TECHNICAL MEMORANDUM #1

RE: SANTA ANA RIVER WATERSHED
DATE: March 3, 2006

Prepared for:	**Prepared by**:
County of Orange Resources &	Tetra Tech, Inc.
Development Management Department	Irvine, CA
Environmental Resources	

The County of Orange Resources and Development Management Department (RDMD) is in the process of developing Watershed Chapters for each of the watersheds within Orange County. These Watershed Chapters will be included as an appendix to the Drainage Area Master Plan (DAMP) and will provide specific information regarding the watershed setting, an assessment of the water quality, the plan of action within the watershed to improve the water quality, and the steps to be taken to assess the effectiveness of the program.

In each watershed the first step in the development of the Watershed Chapter is an inventory of the existing studies that are available in that watershed. This Technical Memorandum for the Santa Ana River Watershed summarizes the studies that were collected as part of this effort.

The Santa Ana River Watershed within Orange County consists of 4 main elements: (1) Lower Santa Ana River; (2) Upper Santa Ana River in Orange County, (3) Talbert Channel and (4) Santiago Creek. The Basin Plan identifies the following receiving waters within Orange County:

Santa Ana River

- Santa Ana River Reach 1 – Tidal Prism to 17th Street
- Santa Ana River Reach 2 – 17th Street – Prado Dam
- Carbon Canyon Creek

Santiago Creek Drainage

- Santiago Creek: Reach 1 – below Irvine Lake
- Santiago Creek: Reach 2 – Irvine Lake
- Santiago Creek: Reach 3 – Irvine Lake to Modjeska Canyon
- Santiago Creek: Reach 4 – in Modjeska Canyon
- Silverado Creek
- Ladd Creek
- Black Star Creek

Lower Santa Ana River closely matches the Basin Plan Santa Ana River Reach 1. Talbert Channel is included as part of the Basin Plan Santa Ana River Reach 1. Upper Santa Ana River in Orange County closely matches the Basin Plan Santa Ana River Reach 2.

Studies Sources / Authors

The data search within the Santa Ana River Watershed included website searches and contact with staff from municipal agencies and non-profit organizations. The main study contributors include the United States Geological Survey (USGS), the Santa Ana Watershed Project Authority (SAWPA), and the Huntington Beach Wetlands Conservancy. The following table identifies the specific agencies and groups for which contact was made to obtain information.

Table 1. Data Research Contacts

Agency	**Comments**
EPA	Several reports were found in their online library and referenced.
United States Geological Survey	Numerous references were obtained.
U.S. Army Corps of Engineers	Two references were obtained.
California Department of Water Resources	No references were obtained.
Regional Board, Santa Ana	Reports available on their website were included.
Santa Ana Watershed Project Authority	Numerous references were obtained.
Scripps Institution of Oceanography	No references were obtained.
County of Orange RDMD Environmental Resources & Flood Control	One report was obtained.
SCCWRP	One report was obtained.
National Water Research Institute	One report was obtained.
OCSD	References being sought.
OCWD	Several references were obtained.
Cities within the Watershed	No references were obtained.
Huntington Beach Wetlands Conservancy	Several references were obtained.
UC Berkeley	One report was obtained.
UC Irvine	Several references were obtained.

Through these sources, a total of 42 studies were obtained within the Santa Ana River Watershed.

Geographical Extent of Studies

The studies that were obtained through the data collection effort were categorized as coastal or watershed studies. Of the 42 studies obtained, 9 were focused on the coastal area and the remaining 33 studies focused on the watershed outside of the coastal area.

Water Quality Data

A significant source of persistent water quality data in the watershed is the Orange County Health Care Agency. The Orange County Health Care Agency monitors the ocean water in the surf zone and specifically tests for bacteria. Within this watershed the sampling is performed by the Orange County Sanitation District at 5 locations along the beach. Each week 5 samples are taken at each of these locations.

The County of Orange monitoring program has evolved through the changing requirements of the NPDES permits. The current program includes 2 basic station types – NPDES stations and TMDL stations. Both station types include wet and dry weather monitoring schedules. NPDES stations are monitored for a broad range of constituent including heavy metals. TMDL stations are largely monitored for nutrients. No County of Orange monitoring stations are located within this watershed.

Bibliography of Studies

A bibliography that includes the existing studies collected as part of this effort was developed and is included as Attachment 1 to this Technical Memorandum.

Santa Ana River Watershed Environmental Matrix

Record #	Program Name or Report Title	Sample Location	Start Date	End Date	flow conditions	entity	Bacteria	nutrients	metals	pesticides	toxicity / TIE studies	water chemistry	fish tissue	sediments	comments
27	Orange County NPDES Program	watershed		ONGOING		OC	1	1	1	1	1	1		1	
2	Annual Ocean and Bay Water Quality Report	along coast		ONGOING		OCHCA	1								
50	Blue Ribbon Panel Report Phase II			2000		NWRI	1								
52	Urban Runoff Impact Study Phase II: Sources and Dynamics of Pollutants in the Lower Santa Ana River Watershed, Proposal			2000		NWRI	1								
24	OCSD Source Control Program: Section 7.8, Urban Runoff Program		2005	ONGOING	d	OCSD	1	1	1	1	1	1			
25	OCSD Urban Runoff Study		2005	ONGOING	d	OCSD									
54	Huntington Beach Closure Investigation Phase I, Final Report			1999		OCSD	1								
8	Dairy Washwater Treatment Demonstration Project (0-036-258-0)	5 Acres in San Bernardino County at Lat/Lon: 33.95000 / -117.65000		Jun-00		OCWD	1	1							Washwater sampled 25-30 times per year for 3 - 4 years for nutrients, "pollutants" and salinity.
26	OCWD Internal Water Quality Database	Throughout Santa Ana River Watershed, Sites change as planning evolves, always below Prado Dam, SAR has lots of sites, not all are sampled all the time, and have varied parameters, and frequency changes		2005		OCWD	1	1	1	1	1	1			They don't do algae or sediment testing, but everything else is typically tested annually. At some sites, sampling is done monthly.
36	Santa Ana River Water Quality and Health (SARWQH) Study	Locations throughout SARW		1988		OCWD	1	1			1	1			
48	In Response to 02/03/04 13267 Directive			2004		RDMD	1								
49	PFRD Medium Range Plan			2000		RDMD	1								
43	Water quality control plan, Santa Ana River basin (8) 1995			1995		RWQCB	1	1	1	1	1	1	1	1	
9	Draft Manure Management Strategy for the Chino Basin, SARW	Throughout the SARW		1999		SARWG						1			TDS and Nitrate quantities are reported for Chino Basin, but no sampling procedures are provided.
4	Chino TMDL Monitoring Program	Locations throughout SARW	Feb-02	ONGOING		SAWPA	1					1			WQ tested includes conductivity, pH, temp, DO, and turbidity. Pathogens sampled for include T. Coli, E. Coli, F. Coli, and Enterococci.
10	Draft Perchlorate Summary Report. Santa Ana River Watershed	Locations throughout SARW		2004		SAWPA					1				This study focuses on perchlorate presence in watershed and reports general concentrations within subbasins, but does not detail study parameters.
12	Feasibility Report for Treatment and Disposal of Toxic Wastes Generated in the SAW	SARW		May-01		SAWPA			1		1				No original studies were conducted, but estimates for these parameters were made based on existing data. Toxic inorganics, toxic organics, oily wastes, solvents and volatile organics, and acids, and alkalies were reviewed.
13	Final Report - Santa Ana Watershed Project Authority Basin Plan Upgrade Task Force. Nitrogen and TDS Studies Upper SAW.	Up to 100 wells throughout the SARW	1988	1989		SAWPA		1				1			TDS and Nitrate quantities are sampled and reported.
17	Lake Elsinore and Canyon Lake Nutrient Source Assessment	The San Jacinto Watershed	Jan-00	Dec-00		SAWPA		1				1			Nitrogen and phosphorous.
31	Santa Ana River - Nitrogen and Total Organic Carbon (1-082-250)	SAR	Oct-90	Dec-93	c	SAWPA		1							"Pollutants- organics" also noted as monitored.
32	Santa Ana River - Sources and Sinks of Nitrogen (8-181-250)	Santa Ana River between Waterman Avenue and Prado Dam	1998	1992	c	SAWPA		1				1			"Nutrients, pollutants, water quality" noted as monitored.

Record #	Program Name or Report Title	Sample Location	Start Date	End Date	flow conditions	entity	Bacteria	nutrients	metals	pesticides	toxicity / TIE studies	water chemistry	fish tissue	sediments	comments
39	Stormwater Quality Standards Study - Phase I Study Report	Locations throughout SARW	1995	1998	w	SAWPA									Existing data was reviewed, but no additional sampling has been done. The documents listed within this matrix were reviewed for existing data.
40	Surface Runoff Wasteload Assessment	Historical data throughout SARW	1931	1967		SAWPA						1			Specific parameters reviewed included TDS, Cl, Total Hardness, NO3, and Boron.
42	Use of Fecal Steroids to Infer the Sources of Fecal Indicator Bacteria in the Lower Santa Ana River Watershed, California: Sewage Is Unlikely a Significant Source	Lower Santa Ana River	Jun-01	Jul-07	d	SCCWRP	1								
1	Amount and Composition of Wastewater Discharged by Dairies in the Chino Basin	10 Dairies within the Chino Basin		Dec-97	d	UC Coop	1	1	1			1			
23	Nitrate removal from a drinking water supply with large free-surface constructed wetlands prior to groundwater recharge	wetland	2000	2000	ground water	UCB		1							
5	Coastal Pollution from Microorganisms in Urban Runoff	w	2005	ONGOING	tidal	UCI	1								
6	Coastal water quality Impact of Stormwater Runoff from an Urban Watershed in S. California	Ocean	2004	2004	w	UCI	1					1			study from feb 18-march 3
19	Locating Sources of Surf Zone Pollution: A Mass Budget Analysis of Fecal Indicator Bacteria at Huntington Beach, CA	surf zone, ocean	2001	2001	tidal	UCI	1								
28	Public Mis-notification of Coastal Water Quality: A Probabilistic Evaluation of Posting Errors at Huntington Beach, CA	surf zone, ocean	1999	1999	tidal	UCI	1								May 1 to Oct 31, 1999
29	Reeves, R.L., S.B. Grant, R.D. Mrse, C.M. Oancea, B.F. Sanders, A.B. Boehm, Scaling and management of fecal indicator bacteria in runoff from a coastal urban watershed in southern California, Environ.	Santa Ana River	1999	2003	tidal	UCI	1								Fecal indicator basteria study. Dec 1999-Jan 2003
51	Huntington Beach Closure Investigation: Technical Review			2000		UCI	1								
53	Tidal Transport of Bacteria between the Talbert Watershed and the Ocean Interim Report 1 for the UCI Coastal Runoff Impact Study (CRIS)	tidal		2000	tidal	UCI	1								
22	Native and contaminated ground waters in the Long Beach-Santa Ana area, California	ground water		1953	ground water	US GPO			1			1			
30	Report on Water Pollution Control, Santa Ana River Basin, California Drainage Basin.	river		1951		US Public Health Agency									
34	Santa Ana River Phase I GDM on the Santa Ana River Mainstem including Santiago Creek and Oak Street Drain. Draft.			1980		USACE									
35	Santa Ana River Phase II GDM on the Santa Ana River Mainstem including Santiago Creek			1988		USACE									
3	Bacterial contamination at Huntington Beach, California - Is it from a local offshore wastewater outfall?	tidal	2001	2001	tidal	USGS	1								
7	Concentrations of dissolved solids and nutrients in water sources and selected streams of the Santa Ana Basin, California, October 1998-September 200, Report #03-4326	All over watershed	Oct-98	Sep-01	w	USGS	1					1			

Record #	Program Name or Report Title	Sample Location	Start Date	End Date	flow conditions	entity	Bacteria	nutrients	metals	pesticides	toxicity / TIE studies	water chemistry	fish tissue	sediments	comments
11	Engineering Services in Support of Investigating and Eliminating Bacteria in Urban Runoff Discharges to Huntington Beach.	Hamilton and Meredith Pump Station Forebays at downstream reach of SAR		1992		USGS	1								Fecal indicator basteria study.
14	Ground-water quality in the Santa Ana Watershed, California : overview and data summary, Report 02-4243	207 wells, coastal range province	1999	2001	ground water	USGS						1			Does not specify what was tested for, just "water quality" and dissolved constituents
15	Ground-water quality in the upper Santa Ana River basin, southern California	Prado Dam	1968	1977	ground water	USGS		1	1						
16	Huntington Beach Shoreline Contamination Investigation, Phase III Coastal Circulation and Transport Patterns: The Likelihood of OCSD's Plume Impacting Huntington Beach Shoreline	surfzone	1999	1999	tidal	USGS	1								
20	Low-Level Volatile Organi Compounds in Active Public Supply Wells as Ground-Water Tracers in the Los Angeles Physiographic Basin, California, 2000	river		2000	ground water	USGS					1	1			VOCs
21	Microbial and Dissolved Organic Carbon Characterization of Stormflow in the Santa Ana River at Imperial Highway, Southern California, 1999-2002		1999	2002	w	USGS	1								
37	Stormflow Chemistry in the Santa Ana River below Prado dam and at the diversion downstream from Imperial Highway, S. CA 1995-98		1995	1998	w	USGS		1	1	1		1			
38	Stormflow Chemistry in the Santa Ana River below Prado Dam and at the Diversion Downstream from Imperial Highway, Southern California, 1995-98. - Water resources investigation (Final).		1995	1998	w	USGS		1	1	1		1			
44	Water Quality in the Santa Ana Basin	watershed	1998	2001	c	USGS		1		1		1	1	1	summary report of a series of USGS reports
45	Water Quality in the Santa Ana Basin, California, 1999-2001			2004		USGS		1	1	1	1	1		1	
46	Water-quality trends in the Santa Ana River at MWD Crossing and below Prado Dam, Riverside County, California	river	1969	1995	c	USGS		1	1						
41	Tailoring Requirements to Reality: The Santa Ana River Use Attainability Analysis	river	1991	1991		Water Environmnt Federation	1	1	1		1	1	1		39 sites studied along the entire length of the river; incl vegetation survey
33	Santa Ana River investigation.	river		1959		Cal DWR		1	1						
47	Watershed Impacts Report	Hamilton and Meredith Pump Station Forebays at downstream reach of SAR		7-Jun-04		Huntington Beach	1	1	1	1	1		1	1	Trash and Debris, Organics, Oils and Grease were also monitored
18	Letter Report, Bolsa Chica Project - Additional Modeling Services Related to Bird Use of the Bolsa Chica Wetland M&N File: 4012-18	wetland	1999	2001	tidal	Moffat & Nichols	1	1							modeling only, no actual data collected at Talbert Marsh. Inner Bolsa Bay data collected from April 1999-May 2001.
55	Enumeration and speciation of enterococci found in marine and tidal sediments and coastal water in Southern California	Huntington Beach State Beach and Dana Point Harbor	Aug-02	Jan-04		OC Public Health Laboratory	1							1	water and sediment samples taken to analyze bacteria levels

DRAFT TECHNICAL MEMORANDUM #2

RE: SANTA ANA RIVER WATERSHED
DATE: MARCH 30, 2006

Prepared for:	**Prepared by**:
County of Orange Resources &	Tetra Tech, Inc.
Development Management Department	Irvine, CA
Environmental Resources	

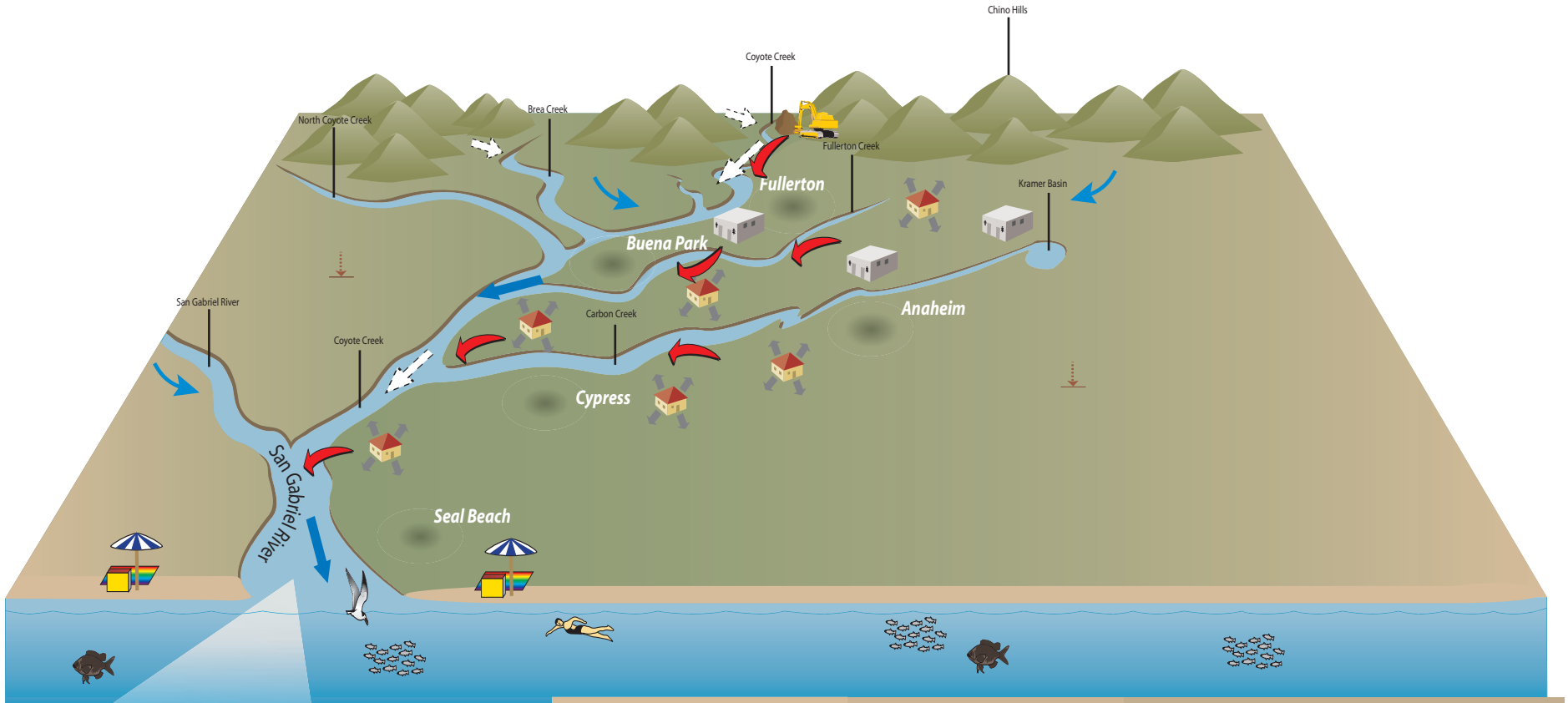
The County of Orange Resources and Development Management Department (RDMD) is in the process of developing Watershed Chapters for each of the watersheds within Orange County. These Watershed Chapters will be included as an appendix to the Drainage Area Master Plan (DAMP) and will provide specific information regarding the watershed setting, an assessment of the water quality, the plan of action within the watershed to improve the water quality, and the steps to be taken to assess the effectiveness of the program.

