan in the County park and facility system to conserve and efficiently manage water usage. | OC Parks / Facility Operations | 1-2 years | Grants and/or Annual Budgets |
| **43** | New | OCFA1 | Wildland Fire | Implementation of a real-time remote sensing and fire detection platform to increase the ability to detect, respond to, and monitor wildland areas in Orange County | Orange County Fire Authority | 2 Years | Grants and/or Annual Budgets |
| **44** | Existing | OCFA2 | Wildland Fire | Increase communication, coordination and collaboration between Wildland-Urban Interface (WUI) property owners, local and county planners and fire prevention crews and officials to address risk, existing mitigation measures and federal assistance programs | Orange County Fire Authority | Ongoing with Annual Review | Grants and/or Annual Budgets |
| **45** | Existing | OCFA3 | Wildland Fire | Reduce the amount of combustible fuels within identified at-risk communities | Orange County Fire Authority | Ongoing | Grants and/or Annual Budgets |

| Priority | Status | Project Number | Hazard | Mitigation Action | Responsible Agency | Time to Completion | Funding Source(s) |
|---|---|---|---|---|---|---|---|
| **46** | Existing | OCFA4 | Wildland Fire | Encourage implementation of wildfire mitigation activities in a manner consistent with the goals of promoting sustainable ecological management and community stability | Orange County Fire Authority | Ongoing | Grants and/or Annual Budget |
| **47** | New | OCFA5 | Wildland Fire | Evaluate and implement roadway hardening measures on identified high risk roadways in wildland areas in Orange County | Orange County Fire Authority | Ongoing | Grants and/or Annual Budget |
| **48** | Existing | OCFA6 | Wildland Fire | Enhance outreach and education programs aimed at mitigating Wildland-Urban Interface (WUI) hazards thereby reducing the exposure of stakeholders (public and private) to these hazards | Orange County Fire Authority | Ongoing | Grants and/or Annual Budget |
| **49** | Existing | OCFA7 | Wildland Fire | Establish a countywide wildland fire prevention education "Task Force" | Orange County Fire Authority | 2 Years | Grants and/or Annual Budget |
| **50** | Existing | OCFA8 | Wildland Fire | Enhance efficiency of Wildland-Urban Interface/Intermix response and recovery activities | Orange County Fire Authority | Ongoing | Grants and/or Annual Budget |
| **51** | Existing | OCFA9 | Wildland Fire | Development and dissemination of maps relating to the fire hazard to help educate and assist builders and home owners in being engaged in wildland/urban mitigation activities and to help guide emergency services during response | Orange County Fire Authority | 1-3 Years | Annual Budget |
| **52** | New | OCFA10 | Earthquake | Seismic Reinforcement for Structural Strengthening of Facilities | Orange County Fire Authority | 2 years from start | Grants |
| **53** | Existing | OCFA11 | Wildland Fire | Inventory alternative firefighting water sources and encourage the development of additional sources | Orange County Fire Authority | TBD | Grants and/or Annual Budget |
| **54** | Existing | OCFA12 | Multi-Hazard | Educate agency personnel on federal cost-share and grant programs, Fire Protection Agreements and other related federal programs | Orange County Fire Authority | 1 – 2 Years | Grants and/or Annual Budget |
| **55** | New | OCHCA1 | Epidemic | Enhance detection and reporting of outbreaks and increases in absenteeism in schools. | Orange County Health Care Agency | 1 to 2 years | Grants and/or annual budgets |

# Chapter 5 Plan Maintenance

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| ***Requirement §201.6(c)(4)(i):*** *[The plan maintenance process* ***shall*** *include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.* |

The Plan Maintenance Chapter of this document details the formal process that will ensure the County of Orange and Orange County Fire Authority Hazard Mitigation Plan remains an active and relevant document. The plan maintenance process is based upon annual review and a plan revision will be produced every five years. This chapter describes how the County will integrate public participation throughout the plan maintenance process. Finally, this chapter includes an explanation of how the Orange County government intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the County's General Plan, Capital Improvement Plans, and Building and Safety Codes.

## Coordinating Body

The County of Orange Hazard Mitigation Planning Task Force will be responsible for coordinating implementation of Plan action items and undertaking the formal review process. The Board of Supervisors and County Executive Officer will assign representatives from County agencies, including, but not limited to, the current Hazard Mitigation Planning Task Force members.

## Convener

The Orange County Sheriff's Department Emergency Management Division will serve as the convener to facilitate the Hazard Mitigation Planning Task Force meetings, and will assign tasks such as updating and presenting the Plan to the members of the committee. Plan implementation and evaluation will be a shared responsibility among all of the Hazard Planning Task Force Members. The Orange County Sheriff's Department Emergency Management Division will conduct annual reviews of the Hazard Mitigation Plan based upon public comments and feedback, as well as facilitate plan updates every five years, at a minimum.

## Adopting, Monitoring, and Updating the Hazard Mitigation Plan

The County Board of Supervisors and the Orange County Fire Authority (OCFA) Board of Directors are responsible for adopting the County of Orange and Orange County Fire Authority Hazard Mitigation Plan. The Board of Supervisors has the authority to promote sound public policy regarding natural hazards and the OCFA Board of Directors is the governing board overseeing Fire Authority matters. Once the plan has been adopted, the County Emergency Manager will be responsible for submitting it to the State Hazard Mitigation Officer at the California Office of Emergency Services. The California Office of Emergency Services will then submit the plan to the Federal Emergency Management Agency (FEMA) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, the County of Orange and the Orange County Fire Authority will gain eligibility for Hazard Mitigation Grant Program funds.

The Hazard Mitigation Plan will need to be periodically revised and re-adopted to meet changes in the hazard risks and exposures in the community. The approved Hazard Mitigation Plan will be significant in the future growth and development of the community.

The Hazard Mitigation Plan will be monitored and evaluated on an annual basis to determine the effectiveness of programs, and to reflect changes in land development or programs that may affect mitigation priorities. The evaluation process includes a firm schedule and time line, and identifies the local agencies and organizations participating in plan evaluation. The Orange County Sheriff's Department, Emergency Management Division will be responsible for contacting the Hazard Mitigation Planning Task Force members and organizing the annual meeting in August of each year. Task Force members will be responsible for monitoring and evaluating the progress of the mitigation strategies in the Plan.

The Task Force will review the goals and action items along with public feedback to determine their relevance to changing situations in the County, as well as changes in State or Federal policy, and to ensure they are addressing current and expected conditions. The Task Force will also review the risk assessment portion of the Plan to determine if this information should be updated or modified, given any new available data. The coordinating organizations responsible for the various action items will report on the status of their projects, the success of various implementation processes, difficulties encountered, success of coordination efforts, and which strategies should be revised. Orange County Public Works will also ensure that a Project Status Report is completed annually for each mitigation project listed in the plan (See Attachment D for Project Status Reports). This Report will be approved as an attachment to the plan by the Emergency Management Council as part of the annual update process.

The Orange County Sheriff's Department, Emergency Management Division will assign the duty of updating the plan to one or more of the Task Force members. The designated members will have 30 days to make appropriate changes to the Plan before submitting it to the Hazard Mitigation Task Force members, and presenting it to the County Emergency Management Council for approval. All updates within the 5 year revision cycle will be adopted by the County Emergency Management Council. The Hazard Mitigation Planning Task Force will also notify all holders of the County plan when changes have been made. Every five years the updated plan will be submitted to the State Hazard Mitigation Officer and the Federal Emergency Management Agency for review. Once approved by FEMA the updated plan is adopted by the County Board of Supervisors and the Orange County Fire Authority Board of Directors.

## Incorporating Mitigation Into Existing Planning Mechanisms

***Requirement §201.6(c)(4)(ii):*** *[The plan **shall** include a] process by which local governments incorporate the requirements of the mitigation plan into other planning mechanisms such as comprehensive or capital improvement plans, when appropriate.*

Each agency will be responsible for implementation of their individual mitigation action item based on funding availability, availability of resources, and agency priorities. The mechanism for implementation through existing programs will vary between agencies and departments. This section is intended to give an overview of the mechanisms available in Orange County.

Orange County addresses statewide planning goals and legislative requirements through its General Plan, Capital Improvement Plans, and County Building and Safety Codes. Each of these processes involves and requires public notification and involvement. The Hazard Mitigation Plan provides a series of recommendations--many of which are closely related to the goals and objectives of existing planning programs. OC Public Works will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

In addition, the County of Orange and Orange County Fire Authority Hazard Mitigation Plan has been incorporated into the Safety Element of the General Plan by the County Board of Supervisors as required by state law. The County Emergency Operations Plan is also a partner document and utilizes much of the vulnerability assessment information available in the Hazard Mitigation Plan. These comprehensive plans are required to be updated regularly by various state and federal laws.

Orange County Public Works is responsible for administering Building and Safety Codes. In addition, the Hazard Planning Task Force will work with other agencies at the state level to review, develop and ensure Building and Safety Codes that are adequate to mitigate or present damage by natural hazards. This is to ensure that life-safety criteria are met for new construction.

The goals and action items in the mitigation plan may be achieved through activities recommended in the County's Capital Improvement Projects (CIP). Various County departments develop plans, and review them on an annual basis. Upon annual review of the Capital Improvement Projects, the Hazard Mitigation Planning Task Force will work with the County departments to identify areas that the hazard mitigation plan action items are consistent with CIP planning goals and integrate them where appropriate. Many of the action items listed in the Hazard Mitigation Plan are directly related to CIP.

Within six months of formal adoption of the mitigation plan, the recommendations listed above will be incorporated into the process of existing planning mechanisms at the County level. The meetings of the Hazard Mitigation Planning Task Force will provide an opportunity for committee members to report back on the progress made on the integration of mitigation planning elements into County planning documents and procedures.

### Flood Event Post-Disaster Policies and Procedures / Action Items

The Community will identify the operations and strategies to allow more effective post-disaster recovery. Much of the County’s most vulnerable areas, as mentioned in Section 3.1, include areas within the cities of Westminster, Garden Grove, Fountain Valley, Huntington Beach, Seal Beach, San Juan Capistrano, and Laguna Beach. The most vulnerable areas within unincorporated Orange County include the canyon areas which will be the focus of post-disaster action items.

To reduce long-term vulnerability and to become more resilient in future disasters, mitigation actions such as effective building code adoption and enforcement, will be applied in the post-disaster recovery activities by our community. A post-disaster planning committee should be formed that includes representatives of all affected communities where flooding had occurred.

Individuals that may be needed for post disaster activities should be trained, made aware of their potential assignments, review mutual aid agreements for negotiation and approval for fire and police departments.

Repairs to buildings located within the 100-year floodplain will comply with the local laws for floodplain development, which specify that structures that are substantially damaged (cost of restoring the structure to its before damaged condition would equal or exceed 50% of the market value of the structure before the damage occurred) will only be rebuilt if they are brought into compliance with the latest floodplain development standards.

**Plan Review and Update**

Following a major flood event, the Plan will be reviewed and revised as necessary to reflect lessons learned or to address specific issues and circumstances arising from the event. It will be the responsibility of the
Floodplain Administrators to reconvene the Post-Disaster Planning Committee and to ensure that appropriate stakeholders are invited to participate in the plan revision and update process following any emergency or disaster events. In addition, the Committee should evaluate which actions from the Plan may be appropriate for implementation during the post-disaster period as resources and needs become clear.

**Flood Event Post-Disaster Action Items**

| *Activity* | *Agency/Department* | *Timeframe* |
|---|---|---|
| Review the mutual aid agreements between the County and communities regarding post disaster actions and revise as appropriate to include code enforcement departments, planning departments and public information officers. | Emergency Management Departments from affected Municipalities | 3 months |
| Prepare brochures or fliers that address post disaster actions by property owners. Disseminate information about floodproofing, building elevation, relocation, and other property protection measures. Many Publications are available from State and federal agencies.<br><br>Prepare and distribute notices to property owners and renters, advising them of the types of insurance available.<br><br>Ensure the public is aware of actions it should be taking to mitigate damages as well as encouraging property owners and renters to work with their insurance agents to help cover their losses | Public Information Officers (PIOs) - Multiagency | 6 months |

| *Activity* | *Agency/Department* | *Timeframe* |
|---|---|---|

| | | |
|---|---|---|
| Conduct preliminary damage assessment to include creation of a map that provides locations and collected data with photos identifying all damaged structures | Affected Cities and OC Public Works | 4 months |
| Advise code enforcement (CE) departments of areas affected by the flood for further evaluation by CE. Determine the extent of damages, including whether the structures are substantially damaged as defined in the ordinances of each affected community | Affected Cities, County Emergency Managers and OC Public Works Building & Safety | 3 months |
| Evaluate the suitability of rebuilding damaged structures in unincorporated Orange County and make recommendations to property owners. | OC Public Works | 3 months |
| Review the Hazard Mitigation Plan to determine if any revisions are needed. | Hazard Mitigation Committee | Within 6 months of a Presidential or state declared disaster |
| Provide outreach to the affected communities informing them of the risks of floods and how to prepare for future events | OC Public Works | 3 months |
| Ensure that residents have the proper permits before repairing structures and ensuring that the repair is completed according to Orange County codes | OC Public Works | As Needed (within 5 years) |
| Determine appropriate mitigation actions given the extent of damages. Consider redevelopment of standards and determine whether any temporary permit and construction moratoriums need to be established. Determine whether necessary to modify the mitigation plan or to revise/modify codes or ordinances. | OC Public Works | 1 year |
| Determine funding that is available to assist the owners in mitigating future damages. Identify potential opportunities to pursue Section 406 mitigation projects under the FEMA Public Assistance Grant Program | OC Public Works | 1 year |
| Determine extent of damages (system-wide or isolated reach) to OCFCD flood control channels, roadways and | Affected County Agencies and OC Public Works | 1 month |

| *Activity* | *Agency/Department* | *Timeframe* |
|---|---|---|
| bridges and other county facilities and study to repair or replace/improve facility. | | |
| Extensive replacement/improvements to County public facilities require incorporation into respective CIP's or alternative funding.<br><br>Seek grant opportunities through DWR and FEMA and apply for grants as appropriate and develop project applications as appropriate. | Affected County Agencies and OC Public Works | 2 to 5 years |
| Work with the State and FEMA to collect important flood data like high water marks | OC Public Works | 6 months |
| Evaluate the need to update FIRMs for the areas that flooded | OC Public Works | 3 years |

## Continued Public Involvement

***Requirement §201.6(c)(4)(iii):*** *[The plan maintenance process* ***shall*** *include a] discussion on how the community will continue public participation in the plan maintenance process.*

The Orange County Emergency Management Council (EMC) is committed to continued public involvement and education. The EMC meets quarterly in a public meeting to discuss emergency management related issues, including hazard mitigation. It will be important that natural hazards mitigation continues to be integrated into existing programs and is part of the way jurisdictions make decisions about land use and facilities planning. As mentioned in the preceding section, General Plan amendment processes as well as capital improvement planning both have elements of public notification and involvement. These local plans require updating regularly with an associated public process. These processes will provide a venue that promotes public dialogue regarding the importance of hazard mitigation.

As was the case in the compilation of this plan, when there is a plan update (at least every 5 years) the General Plan and Capital Improvement Plans will need to be reviewed to assure consistency between all planning efforts. It will be important to identify where and how hazard mitigation planning initiatives have been integrated in the General Plan and Capital Improvement Plans.

The Emergency Management Council will also need to encourage its governmental entities to combine the natural hazards plan elements into existing emergency preparedness activities and information in order to continue to educate the public on the importance of managing the risk for natural hazards. If there are efforts to re-write emergency preparedness public information (such as brochures), integration of natural hazards mitigation information will be considered. The County Emergency Operations Plan will continue to integrate hazard mitigation planning into that document and associated public education efforts.

There is constant public information engagement with the county residents through emergency management staff participation at public safety and preparedness fairs, the annual Orange County Fair, Inner Canyon League preparedness meetings, Orange County Fire Authority town hall meetings, and other opportunities to inform the public as they arise.

The public will also continue to have the opportunity to provide feedback about the Plan. Copies of the Plan will be catalogued and kept at the Orange County Hall of Administration and at all County operated public libraries. The plan also includes the address and the phone number of the Orange County Sheriff's Department Emergency Management Division, responsible for keeping track of public comments on the Plan. In addition, copies of the Plan and any proposed changes will be posted on the Orange County Sheriff's Department Emergency Management website at www.ocgov.com/eoc. This site will also contain an email address to which the public can direct their comments and concerns.

Since 2010, the Emergency Management Division has continued to foster public involvement in the hazard mitigation process, both through existing meetings with stakeholders, like the Orange County Emergency Management Organization, Collaborating Organizations Active in Disasters, and the Disabilities and Access and Functional Needs Working Group, and through direct outreach to the public through the Emergency Management Division's digital presence and at public events. This process has continued to yield constructive feedback and participation in ongoing Orange County hazard mitigation planning.

Moving forward, the Emergency Management Division will seek to augment its efforts to maximize public engagement in the mitigation process. One strategy will be to focus specific attention on the somewhat disparate and fragmented county areas (rural canyon areas in the northeast, planned communities in the southeast, and older neighborhoods closer to the Los Angeles County border) with dedicated presentations that focus on that area's local hazards. This would allow more pointed discussion of the risks present in individual communities. Another strategy will be to enhance social media messaging regarding hazard mitigation to county residents. For the 2015 update, the social media focus was either encouraging residents to participate in the online survey or to review the complete text of the draft plan. Moving forward, the Emergency Management Division will strive to also include short educational messages about the hazards that face the County of Orange and the importance of mitigation planning.

| Agency Name (Mission/Function) | Programs, Plans, Policies, Regulations, Funding, or Practices | Point of Contact Name, Address, Phone, Email | Effect on Loss Reduction*<br><br>Support<br>Facilitate<br>Hinder | Comments |
|---|---|---|---|---|
| Orange County | Codified Ordinances | Orange County<br>Clerk of the Board, Darlene Bloom<br>10 Civic Center Plaza, Room 465<br>Post Office Box 687<br>Santa Ana, CA 92702<br>www.ocgov.com | S | Ordinances dedicated to Public Facilities; Public Morals, Safety and Welfare; Property Maintenance; Health and Sanitation and Animal Regulations; Business and Special Licenses, Regulations; Highways, Bridges, Rights-of-Way, Vehicles; Land Use and Building Regulations; Fees; Water Quality—Orange County Flood Control; Stormwater Management and Urban Runoff. |
| Orange County Agencies & Departments | Standard Operating Procedures | See website, www.ocgov.com for Department Contacts | S | Dependent upon mission and goals of the agency/department. |

| Agency Name (Mission/Function) | Programs, Plans, Policies, Regulations, Funding, or Practices | Point of Contact Name, Address, Phone, Email | Effect on Loss Reduction* Support Facilitate Hinder | Comments |
|---|---|---|---|---|
| Orange County Fire Authority (OCFA) . Mission: To serve the changing needs of the community by providing the highest quality regional emergency, safety and support services, including protecting lives, property, and the environment with compassion, vigilance and dedication to excellence | Orange County Hazardous Materials Area Plan (November, 1999) | Emergency Planning & Coordination Section, OCFA (714-573-6000) | S | Addresses the storage , use and emergency planning for hazardous materials |
| | California Fire Code 2001 | | S | The purpose of the Code is to prescribe regulations governing conditions hazardous to life and property from fire or explosion. (For Fuel Modification and enforcement of hazardous fuels within populated areas) Section 27, Appendix 2-A1, Article 11, Section 1103.2.4 |
| | California Public Resources Code, Division 4. Forests, Forestry and Range and Forage Lands | | S | The purpose is to prescribe regulations governing forests, forestry and fire issues. |

| **Agency Name (Mission/Function)** | **Programs, Plans, Policies, Regulations, Funding, or Practices** | **Point of Contact Name, Address, Phone, Email** | **Effect on Loss Reduction*** <br> **Support** <br> **Facilitate** <br> **Hinder** | **Comments** |
|---|---|---|---|---|
| Orange County Health Care Agency (HCA)<br><br>Mission: Protect and promote the optimal health of individuals, families and our diverse communities | HCA Emergency Operations Plan (EOP) | Health Disaster Management Division<br>405 West 5th Street, Suite 301A<br>Santa Ana, CA 92701<br>(714-834-3500) | S | To provide for and coordinate the response to and recovery from health and environmental emergencies. |
| | Disease Outbreak Response Annex to HCA EOP | Health Disaster Management Division<br>405 West 5th Street, Suite 301A<br>Santa Ana, CA 92701<br>(714-834-3500) | S | Preparedness and response plan for the request and distribution of medical countermeasures such as drugs, vaccines, and medical supplies. |
| | Medical Countermeasures (MCM) Annex | Health Disaster Management Division<br>405 West 5th Street, Suite 301A<br>Santa Ana, CA 92701<br>(714-834-3500) | S | Preparedness and response plan for the request and distribution of medical countermeasures such as drugs, vaccines, and medical supplies. |
| Orange County Mosquito and Vector Control District (OCMVCD) | OCMVCD Integrated Vector Management and Response Plan | 13001 Garden Grove Blvd.<br>Garden Grove, CA 92843<br>(714-971-2421) | S | Enhanced surveillance and response program for mosquito-borne viruses |

| | | | | |
|---|---|---|---|---|
| Orange County Public Works: Operations and Maintenance, Planning, and Infrastructure Programs<br><br>Mission: Protect and enrich the community through efficient delivery and maintenance of public works infrastructure, planning, and development services. | Flood Season Erosion Control<br>Policies and Procedures | OC Public Works<br>O&M<br>2301 Glassell Street, Building A<br>(714)955-0200 | S | Coordinate overall "Flood Season" erosion control efforts to minimize erosion and deposition of sediment on private and public properties. |
| | 7-Year Flood Control Capital Improvement Program | OC Public Works<br>Infrastructure Programs<br>300 North Flower Street<br>Santa Ana, CA 92702<br>(714-834-2300) | S | Coordinates the 7-year Capital Improvement Program with regard to flood control. |
| | OC Public Works Plans and Manuals | OC Public Works<br>Infrastructure Programs<br>300 North Flower Street<br>Santa Ana, CA 92702<br>(714-834-2300) | S | Orange County Hydrology Manual; Orange County Flood Control District Design Manual; Orange County Drainage Design Criteria and Aids; Orange County Standard Plans for Public Works Construction; Americans with Disabilities Act 2 and 3 |
| | Orange County Zoning Code | OC Planning<br>300 North Flower Street<br>Santa Ana, CA 92703<br>(714-834-2300) | S | To provide a guide for the growth and development of the County in accordance with the Government Code. |

| Agency Name (Mission/Function) | Programs, Plans, Policies, Regulations, Funding, or Practices | Point of Contact Name, Address, Phone, Email | Effect on Loss Reduction*<br><br>Support<br>Facilitate<br>Hinder | Comments |
|---|---|---|---|---|
| Orange County Public Works<br><br>(Continued) | Orange County Grading Code | OC Planning<br>300 North Flower Street<br>Santa Ana, CA 92703<br>(714-834-2300) | S | This Code sets forth rules and regulations to control excavation, grading and earthwork construction, including fills and embankments, and establishes administrative requirements for issuance of grading permits and approval of plans and inspection of grading construction in accordance with the requirements for grading and excavation as contained in the Uniform Building Code then in effect as adopted and modified by County ordinance as well as water quality requirements relevant to activities subject to this article. |
| | California Building Code 2007, International Building Code 2006 | | S | The purpose is to prescribe regulations for the erection, construction, enlargement, alteration, repair, improving, removal, conversion, demolition, occupancy, equipment, use, height, area and maintenance of all buildings and structures. |
| OC Waste and Recycling | • Administers the Countywide Integrated Waste Management Plan (CIWMP).<br>• Administers municipal solid waste collection, recycling, and planning for the County unincorporated area. | Environmental Services<br>320 North Flower Street<br>Suite 400<br>Santa Ana, CA 92703<br>(714-834-4122) | S | To meet the solid waste disposal needs of Orange County through efficient operations, sound environmental practices, strategic planning, innovation and technology. |

| **Agency Name (Mission/Function)** | **Programs, Plans, Policies, Regulations, Funding, or Practices** | **Point of Contact Name, Address, Phone, Email** | **Effect on Loss Reduction*<br><br>Support<br>Facilitate<br>Hinder** | **Comments** |
|---|---|---|---|---|
| Orange County Sheriff's Department (OCSD)<br><br>Mission: To provide professional, responsive, and caring law enforcement services to the residents, visitors and businesses of Orange County. We believe a safe community can only exist through a partnership with our employees, residents, businesses and other public entities. | Orange County Emergency Operations Plan | OCSD, Emergency Management<br>2644 Santiago Canyon Road<br>Silverado, CA 92676<br>(714-628-7054) | S | To provide for the coordinated response and recovery from major emergencies and disasters. |
| | County of Orange and Orange County Fire Authority Hazard Mitigation Plan | OCSD, Emergency Management<br>2644 Santiago Canyon Road<br>Silverado, CA 92676<br>(714-628-7054) | S | Describes mitigation strategy, plans and projects within Orange County. |

# Chapter 7 Plan Resource Directory

The following resource directory lists the resources and programs that can assist county communities and organizations. The resource directory will provide contact information for local, county, regional, state and federal programs that deal with natural hazards.

## Multi-Hazard Resources

| County | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| Orange County Health Care Agency | 405 W. Fifth Street<br>Santa Ana, CA 92701<br>Website: http://www.ochealthinfo.com | | | |
| | Health Disaster Management<br>405 W. Fifth Street<br>Santa Ana, CA 92701<br>Website: http://healthdisasteroc.org | 714-834-3500 | | Coordinates the agency's emergency response functions and preparedness activities for all hazards |
| | Public Health Services (PHS)<br>1725 W. 17th Street<br>Santa Ana, CA 92706<br>Website: http://ochealthinfo.com/phs/ | 714-834-7700 | | Provides information and services related to communicable diseases, immunizations, and public health nursing |
| | PHS Environmental Health Division<br>1241 East Dyer Road, Suite 120<br>Santa Ana, CA 92705<br>Website: http://ochealthinfo.com/eh/ | 714-433-6000 | | Provides information and services related to food safety, water quality, and hazardous wastes |

| | | | | |
|---|---|---|---|---|
| Orange County Mosquito and Vector Control District | 13001 Garden Grove Blvd.<br>Garden Grove, CA 92843<br>Website: http://www.ocvcd.org | 714-971-2421 | | Dedicated to controlling mosquitoes, rats, Red Imported Fire Ants, and flies. |

| County | Address | Phone | Fax | Summary of Resources |
| --- | --- | --- | --- | --- |
| OC Public Works - Watershed & Coastal Resources<br><br>OC Environmental Resources<br><br>OC Public Works - Storm Operations Center | 300 North Flower Street<br>Santa Ana, CA 92703<br>Website: http://www.ocpublicworks.com/<br><br>Glassell Field Office<br>2301 North Glassell St.<br>Orange, CA 92865<br>Website: http://www.ocwatersheds.com | 714-834-2300<br><br>714-955-0600<br><br>714-955-0333 | 714-834-2395<br><br>714-955-0639 | Protects property and promotes public safety.<br><br>Provides near real time rainfall accumulations for Orange County.<br><br>Activated when heavy to extreme rainfall is predicted or occurs and/or when storm runoff conditions are such that there is a probability of flood damage. |
| Orange County Sheriff's Department Emergency Management Division | 2644 Santiago Canyon Road Silverado, CA 92676<br>Website:<br>http://www.ocgov.com/eoc | 714-628-7054 | 714-628-7154 | Provides emergency management and preparedness services to Orange County. |

| State | Address | Phone | Fax | Summary of Resources |
| --- | --- | --- | --- | --- |
| California Department of Conservation, Southern California Regional Office | 655 South Hope Street, #700<br>Los Angeles, CA 90017 | 213-239-0878 | 213-239-0984 | Provides services and information to promote environmental health, economic vitality, informed land-use decisions and sound management of the state's natural resources. |

| | | | | |
|---|---|---|---|---|
| California Resources Agency | 1416 Ninth Street, Suite 1311<br>Sacramento, CA 95814 | 916-653-5656 | | Restores, protects and manages the state's natural, historical and cultural resources. |
| California Department of Transportation (CalTrans) | Headquarters<br>1120 N Street<br>P.O. Box 942873<br>Sacramento, CA 94273-0001<br>Website: http://www.dot.ca.gov/<br><br>District 12 (Orange County)<br>3347 Michelson Drive, Suite 380<br>Irvine, CA 92612-7684<br>Website: http://www.dot.ca.gov/dist12/ | 916-654-5266<br><br>949-724-2000 | | Responsible for design, construction, maintenance and operation of highway system. |
| California Department of Water Resources (DWR) | 1416 Ninth Street<br>P.O. Box 942836<br>Sacramento, CA 94236-0001 | 916-653-5791 | 916-653-5028 | Operates and maintains the State Water Project, provides dam safety and flood control and inspection services, assists local water districts in water management and water conservation planning, and plans for future statewide water needs. |
| California Division of Forestry & Fire Protection (CAL FIRE) | 1416 Ninth Street<br>Post Office Box 944246<br>Sacramento, CA 94244-2460<br>Website: http://www.calfire.ca.gov/ | 916-653-5123 | | Responsible for all aspects of wildland fire protection, |

| **Federal** | **Address** | **Phone** | **Fax** | **Summary of Resources** |
|---|---|---|---|---|
| California Division of Mines and Geology (DMG) | 801 K Street<br>Sacramento, CA 95814<br>Website: http://www.consrv.ca.gov/cgs/ | 916-445-1825 | 916-445-5718 | Develops and disseminates technical information and advice on California's geology, geologic hazards, and mineral resources. |

| | | | | |
|---|---|---|---|---|
| California Geological Survey Headquarters,<br>Office of the State Geologist | 801 K Street<br>Sacramento, CA 95814<br>http://www.consrv.ca.gov/cgs/index.htm | 916-845-8162 | 916-323-7778 | Provides information on the geology, natural resources and geologic hazards of California. |
| DWR – California Data Exchange Center (CDEC) | Website: http://cdec.water.ca.gov/ | 916-574-1777 | | Provides real-time decision support system to DWR Flood Management and other flood emergency response organizations, providing operational and historical hydrologic and meteorological data, forecasts, and reports. |
| California Office of Emergency Services (Cal OES)<br><br>Cal OES – Southern Region (Los Alamitos) | Post Office Box 419047<br>Rancho Cordova, CA 95741-9047<br>Website: http://www.caloes.ca.gov<br>4671 Liberty Avenue<br>Los Alamitos, CA 90720 | 916-845-8911<br><br>562-795-2900 or 795-2941 | 916-845-8910<br><br>562-795-2877 | Coordinates overall state agency response to major disasters in support of local government. |

| **Federal** | **Address** | **Phone** | **Fax** | **Summary of Resources** |
|---|---|---|---|---|
| Federal Emergency Management Agency (FEMA) Region IX | 1111 Broadway, Suite 1200<br>Oakland, CA 94607<br>Website: http://www.fema.gov | 510-627-7100 | 510-627-7112 | Tasked with responding to, planning for, recovering from and mitigating against disasters. |
| Federal Emergency Management Agency (FEMA) Mitigation Division | 500 C Street, S.W.<br>Washington, D.C. 20472<br>Website: http://www.fema.gov | 202-566-1600 | | Manages the NFIP and oversees FEMA's mitigation programs. |

| **Federal** | **Address** | **Phone** | **Fax** | **Summary of Resources** |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Institute for Business & Home Safety | 4775 East Fowler Avenue<br>Tampa, FL 33617<br>Website: http://www.ibhs.org/ | 813-286-3400 | 813-286-9960 | Works to reduce death, injury, property damage, economic losses and human suffering caused by natural disasters. |
| United States Geological Survey | 345 Middlefield Road<br>Menlo Park, CA 94025<br>Website: http://www.usgs.gov/ | 650-853-8300 | | Provides reliable scientific information to describe and understand the Earth, minimize loss of live and property. |

## Flood Resources

### County

See Multi-Hazard Resources.

### State

See Multi Hazard Resources.

| Federal | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| American Public Works Association | 2345 Grand Boulevard, Suite 500<br>Kansas City, MO 64108-2641 | 816-472-6100 | 816-472-1610 | Provides a forum in which public works professionals can exchange ideas, improve professional competency, increase the performance of their agencies and companies and bring important public works-related topics to public attention in local, state and federal arenas. |

| Federal | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Association of State Floodplain Managers (ASFPM) | 2809 Fish Hatchery Road<br>Madison, WI 53713<br><br>Website: http://www.floods.org/ | 608-274-0123 | 608-274-0696 | Organization of professionals involved in floodplain management, flood hazard mitigation, the National Flood Insurance Program, and flood preparedness, warning and recover. |
| Bureau of Reclamation<br>Mid Pacific Region<br>Federal Office Building<br><br><br>Southern California Area Office | 2800 Cottage Way<br>Sacramento, CA 95825-1898<br><br>Website: http://www.usbr.gov/mp/<br><br>27710 Jefferson Ave., Suite 201<br>Temecula, CA 92590<br><br>Websites: http://www.usbr.gov/lc/ | 916-978-5000<br><br><br><br>909-695-5310 | 916-978-5599<br><br><br>909-695-5319 | Leadership and technical expertise in water resources development.<br><br><br>Responsible for water conservation, reclamation and reuse projects throughout southern California. |
| Floodplain Management Association (California) | P.O. Box 712080<br>Santee, CA 92072-2080<br><br>Website: http://www.floodplain.org/ | 619-204-4380 | | Promotes the reduction of flood losses and encourages the protection and enhancement of natural floodplain values through the use of effective wetland management strategies and engineering technologies. |
| National Flood Insurance Program (NFIP) | 500 C Street, S.W.<br>Washington, D.C. 20472<br>Websites: http://www.fema.gov/business/nfip/ | 202-566-1600 | | Flood Insurance Rate Maps, General Floodplain information. |
| | | | | |

| Federal | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| National Resources Conservation Service (NRCS)<br>US Department of Agriculture | 14th and Independence Ave., SW, Room 5105-A<br>Washington, D.C. 20250<br><br>Website: http://www.nrcs.usda.gov/ | 202-720-7246 | 202-720-7690 | Wetlands Reserve Program,<br>Flood Risk Management Program,<br>Emergency Watershed Protection Program. |

| | | | | |
|---|---|---|---|---|
| National Oceanic & Atmospheric Administration (NOAA)<br><br>National Weather Service (NWS)<br><br>National Weather Service Los Angeles/Oxnard Weather Forecast Office<br><br>National Weather Service San Diego Weather Forecast Office | 14th Street & Constitution Avenue, NW Room 6217 Washington, DC 20230<br><br>Website: http://www.noaa.gov/<br><br>1325 East West Highway Silver Spring, MD 20910<br><br>Website: http://www.nws.noaa.gov/<br><br>520 North Elevar Street Oxnard, CA 93030<br><br>Website: http://www.nwsla.noaa.gov/<br><br>11440 W. Bernardo Court, Suite 230 San Diego, CA 92172<br><br>Website: http://www.wrh.noaa.gov/sgx/index.php | 202-482-6090<br><br>Administrative: 805-988-6615<br><br>Forecast & Weather Info: 805-988-6610<br><br>858-675-8700 | 202-482-3154 | Primary source of weather data, forecasts and warnings for the United States and the sole US official voice for issuing warnings during lifethreatening weather situations.<br><br>Provides weather information for Los Angeles, Ventura, Santa Barbara, and San Luis Obispo counties, as well as adjacent coastal waters out 60 nautical miles.<br><br>Provides all the weather and flood warnings, daily forecasts, and meteorologic and hydrologic data for extreme Southwest California, including Orange, San Diego, Southwest San Bernardino, and Western Riverside counties.<br><br>NEXRAD (Next Generation Radar) obtains weather information (precipitation and wind) based upon returned |

| | | | | |
|---|---|---|---|---|
| Santa Ana Mountains Radar | Website: http://radar.weather.gov/radar.php?rid=sox | | | energy. |

| Federal | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| NWS Office of Hydrologic Development | 1325 East West Highway, SSMC2<br>Silver Spring, MD 20910<br><br>Website:<br>http://www.nws.noaa.gov/oh/index.html | 301-713-1658 | 301-713-0963 | Information of flooding, water, supply outlooks, current hydrologic conditions. |

| | | | | |
|---|---|---|---|---|
| US Army Corps of Engineers Operations Center (USACE OC)<br><br>Los Angeles District | 441 G. Street, NW<br>Room 3J50<br>Washington, DC 20314-1000<br><br>915 Wilshire Blvd., Suite 980<br>Los Angeles, CA 90017<br><br>E-Mail: publicaffairs-spl@usace.army.mil<br>Website: http://www.spl.usace.army.mil/ | 202-761-1001<br><br>213-452-3333 | | Responsible for protection and development of water resources. |
| USGS Water Resources | 6000 J Street, Placer Hall<br>Sacramento, CA 95819-6129<br><br>Website: http://water.usgs.gov/index.html | 916-278-3000 | 916-278-3070 | Current US water news, current and historical water data, and water survey programs. |

## Publications

| Title | Website | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| Floodplain Management: A Local Floodplain Administrator's Guide to the NFIP | http://www.fema.gov/business/nfip/ | 800-480-2520 | | Discussion for floodplain processes and terminology. |

| | | | | |
|---|---|---|---|---|
| NFIP Community Rating System Coordinator's Manual Indianapolis, IN | http://www.fema.gov/business/nfip/crs.shtm | 800-480-2520<br>317-848-2898 | | Detail the CRS point system and rating for community. |
| **Title** | **Website** | **Phone** | **Fax** | **Summary of Resources** |
| Reducing Losses in High Risk Flood Hazard Areas: A Guidebook for Local Officials, (February, 1987), FEMA-116 | Federal Emergency Management Agency<br>http://www.fema.gov | 800-480-2520 | | Opportunities for flood hazard mitigation, mapping assistance for floodplains. |

## Wildland/Urban Fires

| County | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| Orange County Fire Authority | One Authority Road<br>Irvine, CA<br>Website: http://www.ocfa.org | 714-881-2411 | | Principal agency responding to wildland/urban fires. |

| State | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| Office of the State Fire Marshal (OSFM) | 1131 "S" Street<br>Post Office Box 944246<br>Sacramento, CA 94244-2640 | 916-445-8200 | 916-445-8509 | Protects life and property through the development and application of fire prevention, engineering, education and enforcement. |

| Federal | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| Federal Wildland Fire Policy, Wildland/Urban Interface Protection | http://www.fs.fed.us/fire/management/policy.html | | | Report describing federal policy and interface fire. |
| National Fire Protection Association (NFPA)<br>Public Fire Protection Division<br>Firewise Program | 1 Battery March Park<br>Post Office Box 9101<br>Quincy, MA 02269-9101 | 617-770-3000 | | Principal Federal agency involved in the National Wildland/Urban Interface Fire Protection Initiative. |
| National Interagency Fire Center (NIFC) | 3833 South Development Avenue<br>Boise, Idaho 83705<br>Website: http://www.nifc.gov/ | 208-387-5512 | | Support center for wildland firefighting. |
| US Fire Administration FEMA Planning Branch Mitigation Directorate | 16825 South Seton Avenue Emmitsburg, MD 21727 Websites: http://www.usfa.dhs.gov/ | 301-447-1000 | | To reduce life and economic losses due to fire and related emergencies. |

### Publications

| Title | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| National Fire Protection Association Standard 299: Protection of Life and Property from Wildfire, | National Wildland/Urban Interface Fire Protection Program (1991)<br>National Fire Protection Association Publications<br>Washington, D.C.<br>Website: http://www.nfpa.org or http://www.firewise.org | 800-344-3555 | | Provides criteria for fire agencies, land use planners, architects, developers and local governments. |

## Earthquake

### County

See Multi-Hazard Resources

| Regional | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| Southern California Earthquake Center (SCEC) | 3651 Trousdale Parkway, Suite 169<br>Los Angeles, CA 90089-0742 | 213-740-5843 | 213-740-0011 | Gathers new information on EQ and communicates to public. |

| State | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| Western States Seismic Policy Council (WSSPC) | 801 K St #1236, Sacramento, CA 95814<br>Website: http://www.wsspc.org/ | (916) 444-6816 | (916) 444-8077 | Website is great resource, with information clearly categorized from policy to engineering to education. |

### Publications

| Title | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| "Elementary Seismology" | C F Richter, pp 135-149; 650-653<br>Published by: W H Freeman and Company, San Francisco, CA | | | |
| "Faults of Southern California" | Southern California Earthquake Center, Website: http://www.scec.org/ | | | |

| Title | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| "Land Use Planning for Earthquake Hazard Mitigation: Handbook for Planners" | Myer R Wolf, et. Al.,(1986) University of Colorado, Institute of Behavioral Science, Nations Science Foundation<br>Contact: Natural Hazards Research and Applications Information Center, University of Colorado, 482 UCB, Boulder, CO 80309-0482 Website: http://www.colorado.edu/UCB/Research/IBS/hazards | 303-492-6818 | 303-492-2151 | Provides techniques that planners and others can utilize to help mitigate for seismic hazards. |
| "Late Quaternary Uplift and Earthquake Potential of the San Joaquin Hills, Southern Los Angeles Basin, California" | Geology, Volume 27, Page 1031-1034 (1999)<br>L. B. Grant, K J Mueller, E M Gath, H. Chang, R L Edwards, R Munro and G L Kennedy | | | |
| "Seismic Hazards in Southern California: Probable Earthquakes, 1994 to 2024" | Southern California Earthquake Center Website: http://www.data.scec.org/general/PhaseII.html | | | |

## Landslide

### County

See Multi-.Hazard Resources

### State

See Multi-Hazard Resources.

### Federal

See Multi-Hazard Resources

### Publications

| Title | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Planning for Hillside Development (1996) | Robert B. Olshansky, American Planning Association | | | Describes history, purpose and functions of hillside development. |
| **Title** | **Address** | **Phone** | **Fax** | **Summary of Resources** |
| Public Assistance Debris Management Guide (July 2000) | Federal Emergency Management Agency | | | Developed to assist local officials in planning, mobilizing, organizing and controlling large-scale debris clearance, removal and disposal operations. |

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|---|---|---|---|---|
| Unstable Ground: Landslide Policy in the United States (1987) | Robert B. Olshansky & J. David Rogers, Ecology Law Quarterly | | | History and policy of landslide mitigation in the US. |
| USGS Landslide Program Brochure | National Landslide Information (NLIC), United States Geologic Survey | | | General information on the importance of landslide studies, types and causes of landslides, rock falls, and earth flows. |

## Tsunami

| County | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| Orange County Sheriff's Department,<br>Emergency Management Division | Tsunami Coordinator<br>2644 Santiago Canyon Road<br>Silverado, CA 92676 | 714-628-7054 | 714-628-7154 | General information on the results of Tsunami related disasters. |

| Regional | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| National Tsunami Warning Center | 910 South Felton Street<br>Palmer AK 99645 | 907-745-4212 | 907-745-6071 | To rapidly locate and size major earthquakes, determine their tsunami potential, predict arrival times and run up and proved timely and effective information and warning bulletins. |

| State | Address | Phone | Fax | Summary of Resources |
|---|---|---|---|---|
| University of California, Irvine<br>Department of Earth Sciences | Elizabeth J. Ford, Department Manager<br>Croul Hall<br>Irvine, CA 92697-3100 | 949-824-3877 | | Study of tsunamis. |

| | | | | |
|---|---|---|---|---|
| University of Southern California<br>Department of Civil and Environmental Engineering<br>Tsunami Research Group | Dr. Costas E. Synolakis, Director<br>3620 Vermont Avenue<br>Kaprielian Hall 210<br>Los Angeles, CA 90089-2531 | 213-740-0603 | 213-744-1426 | Study of tsunamis. |

# Chapter 8 Appendices

## Appendix A: List of Acronyms

## Appendix B: List of Maps

## Appendix C: List of Figures

## Appendix A – List of Acronyms

| Acronym | Definition |
|---|---|
| A&W | Alert and Warning |
| AA | Administering Areas |
| AAR | After Action Report |
| AASHTO | American Association of State Highway and Transportation Officials |
| AB | Assembly Bill (State of California) |
| ACOE | US Army Corps of Engineers |
| ALERT | Automated Local Evaluation in Real Time |
| ARC | American Red Cross |
| ARES | Amateur Radio Emergency Services |
| ARP | Accidental Risk Prevention |
| ATC | Applied Technology Council |
| ATC20 | Applied Technology Council Form 20 |
| ATC21 | Applied Technology Council Form 21 |
| ATWC | Alaska Tsunami Warning Center |
| B/CA | Benefit/Cost Analysis |
| BCP | Budge Change Proposal |
| BFE | Base Flood Elevation |
| BLM | Bureau of Land Management |
| BMP | Best Management Practices |
| BNSF | Burlington Northern Santa Fe Railway |
| BOS | Board of Supervisors |
| BSA | California Bureau of State Audits |
| BSSC | Building Seismic Safety Council |
| CAER | Community Awareness & Emergency Response |
| CAL TECH | California Institute of Technology |
| ALARP | California Accidental Release Prevention |
| CALBO | California Building Officials |
| Cal OES | California Office of Emergency Services |
| CALEPA | California Environmental Protection Agency |
| CD | Civil Defense |
| CDBG | Community Development Block Grant |
| CDEC | California Data Exchange Center (DWR) |
| CAL FIRE | California Department of Forestry and Fire Protection |
| CDMG | California Division of Mines and Geology |
| CEC | California Energy Commission |
| CEO | Chief Executive Officer |
| CEPEC | California Earthquake Prediction Evaluation Council |
| CERT | Community Emergency Response Team |
| CESRS | California Emergency Services Radio System |
| CFR | Code of Federal Regulations |
| CFS | Cubic Feet Per Second |
| CHIP | California Hazardous Materials Identification Program |
| CHMIRS | California Hazardous Materials Incident Reporting System |
| CHP | California Highway Patrol |
| CIP | Capital Improvement Projects |
| CIWMB | California Integrated West Management Board |
| CLETS | California Law Enforcement Telecommunications System |
| CRS | Community Rating System |
| CSTI | California Specialized Training Institute |
| CUEA | California Utilities Emergency Association |
| CUPA | Certified Unified Program Agency |
| DAC | Disaster Application Center |
| DAD | Disaster Assistance Division (of Cal OES) |

| | |
|---|---|
| CALREP | California Radiological Emergency Plan |
| CALSTARS | California State Accounting Reporting System |
| CALTRANS | California Department of Transportation |
| CBA | Cost Benefit Analysis |
| CBO | Community Based Organization |
| CBSP | Commuter Bikeways Strategic Plan |

| | |
|---|---|
| DAE | Disaster Assistance Employee |
| DAMP | Drainage Area Management Plan |
| DCO | Defense Coordinating Officer |
| DFO | Disaster Field Office |
| DGS | California Department of General Services |
| DHS | Department of Homeland Security (US Government) |

| | |
|---|---|
| DHSRHB | California Department of Health Services, Radiological Health Branch |
| DMA | Disaster Mitigation Act |
| DMG | California Division of Mines and Geology |
| DO | Duty Officer |
| DOC | Department Operations Center |
| DOE | Department of Energy (US) |
| DOF | California Department of Finance |
| DOJ | California Department of Justice |
| DPA | California Department of Personnel Administration |
| DPIG | Disaster Preparedness Improvement Grant |
| DR | Disaster Response |
| DSA | Division of the State Architect |
| DSR | Damage Survey Report |
| DSW | Disaster Service Worker |
| DWR | California Department of Water Resources |
| EAP | Emergency Action Plan |
| EAS | Emergency Alerting System |
| EDA | Economic Development Administration |
| EDC | Economic Development Commission (Orange County) |
| EDIS | Emergency Digital Information System |
| EERI | Earthquake Engineering Research Institute |
| EICC | Emergency Information Coordination Center (FEMA) |
| EM | Emergency Management |
| EMA | Emergency Management Assistance |

| | |
|---|---|
| ER | Emergency Relief |
| ERT | Emergency Response Team |
| ESC | Emergency Services Coordinator |
| ESRI | Environmental Systems Research Institute |
| EWP | Emergency Watershed Protection (NRCS Program) |
| FAS | Federal Aid System |
| FAST | Field Assessment Team |
| FAY | Federal Award Year |
| FCO | Federal Coordinating Officer (FEMA) |
| FDAA | Federal Disaster Assistance Administration |
| FEAT | Flood Emergency Action Team |
| FEMA | Federal Emergency Management Agency |
| FFY | Federal Fiscal Year |
| FHWA | Federal Highway Administration |
| FIR | Final Inspection Reports |
| FIRM | Flood Insurance Rate Map |
| FIS | Flood Insurance Studies |
| FMA | Flood Mitigation Assistance (FEMA Program) |
| FP | Flood Plan |
| FRP | Federal Response Plan |
| FSR | Feasibility Study Report |
| FTE | Full Time Equivalent |
| FY | Fiscal Year |
| GIS | Geographic Information System |
| GMA | Growth Management Act |
| GNS | Institute of Geological and Nuclear Science (International) |
| GSA | General Services Administration |
| HAD | Housing and Community |

| | |
|---|---|
| EMD | Emergency Management Division (OCSD) |
| EMC | Emergency Management Council (Orange County) |
| EMI | Emergency Management Institute |
| EMMA | Emergency Managers Mutual Aid |
| EMS | Emergency Medical Services |
| EOC | Emergency Operations Center |
| EOP | Emergency Operations Plan |
| EPA | Environmental Protection Agency (US) |
| EPEDAT | Early Post Earthquake Damage Assessment Tool |
| EPI | Emergency Public Information |
| EPIC | Emergency Public Information Council |

| | |
|---|---|
| | Development (alternate - see HCD) |
| HAZMAT | Hazardous Materials |
| HAZMIT | Hazardous Mitigation |
| HAZUS | Hazards US |
| HCA | Health Care Agency |
| HCD | Housing and Community Development (alternate - see HAD) |
| HEICS | Hospital Emergency Incident Command System |
| HEPG | Hospital Emergency Planning Guidance |
| HIA | Hazard Identification and Analysis Unit |
| HMEP | Hazardous Mitigation Emergency Preparedness |

| | |
|---|---|
| HMG | Hazard Mitigation Grant |
| HMGP | Hazard Mitigation Grant Program |
| HMP | Hazard Mitigation Plan |
| HMPG | Hazard Mitigation Program Grant |
| HMPT | Hazard Mitigation Plan Task Force (Orange County) |
| HMST | Hazard Mitigation Survey Team |
| HUD | Housing and Urban Development (US) |
| IA | Individual Assistance |
| IBHS | Institute for Business and Home Safety |
| ICC | Increased Cost of Compliance |
| IDE | Initial Damage Estimate |
| IFG | Individual & Family Grant (program) |
| IHMT | Interagency Hazard Mitigation Team |
| IPA | Information and Public Affairs (Cal OES) |
| IRG | Incident Response Geographic Information System |
| LAMS | Los Angeles Metropolitan Statistical Area |
| LAN | Local Area Network |
| LEA | Local Enforcement Agency |
| LEMMA | Law Enforcement Master Mutual Aid |
| LEPC | Local Emergency Planning Committee |
| LIP | Local Implementation Plan |
| LUPIN | California Land Use Planning Information Network |

| | |
|---|---|
| NIFC | National Interagency Fire Center |
| NMFS | National Marine Fisheries Services |
| NOAA | National Oceanic and Atmospheric Administration |
| NPDES | National Pollutant Discharge Elimination System |
| NPP | Nuclear Power Plant |
| NPS | National Park Service |
| NRCS | National Resources Conservation Service |
| NSF | National Science Foundation |
| NTS | Natural Treatment System |
| NWS | National Weather Service |
| OA | Operational Area |
| OAEX | Operational Area Executive Board |
| OASIS | Operational Area Satellite Information System |
| OCC | Operations Coordination Center |
| OCD | Office of Civil Defense |
| OCEMO | Orange County Emergency Management Organization |
| OCFA | Orange County Fire Authority |
| OCHCA | Orange County Health Care Agency |
| OCPW | OC Public Works |
| OCSD | Orange County Sheriff’s Department |
| OCTA | Orange County Transportation Authority |
| OCWR | OC Waste and Recycling |

| | |
|---|---|
| M | Magnitude |
| MARAC | Mutual Aid Regional Advisory Council |
| MEP | Maximum Extent Practicable |
| MH | Multi-Hazard |
| MHID | Multi-Hazard Identification |
| MOU | Memorandum of Understanding |
| MSL | Meters above Sea Level |
| NAWS | National Warning System |
| NBC | Nuclear, Biological, Chemical |
| NCDC | National Climate Data Center |
| NDAA | National Disaster Assistance Act |
| NEMA | National Emergency Management Association |
| NEMIS | National Emergency Management Information System |
| NEXRAD | Next Generation of Radar |
| NFIP | National Flood Insurance Program |
| NFPA | National Fire Protection Association |
| NHMP | National Hazard Mitigation Plan (AKA 409 Plan) |
| NIBS | National Institute of Building Sciences |

| | |
|---|---|
| OEP | Office of Emergency Planning |
| OSD | Operations Support Division (Sheriff's Department) |
| OSFM | Office of State Fire Marshal |
| OSHPD | Office of Statewide Health Planning and Development |
| OSPR | Oil Spill Prevention and Response |
| PA | Public Assistance |
| PC | Personal Computer |
| PCH | Pacific Coast Highway |
| PDA | Preliminary Damage Assessment |
| PDMGP | Post Disaster Mitigation Grant Program |
| P-DMGP | Pre-Disaster Mitigation Grant Program |
| PDSD | Planning & Development Services Division |
| PEW | Project Evaluation Worksheet |
| PIO | Public Information Office |
| POST | Police Officer Standards and Training |

| | |
|---|---|
| PPA/CA | Performance Partnership Agreement/Cooperative Agreement (FEMA) |
| PSA | Public Service Announcement |
| PSTRG | Private Sector Terrorism Response Group |
| PTAB | Planning and Technological Assistance Branch |
| PTR | Project Time Report |
| RA | Regional Administrator (Cal OES) |
| RADEF | Radiological Defense (program) |
| RAMP | Regional Assessment of Mitigation Priorities |
| RAPID | Railroad Accident Prevention & Immediate Deployment |
| RDMHC | Regional Disaster Medical Health Coordinator |
| RDO | Radiological Defense Officer |
| REOC | Regional Emergency Operations Center |
| REPI | Reserve Emergency Public Information |
| RES | Regional Emergency Staff |
| RMP | Risk Management Plant |
| RPU | Radiological Preparedness Unit (Cal OES) |
| RRT | Regional Response Team |
| SAM | State Administration Manual |
| SARA | Superfund Amendments & Reauthorization Act |
| SARS | Severe Acute Respiratory Syndrome |
| SAVP | Safety Assessment Volunteer Program |
| SB | Senate Bill (State of California) |
| SBA | Small Business Administration |
| SCEC | Southern California Earthquake Center |
| SCO | California State Controller's Office |
| SEAO | Structural Engineers Association of Oregon |
| SEPIC | State Emergency Public Information Committee |
| SFHA | San Francisco Housing Authority |

| | |
|---|---|
| SONGS | San Onofre Nuclear Generating Station |
| SOP | Standard Operation Procedure |
| SWEPC | Statewide Emergency Planning Committee |
| TEC | Travel Expense Claim |
| TOR | Transfer of Development Rights |
| TRU | Transuranic |
| TTT | Train the Trainer |
| UCI | University of California Irvine |
| UCLA | University of California Los Angeles |
| UCSB | University of California Santa Barbara |
| UGB | Urban Growth Boundary |
| UPA | Unified Program Account |
| UPRR | Union Pacific Rail Road |
| UPS | Uninterrupted Power Source |
| URM | Unreinforced Masonry |
| USACE | United States Army Corps of Engineers |
| USAR | Urban Search and Rescue |
| USBR | United States Bureau of Reclamation |
| USC | University of Southern California |
| USDA | United States Department of Agriculture |
| USFA | United States Fire Administration |
| USFS | United States Forest Service |
| USGS | United States Geological Survey |
| WAN | Wide Area Network |
| WC | California State Warning Center |
| WEE | Western Equine Encephalomyelitis |
| WEROC | Water Emergency Response of Orange County |
| WGA | Western Governors' Association |
| WIPP | Waste Isolation Pilot Project |
| WNV | West Nile Virus |
| WSSPC | Western State Seismic Policy Council |

| | |
|---|---|
| SHMO | State Hazard Mitigation Officer |
| SLA | State and Local Assistance |
| SLE | St. Louis Equine Encephalitis |
| SNV | Sin Nombre Virus |
| SOC | Storm Operations Center |

## Appendix B - Table of Maps

Orange County Geomatics developed many of the maps included in this plan. The contributions from this department were essential in illustrating the extent and potential losses associated with the natural hazards affecting the County. The information on the maps in this plan was derived from the Orange County Public Works, Geomatics Office. Care was taken in the creation of these maps, but they are provided "as is." Orange County cannot accept any responsibility for any errors, omissions or positional accuracy, and therefore, there are no warranties that accompany these products (the maps). Although information from Land Surveys may have been used in the creation of these products, in no way does this product represent or constitute a Land Survey. Users are cautioned to field verify information on this product before making any decisions.

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## Appendix C - List of Figures and Tables

## Chapter 9 Attachments

**Attachment A: Hazard Mitigation Task Force Planning Documentation**

**Attachment B: Orange County Essential Facilities Risk Assessment Project Report (Hazus Analysis)**

**Attachment C: County of Orange Property Schedule**

**Attachment D: Project Status Reports**

# APPENDIX I

## APPENDIX I

## San Juan Basin Groundwater and Facilities Management Plan

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# APPENDIX J

# APPENDIX J

## Climate Change Analysis

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# Appendix J: Climate Change and Vulnerability in the South Orange County IRWM Planning Region

November 2016

*Laguna Beach, Source: Wikipedia Commons*

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# Abbreviations

AOGCM: Atmosphere-Ocean General Circulation Model

BCSD: Bias correction-spatial downscaling

CARB: California Air Resources Board

CDEC: California Data Exchange Center

CEC: California Energy Commission

CT: Center of Timing (of streamflow)

DCR (DRR) Delivery Capability (Reliability) Report

DWR: (California) Department of Water Resources

ETWD: El Toro Water District

GCM: General Circulation Model, or more commonly, Global Climate Model

GHG: Greenhouse Gas

IPCC AR4: IPCC Fourth Assessment Report

IPCC: Intergovernmental Panel on Climate Change

LBCWD: Laguna Beach County Water District

MNWD: Moulton Niguel Water District

MWD (Metropolitan): Metropolitan Water District (of Southern California)

MWDOC: Municipal Water District of Orange County

PCMDI: Program for Climate Model Diagnostics and Intercomparison

PDO: Pacific Decadal Oscillation

PRISM: Parameter-elevation Regressions on Independent Slopes Model

RCP: Representative Concentration Pathway

SCWD: South Coast Water District

SMWD: Santa Margarita Water District

SWE: Snow Water Equivalent

TAR: (IPCC) Third Assessment Report

TCWD: Trabuco Canyon Water District

USGS: United States Geological Survey

VIC: Variable Infiltration Capacity Model

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# EXECUTIVE SUMMARY

This document presents an updated assessment of the potential impacts of climate change on the water resources of South Orange County (South OC) in support of the Integrated Regional Water Management (IRWM) Plan being developed for the region.

Water supply in the planning region is largely obtained from imports. The Metropolitan Water District of Southern California (MWD) provides Orange County with the bulk of its water. According to its 2015 Urban Water Management Plan, in 2015 approximately one-third of the water imported to the county is from the State Water Project (SWP), and two-thirds from the Colorado River Aqueduct. The Municipal Water District of Orange County (MWDOC) is the primary entity interfacing with local water agencies in the South Orange County region. MWDOC distributes water to the local water agencies including El Toro Water District (ETWD), Trabuco Canyon Water District (TCWD), Moulton Niguel Water District (MNWD), Laguna Beach County Water District (LBCWD), Santa Margarita Water District (SMWD), South Coast Water District (SCWD), San Juan Capistrano, and San Clemente. Irvine Ranch Water District (IRWD) also supplies a portion of water to the region. The total water demand for all 9 districts in 2015 is 38,203 million gallons per year (or 110 million gallons per day, MGD), and 77% of it is imported from the Sacramento-San Joaquin and Colorado River basins.

Because of the role of imported water supply in South Orange County, potential impacts of climate change to water resources must be examined over a region broader than the IRWM planning area. Changes in observed climatic variables across this larger region representing the Western U.S. have been examined through data collected in the 20$^{th}$ century. Over this period, particularly in winter and spring, temperatures have risen across western North America. In the second half of the 20th century, the warming in the mountainous western North America has led to a higher rain-to-snow ratio, lower snow water content, decline in March snow cover, and a shift toward earlier annual snowmelt timing by 5 to 30 days. These observations support the need for incorporating climate change into long-term water resources planning efforts.

For estimating future climate conditions into the 21$^{st}$ century, global climate processes are represented using atmosphere-ocean general circulation models (AOGCMs or GCMs, also known as "global climate models"). Several published GCMs, developed by research groups worldwide, are in common use, and this work primarily makes use of CMIP5 model results which, build on CMIP3. GCMs are used to project future climate changes based on assumptions of different economic growth pathways and emissions of greenhouse gases, with RCP45 and RCP85, corresponding to B1 and A2 in CMIP3, being the most commonly used scenarios in various climate impact studies. No one model or emission pathway is the best estimate of the future, and, typically, most climate assessments utilize an ensemble of GCM results for evaluating future conditions. In this work, sixteen candidate climate models were selected for evaluation. The greenhouse gas (GHG) emission scenarios used are RCP26, RCP45, RCP60, and RCP85, and represent a range of conditions. GCM outputs are developed at a low resolution and need to be converted into a more spatially detailed form through downscaling, with statistical downscaling being the most commonly used approach. Statistical downscaling is based on the development of relationships between local-scale observations and large scale GCM projections, which are then used to estimate spatially resolved future climate projections. Results from three 21st century periods, statistically downscaled to areas of 1/8 degree latitude by longitude, or about 12 km by 12 km, were analyzed for impacts in the early, mid, and late 21st century, defined as 2010–2039, 2040–2069, and 2070–2099 respectively. The projected data summary for the South OC IRWM planning region show a small decrease in precipitation of slightly around an inch per year by mid- to late-21$^{st}$ century periods (Table ES-1). They also show an increase in temperature of about 3 $^{o}$F and 5 $^{o}$F over the same periods (Table ES-2). In general, climate models project more adverse conditions from the standpoint of water resources (i.e., warmer and drier) in the latter part of the 21$^{st}$ century compared to conditions observed in the second half of the 20$^{th}$ century.

**Table ES-1**
**Average projected change in precipitation in the IRWM Region for GCMs**

| Emission Scenario | Change in Average Precipitation (inches/year) | | |
|---|---|---|---|
| | **2010-2039** | **2040-2069** | **2070-2099** |
| RCP26 | -1.0 | -0.7 | -0.6 |
| RCP45 | -0.7 | -1.0 | -0.8 |
| RCP60 | -1.3 | -0.9 | -0.8 |
| RCP85 | -0.9 | -0.8 | -0.7 |

**Table ES-2**
**Average projected change in temperature in the IRWM Region for GCMs**

| Emission Scenario | Change in Yearly Average Temperature $^{o}$F | | |
|---|---|---|---|
| | **2010-2039** | **2040-2069** | **2070-2099** |
| RCP26 | 1.4 | 3.0 | 4.3 |
| RCP45 | 1.4 | 3.0 | 4.5 |
| RCP60 | 1.4 | 3.1 | 4.5 |
| RCP85 | 1.5 | 3.2 | 4.7 |

Several major planning studies have been performed in the regions supplying water to South OC that consider the impacts of climate change. Projected climate change conditions, typically obtained from statistical downscaling of an ensemble of models, have been used for developing plants in in both regions. A key feature that stands out from the comprehensive analyses that have been performed is that both the California Delta and the Colorado Basin are severely water constrained, where it will be challenging to meet current allocations in future years. In both regions, planning model projections indicate years where deliveries will sometimes fall short of allocations, over planning horizons that range from 20 to 50 years into the future, under conditions where no changes are made to the existing operational infrastructure of the system. Because the regions jointly affected by these basins are continuing to experience relatively rapid population growth, and anticipated increased in municipal demands, water planners must address the dual challenge of reduced supplies and increased demand.

Although variable at different points along the coast due to regional factors, in general, sea levels are rising globally due climate warming including expansion of ocean water and melting of land ice. Along the Pacific Coast, the highest values of sea level rise in Southern California have been reported at Newport Beach, near the study region, where the observed increase is 2.22 mm/year. These rates are projected to accelerate over the 21$^{st}$ century. A recent review of different calculation approaches by the National Academy of Sciences reported that global sea level is estimated to rise 8–23 cm (3-9 inches) by 2030 relative to 2000, 18–48 cm by 2050 (7-19 inches), and 50–140 cm (20-55 inches) by 2100. This review projects that sea level in Southern California is slightly higher than the global average because of land subsidence, and will rise 4–30 cm (2-12 inches) by 2030 relative to 2000, 12–61 cm (5-24 inches) by 2050, and 42–167 cm (17-66 inches) by 2100. Maps illustrating the effects of sea level rise to 2100 and a 100-year flood were developed for the IRWM planning region to identify areas that are vulnerable. An example map is shown in Figure ES-1.

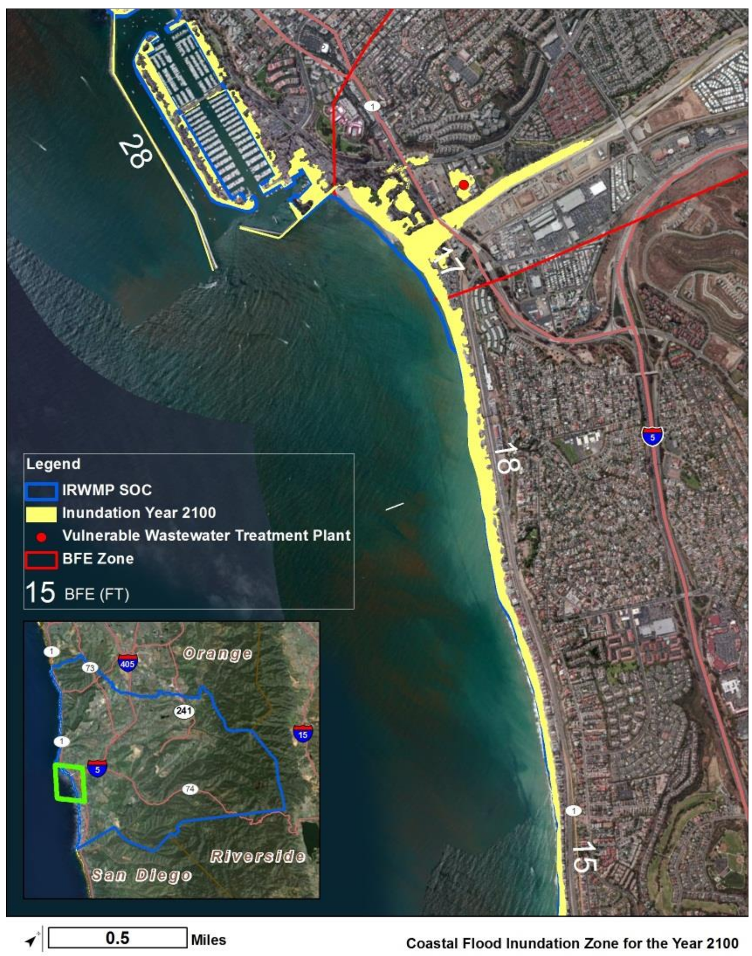


**Figure ES-1. Zoomed-in area of South OC coastline, identifying areas (in yellow) that are under flooding threat due to the combined effects of a 100-year flood and sea-level rise to 2100 (55 inches). Numbers along the coastline are FEMA's base flood elevation values in feet.**

Greenhouse gas emissions associated with the water sector were estimated for the South OC planning region. The General Reporting Protocol, Version 3.1, developed by the California Climate Action Registry is used to calculate indirect emissions of greenhouse gases (GHG) from electricity used for the water system in South Orange County. The water sector is the largest user of electricity in the state of California. The bulk of the water imported into southern California is transported over long distances up steep gradients and is therefore more energy expensive than local sources. Energy use for water is quantified via energy intensity, or the gross energy required for the water system to use a specific amount of water at a specific location. Under current conditions, the water sector in the region generates GHG emissions of over 93,000 metric tons in terms of carbon dioxide equivalent. Water projects that result in lower volumes of imports, through efficiency, conservation, or recycled water use, directly reduce GHG emissions, and have a climate change mitigation benefit.

An overall assessment of vulnerability to climate change for South OC was performed following a checklist presented in the Climate Change Handbook for Regional Water Planning, and specifically recommended for IRWM climate change planning. As noted above, the major water supply system vulnerabilities in this region are not unique, but are tied to the water supply system in California and the Colorado River Basin that are being evaluated through statewide or regional efforts. Besides water supply, other areas of potential concern for this planning region are coastal flooding due to sea level rise, increase in fire risk, and impacts to ecosystems.

The primary differences between this document and the previous version is the use of CMIP5 projections which build on the previous CMIP3 projections, and an assessment of the historic drought in California in terms of its place in history, the anthropogenic contribution from climate change, and insights related to extreme weather events. CMIP5 model results have been used to update climate projections in South OC. The Bureau of Reclamation used CMIP5 results to analyze the future water supply in the Sacramento-San Joaquin River Basins and the Colorado River Basins, and results pertinent to the present analysis are included in this report.

Looking forward, it is expected that climate change planning in support of the IRWM, as well as related activities, will be updated as better information on climate projections, including extreme events, become available, and impacts to other sectors, such as water quality and habitats will be similarly evaluated. Possible future work includes more detailed analysis of the effects of sea level rise in specific areas along the coastline and data collection on the wave climate (height, period, direction) in the region. From the standpoint of water supply and water quality, the impact of sea level rise on the Latham Wastewater Treatment Plant needs to be considered. The county may also interface with other research groups in the region that are evaluating the effects of large floods across California. These scenario runs show planners the extent of damage that may occur across the state, including in Orange County. This planning exercise informs local-level agencies to address the effects of major storm event, in a manner similar to that used for exercises related to earthquake preparedness in California. Longer-term planning studies, perhaps extending 50-75 years into the future may provide greater insight for planners in support of long-term infrastructure sustainability assessment and for investments with a lifetime greater than 20 years. Finally, the creeks and estuaries of the South OC region are home to several native fish species that are the focus of ongoing recovery efforts that may be affected adversely by climate change. A plan for continued monitoring of stream flows, water quality and temperature across the South OC region is recommended for understanding and managing these species impacts.

# 1. INTRODUCTION

Anthropogenic climate change is defined here as a long-term change in weather patterns, including averages and extremes of temperature, precipitation, sea levels, and winds, driven by changes in greenhouse gas (GHG) emissions. Climate change has been a focus of scientific analysis over the past three decades. Global warming is a commonly used term to refer to the increase in the average temperature of air and oceans observed since the mid-20th century and is projected to continue. There is evidence in the scientific literature, particularly as synthesized in the work of the Intergovernmental Panel on Climate Change (IPCC, 2013), that climate change is occurring and is likely to accelerate over the 21$^{st}$ century. Many climate related changes are already being seen in California and the Western United States through monitoring over the past decades. Although there is general agreement on some types of climatic changes (especially temperature), it is important to recognize that modeling of the climate system is very complex, and that there is uncertainty associated with projection of specific changes over the 21$^{st}$ century, especially when focused on a particular geographic region.

Given the direct dependence of water resources on climatic factors, the California Department of Water Resources (DWR) requires the evaluation of climate change as a component of the Integrated Regional Water Management (IRWM) process, as one of 16 required Plan Standards. The IRWM Plan Standards are components that must be part of an IRWM Plan and may be used to determine eligibility for specific projects (Draft IRWM Guidelines, DWR, 2012a). The intent of the Climate Change Standard is to ensure that IRWM Plans, describe, consider, and address the effects of climate change on their regions, and similarly, disclose, consider, and when possible, reduce GHG emissions. The goal of this document is to present an assessment of the potential impacts of climate change on the water resources of South Orange County (South OC) that addresses the IRWM plan standards.

A particular area of focus in this analysis is the water supply system in the IRWM planning region. South Orange County's sources of water include groundwater, supplies from the Municipal Water District of Orange County (MWDOC) via the Metropolitan Water District of Southern California (Metropolitan or MWD), and recycled water. Metropolitan water supplies constitute a large portion of South OC's water supply. In turn, water withdrawn in the Sacramento-San Joaquin Delta in Northern California, and conveyed through the State Water Project, and from the Colorado River system, and conveyed through the Colorado River Aqueduct, form the source of Metropolitan's water supplies. The future sustainability of the Northern California and Colorado River water supply sources are therefore of critical importance to the SOC's growing population and large economy. Figure 1-1 shows the South OC IRWM region and its topography.

Snowmelt, either from the Sierra Nevada or the Rockies, is a major component of the water supply to Metropolitan. A large fraction of the precipitation in western mountain regions falls on days with temperatures just a few degrees below freezing (Bales *et al.,* 2008). Thus, warming by even a few degrees might result in a large shift from snowfall to rainfall, a result of great consequence to the Western US and California, where snowpack represents a significant component of water storage during the year. In addition to the shift in storage, there may be impacts caused by the change in the total quantity of precipitation, and in length and severity of droughts across the large region that supplies water to South OC.

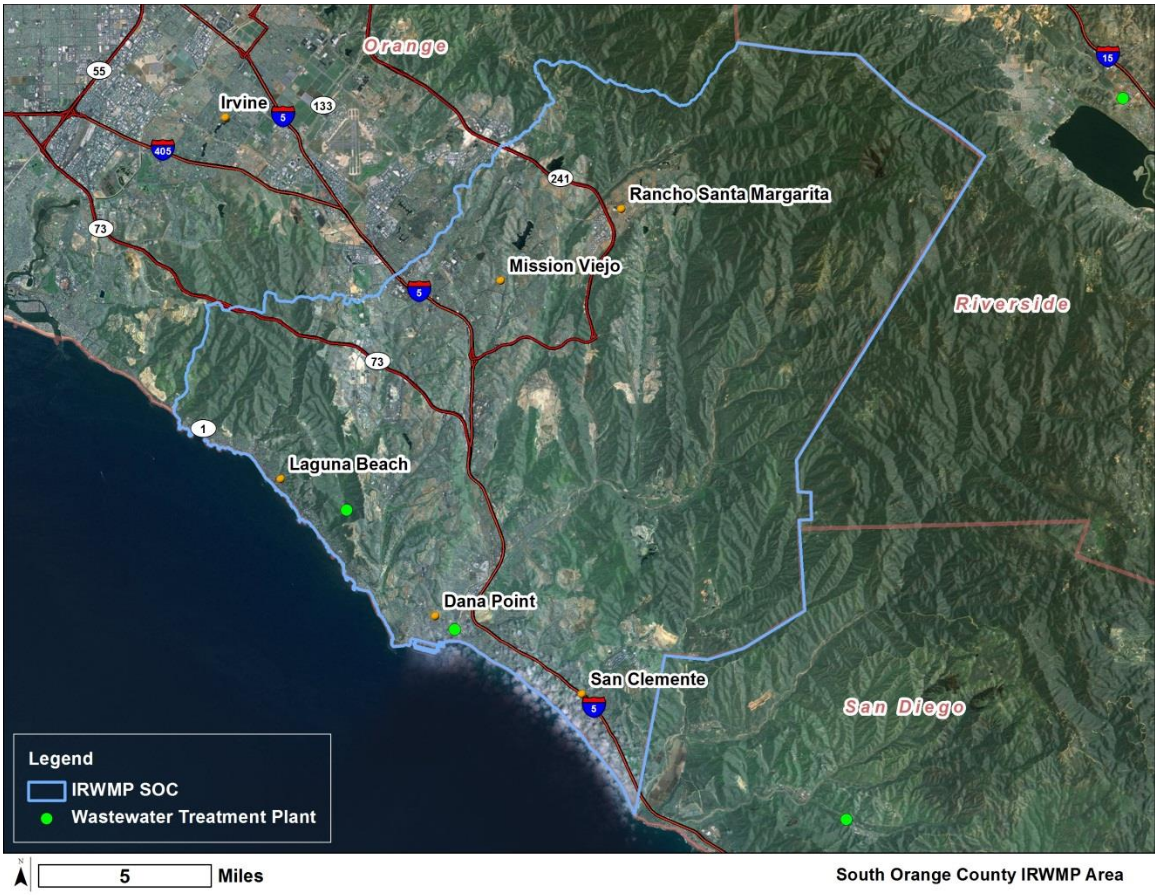


**Figure 1-1 Map showing the regional topography and relative locations and boundaries of the South Orange County IRWM planning region.**

Changes in precipitation distribution as a result of climate change are anticipated to result in more extreme wet events, with higher precipitation intensities and stormwater volumes, thus increasing the flood risk potential in the highly urbanized South OC region. Because local precipitation is not a major component of the water supply in the region, the flood risks in stream channels flowing through urbanized areas must be evaluated separately from the water supply risks identified above. The South OC region must also consider the potential of coastal flooding as a result of winter storms superimposed on sea levels that are higher than current levels.

