CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

Central Coast Regional Water Quality Control Board

Total Maximum Daily Loads for Nitrogen and Phosphate Compounds in Streams of the Franklin Creek Watershed

Santa Barbara County, California

Draft TMDL Report

December 2017

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1 PREFACE

The following Total Maximum Daily Load (TMDL) Report contains information that addresses nutrient-related impairment of Franklin Creek. Franklin Creek is tributary to the Carpinteria Salt Marsh.

Franklin Creek is on the federal Clean Water Act section 303(d) list of impaired waterbodies (303(d) list) due to excessive nitrate concentrations. In addition, water quality data indicate that excessive nutrient inputs into Franklin Creek result in dissolved oxygen super-saturation and excessive algal biomass that are reflective of biostimulatory conditions.

Carpinteria Salt Marsh was placed on the 303(d) list due to nutrients and organic enrichment/low dissolved oxygen in the mid 1990's. However, the basis for these listings is not consistent with the current 303(d) listing criteria contained in the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) list*, September 2004, amended February 2015 (Listing Policy). In addition, adequate water quality data for the Carpinteria Salt Marsh is not available to evaluate these impairments in a manner consistent with the Listing Policy. As a result, Carpinteria Salt Marsh TMDLs that specifically address nutrient, organic enrichment, and low dissolved oxygen impairments are not proposed at this time. The State Water Resources Control Board (State Water Board) is developing nutrient objectives for California which will provide guidance on addressing these impairments and establishing future nutrient-related TMDLs for the Carpinteria Salt Marsh if necessary.

2 BACKGROUND

The federal Clean Water Act requires every state to evaluate its waterbodies and maintain a list of waters that are impaired either because the waterbody exceeds water quality standards or does not achieve its designated beneficial uses. This is known as California's federal Clean Water Act section 303(d) list of impaired waterbodies (303(d) list). For central coast waterbodies that are on the 303(d) list, the Central Coast Regional Water Quality Control Board (Central Coast Water Board) must develop and implement a plan to reduce pollutants so that the waterbody is no longer impaired and can be removed from the 303(d) list. These plans are considered total maximum daily loads.

Total maximum daily load (TMDL) is a term used to describe the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. A TMDL study identifies the probable sources of pollution, establishes the maximum amount of pollution a waterbody can receive and still meet water quality standards, and allocates that amount to all probable contributing sources.

In practical terms, TMDL projects are plans or strategies to restore clean water, and thus a TMDL report is a type of planning document. The California Water Plan characterizes TMDLs as *"action plans…to improve water quality."*

Central Coast Water Board staff (staff) anticipates that this TMDL project will ultimately result in a basin plan amendment to incorporate TMDLs into the Water Quality Control Plan for the Central Coastal Basin (Basin Plan).

2.1 Pollutants Addressed & Their Environmental Impacts

The pollutants addressed in this TMDL are nitrate and phosphate. Elevated levels of nitrate can degrade municipal and domestic water supply, groundwater, and also can impair freshwater aquatic habitat, while elevated phosphate levels contribute to biostimulatory conditions that promote excessive algal biomass and degradation of aquatic habitat. It is widely recognized by scientists and resource professionals that there is a critical need to continue to improve best management practices to reduce nitrogen releases to the environment from human activities, while maintaining the economic viability of farming operations (see for example Shaffer and Delgado, 2002). Franklin Creek frequently exceeds the water quality objective for nitrate in drinking water and therefore does not support the drinking water supply (MUN) beneficial uses[1]. In addition, excessive nitrate concentrations may also impair the groundwater recharge (GWR) beneficial use. The Basin Plan (CCRWQCB, 2017) explicitly requires that the designated GWR beneficial use of streams be maintained, in part, to protect the water quality of the underlying groundwater resources[2].

Regarding nitrate-related health concerns, it has been well-established that infants less than six months old who are fed formula made with water containing nitrate in excess of the U.S. Environmental Protection Agency (USEPA) safe drinking water standard (i.e., 10 milligrams of nitrate as nitrogen per liter) are at risk of becoming seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue baby syndrome, also known as methemoglobinemia[3]. High nitrate levels may also affect the oxygen-carrying ability of the blood of pregnant women[4]. There is some evidence to suggest that exposure to nitrate in drinking water is associated with adverse reproductive outcomes such as intrauterine growth retardations and various birth defects such as anencephaly; however, the evidence is inconsistent (Manassaram et al., 2006). Additionally, some public health concerns have been raised about the linkage between nitrate and cancer. Some peer-reviewed epidemiological studies have suggested elevated nitrate in drinking water may be associated with elevated cancer risk (for example, Ward et al. 2010); however currently there is no strong evidence linking higher risk of cancer in humans to elevated nitrate in drinking water. Further research is recommended by scientists to confirm or refute the linkage between nitrates in drinking water supply and cancer.

Another water quality impairment associated with nutrients and addressed in this TMDL report is biostimulation[5]. While nutrients, specifically nitrogen and phosphorus, are

[1] "Beneficial uses" is a regulatory term which refers to the legally-protected current, potential, or future designated uses of the waterbody. The Water Board is required by law to protect all designated beneficial uses.

[2] See Basin Plan, Chapter 2 Beneficial Use Definitions, Section 2.2.5, page 8.

[3] USEPA: http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm

[4] California Department of Public Health. www.cdph.ca.gov/certlic/drinkingwater/Pages/Nitrate.aspx

[5] The term "eutrophication" has often been considered to be synonymous with the word "biostimulation". California central coast researchers have noted that the word "eutrophication" is problematic because it is based on simplistic categories that fail to appreciate the diversity of aquatic systems, and lacks scientific specificity. Accordingly, these researchers recommend that the regional water quality control boards not use the word "eutrophication" (see Rollins, et al., 2012).

essential for plant growth, they are considered pollutants when they occur at levels that have adverse impacts on water quality. For example, when they cause toxicity or biostimulation. Biostimulation refers to a state of excess growth of aquatic vegetation resulting from anthropogenic nutrient inputs into an aquatic system. Biostimulation is also characterized by a number of other environmental factors in addition to nitrogen and phosphorus inputs; for example, dissolved oxygen levels in the waterbody, chlorophyll *a* levels, sunlight availability, and pH. Biostimulation can adversely affect the entire aquatic food web from macroinvertebrates (principally aquatic insect larvae), through fish, reptiles and amphibians, and then to the mammals and birds at the top of the food web. Reducing the amount of nutrients that enter Franklin Creek will help to reduce the risks of biostimulation and will help restore and maintain viable freshwater aquatic habitat.

In addition to adverse impacts to aquatic habitat, algal blooms resulting from biostimulation may also constitute a potential health risk and public nuisance to humans, their pets, and to livestock. The majority of freshwater harmful algal blooms reported in the United States and worldwide is due to one group of algae, cyanobacteria (blue-green algae), although other groups of algae can be harmful (Worcester and Taberski, 2012). Possible health effects of exposure to blue-green algae blooms and their toxins can include rashes, skin and eye irritation, allergic reactions, gastrointestinal upset, and other effects[6]. At high levels, exposure can result serious illness or death. These effects are not theoretical; worldwide animal poisonings and adverse human health effects have been reported by the World Health Organization (WHO, 1999). The California Department of Public Health and various County Health Departments have documented cases of dog die-offs throughout the state and the nation due to blue-green algae. Dogs can die when their owners allow them to swim or wade in waterbodies with algal blooms. Dogs are also attracted to fermenting mats of cyanobacteria near shorelines of waterbodies (Carmichael, 2011). Dogs reportedly die due to ingestion associated with licking algae and associated toxins from their coats.

Additionally, according to recent findings, algal toxins have been implicated in the deaths of central California southern sea otters (Miller et al., 2010). Currently, there reportedly have been no confirmations of human deaths in the U.S. from exposure to algal toxins, however many people have become ill from exposure, and acute human poisoning is a distinct risk (Dr. Wayne Carmichael of the Wright State University-Department of Biological Sciences, as reported in NBC News, 2009).

TMDL development intended to address nitrate pollution risks to human health and address degradation of aquatic habitat is consistent with the Central Coast Water Board's highest identified priorities. The Central Coast Water Board's two highest priority areas[7] (listed in priority order) are presented below:

[6] California Department of Public Health website, http://www.cdph.ca.gov

[7] See Staff Report (agenda item 3) for the July 11, 2012 Water Board meeting.

Central Coast Water Board Top Two Water Quality Priorities

1) "Preventing and Correcting Threats to Human Health"
   - ✓ *Nitrate contamination is by far the most widespread threat to human health in the central coast region*
2) "Preventing and Correcting Degradation of Aquatic Habitat"
   - ✓ *"Including requirements for aquatic habitat protection in Total Maximum Daily Load Orders"*

Also noteworthy, the USEPA recently reported that nitrogen and phosphorus pollution, and the associated degradation of drinking and environmental water quality, has the potential to become one of the costliest and most challenging environmental problems the nation faces[8]. Over half of the nation's streams, including Franklin Creek, have medium to high levels of nitrogen and phosphorus. According to USEPA, nitrate drinking water standard violations have doubled nationwide in eight years, and algal blooms, resulting from the biostimulatory effects of nutrients, are steadily on the rise nationwide; related toxins have potentially serious health and ecological effects[9]. Water quality monitoring within Franklin Creek has demonstrated that waters have been substantially impacted by nitrate.

Table 2-1. Waterbody and pollutant combinations addressed in this TMDL.

		Impairment Pollutant	
Waterbody Name	SB Waterbody ID	Nitrate	Biostimulatory Substances
Franklin Creek	CAR3153402019990225134357	X	O

X Included on 303(d) list of impaired waterbodies and addressed in this TMDL.
O Not included on 303(d) list of impaired waterbodies, however impairment asserted due to exceedance of WQO's and addressed in this TMDL using more restrictive biostimulatory total nitrogen and total phosphorus targets and allocations.

3 TMDL PROJECT LOCATION

This TMDL project includes Franklin Creek which is within the Carpinteria Salt Marsh watershed, located in southeastern Santa Barbara County. Figure 3-1 and Figure 3-2 depict the Carpinteria Salt Marsh watershed, its two named waterbodies, Franklin and Santa Monica Creeks, and several underground drainage conveyances (conduits) in the western portion of the watershed that transport water south, below U.S. Highway 101 and Southern Pacific Railroad, and ultimately into the salt marsh. The Carpinteria Salt Marsh is also known as Carpinteria Marsh, Carpinteria Slough, El Estero, El Estero del la Carpinteria, and Sandyland Cove (Ferren, 1985). Please note that the terms watershed and drainages are used synonymously throughout this document.

The state waterbody identification number for Franklin Creek is CAR3153402019990225134357. Franklin Creek is located in state watershed identification number 31534020 and U.S. Geologic Survey (USGS) hydrologic unit code (HUC) 18060013.

[8] USEPA: Memorandum from Acting Assistant Administrator Nancy K. Stoner. March 16, 2011. Subject: "Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions".
[9] *Ibid*

Although this TMDL report specifically pertains to Franklin Creek, staff has provided additional information relative to Santa Monica Creek and other areas within the greater Carpinteria Salt Marsh watershed for the sake of comparison and perspective.

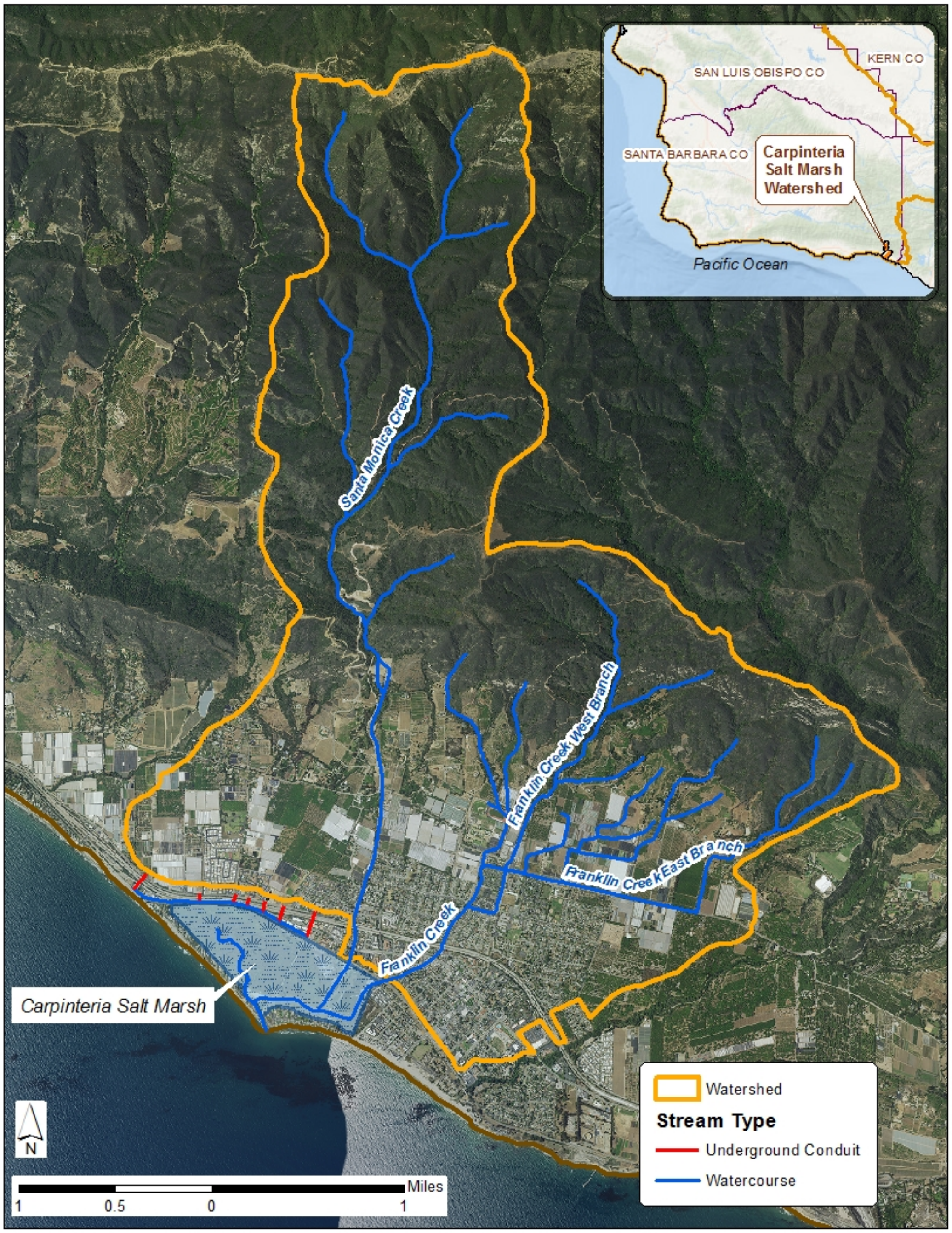

Figure 3-1. Carpinteria Salt Marsh watershed.
Spatial data source for watershed and streams: South Coast Watershed Map (Easterly Section), Santa Barbara County Flood Control and Water Conservation District, 1975.