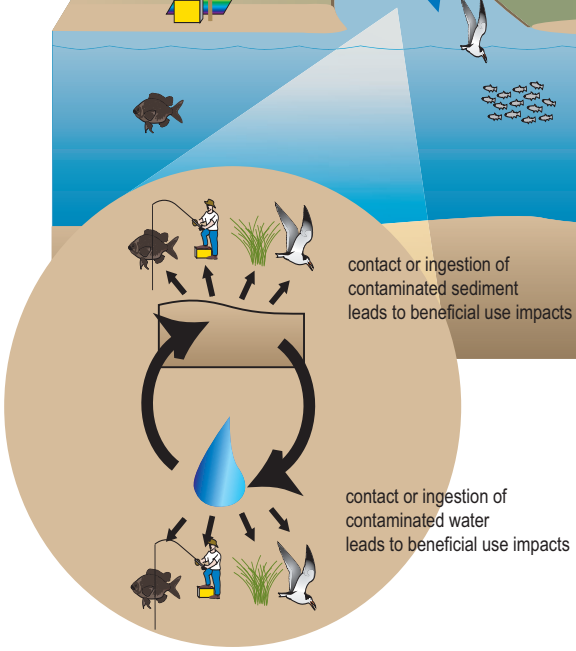
The first step in the development of the Watershed Chapter is an inventory of the existing studies that are available in that watershed. A significant number of studies have been conducted in the Santa Ana River Watershed. A technical memorandum, Technical Memorandum #1, focused on the collection of the existing data. The data collection effort for that memorandum ended in March 2006 and includes studies completed and underway at that time. The second step in the development of the Watershed Chapter is an assessment of the water quality data and identification of data gaps within the body of knowledge that has been generated for the Santa Ana River Watershed. The assessment and identification of data gaps is presented in this technical memorandum (Technical Memorandum #2).

The Santa Ana River Watershed consists of 4 elements: (1) Santa Ana River Reach 1, (2) Santa Ana River Reach 2, (3) Carbon Canyon Creek/Diversion, and (4) Santiago Creek. Before assessing the water quality data, it is helpful to understand the water quality related processes at work within these waterbodies. The following figure provides a graphical representation of those processes. The processes include:

1. Source of pollutants – from where do the pollutants originate. In some instances the origination is known only generally; in others the specific origin is know.
2. Transport of pollutants – how are the pollutants transported from the sources into the receiving waters (the rivers and ocean).
3. Fate of pollutants – how do the pollutants impact various users of the system. The fate of the pollutants is directly tied to the impacts of the beneficial uses present in the watershed.

San Gabriel - Coyote Creek Watershed





Sources of Pollutants

- Construction Runoff
- Industrial / Commercial Runoff
- Urban Runoff
- Atmospheric Deposition
- Groundwater
- Sediment from erosion on the land or in the river
- Cities

Transport of Pollutants

- Pollutant Path into Rivers and Creeks via stormdrains or overland flow
- Dissolved in river water
- Attached to sediment
- Dissolved in groundwater

Fate of Pollutants Leading to Beneficial Use Impacts

- Pollutants are taken up into the vegetation and contaminate birds and fish through ingestion
- Invertebrates, fish, and birds accumulate pollutants by ingesting contaminated water or eating other contaminated species
- Pollutants reach human population by contact through recreational activites or consumption of contaminated fish

WATER QUALITY DATA ASSESSMENT

There is a large amount of water quality data that is available specific to the Santa Ana River Watershed. Fifty four (54) studies were identified that provide water quality information specific to the Santa Ana River Watershed. A matrix was developed to provide a detailed view of each of the studies / programs discussed in this technical memorandum. This matrix is referred to as the Santa Ana River Environmental Matrix and includes information such as the specific constituents of concern included in the study / program, and details of the monitoring and management issues supported by that study / program. The Santa Ana River Environmental Matrix is included in this technical memorandum as Attachment 1.

It is a significant challenge to assemble the report references into a meaningful framework that provides the reader with an idea of what type of data or results are available. In order to meet the various types of user needs that were envisioned, the data has been 'cut' in several directions. Each 'cut' or assessment represents the sum total of all the programs and studies that were assembled as part of this technical memorandum; the difference is only in the perspective taken in that assessment.

Assessment #1: Program Management and Policies

A reasonable question to ask when faced with the abundance of data that exists, is whether this data is providing stormwater program coordinators with the information needed to manage the program and make informed decisions for the watershed. The knowledge needed at various stages in the program development must be able to build on previous efforts to attain constantly improving results. The following passage from Managing Troubled Waters (National Academy Co, 2003) explains this iterative process.

> *"The reality of imperfect knowledge about marine systems means that monitoring should be used as an opportunity to increase and refine our knowledge of them. Data and information derived from monitoring programs should be used to check, validate, and refine the assumptions, models, and understandings on which the monitoring was based. This iterative feedback increased predictive ability, reduces uncertainty, and ultimately reduces the monitoring effort needed. As discussed in Chapter 2, risk-free decision making is not achievable, and monitoring must be viewed as a way of reducing uncertainty, not of eliminating it."*

The following table identifies the aspects of a stormwater program that are needed to advance the knowledge of the systems and identifies the number of studies that are relevant to each category. Each of these categories is considered in relation to specific pollutants of concern or elements of the watershed system.

Table 1. Assessment #1 - Studies by Program Management Category.

	Source Identification	Understanding processes	Developing new tools	Determine compliance with WQs/TMDLs	Evaluate Program/ Measure Effectiveness	Provide Early Warning
Bacteria	15	12	5	9	6	2
Nutrients	9	7	9	13	4	1
Inorganics-Metals	4	5	6	10	3	1
Organics-Pesticides	3	2	4	8	3	1
Toxicity	4	2	5	6	3	1
Water Chemistry	8	8	7	13	3	1
Solids-Sediment	3	2	4	4	3	1
Fish Tissue	2	1	2	3	1	0

The Santa Ana River Environmental Matrix identifies which program aspects relate to which specific reports. The matrix uses the following abbreviations: Source Identification (SI), Understanding Processes (UP), Developing New Tools (NT), Determine compliance with WQs / TMDLs (WT), Evalute Program / Measure Effectiveness (EP), Provide Early Warning (EW)

Assessment #2 – Study and Program Type

The 54 studies and programs identified within the Santa Ana River Watershed have generated different types of water quality data. This data falls within two broad categories including: (1) generation of raw data and (2) assessment of existing data.

Raw data studies and programs include specific sampling or monitoring activities. This accounts for the majority of the 54 studies included in this assessment. New data was generated with two different objectives. The first objective was compliance with National Pollutant Discharge Elimination System (NPDES) permits. Compliance activities include the Orange County NPDES and Total Maximum Daily Load (TMDL) monitoring programs as well as monitoring programs conducted by other permitted facilities. The second objective in generating raw data was to understand the concentration levels or processes related to the pollutants, or the impacts of the pollutants, on the ecosystem. Studies targeting pollutant concentrations and processes generally involved direct measurements of the pollutants while studies targeting the impacts of the pollutants generally involved other environmental measurements.

Studies that focused on the assessment of existing data were performed with the objectives of either understanding the behavior of a pollutant within the Santa Ana River system through direct measurement of those pollutants or understanding the impacts of the pollutants by measuring other environmental parameters.

The following figure shows the category breakdown of the studies as well as the general objective of the study.

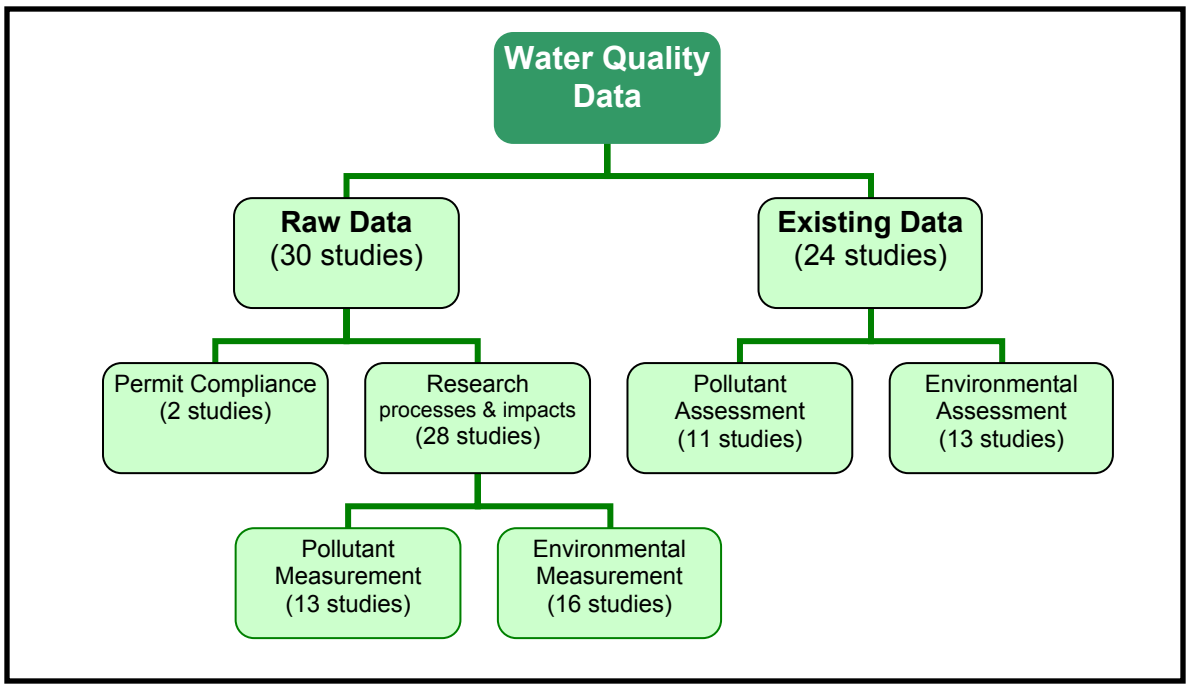


Figure 2. Study Category Breakdown.

Assessment #3 – Study or Program Details
The final assessment that was made of the studies and programs was to look at basic details such as who performed the study and what pollutants were included in those studies and programs.

Within the Santa Ana River Watershed the major generators of water quality data are the United States Geologic Survey (USGS), Santa Ana Watershed Project Authority (SAWPA), and the University of California Irvine (UCI). The following table identifies the organizations responsible for each of the 54 studies. For collaborative studies, the primary organization was used for the accounting below.

Table 2. Study Sources

Organization	# of Studies
USGS	13
SAWPA	9
Other Agencies (RWQCB, DPR, DWR, SARWG, USACE)	8
SCCWRP	1
RDMD, OCWD, OCSD, OCHCA, Cities	11
Universities (UCI, UCB, UC Coop)	9
Private (consultants, NWRI)	3

Each of the 54 water quality studies or programs that were identified as part of this data assessment addressed one or more specific pollutants. Ten (10) categories of constituents were identified that encompass nearly all of the specific data that was monitored or assessed. These 10 categories include:

- Bacteria
- Nutrients
- Metals
- Pesticides
- Toxicity – various levels of toxicity studies were performed
- Conventional water chemistry – this includes a wide ranges of variables such as pH, hardness, and temperature
- Sediment – this includes both bulk sediment and sediment contamination
- Fish Tissue

The following table shows the distribution of the studies within each of these categories. Many studies include work related to several constituents.

Table 3. Constituent Focus of Studies and Programs

Constituent	# of Studies
Bacteria	30
Nutrients	22
Metals	15
Pesticides	9
Toxicity	11
Water chemistry	22
Sediment	5
Fish Tissue	4

DATA GAPS

Managing and improving water quality in an urban environment is a complex issue. The science needed to deal with many of the issues that arise during the management process is evolving, and in some cases has not yet developed to the point that important questions can readily be answered in absolute quantifiable terms. Examples where our understanding is not fully developed are as follows:

- Stormwater runoff modeling relative to pollutants of concern. This modeling is not totally reliable for predictive purposes and needs large data sets to calibrate.
- Methods (such as MST (microbial source tracking)) for more accurately identifying sources of pathogens in runoff (e.g., wildlife, pets, humans) are still being refined. Only qualitative methods exist at this time and they are not yet able to be directly translated into a loading assessment. For example, we may be able to say that 50% of the fecal coliform bacteria from a sample are from dogs but this does not imply that 50% of the loading of fecal bacteria is from dogs.
- The effectiveness of various BMPs (Best Management Practices) under varying conditions has not been systematically assessed under field conditions.

These and other data gaps have been identified to some extent in the research study reports, the research agenda for the Stormwater Monitoring Coalition, and the specific requirements of the NPDES permits. However, a thorough and conceptually organized listing of data gaps must stem from a thoughtful description of the key management questions related to the watershed. There are two reasons for this. First, there is a virtually infinite array of scientific data that could be gathered in a complex system such as this. It is essential to focus effort on those data types that are useful in decision making. Second, data gaps sometimes stem, not from the absence of data, but from the inability to adequately integrate existing data. Articulating clear questions enables studies to be designed so that disparate data types can be combined as needed to address complex issues.

Pollutant Data Gaps

The list below identifies data gaps related to a specific pollutant, bacteria. A lengthier discussion of the bacteria-related data gaps follows the summary list below.

- *Bacteria*
  - Urban vs. natural sources

- Rapid Bacteriological Indicators
- MST (microbiological source tracking) identification methods

Bacteria

A special study will be performed to improve understanding of the correlations between levels of indicator bacteria in the surfzone (where most of the contact recreational activities take place) and levels in the stormdrains themselves. This study will be performed by the County as part of the Santa Ana Region Water Quality Monitoring Program based on the approach recommended by the Stormwater Monitoring Coalition.

The applicability of current bacteriological indicators for measuring human health risk and for identifying the sources of pathogen contamination needs further refinement. Two projects identified in SCCWRP Technical Report 35B *Stormwater Research Needs in Southern California* identify plans to address these issues. The first project (Project 12. *Develop rapid response indicator(s) for microbial contamination*) is focused on producing easily used field tests that would provide a reliable measure of bacteriological contamination within a few hours at most. The second project (Project 13. *Develop microbial source tracking protocol*) will select methods (primarily genetic-based) that provide the most dependable means of identifying and distinguishing among sources.

Considerable resources are being expended to reduce bacterial contamination from watershed sources, but in many cases storms drains continue to discharge large concentrations of fecal indicator bacteria (FIB). A study by SCCWRP will examine if FIB can grow in storm drain sediments. This study, *Storm Drains and Sediments as Reservoirs of Fecal Indicator Bacteria*, is being led by John Griffith.

Other Data Gaps

In addition to the data gaps related to specific pollutants, there are data gaps related to specific beneficial use impairments and the use attainability analyses relative to the achievability of a water quality goal. Specifically, what is the direct and indirect link between the beneficial use impairment by a pollutant and how is this linked to the water quality standard? In addition, what is the link between pollutant source control, and pollutant treatment management relative to achieving a specific water quality standard or goal? In other words, is there data to demonstrate that a goal is achievable or not? In the case of bacteria there may be a need to gather data relative to controllable sources to determine what is truly attainable and whether or not a use attainability analysis should be conducted relative to compliance requirements. Studies needed to answer many of these questions (and eliminate the data gap) have been identified in the *Phase 1 Stormwater Quality Standards* report (SAWPA, 2005).

An additional data gap exists with the ability to use any given set of data for further analysis. Figure 1, which identifies the number of studies in each category, indicates a significant number of studies / programs generating new data. This indicates that some of the studies have been conducted independent of the overall needs of the regulatory compliance goals throughout the watershed. The Stormwater Monitoring Coalition has recognized the need to develop a regional stormwater monitoring infrastructure. As part

of the *Stormwater Research Needs in Southern California* report (SCCWRP, 2002), the coalition has identified 4 projects to address this need. These projects include (1) integrate and evaluate available data; (2) standardize sampling and analysis protocols; (3) develop a regional data infrastructure; and (4) measure BMP effectiveness.

An additional data gap that the Stormwater Monitoring Coalition (SCCWRP, 2002) has identified is a need to improve fundamental understanding of stormwater mechanisms and processes. To meet this need the following projects have been identified: (1) develop a system wide conceptual model; (2) Determine appropriate reference conditions; (3) develop a regional method for measuring beneficial use condition; and (4) identify relative contribution of nonpoint sources to urban runoff loads.

The final data gap identified by the Stormwater Monitoring Coalition (SCCWRP, 2002) is related to identifying receiving water impacts. The following studies were identified to address this need: (1) identify the causes of impact in receiving waters; (2) develop bioassessment indicators and protocols; (3) develop improved toxicity testing procedures; (4) develop raid response indicator(s) for microbial contamination; (5) develop microbial source tracking protocol; (6) evaluate BMP effects on receiving water impacts; and (7) develop improved indicators of peak flow impacts.

Several of the identified Stormwater Monitoring Coalition projects have been funded and are underway.