This document is organized into the following topics:

- Description of source waters of South OC planning region (Chapter 2).

- Changes in the climate of Western North America as inferred from data records on temperature, flow, and precipitation in the twentieth century (Chapter 3).
- Downscaled projections of future climate from global climate models for the South OC region (Chapter 4).
- Climate change planning studies applicable to the regions providing water supplies to the IRWM region (Chapter 5).
- Greenhouse Gas (GHG) emissions as a consequence of the water system requirements in the South OC area and a methodology to calculate savings in GHGs proportional to water savings for proposed projects in the region (Chapter 6).
- Evaluation of sea level rise and associated impacts (Chapter 7).
- A climate change vulnerability assessment for the South OC region following the checklist presented in the Climate Change Handbook for Regional Water Planning (DWR, 2011) (Chapter 8).

The IRWM climate change standard requirements and the information provided in this document are related for each major area of assessment below:

#### Regional Vulnerabilities

- **IRWM Standard:** A discussion of the potential effect of climate change on the IRWM region, including an evaluation of the IRWM region's vulnerabilities to the effects of climate change and potential adaptation responses to those vulnerabilities. The evaluation of vulnerabilities must, at a minimum, be equivalent to the vulnerability assessment contained in the Climate Change Handbook for Regional Water Planning (DWR, 2011)
- **Presentation in this report:** The pertinent information in presented in Chapters 3, 4, 7, and 9.

#### GHG Emissions

- **IRWM Standard:** A process that discloses and considers GHG emissions when choosing between project alternatives and mitigation strategy.
- **Presentation in this report:** GHG emissions associated with the water sector in the planning region and with the specific projects are presented in Chapters 6 and 8.

#### Vulnerability Assessment

- **IRWM Standard:** A list of prioritized vulnerabilities based on the vulnerability assessment and the IRWM's decision making process.
- **Presentation in this report:** Key vulnerabilities of climate change in the South OC region are discussed in Chapter 9.

#### Future Evaluation

- **IRWM Standard:** A plan, program, or methodology for further data gathering and analysis of the prioritized vulnerabilities.

- **Presentation in this report:** Because of the unique situation that almost all of the region's water supply is imported, the water supply vulnerability—a key concern from the standpoint of the IRWM—is addressed through the ongoing regional efforts in California and in the Colorado Basin as discussed in Chapter 5. Potential future actions are described in Chapter 10.

# 2. SOURCE WATERS OF SOUTHERN ORANGE COUNTY

***Key Points:*** *Much of the water supply in South Orange County is imported from outside the region, with supplies from the State Water Project and the Colorado Aqueduct providing approximately 1/3 and 2/3 of the total supply in 2015. The Municipal Water District of Orange County (MWDOC) distributes imported water to local water agencies in the South Orange County region. Recycled water and local groundwater are two additional sources of water that are significant in some districts.*

## 2.1 SOURCE WATERS

Imported water is the primary source of water in Southern Orange County (SOC), with recycled water and ground water also making a significant contribution to some districts. Water imported to SOC is provided by the Metropolitan Water District of Southern California (Metropolitan), via the Municipal Water District of Orange County (MWDOC) which interfaces with nine local water agencies in the region[1]. The water distribution organizational structure for South Orange County is shown in Figure 2-1. Metropolitan water is imported from the Colorado River via the Colorado River Aqueduct (CRA), and the State Water Project (SWP) by way of the California Aqueduct (Figure 2-2).

[1]El Toro Water District (ETWD), Trabuco Canyon Water District (TCWD), Moulton Niguel Water District (MNWD), Laguna Beach County Water District (LBCWD), Santa Margarita Water District (SMWD), South Coast Water District (SCWD), Irvine Ranch Water District (IRWD), San Juan Capistrano, and San Clemente. The Emerald Bay Service District, a small water agency, purchases its water from LBCWD. (MNWD), Laguna Beach County Water District (LBCWD), Santa Margarita Water District (SMWD), South Coast Water District (SCWD), Irvine Ranch Water District (IRWD), San Juan Capistrano, and San Clemente. The Emerald Bay Service District, a small water agency, purchases its water from LBCWD. (MNWD), Laguna Beach County Water District (LBCWD), Santa Margarita Water District (SMWD), South Coast Water District (SCWD), Irvine Ranch Water District (IRWD), San Juan Capistrano, and San Clemente. The Emerald Bay Service District, a small water agency, purchases its water from LBCWD.

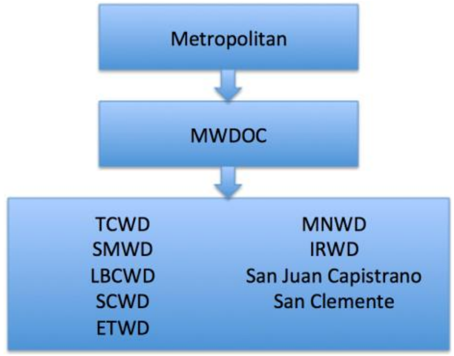


**Figure 2-1 Organizational structure of water agencies in Southern Orange County.**

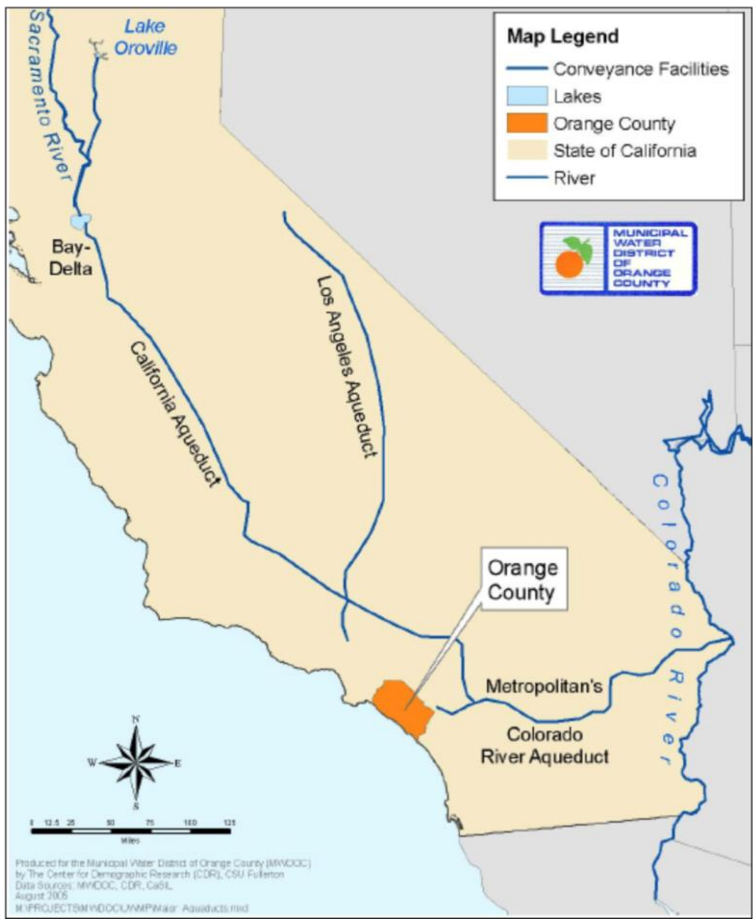


**Figure 2-2 Major aqueducts providing water to southern California. (Source: from MWDOC 2015 Urban Water Management Plan)**

The quantity of water provided by Metropolitan from each source is shown in Figure 2-3, where it can be seen that in 2015 approximately two thirds of the water was supplied by the Colorado River Aqueduct, with SWP supplying the other third. In Chapter 5, these water resources are examined in the context of climate change.

According to the MWDOC 2015 Urban Water Management Plan, imported water accounts for about 35% of the water supplied by MWDOC, with groundwater accounting for the majority of local supplies. However, most this water resides in the northern or central regions, and the majority of the demand in Southern Orange County is met with imported water.

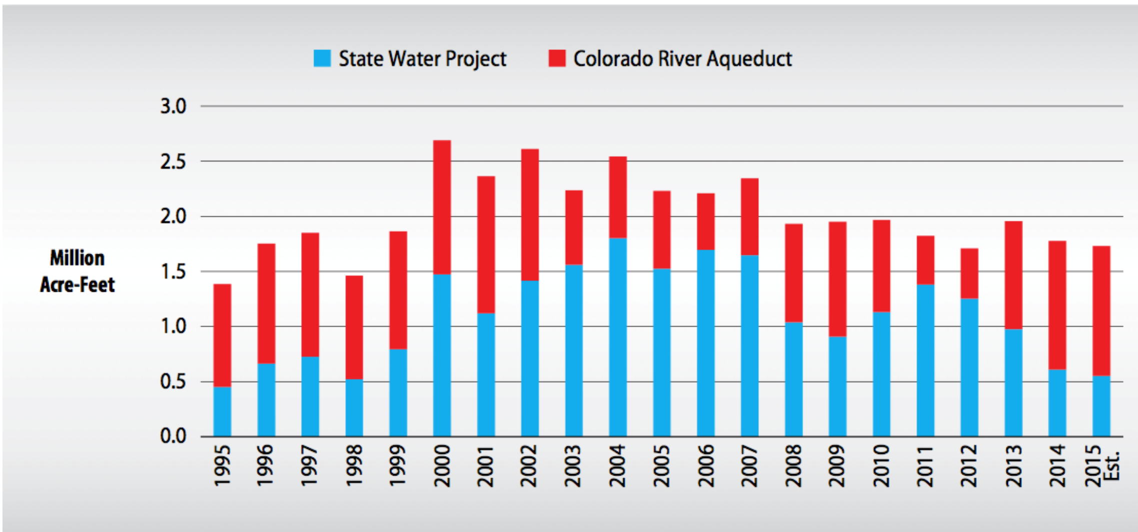


**Figure 2-3** **Imported water to Metropolitan service area from 1995 to 2015 by source in Million Acre Feet. (Source: MWDOC 2015 UWMP).**

## 2.2 LOCAL WATER AGENCIES AND WATER USE

The nine local water agencies interfacing with MWDOC receive the bulk of their water from MWDOC. The service areas for the water agencies are shown in Figure 2-4. **Error! Reference source not found.** presents the 2015 water demand for the agencies in Southern OC, as reported in each agencies 2015 Urban Water Management Plan.

**Table 2-1**
**2015 Water Demand and Sources by South Orange County Water Agency, Obtained from the 2015 Urban Water Management Plan for each Agency. All Units in Millions of Gallons (MG). Recycled Surface Water and Recycled Water Have Been Consolidated into "Recycled."**

| Water Agency | Water Demand | MWDOC | Groundwater | Recycled |
|---|---|---|---|---|
| El Toro Water District | 2,980 | 2,818 | 0 | 162 |
| Trabuco Canyon Water District | 1,207 | 945 | 0 | 262 |
| Moulton Niguel Water District | 11,344 | 8,741 | 0 | 2,603 |
| Laguna Beach County Water District | 1,183 | 1,183 | 0 | 0 |
| Santa Margarita Water District | 11,211 | 8,769 | 0 | 2,442 |
| South Coast Water District | 2,207 | 1,869 | 58 | 278 |
| Irvine Ranch Water District[1] | 2,258 | 457 | 1,242 | 559 |
| San Juan Capistrano | 2,780 | 1,778 | 838 | 164 |
| San Clemente | 3,033 | 2,906 | 38 | 90 |
| Total[2] | 38,203 | 29,466 | 2,176 | 6560 |

[1]Only a portion of the IRWD service area falls within South Orange County (8,658 acres out of 115,840 acres, or 7.5%), so the values for IRWD were scaled by the percentage of area overlap, 7.5%, for inclusion in this table.

[2]The Emerald Bay Service District (EBSD) is not separately listed in this table, because it purchases its water from LBCWD and is too small to be required to prepare its own Urban Water Management Plan. EBSD purchased an average of 272 AF (89 MG) from LBCWD between 2011 and 2015, according to the LBCWD 2015 Urban Water Management Plan.

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Imported water from MWDOC accounted for an average of 77% of water demand in the South Orange County region in 2015. At the low end, IRWD imports 20% of its water, while on the opposite end of the spectrum, LBCWD imports 100% of its water. Four of the water districts currently access groundwater to supplement their imported water: IRWD (54%), SCWD (2.6%), San Clemente (1%), and San Juan Capistrano (30%). All but one district (LBCWD) count recycled water towards their total volume: ETWD (5.4%), TCWD (22%), MNWD (23%), SMWD (22%), SCWD (13%), IRWD (24%), San Juan Capistrano (6%), and San Clemente (3%).

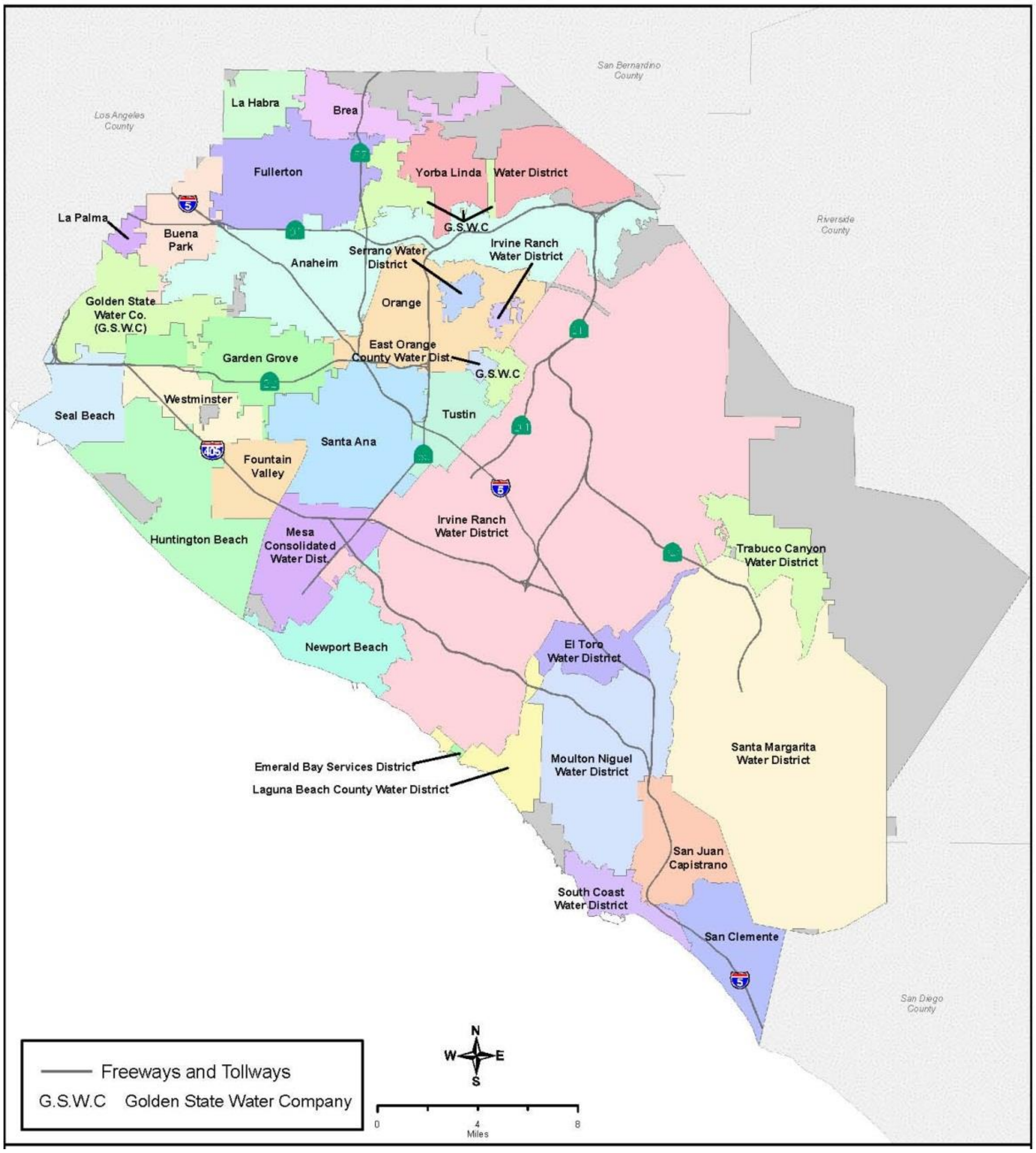


**Figure 2-4** **Map showing the regional water agencies that are part of the MWDOC service area. This IRWM plan is focused on the water districts in the southern portion of Orange County and identified in Figure 2-1.**

# 3. TWENTIETH CENTURY CLIMATE VARIABILITY IN THE WESTERN U.S. AND CALIFORNIA

***Key Points:*** *Because of the importance of imported water supply to South Orange County from the Sacramento-San Joaquin and Colorado River basins, potential impacts of climate change to water resources must be examined over a region broader than the IRWM planning area. During the 20th century, particularly in winter and spring, temperatures have risen across western North America. In the second half of the 20th century, the warming in the mountainous western North America has led to a higher rain-to-snow ratio, lower snow water content, decline in March snow cover, a shift toward earlier annual snowmelt timing by 5 to 30 days, and changes in the timing of biological events, such as flower blooming. These changes illustrate the effects of climate change on the hydrology of California's mountains, and indicate the need to predict 21st century changes in order that appropriate adaptation strategies to protect regional water-supply sources can be developed.*

*In California mean annual temperature increases of 0.6 °C, and winter and spring increases of 1.5 °C and 1 °C, have been documented, respectively, and these trends are unlikely to be solely due to natural variability. The late-spring and early-summer runoff fraction runoff of eight major rivers in the western Sierra Nevada in California have been decreasing since the mid-20$^{th}$ century. There is evidence of trends in climatic and hydrologic variables in western mountain environments in the second half of the 20$^{th}$ century – including temperature, precipitation, rain-to-snow ratio, snow water content, and snowmelt timing. It has been concluded that many of the changes already observed, are, to a high degree of confidence, attributable to climate change that has already occurred over the latter part of the 20th century.*

Because of the wide region from which South Orange County obtains its water supplies, spanning the Sacramento-San Joaquin River basins and the Colorado River basin (Figure 3-1), it is important to examine evidence of climate change over this region, including the role of climate change on snow accumulation and snowmelt in the mountainous portions of the basins. This chapter presents an overview of observed trends in temperature and precipitation in the region supplying water to South Orange County.

During the twentieth century, temperatures, particularly in winter and spring, have risen significantly across western North America (Dettinger and Cayan, 1995; Folland *et al*., 2001; Karoly *et al*., 2003; Bonfils *et al*., 2008a, b). In the second half of the 20$^{th}$ century, such warming in the mountainous western U.S. has led to:

- **a higher rain-to-snow ratio** (ACPI, 2004; Hamlet *et al*., 2005; Knowles *et al.*, 2006),
- **a lower snow water content** (Mote, 2003; Mote *et al.*, 2005; Regonda *et al.*, 2005; Knowles *et al.*, 2006),
- **a decline in March snow cover** (Groisman *et al.*, 2004); and,
- **a shift towards earlier annual snowmelt timing** by 5 to 30 days (Gleick, 1987; Roos, 1987, 1991; Lettenmaier and Gan, 1990; Wahl, 1992; Aguado et al., 1992; Pupacko, 1993; Dettinger and Cayan, 1995; Brown, 2000; Cayan *et al*., 2001; Mote *et al*., 2005; Regonda *et al*., 2005; Stewart *et al.*, 2005; Knowles *et al*., 2006; Maurer *et al*., 2007a).

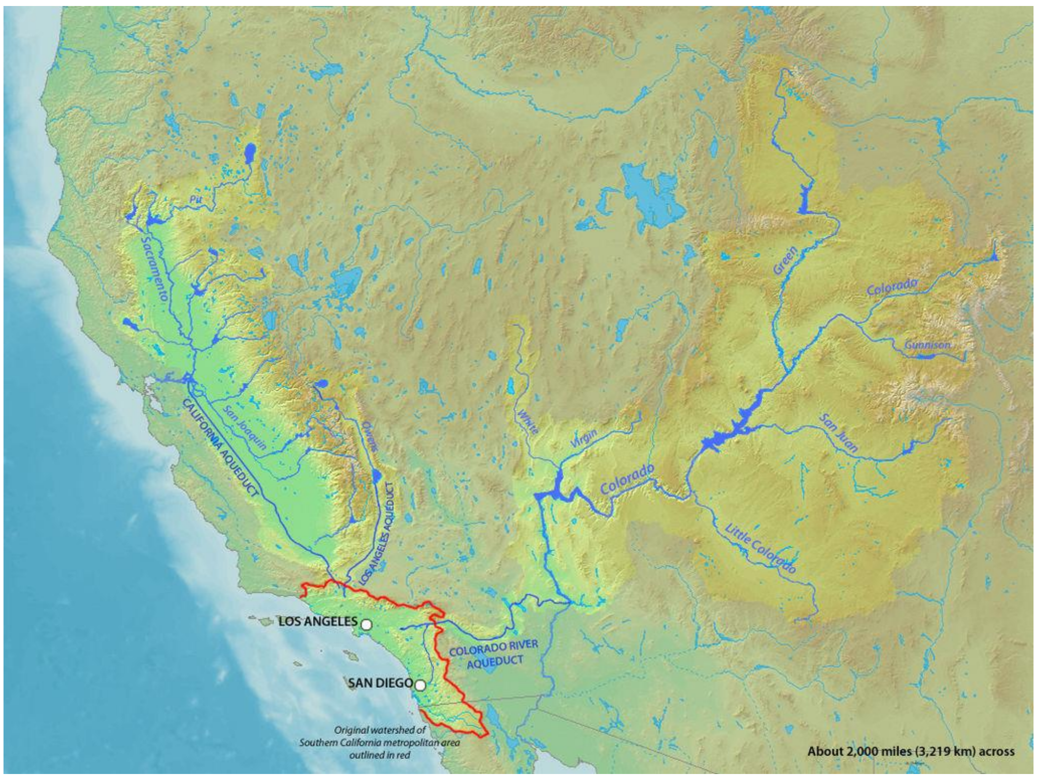


**Figure 3-1** **Map showing the Sacramento-San Joaquin and Colorado River basins relative to the area supplied by the Metropolitan Water District of Southern California (red border). (Source: Wikipedia Commons, http://en.wikipedia.org/wiki/File:SoCal_Watershed.jpg)**

The response of biological variables that are sensitive to climate have also been documented. These include:

- increasing tree mortality (Kelly and Goulden, 2008; van Mantgem et al., 2009);
- shifts in tree species (Thorne et al., 2008);
- earlier flower blooming (Cayan *et al.*, 2001);
- migration of small mammals to higher elevations (Moritz et al., 2008); and

- increased fire frequency (Westerling et al., 2009).

### 3.1 TRENDS IN TEMPERATURE AND PRECIPITATION

California has experienced a mean temperature rise of 0.6 °C, and winter and spring rises of 1.5 °C and 1 °C, respectively (Figure 3-2), which have been shown to be very unlikely due solely to natural variability (Cayan *et al.*, 2006).

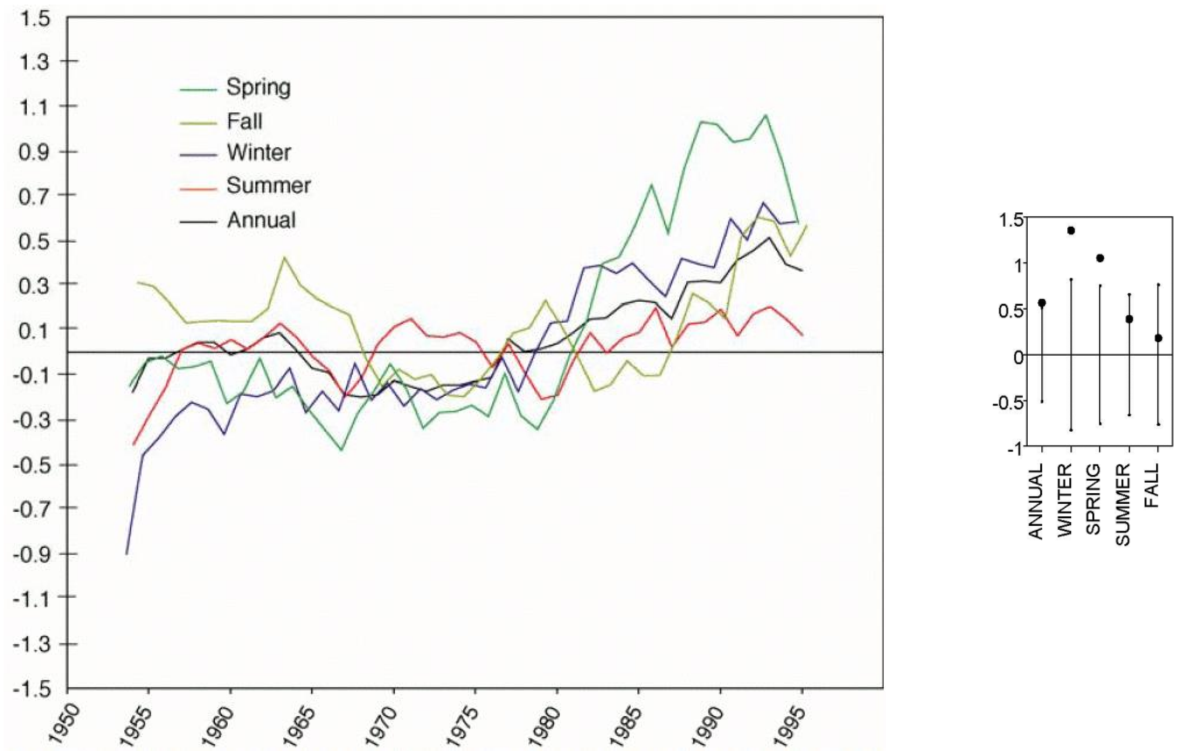


**Figure 3-2 Ten-year running average of temperature anomalies (°C) for California relative to the 1961-1990 base period average using annual (black), winter (blue), spring (green), summer (red), and fall (brown) means. The time-series are computed from the monthly 1/8-degree resolution gridded meteorological dataset from the University of Washington. Smaller inset plot shows estimated natural variability of California temperature without forcing (bars), and observed temperature change (dots) during the 1950-2000 historical record. Figure reproduced from Cayan *et al.* (2006, fig. 1).**

Mote *et al.* (2005) analyzed two separate temperature datasets covering western North America: A) A dataset combining the U.S. Historical Climatology Network (USHCN) with the Historical Canadian Climate Database (HCCD). The USHCN is a subset of the National Weather Service Cooperative (COOP) data. B) The widely used PRISM[2] dataset created at Oregon State University (www.prism.oregonstate.edu) by interpolating temperature and precipitation measured at climate stations. Mote *et al.* (2005) found particularly strong temperature trends for the period 1950-1997 over the entire western region (Figure 3-3(a)). Also using the PRISM data set as well as from NOAA Climate Division averages, Stewart *et al.* (2005) also found rising temperature trends in the range 0.5-2.0 °C (33-35.5 °F) for 1948-

[2] PRISM stand for Parameter-elevation Regressions on Independent Slopes Model.

2002. For precipitation, Mote *et al.* (2005) found increasing trends over most of the west, excepting western Washington, western Oregon, and a portion of the Northern Rockies. These trends are shown in Figure 3-3 (b).

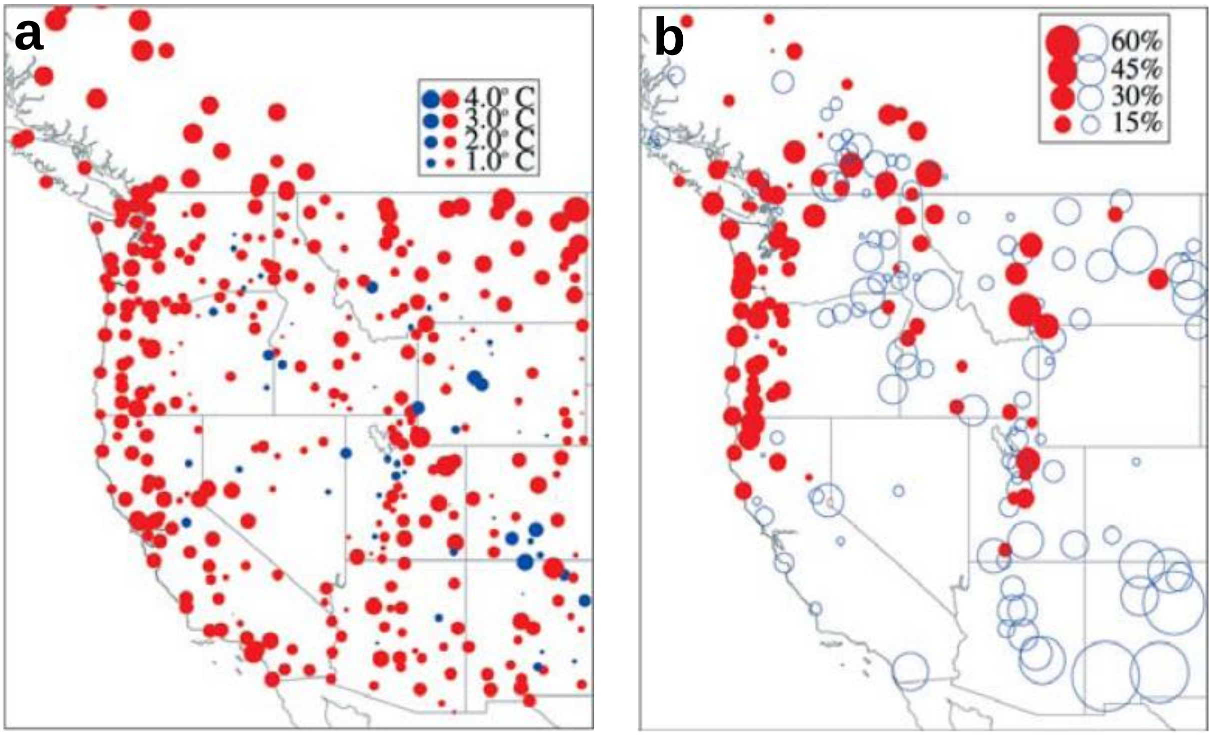


**Figure 3-3 Linear trends for 1950–1997 in winter (November-March) (a) temperature and (b) precipitation. For temperature, negative trends are indicated by blue circles, and positive trends by red circles; and values are expressed as degrees per century. For precipitation, trends are given as a percentage of the starting value (1950): positive trends are shown as blue circles, while negative trends are shown as red circles. Figure reproduced from Mote *et al.* (2005, fig. 6).**

Regonda *et al.* (2005) analyzed the 1950-1997 COOP stations records for springtime warm spells. They defined a warm spell as a sequence of seven consecutive days with temperatures above 12 °C (53 °F). They found trends for earlier occurrence of warm spells at an overwhelming majority of COOP stations throughout the West (Figure 3-4 (a)). These trends were statistically significant over the entire Pacific Northwest and over most of Colorado, Utah, and Wyoming. Although present, the trend was not statistically significant for most stations in California, Arizona, or New Mexico. The exceptions were a few high-elevation stations (above 2,500 m, or 8,200 ft) in Sierra Nevada, as well as some in Colorado and Utah. In the case of these stations, the trend was towards later warm spells rather than earlier; however, such trends were rarely statistically significant. For precipitation, Regonda *et al.* (2005) showed a distinct north-south demarcation in the statistically-significant trends of winter precipitation in the coastal west (Figure 3-4 (b)). They suggest that these correspond to different influences of the ENSO and PDO cycles.

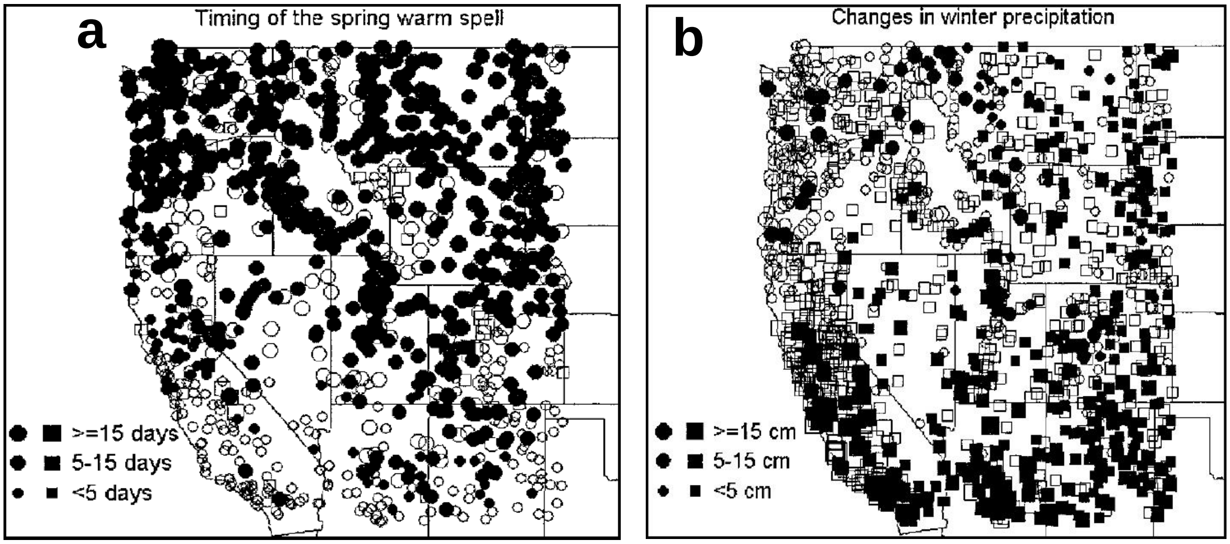


**Figure 3-4** **a) Changes in the timing of the spring warm spell (day) for each station location. Circles indicate earlier timing and squares indicate later timing of spring warm spells. b) Changes in winter (November-March) precipitation (cm). Filled and open symbols respectively indicate stations passing and failing two-tailed *t* tests of significance. Figure reproduced from Regonda *et al.* (2005, fig. 6a and b).**

### 3.2 TRENDS IN THE RAIN-TO-SNOW RATIO

Trends in the rain-to-snow ratio were analyzed by ACPI (2004), Hamlet *et al*. (2005), and by Knowles *et al.* (2006). The specific variable computed by Knowles *et al.* (2006) was the ratio of snowfall liquid water equivalent (SFE) to total winter precipitation (P), i.e., the ratio SFE/P. SFE is similar in definition to Snow Water Equivalent (SWE) but it differs from SWE in that it is a running total of daily snowfall, rather than an accumulated total for snow on the ground. Using COOP station records for 1949-2004, Knowles *et al.* (2006) found decreasing trends in SFE/P for the majority of stations throughout the coastal West (Figure 3-5 (a)), a trend that was unrelated to changes in total precipitation. SFE declines in the coastal West led to declines in the SFE/P ratio, implying an increase in the total amount of (liquid) rainfall, and a rise in the rain-to-snow ratio. Knowles *et al.* (2006) analyzed the minimum daily temperatures of days with precipitation (“wet days”). They found that “the largest reductions (in SFE) were shifts from snowfall to rainfall driven by warming and occurred at relatively warm, low to moderate elevations.” The rise in the proportion of rain versus snow was most pronounced at lower elevation watersheds (below about 2000 m) as shown in Figure 3-5 (b).

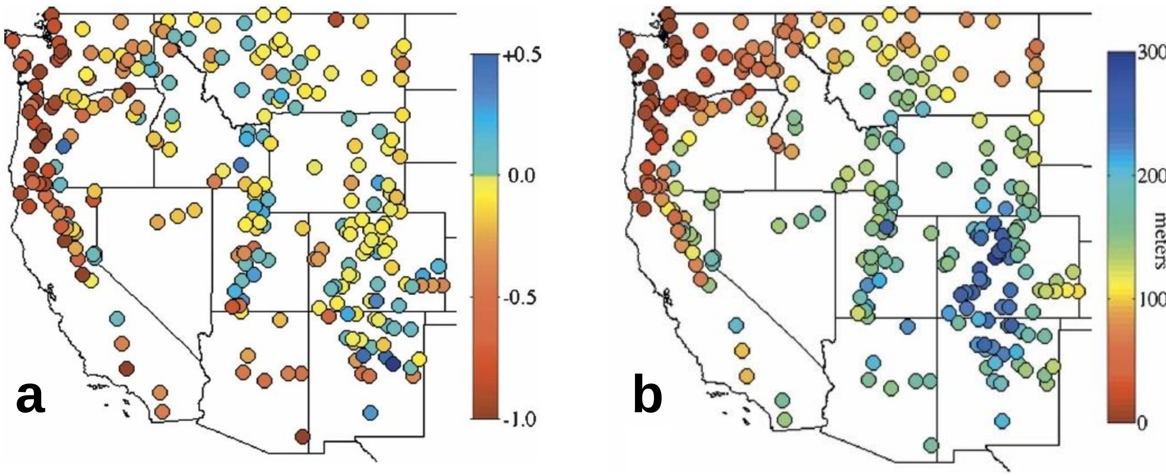


**Figure 3-5 a) Change, from water year 1949 to 2004, in the ratio of snowfall liquid water equivalent to total winter precipitation (SFE/P ratio), after removing the effects of trends in precipitation. Three-quarters of all stations experienced snowfall reductions as a result of widespread warming. b) Stations' elevations. Figures reproduced from Knowles *et al.* (2006, figs. 7 and 2b, respectively).**

### 3.3 TRENDS IN SNOW WATER EQUIVALENT

Trends in Snow Water Equivalent (SWE) in the West were studied by Mote (2003), Mote *et al.* (2005), Regonda *et al.* (2005), Hamlet *et al.* (2005), and Knowles *et al.* (2006). The studies by Mote (2003), Mote *et al.* (2005) and Regonda *et al.* (2005) looked at observed historical trends, and the study by Hamlet *et al.* (2005) used a simulated SWE dataset using the Variable Infiltration Capacity (VIC) distributed hydrological model. The study by Mote *et al.* (2005) used the records from 824 snow stations belonging to the Natural Resources Conservation Service (NRCS), the California Department of Water Resources, and the Ministry of Sustainable Resource Management for British Columbia. It was found that, in the period 1950–1997, April 1 SWE declined at most snow stations (Figure 3-6). In the coastal West, strong declines were found for western Washington, Oregon, and northern California. In the southern Sierra Nevada, however, the opposite trend was found at high-elevation stations. Mean winter temperature was found to be closely related to the identified SWE trends, the largest declines in SWE being associated with the warmest snow-dominated watersheds.

Regonda *et al.* (2005) analyzed snow records at NRCS snow stations containing at least 80% of data for 1950–1999 for March 1 SWE (469 stations), April 1 SWE (501 stations), and May 1 SWE (239 stations). However, this study did not include California snow survey data. Statistically-significant declines in SWE were found throughout the West for all three dates (shown for April 1 in Figure 3-7 (a)), with the lower-elevation stations (below about 2,500 m, or 8,200 ft) showing the greatest SWE losses (Figure 3-7 (b)).

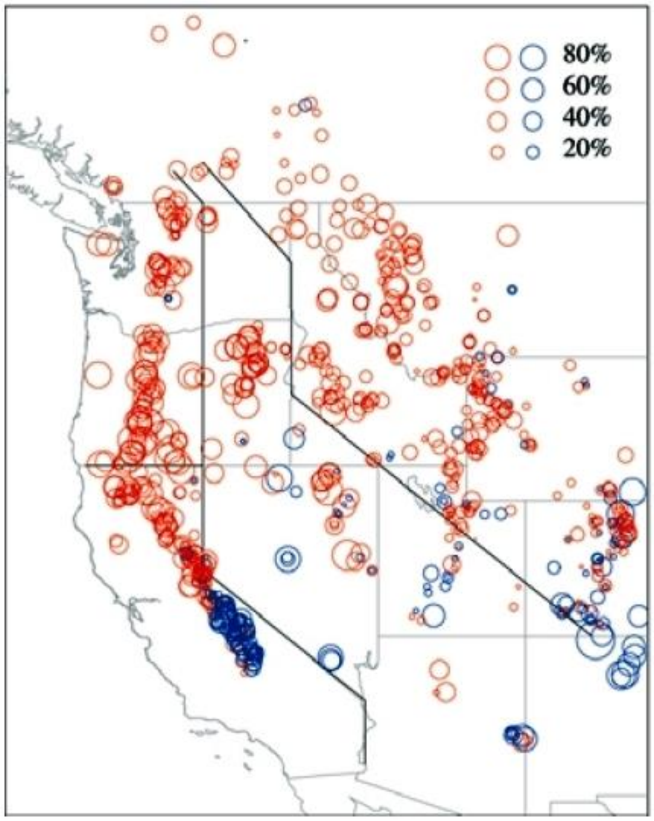


**Figure 3-6** **Linear trends in April 1 Snow Water Equivalent for 824 snow stations from 1950 to 1997, relative to the starting (1950) value. Negative trends are indicated in red, positive trends are in blue, and the size of the circle is proportional to trend size. Figure reproduced from Mote *et al.* (2005, fig. 1). Lines on the map divide the west into sub-regions for additional analysis in the original paper.**

a) b) c)

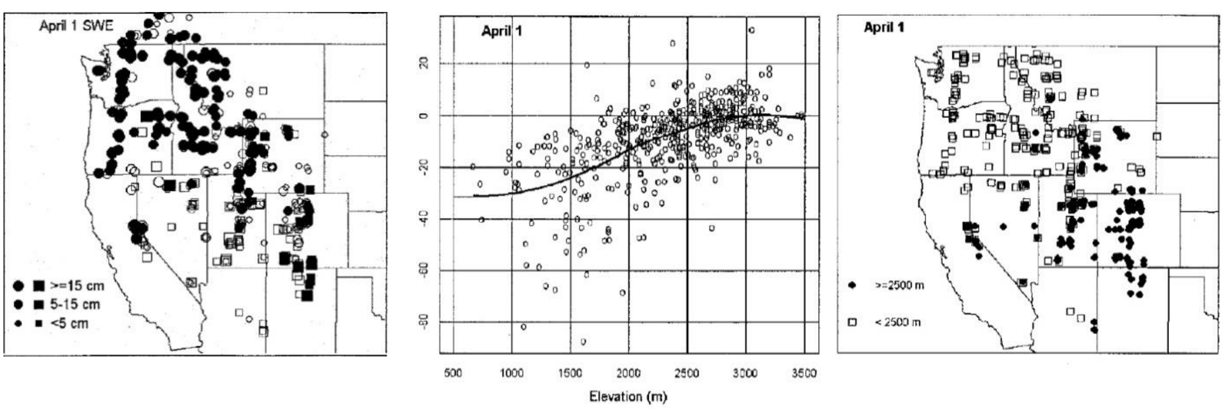


**Figure 3-7** **a) Trends in Snow Water Equivalent in accumulated snow pack for April 1. Circles and squares indicate decreasing and increasing values, respectively. Filled and open symbols respectively indicate stations passing or failing two-tailed *t* tests of significance. b) Scatterplot comparing the trends in SWE (cm) against snow-course elevation (m) for measurements taken on April 1. c) Map illustrating the spatial distribution of stations where the elevation is above or below 2,500 m. Figures reproduced from Regonda *et al.* (2005, figs. 4b and 5c,d).**

Hamlet *et al.* (2005) took a different approach, and rather than analyzing observed datasets, they created a simulated historical (1915-2003) dataset of hydrologic variables, including SWE, using the VIC model. The reasons given for the modeling approach were that A) most snow data was collected only after the 1950s, B) most snow data was collected only for a limited fraction of the West, and C) the ENSO and PDO generate a high degree of natural variability which confounds the analysis of observed data alone. Hamlet *et al.* (2005) concluded that *"(w)idespread warming has occurred in the western U.S. from 1916-2003, resulting in downward trends in 1 April SWE over large area of the domain"* and that *"results show that almost all the upward trends in SWE are due to modest upward precipitation trends and that many of the downward trends in SWE are caused by widespread warming"*.

### 3.4 Trends in Snowmelt Timing and Streamflow Timing

Of all the effects associated with warming in the West, the shift towards earlier annual snowmelt timing and earlier streamflow timing may have the most immediate and severe implications to water managers. These topics have been the focus of several recent studies (Gleick, 1987; Roos, 1987, 1991; Lettenmaier and Gan, 1990; Wahl, 1992; Aguado et al., 1992; Pupacko, 1993; Dettinger and Cayan, 1995; Brown, 2000; Cayan *et al*., 2001; Mote *et al*., 2005; Regonda *et al*., 2005; Stewart *et al.*, 2004, 2005; Knowles *et al*., 2006; Maurer *et al*., 2007a). The magnitude of the shift is estimated in the above studies to vary between 5 and 30 days.

Different measures of streamflow timing have been used in these studies. Roos (1991), Dettinger and Cayan (1995), and USGS (2005) analyzed the fraction of total annual streamflow represented by spring and summer streamflow – the seasons when in the West streamflow can be distributed for immediate use, or easily stored without interfering with flood-control concerns. Cayan *et al.* (2001) analyzed the date, termed the "spring-pulse date," separating low wintertime streamflows from high springtime streamflows resulting from snowmelt. In addition to the spring-pulse date, Stewart *et al.* (2004, 2005) analyzed other measures of streamflow timing: A) the *"center of mass of annual flow (CT)*" of each year's hydrograph, defined as the date by which half of the annual streamflow has passed; and B) the fraction of total annual streamflow contributed by each month of the year.

The U.S. Geological Survey (USGS) has maintained streamflow gages in the West since the late 19$^{th}$ century. Datasets are available at http://waterdata.usgs.gov/usa/nwis/sw. Based on these long records, significant declines in the fraction of annual runoff represented by spring runoff were found, including in the (western) Sierra Nevada (Figure 3-8).

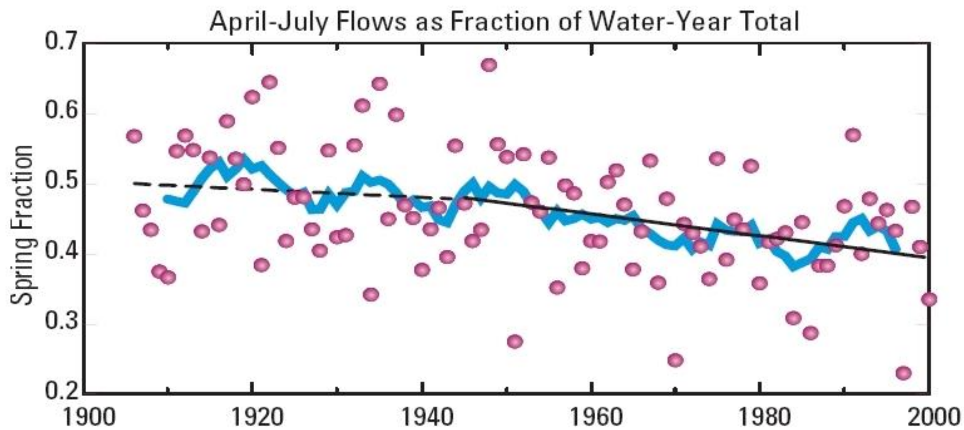


**Figure 3-8 April-July streamflow in eight major rivers of the western Sierra Nevada, California, as a fraction of water-year (October through September) total streamflow. Dots indicate yearly values, blue curve is 9-year moving averages, and dashed line is linear trend prior to 1945 and solid line is trend after 1945. Figure and legend reproduced from USGS (2005).**

Stewart *et al.* (2005) used records from 241 U.S. and 53 Canadian stream gages selected for representing approximate natural conditions (i.e., free from streamflow regulation and other human interference) in snowmelt-dominated watersheds, and having at least 30 years of data within 1948-2002. The U.S. gages are from the USGS Hydro Climate Data Network (HCDN), and the Canadian gages are from Environment Canada. Two-thirds of all stream gages, located throughout the West, revealed a shift in center of timing (CT) from the period 1950-1970 to the period post-1970 in the form of a shift to 1-4 weeks earlier (Figure 3-9). Over the period studied (1948-2002), there have been no significant trends in mean annual streamflows.

The center of mass of annual flow was also studied by Regonda *et al.* (2005) and several subsequent publications, receiving the simpler name "center of timing" in several of them (e.g., Maurer *et al.*, 2007a). Regonda *et al.* (2005) analyzed streamflow records for 89 gages (from the same, HCDN dataset) snowmelt-dominated watersheds with continuous records in 1950-1999. A shift towards earlier timing by 10-20 days was identified but was only statistically significant for the Pacific Northwest. The largest shifts occurred for the lowest-elevation stations; and stations located about 2,500 m (8,200 ft) revealed no trends.

Consistently across the west, there was an elevational dependence to the change in snowmelt timing, with a longer time shift observed at lower elevations (Dettinger *et al.*, 2004; Stewart *et al.*, 2005). Snow extent (Robinson, 1999) and depth (e.g., Groisman et al., 1994, 2003) have also decreased throughout the west, but mostly in valleys and plains which, since snow at such locations melts much earlier, are less crucial to water resources than mountain snowpack (Mote, 2005).

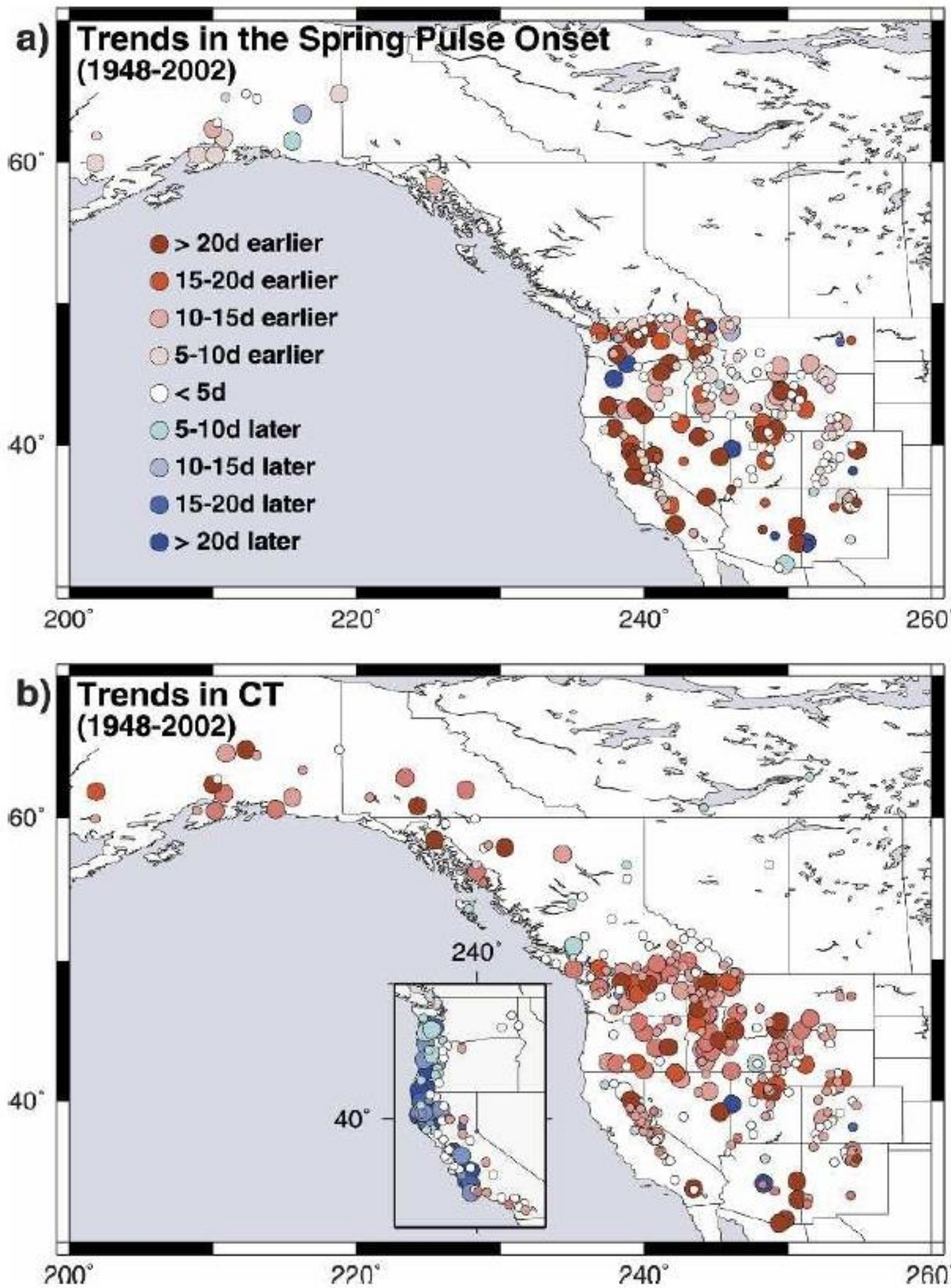


**Figure 3-9 Trends in a) spring pulse onset and b) date of center of mass of annual flow (CT) for snowmelt- and (inset) non-snowmelt-dominated stream gages. Shading indicates magnitude of the trend expressed as the change (days) in timing over the 1948-2000 period. Larger symbols indicate statistically significant trends at the 90% confidence level. Figure and (slightly edited) legend reproduced from Stewart *et al.* (2005, fig. 2).**

Along with a temperature rise, the Sierra also saw a precipitation rise in the 20th century – possibly an indirect effect of warming. At the lowest elevations (below about 2,300 m), the direct effects of warming – a partial shift from snow to rain, and increased winter snowmelt – have dominated the 20th century response to warming, resulting in diminished SWE. At elevations higher than about 2,600 m, however, it was the heightened snowfall that dominated, resulting in increased SWE instead. The increase at higher elevations in some areas partially offset and in others even surpassed the loss at lower elevations. The rise in high-altitude precipitation made it possible for the southern Sierra to experience the largest 20th century positive SWE trend, despite having had the largest temperature rise in California (Howat and Tulaczyk, 2005b).

Warmer air may need to rise up farther in order to produce snow, but on the other hand it can carry more moisture, hence warmer air can sometimes produce higher snowfall volumes. Such a gain in SWE during warming due to enhanced wintertime orographic precipitation has been termed the "snow gun effect" (Prentice and Matthews, 1991). Warmer air is more likely to retain considerable moisture as it passes over the Sierra's summit. Given that the southern Sierra has the steepest gradient of the western side of the Sierras, enhancement of orographic precipitation there can offset increased winter melt due to warming (Howat and Tulaczyk, 2005a, b).

Howat and Tulaczyk (2005a, b; see also Mote, 2006) concluded that, in the 20th century, snowpack trends have been mostly positive at high altitudes (generally above 2,600 m), due to an observed increase in precipitation (possibly a side-effect of warming); and that the 20th century snowpack of the southern Sierra Nevada (its highest altitude region) presented itself as a precipitation-dominated, rather than temperature-dominated, regime where trends in precipitation positively contributed on average 85% to trends in snow water equivalent (SWE). Knowles *et al.* (2006), using an observational dataset with greater distribution of elevations, examined the dependence of snow loss, specifically due to more winter precipitation falling as rain instead of snow, and found the largest impacts close to the snow line, where average minimum winter temperatures were above -5 °C. Most snow loss over recent decades has occurred at elevations below 2,000 m.

### 3.5 ATTRIBUTION OF TRENDS TO CLIMATE CHANGE

Studies have focused on the formal detection and attribution of change in hydrologic quantities to climate change. A recent research collaboration effort between the Scripps Institution of Oceanography at the University of California, San Diego, the Lawrence Livermore National Laboratory, and the U.S. Geological Survey produced a series of five published manuscripts describing detection and attribution – abbreviated as D&A for this discussion – of the causes of hydro-climatological change in the western United States. The first manuscript in the D&A series, by Barnett *et al.* (2008), used the output of GCM simulations for the historical period 1950–1999 to force a distributed hydrologic model. From the simulated results of the hydrologic model, three variables were studied representing some of the most important metrics of western hydrology: A) the snow pack's water content, B) the timing of runoff of the major western rivers, and C) the average January through March daily minimum temperature in the mountainous regions of the West. It was shown that the simultaneous changes in variables (A), (B), and (C) over the period 1950–1999 differed significantly in duration and strength from what would be expected as a result of natural variability. Furthermore, the changes agreed with those simulated under scenarios of human-induced changes in atmospheric composition (attribution).

The second manuscript in the D&A series, by Pierce *et al.* (2008), looked specifically at the Western snowpack. The detection variable used was the ratio of April 1 SWE to water-year-to-date precipitation (P), chosen to minimize the effect of inter-annual *P* variability on the results. To obtain estimates of natural internal climate variability, two control simulations using fully coupled ocean-atmosphere climate models over a simulation period of 1,600 years. These simulations were used to force a hydrologic model, producing estimates of the SWE/P. It was thus possible to characterize the (simulated) of SWE/P to anthropogenically-altered atmospheric composition (enhanced concentrations of greenhouse gases, ozone, and some aerosols). The D&A method showed that both the observed SWE/P and the simulated SWE/P with anthropogenically-altered atmospheric composition have greater reductions than can be explained by natural internal climate variability alone.

The third manuscript in the D&A series, by Bonfils *et al.* (2008b) focused on hydrologically relevant temperature variables from late winter to early spring. It was shown that the changes in mountain regions' observed temperature-based indices are unlikely, at a high statistical confidence, to represent natural variations; and it was concluded that anthropogenic climatic changes (i.e., changes resulting from to anthropogenic GHG, ozone, and aerosols) are partially responsible for those recent changes.

The fourth manuscript in the D&A series, by Hidalgo *et al.* (2009), uses an optimal detection method for trends in streamflow center timing (CT). A trend in CT over the U.S. West was detected at the $p<0.05$ (i.e., at the 95% confidence) level for the second half of the 20$^{th}$ century, which cannot be explained solely by natural variability. However, the western signal was dominated by the Columbia River Basin, and was found to be much weaker for Sierra Nevada watersheds (and not detected for the Colorado River Basin). Therefore, the authors made no definite statement regarding the attribution of trends in Sierra Nevada watersheds, and limited to the Columbia River Basin their statement of "very high confidence" of attribution of earlier streamflows in part to anthropogenic climate change (Hidalgo *et al.*, 2009, p. 3852).

The fifth and final manuscript in the D&A series, by Das *et al.* (2009) addresses the geographic structure (i.e., dependence on latitude, altitude, and geographical region) of observed trends in key hydrologic variables, including: A) late-winter and spring temperature, B) winter-total snowy days as a fraction of winter-total wet days, C) April 1 SWE as a fraction of October-March precipitation total (SWE/Precip(ONDJFM)), and D) March-March accumulated runoff as a fraction of water-year accumulated runoff. Observed changes were compared to natural internal climate variability simulated by an 850-yr control run of a GCM used to force a hydrologic model. Das *et al.* (2009) concluded that *"The strongest changes in the hydrologic variables, unlikely to be associated with natural variability alone, have occurred at medium elevations--750-2500m for JFM runoff fractions and 500-3000 m for SWE/Precip(ONDJFM)--where warming has pushed temperatures from slightly below to slightly above freezing."*

Taken together, these five recent studies provide strong evidence of the linkage of climate change to observed hydroclimatic quantities in the Western U.S. over the 20th century. While some of the changes are small, many cannot be explained by natural variability alone. Data and analysis of this kind provide scientific support for considering climate change for future planning.

## 3.6 Historical Extreme Events

Besides the shifts in temperature, snowmelt, and runoff discussed above, there is great interest in the potential impact of climatic extremes, such as large, intense winter storms and long term droughts.

Geologic evidence in the form of sediment deposits shows that extremely large floods caused by rainfall have occurred in California every 200 years or so (Dettinger and Ingram, 2013). The last such event was in 1861, which was a 43-day storm along the Pacific coast from Northern Mexico to British Columbia, that flooded the entire Central Valley and led to the loss of thousands of lives. It is thought that major rainstorms of this nature are the result of what are termed atmospheric rivers, narrow bands of moisture, which in the case of the California coast, bring heavy rain and snow from the tropics (often termed the "pineapple express"). Atmospheric rivers of this nature are thought to have been responsible for 80% of the flooding in California rivers and 81% of the best-documented levee breaks in the Central Valley between 1950 and 2010 (Dettinger and Ingram, 2013).

Long-term records such as tree rings and sediment deposits are also used to evaluate the historical occurrence of droughts over time frames longer than the direct observational record. The main finding from long-term tree-ring records from California is that decade-long dry periods are the rule rather than the exception, and that these dry periods tend to be relatively widespread, reflecting their link to larger scale atmospheric circulation established by ocean temperature and pressure patterns (Meko et al., 2001; Cook et al., 2004). Were one of these naturally occurring decadal droughts to recur, the consequences for water supply and other important ecosystem services would be significant.

## 3.7 Summary of Observed Changes

The work summarized here presents the best current understanding of observed data and trends on variables of interest to water resource planners: temperature, precipitation, rain-to-snow ratio, snow water equivalent, timing of snowmelt and streamflow. In most cases, the data are consistent with a pattern of warming and earlier snowmelt and runoff, although the precipitation and snow water equivalent data are mixed with some regions showing increases and others decreases. These observations are consistent with future climate projections, presented in the next chapter, that indicate agreement among models with regard to temperature increases, but with greater uncertainty with regard to future precipitation. Observed hydroclimatic data in the Western U.S. have also been examined to determine whether they could be explained by background variability alone. It has been concluded that many of the changes already observed, are, to a high degree of confidence, attributable to climate change that has already occurred over the latter part of the $20^{th}$ century. In addition to the recent trends in average conditions, studies focused on geologic evidence have demonstrated that extreme floods and droughts, beyond the range observed over the last 50 years of rapid growth and development in the Southwest, have occurred at a regular frequency, even in the absence of recent human-induced climate change.

# 4. CLIMATE PROJECTIONS FOR SOUTH ORANGE COUNTY FROM DOWNSCALED GCM RESULTS

***Key Points:*** *Global climate processes are represented using atmosphere-ocean general circulation models (AOGCMs or GCMs, also known as "global climate models"). Several published GCMs, developed by research groups worldwide, are in common use. GCMs are used to project future climate changes based on assumptions of different economic growth pathways and emissions of greenhouse gases, RCP2.6, RCP4.5, RCP6.0, and RCP8.5 being the most common scenarios used in various climate impact studies. It is widely understood in the climate science community that no one model or emission pathway is the best estimate of the future, and, typically, most climate assessments utilize an ensemble of GCM results for evaluating future conditions.*

*In this analysis, sixteen candidate climate models were selected for evaluation. The primary greenhouse gas (GHG) emission scenarios to be used for the climate projections are RCP4.5 and RCP8.5 which are the scenarios most closely aligned with the previously used A2 and B1. GCM outputs are presented in spatially more detailed form through downscaling, with statistical downscaling being the most commonly used approach. Statistical downscaling is based on the development of relationships between local-scale observations and large scale GCM projections, which are then used to estimate spatially resolved future climate projections. Results from three 21st century periods, statistically downscaled to areas of 1/8 degree longitude by latitude or about 12 km by 12 km, were analyzed for impacts in the early, mid, and late 21st century, defined as 2010–2039, 2040–2069, and 2070–2099 respectively.*

*The projected data summary for the South OC IRWM planning region show a small decrease in precipitation of up to an inch per year by mid- to late-21$^{st}$ century periods. They also show an increase in temperature from about 3 $^{o}$F and 5 $^{o}$F over the same periods. In general, climate models project more adverse conditions (i.e., warmer and drier) in the latter part of the 21$^{st}$ century compared to conditions observed in the second half of the 20$^{th}$ century.*

While observations can be used to infer the sensitivity of the climate system to perturbations in atmospheric composition, changes in land use and other conditions, incomplete spatial and temporal coverage of measurements, and a limited database of observed variables makes conclusive statements about causes and feedbacks in past climate difficult. For these reasons, atmosphere-ocean general circulation models (or more informally, global climate models, GCMs) are employed to provide a more complete picture of the climate response to emission changes. Several published GCMs, developed by research groups worldwide, are in common use. In recent climate impacts assessment, these models are used to develop projections for 21st century climatic conditions using various greenhouse gas emission scenarios as the driver (IPCC AR5, 2013).

This chapter presents local CMIP5 climate projections relevant to Orange County, after presenting an overview of the emission scenarios and GCMs used to make them.

## 4.1 EMISSION SCENARIOS

The Intergovernmental Panel on Climate Change (IPCC) requested the development of a new set of emissions scenarios, that is compatible with previous references and mitigation scenarios, for applying with different GCMs. This process and the resulting scenarios called representative concentration pathways (RCPs) are described in (Moss, 2012). Each emission scenario is a projection based on assumptions regarding population, economic growth, energy use and other variables. The emissions scenarios used in this paper are RCP26, RCP45, RCP60, and RCP85, where the number represents the radiative forcing in 2100 in ($W/m^2$) which is used to define the scenario. These are described in detail in (Meinshausen, 2011), and a database of greenhouse gas concentrations for the RCPs is available at http://tntcat.iiasa.ac.at/RcpDb/dsd?Action=htmlpage&page=welcome.

Figure 4-2 is a plot of the radiative forcing for each RCP in units of ($W/m^2$), while Figure 4-1 shows yearly emissions, in units of $GtCO_2$ equivalents, that are consistent with the radiative forcing and were used in climate models (Meinshausen, 2011). A given RCP, represents many different possible future scenarios as multiple emissions pathways, populations, etc. can ultimately lead the same radiative forcing,

RCP85 has a steady increase in emissions that starts to slow down at the end of the 21st century resulting in a total radiative forcing of 8.5 $W/m^2$, while RCP26 has a steady decline in emissions that leads to a total radiative forcing of 2.6 $W/m^2$. RCP45 and RCP 85 are the scenarios most consistent with the previously used A2 and B1 scenarios.

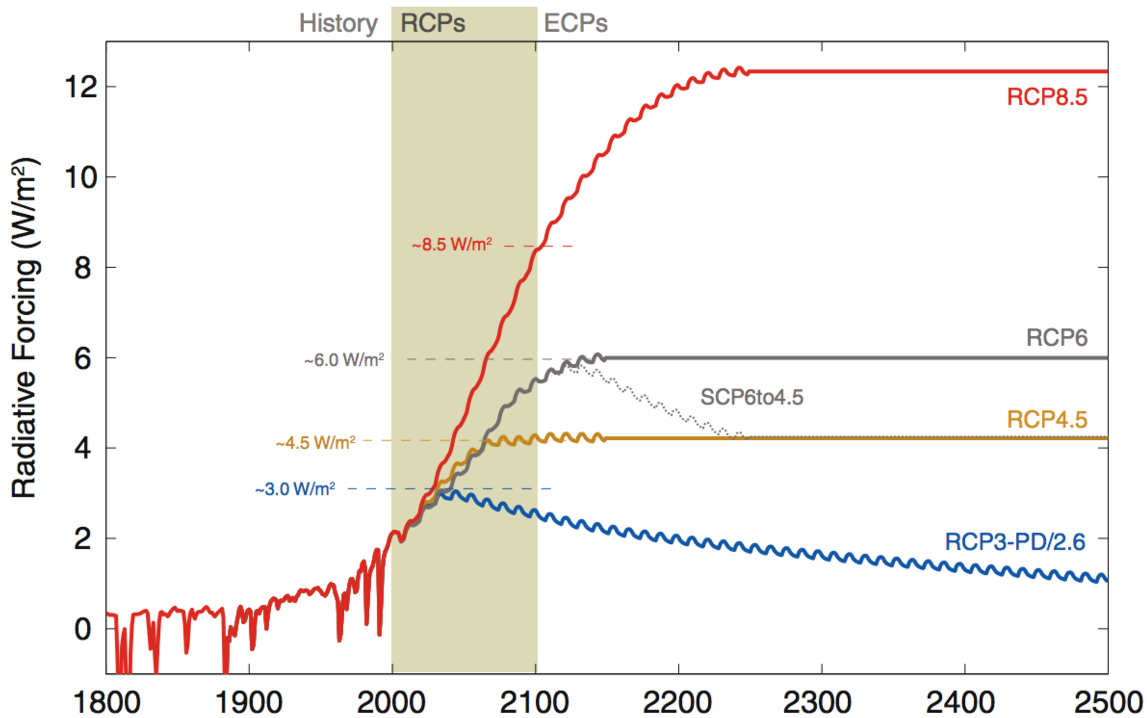


**Figure 4-1** **Radiative forcing for the four RCPs (W/m[2]). Each RCP is named after the radiative forcing defined to occur in 2100 in (W/m[2]). (Source: Meinshausen, 2011)**

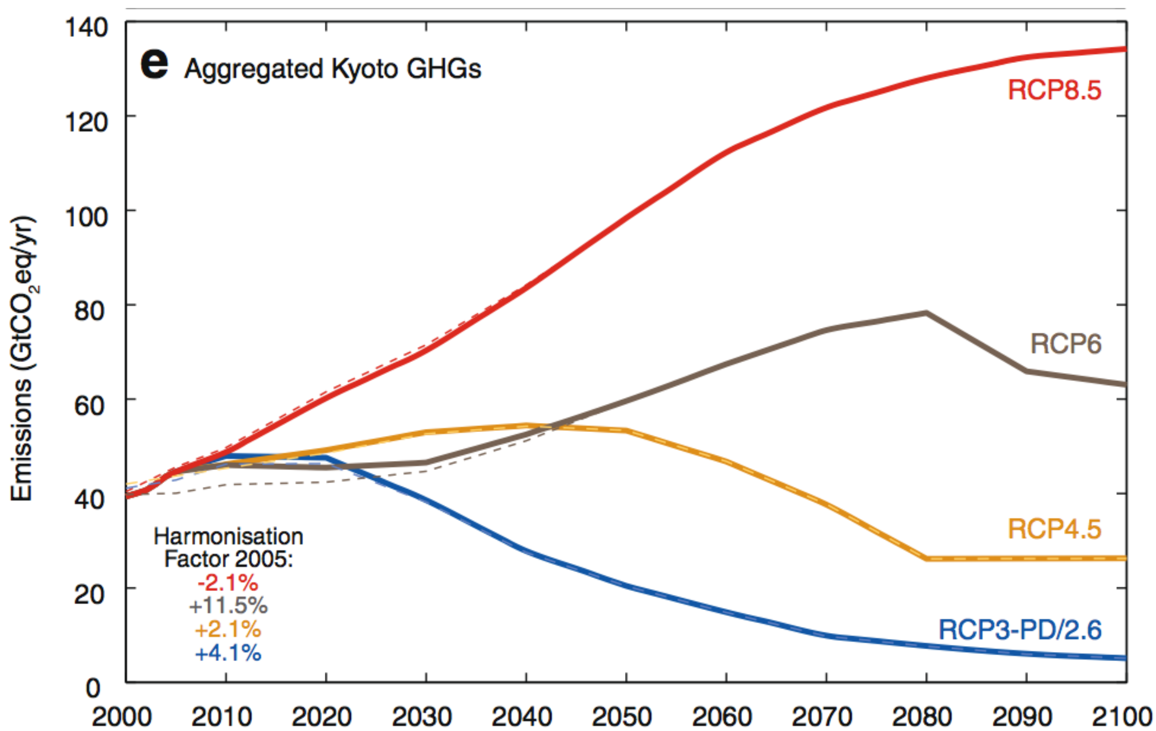


**Figure 4-2** **Total yearly emissions of GHGs in $CO_2$eq resulting from different emissions scenarios through the 21st century (Source: Meinshausen, 2011)**

## 4.2 GCMs

When selecting GCMs for use in a particular regional climate change impacts study, it is important that they have the ability to simulate important regional climate features (e.g., Cayan et al., 2008). Most GCMs represent large-scale climate features, including phenomena such as El Niño (AchutaRao and Sperber, 2006), while small-scale features are generally not represented. In this case, downscaling techniques must be used to get obtain regional detail from the simulation.However, as has been noted in prior research (Christensen et al., 2007; Reichler and Kim, 2008) better predictive skill (in general, regardless of predicted variable) is obtained by using an ensemble of GCMs than using any individual GCM (Brekke et al., 2008; Pierce et al., 2009). An individual model can also be run multiple times to get an ensemble of model runs that can be used independently or averaged to get a single average run that best represents the

This analysis includes results from a set of 16 models that have been archived and downscaled for similar climate impacts studies (Table 4-1) through an international effort called the Coupled Model Intercomparison Project 5 (CMIP5), housed at Lawrence Livermore National Laboratory. An overview of the experimental design can be found in (Taylor, 2012), while (Taylor, 2009) provides a more detailed discussion. All models have been statistically downscaled for the RCP2.6, RCP 4.5, RCP6.0, and RCP8.5, emission scenarios, and are available online at http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html. In many cases, individual models have been run multiple times with slightly different initial conditions to develop an ensemble representing a range of predictions for each model. The number of model runs available for specific models are shown in Table 4-1. These models are evaluated in the context of North America in (Sheffield, 2013, 2013a, Maloney, 2014), and the Northwest and Southeast US in (Rupp, 2013, 2016).

Climate model evaluation and intercomparison provides quantitative evaluations of model and process performance using observations and other models as standards for comparison. It allows for model advancements, leading to improved model performance. Climate model intercomparisons are essential for understanding how model-simulated projections of the future compare with the present. Improved model performance will facilitate better decision making of the actions needed for climate change mitigation, adaptation, and coping strategies.

Since 1989, the U.S. Department of Energy’s (DOE’s) Program for Climate Model Diagnostics and Intercomparison (PCMDI) has led the intercomparison of AOGCMs. The PCMDI mission is to develop and apply improved methods and tools for the diagnosis and intercomparison of AOGCMs, and this effort represents a quality control gatekeeper for the AOGCMs that are part of the IPCC. While these models provide an important understanding of the climate on subcontinental and larger scales, they are unable to resolve fine-scale climate features and forcings that are of importance at local-to-regional scales; hence, downscaling techniques have and will continue to be an essential element of climate change impacts analysis.

**Table 4-1 Table of 16 GCMs used for the evaluation of 21st century climate change in South OC**

| IPCC Model I.D. | Center | Primary Reference | Model Runs RCP26/45/60/85 |
|---|---|---|---|
| ACCESS1-0 | Commonwealth Scientific and Industrial Research Organization/Bureau of Meteorology, Australia | Bi et al. 2012 | 0/1/0/1 |
| CanESM2 | Canadian Centre for Climate Modeling and Analysis, Canada | Arora et al. 2011 | 5/5/0/5 |
| CCSM4 | National Center for Atmospheric Research, United States | Gent et al. 2011 | 5/5/5/5 |
| CNRM-CM5-1 | National Centre for Meteorological Research, France | Voldoire et al. 2013 | 0/1/0/5 |
| CSIRO-Mk3-6-0 | Commonwealth Scientific and Industrial Research Organization/Queensland Climate Change Centre of Excellence, Australia | Rotstayn et al. 2010 | 10/10/10/10 |
| GFDL-CM3 | NOAA/Geophysical Fluid Dynamics Laboratory, United States | Donner et al. 2011 | 1/1/1/1 |
| GFDL-ESM2G/M | NOAA/Geophysical Fluid Dynamics Laboratory, United States | Donner et al. 2011 | 1/1/1/1 |
| GISS-E2-H/R | National Aeronautics and Space Administration (NASA) Goddard Institute for Space Studies, United States | Kim et al. 2012 | 0/1/0/0 |
| HadGEM2-CC | Met Office Hadley Centre, United Kingdom | Jones et al. 2011 | 0/1/0/1 |
| INM-CM4 | Institute of Numerical Mathematics, Russia | Volodin et al. 2010 | 0/1/0/1 |
| IPSL-CM5A-LR | L'Institut Pierre-Simon Laplace, France | Dufresne et al. 2013 | 3/4/1/4 |
| MIROC5 | Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology, Japan | Watanabe et al. 2011 | 1/1/1/1 |
| MIROC-ESM | Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies, Japan | Watanabe et al. 2011 | 1/1/1/1 |
| MPI-ESM-LR | Max Planck Institute for Meteorology, Germany | Jungclaus et al. 2006; Zanchettin et al. 2012 | 3/3/0/3 |
| MRI-CGCM3 | Meteorological Research Institute, Japan | Yukimoto et al. 2012 | 1/1/0/1 |
| NorESM1-M | Norwegian Climate Center, Norway | Zhang et al. 2012 | 1/1/1/1 |

### 4.3 GCM Predictions for the Western United States

CMIP5 GCMs were evaluated in the context of North America in a series of three papers titled *North American Climate in CMIP5 Experiments*. Part I (Sheffield, 2013a) evaluated historical simulations of regional climatology, Part II (Sheffield, 2013) evaluated historical simulations of intraseasonal to decadal variability, and Part III (Maloney, 2014) assessed twenty-first century projections. Part III focused on projections of 17 GCMs, including the 16 listed in **Error! Reference source not found.**, with an emphasis on the RCP85 scenario, nd to a lesser extent RCP45.

Figure 4-3 shows the projected change in mean annual precipitation for the RCP8.5 scenario for winter and summer of the period 2070-99 relative to 1961-90. For precipitation, much greater spatial variability is evident between GCMs. In North America, high latitude regions are generally projected to see an increase in annual precipitation, while mid-latitudes in the southwest are projected to be drier. For California, where precipitation falls in winter as a result of cyclonic activity in the Pacific, a poleward shift in storm tracks is projected (Yin, 2005). The physical drivers for precipitation shifts have been explored in GCM-based sensitivity studies, with important factors including increases in water vapor associated with warming sea surface temperatures (Meehl et al., 2005a) and subsequent changes in moisture convergence, but also modified in synoptic circulation and an expansion of the descending branch of the Hadley circulation. The increase in tropical SST may result in changes to ENSO occurrences and other teleconnections (Meehl et al., 2007b). Additionally, the North-South temperature difference in storm generating regions, such as the Gulf of Alaska, where the Aleutian low is known to develop pacific storms (Favre and Gershunov, 2009), and is well correlated with Western U.S. hydrology (Lins, 1997). Thus, as GCMs vary in their ability to represent these features (and the amount by which these features change under a warming climate), the degree to which storm tracks shift under a warming climate, and hence the projected precipitation change simulated by each GCM, will likewise vary, which is demonstrated by the variability in precipitation projections for California in Figure 4-3.

