United States
Environmental Protection Agency
Region 9

Ventura River Reaches 3 and 4
Total Maximum Daily Loads For
Pumping & Water Diversion-Related
Water Quality Impairments

Draft December 2012

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List of Acronyms

ASSETS	Assessment of Estuarine Trophic Status
Basin Plan	Los Angeles Region Water Quality Control Plan
Caltrans	California Department of Transportation
CDFG	California Department of Fish and Game
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMWD	Casitas Municipal Water District
CWA	Clean Water Act
CZARA	Coastal Zone Act Reauthorization Amendments
DO	Dissolved Oxygen
GIS	Geographic Information System
LARWQCB	Los Angeles RWQCB
LAs	Load Allocations
mg/L	milligrams per liter
mg/m^2	milligrams per square meter
MGD	million gallons per day
MS4	Municipal Separate Storm Sewer System
NEAA	National Estuarine Eutrophication Assessment
NMFS	National Marine Fisheries Service
NNE	Nutrient Numeric Endpoints
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
OVSD	Ojai Valley Sanitation District
Regional Boards	Regional Water Quality Control Boards
SBCK	Santa Barbara ChannelKeeper
SCAG	Southern California Association of Governments
SCCWRP	Southern California Coastal Water Research Project
SWAMP	Surface Water and Ambient Monitoring Program
SWRCB	State Water Resources Control Board
TMDLs	Total Maximum Daily Loads
TN	Total Nitrogen
TP	Total Phosphorous
USEPA	United States Environmental Protection Agency
VCWPD	Ventura County Watershed Protection District
WDRs	Waste Discharge Requirements
WLAs	waste load allocations
WQOs	water quality objectives
WWTP	Waste Water Treatment Plant
µg/L	micrograms per liter

1 Introduction

The Ventura River Estuary and the Ventura River (including its tributaries), located in Ventura County, are identified on the 1998, 2002, 2006, and 2010 Clean Water Act (CWA) Section 303(d) list of impaired waterbodies due to algae, eutrophic conditions, low dissolved oxygen, nitrogen, pumping and water diversions (Table 1-1). The CWA requires the development of Total Maximum Daily Loads (TMDLs) to restore impaired waterbodies to fully support their beneficial uses.

The *Algae, Eutrophic Conditions, and Nutrients Total Maximum Daily Loads for Ventura River and its Tributaries* (Ventura River Watershed Algae TMDL; LARWQCB, 2012) is concurrently being developed to address the algae, eutrophic conditions, low dissolved oxygen, and nitrogen impairments (LARWQCB, 2012). In conjunction with the Ventura River Watershed Algae TMDL, this TMDL provides background information used by the United States Environmental Protection Agency (USEPA) on the pumping and water diversion impairments associated with Ventura River Reach 3 (Reach 3) and Ventura River Reach 4 (Reach 4).

Table 1-1. 2010 CWA Section 303(d) list of impairments for Ventura River Watershed

Water Body Name	Pollutant(s)
Ventura River Reach 4 (Coyote Creek to Camino Cielo Road)	Pumping, water diversion
San Antonio Creek	Nitrogen, indicator bacteria, total dissolved solids
Ventura River Reach 3 (Weldon Canyon to confluence with Coyote Creek at Casitas Vista/Santa Ana Road)	Pumping, water diversion, indicator bacteria
Cañada Larga	Low dissolved oxygen, fecal coliform, total dissolved solids
Ventura River Reach 1 and 2 (Estuary to Weldon Canyon)	Algae
Ventura River Estuary	Algae, eutrophic, total coliform, trash

As documented in this TMDL, the pumping and water diversion impairments of Reach 3 and Reach 4 affect the same beneficial uses addressed in the Ventura River Watershed Algae TMDL (LARWQCB, 2012). This TMDL presents data evaluation and documentation of the impairments observed at Reaches 3 and 4. Our assessment confirms that impairments due to nutrient loading, including low DO conditions, are strongly related to the effects of pumping and water diversions. We find that addressing the nutrient-related water quality impairments will simultaneously benefit the waterbodies impacted from pumping and water diversions. This will result in significant improvement towards protection of the identified beneficial uses for Reaches 3 and 4 of Ventura River. Because the identified impairments are linked to complex sources, a full restoration of Reaches 3 and 4 would require addressing the nutrient-related water quality impairments, as proposed in this TMDL.

1.1 Regulatory Background

Section 303(d) of the CWA requires that "Each State shall identify those waters within its boundaries for which the effluent limitations are not stringent enough to implement any water quality standard applicable to such waters." The CWA also requires states to establish a priority ranking for waters on the 303(d) list of impaired waters and establish TMDLs for such waters.

The elements of a TMDL are described in 40 Code of Federal Regulations (CFR) sections 130.2 and 130.7 and Section 303(d) of the CWA, as well as in the U.S. Environmental Protection Agency guidance (USEPA, 2000). A TMDL defined as the "sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background" (40 CFR section 130.2) such that the capacity of the waterbody to assimilate pollutant loadings (the Loading Capacity) is not exceeded. TMDLs are also required to account for seasonal variations, and include a margin of safety to address uncertainty in the analysis.

The USEPA has oversight authority for the 303(d) program and is required to review and either approve or disapprove the TMDLs submitted by states. In California, the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (Regional Boards) are responsible for preparing lists of impaired waterbodies under the 303(d) program and for preparing TMDLs, both subject to USEPA approval. If the USEPA disapproves a TMDL submitted by a state, USEPA is required to establish a TMDL for that waterbody. The Regional Boards hold regulatory authority for many of the regulatory instruments used to implement the TMDLs, such as National Pollutant Discharge Elimination System (NPDES) permits and state-specified Waste Discharge Requirements (WDRs). In California, the state must develop water quality management plans to implement the TMDL (40 CFR section 130.6).

As part of its 1996 and 1998 regional water quality assessments, the Los Angeles RWQCB (LARWQCB) identified over 700 waterbody-pollutant combinations in the Los Angeles Region where TMDLs would be required (LARWQCB, 1996, 1998). These are referred to as "listed" or "303(d) listed" waterbodies or waterbody segments. A 13-year schedule for development of TMDLs in the Los Angeles Region was established in a consent decree approved between USEPA and several environmental groups on March 22, 1999 (Heal the Bay Inc., et al. v. Browner, et al. C 98-4825 SBA). Following a modification to the consent decree (September 2, 2010), USEPA must establish these TMDLs by March 24, 2013. For the purpose of scheduling TMDL development, the consent decree combined the more than 700 waterbody-pollutant combinations into 92 TMDL analytical units. In accordance with the consent decree, this TMDL addresses the waterbodies in analytical unit 88. This document summarizes the analyses performed and presents the TMDLs for those water quality related impairments linked to pumping and water diversions in the Ventura River Watershed.

1.2 Elements of a TMDL

There are seven elements of a TMDL. Sections 2 through 7 of this document are organized such that each section describes one or two of the elements, with the analysis and findings of this TMDL for that element. The elements are:

- Section 2: Problem Identification. This section reviews the data used to add the waterbody to the 303(d) list, and summarizes existing conditions using that evidence along with any new information acquired since the listing. This element identifies those beneficial uses that are not supported by the waterbody; the water quality objectives (WQOs) designed to protect those beneficial uses; and summarizes the evidence supporting the decision to list each reach, such as the number and severity of exceedances observed.
- Section 3: Numeric Targets. The numeric targets for this TMDL are based upon the WQOs described in the Los Angeles Region Water Quality Control Plan (Basin Plan).
- Section 4: Source Assessment. Describes and identifies the potential point sources and nonpoint sources to the Ventura River and its tributaries.
- Section 5: Linkage Analysis. This analysis shows how the sources of pollutants discharged to the waterbody are linked to the observed conditions in the impaired waterbody.
- Section 6: TMDL and Pollutant Allocations. Each pollutant source is allocated a quantitative load that it can discharge to meet the numeric targets. Point sources are assigned waste load allocations (WLAs) and nonpoint sources are assigned load allocations (LAs). Allocations are designed such that the waterbody will not exceed numeric targets for any of the compounds or related effects. Allocations are based on critical conditions, so that the allocated pollutant loads may be expected to remove the impairments at all times.
- Section 7: Implementation and Monitoring. This section describes the plans, regulatory tools, or other mechanisms by which the WLAs and LAs may be achieved. The TMDL includes a monitoring program to assess TMDL effectiveness and attainment of water quality standards. It also describes special studies to address uncertainties in assumptions made in the development of this TMDL and the process by which new information may be used to refine the TMDL.

1.3 Environmental Setting

The Ventura River Watershed (Figure 1-1) is located in the northwestern portion of Ventura County with a small portion in the southeastern portion of Santa Barbara County. The watershed drains a fan-shaped area of about 220 square miles with an elevation from 6,000 feet to sea level. The Ventura River has several major tributaries, including Matilija Creek, North Fork Matilija Creek, San Antonio Creek, Coyote Creek and Cañada Larga. Matilija Creek (15 miles) drains the Santa Ynez Mountains as it flows to the Matilija Reservoir and the Matilija Dam. The creek continues below the dam for about one half mile before it joins North Fork Matilija Creek. North Fork Matilija Creek, which is about 12 miles long, generally follows Highway 33 in the Los Padres National Forest until it joins Matilija Creek.

Figure 1-1. Major surface waters in Ventura River Watershed

The Ventura River, which is comprised of five reaches, starts at the confluence of Matilija Creek and North Fork Matilija Creek. The Ventura River then flows for about 16 miles in a southerly direction to the estuary and the Pacific Ocean. The Ventura River has intermittent direct discharge to the ocean; longshore transport of sand can cause a sand bar to form at the mouth of the estuary in the late summer and early fall.

The Ventura River Estuary (Reach 1; Figure 1-1) extends from the ocean to approximately 150 meters upstream of the railroad bridge based on tidal influence. The Estuary includes an open water area that is separated from the ocean by a berm that forms during the dry season. The berm is breached during storm events and slowly rebuilds through the summer, sometimes not fully building until August or September. The Estuary is flushed by tides when the berm is open and is dominated by slightly brackish to freshwater when the berm is closed (Ventura River Watershed State of the Watershed Report).

The watershed topography is characterized by rugged mountains in the upper basins transitioning to less steep areas and valleys in the lower watershed. The gradient in the watershed ranges from about 150 feet per mile at the headwaters to about 40 feet per mile near mouth of the river. The U.S. Bureau of Reclamation classifies the watershed topography as fifteen percent valley, forty percent foothill, and forty-five percent mountain. The highest point in the watershed is at 6,025 feet in the Santa Ynez Mountains.

There are two reservoirs within the watershed: Lake Casitas and Matilija Reservoir. Lake Casitas serves as an important source of municipal supply water and is a popular recreation area. The Matilija Reservoir was originally constructed in 1947 to supply water for both agriculture and municipal uses and provide limited flood control. However, over the years large amounts of sediment has been trapped behind the dam and the storage capacity has been significantly reduced. Today the current dam capacity is estimated at less than 500 acre-feet (Tetra Tech, 2012). In 1998, studies were initiated to investigate the effect of removing the dam and the *Matilija Dam Ecosystem Restoration Project* was developed. This project aims to remove both Matilija Dam and the sediment accumulated behind the dam. Removal of the dam would eliminate a barrier to fish passage on Matilija Creek and facilitate the migration, spawning, and rearing of southern steelhead trout.

1.3.1 Land Use

Based on the Southern California Association of Governments (SCAG) Geographic Information System (GIS) database, eighty-five percent of the land use in the Ventura River Watershed (Figure 1-2) is classified as open space and approximately one half of the watershed lies within the Los Padres National Forest. The Matilija Wilderness area, which is managed by the Los Padres National Forest and Ojai Ranger District, is an open space area with access only allowed by foot on marked trails. The remainder of the forest area in the watershed is designated as semi-primitive and has roads leading to recreation areas.

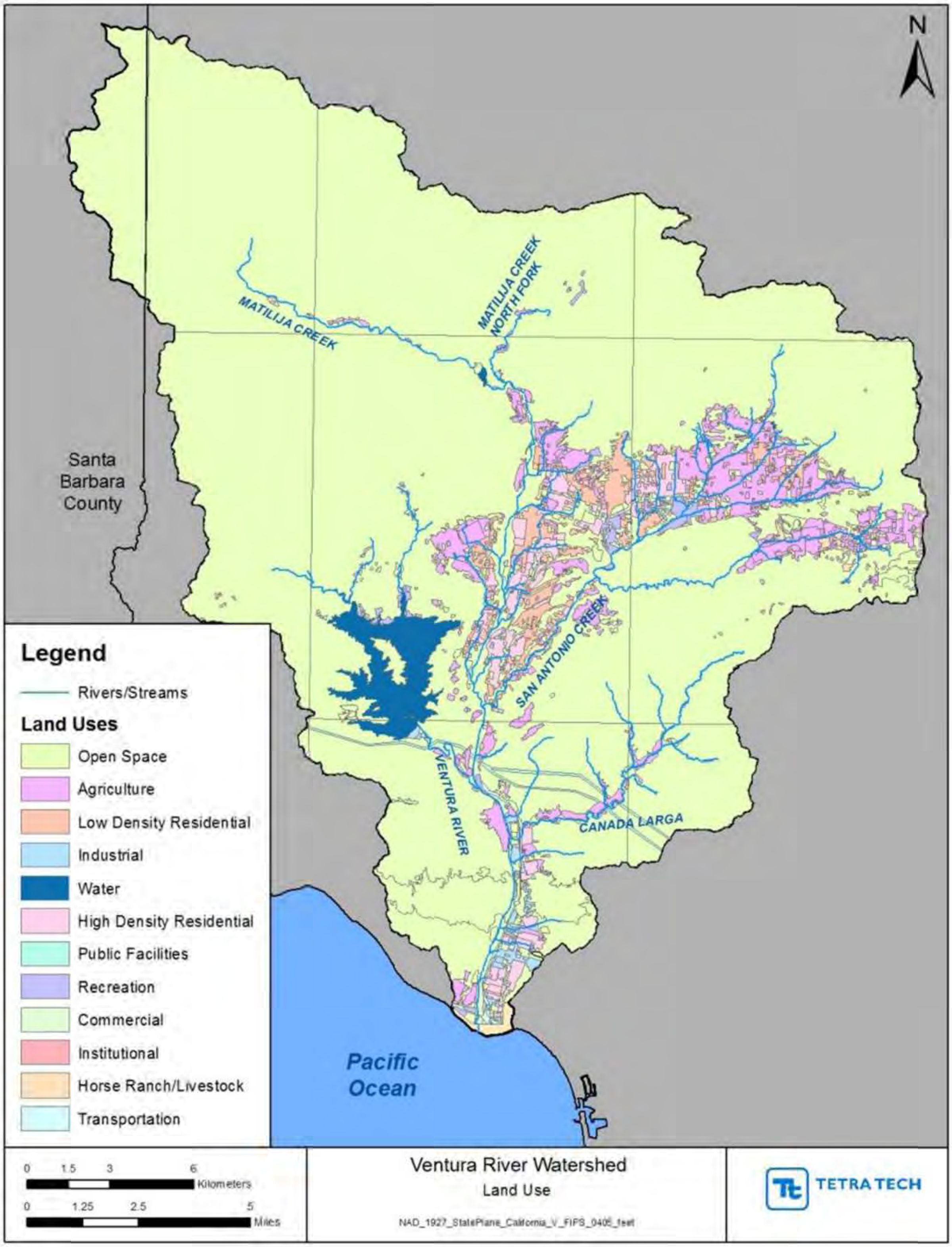

Figure 1-2. Land uses of the Ventura River Watershed

Agricultural land use is the second largest in the watershed at 4.5 percent of the watershed area. The developed area of the watershed is very limited compared to the open space areas, high density and low density residential land uses account for 1.9 and 2.9 percent, respectively. The cities of Ojai and Ventura are the largest urban areas in the watershed and the communities of Casitas Springs, Foster Park, Oak View, Valley Vista, Mira Monte, Meiners Oaks, Upper Ojai and Live Oak Acres are within the unincorporated Ventura County. Industrial areas in the watershed are generally used for oil production and mining and account for 2.1 percent of the watershed area. The remaining land uses (Public Facilities, Recreation, Commercial, Education Institutions, Horse Ranch/Livestock, Transportation, and Mixed Urban) each account for less than 1 percent of the land use within the watershed (Table 1-2).

Table 1-2. Land uses of Ventura River Watershed

Land Use	Area (Square miles)	Percentage (%)
Open Space	186	84.6
Agriculture	9.98	4.5
Low Density Residential	6.33	2.9
Industrial	4.65	2.1
Water	4.17	1.9
High Density Residential	4.08	1.9
Public Facilities	1.17	0.5
Recreation	1.15	0.5
Commercial	0.70	0.3
Education Institutions	0.59	0.3
Horse Ranch/Livestock	0.57	0.3
Transportation	0.39	0.2
Mixed Urban	0.02	<0.1
Total of all classes	**220**	**100**

1.3.2 Hydrology

Flow in the Ventura River varies seasonally due to the Mediterranean climate pattern of wet cool winters from November through March and dry warm summers from April through October. Annual rainfall can vary considerably from year to year. Figure 1-3 presents the annual rainfall from 2005 to 2010 as measured by Ventura County Watershed Protection District at Ojai County Fire Station.

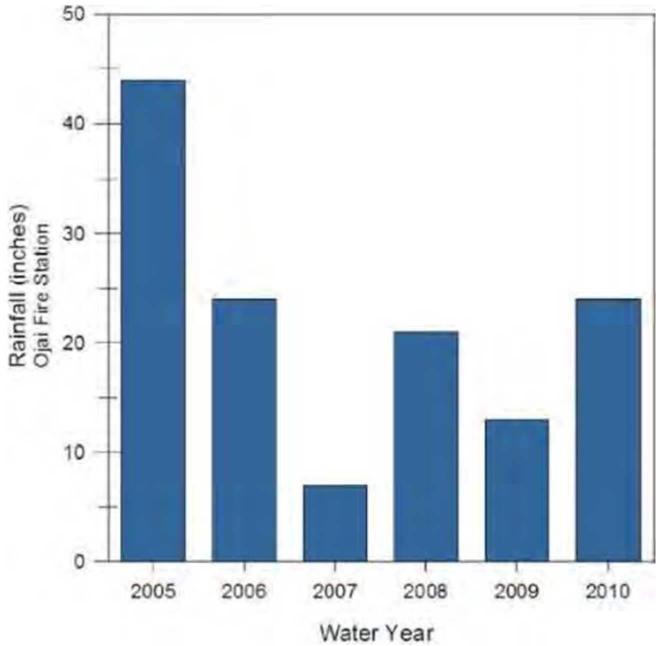

Figure 1-3. Annual rainfall at Ojai County Fire Station (from LACRWQCB, 2012)

High flows predominate during the rainy season, starting in winter through early spring. For example, Figure 1-4 presents flow in the Ventura River at Foster Park from October 2000 – 2008; peak flows occur after winter storm events and the flows decline to very low levels, less than 1 cubic foot per second (cfs), during the summer dry season. However, this pattern is mitigated in the lower Ventura River by effluent from the Ojai Valley Waste Water Treatment Plant (WWTP), which constitutes a majority or, at times, all of the flow in this section of the river during the summers and fall of dry years. The red hydrograph in Figure 1-4 is the flow from Ojai Valley WWTP.