Attachment 1: Santa Ana River Environmental Matrix

Santa Ana River Watershed Environmental Matrix

Record #	Program Name or Report Title	Sample Location	Start Date	End Date	flow conditions	entity	Bacteria	nutrients	metals	pesticides	toxicity / TIE studies	water chemistry	fish tissue	sediments	comments
27	Orange County NPDES Program	watershed		ONGOING		OC	1	1	1	1	1	1		1	
2	Annual Ocean and Bay Water Quality Report	along coast		ONGOING		OCHCA	1								
50	Blue Ribbon Panel Report Phase II			2000		NWRI	1								
52	Urban Runoff Impact Study Phase II: Sources and Dynamics of Pollutants in the Lower Santa Ana River Watershed, Proposal			2000		NWRI	1								
24	OCSD Source Control Program: Section 7.8, Urban Runoff Program		2005	ONGOING	d	OCSD	1	1	1	1	1	1			
25	OCSD Urban Runoff Study		2005	ONGOING	d	OCSD									
54	Huntington Beach Closure Investigation Phase I, Final Report			1999		OCSD	1								
8	Dairy Washwater Treatment Demonstration Project (0-036-258-0)	5 Acres in San Bernardino County at Lat/Lon: 33.95000 / -117.65000		Jun-00		OCWD	1	1							Washwater sampled 25-30 times per year for 3 - 4 years for nutrients, "pollutants" and salinity.
26	OCWD Internal Water Quality Database	Throughout Santa Ana River Watershed, Sites change as planning evolves, always below Prado Dam, SAR has lots of sites, not all are sampled all the time, and have varied parameters, and frequency changes		2005		OCWD	1	1	1	1	1	1			They don't do algae or sediment testing, but everything else is typically tested annually. At some sites, sampling is done monthly.
36	Santa Ana River Water Quality and Health (SARWQH) Study	Locations throughout SARW		1988		OCWD	1	1			1	1			
48	In Response to 02/03/04 13267 Directive			2004		RDMD	1								
49	PFRD Medium Range Plan			2000		RDMD	1								
43	Water quality control plan, Santa Ana River basin (8) 1995			1995		RWQCB	1	1	1	1	1	1	1	1	
9	Draft Manure Management Strategy for the Chino Basin, SARW	Throughout the SARW		1999		SARWG						1			TDS and Nitrate quantities are reported for Chino Basin, but no sampling procedures are provided.
4	Chino TMDL Monitoring Program	Locations throughout SARW	Feb-02	ONGOING		SAWPA	1					1			WQ tested includes conductivity, pH, temp, DO, and turbidity. Pathogens sampled for include T. Coli, E. Coli, F. Coli, and Enterococci.
10	Draft Perchlorate Summary Report. Santa Ana River Watershed	Locations throughout SARW		2004		SAWPA					1				This study focuses on perchlorate presence in watershed and reports general concentrations within subbasins, but does not detail study parameters.
12	Feasibility Report for Treatment and Disposal of Toxic Wastes Generated in the SAW	SARW		May-01		SAWPA			1		1				No original studies were conducted, but estimates for these parameters were made based on existing data. Toxic inorganics, toxic organics, oily wastes, solvents and volatile organics, and acids, and alkalies were reviewed.
13	Final Report - Santa Ana Watershed Project Authority Basin Plan Upgrade Task Force. Nitrogen and TDS Studies Upper SAW.	Up to 100 wells throughout the SARW	1988	1989		SAWPA		1				1			TDS and Nitrate quantities are sampled and reported.
17	Lake Elsinore and Canyon Lake Nutrient Source Assessment	The San Jacinto Watershed	Jan-00	Dec-00		SAWPA		1				1			Nitrogen and phosphorous.
31	Santa Ana River - Nitrogen and Total Organic Carbon (1-082-250)	SAR	Oct-90	Dec-93	c	SAWPA		1							"Pollutants- organics" also noted as monitored.
32	Santa Ana River - Sources and Sinks of Nitrogen (8-181-250)	Santa Ana River between Waterman Avenue and Prado Dam	1998	1992	c	SAWPA		1				1			"Nutrients, pollutants, water quality" noted as monitored.

Record #	Program Name or Report Title	Sample Location	Start Date	End Date	flow conditions	entity	Bacteria	nutrients	metals	pesticides	toxicity / TIE studies	water chemistry	fish tissue	sediments	comments
39	Stormwater Quality Standards Study - Phase I Study Report	Locations throughout SARW	1995	1998	w	SAWPA									Existing data was reviewed, but no additional sampling has been done. The documents listed within this matrix were reviewed for existing data.
40	Surface Runoff Wasteload Assessment	Historical data throughout SARW	1931	1967		SAWPA						1			Specific parameters reviewed included TDS, Cl, Total Hardness, NO3, and Boron.
42	Use of Fecal Steroids to Infer the Sources of Fecal Indicator Bacteria in the Lower Santa Ana River Watershed, California: Sewage Is Unlikely a Significant Source	Lower Santa Ana River	Jun-01	Jul-07	d	SCCWRP	1								
1	Amount and Composition of Wastewater Discharged by Dairies in the Chino Basin	10 Dairies within the Chino Basin		Dec-97	d	UC Coop	1	1	1			1			
23	Nitrate removal from a drinking water supply with large free-surface constructed wetlands prior to groundwater recharge	wetland	2000	2000	ground water	UCB		1							
5	Coastal Pollution from Microorganisms in Urban Runoff	w	2005	ONGOING	tidal	UCI	1								
6	Coastal water quality Impact of Stormwater Runoff from an Urban Watershed in S. California	Ocean	2004	2004	w	UCI	1					1			study from feb 18-march 3
19	Locating Sources of Surf Zone Pollution: A Mass Budget Analysis of Fecal Indicator Bacteria at Huntington Beach, CA	surf zone, ocean	2001	2001	tidal	UCI	1								
28	Public Mis-notification of Coastal Water Quality: A Probabilistic Evaluation of Posting Errors at Huntington Beach, CA	surf zone, ocean	1999	1999	tidal	UCI	1								May 1 to Oct 31, 1999
29	Reeves, R.L., S.B. Grant, R.D. Mrse, C.M. Oancea, B.F. Sanders, A.B. Boehm, Scaling and management of fecal indicator bacteria in runoff from a coastal urban watershed in southern California, Environ.	Santa Ana River	1999	2003	tidal	UCI	1								Fecal indicator basteria study. Dec 1999-Jan 2003
51	Huntington Beach Closure Investigation: Technical Review			2000		UCI	1								
53	Tidal Transport of Bacteria between the Talbert Watershed and the Ocean Interim Report 1 for the UCI Coastal Runoff Impact Study (CRIS)	tidal		2000	tidal	UCI	1								
22	Native and contaminated ground waters in the Long Beach-Santa Ana area, California	ground water		1953	ground water	US GPO			1			1			
30	Report on Water Pollution Control, Santa Ana River Basin, California Drainage Basin.	river		1951		US Public Health Agency									
34	Santa Ana River Phase I GDM on the Santa Ana River Mainstem including Santiago Creek and Oak Street Drain. Draft.			1980		USACE									
35	Santa Ana River Phase II GDM on the Santa Ana River Mainstem including Santiago Creek			1988		USACE									
3	Bacterial contamination at Huntington Beach, California - Is it from a local offshore wastewater outfall?	tidal	2001	2001	tidal	USGS	1								
7	Concentrations of dissolved solids and nutrients in water sources and selected streams of the Santa Ana Basin, California, October 1998-September 200, Report #03-4326	All over watershed	Oct-98	Sep-01	w	USGS	1					1			

Record #	Program Name or Report Title	Sample Location	Start Date	End Date	flow conditions	entity	Bacteria	nutrients	metals	pesticides	toxicity / TIE studies	water chemistry	fish tissue	sediments	comments
11	Engineering Services in Support of Investigating and Eliminating Bacteria in Urban Runoff Discharges to Huntington Beach.	Hamilton and Meredith Pump Station Forebays at downstream reach of SAR		1992		USGS	1								Fecal indicator basteria study.
14	Ground-water quality in the Santa Ana Watershed, California : overview and data summary, Report 02-4243	207 wells, coastal range province	1999	2001	ground water	USGS						1			Does not specify what was tested for, just "water quality" and dissolved constituents
15	Ground-water quality in the upper Santa Ana River basin, southern California	Prado Dam	1968	1977	ground water	USGS		1	1						
16	Huntington Beach Shoreline Contamination Investigation, Phase III Coastal Circulation and Transport Patterns: The Likelihood of OCSD's Plume Impacting Huntington Beach Shoreline	surfzone	1999	1999	tidal	USGS	1								
20	Low-Level Volatile Organi Compounds in Active Public Supply Wells as Ground-Water Tracers in the Los Angeles Physiographic Basin, California, 2000	river		2000	ground water	USGS					1	1			VOCs
21	Microbial and Dissolved Organic Carbon Characterization of Stormflow in the Santa Ana River at Imperial Highway, Southern California, 1999-2002		1999	2002	w	USGS	1								
37	Stormflow Chemistry in the Santa Ana River below Prado dam and at the diversion downstream from Imperial Highway, S. CA 1995-98		1995	1998	w	USGS		1	1	1		1			
38	Stormflow Chemistry in the Santa Ana River below Prado Dam and at the Diversion Downstream from Imperial Highway, Southern California, 1995-98. - Water resources investigation (Final).		1995	1998	w	USGS		1	1	1		1			
44	Water Quality in the Santa Ana Basin	watershed	1998	2001	c	USGS		1		1		1	1	1	summary report of a series of USGS reports
45	Water Quality in the Santa Ana Basin, California, 1999-2001			2004		USGS		1	1	1	1	1		1	
46	Water-quality trends in the Santa Ana River at MWD Crossing and below Prado Dam, Riverside County, California	river	1969	1995	c	USGS		1	1						
41	Tailoring Requirements to Reality: The Santa Ana River Use Attainability Analysis	river	1991	1991		Water Environmnt Federation	1	1	1		1	1	1		39 sites studied along the entire length of the river; incl vegetation survey
33	Santa Ana River investigation.	river		1959		Cal DWR		1	1						
47	Watershed Impacts Report	Hamilton and Meredith Pump Station Forebays at downstream reach of SAR		7-Jun-04		Huntington Beach	1	1	1	1	1		1	1	Trash and Debris, Organics, Oils and Grease were also monitored
18	Letter Report, Bolsa Chica Project - Additional Modeling Services Related to Bird Use of the Bolsa Chica Wetland M&N File: 4012-18	wetland	1999	2001	tidal	Moffat & Nichols	1	1							modeling only, no actual data collected at Talbert Marsh. Inner Bolsa Bay data collected from April 1999-May 2001.
55	Enumeration and speciation of enterococci found in marine and tidal sediments and coastal water in Southern California	Huntington Beach State Beach and Dana Point Harbor	Aug-02	Jan-04		OC Public Health Laboratory	1							1	water and sediment samples taken to analyze bacteria levels

Table 4. Abbreviation Definitions

Abbreviation	Definition
BMP	Best Management Practice
CDFG	California Department Of Fish and Game
DAMP	Drainage Area Management Plan
DPR	Department of Pesticide Regulation
DWR	Department of Water Resources
FIB	Fecal Indicator Bacteria
MST	Microbial Source Tracking
NPDES	National Pollutant Discharge Elimination System
NWRI	National Water Resource Institute
OCHCA	Orange County Health Care Agency
OCSD	Orange County Sanitation District
OCWD	Orange County Water District
RDMD	Resources & Development Management Department
RWQCB	Regional Water Quality Control Board
SARWG	Santa Ana River Watershed Group
SAWPA	Santa Ana Watershed Project Authority
SCCWRP	Southern California Coastal Water Research Project
TMDL	Total Maximum Daily Load
UCI / UCB / UC Coop	University of California Irvine / Berkeley / Coop
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey

DRAFT TECHNICAL MEMORANDUM #3

RE: SANTA ANA RIVER WATERSHED CHAPTER OUTLINE
DATE: May 19, 2006

Prepared for:
County of Orange Resources &
Development Management Department
Environmental Resources

Prepared by:
Tetra Tech, Inc.
Irvine, CA

The County of Orange RDMD is in the process of developing Watershed Chapters for each of the watersheds within Orange County. These Watershed Chapters will be included as an appendix to the DAMP and will provide specific information regarding the watershed setting, an assessment of the water quality, the existing and future plan of action within the watershed to improve the water quality, and the steps to be taken to assess the effectiveness of the program.

The first step in the development of the Watershed Chapter is an inventory of the existing studies that are available in that watershed. A technical memorandum (Technical Memorandum #1 dated March 3, 2006) focused on the collection of the existing. A matrix was created to provide details of the summary. That matrix is included as an attachment to Technical Memorandum #1 and will be included as an attachment to the Watershed Chapter. The second step in the development of the Watershed Chapter is an assessment of the water quality data and identification of data gaps within the body of knowledge that has been generated for the Newport Bay Watershed. The assessment and identification of data gaps was presented in Technical Memorandum #2 (dated March 30, 2006). The third step in the development of the Watershed Chapter is to define an outline for the watershed chapter document. The outline for the Watershed Chapter is presented below and is based on the model Watershed Chapter developed for the Newport Bay Watershed. This outline builds on the outline established in the South County but includes additional sections that focus on TMDL development and implementation planning. The following is an abbreviated description of the contents of each chapter.

Chapter 1 provides general background information on the watershed setting, Basin Plan information, and history of the NPDES program.

Chapter 2 includes a water quality assessment. The information in this chapter relies heavily on the information developed in Technical Memorandum #1 and Technical Memorandum #2.

Chapter 3 is a discussion of the status of TMDLs in the watershed. It provides details on the TMDLs already approved for the listed segments and identifies the priority and/or timeframe of future TMDLs for the remaining 303(d)-listed segments.

Chapter 4 includes a discussion of the existing and planned enhanced watershed BMPs that address specific pollutants of concern. This chapter includes a discussion of the pollutant loading, load reduction estimates for the BMPs, and a discussion of the BMPs that target the pollutants of concern for this watershed. This section will incorporate relevant portions of the County of Orange *BMP Effectiveness Study*.

Chapter 5 focuses on tying BMP implementation with TMDL compliance. The goal of this chapter is to identify the available types of approaches to allow the County to predict if the implemented strategies will reach the goal of TMDL compliance.

Chapter 6 includes short and long term strategies and a discussion of the effectiveness of those strategies. An additional section has been added to discuss the adaptive management process of the program. An appendix to this chapter is a table identifying the action items within the watershed.

PROPOSED SANTA ANA RIVER WATERSHED CHAPTER OUTLINE

CHAPTER 1: Introduction

1.1 Watershed Setting

This section provides background information specific to the physical aspects of the watershed.

1.2 Beneficial Uses

Identify the Beneficial uses within the watershed based on the Basin Plan

1.3 Constituents of Concern

Identify the constituents of concern particular to this watershed based on TMDLs (planned) and local concerns

1.4 Watershed Program Management

This section contains the history of the program and the permits as applicable to this watershed. This section identifies the responsibility of the program to address urban dischargers. Non-urban pollution sources (such as agriculture, atmospheric deposition, etc.) are not addressed.

1.4.1 NPDES Coordination

1.4.2 Watershed Management Framework

CHAPTER 2: Water Quality Assessment

2.1 Summary of Monitoring Activities

This section will focus on the finding from Technical Memorandum #1 and the discussion of the water quality data that is available in the watershed.

2.1.1 Compliance (NPDES)

2.1.2 AB411

2.1.3 SWAMP

2.1.4 Special Studies

2.1.5 Assessment of Data and Studies

This section will focus on the findings from Technical Memorandum #2 and the data assessments included in that memorandum.

2.2 Water Quality Status

2.2.1 Impaired Waters (303(d))

2.3 AB411 Summary

2.4 Water Quality Summary – Prioritization of WQ Problems

This section will include the priority needs identified in Technical Memorandum #2

CHAPTER 3: TMDLs in the Watershed

3.1 Existing TMDL Development

This section will describe the development process of existing adopted TMDLs. No TMDLs are adopted in this watershed in Orange County so this section will briefly discuss those outside of the County along the Santa Ana River.

3.2 Status of Future TMDL Development

This section will focus on receiving waters that are included in the 303(d) list but have no adopted TMDLs. No receiving waters are included on the existing list or the draft list; therefore this section will include a brief discussion of the process by which a TMDL is scheduled.

CHAPTER 4: Pollution Source, Control and Treatment Inventories

4.1 Watershed Pollution Sources

4.1.1 Source types

4.1.2 Specific known sources (by waterbody/pollutant)

4.1.3 Pollutant loading estimates (from TMDL or other source).

4.2 Existing enhanced BMPs in Watershed

This section will focus on enhanced watershed BMP efforts that address specific pollutants of concern. Reference to the LIPs will be given for a summary of jurisdictional efforts.

4.3 Proposed enhanced BMPs in Watershed

This section will focus on enhanced watershed BMP efforts that address specific pollutants of concern. Reference to the LIPs will be given for a summary of jurisdictional efforts.

4.4 Estimate of load reductions for existing BMPs (by pollutant)

The estimations will be based on existing information available through the BMP Effectiveness Study and CASQA.

4.5 Recommendations for watershed BMPs

The recommendations will be based on the performance estimates from the previous section relative to the watershed constituents of concern.

CHAPTER 5: Plan Development

5.1 Implementation Planning Factors

Numerous factors must be assessed and considered while making watershed planning decisions. This section will describe these factors, including cost, efficiency, location, source types, legal requirements, and physical constraints. It will specifically focus on the interrelationship between factors, the impact of scale, and the level of detail necessary to understand each factor.

5.2 Evaluate the Alternatives

This section will describe several methods that can be used to evaluate existing and potential BMPs and the factors associated with their selection and implementation. These methods, which include monitoring and modeling, vary in scale, cost, and complexity.

5.2.1 Monitoring

5.2.2 Modeling (watershed-scale, site-scale)

5.2.3 Special Studies

5.2.4 Screening

5.3 Planning and Prioritization Strategy

The implementation planning factors and evaluation methods described previously can be combined into an implementation planning and prioritization strategy. This section will describe this three-dimensional process, which can be used to select an appropriate implementation approach and help managers identify the most appropriate and cost-effective BMP(s) for a particular set of conditions.

5.4 Watershed Recommendations

This section will present recommendations for continued watershed management efforts based on the evaluation of the available data and information and the existing management efforts in place.

CHAPTER 6: Program Effectiveness Assessment

6.1 Short Term Strategy

The effectiveness assessment for these strategies will be based on the bottom 3 tiers of the CASQA expected outcome pyramid. A table of management strategies will be included.

6.2 Long Term Strategy

The effectiveness assessment for these strategies will be based on the top 3 tiers of the CASQA expected outcome pyramid. A table of management strategies will be included.

6.3 Review of Program Management

This section will describe recommendations for a monitoring plan as well as methodologies to track progress.

CHAPTER 7: References

Glossary of acronyms used in this technical memorandum:

BMP	Best Management Practice
CASQA	California Stormwater Quality Association
DAMP	Drainage Area Master Plan
LIPs	Local Implementation Plans
NPDES	National Pollutant Discharge Elimination System
RDMD	Resources and Development Management Department
TMDL	Total Maximum Daily Load

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EXECUTIVE SUMMARY

This "Watershed Action Plan (WAP)" was prepared to meet Section 12 of the Drainage Area Management Plan (DAMP). Commitments to watershed planning to address water quality issues are also included in Section 3 of the DAMP.