California falls in the middle of the zones where precipitation is more confidently projected to increase, and where it will more likely decrease. About half the models show wetter conditions and half show drying. This does not mean the projection is for no change, but that the variability is high relative to the projected change, making it difficult to identify any specific change with high confidence. It should be noted that these are raw GCM projections, and at their native resolution the Sierra Nevada essentially do not exist. This means that the precipitation variability only represents that due to large-scale circulation patterns, and no representation of localized pressure patterns or orography will appear. As explained below, local scale effects are incorporated through downscaling of GCM output, by either relating statistically to local meteorological stations (statistical downscaling), or by performing additional higher resolution and geographically focused climate model runs (dynamic downscaling).

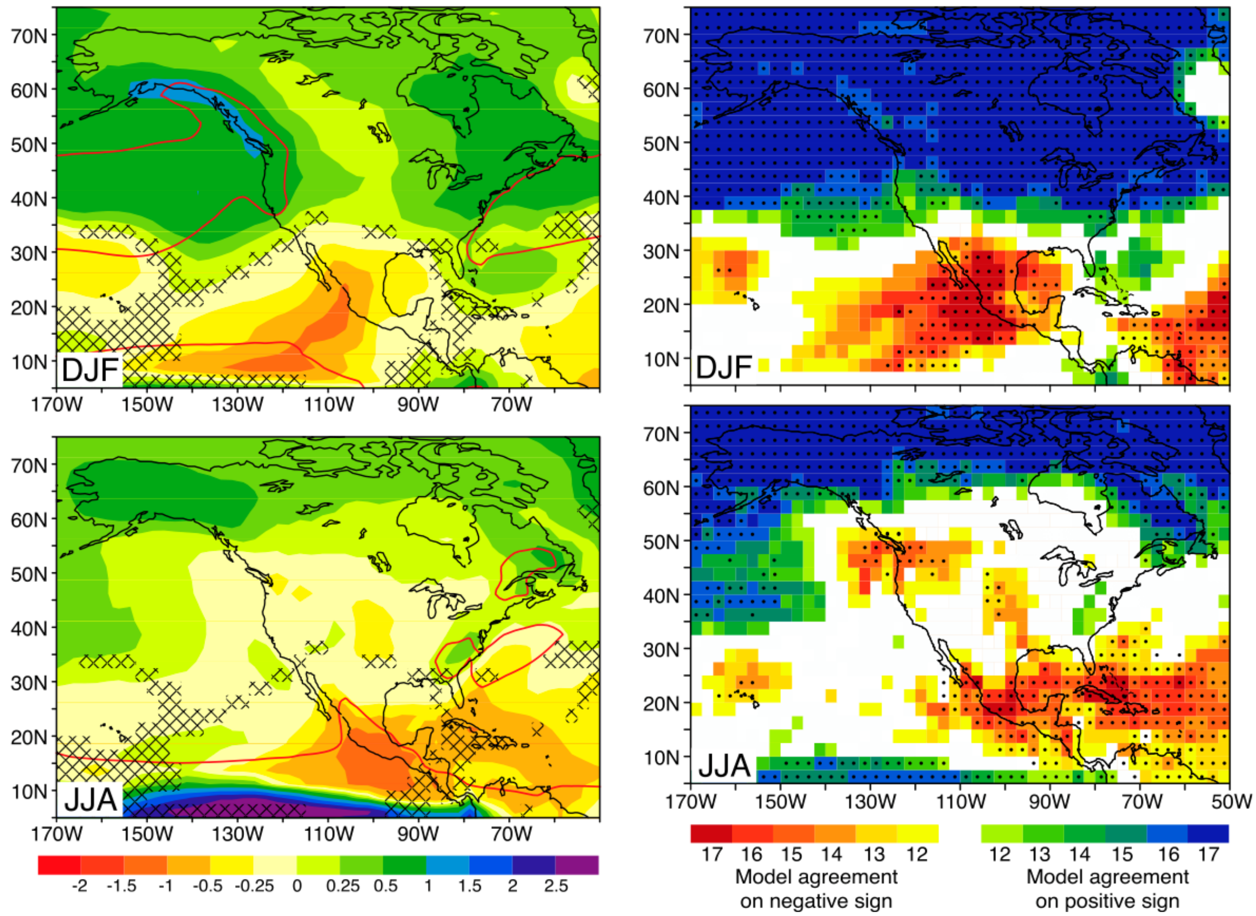


**Figure 4-3** **(left) Mean precipitation change (mm day-1) for RCP8.5, 2070-99 relative to 1961-90, and (right) These plots indicate uncertainty among the models as to whether precipitation will increase or decrease in the Orange County Region. (Source: Maloney, et. al., 2014)**

Figure 4-3 shows the projected change in mean annual temperature for the RCP8.5 scenario for winter and summer of the period 2070-99 relative to 1961-90. This clearly demonstrate that warming is a large-scale phenomenon, as warming is projected everywhere by nearly all GCMs. Most GCMs also show greater warming over land areas, further from the moderating influence of oceans. The models consistently predict that temperatures will rise in California, with the uncertainty being to what extent. The next section discusses downscaling of climate model results, and is followed by downscaled results for south Orange County.

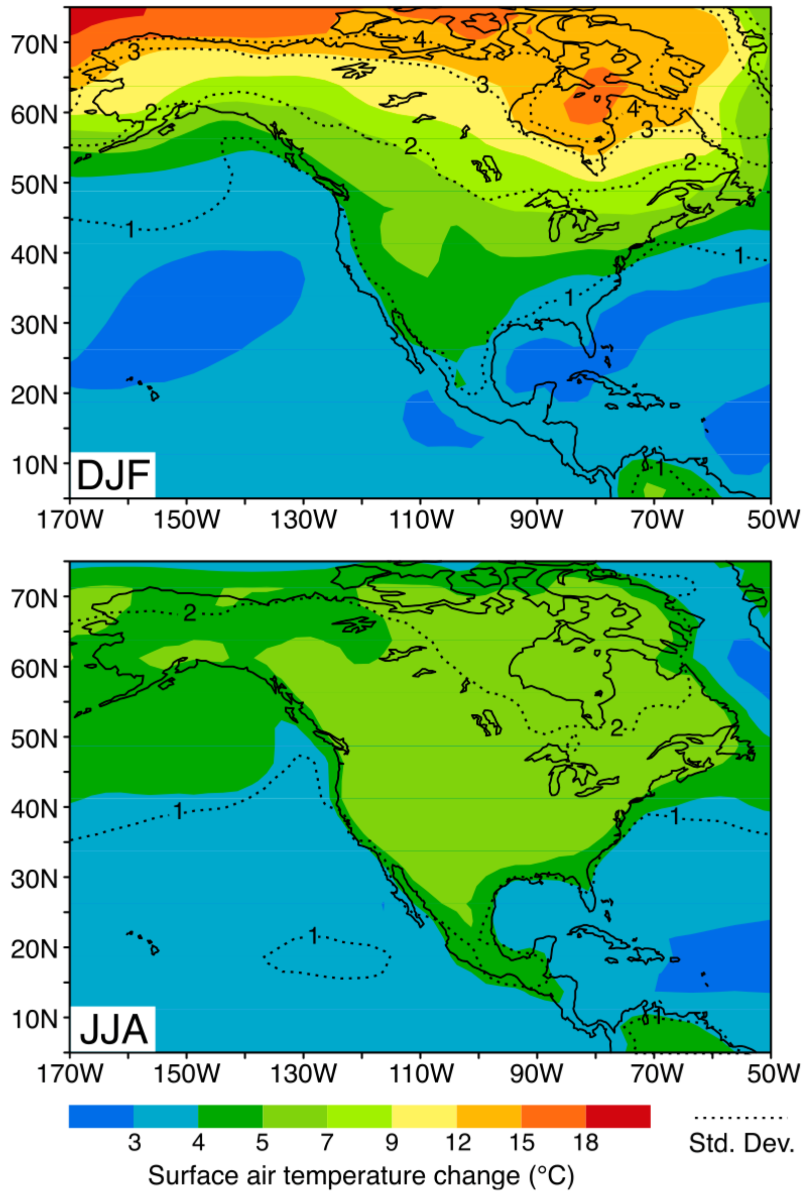


**Figure 4-4** **Predicted changes in mean annual temperature for the ranges1961-1990 to 2040-2059, where DJF is an average over December, January, and February and likewise JJA for June, July, August (Source: Maloney et al., 2014).**

## 4.4 Downscaling of Global Climate Models

Because the spatial scale of GCM output is too large to characterize climate over small areas such as South Orange County, some type of downscaling is necessary. This can take two general forms: statistical and dynamical downscaling (Benestad, 2001; Mearns et al., 2001).

While dynamical downscaling has the advantage of simulating fine-scale physical processes, and therefore being in theory capable of capturing non-linear feedbacks, it suffers from the disadvantage of requiring intensive computational effort, which renders its use impractical for extended transient simulations of multiple emissions scenarios. Statistical downscaling, while very computationally efficient, has the principal drawback of assuming a stationary relationship between large- and fine-scale climate features, the validity of which becomes less certain as the climate warms to levels not observed in the historical record. This document employs statistically downscaled values, where the GCM results are downscaled to a 1/8$^{o}$ by 1/8$^{o}$ grid (Reclamation, 2013).

## 4.5 DOWNSCALED RESULTS FOR THE IRWM PLANNING AREA

Using the GCMs identified in Table 4-1 and the grid cells outlined in Figure 4-5, projected changes in yearly precipitation and yearly average temperature in the IRWM planning area in South Orange County are summarized in Table 4-2 and Table 4-3. Three different time periods are summarized: early, mid, and late 21st century, defined as 2010–2039, 2040–2069, and 2070–2099 respectively. and the change is the average value over this period relative to the historical average from 1970-1999. The ensemble of models project a small decrease in precipitation of up to an inch per year in mid- to late-century periods, and an increase in temperature of about 3 $^{o}$F and 5 $^{o}$F over the same periods.

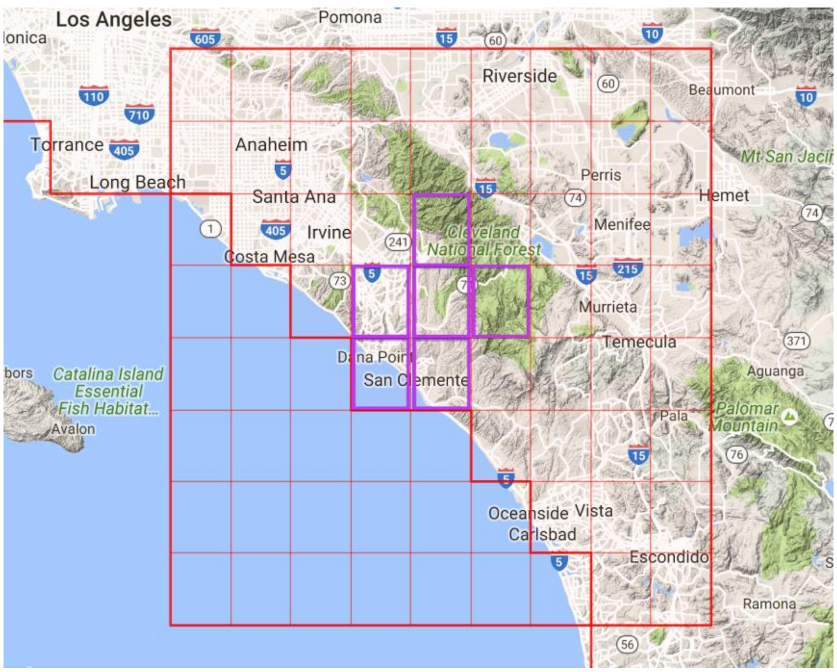


**Figure 4-5. Grid cells used as South Orange County for climate projections are outlined in purple. (Source: http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html)**

**Table 4-2**
**Average projected change in precipitation relative to 1970-1999 in the IRWM Region for 16 models identified in Table 4-1.**

| | Change in Average Precipitation (inches/year) | | |
|---|---|---|---|
| **Emission Scenario** | **2010-2039** | **2040-2069** | **2070-2099** |
| RCP26 | -1.0 | -0.7 | -0.6 |
| RCP45 | -0.7 | -1.0 | -0.8 |
| RCP60 | -1.3 | -0.9 | -0.8 |
| RCP85 | -0.9 | -0.8 | -0.7 |

**Table 4-3**
**Average projected change in temperature relative to 1970-1999 in the IRWM Region for 16 models identified in Table 4-1.**

| | Change in Yearly Average Temperature ºF | | |
|---|---|---|---|
| **Emission Scenario** | **2010-2039** | **2040-2069** | **2070-2099** |
| RCP26 | 1.4 | 3.0 | 4.3 |
| RCP45 | 1.4 | 3.0 | 4.5 |
| RCP60 | 1.4 | 3.1 | 4.5 |
| RCP85 | 1.5 | 3.2 | 4.7 |

Time series of yearly precipitation and average yearly temperature projected by the different CMIP5 models are shown in Figure 4-6 and Figure 4-7. Each line represents an average of the model runs available for each model, and an average over the South OC region identified in Figure 4-5. Projected yearly precipitation shows no consistent pattern, however, there are periods when the precipitation is much greater than and much less than baseline values. Projected temperatures are projected to rise steadily in a all models.

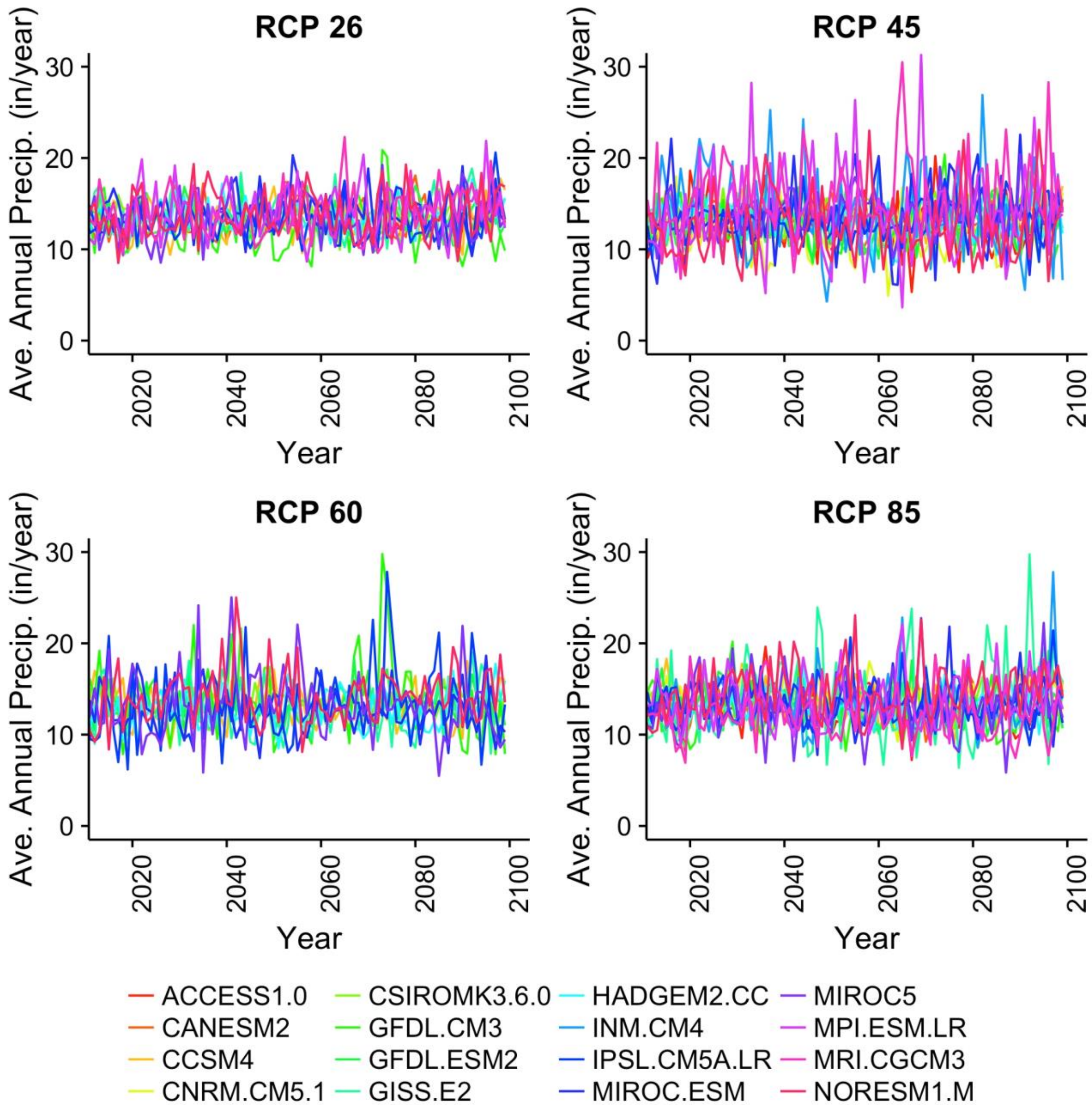


**Figure 4-6. Projected average annual precipitation for different CMIP5 models, averaged over the South OC region. Different model runs for the same model are averaged.**

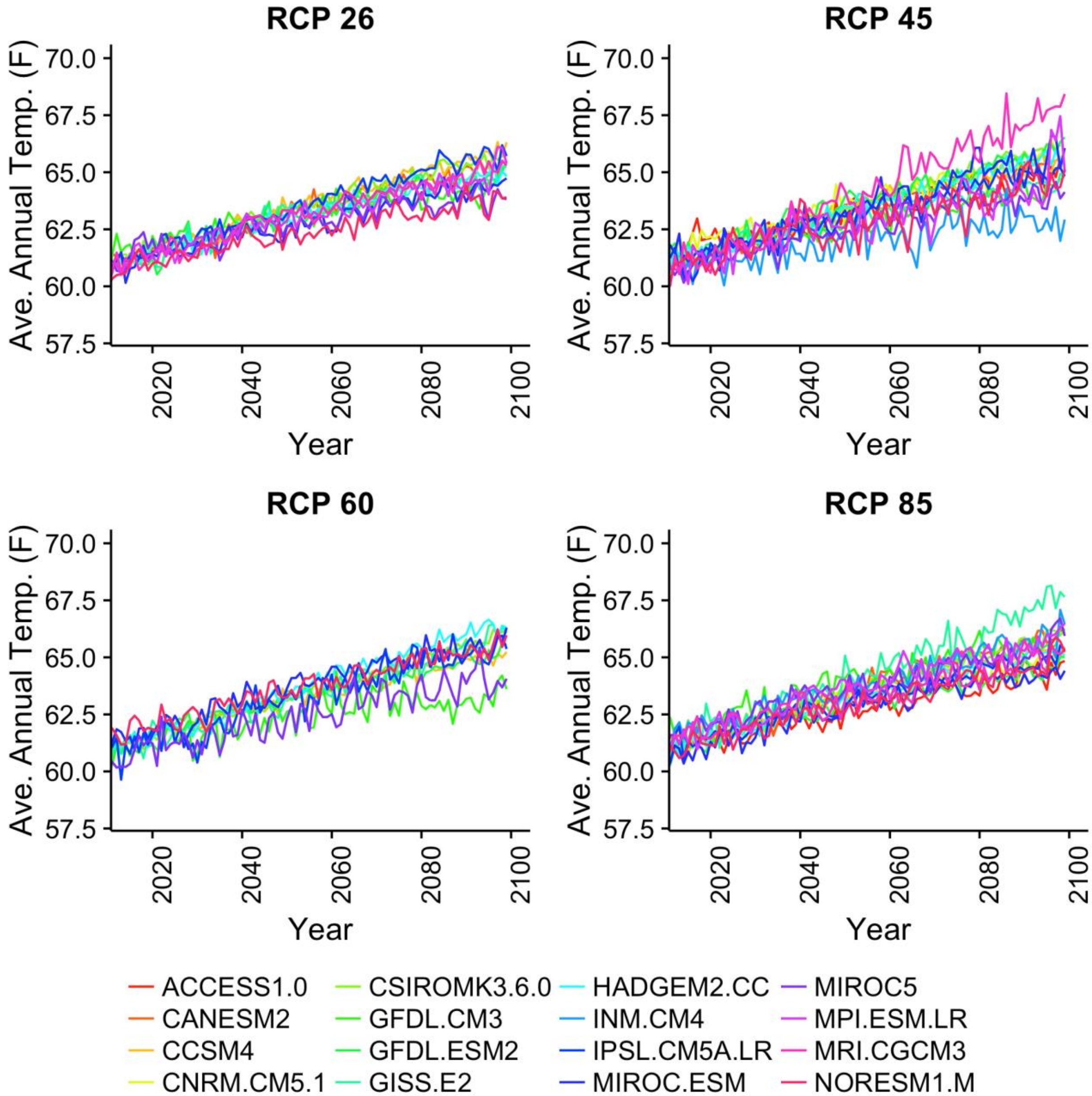


**Figure 4-7** **Projected temperature for an ensemble of 16 GCMs averaged over the South OC region. Different model runs for the same model were averaged.**

## 4.6 EXTREME WEATHER EVENTS AND THE 2012-2015 CALIFORNIA DROUGHT

Much of the climate modeling described above focuses on changes in average or annual conditions, although it is the extremes in the future that are of greatest consequence to human and natural systems. Trends in extreme events are hard to discern because they do not occur often. The scientific literature generally suggests an increase in the likelihood of extreme events in a warmer climate, including heat waves, large winter storms, and floods (Congressional Budget Office, 2009), and the topic is an active area of research (National Academy of Sciences, 2010).

An assessment of extreme conditions derived through climate change model projections (Mastrandrea et al., 2011) suggests the following changes are possible in California: severity of hot spells (both in length and intensity), increases in intensity and duration of heat waves, and decreases in frost days. The downscaled climate models do not produce strong signals with respect to extreme precipitation events. However, other GCM analysis of atmospheric rivers responsible for creating the heaviest storms in California (introduced in Section 3.6) suggests that the intensity and frequency of these extreme precipitation events may increase over the course of the 21$^{st}$ century (Dettinger, 2011, Dettinger and Ingram, 2013). Wildfires are also expected to continue to increase in frequency and severity (CCSP 2009, SNA 2010; Krawchuck and Moritz, 2012).

The drought in California from 2012 to 2015 resulted in the publication of a large number of papers exploring its place in history and what role anthropogenic climate change may have played. The general consensus is that the low levels of precipitation are consistent with natural variability, and that drought conditions were likely exacerbated by human induced warming, which is projected to continue. The 2014 drought year was particularly challenging, and was a result of extreme low precipitation and extreme high temperatures, resulting "in summer time temperature in climatologically coldest month in the year. The extreme daily maximum temperatures exceeded the long-term mean daily maximum by 90% in some locations, which led to very dry soil and significant stress on the ecosystem… [and] triggered wildfire and led to record low storage levels and snowpack conditions" (AghaKouchak et al., 2014).

Diffenbaugh et al., (2014) analyzed historic climate observations from California and results from climate model experiments to analyze the increased drought risk in California due to anthropogenic warming, using the Palmer Modified Drought Index (PMDI). Diffenbaugh et al. concluded that "even in the absence of trends in mean precipitation—or trends in the occurrence of extremely low-precipitation events—the risk of severe drought in California has already increased due to extremely warm conditions induced by anthropogenic global warming… continued global warming is likely to cause a transition to a regime in which essentially every seasonal, annual, and multiannual precipitation deficit co-occurs with historically warm conditions… the projected increase in extremely low precipitation and extremely high temperature during spring and autumn has substantial implications for snowpack water storage, wildfire risk, and terrestrial ecosystems. Likewise, the projected increase in annual and multiannual warm–dry periods implies increasing risk of the acute water shortages, critical groundwater overdraft, and species extinction potential that have been experienced during the 2012–2014 drought."

Williams et al. (2015) used the self-calibrated Palmer Drought Severity Index to assess near-surface soil moisture in California from 1901 to 2014, and concluded that it is not likely that there was "an anthropogenic role in the recent CA precipitation shortfall. Importantly, there is widespread consensus that warmth has intensified the effects of the recent precipitation shortfall by enhancing potential evapotranspiration (PET)… the intensifying effect of high PET on the recent drought was nearly entirely caused by warmth". Williams et al. concluded that "As anthropogenic warming continues, natural climate variability will become increasingly unable to compensate for the drying effect of warming. Instead, the soil moisture conditions associated with the current drought will become increasingly common."

AghaKouchak et al., 2014 showed that "the traditional univariate risk assessment methods based on precipitation may substantially underestimate the risk of extreme events such as the 2014 California drought because of ignoring the effects of temperature," and presented a multivariate approach for assessment of extreme events. It was determined that although there were other years since 1896 with less average precipitation in November-April, the 2014 year was the warmest period on record.

The work in AghaKouchak et al. (2014) was expanded in Cheng et al. (2016) which used "physically based multivariate drought definitions that explicitly incorporate different meteorological variables and surface properties" to explore drought in California. They noted an increase in California precipitation in observations over the twentieth century as well as in CMIP5 projections. Their "results indicate the current drought on California's agricultural sector its forests, and other plant ecosystems have not been substantially caused by long-term climate change" and concluded that "it is plausible that thermal impacts on drought frequency are likely to dominate precipitation changes, increasing drought frequency across a range of drought metrics by the late twenty-first century." This study also showed that "statistics of severe droughts relative to a current warm/wet climate are not distinguishable from those in a preindustrial cold/dry climate", and that the "deep root zone soil moisture is… more sensitive to the increase in precipitation than to the increase in surface temperature, resulting in less severe droughts." The authors state that "the net effect of climate change has made agricultural drought less likely and that the current severe impacts of drought on California's agriculture have not been substantially caused by long-term climate changes… The model simulations show that increases in radiative forcing since the last nineteenth century induce both increased annual precipitation and increased surface temperature over California, consistent with prior model studies and with observed long-term change"

Asner, et al. (2015) "used airborne laser-guided spectroscopy and satellite-based models to assess losses in canopy water content (CWC) of California's forests between 2011 and 2015. Approximately 10.6 million ha of forest containing up to 888 million large trees experienced measurable loss in canopy water content during this drought period. Severe canopy water losses of greater than 30% occurred over 1 million ha, affecting up to 58 million large trees. They also noted that CWC is an indicator of progressive drought effects on forest canopies.

Shukla et al. (2016) explored the impact of temperature on the water year 2014 California drought, using a hydrological model and risk assessment framework. They concluded that the main driver of the drought was low precipitation, and that temperature played a key role in making it worse.

Griffen et al., (2014) used spatial averages from two paleoclimate reconstructions of drought and precipitation, based on tree rings for Central and Southern California and the Palmer Drought Severity Index, to conclude that although "3 year periods of persistent below-average soil moisture are not uncommnon, the current event is the most severe drought in the last 1200 years." They estimated that 2014 was the worst single drought year of at least the last ~1200 years in California. They further concluded that "future 'hot' droughts, driven by increasing temperatures due to anthropogenic emissions of greenhouse gases and enhanced evaporative demand, are assured and will be a substantial influence on future water resources supply and management in the western United States."

Robeson et al., (2015) extended the work of (Griffen, 2014) by using spatial averages to produce a match of the tree ring record to the instrumental data. Robeson et al. calculated return periods of 700-900 years for the one year drought of 2014 while the 2012-2014 drought was estimated to be almost a 10,000 year event. The 2012-2015 drought was considered by the authors to be without precedent in the tree ring record in California.

Cook et al. (2015) examined GCM projections for the 21$^{st}$ century and found that for the RCP8.5 scenario all soil moisture balance metrics showed drying during the latter half of the 21st century (2050–2099). Even though cold season precipitation is actually expected to increase over parts of California in our Southwest region, the increase in evaporative demand is still sufficient to drive a net reduction in soil moisture. For RCP 8.5 Cook et al. concluded that "there is ≥80% chance of a multi-decadal drought during 2050–2099" with a high risk of a multi- decadal megadrought occurring over the Central Plains and Southwest regions during the late 21st century.

Figure 4-8 shows changes in precipitation extremes projected by an emsemble of CMIP5 scenarios. The maps show the California coast is projected to have increased precipitation extremes with greater maximum precipitation and more consecutive dry days. Figure 4-9 and Figure 4-10 show the time series of the maximum and minimum yearly average temperatures plotted for each model. In all model scenarios, a steady increase is seen for both the yearly average minimum and maximum temperatures.

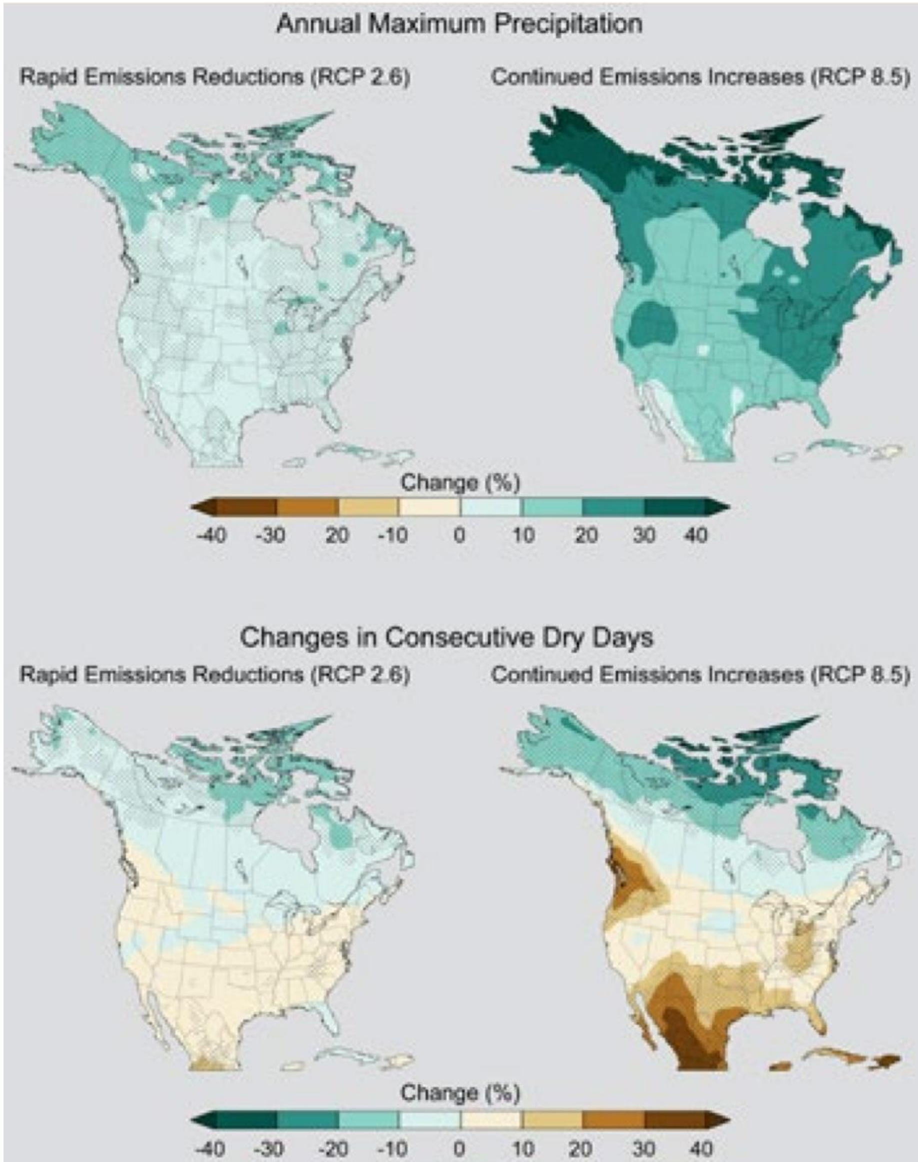


**Figure 4-8 Change in precipitation extremes for 19070-2000 relative to CMIP5 projections for 2070-2099. Top shows percent change in annual maximum precipiation and botton shows percent change in consecutive dry days (less than 0.04 in.). (Source: Melillo, 2014)**

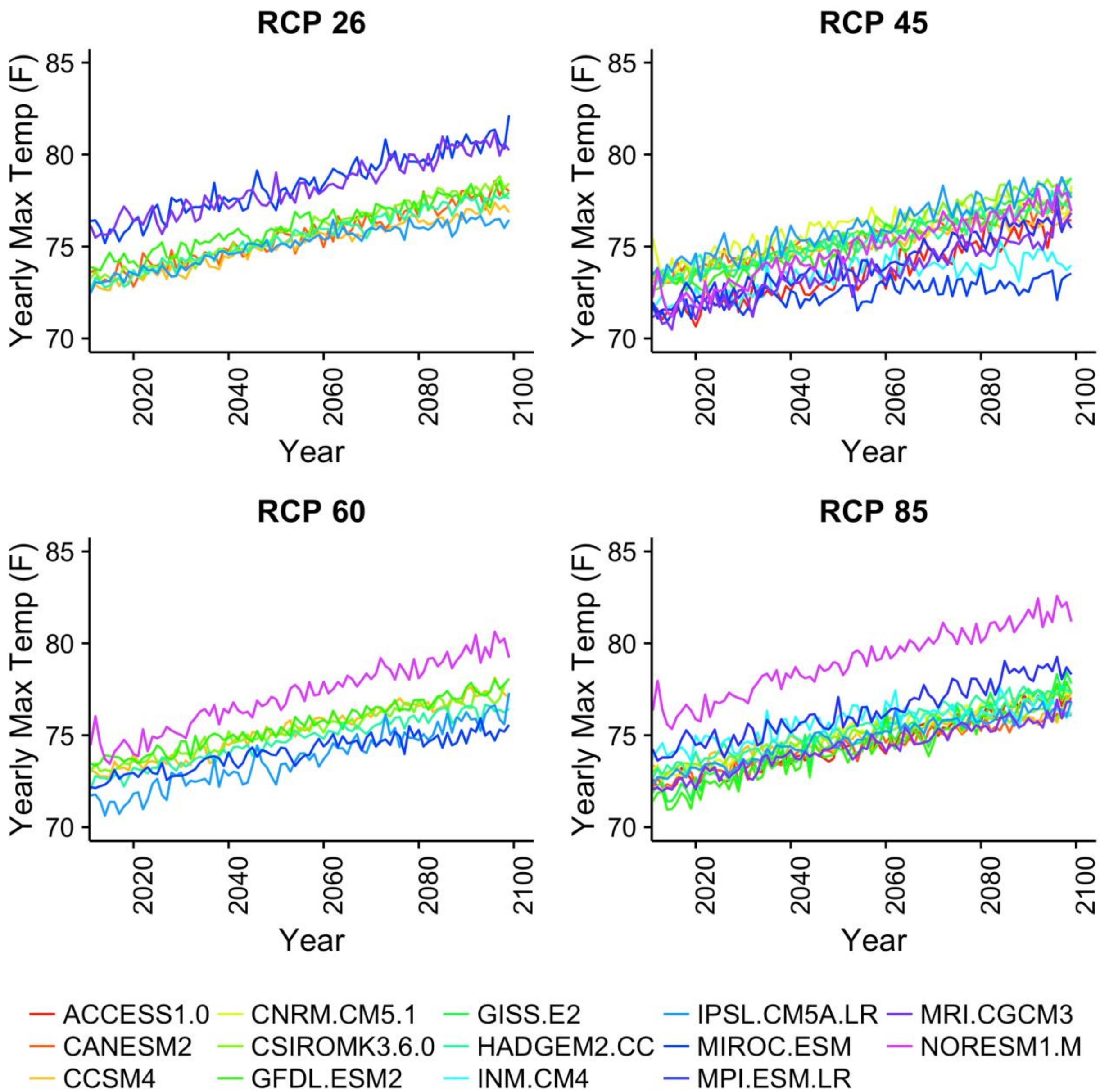


**Figure 4-9 Yearly maximum (average over OC grid cells) temperature in the OC region. For models with multiple runs, the maximum value of all runs is used.**

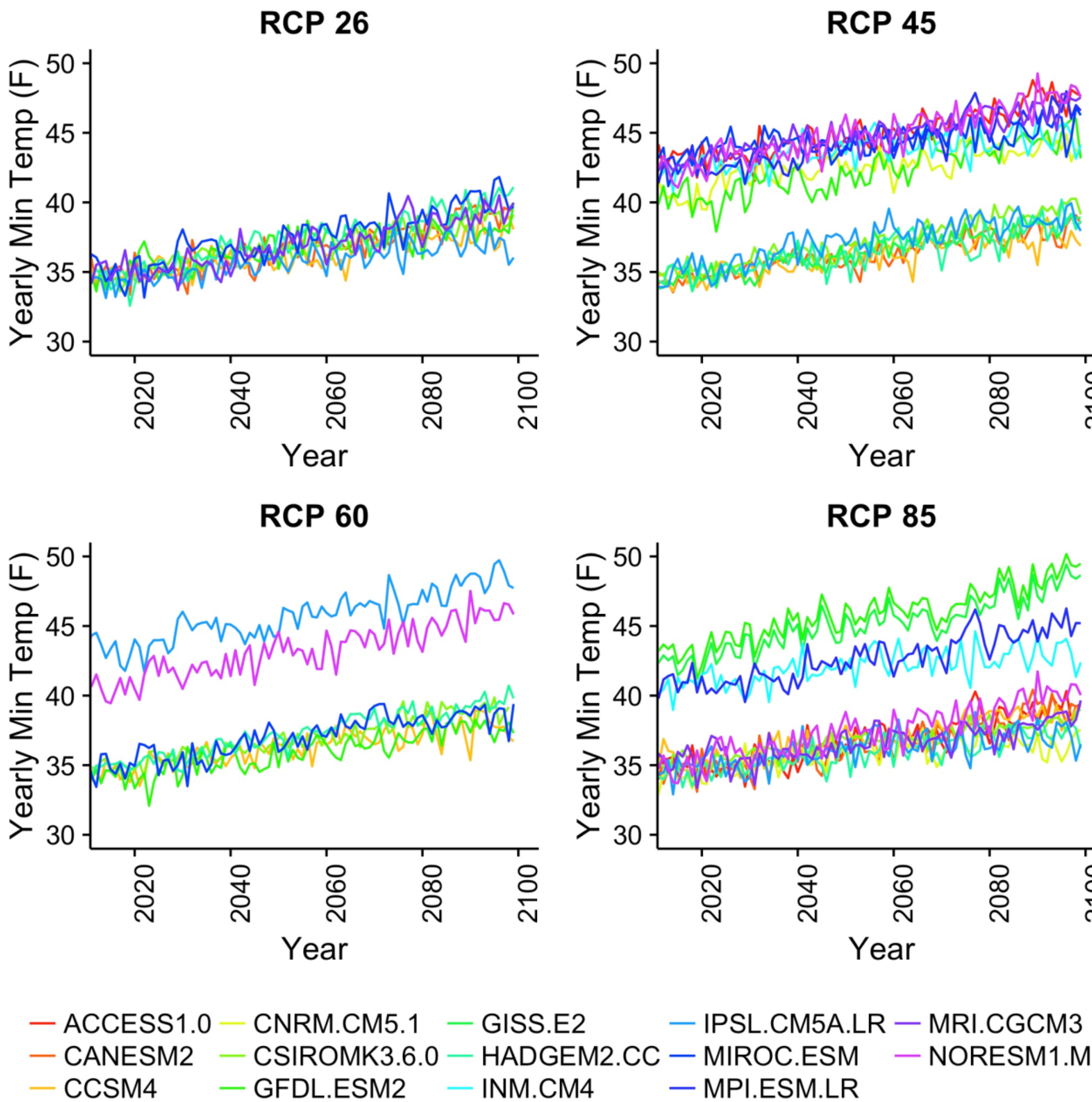


**Figure 4-10 Yearly minimum (average over OC grid cells) temperature in the OC region. For models with multiple runs, the minimum value of all runs is used.**

## 4.7 SUMMARY

Global climate projections are developed using GCMs that represent global climate processes and assumptions about future greenhouse gas emissions. GCMs are used to project future climate changes based on assumptions of different economic growth pathways and emissions of greenhouse gases, RCP45 and RCP85 being the most common scenarios used in various climate impact studies. No one model or emission pathway is the best estimate of the future, and, typically, most climate assessments utilize an ensemble of GCM results for evaluating future conditions. In this analysis, sixteen candidate climate models were selected for evaluation. The primary greenhouse gas (GHG) emission scenarios used for the climate projections are RCP26, RCP45, RCP60, and RCP85. Results from three 21st century periods, statistically downscaled to cells of 1/8 degree or about 12 km by 12 km, were analyzed for impacts in the early, mid, and late 21st century, defined as 2010–2039, 2040–2069, and 2070–2099 respectively. The projected data summary for the South OC IRWM planning region shows a small decrease in precipitation over the mid- to late-21$^{st}$ century period relative to 1970 – 1999 of up to an inch per year. This is a relatively small decrease relative to the average precipitation of 14.2 inches/year for the region in 1970 – 1999. However, the models show a consistent and substantial increase in mean annual temperature, of about 3 $^{o}$F and 5 $^{o}$F over the mid- to late-21$^{st}$ century periods. In general, the climate models project more adverse conditions (i.e., warmer and drier) in the latter part of the 21$^{st}$ century.

Besides the changes in average conditions, climate change is considered likely to increase variability, with more extreme heat events, longer droughts, and more intense flooding through atmospheric rivers that transport moisture from the tropics to the Pacific coast. Although these changes are anticipated on a broad scale, they are typically not quantified at the spatial scale of the South OC planning region.

# 5. Summary of Climate Change Planning Studies in Regions Supplying Water to South Orange County

***Key Points:*** *This section presents an overview of studies that pertain to water resources planning in California and the Colorado River Basin, and have considered climate change as a factor affected water supplies. Projected climate change conditions, such as the suite of models used in Chapter 4, have been used for developing plans in both regions. A key feature that stands out from the comprehensive analyses that have been performed is that both California and the Colorado Basin are severely water constrained, where it will be challenging to meet current allocations in future years. In both regions, planning model projections indicate years where deliveries will sometimes fall short of allocations, over planning horizons that range from 20 to 50 years into the future, under conditions where no changes are made to the existing operational infrastructure of the system. Because the regions jointly affected by these basins are continuing to experience relatively rapid population growth, and anticipated increased in municipal demands, over longer planning horizons water planners must address the dual challenge of reduced supplies and increased demand.*

Because a large fraction of the water supply into South OC is imported from other regions in California and Colorado, an evaluation of climate change impacts relating to water resources must consider a broader geographic region than the boundaries of the South OC IRWM planning area. This chapter presents a summary of the potential impacts across this larger area using information from prior analyses conducted in California and the Colorado Basin. Major resources for developing this summary include California's third climate assessment[3], DWR's climate change handbook for Regional Water Planning (DWR, 2011), the State Water Project Delivery Capability (Reliability) Report (DWR, 2015; DWR, 2012), MWD's Integrated Resources Plan (MWD, 2015), the Bureau of Reclamation's Colorado River Basin Study (Reclamation, 2012) and Sacramento and San Joaquin Rivers Basin Study Report (Reclamation, 2016b) which were incorporated into SECURE Water Act Section 9503(c)—Reclamation Climate Change and Water 2016 (Reclamation, 2016). These reports used downscaled CMIP3 projections. Updated hydroclimate projections based on downscaled

[3] The scientific community in California, in cooperation with resource managers, has been conducting periodic statewide studies about the potential impacts of climate change on natural and managed systems, every three years beginning in 2006. Most recently, the state's third major assessment on climate change was published in 2012. The third assessment consists of 30 peer-reviewed documents and explores local and statewide climate change vulnerabilities and opportunities for limiting impacts (on the internet at http://www.climatechange.ca.gov/adaptation/third_assessment/).

CMIP5 projections were published in the Technical Memorandum West-Wide Climate Risk Assessments: Hydroclimate Projections (Reclamation, 2016a), which determined that the overall difference between CMIP3 and CMIP5 projections “is relatively minor when assessing the range of basin-scale potential future climate and hydrologic conditions” (Reclamation, 2016a). This chapter presents the most important findings from these technical evaluations that pertain to the South OC IRWM. Specific topics addressed include water supply from California and the Colorado River basin, water quality, ecological effects, and hydropower generation. Sea level rise is addressed separately as part of Chapter 6.

## 5.1 SACRAMENTO-SAN JOAQUIN RIVER BASINS

The Bureau of Reclamation performed the Sacramento-San Joaquin River Basin Water Supply and Demand Study (Reclamation, 2016b), which used CMIP3 GCM model results to analyze the future water supply in the Sacramento and San Joaquin River Basins. Projections were later updated with CMIP5 model results in (Reclamation, 2016a). Reclamation found that “variation in precipitation, both temporally and spatially, will likely occur, and snowpack will likely decline consistently over time, primarily due to warming. In addition, runoff and river flows will likely continue to exhibit temporal variability and earlier seasonal runoff, with little overall flow changes in the north and slight reductions in the south. In general, impacts to water-related resources include: increased river water temperatures and Sacramento-San Joaquin Delta salinity; decreased reservoir storage, CVP/SWP water exports and hydropower generation; decreased aquatic habitat quality and recreational opportunities; and increased opportunities for spring riparian flows and fall flood-control storage” (Reclamation, 2016).

Figure 5-1 shows projections of six drought metrics at the Sacramento-San Joaquin River Delta. No clear trend is seen in annual total precipitation or annual runoff. However, steady increases in annual mean temperature coincide with a steady decline in April 1$^{st}$ snow water equivalent and April-July Runoff. Projections of December-March runoff are slightly increasing.

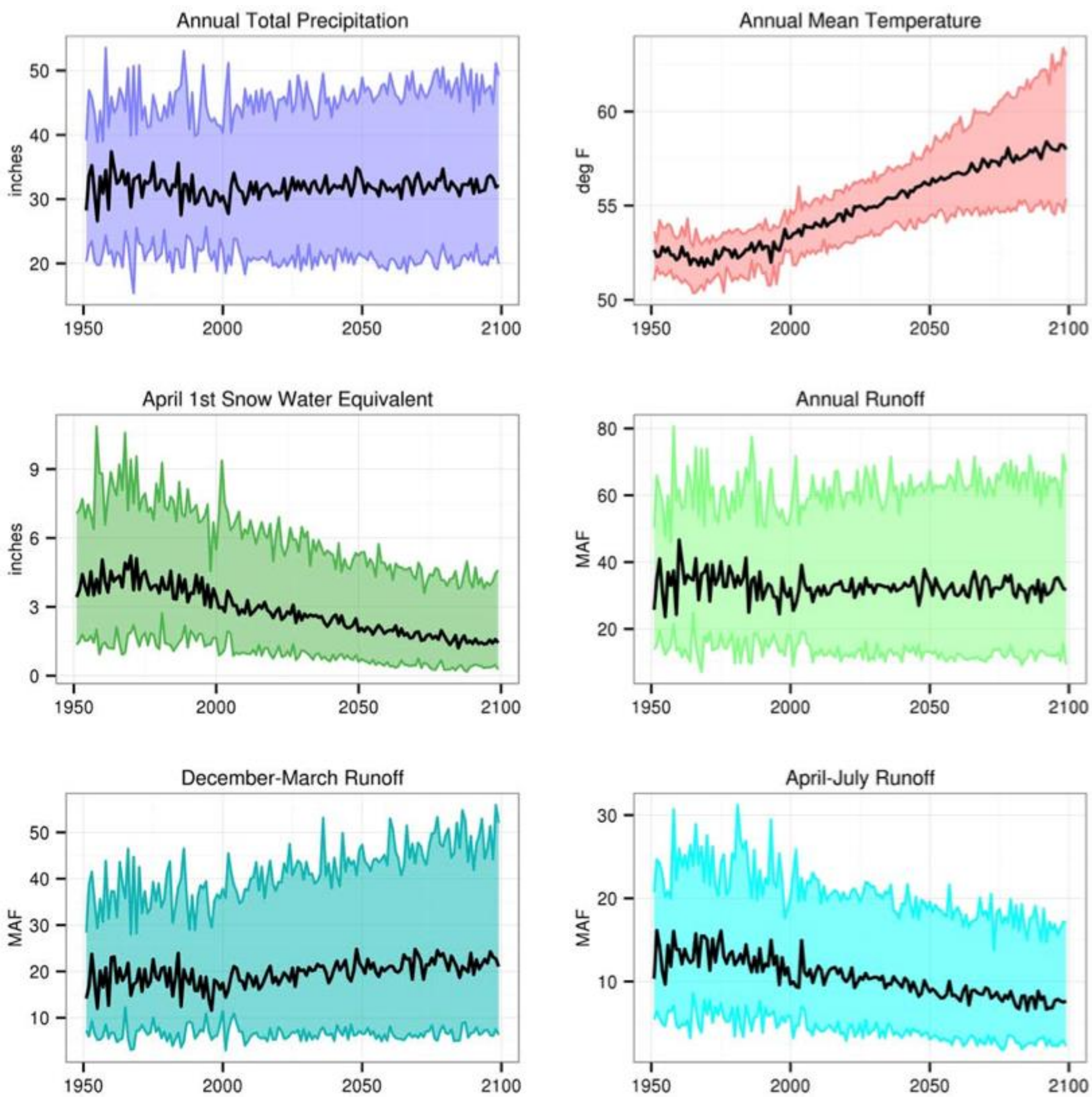


**Figure 5-1 Sacramento-San Joaquin Rivers Basins Projections for Six Hydroclimate Variables. Black line is yearly median and shaded region is 10th to 90th percentiles. (Source: Reclamation, 2016a).**

The percent change in April 1st snow water equivalent (SWE) in the River Basin is shown in Figure 5-2 for the 2020s, 2050s, and 2070s relative to the 1990s. A decline in median SWE is seen at all elevation ranges relative to 1990, and between the 2020s and 2050s, and the 2050s and 2070s (Reclamation, 2016a).

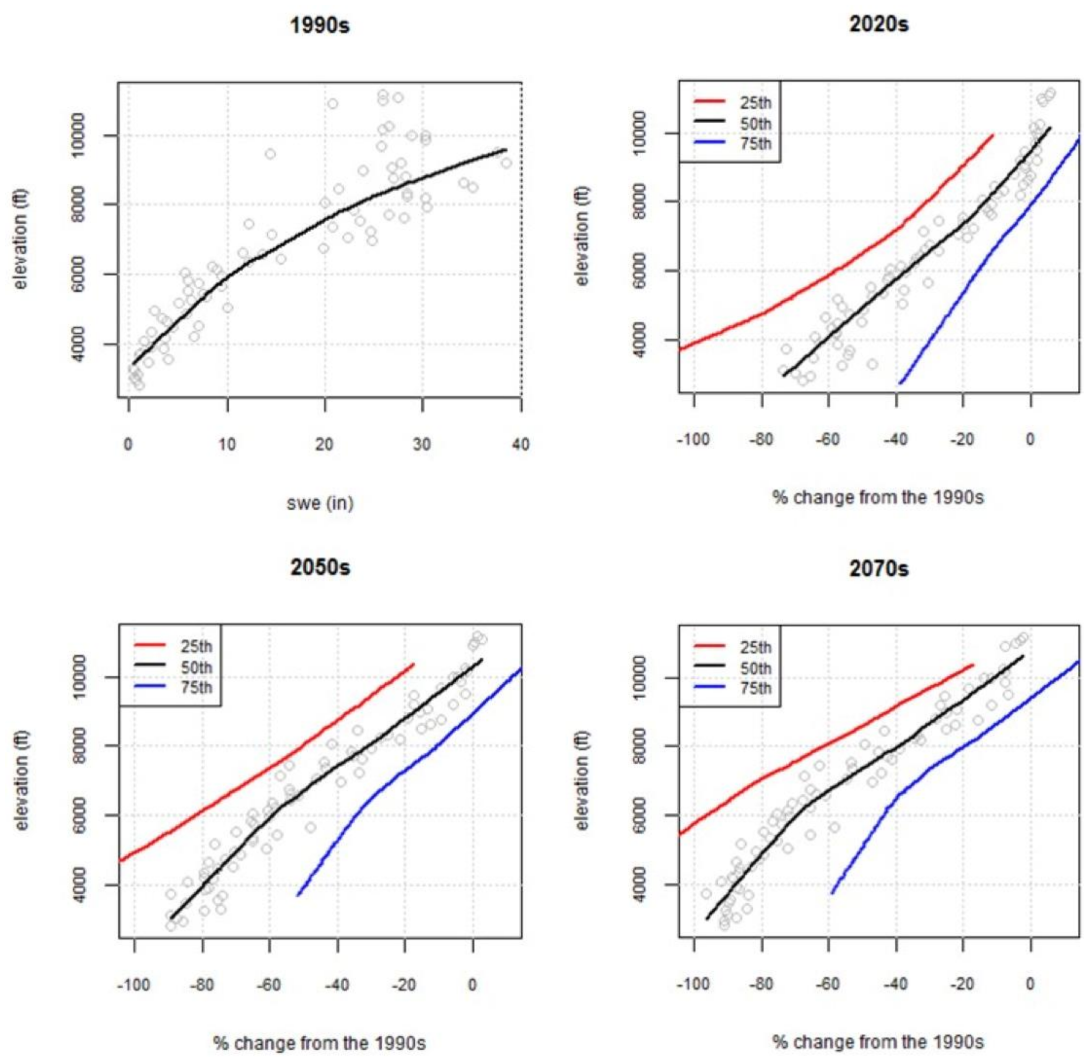


**Figure 5-2 Sacramento-San Joaquin Rivers Basins Snow Water Equivalent (SWE) in 1990 and projected percent change in the 2020s, 2050s, and 2070s. Circles are median values at each elevation and red and blue lines are regression lines for the 25th and 75th percentile (Source: Reclamation, 2016a).**

Figure 5-3 shows the mean monthly streamflow at 8 locations in the Sacramento-San Joaquin River Basin (and 1 in the Tulare Basin) in the 1990s and as projected for the 2020s, 2050s, and 2070s. An earlier peak runoff is projected at all locations (Reclamation, 2016a).

Figure 5-4 shows boxplots of the projected change in runoff magnitude for annual, December-March, and April-July periods. An increase in median runoff is projected for December-March, and a decrease is projected for April-July, for nearly all time periods, with little change in the median annual streamflow runoff magnitudes relative to the 1990s (Reclamation, 2016a).

Figure 5-5 shows the projected change in timing of the median annual streamflow for runoff in the Sacramento-San Joaquin River Basins. The median annual streamflow is projected to shift gradually to earlier times, around 7 days earlier for the 2070s.

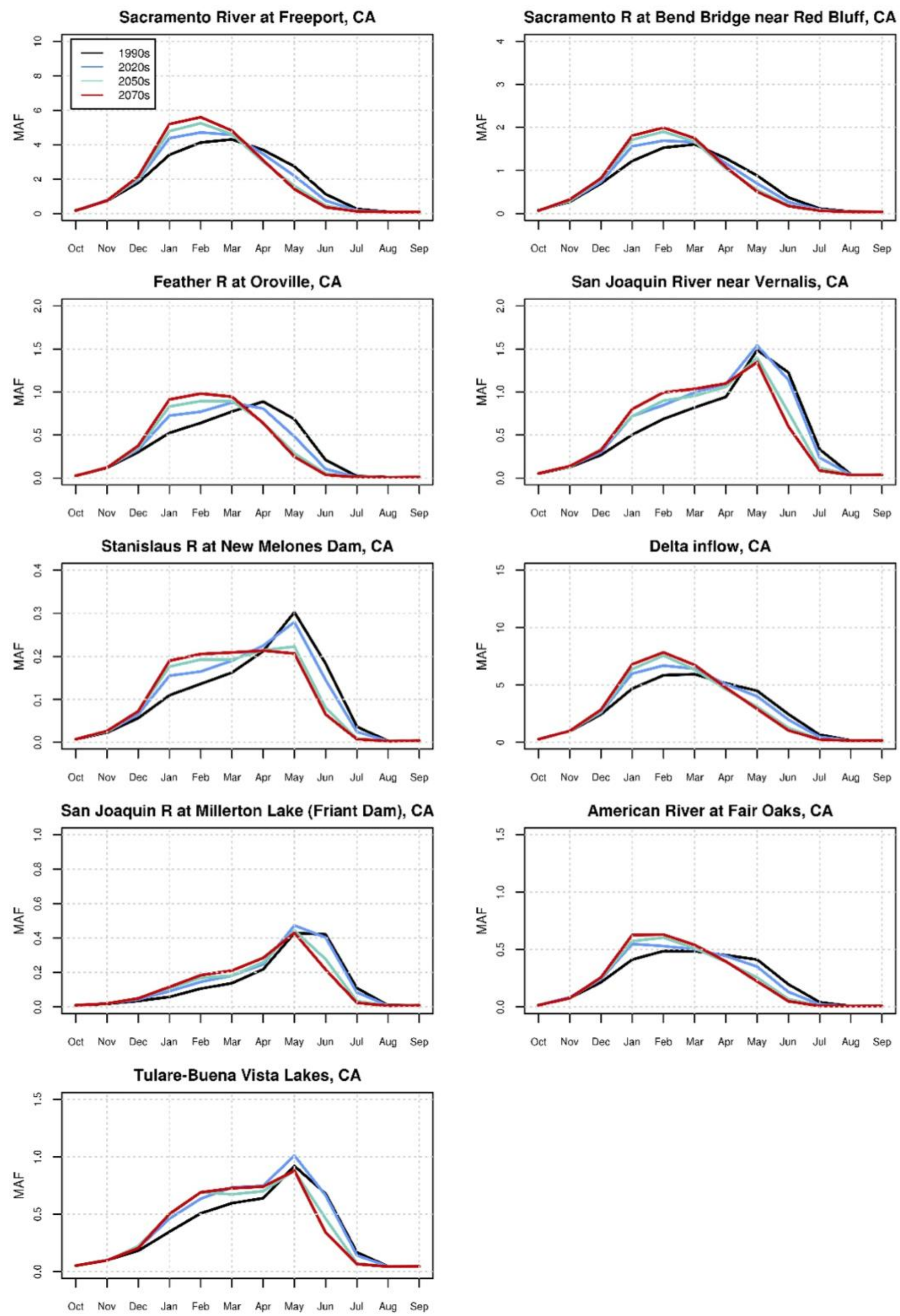


**Figure 5-3 Sacramento-San Joaquin Rivers Basins Projections (Source: Reclamation, 2016a).**

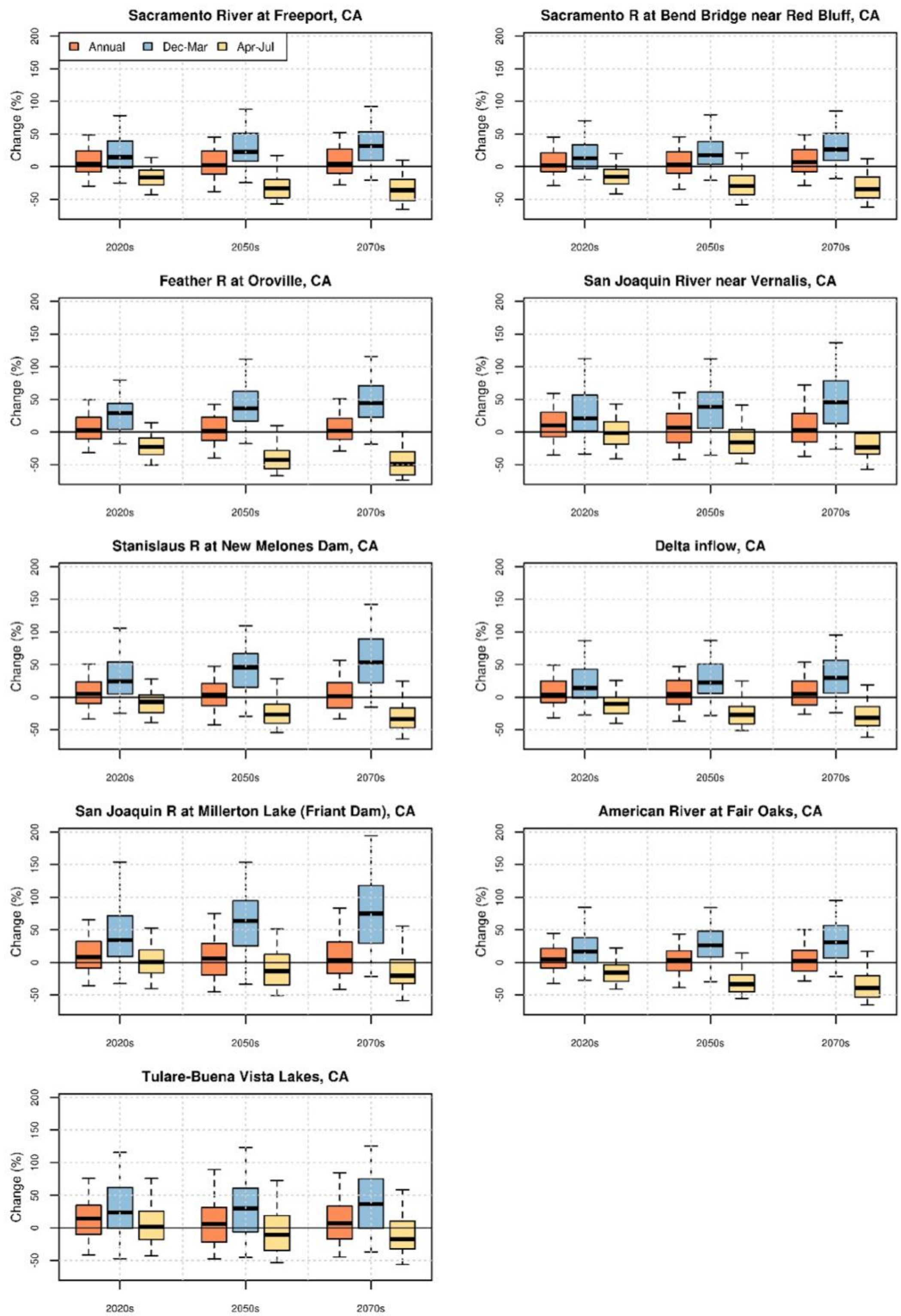


**Figure 5-4 Sacramento-San Joaquin Rivers Basins Projections (Source: Reclamation, 2016a).**

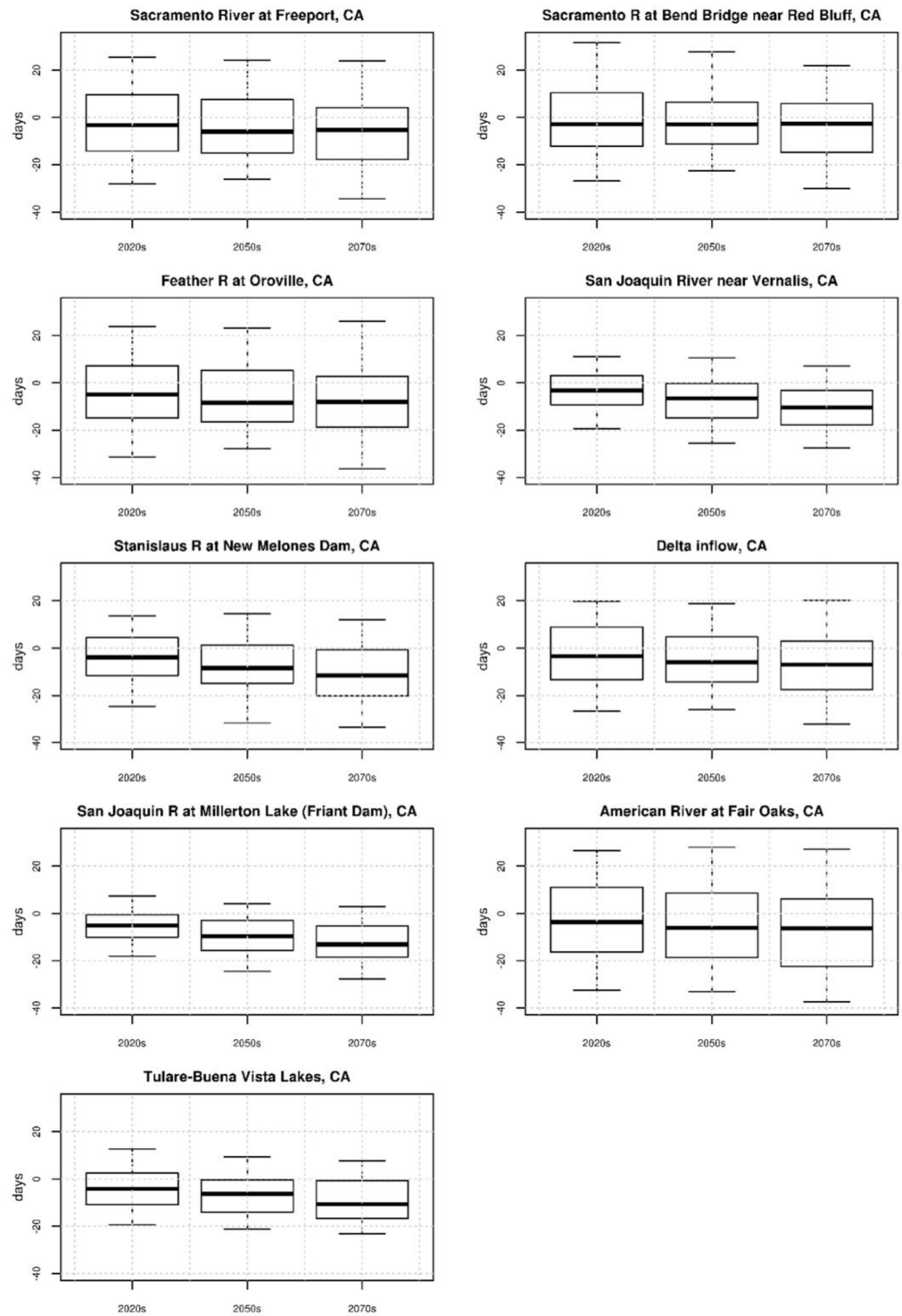


**Figure 5-5 Sacramento-San Joaquin Rivers Basins shift in timing of median annual streamflow with respect to 1990s (Source: Reclamation, 2016a).**

Sea-level also plays an important role in the quality of water at the Sacramento-San Joaquin River Delta. “Higher mean sea level (msl) is associated with increasing salinity in the Delta, which influences the suitability of its water for agricultural, urban, and environmental uses. Global and regional sea levels have been increasing steadily over the past century and are expected to continue to increase throughout this century. Over the past several decades, sea level measured at tide gauges along the California coast has risen at rate of about 6.7 to 7.9 inches (17 to 20 centimeters) per century. The National Research Council (NRC) recently completed a comprehensive assessment of sea- level-change projections for the Pacific Coast of North America (NRC, 2012). In the San Francisco Bay and Delta region, mean sea level rise is projected to accelerate during the century, reaching about 1 foot of sea level rise by mid-century and about 3 feet by the end of the century” (Reclamation, 2016).

## 5.2 COLORADO RIVER BASIN

The Colorado River is a major source of water for MWD and its first source of water after it was established in 1928. Approximately 70 percent of the Colorado River water is used for agriculture, and 40 percent is exported outside the basin’s hydrologic boundaries (Reclamation, 2016). The Colorado River Aqueduct is owned by MWD and is used to transport water from the Colorado River to Lake Mathews in Riverside County. Up to 1.25 million acre feet (maf) per year may be conveyed to MWD member agencies through the aqueduct, with additional rights at lower priority.

The Bureau of Reclamation performed the Colorado River Basin Water Supply and Demand Study (Reclamation, 2012), which defines current and future imbalances in water supply and demand in the Colorado River Basin and assesses the risks to resources, including water allocations and deliveries, hydroelectric power generation, recreation, ecosystems, and flood control. The basin study used CMIP3 model results and was the main source for the analysis of the Colorado River Basin in the SECURE Water Act Section 9503(c) Report to Congress (Reclamation, 2016). Updated projections based on CMIP5 results were published in (Reclamation, 2016a) and presented in this section.

Figure 5-6 shows projections of six drought metrics for the Colorado River Basins. No clear trend is seen in annual total precipitation or annual runoff. However, steady increases in annual mean temperature coincide with a steady decline in April 1$^{st}$ snow water equivalent and April-July Runoff. Projections of December-March runoff are slightly increasing.

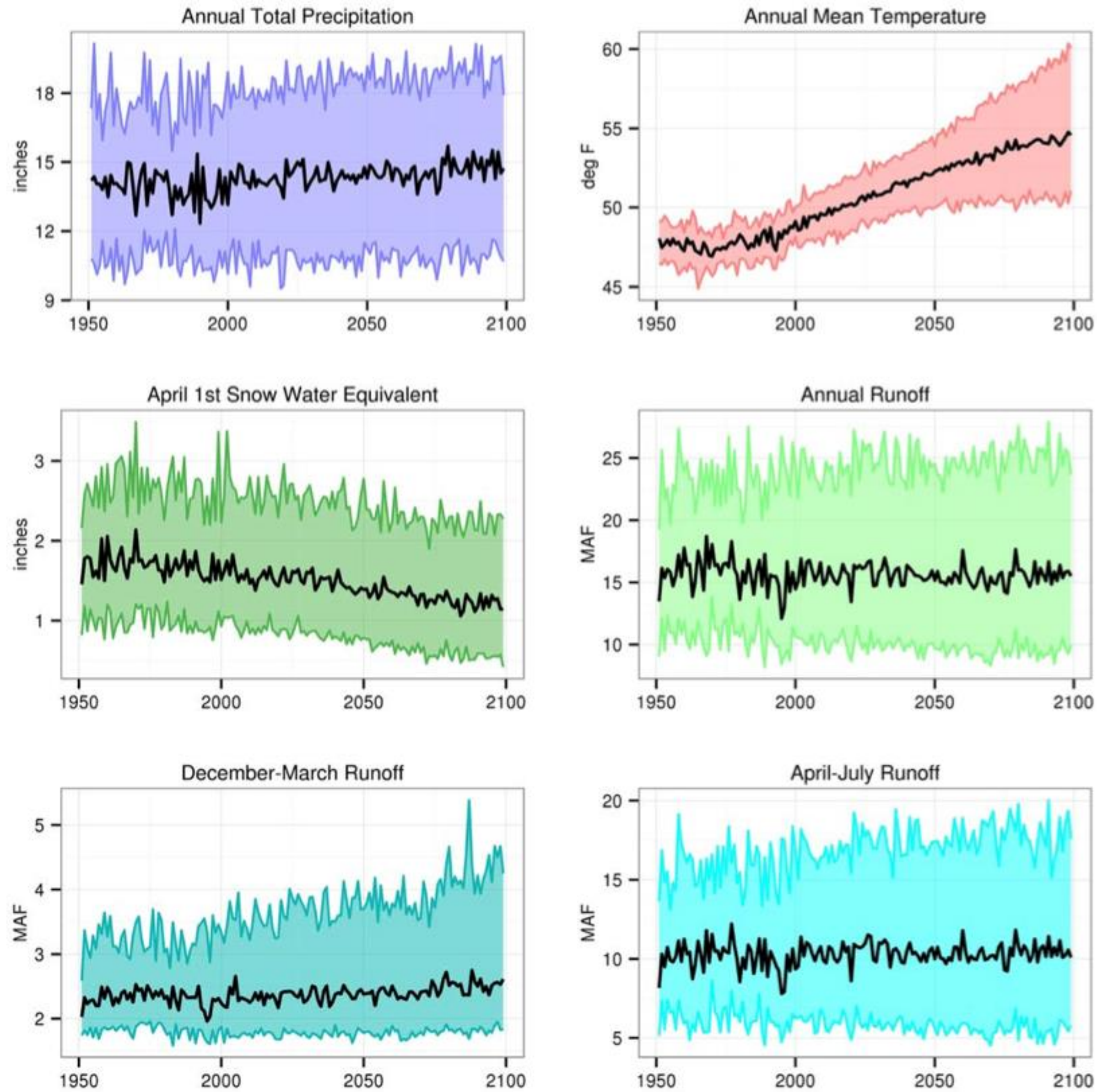


**Figure 5-6 Colorado River Basin Projections for Six Hydroclimate Variables. Black line is yearly median and shaded region is 10th to 90th percentiles. (Source: Reclamation, 2016a).**

The percent change in April 1st snow water equivalent (SWE) in the Colorado River Basin is shown Figure 5-7 for the the 2020s, 2050s, and 2070s relative to the 1990s. There is "a substantial loss in SWE at lower elevations, but at higher elevations (around 11,000 feet) projections indicate that the median SWE change increases in the future decades. Over time, however, even at higher elevations, the analysis indicates a net decline in the median SWE values from the 2020s to 2050s and from the 2050s to the 2070s" (Reclamation, 2016a).

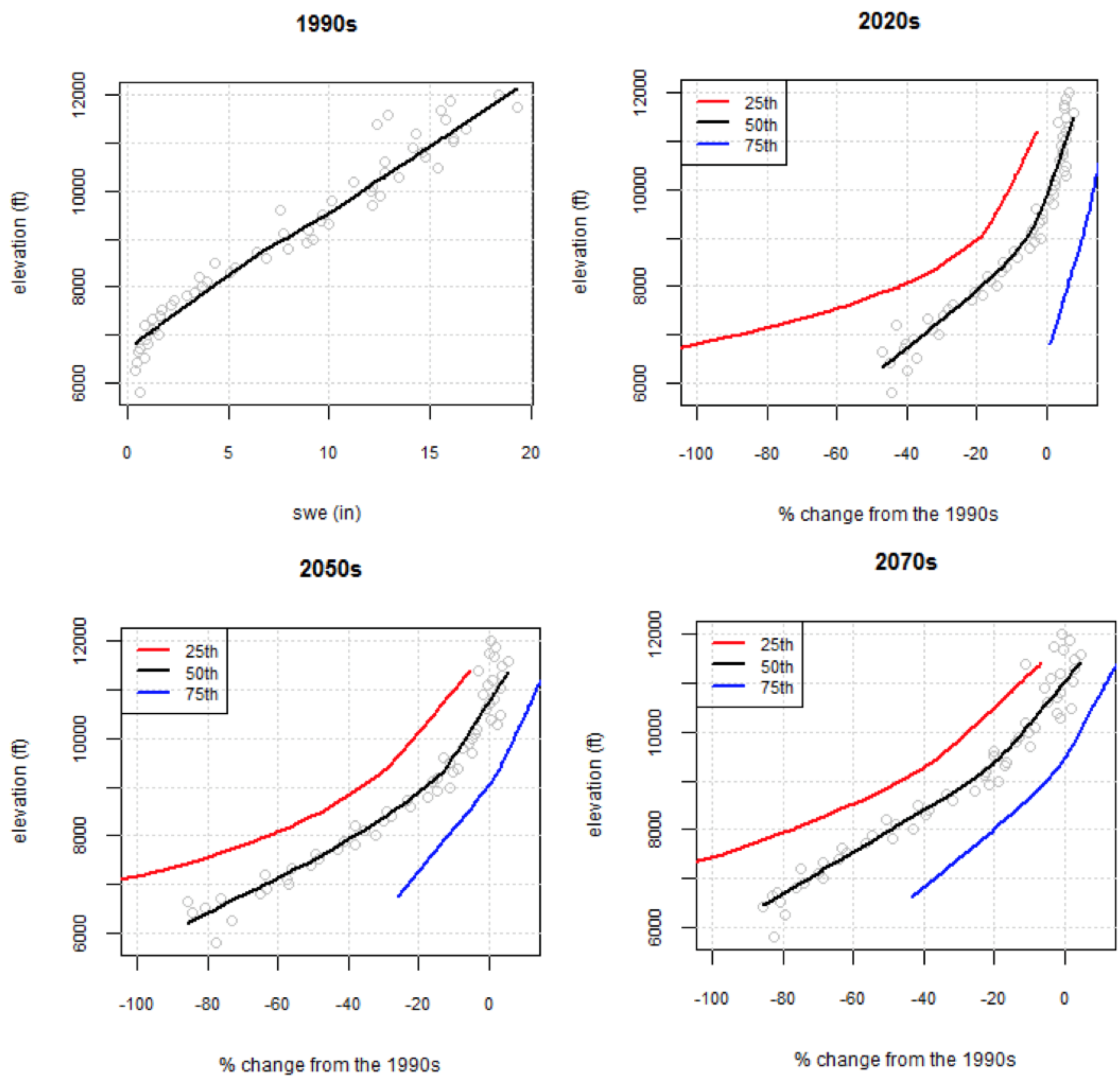


**Figure 5-7 Colorado River Basin April 1st Snow Water Equivalent (SWE) in 1990 and projected percent change SWE in the 2020s, 2050s, and 2070s. Circles are median values at each elevation and red and blue lines are regression lines for the 25th and 75th percentile (Source: Reclamation, 2016a).**

Figure 5-8 shows mean monthly streamflow in six Colorado Rivers sub-basins in the 1990s and projected in the 2020s, 2050s and 2070s. Lees Ferry, on the Colorado River, is the location upon which the water allocations of the river are based. Shifts to earlier peak runoffs are projected at most locations, particularly by the 1970s.