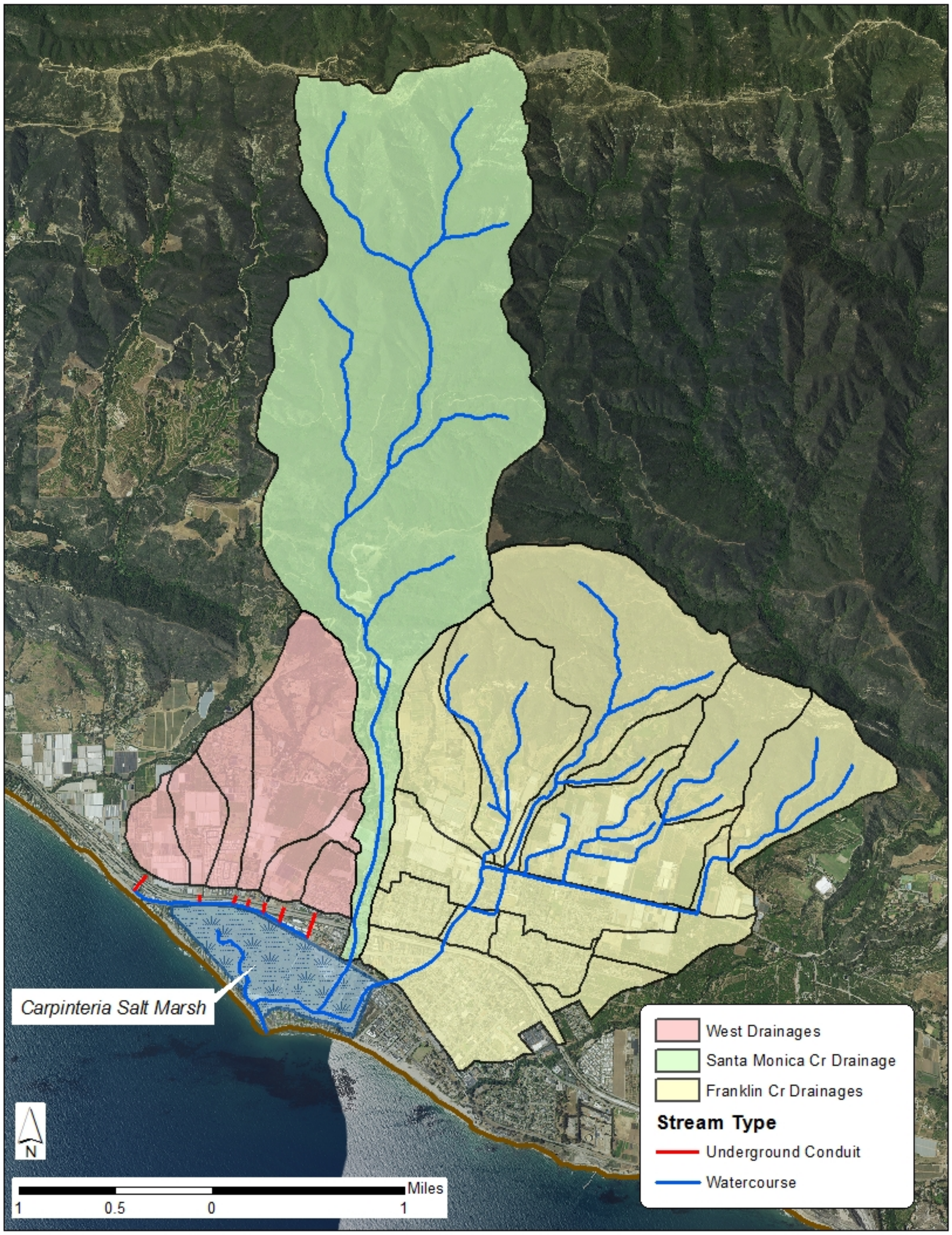

Figure 3-2. Drainages within the Carpinteria Salt Marsh watershed.
Spatial data source for subwatersheds and streams: South Coast Watershed Map (Easterly Section), Santa Barbara County Flood Control and Water Conservation District, 1975.

4 PHYSICAL SETTING

The geographic scope of this TMDL (the project area) is the Franklin Creek watershed[10], which encompasses an area of approximately 5 square miles in southeastern Santa Barbara County (see Figure 3-2). The watershed has a peak elevation of around 1,250 feet. Major tributaries to the main channel of Franklin Creek include the East Branch, West Branch, and High School Creek. The upper watershed is primarily National Forest Land (chaparral) and the creek descends through lower lands comprised of orchards (avocado) agricultural (nurseries, greenhouses), and by urban areas.

4.1 Hydrography

Franklin Creek empties into the 230-acre Carpinteria Salt Marsh, an important coastal wetland. Data from 1993 showed that although freshwater input into the marsh varied seasonally, Franklin Creek contributed 46-86% of freshwater input from the end of June to the end of November (Page, 1993). There is usually year-round low flow in the concrete lined sections of Franklin Creek due to shallow groundwater and return flows from adjacent urban and agricultural areas.

Due to severe flooding in the 1960s, portions of Franklin Creek were channelized and concrete lined during the late 1960s to mid-1970s. The modification was designed by the U.S. Soil Conservation Service and built by the Santa Barbara Soil Conservation District, Santa Barbara Co. Flood Control District, and the City of Carpinteria. The concrete lined channel under Highway 101 is designed to pass waters of a 100-year flood event. It has been estimated there are more than 200 culverts, storm drains, and outflows that discharge into Franklin Creek along the concrete lined section (Page, 1999).

Table 4-1. USGS stream gage in Franklin Creek.

USGS Gage ID	Location Description	Period of Record
11119530	Franklin Creek at Carpinteria	1971-1978

Source: http://waterdata.usgs.gov/nwis/

Table 4-2 and Figure 4-1 show monthly mean discharge in cubic feet per second (cfs) for the USGS gage located at Franklin Creek (USGS 11119530). Monthly flow was calculated by USGS based on mean monthly discharge values for data obtained from October 1, 1970 to September 30, 1978. Mean monthly flow wass typically below 0.3 cfs during summer months (June-August) and increased toward the end of the year and through the winter months (November-March).

[10] The terms watershed and drainage are used synonymously throughout this document.

Table 4-2. Monthly mean discharge (cfs) for Franklin Creek near Carpinteria (USGS gage 11119530, 1970-1978).

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1970										0.01	0.827	1.78
1971	0.256	0.557	0.229	0.187	0.232	0.158	0.1	0.1	0.212	0.154	0.099	5.45
1972	0.256	0.188	0.185	0.142	0.12	0.082	0.084	0.099	0.096	0.397	2.31	0.153
1973	3.41	7.58	2.6	0.295	0.298	0.321	0.414	0.329	0.383	0.365	0.595	0.271
1974	3.91	0.245	0.89	0.499	0.18	0.132	0.203	0.258	0.366	0.198	0.162	2.03
1975	0.244	0.886	1.57	0.279	0.298	0.303	0.295	0.156	0.167	0.137	0.183	0.193
1976	0.185	2.88	0.966	0.274	0.237	0.254	0.188	0.282	3.62	0.247	0.326	0.267
1977	1.29	0.231	0.504	0.264	1.12	0.208	0.176	0.214	0.11	0.09	0.103	1.63
1978	4.11	10.8	6.59	0.864	0.304	0.316	0.103	0.237	0.368			
Mean of Monthly Discharge	1.7	2.9	1.7	0.35	0.35	0.22	0.20	0.21	0.67	0.20	0.58	1.5

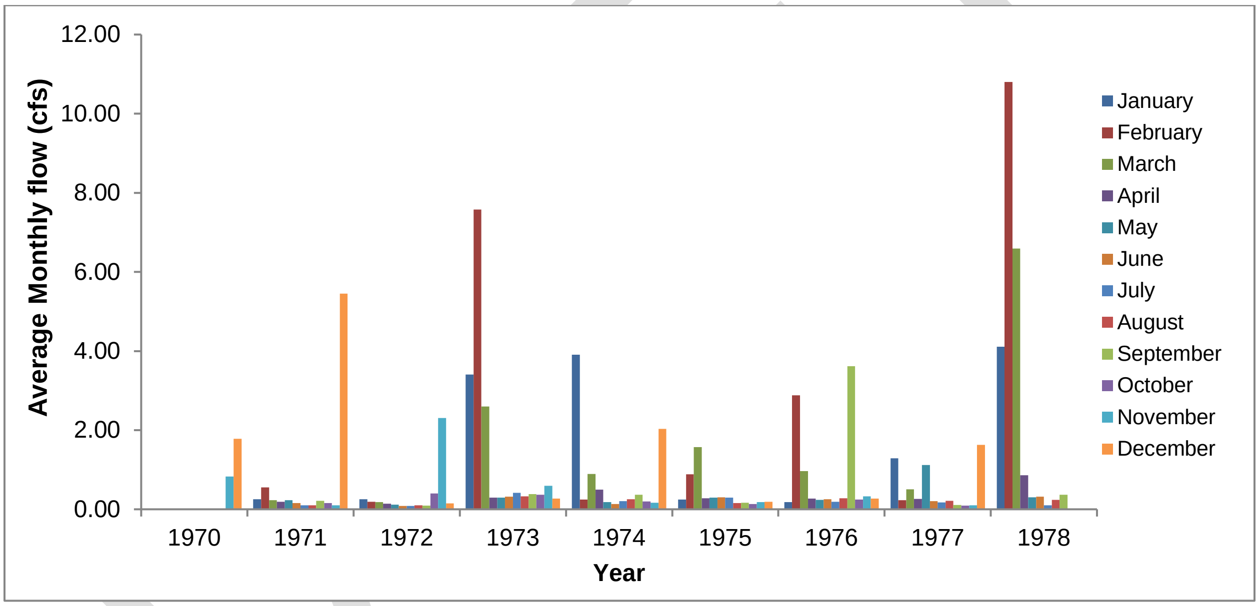

Figure 4-1. Monthly mean discharge (cfs) for Franklin Creek near Carpinteria (USGS gage 11119530, 1970-1978).

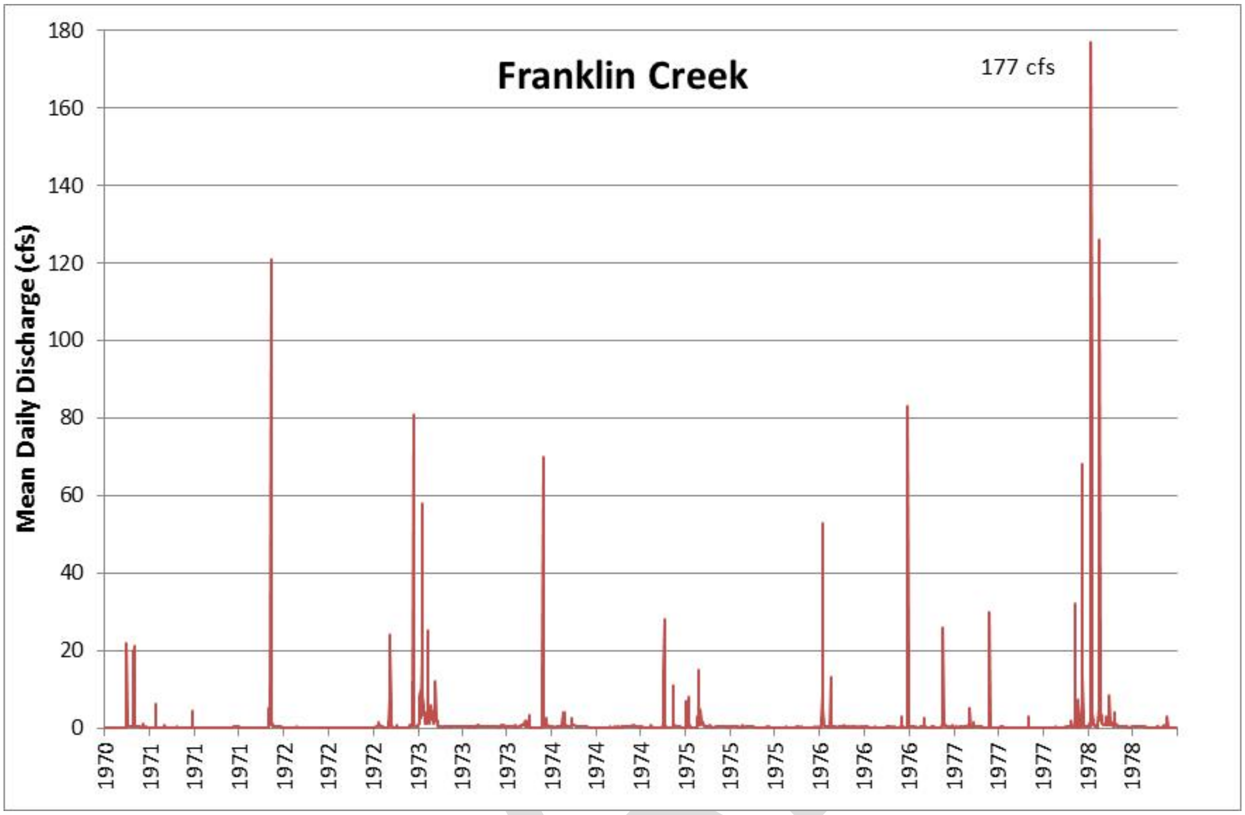

Figure 4-2. USGS gage 11119530 Franklin Creek near Carpinteria (Oct 1970-Sept 1978).

Figure 4-2 shows the mean daily flow for Franklin Creek during the monitoring period. The highest mean daily discharge during the period was 177 cubic feet per second (cfs) recorded on February 9, 1978.

Table 4-3 shows average daily streamflow characteristics for Franklin Creek at USGS gage station 11119530. Average streamflow is estimated to be 0.87 cfs. Baseflow over the 8 year period was estimated to be approximately 25%, as indicated by the base-flow index (BFI). Base flow is the component of streamflow that can be attributed to ground-water discharge into streams. The BFI is the ratio of base flow to total flow, expressed as a percentage.

Table 4-3. USGS average daily stream flow characteristics (cfs).

Station Number and Name	Period	Ave	Days	Min	P1	P5	P10	P20	P25	P50	P75	P80	P90	P95	P99	Max	Years BFI	BFI
11119530 Franklin Cr near Carpinteria	1970-1978	0.87	2,922	0.01	0.01	0.07	0.10	0.12	0.14	0.21	0.32	0.36	0.6	1.7	13	177	8	0.25

Note: " P" indicates percentile daily streamflow values from 1st through 99th percentiles.
BFI indicates average annual base-flow index value (fraction, ranging from 0 to 1).
Source: Wolock, 2003 – historical data through November 2001.

Figure 4-3 presents a flow duration curve for Franklin Creek. Flow duration curves are graphical representations of the flow regime of a stream at a given site. Flow duration curves serve as the foundation for developing load duration curves and they are a type of cumulative distribution function. The flow duration curve represents the fraction of flow observations that exceed a given flow at the site of interest. The observed flow values are first ranked from highest to lowest, then, for each observation, the percentage of observations exceeding that flow is calculated. The lowest measured flow occurs at an exceedance frequency of 100 percent, indicating that flow has equaled or exceeded this value 100 percent of the time, while the highest measured flow is found at an exceedance frequency of 0 percent. The median flow occurs at a flow exceedance frequency of 50 percent. Flow duration curves can be subjectively divided into several hydrologic flow regime classes such as flood periods and drought periods as shown in Figure 4-3.