Within Orange County there are both watershed and jurisdictional efforts to improve water quality. The jurisdictional efforts are captured as part of the Local Implementation Plans (LIPs). The WAP was created to capture the regional efforts that are undertaken to provide a watershed-based collaborative effort to address constituents of concern in a specific watershed.

The purpose of this document is to present a planning framework for the Santa Ana River Watershed to:

- Identify the most significant water quality issues related to urban runoff sources that can be addressed at a multi-jurisdictional watershed-scale,
- Focus jurisdictional pollution prevention and source control programs on local constituents, of concern, to identify treatment control opportunities,
- Incorporate prior data from planning studies,
- Identify indicators to track progress, and
- Ultimately develop an integrated plan of action for urban sources that results in meaningful water quality improvement in the Santa Ana River Watershed.

The document also describes the numerous existing programs related to water quality and the activities conducted by the Watershed Permittees at the watershed scale.

The following sections comprise the WAP:

Section 1.0 describes the environmental setting of the watershed, discusses program coordination between the Watershed Permittees, and outlines the approach taken in plan development.

Section 2.0 provides an assessment of current water quality conditions and identifies issues and data gaps and constituents of concern. The constituent of concern identified for this watershed is bacteria.

Section 3.0 provides information on the future development of total maximum daily load (TMDLs).

Section 4.0 discusses pollution sources and provides an inventory of treatments and enhanced best management practices (BMPs) that have been implemented in the watershed.

Section 5.0 focuses on the recommendations for actions to be taken to address the water quality issues of the watershed and discusses the annual means of assessment of the program effectiveness.

D-1.0 Introduction

The designation of "Santa Ana River Watershed" refers to the hydrologic watershed that is defined by drainage and only minimally by jurisdictional boundaries. The Santa Ana River Watershed drains approximately 210 square miles to the Pacific Ocean within Orange County, California. The watershed extends into and drains portions of Riverside and San Bernardino Counties. This watershed has been divided into the following eleven subwatersheds, based on the named waterbodies or reaches in Orange County included in the Basin Plan, plus the adjacent coastal drainages:

- Coastal Drainages which includes watersheds east and west of Reach 1 from the coast up to Willowick Golf Course along the Santa Ana River, Talbert, Huntington Beach and Greenville-Banning channels;
- Reach 1 begins at the tidal prism and continues to 17th Street in Santa Ana;
- Reach 2 continues from 17th Street to Prado Dam in Riverside County;
- Carbon Canyon Creek begins just downstream of the Glassell Street crossing of the Santa Ana River, extending north, draining northeastern Orange County;
- Santiago Creek Reach 1 from downstream of the Memory Lane crossing of the Santa Ana River, extending up to Irvine Lake;
- Santiago Creek Reach 2 which includes Irvine Lake and its immediate vicinity;
- Santiago Creek Reach 3 which includes Santiago Creek from Irvine Lake to Modjeska Canyon;
- Santiago Creek Reach 4 which includes Modjeska Canyon;
- Silverado Creek;
- Black Star Creek; and
- Ladd Creek

The Santa Ana River Watershed has been impacted by water quality problems most of which are from anthropogenic sources or aggravated by human activity. The most well documented problem is high bacteria pollution along the beach. The extent of bacteria contamination has resulted in beach postings and closures which have a significant impact on the beneficial use of the ocean as well as on the local economy. The Santa Ana River Watershed is a highly urbanized watershed with multiple potential sources of pollution; therefore water resource managers felt that urban runoff would be more appropriately dealt with within the hydrologic boundaries of the watershed, rather than solely on the jurisdictional basis of political boundaries.

The Watershed Permittees includes twelve cities within the watershed (Anaheim, Brea, Costa Mesa, Fountain Valley, Garden Grove, Huntington Beach, Newport Beach, Orange, Placentia, Santa Ana, Villa Park, and Yorba Linda), unincorporated County of Orange, and the Orange County Flood Control District. Based on their experience and recommendations, a Watershed Action Plan (WAP) within the Drainage Area Management Plan (DAMP) has been developed to attain the following multiple objectives:

- To meet the requirement to update Section 12 of the DAMP as contained in the municipal National Pollution Discharge Elimination System (NPDES) stormwater permit (Order R8-2002-0010).

- To identify the most significant water quality issues and constituents of concern on a watershed scale and relate these to urban sources.

- To focus the pollution prevention and source control programs implemented at an individual jurisdiction level on the identified constituents of concern and to identify any jurisdiction-specific treatment control opportunities.

- To identify the water quality issues that are most appropriately addressed through a multi-jurisdictional watershed-scale approach.

- To identify information that is relevant to the Santa Ana River Watershed that has been developed as part of local, watershed, or regional studies.

- To develop an integrated plan of action that results in meaningful water quality improvement in the Santa Ana River Watershed and balances economic, social, and environmental constraints.

- To identify indicators to track progress that lead to improvements in the quality of the receiving waters.

The Watershed Permittees have developed Local Implementation Plans (LIPs) addressing programs and activities that are implemented or being pursued on a jurisdictional basis. Watershed cities and stakeholder groups are also pursuing projects that are intended to have a positive effect on water quality issuing to receiving waters. These include the following major initiatives:

- Since 1990, the Watershed Permittees have developed and implemented common water quality programs within their own jurisdictions in response to the requirements of the municipal NPDES stormwater permit.

- In early 2003, an updated version of the Drainage Area Management Plan (2003 DAMP) was provided to the Santa Ana Regional Water Quality Control Board (Regional Board), including Local Implementation Plans (LIPs – 2003 DAMP Appendix A). The LIPs are detailed plans that focus on specific areas required by the NPDES permits including the legal authority to detect and eliminate pollutant discharges; public education; enhanced standards for new development/significant re-development; implementation of best management practices (BMPs) at municipal facilities, construction sites, and commercial and

industrial facilities; and water quality monitoring. The BMPs can, in most cases, be focused on targeted constituents of concern to be identified through the monitoring program.

- In 1999, the Regional Board issued a Cleanup and Abatement Order to the city of Huntington Beach in response to the beach closures at Huntington State Beach and Huntington City Beach during the summer of 1999 for elevated bacterial indicator concentrations. Numerous studies followed to provide a better understanding of bacterial contamination in this watershed.

Multi-jurisdictional efforts has been taking place to develop solutions to the watershed-scale problems. The Santa Ana Watershed Protection Authority (SAWPA) has been a leader in this area and has led a significant number of study efforts to understand the watershed issues and take steps to provide appropriate management tools. The U.S. Geological Survey has completed several comprehensive studies of the watershed. The watershed cities and the County have also been a part of this effort with significant support from the State Water Resource Control Board through grant funding.

As a result of many of these collaborative efforts related to water quality issues recommendations for management, further study, and treatment have been advised. Many of these recommendations are being pursued, with the County or, in some cases, the individual Watershed Permittees are the lead agency.

The Santa Ana River WAP borrows much of its organization, structure, and terminology from the 2003 DAMP of which it is an appendix. The following sections are included in the WAP:

- **Section 1.0** describes the watershed and environmental setting, the program management coordination between the Watershed Permittees and other stakeholders, and the approach taken to develop the plan.

- **Section 2.0** assesses the water quality information available and identifies the water quality issues and constituents of concern.

- **Section 3.0** provides information on TMDLs and how they will impact watershed planning.

- **Section 4.0** discusses the urban sources of pollution, the available treatments for pollution control, and an inventory of enhanced BMPs that have been implemented in the watershed that address specific pollutants of concern.

- **Section 5.0** focuses on the recommendations for actions to be taken to address the water quality issues of the watershed and discusses the annual means of assessment of the program effectiveness.

The Santa Ana River WAP is intended as a living document, one capable of being modified as new information becomes available and problems are addressed. It identifies the current state of knowledge on the issues facing the Santa Ana River. It also identifies the actions to which the Watershed Permittees have made commitments. Annual assessments will be made to identify the progress on these actions and the schedule for continued efforts related to that action. This

assessment will be reflected through annual updates to the strategy tables described in **Section 5.0** and included as an Exhibit to the WAP.

D-1.1 Watershed Setting

The Santa Ana River Watershed is located in northern Orange County, approximately 30 miles south of Los Angeles and 80 miles north of San Diego. The Santa Ana River drains the largest watershed in Orange County, spanning 210 square miles (**Figure D-1**). The headwaters of the Santa Ana River, along with many of its tributaries are in the San Bernardino Mountains, in Riverside County, approximately 60 miles from the Orange County boundary line. Below Prado Dam, just outside of the Orange County line, the channel is deep in many places, with some rocky substrate and rapid sections. The river ecosystem supports a variety of organisms. In contrast many of the downstream reaches are improved (paved) for flood control. The river slows as it reaches Anaheim, where Orange County Water District diverts and recharges essentially all the dry weather flow. Downstream from the groundwater recharge areas near Anaheim, the Santa Ana River is normally dry during non-storm periods.

Approximately 30 miles of the Santa Ana River cross Orange County from the northeast to the southwest where it eventually enters the Pacific Ocean at the Huntington Beach Wetlands – Talbert Marsh. Talbert Channel also outlets into the Pacific Ocean at the Huntington Beach Wetlands, approximately 400 yards north of the Santa Ana River outlet. Santiago Creek is the largest tributary and drains approximately half of the watershed, predominantly undeveloped unincorporated County land. Other tributaries that drain to the Santa Ana River include the Greenville Banning Channel, Fairview Channel, Huntington Beach Channel, Talbert Channel and Newport Beach Channel. All drain highly urban areas.

Figure D-1: Location Map

See next page for figure.

Figure D3-1 Location Map
Santa Ana River Watershed

Almost half of the Santa Ana River Watershed is covered with dense development with a few fringe areas that are still developing. Much of the remaining undeveloped land has mountainous slopes or is set aside as parks and protected habitat. Within the watershed several agencies and organizations have protected habitat set aside for wildlife species. California State Parks owns 12,452 acres (Chino Hills State Park) just north of Yorba Linda. The State Fish and Game owns 727 acres (Coal Canyon Ecological Reserve) east of Anaheim near the border with Riverside County. The County of Orange has various reserves including the Limestone Whiting Wilderness Park with 4300 acres. Additionally, the Cleveland National Forest spans the border of Orange and Riverside Counties, approximately 60,300 acres of the Cleveland National Forest are in Orange County. This watershed is bounded by the Newport Bay Watershed to the south, and the San Gabriel/Coyote Creek and Anaheim Bay-Huntington Harbor Watersheds to the west. Open spaces consist of city and regional parks and golf courses.

Major transportation arteries through the watershed include Interstate 5 (I-5), Interstate 405 (I-405) and the Pacific Coast Highway (Hwy 1). All three roughly parallel the Pacific Ocean coastline, in southern Orange County I-405 rejoins I-5. Major roadways of the Santa Ana River Watershed are shown in **Figure D-2**. The school districts are shown in **Figure D-3a**, cities are shown in **Figure D-3b**, water districts are shown in **Figure D-3c**, and parks are shown in **Figure D-3d**. Existing land use within the watershed is shown in **Figure D3-4**.

Figure D-2: Transportation

See next page for figure.

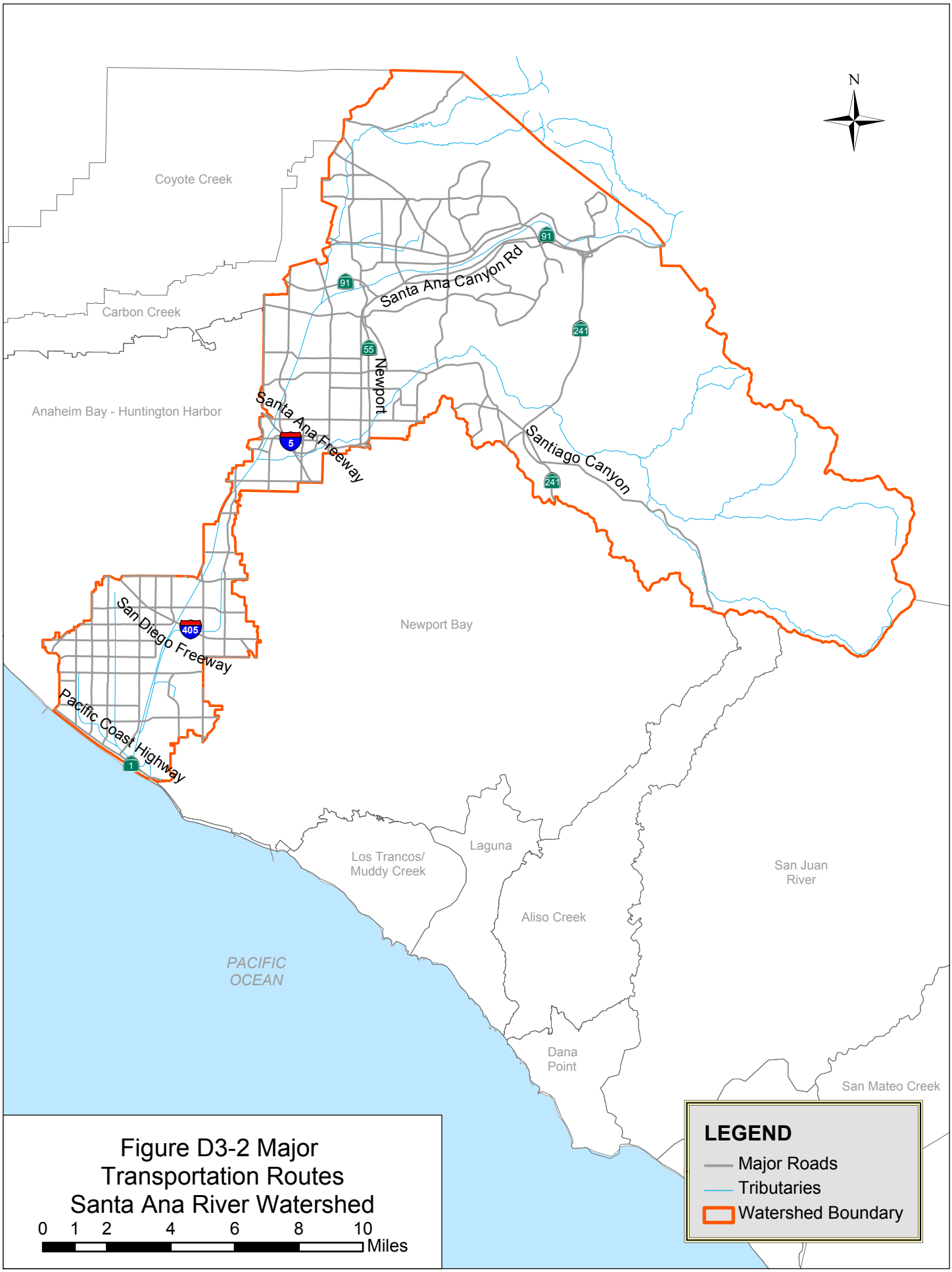

Figure D3-2 Major Transportation Routes Santa Ana River Watershed

Figure D-3a: Unified School Districts

See next page for figure.

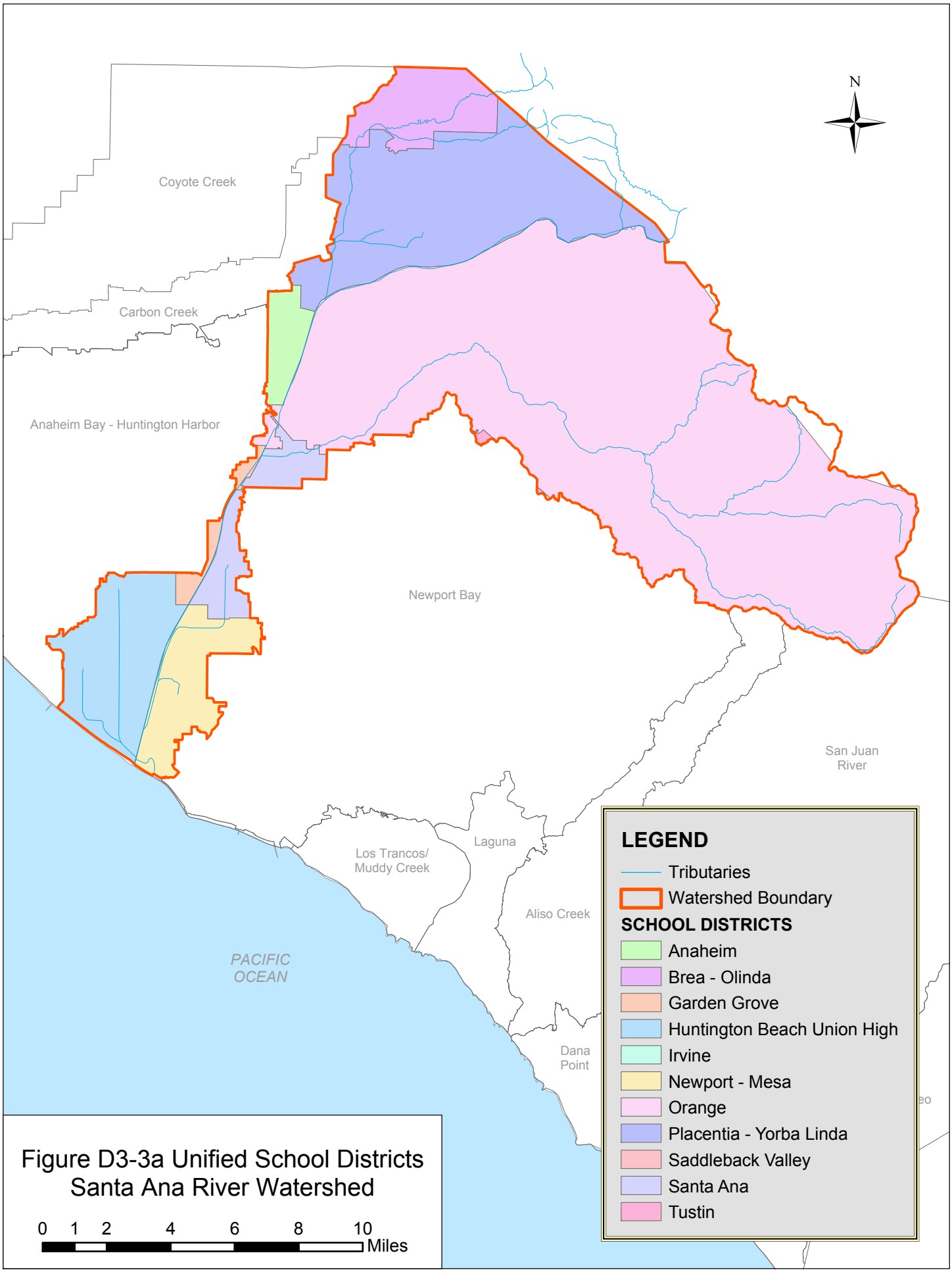

Figure D3-3a Unified School Districts
Santa Ana River Watershed

Figure D-3b: City Boundaries

See next page for figure.