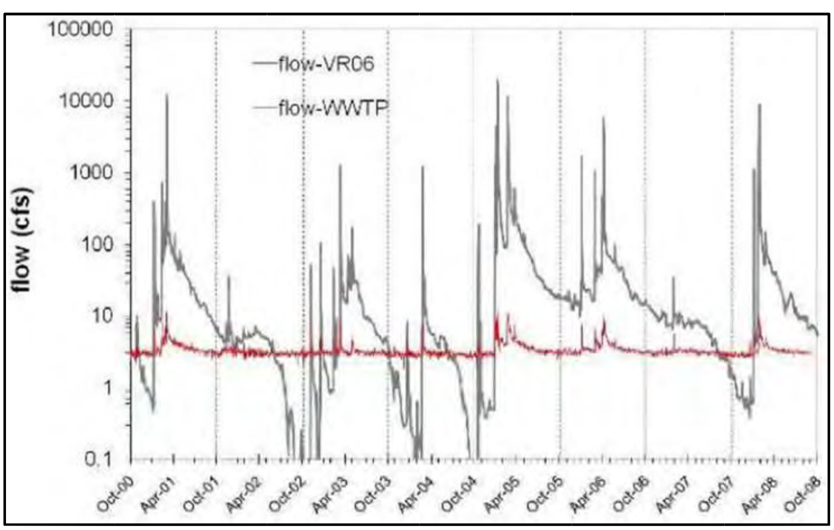

Figure 1-4. Stream flow in Ventura River at Foster Park and effluent discharge from Ojai Valley WWTP (Klose et al., 2009)

In addition to natural variations in flow, based on annual rainfall, flow regimes in the Ventura River have been altered to support water supply. Typically there is perennial flow from the headwaters to the Robles Diversion Dam, which is located about two miles downstream from the Matilija Dam. The Robles Diversion Dam was built in 1958 and is used to divert water from the Ventura River into Lake Casitas via the Robles-Casitas Canal.

Streamflow is highly climate-driven and variable; total precipitation over the course of a year, the frequency and intensity of storms, the proceeding years' rainfall regime (drought, normal, or wet), and other general weather characteristics (i.e., cooler than usual summers, warmer than usual winters) all contribute to any one year's streamflows, which generally follow a pattern of higher flows in the winter/spring and lower flows in summer/fall. Flow in any particular reach of the river is additionally affected by the status of the underlying groundwater basin (whether full, filling, or emptying), the occurrence of natural recharge areas where surface flows will disappear at times, flow between groundwater basins, and the amount of surface or groundwater withdrawals for municipal, domestic, or agricultural uses. Residents, businesses, water utilities, and wildlife in the watershed are reliant on local water ultimately derived from precipitation; there is no infrastructure in place to import water.

The flow downstream of the Robles Diversion Dam to the confluence with San Antonio Creek is intermittent, particularly during the dry summer months. In 2005, the Casitas Municipal Water District (CMWD) constructed a fish ladder at the Robles Diversion Dam to provide fish access to spawning areas that were not previously accessible for over fifty years[1]. Geologic features in the area of Casitas Springs (lower part of Reach 4) causes rising groundwater and provides perennial base flow in the river. The flow in the river is disrupted at Foster Park (which overlies the Upper Ventura River Groundwater Basin) due to subsurface diversions and groundwater extraction. However, the river flow below Foster Park to the estuary increases due to effluent discharges from the Ojai Valley WWTP, flow under and around the Foster Park subsurface diversion, and rising groundwater associated with the Lower Ventura River Groundwater Basin.

1.3.3 Southern Steelhead Trout Life History in the Watershed

Southern steelhead trout are acclimated to the highly variable conditions described above. During average to wet water-years, winter storms breach the lagoons often formed at the mouths of rivers. This provides both access and a signal for the anadromous fish to leave the ocean and start the journey upstream to spawn. In a watershed unrestricted by physical barriers to passage such as dams, the fish would normally transit through the mainstem of the river over several days and eventually spawn where habitat is generally most suitable, in tributaries such as Matilija Creek. Even in barrier-free watersheds, however, smaller than normal winter storms might fail to breach the lagoon leaving the fish to stay in the ocean for another year. Or a large initial storm might breach the lagoon, but not be followed by enough subsequent rainfall to maintain streamflows in order for the fish to transit through the whole system. The steelhead runs for years such as those might be very small to nonexistent. In the Ventura River Watershed, during normal to wet years before dams were constructed that created physical barriers (i.e., prior to 1948), the steelhead run was estimated at 4,000-5,000 individuals. However, following the

[1] http://www.casitaswater.org/lower.php?url=robles-fish-facility

construction of Matilija Dam (located upstream of Reach 3), which cut off access to about half of the prime spawning habitat, and coincident with a drought in the late 1940s, steelhead runs dropped to about 2,000-2,500 individuals. Once the Robles Diversion was constructed around 1959, access to good spawning habitat in the North Fork of Matilija Creek was also cut off and fewer fish were produced that would eventually return to spawn as adults. The steelhead run dropped to around 100 individuals; these individuals had to utilize remaining favorable areas within the mainstem for spawning and rearing. Considering the high flows that can occur in the mainstem with larger storms (relative to flows in the tributaries), access might be attained but spawning and rearing might prove to be impossible at times. Conversely, during dry years, fish unable to transit back downstream to the ocean due to low flows must survive in pools in the mainstem and be subjected to elevated temperatures at times, endure competition with other fish for a decreasing food supply, and survive exposure to predators. Spawning might not occur or be extremely limited due to lack of water at sites appropriate for spawning during wetter years.

2 Problem Identification

This section provides an overview of the pumping and water diversion impairments of Ventura River Reaches 3 and 4. Subsection 2.1 provides background information on the impairments and their relation to water quality. Subsection 2.2 presents the numeric and narrative water quality objectives and beneficial uses applicable to the Ventura River reaches. Subsection 2.3 provides a review of the information used by the Regional Board to list Ventura River Reach 3 and Ventura River Reach 4 for pumping and water diversions and Section 2.4 presents the problem statement.

2.1 Water Pumping and Diversion History in Ventura River Watershed

The Ventura River has gone through a series of hydromodifications since the early 1900s. In 1906, the Foster Park Diversion/subsurface dam was constructed. This dam is downstream of San Antonio Creek near the point at which Reach 4 ends and Reach 3 begins; it also overlies the downstream end of the Upper Ventura River Groundwater Basin. In 1948, the Matilija Dam was constructed in the headwaters of the Ventura River (upstream of Reach 4). In 1958-1959, the Robles Diversion Dam and Robles-Casitas Canal was constructed two miles downstream of the Matilija Dam. The Robles Diversion diverts water from the Ventura River to Lake Casitas via the Robles-Casitas Canal and is located in the most upstream portion of Reach 4. In 2005, the CMWD constructed a fish ladder at the Robles Diversion Dam. Also located within the vicinity of Reach 4 are City of San Buenaventura diversions and City of Ventura municipal wells which draw water from the Ventura River system. In the downstream waters of Reach 4, water supply is replenished by the San Antonio Creek and rising groundwater from Casitas Springs before the Foster Park Diversion. Reach 3 starts downstream of the Foster Park Diversion and receives rising groundwater (from the Lower Ventura River Groundwater Basin), flow under and around the Foster Park subsurface diversion, and water from the Ojai Valley WWTP discharges into the very bottom of the Reach 3.

The Ventura River system has historically experienced highly variable flows that are significantly driven by annual rainfall. This variable and, at times, intermittent flow is illustrated through historical flow records (summarized by Tetra Tech, 2012) and a recently completed historical ecology study (Beller et al., 2011).

Although low and intermittent flows may be natural in the Ventura River system, low flows due to pumping and diversion activities likely exacerbate the flow and water quality conditions in Reaches 3 and 4. The low flows in conjunction with other existing degraded water quality conditions may affect beneficial uses of the two waterbodies. Excess nutrients and eutrophic conditions are present in the Ventura River system. Low and intermittent flows exacerbate the nutrient-related problems (too much algae) and lead to low dissolved oxygen concentrations in the River. The cumulative impacts of these conditions result in the failure to attain several beneficial uses, as described throughout the remainder of this section.

2.2 Water Quality Standards

California water quality standards consist of the following three elements: 1) beneficial uses, 2) narrative and/or numeric water quality objectives, and 3) an antidegradation policy. In California, beneficial uses are defined by the regional boards in their Water Quality Control Plans (Basin Plans). Narrative and numeric objectives are designed to be protective of the beneficial uses specified in the Los Angeles Region Basin Plan.

2.2.1 Beneficial Uses

The Basin Plan for the Los Angeles Regional Board (LARWQCB, 1994) defines twenty (20) beneficial uses for Ventura River and Ventura River Estuary (Table 2-1). These beneficial uses are recognized as existing (E), potential (P) or intermittent (I) uses. The most sensitive beneficial use in the Ventura River Watershed is the cold water aquatic habitat (COLD) use and the associated migratory (MIGR) and spawning and early development (SPWN) uses.

Table 2-1. Beneficial uses of the Ventura River Watershed

Watershed	MUN	IND	PROC	AGR	GWR	FRSH	NAV	REC1	REC2	COMM	WARM	COLD	EST	MAR	WILD	RARE	MIGR	SPWN	SHELL	WET
Ventura River Estuary							E	E	E	E	E		E	E	E	Ee	Ef	Ef	E	E
Ventura River R 1	P*	E		E	E	E		E	E		E	E			E	E	E	E		E
Ventura River R 2	P*	E		E	E	E		E	E		E	E			E	E	E	E		E
Ventura River R 3	P*	E		E	E	E		E	E		E	E			E	E	E	E		E
Ventura River R 4	E	E	E	E	E	E		E	E		E	E			E	Eg	E	E		E
Ventura River R 5	E	E	E	E	E	E		E	E		E	E			E	Eg	E	E		E
Cañada Larga	P*		I	I	I	I		I	I		I	I			E		I	I		
San Antonio Creek	E	E	E	E	E			E	E		E	E			E		E	E		E
San Antonio Creek (above Lion Creek)	E	E	E	E	E	E		E	E		E	E			E		E	E		E
Matilija Creek	P*				E			E	E			E			E		E	E		E
North Fork Matilija Creek	E*	E	E	E	E			E	E		E	E			E	E	E	E		E

Notes:
E = existing uses
P = potential uses
I = intermittent uses
* = Indicates a conditional use as defined in the Basin Plan
e = One or more rare species utilize all ocean, bays, estuaries, lagoons and coastal wetlands for foraging and/or nesting.
f = Aquatic organisms utilize all bays, estuaries, lagoons and coastal wetlands, to a certain extent, for spawning and early development. This may include migration into areas which are heavily influenced by freshwater
g = Condor refuge.

The Ventura River and its tributaries are home to Southern California Steelhead, which was first recognized as endangered by the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) in 1997. Its status as endangered was reaffirmed in 2006. According to NMFS, the total population of the Southern California Steelhead has dropped from 32,000-46,000 spawning adults to less than 500 (NOAA, 2012). The Ventura River (including Reaches 3 and 4), Ventura River Estuary, San Antonio Creek, Cañada Larga, Matilija Creek and North Fork Matilija Creek, among other tributaries, have been designated by NMFS as critical habitat for the remaining population of the Southern California Steelhead.

The municipal and domestic supply (MUN) use designation applies to Ventura River Reaches 1, 2 and 3, Cañada Larga, and Matilija Creek as a potential (P) beneficial use. This beneficial use, for Ventura River and its tributaries, is indicated with an asterisk in the Basin Plan as a conditional use. Conditional designations are not recognized under federal law and are not water quality standards requiring TMDL development at this time. (See Letter from Alexis Strauss [USEPA] to Celeste Cantú [State Board], Feb. 15, 2002).

The recreation (REC1 and REC2), aquatic life (WARM, COLD, EST, WILD, RARE, MIGR, SPWN, and WET), and water supply (MUN) beneficial uses are likely affected by pumping and water diversion activities in Reaches 3 and 4. The COLD, MIGR, and SPWN beneficial uses are the most sensitive for protection. Low dissolved oxygen concentrations associated with nutrient loading and low flow result, at least in part, in impairments of these beneficial uses.

2.2.2 Water Quality Objectives

The Basin Plan specifies narrative and numeric water quality objectives, both of which apply to Ventura River Reaches 3 and 4 and the Ventura River Estuary. Although the listed impairment is pumping and water diversion, USEPA evaluated the linkages between the water quality related impairments and the water pumping and diversion activities. The related water quality parameters that are directly affected by pumping and water diversion activities are associated with nutrients. Excessive nutrients are linked to low flow conditions through data and trend analyses (see Section 5).

The following narrative objectives apply to this TMDL.

> **Biostimulatory Substances:** *Waters shall not contain biostimulatory substances in concentrations that promote aquatic growth to the extent that such growth causes nuisance or adversely affects beneficial uses.*

The numeric water quality objects applicable to this TMDL are listed below.

> **Dissolved Oxygen (DO):** *At a minimum the mean annual DO concentrations of all waters shall be greater than 7.0 mg/L, and no single determinations shall be less than 5.0 mg/L except when natural conditions cause lesser concentrations.*
>
> *The dissolved oxygen content of all surface waters designated as both COLD and SPWN shall not be depressed below 7 mg/L as a result of waste discharges.*

Ammonia: *In order to protect aquatic life, ammonia concentrations in inland freshwaters shall not exceed the values calculated for the appropriated in-stream conditions shown in tables 3-1 to 3-3 in the Basin Plan.*

For inland surface waters not characteristic of freshwater the four-day average concentration of un-ionized ammonia shall not exceed 0.035 mg/L and the one-hour average concentration shall not exceed 0.233 mg/L.

Determination of Freshwater, Brackish Water or Saltwater Conditions

For inland surface waters in which the salinity is equal to or less than 1 part per thousand 95% or more of the time, the applicable objectives are the freshwater objectives, based on the US EPA "1999 Update of Ambient Water Quality Criteria for Ammonia." (2) For waters in which the salinity is equal to or greater than 10 parts per thousand 95% or more of the time, the applicable objectives are a 4-day average concentration of 0.035 mg un-ionized NH_3/L and a one-hour average concentration of 0.233 mg un-ionized NH_3/L. (3) For waters in which the salinity is greater than 1 but less than 10 parts per thousand, the applicable objectives the more stringent of the freshwater or saltwater objectives.

Nitrogen: *Waters shall not exceed 10 mg/L nitrogen as nitrate-nitrogen plus nitrite-nitrogen (NO_3-N + NO_2 – N), 45 mg/L as nitrate (NO_3), 10 mg/L as nitrate-nitrogen (NO_3-N) or 1 mg/L as nitrite-nitrogen (NO_2-N) or as otherwise designated in Table 3-8.*

Basin Plan Table 3-8 presents the nitrogen objective for Ventura River Reaches 5, 4, 3, and 2 as 5 milligrams per liter (mg/L). This limit also applies to Cañada Larga and San Antonio Creek as tributaries to Reaches 2 and 4, respectively.

This nitrogen objective is established for the protection of the MUN beneficial use and objectives in Table 3-8 of the Basin Plan are waterbody-specific (LARWQCB, 1994). As presented in the next section, the numeric objective of 10 mg/L and the waterbody-specific objective of 5 mg/L is not sufficiently protective to control excessive algal growth and eutrophic conditions in the river and estuary and thus protect the most sensitive beneficial use in the watershed, which is aquatic life (LARWQCB, 2012). Because low flow conditions exacerbate excessive nutrient conditions, this TMDL will focus on attaining nutrient related WQOs to restore beneficial uses. USEPA concludes that a critical step in improving the impaired condition of Reaches 3 and 4 must involve, in a large part, the focus on reducing the excessive nutrient conditions. Although we understand that future actions may involve the removal of Matilija Dam, which may improve the water quality conditions and improve steelhead trout stream habitat access , this TMDL is currently addressing the relevant water quality parameters that are linked to the impairments and impacts to applicable beneficial uses in these Ventura River Reaches. .

2.2.3 Antidegradation

State Board Resolution 68-16, "Statement of Policy with Respect to Maintaining High Quality Water" in California, known as the "Antidegradation Policy," protects surface and ground waters from degradation. Any actions that can adversely affect water quality in all surface and ground waters must be consistent with the maximum benefit to the people of the state, must not unreasonably affect present and anticipated beneficial use of such water, and must not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the federal Antidegradation Policy (40 CFR 131.12). The proposed TMDL will not degrade water quality, and will in fact improve water quality as it is designed to achieve compliance with existing water quality standards in order to ensure that beneficial uses of the Ventura River system are fully supported.

2.3 Basis for Listing

The impairment listing for Reach 3 and Reach 4 is for pumping and water diversions. These impairments originally appeared in the 1996 water quality assessment as not supporting aquatic life uses. A specific beneficial use, such as cold freshwater habitat or warm freshwater habitat was not cited although later listing cycles associated the impairments with cold freshwater habitat. The Steelhead Restoration and Management Plan for California (CDFG, 1995, finalized in 1996) was cited as the data source for the Reach 4 pumping and water diversion impairments. This plan made specific references to the Robles Diversion bypass flows and lack of fish passage as contributing factors not supporting beneficial uses such as cold freshwater habitat and migration. The impairment of cold freshwater habitat is a concern for Steelhead Trout which utilize cold waters, for spawning and growth. The Foster Park subsurface diversion located at the downstream end of Reach 4 is not mentioned in the California Department of Fish and Game (CDFG) Report nor is there reference to any specific pumping activities. As for the impairments in Reach 3, no specific information was cited to support the listing for pumping and water diversions. Although the Steelhead Restoration and Management Plan for California was used to support the same impairments in Reach 4 (directly upstream of Reach 3), there is no reference to any portion of Reach 3.

2.4 Problem Statement

A detailed data and trend analysis is presented in Section 5, documenting the linkage between the sources, WQOs, and impairments. The data analysis demonstrates the water quality problems related to eutrophication (note: additional analyses are presented in the Ventura River Watershed Algae TMDL [LARWQCB, 2012]), which are compounded by low flow. It also documents exceedances of the dissolved oxygen and biostimulatory substances WQOs during the growing season (dry, summer season). Decreased summer flows and elevated nutrient concentrations in the Ventura River contribute to the excessive algal biomass growth, which in turn contributes to low DO conditions. Reducing nutrient loading, concurrent with maintaining or increasing existing river flow, are the most effective way to address eutrophication, which is the underlying cause of the impaired aquatic life beneficial uses in the Ventura River system.