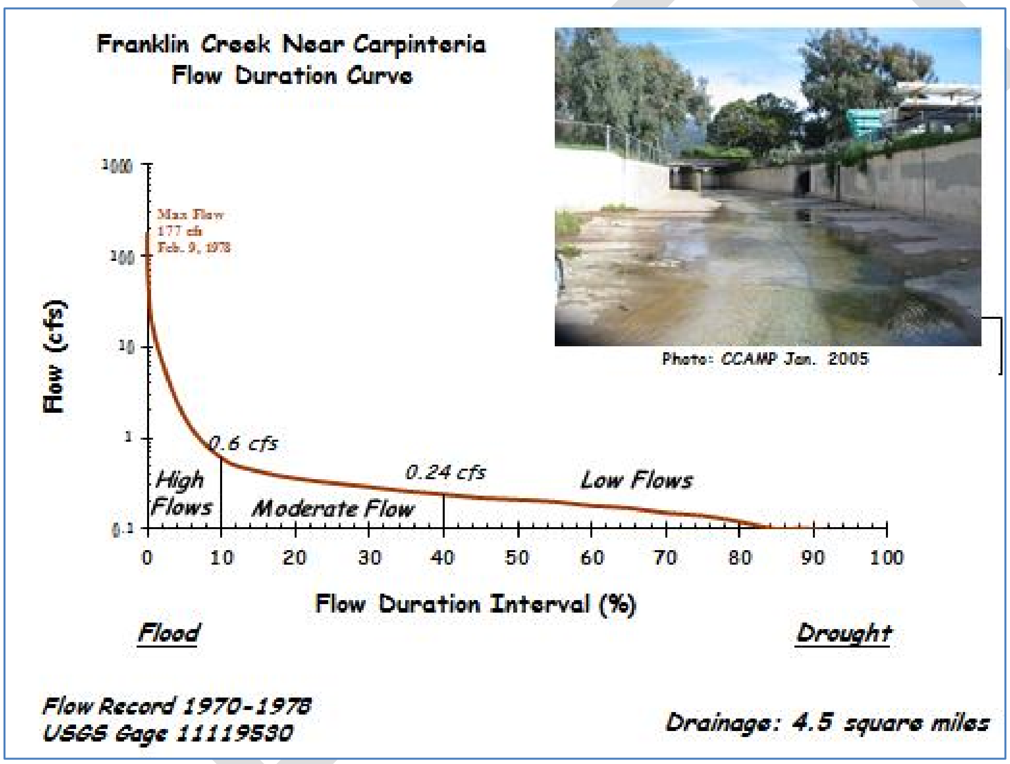

Figure 4-3.Flow Duration Curve.

As shown in Figure 4-3, flow within Franklin Creek is below 1 cubic feet per second (cfs) more than ninety percent of the time.

4.2 Land Use/Land Cover

Staff used Enhanced Historical Land-Use and Land-Cover Data Sets of the U.S. Geological Survey (2006)[11] to characterize land use and land cover.

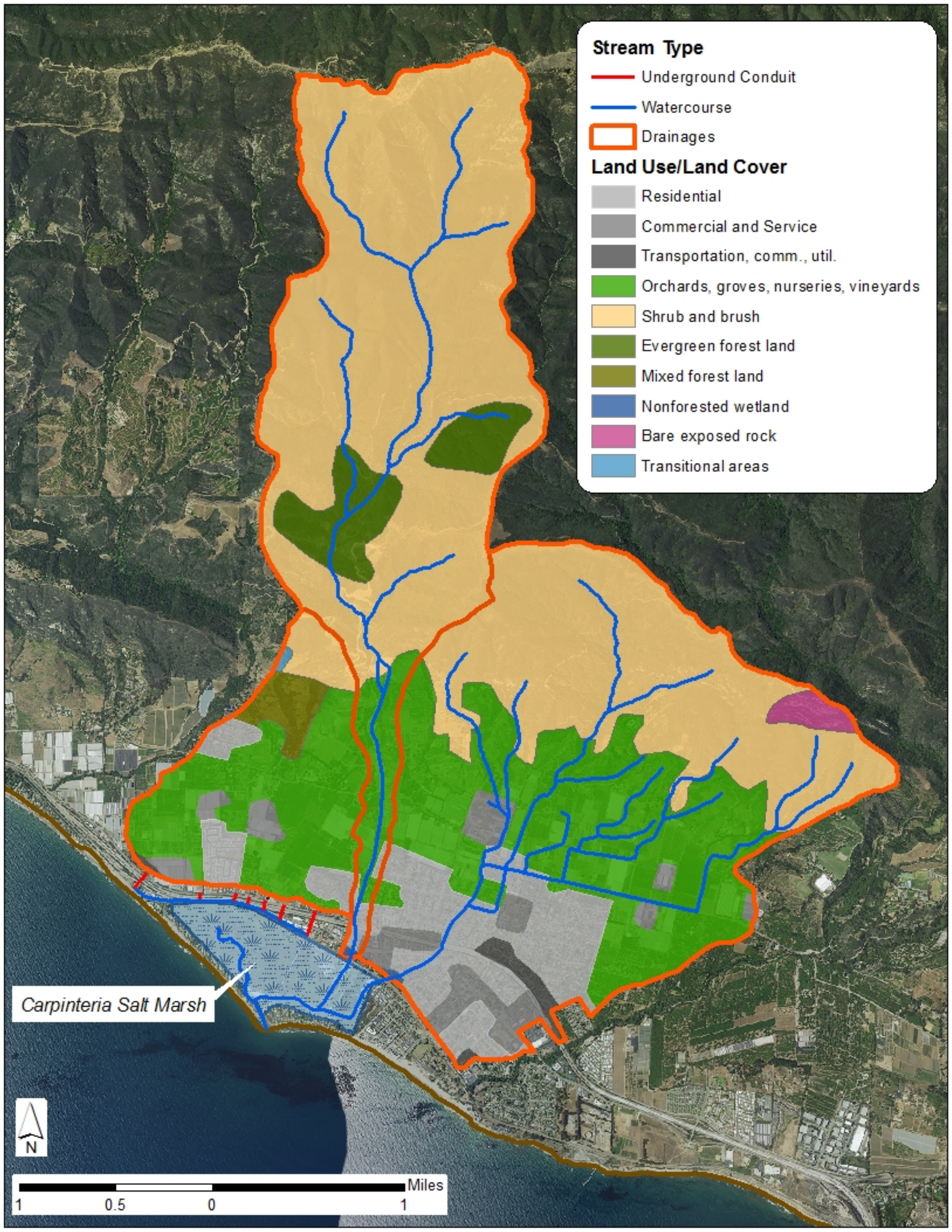

Figure 4-4. Land use and land cover.
Source: Enhanced Historical Land-Use and Land-Cover Data Sets of the U.S. Geological Survey (2006).

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[11] Price, C.V., Nakagaki, N., Hitt, K.J., and Clawges, R.C., 2006, Enhanced Historical Land-Use and Land-Cover Data Sets of the U.S. Geological Survey, U.S. Geological Survey Digital Data Series 240. [Digital Dataset] http://pubs.usgs.gov/ds/2006/240.

Most of the developed land use in the area is characterized by agricultural operations (orchards, vineyards, nurseries, etc.) and urban use (residential, commercial, industrial etc.), whereas most of the undeveloped land cover in the upper watershed is dominated by shrub-brushland, interspersed with small areas of forest (Figure 4-4, Figure 4-5, and Table 4-4).

Table 4-4. Land use area and percent composition (USGS 2006).

LU/LC Code	LU/LC Name	West Side Drainage (acres)	West Side Drainage (%)	Santa Monica Cr Drainage (acres)	Santa Monica Cr Drainage (%)	Franklin Cr Drainage (acres)	Franklin Cr Drainage (%)
11	Residential	95.3	12.8	21.2	0.9	426.9	15.0
12	Commercial and Services	43.6	5.8	1.3	0.1	175.7	6.2
14	Transportation, communications and services	3.9	0.5	—	—	37.4	1.3
22	Orchards, groves, vineyards, nurseries	465.6	62.4	137.6	5.7	1,063.9	37.3
32	Shrub-brushland	62.7	8.4	2,016.9	83.3	1,103.5	38.7
42	Evergreen forest land	—	—	240.3	9.9	—	—
43	Mixed forest land	70.6	9.5	—	—	—	—
62	Nonforested wetland	—	—	2.9	0.1	4.3	0.2
74	Bare exposed rock	—	—	—	—	41.1	1.4
76	Transitional areas	4.4	0.6	—	—	—	—
	Drainage Area Total	746	100	2,420	100	2,854	100

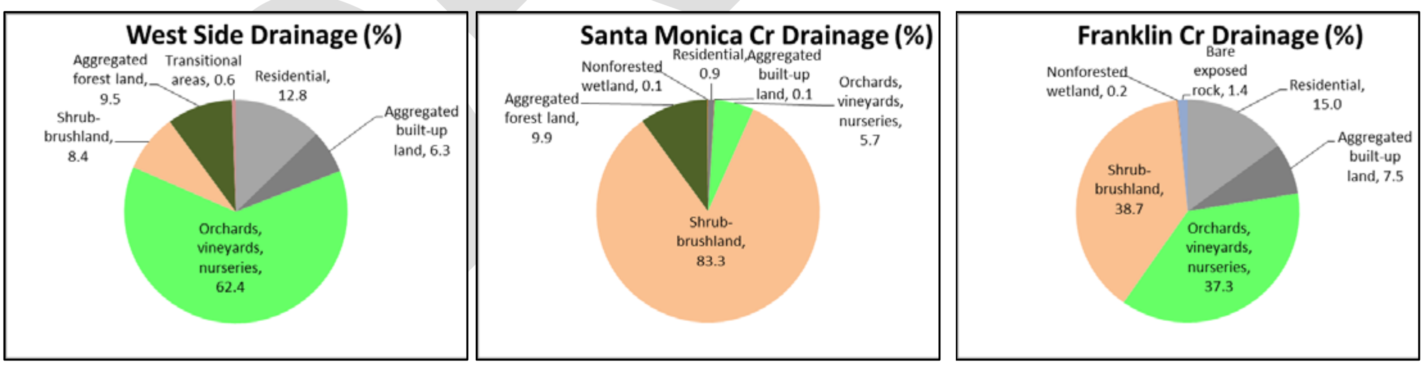


Figure 4-5. Land use land cover of drainages of Carpinteria Salt Marsh watershed.

4.3 Climate

The climate of the watershed is characterized as Mediterranean, with dry summers and mild, rainy winters. Average annual precipitation ranges from around 18 inches near the coastline to over 30 inches in the Santa Ynez Mountains as depicted in Figure 4-6.

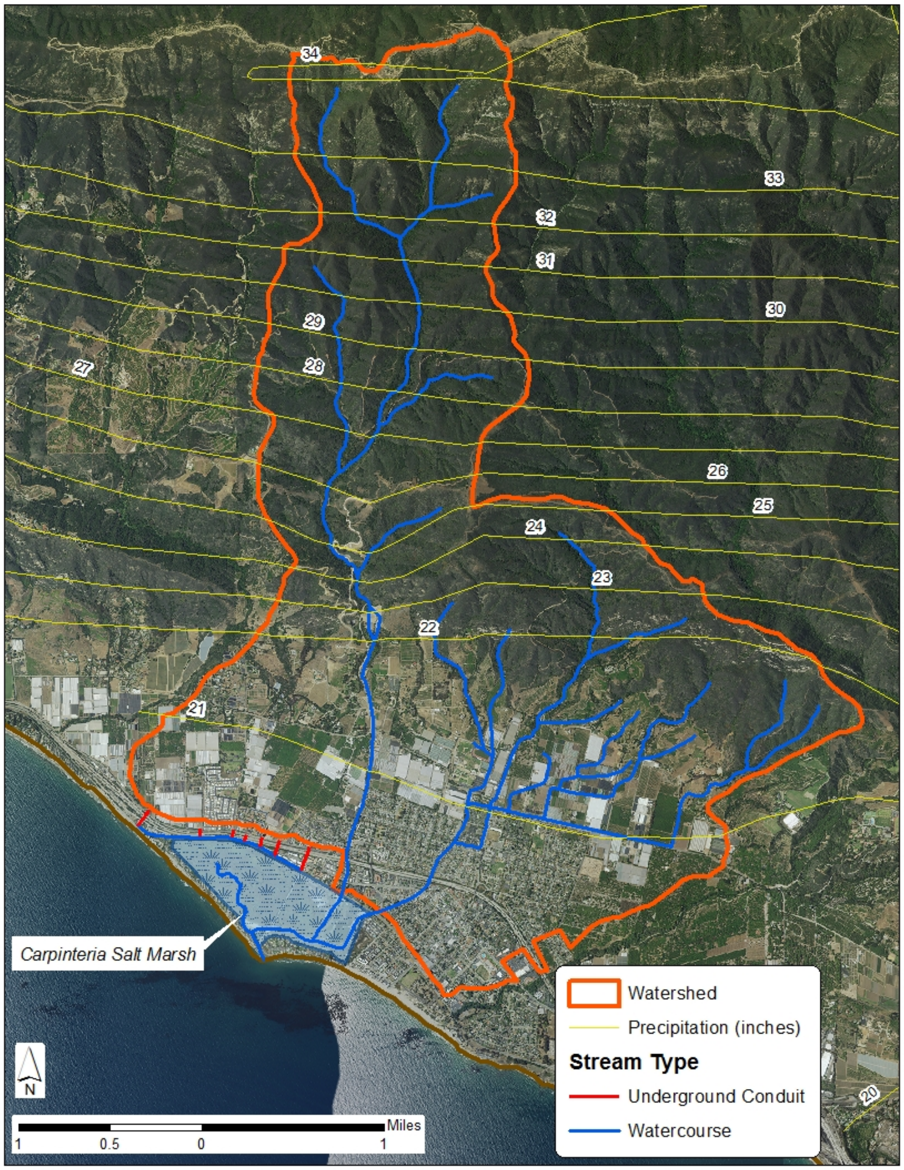


Figure 4-6. Precipitation isohyets (inches).
Source: United States Average Annual Precipitation (1981-2010). The PRISM Climate Group at Oregon State University (2006).

As shown in Table 4-5, monthly climate statistics for Santa Barbara (site 047902) indicate that most of the annual precipitation occurs between October and April[12]. The highest average monthly temperature occurs in July (76 °F) and the lowest average monthly temperature occurs in January (43 °F).