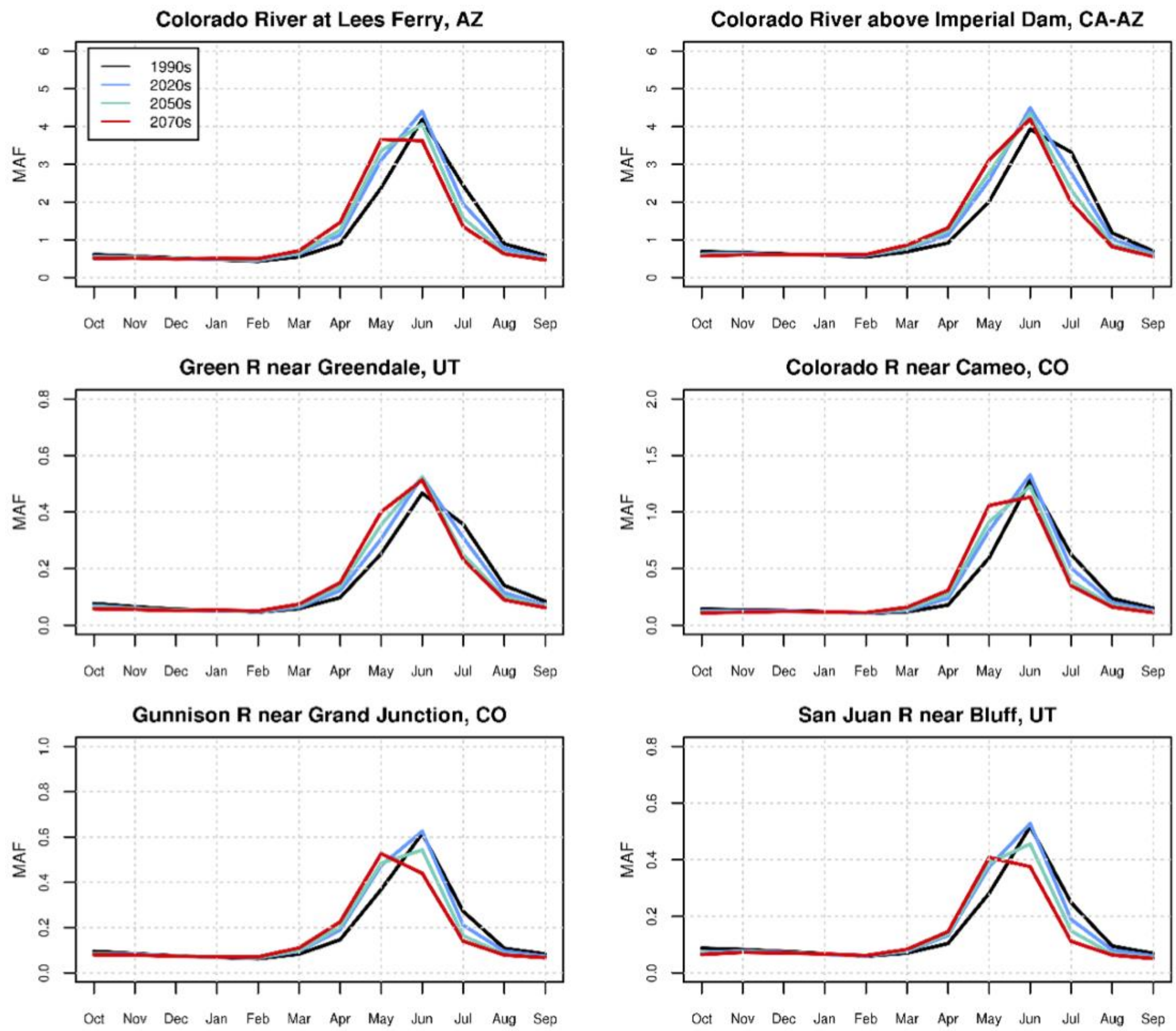


**Figure 5-8 Colorado River Basin projeections of mean monthly streamflow. (Source: Reclamation, 2016a).**

Figure 5-9 shows boxplots of the projected change in runoff magnitude for annual, December-March, and April-July periods. An increase in runoff is projected for December-March for all time periods, with little change in the median annual streamflow at Lees Ferry in the 2050s and 2070s relative to the 1990s (Reclamation, 2016a).

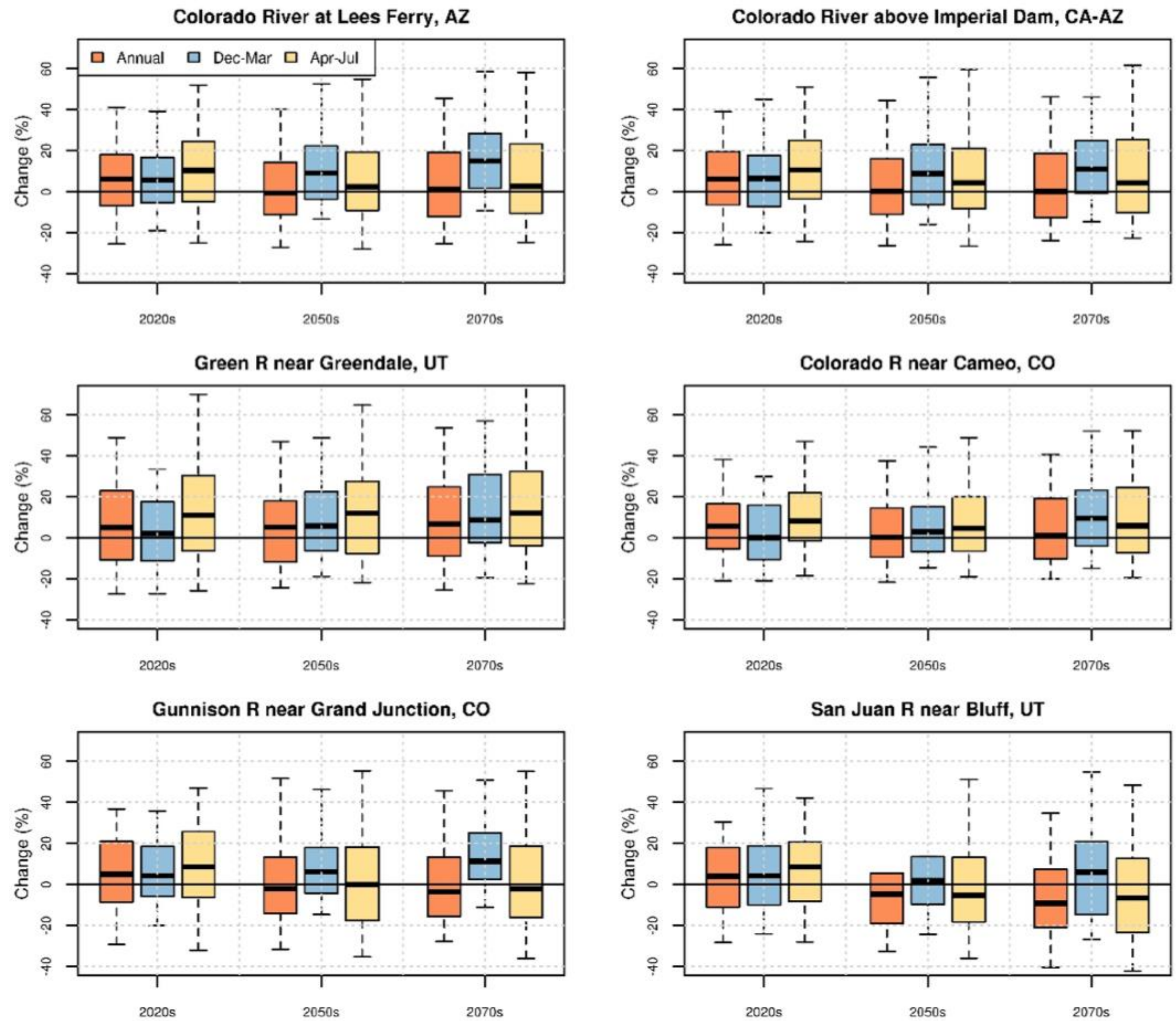


**Figure 5-9 Colorado River Basin projected change in streamflow magnitude for six sub-basins. (Source: Reclamation, 2016a).**

Figure 5-10 shows the projected change in timing of the median annual streamflow for runoff in the Colorado sub-basins. Nearly all projections indicate earlier runoff. The timing median streamflow for the Colorado River at Lees Ferry is projected to be around 13 days earlier in the 2070s.

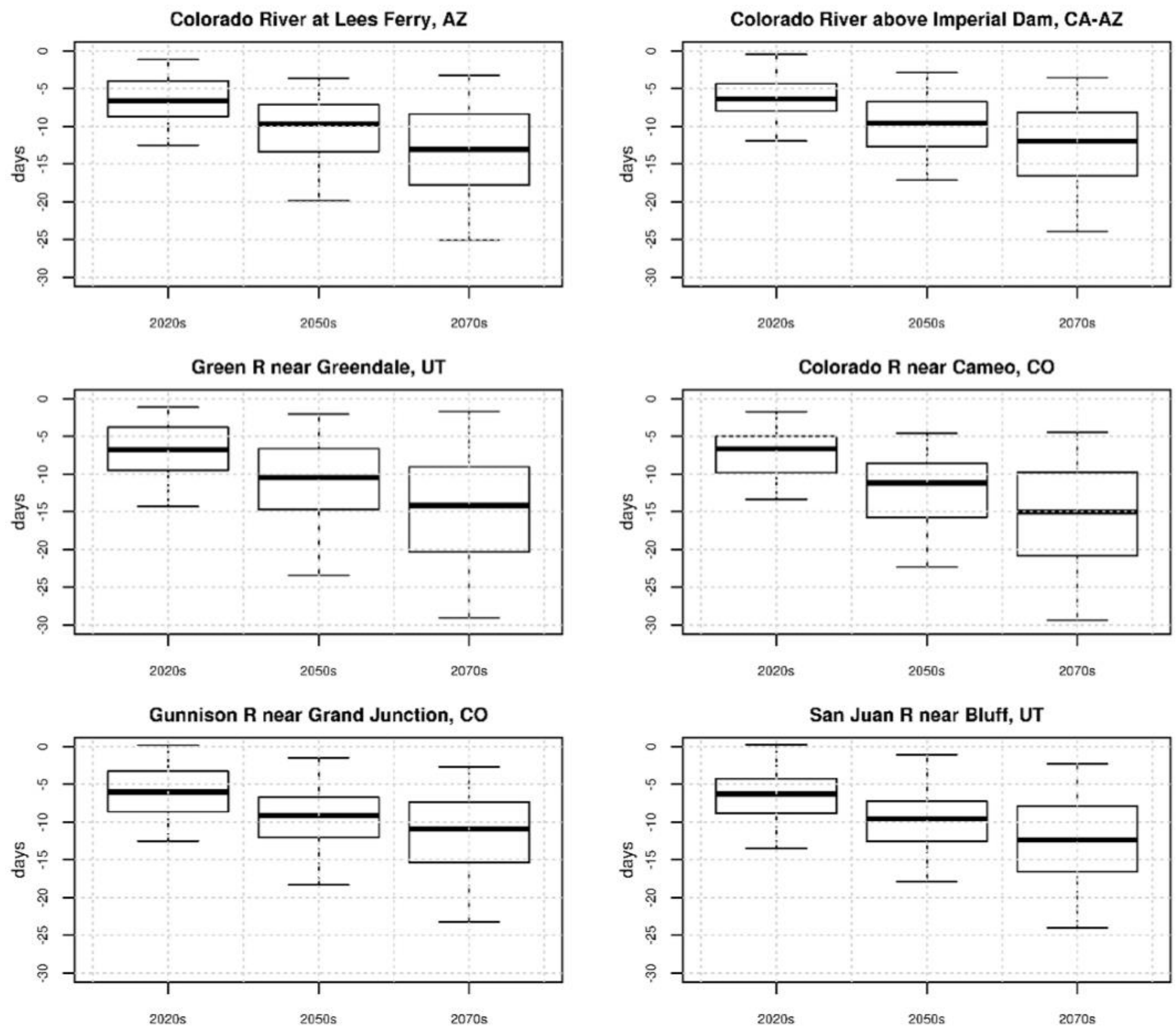


**Figure 5-10 Colorado River Basins shift in timing of median annual streamflow with respect to 1990s (Source: Reclamation, 2016a).**

## 5.3 WATER SUPPLY, DEMAND, AND ADAPTATION IN THE SOUTH OC PLANNING REGION

Water demand projected in 2040 for South OC water agencies is presented in Table 5-1, as reported in each agencies 2015 Urban Water Management Plan. Relative to the values for 2015 reported in

Table 2-1, total demand is projected to increase by nearly 8,000 MG per year, with most of the increase accounted for by recycled water, and to a lesser extent groundwater.

**Table 5-1**
**2040 Projected Water Demand and Supply by Sources by South Orange County Water Agency, Obtained from the 2015 Urban Water Management Plan for each Agency. All Units in Millions of Gallons (MG). Recycled Surface Water and Recycled Water Have Been Consolidated into "Recycled."**

| Water Agency | Water Demand | MWDOC | Groundwater | Recycled |
|---|---|---|---|---|
| El Toro Water District | 2,915 | 2,374 | 0 | 541 |
| Trabuco Canyon Water District | 1,558 | 1,232 | 0 | 326 |
| Moulton Niguel Water District[4] | 14,790 | 11,396 | 0 | 3,393 |
| Laguna Beach County Water District | 1,156 | 1,133 | 0 | 23 |
| Santa Margarita Water District[3] | 12,941 | 7,560 | 1,630 | 3,752 |
| South Coast Water District | 2,846 | 2,028 | 339 | 480 |
| Irvine Ranch Water District[1] | 3,850 | 1,460 | 1,687 | 703 |
| San Juan Capistrano | 2,831 | 625 | 1,727 | 479 |
| San Clemente | 2,952 | 2,268 | 163 | 521 |
| Total[2] | 45,839 | 30,076 | 5,546 | 10,218 |

[1]Only a portion of the IRWD service area falls within South Orange County (8,658 acres out of 115,840 acres, or 7.5%), so the values for IRWD were scaled by the percentage of area overlap, 7.5%, for inclusion in this table. Value for 1935 used.
[2]The Emerald Bay Service District (EBSD) is not separately listed in this table, because it purchases its water from LBCWD and is too small to be required to prepare its own Urban Water Management Plan. EBSD purchased an average of 272 AF (89 MG) from LBCWD between 2011 and 2015, according to the LBCWD 2015 Urban Water Management Plan.
[3]The Santa Margarita District currently has transfer and exchange opportunities with CVWD, GSWC, and potentially Inland Empire Utilities Agency (IEUA) which is included as 1,630 MG in MWDOC
[4]Moulton Niguel UWMP did not explicitly list purchased and recycled portion so percentage from 2015 was applied

Increased temperatures will result in more winter precipitation in the mountains falling as rain rather than snow as described in Chapter 3. DWR anticipates a 20 to 40 percent decrease in the state's snowpack water storage by the year 2050 (DWR 2008). This snowpack reduction impacts large water systems such as the State Water Project (SWP), the Central Valley Project (CVP), and water systems that rely on the Colorado River. It also impacts smaller watersheds relying on snowpack for water supply. Shifts in run-off timing have already been observed as discussed in Chapter 3.

Evaluation of climate change is one of the considerations for the development of the State Water Project Delivery Capability (Reliability) Report (DWR 2010, 2012, 2015). The Delivery Capability (Reliability) Report, or DCR (DRR), is a biannual report that describes the existing and future conditions for SWP water supply that are expected if no significant changes are made to the infrastructure to convey water past the Sacramento–San Joaquin Delta (Delta). Besides climate change the DRR projections also consider constraints imposed by federal biological opinions that seek to modify SWP (and CVP) operations to minimize impacts to certain aquatic species such as the Delta smelt.

The calculations are performed for variable hydrologic conditions using an 82-year record, representing 1922-2004 conditions, and implemented through the CALSIM II model used for water planning in California. The goal of the analysis is to estimate the percentage of years where specific levels of water allocations will be met by the SWP. Water allocations are defined for each water contractor (identified in what is termed SWP Table A, (DWR, 2015)). Under the existing conditions scenario for the 2015 report, the maximum water demand for all contractors is 4,055 thousand acre feet (taf). Of this delivery, the maximum allocation for MWD—the source of water for MWDOC and then to the South OC region—is 1,912 taf. In comparison to its maximum allocation of 1,912 taf MWD's water delivery from the SWP has recently ranged from 556 taf (2009, a dry year) to 1,720 taf (2003, an above normal year). In the most recent DCR (DWR 2015), it is estimated that under existing conditions there is a 74% likelihood that a delivery target of over 2,000 to taf, aggregated for all contractors, will be met (Figure 5-11). There is a 20% likelihood of water delivery of 1,000–2,000 taf, a 6% likelihood of less than 1,000 taf, The delivery capability as a function of the type of year is shown in Table 5-2, and ranges from 1,349 taf for a 6-year drought period to 454 taf for a single extreme dry year. Since MWD's allocations are 46% of the maximum SWP Table A allocations, MWD's allocation in dry years could be much lower than observed in the recent past. As noted in (Reclamation, 2016) "current demands for water supplies across these resource categories have already exceeded the capacity of the existing water management system to meet all the potential needs".

The seasonal component of water demands (e.g., landscape irrigation and water used for cooling processes) will likely increase with climate change as droughts become more common and more severe, increasing temperatures increase evapotranspiration rates, and growing seasons become longer. Without accounting for changes in evapotranspiration rates, agricultural crop and urban outdoor demands are expected to increase in the Sacramento Valley by as much as 6% (Chung et al., 2009). However, in urban areas such as the South OC IRWM planning region, the potential increase in water demands due to climate change is severely constrained by statewide efforts—the Water Conservation Act of 2009, or SBx7-7—to enhance water conservation and reduce water consumption on a per capita basis by 20% from current levels to the year 2020 (MWDOC Urban Water Management Plan, 2011). MWDOC, in association with its member retail agencies, has created the Orange County 20x2020 Regional Alliance to meet the water use reduction targets. The future plans for compliance with the 2020 goals do not explicitly consider climate change, although the effects of climate change are likely to be relatively small over this time frame. However, over the longer term, i.e., in future decades in the 21st century, climate change will make this goal harder to achieve. From the standpoint of water availability over the long term, even with constrained per capita water use, water demands may continue to grow as population in the region grows. The population of Orange County is expected to grow by 0.66% annually over the next two to three decades (MWDOC, 2011).

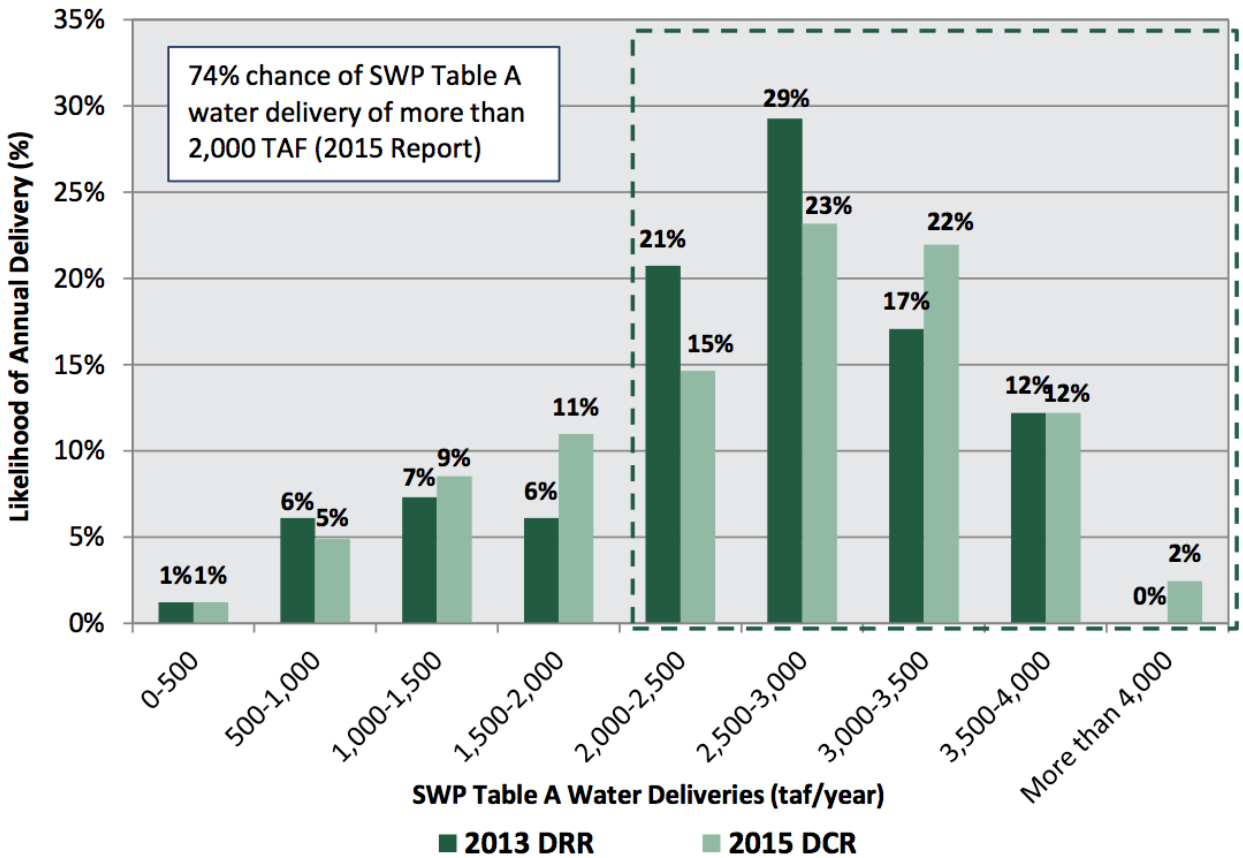


**Figure 5-11** **Likelihood of specific levels of water delivery under 2015 conditions (Source: DWR, 2015).**

**Table 5-2**
**Estimated Average and Dry-Period Deliveries of SWP Table A Water under Conditions Existing in 2011 and 2015 (taf/year)**

| Time Period | Long-term Average (1921-2003) | Single Dry Year (1977) | 2-Year Drought (1976–1977) | 4- Year Drought (1931–1934) | 6-Year Drought (1987–1992) | 6-Year Drought (1929–1934) |
|---|---|---|---|---|---|---|
| 2011 (DWR, 2012) | 2,466 | 443 | 1,457 | 1,401 | 1,227 | 1,366 |
| 2015 (DWR, 2015) | 2,550 | 454 | 1,165 | 1,356 | 1,182 | 1,349 |

Adaptation plans for Sacramento-San Joaquin River Basins include: “Reduce Water Demand: Through CalFED Water Conservation Grants and WaterSMART Grants, Reclamation continues to make cost-shared funding available to agricultural and municipal water management agencies in the basin, resulting in improvements in management and water use efficiency;

Increase Water Supply: Through the CalFED Bay Delta Storage Projects investigations, Reclamation has recently completed planning documents addressing needed improvements in water supply reliability and water quality (temperature and salinity) by increasing water storage in Sacramento and San Joaquin Basins. These plans are currently being reviewed prior to submission to Congress;

Improve Operating Efficiency: Through the California Water Fix program (i.e., the Bay Delta Conservation Plan) Reclamation is coordinating with the State of California to develop a comprehensive plan addressing risks to California's current water management system, environment, and economy. Climate change adaptations, including new Delta water conveyance infrastructure, are included to address key vulnerabilities to water supply and the Delta environment from potential changes in climate and rising sea levels. The plan is currently considering public comments" (Reclamation, 2016).

The Colorado River flow over the period 2000-2015 was the "lowest 16-year period for natural flow in the last century. Paleorecords indicate that this period was also one of the lowest 16-year periods for natural flow in the past 1,200 years. During the drought, storage in Colorado River system reservoirs (system storage) has declined from nearly full to about half of capacity. Lake Mead has experienced its lowest elevations since May 1937 during the reservoir's initial filling" (Reclamation, 2016).

The Colorado River Basin Study solicited input from stakeholders and the general public to identify options to resolve water supply and demand imbalances. Options were classified into four groups that focused on increased supply, reduced demand, modifying operations modifying governance and option implementation. Representative options to increase supply included desalination of water from the Pacific Ocean, water reuse, development of local supplies, and water imports from outside the basin. Options to reduce demand included greater conservation in municipal, agricultural, power generation sectors. Changed operations included consideration of reduced evaporation from reservoirs and aqueducts, and changed system operations. Potential volumes of water that could be generated or saved through each of these options were estimated. Many of these options are not feasible or reliable over the long term, or have technical and environmental challenges. Excluding less feasible options, an additional 3.7 maf per year may be produced by 2035 and 7 mafy by 2060 (Reclamation, 2012).

Multiple scenarios were assumed for the water demand in the basin states, assuming a range of population and economic growth. Based on these scenarios, the Colorado River demand for consumptive uses is projected to range between about 18.1 maf and 20.4 maf, exceeding the historical natural flows, and the reduced flows expected under climate change scenarios. The future demand as projected in the Basin Study exhibits significant growth, and may be compared with a demand of 15.3 maf over the past decade. The largest increase in demand is projected to be for municipal and industrial uses, due to population growth. Population within the areas supplied by the Colorado River are projected to grow from about 40 million in 2015 to between 49.3 million and 76.5 for different scenarios by 2060. A comparison of the water supply and demand projections indicates a long-term projected imbalance in future supply and demand of about 3.2 maf by 2060 (Reclamation, 2012).

There is also a projected increase in both drought frequency and duration as compared to the observed historical and long-term scenarios obtained from tree-ring records. Droughts 5 years or longer are projected to occur 50 percent of the time over the next 50 years. Projected changes in climate and hydrologic processes include continued warming across the basin, a trend towards drying, increased evapotranspiration, and decreased snowpack as a higher percentage of precipitation falls as rain (Reclamation, 2012).

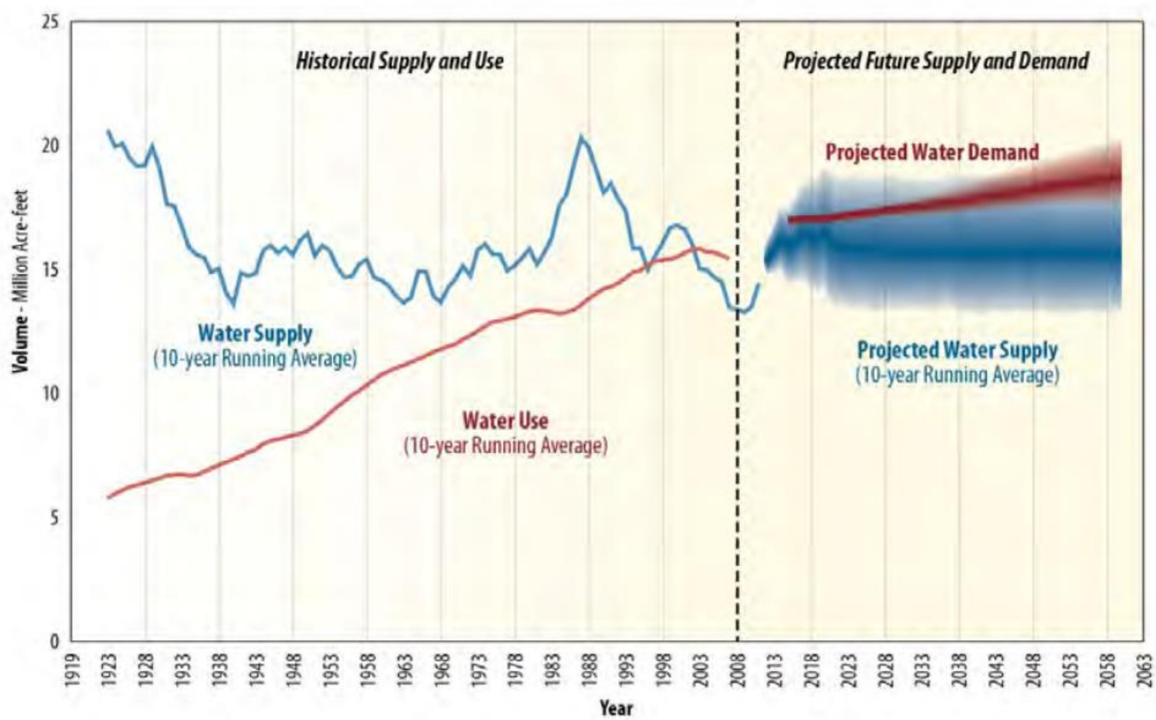


**Figure 5-12 Histoical and projected water supply and demand on the Colorado River (Source: Bureau of Reclamation, 2012).**

The basin study technical evaluation presents an approach for quantifying climate change impacts in a complex system, and for developing responses through changes in supply, demand, and operations. The analysis demonstrates that it is possible for the system to adapt to conditions as they are currently understood, albeit at significant additional investment across the basin. Conservation and desalination are an important part of all portfolios considered in the basin study, and both are being considered in the South OC planning region.

A general discussion of climate change adaptation strategy can be found in (Reclamation, 2014).

## 5.4 WATER QUALITY

Water quality can be impacted by both extreme increases and decreases in precipitation. Increases in storm event severity may result in increased turbidity in surface water supplies (DWR, 2008). Lower summertime precipitation may also leave contaminants more concentrated in streamflows. Higher water temperatures may exacerbate water quality issues associated with dissolved oxygen levels and increased algal blooms (DWR, 2008). These changes may occur in reservoirs where water is stored in the SWP system and in the Colorado Basin, and in aqueducts used to transport water to Southern California.

Salt intrusion may also impact estuarine water supplies like the Delta (Chung et al 2009) and coastal aquifers. Water quality concerns may impact both drinking water supplies and instream flows for environmental uses. Water quality issues may also have impacts on wastewater treatment, the altered assimilative capacity of receiving waters may alter treatment standards, and collection systems may be inundated in flooding events.

### 5.5 Ecological Effects

Climate change is expected to have widespread effects on ecosystems and landscapes (DWR, 2011). Habitats for temperature-sensitive fish may be impacted by increased water temperatures (DWR 2008). Many commercially valuable species, such as coho salmon and steelhead trout, are at risk of extinction because they require waters below 72 $^{o}$F (Moyle et al., 2012). Surface water bodies will also be more susceptible to eutrophication with increased temperatures. Invasive species may become even more challenging to manage. Climate change will stress forested areas, making them more susceptible to pests, disease, and changes in species composition. With lower rainfall, or less frequent but more intense rainfall, wildfires incidence are areas of risk are expected to increase are likely to become more frequent and intense, potentially resulting in changes in vegetative cover (CCSP 2009, Krawchuck and Moritz, 2012). Coastal ecosystems that are sensitive to acidification and changes in salinity balances, sedimentation, and nutrient flows (such as estuaries and coastal wetlands) may be particularly vulnerable (California Natural Resources Agency, 2009).

### 5.6 Hydropower Generation

Hydropower is a significant clean low-carbon electricity source in California: 21% of the state's electricity is generated from hydropower (CAT 2008). High-elevation hydropower units generate, on average, 74 percent of California's in-state hydroelectricity and are particularly vulnerable to climate change because they rely on natural snowpack reserves and snowmelt for power generation. As spring snow-melt timing shifts, power generation operations at higher elevations may have limited flexibility compared to lower elevation plants (Medellin-Azuara et al 2009; Guegan et al., 2012). Higher elevation hydropower generation units may see a decrease of as much as 20% of annual power generation (Medellin-Azuara et al., 2009). Maximum power generation capacity may not coincide with maximum energy demands in the hot summer months. Several studies have projected various levels of hydropower losses. The California Climate Action Team projected that power generation will decrease by 6% by the end of the century for the State Water Project system, and by 10% for the Central Valley system.

### 5.7 Summary

This section presents an overview of activities that pertain to water resources planning in California and the Colorado River Basin, which indirectly affect the supply to MWD and then to South Orange County. Projected climate change conditions, such as the suite of models used in Chapter 4, has been an important part of the planning activities conducted over the past decade in both regions. Two features stand out from the comprehensive analyses that have been performed: both California and the Colorado Basin are severely water constrained, where it will be challenging to meet current allocations in future years. In both regions, planning model projections indicate years where deliveries will sometimes fall short of allocations, over planning horizons that range from 20 to 50 years into the future. For the

State Water Project, the model calculations show a supply of 2,500 to 3,500 TAF over 70% of the time, with supplies well below 1,500 TAF during drought periods. Because the regions jointly affected by these basins are continuing to experience relatively rapid population growth, and anticipated increased in municipal demands, water planners must address the dual challenge of reduced supplies and increased demand.

# 6. GREENHOUSE GAS EMISSIONS FOR WATER SUPPLIES

***Key Points:*** *The General Reporting Protocol, Version 3.1, developed by the California Climate Action Registry is used to calculate indirect emissions of greenhouse gases (GHG) from electricity used for the water system in South Orange County. The water sector is the largest user of electricity in the state of California. The bulk of water for southern California specifically is transported over long distances up steep gradients and is therefore more energy expensive than local sources. Energy use for water is quantified via energy intensity, or the gross energy required for the water system to use a specific amount of water at a specific location. Under baseline conditions, the water sector in the region generates GHG emissions of over 93,000 metric tons in terms of carbon dioxide equivalents.*

## 6.1 GREENHOUSE GAS PROTOCOL

This study used the General Reporting Protocol (GRP), Version 3.1 developed by the California Climate Action Registry (CCAR) in 2009 to calculate greenhouse gas (GHG) emissions. The GRP was designed as a tool for businesses, government agencies, and non-profit organizations to calculate their general emissions or emissions related to a specific sector (utilities, construction, etc.). This methodology includes indirect emissions of GHG from electricity use and involves a five step process.

- Determine annual electricity use
- Select the appropriate electricity emission factors that apply to the electricity source used
- Determine total annual emissions in metric tons
- Convert non-$CO_2$ gases to carbon dioxide equivalent ($CO_2e$)
- Total the sum of all $CO_2$ and $CO_2e$ gases emitted from electricity use

GHG emissions from energy related to the water supply for a region may be calculated in proportion to the volume of water obtained through its water infrastructure. The total annual water volume for a region or facility is multiplied by an electrical consumption factor, or energy intensity, from the appropriate utility to obtain the estimated annual electrical consumption per year. The energy intensity is defined as the total amount of energy in the entire system that is necessary to use a certain volume of water at a specific location (Wilkinson, 2006). Then, following the steps outlined above, the appropriate emissions factors for the greenhouse gases of interest, for instance $CO_2$, $CH_4$, and $N_2O$, are multiplied by the annual electrical consumption of the water volume to obtain the emission of that individual gas. After converting into metric tons, the amount of gas is multiplied by its global warming potential (GWP) to obtain its $CO_2e$. The GWP defines how much a mass of non-$CO_2$ GHG contributes to global warming per unit time when compared with the same mass of $CO_2$ (EPA, 2011). The $CO_2e$'s are then summed to obtain the total $CO_2e$. Table 6-1 contains GHGs and their GWPs.

**Table 6-1**
**Table of GHGs and their GWP**

| Greenhouse Gas | Global Warming Potential |
|---|---|
| $CO_2$ | 1 |
| $CH_4$ | 21 |
| $N_2O$ | 310 |

## 6.2 Energy in the Water System

Nineteen percent of electricity in California is used for its water infrastructure. Thirty-three percent of non-power plant natural gas is used in the state's water systems. This energy is leveraged for groundwater extraction and pumping, conveyance of our water supply through canals and aqueducts, storage in reservoirs, treatment and distribution, wastewater treatment, recycling, and a myriad of end uses ranging from municipal to industrial to agriculture (Garrison et al, 2009, Wilkinson, 2006).

The State Water Project (SWP) is the largest user of electricity in the state of California (Cohen et al, 2004). In fact it consumes an amount equivalent to 2–3 percent of total California electricity. Much of this energy is expended pumping water over long distances of up to 400 miles. Water is pumped from essentially sea-level upwards to over 3400 feet between the Sacramento-San Joaquin Delta and the southern end of the California Aqueduct along its East Branch (DWR, 2008). The SWP obtains its electricity through a combination of purchasing and generation. It owns nine hydroelectric power plants and partially owns a coal-fired plant in Nevada, which together produce 5.9 billion kilowatt-hours of electricity per year. Four and one half billion kilowatt-hours, or approximately 76% is due to hydroelectric power.

Similarly, the Metropolitan's Colorado River Aqueduct pumps its water 242 miles from Lake Havasu, Arizona to Lake Mathews, California. The elevation gain between the two points is 1617 feet. According to Cohen et al (2004), MWD estimates that the amount of energy it takes to deliver water to its service area is roughly one-third total average household electric use there. In 2006 MWD projected its expected delivery of water would require 1,700 gigawatt-hours (GWh). This electricity comes from a combination of purchased power, and power exchanges. The primary energy sources are hydroelectric power from the Colorado River generated at the Hoover and Parker Power Plants. In the expected delivery scenario, 1,403 GWh is from the two hydroelectric power plants, and 297 GWh is from other resources including Southern California Edison and the Western Systems Power Pool.

## 6.3 Summary of Energy Intensities and Emissions Factors

Electricity use as it applies to the water system is typically described via energy intensity. Energy intensity is defined as "the total amount of energy, calculated on a whole-system basis, required for the use of a given amount of water in a specific location (Wilkinson, 2006)." Water intensity is generally calculated in units of kWh per million gallons, and thus may be examined by water use sector, individual project, or segment of the water supply and delivery system. As described above, the water intensity figures are for the entire system, project, or sector regardless of source of electricity.

The California Energy Commission (2006) describes the water intensity of the water system in several ways. In its baseline estimates of water energy intensity (Table 6-2), it divides the parameter by location (Northern versus Southern California), indoor and outdoor uses, and segment of the water delivery system.

**Table 6-2**
**Energy Intensity of Water (kWh/MG). Reproduced from CEC (2006)**

| | Indoor Uses | | Outdoor Uses | |
|---|---|---|---|---|
| | **Northern CA** | **Southern CA** | **Northern CA** | **Southern CA** |
| Water Supply and Conveyance | 2117 | 9727 | 2117 | 9727 |
| Water Treatment | 111 | 111 | 111 | 111 |
| Water Distribution | 1272 | 1272 | 1272 | 1272 |
| Wastewater Treatment | 1911 | 1911 | 0 | 0 |
| Regional Total | 5411 | 13,022 | 3500 | 11,111 |

The energy intensity values between Northern and Southern California vary quite significantly in the water supply and conveyance category because the bulk of water for Southern California is imported to the region through the SWP and Colorado River Aqueduct infrastructure previously described. The water supply for the northern region of the states is typically much closer to consumers, and thus much less energy intensive.

Wilkinson (2006) subdivides water intensity by specific infrastructure. For southern California, the energy intensities of water sources are shown in Table 6-3.

**Table 6-3**
**Energy Intensity of Water, after Wilkinson (2006)**

| Water Source | Energy Intensity (kWh/MG) |
|---|---|
| SWP East Branch CA Aqueduct | 9820 |
| CO River Aqueduct | 6140 |
| Groundwater | 2915 |
| Recycled Water | 1230 |

The location along the SWP East Branch where water energy intensity is calculated is the Devil Canyon Power Plant, which pumps water to the Deimer Water Treatment Plant supplying South Orange County. In comparing the estimates of energy intensity between the two studies, the figures match well between the CEC estimate of water supply and conveyance and the Wilkinson estimate for the SWP. In fact the numbers are within 1%. The value for the

Colorado River Aqueduct is only 62% of the CEC number. However, this is not unexpected as the source waters and transport systems differ.

In addition to energy intensity, several other factors are necessary to scale the GHG emissions calculated via the GRP. We obtained emissions factors for $CO_2$, $CH_4$, and $N_2O$ from CCAR (2009) for the San Diego Gas & Electric Company which provides power to the service area (Table 6-4).

**Table 6-4**
**Table of Emission Factors**

| Greenhouse Gas | lbs/MWh |
|---|---|
| $CO_2$ | 806.27 |
| $CH_4$ | 0.0302 |
| $N_2O$ | 0.0081 |

## 6.4 GREENHOUSE GAS EMISSIONS SUMMARY FOR SOUTH ORANGE COUNTY

This study is focused specifically on South Orange County and its GHG emissions footprint, thus the energy intensities of Wilkinson (2006) is used for the necessary calculations. The next step is to estimate the amount of water from each of the sources that South Orange County uses for its water supply. As described in Chapter 2, South Orange County obtains the bulk of its water through MWD to MWDOC. MWDOC distributes the water to its member agencies, which in turn distribute it to their respective end users. Using figures from the respective water agencies themselves (ETWD, TCWD, MNWD, LBCWD, SMWD, SCWD, San Juan Capistrano, and San Clemente), and assuming that the proportion of imported water reaching end users from the SWP and the Colorado River Aqueduct is the same as that distributed from Metropolitan (54.5% and 45.5% of imported water), we follow the GRP to calculate the GHG emissions. Table 6-5 shows the GHG emissions calculations for the baseline scenario in which the water use by the local water agencies remains the same as that outlined in the respective 2010 Urban Water Management Plans. If all of the water agencies were to reduce water use from every source by 2%, the GHG emissions would fall proportionally by 2% as shown in Table 6-6. If all water agencies were to reduce water use from every source by 5%, the GHG emissions would again fall proportionally by 5% as shown in Table 6-7.

**Table 6-5**
**Indirect GHG emissions from Electricity Use – Baseline or Current Scenario (3, 4).**

| Emissions Scenario | Potable Water Estimate MG/yr | Electrical Consumption Factor kwh/MG | Annual Electrical Consumption MWh/yr | $CO_2$ Emission Factor (6) lbs/MWh | $CH_4$ Emission Factor (5) lbs/MWh | $N_2O$ Emission Factor (5) lbs/MWh | $CO_2$ Emission $MTCO_2$/yr | $CH_4$ Emission $MTCH_4$/yr | $N_2O$ Emission $MTN_2O$/yr | Annual $CO_2e$ Emissions $MTCO_2e$/yr |
|---|---|---|---|---|---|---|---|---|---|---|
| SWP East Branch CA Aqueduct (1) | 16,352 | 9820 | 160,580 | 806.27 | 0.0302 | 0.0081 | 58,727 | 2 | 1 | 58,956 |
| CO River Aqueduct (1) | 13,626 | 6138 | 83635 | 806.27 | 0.0302 | 0.0081 | 30,587 | 1 | 0 | 30,706 |
| Groundwater (1) | 1179 | 2915 | 3436 | 806.27 | 0.0302 | 0.0081 | 1257 | 0 | 0 | 1262 |
| Recycled (1) | 5399 | 1228 | 6627 | 806.27 | 0.0302 | 0.0081 | 2424 | 0 | 0 | 2433 |
| Subtotal | 36,555 | | | | | | 92,994 | 3 | 1 | 93,357 |

(1): Wilkinson et al (2006)

(2): Recycled value obtained from CEC (2006) via Wilkinson et al (2004, 2006)

(3): Methodology taken from CCAR GHG Emissions Protocol 3.1 (2009)

(4): Chart layout taken from UC Davis - Appendix 3: Greenhouse Gas Calculations

(5): $CH_4$ and $N_2O$ factors retrieved from CCAR (2009)

(6): $CO_2$ Emission Factor retrieved from CCAR Pup_Metrics_June-2009.xls

Assumptions:

Imported water proportion from CA (54.5%) & CO River (45.5%) Aqueduct the same as distribution from Metropolitan & MWDOC

Electrical consumption factor for "recycled water" is the same as for "recycled surface water"

Natural Gas is not a factor in this calculation

San Diego Gas & Electric provides all power

**Table 6-6**
**Indirect GHG emissions from Electricity Use – 2% Decrease in Water Use Scenario (3, 4).**

| Emissions Scenario | Potable Water Estimate MG/yr | Electrical Consumption Factor kwh/MG | Annual Electrical Consumption MWh/yr | $CO_2$ Emission Factor (6) lbs/MWh | $CH_4$ Emission Factor (5) lbs/MWh | $N_2O$ Emission Factor (5) lbs/MWh | $CO_2$ Emission $MTCO_2$/yr | $CH_4$ Emission $MTCH_4$/yr | $N_2O$ Emission $MTN_2O$/yr | Annual $CO_2e$ Emissions $MTCO_2e$/yr |
|---|---|---|---|---|---|---|---|---|---|---|
| SWP East Branch CA Aqueduct (1) | 16,025 | 9820 | 157,368 | 806.27 | 0.0302 | 0.0081 | 57,553 | 2 | 1 | 57,777 |
| CO River Aqueduct (1) | 13,354 | 6138 | 81,963 | 806.27 | 0.0302 | 0.0081 | 29,975 | 1 | 0 | 30,092 |
| Groundwater (1) | 1155 | 2915 | 3367 | 806.27 | 0.0302 | 0.0081 | 1232 | 0 | 0 | 1236 |
| Recycled (1) | 5291 | 1228 | 6495 | 806.27 | 0.0302 | 0.0081 | 2375 | 0 | 0 | 2384 |
| Subtotal | 35,824 | | | | | | 91,135 | 3 | 1 | 91,490 |

(1): Wilkinson et al (2006)

(2): Recycled value obtained from CEC (2006)

(3): Methodology taken from CCAR GHG Emissions Protocol 3.1 (2009)

(4): Chart layout taken from UC Davis - Appendix 3: Greenhouse Gas Calculations

(5): $CH_4$ and $N_2O$ factors retrieved from CCAR (2009)

(6): $CO_2$ Emission Factor retrieved from CCAR Pup_Metrics_June-2009.xls

Assumptions:

Imported water proportion from CA (54.5%) & CO River (45.5%) Aqueduct the same as distribution from Metropolitan & MWDOC

Electrical consumption factor for "recycled water" is the same as for "recycled surface water"

Natural Gas is not a factor in this calculation

San Diego Gas & Electric provides all power

**Table 6-7**
**Indirect GHG emissions from Electricity Use – 5% Decrease in Water Use Scenario (3, 4).**

| Emissions Scenario | Potable Water Estimate MG/yr | Electrical Consumption Factor kwh/MG | Annual Electrical Consumption MWh/yr | $CO_2$ Emission Factor (6) lbs/MWh | $CH_4$ Emission Factor (5) lbs/MWh | $N_2O$ Emission Factor (5) lbs/MWh | $CO_2$ Emission $MTCO_2$/yr | $CH_4$ Emission $MTCH_4$/yr | $N_2O$ Emission $MTN_2O$/yr | Annual $CO_2e$ Emissions $MTCO_2e$/yr |
|---|---|---|---|---|---|---|---|---|---|---|
| SWP East Branch CA Aqueduct (1) | 15,534 | 9820 | 15,2551 | 806.27 | 0.0302 | 0.0081 | 55,791 | 2 | 1 | 56,008 |
| CO River Aqueduct (1) | 12,945 | 6138 | 79,454 | 806.27 | 0.0302 | 0.0081 | 29,058 | 1 | 0 | 29,171 |
| Groundwater (1) | 1120 | 2915 | 3264 | 806.27 | 0.0302 | 0.0081 | 1194 | 0 | 0 | 1198 |
| Recycled (1) | 5129 | 1228 | 6296 | 806.27 | 0.0302 | 0.0081 | 2303 | 0 | 0 | 2311 |
| Subtotal | 34,728 | | | | | | 88,345 | 3 | 1 | 88,689 |

(1): Wilkinson et al (2006)

(2): Recycled value obtained from CEC (2006)

(3): Methodology taken from CCAR GHG Emissions Protocol 3.1 (2009)

(4): Chart layout taken from UC Davis - Appendix 3: Greenhouse Gas Calculations

(5): $CH_4$ and $N_2O$ factors retrieved from CCAR (2009)

(6): $CO_2$ Emission Factor retrieved from CCAR Pup_Metrics_June-2009.xls

Assumptions:

Imported water proportion from CA (54.5%) & CO River (45.5%) Aqueduct the same as distribution from Metropolitan & MWDOC

Electrical consumption factor for "recycled water" is the same as for "recycled surface water"

Natural Gas is not a factor in this calculation

San Diego Gas & Electric provides all power

## 6.5 Savings in Greenhouse Gas Emissions for Proposed Projects

Savings in GHG emissions may be quantified by calculating the reduction in emissions proportional to the water savings generated by a particular project, and considering the source of the water. For instance, if a project annually reduces regional imported water use by 5,000 MG, then using the electrical consumption factors and emissions factors from Table 6-5 to Table 6-7 above, the savings in GHG emissions is calculated to be approximately 2,250 $MTCO_2e$ annually. In other words, savings in water volumes translates directly to savings in GHG emissions.

Table 6-8 below provides a template for the calculation of GHG emissions savings. The potable water savings in MG/yr is mulitplied by the appropriate electrical consumption factor in kWh/MG to obtain the annual electrical consumption in MWh/yr. The $CO_2$ emissions are calculated by multiplying the annual electrical consumption by the $CO_2$ emission factor. This procedure is repeated to calculate both the $CH_4$ and $N_2O$ emissions, substituting the appropriate emissions factors. The total emissions for each of the GHGs is multiplied by the appropriate GWP factor (Table 6-1), and the results summed to find the annual $CO_2e$ emissions savings. Close attention must be paid to the units of each value. Detailed equations with conversion factors are included with Table 6-8.

The emissions methodology presented here are applied to the specific projects that have been identified as the high priority projects for this region in Chapter 8.

**Table 6-8**
**Template for GHG Emissions Savings due to Potable Water Savings**

| Emissions Scenario | Potable Water Savings Estimate MG/yr | Electrical Consumption Factor kwh/MG | Annual Electrical Consumption MWh/yr | $CO_2$ Emission Factor (6) lbs/MWh | $CH_4$ Emission Factor (5) lbs/MWh | $N_2O$ Emission Factor (5) lbs/MWh | $CO_2$ Emission $MTCO_2/yr$ | $CH_4$ Emission $MTCH_4/yr$ | $N_2O$ Emission $MTN_2O/yr$ | Annual $CO_2e$ Emissions Savings $MTCO_2e/yr$ |
|---|---|---|---|---|---|---|---|---|---|---|
| SWP East Branch CA Aqueduct (1) | 0 | 9820 | 0 | 806.27 | 0.0302 | 0.0081 | 0 | 0 | 0 | 0 |
| CO River Aqueduct (1) | 0 | 6138 | 0 | 806.27 | 0.0302 | 0.0081 | 0 | 0 | 0 | 0 |
| Groundwater (1) | 0 | 2915 | 0 | 806.27 | 0.0302 | 0.0081 | 0 | 0 | 0 | 0 |
| Recycled (1) | 0 | 1228 | 0 | 806.27 | 0.0302 | 0.0081 | 0 | 0 | 0 | 0 |
| Subtotal | 0 | | 0 | | | | 0 | 0 | 0 | 0 |

Annual Electrical Consumption (MWh/yr) = (Potable Water Savings Estimate (MG/yr) * Electrical Consumption Factor (kWh/MG)) / 1000

$CO_2$ Emission ($MTCO_2$/yr) = (Annual Electrical Consumption (MWh/yr) * $CO_2$ Emission Factor (lbs/MWh)) / 2204.62

$CH_4$ Emission ($MTCH_4$/yr) = (Annual Electrical Consumption (MWh/yr) * $CH_4$ Emission Factor (lbs/MWh)) / 2204.62

$N_2O$ Emission ($MTN_2O$/yr) = (Annual Electrical Consumption (MWh/yr) * $N_2O$ Emission Factor (lbs/MWh)) / 2204.62

Annual $CO_2e$ Emissions ($MTCO_2e$/yr) = $CO_2$ Emission ($MTCO_2$/yr) * GWP $CO_2$ + $CH_4$ Emission ($MTCH_4$/yr) * GWP $CH_4$ + $N_2O$ Emission ($MTN_2O$/yr)* GWP $N_2O$

Where:

1000 is the conversion factor between kW and MW

2204.62 is the conversion factor between lbs and metric tons

# 7. SEA LEVEL RISE AND ASSOCIATED IMPACTS

***Key Points:** Although variable at different points along the coast due to regional factors, in general, sea levels are rising globally due climate warming including expansion of ocean water and melting of land ice. Along the Pacific Coast, the highest values of sea level rise in Southern California have been reported at Newport Beach, near the study region, where the observed increase is 2.22 mm/year. These rates are projected to accelerate over the 21st century. A recent review of different calculation approaches by the National Academy of Sciences reported that global sea level is estimated to rise 8–23 cm (3-9 inches) by 2030 relative to 2000, 18–48 cm by 2050 (7-19 inches), and 50–140 cm (20-55 inches) by 2100. This review projects that sea level in Southern California is slightly higher than the global average because of land subsidence, and will rise 4–30 cm (2-12 inches) by 2030 relative to 2000, 12–61 cm (5-24 inches) by 2050, and 42–167 cm (17-66 inches) by 2100. Maps illustrating the effects of sea level rise to 2100 and a 100-year flood were developed for the South IRWM planning region to identify areas that are vulnerable.*

## 7.1 SEA LEVEL RISE

Changes in sea level occur due to a complex interaction of climatic and geologic factors. The climatic factors are global, and the sea levels are rising largely because global temperatures are rising, causing ocean water to expand and land ice to melt. Besides this global trend there are also regional changes in ocean and atmospheric circulation patterns in the northern Pacific Ocean that affect sea level. The geologic factors (subsidence, rebound, and uplift) are also regional in nature, and for these reason, actual sea level rise varies by location. Across Southern California locations, the reported ranged over the 20th century is between 0.8 and 2.2 mm/year (data from the National Oceanic and Atmospheric Administration at http://tidesandcurrents.noaa.gov/sltrends). The highest values in Southern California have been reported at Newport Beach, near the study region, where data have been recorded over 1955–1993. Over this period, the recorded mean sea level increase is 2.22 mm/year, which is equivalent to a change of 0.73 feet over 100 years (Figure 7-1). A much longer-term record of sea level change in California is available at San Francisco, and shows more clearly a similar annual increase (2.0 mm/yr) over 1897-2012 (Figure 7-2). These values may be compared with a global 20th century average increase of 1.7 ± 0.5 mm per year (Intergovernmental Panel on Climate Change, 2007). Over a more recent period, 1993–2003, the global increase has been reported to be 3.1± 0.7 mm per year using satellite altimetry data (National Academy of Sciences, 2012).

The relatively slow rate of sea level rise over the 20th century is expected to increase substantially worldwide. An example of the historical and future sea level rise is shown in

Figure 7-5, which displays the rate of sea level rise based on model projections. The increase rate is closely tied to warming temperatures and increases in melting rates of ice packs.

The sea level projections in this document are based on a recent summary of research applicable to the Pacific Coast that was prepared to meet the planning needs of the region (National Academy of Sciences, 2012). Based on an assessment of calculations using multiple GCMs as well as empirical methods, global sea level is estimated to rise 8–23 cm (3-9 inches) by 2030 relative to 2000, 18–48 cm by 2050 (7-19 inches), and 50–140 cm (20-55 inches) by 2100. The global high end projections of sea level rise are nearly 5 feet over levels in 2000 (Figure 7-4). There is uncertainty among the calculation approaches, and the most recent estimates of sea level rise are considerably higher than even those published by the IPCC in 2007 (IPCC AR4, 2007).

For the U.S. Pacific Coast in particular, the rates of relative sea level rise vary among the northern and southern halves. North of Cape Mendocino, in Humboldt County (the westernmost point on the coast of California), the coast is rising about 1.5–3.0 mm per year, and south of this point, the coast is sinking at an average rate of about 1 mm per year. Relative sea level rise, therefore is higher in Southern California and in the study region, compared to the global sea level rise estimates shown in Figure 7-4. For the California coast south of Cape Mendocino, the NAS (2012) report projects that sea level will rise 4–30 cm (2-12 inches) by 2030 relative to 2000, 12–61 cm (5-24 inches) by 2050, and 42–167 cm (17-66 inches) by 2100, i.e., because of land subsidence, the rates of sea level rise are slightly higher than the global average (Figure 7-5). These values are also higher than estimated for the Pacific Coast north of Cape Mendocino.

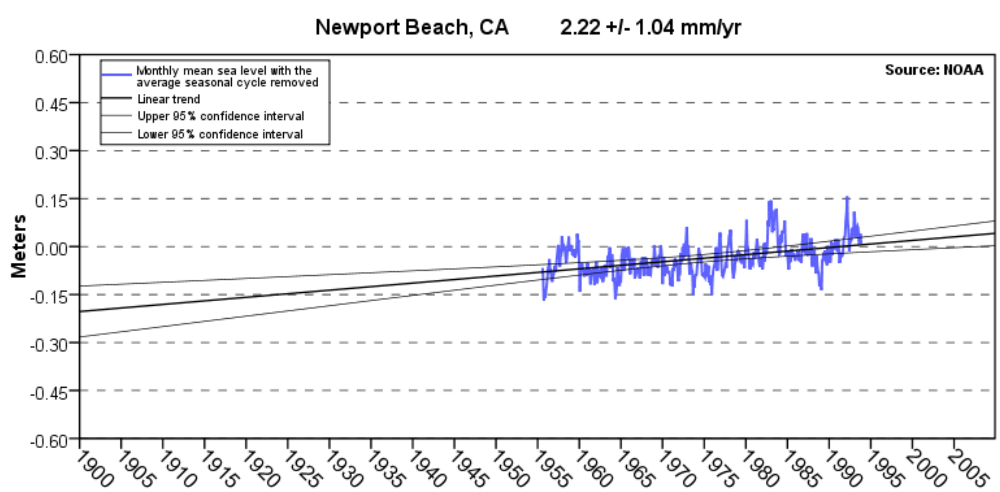


**Figure 7-1 The mean sea level trend is 2.22 millimeters/year with a 95% confidence interval of +/- 1.04 mm/yr based on monthly mean sea level data from 1955 to 1993 at Newport Beach. (Source: http://tidesandcurrents.noaa.gov/sltrends/)**

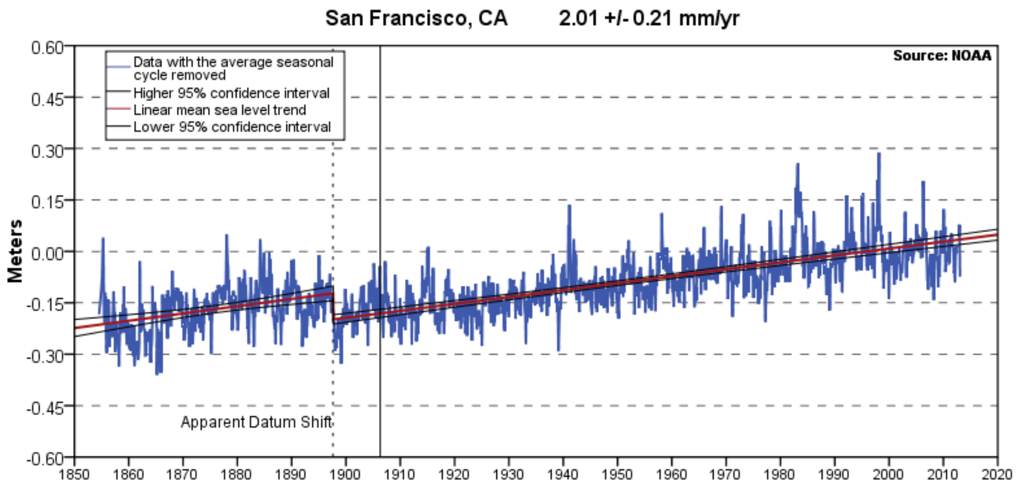


**Figure 7-2** **At San Francisco, the mean sea level trend is 2.01 millimeters/year with a 95% confidence interval of +/- 0.21 mm/yr based on monthly mean sea level data from 1897 to 2006. (Source: http://tidesandcurrents.noaa.gov/sltrends/)**

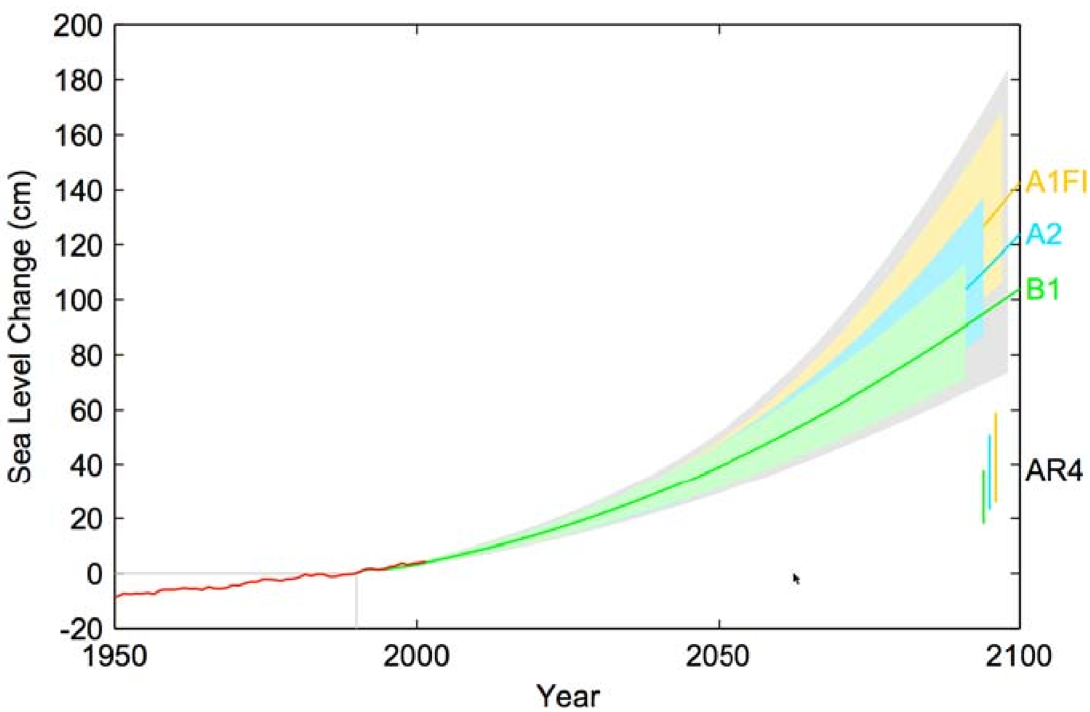


**Figure 7-3** **Sea level rise from 1950 to 2100 based on a semi-empirical model (Vermeer and Rahmstorf, 2009) and three emission scenarios (A2, B1, and A1FI). The increase seen over the historical period is expected to accelerate significantly based on this model.**

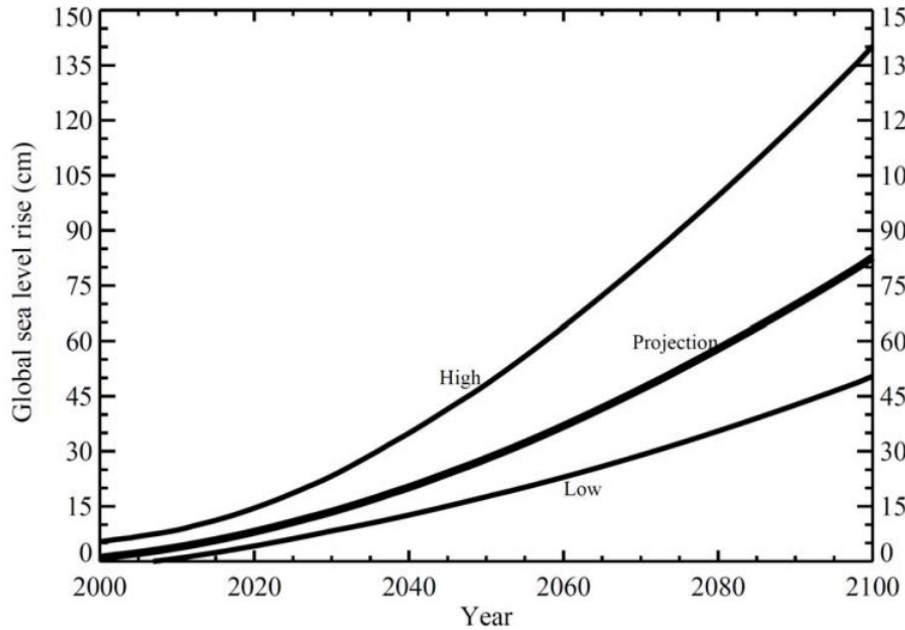


**Figure 7-4** **Projection of global sea level rise from 2000 to 2100, along with upper and lower uncertainty bounds, based on an evaluation of the literature and alternative modeling methods (graphic reproduced from National Academy of Sciences, 2012). The models employed for this composite projection are in addition to the Vermeer and Rahmstorf (2009) projections shown in Figure 7-3. Note that the projection shown here are global estimate, and Southern California estimates slightly different, as discussed in the text.**

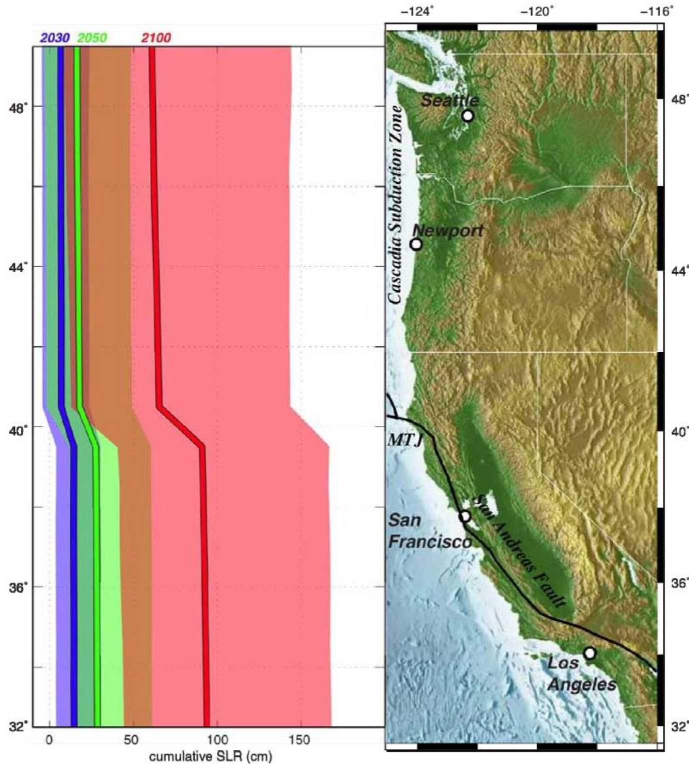


**Figure 7-5 Projected sea-level rise off California, Oregon, and Washington for 2030 (blue), 2050 (green), and 2100 (pink), relative to 2000, as a function of latitude. (Source: National Academy of Sciences, 2012). Cape Mendocino corresponds approximately to the point shown as MTJ on the map, representing the westernmost point along the coast of California, with areas south of it showing a subsidence over time, and areas north showing a rise in the land level. Thus, projected sea level rise is higher in the lower latitudes along the California coast.**

## 7.2 EXTREME TIDES AND STORM SURGE

One reason sea level rise is so important is that it is a permanent change, having impacts over decades to centuries. However, extreme tides and storm surges are not permanent but may be more damaging since storm surges can contribute flood water above the natural sea level. Indeed, historical events with large waves, storm surges, and high astronomical tides during a strong El Niño can exceed the levels associated with projected sea level rise in 2100 (National Academy of Sciences, 2012). If such extreme events occur simultaneously with future sea level rise, the flooding effects can be severe.

Although climate change is thought to modify storm frequency, magnitude, and direction, there is no consensus among climate model simulations about whether the number and severity of storms will change along the U.S. Pacific Coast. It is possible that storm tracks may move further northward over the 21st century, as projected by some models, but the observational support for this is limited at present. Similarly, observational studies have reported that the largest waves have been getting higher and that winds have been getting stronger in the northeastern Pacific over the past few decades, but the trends are based on limited periods of record (National Academy of Sciences, 2012).

The current state of science does not provide clear evidence of the change of storminess along the Southern California coast, although it is recognized that even with current levels of storminess, future sea-level rise will magnify the adverse impact of storm surges and high waves along the coast.

## 7.3 Areas Impacted by Sea Level Rise

For the purpose of this analysis, we identified areas in the South OC region that are vulnerable to coastal flooding as a consequence of sea level rise to 2100 under the conditions of a 100-year flood--the flood having a one percent chance of being equaled or exceeded in any given year--termed as the base flood by the Federal Emergency Management Agency (FEMA). Although geographically focused on the study area, this approach follows the methodology presented on the State of California's decision support website, Cal-Adapt (*http://www.cal-adapt.org*), developed for estimations such as those presented in this report. The base flood is the national standard used by the National Flood Insurance Program (NFIP) and all Federal agencies for the purposes of requiring the purchase of flood insurance and regulating new development. Base Flood Elevations (BFEs) are typically shown on Flood Insurance Rate Maps (FIRMs). The computed elevation to which floodwater is anticipated to rise during the base flood. Base Flood Elevations (BFEs) are shown on Flood Insurance Rate Maps (FIRMs) and on the flood profiles. The BFE is the regulatory requirement for the elevation or floodproofing of structures. The relationship between the BFE and a structure's elevation determines the flood insurance premium. To compute the effect of sea level rise, we took the BFE values (in feet, NAVD88 datum) for the South OC region from FEMA and added 55 inches of sea level rise corresponding to the year 2100. The 55-inch value, representing a high estimate of sea level rise, although not the highest projection of 66 inches noted above, was used for consistency with the numbers in the Cal-Adapt website.

Maps displaying areas in the South OC planning region under threat of inundation during a 100-year flood under future conditions of sea level rise were developed. The region-wide map of inundation (Figure 7-6) shows that the areas influenced by future coastal flooding, with some exceptions, occur along a narrow strip along the coast. This is largely due to the topography along the South OC coast. To better view the areas of potential impact, a series of six maps are presented that show the affected regions from north to south (Figure 7-7 to Figure 7-12).

These maps are considered initial assessments for the purpose of the IRWM, and follow a reasonably simplified approach for large scale analysis, consistent with the methodology presented in Cal-Adapt. Importantly, this approach does not take into account protective structures such as levees and sea walls, which may reduce the extent of inundation. Although helpful as a tool to assess relative risks, these maps cannot be used to assess actual coastal hazards, insurance requirements, or property values. More detailed assessments are typically performed though Flood Insurance Studies by FEMA and presented through updated FIRMs.