Favorable conditions for algal growth depend on the availability of nutrients, the form of nutrients, light, and other factors or “cofactors” including pH, temperature, oxygen, canopy cover, and flow. Favorable algal growth conditions may be enhanced by degraded or reduced riparian habitat where limited canopy cover allows more sunlight and increases water temperatures. Low flows also contribute to favorable algal growth conditions, which yield more extreme DO conditions. In the Ventura River Watershed, these favorable conditions have been identified as critical conditions that occur during the summer dry season (May 1 to September 30). Under favorable conditions, excess algal biomass increases biological activities such as respiration and photosynthesis which drive significant changes in diurnal dissolved oxygen (DO) concentrations. Nighttime respiration naturally decreases oxygen levels. Increased nighttime respiration caused by eutrophication reduces DO to severely low levels which cause physiological stress on fish as their metabolic demands are being strained. This can severely affect fish specifically with greater oxygen demand requirements, such as Steelhead Trout, by impacting growth, development, swimming, feeding, and reproductive ability of juvenile and adult fish (Carter, 2005; Bjornn and Reiser, 1991).

The extreme diurnal effects of eutrophication and low flows both affect aquatic life as they contribute to low DO concentrations. Unlike high flows, low flows are often marked by low DO due to the lack of turbulence and water depth, which do not replenish oxygen levels in the water. In addition, low flows may contribute to increased temperatures which add to the favorable conditions conducive to eutrophication. Therefore, reduced flows in a eutrophic system exacerbate DO depletion. The DO trends presented in Section 5 document the extent of poor DO conditions during the summer dry season. Low DO contributes to multiple impacts on cold water fish, including decreased growth, increased stress, decreased reproductive success and increased juvenile and adult fish mortality. The changes in the river and estuary ecosystem degrades cold water habitat leading to impaired aquatic life and recreation beneficial uses. This TMDL will address the critical impairments causing the summer dry season exceedance of the biostimulatory substances WQO; by addressing these water quality parameters, this would effectively restore beneficial uses also impaired by pumping and water diversions in Reach 3 and Reach 4 (Table 2-2) because low flow conditions compound the concurrent nutrient impairments.

Table 2-2. Water quality impairments addressed by this TMDL

Waterbody	Impairment
Ventura River Reach 3	Pumping, water diversions
Ventura River Reach 4	Pumping, water diversions

Together these water quality conditions provide a stress on the aquatic environment leading to impaired beneficial uses as demonstrated in a conceptual model for rivers (Figure 2-1 [from LARWQCB, 2012]). In Figure 2-1, decreased flows serve as “Risk Cofactors,” which promote favorable conditions for eutrophication. The conceptual model demonstrates that increased nutrient loading in conjunction with decreased river flows may lead to impairments of several beneficial uses including WARM, COLD, RARE, SPWN, MIGR, REC 1, and REC 2. These beneficial uses, with the exception of WARM, are existing beneficial uses recognized in Ventura River Reach 3 and Reach 4. To protect beneficial uses, limiting nutrient input and maintaining river flow would increase minimum DO concentrations, restore a natural nutrient balance in the system, and overall improve aquatic life habitat; therefore, the pumping and water diversion impairments addressed in this TMDL should be considered concurrently with the impairments documented in the Ventura River Watershed Algae TMDL (LARWQCB, 2012).

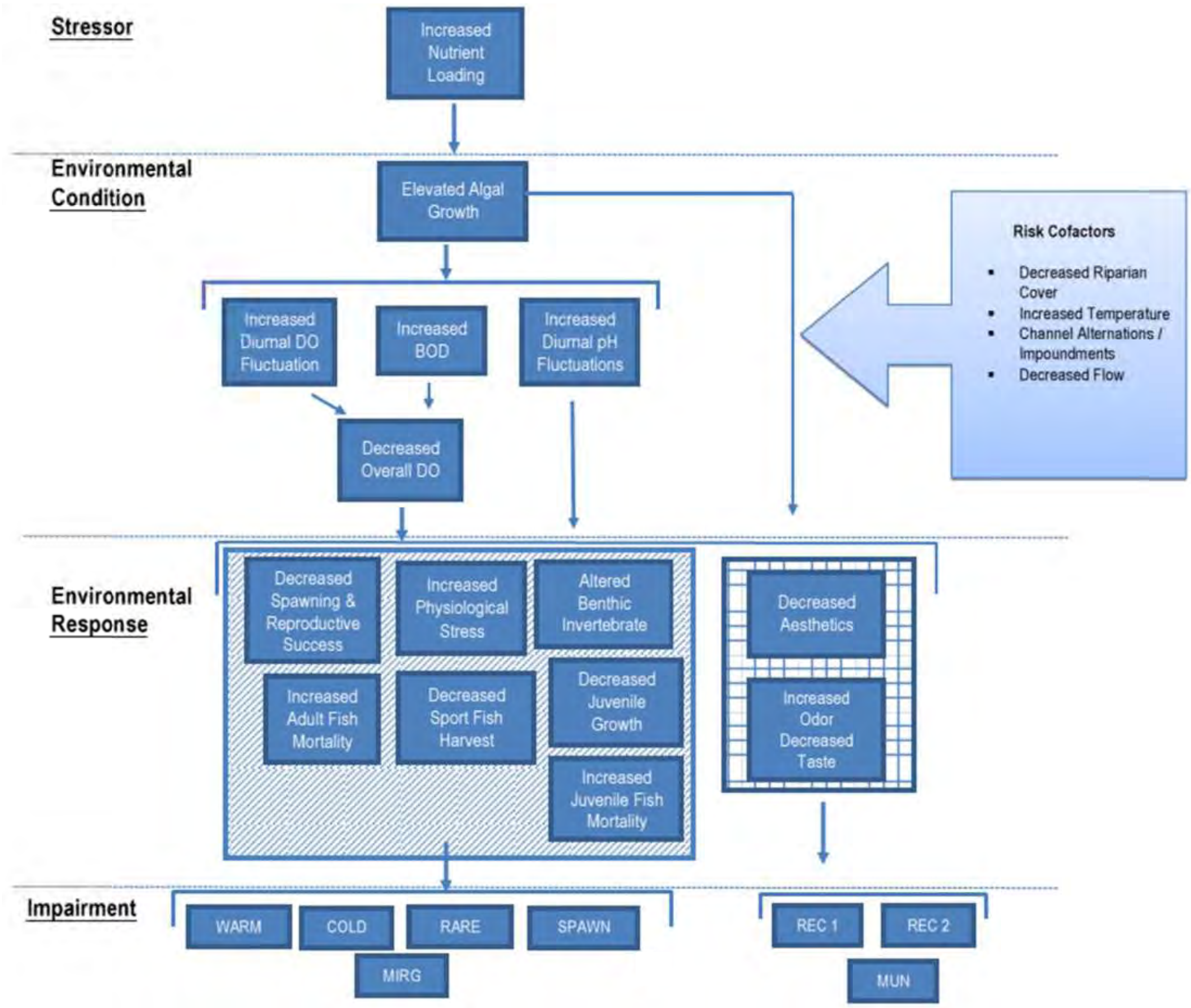

Figure 2-1. Conceptual model for rivers

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3 Numeric Targets

This section identifies numeric targets that will be used to assess attainment of water quality objectives and the protection of beneficial uses. Multiple numeric targets may be used when a single target is not sufficient to fully evaluate attainment of water quality standards and protect beneficial uses. This is especially critical for pumping and water diversion impairments. These TMDLs address those water quality related parameters that are linked to the listed impairments, but, most critically, that will lead to the goal of protection of the identified beneficial aquatic life uses. As noted previously, pumping and water diversion impairments are closely linked to nutrient impairments; therefore, the WQOs in this TMDL are associated with nutrient-related parameters.

Specifically, the numeric targets are expressed as algal biomass, macroalgal percent cover, phytoplankton biomass, dissolved oxygen, and pH (Table 3-1). The DO and pH numeric targets are set equal to the numeric water quality objectives contained in Chapter 3 of the Basin Plan and the numeric targets for algal and phytoplankton biomass and cover are established as a numeric interpretation the water quality condition that will demonstrate attainment of the narrative WQO for biostimulatory substances presented in Chapter 3 of the Basin Plan.

Table 3-1. TMDL numeric targets

Indicator	Numeric Target	Waterbody
Total Algal Biomass	150 mg/m^2 chlorophyll *a* as seasonal average	Ventura River and tributaries
Macroalgal Cover (attached & unattached)	< 30 percent (seasonal average)	Ventura River and tributaries
Phytoplankton Biomass	20 µg/L chlorophyll *a* as seasonal average	Estuary (shallow subtidal area)
Macroalgal Cover	< 15 percent (seasonal average)	Estuary (intertidal and shallow subtidal areas)
Dissolved Oxygen	> 7 mg/L daily minimum	River, Tributaries and Estuary
pH	6.5 – 8.5 (instantaneous value)	River, Tributaries and Estuary

Notes:

Biomass and percent cover indicator targets apply during the dry, summer season. The seasonal averaging period for algal biomass and percent cover is the summer season of May 1 to September 30th. River Indicators are averaged over a sampling reach as required by the SWAMP monitoring protocol Bioassessment SOP 0_2.

Estuary macroalgal cover is measured using 3 transects and evaluating percent cover at 10 random points along each transect. Results are reported as a transect average. See methods used in the Bight '08 Estuarine Eutrophication Assessment (McLaughlin K et. al. Southern California Bight 2008 Regional Monitoring Program: Estuarine Eutrophication Assessment. Southern California Coastal Water Research Project. Costa Mesa, CA.

These targets are consistent with those presented in the Ventura River Watershed Algae TMDL (LARWQCB, 2012). In addition, the Ventura River Watershed Algae TMDL provides detail on the various sources of the WQOs. These sources are summarized in the remainder of this section and the Ventura River Watershed Algae TMDL should be referenced for specific, technical detail.

The California Nutrient Numeric Endpoints (NNE) framework (Tetra Tech, 2006) was used to set the total algal biomass numeric target. This is a science-based approach to translate the narrative water quality objective for *Biostimulatory Substances* to numeric endpoints that can be applied in a TMDL or other regulatory program. Other biological indicators (macroalgal cover and phytoplankton biomass) are based on the review of available data and scientific literature, while the estuary phytoplankton biomass target is based on the Assessment of Estuarine Trophic Status (ASSETS), developed by the NOAA National Estuarine Eutrophication Assessment (NEAA) (Bricker, 2003). Chlorophyll *a* is used a primary indicator for eutrophic condition.

For the macroalgal percent cover numeric target in the estuary, staff relied upon the classification framework presented in Scanlan (2007). The numeric target for percent cover algal biomass is set at < 15 percent; this target equates to good water quality at moderate amounts of biomass. Both of these estuarine water quality assessment frameworks (ASSETS and Scanlan) were also used by the Southern California Bight 2008 Regional Monitoring Program coordinated by the Southern California Coastal Water Research Project (SCCWRP) to evaluate estuarine eutrophication. The numeric target for dissolved oxygen of 7 mg/L is set equal to the Basin Plan objective for all waters in the Ventura River Watershed designated COLD and SPWN. This target is also applied to the estuary, which is designated SPWN and MIGR because this watershed supports a Southern California steelhead trout cold water fishery.

4 Source Assessment

This section identifies the potential sources of pumping and water diversion and nutrients in the Ventura River Watershed, in particular, those associated with Reaches 3 and 4. In the context of TMDLs, pollutant sources are classified as either point sources or nonpoint sources. Nonpoint sources originate from land runoff, precipitation, atmospheric deposition, drainage, seepage, or hydrologic modification. The term "nonpoint source" is defined to mean any source of water pollution that does not meet the legal definition of "point source" in section 502(14) of the Clean Water Act. A point source, as defined in the Clean Water Act, means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. Point sources include discharges from wastewater treatment plants and industrial and municipal storm drain outfalls, but do not include agricultural storm water discharges and return flows from irrigated agriculture.

The major categories of pumping and water diversion and nutrient sources in the Ventura River Watershed are (note: these sources are present throughout the watershed; however, those directly connected to Reach 3 and/or Reach 4 are identified in parentheses below):

<u>Point Sources</u>

- Stormwater and dry weather runoff from storm drains (Reaches 3 and 4)
- Ojai Valley WWTP discharge (Reach 3)
- Other NPDES permits (Reach 4)

<u>Nonpoint Sources</u>

- Runoff from horse and cattle facilities (Reaches 3 and 4)
- Runoff from agricultural areas (Reaches 3 and 4)
- Runoff from undeveloped natural areas (Reaches 3 and 4)
- Onsite wastewater treatment systems (i.e., septic tanks) (Reaches 3 and 4)
- Groundwater discharge (Reaches 3 and 4)
- Atmospheric deposition (Reaches 3 and 4)

<u>Additional Entities Related to Assimilative Capacity</u>

- Robles-Casitas Canal (Reach 4) – operated by CMWD
- City of Ventura municipal wells (Reach 4)
- Foster Park Subsurface Diversion – operated by the City of San Buenaventura (Reach 4)

For the purposes of the source assessment, the Ventura River Watershed was divided into seven subwatersheds based on a GIS layer from Ventura County Watershed Protection District (VCWPD) (Figure 4-1). These subwatersheds are the Upper Watershed, Ventura River Reach 4, Ventura River Reach 3, the Lower Watershed, San Antonio Creek, Cañada Larga, and Other (Coyote Creek above Casitas Dam).

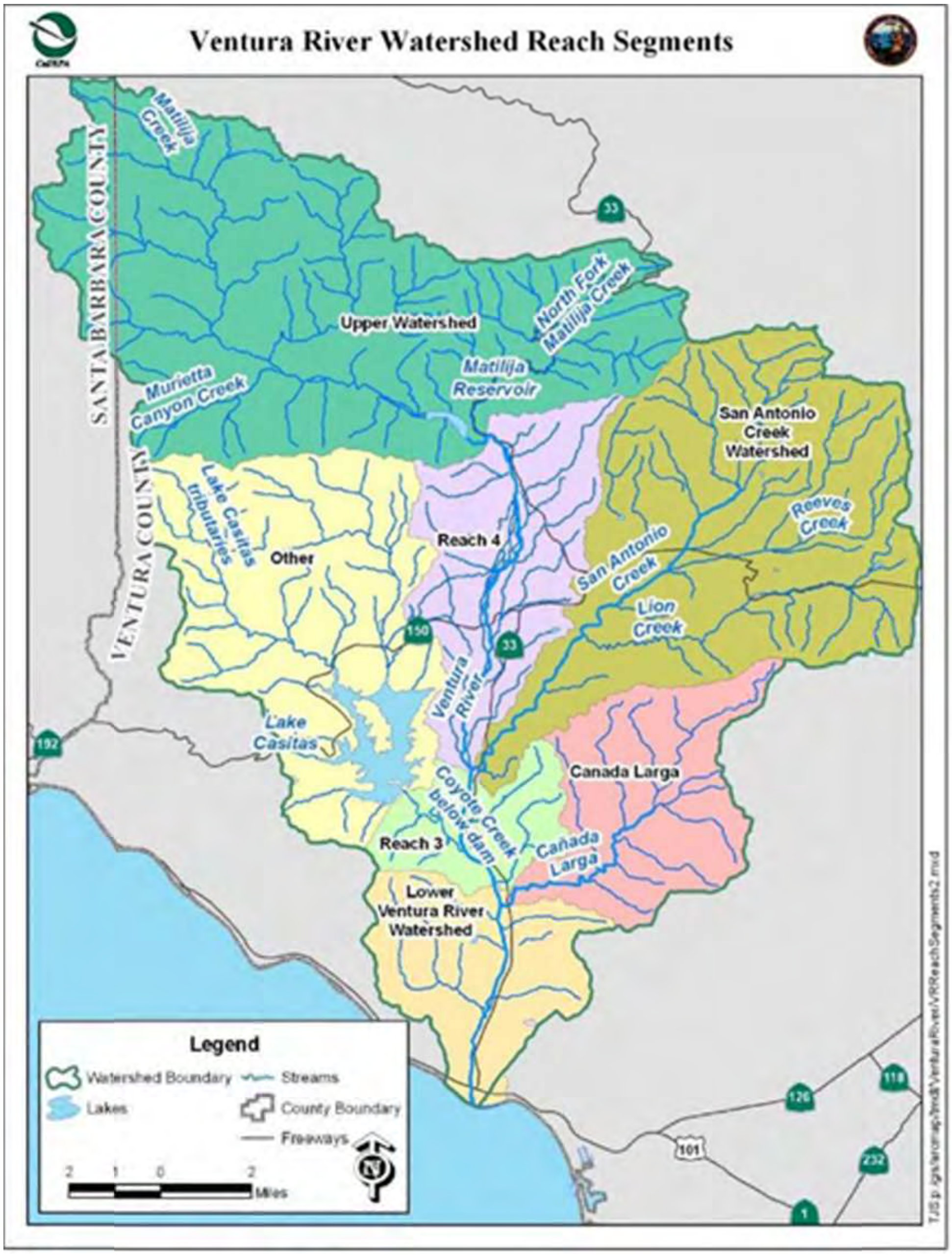

Figure 4-1. Ventura River subwatersheds (from LARWQCB, 2012)

Most water in Lake Casitas goes to consumptive uses or evaporation and is rarely released below the dam (Tetra Tech, 2012). According to CMWD staff, water is only released from the dam when it overflows. The last time water spilled over the Dam was in 1998 (an El Niño year). Thus, water is only released from the dam during very high flows and is released from the top of the reservoir. Therefore, the subwatershed draining to Lake Casitas (named "Other" in the figure below) is not considered a potential source of nutrients to the Ventura River for the purposes of this source assessment. Land that drains to Coyote Creek downstream of the dam is considered a source and is included as part of the Reach 3 subwatershed.

The Upper Watershed, Reach 4, and San Antonio Creek subwatersheds all contribute loadings to Reach 4. Loads to Reach 3 are comprised of the total loadings to Reach 4 as well as those from the Reach 3 subwatershed.

Land use data (Table 1-2) were obtained from Southern California Association of Governments (SCAG, 2005). The 2005 dataset was used because the 2008 SCAG dataset is based on parcels and can leave out roads, which are considered in this source assessment. In addition, it should be noted that the total area for the 2005 SCAG land use data does not match the total area of the watershed based on the watershed delineation in the GIS maps provided by VCWPD. However, the discrepancy in area is due to differences in the area of open space, which has a negligible effect on the source assessment. The land uses in Table 1-2 were aggregated into 17 categories corresponding to high density residential, low density residential, commercial, industrial, public facilities, education, transportation, mixed urban, open, water, recreation, cropland/improved pasture, orchards/vineyards, nurseries, dairy/intensive livestock, other agriculture, and horse ranches land uses. The acreages of various land uses by subwatershed are presented in Table 4-1 and the subwatersheds draining to Reaches 3 and 4 are shaded.