Table 4-5. Monthly climate summary (period of record January 1893 to June 2016). Station 047902, Santa Barbara, California:

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (F)	64.9	65.6	66.8	69.0	69.9	72.4	75.9	77.1	76.7	74.4	70.9	66.4	70.8
Average Min. Temperature (F)	43.0	44.6	46.2	48.6	51.3	54.3	57.3	57.9	56.4	52.5	46.9	43.4	50.2
Average Total Precipitation (in.)	3.98	3.86	2.97	1.21	0.36	0.08	0.02	0.03	0.20	0.69	1.50	2.82	17.73

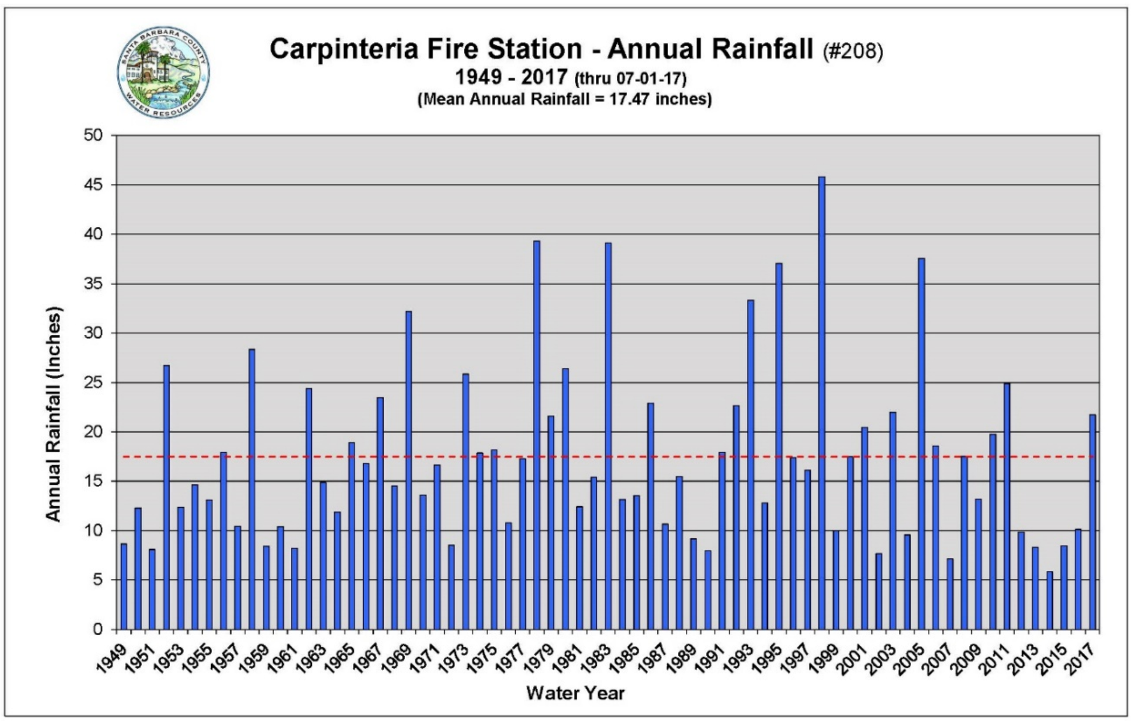


Figure 4-7. Annual rainfall (inches) at Carpinteria Fire Station (#208)
County of Santa Barbara Public Works (http://cosb.countyofsb.org/pwd/pwwater.aspx)

[12]National Oceanic and Atmospheric Administration, Western Regional Climate Center. http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca7902. Accessed June 28, 2016.

Annual rainfall amounts vary from a minimum of around 6 inches, observed in 2014 during the recent drought period, to a maximum of around 45 inches, observed in 1998 during an El Niño climate pattern. Mean annual rainfall is around 17.5 inches.

4.4 Soils

Soils have physical and hydrologic characteristics which may have a significant influence on the transport and fate of nutrients. As such, it is pertinent to assess soil characteristics in conjunction with other physical watershed parameters to estimate the risk and magnitude of nutrient loading to waterbodies (Mitsova-Boneva and Wang, 2008; McMahon and Roessler, 2002). The relationship between nutrient export (loads) and soil texture are illustrated in Figure 4-8 and Figure 4-9. Generally, fine-textured soils with lower capacity for infiltration of precipitation/water are more prone to runoff, and are consequently typically associated with a higher risk of nutrient loads to surface waters.

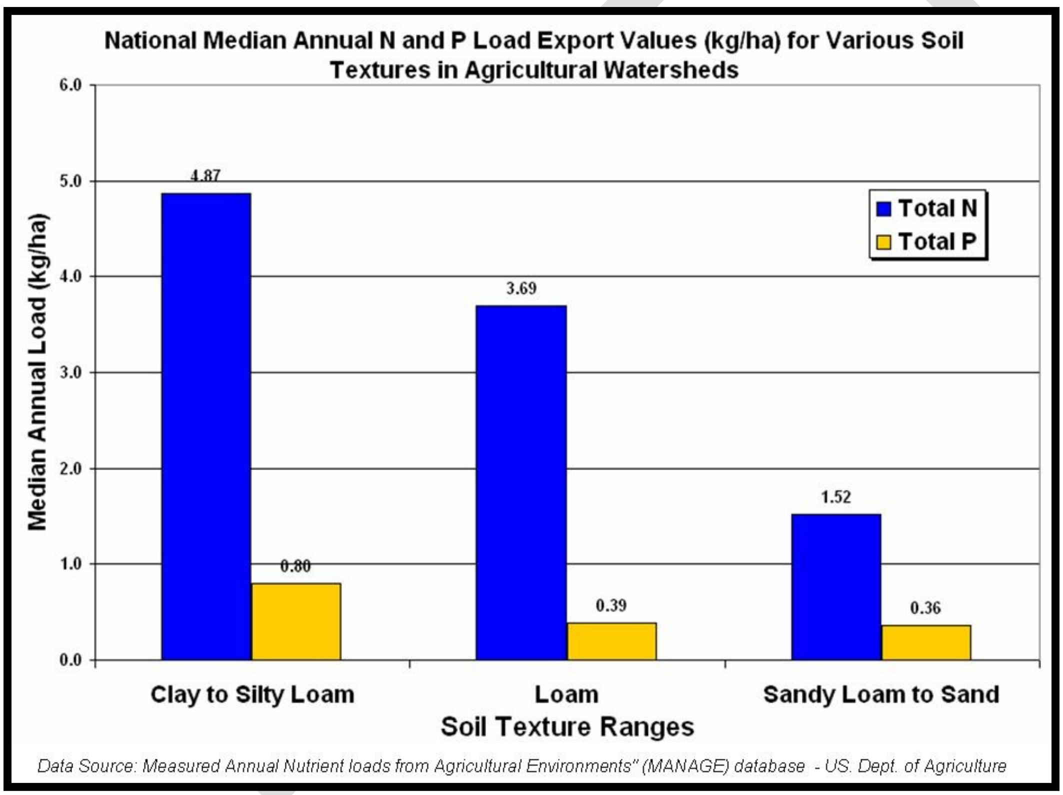
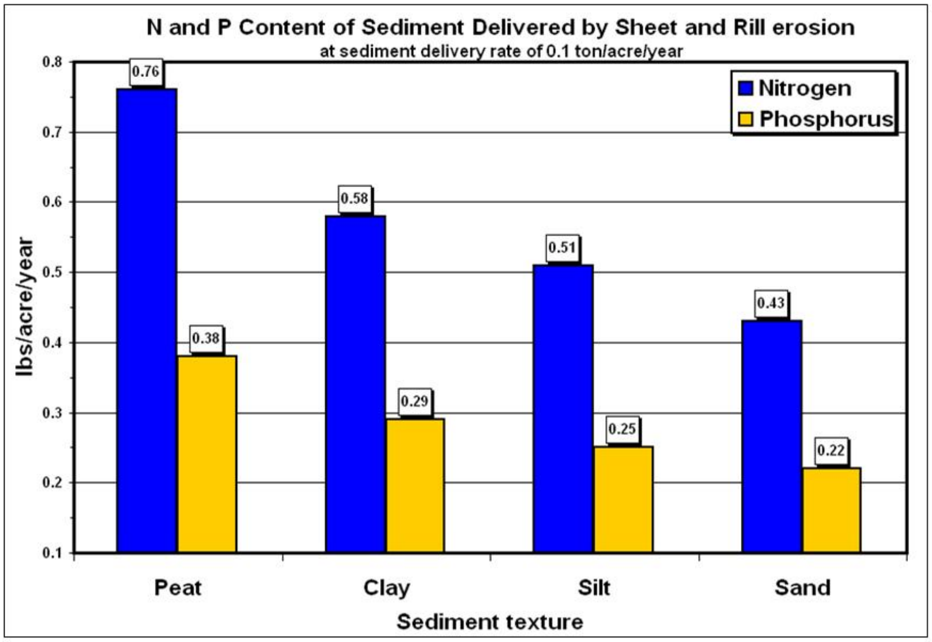


Figure 4-8. Median annual Total N and Total P export for various soil textures.



Data source: Derived from AGNPS equations in Young, R.A., C.A. Onstad, D.D. Bosch, and W.P. Anderson, 1987. AGNPS, Agricultural –Non-Point-Source Pollution Model; A Large Watershed Analysis Tool. U.S. Department of Agriculture – Agriculture Res. Serv., Conservation Resource Report 35 – and reported in *"Pollutants Controlled Calculation And Documentation For Section 319 Watersheds Training Manual, Michigan Department of Environmental Quality.*

Figure 4-9. N and P content of sediment delivered by sheet and rill erosion.

Thus, in the development of nutrient TMDLs it can be important to evaluate ambient concentrations of nutrients in soils. Soil nutrients can be a contributing source to nutrients in stream waters. Furthermore, the spreadsheet pollutant source estimation tool used in this TMDL project requires user-inputs for soil nutrient concentrations (refer to Section 8.1).

As shown in Table 4-6, staff summarized soil nitrogen data from Post and Mann (1990) where the percent soil total nitrogen for seven land cover types is represented. These data can be used to infer a plausible average soil nitrogen content that could be expected within Franklin Creek watershed. For the pollutant source estimation tool used in this TMDL project, staff chose the median soil nitrogen content for all land cover, which is 0.068 % nitrogen.

Table 4-6. Numerical summaries of United States observed soil total nitrogen (%).
Note: For select vegetative land cover systems on the basis of data used in Post and Mann, 1990[A].

Vegetation Land Cover	Mean	Standard Deviation	Min	25th %	50th % (median)	75th %	Max	Number of Samples
cultivated	0.203694	0.565534	0.004	0.042	0.07	0.12675	3.67	654
fields	0.080465	0.064178	0.019	0.033	0.051	0.112	0.255	43
native prairie	0.142215	0.134856	0.008	0.068	0.101	0.1695	1.088	191
orchards	0.054706	0.061158	0.013	0.024	0.032	0.066	0.266	17
pasture	0.103363	0.126064	0.005	0.038	0.068	0.125	1.422	383
range	0.111329	0.096355	0.011	0.05025	0.0905	0.13475	0.581	82
trees	0.106121	0.155925	0.007	0.032	0.051	0.115	1.67	497
Numerical summary for composite of entire dataset	0.142525	0.355064	0.004	0.039	0.068	0.126	3.67	1869

[A] Post, W.M. and L.K. Mann. 1990. *Changes in Soil Organic Carbon and Nitrogen as a Result of Cultivation*. In A.F. Bowman, editor, *Soils and the Greenhouse Effect*, John Wiley and Sons. The authors assembled and analyzed a data base of soil organic carbon and nitrogen information from a broad range of soil types from over 1100 profiles and representing major agricultural soils in the United States, using data compiled by the U.S. Dept. of Agriculture Soil Conservation Service National Soils Analytical Laboratory.

Data on ambient soil concentrations of phosphorus in California soils is available from the University of California–Kearney Foundation of Soil Science (Kearney Foundation, 1996). Figure 4-10 illustrates background concentrations of phosphorus in California soils on the basis of Kearney benchmark soils selected from throughout the state. The median soil phosphorus content in benchmark soils from within the California Oak and Chaparral Subecoregion is 378 mg/kg (0.038 weight percent). For the pollutant source estimation tool used in this TMDL project (see Section 8.1), staff chose the median soil phosphorus content of 0.038 %.

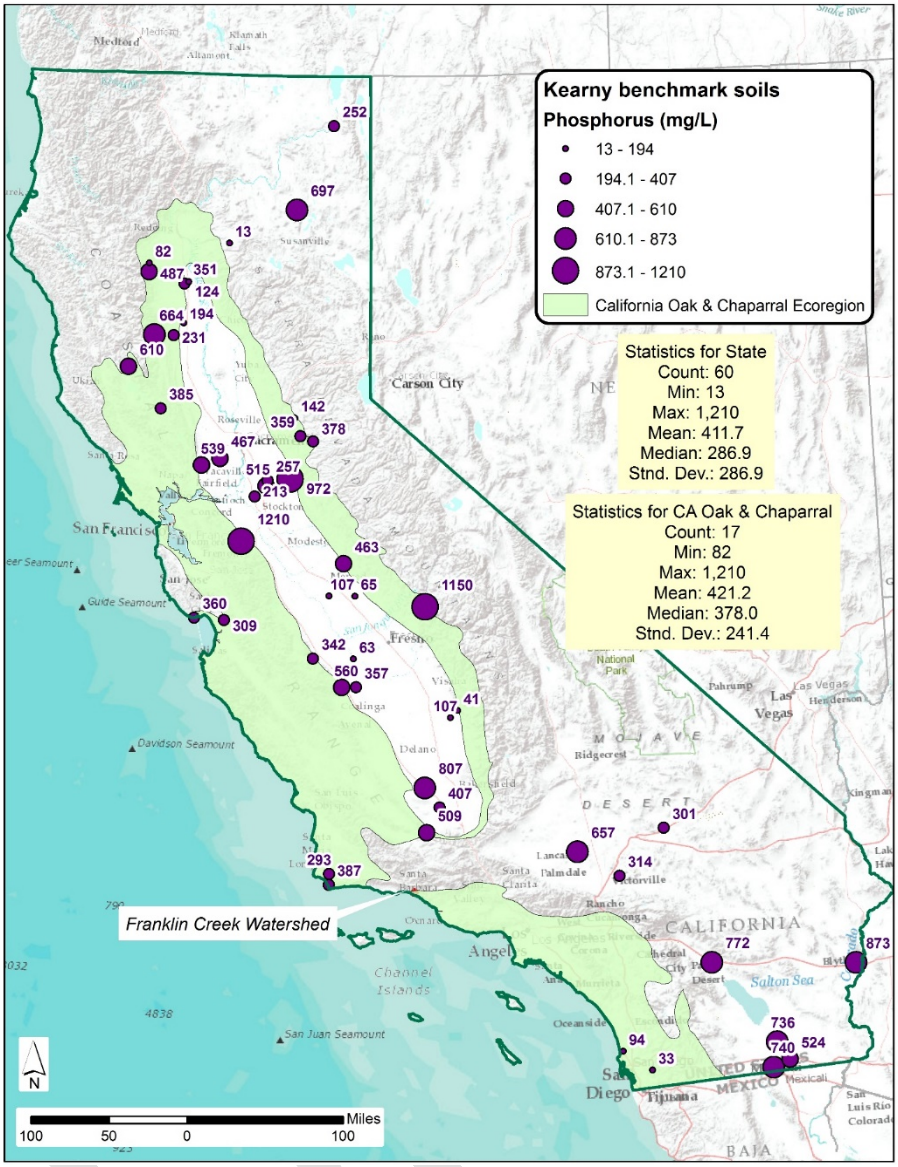


Figure 4-10. Background concentrations of phosphorus in California soils.