**Figure 7-6** **Projected inundation areas (in yellow) corresponding to a 55-inch rise in sea-level along South OC. The areas of inundation in this region occur along a narrow strip along the coastline and do not extend inland. There is a vulnerable wastewater treatment plant near Dana Point that is identified on the map.**


**Figure 7-7** **Zoomed-in area of South OC coastline, zone 1, identifying areas (in yellow) that are under flooding threat due to the combined effects of a 100-year flood and sea-level rise to 2100 (55 inches). Numbers along the coastline are FEMA's BFE values in feet.**

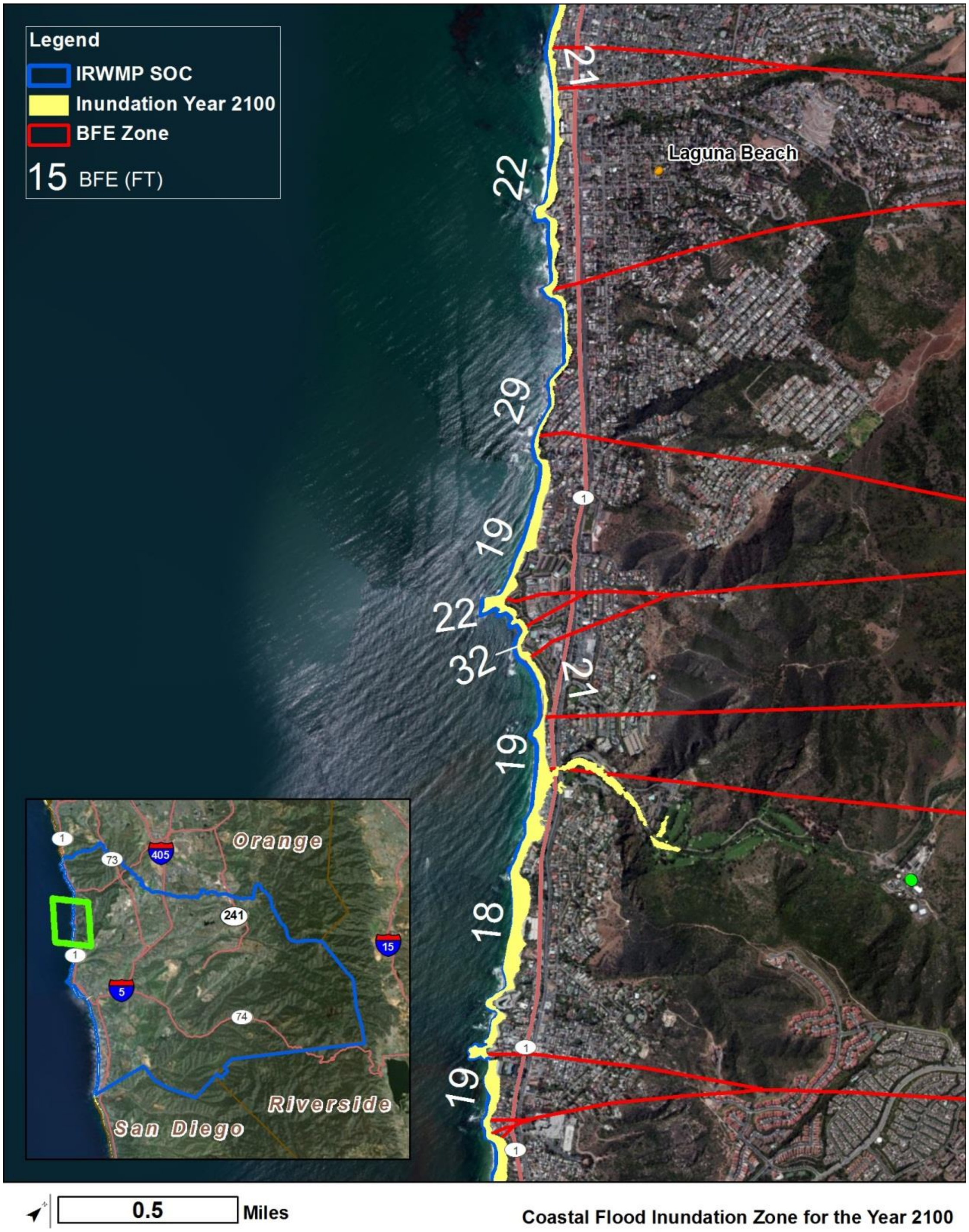


**Figure 7-8** **Zoomed-in area of South OC coastline, zone 2, identifying areas (in yellow) that are under flooding threat due to the combined effects of a 100-year flood and sea-level rise to 2100 (55 inches). Numbers along the coastline are FEMA's BFE values in feet.**

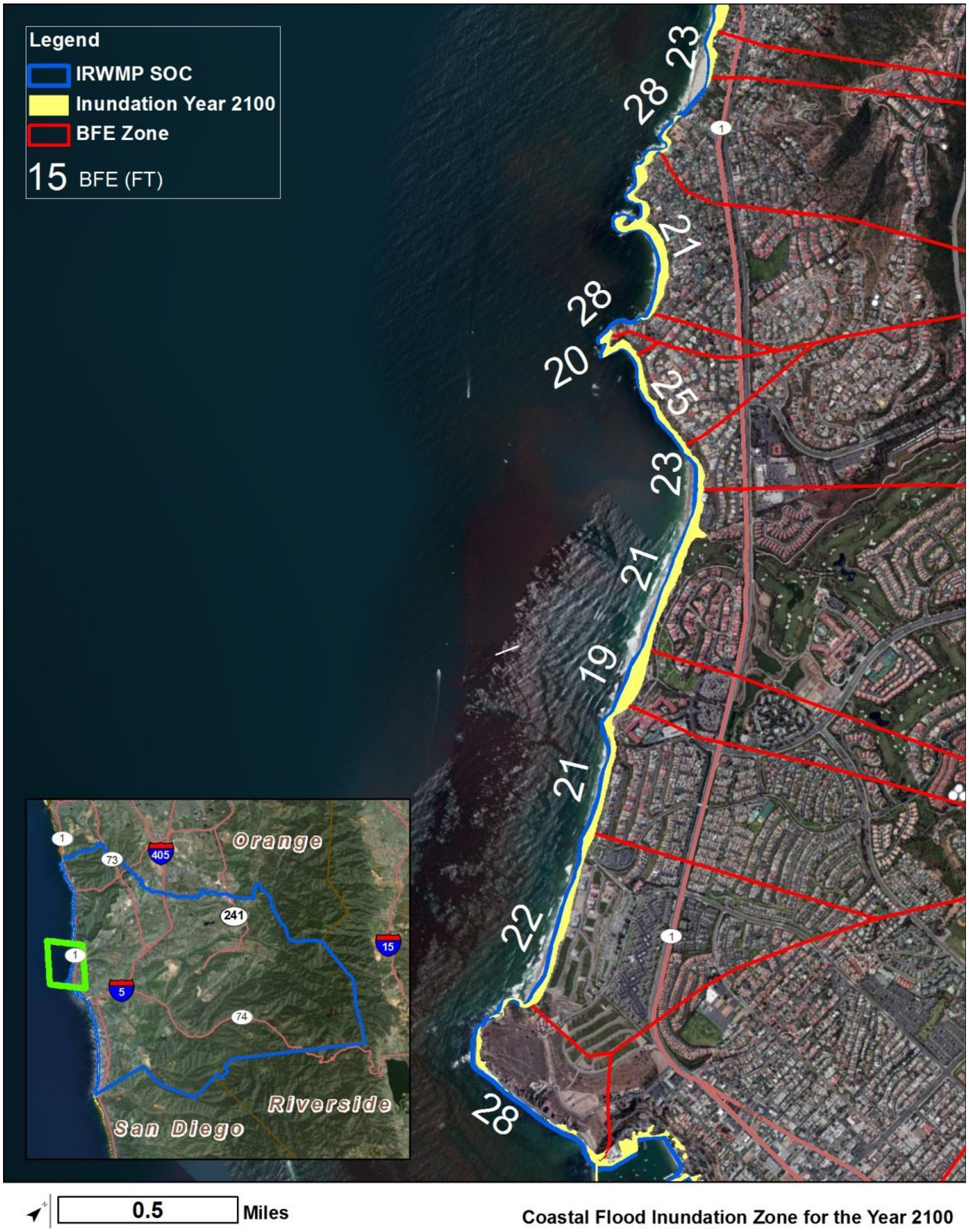


**Figure 7-9** **Zoomed-in area of South OC coastline, zone 3, identifying areas (in yellow) that are under flooding threat due to the combined effects of a 100-year flood and sea-level rise to 2100 (55 inches). Numbers along the coastline are FEMA's BFE values in feet.**


**Figure 7-10** **Zoomed-in area of South OC coastline, zone 4, identifying areas (in yellow) that are under flooding threat due to the combined effects of a 100-year flood and sea-level rise to 2100 (55 inches). Numbers along the coastline are FEMA's BFE values in feet. The red symbol denotes the Latham Wastewater Treatment Plant.**

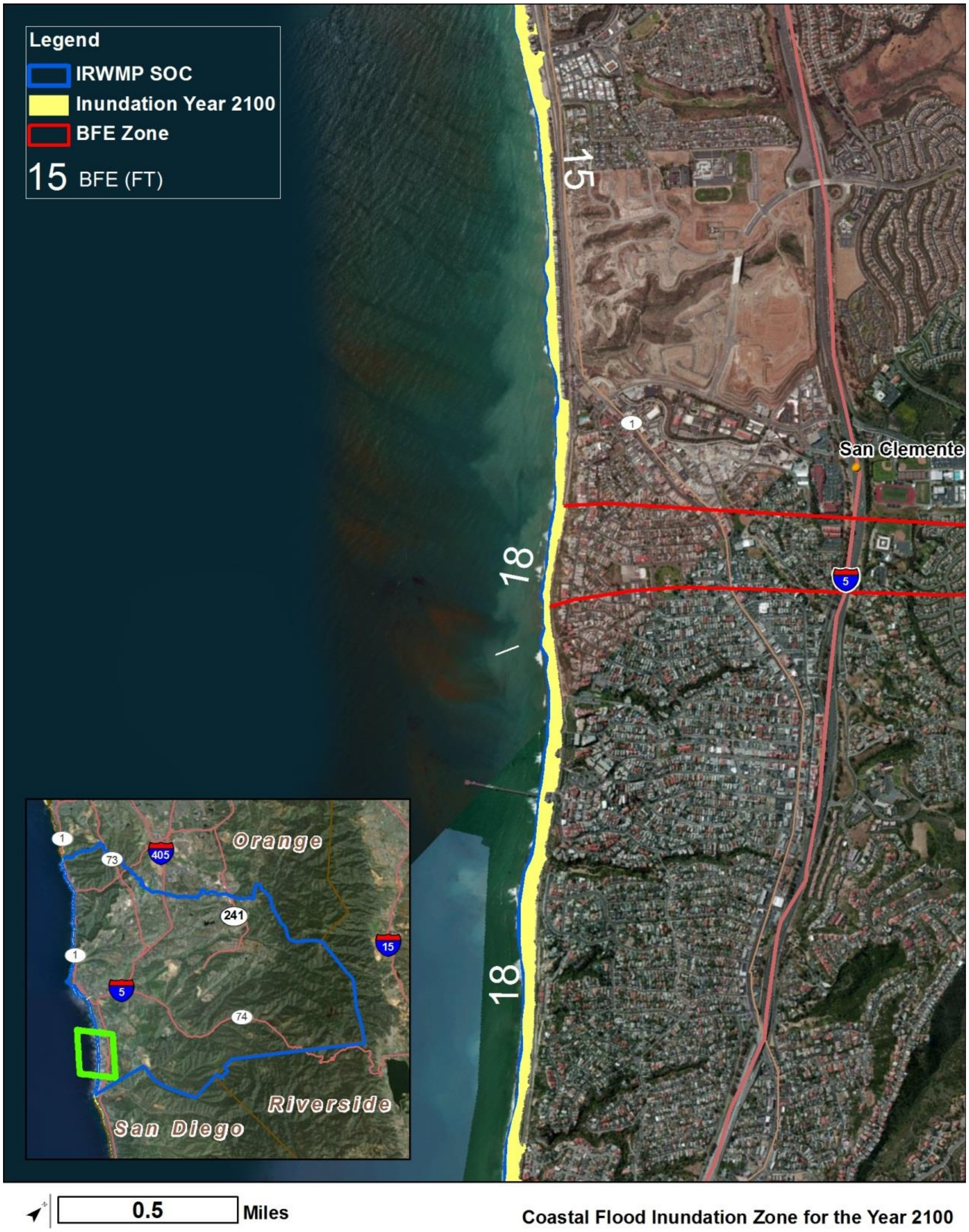


**Figure 7-11** **Zoomed-in area of South OC coastline, zone 5, identifying areas (in yellow) that are under flooding threat due to the combined effects of a 100-year flood and sea-level rise to 2100 (55 inches). Numbers along the coastline are FEMA's BFE values in feet.**


**Figure 7-12** **Zoomed-in area of South OC coastline, zone 6, identifying areas (in yellow) that are under flooding threat due to the combined effects of a 100-year flood and sea-level rise to 2100 (55 inches). Numbers along the coastline are FEMA's BFE values in feet.**

# 8. CLIMATE CHANGE VULNERABILITY ASSESSMENT

***Key Points:** This section presents an overall assessment of vulnerability to climate change for South OC. The assessment follows a checklist presented in the Climate Change Handbook for Regional Water Planning, developed by DWR. As noted throughout this document, the major water supply system vulnerabilities in this region are not unique, but are tied to the water supply system in California and the Colorado River Basin that are being evaluated through statewide or regional efforts. Besides water supply, other areas of potential concern for this planning region are coastal flooding due to sea level rise, increase in fire risk, and impacts to ecosystems.*

A local vulnerability assessment, applicable to resources in South OC, was performed using a checklist presented in the Climate Change Handbook for Regional Water Planning (DWR and EPA, 2011, presented as Box 4-1 in the source document). This checklist is meant to identify potential vulnerabilities to water supply, water quality, flooding, ecosystems and habitats, and hydropower. This is a broad list and the goal is to identify vulnerabilities at a high level and provide a summary of the most important climate-related risks for the region.

## 8.1 WATER DEMAND

1. *Are there any major industries that require cooling/process water in your planning region?*

   There are no major cooling water/process water using industries in the South OC region, according to the Urban Water Management Plans for MWDOC and its member agencies that were reviewed for the development of this report. The major demand for water in the region is for municipal use.

2. *Does water use vary by more than 50% seasonally in parts of your region?*

   Monthly or seasonal water use data are not provided in any of the Urban Water Management Plans for the region. Because the water use is largely municipal, with a small component for landscape irrigation, it is expected that the seasonal variation will not exceed 50%.

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

   Agricultural water use is a very small component of the water use in the region, and is zero for 6 of 8 water agencies and less than 2% for the other two agencies (San Juan Capistrano and Trabuco Canyon Water District). Because this is such a small component of water use in the region, climate impacts are not expected to have a large overall effect of water demand.

4. *Do groundwater supplies in your region lack resiliency after drought events?*

   Drought effects on groundwater may be relevant for the San Juan Basin within the South Orange County Planning region.,

5. *Are water use curtailment measures effective in your region?*

   Yes, all water agencies in the South OC region have adopted Water Shortage Contingency Plans adopted within their respective Urban Water Management Plans. These plans are updated at least every five years and have been effective in responding to both drought and other water emergencies such as pipeline breaks and treatment plant shutdowns. Other measures, such as assigned weekly outdoor watering days have been effective as well.

6. *Are some instream flow requirements in your region either currently insufficient to support aquatic life, or occasionally unmet?*

   Historically most streams in the region were intermittent. Where streams receive urban runoff flows or groundwater is supplemented by landscape irrigation, streams have become perennial. No in-stream flow requirements have been established in the South OC region due primarily to its arid hydrology.

## 8.2 WATER SUPPLY

1. *Does a portion of the water supply in your region come from snowmelt?*

   Roughly 90% of the water supply in the region originates from sources external to South OC. The imported water is supplied by MWD and originates as snowmelt in the Sierra Nevada and Rocky Mountains.

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

   A majority of the water supply in the region (nearly 90%) originates from the Delta and from the Colorado River.

3. *Does part of your region rely on coastal aquifers? Has salt intrusion been a problem in the past?*

   Groundwater is a small, but important component of the water supply in the South OC region. The San Juan Basin in South OC, a source of groundwater supply, may have a problem with seawater intrusion, which is a concern because the City of San Juan Capistrano is very invested and is taking a large part of its regular potable water supply from the basin.

4. *Would your region have difficulty in storing carryover supply surpluses from year to year?*

   South OC relies on Metropolitan's extensive water storage capabilities. At present, Metropolitan has approximately 2.65 million acre feet in storage for future use. This storage is outside the planning region.

5. *Has your region faced a drought in the past during which it failed to meet local water demands?*

   There is no record of local water needs not being met in the recent past. Looking forward, regional planning done by MWD indicated that it will be able to meet full service demands from 2015 to 2035 for various types of water years including years that consider an extremely dry year such as 1977, and a multiple dry year condition (1990, 1991, and 1992) (MWDOC, 2012). Longer term planning, beyond a 20-year time frame, is not typically performed by these agencies.

6. *Does your region have invasive species management issues at your facilities, along conveyance structures, or in habitat areas?*

   Some habitat areas along stream courses have become infested with Arundo and other exotic species. Aliso Creek Watershed and the San Juan Capistrano watershed have invasive species that reduce water flows in those creeks, in the case of Aliso Creek that limits the water available to the Aliso Creek Runoff Recovery facility that SCWD is now constructing. The presence and spawning of quagga mussels in the lower Colorado River from Lake Mead through Lake Havasu also poses a threat to Metropolitan and other Colorado River water users. Although the introduction of this species into drinking water supplies does not typically result in violation of drinking water standards, invasive mussel infestations can adversely impact aquatic environments. In 2007, Metropolitan developed a quagga mussel control plan (QMCP) incorporating enhanced detection, surveillance, and mitigation strategies.

## 8.3 WATER QUALITY

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

   Increased wildfire risk as a result of urban growth and climate change is a risk in the South OC planning area. More broadly, many of the reservoirs that are part of California's water supply system that manage water flows into the Delta are surrounded by lands that are susceptible to fire. Thus, there is a potential for indirect impacts to water quality. Fire risk maps for the planning region have recently been completed and available at: www.fire.ca.gov/fire_prevention/fire_prevention_wildland_zones_maps.php. Several cities in the planning region have Very High Fire Hazard Severity zones within their boundaries.

2. *Does part of your region 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?*

   The South OC region does not rely on local surface water sources with eutrophication related concerns, because most of the local sources are in the form of groundwater or recycled water. However, potential eutrophication is a concern in the external supplies especially along the California aqueduct where there is potential for algal growth and creation of organic carbon that can serve as a precursor for disinfection byproduct (DBP) formation during drinking water treatment. DBPs are carcinogens and elevated levels of organic carbon in source waters are a concern.

3. *Are seasonal low flows decreasing for some waterbodies in your region? If so, are the reduced low flows limiting the waterbodies' assimilative capacity?*

Seasonal low flows have been observed to decrease as water district conservation measures have reduced urban runoff discharge into streams. Concentrations of certain constituents naturally occurring in local groundwaters have been observed to increase in surface streams due to lessening of dilution by low flow urban runoff.

4. *Are there beneficial uses designated for some water bodies in your region that cannot always be met due to water quality issues?*

   Several water bodies in the planning region are listed on the San Diego Regional Water Board list on impaired waters (the 303(d) list), implying that one or more beneficial uses are not being met. The listings include nutrients (nitrogen and phosphorus), total dissolved solids, diazinon, toxicity, enterococcus and coliform bacteria, and turbidity. Total maximum daily load (TMDL) assessments for different water bodies are planned over the next decade.

5. *Does part of your region currently observe water quality shifts during rain events that impact treatment facility operation?*

   Storm flows that find their way into sanitary sewer systems can impact treatment times and resultant quality of recycled water supply and water supplies from Aliso Creek being proposed for use in the Aliso Creek Runoff Recovery Facility.

## 8.4 Sea Level Rise

1. *Has coastal erosion already been observed in your region?*

   Coastal erosion has been observed in the region, both over the long and short term (Hapke et al., 2009).

2. *Are there coastal structures, such as levees or breakwaters, in your region?*

   The Dana Point Harbor is a coastal structure that may be affected by sea level rise.

3. *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 your region?*

   Areas that are within the inundation zone are described in Chapter 7 of this assessment. There is private and public infrastructure, including a wastewater treatment plant (South Orange County Wastewater Authority JB Latham Plant) that may be considered vulnerable to sea level rise.

4. *Are there climate-sensitive low-lying coastal habitats in your region?*

   There are some low-lying coastal habitats in the South OC region, but because of the regional topography, their areal extent along the coastline is small.

5. *Are there areas in your region that currently flood during extreme high tides or storm surges?*

   There are areas in the South OC region that are currently under risk of coastal flooding as determined by FEMA.

6. *Is there land subsidence in the coastal areas of your region?*

Based on statewide data, the South OC region, and Southern California in general, is subsiding at the rate of 1 mm/yr (NAS, 2012).

7. *Do tidal gauges along the coastal parts of your region show an increase over the past several decades?*

   Tide gauges at a nearby location operated by the National Oceanic and Atmospheric Administration (Newport Beach), with data from 1955–1993, show an increase in mean sea level of 2.22 mm/yr. This corresponds to a sea level increase of 0.73 feet over the past century. These data are shown in Chapter 7 of this assessment.

## 8.5 FLOODING

1. *Does critical infrastructure in your region 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/.*

   The 200-year floodplains have not been developed for Orange County, following the above link and maps at http://gis.bam.water.ca.gov/bam/. Based on other information, the South Coast Water District groundwater recovery facility and the JB Latham Wastewater Treatment Plants are within areas that would be substantially negatively impacted by a 200-year flood event.

2. *Does part of your region lie within the Sacramento-San Joaquin Drainage District?*

   No, the region falls outside the Sacramento-San Joaquin Drainage District.

3. *Does aging critical flood protection infrastructure exist in your region?*

   Yes. Also, see response to the following question.

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

   In the 1960's residential homes were being developed over agricultural land and the channel infrastructure was constructed to convey the 25-year storm event. With the inception of the National Flood Insurance Program in 1978, the design criteria "100-year storm event" for channel infrastructure was introduced. The Orange County Flood Control District has been and continues to improve its flood control infrastructure and uphold this threshold. To date only 50% been constructed to adequately convey the 100-year storm flow and approximately $2.5 billion dollars today is estimated to construct the remaining (Countywide).

   Although the overall condition has slightly improved over recent years, it remains a daunting task faced by the state and local jurisdictions to continuously upgrade, repair, and maintain the systems which provide public safety. The local levees and flood control systems are aging and in some areas do not meet the current standards. These deficient and marginally adequate facilities are increasingly impacting the abilities of jurisdictions to keep pace with maintenance efforts. The problem is further compounded by the increasingly more stringent environmental regulations including additional mitigation for ongoing maintenance of flood control facilities, which are driving the costs up and forcing jurisdictions to limit the extent of systems that can be annually maintained.

FEMA is remapping coastal zones on the Flood Insurance Rate Map (FIRM) to depict the climate change in regards to sea level rise. Coastal cities must be prepared to regulate any impacts the FIRM may have in their jurisdiction.

5. *Are wildfires a concern in parts of your region?*

   Wildfire is a major concern in the parts of the South OC region, with a large fraction of the region being defined to be in the very high risk zone by CalFire (*http://www.fire.ca.gov/fire_prevention/fhsz_maps_orange.php*). In the future, wildfire risk is expected to increase as a consequence of changed precipitation and urban growth.

## 8.6 Ecosystems and Habitat Vulnerability

1. *Does your region include inland or coastal aquatic habitats vulnerable to erosion and sedimentation issues?*

   The region contains coastal habitats that are vulnerable to sedimentation issues. The San Juan Creek Estuary is highly impacted by excess sediment which adversely affects it habitat suitability for fish species.

2. *Does your region include estuarine habitats which rely on seasonal freshwater flow patterns?*

   There are estuaries in the region that rely on freshwater patterns and tidal flushing (Aliso and San Juan Creek Estuary).

3. *Do climate-sensitive fauna or flora populations live in your region?*

   Temperature sensitive fish species, such as steelhead in Trabuco and San Juan Creek exist in the region.

4. *Do endangered or threatened species exist in your region? Are changes in species distribution already being observed in parts of your region?*

   The U.S. Fish and Wildlife Service notes the *possible* presence of 33 endangered and threatened species of birds, fish, crustaceans, amphibians, flowering plants, and insects in the region. More broadly, the protection of endangered aquatic species in the Delta and Central Valley (Delta smelt, Chinook salmon, and Central Valley steelhead) affects the operation of the State Water Project, and the delivery of water to MWD.

5. *Does the region rely on aquatic or water-dependent habitats for recreation or other economic activities?*

   Water dependent recreation along the Pacific Ocean is an important part of the economy of the South OC region.

6. *Are there rivers in your region with quantified environmental flow requirements or known water quality/quantity stressors to aquatic life?*

   Some creeks in the region have been identified to have stressors to aquatic life, including water quality, barriers, and temperature. While the San Juan Creek watershed has no major dams, there are a number of smaller diversions and other impediments to fish passage. Water management and land use practices have altered natural sediment and hydrologic processes in the region.

7. *Do estuaries, coastal dunes, wetlands, marches, or exposed beaches exist in your region? If so, are coastal storms possible/frequent in your region?*

   Estuaries, coastal dunes and beaches exist in the region. Coastal storms leading to erosion are possible in the region.

8. *Does your region include one or more of the habitats described in the Endangered Species Coalitions' Top 10 habitats vulnerable to climate change (http://www.itsgettinghotoutthere.org/)?*

   The Endangered Species Coalition's report identifies the Bay-Delta which is an area that is indirectly linked to the water supply for South OC via the California aqueduct.

9. *Are there areas of fragmented estuarine, aquatic, or wetland wildlife habitat within your region? Are there movement corridors for species to naturally migrate? Are there infrastructure projects planned that might preclude species movement?*

   The South OC region is densely urbanized with a large fraction of developed land. Over the $20^{th}$ century there has been a loss of estuarine habitat in the broader region. While there has been widespread habitat degradation to the coastal and middle mainstems in these watersheds, native non-anadromous steelhead populations do inhabit the relatively high-quality habitat that remains in the upper portions of the watersheds. No specific future projects are known that might impede species movement, although a Steelhead Recovery Watershed Management Plan proposes a variety of future steps to improve populations.

### 8.7 Hydropower

1. *Is hydropower a source of electricity in your region?*

   The hydropower plants in the region are small (<10 MW capacity), but hydropower is a part of the energy portfolio for some of the major utilities supplying power to the region (San Diego Gas and Electric and Southern California Edison). More importantly hydropower is a major source of electricity for the State Water Project that is used to transport water from Northern to Southern California

2. *Are energy needs in your region expected to increase in the future? If so, are there future plans for hydropower generation facilities or conditions for hydropower generation in you region?*

   Electricity needs are expected to increase according to forecasts made by the major utilities: San Diego Gas and Electric (1.95% per year growth in consumption) and Southern California Edison (1.1% per year) (data from California Energy Commission (2012). There are no known plans for hydropower generation in the region.

### 8.8 Conclusions from Vulnerability Assessment

The vulnerability assessment above is a summary of major climate change related sensitivities to the human and natural systems in the planning region. Given the characteristics of the region and its largely imported water supply, not all of the impacts are likely to be as important. Based on the discussion and information presented above, following concerns are of particular importance for each of the topic areas:

**Water demand:** There little quantitative evaluation of the impacts of climate change on water demands in the South OC planning region. Given increased temperatures and evapotranspiration, it is expected that landscape irrigation use may tend to increase. However, this is countered by the statewide mandate to reduce per capita use by 20%, and it is likely that this mandate will override any climate-related changes. In addition, significant investments in the development of recycled water continue to be made by water agencies throughout the South OC region. These recycled water supplies are used primarily for irrigation of urban landscape further offsetting potential increased irrigation needs associated with climate change.

**Water supply:** Climate change has the potential to impact water supplies because of the dependence on snowmelt. However, the South OC planning region is part of a much larger network of supply, storage, and delivery infrastructure that spans the Southwestern U.S., and climate change planning for water supplies is being done at this larger regional scale. Over the near to medium term (20 years), water supplies are constrained, but various management options undertaken by MWD and MWDOC, including storage, banking, and water use efficiency, indicate that water supply reliability levels will be met.

**Water quality:** The water quality effects of climate change in the study region have not been quantified, although it is possible that larger precipitation events or longer dry periods both adversely affect stream water quality. Warmer temperatures in summer have the potential to increase wildfire risk in the region, a substantial portion of which is already considered to be at high risk.

**Sea level rise:** Sea level rise is a potential concern in the region, but the topography of the South OC region indicates that the areas affected by coastal flooding may be limited to a narrow strip along the coastline, without extensive flooding inland. There is a wastewater treatment plant in the region that is considered vulnerable to sea level rise (Latham Wastewater Treatment Plant). The analysis presented here is based on a preliminary assessment of coastal flooding in the context of sea level rise, although specific urban areas may need to do more detailed characterization and dynamic modeling to fully assess impacts The potential for enhanced erosion along beaches and bluffs is also a concern.

**Flooding:** Areas of the South OC region, particularly along the canyons are liable to flooding (http://ocflood.com). There is aging flood protection infrastructure or infrastructure that needs to be upgraded to meet current flood protection levels. The region in general may be adversely impacted by a very large flood, such as that caused by large atmospheric river events.

**Ecosystems and habitat vulnerability:** Changes in stream temperatures have the potential to adversely impact endangered fish species that occur in the creeks and estuaries of the South OC planning region.

**Hydropower:** The dependence of the region on hydropower is indirect, largely through the its use for the transport of State Water Project water to Southern California. Impacts on hydropower production will be felt regionally, and not only to the planning region.

# 9. SUMMARY AND NEXT STEPS

This document presented an updated assessment of the potential impacts of climate change on the water resources of South Orange County (South OC) that addresses the 2016 IRWM plan standards developed by DWR. The intent of the Climate Change Standard is to ensure that IRWM Plans, describe, consider, and address the effects of climate change on their regions, and similarly, and disclose, consider, and when possible, reduce when GHG emissions.

As a first step, this assessment reviewed the water supply sources summarized in the Urban Water Management Plans of the wholesale suppliers and retail agencies in the South OC region. MWD provides Orange County with the bulk of its water. Much of the water supply in South Orange County is imported from outside the region, with supplies from the State Water Project and the Colorado Aqueduct providing approximately 1/3 and 2/3 of the total supply in 2015. In part this is a consequence of the acute drought in northern California, which reduced the water availability to MWD from the State Water Project (SWP). For example, in 2010, approximately 55% of the water provided to the county was from the SWP, and 45% of the water from the Colorado River Aqueduct. The Municipal Water District of Orange County (MWDOC) is the entity interfacing with local water agencies in the South Orange County region. It distributes water to the local water agencies including El Toro Water District (ETWD), Trabuco Canyon Water District (TCWD), Moulton Niguel Water District (MNWD), Laguna Beach County Water District (LBCWD), Santa Margarita Water District (SMWD), South Coast Water District (SCWD), San Juan Capistrano, and San Clemente. The total water demand for all 8 districts is 38.2 million gallons per day, and 77% of it is imported obtained from the Sacramento-San Joaquin and Colorado River basins.

Because of the importance of imported water supply to South Orange County, potential impacts of climate change to water resources must be examined over a region broader than the IRWM planning area. Changes in observed climatic variables in this larger region representing the Western U.S. have been examined through data collected in the $20^{th}$ century. Over this period, particularly in winter and spring, temperatures have risen across western North America. In the second half of the 20th century, the warming in the mountainous western North America has led to a higher rain-to-snow ratio, lower snow water content (one exception is the high Southern Sierra Nevada Mountains where April 1 snow water equivalent has been increasing at the high elevation stations), decline in March snow cover, a shift toward earlier annual snowmelt timing by 5 to 30 days, and changes in the timing of biological events, such as flower blooming. These changes illustrate the effects of climate change on the hydrology of California's mountains, and indicate the need to predict future 21st century changes in order that appropriate adaptation strategies to protect South OC's water-supply sources can be developed.

In California mean annual temperature increases of 0.6 °C, and winter and spring increases of 1.5 °C and 1 °C, have been documented, respectively, and these trends are very unlikely to be solely due to natural variability. The late-spring and early-summer runoff fraction runoff of eight major rivers in the western Sierra Nevada in California have been decreasing since the mid-20th century. There is evidence of trends in climatic and hydrologic variables in western mountain environments in the second half of the 20th century – including temperature, precipitation, rain-to-snow ratio, snow water content, and snowmelt timing. It has been concluded that many of the changes already observed, are, to a high degree of confidence, attributable to climate change that has already occurred over the latter part of the 20th century.

For estimating future climate conditions, global climate processes are represented using atmosphere-ocean general circulation models (AOGCMs or GCMs, also known as "global climate models"). Several published GCMs, developed by research groups worldwide, are in common use. GCMs are used to project future climate changes based on assumptions of different economic growth pathways and emissions of greenhouse gases, with RCP 45 and RCP85 being the most common named scenarios used in various climate impact studies. No one model or emission pathway is the best estimate of the future, and, typically, most climate assessments utilize an ensemble of GCM results for evaluating future conditions. In this review, sixteen candidate climate models were selected for evaluation. GCM outputs are presented in spatially more detailed form through downscaling, with statistical downscaling being the most commonly used approach. Statistical downscaling is based on the development of relationships between local-scale observations and large scale GCM projections, which are then used to estimate spatially resolved future climate projections. Results from three 21st century periods, statistically downscaled to cells of 1/8 degree or about 12 km by 12 km, were analyzed for impacts in the early, mid, and late 21st century, defined as 2010–2039, 2040–2069, and 2070–2099 respectively. The projected data summary for the South OC IRWM planning region show a small decrease in precipitation of slightly over an inch per year by mid- to late-21$^{st}$ century periods. They also show an increase in temperature from >2 to >5 $^{o}$F over the same periods. In general, climate models project more adverse conditions (i.e., warmer and drier) in the latter part of the 21$^{st}$ century compared to conditions observed in the second half of the 20$^{th}$ century.

Several major planning studies have been performed in South OC water supply regions that consider the impacts of climate change. Projected climate change conditions, typically obtained from statistical downscaling of an ensemble of models, have been used for developing plants in in both regions. A key feature that stands out from the comprehensive analyses that have been performed is that both California and the Colorado Basin are severely water constrained, where it will be challenging to meet current allocations in future years. In both regions, planning model projections indicate years where deliveries will sometimes fall short of allocations, over planning horizons that range from 20 to 50 years into the future, under conditions where no changes are made to the existing operational infrastructure of the system. Because the regions jointly affected by these basins are continuing to experience relatively rapid population growth, and anticipated increased in municipal demands, water planners must address the dual challenge of reduced supplies and increased demand.

Although variable at different points along the coast due to regional factors, in general, sea levels are rising globally as a result of climate change, resulting in expansion of ocean water and melting of land ice. Along the Pacific Coast, the highest values of sea level rise in Southern California have been reported at Newport Beach, near the study region, where the observed increase is 2.22 mm/year. These rates are projected to accelerate over the 21$^{st}$

century. A review of different calculation approaches by the National Academy of Sciences reported that global sea level is estimated to rise 8–23 cm (3-9 inches) by 2030 relative to 2000, 18–48 cm by 2050 (7-19 inches), and 50–140 cm (20-55 inches) by 2100. This review projects that sea level in Southern California is slightly higher than the global average because of land subsidence, and will rise 4–30 cm (2-12 inches) by 2030 relative to 2000, 12–61 cm (5-24 inches) by 2050, and 42–167 cm (17-66 inches) by 2100. Maps illustrating the effects of sea level rise to 2100 and a 100-year flood were developed for the South IRWM planning region to identify areas that are vulnerable.

Greenhouse gas emissions associated with the water sector were estimated for the South OC planning region. The General Reporting Protocol, Version 3.1, developed by the California Climate Action Registry is used to calculate indirect emissions of greenhouse gases (GHG) from electricity used for the water system in south Orange County. The water sector is the largest user of electricity in the state of California. The bulk of water for southern California specifically is transported over long distances up steep gradients and is therefore more energy expensive than local sources. Energy use for water is quantified via energy intensity, or the gross energy required for the water system to use a specific amount of water at a specific location. Under baseline conditions, the water sector in the region generates GHG emissions of over 93,000 metric tons in terms of carbon dioxide equivalent. Any projects that lead to a reduction of imported water use are also associated with a reduction in GHG emissions.

An overall assessment of vulnerability to climate change for South OC following a checklist presented in the Climate Change Handbook for Regional Water Planning, and specifically recommended for IRWM climate change planning. As noted above, the major water supply system vulnerabilities in this region are not unique, but are tied to the water supply system in California and the Colorado River Basin that are being evaluated through statewide or regional efforts. Besides water supply, other areas of potential concern for this planning region are coastal flooding due to sea level rise, increase in fire risk, and impacts to ecosystems.

Taken together, the information presented in this report shows that climate change assessment is an integral part of the water resources related planning in the South OC region, as well as the larger region, spanning the Southwestern U.S., that supplies its water. The best current understanding of climate change has been incorporated in the assessment of impacts, especially those relating to water supply and sea level rise.

## 9.1 FUTURE WORK

Looking forward, it is expected that climate change planning in support of the IRWM will be updated as better information on climate projections, including extreme events, become available, and impacts to other sectors, such as water quality and habitats will be similarly evaluated. Examples of possible future work are described below.

Given the coastal location of the South OC IRWM planning region, more detailed analysis of the effects of sea level rise in specific areas along the coastline are required. These analyses need to consider the dynamics of storm surges, and the existing protective infrastructure that exists. To support understanding of sea level rise impacts, there should be continued data collection on the wave climate (height, period, direction) in the region. From the standpoint of water supply and water quality, the impact of sea level rise on the Latham Wastewater Treatment Plant needs to be considered.

Climate change, on larger geographic scales, is expected to increase the intensity of precipitation events through the occurrence of atmospheric rivers along the Pacific coast, with the possibility of increased riverine flooding. However, there is limited quantitative information at the spatial scale of a county that can be used to assess the degree to which flooding extents may change. Further developments in climate modeling as well as local data can provide more insight into changes that are occurring. The county may also interface with other research groups in the region that are evaluating the effects of large floods across California (such as the ARkStorm, for Atmospheric River 1000 Storm, project being performed by the US Geological Survey, http://urbanearth.gps.caltech.edu/winter-storm-2). These scenario runs show planners the extent of damage that may occur across the state, including in Orange County. This planning exercise informs local-level agencies to address the effects of major storm event, in a manner similar to that used for exercises related to earthquake preparedness in California.

The current water supply planning efforts in California are mostly focused over a 20-year planning horizon. Most climate models do not project major changes in climate over this time frame. Additional, longer-term planning studies, perhaps extending 50-75 years into the future may provide greater insight for planners in support of long-term infrastructure sustainability assessment and for investments with a lifetime greater than 20 years.

The creeks and estuaries of the South OC region are home to several native fish species that are the focus of ongoing recovery efforts that may be affected adversely by climate change. A plan for continued monitoring of stream flows, water quality and temperature across the South OC region is recommended for understanding and managing these species impacts. To further support the ecosystem functions of the planning region, watershed modeling to quantify future impacts is also recommended.

# 10. References

"We acknowledge the World Climate Research Programme's Working Group on Coupled Modelling, which is responsible for CMIP, and we thank the climate modeling groups (listed in Table 1 of this paper) for producing and making available their model output. For CMIP the U.S. Department of Energy's Program for Climate Model Diagnosis and Intercomparison provides coordinating support and led development of software infrastructure in partnership with the Global Organization for Earth System Science Portals."

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# APPENDIX K

# APPENDIX K

## Objectives & Project List Prioritization

## Introduction

The IRWM Group and stakeholders have collaboratively developed and updated the goals, objectives and strategies of the IRWM Plan since the initial 2005 IRWM Plan. This Appendix includes the updated objective and strategy weighting utilized to assess projects in Phase 1 of project submittal process described in **Section 6** of the IRWM Plan. Additional updates were made to the objectives to bring the existing 2013 IRWM Plan's goals, objectives, and strategies up to the 2016 IRWM Guideline requirements and to reflect requested changes by the EC to merge the Water Supply and Water Use Efficiency goals and objectives into one goal category. The new guidelines require an integration of climate change impacts or risk into the IRWM objectives. Also reflected in the objectives below are modifications to the objectives (not weighting) made in late 2013 to reflect requirements of the 2014 IRWM Grant – Drought Round.

The measurable objectives portion of this Appendix details the metrics utilized for the IRWM Plan to measure progress in project implementation to meet WMA goals over the next 5-10 year planning horizon.

## Objectives & Strategies for Project Prioritization

The objectives and strategies in the 2013 IRWM were being amended at the time of document submittal with preliminary objectives and new strategies listed in Appendix K of the 2013 IRWM Plan. Those objectives and strategies were further revised, and subsequently utilized for the 2014 and 2015 grant submittals. Although the goals became more specific in targets, they were thematically the same as the 2013 goals. Strategies defined for each of the objective categories provide greater specificity for how objectives should be measured – each with a separate weighting. The 2018 IRWM Plan includes a revised process for submitting projects for inclusion on the IRWM Project List; the Project Score Sheet that replaced the 2013 IRWM Plan Project Form is included as **Appendix C**. The Project Score Sheet utilizes the objective and strategy weights approved by the IRWM Group to assess projects as a preliminary assessment of how a project aligns with the IRWM Plan. The Project List attached to the 2018 IRWM Plan in **Appendix F** aligns with the 2016 IRWM Guidelines; the Project List represents an preliminary prioritization of potential projects for funding and regional planning that is further refined by additional prioritization and ranking of projects for each grant round. **Table K-1** summarizes the objectives, strategies and accompanying weights included in the 2018 IRWM Plan. The weighting reflects a scale of 1-5; the MC and stakeholders developed the weights approved by the EC in 2013. As noted, two objective categories merged – the overall objective weight represents the higher of the two previous categories, for consistency.

**Table K-1**

| Goals & Objectives | Weight |
|---|---|
| **Integrate Flood Management (FM)** | **3.4** |
| **FM1**: Improve conveyance and/or reliability of channelized flood control systems and related facilities and remove properties from the 100-year floodplain with consideration for climate change on flow regimes | 3.6 |
| **FM2**: Reduce scour and erosion to river, stream, and the channel banks | 3.2 |
| **FM3**: Improve sub-regional facilities and local storm drain systems where historical flooding exists where the regional system has the capacity to accept the additional flows | 3.2 |
| **FM4**: Preserve or return floodplains as open space | 3.2 |
| **FM5**: Planning, studies, research to acquire Best Data with consideration for climate change impacts | 3.2 |
| **Improve Water Quality (WQ)** | **4.5** |
| **WQ1**: Control anthropogenic pollutants over the developed area of the SOCWMA | 4.4 |
| **WQ2**: Control anthropogenic dry weather flows from the developed area within the SOCWMA | 4.1 |
| **WQ3**: Control wet weather flows to meet NPDES MS4 permit criteria from developed acres within the SOCWMA with consideration for how climate change may impact flow regimes | 4.1 |
| **WQ4**: Improve water quality regulatory framework and/or awareness and/or knowledge of water quality issues within the SOCWMA | 4.1 |
| **Increase Water Supply, and Reliability, and Efficiency** | **4.3** |
| **WS1**: Increase the supply of potable water | 3.5 |
| **WS2**: Increase the supply and use of non-potable water | 3.5 |
| **WS3**: Improve Reliability of all Water Supplies with consideration for how climate change may impact local and external sources. | 3.5 |
| **WS4**: Improve Planning and Awareness of Water Supply with consideration for climate change stresses | 2.7 |
| **WS5**: Reduce consumption from outdoor residential, commercial, industrial, and institutional landscapes | 3.5 |
| **WS6**: Reduce consumption through enhanced water utility operations | 3.1 |
| **WS7**: Reduce consumption from indoor residential, commercial, industrial, and institutional uses | 3.5 |
| **WS8**: Research, Evaluation, Planning & Education with consideration for climate change | 2.7 |
| **Protect and Enhance Natural Resources** | **3.3** |
| **NR1**: Benefit aquatic and riparian ecosystems with consideration for how climate change may impact water availability | 3.1 |
| **NR2**: Benefit terrestrial ecosystems | 3.1 |
| **NR3**: Benefit air, climate, and energy resources with consideration for reducing greenhouse gas emissions, carbon sequestration, and/or increased renewable energy | 3.1 |
| **NR4**: Research, evaluation, monitoring, planning, recreation, and education | 3.1 |

**Measurable Objectives**

The IRWM Plan objectives are measurable and iteratively revised. For the 2018 IRWM Plan, the MC approved amending the metrics for each objective to reflect the merger of Water Supply and Water Use Efficiency goals and recent local planning, namely the development of the WQIP and the OC Water Reliability Study. Both the WQIP and OC Water Reliability Study represent significant local watershed-scale water resource planning efforts and are appropriate for IRWM Planning.

***A) Water Quality***

As noted in the IRWM Plan, the WQIP identified the highest priority water quality concerns for the San Juan Hydrologic Unit, which mirrors the boundaries of the WMA. One of the highest priorities identified in the WQIP is the reduction of pathogenic bacteria health risk in receiving waters that have high intensity recreational use by implementing structural and non-structural measures. The WQIP developed a total load reduction based upon anticipated strategies to accomplish that goal and to meet final TMDL target load reductions. The Water Quality objective of this plan includes the following total load reduction targets (%) for each sub-watershed (hydrologic sub-area) from the WQIP:

| Total Load Reduction as a Percentage (%) of Average Municipal Load for each HSA[1] | Laguna Hills/San Joaquin HSAs | Aliso HSA | Dana Point HSA | Lower San Juan HSA | San Clemente HSA |
|---|---|---|---|---|---|
| | **54.0 %** | **28.1 %** | **31.5 %** | **26.2 %** | **29.8 %** |

[1] Hydrologic Sub-Area as defined by the WQIP submitted April 2017

A second Water Quality objective measure was drawn from the WQIP, reflective of another highest priority water quality concern – unnatural water balance. Through an extensive outfall monitoring and subsequent prioritization process, it was found that 35 outfalls within the WMA accounted for 75% of persistent dry weather flow (based upon composite scores); these outfalls were slated for structural controls and other strategies to address unnatural dry weather flows. Projects and strategies implemented through the IRWM Plan would assist in addressing priority outfall tributary area within the WMA; this represents treatment of **27,955 total tributary acres**.

***B) Water Supply Reliability & Efficiency***

Water Supply

The OC Water Reliability Study (Study), finalized in December 2016, identified the total water supply shortages for South Orange County. The Study demonstrates several pathways to achieve the target of eliminating the identified supply shortage. Projects and strategies in the IRWM Plan would assist in **reducing the total shortage of 48,500 AFY**.

<u>Water Use Efficiency</u>
The Study also identified water use efficiency needs to meet water supply targets in South Orange County. The forecasted demand curtailment is utilized in the IRWM Plan as a measure for water use efficiency as a portion of the Water Supply Reliability & Efficiency goal and objective. **The total forecasted curtailment (by 2025) is 5,392 AFY.**

### *C) Natural Resources*

As part of the WQIP, the watershed catchment was defined for planning purposes. Drawn from 170 miles of “significant” inland receiving water stream reaches that receive runoff from developed land, the **total watershed catchment of 88,000 Acres** will serve as the area for which natural resource restoration and protection projects would provide the most benefit. Projects implemented through the IRWM Plan will assist in restoring and/or protecting watershed area within this priority, impacted, catchment; progress will be shown in Acres restored.

### *D) Flood Management*

OC Flood prioritizes projects in areas of the WMA where associated land area is in a FEMA designated floodplain. The objective measure is drawn from the goal to reduce flood risk in the WMA, thus utilizing the **FEMA designated floodplain area in South Orange County, representing 5,220 Acres**. The planning horizon (5-7 years) for flood projects seeks to accomplish this goal. Localized flood management benefits can be included for projects outside of this focus area; however, the IRWM Plan utilizes this as the primary Flood Management measure. Progress will be shown in Acres of floodplain for which flood risk is reduced in the WMA.

# APPENDIX L

# APPENDIX L

## Orange County Stormwater Resource Plan (OC SWRP)

APR 28 PM 3:27

APR 2 4 2017

Jenna Voss
Orange County Public Works
2301 N. Glassell Street
Orange, CA 92865

**SUBJECT: ORANGE COUNTY PUBLIC WORKS (ORANGE COUNTY), FUNCTIONALLY EQUIVALENT STORM WATER RESOURCE PLAN ACCEPTANCE LETTER**

Dear Ms. Voss:

Thank you for submitting Orange County's functionally equivalent Storm Water Resource Plan (SWRP) and Self-Certification and Checklist to the State Water Resources Control Board (State Water Board), Division of Financial Assistance (DFA) on February 28, 2017.

State Water Board staff have completed a review of the revised Self-Certification Checklist and referenced pages provided with the proposed functionally equivalent SWRP. State Water Board staff concurs that the SWRP Self-certification and Checklist demonstrates that Orange County's functionally equivalent SWRP is consistent with the minimum requirements of the California Water Code Sections 10561-10573 and the State Water Board's SWRP Guidelines. This concurrence letter does not address whether the functionally equivalent SWRP is consistent with all of the non-mandatory recommendations in the SWRP Guidelines. By this concurrence, Orange County and other eligible entities with projects in the functionally equivalent SWRP are eligible to receive funding from a bond act approved by voters after January 1, 2014 for storm water and dry weather runoff capture projects included in the *Orange County Storm Water Resource Plan*.

This review conducted by State Water Board staff was for funding eligibility related to a bond act only. The State Water Board's review of the submitted Self-Certification and Checklist does not include a technical evaluation or analysis of the SWRP or any supporting documents and no approval of these documents is provided by this letter.

Please do not hesitate to contact Ravi Jawanda at (916) 341-5865, or at Ravinder.Jawanda@waterboards.ca.gov, should you have any additional questions.

Sincerely,

Leslie S. Laudon, Deputy Director
Division of Financial Assistance

OC Public Works
Integrity, Accountability, Service, Trust
Shane L. Silsby, Director

February 28, 2017

State Water Resources Control Board
Division of Financial Assistance
Storm Water Grant Program
1001 I Street
Sacramento, CA 94244-2120

Re: Functionally Equivalent Orange County Stormwater Resource Plan (OC SWRP)

To Whom It May Concern,

This OC SWRP has been prepared to fulfil functional equivalency through the compilation of existing Orange County plans, documents and mapping efforts to meet requirements of Water Code sections 10560 et seq (as amended by SB 985, Stats. 2014, ch. 555, § 5).

Four primary significant planning efforts referenced throughout this plan work together to address the Stormwater Resource Plan Guidelines. These include (1) the 2013/2014 Reports of Waste Discharge (ROWDs), (2) Integrated Regional Watershed Management Plans (IRWM Plans) for North, Central and South Orange County Watershed Management Areas, (3) Watershed Infiltration and Hydromodification Management Plan (WIHMP) mapping tools, and (4) the South Orange County Water Quality Improvement Plan (WQIP) (WQIP B2 and B3 Reports). In addition to meeting the Storm Water Resource Plan Guidelines, the four primary documents also provide the basis for project identification and prioritization in this OC SWRP (**OC SWRP Section 5**). Other documents produced by Orange County agencies are referenced in this OC SWRP to meet specific requirements of **Appendix A** as needed; however, the documents largely utilized to frame the OC SWRP are described below.

***Reports of Waste Discharge (ROWDs)***
The ROWDs for the San Diego and Santa Ana Regions (SDR and SAR, respectively) summarize data collected over several National Pollutant Discharge Elimination System (NPDES) permit cycles, establish the priority water quality concerns, and outline the "state of the environment" in Orange County watersheds. The ROWDs also assess program status and accomplishments, establish goals for future program development and identify areas for improvement. The ROWDS were developed via a collaborative NPDES Permittee-based process, including solicitation of stakeholder input at public meetings. As such, the ROWDs provided the baseline data review for the Water Quality Improvement Plan (WQIP) and the water quality analysis for this OC SWRP. Watershed Management Plans (WMPs) for the four primary watersheds in the SAR will be developed upon approval of the Fifth Term NPDES Permit for the SAR. These WMPs will be equivalent to the WQIP described below in form and function. As with the WQIP, the SAR ROWD analysis will provide the baseline data and

geospatial review utilized to develop the water quality priorities for watershed planning. The ROWD analyses for both the SAR and SDR indicated similar water quality concerns County-wide; as WMPs for the SAR will not be developed until the permit is approved, the SAR ROWD analyses along with the WQIP will be utilized in this OC SWRP for the SAR.

***Integrated Regional Watershed Management Plans (IRWM Plans)***
IRWM Plans were developed for three watershed regions in Orange County. The North IRWM Plan covers the Santa Ana River watershed and Carbon and Coyote Creeks – subwatersheds of the San Gabriel River watershed. The Central IRWM Plan comprises the Newport Bay watershed. The South IRWM Plan comprises the entire San Juan Hydrologic Unit (**OC SWRP Sections 3.2 and 5.1.4**). These plans provide guidance at a regional planning level for short and long term management strategies that will protect the water supply and water quality of the watershed management areas (WMAs). They are designed to help local agencies and governments manage their water, wastewater, and ecological resources.

The South Orange County IRWM Plan is referenced as the model functionally equivalent document for Orange County integrated water management planning in this OC SWRP. The project prioritization methodology developed for the OC SWRP is largely modeled after the analogous process in the South IRWM Plan, which considers the most current climate change analysis of the three IRWM Plans and was most recently updated to meet Department of Water Resources IRWM Plan Standards for Proposition 84. Additionally, as a recognized IRWM Region, the South OC WMA governance body – the Executive Committee – identifies potential projects intended to improve water quality and supply, engages in long range water planning, and establishes priorities among project proposals of the member entities to obtain potential funding. The IRWM Plans for North and Central Orange County represent local plans and are utilized in the OC SWRP in tandem with the South IRWM Plan to demonstrate Orange County-wide IRWM planning.

All three IRWM Plans are currently being updated to meet Department of Water Resources 2016 IRWM Plan Standards. As part of this update, the North and Central IRWM Plans will be merged. All revised IRWM Plan information will be included in future iterations of the OC SWRP, as needed.

***Water Quality Improvement Plan (WQIP)***
The WQIP Permit Provisions B.2 and B.3 are the latest watershed-scale analyses included in the OC SWRP. The WQIP focuses on system value and function and the ways these are affected by the municipal separate storm sewer system (MS4). The WQIP defines broader concepts of "condition" that more closely relate to beneficial uses rather than focusing only or mainly on the values of individual water quality constituents to achieve better alignment with the Ocean Plan and Basin Plan. The WQIP covers all permittees and sub-watersheds in the San Juan Hydrologic Unit. Adaptive planning and management processes in the WQIP identify watershed-specific priorities within the South Orange County watersheds and implements strategies through collective watershed-scale efforts and respective jurisdictional programs.

Additional measures to meet TMDL and SDR permit requirements are found in the TMDL Comprehensive Load Reduction Plans (CLRPs) which describe specific activities, BMPs and timelines to address bacteria loads in the Aliso Creek, San Juan Creek, and San Clemente Coastal Stream watersheds. The WQIP incorporates the monitoring locations, load reduction schedules and projects included in the CLRPs. Additional documents that implement programs to meet water quality standards built into the WQIP include: Model Water Quality Management Plans for the SAR and SDR (Model WQMPs) and the associated Technical Guidance Document (TGDs) for land development, and the Hydromodification Management Plan (HMP) to reduce hydromodification resultant from development in South Orange County.

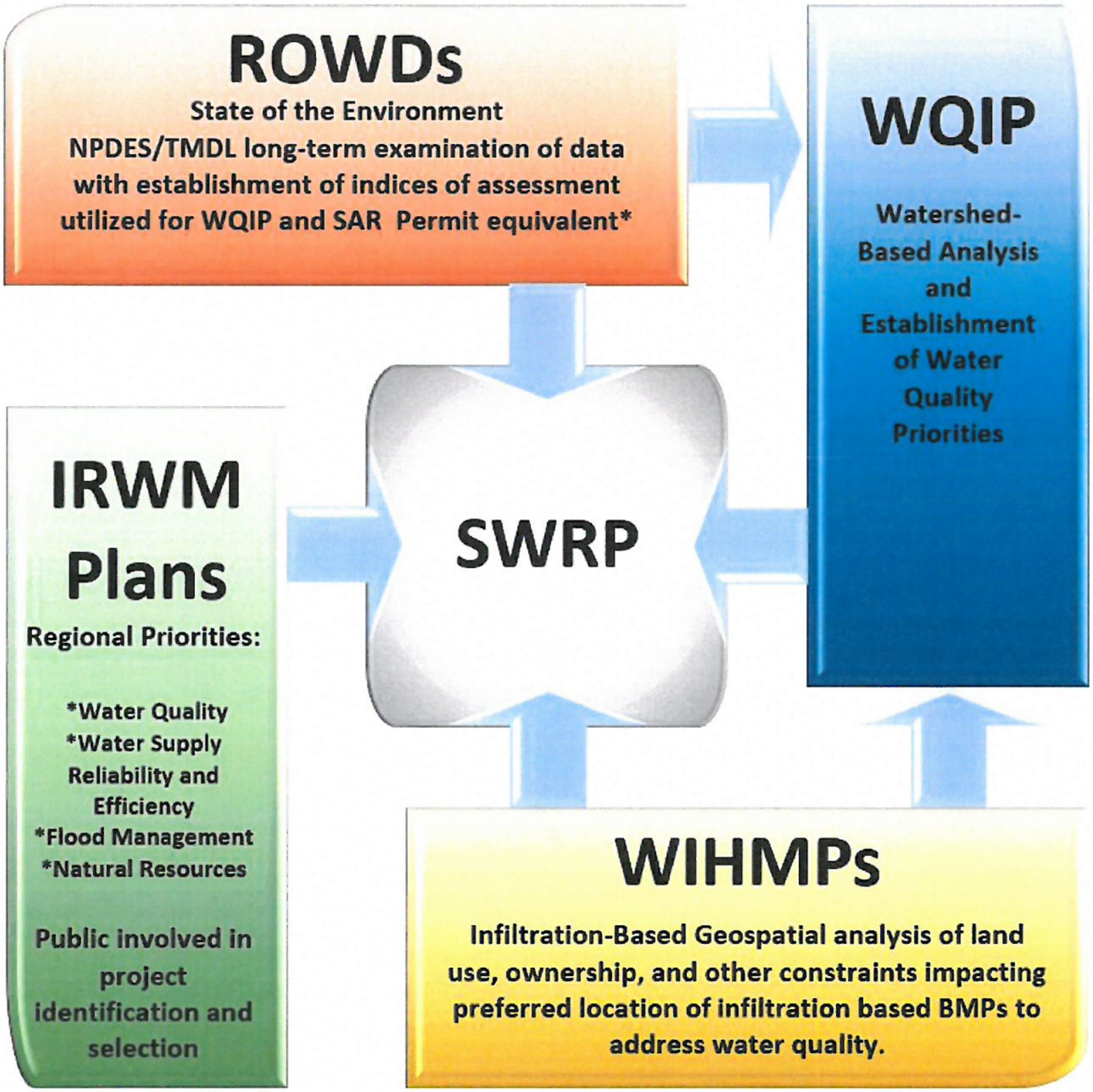
***Watershed Infiltration and Hydromodification Management Plan (WIHMP) Mapping Tools***
The WIHMPs provide a watershed-scale mapping analysis tool to determine for provide guidance in appropriately locating and siting projects based on watershed characteristics. The WIHMPs comprised a GIS review of hydromodification susceptibility and infiltration feasibility and are described in greater detail in **OC SWRP Section 5.1.1**. The WIHMP mapping provided a basis for similar GIS-based analyses conducted for the WQIP and will for future watershed planning efforts in the SAR.

***Primary Functionally Equivalent Plans – How the Plans Integrate to Meet Guidelines***
The metrics-based analysis described in **OC SWRP Section 4.1** merges priorities established by the IRWM Plans for Orange County with the WQIP priorities described in **OC SWRP Section 1.4** and ROWD analyses described in **OC SWRP Section 2.1**. This merger provides a County-wide view of watershed priorities based upon water quality, water supply, habitat, and flood control needs for the region and serves as the basis for the project prioritization described in **OC SWRP Section 5**. The two figures below highlight how the functionally equivalent documents collectively form the OC SWRP and the decision-making process for project identification and prioritization.

OC Public Works

*Integrity, Accountability, Service, Trust*

**Shane L. Silsby, Director**




*Anticipated Watershed Management Plan process will begin upon SAR Fifth Term Permit adoption.

OC Public Works

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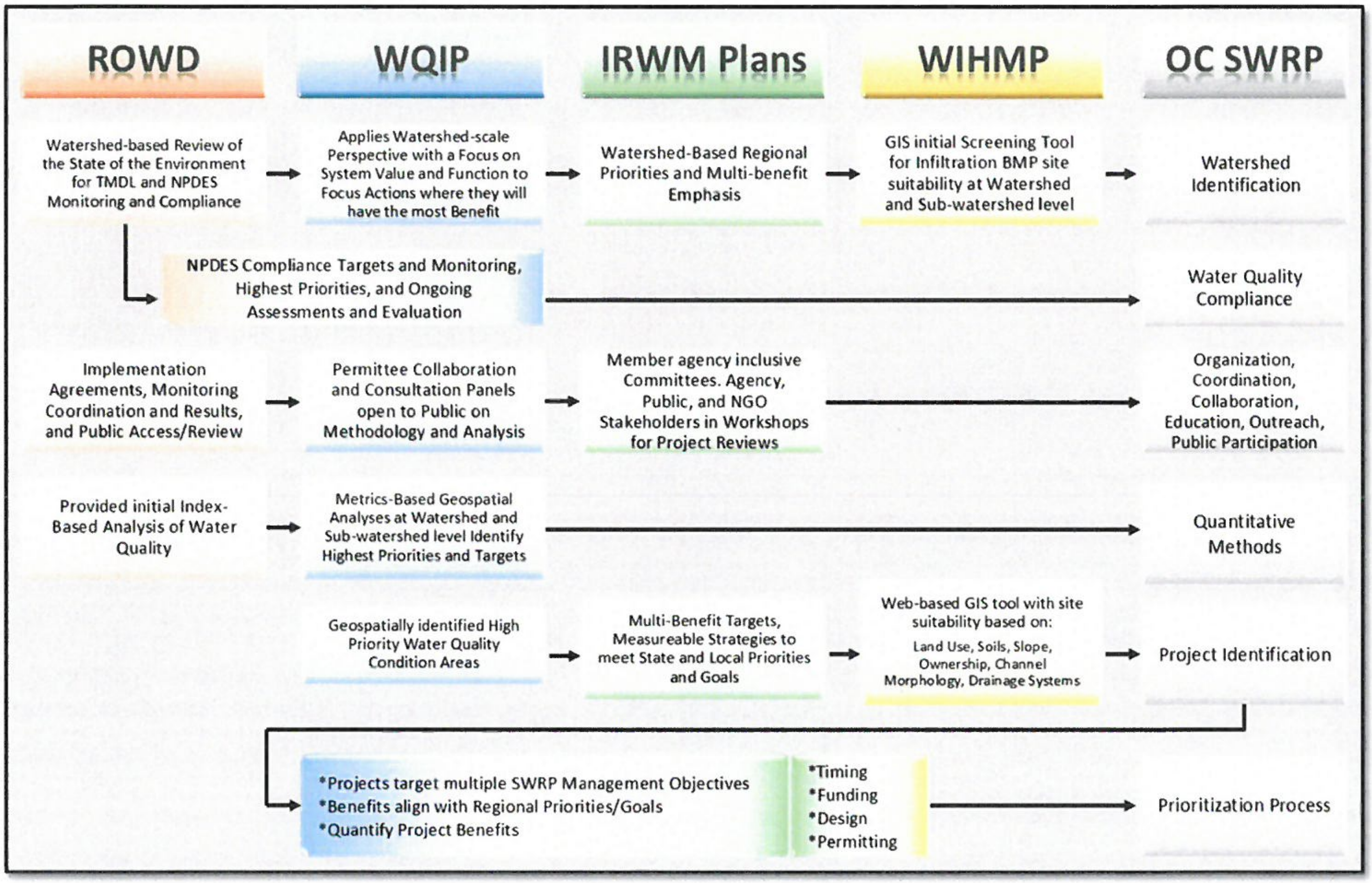



Please feel free to contact me should you have any questions.

Regards,

*Marilyn Thoms* (signature)

Marilyn Thoms
Manager, Watershed Management Division
OC Environmental Resources

# ORANGE COUNTY STORMWATER RESOURCE PLAN

APPLICABLE TO THE SANTA ANA AND SAN DIEGO REGIONAL WATER QUALITY CONTROL BOARD REGIONS

# TABLE OF CONTENTS

## TABLES



## FIGURES

**APPENDICES**

## LIST OF ACRONYMS

| | |
|---|---|
| BLRP | Bacteria Load Reduction Program |
| BMP | Best Management Practice |
| CEQA | California Environmental Quality Act |
| CLRP | Consolidated Load Reduction Program |
| DAMP | Drainage Area Management Plan |
| EPA | Environmental Protection Agency |
| ETWD | El Toro Water District |
| HMP | Hydromodification Plan |
| IRWD | Irvine Ranch Water District |
| IRWM Plans | Integrated Regional Water Management Plan |
| LID | Low Impact Development |
| MNWD | Moulton Niguel Water District |
| MS4 | Municipal separate storm sewer systems |
| MWD | Metropolitan Water District of Southern California |
| MWDOC | Municipal Water District of Orange County |
| NPDES | National Pollutant Discharge Elimination System |
| OC | Orange County |
| OC SWRP | Orange County Stormwater Resource Plan |
| OCFCD | Orange County Flood Control District |
| OCPW | Orange County Public Works |
| OCSD | Orange County Sanitation District |
| OCSP | Orange County Stormwater Program |
| OCTA | Orange County Transportation Authority |
| ROWD | Report on Wastewater Discharge |
| RWQCB | Regional Water Quality Control Board |
| SAR | Santa Ana Region |
| SCWD | South Coast Water District |
| SDR | San Diego Region |
| SJBA | San Juan Basin Authority |
| SMWD | Santa Margarita Water District |
| SOCWA | South Orange County Wastewater Authority |
| SWRCB | State Water Resources Control Board |
| TCWD | Trabuco Canyon Water District |
| TGD | Technical Guidance Plan |
| TMDL | Total Maximum Daily Load |
| WAP | Watershed Workplan (formerly Watershed Action Plan) |
| WIHMP | Watershed Infiltration & Hydromodification Management Plans |
| WMA | Watershed Management Area |
| WMP | Watershed Management Plan |
| WWP | Wastewater Plans |
| WQBEL | Water Quality-Based Effluent Limitations |
| WQIP | Water Quality Improvement Plan |
| WQMP | Water Quality Management Plan |

# ORANGE COUNTY STORMWATER RESOURCE PLAN (OC SWRP)

## 2016 FUNCTIONAL EQUIVALENCY PLAN APPLICABLE TO THE SANTA ANA AND SAN DIEGO REGIONS

### EXECUTIVE SUMMARY

Paramount to the implementation of an integrated watershed-based approach to address stormwater and dry weather runoff pollution is a strategic prioritization of water quality issues of concern based upon the characteristics of each watershed and monitoring results garnered over time. Additionally, water quality must be examined in context to the overall water needs of a region. In the framework of integrated water resource management, addressing water quality concerns should also consider water supply and groundwater recharge opportunities. Watershed management in Orange County relies upon partnerships between cities, water agencies, groundwater authorities, environmental groups, and other stakeholders to develop projects and prioritize efforts that balance water quality, water supply and efficiency, flood management and natural resource protection. Documents included in the OC SWRP to meet functional equivalency collectively balance these watershed priorities; however, the primary intent of the OC SWRP is to prioritize stormwater and dry weather runoff projects.

Project identification and prioritization in the OC SWRP is for implementation and funding through the State Water Resources Control Board Proposition 1 Storm Water Grant Program; however, the framework established for prioritization will apply to stormwater projects seeking funding through any applicable State Bond financed grant programs per Senate Bill (SB) 985. Project prioritization is based upon water quality constituents of concern; opportunities for infiltration or capture and use; and groundwater replenishment (where possible). Regional goals for identification and prioritization of projects were drawn principally from the South Orange County Water Quality Improvement Plan (WQIP), Report of Waste Discharge State of the Environment Reports for the Santa Ana and San Diego Regions of Orange County, and Integrated Regional Watershed Management Plans (IRWM Plans).

Regional goals are summarized by the OC SWRP Management Objectives (**Table 4-1**) below:

| OC SWRP Management Objectives | Project Objectives |
|---|---|
| **Improve Water Quality** | ▪ Address NPDES and TMDL constituents of concern through non-point source control<br>▪ Increase infiltration and/or treatment of runoff to address WQIP priorities – indicator bacteria and/or nutrients<br>▪ Decrease or eliminate dry weather flows to reduce conveyance of pollutants to receiving waters and bacterial regrowth |
| **Increase Water Supply Reliability & Efficiency** | ▪ Address unnatural water balance from urbanization through water conservation<br>▪ Creation of new water supply through beneficial use of stormwater<br>▪ Enhancing local water supply reliability through groundwater recharge |
| **Improve Flood Management** | ▪ Address channel erosion and geomorphic impacts from flood events<br>▪ Decrease flood risk by reducing peak flow (i.e. control system flashiness) |
| **Protect and Enhance Natural Resources & Community Benefits** | ▪ Habitat protection or enhancement<br>▪ Erosion control to re-establish riparian habitat<br>▪ Sediment and flow control to return to a more natural condition<br>▪ Public education and outreach<br>▪ Provision of new or enhancement of existing urban recreational use areas |

The OC SWRP was developed by the County of Orange in coordination with and utilizing documents developed by water agencies and cities in Orange County (referred to as "Plan Agencies"). Plan Agencies and stakeholders were involved in the development of the functionally equivalent OC SWRP components. Participation in development of each functionally equivalent component by Plan Agencies was enhanced with work groups, planning committees, and comment and review periods. **Section 3** of this OC SWRP highlights the interlocking coordination and implementation of each of the primary functionally equivalent components with examples provided in **Section 3.1**. The public, as a key stakeholder, was involved in public education, outreach, and participation associated with the documents and plans prepared to meet functional equivalency. **Section 7** of this OC SWRP details these efforts further. Additionally, a webpage has been created for the OC SWRP to provide further public access; included on the webpage is a link to the OC SWRP, access to the database of functionally equivalent documents and project forms for proponents to add projects to the OC SWRP project list.

The OC SWRP represents a collection of functionally equivalent documents and previous planning efforts conducted by the Plan Agencies to meet compliance with National Pollutant Discharge Elimination System (NPDES), Total Maximum Daily Load (TMDL) and Integrated Regional Water Management (IRWM) State planning standards. **Section i** includes a roadmap for how the primary functionally equivalent documents collectively meet SWRP Guidelines and provide the basis for stormwater capture and use project prioritization in Orange County.

Documents, methodologies and mapping described in the OC SWRP will be made available to State Water Board staff via links and access through the OC SWRP Webpage to meet functional equivalency. These documents will also be available to the public via a County webpage.

It is noted that as of February 2017, the IRWM Plans are in the midst of updates to meet new State Planning Standards and the WQIP is slated for submission to the SDR Water Board on April 1, 2017.

As part of the IRWM Plan update process, the North and Central IRWM Plans will be combined into one Plan. The geographic boundaries for both of these Plans are within the Santa Ana Regional (SAR) Water Quality Control Board boundary. It is envisioned that having one Plan will provide greater opportunity for identifying and integrating regional projects resulting in multi-beneficial and jurisdictional-focused successes.

At the same time, the County of Orange is initiating efforts to develop Watershed Management Plans (WMPs), equivalent to the WQIP, for each of the principal North Orange County watersheds. The OC SWRP therefore represents a living document; as such, it will be iteratively reviewed and modified over time to incorporate developments in the functionally equivalent documents, as needed.

## i. FUNCTIONALLY-EQUIVALENT PLAN ROADMAP

This OC SWRP meets functional equivalency through the compilation of existing Orange County plans, documents and mapping efforts to meet requirements of Water Code sections 10560 et seq (as amended by SB 985, Stats. 2014, ch. 555, § 5). Four primary significant planning efforts referenced throughout this OC SWRP are used for functional equivalency to meet the SWRP guidelines. These include (1) the 2013/2014 Reports of Waste Discharge (ROWDs), (2) Integrated Regional Watershed Management Plans, (3) Watershed Infiltration and Hydromodification Management Plan (WIHMP) mapping tools, and (4) the South Orange County Water Quality Improvement Plan (WQIP). In addition to meeting the SWRP guidelines, these four primary documents also provide the basis for project identification and prioritization in this OC SWRP (**Section 1**). Other documents produced by the Plan Agencies are referenced in this OC SWRP to meet specific requirements of **Appendix A** as needed. The four planning documents largely used to frame the OC SWRP are described below.

The ROWDs (OCPW 2013c, 2014c) for the Santa Ana and San Diego Regions (SAR and SDR, respectively) summarize data collected over several NPDES permit cycles, establish the priority water quality concerns, and outline the "state of the environment" in Orange County watersheds. The ROWDs also assess program status and accomplishments, establish goals for future program development and identify areas for improvement. As such, the ROWDs provided the baseline water quality assessment for the WQIP as well as for this OC SWRP. Additionally, the ROWD analyses indicated similar water quality concerns County-wide; as the WMPs for the SAR are under development but will not be formalized until approval of the Fifth Term NPDES Permit, these analyses along with the WQIP will be utilized in this OC SWRP for Orange County. The ROWDs were developed via a collaborative NPDES Permittee-based process, including solicitation of stakeholder input at public meetings.

Integrated Regional Watershed Management Plans (IRWM Plans) were developed for three watershed management areas (WMA) in Orange County. The North IRWM Plan covers the Santa Ana River Watershed, the Lower San Gabriel River/Coyote Creek Watershed, and the Anaheim Bay-Huntington Harbour Watershed. The Central IRWM Plan covers the Newport Bay watershed. Both of these Plans are currently being combined into one Plan. The South IRWM Plan comprises the entire San Juan Hydrologic Unit (**Sections 3.2** and **5.1.4**). Collectively, these plans provide guidance at a regional planning scale for short- and long-term management strategies that will protect the water supply and water quality of the WMAs. They are designed to help local agencies and governments manage their water, wastewater, and ecological resources. The South IRWM Plan is referenced as the model functionally equivalent document for Orange County integrated water management planning in the OC SWRP. The project prioritization methodology developed for the OC SWRP is largely modeled after the scoring process used in the South IRWM Plan, as it has the most updated climate change analysis and was more recently updated and revised pursuant to Department of Water Resources IRWM Plan Standards for Proposition 84. Additionally, as a recognized Region, the South Orange County WMA governance body – the Executive Committee – identifies potential projects intended to improve water quality and supply, engages in long range water planning, and establishes priorities among project proposals of the member entities to obtain potential funding. The County of Orange, as an agent of the State of California, serves as the conduit for funding to the individual agencies proposing projects in the South IRWM Plan as a recognized Region.

The South Orange County (San Juan Hydrologic Unit) Water Quality Improvement Plan (WQIP) (OCPW 2016a and 2016b) is a watershed-scale plan nearing completion. The WQIP is being prepared pursuant to requirements of a NPDES Permit (Order R9-2013-0001, NPDES No. CAS0109266) adopted by the San Diego Regional Water Quality Control Board on May 8, 2013 and subsequently amended by Order No. R9-2015-001 and Order No. R9-2015-0100[1]. The WQIP covers all municipal Permittees and urbanized portions of the San Juan Hydrologic Unit (i.e., the South Orange County WMA) with a focus on stream system and coastal waters value and function and the ways these are affected by the municipal separate storm sewer system (MS4). The goal of the WQIP is to further the Clean Water Act's objective to protect, preserve, enhance, and restore the water quality and designated beneficial uses. The WQIP defines broader concepts of "water quality condition" that more closely relate to beneficial uses rather than focusing only on pollutants and water chemistry. Further, the WQIP identifies "highest priority water quality conditions" for receiving waters based on the best available data and information; these conditions warrant consideration for focused activity, manifested through the implementation of water quality improvement strategies. The WQIP includes an adaptive planning and management process to identify watershed-specific priorities within the South Orange County WMA, and implements strategies through collective watershed-scale efforts and respective jurisdictional programs. The WQIP integrates by reference many other planning and guidance documents that direct strategies intended to meet water quality standards including individual jurisdictional runoff management plans (JRMPs); the Model Water Quality Management Plan (Model WQMP) for the San Diego Region (SDR) (OCPW 2013b) and the associated Technical Guidance Document (TGD) (OCPW 2013e) for land development; and the South Orange County Hydromodification Management Plan (HMP) (OCPW 2015d).

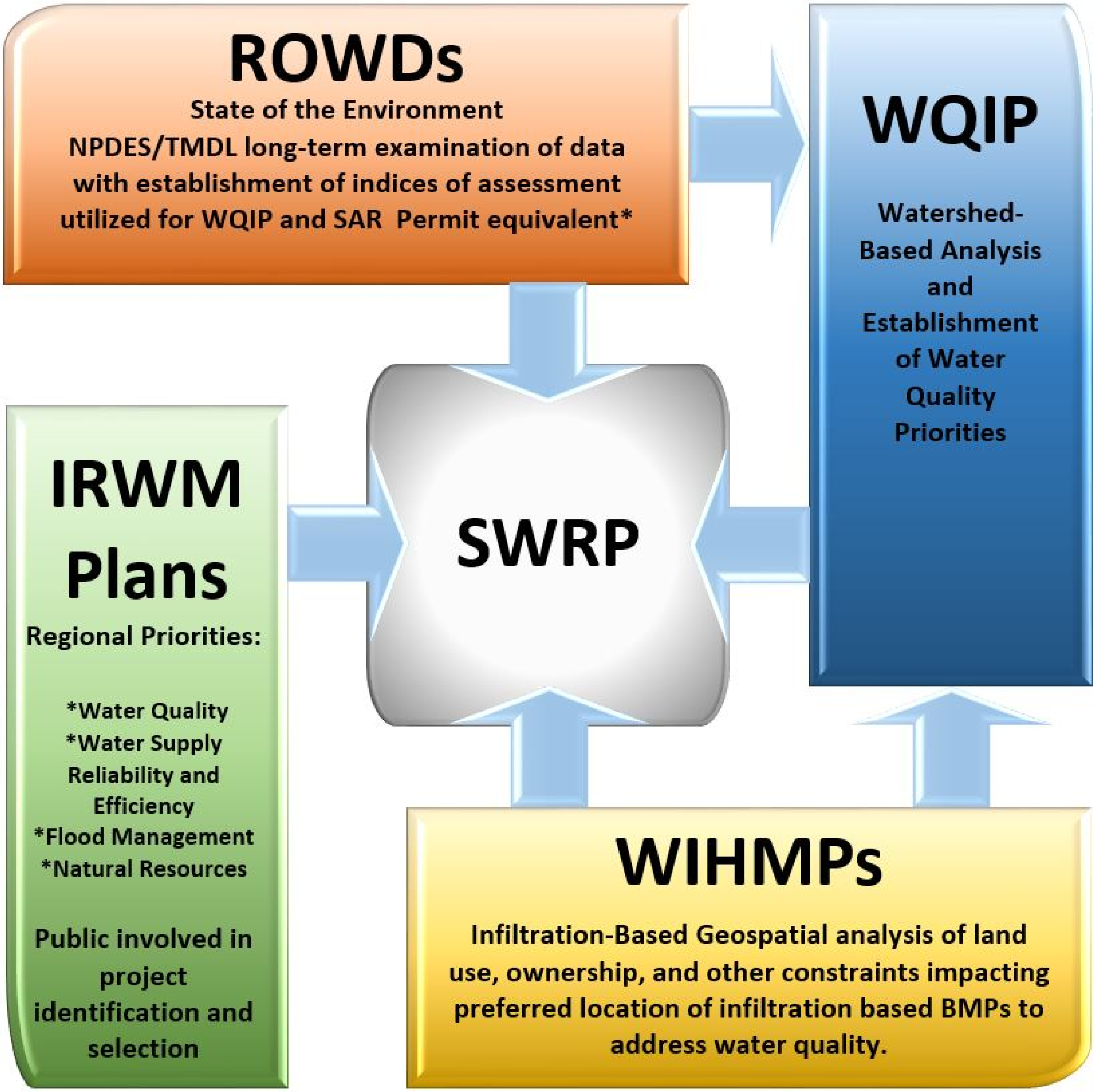
Lastly, the Countywide mapping that informed the Watershed Infiltration and Hydromodification Management Plans (WIHMPs) (OCPW 2016c) provides a watershed-scale analysis that provides guidance to low impact development (LID) and best management practice (BMP) selection for new or redevelopment projects throughout Orange County and identifies potential regional BMP retrofit opportunities for stormwater runoff retention.

The metrics-based analysis described in **Section 4.1** merges priorities established by the IRWM Plans for North, Central and South Orange County with the ROWD analyses and subsequent

[1] On November 8, 2016, the Santa Ana Regional Board withdrew Draft Board Order R8-2016-0001. In anticipation of the adoption of this Order in late 2017 or early 2018, the County of Orange has initiated development of Watershed Management Plans for each of the four principal North Orange County watersheds. The WMPs will be equivalent in structure and purpose to the WQIP.

WQIP water quality priorities described in **Section 1.4**. This merger provides a County-wide view of watershed priorities based upon water quality, water supply, habitat, and flood control needs for the region and serves as the basis for the project prioritization described in **Section 1**.

**Figure i-1** highlights how the four primary functionally equivalent documents detailed above relate to one another and integrate to form the basis for the OC SWRP. The flow chart shown in **Figure i-2** provides a more detailed overview of how the four main functionally equivalent documents form the OC SWRP; other documents related to these are referenced in the OC SWRP but these represent the majority. **Figure i-2** also summarizes the decision process for OC SWRP project identification and prioritization.




*Anticipated Watershed Management Plan process will begin upon SAR Fifth Term Permit adoption.