Table 4-1. Drainage areas (acres) for various land uses in the Ventura River Watershed

Land Use	Upper Watershed	Reach 4	Reach 3	Lower Watershed	San Antonio Creek	Cañada Larga	Other	Total
High Density Residential	0	1,256	28.8	611	680	33.2	0	**2,610**
Low Density Residential	110	1,548	154	20.9	2,160	33.3	24.4	**4,051**
Commercial	0	83	0	207	153	1.69	0	**445**
Industrial	12.6	6.53	25.3	2,766	163	5.08	0	**2,978**
Public Facilities	0	97.1	275	53.6	80.7	127	112	**746**
Education	0	99.3	0.05	52.9	227	0.04	0	**379**
Transportation	0	7.58	44.3	185	6.38	8.40	0	**251**
Mixed Urban	0	0	0	6.30	7.62	0	0	**13.92**
Open	40,838	8,990	4,865	5,950	24,829	11,721	21,827	**119,018**
Water	30.1	10.99	0	6.56	25.52	0	2,596	**2,669**
Recreation	34.4	45.0	28.7	84.1	408	0	134	**735**
Cropland/ Improved Pasture	0	487	171	133	695	335	0	**1,821**
Orchards/ Vineyards	3.41	1,027	101	214	3,009	21.9	25.5	**4,401**
Nurseries	0	0	0	4.33	12.3	0	0	**16.7**

Land Use	Upper Watershed	Reach 4	Reach 3	Lower Watershed	San Antonio Creek	Cañada Larga	Other	Total
Dairy/Intensive Livestock	0	3.93	0	0	0	0	0	**3.93**
Other Agriculture	4.93	19.7	5.98	12.7	82.0	7.65	9.21	**142**
Horse Ranches	9.41	107	9.12	0	207	18.8	5.53	**357**
Total area	**41,043**	**13,787**	**5,709**	**10,307**	**32,745**	**12,312**	**24,734**	**140,638**

Note: Shading indicates subwatershed draining to Ventura River Reach 3 and 4.

The drainage to Ventura River Reaches 3 and 4 (Upper Watershed, Reach 4, San Antonio Creek, and Reach 3 subwatersheds) makes up two thirds of the Ventura River Watershed. Overall, the Reach 3 and 4 drainage area is 85 percent open. Residential (combination of high and low density) and agricultural (sum of cropland, orchards, nurseries, and other agriculture) areas each contribute about 6 percent of the total area.

4.1 Point Sources

The NPDES permits for stormwater and dry weather urban runoff discharges in the Ventura River Watershed are the Ventura County municipal separate storm sewer system (MS4) permit (R4-2010-0108), the statewide California Department of Transportation (Caltrans) MS4 permit (99-06-DWQ), the statewide general industrial stormwater permit (97-03-DWQ), and the statewide general construction stormwater permit (2009-0009- DWQ).

The NPDES permits for wastewater and industrial discharges in the Ventura River Watershed are for the Ojai Valley WWTP (R4-2008-0039) and four general NPDES permits for Foster Park Well Field (R4-2003-0108), Development and Startup Project Well #2 Aquifer Testing (R4-2003-0108), San Antonio Filter Plant (R4-2009-0047), and Golden State Water Company Ojai-Mutual Plant (R4-2003-0108) (Table 4-2).

This source assessment describes point source loadings of nutrients from stormwater and dry weather urban runoff sources and the Ojai Valley WWTP, both of which impact Reach 3 and/or 4. The loadings from the general NPDES permits are not quantified in this source assessment. General Permit No. R4-2003- 0108 is for discharges of groundwater from potable water supply wells to surface waters, including groundwater generated during well purging for data collection purposes, extracted from major well-rehabilitation and redevelopment activities, and generated from well drilling, construction, and development. General Permit No. R4-2009-0047 is issued to the San Antonio Filter Plant for the discharge of filter backwash water, redevelopment and start-up wastewater to San Antonio Creek. The discharges from the general NPDES permits are intermittent and considered negligible for the purposes of this source assessment.

Table 4-2. Summary of NPDES permits in the Ventura River Watershed

Type of NPDES Permit	Total Permits
Ventura County MS4	1
Caltrans MS4	1
General Industrial Stormwater	28
General Construction Stormwater	14
Ojai Valley WWTP (Major)	1
General NPDES Permits	4
Total	**50**

4.1.1 Nutrient Loading from Stormwater and Dry Weather Urban Runoff Sources

Runoff from residential, industrial, commercial, and transportation areas are a significant source of nutrients to the Ventura River. The potential sources of nutrients from urban areas include fertilizer used for lawns and landscaping; organic debris from gardens, landscaping, and parks; trash such as food wastes; and domestic waste. Potential sources of nutrients from highways and transportation land uses include fallen leaves and other vegetation, vehicle exhaust, and atmospheric deposition. Nutrients build up, particularly on impervious surfaces, and are discharged into the receiving waters through storm drains when it rains or by dry weather runoff (i.e., wet-weather and dry-weather loading). The Ventura River Watershed Algae TMDL provides wet- and dry- weather loadings for the subwatersheds (LARWQCB, 2012). These values were used to characterize existing conditions and calculate required reductions.

4.1.2 Nutrient Loading from Ojai Valley WWTP Discharge

The Ojai Valley WWTP has capacity of 3.0 million gallons per day (MGD) of tertiary-treated wastewater. The Ojai Valley Sanitary District serves 5,600 acres of watershed and the treatment plant provides wastewater collection services for an estimated population of 23,000 in the city of Ojai and in the communities of Meiners Oaks, Mira Monte, Oak View, Casitas Springs, and Foster Park.

Based on data collected from 2000 through 2012, Ojai Valley WWTP discharged tertiary-treated wastewater through an outfall at an average rate of 2.1 MGD into Ventura River. The discharge outfall is located approximately 3,000 feet upstream of the confluence of the Ventura River with Cañada Larga. The effluent concentrations of total nitrogen ranged from 2.6 mg/L to 21.1 mg/L, with an average of 5.86 mg/L. Nitrate-N was the dominant nitrogen compound, with concentrations ranging from 1.6 mg/L to 14.1 mg/L, and an average of 4.71 mg/L. Nitrite-N was generally below the detection limit of 0.1 mg/L. Ammonia-N was generally below the detection limit of 0.2 mg/L. Organic-N concentrations ranged from 0.2 mg/L to 12.7 mg/L, with an average of 1.1 mg/L. The total phosphorus concentration ranged from 0.062 mg/L to 5.7 mg/L, with an average of 1.38 mg/L. Phosphate-P was the dominant phosphorus compound, with concentrations ranging from 0.07 mg/L to 3.8 mg/L, and an average of 1.2 mg/L. (OVSD, 2000-2012). The Ventura River Watershed Algae TMDL estimates nutrient loading to Ventura River from Ojai Valley WWTP by multiplying the average effluent flow with average total nutrient concentrations (LARWQCB, 2012).

4.2 Non Point Sources

Nonpoint sources of nutrients in the Ventura River Watershed include inputs from agricultural lands, horses and livestock, onsite wastewater treatment systems, groundwater, undeveloped open space, wildlife, and atmospheric deposition. An overview of each source and data used to characterize each source is presented in the Ventura River Watershed Algae TMDL (LARWQCB, 2012).

4.2.1 Additional Entities Related to Assimilative Capacity

In addition to these nutrient sources, several sources related to flow withdrawal or diversion contribute to the degraded water quality in Ventura River Reaches 3 and 4. These include the Robles-Casitas Canal (operated by CMWD; near the upstream end of Reach 4), the City of Ventura municipal wells in Reach 4, and the Foster Park Subsurface Diversion – operated by the City of San Buenaventura (near the downstream end of Reach 4). These facilities reduce water in the river and are also likely contributing to the nutrient impairments.

4.3 Summary of Sources

A summary of the source assessment by source/land use type for total nitrogen and total phosphorous is presented in Table 4-3 and Table 4-4, respectively (note: these are consistent with the existing loads for Reaches 3 and 4 presented in the Ventura River Watershed Algae TMDL [LARWQCB, 2012]). Based on available data and an estimation of nutrient loadings, stormwater and dry weather urban runoff via the MS4 contributes a large percentage of the total nitrogen loading to the Ventura River and its tributaries (18% in dry weather and 39% in wet weather). The Ojai Valley WWTP contributes a large portion of nitrogen loading to Reach 3 in dry-weather (50%) but a smaller portion in wet weather (2%). Horses/livestock and agricultural land uses contribute significant nitrogen loading in both dry and wet weather. Open space loading is a significant source of total nitrogen in wet weather (26%) and a smaller source of nutrients in dry weather (8%). Overall, these loads make up 73% of the land use-based and Ojai WWTP total nitrogen loads for the entire watershed. For total phosphorous (Table 4-4), the Ojai WWTP contributes 71% of loading during dry weather, while horses/livestock contribute 20%. Horses/livestock also contribute a significant amount during wet weather (35%), just below wet weather urban runoff at 47%. Collectively, the total phosphorous loads contributing to Reaches 3 and 4 are 71.4% of the watershed-wide land-use based and Ojai WWTP loads.

The Ventura River Watershed Algae TMDL also presents loads associated with groundwater discharge, septic systems, and atmospheric deposition, which cannot be readily separated to the Reach 3 and 4 drainage area (LARWQCB, 2012) and is therefore not included in the table below. All sources of nutrients are assigned WLAs and LAs in the TMDL. In addition, parties responsible for pumping, water diversions, and withdrawals are assigned LAs.

Table 4-3. Summary of land use-based and WWTP TN loading to Ventura River Reaches 3 and 4

Source Type	TN (lb/year)	% total	% dry	% wet
Dry Weather				
Dry-weather Runoff from Urban Areas	12,111	5%	18%	n/a
Ojai Valley WWTP dry days	33,984	15%	50%	n/a
Dry-weather Runoff from Agriculture	7,132	3%	11%	n/a
Dry-weather Runoff from Horse/Livestock	8,694	4%	13%	n/a
Dry-weather Runoff from Open Space	5,628	3%	8%	n/a
Wet-weather				
Urban Wet-weather Runoff	58,895	27%	n/a	39%
Ojai Valley WWTP wet days	3,491	2%	n/a	2%
Agriculture Wet-weather Runoff	17,046	8%	n/a	11%
Horse/Livestock Wet-weather Runoff	33,987	15%	n/a	22%
Open Space Wet-weather Runoff	39,253	18%	n/a	26%
Total	**220,221**			

Table 4-4. Summary of land use-based and WWTP TP loading to Ventura River Reaches 3 and 4

Source Type	TP (lb/year)	% total	% dry	% wet
Dry Weather				
Dry-weather Runoff from Urban Areas	128	0%	1%	n/a
Ojai Valley WWTP dry days	8,030	30%	71%	n/a
Dry-weather Runoff from Agriculture	28	0%	0%	n/a
Dry-weather Runoff from Horse/Livestock	2,295	8%	20%	n/a
Dry-weather Runoff from Open Space	853	3%	8%	n/a
Wet-weather				
Urban Wet-weather Runoff	7,474	28%	n/a	47%
Ojai Valley WWTP wet days	825	3%	n/a	5%
Agriculture Wet-weather Runoff	1,342	5%	n/a	8%
Horse/Livestock Wet-weather Runoff	5,469	20%	n/a	35%
Open Space Wet-weather Runoff	726	3%	n/a	5%
Total	**27,169**			

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5 Linkage Analysis

To determine the effects of sources on water quality, it is necessary to describe the linkage between the sources, existing water quality, and numeric targets. This linkage defines the assimilative capacity of the receiving water under critical conditions to protect the aquatic life beneficial uses. The linkage analysis for this TMDL uses data analyses to make the connections between flow and nutrient impairments in the Ventura River watershed, particularly Ventura River Reaches 3 and 4. Subsequent TMDLs and allocations are built off of these analyses and utilize the linkage analysis for nutrients presented in the Ventura River Watershed Algae TMDL (LARWQCB, 2012).

USEPA evaluated the critical impacts to the identified beneficial use during the assessment of the listed impairment of pumping and water diversion for Reaches 3 and 4. In reviewing the ecological structure and function of the river reach, it is necessary to consider all the variables that have a direct impact on the impaired condition of the waterbody. In this case, USEPA reviewed all the available data for Ventura River Reaches 3 and 4, and determined that these waterbodies are impaired.

Although the listing is for pumping and water diversion, we investigated the applicable and relevant causes of the impairment. USEPA finds that multiple variables are at play in causing the impaired condition of the reaches; these variables, both nutrient-related and flow parameters, are interlinked. In rivers and streams with low flushing rates, eutrophication becomes a concern when excessive algal biomass develops in response to nutrient enrichment. For example, the Shasta River TMDL was developed to address impairments due to low DO and elevated temperatures, and low stream flow conditions were contributing to the problem in certain segments (NCRWQCB, 2006). In Oregon, the Rogue River TMDL, correlated high stream temperatures with “removal of water” amongst other causes (Oregon Department of Environmental Quality, 2008). The Bitterroot River TMDL described certain impaired segments were due to “low flow alterations” (Montana Department of Environmental Quality, 2011). Also, the Murray Darling River (Australia) is subject to excessive algal blooms during low flow periods (Maier, 2001).

When natural dilution exceeds the growth rate in a waterbody, it becomes challenging for phytoplankton populations to significantly flourish without additional or external sources of phytoplankton (e.g., upstream reservoir) (Dodd, 2007). As such, it is the availability of energy to the food web that defines the health of the community integrity and ecosystem function; and this availability of energy is directly influenced by light, external carbon source, nutrients, food web structure, and the hydrology (Dodd, 2007). It is difficult to determine, in this case, which factor is more critical; instead, it is important to recognize that these factors are intimately linked and the improvement of one factor will likely contribute to the overall benefit of the waterbody’s condition, in this case the critical aquatic life habitat.

The following sections discuss and confirm the trends in flow, nutrients, and DO levels throughout the Ventura River watershed in Sections 5.1.1, Section 5.1.2, and Section 5.1.2.2, respectively. Collectively, these water quality conditions play an intertwined role in eutrophic conditions and non-attainment of beneficial uses in the system.

5.1 Data-driven and Geographic-based Analyses

Most current and available data were used to assess flow, nutrient, and dissolved oxygen conditions in the Ventura River watershed. Hydrologic and water quality datasets are identified and discussed below. Flow, nutrients, and dissolved oxygen all play a collective role in eutrophic conditions within the Ventura River system, which is a primary cause of the aquatic life impairment. To examine these parameters under critical conditions, flow and nutrients were evaluated seasonally and DO levels were assessed in pre-dawn samples. Flow and nutrients play a critical role in eutrophication during the dry, summer season and DO levels are lowest during pre-dawn hours while nighttime respiration is at its peak. Evaluating water quality under these critical conditions focuses the protection of beneficial uses during the most sensitive periods.

5.1.1 Flow Trends

For a conservative hydrologic evaluation of the Ventura River system, median winter flows and median summer flows were examined. The stream gages used in this hydrologic assessment are listed in Table 5-1 and illustrated in Figure 5-1. It is important to note that Gage 605 is situated on San Antonio Creek near its confluence with Ventura River. It is therefore representative of flow entering Ventura River, rather than the Ventura River itself. Only gages with daily flows in the Ventura River or at the confluence with a tributary were evaluated in this analysis. Flow in the Ventura River Estuary was estimated based on flow at other gages on the mainstem as well as major tributaries (Tetra Tech, 2012).

Table 5-1. Ventura River stream gages

ID	USGS ID	Name/Location
602B	11115500	Matilija Creek below Dam at Matilija Hot Springs
607	11116550	Ventura River at Robles Diversion (Reach 4)
605		San Antonio Creek
608	11118500	Ventura River near Ventura (Reach 3)
630		Cañada Larga

For a conservative hydrologic evaluation of the Ventura River system, median winter flows and median summer flows were examined, as illustrated in Figure 5-2 and Figure 5-3, respectively. Direct comparison of seasonal median flows is illustrated in Figure 5-4. As shown, flows are generally higher during winter season with the exception of a few sites. In both seasons, flow is reduced at Gage 607 when compared to Gage 602B, which is located a few miles upstream. This gage is downstream of the Casitas-Robles diversion and may reflect the effects of water diversions. There is then a long span on the mainstem without long-term flow data. The next gage downstream is Gage 608, which is downstream of both the Foster Park Diversion and Coyote Creek. Gage 608 demonstrates increased flows when compared to Gage 607, which can be attributed to input from Coyote Creek. Ultimately, the diversions near the end of Reach 4 have minimal impact on overall stream flow during the wet and dry seasons, when considering groundwater and tributary inputs in that stretch of river. After the Foster Park Diversion, flows generally increase as the river reaches the Ventura Estuary and Pacific Ocean, in part due to the contribution of the Ojai WWTP effluent just upstream of the transition between Reaches 2 and 3; and the increase is also due to discharge from the Upper Ventura River Groundwater Basin into the Lower Groundwater Basin, which rises to the surface, and flow under and around one end of the Foster Park Subsurface Diversion (through a gap due to the diversion not extending completely across the river underground).