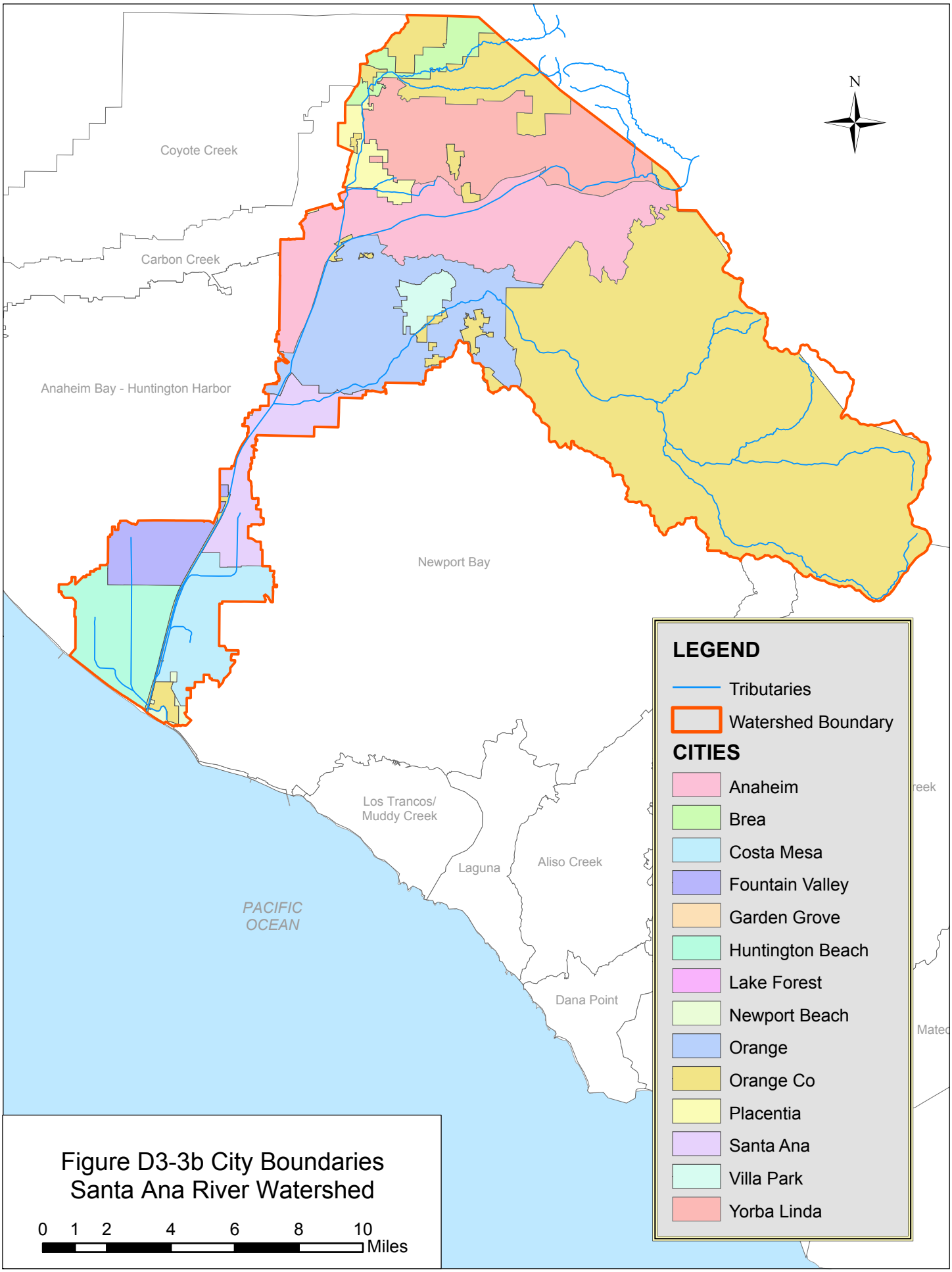

Figure D3-3b City Boundaries
Santa Ana River Watershed

Figure D-3c: Water Providers

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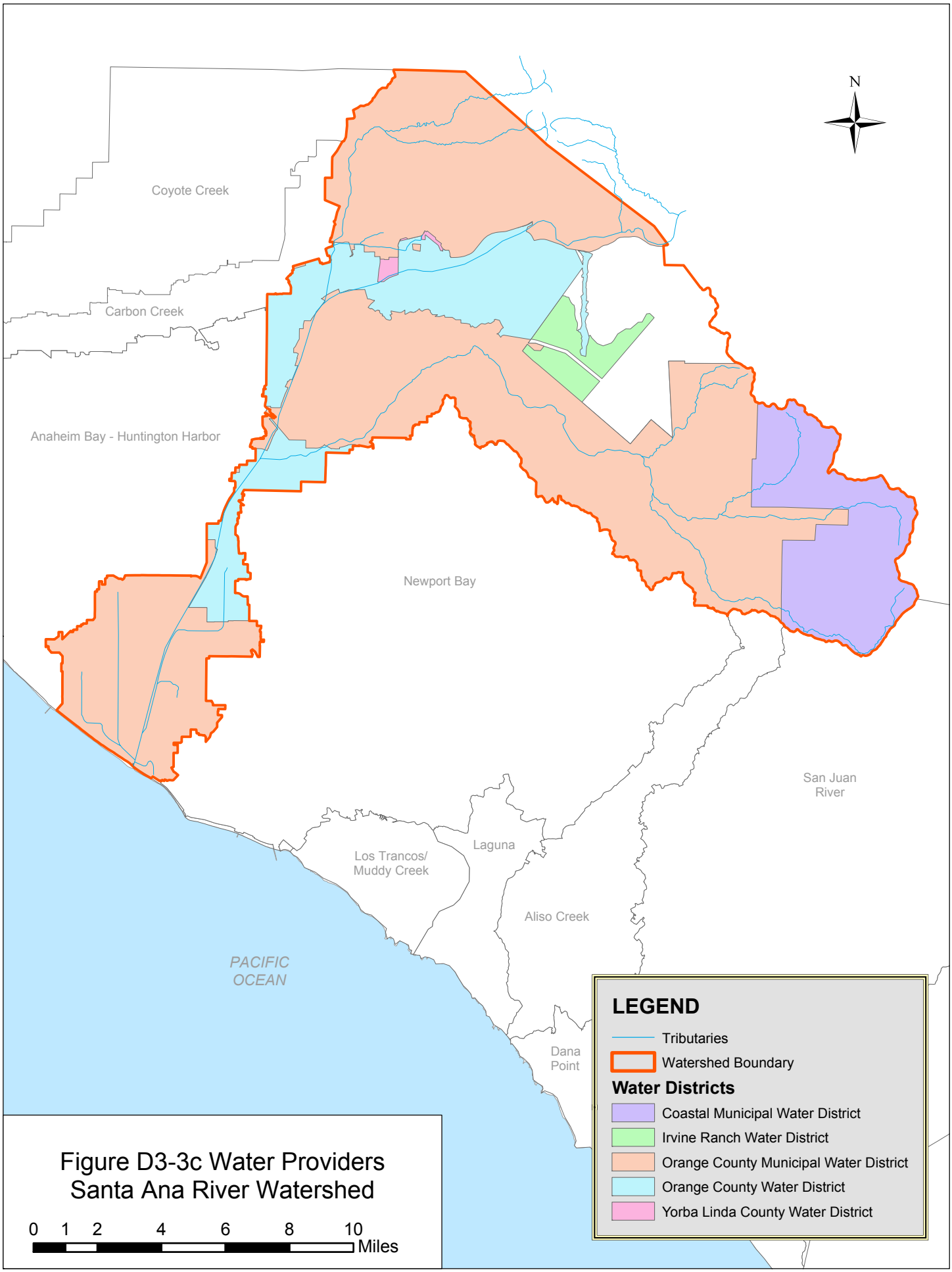

Figure D3-3c Water Providers
Santa Ana River Watershed

Figure D-3d: Parks and Open Space

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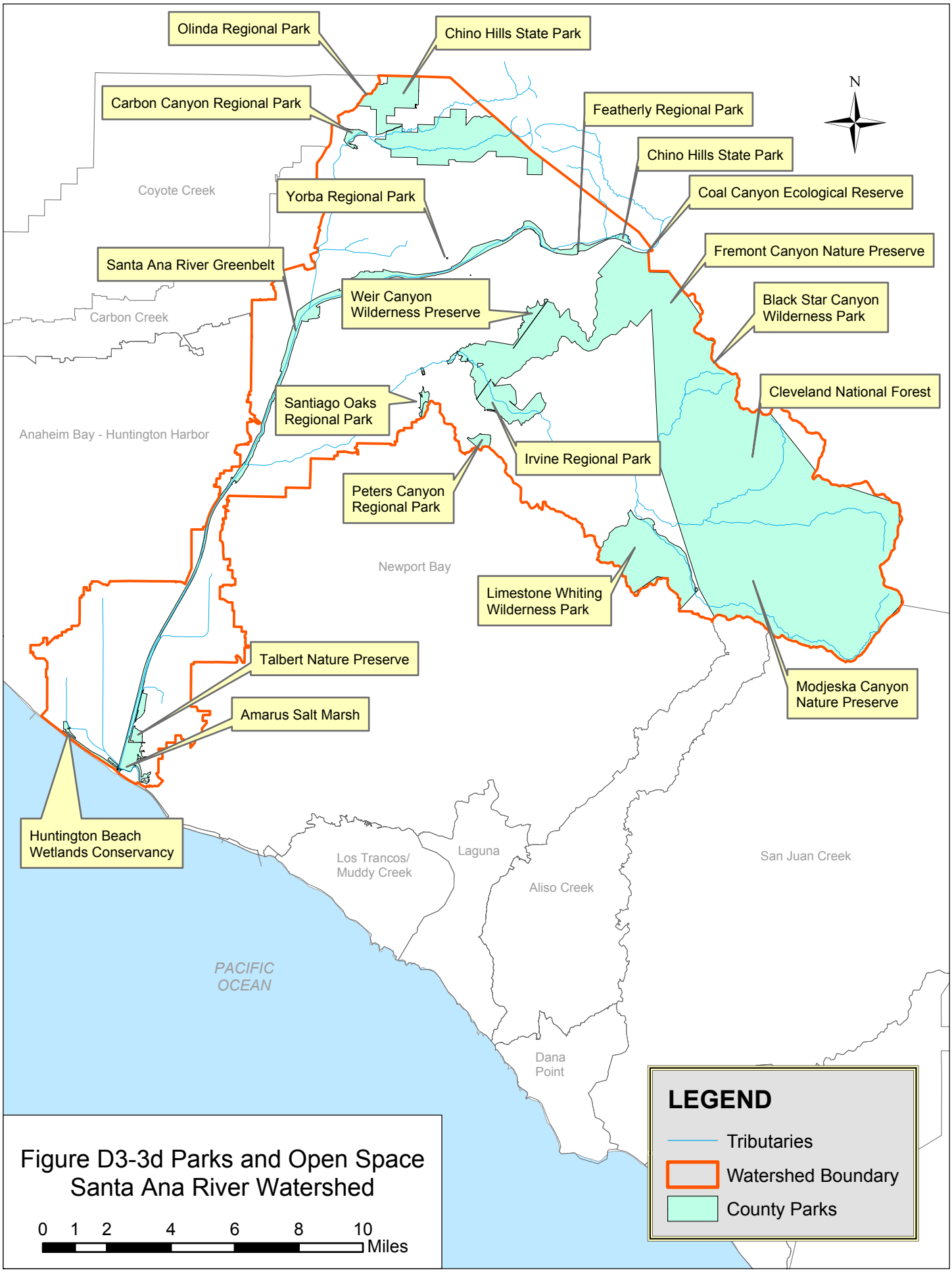

Olinda Regional Park
Chino Hills State Park
Carbon Canyon Regional Park
Featherly Regional Park
Chino Hills State Park
Coyote Creek
Yorba Regional Park
Coal Canyon Ecological Reserve
Fremont Canyon Nature Preserve
Santa Ana River Greenbelt
Weir Canyon Wilderness Preserve
Black Star Canyon Wilderness Park
Carbon Creek
Cleveland National Forest
Santiago Oaks Regional Park
Anaheim Bay - Huntington Harbor
Irvine Regional Park
Peters Canyon Regional Park
Newport Bay
Limestone Whiting Wilderness Park
Talbert Nature Preserve
Modjeska Canyon Nature Preserve
Amarus Salt Marsh
Huntington Beach Wetlands Conservancy
Los Trancos/ Muddy Creek
Laguna
Aliso Creek
San Juan Creek
PACIFIC OCEAN
Dana Point
N
LEGEND
Tributaries
Watershed Boundary
County Parks
Figure D3-3d Parks and Open Space
Santa Ana River Watershed
0 1 2 4 6 8 10
Miles

Figure D-4: Land Use - Existing

See next page for figure.

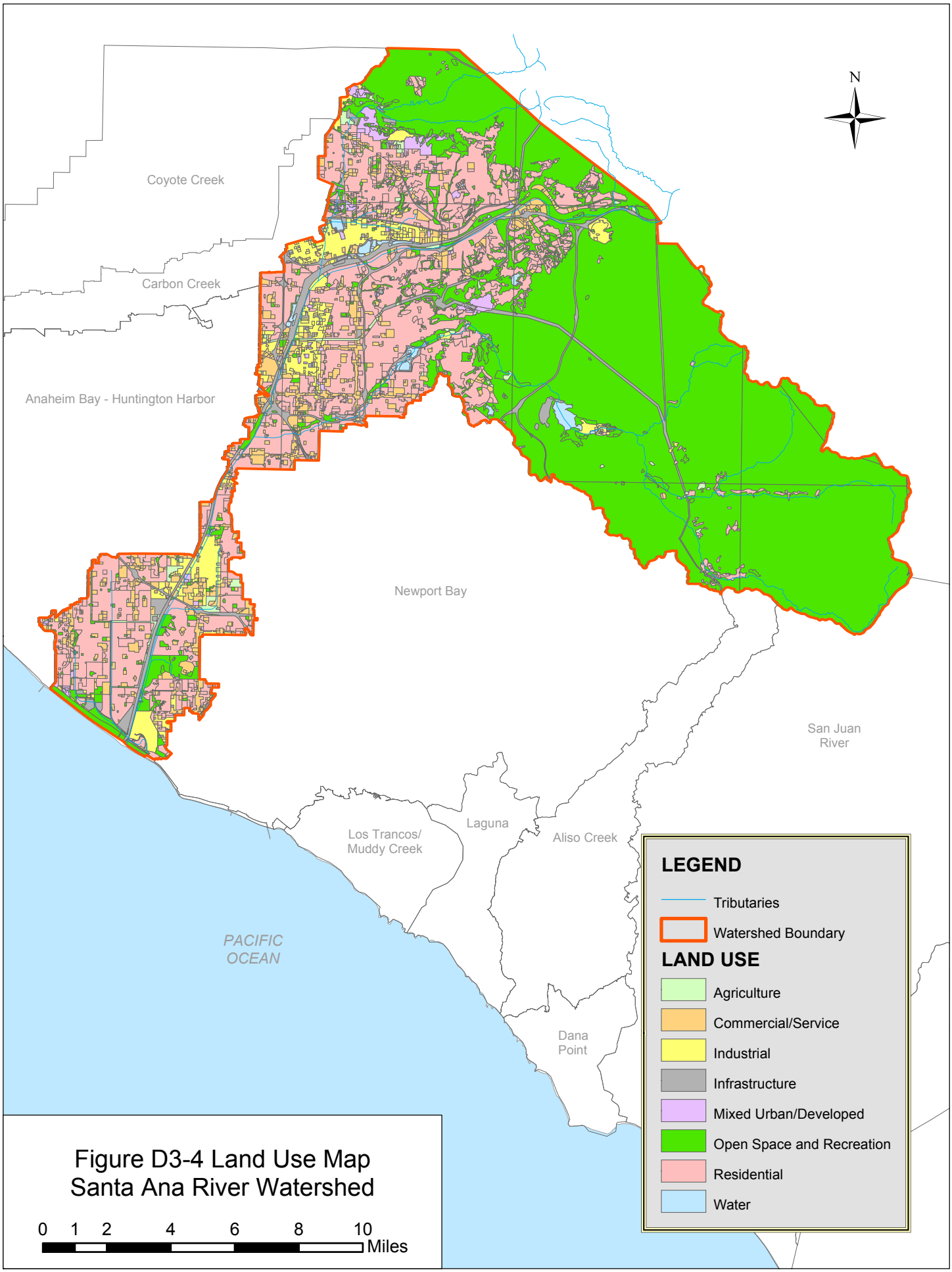


Figure D3-4 Land Use Map
Santa Ana River Watershed

D-1.2 Beneficial Uses

The Santa Ana River Watershed is within the jurisdiction of the Santa Ana Regional Water Quality Control Board (Regional Board), within the subunit of the Lower Santa Ana River Basin (designated Hydrologic Unit 801.11). The Water Quality Control Plan for the Santa Ana River Basin (hereafter, Basin Plan) lists a number of water bodies in the following table (**Table D-1)** as receiving waters. The following existing beneficial uses are designated in the Basin Plan for the above lakes, bays, estuaries and tidal prisms:

AGR – agricultural supply
BIOL – biological significance
COLD – cold freshwater habitat
COMM – commercial and sportfishing
EST – estuarine habitat
GWR – groundwater recharge
MAR – marine habitat
MUN – municipal and domestic supply
RARE - rare, threatened, or endangered species
REC1 – contact water recreation
REC2 – non-contact water recreation
WARM – warm freshwater habitat
WILD – wildlife habitat

Table D-1 shows the beneficial uses associated with each waterbody.