Santa Barbara County soil surveys were compiled by the U.S. Department of Agriculture National Resources Conservation Service (NRCS) and is available online under the title of Soil Survey Geographic Database (SSURGO; Soil Survey Staff, 2017). SSURGO has been updated with extensive soil attribute data, including surface texture and hydrologic soil groups.

Soil surface texture is shown in Figure 4-11. Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter. "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is 15 percent or more, an appropriate modifier is added, for example, "gravelly."

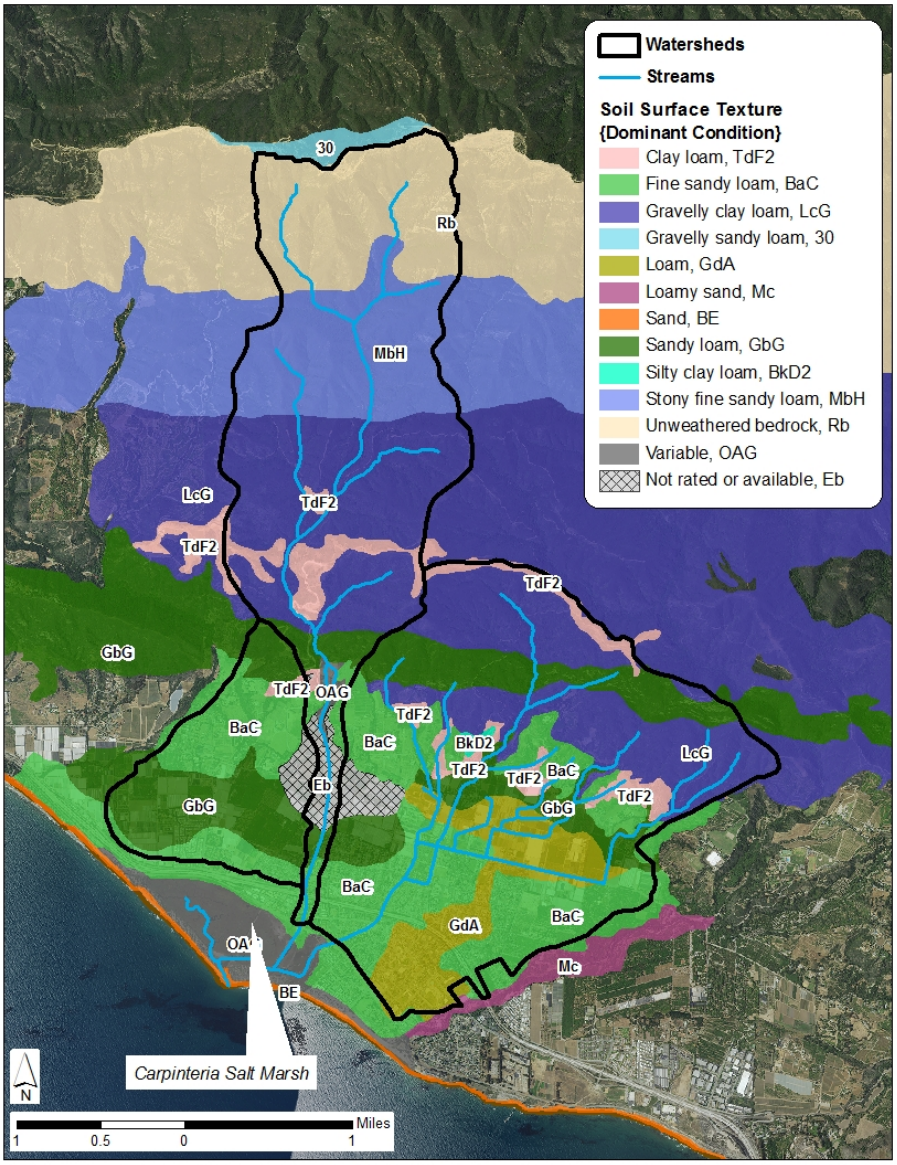
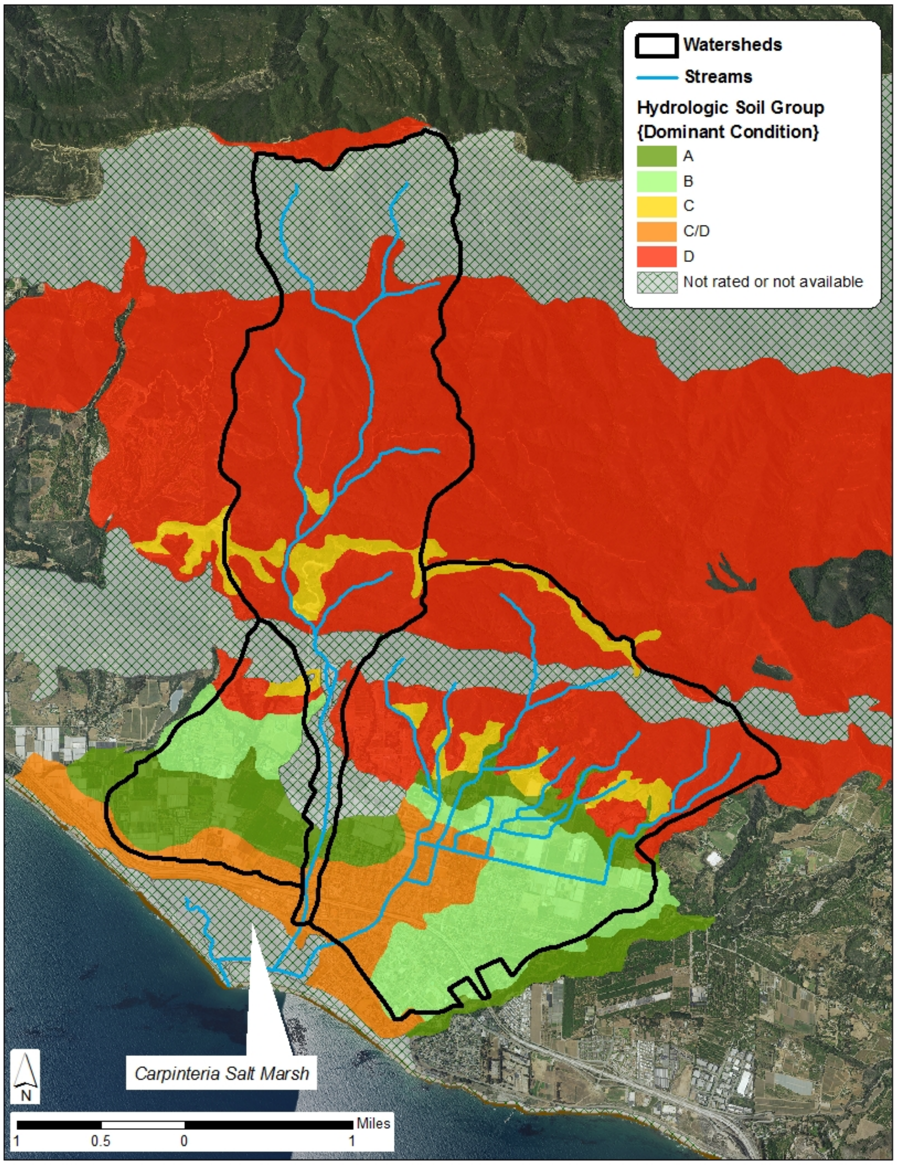


Figure 4-11. Soil surface texture.

Soil surface texture within the Franklin Creek watershed is primarily fine sandy loam (BaC) and loam (GdA).

Hydrologic soil groups (HSG) are a soil attribute associated with a mapped soil unit, which indicates the soil's infiltration rate and potential for runoff. Figure 4-12 illustrates the distribution of hydrologic soil groups in the Project Area along with a tabular description of the soil group's hydrologic properties.



Hydrologic Soil Group Descriptions:	
A	Well-drained sand and gravel; high permeability
B	Moderate to well-drained; fine to moderately course texture; moderate permeability
C	Poor to moderately well-drained; moderately fine to fine texture; slow permeability
D	Poorly drained; clay soils, or shallow soils over nearly impervious layers(s)

Figure 4-12. Hydrologic soil groups in the Carpinteria Salt Marsh watershed.

As shown in Figure 4-12, upper portions of the watershed consist primarily of moderately and poorly drained soils (HSG groups C and D). Lower portions of the watershed contain moderate to well-drained soils (HSG groups A and B), with the main portion of Franklin Creek within poor to moderately well-drained soils (HSG groups B and C).

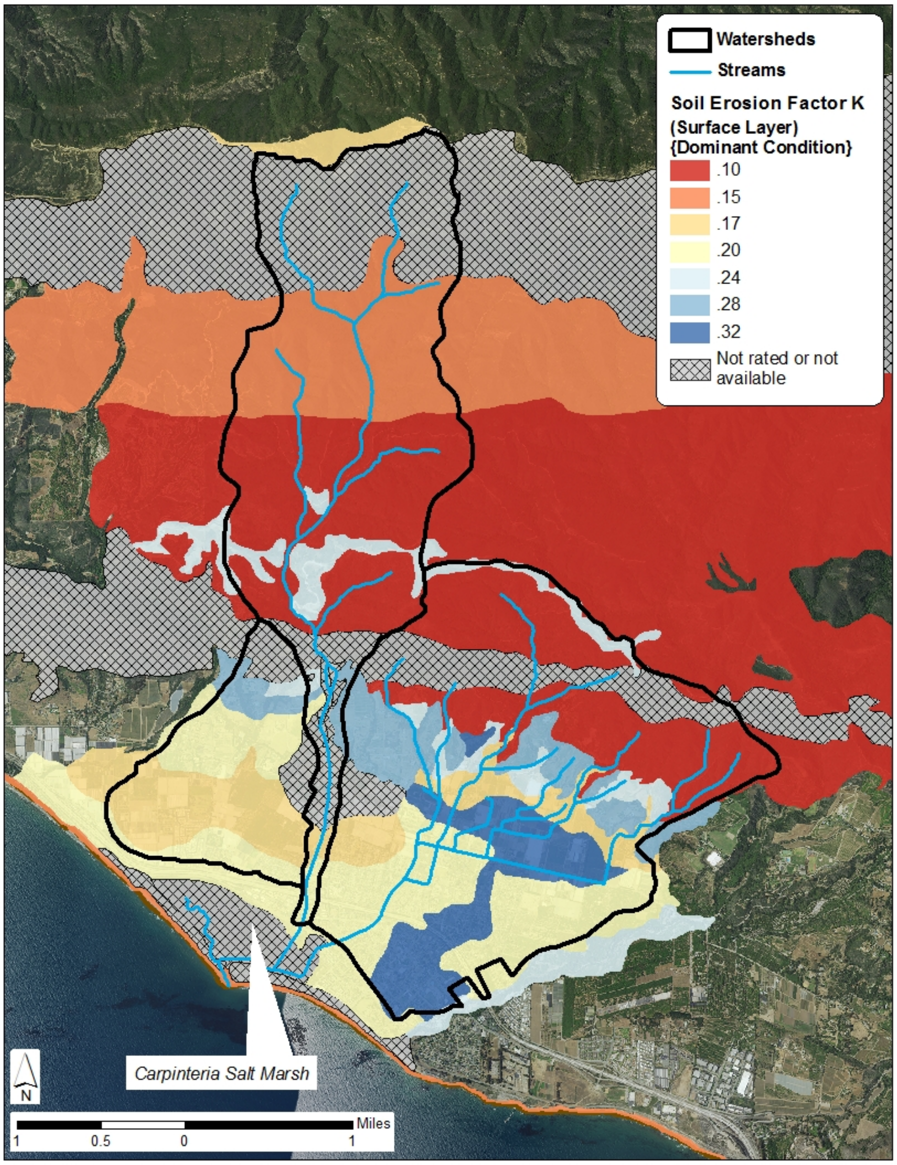


Figure 4-13. Soil erosion factor (K).

Erosion factor K, sometimes referred to as soil erodibility factor, indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water. Based on the information contained in Figure 4-13, staff will use a soil erosion factor K value of 0.24 for the STEPL nutrient loading model.

4.5 Hydrogeology and Groundwater

Information contained in this section is derived from a report titled, "Carpinteria Groundwater Basin, Hydrogeologic Update and Groundwater Model Project," prepared by Pueblo Water Resources, Inc. (2012).

The Carpinteria groundwater basin represents the north limb of a structural syncline that has been filled with water-bearing sediments. Water-bearing deposits include all unconsolidated and semiconsolidated sediments of Plio-Pleistocene and Holocene age, with older consolidated non-water bearing rocks forming the boundaries of the basin.

The Rincon Creek Thrust Fault has created a barrier to subsurface groundwater movement within the basin, and the surface trace of the fault has been used to segregate the basin into two Storage Units: Storage Unit No. 1 (SU-1) is on the north side of the fault trace, and Storage Unit No. 2 (SU-2) is to the south. The southeastern portion of SU-1 is hydrogeologically separated from the ocean by the Rincon Creek Thrust Fault; however, west of El Estero basin deposits are in contact with the ocean. All principal municipal supply wells are contained in SU-1. Figure 4-14 shows the two groundwater storage units.

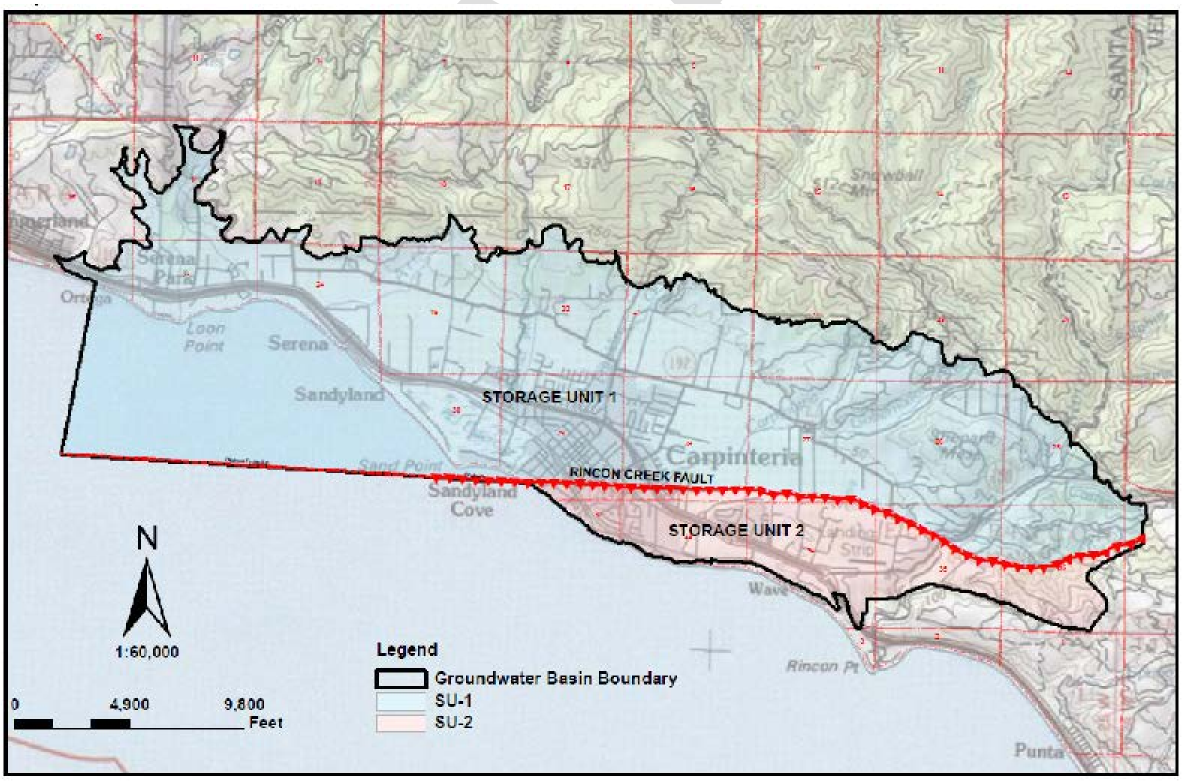


Figure 4-14. Groundwater storage units.
Source: Pueblo Water Resources, Inc. (2012).