Figure 5-1. Flow gages in the Ventura River Watershed

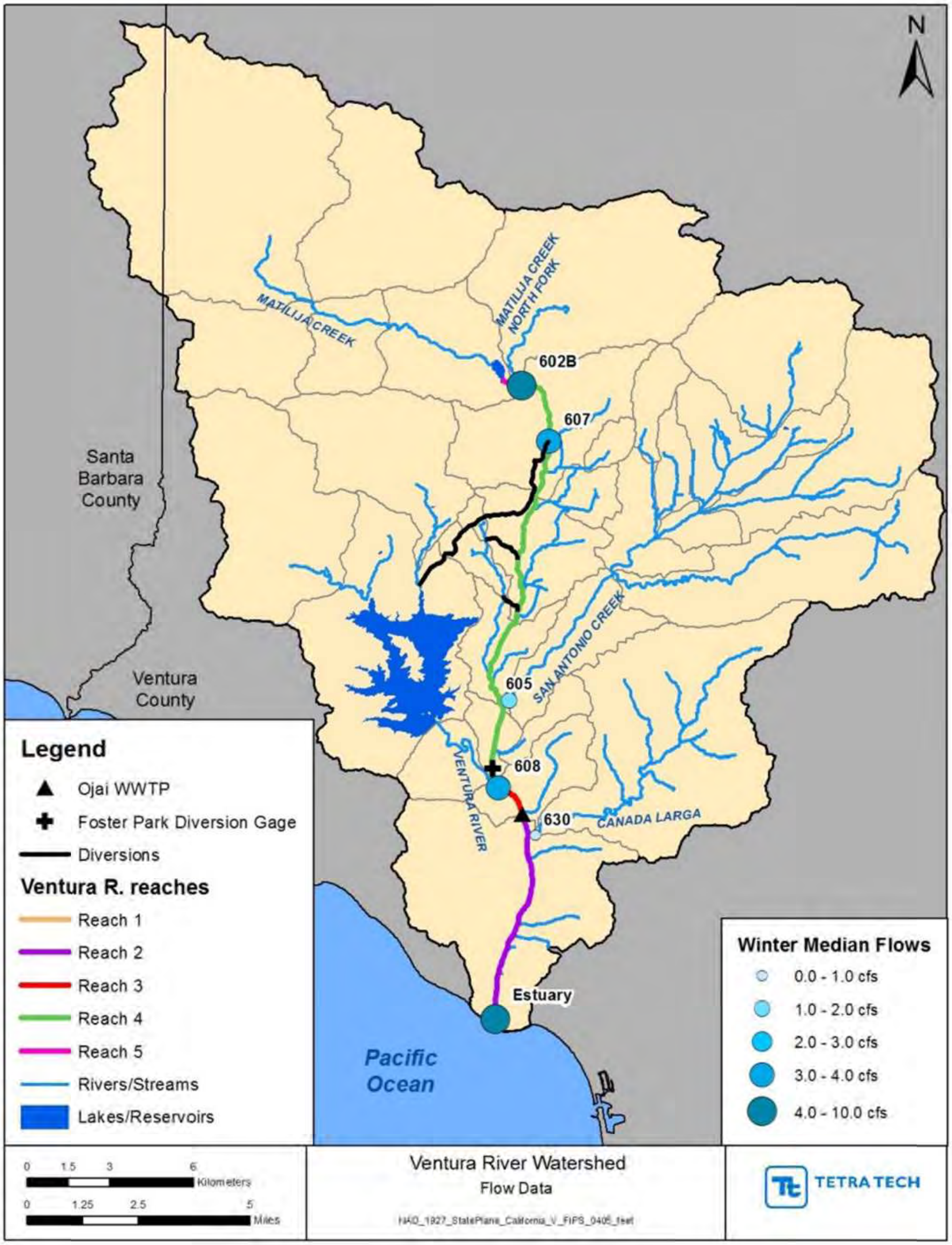

Figure 5-2. Winter median flows within the Ventura River

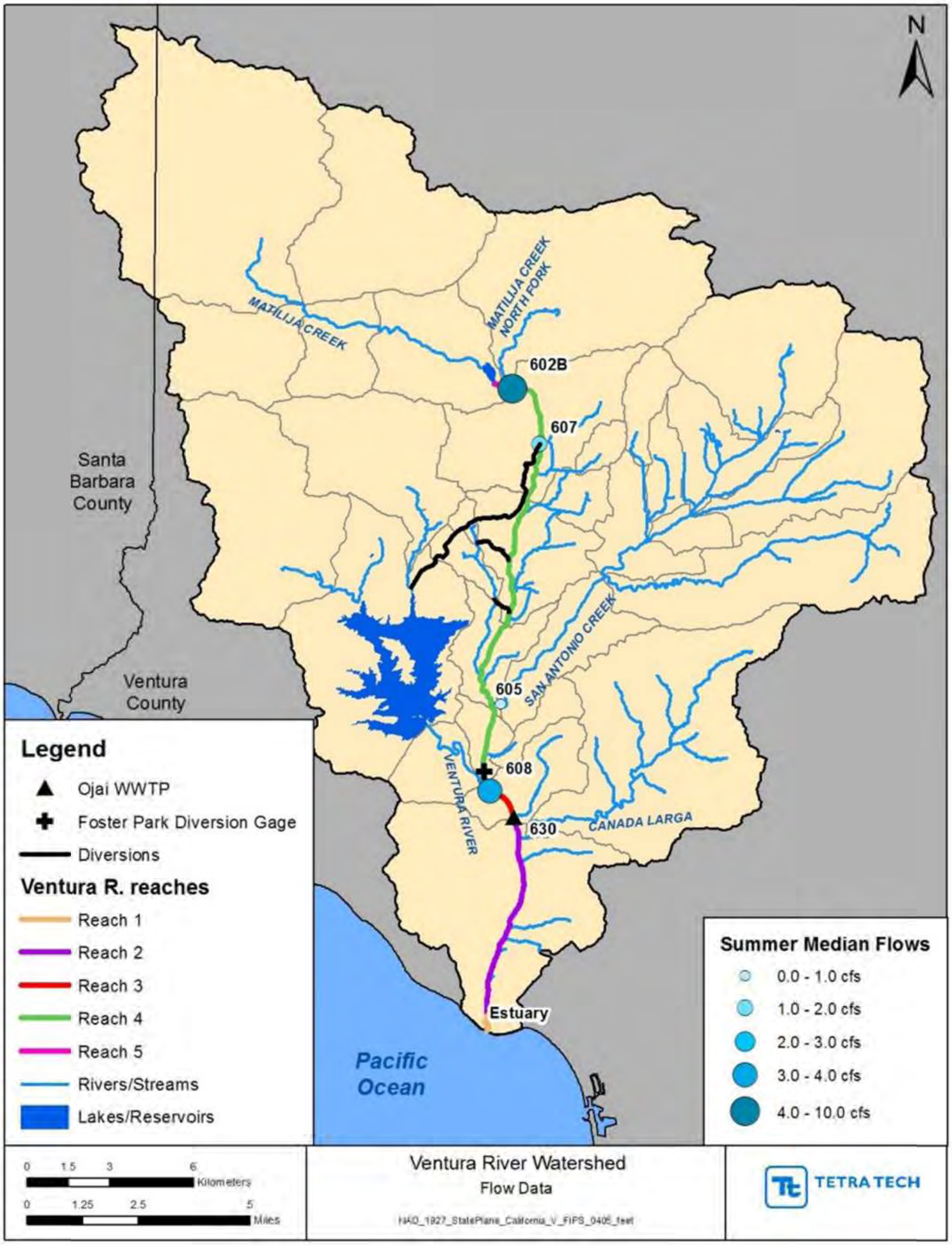

Figure 5-3. Summer median flows within the Ventura River

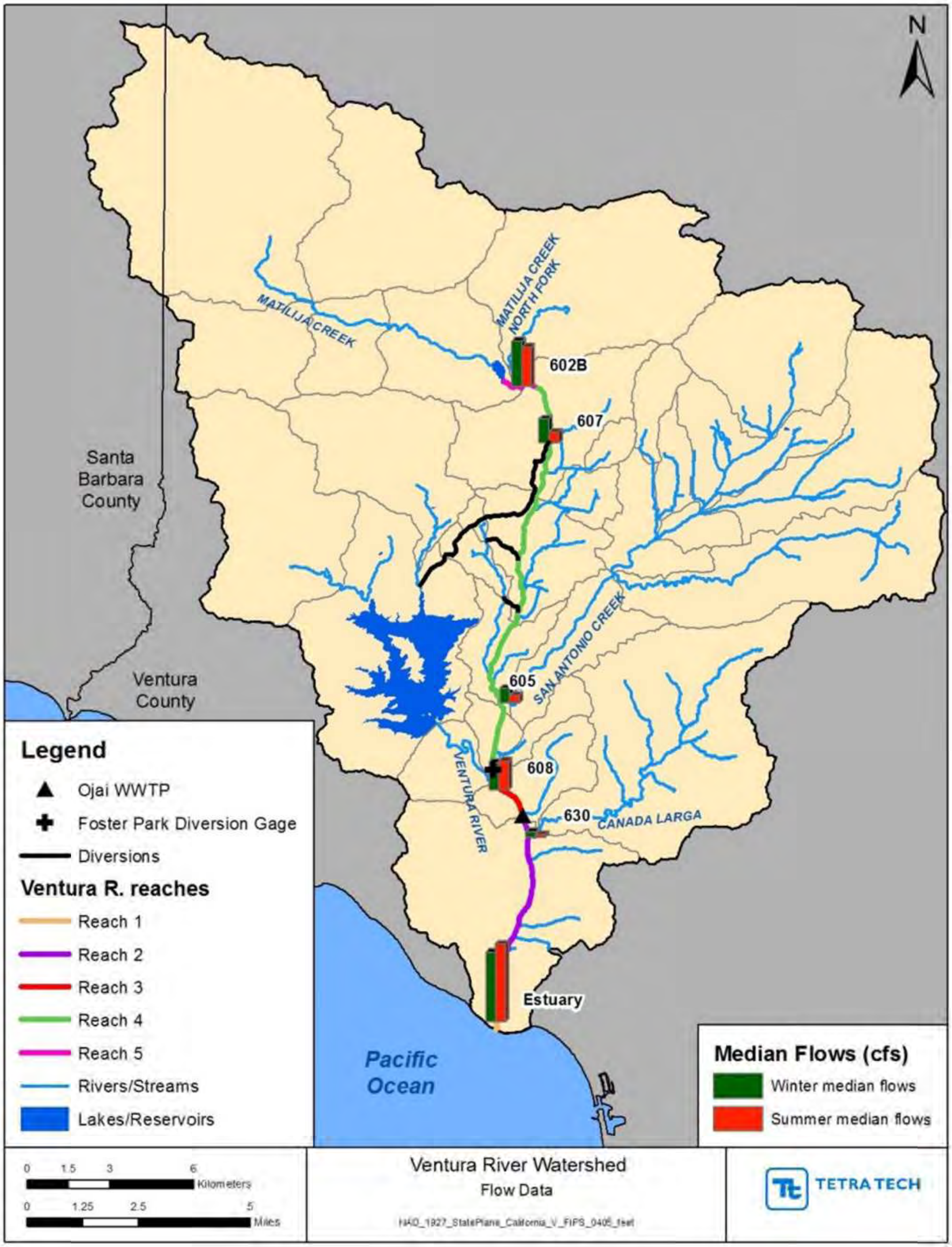

Figure 5-4. Median winter and summer flows

5.1.2 Water Quality Trends

Similar to the flow assessment above, nutrients (nitrate and phosphate) were compared seasonally to illustrate trends between critical and non-critical conditions. Nutrient data were obtained from Santa Barbara ChannelKeeper (SBCK). The period of record spans from 2001 through 2012. To study the low DO trends, pre-dawn DO sampling results were used in this assessment as they represent minimum DO concentrations or truly critical DO concentrations.

Through SBCK monitoring efforts, pre-dawn monitoring has been performed in 2005 and more consistently in 2008 through 2009. These efforts started at a few sites and then expanded to cover several sites as years progressed. Pre-dawn conditions occur naturally each day due to diurnal patterns in temperature and respiration, so while they may be truly critical conditions, they may not illustrate the remainder of the day, which may be more representative of cumulative longer-term impaired conditions. Therefore, additional DO data were evaluated to ensure the full suite of conditions in the watershed is presented.

A list of the monitoring locations and respective water quality data is presented in Table 5-2. Pre-dawn DO data were obtained at both the eastern and western ends of the Ventura Estuary. These values were averaged and presented as a single Ventura Estuary point in the data analysis. Locations of the nutrient and DO monitoring locations are presented in Figure 5-5.

Table 5-2. Water quality monitoring locations in the Ventura River Watershed

Site ID	Site Location	SBCK Data (Nutrients)	SBCK Data (pre-dawn DO)
VRW000	Ventura @ Estuary	x	x
VRW000E	Ventura Estuary, East		x
VRW00W	Ventura Estuary, West		x
VRW001	Ventura @ Main St. Bridge	x	x
VRW002	Ventura @ Stanley Ave	x	
VRW003	Ventura @ Shell Bridge	x	x
VRW03.5	Ventura @ above Cañada Larga confluence	x	x
VRW004	Cañada Larga @ confluence (@ Ventura Ave., @ bicycle Bridge, Lower Cañada Larga)	x	x
VRW005	Cañada Larga @ upper crossing (Upper Cañada Larga)	x	
VRW006	Ventura @ Foster Park	x	x
VRW06.1	Ventura @ above OVSD	x	x
VRW06.3	Ventura @ above S. Antonio confluence (@ San Antonio Creek Confluence)	x	x
VRW007	San Antonio @ Old Creek Rd. (Lower San Antonio Creek)	x	x
VRW007A	San Antonio @ confluence (bike path)	x	x
VRW008	Lion Canyon Creek (Close to VR017, 50m up from San Antonio Creek)	x	

Site ID	Site Location	SBCK Data (Nutrients)	SBCK data (pre-dawn do)
VRW009	Stewart/Fox (Pirie Cr.)	x	x
VRW010	Upper San Antonio Creek	x	x
VRW011	Ventura @ Santa Anna Blvd. (@ Santa Ana Rd Bridge)	x	x
VRW012	Ventura @ Hwy 150	x	x
VRW12.4	Ventura @ below Robles Diversion (VR12.4)	x	
VRW12.5	Ventura @ above Robles Diversion (VR12.5)	x	
VRW12.9	Ventura @ Camino Cielo, below Matilija Forks	x	x
VRW013	Matilija Creek below dam (250m up from confluence)	x	x
VRW014	N. Fork Matilija Creek	x	x
VRW015	Matilija Creek above dam (Upper Matilija)	x	x
VRW017	San Antonio @ Lion Canyon, above or below (Middle San Antonio Creek)	x	x
VRW021	Matilija @ Wilderness Boundary (Upper N. Fork Matilija)	x	
VRW022	N. Fork Matilija @ near FS Campground (At Wheeler Gorge)	x	

Figure 5-5. Water quality monitoring locations in the Ventura River Watershed

5.1.2.1 *Trends in Nutrient Concentrations*

Similar to the flow assessment, nutrients (represented by nitrate and phosphate) were compared seasonally to illustrate trends between critical and non-critical conditions. Table 5-3 presents the period of record for nutrient data at each monitoring station.

Table 5-3. Monitoring locations in the Ventura River Watershed

Site ID	Site Name	Start Date	End Date
VRW000	Ventura @ Estuary	11/29/2007	3/3/2012
VRW001	Ventura @ Main St. Bridge	11/18/2000	3/3/2012
VRW002	Ventura @ Stanley Ave	5/19/2001	10/4/2008
VRW003	Ventura @ Shell Bridge	5/19/2001	9/1/2008
VRW03.5	Ventura @ above Cañada Larga confluence	5/20/2008	3/3/2012
VRW004	Cañada Larga @ confluence (@ Ventura Ave., @ bicycle Bridge, Lower Cañada Larga)	4/22/2001	3/3/2012
VRW005	Cañada Larga @ upper crossing (Upper Cañada Larga)	5/19/2001	7/12/2008
VRW006	Ventura @ Foster Park	5/19/2001	3/3/2012
VRW06.1	Ventura @ above OVSD	4/2/2011	10/1/2011
VRW06.3	Ventura @ above S. Antonio confluence (@ San Antonio Creek Confluence)	5/18/2008	3/3/2012
VRW007	San Antonio @ Old Creek Rd. (Lower San Antonio Creek)	5/19/2001	9/6/2008
VRW007A	San Antonio @ confluence (bike path)	5/16/2008	3/3/2012
VRW008	Lion Canyon Creek (Close to VR017, 50m up from San Antonio Creek)	5/19/2001	7/11/2009
VRW009	Stewart/Fox (Pirie Cr.)	5/19/2001	3/3/2012
VRW010	Upper San Antonio Creek	5/19/2001	3/3/2012
VRW011	Ventura @ Santa Anna Blvd. (@ Santa Ana Rd Bridge)	4/22/2001	6/5/2010
VRW012	Ventura @ Hwy 150	4/22/2001	6/4/2011
VRW12.4	Ventura @ below Robles Diversion (VR12.4)	9/2/2008	9/2/2008
VRW12.5	Ventura @ above Robles Diversion (VR12.5)	9/2/2008	9/2/2008
VRW12.9	Ventura @ Camino Cielo, below Matilija Forks	6/4/2008	3/3/2012
VRW013	Matilija Creek below dam (250m up from confluence)	4/22/2001	1/10/2009
VRW014	N. Fork Matilija Creek	4/22/2001	3/3/2012
VRW015	Matilija Creek above dam (Upper Matilija)	7/14/2001	3/3/2012
VRW017	San Antonio @ Lion Canyon, above or below (Middle San Antonio Creek)	6/1/2002	3/3/2012
VRW021	Matilija @ Wilderness Boundary (Upper N. Fork Matilija)	3/8/2007	7/9/2008
VRW022	N. Fork Matilija @ near FS Campground (At Wheeler Gorge)	3/8/2007	7/9/2008

Average winter and summer nitrate concentrations are illustrated in Figure 5-6 and Figure 5-7, respectively. The assessment of nutrients in the Ventura River system illustrates that the Matilija Creek and the Matilija Creek North Fork headwaters do not significantly influence nutrient levels in the Ventura River. Comparatively, some of the highest nutrient levels in the system are observed in the headwaters of San Antonio Creek, which may be attributed to the agricultural and developed land uses in that subwatershed. Winter season nitrate concentrations begin to increase throughout Reach 4, upstream and downstream of the San Antonio Creek confluence, while during the dry season, the nitrate concentrations typically increase only below this confluence (Figure 5-6 and Figure 5-7).

Direct comparison between winter and summer season nitrate and phosphate concentrations are presented in Figure 5-8 and Figure 5-9, respectively. Nutrient concentrations are generally higher in the winter season than in the summer season; however, concentrations of nitrate during the summer season are typically similar to the winter season values. Nitrate levels are particularly high in San Antonio Creek, just downstream of the Cañada Larga confluence, and downstream of the Ojai WWTP along Reaches 1 and 2 of the Ventura River. Following the Cañada Larga confluence, summer nitrate levels appear to be higher at VRW003 (Ventura River at Shell Bridge) compared to nitrate levels upstream in the Ventura River and in Cañada Larga itself. Phosphate concentrations appear to be most significant in the downstream reaches of the Ventura River, south of the Cañada Larga confluence and the Ojai WWTP. This may indicate significant phosphate uptake sources throughout other portions of the watershed, but further assessment of sources would be needed to confirm.