**Figure i-1: Orange County Planning Documents Relationships to OC SWRP**

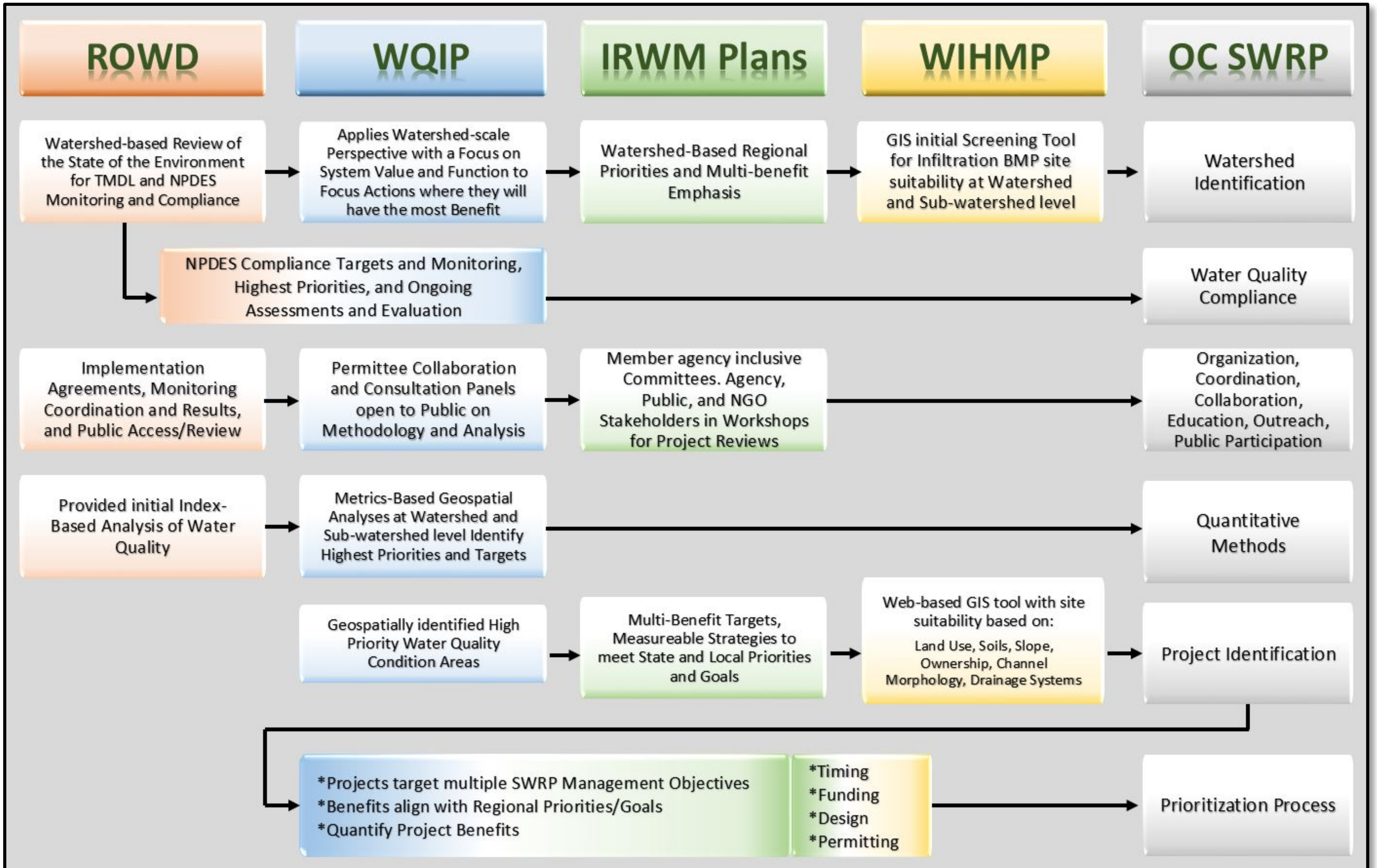



**Figure i-2: OC SWRP Functionally Equivalent Program Elements**

## ii. ORGANIZATION OF PLAN

The intention of the OC SWRP is to both meet compliance with Proposition 1 State Water Resources Control Board Stormwater Grant guidelines (SWRCB 2015) and to assist Orange County agencies with watershed-level project planning. Sections of the OC SWRP mirror the required elements included in the Storm Water Resource Plan Guidelines and are as follows:

- **Section 1: Watershed Identification** – Provides compliant watershed and sub-watershed information pertinent to Section VI.A of the Storm Water Resource Plan Guidelines (SWRCB 2015), and identifies regional priorities for stormwater and dry weather runoff projects based upon water quality, water supply and groundwater storage needs in the region.
- **Section 2: Water Quality Compliance** – Summarizes the documents used to achieve functional equivalency pertaining to compliance with NPDES permit requirements, including TMDLs, and the identification of contributors to runoff pollution.
- **Section 3: Organization, Coordination and Collaboration** – Highlights multi-agency and stakeholder consultation and community participation, and details local IRWM groups as well as decisions for OC SWRP implementation through functionally equivalent document coordination and implementation.
- **Section 4: Quantitative Methods** – Describes the framework by which project benefits are assessed and quantified in accordance with Section VI.C of the OC SWRP Guidelines (SWRCB 2015).
- **Section 5: Identification and Prioritization of Projects** – Describes project identification and prioritization procedures and outlines the specific process for the OC SWRP in accordance with the OC SWRP Guidelines (SWRCB 2015).
- **Section 6: Implementation Strategy & Schedule** – Outlines the iterative approach to plan development, review and refinement based upon an ever-changing regulatory climate. A schedule for plan implementation is provided.
- **Section 7**: **Education, Outreach and Public Participation** – Provides an overview of public education, outreach, and participation methods applied within the functionally equivalent documents.

The functionally equivalent documents detailed in **Section i**, as well as other related references used in this OC SWRP, can be found at the OC SWRP Webpage by following this link. Additional links to referenced documents are provided in **Appendix A**, as well as within the SWRP Checklist and Self-certification elements included after each section or subsection of this OC SWRP. Finally, additional GIS data, including WIHMP data[2], is accessible through a link at the OC SWRP Webpage referenced previously.

[2] The Orange County GIS portal to WIHMP data requires registration set up using an individual email and password. All data is accessible once registered.

# 1 WATERSHED IDENTIFICATION

## *1.1 Watershed Basis*

The County of Orange, Orange County Flood Control District and 34 incorporated Orange County cities (collectively "OC Stormwater Permittees") identified the major watersheds and sub-watersheds of the County of Orange in the 2003 Drainage Area Management Plan (DAMP) (OCPW 2003). United States Geologic Survey (USGS) hydrologic area boundaries provide the base watershed definition. These include the San Gabriel, Seal Beach, Santa Ana, and Newport Bay watershed units for the SAR and the San Juan Hydrologic Unit for the SDR. Sub-watersheds were delineated to recognize coastal watercourses based upon drainage. Watershed delineations were further refined based upon USGS boundaries and existing storm drain systems, and were most recently used for development of the WIHMP watershed planning maps and WQIP (OCPW 2016a, OCPW 2016c). The delineated watersheds and their respective areas are summarized in **Table 1-1** and **Figure 1-1**.

| Watershed | Square Miles | Acres |
|---|---|---|
| Aliso Creek | **34** | **21,956** |
| Anaheim Bay/Huntington Harbour | **80** | **50,905** |
| San Gabriel/Coyote Creek | **86** | **55,049** |
| Dana Point Coastal Streams | **11** | **6,750** |
| Laguna Coastal Streams | **20** | **12,522** |
| Newport Bay | **150** | **96,271** |
| Newport Coastal Streams | **7** | **4,594** |
| San Clemente Coastal Streams | **20** | **12,773** |
| San Juan Creek | **157** | **100,711** |
| San Mateo Creek | **19** | **12,069** |
| Santa Ana River | **210** | **134,184** |

**Table 1-1: Orange County Watersheds (OCPW 2016a, OCPW 2016c)**

Watershed delineations developed through the hydrologic analysis described above have been used for NPDES, TMDL and IRWM planning purposes in Orange County. Additionally, water courses and their tributaries in the county have alphabetical and numerical flood control delineations and are often cited within this numbering system for uniquely identifying separate tributaries and outfalls for flood control and/or monitoring purposes. Orange County Flood Control District (OCFCD) maintains drainage facility maps based upon both drainage and urban infrastructure for refined planning purposes; maps are available here.

<table>
<tr><th colspan="3">Stormwater Resource Plan Checklist and Self-Certification: Appendix A</th></tr>
<tr><td rowspan="2">☒</td><td>1. Plan identifies watershed and sub-watershed(s) for stormwater resource planning.</td><td rowspan="2">10565(c), 10562(b)(1), 10565(c)</td></tr>
<tr><td>OC SWRP Section 1.1 (p.1-1), Figure 1-1, Table 1-1 (p.1-3 and 1-1); OCPW 2003 DAMP (Appendix D: Watershed Chapters, Executive Summaries and All Figures); OCPW 2012a Central IRWM Plan (Section 3, p.3-4 to 3-6); OCPW 2011b North IRWM Plan (Section 3, p.3-1 to 3-5); OCPW 2013d South IRWM Plan (Section 3, p.3-2 to 3-5); OCPW 2016a WQIP.B2 (Section 1, p.1-2); OCPW 2016b WQIP.B3 (Introduction, p.x); OCPW 2016c WIHMPs (Exhibits 1.1); OC Flood drainage facility maps</td></tr>
<tr><td rowspan="2">☒</td><td colspan="2">2. Plan is developed on a watershed basis, using boundaries as delineated by USGS, CalWater, USGS Hydrologic Unit designations, or an applicable integrated regional water management group, and includes a description and boundary map of each watershed and sub-watershed applicable to the Plan.</td></tr>
<tr><td colspan="2">OC SWRP Section 1.1 (p.1-1), Figure 1-1, Table 1-1 (p.1-3 and 1-1); OCPW 2003 DAMP (Appendix D: Watershed Chapters, Figures 1); OCPW 2012a Central IRWM Plan (Section 3, p.3-4 to 3-6); OCPW 2011b North IRWM Plan (Section 3, p.3-1 to 3-5); OCPW 2013d South IRWM Plan (Section 3, p.3-2 to 3-5); OCPW 2016a WQIP.B2 (Section 1, p.1-2); OCPW 2016b WQIP.B3 (Introduction, p.x); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OC Flood drainage facility maps</td></tr>
</table>

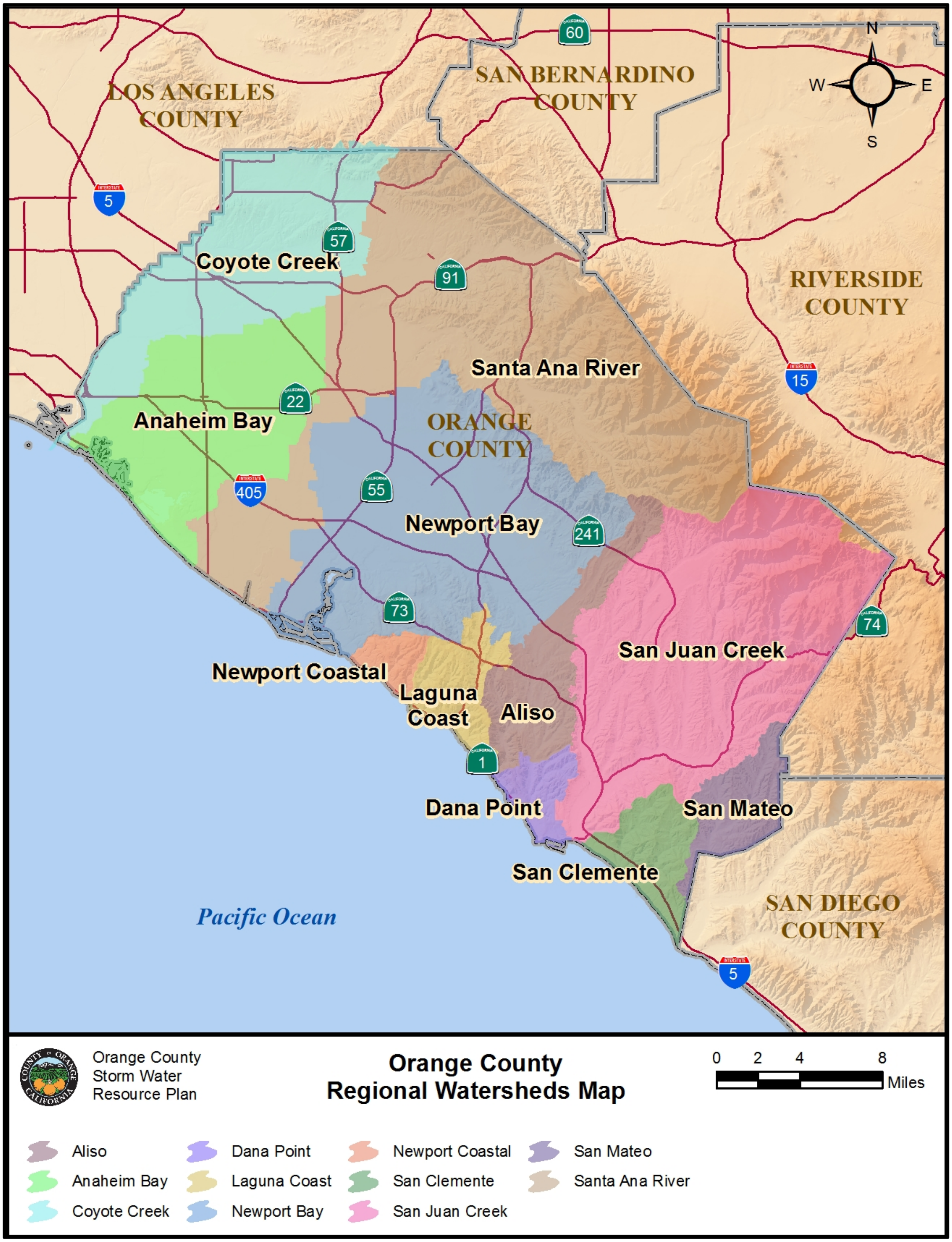



**Figure 1-1: Orange County Watersheds Represented in 2003 DAMP (OCPW 2003)**

## *1.2 Watershed Selection*

The watersheds and sub-watersheds described in **Section 1.1** are based upon Regional Water Quality Control Board Basin Plans for the SAR and SDR, USGS Hydrologic Units and OCFCD drainage facilities. As a result, the watersheds and sub-watersheds described are used for regulatory compliance and IRWM planning in Orange County and are appropriate for stormwater management with a multi-benefit approach. These watersheds are used and referenced in all relevant activities and documentation in this OC SWRP (**Section 7**). For reference, SAR and SDR Basin Plans can be found here and here, respectively.

The ROWDs used the watersheds established in **Section 1.1** to determine water quality priorities for all Orange County watershed areas. Further, the OC Stormwater Permittees and local stakeholders in the SDR have completed an analysis of water quality and other indicators of watershed health during development of the WQIP (OCPW 2016a, 2016b). This analysis has resulted in a prioritization of water quality concerns and associated strategies to address these concerns using a multi-benefit approach to improve water quality, reduce runoff, and promote infiltration (including groundwater recharge, where possible) and habitat restoration.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 3. Plan includes an explanation of why the watershed(s) and sub-watershed(s) are appropriate for stormwater management with a multiple-benefit watershed approach. |
| | *OC SWRP* ***Section 1.2*** *(p.1-4); Links to RWQCB Basin Plans here and here; OCPW 2012a Central IRWM Plan (Section 2, p.2-9 to 2-11); OCPW 2011b North IRWM Plan (Section 2, p.2-3); OCPW 2013d South IRWM Plan (Section 3, p.3-2); OCPW 2016a WQIP B.2 Report (Section 1, p.1-1 to 1-4. Appendix A, Figure A-1).* |

## *1.3 Internal Boundaries*

Orange County is a highly urbanized coastal municipal area. A large number of municipalities, agencies and stakeholders with interest in watershed management are internal to the boundaries of the County. Boundaries for County facilities, unincorporated areas, cities, water supply districts, wastewater agencies, and OCFCD have been defined for planning purposes. These boundaries can be found in GIS datasets through the OC SWRP Webpage for easy reference. Jurisdictional delineation layers found at the OC SWRP Webpage were provided by the Plan Agencies and have been used in the IRWM Plans (OCPW 2011b, 2012a, 2013d), WIHMP mapping (OCWD 2016c), the Orange County Groundwater Management Plan (OCWD 2015) and the San Juan Basin Facilities Management Plan (SJBA 2016).

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 4. Plan describes the internal boundaries within the watershed (boundaries of municipalities; service areas of individual water, wastewater, and land use agencies, including those not involved in the Plan; groundwater basin boundaries, etc.; preferably provided in a geographic information system shape file). |
| | *OC SWRP **Section 1.3** (p.1-4); Links to GIS datasets can be found at the OC SWRP Webpage.* |

## 1.4 Water Quality Priorities

Water quality priorities are integrated into all aspects of watershed management in Orange County. Both the SAR and SDR ROWDs (OCPW 2013b, 2014c) identify key constituents of concern based upon indices of water quality. The SAR and SDR ROWDs identify subject water bodies and summarize progress toward achieving water quality goals established by NPDES permit and TMDL requirements.

TMDL-impacted water bodies for the SDR are listed in Table 3-2 in Section 3.3.4.3 of the South Orange County IRWM Plan (OCPW 2013d). 303(d) listed water quality limited segments requiring TMDLs within the North Orange County WMA are listed in Table 3-3 in Section 3.6.2 of the North IRWM Plan (OCPW 2011b). The Newport Bay Watershed has a large number of TMDLs, which are listed in the Central Orange County IRWM Plan (Section 2.6, p.2-11 to 2-12) (OCPW 2012a). A complete list of TMDLs can be found at the website of the State Water Resources Control Board (SWRCB) by following this link.

The WQIP addresses the priorities identified in the ROWD by providing a GIS-based evaluation of the potential spatial relationships between water quality data collected from NPDES, TMDL and habitat-based monitoring, and the urbanized footprint within the watershed area. Non-priority and priority water quality conditions were identified through this evaluation process and are detailed in the WQIP B.2 report (pages 2-7 through 2-10). The highest priority water quality conditions identified by the WQIP (page 2-23) are summarized below.

- Pathogen Health Risk: Applies to beaches during dry and wet weather, where recreational use is high and there are persistent exceedances of fecal indicator bacteria standards (limited extent during dry weather and most beaches during wet weather);
- Unnatural Water Balance/Flow Regime: Applies to inland stream reaches during dry weather where there are ponded or flowing outfalls or other observed issues exacerbated by an unnatural water balance; and
- Channel erosion/Geomorphic Impacts: Applies to inland stream reaches during wet weather where degraded channel form has become a limiting factor in channel ecology.

Based upon historical monitoring and assessment of data, including the use of both water quality and biological indices, the SAR and SDR ROWDs present a set of similar conclusions. Although a new SAR Fifth Term Permit has not yet been adopted, the Permittees are moving forward with the development of WMPs, equivalent to the WQIP, for each of the principal north Orange County watersheds.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 5. Plan describes the water quality priorities within the watershed based on, at a minimum, applicable TMDLs and consideration of water body-pollutant combinations listed on the State's Clean Water Act Section 303(d) list of water quality limited segments (a.k.a impaired waters list). |
| | *OC SWRP **Section 1.4** (p.1-5); OCPW 2013c SAR ROWD (Sections 1-2, p.1.1-2.4.12 and Section 4, p.4.1-4.9); OCPW 2014c SDR ROWD (Sections 1-2, p.1.1-2.7.5 and Section 4, p.4.1-4.10); OCPW 2012a Central IRWM Plan (Section 2.6, p.2-11 to 2-12); OCPW 2011b North IRWM Plan (Section 3.6.2, p.3-14 to 3-15); OCPW 2013d South IRWM Plan (Section 3.3.4, p.3-31 to 3-53); SARWQCB website; OCPW 2016a WQIP B.2 (Section 2, p. 2-7 through 2-10 and 2-24) summarizes water quality priorities.* |

## *1.5 Surface and Groundwater Resources*

North and central Orange County overlay extensive and deep sediment basins deposited by the San Gabriel and Santa Ana Rivers, which have historically migrated across their alluvial plains and created large groundwater aquifers with high quality water. These aquifers have been a long time source of drinking water. The Orange County Water District (OCWD) has for decades managed the aquifer by diverting flow into large infiltration basins along the Santa Ana River and infiltrating treated water from the Orange County Sanitation District's treatment plants. The Santa Ana River basin in North Orange County is highly porous and deep compared to groundwater basins found in South Orange County. The San Juan Basin groundwater aquifer is the only basin of significance in the rugged terrain of South Orange County. Technically classified as an underground river, San Juan Basin is shallow and limited to the valley floor of San Juan Creek and its main tributaries. The San Juan Basin is a very limited source of water for South Orange County, not only due to its limited size, but also due to the presence of higher concentrations of salts (total dissolved solids) in the groundwater. **Figure 1-5** demarcates groundwater bodies in Orange County.

The IRWM Plans for the North, Central, and South Orange County WMAs recognize the interaction between surface water and groundwater in the region and guide collaborative efforts by regional stakeholders to address issues related to surface water and groundwater quality, water supply, flood risk management, habitat, and sustainability. The IRWM Plans present and prioritize multi-benefit projects that seek to restore and enhance water quality and specifically address the region's water supply needs (OCPW 2011b, 2012a, 2013d). The IRWM Plans accomplish this by proposing and targeting projects with multiple benefits, such as those that can improve surface and groundwater supply and quality, and ecosystem function. Similarly, the WQIP has identified strategies such as watercourse rehabilitation to reduce erosion and improve water quality, while also enhancing aquatic habitat. The WIHMP spatial analysis can be used to identify locations for such project sites. Together, the functionally equivalent plans work in concert to improve the quality of water and habitats while simultaneously expanding water supply.

Surface water bodies and associated pollutants are described in detail within both the SAR and SDR ROWDs (OCPW 2013b, 2014c) and the south Orange County WQIP (OCPW 2016a, OCPW 2016b). These documents provide long-term trend analysis, water quality and biological index scoring, and summarize general and specific water quality concerns.

In general, for inland creeks and channels, bacteria, dissolved solids, and nutrients are persistent water quality concerns. The prevalence of toxicity in waterbodies is somewhat higher in wet than in dry weather, but is not substantially above background conditions. Biological condition (i.e., bioassessment) is generally poor and is in the lower 50% of the distribution compared to other urban areas in southern California. For the coastal surfzone, nutrients and bacteria are mild to moderate issues in wet weather, with most bacteria issues due to a small number of persistent problem beaches. Elevated nutrient concentrations in wet weather are a concern because they may contribute to regional eutrophication in coastal estuaries and to harmful algal blooms along the coast.

Urban sources of pollution may enter groundwater through infiltration in streams, lakes, landscaping, or other urban open spaces. Shallow or perched groundwater can intrude or seep into surface water bodies and contribute diffuse sources of pollutants such as nutrients and dissolved solids that may have moved from upland sources, or have accumulated and/or migrated over historical time frames.

Surface and groundwater resources can also be found in the maps referenced in this OC SWRP, **Section 1.7**. GIS data pertaining to surface and groundwater resources can be accessed through the OC SWRP Webpage, and monitoring sites can be reviewed at the same location. Groundwater Basin descriptions and planning are included in the IRWM Plans for Central and South Orange County as well as the Orange County Groundwater Management Plan and San Juan Basin Facilities Management Plan.

**Table 4-1** of this OC SWRP ties together the water quality concerns identified in the functionally equivalent documents with the overarching watershed management objectives of the region. These OC SWRP Management Objectives form the basis of the quantifiable methods for project prioritization.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| | 6. Plan describes the general quality and identification of surface and ground water resources within the watershed (preferably provided in a geographic information system shape file). |
| ☒ | *OC SWRP* ***Section 1.5*** *(p.1-6); OCPW 2013c SAR ROWD (Section 2, p.2.1.1-2.5.1); OCPW 2014c SDR ROWD (Section 2, p.2.1.1-2.8.1), OCPW 2011b North IRWM Plan (Section 3, p.3-20 to 3-22); OCPW 2012a Central IRWM Plan (Section 3, p3-23 to 3-29); OCPW 2013d South IRWM Plan (Section 3.3, p.3-27 to 3-31); OCPW 2016a WQIP B.2 (Section 2, p.2-29 to 2-30); Links to GIS shapefiles and monitoring sites data in the OC SWRP Webpage. Links to OC Groundwater Management Plan and SJBA Facilities Management Plan.* |

## *1.6 Water Supply*

Orange County has fourteen water districts and seventeen cities providing potable water to its residents and businesses. All of these agencies purchase water through the Municipal Water District of Orange County (MWDOC) except for the cities of Anaheim, Fullerton, and Santa Ana which purchase directly from the Metropolitan Water District of Southern California (MWD). Total retail water demand for the member agencies' service areas for Fiscal Year 2014-2015 was 499,120 AF (MWDOC 2016). Additional data provided by MWDOC includes a summary of potable water demand for January 2014 – January 2015, including non-member agencies, by Regional Board area, and is found in Table 1-2 below. **Figure 1-2** illustrates the agency service area boundaries.

| Orange County Water Supply Region | Volume (AFY) |
|---|---|
| Santa Ana Regional Water Quality Control Board | **344,227** |
| San Diego Regional Water Quality Control Board | **195,339** |
| **TOTAL** | **539,566** |

**Table 1-2: Orange County Water Supply by Regional Board Area (Jan 2014 – Jan 2015).**

Enhancing regional water supply is one of the main objectives of the IRWM Plans for the three Orange County WMAs, and numerous water management plan strategies contribute to meeting that objective (OCPW 2011b, 2012a, 2013d). Although the region imports much of its water, local water sources are important to reduce dependence on imported water and improve water supply reliability. The feasibility of using local water supplies is affected by the quality of the local water sources. Poor water quality leads to higher water treatment costs and could result in water losses during processing if advanced treatment methods (e.g., membrane treatment) are used. Potential strategies listed in the WQIP can simultaneously target water quality improvement while providing infiltration for water supply augmentation. Similarly, a multi-benefit approach is highlighted in all three of Orange County's IRWM plans.

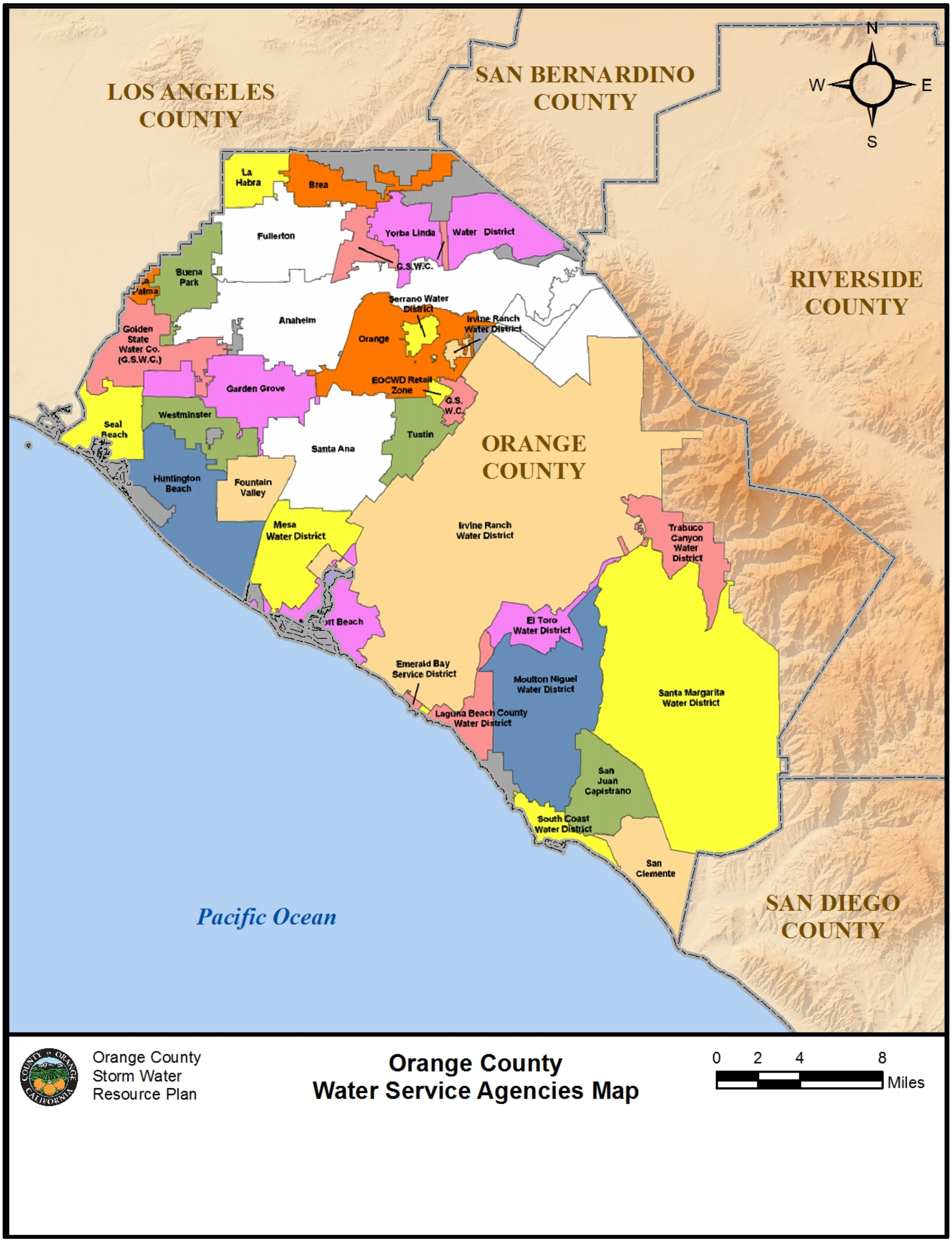



**Figure 1-2: Water Service Agency Boundaries (MWDOC 2016)**

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 7. Plan describes the local entity or entities that provide potable water supplies and the estimated volume of potable water provided by the water suppliers. |
| | *OC SWRP* ***Section 1.6*** *(p.1-8),* ***Table 1-2*** *(p.1-8),* ***Figure 1-2*** *(p.1-9); MWDOC 2015 UWMP (Section 2, p.2-5 to 2-7); GIS data of service area boundaries available at the OC SWRP Webpage.* |

## 1.7 Physical Features

Orange County is home to a diverse set of geographic features, from coastal beaches, to urbanized coastal plains, hills and valleys, as well as undeveloped canyon areas, mountains and open space. A series of maps on the following pages highlight some of those features including, special habitat areas (**Figure 1-3**), stream systems (**Figure 1-4**), and wilderness, recreational and open space areas (**Figure 1-6**). These features are highlighted in **Section 1.8**, and briefly described in the SAR and SDR ROWDs (OCPW 2013c, 2014c). GIS data for the figures is available at the OC SWRP Webpage. Habitat mapping information from the Central and Coastal Subregion Natural Community Conservation Plan/Habitat Conservation Plan was included with permission from the Natural Communities Coalition. The figures presented in this OC SWRP use data also included in the SAR and SDR ROWDs, WQIP and IRWM Plans.

Several wildlife conservation areas within the urbanized areas provide connectivity between the coastal areas and the mountains in the east (**Figure 1-6**). Non-native species of flora are found in these watersheds, but the most pervasive problems in natural areas are *Arundo donax,* which can quickly dominate riparian areas of the more natural bed streams, as well as *Cortaderia selloana* (aka pampas grass). Control efforts for both are coordinated locally and described in the IRWM Plans; see Section 2.6.1 of the South Orange County IRWM Plan as an example (OCPW 2013d).

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 8. Plan includes map(s) showing location of native habitats, creeks, lakes, rivers, parks, and other natural or open space within the sub-watershed boundaries. |
| | *OC SWRP* ***Section 1.7*** *(p.1-10),* ***Figure 1-3*** *(p.1-11),* ***Figure 1-4*** *(p.1-12),* ***Figure 1-6*** *(p.1-14),* ***Figure 1-7*** *(p.1-15); OCPW 2013d SAR ROWD (Section 1,p.1.5 to 1.13); OCPW 2014c SDR ROWD (Section 1, p.1.5 to 1.17); GIS data accessible at the OC SWRP Webpage.* |

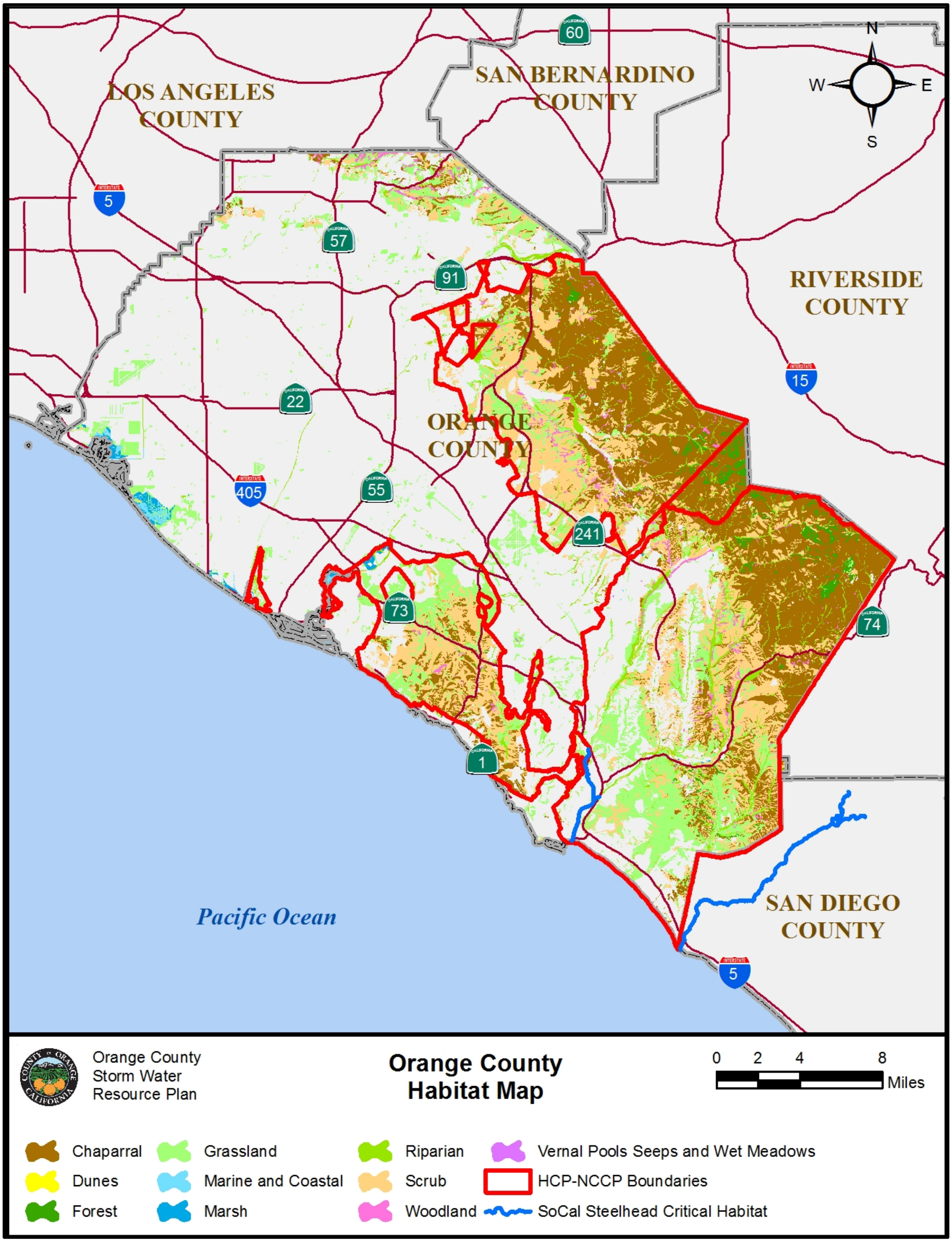



**Figure 1-3: Native habitats and NCCP boundaries (NCC 2013).**

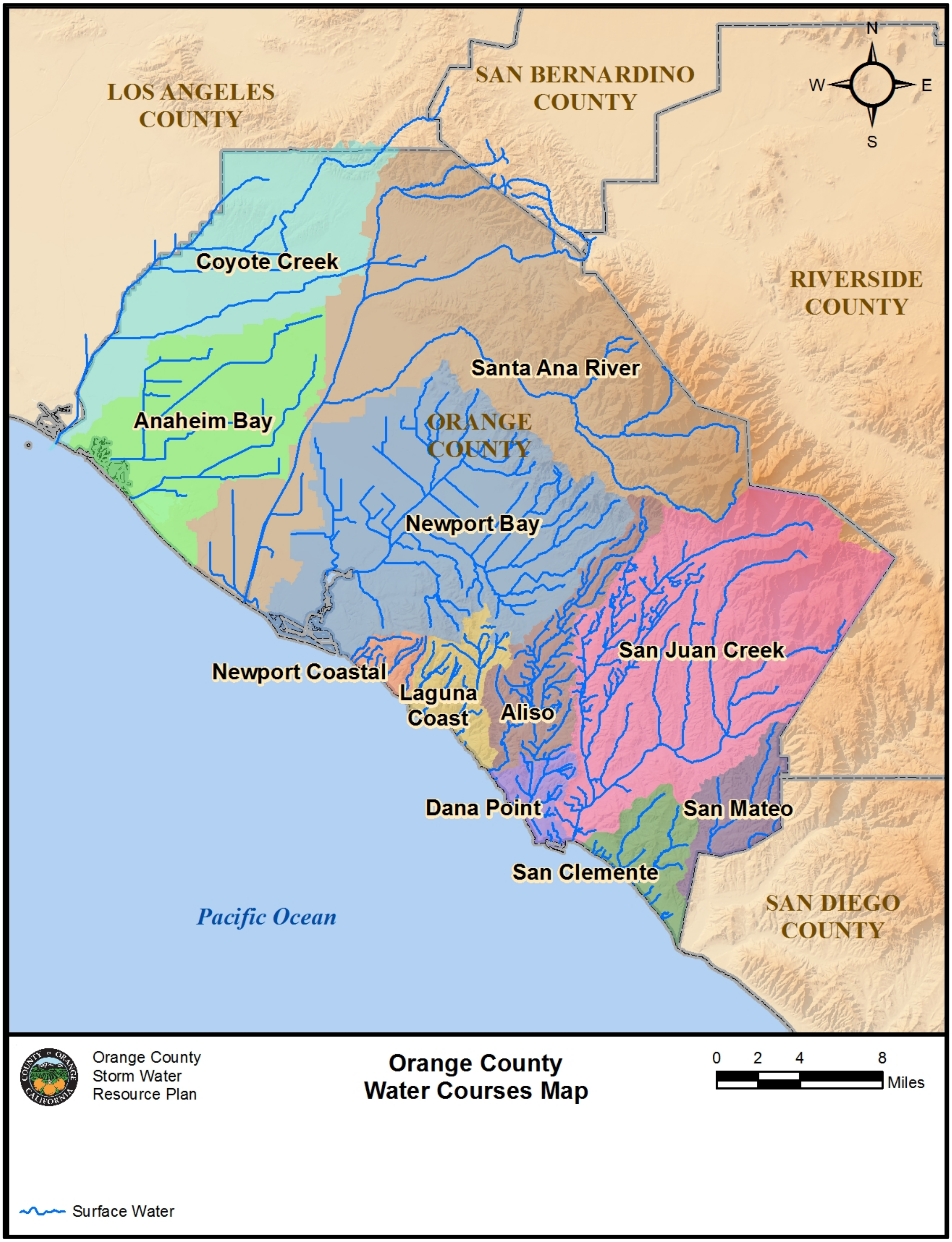



**Figure 1-4: Orange County Water Courses Delineated by Watershed (OCPW 2003)**


**Figure 1-5: Orange County Groundwater Resources (CA DWR 2016)**

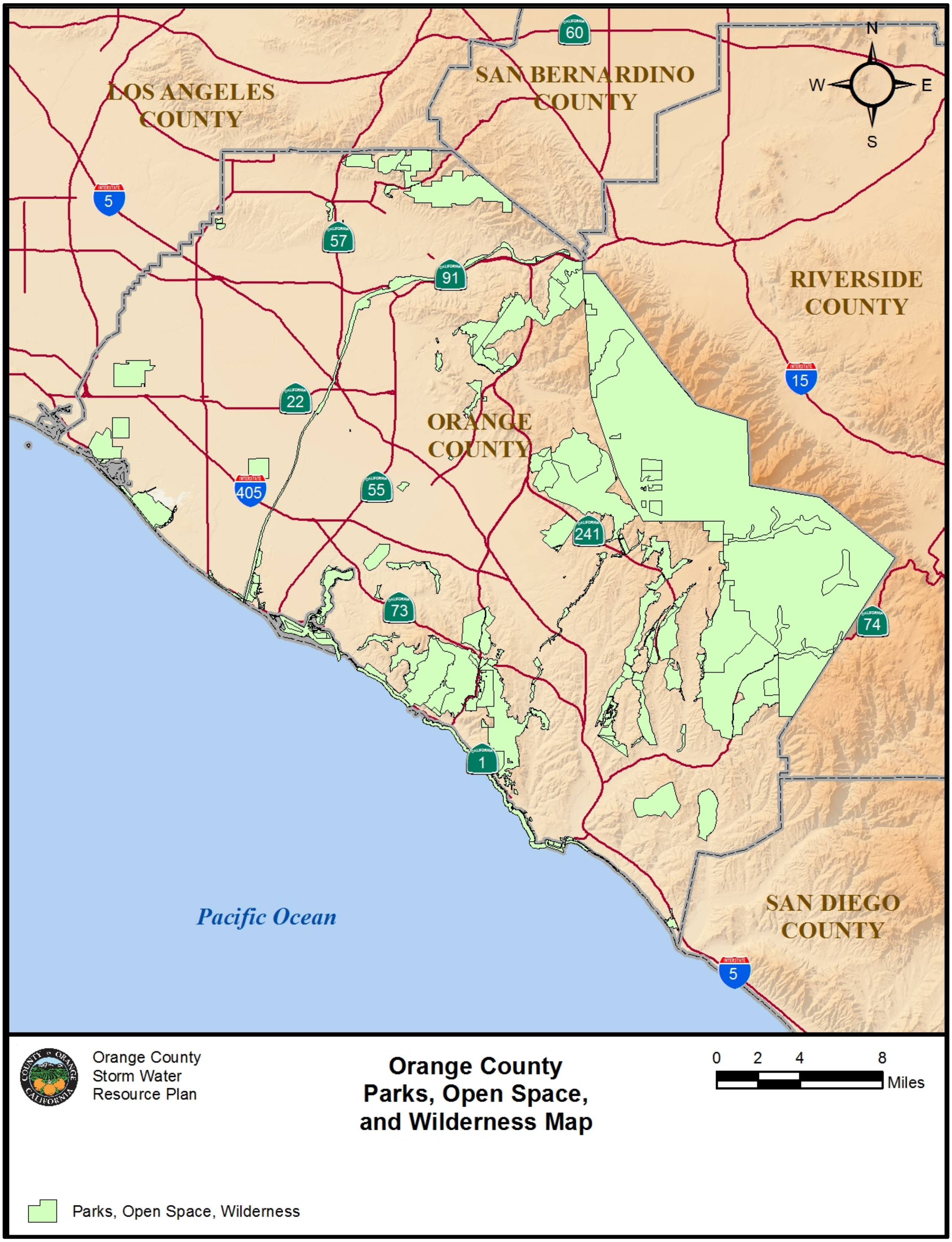



**Figure 1-6: Parks, Open Space, and Wilderness Areas (OCPW and OC Parks 2016)**

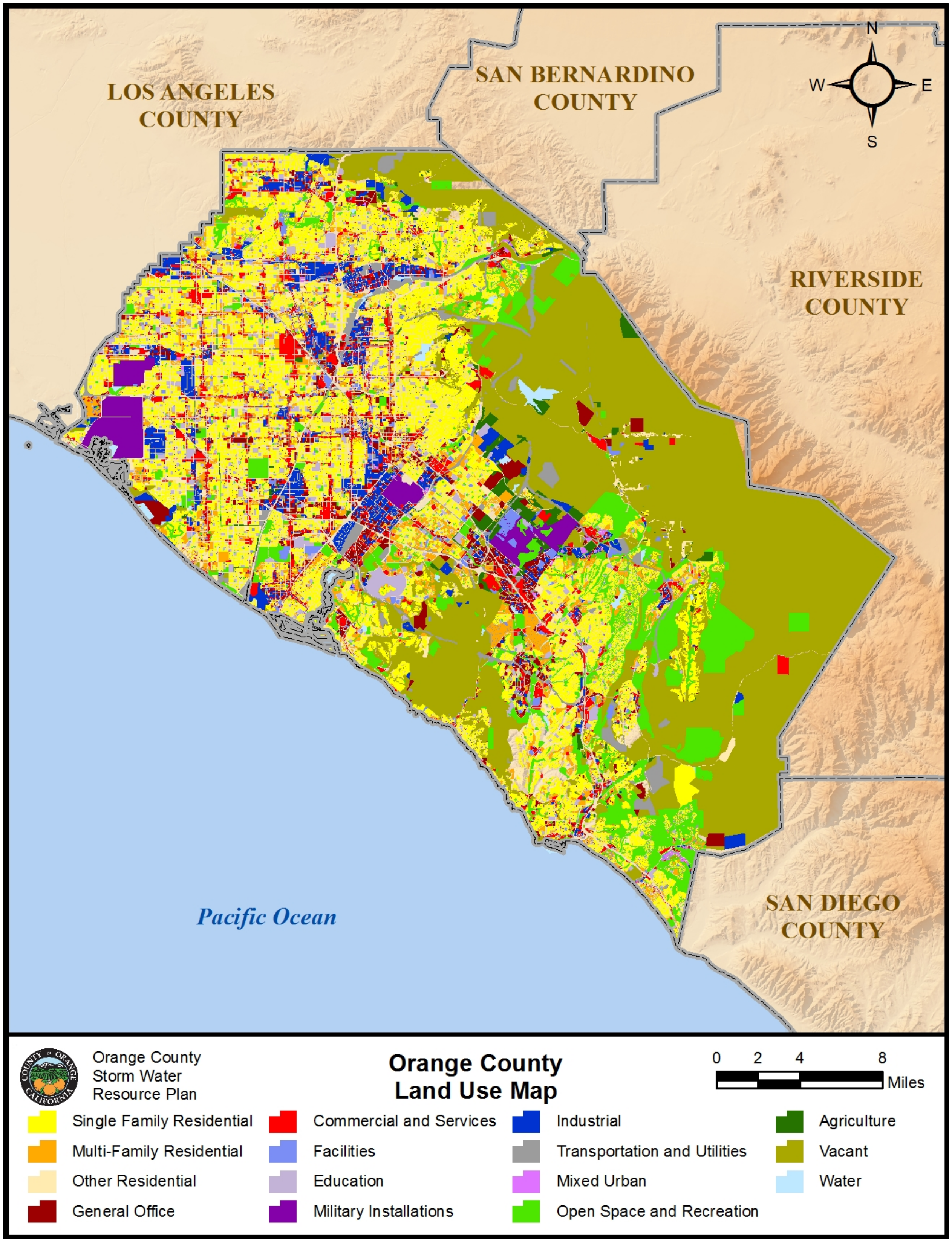



**Figure 1-7: Orange County Land Use as Represented in the WIHMP Analysis (OCPW 2013)**

### *1.8 Physiography, Features, Landscape*

Orange County is a densely urbanized jurisdictional area; the impacts of urbanization on watershed health and function are described in the SAR and SDR ROWDs and summarized below. For South Orange County, the WQIP uses the term "urban stream syndrome" to describe the combination of impacts that can arise from watershed urbanization and include modifications in stream form (i.e. channelization), increases in hydrologic loading primarily from increased imperviousness, dry weather nuisance water discharges, and/or increases in pollutant loads from urbanization (OCPW 2016a). These impacts may also include the establishment of non-native vegetation, which is detrimental to native Orange County ecosystems (OCPW 2011b, 2012a, 2013d). Similar impacts are documented for North and Central Orange County in the SAR ROWD (OCPW 2013c); combined, these are used here to represent the documented impacts of urbanization to Orange County waterways and natural systems. Requirements for new and re-development designed to lessen these impacts are addressed by the Model WQMP and associated TGDs, as well as HMPs further discussed in **Section 1** of this OC SWRP.

Through the functionally equivalent plans summarized in **Section i**, the OC SWRP addresses the impacts to creeks, rivers, streams and coastal waters that can arise from the imprint of urban development on the landscape. The environmental consequences of these impacts can be loss or impairment of aquatic beneficial uses due to:

- Water quality degradation from increased loadings of sediment, nutrients, metals hydrocarbons, pesticides, and bacteria;
- Stream channel instability and habitat loss from increased severity and frequency of runoff events;
- Loss of groundwater recharge; and
- Increased water temperatures from solar energy absorption by urban surfaces and elimination of riparian shading.

Mapping conducted for the WIHMPs and WQIP provide a clear picture of the impacts urbanization has had on natural watershed process within the County. These impacts are further quantified in the ROWDs and WQIP using water quality and biological indices. The WQIP includes multiple appendices that summarize data sources, technical documentation, and analytical methodologies used in the WQIP. For example, the WQIP describes how the spatial extent of hydromodification within the South Orange County WMA was assessed using a rapid aerial survey. Potentially susceptible channels were identified if they were located downstream of developed land and were not fully armored. Exhibit A-9 of Appendix C to the WQIP provides a visual of the geomorphic impacts related to biology, including major hydromodification impact areas identified from the rapid aerial survey (OCPW 2016a). Similar geospatial analyses will be conducted for the SAR WMPs upon adoption of the SAR Fifth Term NPDES Permit.

Urbanized low lying areas with engineered channels often funnel erosion from upstream foothills and natural channels that had previously been deposited in the valleys, directly to coastal bays and estuaries. Additional sediment may be introduced to systems through construction activities. Sediment monitoring and abatement are often required in flood control channels, but also in sensitive habitat areas such as bays where attached pollutants may affect aquatic biota. Monitoring and efforts that address sediment impacts are found in annual reports and summarized in the ROWDs. Evidence from a number of the OC Stormwater Program's monitoring efforts also supports the value of water conservation and reduced urban runoff in reducing pollutant inputs and impacts. Water conservation and related efforts to reduce urban runoff represent a potentially powerful all-around tool for addressing impacts of urban runoff (OCPW ROWDs 2013c, 2014c). The Plan Agencies have developed programming to encourage dry weather runoff reduction, including requirements for LID in new/significant re-development, the Overwatering Is Out coordinated outreach campaign and support for water use efficiency projects through IRWM programs. Projects that encourage beneficial use of stormwater and urban runoff and/or promote public involvement in solutions are further described in **Section 5**, and meet the goals of this OC SWRP.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 9. Plan identifies (quantitative, if possible) the natural watershed processes that occur within the sub-watershed and a description of how those natural watershed processes have been disrupted within the sub-watershed (e.g., high levels of imperviousness convert the watershed processes of infiltration and interflow to surface runoff increasing runoff volumes; development commonly covers natural surfaces and often introduces non-native vegetation, preventing the natural supply of sediment from reaching receiving waters). |
| | *OC SWRP **Section 1.8** (p.1-16); OCPW 2013 SAR ROWD 2013c (Section 1, p.1.2-1.3. Section 2, p.2.4.10 to ); OCPW 2014c SDR ROWD (Section 1, p.1.2); OCPW 2016a WQIP B.2 (Section 1, p.1-3 through 2-32, Appendix C); OCPW 2011b Central IRWM (Section 3, p.3-63 and 3-64); OCPW 2012a North IRWM (Section 3, p3-34 to 3-36); OCPW 2013d South IRWM (Section 2.6.1, p.2-10); OCPW 2016c WIHMPs (Mapping through OC SWRP Webpage); www.overwateringisout.org* |

# 2 WATER QUALITY COMPLIANCE

## *2.1 Contributors to Pollution of Runoff*

The Plan Agencies have documented pollutants in stormwater in a number of compliance-based reports and documents; examples include the SAR and SDR ROWDs (OCPW 2013c, 2014c), and the WQIP (OCPW 2016a, 2016b).

According to the SAR and SDR ROWDs (OCPW 2013c, 2014c), the constituents of concern in dry and wet weather runoff include bacteria, dissolved solids, nutrients, metals, and toxicity, primarily from pesticides. The contributors of these constituents include urban landscaping and gardening, construction, automobiles, and natural components. Other less common contributors include illicit discharges and sewage spills. Water quality issues are more widespread during wet weather. Regional monitoring has shown that nutrient enrichment not only impacts urban areas of the County, but also streams in undeveloped regions, increasing macro-algal cover and contributing to lower dissolved oxygen levels. Nutrient-laden stormwater discharges can also cause the growth of harmful algal blooms and have toxic effects in the coastal ocean. While major point sources of nutrients have been controlled, non-point sources such as leaching from upland soils and intrusions from shallow groundwater and are difficult to effectively address.

As discussed in **Section 1.4**, the WQIP (OCPW 2016a) describes priority water quality conditions (PWQCs) such as pollutants, stressors, and/or conditions that threaten or adversely affect receiving water quality. The PWQCs for the south Orange County WQIP (OCPW 2016a) include human health risk related to recreation, eutrophication, geomorphic impacts related to biology, and water quality conditions related to biology, as seen in the below table. The highest priority water quality conditions (HPWQCs) are a subset of these that take precedent and pose a greater risk for the associated watershed. The HPWQCs for the San Juan Hydrologic Unit, as seen in **Table 2-1**, include pathogen health risk, unnatural water balance/flow regime, and channel erosion/geomorphic impacts.

According to the WQIP (OCPW 2016b), sources that contribute to fecal indicator bacteria (FIB) within the MS4 include but are not limited to anthropogenic sources such as pet waste, human waste, and sewage leaks, and natural sources such as birds, wildlife, non-fecal environmental sources and resuspension from sediment and regrowth.

Imported or recycled water is a significant element of the current urban water balance and contributes to unnatural flow and quantity in stream systems. Imbalance of flow regimes in stream systems is considered one of the prime stressors associated with “urban stream syndrome”, which is described in **Section 1.8**. Unnatural MS4 dry weather inputs can have different chemistry and carry pollutants from urban land uses, contributing to both unnatural water balance and quality.

Severe erosion adversely affects the geomorphology of streams, altering the underlying physical forms of streams. In turn, these geomorphic alterations affect the physical habitat (channel geometry, substrate, vegetation) and hydraulic flow regimes of a channel. Because restoration of biological and beneficial uses in streams rely on stream form components such as physical habitat and hydraulic flow, channel erosion and geomorphological impacts was identified as a HPWQC.

| Condition | Temporal Extent | Geographic Extent |
|---|---|---|
| **Pathogen Health Risk** | Dry and Wet | Beaches<br><br>Where recreational use/high value and persistent exceedances of FIB standards (limited extent in dry; most beaches during wet) |
| **Unnatural Water Balance/Flow Regime** | Dry | Stream Reaches<br>• Reaches and outfalls demonstrated to be ponded or flowing in dry weather<br>• Areas with other observed issues exacerbated by unnatural water balance (e.g., low IBI, high eutrophication, high invasive species)<br>• Areas with highest intensity of recreational use/visibility |
| **Channel Erosion/ Geomorphologic Impacts** | Wet | Stream Reaches<br>• Where impacted<br>• Where degraded channel form has become limiting factor in channel ecology<br>• Areas with highest intensity of recreational use/visibility<br>• Where sediment or particulate-bound pollutants are contributing to downstream water quality impairment or complicating restoration efforts |

**Table 2-1: Highest Priority Water Quality Conditions for the San Juan Hydrologic Unit (OCPW 2016a)**

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 10. Plan identifies activities that generate or contribute to the pollution of stormwater or dry weather runoff, or that impair the effective beneficial use of stormwater or dry weather runoff.<br><br>*OC SWRP **Section 2.1** (p.2-1); OCPW 2013c SAR ROWD (Section 2, p.2.1.1 to 2.5.2); OCPW 2014c SDR ROWD (Section 2, p.2.1.1 to 2.7.5) and Section 3 (in full); OCPW 2016a WQIP B.2 (Section 2, p. 2-7 through 2-10 and 2-24) summarizes water quality priorities, OCPW 2016b WQIP B.3 (Section 2, p. 2-1, 2-32, and 2-59) identifies pollutant generating activities.* | 10562(d)(7) |

## *2.2 TMDL and NPDES Compliance*

Since 1990, operators of municipal separate storm sewer systems (MS4s) have been required to develop a stormwater management program designed to prevent harmful pollutants from impacting water resources. As MS4 operators, the County of Orange and Co-Permittee cities must comply with NPDES MS4 permits adopted by both the Santa Ana (SAR) and San Diego (SDR) Regional Water Quality Control Boards. The Orange County Stormwater Program is a cooperative of the County of Orange, OCFCD and all 34 cities within County boundaries. As the Principal Permittee on both the SAR and SDR NPDES MS4 permits, the County guides development and implementation of the Program, collaborating regularly with Permittees to ensure compliance and prevent pollution. All the cities within Orange County are individually responsible for permit implementation within its jurisdiction.

In May 2009, the Santa Ana Regional Water Board adopted the Fourth Term NPDES MS4 permit for the SAR, which was administratively extended and is currently active (SARWQCB Order No. R8-2009-0030 (CAS618030)). In the SAR, Orange County and applicable Permittees are also addressing a variety of TMDLs in Newport Bay (i.e., sediment, nutrients, toxics, and coliform) and Coyote Creek (i.e., lead, copper, and zinc).

In April 2015, the San Diego Regional Water Board adopted the Fifth Term NPDES MS4 Permit for the SDR (SDRWQCB Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 (CAS0109266)). This permit integrates the TMDLs established by the San Diego Regional Water Board including those for bacteria at Baby Beach in Dana Point, and for indicator bacteria along segments of the South Orange County Shoreline and lower reaches of Aliso Creek and San Juan Creek.

The SAR and SDR NPDES MS4 permits are issued for a five-year term and have generally followed a progressive pattern. The NPDES Permits require the submittal of an Annual Progress Report to the Regional Board and EPA. There are also annual reports to monitor water quality related to adopted TMDLs. These include the Aliso Creek TMDL Annual Report, Baby Beach TMDL Annual Progress Report, and the Newport Bay Nutrient, Sediment, Fecal Coliform TMDL Annual Reports. All of these reports can be found at the OC Watersheds Document Library here.

The functionally equivalent plans describe compliance with the NPDES permits and TMDLS.

### 2.2.1 Reports of Wastewater Discharge

The ROWDs present a compilation of data from the current and previous NPDES MS4 Permits and generally describes the Permittee's plans for future water quality improvement. Section 2 of the ROWDs provide an overview of the program in terms of dealing with pollutant sources (bacteria, nutrients, and toxicity, among others), as well as detailing progress, challenges, sources, monitoring methods, and recommendations. ROWD Section 3 details pollutant source categories and activities to control those sources mentioned in **Section 2.1**. ROWD Section 4 details watershed oriented programs to control pollutant sources. ROWD Sections 5 through 7 propose future planning, program management and financing, and make recommendations for adjustments to NPDES MS4 Permit provisions.

### 2.2.2 Water Quality Improvement Plan

The County and NPDES MS4 Permit Permittees located in the SDR have developed a WQIP to guide jurisdictional runoff management programs towards achieving the outcome of improved water quality in MS4 discharges and receiving waters. Through identification of HPWQCs; identification of water quality improvement goals, strategies, and schedules; and rigorous monitoring and assessment, the WQIP is ultimately intended to achieve water quality objectives and meet water quality based effluent limitations.

### 2.2.3 Water Quality Management Plans

Pursuant to the SAR and SDR NPDES MS4 Permits, the County and Permittees have developed Model WQMPs and associated TGDs for new and redevelopment projects. The Model WQMPs and TGDs define a set of guidelines for controlling post-construction runoff associated with new and redevelopment activities including implementation of LID and green infrastructure.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 11. Plan describes how it is consistent with and assists in, compliance with total maximum daily load implementation plans and applicable national pollutant discharge elimination system permits.<br>*OC SWRP **Section 2.2** (p.2-2); OCPW 2013c SAR ROWD (Executive Summary, p.i-iii); OCPW 2014c SDR ROWD (Executive Summary, p.i-vi); OCPW 2016a WQIP B.2 (Section 1, p. 1-1 to 1-2), OCPW 2016b WQIP B.3 (Executive Summary, p.vi); OCPW 2013e WQMP (Section 1 Introduction, p.1-1); OC Watersheds Document Library here (for other activities/reports).* | 10562(b)(5) |

## *2.3 Satisfaction of Applicable Waste Discharge Permit Requirements*

The primary waste discharge permit requirements applicable to the County of Orange are summarized in two NPDES MS4 Permit discussed in **Section 2.2**:

- SARWQCB Order No. R8-2009-0030 (CAS618030)
- SDRWQCB Order No. R9-2013-0001 as amended by R9-2015-0001 and R9-2015-0100 (CAS0109266)

The SAR and SDR ROWDs (OCPW 2013c, 2014c) describe how the County and Permittees comply with these NPDES permits and incorporated TMDLs. The 2014-15 OC Stormwater Program Unified Annual Report also outlines the permit history and current/recent permit renewal activities for Orange County (OCPW 2015g). The ROWDs summarize the Permittees' Fourth Term MS4 Permit compliance activities and accomplishments over the period June 2009 to June, 2013 to meet all applicable waste discharge permit requirements. The ROWDs also identify all of the activities, research and pilot studies the Permittees propose to undertake during the next permit term based upon a consideration of the effectiveness of the Program and need for additional pollutant control initiatives. The ROWD executive summaries list key findings or accomplishments on the effectiveness or "state of the environment" of the Permittees' programs, controlling pollutant sources, plan development, and program management and financing. The three key themes identified in the ROWD – planning, monitoring, and adaptive management, are carried on through the WQIP and will be carried through the WMPs subsequent to Fifth Term Permit adoption in the SAR. Rather than monitoring all constituents and potential issues, the WQIP focuses on priority areas and constituents by integrating data from a wider range of sources. The adaptive planning and management process under development in the WQIP (B.5 chapter) reflects the iterative assessment process in the ROWD and helps Permittees to accomplish their objectives. As the WQIP is further developed and annually assessed, the OC SWRP will be updated to reflect the adaptive management process and any programmatic changes made as a result of new data[3].

For South Orange County, the adoption of Permit Order R9-2013-0001 initiates a strategic, risk-based prioritization and outcome-driven approach centered on watershed-wide improvements through collaborative jurisdictional planning and implementation. The County and Permittees of the South Orange County WMA have identified within the WQIP the high priority water quality conditions of the SDR, and developed numeric goals, water quality improvement strategies, and schedules to address the identified HPWQCs. The goals, strategies, and schedules are consistent with interim and final goals established by TMDLs, the California Ocean Plan, and the SDR Basin Plan[4]. Along with numeric goals and strategies, the WQIP describes the strategies and methods that Permittees will use to monitor and assess the progress toward numeric goals and schedules, as well as the conditions of receiving waters and discharges from the MS4 under wet and dry weather conditions. Through focused, question-based assessments, the Permittees will be able to assess their progress toward and compliance with WDRs. The County has initiated WMPs similar in structure and purpose to the WQIP for the SAR; however, the WMPs will not be completed until adoption of the Fifth Term NPDES Permit. The WMPs will include an analogous approach to be identified and applied in the North and Central WMAs. Until adoption of the Fifth Term Permit for SAR, the analysis in the ROWDs suggests that the priorities in the WMPs will be similar to the WQIP. Once the WMPs are developed, the OC SWRP will be amended to include the WMP priorities and analyses; however, for now, the OC SWRP will utilize the ROWD findings and WQIP analyses for all of Orange County drawing on the similarities noted in the ROWDs for both regions.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 12. Plan identifies applicable permits and describes how it meets all applicable waste discharge permit requirements.<br>*OC SWRP **Section 2.3** (p.2-4); Regional Board links to permits here and here; OCPW 2013c ROWD (Executive Summary, p.i-iii); OCPW 2014c SDR ROWD (Executive Summary, p. i-vi) provide justification for how applicable requirements are met; OCPW 2016b WQIP B.3 (Section 2, p. 2-88 through 2-95) summarizes how the WQIP demonstrates compliance with the Prohibitions and Limitations Compliance Option* | 10562(b)(6) |

[3] The final WQIP will be completed in April 2017, and will include monitoring and assessment (WQIP Section B.4) and adaptive management (WQIP Section B.5) plans. Any adaptive management changes will be reflected in further updates to the WQIP.

[4] Provision B.3.c of the Permit constitutes compliance of waste discharge requirements outlined in Provision A.

# 3 ORGANIZATION, COORDINATION, COLLABORATION

Water resource management in Orange County occurs on both organizational and watershed levels. Collaboration amongst local stakeholders is encouraged in the planning of stormwater management and IRWM programs and projects. Additionally, implementation agreements, joint powers authorities and other similar arrangements provide mechanisms for agencies and stakeholders to coordinate and collaborate on organizational and shared-cost approaches.

## *3.1 Agency Consultation and Community Participation*

Agency consultation occurs with various stakeholders for development of programs associated with the functionally equivalent documents. **Table 3-1** identifies categories of entities involved with the functionally-equivalent documents required in this OC SWRP, related to water resource management within Orange County, and identifies with which aspects of the document processes the entities are involved. The compliance table below highlights how planning documentation is developed through a process that includes consultation with a wide range of stakeholders. Individual stakeholders are specifically identified in the ROWDs (OCPW 2013c, 2014c) and IRWM Plans (OCPW 2011b, 2012a, 2013d).

| Document & Involvement Processes | County & OCFCD | Cities | Wastewater / Water Districts | Non-Governmental Organizations | Other Government Bodies | The Public |
|---|---|---|---|---|---|---|
| **ROWD** | | | | | | |
| Implementation Agreement / Cost Sharing | X | X | | | | |
| Committees / Task Forces | X | X | X | X | X | |
| Monitoring | X | X | X | X | X | |
| Data/Plan Access & Review | X | X | X | X | X | X |
| **WQIP** | | | | | | |
| Plan Formulation | X | X | X | X | | X |
| Analysis | X | X | | | | |
| Workshops | X | X | X | X | X | X |
| Plan Access & Review | X | X | X | X | X | X |
| Monitoring and Assessment | X | X | | | | X |
| **IRWM Plans** | | | | | | |
| Implementation Agreement / Cost Sharing | X | X | X | X | | |
| Committees/Meetings | X | X | X | X | X | X |
| Workshops | X | X | X | X | X | X |
| Plan Access & Review | X | X | X | X | X | X |
| **WIHMP** | | | | | | |
| WIHMP / HMP Planning | X | X | | | | |
| Analysis | X | | | | | |
| Review/Access | X | X | X | X | X | X |

**Table 3-1: Involvement by Stakeholders in Functionally Equivalent Documents**

The Plan Agencies also strive to make data and public meeting information available to the public, other agencies, and nongovernmental stakeholders; this is a key aspect of public involvement in the OC SWRP functionally equivalent documents.

An Orange County water quality data portal has been developed for the public to view and download data from the County[5] and is accessible through the OC SWRP Webpage. Annual, quarterly and other water quality reports are made available to the public on a regular basis through the County's website[6] as well as via Plan Agency websites (e.g. San Juan Basin Authority Groundwater and Facilities Management Plan[7]) and Regional Board websites. Additional information on publicly accessible data, reports, and information can be found in **Section 4.3**, Data Management, as well as **Section 7**, Education, Outreach, and Public Participation.

Local stakeholders are also encouraged to participate in discussions about water quality at public meetings and workshops, including those open to the public via the Brown Act (sections 54950 et seq.). More information on public participation is provided in **Section 7**. Examples of public participation provided during development of the functionally equivalent documents include but is not limited to:

- **ROWDs**: the Orange County Stormwater Program held two public workshops in Fall 2013 and Spring 2014 to request feedback on the SAR and SDR ROWDs, respectively. These meetings provided a forum for local agencies to solicit feedback from the public on an assessment of water quality data over more than a decade, and the resultant prioritization of constituents of concern based on this analysis.
- **IRWM Plans**: All three plan development processes included solicitation of input from stakeholders. The South IRWM Plan has been updated most recently to comply with revised Proposition 84 Plan Standards (2013); the update process included a public stakeholder workshop and discussion at public Executive Committee meetings (held per Brown Act requirements for posting and transparency). All three plans are currently undergoing updates to comply with 2016 Proposition 1 Plan Standards. The North and Central IRWM Plans are currently being combined into one document, and stakeholder meetings are underway to solicit input on the process. Also, the South IRWM Plan project review and approval process for IRWM Grant funding includes a public stakeholder workshop for each round; this process is described in the IRWM Plan (reference included below and in **Appendix A**). Stakeholder involvement was also provided for in the North and Central IRWM Plans.

[5] OC SWRP Webpage (http://www.ocwatersheds.com/programs/ourws/oc_stormwater_resource_plan)
[6] http://ocwatersheds.com/documents
[7] http://www.sjbauthority.com/sjbgwmp.html

- **WQIP**: development of the WQIP has included two levels of public input in addition to agency collaboration throughout the South Orange County WMA. A WQIP Consultation Panel and the public workshops have been used to present WQIP information and solicit public comments. The Consultation Panel comprises representatives from non-governmental environmental groups, science-based organizations, and other agencies (see **Table 3-2**). All those who applied to participate on the panel were accepted. Public workshops have been held at key points in WQIP development and are further detailed in **Section 7**.

| | |
|---|---|
| South OC Economic Coalition | Ocean Institute |
| OC Taxpayers Association | South Coast Steelhead Coalition |
| Building Industry Association of Southern California | Reserve at Rancho Mission Viejo |
| Surfrider Foundation | South Coast Water District |

**Table 3-2: WQIP Consultation Panel Members**

In addition to the involvement summarized in **Table 3-1**, **Table 3-3** below identifies jurisdictions and their associated authorities or mandates that fall under the referenced functionally equivalent documents. Plan Agencies and other agencies, special districts and non-governmental groups have formed joint powers authorities, entered into implementation agreements and memorandums of understanding to develop shared-cost budgets and implement projects. These agreements assist implementation of programs and projects to meet water quality, groundwater management, IRWM and land development regulations in Orange County. **Table 3-3** summarizes the responsibilities, authorities and mandates for applicable OC SWRP groups to address the stormwater and dry weather runoff management objectives of the OC SWRP for all Orange County watersheds.

| Document & Associated Jurisdiction Authorities/Mandates | County & OC Flood | Cities | Wastewater Districts | Water Districts | Groundwater Authorities |
|---|---|---|---|---|---|
| **ROWDs** | | | | | |
| WDRs | X | X | X | X | X |
| General Plans | X | X | | | |
| TMDL Shared-Cost Agreements* | X | X | | X | |
| WQMPs / HMPs | X | X | | | |
| Water Quality Ordinance | X | X | | | |
| Implementation Agreements (NPDES) | X | X | | | |
| **WQIPs** | | | | | |
| WDRs | X | X | X | X | X |
| General Plans | X | X | | | |
| TMDL Shared-Cost Agreements* | X | X | | X | |
| WQMPs / HMPs | X | X | | | |
| Water Quality Ordinance | X | X | | | |
| Implementation Agreements (NPDES) | X | X | | | |
| **IRWM Plans** | | | | | |
| WDRs | X | X | X | X | X |
| Water Supply (e.g. SBX 7-7) | | | X | X | X |
| Flood Control | X | | | | |
| Natural Resource Projects** | X | X | | | |
| Groundwater Management*** | | | | X | X |

***For the Newport Bay Watershed, TMDL shared-cost partners include The Irvine Ranch, cities and water agencies; other TMDL shared-cost agreements (e.g. Aliso Creek Watershed for the Beaches and Creeks Indicator Bacteria TMDL) include the County/OCFCD and the cities.**

****Natural Resources are managed by the jurisdiction in which the resource resides; however, OC Parks (County of Orange) and the Natural Communities Coalition implement and review projects in the Nature Reserve of Orange County (NCCP) areas, respectively.**

*****Groundwater management mandates (e.g. Sustainable Groundwater Management Act requirements) are met through agreements with special district (Orange County Water District) or through Joint Powers Authority (San Juan Basin Authority).**

**Table 3-3: Jurisdictions and Associated Authorities/Mandates**

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 13. Local agencies and nongovernmental organizations were consulted in Plan development. (Appendix A, 13) | 10565(a) |
| | *OC SWRP **Sections 3.1 and 7.1** (p.3-1 and p.7-1), **Table 3-1** (p.3-1), **Table 3-2** (p.3-3); OCPW 2013c SAR ROWD (Sections 1 and 6, p.1.1 and 6.1 to 6.4); OCPW 2014c SDR ROWD (Sections 1 and 6, p.1.1 and 6.1 to 6.4); OCPW 2011b North IRWM Plan (Section 2, p.2-1 to 2-8, Section 11, p.11-1 to 11.4); OCPW 2012a Central IRWM Plan (Section 2, p.2-1 to 2-14, Section 11, p.11-1 to 11-4); OCPW 2013d South IRWM Plan (Section 2, p.2-1 to 2-28, Section 11, p.11-1 to 11-7); OCPW OC Environmental data through the OC SWRP Webpage GIS links; OC Watersheds Document Library here, and San Juan Basin Authority documents here.* | |
| ☒ | 14. Community participation was provided for in Plan development. (Appendix A, 14) | 10562(b)(4) |
| | *OC SWRP **Sections 3.1 and 7** (p.3-1 and p.7-1), **Table 3-1** (p.3-1), **Table 3-2** (p.3-3); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6); OCPW 2011b North IRWM Plan (Section 4, p.4-1); OCPW 2012a Central IRWM Plan (Section 4, p.4-1 to 4-2); OCPW 2013d South IRWM Plan (Section 2.5, p.2-5 to 2-6, Section 11, p.11-1 to 11-7); OCPW WQIP B.2 2016 Section 1 (p.1-4); OCPW OC Environmental data through the OC SWRP Webpage GIS links; OC Watersheds Document Library here.* | |
| ☒ | 16. Plan includes identification of and coordination with agencies and organizations (including, but not limited to public agencies, nonprofit organizations, and privately owned water utilities) that need to participate and implement their own authorities and mandates in order to address the stormwater and dry weather runoff management objectives of the Plan for the targeted watershed. (Appendix A, 16) | |
| | *OC SWRP **Sections 3.1** (p.3-1), **Table 3-3** (p.3-4); OCPW 2011b North IRWM Plan (Section 2, p.2-1 to 2-8); OCPW 2012a Central IRWM Plan (Section 2, p.2-1 to 2-14); OCPW 2013d South IRWM Plan (Section 2, p.2-1 to 2-28); OCPW 2013c SAR ROWD (Section 1, p.1.1); OCPW 2014c SDR ROWD (Section 1, p.1.1).* | |
| ☒ | 17. Plan includes identification of nonprofit organizations working on stormwater and dry weather resource planning or management in the watershed. (Appendix A, 17) | |
| | *OC SWRP **Sections 3.1** (p.3-1), **Table 3-2** (p.3-3); OCPW 2011b North IRWM Plan (Section 3, p.3-8 to 3-9); OCPW 2012a Central IRWM Plan (Section 7, p.7-1); OCPW 2013d South IRWM Plan (Section 2.3.3, p.2-14 to 2-15)* | |
| ☒ | 18. Plan includes identification and discussion of public engagement efforts and community participation in Plan development. (Appendix A, 18) | |
| | *OC SWRP **Sections 3.1 and 7** (p.3-1 and p.7-1); OCPW 2011b North IRWM Plan (Section 11, p.11-1 to 11-6); OCPW 2012a Central IRWM Plan (Section 11, p.11-1); OCPW 2013d South IRWM Plan (Section 2.5 and 11 (p.2-5 to 2-6 and 11-1 to 11-8); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6).* | |

## *3.2 IRWM Groups*

IRWM areas and associated plans were developed in response to Regional Water Management Planning Act of 2002, subsequently replaced by SBX2-1 in 2008. Orange County has eleven major watersheds delineated for water resource management as discussed in **Sections 1.1 and 1.2**. All eleven watersheds are further organized into three WMAs, for which individual IRWM Plans have been developed. The North WMA includes San Gabriel/Coyote Creek, Santa Ana River, and Anaheim Bay-Huntington Harbor watersheds. The Central WMA includes Newport Bay and Newport Coastal Streams watersheds. The South WMA includes Laguna Coastal Streams, Aliso Creek, Dana Point Coastal Streams, San Juan Creek, San Clemente Coastal Streams and San Mateo Creek.

The North and Central IRWM Plans were not submitted to the State through the Regional Acceptance Process; the watershed stakeholders joined the Santa Ana River Watershed Project Authority (SAWPA) – One Water, One Watershed (OWOW) IRWM Plan in 2014. Local IRWM Plans for North and Central Orange County WMAs are recognized in the larger OWOW IRWM Plan. As the local IRWM Plans for North and Central Orange County WMAs describe local project planning and watershed priorities specific to Orange County waterways, these are used as the primary references for this OC SWRP instead of the OWOW plan. Indeed, the local IRWM Plans provide linkage to the other locally developed functionally equivalent plans.

Alternatively, the South IRWM Plan was submitted and accepted through the Regional Acceptance Process in 2006 and is an active stand-alone IRWM Region within the San Diego Funding Area. Project lists associated with the local IRWM Plans are maintained on an as-needed basis to assist local projects in receiving funding through both State and local grant programs (e.g. Orange County Transportation Authority Measure M Tier 1 & 2 Grants). Project prioritization methodologies are described in each IRWM Plan.

As further described in **Section 7.1** of the OC SWRP, all three IRWM Plans for Orange County are currently being updated to meet the 2016 IRWM Planning Standards for Proposition 1 (the North and Central IRWM Plans are being combined into one document). As the plans are finalized, any necessary resultant modifications to the OC SWRP to align with these documents will be included.

<table>
<tr><th colspan="2">Stormwater Resource Plan Checklist and Self-Certification: Appendix A</th></tr>
<tr><td rowspan="2">☒</td><td>15. Plan includes description of the existing integrated regional water management group(s) implementing an integrated regional water management plan. (Appendix A, 15)</td></tr>
<tr><td>OC SWRP Sections 3.2 and 7.1 (p.3-6 and p.7-1); OCPW 2011b North IRWM Plan (Sections 2 and 6, p.2-1 to 2-8, p. 6.1-6.5); OCPW 2012a Central IRWM Plan (Sections 2 and 6, p.2-1 to 2-14, p 6.1-6.8); OCPW 2013d South IRWM Plan (Sections 2 and 6, p.2-1 to 2-46, p. 6.1 – 6.21); SAWPA 2014 OWOW (Section 2.1, p.1-4).</td></tr>
</table>

## *3.3 Required Decisions for Plan Implementation*

Governance structures currently exist to support OC SWRP implementation of prioritized projects within the region. Water quality projects developed to assist with NPDES MS4 permit compliance will be implemented at the jurisdictional level and assessed as part of an NPDES program effectiveness assessment that uses performance metrics to gauge the success of program activities. Assessments and recommendations for future direction or necessary decisions are detailed throughout the ROWDs. Permit compliance-related projects will be supported by the OC Stormwater Program via the 2002 Implementation Agreement or TMDL specific implementation agreements (e.g. Newport Bay Sediment TMDL). WQIP strategy implementation, monitoring and assessment results, and progress towards achieving water quality improvement goals and milestones will be documented annually. Regional monitoring, visualization, and data analysis completed for NPDES, TMDL, and WQIP programs implemented by the County on behalf of the permittees and TMDL partners (as described in the implementation agreements) can be used to quantify the effectiveness of prioritized projects and determine if projects should be altered or additional projects added to meet the goals of the OC SWRP. These data can also be used to assess projects based on changing priorities, if necessary.