Table D-1: Beneficial Uses – Santa Ana River Watershed

	Beneficial Use																				
Name	**MUN**	**AGR**	**IND**	**PROC**	**GWR**	**NAV**	**POW**	**REC 1**	**REC 2**	**COMM**	**WARM**	**LWRM**	**COLD**	**BIOL**	**WILD**	**RARE**	**SPWN**	**MAR**	**SHEL**	**EST**	**Hydrologic Unit**
Lakes																					
Anaheim Lake	+				X			X	X		X				X						801.11
Irvine Lake	X	X						X	X		X		X		X						801.12
Bays, Estuaries, and Tidal Prisms																					
Santa Ana River Salt Marsh	+							X	X					X	X	X		X		X	801.11
Tidal Prism of Santa Ana River (to within 1000' of Victoria Street and Newport Slough	+																				
Tidal Prisms of Flood Control Channels Discharging to Coastal or Bay Waters	+							X	X	X					X			X			801.11
Inland Surface Streams																					
Santa Ana River:																					
Reach 1- Tidal Prism to 17th St in Santa Ana	+							X[2]	X		●				●						801.11
Reach 2- 17th St in Santa Ana to Prado Dam	+	X			X			X	X		X				X	X					801.11
Santiago Creek:																					801.11
Reach 1-below Irvine Lake	X				X			X[2]	X		X				X						801.11
Reach 2-Irvine Lake (above)																					
Reach 3-Irvine Lake to Modjeska Canyon	●				●			●	●		●				●						801.12
Reach 4-in Modjeska Canyon	X				X			X	X		X				X						801.12
Silverado Creek	X				X			X	X		X				X						
Black Star Creek	●				●			●	●		●				●						
Ladd Creek	●				●			●	●		●				●						

X Present or Potential Beneficial Use ● Intermittent Beneficial Use + Excepted from MUN

[2] Access prohibited in all or part by Orange County Environmental Management Agency (OCEMA)

The following is a description of the relevant beneficial use designations:

Agricultural Supply (AGR) – Used for farming, horticulture or ranching. Uses may include irrigation, stock watering, and support of vegetation for range grazing.

Biological Significance (BIOL) – Preservation of Biological Habitats of Special Significance. These waters support designated areas or habitats, including, but not limited to, established refuges, parks, sanctuaries, ecological reserves or preserves, and Areas of Special Biological Significance (ASBS), where the preservation and enhancement of natural resources requires special protection.

Cold Freshwater Habitat (COLD) – Supports coldwater ecosystems that may preserve and enhance aquatic habitats, vegetation, fish and wildlife, including invertebrates.

Commercial and Sportfishing (COMM) – Includes uses of water for commercial or recreational collection of fish or other organisms, including those collected for bait. These uses may include, but are not limited to, uses involving organisms intended for human consumption.

Estuarine Habitat (EST) – Include uses of water to support estuarine ecosystems, which are not limited to, preservation and enhancement of estuarine habitats, vegetation, fish and shellfish, and wildlife, such as waterfowl, shorebirds, and marine mammals.

Groundwater Recharge (GWR) – Waters are used for natural or artificial recharge of groundwater for future extraction, water quality maintenance or halting saltwater intrusion into freshwater aquifers.

Marine Habitat (*MAR*) – Include uses of water to support marine ecosystems that are not limited to, preservation and enhancement of marine habitats, vegetation (e.g., kelp), fish and shellfish, and wildlife (e.g., marine mammals and shorebirds).

Municipal and Domestic Supply (*MUN*) – Supports use for community, military, municipal or individual water supply systems, including drinking water supply.

Rare, Threatened, or Endangered Species (RARE) – Includes uses of water that support habitat necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened or endangered. Among plants or animal species which were used in the designation of specific water bodies with RARE beneficial uses are: least Bell's vireo (bird), California least tern (bird), light-footed clapper rail (bird), California brown pelican (bird), Belding's savannah sparrow (bird), willowy monardella (plant), humpback and blue whale (mammals), bald eagle (bird), tidewater goby (fish), southwestern willow flycatcher (bird), salt-marsh bird's beak (plant), Pacific green sea turtle (reptile), and western snowy plover (shore bird). The RARE designation is placed on water bodies where the protection of a threatened or endangered species depends on the water either directly, or to support its habitat.

Contact Water Recreation (REC1) – Includes uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include,

but are not limited to, swimming, wading, water-skiing, skin and scuba diving, white water activities, fishing, or use of natural hot springs.

Non-Contact Water Recreation (REC2) – Includes uses of water for recreational activities involving proximity to water, but not normally involving body contact with water where ingestion of water would be reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beach combing, camping, boating, tidepool, and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Warm Freshwater Habitat (WARM) –Supports warm water ecosystems that may preserve and enhance aquatic habitats, vegetation, fish and wildlife, including invertebrates.

Wildlife Habitat (WILD) – Includes uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

D-1.3 Constituents of Concern

The focus of the WAP is to address the constituents of concern within the watershed. The constituent of concern in the Santa Ana River Watershed is bacteria. In 1999 the Regional Board issued a Cleanup and Abatement Order within this watershed to address bacteria. Considerable research and study continues to be done related to this constituent. In addition, the data produced through the County of Orange NPDES monitoring program is currently under assessment. As additional constituents of concern are identified, the Watershed Permittees will address those concerns and they will be reflected in the WAP.

D-1.4 Watershed Program Management

Program management of various water quality improvement programs within the Santa Ana River Watershed occurs at two distinct levels: (1) activities conducted by the Watershed Permittees individually in implementing jurisdictional programs in their LIPs based on the model programs in the DAMP and in compliance with the municipal NPDES stormwater permits and (2) activities conducted by the Watershed Permittees and others collectively to address specific water quality issues on a watershed scale identified through the Water Quality Planning Process (see **DAMP Section 3**).

Within the Santa Ana River watershed an initiative is currently underway to form a Santa Ana River Watershed Committee which will meet twice annually. Based upon the annual watershed assessment (discussed in **Section 5.0**), the Watershed Permittees and other participating jurisdictions will work together to address the priority water quality issues identified through the watershed planning processes. It is anticipated that water quality issues that are determined to be specific to a jurisdiction would be referred to that jurisdiction and thereafter be addressed as a jurisdictional program initiative through the LIP. Alternatively, the issue may originate from multiple jurisdictions within the watershed. In this instance, the problem would be addressed as a watershed cooperative effort.

Updates to this program will be the subject of annual reporting each November, which will include a water quality assessment and revisions to the listed water quality improvement initiatives.

D-1.4.1 NPDES Coordination

The Orange County Stormwater Program is underpinned by an Implementation Agreement between the County of Orange, the Orange County Flood Control District, and the 34 cities of Orange County. The Agreement provides a funding formula and budgeting process for shared countywide costs and Regional Board monitoring costs by area.

The Orange County Stormwater Program also has an extensive committee structure that is described in the DAMP (**2003 DAMP Section 2**) and in the LIPs of the Watershed Permittees (**2003 DAMP Appendix A-2**). Each of the Watershed Permittees participates in the General Permittee meeting and, selectively, in the other oversight and technical committees.

D-2.0 Water Quality Assessment

The WAPs of the DAMP focus on the water quality within particular watersheds and how the water quality is impacted by urban discharges. Urban discharges include surface runoff from residential, commercial, and industrial areas. Pollution sources that are not considered as part of the urban watershed planning responsibilities are atmospheric deposition and agricultural runoff. The following figure (**Figure D-5**) demonstrates the physical processes involved with generation of pollution and its fate and transport.

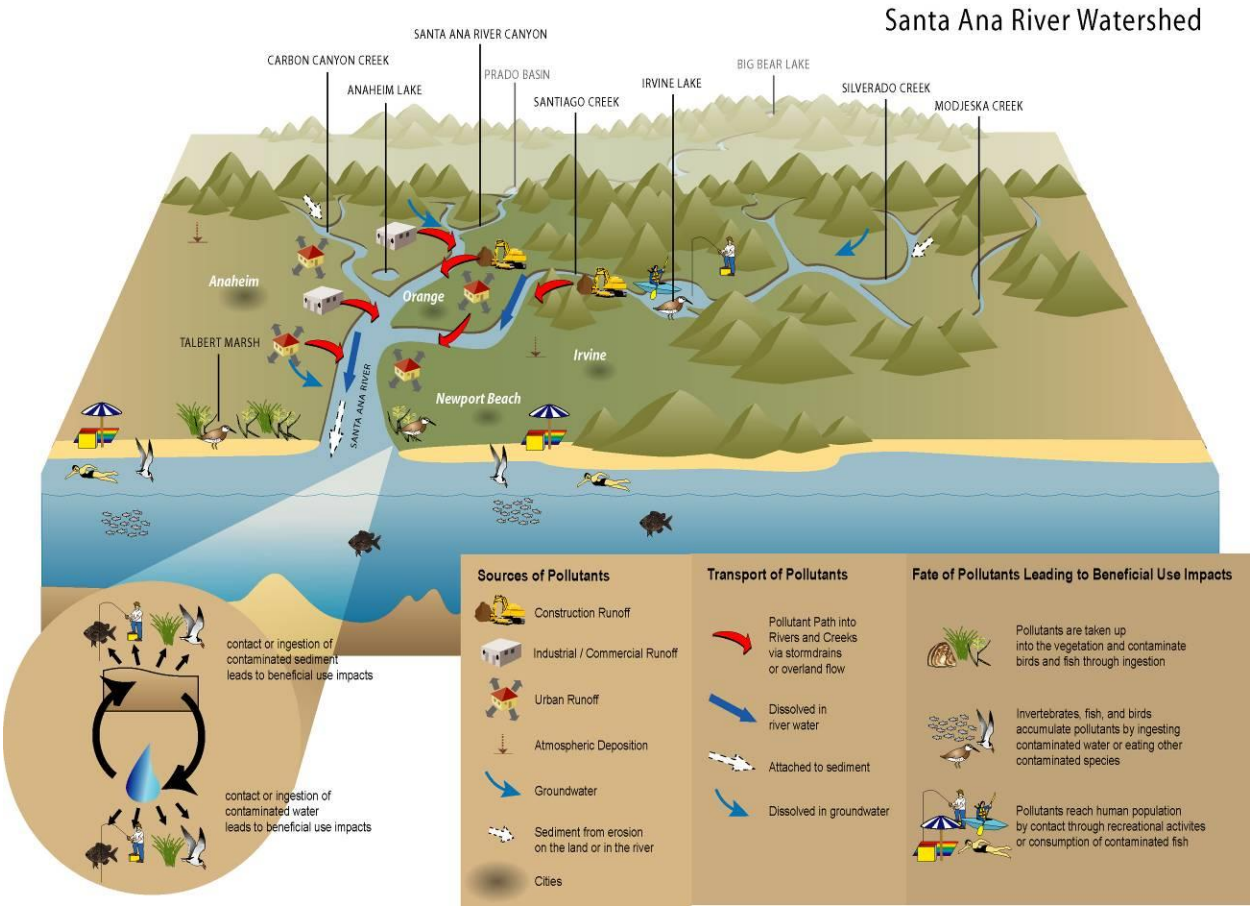


Figure D-5: Santa Ana River Watershed Processes

Within the Santa Ana River Watershed there have been several major initiatives to monitor and assess the water quality:

- The NPDES Program began in 1990 and is anticipated to continue into the foreseeable future.

- The OCHCA (in cooperation with OCSD) has been testing coastal waters in Orange County over the past 40 years for bacteria that indicate the possible presence of disease-causing organisms. Monitoring the Santa Ana River coastal system is performed by OCHCA. Monitoring data are compared to the bacteria water quality standards established following the adoption of AB411.

D-2.1 Summary of Monitoring Activities

D-2.1.1 NPDES Program

NPDES permits are issued for a five-year term and are issued on an area-wide basis. The first municipal NPDES Stormwater Permit was for the period 1990-1996; the Second Term Permit covered 1996-2002; and the Third Term Permit covers 2002-2007. Each of the permits has required the development and implementation of a monitoring program to support an effective County-wide urban stormwater management program.

D-2.1.1.1 *First Term Permit*

The monitoring program for the First Term Permit, which extended through 1998, consisted of four elements—field screening, channel monitoring, harbor/bay monitoring, and sediment sampling.

- Field Screening was performed to detect the presence of illegal discharges or illicit connections. Physical and chemical analyses were conducted in the field. The annual evaluation of each station included two dry-weather samplings and one storm sampling. Field screening monitoring stations within the Santa Ana River Watershed included:

Santa Ana River

* Greenville Banning Channel
* Santa Ana River
* Fairview Channel
* Fountain Valley Channel
* Carbon Canyon Diversion Channel
* Miller Basin
* Carbon Creek Channel
* Richfield Channel
* Esperanza Channel
* Collins Channel
* Santiago Creek Channel
* Villa Park Dam
* Gypsum Creek Channel
* Bitterbush Channel
* Southeast Anaheim Channel

- Channel monitoring focused on specific watercourses with beneficial uses identified in the Basin Plan. Stations were monitored monthly and during storms. Samples were collected using automatic samplers and analyzed for pH, electrical conductivity, turbidity, nutrients, total suspended solids, volatile suspended solids, and total recoverable metals.

- Harbor/bay sites were monitored semiannually and during storms for nutrients in the water column and trace metals and organics in the sediment. In addition sediment sampling was conducted semiannually from designated channels and several bays and harbors. Samples were evaluated for metals, pesticides, herbicides, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs).

D-2.1.1.2 *Second Term Permit*

The First Permit Term monitoring program was continued into the second permit term. In 1999, the 99-04 Plan was developed and implemented as a transition program between the 2nd and 3rd term permits. This Plan revised the geographic focus of the monitoring effort by designating "warm spots" (where constituents are substantially above system-wide averages) and "Critical Aquatic Resources" or CARs. The CARs were prioritized and additional monitoring stations selected to gather data at those sites. In the Santa Ana River Watershed there were no 'warm spots' and three second priority CAR monitoring sites - Talbert Channel, Santa Ana River, and Santiago Creek.

D-2.1.1.3 *Third Term Permit*

This current permit period is the most comprehensive monitoring effort to date. It extends the monitoring program to a broader range of locations and to a wider array of methods for measuring impacts. Three kinds of monitoring are considered for this plan.

- Core Monitoring – routine and related to small-scale or site-specific problems and processes,

- Regional Monitoring – periodic, collaborative, and larger-scale surveys, and

- Special Studies – tightly focused and relatively short-term studies.

The following is a list of the seven Program Elements. Each of the 3 types of monitoring listed above are considered and incorporated as appropriate into each of the program elements.

Long-term mass emissions monitoring – includes measurements of key pollutants, loads and exceedances to monitoring progress. Within the Santa Ana River Watershed there are no established stations.

Estuary / wetlands monitoring – includes measurements of key pollutants, loads and biological community parameters to describe impacts of urbanization on estuarine and

wetland ecosystems. There is one (1) site located on Talbert Channel at Banning Avenue in Huntington Beach.

Bacteriological/ pathogen – uses a suite of bacterial indicators to determine the impacts of stormwater and non-stormwater runoff and identify spatial and temporal patterns of elevated concentrations in order to prioritize problem areas. Stations were identified through a joint field reconnaissance effort between the County Health Care Agency (HCA) and the County Sanitations Districts of Orange County. Within the Santa Ana River watershed there are no established stations for this program element.

Urban stream bioassessment monitoring – uses a triad of indicators (bioassessment, chemistry, and toxicity) to define the impacts to stream communities and the relationship of the impacts to runoff. Within the Santa Ana River watershed there are currently no established stations.

Dry weather reconnaissance – uses measurements of key pollutants to identify illegal discharges and illicit connections. Throughout the County approximately 30 sites will be monitored, with 10 additional sites selected at random. Within the Santa Ana River watershed there are currently seven (7) established stations. These are located as follows:

- Santa Ana River Reach 2 at Chapman in Anaheim
- Fountain Valley Channel at Euclid in Fountain Valley
- Collins Channel at Katella in Orange
- Collins Channel at Glassell in Orange
- Carbon Creek at Chapman in Placentia
- Channel E08 at Canyon Circle in Villa Park
- Santa Ana River, Reach 2, upstream of Weir Canyon in Yorba Linda.

Land use correlations– uses available experimental designs to identify changes in runoff and sediment load associated with the urbanization of previously agricultural land. Two land use sites will represent both a flat and a hillside agricultural plot. Within the Santa Ana River watershed there are currently no established stations.

D-2.1.2 Orange County Health Care Agency

Over the past 40 years, the Orange County Health Care Agency (also known as Environmental Health) and local sanitation agencies (Orange County Sanitation District and South Orange County Wastewater Authority) have been testing the coastal waters in Orange County for bacteria that indicate possible presence of human disease-causing organisms. Samples are collected weekly at approximately 150 ocean, bay, and drainage locations throughout coastal Orange County. Within the Santa Ana River Watershed, there are approximately 11 sample locations along the coast. **Figure D-6** shows the subwatersheds and the monitoring locations within the Santa Ana River Watershed.

On July 26, 1999, State law (AB411), mandating new protocols for surf zone monitoring of indicator bacteria, went into effect. The new law requires posting advisory signs to warn against swimming when indicator bacteria exceed regulatory thresholds for total coliform, fecal coliform, and enterococcus. Beach closures during the summer months of 1999 were the response of health officials to the elevated levels of indicator bacteria at Huntington State Beach and Huntington City Beach. The Orange County Sanitation District with Orange County Health Care Agency, the California State Department of Parks and Recreation, the City of Huntington Beach, and the Regional Board to conduct a series of investigations to ascertain the sources of bacterial contamination in the near shore environment.

D-2.1.3 SCCWRP Bight Study

SCCWRP coordinates regular monitoring efforts of the Southern California Bight from Point Conception to the Mexico border. The most recent Bight '03 Study was divided into three program components—coastal ecology, water quality, and shoreline microbiology. The coastal ecology component includes monitoring and assessment within coastal reaches of the Santa Ana River Watershed. The Sediment Toxicity Report (Volume I) has been published and includes monitoring data for stations along the beach in proximity to the Santa Ana River estuary. As part of the Sediment Toxicity work, analyses were performed on samples taken at 359 sites with varying toxicity level results. The samples taken in the Santa Ana River estuary and Talbert Marsh showed no toxicity was present in the sediment; however only 1 -2 samples were taken at each site. Ongoing surveys for the Coastal Ecology component of the Bight '03 Study will continue to produce data along the coastal reach of the Santa Ana River watershed. The planned reports that will include this information are: Sediment Chemistry, Benthic Macrofauna, and Demersal Fish and Megabenthic Invertebrates.

Figure D-6: Subwatersheds and Monitoring Stations

See next page for figure.