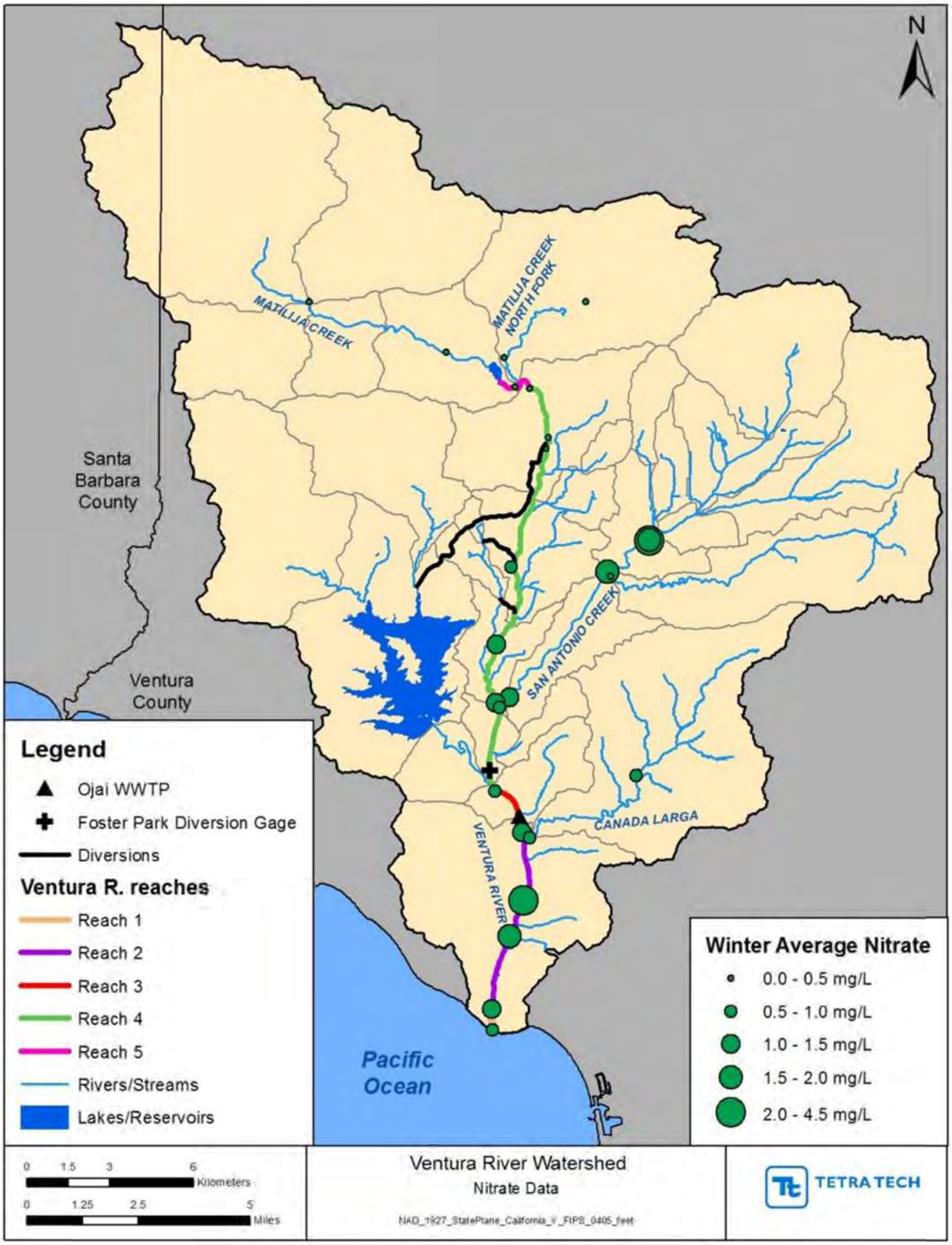

Figure 5-6. Average nitrate concentrations during winter season

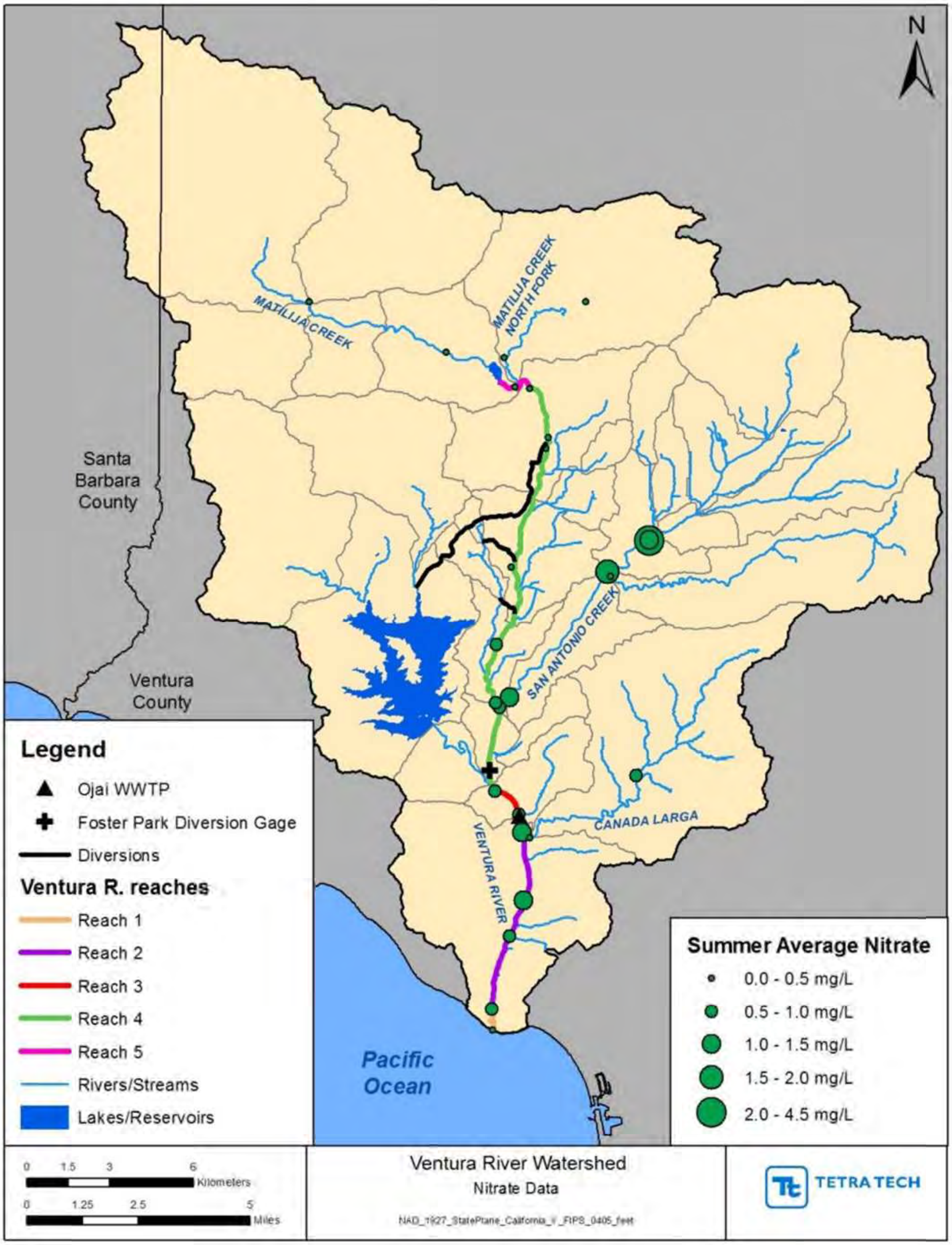

Figure 5-7. Average nitrate concentrations during summer season

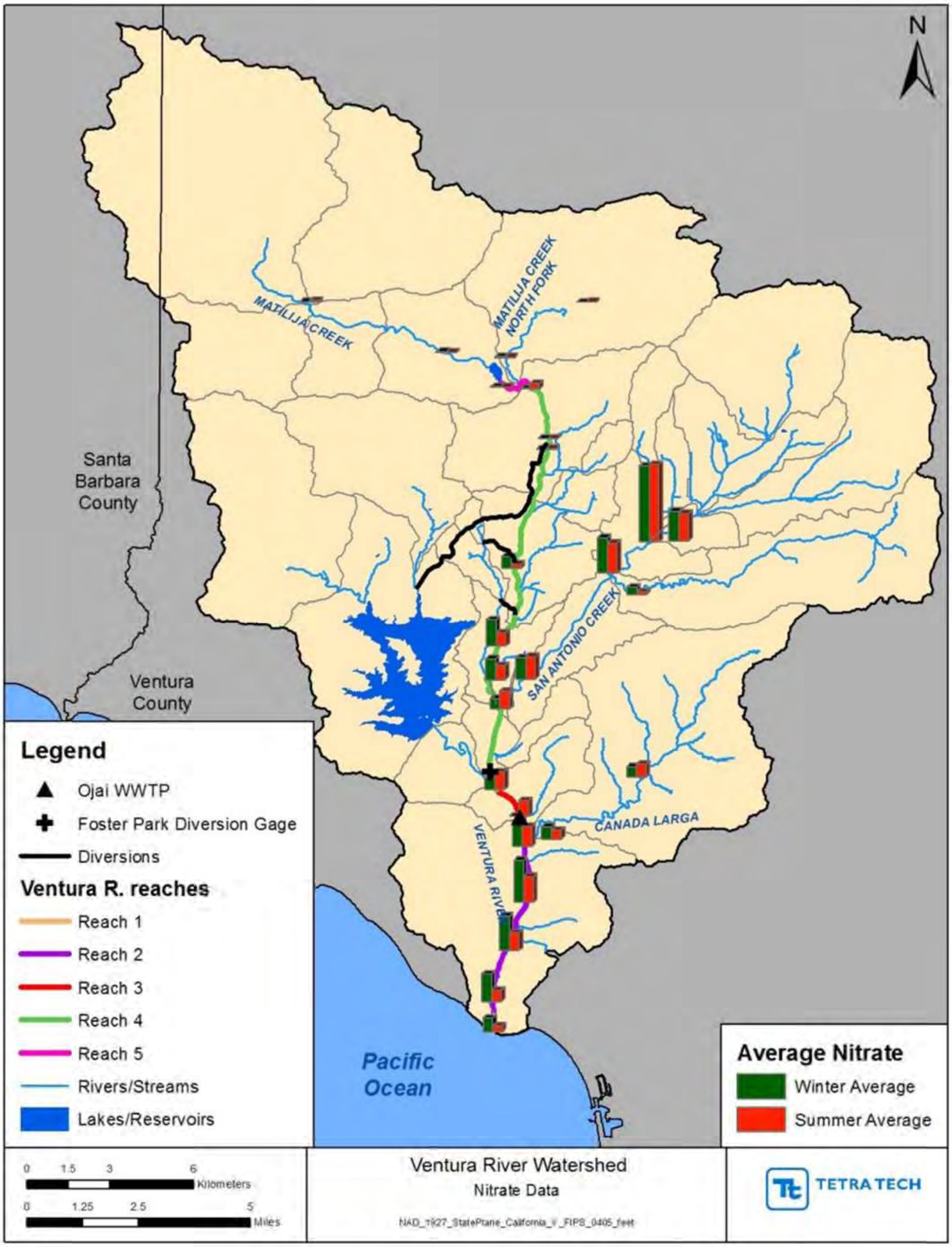

Figure 5-8. Comparison of average winter and summer nitrate concentrations in the Ventura River Watershed

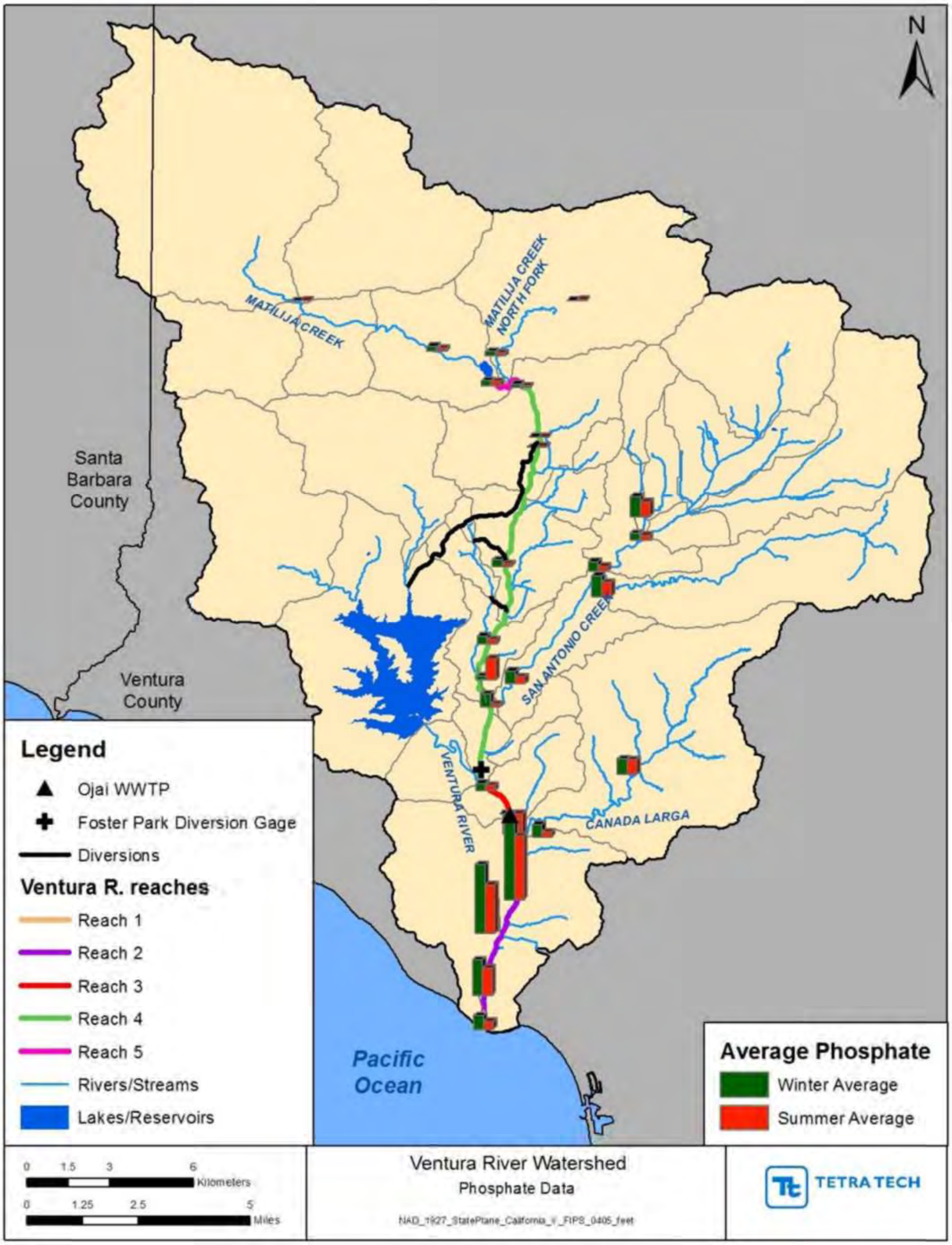

Figure 5-9. Comparison of average winter and summer phosphate concentrations in the Ventura River Watershed

5.1.2.2 Trends in Pre-dawn DO

To study the trends in dissolved oxygen concentration, pre-dawn DO sampling results were used as they represent minimum DO concentrations during the most critical conditions. Through SBCK monitoring efforts, pre-dawn monitoring has been performed starting in 2005 and more consistently in 2008 through 2009. These efforts started at a few sites and then expanded to cover several sites as years progressed. Table 5-4 presents a summary of the pre-dawn DO data, including the number of samples, summary statistics at each station (minimum, maximum, and mean concentration), and a comparison to the DO WQO (number and percentage of excursions).

Table 5-4. Pre-dawn DO monitoring data summary

Site ID	Site Location	Total number of samples	Number of samples below 7.0 mg/L	Percent of samples below 7.0 mg/L (%)	Min (mg/L)	Max (mg/L)	Mean (mg/L)
VRW000	Ventura Estuary (East/West average)	24	12	50.0	5.04	9.07	7.00
VRW000e	Estuary east side	15	5	33.3	5.19	10.27	7.43
VRW000w	Estuary west side	22	11	50.0	3.99	10.03	6.83
VRW001	Ventura River at Main Street	26	13	50.0	4.54	9.16	6.85
VRW003	Ventura River at Shell Road	4	2	50.0	4.93	8.32	6.98
VRW003.5	Ventura River above Cañada Larga confluence	22	5	22.7	5.92	9.09	7.46
VRW004	Lower Cañada Larga	10	0	0.0	7.3	11.08	8.90
VRW006	Ventura River at Foster Park	25	9	36.0	5.28	9.32	7.32
VRW006.1	Ventura River above OVSD	18	2	11.1	6.62	9.23	7.79
VRW006.3	Ventura River above S.A. Creek confluence	20	17	85.0	5.29	8.51	6.41
VRW007	Lower S.A. Creek	14	11	78.6	5.56	8.9	6.57
VRW007A	S.A. Creek at confluence	19	13	68.4	1.87	9.21	5.93
VRW009	Pirie Creek	19	9	47.4	4.91	9.44	7.33
VRW010	Upper S.A. Creek	13	10	76.9	5.7	8.74	6.64
VRW011	Ventura River at Santa Ana Blvd	3	1	33.3	6.73	9.31	7.72
VRW012	Ventura River at Highway 150	7	3	42.9	4.17	9.33	7.05
VRW012.9	Camino Cielo	22	0	0.0	7.49	10.09	8.64

Site ID	Site Location	Total number of samples	Number of samples below 7.0 mg/L	Percent of samples below 7.0 mg/L (%)	Min (mg/L)	Max (mg/L)	Mean (mg/L)
VRW013	Matilija Creek below dam	14	2	14.3	5.82	9.74	7.80
VRW014	N. Fork Matilija Creek	26	1	3.9	6.6	10.55	8.84
VRW015	Matilija Creek above dam	24	3	12.5	6.3	9.81	8.01
VRW017	Middle S.A. Creek	18	2	11.1	6.38	10.05	8.23

Some of the components of the data summary presented in the table above are illustrated in Figure 5-10 and Figure 5-11. As shown in Figure 5-10, pre-dawn DO concentrations fall below the 7.0 mg/L dissolved oxygen WQO at nearly all stations with pre-dawn data. The frequency of observations below WQO is demonstrated in Figure 5-11. In general and as expected, the monitoring stations with considerably low DO values also have elevated nutrient levels. As discussed previously, San Antonio Creek headwaters are responsible for significant nutrient input into the Ventura River. The highest percent exceedances of the DO WQO occur at and around the San Antonio Creek confluence.

5.1.2.3 Trends in Mid-Morning and Afternoon DO

DO data were also evaluated at times later in the day when natural overnight conditions represented in the pre-dawn data no longer impact the receiving waters. These data are illustrated in Figure 5-12 through Figure 5-14. These figures present the percent exceedance and minimum, average, and maximum concentrations at several stations moving upstream to downstream from just above Reach 4 through just below Reach 3 (blue symbols in graphs). In addition, one station is shown for San Antonio Creek (orange symbols in graphs) as this tributary is a significant source of loading to Reach 4. Figure 5-12 shows data at all of these stations, while Figure 5-13 and Figure 5-14 present wet and dry season data, respectively.

In all cases, the average DO concentration was above the 7 mg/L minimum WQO. The upstream station consistently had the most DO exceedances and the lowest minimum DO concentration on the main stem; however, San Antonio Creek had the lowest minimum DO concentration of all stations evaluated (Figure 5-12). Overall, these results show the similar trends to the pre-dawn data. Immediately upstream of San Antonio Creek at Station VRW006.3, no exceedances are observed during dry weather; however, some exceedances are observed during wet weather (which impact the overall results). Then San Antonio Creek enters along Reach 4, with the highest exceedances and lowest minimum DO concentrations. Downstream of San Antonio Creek, at Station VRW006, dry weather exceedances are observed, likely due to the influence of the creek. In summary, during the summer, dry season, which is the critical period represented in this TMDL, exceedances are observed at the station upstream of Reach 4 as well as at several stations along Reaches 4 and 3 (Figure 5-14).