For water quality and/or stormwater capture projects implemented by agencies not party to existing implementation agreements, the implementing organization will provide updated information to be included in iterative revisions to the OC SWRP, as necessary. Decisions regarding which projects are prioritized for other regional planning efforts that take into account and/or address water supply, flood control, and natural resources (e.g. IRWM) are described in the applicable planning documents (e.g. IRWM Plans).

OC SWRP project solicitation and prioritization are based upon processes included in the functionally equivalent documents for which the Plan Agencies have established the necessary decision-making processes. The County will maintain continuous open solicitation for OC SWRP projects, and those submitted will be automatically prioritized per the discussion in **Section 5**. Project proponents will maintain responsibility for the determination of project identification, as discussed in **Section 5**, and whether to move forward with a project based upon individual funding and timeline limitations.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 19. Plan includes identification of required decisions that must be made by local, state or federal regulatory agencies for Plan implementation and coordinated watershed-based or regional monitoring and visualization. (Appendix A, 19) |
| | *OC SWRP **Sections 3.3** (p.3-7); OCPW 2013c SAR ROWD (Sections 2-7, Assessment/Accomplishments and Recommendations subsections, p.2.2.13, 2.3.11, 2.4.11, 3.2.2, 3.3.4, 3.4.5, 3.5.4, 3.6.9, 3.7.9, 4.9, 5.5, 6.5, and 7.2); OCPW 2014c SDR ROWD (Sections 2-7, Assessment/Accomplishments and Recommendations subsections, p.2.3.13, 2.4.7, 2.5.10, 2.6.12, 3.2.8, 3.3.6, 3.4.2, 3.5.1, 3.6.1, 3.7.1, 4.10, 5.4, 6.1, and 7.2); OCPW 2011b North IRWM Plan (Section 2.3 and 2.4, p.2-4 to 2-5); OCPW 2012a Central IRWM Plan (Section 2.3, p.2-6 to 2-9); OCPW 2013d South IRWM Plan (Section 2.2, p.2-2 to 2-9); OCPW 2016a WQIP B.2 (Section 1, p. 1-1 through 1-4)* |

### *3.4 Functionally Equivalent Document Coordination & Plan Implementation*

The functionally equivalent documents have governance structures in place that exhibit the coordination and structures necessary to implement this OC SWRP. The ROWDs apply under the NPDES Implementation Agreement signed by the County of Orange and Permittees. The County of Orange acts and coordinates as the administrator of the program which is funded through cost sharing agreements. Decisions and coordination are conducted within that framework. Similarly, the IRWM Plans contain cooperative agreements and MOUs as well as governance structures for making decisions and sharing costs for plan implementation, where applicable. Most of the signatories to these agreements and MOUs participate in the ROWDs, IRWM Plans, and WQIP, and in doing so regularly coordinate their activities. As such, the OC SWRP will not require any alterations to existing governance structures.

The functionally equivalent document relationships to each other are exemplified in **Figure i-1**. The ROWDs summarize and communicate long-term data and assessment that inform the WQIP and other planning processes. The geospatial analyses performed as part of the WIHMP provided additional input into the WQIP analysis and ultimately strategy implementation. Finally, the IRWM Plans provide a focus on multiple benefits and local priorities when projects that address priorities identified in the WQIP and ROWDs move forward. Each of these components plays an integral role in the OC SWRP.

Isolated project efforts that are undertaken by individual agencies that provide all the development, funding, and project implementation, and that do not require outside jurisdiction support, are appropriate for this OC SWRP regardless of the stakeholder involved. If the benefits only accrue to that stakeholder, they are still captured by the intent of and utilizing the resources of the functionally equivalent documents which encompass any project that targets priorities that accrue to the watershed area as a whole.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 20. Plan describes planning and coordination of existing local governmental agencies, including where necessary new or altered governance structures to support collaboration among two or more lead local agencies responsible for plan implementation. (Appendix A, 20) |
| | *OC SWRP **Section 3** (p.3-1) and subsections and **Figure i-1 (p.i-4)** for coordination and governance structures review; OCPW North IRWM Plan 2011, Section 2 (inclusive); OCPW Central IRWM Plan 2012, Section 2 (inclusive); OCPW South IRWM Plan 2013, Section 2 (inclusive); OCPW DAMP 2003, Section 2 (inclusive); No altered or new governance structures are needed to support plan implementation at this time.* |
| ☒ | 21. Plan describes the relationship of the Plan to other existing planning documents, ordinances, and programs established by local agencies. (Appendix A, 21) |
| | *OC SWRP **Section 3.4** (p.3-8); The OC SWRP is a functionally equivalent collection of numerous program planning documents, including the ROWDs, WQIP, WIHMP, and IRWM planning. See OC SWRP **Figure i-1** (p.i-4) which highlights the structural relationship of the aforementioned planning documents and their relationship to each other and the OC SWRP.* |

| | |
|---|---|
| ☒ | 22. (If applicable) Plan explains why individual agency participation in various isolated efforts is appropriate. (Appendix A, 22) |
| | *OC SWRP* ***Section 3.4*** *(p.3-8); As the OC SWRP is a functionally equivalent collection of NPDES, TMDL and IRWM planning documents, jurisdictional or agency/organization-specific projects will not be isolated from regional planning for compliance purposes.* |

# 4 QUANTITATIVE METHODS

## *4.1 Metrics-based Analysis*

Extensive local planning at the jurisdiction, agency and regional levels has provided metrics based analyses to identify projects throughout Orange County that will provide potential solutions to priority water quality issues (see **Section 1.4**). Water resource goals and priorities as expressed in IRWM Plans and ROWDs were considered in the WQIP and its analyses for the SDR[8]. County and associated Permittees conducted a quantitative analysis in the WQIP to identify priorities, demonstrating that the implementation of selected water quality improvement strategies will achieve final numeric goals within a specified timeframe. The WQIP analyses included a public participation process which allowed the public to review and provide comments on the methodology used and the assumptions included in the analysis. Going forward, the analysis will be updated as part of the iterative approach and adaptive management process inherent to the WQIP. This analysis, in conjunction with the assessments and recommendations in the ROWDs, and the regional goals set forth in the IRWMs, provides the analytical background for project proponents to move forward to target the priorities identified through projects that they formulate based on local needs and priorities, and regulatory or physical constraints.

The highest priority water quality conditions in the WQIP and the four primary IRWM goals of the South IRWM Plan (which align with the North and Central IRWM Plan) are summarized below. Additional considerations for determining local water priorities are based upon State-driven resource planning (e.g. the San Diego Regional Water Board's Practical Vision).

The HPWQCs identified in the WQIP are:

- <u>Pathogen Health Risk</u>: Applies to beaches during dry and wet weather, where recreational use is high and there are persistent exceedances of fecal indicator bacteria standards (limited extent during dry weather and most beaches during wet weather);
- <u>Unnatural Water Balance/Flow Regime</u>: Applies to inland stream reaches during dry weather where there are ponded or flowing outfalls or other observed issues exacerbated by an unnatural water balance; and
- <u>Channel erosion/Geomorphic Impacts</u>: Applies to inland stream reaches during wet weather where degraded channel form has become a limiting factor in channel ecology.

[8] A similar geospatial and index-based analysis will be conducted for the SAR, pending approval of the fifth term NPDES permit. Based upon the 2013/2014 ROWDs, results of the WMPs will likely be similar to the priorities established in the WQIP. For the OC SWRP, the WQIP will serve as the model goal-based guidance for stormwater management; goals will be adjusted as needed once the SAR WMPs are completed.

The South Orange County WMA Goals[9] are to:

- Improve water quality;
- Increase water supply, reliability, and efficiency;
- Improve flood management; and
- Protect natural resources.

Management Objectives for the OC SWRP consider WQIP, IRWM and State goals and can be summarized as:

| OC SWRP Management Objectives | Project Objectives |
|---|---|
| **Improve Water Quality** | ▪ Address NPDES and TMDL constituents of concern through non-point source control<br>▪ Increase infiltration and/or treatment of runoff to address WQIP priorities – indicator bacteria and/or nutrients<br>▪ Decrease or eliminate dry weather flows to reduce conveyance of pollutants to receiving waters and bacterial regrowth |
| **Increase Water Supply Reliability & Efficiency** | ▪ Address unnatural water balance from urbanization through water conservation<br>▪ Creation of new water supply through beneficial use of stormwater<br>▪ Enhancing local water supply reliability through groundwater recharge |
| **Improve Flood Management** | ▪ Address channel erosion and geomorphic impacts from flood events<br>▪ Decrease flood risk by reducing peak flow (i.e. control system flashiness) |
| **Protect and Enhance Natural Resources & Community Benefits** | ▪ Habitat protection or enhancement<br>▪ Erosion control to re-establish riparian habitat<br>▪ Sediment and flow control to return to a more natural condition<br>▪ Public education and outreach<br>▪ Provision of new or enhancement of existing urban recreational use areas |

**Table 4-1: OC SWRP Management Objectives**

The OC SWRP Management Objectives closely align with the benefit categories expressed in the Storm Water Resource Plan Guidelines (SWRCB 2015). The main and secondary benefits identified in Table 4 of the Guidelines are included in **Table 4-2** on the following page for

[9] The South Orange County IRWM Plan utilizes the same goals as the North and Central local IRWM Plans; however, the South Orange County IRWM Plan is currently being updated to merge the goals of increasing water supply reliability and maximizing water use efficiency; the merged goal is utilized here.

reference and have been used in this OC SWRP to recognize, identify and align local priorities and Storm Water Grant Program goals, where possible. The benefits from the Guidelines align with Orange County stakeholder regional strategies to achieve these same benefits as found in Sections 4 and 5 of all three IRWM Plans. The methodology used to prioritize projects is further described in **Section 5** of this OC SWRP.

Project proponents utilize a wide variety of metrics in their project solutions to target the HPWQCs and IRWM goals identified previously, and these and other factors are used by this OC SWRP to prioritize projects that will best achieve the Management Objectives. Each project is evaluated to determine which main benefit(s) and secondary benefit(s) are achieved by the project, and the quantifiable metric results each project provides. Projects go through review processes found in the IRWM Plans (Section 6, p.6-1 to 6-7), where projects are submitted, reviewed, and prioritized, based upon quantified benefit metrics, and finally evaluated for contribution to statewide priorities and integration into regional strategies. This IRWM process is used as a model for this Plan and is detailed further in **Section 5.1**.

| Benefit Category | Main Benefits | Secondary Benefits |
|---|---|---|
| Water Quality | Increase filtration and/or treatment of runoff | Nonpoint source pollution control |
| | | Reestablished natural water drainage and treatment |
| Water Supply | Water supply reliability | Water conservation |
| | Conjunctive Use | |
| Flood Management | Decreased flood risk by reducing runoff rate and/or volume | Reduced sanitary sewer outflows |
| Environmental | Environmental and habitat protection and improvement | Reduced energy use, greenhouse gas emissions, or provision of a carbon sink |
| | Increased urban green space | Reestablishment of the natural hydrograph |
| | | Water temperature improvements |
| Community | Employment opportunities provided | Community involvement |
| | | Enhance and/or create recreational and public use areas |
| | Public Education | |

**Table 4-2: Stormwater Management Benefits**

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 23. Plan includes an integrated metrics-based analysis to demonstrate that the Plan's proposed stormwater and dry weather capture projects and programs will satisfy the Plan's identified water management objectives and multiple benefits. |
| | *OC SWRP **Sections 1.8, 4.1, 4.2.1, 5.1.1** (p. 1-16, 4-1, 4-5, and 5-3); SWRCB 2015 (SWRP Guidelines-Section 4.C, p.22-23); OCPW 2011b North IRWM Plan (Sections 4-5, p.4-1 to 5-9); OCPW 2012a Central IRWM Plan (Sections 4-5, p.4-1 to 5-9); OCPW 2013d South IRWM Plan (Sections 4-6, p.4-1 to 5-48 and 6-1 to 6-8); OCPW 2016a WQIP B.2 (Section 2, p. 2-1 through 2-33); OCPW 2016c WIHMP (Mapping* |

| | |
|---|---|
| | *through OC SWRP Webpage)* |

## *4.2 Project Analysis*

The OC SWRP is maintained by the County of Orange (County) on behalf of the Plan Agencies. Organizations wishing to have projects included in the OC SWRP and considered for State Bond funding, submitted project descriptions and justification of benefits to the County. A total of 20 projects were received, assessed, and prioritized. All projects submitted to the County for inclusion on the project list were prioritized according to the same criteria; no projects were excluded from the list for prioritization. The project assessment methodology is similar to the IRWM project review process template; therefore it was familiar to stakeholders. The following section provides a summary of the benefits targeted by 20 projects incorporated into the OC SWRP. The information provided by project proponents was used in the project prioritization process; projects that both meet local Management Objectives and are best prepared to move forward gain higher priority.

Project information used through the identification and prioritization process included:

- **Basic Project Information:**
  - Applicant Organization Contact
  - General Project Information
  - Project Type and Benefits Claimed (See **Table 4-2**)

- **Project Readiness:**
  - Percent Design Complete (i.e. what percent of design will need to be done before bidding the project and going to construction)
  - Confirmation of Requisite Funding Match (established by Proposition 1)
  - Verification of Potential Benefits to Disadvantaged Communities (DACs), if Applicable
  - Environmental Permitting Status
  - Expected Project Start and Completion Dates

- **Quantification of Benefits**
  - Benefit Metrics (with supporting documentation)
  - Useful Project Lifespan
  - Measurement Tools and Methods for Benefit(s) Claimed
  - Description of how Quantified Benefits Address Local Priorities (Management Objectives and IRWM Plan Objectives)

All projects are broken down by type and summarized in the following sub-sections. A project benefits matrix is found in **Table 4-3.** Benefits provided by all of the projects included in the OC SWRP are summarized in **Table 4-3** and **Table 4-4** to demonstrate how the collective projects will benefit Orange County watersheds. For projects in the process of calculating benefit metrics, **Table 4-4** includes "TBD" – this information will be updated as the project proponents provide revised information. These tables showcase the benefits provided to Orange County watersheds through the execution of multi-benefit stormwater capture, water supply, flood management, environmental and community-based projects.

| | Targeted Benefits | Flood Management | Water Quality | Water Supply | Community / Environmental |
|---|---|---|---|---|---|
| Primary Benefits | Conjunctive use | - | - | 3 | - |
| | Decreased flood risk by reducing runoff rate and/or volume | 8 | - | - | - |
| | Employment Opportunities provided | - | - | - | 0 |
| | Environmental and Habitat protection and improvement | - | - | - | 6 |
| | Increased filtration and/or treatment of runoff | - | 15 | - | - |
| | Increased urban green space | - | - | - | 1 |
| | Public Education | - | - | - | 0 |
| | Water Supply Reliability | - | - | 9 | - |
| Secondary Benefits | (s) Nonpoint source pollution control | - | 6 | - | - |
| | (s) Community Involvement | - | - | - | 1 |
| | (s) Enhance and/or create recreational and public use areas | - | - | - | 4 |
| | (s) Reduce Sanitary Sewer Outflows | - | 0 | - | - |
| | (s) Reduced energy use, greenhouse gas emissions or provides a carbon sink | - | - | - | 0 |
| | (s) Re-established natural water drainage and treatment | - | 5 | - | - |
| | (s) Re-establishment of the natural hydrograph | 0 | - | - | 0 |
| | (s) Water conservation | - | - | 2 | - |
| | (s) Water temperature improvements | - | - | - | - |

**Table 4-3: Identified OC SWRP Benefits**

### 4.2.1 Water Quality Projects

The highest priority water quality conditions are generally summarized in the SAR and SDR ROWDs and WQIP. WQIP priorities were determined by evaluating applicable data and assessments for environmental significance and spatial extent. The first step was to evaluate water quality data using a combination of index-based water quality scoring systems. This evaluation was consistent with validated approaches used in a handful of similar efforts, including the SAR and SDR ROWDs, as well as for water quality assessments conducted by the Central Coast Regional Water Quality Control Board and the Ventura Countywide Stormwater Quality Management Program. The second step was to use a GIS-based approach to visualize the spatial relationships and extents of measured water quality data. GIS tools were used to propagate water quality data or scores from discrete monitoring points moving upstream along stream reaches. A GIS-based approach was also employed to aggregate properties from the portions of the watershed tributary to each reach segment to display metrics related to cumulative upstream stressors. This analysis also focused attention on areas where dry weather flow reduction should be targeted, providing a metrics-based site location screening for project proponents developing projects. Projects that target TMDL priorities in the ROWDs in high priority areas identified by the WQIP create the solutions necessary to assist achievement of compliance.

Management objectives targeted by these water quality projects include:

- Address NPDES and TMDL constituents of concern through non-point source control;
- Increase infiltration and/or treatment of runoff to address WQIP priorities – indicator bacteria and/or nutrients; and
- Decrease or eliminate dry weather flows to reduce conveyance of pollutants to receiving waters and bacterial regrowth.

Project scoring, described further in **Section 5.8**, asks proponents to indicate which of these OC SWRP management objectives, regional priorities, and metrics the project is expected to target and achieve. Of the 20 projects listed in this OC SWRP, the vast majority have primary and/or secondary benefits that improve water quality. The total number of Water Quality related projects is shown in **Table 4-3. Table 4-4** summarizes the expected treatment rates as provided by the project proponents targeting the region's highest water quality priorities detailed previously in **Section 4.1**.

### 4.2.2 Stormwater Capture and Use Projects

Stormwater capture and use projects are a regional priority included in all IRWM Plans in order to increase groundwater water supply, local supply reliability, and efficient use of stormwater runoff. These projects are especially important when they can also provide other benefits such as water quality improvement in receiving waters. Project sites are favored when they correspond with areas prioritized by the WQIP for capture, infiltration, and/or treatment or those identified via WIHMP mapping as ideal for infiltration.

Management objectives targeted by these stormwater projects include:

- Address unnatural water balance from urbanization through water conservation;
- Creation of new water supply through beneficial use of stormwater; and
- Enhancing local water supply reliability through groundwater recharge.

Project scoring, described further in **Section 5.8**, asks proponents to indicate which of these OC SWRP management objectives, regional priorities, and metrics the project is expected to target and achieve. Stormwater capture and use is considered a priority of this OC SWRP; aligning with this regional priority, 14 of the 20 projects listed in this OC SWRP have primary and/or secondary benefits that capture and reuse stormwater. The number of Stormwater Capture related projects are included in **Table 4-3. Table 4-4** quantifies the expected captured volumes provided by the project proponents targeting the region's IRWM water supply goals.

#### 4.2.3 Water Supply and Flood Management Projects

As discussed in the previous section, water supply is a regional priority outlined in the IRWM Plans. However, flood control is also an important priority of the Plan Agencies given the significant urbanization of the County. These two goals can be targeted separately, or in tandem, and/or with other benefits such as water capture, or pollution control. Where WQIP analyses identify locations to potentially capture and infiltrate water as a pollution control measure, or to minimize geomorphic instability that adversely impacts water quality, water supply and flood management can align.

Management objectives targeted by these water supply or flood protection projects include:

- Address channel erosion and geomorphic impacts from flood events; and
- Decrease flood risk by reducing peak flow (i.e. control system flashiness).

Project scoring, described further in **Section 5.8**, asks proponents to indicate which of these OC SWRP management objectives, regional priorities, and metrics the project is expected to target and achieve. In keeping with the goal of multiple benefit stormwater projects, five water supply and flood management projects also provide stormwater capture and use benefits. Projects that provide water supply, flood management and water quality benefit assist the region in meeting both water quality (including unnatural water balance) and water reliability goals. The number of Stormwater Capture projects is totaled in **Table 4-3. Table 4-4** summarizes the expected diversion, capture rates, or protected area for these projects targeting the region's IRWM water supply and flood protection goals.

#### 4.2.4 Environmental and Community Benefit Projects

The WQIP is rooted in a function-based framework for stream restoration which is inclusive of the conventional physiochemical elements of water quality as well as the aquatic and riparian biota that is part of the more holistic definition of water quality. As such, the WQIP has identified highest priority water quality conditions which will not only improve water quality, but also directly improve aquatic, riparian and upland habitat. The SAR and SDR ROWDs consolidate, summarize, and track beach water quality assessments including threat to human health, and the IRWM Plans seek to bring benefits to the environment and community in the form of habitat restoration integrated with community benefits (e.g., walking trails with interpretive signs). These project benefits can be integrated into multi-benefit projects emphasized by the IRWM Plans.

Management objectives targeted by these community and environment oriented projects include:

- Habitat protection or enhancement;
- Erosion control to re-establish riparian habitat;
- Sediment and flow control to return to a more natural condition;

- Public education and outreach; and
- Provision of new or enhancement of existing urban recreational use areas.

Project scoring, described further in **Section 5.8**, asks proponents to indicate which of these OC SWRP management objectives, regional priorities, and metrics the project is expected to target and achieve. Of the 20 projects listed in this OC SWRP, 12 have primary and/or secondary benefits that improve or protect habitat, and/or enhance public areas or community involvement. These projects restore, protect, and/or provide public access by targeting the aforementioned management objectives. The number of Environmental / Community Benefit related projects is totaled in **Table 4-3. Table 4-4** summarizes the quantified benefits, such as acres restored or lengths/distances improved, achieved by these projects targeting the region's IRWM natural resource protection and enhancement objectives.

| Project Name | Agency | Benefit 1 | Value | Units for benefit 1 | Benefit 2 | Value | Units for benefit 2 | Benefit 3 | Value | Units for benefit 3 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Green Infrastructure and Low Impact Development Improvement Project** | California State University, Fullerton | Conjunctive use | TBD | TBD | (s) Re-established natural water drainage and treatment | TBD | TBD | Decreased flood risk by reducing runoff rate and/or volume | 270 | cfs / 2-yr Storm |
| **Ball Road and Western Avenue Storm Drain** | City of Anaheim | Decreased flood risk by reducing runoff rate and/or volume | 279 | AFY Diverted | Water Supply Reliability | 304 | AFY | Increased filtration and/or treatment of runoff | 128,000 | MPN / 100ml |
| **Brookhurst Bio-Swales** | City of Anaheim | Increased filtration and/or treatment of runoff | 50 | reduction % copper, lead, nickel | Decreased flood risk by reducing runoff rate and/or volume | 53 | AFY Diverted | Increased urban green space | TBD | # of Bioswales |
| **La Palma & Richfield Storm Drain Extension and Stormwater Infiltration** | City of Anaheim | Increased filtration and/or treatment of runoff | 128,000 | MPN / 100ml | Water Supply Reliability | 74 | AFY | Decreased flood risk by reducing runoff rate and/or volume | 49 | AFY Diverted |
| **Modjeska Park Underground Stormwater Detention and Infiltration System** | City of Anaheim | Increased filtration and/or treatment of runoff | 0.13 / 128,000 | lbs ammonia/ 128,000 MPN / 100ml | Water Supply Reliability | 182 | AFY Diverted | Decreased flood risk by reducing runoff rate and/or volume | 182 | AFY Diverted |
| **Lower San Juan Creek LO1SO2 Nuisance Water Management Project** | City of Dana Point | Increased filtration and/or treatment of runoff | TBD | TBD | (s) Nonpoint source pollution control | TBD | TBD | (s) Enhance and/or create recreational and public use areas | TBD | TBD |
| **Bluebird Canyon and Diversion Structure** | City of Laguna Beach | Water Supply Reliability | 13 | AFY | (s) Nonpoint source pollution control | 6.5% / 93% | Bacteria reduced ocean/pt zero | Environmental and Habitat protection and improvement | TBD | People visiting site |
| **Presidential Heights Stormwater Reuse Project** | City of San Clemente | Water Supply Reliability | 15.5 | AFY | (s) Nonpoint source pollution control | 24 / 31 | lbs lead / lbs PAH | Environmental and Habitat protection and improvement | 17.4 | acres urban flow diverted |
| **OC Coastkeeper SmartScape** | OC Coastkeeper | Water Supply Reliability | 8.38 | AFY Captured | (s) Nonpoint source pollution control | 8.38 | AFY Captured | (s) Enhance and/or create recreational and public use areas | 2.29 | acres |
| **East Bluff Erosion Repair** | OC Parks | Increased filtration and/or treatment of runoff | TBD | TBD | (s) Re-established natural water drainage and treatment | TBD | TBD | Environmental and Habitat protection and improvement | TBD | TBD |
| **Irivne Regional Park Stormwater runoff quality and quantity control** | OC Parks | Increased filtration and/or treatment of runoff | TBD | TBD | Decreased flood risk by reducing runoff rate and/or volume | TBD | TBD | (s) Re-established natural water drainage and treatment | TBD | TBD |
| **Talbert Regional Park Habitat enhancement** | OC Parks | Increased filtration and/or treatment of runoff | TBD | TBD | Water Supply Reliability | TBD | TBD | Environmental and Habitat protection and improvement | TBD | TBD |
| **Water Quality Improvement and Development of Class 1 Bikeway along a segment of Coyote Creek** | OC Parks | Increased filtration and/or treatment of runoff | TBD | TBD | Environmental and Habitat protection and improvement | TBD | TBD | (s) Enhance and/or create recreational and public use areas | TBD | TBD |
| **Hutton Center and Angels Park Stormwater Capture and Use Project** | OC Public Works | (s) Water conservation | 1 | AFY | Increased filtration and/or treatment of runoff | 55000 | gal | (s) Enhance and/or create recreational and public use areas | 3000 | Sq. Ft |
| **Placentia and Raymond Basins Improvement Project** | Orange County Water District | Conjunctive use | 1,050 | AFY | Decreased flood risk by reducing runoff rate and/or volume | 1,050 | AFY Diverted | Increased filtration and/or treatment of runoff | 1,000,000 | mgd diverted |
| **San Juan Groundwater Basin Recharge, Stormwater Capture and Reuse Project** | Santa Margarita Water District | Water Supply Reliability | 1,600 | AFY | Increased filtration and/or treatment of runoff | 52 | lbs/yr | Conjunctive use | 2,000 | AFY |
| **JCR Project** | City of Lake Forest | (s) Water conservation | TBD | TBD | (s) Nonpoint source pollution control | TBD | TBD | Increased filtration and/or treatment of runoff | TBD | TBD |
| **Trabuco Road Water Conservation and Pollution Abatement Project** | City of Mission Viejo | Water Supply Reliability | TBD | TBD | (s) Nonpoint source pollution control | TBD | TBD | Increased filtration and/or treatment of runoff | TBD | TBD |
| **Bristol Street Improvement and Widening** | City of Santa Ana | Increased filtration and/or treatment of runoff | TBD | TBD | (s) Re-established natural water drainage and treatment | TBD | TBD | Decreased flood risk by reducing runoff rate and/or volume | TBD | TBD |
| **Fullerton Creek Restoration project** | OC Parks/City of Brea | Environmental and Habitat protection and improvement | 1.75 | acres restored | (s) Re-established natural water drainage and treatment | 25 | % dry flow reduced | (s) Community Involvement | 25 | community events |

**Table 4-4: Summary of OC SWRP Project Benefits**

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 24. For water quality project analysis (section VI.C.2.a)<br><br>Plan includes an analysis of how each project and program complies with or is consistent with an applicable NPDES permit. The analysis should simulate the proposed watershed-based outcomes using modeling, calculations, pollutant mass balances, water volume balances, and/or other methods of analysis.<br><br>Describes how each project or program will contribute to the preservation, restoration, or enhancement of watershed processes (as described in Guidelines section VI.C.2.a) |
| | *OC SWRP **Section 4.1** and **4.2.1** (p.4-1 and 4-5) of this OC SWRP summarizes the WQIP Analysis conducted that provides the priorities and goals for projects are targeting; OCPW 2016a WQIP B.2 (Section 2, p. 2-1 through 2-18); Adherence to targeting WQIP highest priority concerns will contribute the preserving, restoring, and/or enhancing watershed processes; OC SWRP **Table 4-4** (p.4-9) lists Projects and their details with any expected treated volumes calculated or expressed in appropriate units (AFY or MGD), and pollutant load reductions expressed in accordance with pollutant being addressed (e.g. mg/L, CFU).* |
| ☒ | 25. For stormwater capture and use project analysis (section VI.C.2.b):<br><br>Plan includes an analysis of how collectively the projects and programs in the watershed will capture and use the proposed amount of stormwater and dry weather runoff. |
| | *OC SWRP **Section 4.2.2** (p.4-6) highlights IRWM goals to improve stormwater capture and increase water supply, its reliability, and use efficiency, as well as how these goals overlap with WQIP proposed strategies that these projects are targeting; OCPW 2011b North IRWM Plan (Sections 4.3, p.4-4); OCPW 2012a Central IRWM Plan (Sections 4.4.1 and 4.4.3, p.4-6 to 4-7); OCPW 2013d South IRWM Plan (Sections 4.3.1, and 4.3.3 to 4.3.4, p.4-15 and 4-24 to 4-27); OCPW 2016a WQIP B.2 (Section 2, p. 2-25 through 2-33). OC SWRP **Table 4-4** (p.4-9) lists Projects and their details with any expected captured volumes to be calculated or expressed in appropriate units (AFY or MGD) for reuse.* |
| ☒ | 26. For water supply and flood management project analysis (section VI.C.2.c):<br><br>Plan includes an analysis of how each project and program will maximize and/or augment water supply. |
| | *OC SWRP **Section 4.2.3** (p.4-7) highlights IRWM goals to increase water supply, its reliability, and use efficiency as well as enhancing flood protection. These goals overlap with WQIP proposed strategies, forming multi-benefit synergies these projects target; OCPW 2011b North IRWM Plan (Sections 4.3, p.4-4); OCPW 2012a Central IRWM Plan (Sections 4.4.1 and 4.4.3, p.4-6 to 4-7); OCPW 2013d South IRWM Plan (Sections 4.3.1 and 4.3.3, p.4-15 and 4-24); OCPW 2016a WQIP B.2 (Section 2, p. 2-25 through 2-33); OC SWRP **Table 4-4** (p.4-9) lists Projects and their details with any expected volumes created, offset, or diverted to be calculated or expressed in appropriate units (AFY or MGD), and/or areas managed or protected from flooding to be calculated or expressed in appropriate units (acres or stream miles).* |

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 27. For environmental and community benefit analysis (section VI.C.2.d):<br><br>Plan includes a narrative of how each project and program will benefit the environment and/or community, with some type of quantitative measurement. |
| | *OC SWRP **Section 4.2.4** (p.4-7) highlights IRWM goals to protect natural resources and how these projects addressing high priority areas identified in the WQIP, as well as WQIP identified strategies, can work in concert to benefit the environment and/or the community. OCPW 2011b North IRWM Plan (Sections 4.3, p.4-4); OCPW 2012a Central IRWM Plan (Sections 4.4.4 and 4.4.5, p.4-7); OCPW 2013d South IRWM Plan (Sections 4.3.5, p.4-31); OCPW 2016a WQIP B.2 (Section 2, p. 2-25 through 2-33); OC SWRP **Table 4-4** (p.4-9) lists Projects and their details with any expected environmental and/or community benefits to be expressed or calculated by area (e.g. acres), distance (e.g. stream/street miles), flow augmentation (e.g. cfs) or reduced energy usage (e.g. kilowatt hours).* |

## 4.3 Data Management

Water management data has been and continues to be collected by multiple organizations throughout the region (e.g., permitted dischargers, non-governmental organizations (NGOs), research institutions, and government agencies) to:

- Define existing conditions;
- Help develop water management objectives;
- Evaluate project and overall OC SWRP effectiveness;
- Provide a tool for IRWM planning and decision making; and
- Provide a means of sharing information with state agencies, stakeholders, and the general public.

The following types of data are collected:

- Surface water quality;
- Surface flow;
- Groundwater quality and quantity;
- Stormwater runoff volume, flow, and quality;
- Water use; and
- Habitat integrity.

Monitoring programs have been in place since 1990 for compliance with NPDES requirements (some programs even longer); these programs and the data collected are managed by the County on behalf of the OC Stormwater Program Permittees and TMDL partners. Monitoring plans have been developed for both the SAR and SDR watershed areas and are available online; these describe procedures for determining site locations, assessment and iterative review of sites and data collection/analysis methodologies (OCPW 2003 DAMP, Section 11). Additionally, a WQIP Monitoring and Assessment Program is currently being developed that describes the strategies and methods that Permittees will use to monitor and assess progress of the strategies defined in the WQIP, and the conditions of receiving waters and discharges from the

MS4 under wet weather and dry weather conditions. This Monitoring and Assessment Program will be completed by April 1, 2017, and will provide extensive descriptions of monitoring programs to track success with targeting the HPWQCs over time. Technical information and data sets are also obtained from the extensive planning and technical studies that have been conducted for Orange County watersheds; data obtained by the County on behalf of the Permittees (for NPDES and TMDL programs) is included in a County-administered GIS database accessible through the OC SWRP Webpage, which was used for development of the WQIP.

Projects implemented through the OC SWRP are supported by monitoring conducted by the project proponents and by the County, when requested. Some projects included on the OC SWRP project list used existing water quality data from routine NPDES or TMDL monitoring programs to design the project; follow-up monitoring will then be provided by a continuation of that monitoring program. Water quality data storage and quality assurance/quality control (QA/QC) is currently managed through a proprietary database managed by the County and made available to the OC SWRP Stakeholders and the public through the OC SWRP Webpage. Project proponents will track post-project results and coordinate with the County to upload those data to the portal for access by the public.

The IRWM planning process helps to provide a regional focus, prevent duplicating data efforts, and provide access to plans, data, and information useful for water-related planning and management. Entities implementing projects are responsible for collecting, storing, performing QA/QC review, analyzing, reporting in compatible formats, and disseminating the data. The County and IRWM groups will assist with consistency, management, and dissemination of the data to support regional decision making, stakeholder interests, and public education and involvement. The data management system for the OC SWRP is modeled primarily on the South IRWM Plan and WQIP data management processes.

#### 4.3.1 Data Storage and Management

The responsibility of maintaining and managing this data is typically the responsibility of the entity collecting it. Primary data management functions will continue to reside with the primary data collectors (data owners). The data owners are responsible for the collection, storage, QA/QC, analysis, reporting in compatible formats, and dissemination of the data to any data bases already receiving their data. Data owners are responsible for ensuring that the data disseminated to the existing state databases, including California Environmental Data Exchange Network (CEDEN), Groundwater Ambient Monitoring and Assessment (GAMA), and other RWQCB programs, is in a format compatible with those databases.

The County works with stakeholders to implement a consistent QA/QC program for data collection and analysis, avoid data redundancy, work to fill data gaps, and ensure data comparability. Projects implemented through the OC SWRP functionally equivalent documents will also utilize Orange County GIS data through the OC SWRP Webpage, where possible.

All data related to development, update, implementation, monitoring, and assessment of the WQIP will be stored in a Regional Clearinghouse administered by the County here.

### 4.3.2 Data Access by Stakeholders and Public

As previously described, water quality data storage and QA/QC is currently managed through GIS data viewers and links at the OC SWRP Webpage. Additional reports and interactive maps are available at the OC Watersheds website through this link. Per the previous section, the WQIP regional "clearinghouse" data will be available to the public here. Examples of data to be made available on the County's website include: project location and/or footprints; real time, and verified and validated data sets; project information; annual reports; OC SWRP updates; etc. All information will be posted in user-friendly electronic formats accessible to the general public. Other relevant information will be made available on the website such as related web links and stakeholder and agency contact information. Other monitoring websites will be identified and utilized as appropriate during implementation of the OC SWRP. Some of these tools are currently under development through the WQIP development and IRWM Plan updates. Additionally, the combining of the North and Central IRWM Plans will lead to greater data access by stakeholders and other interested parties.

The County of Orange, through these online portals, supports efforts to share collected data with other interested parties including local, state, and federal agencies by providing transparency of information and consistency of data. The data formats will be compatible with state data management programs to provide widespread access to the general public.

### 4.3.3 Assessment of Existing Water Quality and Water Quality Monitoring

The WQIP Monitoring and Assessment Program[10] describes the methods that the County and Permittees will use to assess monitoring data. The Permittees will regularly assess its progress toward achieving the WQIP goals and schedules, including addressing the HPWQCs. This will be accomplished by evaluating monitoring data, as well as information collected by individual Permittees via their JRMPs. Six primary assessments and their associated timeframes are summarized in **Table 4-5**. Based on the findings of the assessments, the WQIP Monitoring and Assessment Program will be regularly updated. Updates will close data gaps, refine monitoring methods, revise monitoring locations and frequency of sampling, and incorporate new or enhanced predictive tools. Ultimately, all Monitoring and Assessment Program updates will be determined based on opportunities for Permittees to better assess its progress toward achieving the WQIP goals and schedules.

| | |
|---|---|
| **Annual** | HPWQC Assessments |
| | Receiving Water Assessments |
| | MS4 Outfall Assessments |
| | TMDL Assessments |
| | Special Study Assessments |
| **5-Year Permit Term** | Integrated Assessment |

**Table 4-5: WQIP Assessment Process**

[10] The WQIP Monitoring and Assessment Programs will be part of the B.4 chapter report that is currently under development and scheduled for submittal by April 1, 2017.

### 4.3.4 Data Update Frequency

The WQIP and associated monitoring, assessment, and reporting, will be updated iteratively pursuant to the adaptive management approach currently being incorporated into the WQIP. Adaptation of priority water quality conditions will be performed as necessary. Adaptation of water quality improvement goals, strategies and schedules, and the monitoring and assessment program included in the WQIP will be performed as new information becomes available that results in more effective and efficient measures to address the highest priority water quality. Though WMPs are under development for the SAR, the current MS4 NPDES Permit requirements and data management procedures apply until the Fifth Term Permit is adopted. Data will be collected via the monitoring programs discussed in the Monitoring Plan (**Section 4.3**, pg. 4-11) and reported annually.

Data associated with IRWM objectives will be updated as provided by the project proponents. The IRWM Plans are currently being updated to meet Proposition 1 requirements, including the addition of a data management system that will align the aforementioned GIS data portal with project-specific data from the IRWM Plans. The OC SWRP will be updated to reflect this change, once the plans are finalized.

### 4.3.5 Data Gap Identification

Both annual and 5-year integrated assessments will be performed by the County and Permittees. Both types of assessments are summarized within the WQIP Monitoring and Assessment Program (see footnote 10). Through the assessment of monitoring data, data gaps that prevent more effective evaluation of priority water quality conditions or more effective and efficient implementation of water quality improvement strategies, will be identified. As data gaps are identified, they will be documented and reported within Annual Reports. Annual reporting in the SAR follows data management procedures that currently apply under the current MS4 NPDES Permit requirements until the Fifth Term Permit is adopted, with data monitoring, analysis, and data gap identification occurring in annual program effectiveness assessments.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 28. Plan describes data collection and management, including: a) mechanisms by which data will be managed and stored; b) how data will be accessed by stakeholders and the public; c) how existing water quality and water quality monitoring will be assessed; d) frequency at which data will be updated; and e) how data gaps will be identified. |
| | *OC SWRP **Section 4.3** (p.4-11); RWQCB Monitoring Plans: SAR and SDR; OC SWRP Webpage; OC Monitoring Data; WQIP Clearinghouse; OCPW 2013c SAR ROWD (Sections 2.1, p.2.1.2); OCPW 2014c SDR ROWD (Section 2.1, p.2.1.2); OCPW 2011b North IRWM Plan (Section 7, p.7-1 to 7-5); OCPW 2012a Central IRWM Plan (Section 7, p.7-1 to 7-12); OCPW 2013d South IRWM Plan (Section 7, p.7-1 to 7-10); OCPW 2016a WQIP B.2 (Section 2.2.4, p. 2-19); OCPW 2016b WQIP B.3 (Executive Summary, p.vi)* |

# 5 IDENTIFICATION AND PRIORITIZATION OF PROJECTS

## *5.1 Project Identification*

The OC SWRP stakeholders, OC Stormwater Program Permittees, IRWM participants, and watershed agencies, identify potential project types and locations with assistance from the functionally equivalent documents and based upon local water resource priorities and available resources. This OC SWRP prioritizes a subset of projects which meet the OC SWRP Management Priorities expressed in the functionally equivalent documents (ie. the ROWDs, WQIP, and IRWM Plans). Projects identified through jurisdictional and collaborative efforts to comply with NPDES, TMDL and IRWM regulations and regional goals comprise the majority of prioritized projects; however, other projects proposed within the region would be administered by non-profits, non-governmental agencies or water agencies to meet watershed-based goals that align with the Management Objectives of the OC SWRP.

The OC SWRP stakeholders have developed and submitted to the County of Orange for inclusion in this OC SWRP a list of projects that are the result of extensive local planning. The overarching process for identifying and prioritizing projects is shown in **Figure 5-1**. Some of the collaborative processes and/or water quality based-tools expressed in the OC SWRP functionally equivalent documents are described below; these were used to identify potential projects and opportunities for regional stormwater management, as applicable. Projects that move through this process to completion are then monitored and tracked by project proponents and integrated into data management systems, where possible (see **Section 4.3**).

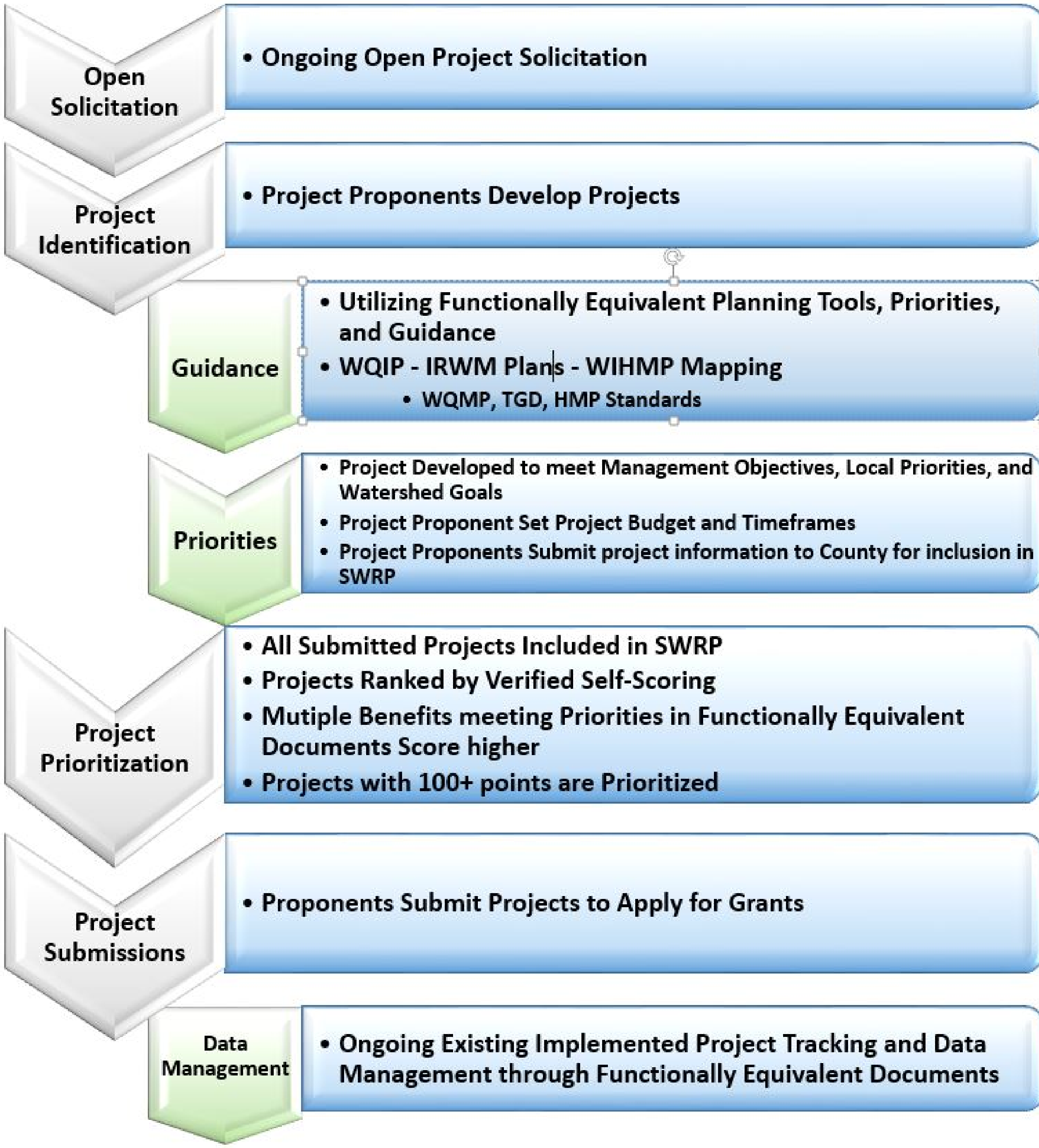



**Figure 5-1: Project Identification and Prioritization Process**

### 5.1.1 Watershed Infiltration and Hydromodification Management (WIHMP) Planning

OC Stormwater Permittees conducted a County-wide GIS review of hydromodification susceptibility and infiltration feasibility in 2014 and 2015 to identify regional opportunities for infiltration. In addition to identifying potential publicly owned and/or open space sites ideal for intercepting and treating runoff, the WIHMP maps also provided an initial screening tool for where infiltration is likely to be infeasible:

- Depth to first groundwater that is less than or equal to 5 feet below the ground surface;
- Presence of Hydrologic Soil Group D (low infiltration potential);
- Landslide susceptibility (mapped by the California Geological Survey);
- Presence of groundwater contamination; and
- Zones of sanitary sewer infrastructure susceptible to inflow and infiltration.

The WIHMP mapping effort is described in the 2013-14 and 2014-15 Unified Annual Reports (pages C-7-2 and C-12-2, respectively). WIHMP map overlays for all Orange County watersheds are available through the OC SWRP Webpage. Orange County-wide, the WIHMP mapping is particularly suited to identifying areas where water infiltration and recharge projects are feasible, acting as guidance to project proponents and developers to identify these locations. The WIHMPs also work in tandem with the WQMP and TGD, which require project proponents to address source control; mapping tools assist identification of BMP locations ideal for infiltration.

### 5.1.2 Model Watershed Master Plan – Management Tool

A GIS-based watershed management planning tool was developed in 2014-15, building upon the WIHMP infiltration feasibility and hydromodification susceptibility mapping to include assessment screening for LID and identification of areas with hydrologic conditions of concern. The tool provides project developers a method to quickly locate and assess suitable site locations for new projects. This tool is further described in the 2014-15 Unified Annual Report (p.3-9) and can be found through the OC SWRP Webpage, with WIHMP mapping available for all of Orange County.

### 5.1.3 Water Quality Improvement Plan

Permittees in South Orange County are required to identify potential strategies that may improve water quality in storm drain discharges and/or receiving waters as part of a WQIP (see **Section 2.2.2**). Potential strategies may include structural and nonstructural BMPs, retrofits, stream restoration projects, and management measures or baseline programs already included in jurisdictional programs. Strategies are identified and selected based on their ability to achieve required load reductions, specific numeric goals, and timelines required by the MS4 Permit. Strategies are prioritized if they focus on and address the HPWQCs within the watershed. Prioritization of strategies may also include the ability of strategies to address multiple pollutants and have multi-benefits. The adaptive management approach to the WQIP allows jurisdictions the flexibility in selecting and updating strategies as needed based upon ever-changing priorities and regulatory climate.

### 5.1.4 IRWM Planning

The North and Central Orange County IRWM Groups have established a prioritization framework in the local IRWM Plans based upon weighted ranking categories for evaluating potential projects. A regional description is provided in Section 3, planning area objectives in Section 4, and strategies in Section 5 of the local IRWM Plans. Both of these plans are in the process of being updated to meet Proposition 1 Planning Standards for IRWM; these weighting categories will be updated or removed from the OC SWRP once the revised process is defined. As the South IRWM project prioritization process has been refined more recently, this OC SWRP utilizes that methodology; however, it is important to note that projects in North and Central Orange County have used a similar methodology to prioritize projects. These three components provide the foundation for the four main project weighting categories. The ranking categories and weighting[11] developed for the North and Central IRWM Plans were:

- Regional/Local Objectives (North OC 39%; Central OC 33%) - How closely projects align with issues of concern as predetermined by stakeholders.
- Project Factors (North OC 24%; Central OC 21%) - Critical aspects of proposed projects are scored based on how those characteristics are prioritized in the IRWM Plan.
- State Objectives (North OC 20%; Central OC 18%) - Degree to which projects meet state objectives and priorities.
- Regulatory Compliance (North OC 17%; Central OC 28%) - degree to which they meet requirements of compliance directives relevant to the North Orange County WMA issued from State and Federal agencies.

The South Orange County IRWM Group has established a project review process that supports the objectives and regional strategies of the IRWM Plan[12]; this process was utilized as a model for project prioritization in this OC SWRP. As a separate Region in the San Diego Funding Area recognized by the Department of Water Resources (DWR), the South IRWM Group prioritizes and selects projects for State bond funding applications for the region. The project selection and review process includes a point-based project ranking to determine which multi-benefit projects best support the goals and objectives of the WMA. The goals align with the listed stormwater benefits detailed in **Table 4-1** of this OC SWRP and will be detailed further in the prioritization of projects in **Section 5.8**.

[11] Each of the ranking categories are further broken down into weighted sub-categories; these are detailed in Tables 6-2, 6-3, 6-4, and 6-5, p.6-2 to 6-5 for North OC and Tables 6-1, 6-2, 6-3, and 6-4, p.6-5 to 6-8 for Central OC.

[12] Regional objectives are described in Chapter 4, the Resource Management Strategies applicable to the WMA in Chapter 5 and the project selection and review process in Chapter 6 (Table 6-1 on pg.6-3).

## *5.2 Opportunities to Augment Local Water Supply*

North and Central Orange County (SAR) receive approximately 70% of its water supplies from the Orange County Groundwater Basin managed by the Orange County Water District (OCWD) (OCWD 2015). OCWD manages the resource, recharging the aquifers primarily through infiltration basins and injection wells. Of the water used for basin recharge, approximately 12.5% is imported[13]; however, the percentage of imported water is increasing as base flow from the Santa Ana River decreases. OCWD seeks to expand opportunities for additional infiltration to maintain and augment local supply.

In South Orange County (SDR), 78% of total water demand is imported, with that number rising to 92% for potable water supplies (SJBA 2013, 2016). South Orange County has very limited groundwater capacity; opportunities for recharge are limited to areas adjacent to San Juan Creek and its tributaries due to clay soils and underlying bedrock[14]. To reduce dependence on imported water, the San Juan Basin Authority (SJBA) and Plan Agencies are coordinating with other regional stakeholders to implement projects and/or programs that increase water use efficiency, water recycling, groundwater recovery, stormwater and dry weather runoff capture for irrigation and ocean desalination (SJBA 2016).

Orange County-wide, the WIHMP mapping (**Section 5.1.1**) is particularly suited to identifying areas where water infiltration and recharge projects are feasible, acting as guidance to project proponents and developers to identify these locations. The WIHMPs also work in tandem with the WQMP and TGD. These resources are followed by developers who, in addressing source control with location recommended BMPs, can seek to implement infiltration in locations identified by the WIHMPs with WQMP guided BMPs to attain low impact development. Upland source control strategies in the WQIP can also augment local water supply, for example, by aiming to reduce the amount of dry weather flow present at storm drain outfalls that can be reduced through wet weather retrofit BMPs such as an infiltration sump that contributes to groundwater supply. Projects specifically identified within this OC SWRP that address opportunities to augment the local water supply are found in **Table 4-3** and **Table 4-4.**

[13] OCWD Groundwater Management Plan (p.ES4)

[14] San Juan Basin Authority's (SJBA) San Juan Basin Groundwater and Facilities Management Plan, Figure 3-13.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 29. Plan identifies opportunities to augment local water supply through groundwater recharge or storage for beneficial use of stormwater and dry weather runoff. | 10562(d)(1) |
| | *OC SWRP **Section 5.2** (p.5-5), **Table 4-3** (p.4-5), **Table 4-4** (p.4-9); OCPW 2013c SAR ROWD (Sections Introduction, 3, and 4. p.ii to iii, 3.4.2, 4.1); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2011a SAR Model WQMP (Section 2, p.2-1); OCPW 2013b SDR Model WQMP (Section 2, p.2-6); OCPW 2016b WQIP B.2 (Section 2.4, p. 2-29); SJBA 2013 Groundwater Management and Facilities Plan (Section 3, Figure 3-13); OCWD 2015 Groundwater Management Plan (Executive Summary, p.ES4)* | |

## *5.3 Opportunities for Source Control*

The Model WQMP[15] and companion TGD require new/re-development to control pollution at the source by implementing LID site design principles and structural BMPs. Project proponents are required to first consider the feasibility of onsite infiltration; other LID-based BMPs are subsequently prioritized – evapotranspiration, harvest/capture and use, and biotreatment. As a result, any project meeting the requirements of significant new/re-development provides an opportunity for jurisdictions to incorporate source control in land development project planning. Additionally, water quality monitoring results are provided to the OC Stormwater Permittees in real time, daily, quarterly and annually through the GIS data viewers at the OC SWRP Webpage, allowing Permittees and stakeholders to identify watershed areas ideal for source control.

As part of the WQIP analysis, mapping of dry weather conditions to support the identification of the highest priority water quality conditions provides an initial screening of priority locations to assess for potential projects to address source control. The WIHMP (OCPW 2016c) mapping process works in tandem with the WQIP and WQMPs to identify potential project locations where source control for both pollution and dry weather runoff volume, onsite and local infiltration, and use of stormwater and dry weather runoff, is obtainable (see **Sections 4-1** and **5.1.1**).

Projects specifically identified within this OC SWRP that address opportunities for source control are found in **Table 4-3** and **Table 4-4**.

[15] http://ocwatersheds.com/documents/wqmp

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 30. Plan identifies opportunities for source control for both pollution and dry weather runoff volume, onsite and local infiltration, and use of stormwater and dry weather runoff. | 10562(d)(2) |
| | *OC SWRP **Sections 4.1, 4.2.1, 5.1.1, and 5.3** (p.4-1, 4-5, 5-3, 5-6), **Table 4-3** (p.4-5), **Table 4-4** (p.4-9); OCPW 2011a SAR Model WQMP 2011 (Section 2, p.2-1 to 2-5); OCPW 2013b SDR Model WQMP (Section 2, p.2-1 to 2-5); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2016a WQIP B.2 (Section 2, p. 2-1 to 2-4)* | |

## *5.4 Projects that Re-establish or Mimic Natural Drainage Systems and Functions*

The Model WQMPs and TGD provide guidance for permittee and stakeholder projects, as well as new/re-development to design, mimic, or have least impact upon natural drainage systems by implementing those guidelines for hydromodification control design (See **Section 5.3**). For projects in the SDR, additional guidance is provided in the HMP. The County of Orange is initiating efforts to develop WMPs, equivalent to the WQIP, for each of the principal North Orange County watersheds, in anticipation of adoption of Fifth Term Permits. The WMPs will provide hydromodification guidance to the SAR when completed under Fifth Term permitting. Priority Development Projects are required to implement hydrologic control measures and onsite management controls so that post-project runoff flow rates and durations do not exceed pre-development (i.e., naturally occurring conditions), flow rates and durations where they would result in an increased potential for erosion or degraded instream habitat downstream[16]. Because unnatural water balance and geomorphologic impacts are HPWQCs identified in the WQIP, projects that address these issues will seek to restore or mimic natural drainage patterns (see **Section 4-1**). Additionally, the WIHMPs provide guidance by mapping areas susceptible to different types of hydromodification.

Projects specifically identified within this OC SWRP that reestablish or mimic natural drainage system and functions are found in **Table 4-3** and **Table 4-4.**

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 31. Plan identifies projects that reestablish natural water drainage treatment and infiltration systems, or mimic natural system functions to the maximum extent feasible. | 10562(d)(3) |

[16] Permit Order R9-2013-0001 as amended by Order No. R9-2015-0001 Section E.3.c.(2)(a)

| | | |
|---|---|---|
| | *OC SWRP* ***Sections 4-1*** *and* ***5.4*** *(p.4-1 and 5-7),* ***Table 4-3*** *(p.4-5),* ***Table 4-4*** *(p.4-9); OCPW 2011a Model SAR WQMP (Section 1, p.1-1 to 1-2); OCPW 2013b Model SDR WQMP (Section 1, p.1-1 to 1-2); OCPW 2015d SOC HMP (Section 3, p. 3-1 to 3-2); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2016b WQIP B.2 (Section 2.3, p. 2-19 to 2-24); OCPW 2016b WQIP B.2 (Section 2.4, p. 2-29 to 2-30)* | |

## *5.5 Opportunities to Develop, Restore, or Enhance Habitat and Open Space*

All three IRWM Plans promote restoration or protection of natural habitat through goals and objectives that assist prioritization of regional projects. Additionally, the WIHMPs provide an initial screening for potential restoration sites based on infiltration feasibility and hydromodification susceptibility through GIS mapping analysis. Participating in projects to develop, restore, or enhance habitat and open space helps achieve goals set forth by the WQIP to address HPWQCs like geomorphologic impacts (see **Section 4-1**). The WQIP lists measures that can target these HPWQCs while simultaneously improving habitat or open spaces. As the County of Orange moves forward with its WMPs after adoption of Fifth Term Permitting, the WMPs will provide recommended strategies similar to those proposed in the WQIP for targeting priority areas that will benefit from source control and enhance geomorphic and habitat function. Permittees collaborate with OC Parks to identify areas for restoration in their public lands that provide benefits to a watershed, such as the Fullerton Creek Restoration Project, which is identified in **Table 5-1**. OCWD also participates in collaborative projects and programs that improve natural resources in conjunction with groundwater improvements and supply (OCWD 2015). Projects specifically identified within this OC SWRP that address opportunities to develop, restore, or enhance habitat and open space are found in **Table 4-3** and **Table 4-4**.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 32. Plan identifies opportunities to develop, restore, or enhance habitat and open space through stormwater and dry weather runoff management, including wetlands, riverside habitats, parkways, and parks. | 10562(d)(4) |
| | *OC SWRP* ***Sections 4-1*** *and* ***5.5*** *(p.4-1 and 5-8),* ***Table 4-3*** *(p.4-5),* ***Table 4-4*** *(p.4-9); OCPW 2011a North IRWM (Section 4, p.4-5 to 4-6); OCPW 2012b Central IRWM (Section 4, p.4-4 to 4-9); OCPW 2013d South IRWM (Section 4.3.4, p.4-26 to 4-29); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCWD 2015 Groundwater Management Plan (Section 9, p.9-1 to 9-23); OCPW 2016b WQIP B.2 (Section 2.4, p. 2-25 to 2-31)* | |

## *5.6 Opportunities for Use of Existing Publicly Owned Lands*

The WIHMP mapping provides an initial screening tool for identifying constraints on infiltration and publicly owned lands (i.e. land use classified as open space, parks, natural, public facilities, etc.) for project location consideration. Additionally, the WIHMP GIS analysis identified publicly-owned sites ideal for capturing runoff from catchment areas. The WQIP promotes rehabilitation of geomorphically unstable channels within urbanized corridors that are often associated with or contained wholly within publicly owned rights-of-way. City collaboration with OC Parks aims to identify restoration opportunities, which may consist of using publicly owned land for restoration.

Projects specifically identified within this plan that may address specific opportunities for use of existing publicly owned lands for project sites are found in **Table 4-3** and **Table 4-4.**

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 33. Plan identifies opportunities to use existing publicly owned lands and easements, including, but not limited to, parks, public open space, community gardens, farm and agricultural preserves, school sites, and government office buildings and complexes, to capture, clean, store, and use stormwater and dry weather runoff either onsite or offsite. | 10562(d)(5), 10562(b)(8) |
| | *OC SWRP* ***Sections 1.8*** *and* ***5.6*** *(p.1-16 and 5-8),* ***Figure 1-7*** *(p.1-15),* ***Table 4-3*** *(p.4-5),* ***Table 4-4*** *(p.4-9); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2016b WQIP B.3 (Section 2, p. 2-47)* | |

## *5.7 New Development and Redevelopment Criteria and Practices*

The Model WQMPs for the SAR and SDR (OCPW 2011a, OCPW 2013b), the associated TGDs (OCPW 2013e), and the Hydromodification Plan (HMP) are the principal screening tools and guidance for new development or significant redevelopment in Orange County. These underwent an extensive stakeholder process in 2010, including Permittees, water agencies, land use/planning agencies (e.g. Orange County Transportation Authority (OCTA)) and non-governmental organizations (NGOs). Model WQMPs for both regions describe required elements and provide technical guidance for post-construction urban runoff and stormwater pollution prevention best management practices (BMPs). Guidelines set forth in these documents include:

- Technical Guidance for Preparing Project WQMPs;
- Design Criteria;
- Site Design Principles and Techniques;
- LID and Treatment Control BMP Design;
- Hydromodification Control Design;
- Source Control Measures; and
- Operation and Maintenance Planning.

The WIHMP mapping and associated screening tool described in **Sections 5.1.1 and 5.1.2** provide initial screening for potential project sites based on infiltration feasibility. The South Orange County Hydrology Model (SOCHM) and associated Guidance Manual provide guidance on addressing hydromodification susceptibility through proper hydromodification control selection and sizing.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 34. For new development and redevelopments (if applicable): Plan identifies design criteria and best management practices to prevent stormwater and dry weather runoff pollution and increase effective stormwater and dry weather runoff management for new and upgraded infrastructure and residential, commercial, industrial, and public development. | 10562(d)(6) |
| | *OC SWRP* ***Sections 5.1.1, 5.1.2,*** *and* ***5.7*** *(p.5-3, 5-3, and 5-9),* ***Table 4-3*** *(p.4-5),* ***Table 4-4*** *(p.4-9); OCPW 2011a SAR WQMP (All); OCPW 2013b SDR WQMP (All); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); SOCHM.* | |

## *5.8 Prioritization of Projects*

Projects identified through the planning processes outlined in **Section 5.1** are prioritized through a step-wise process, assigning cumulative points based upon OC SWRP Management Objectives targeted, benefits claimed, quantification of benefits and project readiness (see **Section 4.1**). Projects are designated as a priority for implementation based upon the following prioritization criteria:

- Identify OC SWRP Management Objectives and benefits targeted (at least two) to demonstrate multiple benefits to the region;
- Indicate how benefits align with regional priorities/goals;
- Quantify and describe benefits;
- Demonstrate that the project will meet required Storm Water Grant start dates (will be adjusted for each grant round or for other, applicable grants);
- Demonstrate that a majority of project design will be completed by Storm Water Grant award (or other timeline determined by the Plan Agencies to ensure projects planning to move forward in a timely manner are prioritized);

Additional points will be awarded for projects that[17]:

[17] Note that geospatial considerations were made in the development of WQIP priorities and in the WIHMP tools for project site selection. Projects are not subsequently re-evaluated geospatially in the prioritization form.

- Address multiple regional priorities;
- Have started or completed environmental permitting; and
- Can ensure at least a 50% funding match (DAC match may vary).

The point-based system is exemplified in the South IRWM Plan project prioritization process (Section 6), which awards points based on how well a project meets goals and/or objectives, weights and sums those points, and provides a point total to rank projects. **Figure 5-2** provides a sample of the OC SWRP project scoring sheet for prioritization.

SWRP TOTAL SCORE: 0

REPLACE WITH PROJECT NAME and PROJECT SPONSOR (e.g. agency, city name, etc.)
PROJECT SCORING

| PROJECT CHECKLIST (Readiness Factors) | |
|---|---|
| How well does your project meet these other priority factors? | 0 |
| Does your project hit TWO SWRP Management Objectives? Select your two. 1) 2) | |
| How many Secondary/Additional Benefits does your project provide (from Project Form B)? | |
| Does your project have 50% funding match? | |
| Does your project have permitting complete? (ie. NEPA, CEQA, etc.) | |
| When is your project capable of starting? (ie. Time until construction start) | |
| Expected percent complete by July 8, 2016 (ie. How ready are you to submit your application) | |

SPREADSHEET USE NOTES
1. FILL IN THE YELLOW AREAS ONLY.
If a triangle appears when you click a yellow cell, select from the dropdown menu.
2. Blue areas will be automatically calculated
3. Additional sheets in this workbook include the local/regional objectives for reference.
The Due Date for this Application is July 8th, 2016, by 4:00pm.
There are four SWRP Management Objectives on this sheet, each with its own scoring area. Score and describe all those that your project targets. Each Objective has Local and Regional priorities. They are WQ, WS, FM, and NR, and are listed under each individual objective. Mark with an 'x' those your project target.

**(WQ) IMPROVE WATER QUALITY**

| Does your project hit any of the following SWRP Management Objectives? | 0 | Provide/Describe a metric achieved (Example: kg/day reduced, mg/L target met, mgd captured, etc.) | 0 |
|---|---|---|---|
| Address NPDES and TMDL constituents of concern through non-point source control. | | | |
| Increase infiltration and/or treatment of runoff to address WQIP priorities – indicator bacteria and/or nutrients | | | |
| Decrease or eliminate dry weather flows to reduce conveyance of pollutants to receiving waters and bacterial regrov | | | |

Which Local and Regional Priorities does your project target? 0
Refer to the Objectives tabs and mark with an 'x' objective codes targeted.
WQ1 ☐ WQ2 ☐ WQ3 ☐ WQ4 ☐

**(WS) INCREASE WATER SUPPLY RELIABILITY and EFFICIENCY**

| Does your project hit any of the following SWRP Management Objectives? | 0 | Provide/Describe a metric achieved (Example: mgd produced, afy captured, $ per volume per year, etc.) | 0 |
|---|---|---|---|
| Address unnatural water balance from urbanization through water conservation | | | |
| Creation of new water supply through beneficial use of stormwater (ie. new supply, or offsetting existing supply) | | | |
| Enhancing local water supply reliability through groundwater recharge | | | |

Which Local and Regional Priorities does your project target? 0
Refer to the Objectives tabs and mark with an 'x' objective codes targeted.
WS1 ☐ WS2 ☐ WS3 ☐ WS4 ☐ WU1 ☐ WU2 ☐ WU3 ☐ WU4 ☐

**(FM) IMPROVE FLOOD MANAGEMENT**

| Does your project hit any of the following SWRP Management Objectives? | 0 | Provide/Describe a metric achieved (Example: acre-feet stored/diverted, acres or linear feet protected, etc.) | 0 |
|---|---|---|---|
| Address channel erosion and geomorphic impacts from flood events | | | |
| Decrease flood risk by reducing peak flow (i.e. control system flashiness) | | | |

Which Local and Regional Priorities does your project target? 0
Refer to the Objectives tabs and mark with an 'x' objective codes targeted.
FM1 ☐ FM2 ☐ FM3 ☐ FM4 ☐ FM5 ☐

**(NR) ENVIRONMENTAL / NATURAL RESOURCES and COMMUNITY BENEFITS**

| Does your project hit any of the following SWRP Management Objectives? | 0 | Provide/Describe a metric achieved (Example: acres restored, megagrams carbon sequestered, people served, # jobs, etc.) | 0 |
|---|---|---|---|
| Habitat protection or enhancement | | | |
| Erosion control to re-establish riparian habitat | | | |
| Sediment and flow control to return to a more natural condition | | | |
| Public education and outreach | | | |
| Provision of new or enhancement of existing urban recreational use areas | | | |

Which Local and Regional Priorities does your project target? 0
Refer to the Objectives tabs and mark with an 'x' objective codes targeted.
NR1 ☐ NR2 ☐ NR3 ☐ NR4 ☐

**Figure 5-2: Project Prioritization Scoring Form**

Projects that target multiple goals and objectives and can provide quantifiable metrics, receive greater points and achieve a higher prioritization score. Project details and benefits included in this OC SWRP are listed in **Table 4-3** and summarized in the prioritization results in **Table 5-1**. The number of points necessary to achieve prioritization in this OC SWRP based upon a combination of benefits claimed and project readiness is 100. Projects that meet this threshold show that they achieve two OC SWRP Management Objectives, providing appropriate target metrics for both, and have good marks on the project checklist (see **Figure 5-2**) which prioritizes projects that are moderately close to shovel-ready and thus more likely to proceed in accordance with grant requirements. Each project's specific metrics and planning details are reviewed for completeness and appropriateness to be included in the prioritization ranking. Whether or not project proponents decide to seek Storm Water Grant or other grant program funding is up to the implementing agency; projects may be prioritized but not move forward based upon project proponent-specific determinations. Additionally, projects may amend their prioritization scores by providing further information (e.g. metrics) once projects move ahead further in design.

| Agency | Project Name | Prioritization Score | Prioritized |
|---|---|---|---|
| California State University, Fullerton | Green Infrastructure and Low Impact Development Improvement Project | *170* | ✓ |
| City of Anaheim | Ball Road and Western Avenue Storm Drain | *310* | ✓ |
| City of Anaheim | Brookhurst Bio-Swales | *325* | ✓ |
| City of Anaheim | La Palma & Richfield Storm Drain Extension and Stormwater Infiltration | *295* | ✓ |
| City of Anaheim | Modjeska Park Underground Stormwater Detention and Infiltration System | *280* | ✓ |
| City of Dana Point | Lower San Juan Creek LO1SO2 Nuisance Water Management Project | *65* | |
| City of Laguna Beach | Bluebird Canyon and Diversion Structure | *320* | ✓ |
| City of San Clemente | Presidential Heights Stormwater Reuse Project | *165* | ✓ |
| OC Coastkeeper | SmartScape | *315* | ✓ |
| OC Parks | East Bluff Erosion Repair | *125* | ✓ |
| OC Parks | Irivne Regional Park Stormwater runoff quality and quantity control | *155* | ✓ |
| OC Parks | Talbert Regional Park Habitat enhancement | *50* | |
| OC Parks | Water Quality Improvement and Development of Class 1 Bikeway along a segment of Coyote Creek | *55* | |
| OC Public Works | Hutton Center and Angels Community Park Stormwater Capture and Reuse Project | *235* | ✓ |
| Orange County Water District | Placentia and Raymond Basins Improvement Project | *230* | ✓ |
| Santa Margarita Water District | San Juan Groundwater Basin Recharge, Stormwater Capture and Reuse Project | *175* | ✓ |
| City of Lake Forest | JCR Project | *45* | |
| City of Mission Viejo | Trabuco Road Water Conservation and Pollution Abatement Project | *45* | |
| City of Santa Ana | Bristol Street Improvement and Widening | *75* | |
| OC Parks/City of Brea | Fulllerton Creek Restoration project | *150* | ✓ |

## Table 5-1: Prioritized Projects

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 35. Plan uses appropriate quantitative methods for prioritization of projects. (This should be accomplished by using a metrics-based and integrated evaluation and analysis of multiple benefits to maximize water supply, water quality, flood management, environmental, and other community benefits within the watershed.) | 10562(b)(2) |
| | *OC SWRP* ***Sections 4 and 5.1*** *(p.4-1 and 5-1),* ***Figure i-2*** *(p.5), and* ***Figure 5-2*** *(p.5-11); OCPW 2013d South IRWM (Sections 4.3 and 6.1.2, p.4-8 to 4-28, and 6-3 to 6-7)* | |
| ☒ | 36. Overall: Plan prioritizes projects and programs using a metric-driven approach and a geospatial analysis of multiple benefits to maximize water supply, water quality, flood management, environmental, and community benefits within the watershed. | |
| | *OC SWRP* ***Sections 4 and 5.1*** *(p.4-1 and 5-1),* ***Figure i-2*** *(p.i-5), and* ***Figure 5-2*** *(p.5-11); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2013d South IRWM (Sections 4.3 and 6.1.2, p.4-8 to 4-28, and 6-3 to 6-7); OC SWRP* ***Figure 5-2*** *Prioritized Project List.* | |
| ☒ | 37. Multiple benefits: Each project in accordance with the Plan contributes to at least two or more Main Benefits and the maximum number of Additional Benefits as listed in Table 4 of the Guidelines. (Benefits are not counted twice if they apply to more than one category.) | |
| | *OC SWRP* ***Sections 4, 5.1, and 5.8*** *(p.4-1, 5-1, and 5-10),* ***Figure i-2*** *(p.i-5), and* ***Figure 5-2*** *(p.5-11)* | |

# 6 IMPLEMENTATION STRATEGY AND SCHEDULE

## 6.1 Funding Needs and Sources

Administration of the OC SWRP will be accomplished though the functionally equivalent plans. Funding for the functionally equivalent plans comprising this OC SWRP is provided through shared budgets associated with IRWM and NPDES implementation agreements, TMDL MOUs and agreements, and OCWD and SJBA JPAs. The Plan Agencies have documented procedures for budget development, review, and approval to ensure regional priorities are met. Funding needs and sources for functionally equivalent plans will be updated as needed to adequately adjust to regional needs/priorities. The processes described in this OC SWRP represent an iterative process; budgets will be developed and reviewed as funding needs and priorities change.

Funding needs for individual projects in this OC SWRP will be met and budgeted by project proponents. The IRWM processes assist project proponents in evaluating the costs of projects, evaluating impacts and benefits, addressing cost effectiveness and affordability, and identifying and procuring funding. Funding sources typically consist of a mix of project proponent agency capital improvement budgets as well as grant sources. Grant funding sources can include bond-funded State grant programs (i.e. Prop 1E, Prop 50, Prop 84, Prop 1, etc.) or California Department of Transportation for project supporting transportation facilities, Federal grants such as those offered by FEMA for hazard mitigation, as well as local funding sources such as OCTA Measure M Environmental Cleanup Program.

## 6.2 Schedule for Securing Financing

Financing for OC SWRP functionally equivalent components is principally secured through shared-cost budgeting of the Plan Agencies through NPDES implementation agreements, TMDL MOUs and agreements, and OCWD and SJBA JPAs as described in **Section 6.1**. Shared-cost budgets that cover plan administration and implementation are approved on an annual basis for NPDES, TMDL, and South Orange County IRWM programs and plans. Financing for WQIP administration and implementation is currently under development and will be addressed in subsequent revisions to the OC SWRP, as applicable.

A schedule of financing for projects in this OC SWRP will be determined by individual project proponents. Time frames for project financing and development are dictated by local fiscal year budgeting and submittal dates for applicable grants being targeted by the project proponents. These time frames are further influenced by the completeness of project design, and permitting approval time frames for individual projects.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 38. Plan identifies resources for Plan implementation, including: 1) projection of additional funding needs and sources for administration and implementation needs; and 2) schedule for arranging and securing Plan implementation financing. |
| | *OC SWRP **Section 6.2** (p.6-1); OC OCPW 2003 DAMP (Section 2, p.2-6 to 2-7, and Exhibit 2.II); OCPW South IRWM 2013 (Section 2.2 and 8, p.2-5 to 2-9 and 8-1 to 8-8); OCPW North IRWM 2011 (Section 8, p. 8-1 to 8-3); OCPW Central IRWM 2012 (Section 8, p. 8-1 to 8-3)* |

## 6.3 Identification of Projects for OC SWRP Implementation

All projects submitted to the County for implementation must meet the requirements of the functionally equivalent plans of this OC SWRP, where applicable. All projects submitted for the OC SWRP qualify for inclusion in the prioritization process described in **Section 5.8.** Current projects included in this Plan are identified in **Table 4-4**, and projects selected for prioritization can be found in **Table 5-1**. The process of evaluating and prioritizing projects described in **Section 5.8** will ensure that projects with demonstrable and quantifiable multiple benefits will be awarded higher scores. Project sponsors who receive grants will likely be required to implement a Project Assessment and Evaluation Plan to monitor and assess benefits achieved by their projects, which will provide further assurance that multiple benefits are achieved.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 39. Plan projects and programs are identified to ensure the effective implementation of the stormwater resource plan pursuant to this part and achieve multiple benefits. | 10562(d)(8) |
| | *OC SWRP **Section 6.3** (p.6-2); OC SWRP projects and their benefits are identified in **Table 4-4** (p.4-9). OC SWRP projects selected for prioritization are identified in **Table 5-1** (p.5-13). Project prioritization procedure (**Section 5.8,** p.5-10) ranks multi-benefit projects and those with quantified benefits higher to ensure multiple benefits are achieved. Functionally equivalent documents of programs are described in this OC SWRP (**Section i,** p.i-1) and referenced throughout the document.* | |

## 6.4 Identification of Decision Support Tools

Decision support tools are included in the processes of the functionally equivalent plans comprising this OC SWRP. These include land development guidelines found in the Model WQMPs, site identification processes and tools in the WIHMP mapping, and the governance and prioritization decision making bodies found in the IRWM plans for all of Orange County. Lastly, the WQIP provides adaptive planning and management processes to identify watershed specific priorities. These documents are described in more detail in **Section i (Functionally-Equivalent Plan Roadmap)**.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 40. The Plan identifies the development of appropriate decision support tools and the data necessary to use the decision support tools. | 10562(d)(8) |
| | *OC SWRP* ***Sections i, 4.1, 4.2, 5.1,*** *and* ***6.4*** *(p. i-1, 4-1, 4-4, 5-1, and 6-2) detail Functionally-Equivalent Plan Roadmap, metrics and project analysis, and project identification for decision support tools and data; OCPW North IRWM 2011, (Section 10, p.10-5 to 10-6); OCPW Central IRWM 2012 (Section 1, p.1.2); OCPW South IRWM 2013 (Section 4, p.4-13); OCPW WQMP SAR 2011 (Section 7.II-1.6, p.1-10 to 1-14); OCPW WQMP SDR 2013 (Section 7.II-1.8, p.1-8 to 1-10); OCPW WIHMP 2016 (Mapping through OC SWRP Webpage); OCPW WQIP B2 2016 (Section 1, p.1.2).* | |

## *6.5 Implementation Strategy*

This OC SWRP references numerous functionally equivalent plans developed by the Plan Agencies, all of which are updated on an as-needed basis for compliance and planning. During those updates references to the OC SWRP will be amended, as necessary. The Plan Agencies, led by the County, will review, update and amend the OC SWRP as State SWRP guidelines are updated, as projects are submitted for inclusion and prioritization, and when relevant changes to the functionally equivalent documents necessitate updates to the OC SWRP. Timelines for submittal to existing IRWM Plans is addressed in **Section 6.6.**

The OC SWRP is implemented after concurrence of the Plan Agencies through the functionally equivalent documents and acceptance by the State, and administered by the County through its IRWM and/or NPDES cooperative agreements. Plan Agencies will implement the OC SWRP through project development and implementation and by implementing the functionally equivalent documents (e.g. WQIP strategies). Entities responsible for project implementation that are not Plan Agencies (e.g. NGOs) are involved in the process through the public review of functionally equivalent plans and updates on project status submitted for inclusion in the OC SWRP.