LEGEND

- Estuary
- Reconnaissance
- OCHCA / OCSD

Subwatersheds

- Santa Ana River
- Tributaries
- Orange County Boundary

N

Carbon Canyon Creek

Santa Ana River: Reach 2

Santiago Creek: Reach 1

Black Star Creek

Santiago Creek: Reach 2

Ladd Creek

Silverado Creek

Santiago Creek: Reach 3

Santiago Creek: Reach 4
Modjeska Canyon

Santa Ana River: Reach 1

Talbert (West)

Talbert (East)

Santa Ana River: Reach 1

Figure D3-6 Subwatersheds and Monitoring Stations
Santa Ana River Watershed

3 1.5 0 3 Miles

Aerial Photo provided by AirPhoto Mapper, 2002.

D-2.2 Assessment of Data and Studies

There is a large amount of water quality data that is available specific to the Santa Ana River Watershed. Fifty four (54) studies were identified that provide water quality information specific to the Santa Ana River Watershed. The data collection effort ended in October of 2003. A matrix was developed to provide a detailed view of each of the studies / programs discussed in this technical memorandum. This matrix is referred to as the Santa Ana River Environmental Matrix and includes information such as the specific constituents of concern included in the study / program, and details of the monitoring and management issues supported by that study / program. The Santa Ana River Environmental Matrix is attached as Exhibit 1 to this WAP.

It is a significant challenge to assemble the report references into a meaningful framework that provides the reader with an idea of what type of data or results are available. In order to meet the various types of user needs that were envisioned, the data has been 'cut' in several directions. Each 'cut' or assessment represents the sum total of all the programs and studies that were assembled as part of this technical memorandum; the difference is only in the perspective taken in that assessment.

Assessment #1: Program Management and Policies

When faced with the abundance of data that exist, it is appropriate to assess whether the data are providing stormwater program coordinators with the information needed to manage the program and make informed decisions for the watershed. The knowledge needed at various stages in the program development must be able to build on previous efforts to attain constantly improving results. The following passage from *Managing Troubled Waters* (National Academy Co, 2003) explains this iterative process.

> *"The reality of imperfect knowledge about marine systems means that monitoring should be used as an opportunity to increase and refine our knowledge of them. Data and information derived from monitoring programs should be used to check, validate, and refine the assumptions, models, and understandings on which the monitoring was based. This iterative feedback increased predictive ability, reduces uncertainty, and ultimately reduces the monitoring effort needed. As discussed in Chapter 2, risk-free decision making is not achievable, and monitoring must be viewed as a way of reducing uncertainty, not of eliminating it."*

The following table (**Table D-2**) identifies the management categories of a stormwater program that are needed to advance the knowledge of the systems and identifies the number of studies within the data collection effort that are relevant to each category. Each of these categories is considered for specific pollutants of concern or elements of the watershed system. The table shows that the majority of the study effort has been placed in identifying sources, understanding processes, and determining compliance with water quality standards and TMDLs. Less study efforts have been made towards developing new tools and evaluating program and measure effectiveness. This indicates the need to further assess the management needs in these areas and potentially focus efforts on improving the level of knowledge in these areas.

Table D-2: Assessment #1 - Studies by Program Management Category

	Source Identification	Understanding Processes	Developing New Tools	Determine Compliance with WQs/TMDLs	Evaluate Program/ Measure Effectiveness	Provide Early Warning
Bacteria	15	12	5	9	6	2
Nutrients	9	7	9	13	4	1
Inorganics-Metals	4	5	6	10	3	1
Organics-Pesticides	3	2	4	8	3	1
Toxicity	4	2	5	6	3	1
Water Chemistry	8	8	7	13	3	1
Solids-Sediment	3	2	4	4	3	1
Fish Tissue	2	1	2	3	1	0

The Santa Ana River Environmental Matrix identifies which program aspects relate to which specific reports. The matrix uses the following abbreviations: Source Identification (SI), Understanding Processes (UP), Developing New Tools (NT), Determine compliance with WQs / TMDLs (WT), Evaluate Program / Measure Effectiveness (EP), Provide Early Warning (EW)

Assessment #2 – Study and Program Type

The 54 water quality studies identified in the Santa Ana River Watershed have generated different types of water quality data. The data fall into two broad categories—generation of raw data and assessment of existing data. Raw data studies and programs include specific sampling or monitoring activities and account for most of the 54 studies added to the bibliography. New data were generated with the following two objectives:

- Compliance with NPDES permits, monitoring, and directives for TMDL monitoring.
- Provide an understanding of the concentration levels or processes related to the pollutants, or the impacts of the pollutants, on the ecosystem. Studies targeting pollutant concentrations and processes generally involve direct measurements of the pollutants while studies targeting the impacts of the pollutants generally involve other environmental measurements (e.g., analysis of fish tissue).

Studies that focus on the assessment of existing data are performed with the objective of:

- Understanding the behavior of pollutants within the Santa Ana River system through direct measurement of the pollutants, or
- Understanding the impacts of the pollutants by measuring other environmental parameters.

The following figure (**Figure D-7**) shows the category breakdown of the studies as well as the general objective of the study.

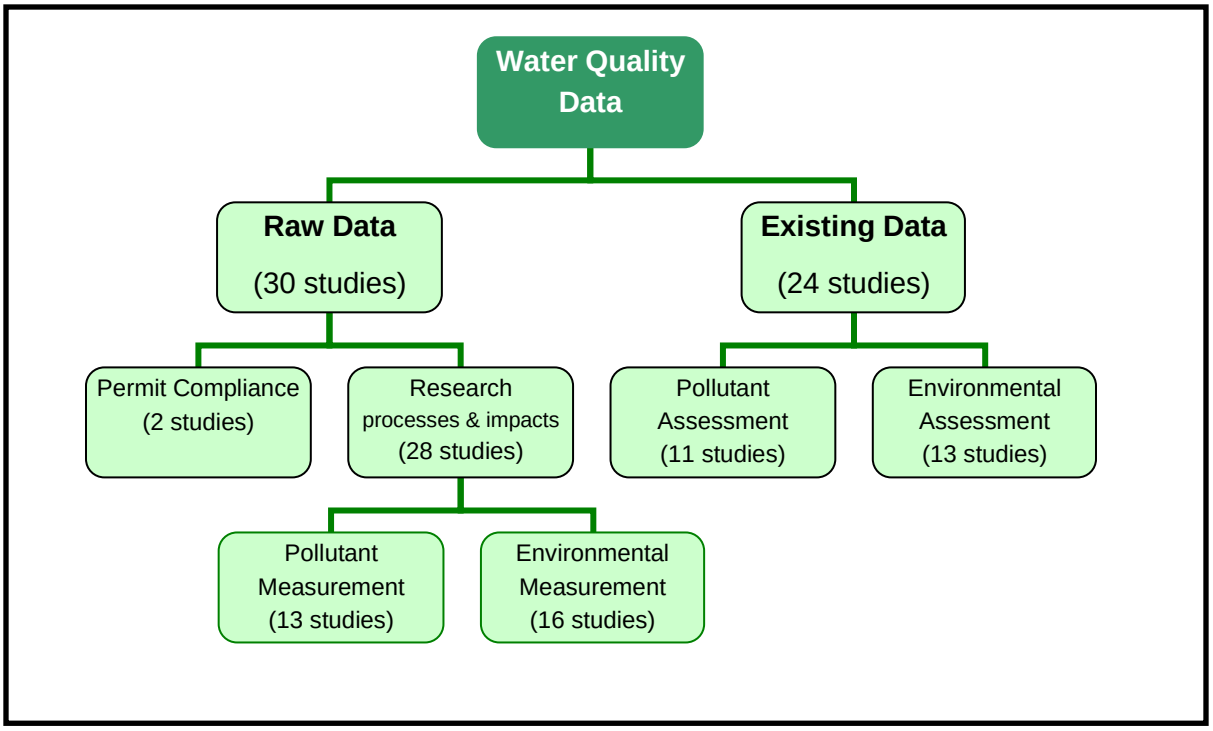


Figure D-7: Study Category Breakdown

Assessment #3 – Study or Program Details

The final assessment that was made of the studies and programs was to look at basic details such as who performed the study and what pollutants were included in those studies and programs.

Within the Santa Ana River Watershed the major generators of water quality data are the United States Geologic Survey (USGS), Santa Ana Watershed Project Authority (SAWPA), and the University of California Irvine (UCI). The following table (**Table D-3**) identifies the organizations responsible for each of the 54 studies. For collaborative studies, the primary organization was used for the accounting below.

Table D-3: Study Sources

Organization	Number of Studies
USGS	13
SAWPA	9
Other Agencies (RWQCB, DPR, DWR, SARWG, USACE)	8
SCCWRP	1
RDMD, OCWD, OCSD, OCHCA, Cities	11
Universities (UCI, UCB, UC Coop)	9
Private (consultants, NWRI)	3

Each of the 54 water quality studies or programs that were identified as part of this data assessment addressed one or more specific pollutants. Eight (8) categories of constituents were identified that encompass nearly all of the specific data that was monitored or assessed. These categories include:

- Bacteria
- Nutrients
- Metals
- Pesticides
- Toxicity – various levels of toxicity studies were performed
- Conventional water chemistry – this includes a wide ranges of variables such as pH, hardness, and temperature
- Sediment – this includes both bulk sediment and sediment contamination
- Fish Tissue

The following table (**Table D-4**) shows the distribution of the studies within each of these categories. Many studies include work related to several constituents.

Table D-4: Constituent Focus of Studies and Programs

Constituent	Number of Studies
Bacteria	30
Nutrients	22
Metals	15
Pesticides	9
Toxicity	11
Water chemistry	22
Sediment	5
Fish Tissue	4

D-2.3 Water Quality Status

D-2.3.1 Impaired Waters

Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop a list of water quality limited segments—waters that 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 state or local jurisdictions establish priority rankings for water quality impairment on the list and develop action plans, referred to as TMDLs, to improve water quality.

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. These recommendations are based upon "all existing and readily available data and information" (40 CFR 130.7(b)(5)). In developing the recommendations, the SWRCB staff used the recommendations and analysis of the Regional Board as the basis of its analysis.

A new listing policy was used to develop the 2006 draft 303(d) list. Based on that policy, some data, for purposes of developing the section 303(d) list, are sufficient by themselves to demonstrate non-attainment of standards. Examples of these listing factors are (1) numeric data exceeding numeric water quality objectives, maximum contaminant levels, or California/National Toxics Rule water quality criteria and (2) use of numeric evaluation values focused on protection of consumption of aquatic species. Other data types require that multiple lines of evidence be used for listing and de-listing. The listing factors that require multiple lines of evidence are (1) toxicity, (2) health advisories, (3) nuisance, (4) beach postings, (5) adverse biological response, and (6) degradation of aquatic life populations or communities. Each of these lines of evidence generally need evidence of the presence of the pollutant(s) that cause or contribute to the adverse condition.

Activities within all of the Orange County watersheds have a potential effect on the coastal beaches and nearshore zones, which have been identified as having bacterial problems. Beach closures due to exceedance of bacterial standards are a cause of concern to jurisdictions within this group, as well as the residents of the watershed.

The 2002 303(d) list of impaired waters approved by the SWRCB that could potentially be affected by activities occurring within Santa Ana River Watershed is presented in **Table D-5**. **Figure D-8** includes a map that shows the 303(d) listed receiving waters.

Table D-5: 2002 303(d) List and TMDL Priority Schedule – Santa Ana River Watershed

Type	Name	Hydro Unit	Pollutant/Stressor	Source	Priority	Estimated Size Affected	Proposed TMDL Completion
R	Santiago Creek, Reach 4	801.12	Salinity/TDS/Chlorides	Source Unknown	Low	9.8 Miles	--
R	Silverado Creek	801.12	Salinity/TDS/Chlorides	Source Unknown	Low	11 Miles	--
			Pathogens	Source Unknown	Low	11 Miles	--
C	Huntington Beach State Park	801.11	Enterococci *Impaired 50 yards around drain at Magnolia*	Source Unknown	Low	5.8 Miles	--

(Note: B – Bay; R – Rivers; E – Estuary; C – Coastal Shoreline/Beaches)

D-2.3.2 AB411 Summary

The 2005 Annual Ocean and Bay Water Quality Report (OCHCA, 2006) summarizes monitoring activities that took place near the Santa Ana River mouth. Five sites are monitored along the 2.5 miles of beach front at Huntington State Beach. In 2005 there were 14 beach postings from April-October, a decrease compared with previous years (since 2000) when postings ranged from 28 to 23. In 2005 there were 32 postings throughout the 2005 calendar year. This is a decrease compared with previous years since 2000 when the postings ranged from 42 to 33.

D-2.4 Priority Water Quality Needs

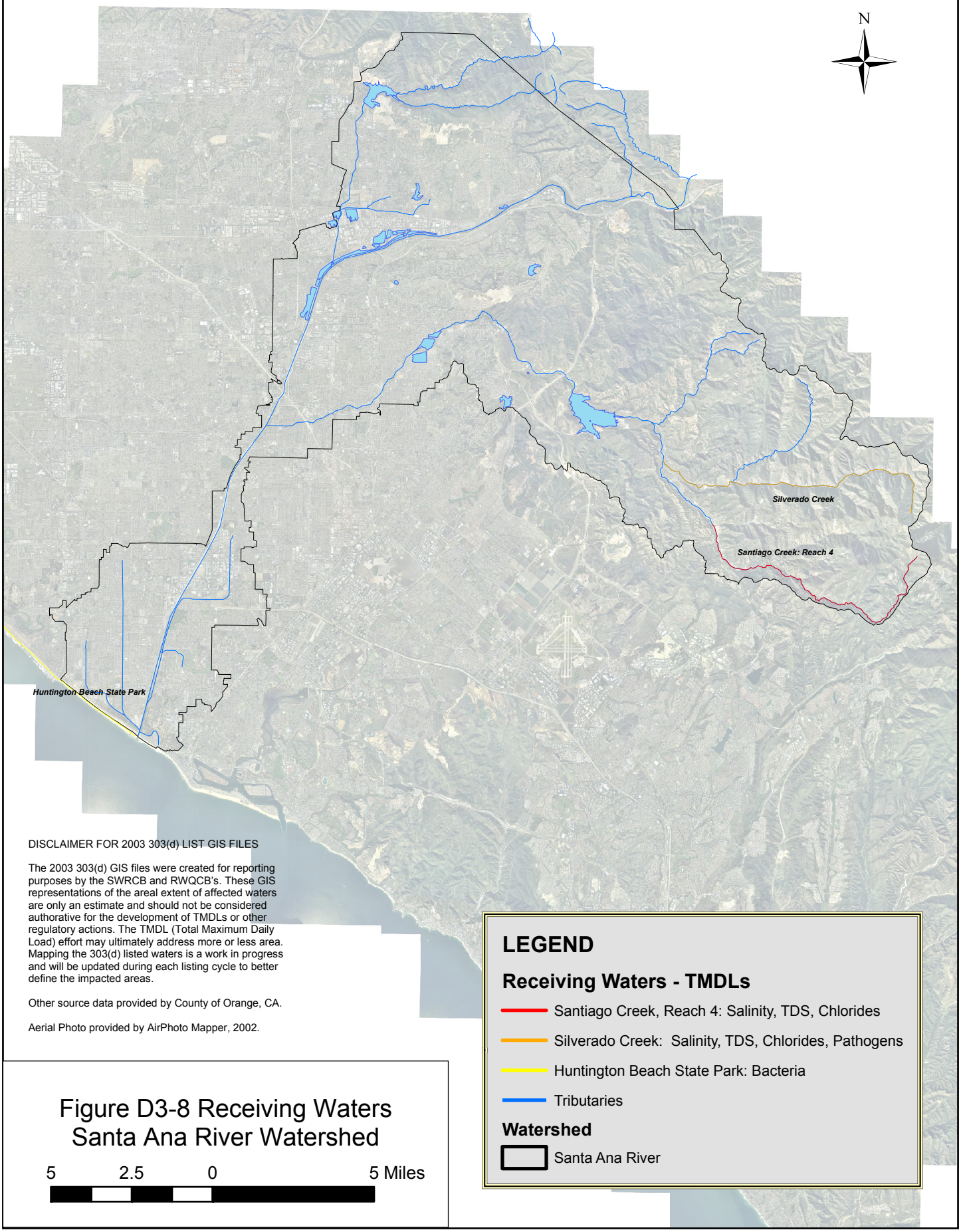
Managing and improving water quality in an urban environment is a complex issue. The science needed to deal with many of the issues that arise during the management process is evolving, and in some cases has not yet developed to the point that important questions can readily be answered in absolute quantifiable terms. Examples where our understanding is not fully developed are as follows:

- Stormwater runoff modeling relative to pollutants of concern. This modeling is not totally reliable for predictive purposes and needs large data sets to calibrate.
- Methods (such as MST (microbial source tracking) for more accurately identifying sources of pathogens in runoff (e.g., wildlife, pets, humans) are still being refined. Only qualitative methods exist at this time and they are not yet able to be directly translated into a loading assessment. For example, we may be able to say that 50% of the fecal coliform bacteria from a sample are from dogs but this does not imply that 50% of the loading of fecal bacteria is from dogs.
- The effectiveness of various BMPs (Best Management Practices) under varying conditions has not been systematically assessed under field conditions.

These and other data gaps have been identified to some extent in the research study reports, the research agenda for the Stormwater Monitoring Coalition, and the specific requirements of the NPDES permits. However, a thorough and conceptually organized listing of data gaps must stem from a thoughtful description of the key management questions related to the watershed. There are two reasons for this. First, there is a virtually infinite array of scientific data that could be gathered in a complex system such as this. It is essential to focus effort on those data types that are useful in decision making. Second, data gaps sometimes stem, not from the absence of data, but from the inability to adequately integrate existing data. Articulating clear questions enables studies to be designed so that disparate data types can be combined as needed to address complex issues.

Figure D-8: Receiving Waters

See next page for figure.



DISCLAIMER FOR 2003 303(d) LIST GIS FILES

The 2003 303(d) GIS files were created for reporting purposes by the SWRCB and RWQCB's. These GIS representations of the areal extent of affected waters are only an estimate and should not be considered authorative for the development of TMDLs or other regulatory actions. The TMDL (Total Maximum Daily Load) effort may ultimately address more or less area. Mapping the 303(d) listed waters is a work in progress and will be updated during each listing cycle to better define the impacted areas.

Other source data provided by County of Orange, CA.

Aerial Photo provided by AirPhoto Mapper, 2002.