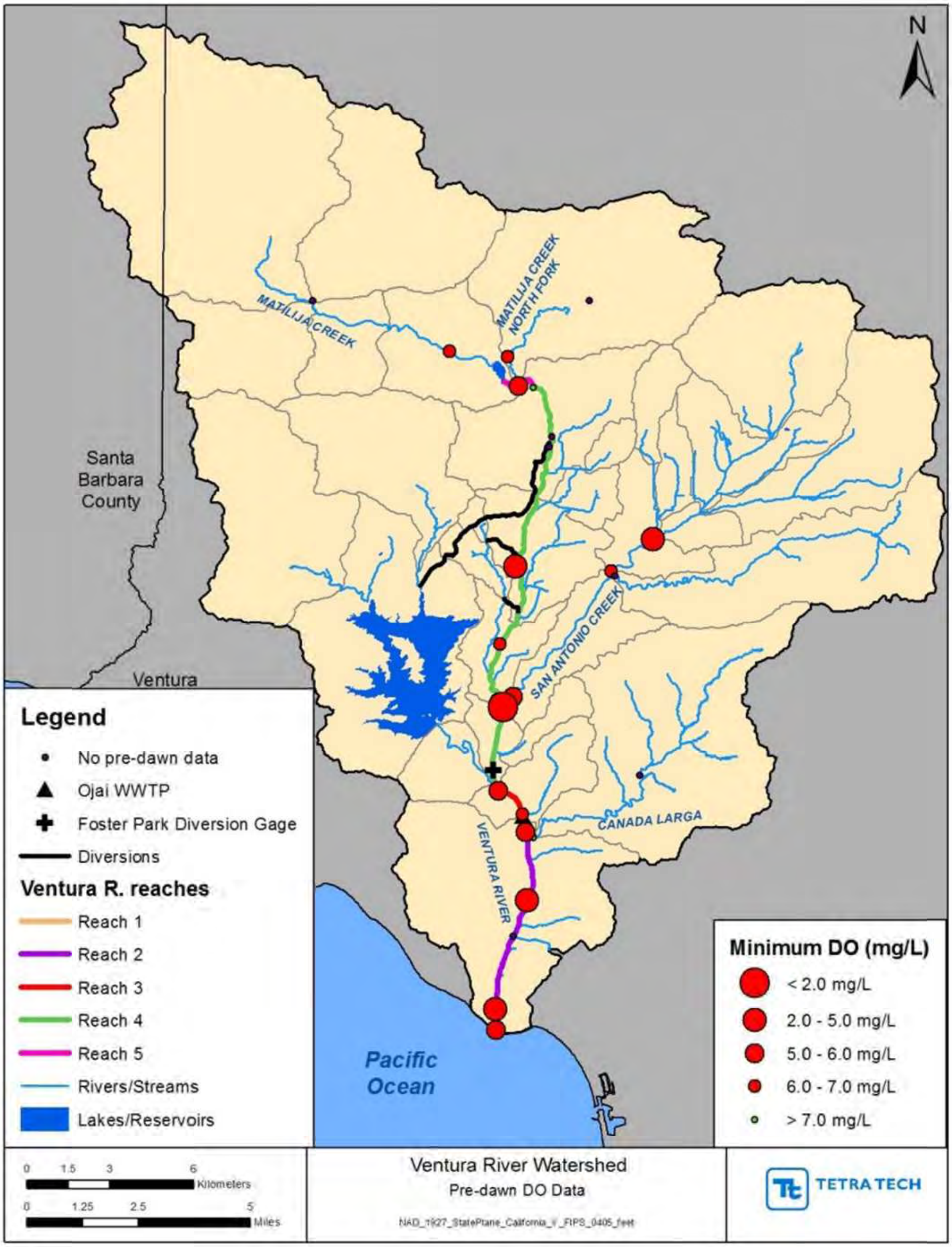

Figure 5-10. Minimum DO concentrations in Ventura River Watershed

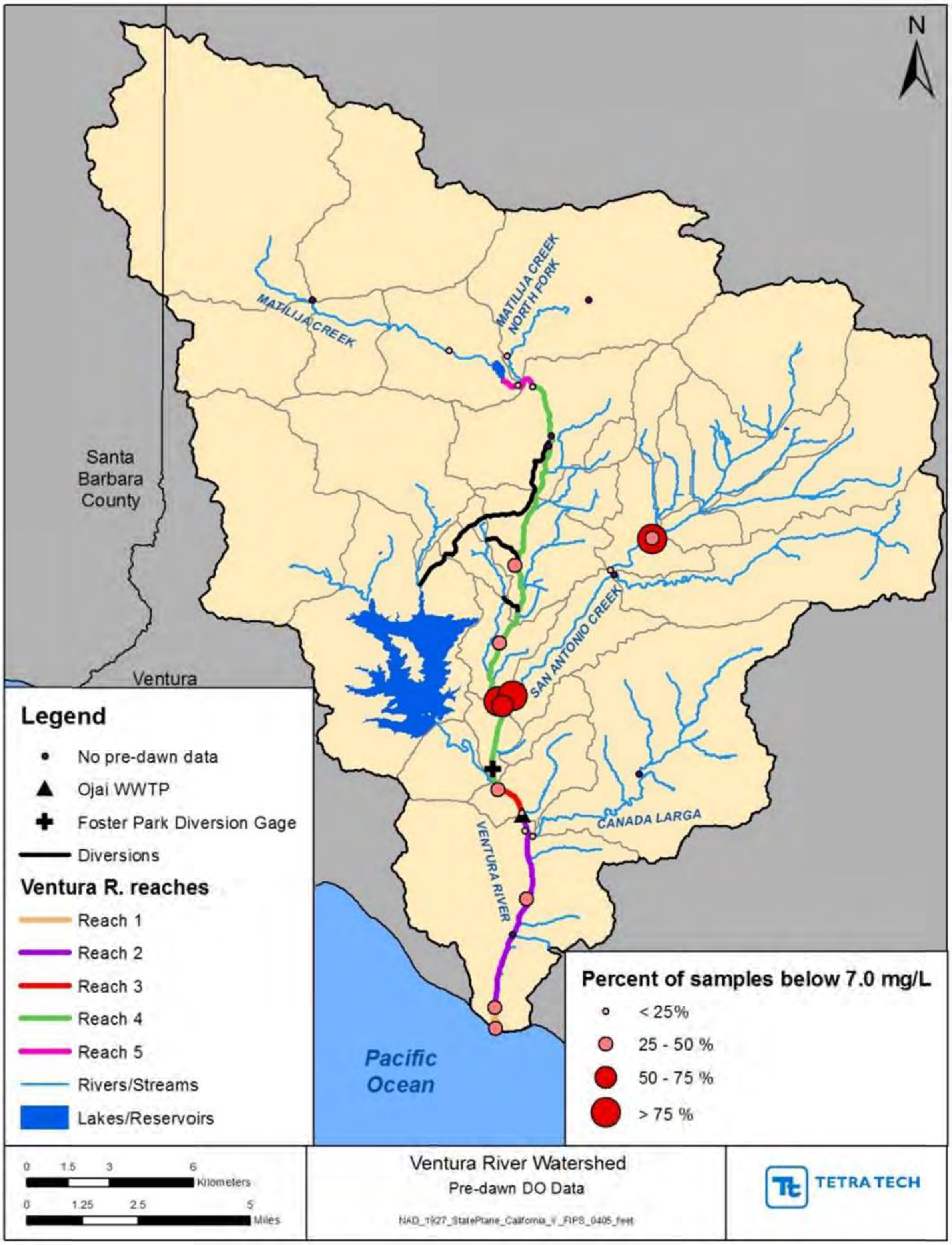

Figure 5-11. Percentage of DO samples below the water quality standard

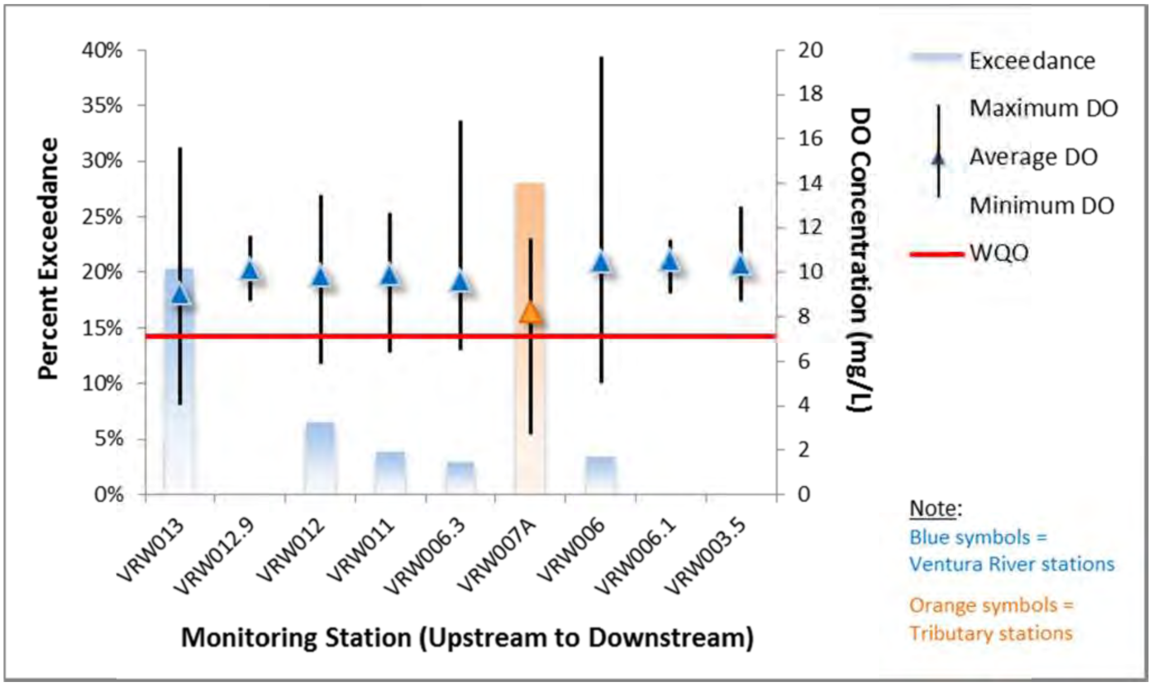

Figure 5-12. Mid-morning and afternoon DO data summary (all data)

Notes on Ventura River station identification numbers: VRW013 = Matilija Creek below Dam; VRW012.9 = Camino Cielo; VRW012 = Hwy 150; VRW011 = Santa Ana Blvd./Bridge; VRW06.3 = above San Antonio confluence; VRW007A = San Antonio Creek at confluence *(tributary to Ventura River)*; VRW006 = Foster Park; VRW006.1 = above OVSD (WWTP); VRW003.5 = above Cañada Larga confluence

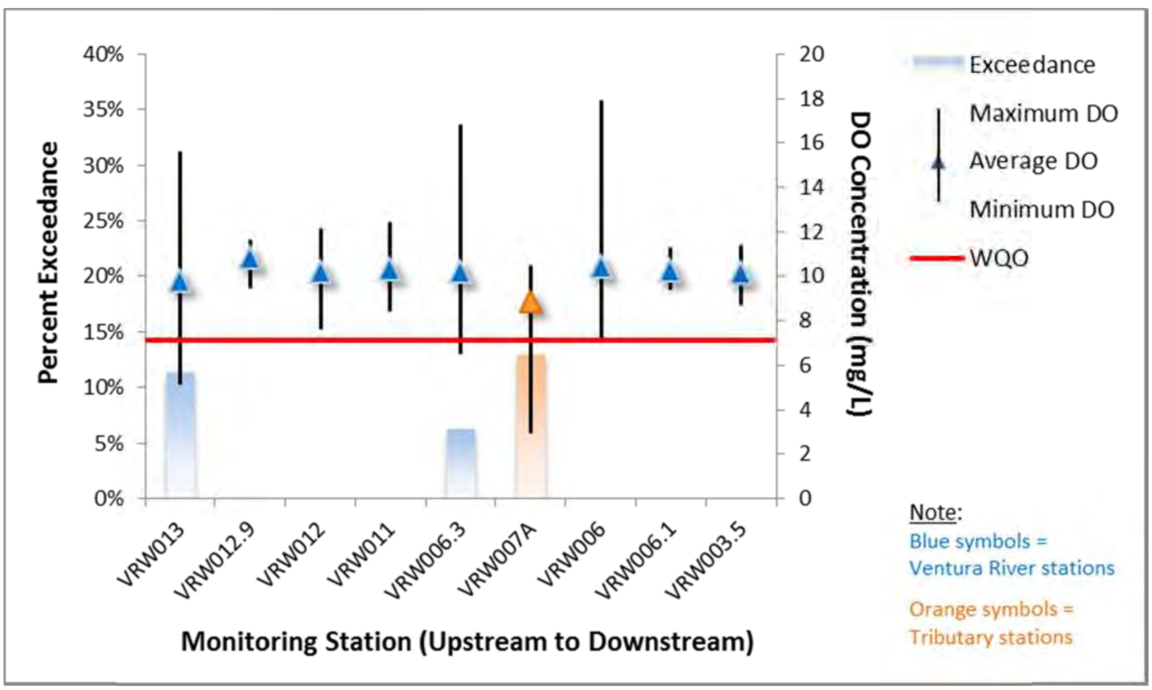

Figure 5-13. Mid-morning and afternoon DO data summary (wet season)

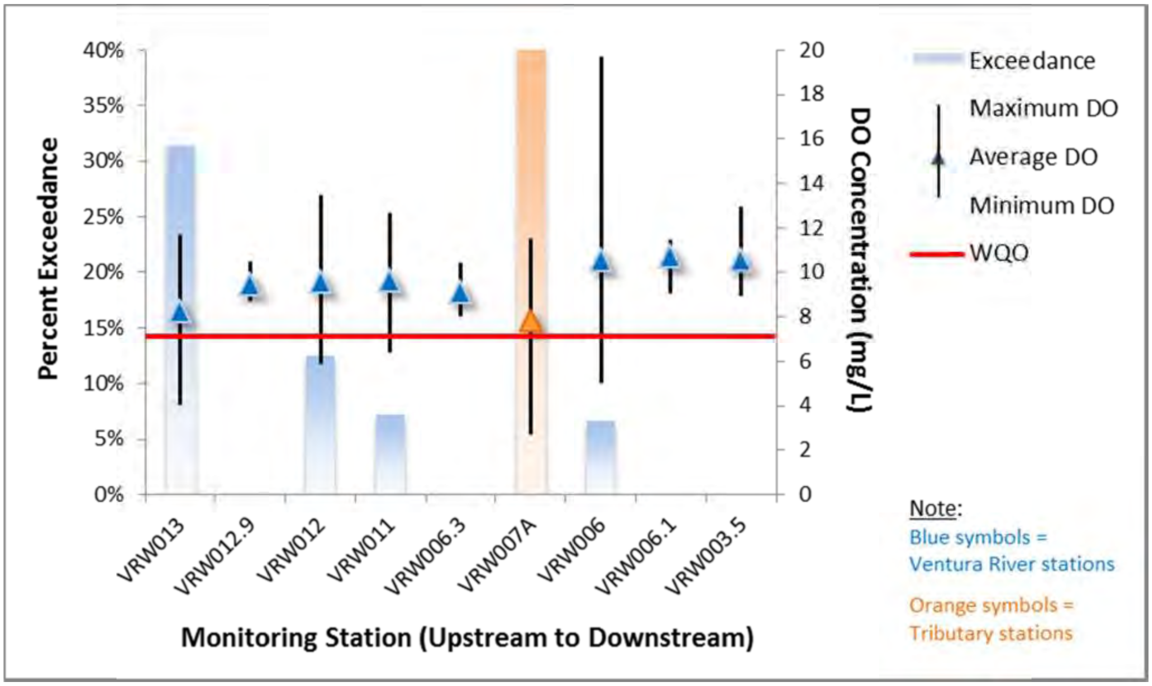

Figure 5-14. Mid-morning and afternoon DO data summary (dry season)

5.2 Summary

In general, we observe between a 25% to over 75% exceedance of the DO objective at Reaches 3 and 4 based on pre-dawn data and a 0 to 20% exceedance rate later in the day along the main stem (including stations immediately upstream and downstream of the impaired reaches). Furthermore, upon review of the pre-dawn and other DO data, it is evident that the critical location during the summer dry season for low dissolved oxygen is near and along Reach 4, immediately around the San Antonio Creek confluence. This area has the potential to significantly impair the aquatic life beneficial uses as survival is threatened in such degraded water quality. When comparing this area with the flow analyses, this stretch of Reach 4 appears to be gaining flow, despite the presence of diversions and well withdrawals; therefore, flow conditions are only a contributing factor to the overall impairments of the aquatic life beneficial uses. As discussed earlier, there are multiple factors that cause the observed impaired conditions of Reach 4, and these results support the conclusion that this TMDL examine all the relevant and applicable parameters responsible for the impaired condition.

The Ventura River Watershed Algae TMDL presents a detailed linkage between nutrient sources and their resulting in-stream concentrations for the Ventura River. This approach utilizes a one-dimensional QUAL2K steady state model that simulates stream transport and mixing processes. Conditions in the estuary were assessed using the NNE BATHTUB spreadsheet modeling tool as well as empirical relationships between nutrient loading and algal biomass (see LARWQCB, 2012 for additional detail). Given that the Ventura River Watershed Algae TMDL focuses on the same beneficial use impairments and the pollutants causing these impairments are related, the results of the Ventura River Watershed Algae TMDL inform this TMDL's calculations.

6 Pollutant Allocations and TMDLs

This section explains the development of the loading capacity and allocations for Ventura River Reaches 3 and 4. USEPA regulations require that a TMDL include waste load allocations (WLAs), which identify the portion of the loading capacity allocated to existing and future point sources (40 CFR §130.2(h)), and load allocations (LAs), which identify the portion of the loading capacity allocated to nonpoint sources (40 CFR §130.2 (g)). TMDLs also include a margin of safety to account for any uncertainty in the analyses. These components are described below.

6.1 Dry-weather Allocations

As established in the problem statement, linkage analysis, and Section 6.3 below, the critical condition for this TMDL is the summer dry season as it is loading in this season that results in water quality impairments to the aquatic life beneficial use. The allocations are thus primarily focused on dry-weather nutrient reductions. Basing the allocations on *dry-weather* loading is a conservative approach to addressing impairments in the *summer dry season* (because dry-weather days occur during both the wet and dry seasons). Dry-weather is defined as a day with no rain. Wet-weather is defined as any day with rain.