Major aquifers occur primarily within unconsolidated marine sediments of the Pleistocene and upper Pliocene-aged Carpinteria and Casitas Formations. These major aquifers have been designated as so-called Aquifers A, B, C, and D. Aquifer A represents the shallowest major aquifer with Aquifer D being the deepest. Pliocene and older Tertiary sedimentary bedrock units are considered non water-bearing and constitute the boundaries of the groundwater basin. The top of bedrock in the deepest portion of the basin is as much as 4,000 feet below sea level in SU-1 and rises to approximately 500 feet above sea level along the northern boundary of the basin.

Primary water bearing deposits in the basin consist of interbedded unconsolidated and semi-consolidated sand, gravel, silt and clay (and combinations thereof) deposits. The coarser grained sandy/gravelly strata in these deposits comprise the individual primary aquifer zones (i.e., Aquifers A - D). These primary aquifer zones are generally on the order of 50 to 100 feet thick each. Finer grained strata of silt and clay are generally thicker and form a series of aquitards between the primary aquifer zones. These aquitards are laterally extensive in the central alluvial plain portion of the basin and confine water held in the primary aquifers under artesian pressure. This area of the basin is referred to as the confined area.

Outside the confined area of the basin and extending to the bedrock boundaries, Aquifers A - D become laterally discontinuous and generally non-correlatable. The older alluvium and Casitas Formation in these areas contain laterally discontinuous layers of both permeable and impermeable materials, and water held in these areas is generally unconfined (although various degrees of local confinement occur). The source of recharge water to the basin is primarily by infiltration of precipitation, irrigation water and streamflow seepage; however, in the confined area, downward percolation of water is limited due to the presence of fine-grained low-permeability materials overlying most of the area of the principal aquifers; therefore, recharge to the primary aquifers occurs in the areas between the confined area and the boundaries of consolidated bedrock. This area is referred to as the recharge area.

Confined and recharge areas are shown in Figure 4-15.

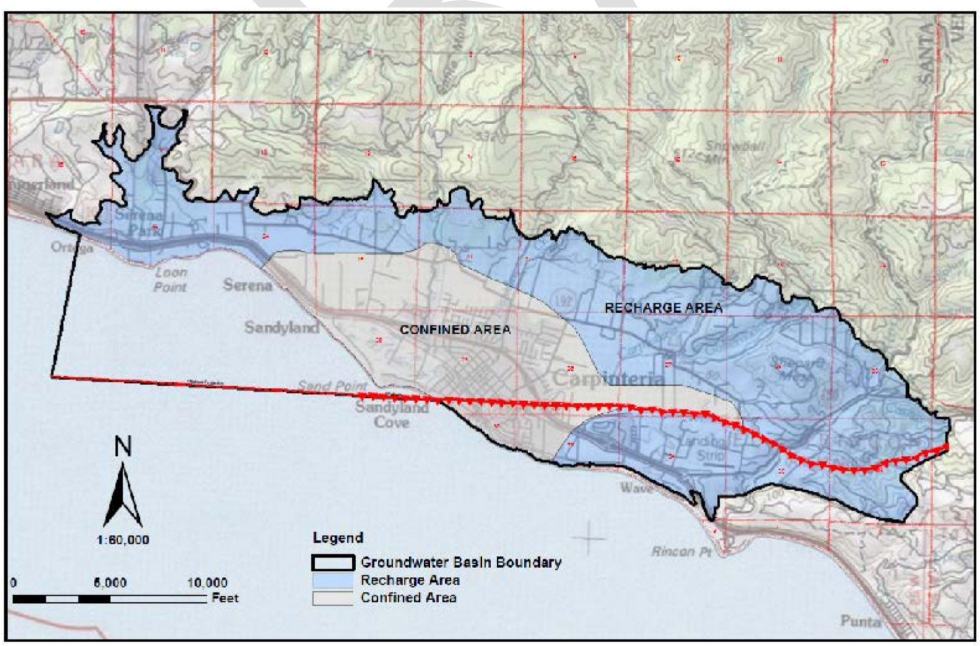


Figure 4-15. Confined and recharge areas.
Source: Pueblo Water Resources, Inc. (2012).

Figure 4-16 depicts a well and cross-section map. Figure 4-17 and Figure 4-18 depict two examples of hydrogeologic cross-sections within the Carpinteria groundwater basin.

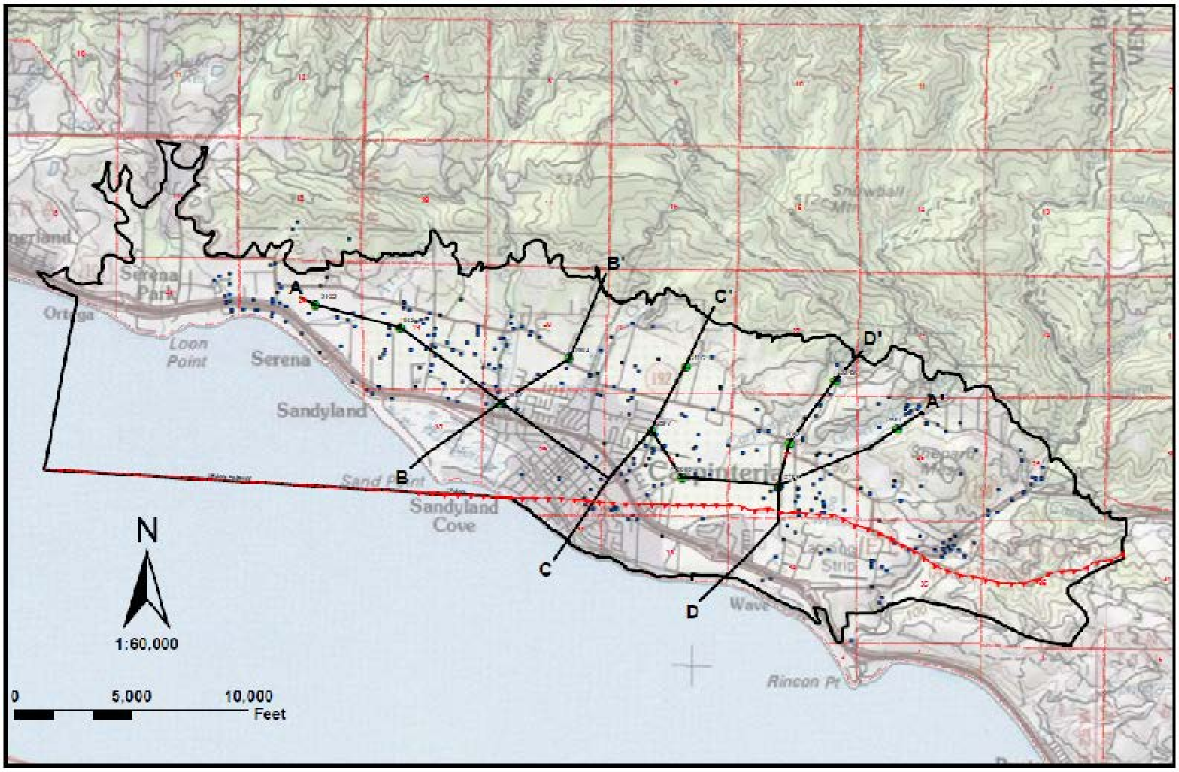


Figure 4-16. Well and cross-section location map.
Source: Pueblo Water Resources, Inc. (2012).

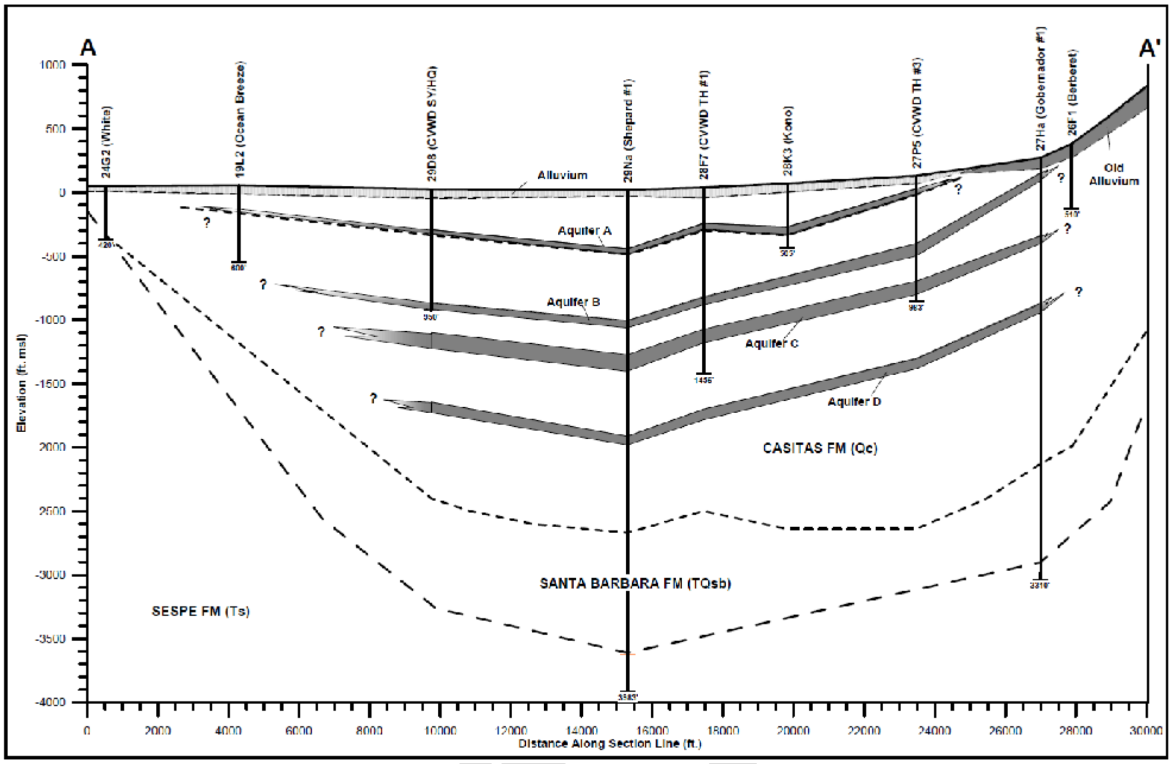


Figure 4-17. Hydrogeologic cross section A-A'
Source: Pueblo Water Resources, Inc. (2012).

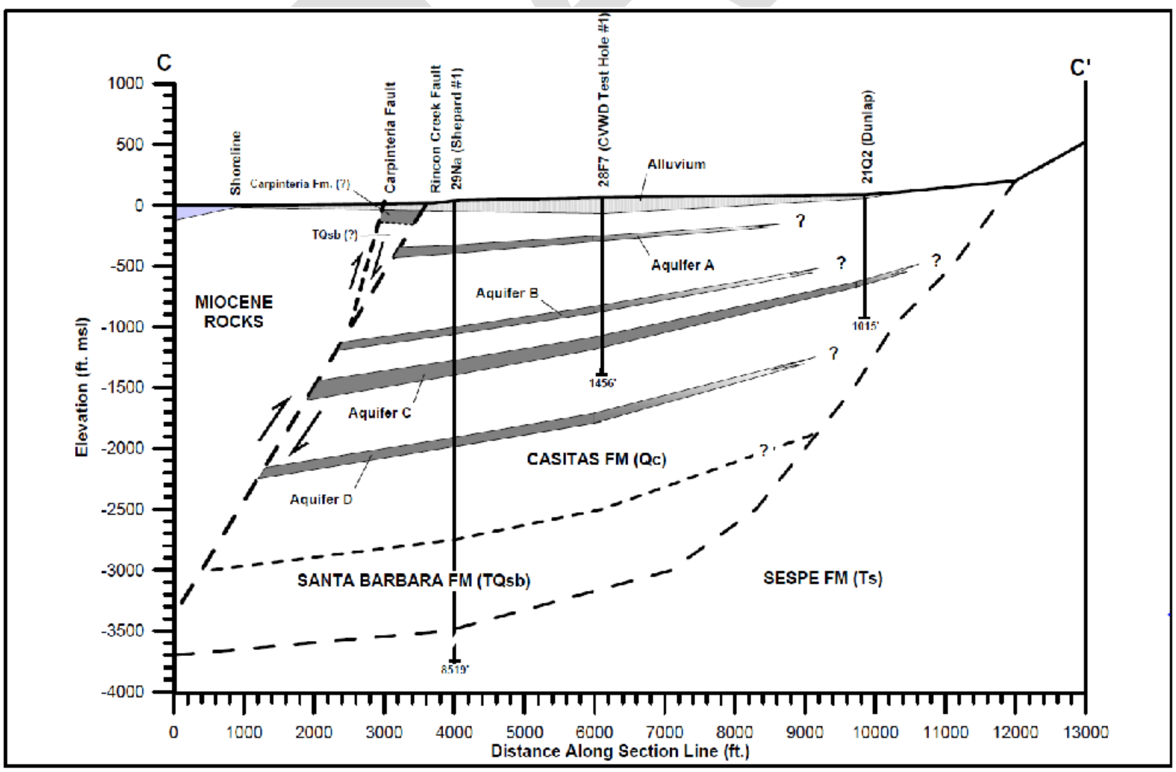


Figure 4-18. Hydrogeologic cross section C-C'
Source: Pueblo Water Resources, Inc. (2012).

Several studies have reported the presence of shallow groundwater within portions of the Carpinteria coastal plain (Page, 1993; Page, et. al., 1994; Page 1999; Robinson, 2006). This is due to an aquiclude that is located near the ground surface. Depths of the perched groundwater table were found to be extremely variable both spatially and seasonally, ranging from 1.5 feet to 5.5 feet, with surface water nitrate concentrations near groundwater seeps in the upper reaches of Franklin Creek ranging from 28 to 99 mg/L (Page, 1994). It was also reported that Franklin Creek is supplied primarily by ground water surfacing in the north and east branches of the channelized streambed just north of the juncture of Foothill Road and Linden Avenue (Page, 1993).