LEGEND

Receiving Waters - TMDLs

- Santiago Creek, Reach 4: Salinity, TDS, Chlorides
- Silverado Creek: Salinity, TDS, Chlorides, Pathogens
- Huntington Beach State Park: Bacteria
- Tributaries

Watershed

- Santa Ana River

Figure D3-8 Receiving Waters Santa Ana River Watershed

5 2.5 0 5 Miles

D-2.4.1 Pollutant Data Gaps

Bacteria is the constituent of concern in the Santa Ana River Watershed. Significant studies have been performed related to this pollutant. Many of these studies identify additional gaps in knowledge and recommend further studies. The most commonly noted data gaps with respect to bacteria are noted below and further discussion of these items follow.

- *Bacteria*
  - Sources Characterization
  - Human Health Risk
  - Rapid Bacteriological Indicators
  - MST (microbiological source tracking) identification methods

D-2.4.1.1 *Bacteria – Source Characterization*

Identification of the source of bacteria is a difficult question. In the Santa Ana River Watershed identifying and quantifying the contribution of urban and natural sources of bacterial impairment in the watershed is a data gap. Data and observations indicated the erosion of sediment from land and channels as well as bird droppings are likely significant contributors of bacteria to the river and the Pacific Ocean near the river outlet. Ongoing work by the National Water Research Institute (NWRI) as part of the *Coastal Runoff Impact Studies* will focus on responding to this data gap.

Considerable resources are being expended to reduce bacterial contamination from watershed sources, but in many cases storm drains continue to discharge large concentrations of bacteria. A study by SCCWRP will examine if bacteria can grow in storm drain sediments. This study, *Storm Drains and Sediments as Reservoirs of Fecal Indicator Bacteria*, is being led by John Griffith. It is expected that the findings from this effort will have application to the Santa Ana River Watershed.

D-2.4.1.2 *Bacteria – Rapid Human Health Risk*

Questions have been raised regarding the applicability of the current REC-1 and REC-2 standards in assessing human health risk. Significant work in this area has been performed by SAWPA through the *Stormwater Quality Standards Study* in which recommendations are made to adopt additional recreational designations and to revise the beneficial use of designation of waterbodies as appropriate.

D-2.4.1.3 *Bacteria – Rapid Bacteriological Indicators*

The applicability of current bacteriological indicators for measuring human health risk and for identifying the sources of pathogen contamination needs further refinement. Two projects identified in SCCWRP Technical Report 35B, *Stormwater Research Needs in Southern California,* identify plans to address these issues. The first project (Project 12. *Develop rapid response indicator(s) for microbial contamination*) is focused on producing easily used field tests that would provide a reliable measure of bacteriological contamination within a few hours at most. A portion of funding for this project is provided by the Newport Bay watershed Permittees

through funding of the broader NPDES program. It is expected that findings from the effort will have application to the Newport Bay watershed.

D-2.4.1.4 *Bacteria – Microbial Source Tracking*

The applicability of current bacteriological indicators for measuring human health risk and for identifying the sources of pathogen contamination needs further refinement. Two projects identified in SCCWRP Technical Report 35B *Stormwater Research Needs in Southern California* identify plans to address these issues. The second project (Project 13. *Develop microbial source tracking protocol*) will select methods (primarily genetic-based) that provide the most dependable means of identifying and distinguishing among sources.

D-2.4.2 Other Data Gaps

Other data gaps that exist are not pollutant specific. These data gaps are related to a broader understanding of pollutants, such as how they travel, how they impact the habitat, how to develop regional stormwater infrastructure. The following describes actions being taken to address these data gaps.

D-2.4.2.1 *Stormwater Infrastructure*

Guidance on how to use existing data for further analysis is limited. The Southern California Stormwater Monitoring Coalition has recognized the need to develop projects to (1) integrate and evaluate available data (Project 1); (2) standardize sampling and analysis protocols (Project 2); (3) develop a regional data infrastructure (Project 3); and (4) measure BMP effectiveness (Project 4).

D-2.4.2.2 *Stormwater Mechanisms and Processes*

The Stormwater Monitoring Coalition has identified a need to improve fundamental understanding of stormwater mechanisms and processes. To meet this need the following project have been identified: (1) develop a systemwide conceptual model (Project 5); (2) determine appropriate reference conditions (Project 6); (3) develop a regional method for measuring beneficial use condition (Project 7); and (4) identify relative contribution of nonpoint sources to urban runoff loads (Project 8).

Additionally, a study will be performed by the County as part of the Santa Ana Region Water Quality Monitoring Program through the Estuary / Wetlands Monitoring Program to assess the transport modes of pollutants into wetland upland areas. The transport modes include two mechanisms: (1) by floating on the surface of the water and collecting on the land/water interface and (2) through periodic flooding of contaminated stormwater into the upland areas. The design process for the study will be developed in cooperation with the Regional Board and SCCWRP.

D-2.4.2.3 *Receiving Water Impacts*

The final data gap identified by the Stormwater Monitoring Coalition is related to identifying receiving water impacts. The following studies were identified to address this need: (1) identify the causes of impact in receiving waters (Project 9); (2) develop bioassessment indicators and protocols (Project 10); (3) develop improved toxicity testing procedures (Project 11); (4) develop raid response indicator(s) for microbial contamination (Project 12); (5) develop microbial source tracking protocol (Project 13); (6) evaluate BMP effects on receiving water impacts (Project 14); and (7) develop improved indicators of peak flow impacts (Project 15).

Several of the identified Stormwater Monitoring Coalition projects have been funded and are underway. Projects that are underway or completed included Projects 2, 5, 8,9, 10, 12, 13, and 15.

D-3.0 TMDLs in the Watershed

Section 303(d) of the Clean Water Act requires that each State identify waters that are not meeting the water quality standards for their applicable beneficial uses. This process involves requesting and compiling readily available data and comparing these data to the appropriate water quality objectives (WQOs). The waterbody-pollutant combinations exceeding WQOs at predefined frequencies, which are specified in the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List, are placed on the 303(d) list of impaired waters. Section 303(d) also requires states to establish a priority ranking for waterbody-pollutant combinations on the 303(d) list and to subsequently establish TMDLs for each.

The goal of the TMDL process is to attain water quality standards and protect the beneficial uses of water bodies. It is defined as "the sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR 130.2) and requires that the capacity of the water body to assimilate pollutant loadings (the Loading Capacity) is not exceeded.

The TMDL process begins with the development of a technical analysis which includes the following 7 components: (1) a **Problem Statement** describing which WQOs are not being attained and which beneficial uses are impaired; (2) identification of **Numeric Targets** which will result in attainment of the WQOs and protection of beneficial uses; (3) a **Source Analysis** to identify all of the point and nonpoint sources of the impairing pollutant in the watershed and to estimate the current pollutant loading for each source; (4) a **Linkage Analysis** to calculate the Loading Capacity of the waterbodies for the pollutant; i.e., the maximum amount of the pollutant that may be discharged to the waterbodies without causing exceedances of WQOs and impairment of beneficial uses; (5) a **Margin of Safety** to account for uncertainties in the analyses; (6) the division and **Allocation** of the TMDL among each of the contributing sources in the watersheds, wasteload allocations (WLAs) for point sources and load allocations (LAs) for nonpoint and background sources; and (7) a description of how **Seasonal Variation and Critical Conditions** are accounted for in the TMDL determination. The write-up of the above components is generally referred to as the technical TMDL analysis.

In addition to a technical TMDL analysis, the State is required to incorporate the TMDLs and their appropriate implementation measures into the State Water Quality Management Plan (40 CFR 130.6(c)(1), 130.7), such as the Regional Board Basin Plan. After a TMDL is adopted into the Basin Plan, it is submitted to EPA and reviewed. Approval from EPA is the last step in the TMDL process.

D-3.1 Existing TMDL Development

There are four waterbody-pollutant combinations on the current 303(d) list (Section D-2.3.1). To date, TMDLs have not been completed for these listings.

D-3.2 Status of Future TMDL Development

TMDLs will be developed in the future for all waterbody-pollutant combinations on the current 303(d) list. The 2002 303(d) list is the active, approved list. Section D-2.3.1 identifies the waterbodies in the Santa Ana River Watershed that are on the 2002 303d list. No TMDLs have currently been completed and approved for these listings. A draft 2006 list is available; however, the final version may change based on comments from the County and other interested parties and it is unknown when the final list will become available. There are no proposed listings for the Santa Ana River Watershed on the draft 2006 list. Because this list is not yet approved, additional listings may be included on the final list. TMDLs will only be required for the final list of impaired waters.

D-4.0 BMP Inventory

In developing a plan to address water quality within the Santa Ana River Watershed, it is important to (1) understand the sources of pollution within the watershed and (2) know the specific source and treatment controls that have been implemented (or proposed to be implemented) within the watershed to deal with the watershed constituents of concern. This section provides the available information for these two areas and identifies the related knowledge gaps that exist.

D-4.1 Watershed Pollution Sources

Pollution sources in the Santa Ana River Watershed include urban runoff, open space runoff, groundwater, permitted discharges, atmospheric deposition, agriculture, and wildlife. Because the mandate of the Orange County Stormwater Program is to address urban runoff, this WAP and planning effort will focus mainly on the urban sources although it is inherently recognized that in many cases, such as sediment control, the Watershed Permittees have taken on a broader role as responsible stakeholders even though the urban contribution is limited.

The urban sources in the watershed include runoff generated during storm events and non-storm related runoff from municipal facilities, residential, commercial, and industrial areas and parks.

D-4.2 Existing Structural Enhanced BMPs

Structural BMPs include engineered facilities that are designed to remove pollutants. These facilities can include, but are not limited to, wetlands, bioswales, extended detention basins, and proprietary separator units. Enhanced structural BMPs include facilities in which a specific pollutant of concern for that watershed is addressed. Enhanced BMPs are considered to be regional and treat runoff from more than a single developed area, such as a single residential tract. **Table D-6** identifies the enhanced structural BMPs that have been implemented in the Santa Ana River Watershed and a description of each BMP is included following the table.

Table D-6: Enhanced Structural BMPs

Project	Location	Constituent of Concern
Sewer Diversion Project	Santa Ana River at Ellis Avenue	Bacteria – primary
Sewer Diversion Project	Talbert Channel at Waterbury Lane	Bacteria – primary
Sewer Diversion Project	Greenville Banning Channel downstream of Adams Ave	Bacteria – primary

D-4.2.1 Bacteria

D-4.2.1.1 *Santa Ana River Urban Runoff Diversion at Ellis Avenue*

This BMP is part of the Talbert – Lower Santa Ana River Watershed Urban Runoff Diversion Project, the purpose of which is to remediate sources of microbial contamination in ocean water at Huntington Beach. This is accomplished by diverting the urban runoff to the Orange County Sanitation District from four flood control facilities for treatment prior to the release of the water into the ocean. The project consists of four components, three of which are located in the Santa Ana River watershed at three different sites. The Ellis Avenue diversion began operation in May of 2003. It consists of a two foot dam with a catch basin and grate, capable of catching some sediment. Dry weather flow is pumped to the OCSD Plant No. 1 with a capacity of 500 GPM, reducing bacteria in dry weather flow by 100%.

D-4.2.1.2 *Talbert Channel Urban Runoff Diversion at Waterbury Lane*

Second of three components to the Talbert – Lower Santa Ana River Watershed Urban Runoff Diversion Project, this diversion structure consists of a four foot tall rubber dam and two pumps, diverting dry weather flow to OCSD Facility D02 at a rate of approximately 600 GPM. Bacteria load reduction for treated flow is 100%. The Waterbury Lane diversion began operation in May of 2003.

D-4.2.1.3 *Greenville Banning Channel Downstream of Adams Ave*

The third of three components to the Talbert – Lower Santa Ana River Watershed Urban Runoff Diversion Project, this diversion structure consists of a six foot tall rubber dam and two pumps, diverting dry weather flow at a rate of approximately 1000 GPM. Bacteria load reduction for treated flow is 100%. The Greenville Banning diversion was completed in December of 2002.

D-4.3 Estimates of Load Reductions of Existing BMPs

Understanding the load reduction of implemented BMPs is important in assessing whether or not those BMPs are improving the quality of the receiving waters. Guidelines available through the DAMP (Appendix E-1, BMP Effectiveness and Applicability for Orange County) as well as California Stormwater Quality Association (CASQA) (CASQA BMP Handbook) associate wide ranges of estimates for the reduction in pollutants with various types of BMPs. Because the pollutant reductions are highly variable, actual monitoring data is often collected to assess the load reduction of the existing BMPs. In the case of diversions, the effectiveness is considered to be 100% because all of the polluted water treated by the BMP is removed from the system. The following table (**Table D-7**) presents that information as available.

Table D-7: Pollutant Removal for Existing Enhanced Structural BMPs

Project	Constituent	Pollutant Reduction
Santa Ana River at Ellis Avenue	Bacteria	100%
Talbert Channel at Waterbury Lane	Bacteria	100%
Greenville Banning Channel downstream of Adams Ave	Bacteria	100%

D-4.4 Recommendations for BMPs in the Watershed

New candidate BMPs can be prevention or removal oriented and can be considered either for updating baseline BMPs or for incorporation as watershed based BMPs. New BMPs are generally identified from one or more of the following:

- A review of technical literature (such as the ASCE/EPA database);
- A review of existing control programs;
- Demonstration or research projects;
- Input from consulting firms and municipalities already involved in new BMP implementation; or
- Other sources.

Consistent with DAMP Section 3.0, the process for BMP selection and implementation at the watershed scale involves consideration of a candidate BMP with respect to:

- The Watershed Permittees' needs, goals, and objectives
- Consistency with federal and state programs
- Economies from streamlined analysis and implementation procedures
- Opportunities for flexibility in the development of management alternatives
- Decision-making based on environmental and local considerations
- Effective Capital Improvement Program planning and budgeting

The following table (**Table D-8**) has been modified from that presented in DAMP Section 7.0 referencing the effectiveness of BMPs for specific pollutants. Specifically the types of BMPs have been reduced to reflect those that are more effective in reducing the pollutant of concern (bacteria) within the Santa Ana River Watershed. In particular the infiltration BMPs (shaded in the table) have high removal efficiencies for all pollutants of concern in this watershed.

Table D-8: BMPs that target Santa Ana River Watershed pollutants of concern.

	INFILTRATION (2)			*WET PONDS AND WETLANDS*		BIOFILTERS		*FILTRATION*	
Pollutant of Concern	**TC-10 Infiltration Trench**	**TC-11 Infiltration Basin**	**TC-12 Retention/ Irrigation**	**TC-20 Wet Pond**	**TC-21 Constructed Wetland**	**TC-31 Vegetated Buffer Strip**	**TC-32 Bioretention**	**TC-40 Media Filter**	**TC-60 Multiple Systems**
Bacteria & Viruses	H	H	H	H	H	H	H	H	H

Cooperative periodic performance assessment may be necessary. This Treatment Control BMP table will be updated as needed and as knowledge of stormwater treatment BMPs improves.

(2) Including trenches and porous pavement.

H High removal efficiency

Sources:

International Stormwater Best Management Practices Database (2001), including Analysis of treatment system performance (1999 - 2005), dated February 2006

California Stormwater Quality Association (CASQA) Stormwater Best Management Practice Handbook – New Development and Redevelopment (January 2003 with September 2004 Errata)

Guide for BMP Selection in Urban Developed Areas (2001) Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (1993)

D-5.0 Plan Implementation and Assessment

D-5.1 Plan Implementation

Strategy Tables have been developed for the Santa Ana River Watershed that identifies the specific actions that are being undertaken to improve urban water quality within the watershed. These strategy tables are specific to the constituents of concern for the watershed and include information on past progress as well as the scheduled tasks to support this action. On an annual basis these tables will be updated to identify the progress made in that year as well as the schedule for the subsequent year. The Santa Ana River Watershed Strategy Tables are included as **Exhibit 2** to this WAP.

D-5.2 Plan Assessment

Effectiveness Assessment is the process that managers use to evaluate whether their programs are resulting in desired outcomes, and whether these outcomes are being achieved efficiently and cost-effectively (CASQA, 2003). A principle objective of the WAP is to present an integrated plan of action that will result in meaningful water quality improvements in the Santa Ana River Watershed while balancing economic, social and environmental constraints. This plan of action is laid out in the strategy tables which are referenced in **Section 5.1** and included herein as **Exhibit 2**. The program effectiveness assessment strategy requires the identification and thereafter annual consideration of measures that indicate whether progress is being made toward attainment of this objective and the other program objectives discussed in **Section 1.0**.

Assessment measures that are pertinent to the WAP are related to the confirmation of progress on the actions identified in the strategy table. The assessment of progress is integrated in the strategy tables through the annual update to the tables that require documentation on the progress that has been made on that specific action. Reasonable progress on these action items indicates that the WAP is effective.

D-6.0 References

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Nomenclature (Abbreviations)

Table D-9: Abbreviation Definitions

Abbreviation	Definition
NPDES	National Pollutant Discharge Elimination System
OCHCA	Orange County Health Care Agency
SCCWRP	Southern California Coastal Water Research Project
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
BMP	Best Management Practice
USEPA / EPA	United States Environmental Protection Agency
DAMP	Drainage Area Management Plan
LIP	Local Implementation Plan
OCSD	Orange County Sanitation District
RWQCB	Regional Water Quality Control Board
GIS	Geographic Information System/Science
NCCP/HCP	Natural Community Conservation Plan & Habitat Conservation Plan
USACE, ACOE	United States Army Corps of Engineers
ASBS	Areas of Special Biological Significance
SOCWA	South Orange County Wastewater Authority
SWRCB	State Water Resources Control Board
RDMD	Resources & Development Management Department
PCB	Polychlorinated Biphenyls
PAH	Polycyclic Aromatic Hydrocarbons
CARs	Critical Aquatic Resources
TSMP	Toxic Substances Monitoring Program
SMWP	California Sate Mussel Watch Program
CDFG	California Department Of Fish and Game
DO	Dissolved Oxygen
UCLA/UCI	University of California Los Angeles / Irvine
IBI	Index of Biotic Integrity

IRWD	Irvine Ranch Water District
MPN	Most Probable Number
WLA / LA	Waste Load Allocation / Load Allocation
CTR	California Toxics Rule
RMA	Resource Management Associates
NTS	Natural Treatment System
CASQA	California Stormwater Quality Association

EXHIBIT D-1

ENVIRONMENTAL MATRIX

EXHIBIT D-2

STRATEGY TABLES