Based on the relationship between nutrient concentrations and algal biomass obtained from the freshwater model used in the Ventura River Watershed Algae TMDL, the allowable in-stream concentration of total nitrogen (TN) is equal to 1.15 mg/L (LARWQCB, 2012). To maintain a balance of nutrients for biomass growth and prevent limitation by one nutrient or another, a ratio of total nitrogen to total phosphorus of 10:1 is used to derive the allowable in-stream concentration of total phosphorus equal to 0.115 mg/L (Thomann, Mueller, 1987).

The Ventura River Watershed Algae TMDL provides load-based dry weather allocations based on a modeling scenario that resulted in in-stream nutrient concentrations that attained numeric targets for algal biomass with an explicit margin of safety (LARWQCB, 2012). In this TMDL, the dry weather allocations are consistent with nutrient concentrations in the Ventura River Watershed Algae TMDL; however, for this TMDL, these allocations are strictly concentration-based. This consistent concentration ensures that the allocations identified in the Ventura River Watershed Algae TMDL are met. It also ensures that flow rates cannot be reduced as the only means to achieve the Ventura River Watershed Algae TMDL since maintaining flow rates are important to the pumping and water diversion impairments (which are ultimately interpreted as low flows) and ensuring adequate water is maintained in the stream for fish passage and protection of critical aquatic life habitat.

The concentration-based allocations are presented for each source in Table 6-1 for total nitrogen and total phosphorous. These concentrations are based on the Ventura River Watershed Algae TMDL mass-based allocation scenarios . The mass-based allocations in the Ventura River Watershed Algae TMDL have been translated into concentration-based allocations for this TMDL using assumptions presented in the Ventura River Watershed Algae TMDL Source Assessment and Pollutant Allocations Sections (LARWQCB, 2012). For example, the allowable dry-weather concentration for the Ventura MS4, the Caltrans MS4, and Agriculture are based on a 50% reduction of existing concentrations in effluent. When existing discharge concentrations are less than required in-stream concentrations (i.e., Ventura MS4 and Agriculture TP existing discharge concentrations), the allocations are set equal to existing discharge concentrations. The percent reductions required are consistent with those in the Ventura River Watershed Algae TMDL.

Table 6-1. Summer dry season WLAs and LAs for TN and TP

Source Type	TN Allowable Dry-Weather Concentration (mg/L)	Percent TN Reduction	TP Allowable Dry-Weather Concentration (mg/L)	Percent TP Reduction
Dry-weather WLAs for Ventura MS4[1]	1.5	50%	0.028	0%
Dry-weather WLAs for Caltrans MS4[1]	2.5	50%	0.25	50%
Dry-weather WLAs for Ojai Valley WWTP[1]	3.00	40%	1.00	28%
Dry-weather WLAs for General Industrial Stormwater Permittees[1]	1.15	---	0.115	---
Dry-weather WLAs for General Construction Stormwater Permittees[1]	1.15	---	0.115	---
Dry-weather WLAs for Other NPDES Permittees[1]	1.15	---	0.115	---
Dry-weather LAs for Agriculture[1]	7.6	50%	0.06	0%
Dry-weather LAs for Horses/Intensive Livestock[2]	1.15	*	0.115	*
Dry-weather LAs for Grazing Activities[2]	1.15	*	0.115	*
Dry-weather LAs for OWTS[2]	1.15	*	---	---

Notes:

"---" indicates that no percent reductions were presented in the Ventura River Watershed Algae TMDL.

1 – Applies at the discharge point.

2 – Applies in-stream.

* Percent reduction in Ventura River Watershed Algae TMDL not based on discharge concentration; thus, allocation here is presented as required in-stream concentration.

6.1.1 Additional Entities Related to Assimilative Capacity

In addition to the identified sources in Table 6-1, this TMDL also identifies those entities responsible for pumping or diverting the surface or subsurface flow from Reaches 3 and 4; these activities have influence on the water quality condition of the listed impaired reaches, as described above. Decreases in surface flow and volume are exacerbating nutrient levels, contributing to excessive algae and low DO conditions during the summer dry season. In addition, such activities may indirectly lead to overland runoff flow into the stream reaches elsewhere (i.e., redirected flow results in runoff). Such activities decrease the assimilative capacity of the Reaches. At this point, it is imperative to understand the pumping-, diverting-, and/or discharge-related activities that likely have a direct impact on the waterbody's in-stream water quality condition.

USEPA is inviting comments from those entities impacting the assimilative capacity of Reaches 3 and 4 to provide additional information on the direct, indirect or a clear lack of impact from such activities on the water quality condition.

6.2 Wet-weather Allocations

Wet-weather loads do not have a significant impact on receiving water quality in the Ventura River and its tributaries or the Estuary (Section 6.3). Thus, wet-weather allocations are set to attain site-specific concentration-based WQOs from Table 3-8 of the Basin Plan (Table 6-2). There are no site-specific objectives for Reach 1 or the Estuary. For Reach 1 and the Estuary, wet-weather WLAs for stormwater sources are equal to existing water quality in stormwater discharges (maximum TN = 7.4 mg/L from LARWQCB, 2012) and LAs for agriculture and horse/livestock sources are equal to benchmarks of 10 mg/L nitrate-N + nitrite-N in the Agriculture Waiver.

Table 6-2. Wet- weather WLAs and LAs for TN and TP by segment

Reach	Nitrate-N + Nitrite-N (mg/L)
Ventura River Estuary	*
Ventura River Reach 1	*
Ventura River Reach 2	10
Cañada Larga	10
Ventura River Reach 3	5
San Antonio Creek	5
Ventura River Reach 4	5
Ventura River Reach 5	5

*WLAs for stormwater are equal to 7.4 mg/ L TN and LAs for agriculture and horse/livestock sources are equal to 10 mg/L nitrate-N + nitrite-N.

In wet-weather conditions, the biological performance of treatment operations at the Ojai Valley WWTP may be reduced due to lower temperatures and loading may increase due to increased inflows. For nitrogen (TN) discharges of Ojai Valley WWTP, the WLAs in Table 6-3 apply to wet and dry weather conditions in the winter season (October 1st to April 30th). The phosphorus (TP) discharges apply during wet-weather conditions only, which are defined as any day of rainfall.

Table 6-3. Ojai Valley WWTP Winter/Wet-weather WLAs

TN (mg/L)	TP (mg/L)
4.6	2.6

Note: TN WLA applies during winter season; TP WLA applies during wet-weather only.

6.3 Critical Conditions

The critical condition is the period in which the receiving waterbody is most sensitive to the impacts associated with the pollutants of concern. Critical conditions for nutrients and low flow in the Ventura River watershed are during the summer dry season (defined as May 1 to September 30, consistent with the Ventura River Watershed Algae TMDL), especially during consecutive dry-weather days (i.e., days with no rainfall) during the summer dry season. The summer dry season is when flows are the lowest and temperatures are the highest, creating favorable conditions for algae growth, which reduces dissolved oxygen (note: nutrients are loaded year round; however those in the summer dry season are responsible for the aquatic life impairments). The Ventura River Watershed Algae TMDL provides a detailed discussion justifying the selection of the critical condition (LARWQCB, 2012). These calculations are applicable to this TMDL because Reaches 3 and 4 are located with the Ventura River Watershed and it is important to maintain consistency for comparable water quality parameters.

6.4 Margin of Safety

This TMDL establishes a relationship with the analyses presented in the Ventura River Watershed Algae TMDL (LARWQCB, 2012). Therefore, the sources of uncertainty in this TMDL are consistent with that TMDL and are related to the selection of the algal biomass target, the relationship between nutrient concentrations and algal biomass in freshwater river systems and estuaries, the estimate of watershed-based nutrient loading, and the model-predicted water quality conditions in the receiving water. These areas of uncertainty are addressed with both an implicit and explicit margin of safety.

The implicit margin of safety includes conservative assumptions made when estimated watershed-based nutrient loading. For example, the nitrate and phosphate concentrations used to estimate dry-weather loading from agriculture is based upon measured data from an area more intensely farmed (and having tile drains, which concentrate nutrients) than in the Ventura River watershed. The flows for Cañada Larga and San Antonio Creek were higher than the median flows obtained from long-term flow records. This overestimates the loading into the main stem of the river and conservatively predicts main stem nutrient concentrations. Finally, basing the allocations on dry-weather loading is a conservative approach to addressing impairments in the summer dry season.

The explicit margin of safety is calculated as the difference between the model-predicted maximum concentration in-stream after implementation of reduction scenarios and the desired in-stream concentrations of 1.15 mg/L TN and 0.115 mg/L TP. The resulting explicit margin of safety is 7%. This explicit margin of safety is applied to account for uncertainty in the algal biomass numeric target of 150 mg/m^2 and the relationship between the required in-stream nutrient concentrations necessary to attain this value. This explicit margin of safety also addresses the fact that the model-predicted nutrient concentrations are reflective of median measured concentrations, and do not capture not maximum concentrations.

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7 Implementation

This section describes the regulatory mechanisms that may be used to implement the TMDL and monitoring recommendations. The Ventura River Watershed Algae TMDL provided a detailed implementation plan, including specific regulatory mechanisms, how compliance with WLAs and LAs will be determined, implementation measures that could be used to attain WLAs and LAs and their associated costs, and an implementation schedule (LARWQCB, 2012). Implementation of this plan will attain both the Ventura River Watershed Algae TMDL as well as this TMDL for pumping and water diversions by restoring all applicable beneficial uses.

7.1 Implementation of WLAs

The regulatory mechanisms used to implement the WLAs include the Ojai Valley WWTP NPDES permit, the Ventura County MS4 NPDES permit, the Caltrans MS4 NPDES permit, the general industrial storm water permits, the general construction storm water permits, and other NPDES permits. WLAs shall be incorporated into each permit at the time of permit issuance, modification, or renewal of the permit.

7.2 Implementation of LAs

Two primary federal statutes establish a framework in California for addressing nonpoint source water pollution: Section 319 of the CWA of 1987 and Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). In accordance with these statutes, the state assesses water quality associated with nonpoint sources of pollution and develops programs to address nonpoint sources. The *Plan for California's Nonpoint Source Pollution Control Program* (Nonpoint Source [NPS] Program Plan), which became effective in 2000, provides a coordinated statewide approach to dealing with nonpoint source pollution. Federal approval of the NPS Program Plan required the SWRCB to provide assurances that it has the legal authority to implement and enforce the NPS Program Plan. In 2004, the SWRCB adopted the Nonpoint Source Implementation and Enforcement Policy. This policy specified that the regional boards have the administrative permitting authorities to regulate nonpoint sources of pollution through Basin Plan prohibitions, WDRs, and waivers of WDRs. The regulatory mechanisms that will be used to implement LAs for each source category are described below.

7.3 Potential Implementation Strategies

The TMDL requires responsible parties to attain WLAs and LAs for nutrients to prevent excessive algal growth and maintain adequate dissolved oxygen concentrations and pH values in the Ventura River and its tributaries. There are many implementation alternatives available to reduce nutrient loading. Rather than a single treatment solution, a combination of implementation measures may be required to reduce nutrients and algae and improve DO to acceptable levels. Several potential implementation strategies could be used to comply with the TMDL. Many of the structural and nonstructural BMPs to address nutrient loadings could also reduce the loading of other contaminants, which could assist in meeting the requirements of other existing or future Ventura River TMDLs. Additionally for this TMDL, care should be taken during BMP planning and implementation to monitor river flows (with the goal of maintaining existing flows, especially with higher quality water or increasing river flow rates) to ensure water levels are high enough to support fish populations, most notably the southern steelhead trout.

Additional potential implementation strategies are described below.

7.3.1 Compliance With and Enforcement of State Water Rights Laws

USEPA recognizes the State has additional options for implementation strategies through compliance and enforcement with water rights laws. The State Water Resources Control Board, Division of Water Rights, enforces water rights laws in the State. The Division may be involved at several levels of effort as resources allow.

Briefly, the State has authority over water rights appropriation. USEPA recommends that the State review the specific activities in Reaches 3 and 4 and ensure that the appropriate requirements are met in the waterbody (e.g., holders cannot store water during a wet time period; riparian right holders must file with the Division of Water Rights and describe their activity and any impacts resulting from their activity; failure to report can be subject to civil liabilities). As described earlier, the stream ecosystem is connected to water quality, habitat, hydrology, and physical structure conditions; all related activities, such as the general activity of pumping and diverting, are critical to ensuring that the water quality impairments can be achieved.

7.3.2 Maintenance of Bypass Flow Pattern at Robles Diversions

It is USEPA's current understanding that the Casitas Municipal Water District (Casitas MWD) currently operates a bypass flow pattern at the Robles Diversion (located in the upper part of Reach 4); this was established in the National Oceanic and Atmospheric Administration (NOAA) Fisheries Biological Opinion (BO) of 2003. The BO established bypass flows to closely duplicate the surge of water in the river coincident with large storms followed by the gradual reductions in flows during the days after rain ceases. The owner of the dam is the federal Bureau of Reclamation (BOR). If transfer of ownership from the BOR to Casitas MWD occurs at any point in the future, the terms of the BO would no longer apply. USEPA strongly recommends that voluntary maintenance of this bypass flow pattern be continued by Casitas MWD since this would continue support of steelhead trout in this reach.

7.3.3 Continued Implementation of the 2004 Ecosystem Restoration Feasibility Study

In reviewing the past implementation related activities relevant to Reaches 3 and 4, we are aware that multiple stakeholders in the watershed (led by the Ventura County Watershed Protection District and the U.S. Army Corps of Engineers) participated in the completion of the Ecosystem Restoration Feasibility Study in 2004, which recommended removal of Matilija Dam. Various implementation activities described in the plan has been occurring, including the demolition of the dam; however, this is dependent on the availability of future federal funding. All entities, including the numerous local stakeholders, state and federal agencies involved view this latter action as the critical long-term action to restore access to steelhead trout to prime spawning and rearing habitat in the upper watershed.

7.3.4 Development of a Groundwater Management Plan

The Upper Ventura River Groundwater Basin supports about 160 active domestic, municipal, and agricultural wells. Water agencies in the Upper Basin have stated that a Groundwater Management Plan would be beneficial to the larger impairment condition for the region.

7.3.5 Identification and Completion of Studies to Evaluate the Effects of Pumping on Habitat

The identification and completion of studies to evaluate the effects of pumping on surface flows and water levels in pools would be useful to our overall understanding of the many variables that impact water quality condition in these Reaches. A regular monitoring program associated with documenting water quality, flows, depth of pools, and presence/absence of steelhead trout should be established to evaluate better the relationship between condition and flow.

7.3.6 Implementation of Actions from NOAA Fisheries' 2012 Southern California Steelhead Recovery Plan

Implementation of additional conservation actions to address threats to steelhead trout recovery described in NOAA Fisheries' 2012 Southern California Steelhead Recovery Plan should be evaluated.

7.4 Monitoring Program

Monitoring programs will be designed to measure improvement in water quality and pollutant load reductions. The monitoring program has several goals including:

- Determine attainment of numeric targets;
- Determine compliance with the waste load and load allocations;
- Monitor the effect of implementation actions on river and estuary water quality.

The TMDL monitoring program is intended to be consistent with the Ventura River Watershed Algae TMDL (more details are provided in LARWQCB, 2012) and consists of three components: 1) receiving water monitoring, 2) discharger monitoring, and 3) optional special studies. All monitoring requirements may be included in subsequent permits or other orders and are subject to LARWQCB Executive Officer approval.

7.4.1 Receiving Water Monitoring

Responsible parties (Ojai Valley Sanitation District [OVSD], VCWPD, Ventura County, the City of Ojai, the City of Ventura, Caltrans, and agricultural dischargers) are responsible for developing and implementing a comprehensive monitoring plan to assess numeric target attainment and measure in-stream nutrient concentrations. Responsible parties are encouraged to work together to submit a join watershed-wide plan. Once horse and livestock owners are enrolled in the regulatory mechanism to implement their LAs, they shall participate in the implementation of the watershed-wide monitoring plan or submit their own plan. The monitoring plan should outline a program to sample for algal biomass, algal percent cover, nutrients (total and dissolved), *in situ* water quality parameters (dissolved oxygen, pH, temperature, electrical conductivity), and flow for the river and estuary. The monitoring procedures/methods, analysis, and quality assurance shall be Surface Water and Ambient Monitoring Program (SWAMP) comparable, where appropriate. The sampling frequency and locations must be adequate to assess beneficial use condition and attainment of applicable water quality objectives. At a minimum, for algal biomass and percent algal cover, the monitoring frequency shall be once per month in the summer dry season (May 1st to September 30th). After two years, if a significant difference between monthly algal biomass measurement is not observed, algal biomass monitoring may be reduced to three times during the summer dry season, during the months of May, July and September. DO and pH shall be measured continuously for two week periods on a quarterly basis. Continuous monitoring of DO shall occur during the months of May and September in the 2nd and 3rd quarters. All other parameters, including algal percent cover, shall be monitored monthly.

Existing receiving water monitoring conducted under other programs can be leveraged to assist in meeting these monitoring requirements. Responsible parties may build upon existing monitoring programs in the Ventura River watershed when developing the receiving water quality monitoring plan for this TMDL. Receiving water monitoring requirements shall be incorporated into the regulatory mechanisms for each responsible party upon issuance, renewal, or modification. The responsible parties may continue to coordinate a watershed-wide monitoring program to meet this requirement in order to fulfill permit, WDR, or waiver requirements. Receiving water monitoring shall continue beyond the final implementation date of the TMDL unless the Executive Officer approves a reduction or elimination of such monitoring.

7.4.2 Discharge Monitoring

Discharge monitoring will assess attainment of the waste load and load allocations. Discharge monitoring shall be required through the regulatory mechanisms used to implement the waste load and load allocations. Discharge monitoring shall be conducted as specified by the LARWQCB (2012). The monitoring procedures/methods, analysis, and quality assurance shall be SWAMP comparable, where appropriate, and are subject to approval by the LARWQCB Executive Officer.

7.4.3 Special Studies

Responsible parties within the watershed may conduct optional special studies designed to refine waste load and load allocations and numeric targets. The results of special studies and monitoring may be used to revise numeric targets and allocations, if supported, when the TMDL is reconsidered. The following are potential special studies.

- Build upon the algal biomass and total nitrogen relationship established in the 2008 University of California at Santa Barbara (UCSB) Study (Klose et al., 2009) and collect data to support the establishment of reach-specific relationships.
- Confirm the conclusion that an algal biomass target of 150 mg/m^2 is fully protective of aquatic life and minimizes the risk of low DO events.
- Collect additional source assessment information and model input data to refine model predicted relationships between watershed loading and in-stream nutrient concentrations.
- Investigate the influence of OWTS on surface water quality.
- Collect data to support development of an estuary model, which takes into account tidal influence, the dynamics of macroalgae and phytoplankton growth, residence time, and breaching conditions.
- Collect continuous flow and DO data in Reach 4 to characterize these parameters within stream inputs and outputs, especially near and downstream of San Antonio Creek.
- Investigate potential sources of low DO exceedances with Reach 4, especially near and downstream of San Antonio Creek.

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