4.6 Nutrient Ecoregions and Reference Conditions

Reference conditions refer to water quality conditions associated with relatively undisturbed stream basins, thus representing conditions that could be expected in the absence of excessive human impacts. Reference conditions are not necessarily pristine and undisturbed natural conditions. Reference conditions can be evaluated in nutrient TMDL development as a way of assessing water quality expected to be associated with water resources that have not been significantly degraded by human inputs.

Since reference conditions are not uniform across the nation nor across any given state due to natural variability, the USEPA has designated nutrient ecoregions that denote areas with ecosystems that are generally similar (e.g., physiography, climate, geology, soils, land use, hydrology). The Franklin Creek watershed is located in Ecoregion III subecoregion 6 – Southern and Central California Chaparral and Oak Woodlands[13] (see Figure 4-19). The primary distinguishing characteristic of this ecoregion is its Mediterranean climate of hot dry summers and cool moist winters, and associated vegetative cover comprising mainly chaparral and oak woodlands; grasslands occur in some lower elevations and patches of pine are found at higher elevations. Most of the California Chaparral and Oak Woodlands ecoregion consists of open low mountains or foothills, but there are areas of irregular plains in the south and near the border of the adjacent Central California Valley ecoregion.

[13] Also referred to throughout this report more concisely as “Nutrient subecoregion 6”.

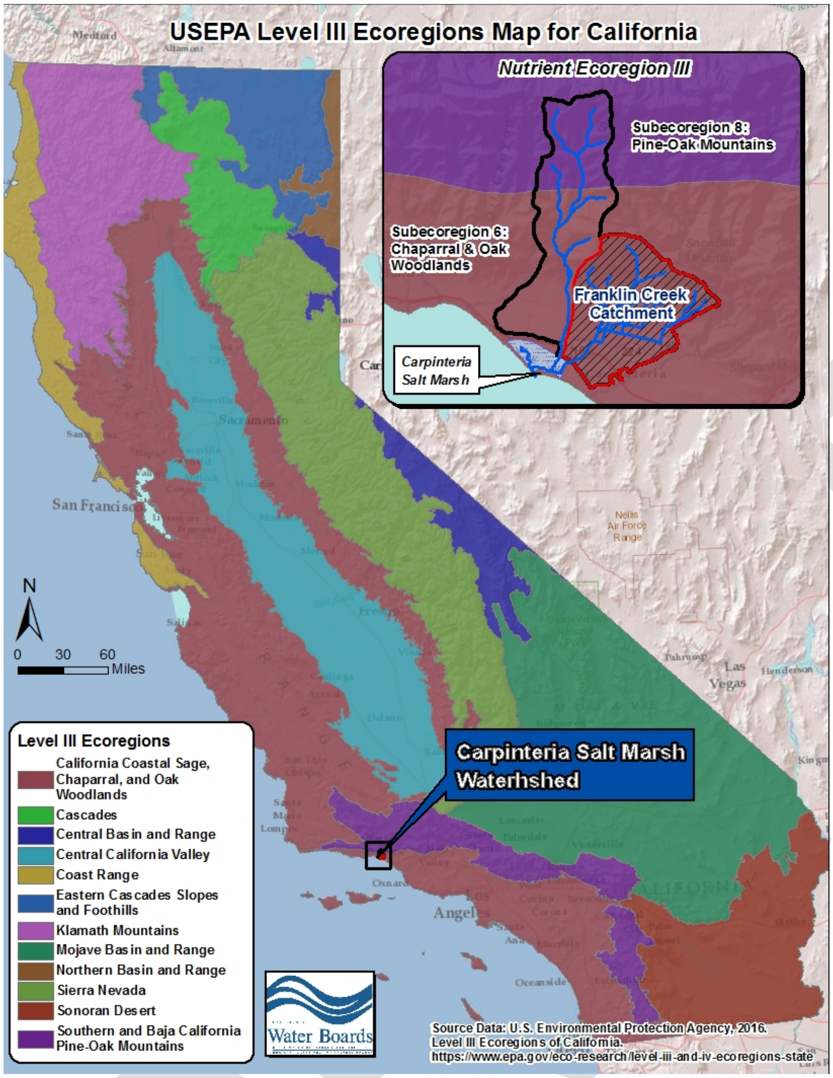


Figure 4-19. California Level III nutrient ecoregions.

USEPA’s Technical Guidance Manual for Developing Nutrient Criteria for Rivers and Streams (USEPA, 2000a) describes two ways of evaluating reference conditions: 1) use the 25th percentile of all water quality data for the study area; and 2) use the 75th percentile of water quality data from unimpacted reference sites. USEPA proposed that the 25th percentiles of all nutrient water quality data could be assumed to represent unimpacted reference conditions for each aggregate ecoregion, and also provide a comparison of reference conditions for the aggregate ecoregion versus the subecoregions.

USEPA characterized 25th percentile values of a population of water quality data as criteria recommendations that could be used to protect waters against nutrient over-enrichment (USEPA, 2000a). However, USEPA also cautioned that States and Tribes may “need to identify with greater precision the nutrient levels that protect aquatic life and recreational uses.” USEPA also proposed that the 75th percentiles of all nutrient data of reference stream(s) could be assumed to represent unimpacted reference conditions for each aggregate ecoregion, and also provided a comparison of reference condition for the aggregate ecoregion versus the subecoregions. USEPA (U.S. Environmental Protection Agency) defines a reference stream as follows:

> *"A reference stream is a least impacted waterbody within an ecoregion that can be monitored to establish a baseline to which other waters can be compared. Reference streams are not necessarily pristine or undisturbed by humans."*

For reference, USEPA's 25th percentiles (representing unimpacted reference conditions) for the California Oak and Chaparral subecoregion (i.e., nutrient subecoregion 6) are presented in Table 4-7.

Table 4-7. USEPA Reference conditions for Level III subecoregion 6 streams.

Parameter	**25th Percentiles based on all seasons data for the decade**
Total Nitrogen (TN) – mg/L	0.52
Total Phosphorus (TP) – mg/L	0.03
Chlorophyll *a* – μg/L	2.4
Turbidity - NTU	1.9

USEPA has also recommended an approach that evaluates the upper 75th percentile of a reference population of streams, such as streams within headwater and lightly disturbed reaches (USEPA, 2000a). According to USEPA, the 75th percentile likely represents minimally impacted conditions that are protective of designated beneficial uses.

Figure 4-20 and Figure 4-21 illustrate the statistics and 75th percentile values for nitrate (as nitrogen) and orthophosphate (as phosphorus) concentrations in headwater reaches and lightly disturbed tributaries of the Santa Maria River watershed. Staff choose the Santa Maria River watershed because water quality data from a reference population of headwater and lightly disturbed reaches within the south coast of Santa Barbara county is not available because monitoring stations are located primarily in moderately to highly disturbed portions of the coastal plain. Nitrate typically comprises over 95% of total water column total nitrogen concentrations while orthophosphate is estimated to generally (but not always) be the largest fraction of water column total phosphorus..

As shown in Figure 4-20 and Figure 4-21, the 75th percentiles for this population of stream data are 0.10 mg/L nitrate as nitrogen, and 0.06 mg/L orthophosphate as phosphorus. For comparative purposes, note that USEPA's reference condition for total phosphorus in subecoregion III-6 (Calif. Chaparral and Oak Woodlands) is 0.03 mg/L[14] (see Table 5). Note that the 90th percentile of nitrate as nitrogen in Santa Maria River watershed reference streams is 0.27 mg/L, which suggests that concentrations of nitrate as nitrogen in reference streams do not typically exceed 1 mg/L.

[14] USEPA. 2000. Ambient Water Quality Criteria Recommendations. Information Supporting the Development of State and Tribal Nutrient Criteria for River and Streams in Nutrient Ecoregion III – Xeric West. EPA-822-B-00-016.

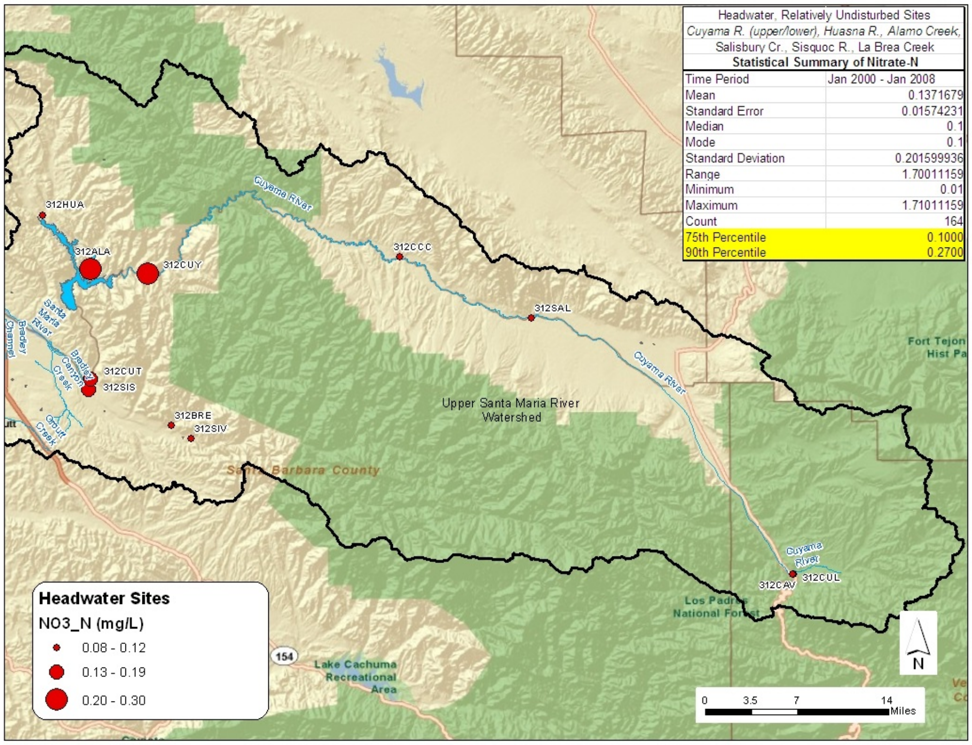


Figure 4-20. Nitrate as nitrogen (mg/L) statistics for headwater and undisturbed streams.

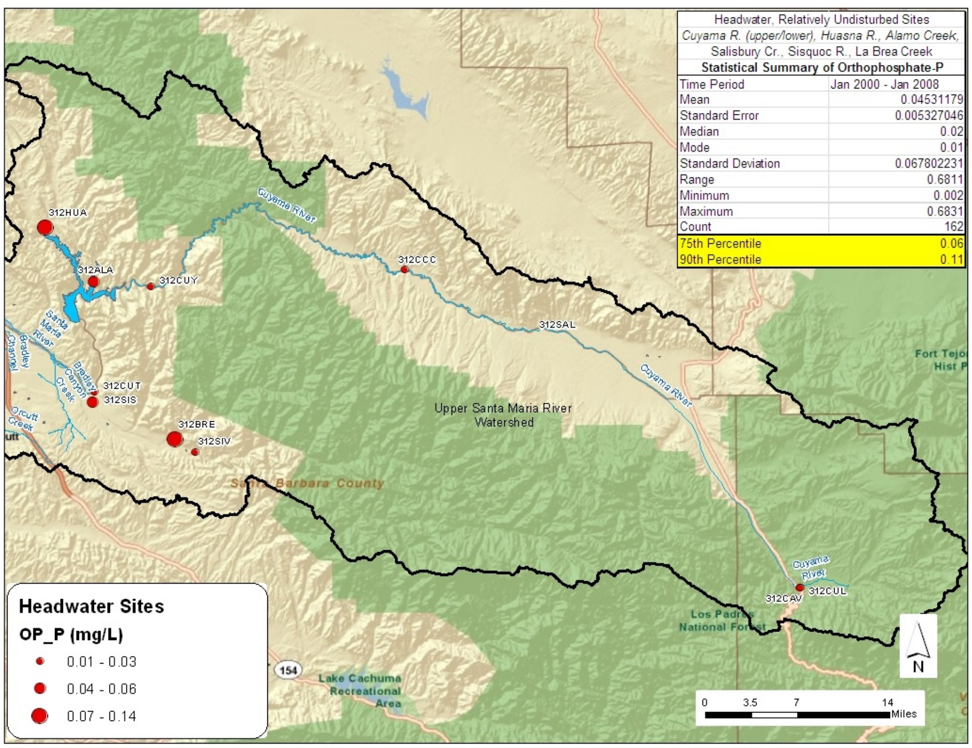


Figure 4-21. Orthophosphate as phosphorus (mg/L) statistics for headwater and undisturbed streams.

It should be re-emphasized that the above ecoregional criteria are not regulatory standards, and USEPA in fact considers them “starting points” developed on the basis of data available at the time. USEPA has recognized that states need to evaluate these values critically, and assess the need to develop nutrient targets appropriate to different geographic scales and at higher spatial resolution.

4.7 Special Status Species

The Regional Water Quality Control Boards are required to perform a programmatic-level environmental analysis for purposes of complying with the California Environmental Quality Act (California Public Resources Code §21159). Part of this environmental analysis includes assessing whether or not a programmatic action by the Regional Water Quality Control Boards would have a substantial adverse impact on biological resources, including sensitive or special status species in the area affected by the programmatic action.

“Special status species” is a broad term used to refer to all the animal taxa tracked by the California Department of Fish and Wildlife’s California Natural Diversity Database. The list is sometimes referred to as the list of “species at risk” or the “special animals” list. To be included on the special status species list, the animal or plant taxa must meet certain conditions indicating the species is rare, threatened, endangered, declining in population, sensitive, or otherwise meeting some level of conservation concern.

Table 4-8 tabulates the special status species known to occur within the Carpinteria Salt Marsh and Franklin Creek watersheds, based on information available from the California Department of Fish and Wildlife. It should be noted that the California Natural Diversity Database is a “positive detection” database, meaning that records of sensitive species only exist in the database where these species were observed. Geographic areas in the database that have no records simply mean there is limited information there, or that no organized surveys have taken place there. One cannot conclude that there is less biological diversity in these places, simply due to lack of information.

Table 4-8. Special status species within the Carpinteria Salt Marsh and Franklin Creek watersheds.