Community participation in OC SWRP development and implementation is further described in **Section 7**.

Project status tracking is the responsibility of the project proponent agencies/organizations. Project status and timelines to completion for OC SWRP projects are finalized by project proponents and reported to the County for tracking purposes, as applicable. OC SWRP review, updates, and adaptive management will occur as state SWRP guidelines are updated, and as projects are submitted for inclusion and prioritization. Any relevant changes to the functionally equivalent documents referenced throughout the OC SWRP will be incorporated into the OC SWRP where necessary.

Strategies and timelines for projects to obtain necessary federal, state, and local permits are determined by the project proponents, and the OC SWRP prioritization process detailed in **Section 5.8**.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 41. Plan describes implementation strategy, including:<br>a) Timeline for submitting Plan into existing plans, as applicable;<br>b) Specific actions by which Plan will be implemented;<br>c) All entities responsible for project implementation;<br>d) Description of community participation strategy;<br>e) Procedures to track status of each project;<br>f) Timelines for all active or planned projects;<br>g) Procedures for ongoing review, updates, and adaptive management of the Plan; and<br>h) A strategy and timeline for obtaining necessary federal, state, and local permits. |
| | *Timeline for submission of the OC SWRP to IRWM Plans and specific actions by which the OC SWRP will be implemented are addressed in **Section 6.5** (p.6-3). Entities responsible for project implementation summarized in **Section 3.1** (p.3-1) and are listed in OCPW North IRWM 2011, Section 3.4 (p. 3-6 to 3-10); OCPW Central IRWM 2012, Section 3.4.1, 3.4.2, 3.4.3 (p. 3-11 to 3-20); OCPW South IRWM 2013, Section 2.3 (p. 2-9 to 2-17); OCPW 2014c ROWD and OCPW 2013c ROWD (list of municipalities on front cover). Community participation is described in **Section 3.1 and 7** (p.3-1 and 7-1) and detailed in OCPW South IRWM 2013, Section 11.1 (p.11-1 to 11-4); OCPW Central IRWM 2012, Section 11.1 (p.11-1 to 11-2); OCPW North IRWM 2011, Section 11.1 (p.11-1 to 11-3). OC SWRP **Section 6.5** (p.6-3) describes: Tracking of project status; timelines for active/planned projects; procedures for ongoing review, updates, adaptive management of the OC SWRP; and the strategy/timeline for obtaining necessary federal, state, and local permits.* |

## *6.6 Submittal of OC SWRP to Applicable IRWM Regions*

The OC SWRP will be submitted to the South Orange County IRWM Region for inclusion in the South Orange County IRWM Plan. The governing body for the South Orange County WMA will determine how/when the OC SWRP is incorporated into the document. Verification of submittal will be appended to this OC SWRP and included with the submittal of Appendix A.

The OC SWRP will be submitted to SAWPA for inclusion in the OWOW IRWM Plan. The governing body for the OWOW IRWM Plan will determine how/when the OC SWRP is incorporated into the document. Verification of submittal will be appended to this OC SWRP and included with the submittal of Appendix A.

Additionally, the OC SWRP will be submitted to the County for inclusion in the North and Central Orange County IRWM Group local plans currently being updated to meet the requirements of Proposition 1. Verification of submittal will be appended to this OC SWRP and included with the submittal of Appendix A.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 42. Applicable IRWM plan: The Plan will be submitted, upon development, to the applicable integrated regional water management (IRWM) group for incorporation | 10562(b)(7) |

| | | |
|---|---|---|
| | into the IRWM plan. | |
| | *OC SWRP **Section 6.6** (p.6-4); OC SWRP will be submitted to the County for inclusion in the North, Central and South IRWM 2016 Updates. OC SWRP to be included into the OWOW dependent upon SAWPA planning revision timelines and processes.* | |

## 6.7 Performance Measures

The OC SWRP performance measures align with individual project performance based on the metrics and goals set for projects submitted to this OC SWRP for prioritization. Projects set benefit targets to meet goals set forth in the functionally equivalent documents referenced within this OC SWRP. Progress in meeting regional goals will be described in the associated functionally equivalent plans. For example, IRWM processes are in place to review and/or refine overall targets associated with each project.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 43. Plan describes how implementation performance measures will be tracked. |
| | *OC SWRP **Section 6.7** (p.6-5); Tracking of project performance: OCPW South IRWM 2013 (Section 6.2, p.6-7 to 6-18); OCPW North IRWM 2011 (Section 6.3 to 6.4, p.6-4 to 6-5). Tracking of Functionally Equivalent Document performance: OCPW South IRWM 2013 (Section 9, p. 9-1 to 9-20); OCPW North IRWM 2011 (Section 9, p.9-1 to 9-10); OCPW Central IRWM 2012 (Sections 9.2 and 9.3, p. 9-2 to 9-4). Methods for evaluating WQIP performance are under development (see OC SWRP footnote 10).* |

# 7 EDUCATION, OUTREACH, PUBLIC PARTICIPATION

## *7.1 Plan Agency and Public Participation in Functional Equivalent OC SWRP Elements*

This OC SWRP meets functional equivalency through compilation of existing Orange County plans, documents and mapping efforts to meet requirements of Water Code sections 10560 et seq (as amended by Senate Bill 985, Stats. 2014, ch. 555, § 5). As described in previous sections (see **Section 3**), these documents collectively provided for public participation, stakeholder outreach and Plan Agency collaboration. These processes included (but were not limited to)[18]:

**<u>Reports of Waste Discharge (ROWDs)</u>**

The ROWDs represent a culmination of data and summary of efforts conducted by the Permittees over an entire permit term; the Permittees were involved in the development of the ROWDs and assisted in their review. Additionally, the Orange County Stormwater Program held two public workshops in Fall 2013 and Spring 2014 to request public feedback on the ROWDs. Workshops were advertised in local papers and online to encourage attendance. At the workshop, the County on behalf of the Permittees provided a forum to solicit feedback from the public on an assessment of water quality data over more than a decade, and the resultant prioritization of constituents of concern based on this analysis. The public was also provided an overview of recommendations for future program implementation (2013 onward) included in the ROWDs; some of these recommendations were carried over into the development of the WQIP for the SDR and will be considered for the SAR WMPs developed pending the Fifth Term Permit approval[19].

As the ROWDs discuss, community participation in preventing pollution is essential. At the workshops, the Permittees provided for community input on the public outreach efforts planned through the Overwatering Is Out campaign. As a community-based social marketing program, Overwatering Is Out provides additional opportunities for the public to assist implementation of the OC SWRP through participation in source control activities. This

[18] Public participation, Plan Agency coordination and outreach activities were involved in the development and iterative update/review of the primary OC SWRP functionally equivalent documents, tools and activities as noted here; however, other documents referenced in the OC SWRP to meet functional equivalency also included opportunities for stakeholders, agencies and the general public to participate in development and provide feedback. As the OC SWRP will be primarily implemented through the primary functionally equivalent documents, these are described in full here to fulfil the requirements of SB 985 and Appendix A of the Storm Water Resource Plan Guidelines (2015).

[19] The Santa Ana Region (SAR) NPDES permit for Orange County has been under development and review since 2013-14; the Permittees have planned for development of Watershed Management Plans (WMPs) for the four watersheds in North and Central Orange County; however, these efforts will not begin in earnest until the permit is approved. The OC SWRP will be updated to reflect these documents, once the permit is approved and the WMPs are completed. The ROWD analysis provided the basis for both the SDR WQIP and will for the SAR WMPs; as such, the ROWDS provide a picture of the water quality priorities for the SAR.

program was also the result of extensive collaboration between the County, cities, water utility providers and UC Cooperative Extension scientists to encourage onsite BMPs to reduce or eliminate urban runoff from residential areas. The Overwatering Is Out program is similarly noted as a source control technique in the SDR WQIP.

**Integrated Regional Watershed Management (IRWM) Plans**

All three IRWM Plan development processes included solicitation of input from stakeholders and community involvement. As detailed in Chapter 11 of all three plans, processes have been established to identify and continually involve stakeholders in IRWM planning. Additionally, the IRWM Plans detail how plan development and implementation includes coordination with other local and regional plans. This includes coordinating with agencies and groups responsible for groundwater, urban water supply, wastewater, flood management and ecological resource management. Plans implemented by these agencies and groups are referenced in the IRWM Plans and provide supplemental opportunities for public input[20].

***Plan Update Process***

As discussed in **Section 3.1** of the OC SWRP, all three IRWM Plans are in the process of being updated to meet State Planning Standards approved in 2016 by the Department of Water Resources. Plan update processes for all three WMAs provide an opportunity for stakeholder and community involvement. The local North and Central IRWM Plans committed to review of and update to plan content at least every five years or sooner as needed per updated IRWM guidelines (OCPW 2012a, 2011b). The current process to combine and update the North and Central IRWM Plans started in early 2017 and will include 4 public meetings/workshops to address plan gaps and receive public input. The combined North/Central IRWM Plan is slated for completion in Summer 2017. The South Orange County IRWM Plan similarly commits to updates every five years at a minimum; however, as a recognized Region by DWR, the plan has been updated more frequently to meet Plan Standards for Proposition 84 and currently, Proposition 1. The South IRWM Plan includes a detailed process for community participation including member agency coordination at the Management and Executive Committee levels, a public stakeholder workshop and approval by the Executive Committee at a public meeting. This process is detailed in the South IRWM Plan and is slated for completion in Fall 2017 (OCPW 2013d).

***Project Selection Process***

The IRWM Plans are implemented through projects prioritized to meet the goals and objectives of the WMAs. As described in **Section 3.2** of this OC SWRP, the South WMA has undergone the

[20] Chapter 10 in each IRWM Plan provides greater detail; however, planning efforts available to the public include Urban Water Management Plans, Groundwater Management and Facilities Plans, feasibility studies and water reliability studies. These documents are managed by other agencies involved in IRWM activities in Orange County and provide additional opportunities for public comment and review.

Regional Acceptance Process through the Department of Water Resources and is considered its own Region eligible for grant funding in the San Diego Funding Area. The process of project identification, prioritization and selection is detailed in the plan (Section 2.6.1 and Section 6.1) and provides additional opportunities for community participation, including calls for projects, project review workshops and at Executive Committee meetings. Additionally, the South IRWM webpage includes information with calls for projects, project forms, meeting and presentation information (OCPW 2013d). Project coordination and community involvement in the process began with Proposition 50 in 2007 and continued through subsequent Proposition 84 grant rounds (the most recent in 2015). A continuation of this process will occur in 2018 with the next expected round of IRWM Grant funding through Proposition 1.

For the North WMA, stakeholders participated in a collaborative discussion focused on the watersheds in the North WMA in 2008 to develop potential projects for inclusion in the North IRWM Plan. This process included project prioritization related to achievement of Plan objectives. Community participation in a project selection sub-committee included stakeholder representation from cities, non-profits and water agencies. This sub-committee participated in a project prioritization by ranking major categories shown in **Section 5.1** of this OC SWRP. A project list was finalized in the IRWM Plan and project proponents submitted project applications for consideration in the Santa Ana Funding Area. This project list along with the local North WMA IRWM Plan is available at this webpage.

Similar to the process for the North WMA, a steering committee of Central WMA stakeholders developed a decision-making framework for project selection and prioritization (OCPW 2012a). This steering committee along with the Newport Bay Watershed Management Committee prioritized projects for the region based upon the categories identified in **Section 5.1** of this OC SWRP.

As part of the current IRWM Plan update process, the project lists for North and Central WMAs will be reviewed, combined and updated with stakeholders to ensure new projects are considered in the regional prioritization process for Proposition 1. While this may be accomplished through a series of stakeholder workshops, the plan will be stakeholder driven and may require focus groups comprised of public, NGO, city and water district representatives. The County's website will be used to post both draft and final products from this process.

**Water Quality Improvement Plan (WQIP)**

The primary goal of the WQIP is to protect, preserve, enhance and restore the water quality and designated beneficial uses of the waters of the state. This process to identify the highest priority water quality conditions is further described in **Sections 1.4, 2.1, and 4.1** of this OC SWRP. Throughout the process to identify the highest priority water quality conditions, public input has been essential; key feedback received from agencies, NGOs and other members of the public included solicitation for and subsequent provision of data for inclusion in the extensive water quality analyses. A WQIP "clearinghouse" was established for online access to hydrologic data, water quality monitoring data and applicable documents.

Development of the WQIP has included several opportunities for community involvement and public input (see **Section 3**) and will continue to do so through submittal to the SDR Board on April 1, 2017. Public input will also be solicited annually thereafter. The County maintains a website for the public, highlighting information on the WQIP process; included is a summary of how the public has been/can be involved:

- **Notification** – interested members of the public were provided the opportunity to be added to interested party distribution lists for notification of key development milestones and activities; this would principally include notification of meetings, workshops and opportunities to comment on WQIP elements for review;
- **Participation** – members of the public, NGOs and agency stakeholders were notified of public workshops and meetings that have provided opportunities to participate in the formulation of objectives, policies and approaches. The Permittees committed to holding a minimum of four public workshops; so far, three workshops were held in September 2015, April 2016 and September 2016. Public workshops for the WQIP were and will continue to be advertised, including email distribution, newspaper advertisements, posting on social media outlets (i.e. Facebook), dissemination by the Permittees to other local groups and to the South Orange County IRWM groups;
- **Consultation** – participation in the Consultation Panel was offered to members of the public and agency stakeholders; all applicants were accepted to participate on the panel. The Consultation Panel represents a more intensive method of participation, whereby members representing water agencies, environmental non-profits, industry/development, NGOs and SDR Board staff are consulted at key points in the WQIP development process. The Permittees have dedicated to making Consultation Panel meetings open to the public as well; Consultation Panel meetings have been held in January, March and September 2016 and March 2017; and
- **Public Comment** – community participation and involvement is also provided for during periods of public comment on portions of the WQIP. As of March 2017, two comment periods have been provided for the B.2 portion (April 1 – May 5, 2016) and B.3 portion (October 1 – November 8, 2016).

## *7.2 Public Engagement during OC SWRP Implementation*

Public engagement opportunities will continue to be provided during plan implementation through the IRWM and WQIP processes described in **Section 7.1** of this OC SWRP. Iterative development and refinement of the functionally equivalent documents will also provide opportunities for community involvement in the OC SWRP. Additionally, a webpage has been created to provide public access to the OC SWRP, database of functionally equivalent documents and the GIS data map products. This webpage will be updated as the OC SWRP is updated and provide the public and Plan Agencies access to project forms for each applicable round of Proposition 1 funding. Community participation in OC SWRP implementation will include (but not be limited to) the following:

- Public workshops for OC SWRP project solicitations – a workshop was held in March 2016 to solicit initial input on project identification, SWRP and SWGP requirements. IRWM member agencies, interested NGOs (e.g. OC Coastkeeper), NPDES Permittees and other non-profit groups (e.g. Cal State Fullerton) were invited to participate. Feedback from project proponents who expressed interest in further participation and applying for the SWGP was sought during solicitation of project details included in **Section 5**. Though there is continuous open solicitation for OC SWRP projects, a similar workshop will be held prior to the next Storm Water Grant solicitation to prepare project proponents and to solicit feedback on the OC SWRP, should the plan need to be amended to reflect changes in the functionally equivalent documents or priorities.
- IRWM Plan update and project identification/solicitation processes – described in **Section 7.1** of the OC SWRP.
- WQIP development and iterative updating – in addition to the WQIP development process described in **Section 7.1**, community participation will be encouraged beyond the April 1, 2017 submittal deadline through public comment periods associated with SDR Board approval of the plan and annual updates to the WQIP. On an annual basis, the Permittees will present progress made toward meeting the goals and milestones of the WQIP and solicit public feedback on proposed updates.
- Public access to data – as described in **Section 4.3** of the OC SWRP, the WQIP includes an extensive database of monitoring data that is made available to the public to assist participation in project selection and prioritization in the region. As part of the IRWM Plan updates to fulfil requirements of Proposition 1, a geospatial database of projects listed and implemented in the plan will be developed. Once completed, members of the public and stakeholders will be able to see through a GIS StoryMap (or similar) where prioritized project fall within the watershed area and view applicable data and information related to each project (as available). The OC SWRP will be iteratively reviewed and updated to reflect changes in access to data. Updates to the OC SWRP will be made available on the County website.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | | |
|---|---|---|
| ☒ | 44. Outreach and Scoping:<br><br>Community participation is provided for in Plan implementation. | 10562(b)(4) |
| | *OC SWRP **Sections 3.1, 3.2, 4.3, 7.1 and 7.2** (p.3-1, 3-6, 4-11, 7-1, and 7-4); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6); OCPW 2012a Central IRWM Plan 2012 (Section 2, p.2.6 to 2.9, Section 6, p.6-1 to 6-4, Section 10, p.10-1 to 10-2, and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 2, p.2-7 to 2-8, Section 10, p.10-2 to 10-3, and Section 11, p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 2.6.2, p. 2-27 to 2-30, Section 10, p. 10-1 to 10-8, and Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* | |
| ☒ | 45. Plan describes public education and public participation opportunities to engage the public when considering major technical and policy issues related to the development and implementation. | |
| | *OC SWRP **Sections 7.1 and 7.2** (p. 7-1 and 7-4); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6); OCPW 2012a Central IRWM Plan 2012 (Section 6, p.6-4, Section 10, p.10-1 to 10-2, and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 10, p.10-2 to 10-3, and Section 11, p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* | |
| ☒ | 46. Plan describes mechanisms, processes, and milestones that have been or will be used to facilitate public participation and communication during development and implementation of the Plan. | |
| | *OC SWRP **Sections 7.1 and 7.2** (p. 7-1 and 7-4); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6); OCPW 2012a Central IRWM Plan 2012 (Section 6, p.6-4 and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 11, (p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* | |
| ☒ | 47. Plan describes mechanisms to engage communities in project design and implementation. | |
| | *OC SWRP **Sections 7.1 and 7.2** (p. 7-1 and 7-4); OCPW 2012a Central IRWM Plan 2012 (Section 6, p.6-4 and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 11, p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* | |
| ☒ | 51. Plan includes a schedule for initial public engagement and education. | |
| | *OC SWRP **Sections 7.1 and 7.2** (p. 7-1 and 7-4); OCPW 2012a Central IRWM Plan 2012 (Section 6, p.6-4 and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 11, p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* | |

## *7.3 OC SWRP Audiences*

The OC SWRP identifies stakeholders involved in the development and implementation of the main functionally equivalent documents in **Section 3.1**; additionally, **Section 1.6** provides the service areas for water agencies, denoting rate payers via jurisdictional area. The following represents a summary of audiences identified in the OC SWRP functionally equivalent documents:

- **ROWDs**: As a compilation of data over an entire NPDES permit term, the ROWDs provide a summarization of data on commercial and industrial facilities inspected over the 5-year period by the Permittees (who identify in greater detail in each applicable annual report the commercial and industrial facility names and inspection results within their jurisdiction); the ROWDs were prepared for and presented to the general public, as described in **Section 7.1** of this OC SWRP.
- **WQIP**: Included in that description is the WQIP Consultation Panel, comprising representatives for local ratepayers (South OC Economic Coalition and OC Taxpayers Association), developers (Building Industry Association), commercial/industrial stakeholders (South OC Economic Coalition), and non-profit organizations (Surfrider, The Reserve at Rancho Mission Viejo, Ocean Institute, South Coast Steelhead Coalition). The general public is invited to participate in public workshops and Consultation Panel meetings as described in **Section 7.1** of this OC SWRP.
- **IRWM Plans**: As noted in previous OC SWRP sections, the IRWM Plans identify local ratepayers through identification of water agency jurisdiction (see **Section 1.6**), non-profit organizations, and the general public. Developers also participate in IRWM processes, most notably The Irvine Company in the Central WMA and Rancho Mission Viejo in the South WMA.
- **2003 DAMP**: Section 9 of the 2003 DAMP identifies the industrial, commercial and residential sectors applicable to inspection and tracking by the County and cities per the NPDES Permits for the SAR and SDR. The DAMP will be updated to include references to the Fifth Term Permits pending adoption by the SAR. (see footnote 19).

| Document & Involvement Processes | ROWDs | WQIP | IRWM Plans | 2003 DAMP |
|---|---|---|---|---|
| Local Rate Payers (i.e. Water Rate Payers) | | | X | |
| Developers | | X | X | |
| Locally Regulated Commercial and Industrial Stakeholders | X | X | X | X |
| Non-profit Organizations | | X | X | |
| General Public | X | X | X | X |

**Table 7-1: OC SWRP Audiences**

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 48. Plan identifies specific audiences including local ratepayers, developers, locally regulated commercial and industrial stakeholders, nonprofit organizations, and the general public. |
| | *OC SWRP **Sections 1.6, 3.1, 7.1 and 7.3** (p. 1-8, 3-1, 7-1, and 7-4), **Table 7-1** (p.7-7); OCPW 2013c SAR ROWD (Section 3.6, p.3.6.1 to 3.6.17); OCPW 2014c SDR ROWD (Section 3.6, p.3.6.1 to 3.6.14); OCPW 2012a Central IRWM Plan 2012 (Section 3, p.3-10 to 3-20); OCPW 2011b North IRWM Plan 2011 (Section 3, p.3-3 to 3-10); OCPW 2013d South IRWM Plan (Section 2, p.2-18 to 2-22, Section 3, p.3-6 to 3-9 and 3-79 to 3-80); OCPW 2003 DAMP (Section 9, p.9-1 to 9-17)* |

## *7.4 Disadvantaged Community, Climate & Environmental Justice*

**Disadvantaged Communities (DACs)**

The IRWM Plans for the North, Central, and South Orange County WMAs developed and utilized a methodology to engage DACs. Additionally, the IRWM Plans include projects and programs aimed at protecting the population as a whole, including residents who represent disadvantaged communities. The IRWM Plans describe the process to identify communities in Orange County that are disadvantaged as defined by (California Water Code, Section 79505.5 (a)) and consideration of those communities in the project selection and prioritization process.

For South Orange County, DACs are in the City of Laguna Woods. North and Central Orange County have greater area considered as DACs. For North and Central Orange County, the process to identify DACs was the same; however, community and non-profit organizations were solicited as partners to further assess needs of these communities and to assist garnering of grant funding (e.g. Latino Health Access, Cal State University Fullerton). Educational and public outreach activities implemented as part of the IRWM Plans will continue to increase residents' understanding and appreciation of watersheds and other areas of significance, including how human interaction impacts water quality and other natural resources.

**Climate Change & Vulnerable Communities**

Section 12 and Appendix J of the South Orange County IRWM Plan details an exhaustive climate change analysis, including an assessment of potential impacts to water resources in South Orange County. The primary areas of concern are water supply, coastal flooding due to sea level rise, increased fire risk and impacts to ecosystems. The South Orange County WMA stakeholders committed to addressing the effects of climate change by incorporating climate change considerations into both the Region's resource management strategies, as well as part of the project review process. A Climate Change Vulnerability Analysis is included in Section 9 of Appendix J; this assessment summarized in subsection 9.8 highlights the primary concerns to communities in South Orange County. This analysis is currently being updated to fulfil Proposition 1 IRWM Planning Standards and to consider updated data.

Similarly to the South IRWM Plan, the North and Central IRWM Plans each include a chapter on climate change which discusses potential impacts to the WMAs. Potential impacts to the region that would disproportionately impact vulnerable communities include higher air temperatures and poorer air quality. For the North and Central Orange County WMAs, the climate change analysis conducted for South Orange County applies to the region as a whole in areas where data was used on a more regional scale. North and Central Orange County are less reliant upon imported water than South Orange County because of groundwater resources available for drinking water. However, potential impacts from climate change would include variables such as increased temperatures, decreased precipitation and snowpack and increased fire risk (i.e. including water demand) that would apply to the region as a whole. Additionally, coastal flood risk would apply to all of Orange County, as coastal areas extend into all three WMAs. The general assessment of vulnerability to climate change included in the South Orange County IRWM Plan will be used in the OC SWRP to represent the region as a whole.

**Environmental Justice Considerations**

Environmental justice is considered in the South Orange County IRWM Plan in the setting of regional goals and objectives (Section 4.1.1.8), project selection (Section 6.2.3) and stakeholder involvement (Section 11) processes.

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 49. Plan describes strategies to engage disadvantaged and climate vulnerable communities within the Plan boundaries and ongoing tracking of their involvement in the planning process. |
| | *OC SWRP **Section 7.4** (p.7-8); OCPW 2012a Central IRWM Plan 2012 (Section 11, p.11-2 to 11-4 and Section 12, inclusive; impacts to DACs on p. 12-9); OCPW 2011b North IRWM Plan (Section 3, p. 3-11-3-12, Section 11, p.11-3 to 11-5, and Section 12, inclusive; impacts to DACs on p. 12-8), OCPW 2013d South IRWM Plan (Section 3, p.3-82 to 3-83 and 3-86, Section 6.2.3, p.6-16 to 6-18, Section 11, p.11-1 to 11-7, Section 12, inclusive, and Appendix J, inclusive).* |

| Stormwater Resource Plan Checklist and Self-Certification: Appendix A | |
|---|---|
| ☒ | 50. Plan describes efforts to identify and address environmental injustice needs and issues within the watershed. |
| | *OC SWRP **Section 7.4** (p.7-8); OCPW 2012a Central IRWM Plan (Section 11, p.11-2 to 11-4); OCPW 2011b North IRWM Plan (Section 3, p. 3-11 to 3-12, Section 11, p.11-3 to 11-5); OCPW 2013d South IRWM Plan (Section 4.1.1.8, p.4-7 to 4-8, Section 6.2.3, p. 6-16 to 6-18, and Section 11, p.11-4 to 11-7)* |

## 8 REFERENCES

Metropolitan Water District of Orange County (MWDOC) (2016): 2015 Urban Water Management Plan. Orange County, CA.

Orange County Public Works (OCPW), OC Watersheds (2003): Drainage Area Management Plan (DAMP). Orange County, CA.

OCPW, OC Watersheds (2006): Watershed Action Plans, *DAMP Watershed Chapters*. Orange County, CA.

OCPW, OC Watersheds (2011a): Model Water Quality Management Plans (WQMP) (SAR). Orange County, CA.

OCPW, OC Watersheds (2011b): North Orange County Watershed Management Area: *Integrated Regional Watershed Management Plan*. Orange County, CA.

OCPW. OC Watersheds. (2012a): Central Orange County Watershed Management Area: *Integrated Regional Watershed Management Plan*. Orange County, CA.

OCPW, OC Watersheds (2012b): San Clemente Coastal Streams Comprehensive Load Reduction Plan (CLRP). Orange County, CA.

OCPW, OC Watersheds (2013a): Aliso Creek Watershed Workplan. Orange County, CA.

OCPW, OC Watersheds (2013b): Model Water Quality Management Plans (WQMP) (SDR). Orange County, CA.

OCPW, OC Watersheds (2013c): Report of Waste Discharge (*Santa Ana Region)*. Orange County, CA.

OCPW, OC Watersheds (2013d): South Orange County Watershed Management Area: *Integrated Regional Watershed Management Plan*. Orange County, CA.

OCPW, OC Watersheds (2013e): Technical Guidance Document for Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMP). Orange County, CA.

OCPW, OC Watersheds (2014a): Aliso Creek Watershed Comprehensive Load Reduction Plan (CLRP). Orange County, CA.

OCPW, OC Watersheds (2014b): Aliso Creek Watershed Runoff Management Plan, Water Quality Data Assessment Annual Report. Orange County, CA.

OCPW, OC Watersheds (2014c): Report of Waste Discharge (*San Diego Region)*. Orange County, CA.

OCPW, OC Watersheds (2015a): Baby Beach Indicator Bacteria TMDL Annual Progress Report. Orange County, CA.

OCPW, OC Watersheds (2015b): Newport Bay Watershed Nutrient TMDL, *Annual Data Report*. Orange County, CA.

OCPW, OC Watersheds (2015c): Newport Bay Watershed Sediment TMDL, *Annual Data Report*. Orange County, CA.

OCPW, OC Watersheds (2015d): South Orange County Hydromodification Management Plan (HMP). Orange County, CA.

OCPW, OC Watersheds (2015e): San Juan Creek Watershed Comprehensive Load Reduction Plan (CLRP). Orange County, CA.

OCPW, OC Watersheds (2015f): Unified Annual Progress Report, *Program Effectiveness Assessment*. Orange County, CA.

OCPW, OC Watersheds (2016a): South Orange County Water Quality Improvement Plan (WQIP), *Permit Provision B.2.* Orange County, CA.

OCPW, OC Watersheds (2016b): South Orange County Water Quality Improvement Plan (WQIP), *Permit Provision B.3.* Orange County, CA.

OCPW, OC Watersheds (2016c): Watershed Infiltration and Hydromodification Management Plan (WIHMP). Orange County, CA.

Orange County Water District (OCWD) (2015): Groundwater Management Plan. Orange County, CA.

San Juan Basin Authority (SJBA) (2013): Groundwater Management and Facilities Plan. Orange County, CA.

SJBA (2016): San Juan Basin Groundwater and Desalination Optimization Plan. Orange County, CA.

Santa Ana Watershed Project Authority (SAWPA) (2014): One Water One Watershed 2.0 Plan, *Santa Ana River Watershed.* Riverside County, CA.

South Orange County Wastewater Authority (SOCWA) (2014): Draft Salt and Nutrient Management Plan for the South Orange County Aliso Creek, San Juan Creek, and Portions of Other Basins, Phase 2 Services. Dana Point, Orange County, CA.

State Water Resources Control Board (SWRCB) (2015): Stormwater Resource Plan Guidelines. Sacramento, CA.

# APPENDIX A

# Storm Water Resource Plan Checklist and Self-Certification

The following should be completed and submitted to the State Water Resources Control Board Division of Financial Assistance in support of a storm water resource plan /functionally equivalent plan. The documents submitted, including this checklist, will be used to determine State Water Board concurrence with the Storm Water Resource Plan Guidelines and statutory water code requirements.

When combining multiple documents to form a functionally equivalent Storm Water Resource Plan, submit a cover letter explaining the approach used to arrive at the functionally equivalent document. The cover letter should explain how the documents work together to address the Storm Water Resource Plan Guidelines.

| STORM WATER RESOURCE PLAN GENERAL CONTACT INFORMATION | |
|---|---|
| **Contact Info:**<br>**Name**<br>**Phone Number**<br>**Email** | **County of Orange – OC Public Works**<br>**Jenna Voss**<br>**(714) 955-0652**<br>**jenna.voss@ocpw.ocgov.com** |
| **Date Submitted to State Water Resource Control Board:** | **February 28, 2017** |
| **Regional Water Quality Control Board:** | **Santa Ana Regional Water Quality Control Board (Region 8) and San Diego Regional Water Quality Control Board (Region 9)** |
| **Title of attached documents (expand list as needed):** | 1. Orange County Public Works (OCPW), OC Watersheds (2013c): Report of Waste Discharge (Santa Ana Region). Orange County, CA.<br>2. OCPW, OC Watersheds (2014c): Report of Waste Discharge (San Diego Region). Orange County, CA.<br>3. OCPW, OC Watersheds (2011b): North Orange County Watershed Management Area: *Integrated Regional Watershed Management Plan*. Orange County, CA.<br>4. OCPW. OC Watersheds. (2012a): Central Orange County Watershed Management Area: *Integrated Regional Watershed Management Plan*. Orange County, CA. |

| | |
|---|---|
| | 5. OCPW, OC Watersheds (2013d): South Orange County Watershed Management Area: *Integrated Regional Watershed Management Plan*. Orange County, CA.<br>6. OCPW, OC Watersheds (2016a): South Orange County Water Quality Improvement Plan (WQIP), *Permit Provision B.2.* Orange County, CA.<br>7. OCPW, OC Watersheds (2016b): South Orange County Water Quality Improvement Plan (WQIP), *Permit Provision B.3.* Orange County, CA.<br>8. OCPW, OC Watersheds (2016c): Watershed Infiltration and Hydromodification Management Plan (WIHMP). Orange County, CA.<br>9. OCPW, OC Watersheds (2011a): Model Water Quality Management Plans (WQMP) (SAR). Orange County, CA.<br>10. OCPW, OC Watersheds (2013e): Technical Guidance Document for Preparation of Conceptual/Preliminary and/or Project Water Quality Management Plans (WQMP). Orange County, CA.<br>11. OCPW, OC Watersheds (2013b): Model Water Quality Management Plans (WQMP) (SDR). Orange County, CA.<br>12. OCPW, OC Watersheds (2015d): South Orange County Hydromodification Management Plan (HMP). Orange County, CA.<br>13. OCPW, OC Watersheds (2003): Drainage Area Management Plan (DAMP). Orange County, CA.<br>14. OCPW, OC Watersheds (2015f): Unified Annual Progress Report, Program Effectiveness Assessment. Orange County, CA.<br>15. Metropolitan Water District of Orange County (MWDOC) (2016): 2015 Urban Water Management Plan. Orange County, CA.<br>16. Orange County Water District (OCWD) (2015): Groundwater Management Plan. Orange County, CA.<br>17. San Juan Basin Authority (SJBA) (2016): Groundwater Facilities Management and Optimization Plan. Orange County, CA.<br>18. Santa Ana Watershed Project Authority (SAWPA) (2014): One Water One Watershed 2.0 Plan, Santa Ana River Watershed. Riverside County, CA. |

| STORM WATER RESOURCE PLAN INFORMATION | |
|---|---|
| **Storm Water Resource Plan Title:** | **<u>Orange County Stormwater Resource Plan</u>** |
| **Date Plan Completed/Adopted:** | **<u>February 28, 2017</u>** |
| **Public Agency Preparer:** | **<u>County of Orange (OC Public Works)</u>** |
| **IRWM Submission:** | **<u>Submitted to the North, Central and South IRWM Groups and SAWPA OWOW IRWM Group on February 28, 2017. Proof of submittal appended.</u>** |
| **Plan Description:** | This OC SWRP meets functional equivalency through the compilation of existing Orange County plans, documents and mapping efforts to meet requirements of Water Code sections 10560 et seq (as amended by SB 985, Stats. 2014, ch. 555, § 5). Four primary significant planning efforts referenced throughout this OC SWRP are used for functional equivalency to meet the SWRP guidelines. These include (1) the 2013/2014 Reports of Waste Discharge (ROWDs), (2) Integrated Regional Watershed Management Plans, (3) Watershed Infiltration and Hydromodification Management Plan (WIHMP) mapping tools, and (4) the South Orange County Water Quality Improvement Plan (WQIP). In addition to meeting the SWRP guidelines, these four primary documents also provide the basis for project identification and prioritization in this OC SWRP (Section 5). Other documents produced by the Plan Agencies are referenced in this OC SWRP to meet specific requirements of Appendix A as needed. |

## Checklist Instructions:

For **each element** listed below, review the applicable section in the Storm Water Resource Plan Guidelines and enter ALL of the following information**.** Be sure to **p**rovide a clear and thorough justification if a recommended element (non shaded) is not addressed by the Storm Water Resource Plan.

A. Mark the box if the Storm Water Resource Plan meets the provision

B. In the provided space labeled **References**, enter:

1. Title of document(s) that contain the information (or the number of the document listed in the General Information table above);
2. The chapter/section, **and page number(s)** where the information is located within the document(s);
3. The entity(ies) that prepared the document(s) if different from plan preparer;
4. The date the document(s) was prepared, and subsequent updates; and
5. Where each document can be accessed[1] (website address or attached).

| STORM WATER RESOURCE PLAN CHECKLIST AND SELF-CERTIFICATION | | |
|---|---|---|
| Mandatory Required Elements per California Water Code are Shaded | | |
| **Y/N** | **Plan Element** | **Water Code** |

**NOTE: For All non-linked references in the following certification checklist boxes, the references can be found through the *OC SWRP Webpage*.**

[1] All documents referenced must include a website address. If a document is not accessible to the public electronically, the document must be attached in the form of an electronic file (e.g. pdf or Word 2013) on a compact disk or other electronic transmittal tool.

| WATERSHED IDENTIFICATION (GUIDELINES SECTION VI.A) | | |
|---|---|---|
| ☒ | 1. Plan identifies watershed and sub-watershed(s) for stormwater resource planning.<br>*OC SWRP* ***Section 1.1*** *(p.1-1),* ***Figure 1-1, Table 1-1*** *(p.1-3 and 1-1); OCPW 2003 DAMP (Appendix D: Watershed Chapters, Executive Summaries and All Figures); OCPW 2012a Central IRWM Plan (Section 3, p.3-4 to 3-6); OCPW 2011b North IRWM Plan (Section 3, p.3-1 to 3-5); OCPW 2013d South IRWM Plan (Section 3, p.3-2 to 3-5); OCPW 2016a WQIP.B2 (Section 1, p.1-2); OCPW 2016b WQIP.B3 (Introduction, p.x); OCPW 2016c WIHMPs (Exhibits 1.1); OC Flood drainage facility maps* | 10565(c), 10562(b)(1), 10565(c) |
| ☒ | 2. Plan is developed on a watershed basis, using boundaries as delineated by USGS, CalWater, USGS Hydrologic Unit designations, or an applicable integrated regional water management group, and includes a description and boundary map of each watershed and sub-watershed applicable to the Plan.<br>*OC SWRP* ***Section 1.1*** *(p.1-1),* ***Figure 1-1, Table 1-1*** *(p.1-3 and 1-1); OCPW 2003 DAMP (Appendix D: Watershed Chapters, Figures 1); OCPW 2012a Central IRWM Plan (Section 3, p.3-4 to 3-6); OCPW 2011b North IRWM Plan (Section 3, p.3-1 to 3-5); OCPW 2013d South IRWM Plan (Section 3, p.3-2 to 3-5); OCPW 2016a WQIP.B2 (Section 1, p.1-2); OCPW 2016b WQIP.B3 (Introduction, p.x); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OC Flood drainage facility maps* | |

| WATERSHED IDENTIFICATION (GUIDELINES SECTION VI.A) | |
|---|---|
| ☒ | 3. Plan includes an explanation of why the watershed(s) and sub-watershed(s) are appropriate for stormwater management with a multiple-benefit watershed approach.<br>*OC SWRP* ***Section 1.2*** *(p.1-4); Links to RWQCB Basin Plans here and here; OCPW 2012a Central IRWM Plan (Section 2, p.2-9 to 2-11); OCPW 2011b North IRWM Plan (Section 2, p.2-3); OCPW 2013d South IRWM Plan (Section 3, p.3-2); OCPW 2016a WQIP B.2 Report (Section 1, p.1-1 to 1-4. Appendix A, Figure A-1).* |
| ☒ | 4. Plan describes the internal boundaries within the watershed (boundaries of municipalities; service areas of individual water, wastewater, and land use agencies, including those not involved in the Plan; groundwater basin boundaries, etc.; preferably provided in a geographic information system shape file).<br>*OC SWRP* ***Section 1.3*** *(p.1-4); Links to GIS datasets can be found at the OC SWRP Webpage.* |
| ☒ | 5. Plan describes the water quality priorities within the watershed based on, at a minimum, applicable TMDLs and consideration of water body-pollutant combinations listed on the State's Clean Water Act Section 303(d) list of water quality limited segments (a.k.a impaired waters list).<br>*OC SWRP* ***Section 1.4*** *(p.1-5); OCPW 2013c SAR ROWD (Sections 1-2, p.1.1-2.4.12 and Section 4, p.4.1-4.9); OCPW 2014c SDR ROWD (Sections 1-2, p.1.1-2.7.5 and Section 4, p.4.1-4.10); OCPW 2012a Central IRWM Plan (Section 2.6, p.2-11 to 2-12); OCPW 2011b* |

| | |
|---|---|
| | *North IRWM Plan (Section 3.6.2, p.3-14 to 3-15); OCPW 2013d South IRWM Plan (Section 3.3.4, p.3-31 to 3-53); SARWQCB website; OCPW 2016a WQIP B.2 (Section 2, p. 2-7 through 2-10 and 2-24) summarizes water quality priorities.* |
| ☒ | 6. Plan describes the general quality and identification of surface and ground water resources within the watershed (preferably provided in a geographic information system shape file). |
| | *OC SWRP **Section 1.5** (p.1-6); OCPW 2013c SAR ROWD (Section 2, p.2.1.1-2.5.1); OCPW 2014c SDR ROWD (Section 2, p.2.1.1-2.8.1), OCPW 2011b North IRWM Plan (Section 3, p.3-20 to 3-22); OCPW 2012a Central IRWM Plan (Section 3, p3-23 to 3-29); OCPW 2013d South IRWM Plan (Section 3.3, p.3-27 to 3-31); OCPW 2016a WQIP B.2 (Section 2, p.2-29 to 2-30); Links to GIS shapefiles and monitoring sites data in the OC SWRP Webpage. Links to OC Groundwater Management Plan and SJBA Facilities Management Plan.* |
| ☒ | 7. Plan describes the local entity or entities that provide potable water supplies and the estimated volume of potable water provided by the water suppliers. |
| | *OC SWRP **Section 1.6** (p.1-8), **Table 1-2** (p.1-8), **Figure 1-2** (p.1-9); MWDOC 2015 UWMP (Section 2, p.2-5 to 2-7); GIS data of service area boundaries available at the OC SWRP Webpage.* |
| ☒ | 8. Plan includes map(s) showing location of native habitats, creeks, lakes, rivers, parks, and other natural or open space within the sub-watershed boundaries. |
| | *OC SWRP **Section 1.7** (p.1-10), **Figure 1-3** (p.1-11), **Figure 1-4** (p.1-12), **Figure 1-6** (p.1-14), **Figure 1-7** (p.1-15); OCPW 2013d SAR ROWD (Section 1,p.1.5 to 1.13); OCPW 2014c SDR ROWD (Section 1, p.1.5 to 1.17); GIS data accessible at the OC SWRP Webpage.* |
| ☒ | 9. Plan identifies (quantitative, if possible) the natural watershed processes that occur within the sub-watershed and a description of how those natural watershed processes have been disrupted within the sub-watershed (e.g., high levels of imperviousness convert the watershed processes of infiltration and interflow to surface runoff increasing runoff volumes; development commonly covers natural surfaces and often introduces non-native vegetation, preventing the natural supply of sediment from reaching receiving waters). |
| | *OC SWRP **Section 1.8** (p.1-16); OCPW 2013 SAR ROWD 2013c (Section 1, p.1.2-1.3. Section 2, p.2.4.10 to ); OCPW 2014c SDR ROWD (Section 1, p.1.2); OCPW 2016a WQIP B.2 (Section 1, p.1-3 through 2-32, Appendix C); OCPW 2011b Central IRWM (Section 3, p.3-63 and 3-64); OCPW 2012a North IRWM (Section 3, p3-34 to 3-36); OCPW 2013d South IRWM (Section 2.6.1, p.2-10); OCPW 2016c WIHMPs (Mapping through OC SWRP Webpage); www.overwateringisout.org* |

| WATER QUALITY COMPLIANCE (GUIDELINES SECTION V) | | |
|---|---|---|
| ☒ | 10. Plan identifies activities that generate or contribute to the pollution of stormwater or dry weather runoff, or that impair the effective beneficial use of stormwater or dry weather runoff.<br>*OC SWRP **Section 2.1** (p.2-1); OCPW 2013c SAR ROWD (Section 2, p.2.1.1 to 2.5.2); OCPW 2014c SDR ROWD (Section 2, p.2.1.1 to 2.7.5) and Section 3 (in full); OCPW 2016a WQIP B.2 (Section 2, p. 2-7 through 2-10 and 2-24) summarizes water quality priorities, OCPW 2016b WQIP B.3 (Section 2, p. 2-1, 2-32, and 2-59) identifies pollutant generating activities.* | 10562(d)(7) |
| ☒ | 11. Plan describes how it is consistent with and assists in, compliance with total maximum daily load implementation plans and applicable national pollutant discharge elimination system permits.<br>*OC SWRP **Section 2.2** (p.2-2); OCPW 2013c SAR ROWD (Executive Summary, p.i-iii); OCPW 2014c SDR ROWD (Executive Summary, p.i-vi); OCPW 2016a WQIP B.2 (Section 1, p. 1-1 to 1-2), OCPW 2016b WQIP B.3 (Executive Summary, p.vi); OCPW 2013e WQMP (Section 1 Introduction, p.1-1); OC Watersheds Document Library here (for other activities/reports).* | 10562(b)(5) |
| ☒ | 12. Plan identifies applicable permits and describes how it meets all applicable waste discharge permit requirements.<br>*OC SWRP **Section 2.3** (p.2-4); Regional Board links to permits here and here; OCPW 2013c ROWD (Executive Summary, p.i-iii); OCPW 2014c SDR ROWD (Executive Summary, p. i-vi) provide justification for how applicable requirements are met; OCPW 2016b WQIP B.3 (Section 2, p. 2-88 through 2-95) summarizes how the WQIP demonstrates compliance with the Prohibitions and Limitations Compliance Option* | 10562(b)(6) |
| **ORGANIZATION, COORDINATION, COLLABORATION (GUIDELINES SECTION VI.B)** | | |
| ☒ | 13. Local agencies and nongovernmental organizations were consulted in Plan development. (Appendix A, 13)<br>*OC SWRP **Sections 3.1 and 7.1** (p.3-1 and p.7-1), **Table 3-1** (p.3-1), **Table 3-2** (p.3-3); OCPW 2013c SAR ROWD (Sections 1 and 6, p.1.1 and 6.1 to 6.4); OCPW 2014c SDR ROWD (Sections 1 and 6, p.1.1 and 6.1 to 6.4); OCPW 2011b North IRWM Plan (Section 2, p.2-1 to 2-8, Section 11, p.11-1 to 11.4); OCPW 2012a Central IRWM Plan (Section 2, p.2-1 to 2-14, Section 11, p.11-1 to 11-4); OCPW 2013d South IRWM Plan (Section 2, p.2-1 to 2-28, Section 11, p.11-1 to 11-7); OCPW OC Environmental data through the OC SWRP Webpage GIS links; OC Watersheds Document Library here, and San* | 10565(a) |

| | | |
|---|---|---|
| | *Juan Basin Authority documents here.* | |
| ☒ | 14. Community participation was provided for in Plan development. (Appendix A, 14)<br>*OC SWRP **Sections 3.1 and 7** (p.3-1 and p.7-1), **Table 3-1** (p.3-1), **Table 3-2** (p.3-3); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6); OCPW 2011b North IRWM Plan (Section 4, p.4-1); OCPW 2012a Central IRWM Plan (Section 4, p.4-1 to 4-2); OCPW 2013d South IRWM Plan (Section 2.5, p.2-5 to 2-6, Section 11, p.11-1 to 11-7); OCPW WQIP B.2 2016 Section 1 (p.1-4); OCPW OC Environmental data through the OC SWRP Webpage GIS links, OC Watersheds Document Library here.* | 10562(b)(4) |
| ☒ | 15. Plan includes description of the existing integrated regional water management group(s) implementing an integrated regional water management plan. (Appendix A, 15)<br>*OC SWRP **Sections 3.2 and 7.1** (p.3-6 and p.7-1); OCPW 2011b North IRWM Plan (Sections 2 and 6, p.2-1 to 2-8, p. 6.1-6.5); OCPW 2012a Central IRWM Plan (Sections 2 and 6, p.2-1 to 2-14, p 6.1-6.8); OCPW 2013d South IRWM Plan (Sections 2 and 6, p.2-1 to 2-46, p. 6.1 – 6.21); SAWPA 2014 OWOW (Section 2.1, p.1-4).* | |
| **ORGANIZATION, COORDINATION, COLLABORATION (GUIDELINES SECTION VI.B)** | | |
| ☒ | 16. Plan includes identification of and coordination with agencies and organizations (including, but not limited to public agencies, nonprofit organizations, and privately owned water utilities) that need to participate and implement their own authorities and mandates in order to address the stormwater and dry weather runoff management objectives of the Plan for the targeted watershed. (Appendix A, 16)<br>*OC SWRP **Sections 3.1** (p.3-1), **Table 3-3** (p.3-4); OCPW 2011b North IRWM Plan (Section 2, p.2-1 to 2-8); OCPW 2012a Central IRWM Plan (Section 2, p.2-1 to 2-14); OCPW 2013d South IRWM Plan (Section 2, p.2-1 to 2-28); OCPW 2013c SAR ROWD (Section 1, p.1.1); OCPW 2014c SDR ROWD (Section 1, p.1.1).* | |
| ☒ | 17. Plan includes identification of nonprofit organizations working on stormwater and dry weather resource planning or management in the watershed. (Appendix A, 17)<br>*OC SWRP **Sections 3.1** (p.3-1), **Table 3-2** (p.3-3); OCPW 2011b North IRWM Plan (Section 3, p.3-8 to 3-9); OCPW 2012a Central IRWM Plan (Section 7, p.7-1); OCPW 2013d South IRWM Plan (Section 2.3.3, p.2-14 to 2-15)* | |
| ☒ | 18. Plan includes identification and discussion of public engagement efforts and community participation in Plan development. (Appendix A, 18)<br>*OC SWRP **Sections 3.1 and 7** (p.3-1 and p.7-1); OCPW 2011b North IRWM Plan (Section 11, p.11-1 to 11-6); OCPW 2012a Central IRWM Plan (Section 11, p.11-1); OCPW 2013d South IRWM Plan (Section 2.5 and 11 (p.2-5 to 2-6 and 11-1 to 11-8); OCPW 2013c SAR* | |

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| | *ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6).* |
| ☒ | 19. Plan includes identification of required decisions that must be made by local, state or federal regulatory agencies for Plan implementation and coordinated watershed-based or regional monitoring and visualization. (Appendix A, 19) |
| | *OC SWRP **Sections 3.3** (p.3-7); OCPW 2013c SAR ROWD (Sections 2-7, Assessment/Accomplishments and Recommendations subsections, p.2.2.13, 2.3.11, 2.4.11, 3.2.2, 3.3.4, 3.4.5, 3.5.4, 3.6.9, 3.7.9, 4.9, 5.5, 6.5, and 7.2); OCPW 2014c SDR ROWD (Sections 2-7, Assessment/Accomplishments and Recommendations subsections, p.2.3.13, 2.4.7, 2.5.10, 2.6.12, 3.2.8, 3.3.6, 3.4.2, 3.5.1, 3.6.1, 3.7.1, 4.10, 5.4, 6.1, and 7.2); OCPW 2011b North IRWM Plan (Section 2.3 and 2.4, p.2-4 to 2-5); OCPW 2012a Central IRWM Plan (Section 2.3, p.2-6 to 2-9); OCPW 2013d South IRWM Plan (Section 2.2, p.2-2 to 2-9); OCPW 2016a WQIP B.2 (Section 1, p. 1-1 through 1-4)* |
| ☒ | 20. Plan describes planning and coordination of existing local governmental agencies, including where necessary new or altered governance structures to support collaboration among two or more lead local agencies responsible for plan implementation. (Appendix A, 20) |
| | *OC SWRP **Section 3** (p.3-1) and subsections and **Figure i-1 (p.i-4)** for coordination and governance structures review; OCPW North IRWM Plan 2011, Section 2 (inclusive); OCPW Central IRWM Plan 2012, Section 2 (inclusive); OCPW South IRWM Plan 2013, Section 2 (inclusive); OCPW DAMP 2003, Section 2 (inclusive); No altered or new governance structures are needed to support plan implementation at this time.* |
| ☒ | 21. Plan describes the relationship of the Plan to other existing planning documents, ordinances, and programs established by local agencies. (Appendix A, 21) |
| | *OC SWRP **Section 3.4** (p.3-8); The OC SWRP is a functionally equivalent collection of numerous program planning documents, including the ROWDs, WQIP, WIHMP, and IRWM planning. See OC SWRP **Figure i-1** (p.i-4) which highlights the structural relationship of the aforementioned planning documents and their relationship to each other and the OC SWRP.* |
| ☒ | 22. (If applicable) Plan explains why individual agency participation in various isolated efforts is appropriate. (Appendix A, 22) |
| | *OC SWRP **Section 3.4** (p.3-8); As the OC SWRP is a functionally equivalent collection of NPDES, TMDL and IRWM planning documents, jurisdictional or agency/organization-specific projects will not be isolated from regional planning for compliance purposes.* |

| **QUANTITATIVE METHODS (GUIDELINES SECTION VI.C)** | |
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| ☒ | **23. For all analyses:** Plan includes an integrated metrics-based analysis to demonstrate that the Plan's proposed stormwater and dry weather capture projects and programs will satisfy the Plan's identified water management objectives and multiple benefits. |
| | *OC SWRP **Sections 1.8, 4.1, 4.2.1, 5.1.1** (p. 1-16, 4-1, 4-5, and 5-3); SWRCB 2015 (SWRP Guidelines-Section 4.C, p.22-23); OCPW 2011b North IRWM Plan (Sections 4-5, p.4-1 to 5-* |

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| | *9); OCPW 2012a Central IRWM Plan (Sections 4-5, p.4-1 to 5-9); OCPW 2013d South IRWM Plan (Sections 4-6, p.4-1 to 5-48 and 6-1 to 6-8); OCPW 2016a WQIP B.2 (Section 2, p. 2-1 through 2-33) OCPW 2016c WIHMP (Mapping through OC SWRP Webpage)* |
| ☒ | **24. For water quality project analysis (section VI.C.2.a)**<br>Plan includes an analysis of how each project and program complies with or is consistent with an applicable NPDES permit. The analysis should simulate the proposed watershed-based outcomes using modeling, calculations, pollutant mass balances, water volume balances, and/or other methods of analysis.<br>Describes how each project or program will contribute to the preservation, restoration, or enhancement of watershed processes (as described in Guidelines section VI.C.2.a) |
| | *OC SWRP **Section 4.1** and **4.2.1** (p.4-1 and 4-5) of this OC SWRP summarizes the WQIP Analysis conducted that provides the priorities and goals for projects are targeting; OCPW 2016a WQIP B.2 (Section 2, p. 2-1 through 2-18); Adherence to targeting WQIP highest priority concerns will contribute the preserving, restoring, and/or enhancing watershed processes; OC SWRP **Table 4-4** (p.4-9) lists Projects and their details with any expected treated volumes calculated or expressed in appropriate units (AFY or MGD), and pollutant load reductions expressed in accordance with pollutant being addressed (e.g. mg/L, CFU).* |
| ☒ | **25. For stormwater capture and use project analysis (section VI.C.2.b):**<br>Plan includes an analysis of how collectively the projects and programs in the watershed will capture and use the proposed amount of stormwater and dry weather runoff. |
| | *OC SWRP **Section 4.2.2** (p.4-6) highlights IRWM goals to improve stormwater capture and increase water supply, its reliability, and use efficiency, as well as how these goals overlap with WQIP proposed strategies that these projects are targeting; OCPW 2011b North IRWM Plan (Sections 4.3, p.4-4); OCPW 2012a Central IRWM Plan (Sections 4.4.1 and 4.4.3, p.4-6 to 4-7); OCPW 2013d South IRWM Plan (Sections 4.3.1, and 4.3.3 to 4.3.4, p.4-15 and 4-24 to 4-27); OCPW 2016a WQIP B.2 (Section 2, p. 2-25 through 2-33). OC SWRP **Table 4-4** (p.4-9) lists Projects and their details with any expected captured volumes to be calculated or expressed in appropriate units (AFY or MGD) for reuse.* |
| ☒ | **26. For water supply and flood management project analysis (section VI.C.2.c):**<br>Plan includes an analysis of how each project and program will maximize and/or augment water supply. |
| | *OC SWRP **Section 4.2.3** (p.4-7) highlights IRWM goals to increase water supply, its reliability, and use efficiency as well as enhancing flood protection. These goals overlap with WQIP proposed strategies, forming multi-benefit synergies these projects target; OCPW 2011b North IRWM Plan (Sections 4.3, p.4-4); OCPW 2012a Central IRWM Plan (Sections 4.4.1 and 4.4.3, p.4-6 to 4-7); OCPW 2013d South IRWM Plan (Sections 4.3.1 and 4.3.3, p.4-15 and 4-24); OCPW 2016a WQIP B.2 (Section 2, p. 2-25 through 2-33); OC SWRP **Table 4-4** (p.4-9) lists Projects and their details with any expected volumes created, offset, or diverted to be calculated or expressed in appropriate units (AFY or MGD), and/or areas managed or protected from flooding to be calculated or expressed in appropriate units (acres or stream miles).* |
| ☒ | **27. For environmental and community benefit analysis (section VI.C.2.d):**<br>Plan includes a narrative of how each project and program will benefit the environment and/or community, with some type of quantitative measurement. |
| | *OC SWRP **Section 4.2.4** (p.4-7) highlights IRWM goals to protect natural resources and how these projects addressing high priority areas identified in the WQIP, as well as WQIP identified strategies, can work in concert to benefit the environment and/or the community. OCPW 2011b North IRWM Plan (Sections 4.3, p.4-4); OCPW 2012a Central IRWM Plan (Sections 4.4.4 and 4.4.5, p.4-7); OCPW 2013d South IRWM Plan (Sections 4.3.5, p.4-31); OCPW 2016a WQIP B.2 (Section 2, p. 2-25 through 2-33); OC SWRP **Table 4-4** (p.4-9) lists* |

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| | *Projects and their details with any expected environmental and/or community benefits to be expressed or calculated by area (e.g. acres), distance (e.g. stream/street miles), flow augmentation (e.g. cfs) or reduced energy usage (e.g. kilowatt hours).* |
| ☒ | **28. Data management (section VI.C.3):**<br>Plan describes data collection and management, including: a) mechanisms by which data will be managed and stored; b) how data will be accessed by stakeholders and the public; c) how existing water quality and water quality monitoring will be assessed; d) frequency at which data will be updated; and e) how data gaps will be identified. |
| | *OC SWRP **Section 4.3** (p.4-11); RWQCB Monitoring Plans: SAR and SDR; OC SWRP Webpage; OC Monitoring Data; WQIP Clearinghouse; OCPW 2013c SAR ROWD (Sections 2.1, p.2.1.2); OCPW 2014c SDR ROWD (Section 2.1, p.2.1.2); OCPW 2011b North IRWM Plan (Section 7, p.7-1 to 7-5); OCPW 2012a Central IRWM Plan (Section 7, p.7-1 to 7-12); OCPW 2013d South IRWM Plan (Section 7, p.7-1 to 7-10); OCPW 2016a WQIP B.2 (Section 2.2.4, p. 2-19); OCPW 2016b WQIP B.3 (Executive Summary, p.vi)* |

| IDENTIFICATION AND PRIORITIZATION OF PROJECTS (GUIDELINES SECTION VI.D) | | |
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| ☒ | 29. Plan identifies opportunities to augment local water supply through groundwater recharge or storage for beneficial use of stormwater and dry weather runoff.<br>*OC SWRP **Section 5.2** (p.5-5), **Table 4-3** (p.4-5), **Table 4-4** (p.4-9); OCPW 2013c SAR ROWD (Sections Introduction, 3, and 4. p.ii to iii, 3.4.2, 4.1); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2011a SAR Model WQMP (Section 2, p.2-1); OCPW 2013b SDR Model WQMP (Section 2, p.2-6); OCPW 2016b WQIP B.2 (Section 2.4, p. 2-29); SJBA 2013 Groundwater Management and Facilities Plan (Section 3, Figure 3-13); OCWD 2015 Groundwater Management Plan (Executive Summary, p.ES4)* | 10562(d)(1) |
| ☒ | 30. Plan identifies opportunities for source control for both pollution and dry weather runoff volume, onsite and local infiltration, and use of stormwater and dry weather runoff.<br>*OC SWRP **Sections 4.1, 4.2.1, 5.1.1, and 5.3** (p.4-1, 4-5, 5-3, 5-6), **Table 4-3** (p.4-5), **Table 4-4** (p.4-9); OCPW 2011a SAR Model WQMP 2011 (Section 2, p.2-1 to 2-5); OCPW 2013b SDR Model WQMP (Section 2, p.2-1 to 2-5); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2016a WQIP B.2 (Section 2, p. 2-1 to 2-4)* | 10562(d)(2) |
| ☒ | 31. Plan identifies projects that reestablish natural water drainage treatment and infiltration systems, or mimic natural system functions to the maximum extent feasible.<br>*OC SWRP **Sections 4-1** and **5.4** (p.4-1 and 5-7), **Table 4-3** (p.4-5), **Table 4-4** (p.4-9); OCPW 2011a Model SAR WQMP (Section 1, p.1-1 to 1-2); OCPW 2013b Model SDR WQMP (Section 1, p.1-1 to 1-2); OCPW 2015d SOC HMP (Section 3, p. 3-1 to 3-2); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2016b WQIP B.2 (Section 2.3, p. 2-19 to 2-24); OCPW 2016b WQIP B.2 (Section 2.4, p. 2-29 to 2-30)* | 10562(d)(3) |
| ☒ | 32. Plan identifies opportunities to develop, restore, or enhance habitat and open space through stormwater and dry weather runoff management, including wetlands, riverside habitats, parkways, and parks.<br>*OC SWRP **Sections 4-1** and **5.5** (p.4-1 and 5-8), **Table 4-3** (p.4-5), **Table 4-4** (p.4-9); OCPW 2011a North IRWM (Section 4, p.4-5 to 4-6); OCPW 2012b Central IRWM (Section 4, p.4-4 to 4-9); OCPW 2013d South IRWM (Section 4.3.4, p.4-26 to 4-29); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCWD 2015 Groundwater Management Plan (Section 9, p.9-1 to 9-23); OCPW 2016b WQIP B.2 (Section 2.4, p. 2-25 to 2-31)* | 10562(d)(4) |
| ☒ | 33. Plan identifies opportunities to use existing publicly owned lands and easements, including, but not limited to, parks, public open space, community gardens, farm and agricultural preserves, school sites, and government office buildings and complexes, to capture, clean, store, and use stormwater and dry weather runoff either onsite or offsite.<br>*OC SWRP **Sections 1.8** and **5.6** (p.1-16 and 5-8), **Figure 1-7** (p.1-15), **Table 4-3** (p.4-5), **Table 4-4** (p.4-9); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2016b WQIP B.3 (Section 2, p. 2-47)* | 10562(d)(5), 10562(b)(8) |

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| ☒ | 34. For new development and redevelopments (if applicable): Plan identifies design criteria and best management practices to prevent stormwater and dry weather runoff pollution and increase effective stormwater and dry weather runoff management for new and upgraded infrastructure and residential, commercial, industrial, and public development.<br>*OC SWRP* ***Sections 5.1.1, 5.1.2,*** *and* ***5.7*** *(p.5-3, 5-3, and 5-9),* ***Table 4-3*** *(p.4-5),* ***Table 4-4*** *(p.4-9); OCPW 2011a SAR WQMP (All); OCPW 2013b SDR WQMP (All); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); SOCHM.* | 10562(d)(6) |
| ☒ | 35. Plan uses appropriate quantitative methods for prioritization of projects. (This should be accomplished by using a metrics-based and integrated evaluation and analysis of multiple benefits to maximize water supply, water quality, flood management, environmental, and other community benefits within the watershed.)<br>*OC SWRP* ***Sections 4 and 5.1*** *(p.4-1 and 5-1),* ***Figure i-2*** *(p.i-5), and* ***Figure 5-2*** *(p.5-11); OCPW 2013d South IRWM (Sections 4.3 and 6.1.2, p.4-8 to 4-28, and 6-3 to 6-7)* | 10562(b)(2) |
| ☒ | 36. Overall: Plan prioritizes projects and programs using a metric-driven approach and a geospatial analysis of multiple benefits to maximize water supply, water quality, flood management, environmental, and community benefits within the watershed.<br>*OC SWRP* ***Sections 4 and 5.1*** *(p.4-1 and 5-1),* ***Figure i-2*** *(p.i-5), and* ***Figure 5-2*** *(p.5-11); OCPW 2016c WIHMP (Mapping through OC SWRP Webpage); OCPW 2013d South IRWM (Sections 4.3 and 6.1.2, p.4-8 to 4-28, and 6-3 to 6-7); OC SWRP* ***Figure 5-2*** *Prioritized Project List.* | |
| ☒ | 37. Multiple benefits: Each project in accordance with the Plan contributes to at least two or more Main Benefits and the maximum number of Additional Benefits as listed in Table 4 of the Guidelines. (Benefits are not counted twice if they apply to more than one category.)<br>*OC SWRP* ***Sections 4, 5.1, and 5.8*** *(p.4-1, 5-1, and 5-10),* ***Figure i-2*** *(p.i-5), and* ***Figure 5-2*** *(p.5-11)* | |

<table>
<tr><th colspan="3">(GUIDELINES SECTION VI.E)</th></tr>
<tr><td rowspan="2">☒</td><td colspan="2">38. Plan identifies resources for Plan implementation, including: 1) projection of additional funding needs and sources for administration and implementation needs; and 2) schedule for arranging and securing Plan implementation financing.</td></tr>
<tr><td colspan="2">OC SWRP Section 6.2 (p.6-1); OC OCPW 2003 DAMP (Section 2, p.2-6 to 2-7, and Exhibit 2.II); OCPW South IRWM 2013 (Section 2.2 and 8, p.2-5 to 2-9 and 8-1 to 8-8); OCPW North IRWM 2011 (Section 8, p. 8-1 to 8-3); OCPW Central IRWM 2012 (Section 8, p. 8-1 to 8-3)</td></tr>
<tr><td rowspan="2">☒</td><td>39. Plan projects and programs are identified to ensure the effective implementation of the stormwater resource plan pursuant to this part and achieve multiple benefits.</td><td rowspan="2">10562(d)(8)</td></tr>
<tr><td>OC SWRP Section 6.3 (p.6-2); OC SWRP projects and their benefits are identified in Table 4-4 (p.4-9). OC SWRP projects selected for prioritization are identified in Table 5-1 (p.5-13). Project prioritization procedure (Section 5.8, p.5-10) ranks multi-benefit projects and those with quantified benefits higher to ensure multiple benefits are achieved. Functionally equivalent documents of programs are described in this OC SWRP (Section i, p.i-1) and referenced throughout the document.</td></tr>
<tr><td rowspan="2">☒</td><td>40. The Plan identifies the development of appropriate decision support tools and the data necessary to use the decision support tools.</td><td rowspan="2">10562(d)(8)</td></tr>
<tr><td>OC SWRP Sections i, 4.1, 4.2, 5.1, and 6.4 (p. i-1, 4-1, 4-4, 5-1, and 6-2) detail Functionally-Equivalent Plan Roadmap, metrics and project analysis, and project identification for decision support tools and data; OCPW North IRWM 2011, (Section 10, p.10-5 to 10-6); OCPW Central IRWM 2012 (Section 1, p.1.2); OCPW South IRWM 2013 (Section 4, p.4-13); OCPW WQMP SAR 2011 (Section 7.II-1.6, p.1-10 to 1-14); OCPW WQMP SDR 2013 (Section 7.II-1.8, p.1-8 to 1-10); OCPW WIHMP 2016 (Mapping through OC SWRP Webpage); OCPW WQIP B2 2016 (Section 1, p.1.2).</td></tr>
<tr><td rowspan="2">☒</td><td colspan="2">41. Plan describes implementation strategy, including:<br>a) Timeline for submitting Plan into existing plans, as applicable;<br>b) Specific actions by which Plan will be implemented;<br>c) All entities responsible for project implementation;<br>d) Description of community participation strategy;<br>e) Procedures to track status of each project;<br>f) Timelines for all active or planned projects;<br>g) Procedures for ongoing review, updates, and adaptive management of the Plan; and<br>h) A strategy and timeline for obtaining necessary federal, state, and local permits.</td></tr>
<tr><td colspan="2">Timeline for submission of the OC SWRP to IRWM Plans and specific actions by which the OC SWRP will be implemented are addressed in Section 6.5 (p.6-3). Entities responsible for project implementation summarized in Section 3.1 (p.3-1) and are listed in OCPW North IRWM 2011, Section 3.4 (p. 3-6 to 3-10); OCPW Central IRWM 2012, Section 3.4.1, 3.4.2, 3.4.3 (p. 3-11 to 3-20); OCPW South IRWM 2013, Section 2.3 (p. 2-9 to 2-17); OCPW 2014c ROWD and OCPW 2013c ROWD (list of municipalities on front cover). Community participation is described in Section 3.1 and 7 (p.3-1 and 7-1) and detailed in OCPW South IRWM 2013, Section 11.1 (p.11-1 to 11-4); OCPW Central IRWM 2012, Section 11.1 (p.11-1 to 11-2); OCPW North IRWM 2011, Section 11.1 (p.11-1 to 11-3). OC SWRP Section 6.5 (p.6-3) describes: Tracking of project status; timelines for active/planned projects; procedures for ongoing review, updates, adaptive management of the OC SWRP; and the strategy/timeline for obtaining necessary federal, state, and local permits.</td></tr>
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| ☒ | 42. Applicable IRWM plan: The Plan will be submitted, upon development, to the applicable integrated regional water management (IRWM) group for incorporation into the IRWM plan.<br>*OC SWRP* ***Section 6.6*** *(p.6-4); OC SWRP will be submitted to the County for inclusion in the North, Central and South IRWM 2016 Updates. OC SWRP to be included into the OWOW dependent upon SAWPA planning revision timelines and processes.* | 10562(b)(7) |
| ☒ | 43. Plan describes how implementation performance measures will be tracked.<br>*OC SWRP* ***Section 6.7*** *(p.6-5); Tracking of project performance: OCPW South IRWM 2013 (Section 6.2, p.6-7 to 6-18); OCPW North IRWM 2011 (Section 6.3 to 6.4, p.6-4 to 6-5). Tracking of Functionally Equivalent Document performance: OCPW South IRWM 2013 (Section 9, p. 9-1 to 9-20); OCPW North IRWM 2011 (Section 9, p.9-1 to 9-10); OCPW Central IRWM 2012 (Sections 9.2 and 9.3, p. 9-2 to 9-4). Methods for evaluating WQIP performance are under development (see OC SWRP footnote 10).* | |

| EDUCATION, OUTREACH, PUBLIC PARTICIPATION<br>(GUIDELINES SECTION VI.F) | | |
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| ☒ | 44. Outreach and Scoping:<br>Community participation is provided for in Plan implementation.<br>*OC SWRP* ***Sections 3.1, 3.2, 4.3, 7.1 and 7.2*** *(p.3-1, 3-6, 4-11, 7-1, and 7-4); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6); OCPW 2012a Central IRWM Plan 2012 (Section 2, p.2.6 to 2.9, Section 6, p.6-1 to 6-4, Section 10, p.10-1 to 10-2, and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 2, p.2-7 to 2-8, Section 10, p.10-2 to 10-3, and Section 11, p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 2.6.2, p. 2-27 to 2-30, Section 10, p. 10-1 to 10-8, and Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* | 10562(b)(4) |
| ☒ | 45. Plan describes public education and public participation opportunities to engage the public when considering major technical and policy issues related to the development and implementation.<br>*OC SWRP* ***Sections 7.1 and 7.2*** *(p. 7-1 and 7-4); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6); OCPW 2012a Central IRWM Plan 2012 (Section 6, p.6-4, Section 10, p.10-1 to 10-2, and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 10, p.10-2 to 10-3, and Section 11, p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* | |
| ☒ | 46. Plan describes mechanisms, processes, and milestones that have been or will be used to facilitate public participation and communication during development and implementation of the Plan.<br>*OC SWRP* ***Sections 7.1 and 7.2*** *(p. 7-1 and 7-4); OCPW 2013c SAR ROWD (Section 3.3, p.3.3.1 to 3.3.4); OCPW 2014c SDR ROWD (Section 3.3, p.3.3.1 to 3.3.6); OCPW 2012a Central IRWM Plan 2012 (Section 6, p.6-4 and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 11, (p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* | |

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| ☒ | 47. Plan describes mechanisms to engage communities in project design and implementation.<br>*OC SWRP* ***Sections 7.1 and 7.2*** *(p. 7-1 and 7-4); OCPW 2012a Central IRWM Plan 2012 (Section 6, p.6-4 and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 11, p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* |
| ☒ | 48. Plan identifies specific audiences including local ratepayers, developers, locally regulated commercial and industrial stakeholders, nonprofit organizations, and the general public.<br>*OC SWRP* ***Sections 1.6, 3.1, 7.1 and 7.3*** *(p. 1-8, 3-1, 7-1, and 7-4),* ***Table 7-1*** *(p.7-7); OCPW 2013c SAR ROWD (Section 3.6, p.3.6.1 to 3.6.17); OCPW 2014c SDR ROWD (Section 3.6, p.3.6.1 to 3.6.14); OCPW 2012a Central IRWM Plan 2012 (Section 3, p.3-10 to 3-20); OCPW 2011b North IRWM Plan 2011 (Section 3, p.3-3 to 3-10); OCPW 2013d South IRWM Plan (Section 2, p.2-18 to 2-22, Section 3, p.3-6 to 3-9 and 3-79 to 3-80); OCPW 2003 DAMP (Section 9, p.9-1 to 9-17)* |
| ☒ | 49. Plan describes strategies to engage disadvantaged and climate vulnerable communities within the Plan boundaries and ongoing tracking of their involvement in the planning process.<br>*OC SWRP* ***Section 7.4*** *(p.7-8); OCPW 2012a Central IRWM Plan 2012 (Section 11, p.11-2 to 11-4 and Section 12, inclusive; impacts to DACs on p. 12-9); OCPW 2011b North IRWM Plan (Section 3, p. 3-11-3-12, Section 11, p.11-3 to 11-5, and Section 12, inclusive; impacts to DACs on p. 12-8), OCPW 2013d South IRWM Plan (Section 3, p.3-82 to 3-83 and 3-86, Section 6.2.3, p.6-16 to 6-18, Section 11, p.11-1 to 11-7, Section 12, inclusive, and Appendix J, inclusive).* |
| ☒ | 50. Plan describes efforts to identify and address environmental injustice needs and issues within the watershed.<br>*OC SWRP* ***Section 7.4*** *(p.7-8); OCPW 2012a Central IRWM Plan (Section 11, p.11-2 to 11-4); OCPW 2011b North IRWM Plan (Section 3, p. 3-11 to 3-12, Section 11, p.11-3 to 11-5); OCPW 2013d South IRWM Plan (Section 4.1.1.8, p.4-7 to 4-8, Section 6.2.3, p. 6-16 to 6-18, and Section 11, p.11-4 to 11-7)* |
| ☒ | 51. Plan includes a schedule for initial public engagement and education.<br>*OC SWRP* ***Sections 7.1 and 7.2*** *(p. 7-1 and 7-4); OCPW 2012a Central IRWM Plan 2012 (Section 6, p.6-4 and Section 11, p.11-1 to 11-2); OCPW 2011b North IRWM Plan 2011 (Section 11, p.11-1 to 11-2); OCPW 2013d South IRWM Plan (Section 11, p.11-1 to 11-5); OCPW 2016a WQIP (Section 1.4, p.1-4 to 1-5)* |

## DECLARATION AND SIGNATURE

**I declare under penalty of perjury that all information provided is true and correct to the best of my knowledge and belief.**

Jenna Voss — Environmental Eng. Specialist — 2/28/17

**Signature** **Title** **Date**

Marilyn Thoms — Mgr, Watershed Management Division — 2/28/17

**Signature** **Title** **Date**

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