SCIENTIFIC NAME	COMMON NAME	FEDERAL LEGAL STATUS	CALIF. LEGAL STATUS	STATE RANKING THREAT DESIGNATION
Quercus dumosa	Nuttall's scrub oak	None	None	S3
Atriplex coulteri	Coulter's saltbush	None	None	S1S2
Corynorhinus townsendii	Townsend's big-eared bat	None	None	S2
Lasthenia glabrata ssp. coulteri	Coulter's goldfields	None	None	S2
Rallus longirostris levipes	light-footed clapper rail	Endangered	Endangered	S1
Panoquina errans	wandering (=saltmarsh) skipper	None	None	S2
Southern Coastal Salt Marsh	Southern Coastal Salt Marsh	None	None	S2.1
Eucyclogobius newberryi	tidewater goby	Endangered	None	S3
Passerculus sandwichensis beldingi	Belding's savannah sparrow	None	Endangered	S3
Charadrius alexandrinus nivosus	western snowy plover	Threatened	None	S2S3
Danaus plexippus pop. 1	Monarch – California overwintering population	None	None	S2S3
Chloropyron maritimum ssp. Maritimum	Salt marsh bird's-beak	Endangered	Endangered	S1
Calochortus fimbriatus	Late-flowered mariposa-lily	None	None	S3
Rana draytonii	California red-legged frog	Threatened	None	S2S3

The State Rank (S-rank) is a ranking methodology which is intended to reflect of the overall conditions and conservation status of an element over its state distribution to inform biodiversity conservation.
State Ranking Threat Designations
S1 = Less than 6 Element Occurrences (Eos) OR less than 1,000 individuals OR less than 2,000 acres
S1.1 = very threatened
S1.2 = threatened
S1.3 = no current threats known
S2 = 6-20 EOs OR 1,000-3,000 individuals OR 2,000-10,000 acres
S2.1 = very threatened
S2.2 = threatened
S2.3 = no current threats known
S3 = 21-100 EOs or 3,000-10,000 individuals OR 10,000-50,000 acres
S3.1 = very threatened
S3.2 = threatened
S3.3 = no current threats known
S4 - Apparently secure within California; this rank is clearly lower than S3 but factors exist to cause some concern; i.e. there is some threat, or somewhat narrow habitat. NO THREAT RANK.
S5 - Demonstrably secure to ineradicable in California. NO THREAT RANK.

4.8 Coastal Receiving Waters & Downstream Impacts

In coastal watersheds, excess nutrients and cyanotoxins in freshwater inland streams may ultimately end up in coastal marine receiving waters (lagoons, estuaries, bays) where the nutrient concentrations, toxins, and pollutant loads may degrade the coastal marine water resource. Excessive nutrient inputs from human activities upstream of coastal waterbodies, even hundreds of miles inland, can degrade the health of coastal ecosystems, especially estuaries[15].

[15] National Oceanic and Atmospheric Administration, "State of the Coast" webpage. Online linkage: https://oceanservice.noaa.gov/websites/retiredsites/supp_sotc_retired.html.

Federal water quality regulations require that water quality standards for lakes and streams must take into consideration and be protective of *downstream* water quality, such as coastal waters. Thus, watershed improvement activities and water quality goals in any given coastal watershed should take into account minimizing downstream impacts to downstream estuaries, lagoons, and coastal marine waters.

> *"In designating uses of a water body and the appropriate criteria for those uses, the State **shall take into consideration** the water quality standards of **downstream waters** and shall ensure that its water quality standards provide for the attainment and maintenance of the water quality standards of **downstream waters**."*
>
> *➔ Code of Federal Regulations, 40 C.F.R. 131.10(b)*
>
> *emphasis added by Central Coast Water Board staff*

Coastal estuaries, lagoons, and bays are ecologically sensitive areas that are especially prone to pollution loading from land activities and freshwater stream inputs. Franklin Creek drains through the Carpinteria Salt Marsh and then ultimately into the Pacific Ocean. The California Coastal Commission has identified the Carpinteria Salt Marsh as a Critical Coastal Areas (CCA)[16]. CCAs are an administrative, non-regulatory designation for coastal waterbodies that need protection from polluted runoff.

5 WATER QUALITY STANDARDS

TMDLs are requirements pursuant to the federal Clean Water Act. The broad objective of the federal Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. Water quality standards are provisions of state and federal law intended to implement the federal Clean Water Act. In accordance with state and federal law, California's water quality standards consist of:

- Beneficial uses, which refer to legally-designated uses of waters of the state that may be protected against water quality degradation (e.g., drinking water supply, recreation, aquatic habitat, agricultural supply, etc.).
- Water quality objectives, which refer to limits or levels (numeric or narrative) of water quality constituents or characteristics that provide for the reasonable protection of beneficial uses of waters of the state.
- Anti-degradation policies, which are implemented to maintain and protect existing water quality, and high quality waters.

Therefore, beneficial uses, water quality objectives, and anti-degradation policies collectively constitute water quality standards. Beneficial uses, relevant water quality objectives pertaining to specific beneficial uses, and anti-degradation requirements that pertain to this TMDL are presented below in Section 5.1, Section 5.2, and Section 5.3, respectively.

[16]Pursuant to the federal Coastal Zone Act Reauthorization Amendments of 1990, the state's Critical Coastal Areas (CCA) Program is a program to foster collaboration among local stakeholders and government agencies, to better coordinate resources and focus efforts on coastal waters in critical need of protection from polluted runoff

5.1 Beneficial Uses

California's water quality standards designate beneficial uses for each waterbody and the scientific criteria to support that use. The Central Coast Water Board is required under both state and federal law to protect and regulate beneficial uses of waters of the state.

The Basin Plan specifically identifies beneficial uses for the listed waterbodies included in this project. The beneficial uses for waterbodies within the Carpinteria Salt Marsh watershed are shown in Table 5-1.

Table 5-1. Basin Plan designated beneficial uses.

Beneficial Use	Carpinteria Salt Marsh	Santa Monica Creek	Franklin Creek
Municipal and Domestic Supply (MUN)		X	X
Agricultural Supply (AGR)		X	X
Ground Water Recharge (GWR)		X	X
Water Contact Recreation (REC-1)	X	X	X
Non-Contact Water Recreation (REC-2)	X	X	X
Wildlife Habitat (WILD)	X	X	X
Cold Fresh Water Habitat (COLD)		X	X
Warm Fresh Water Habitat (WARM)	X	X	X
Migration of Aquatic Organisms (MIGR)	X		X
Spawning, Reproduction, and/or Early Development (SPWN)	X	X	X
Preservation of Biological Habitats of Special Significance (BIOL)	X	X	
Rare, Threatened, or Endangered Species (RARE)	X		X
Estuarine Habitat (EST)	X		
Freshwater Replenishment (FRSH)		X	X
Commercial and Sport Fishing (COMM)	X	X	X

Beneficial uses are regarded as existing whether the waterbody is perennial or ephemeral, or the flow is intermittent or continuous. The beneficial uses of surface waters in the project area are presented below along with relevant water quality objectives pertaining to un-ionized ammonia, nitrite, and nitrate.

5.1.1 *Municipal and Domestic Water Supply (MUN)*

MUN: Uses of water for community, military, or individual water supply systems including, but not limited to, drinking water supply. According to State Board Resolution No. 88- 63, "Sources of Drinking Water Policy" all surface waters are considered suitable, or potentially suitable, for municipal or domestic water supply except where:

a. *TDS exceeds 3000 mg/L (5000 uS/cm electrical conductivity);*

b. Contamination exists, that cannot reasonably be treated for domestic use;
c. The source is not sufficient to supply an average sustained yield of 200 gallons per day;
d. The water is in collection or treatment systems of municipal or industrial wastewaters, process waters, mining wastewaters, or storm water runoff; and
e. The water is in systems for conveying or holding agricultural drainage waters.

The nitrate numeric water quality objective protective of the MUN beneficial uses is legally established as 10 mg/L[17] nitrate as nitrogen. This level is established to protect public health and is contained in California Code of Regulations, Title 22, Division 4, Chapter 15, Sections 64431 and 64433.2.

The Office of Environmental Health Hazard Assessment (OEHHA) developed Public Health Goals (PHGs) for drinking water of 45 mg/L for nitrate (equivalent to 10 mg/L nitrate as nitrogen), 1 mg/L for nitrite as nitrogen, and 10 mg/L for joint nitrate/nitrite (expressed as nitrogen) in drinking water (OEHHA, 1997). The calculation of these PHGs is based on the protection of infants from the occurrence of methemoglobinemia, the principal toxic effect observed in humans exposed to nitrate or nitrite. The PHGs are equivalent to California's current drinking water standards for nitrate (45 mg/L nitrate as nitrate), nitrite (1 mg/L nitrite as nitrogen), and 10 mg/L (joint nitrate/nitrite expressed as nitrogen) which were adopted by the California Department of Health Services (DHS) in 1994 from USEPA's Maximum Contaminant Levels (MCLs) promulgated in 1991.

5.1.2 *Agricultural Supply (AGR)*

AGR: Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

In accordance with the Basin Plan, interpretation of the amount of nitrate which adversely affects the agricultural supply beneficial uses of waters of the state shall be derived from the University of California Agricultural Extension Service guidelines, which are found in Basin Plan Table 3-1. Accordingly, increasing problems for sensitive crops could occur when irrigation water contains nitrate nitrogen concentrations between 5-30 mg/L and severe problems for sensitive crops could occur with irrigation water above 30 mg/L[18].

High concentrations of nitrate in irrigation water can potentially create problems for sensitive crops (e.g., grapes, avocado, citrus, sugar beets, apricots, almonds, cotton) by detrimentally impacting crop yield or quality. For example, according to Ayers and Westcot (1985)[19] grapes are sensitive to high nitrate in irrigation water and may continue to grow late into the season at the expense of fruit production; yields are often reduced

[17] This value is equivalent to, and may be expressed as, 45 mg/L nitrate as nitrogen.
[18] The University of California Agricultural Extension Service guideline values are flexible, and may not necessarily be appropriate due to local conditions or special conditions of crop, soil, and method of irrigation. 30 mg/L nitrate as nitrogen is the recommended uppermost threshold concentration for nitrate in irrigation supply water as identified by the University of California Agricultural Extension Service which potentially cause severe problems for sensitive crops (see Table 3-3 in the Basin Plan). Selecting the least stringent threshold (30 mg/L) therefore conservatively identifies exceedances which could detrimentally impact the AGR beneficial uses for irrigation water.
[19] R.S. Ayers (Soil and Water Specialist, University of California, Davis) and D.W. Westcot (Senior Land and Water Resources Specialist – Central Valley Regional Water Quality Control Board) published in the Food and Agriculture Organization of the United Nations (UN-FAO) Irrigation and Drainage Paper 29 Rev.1.

and grapes may be late in maturing and have a lower sugar content. Maturity of fruit such as apricot, citrus and avocado may also be delayed and the fruit may be poorer in quality, thus affecting the marketability and storage life. Excessive nitrogen can also trigger and favor the production of green tissue (leaves) over vegetative tissue in sensitive crops. In many grain crops, excess nitrogen may promote excessive vegetative growth producing weak stalks that cannot support the grain weight. According to the *Draft Conclusions of the Agricultural Expert Panel* (SWRCB, 2014), the yield and quality of cotton and almonds will suffer from excess nitrogen. These problems can usually be overcome by good fertilizer and irrigation management. However, regardless of the type of crop, many resource professionals recommend that nitrate in the irrigation water should be credited toward the fertilizer rate[20] especially when the concentration exceeds 10 mg/L nitrate as nitrogen[21]. Should this be ignored, the resulting excess input of nitrogen could cause problems such as excessive vegetative growth and contamination of groundwater[22]. It should be noted that irrigation water that is high in nitrate does not necessarily mean that in contains enough nitrate to eliminate the need for additional nitrogen fertilizer; however, the grower may be able to reduce and replace the amount of fertilizer normally applied with the nitrate present in the irrigation water[23].

Further, the Basin Plan provides water quality objectives for nitrate, which are protective of the AGR beneficial uses for livestock watering. While nitrate (NO_3) itself is relatively non-toxic to livestock, ingested nitrate is broken down to nitrite (NO_2^-); subsequently nitrite enters the bloodstream where it converts blood hemoglobin to methemoglobin. This greatly reduces the oxygen-carrying capacity of the blood, and the animal suffers from oxygen starvation of the tissues[24]. Death can occur when blood hemoglobin has fallen to one-third normal levels. Resource professionals[25] report that nitrate can reach dangerous levels for livestock in streams, ponds, or shallow wells that collect drainage from highly fertilized fields. Accordingly, the Basin Plan identifies the safe threshold of nitrate as nitrogen for purposes of livestock watering at 100 mg/L[26].

Also noteworthy is that the AGR beneficial uses of surface water not only applies to several stream reaches of the project area, but can also apply to the groundwater resources underlying those stream reaches. The groundwater in some of these reaches is recharged by stream infiltration. Therefore, the groundwater recharge (GWR) beneficial uses of stream reaches provides the nexus between protection of designated

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[20] Crediting of irrigation source-water nitrogen may not be a 1:1 relationship as some irrigation water may not be retained entirely within the cropped area.

[21] Colorado State University Extension - Irrigation Water Quality Criteria. Authors: T.A. Bauder, Colorado State University Extension water quality specialist; R.M. Waskom, director, Colorado Water Institute; P.L. Sutherland, United States Department of Agriculture, Natural Resources Conservation Service (USDA/NRCS) area resource conservationist; and J.G. Davis, Extension soils specialist and professor, soil and crop sciences.

[22] University of California, Davis, Farm Water Quality Planning Reference Sheet 9.10. Publication 8066. Author: S. R. Grattan, Plant-Water Relations Specialist, UC Davis.

[23] Monterey County Water Resources Agency – Santa Clara Valley Water District, Fact Sheet 4. *Using the Nitrate Present in Soil and Water in Your Fertilizer Calculations.*

[24] New Mexico State University, Cooperative Extension Service. Nitrate Poisoning of Livestock. Guide B-807.

[25] University of Arkansas, Division of Agriculture - Cooperative Extension. “Nitrate Poisoning in Cattle”. Publication FSA3024.

[26] 100 mg/L nitrate as nitrogen is the Basin Plan’s water quality objective protective of livestock watering, and is based on National Academy of Sciences-National Academy of Engineering guidelines (see Table 3-3 in the Basin Plan).

AGR beneficial uses of both the surface waters and the underlying groundwater resource.

The Basin Plan also contains a dissolved oxygen water quality objective for the AGR beneficial use whereby dissolved oxygen concentration shall not be reduced below 2.0 mg/L at any time.

5.1.3 *Ground Water Recharge (GWR)*

> *GWR: Uses of water for natural or artificial recharge of ground water for purposes of future extraction,* ***maintenance of water quality****, or halting of saltwater intrusion into freshwater aquifers. Ground water recharge includes recharge of surface water underflow.* (Emphasis added.)

Groundwater recharge (GWR) beneficial uses recognize the fundamental nature of the hydrologic cycle, in that surface waters and groundwater are not closed systems that act independently from each other. Underlying groundwaters are, in effect, receiving waters for stream waters that infiltrate and recharge the subsurface water resource. Most surface waters and groundwaters of the central coast region are designated with both the MUN (drinking water) and AGR (agricultural supply) beneficial uses. The MUN nitrate water quality objective (10 mg/L) therefore applies to *both* the stream waters, and to the underlying groundwater.

The Basin Plan GWR beneficial uses explicitly state that the designated groundwater recharge use of surface waters is to be protected to maintain groundwater quality. Note that surface waters and groundwaters are often in direct or indirect hydrologic communication. As such, where necessary, the GWR beneficial uses of the surface waters need to be protected to support and maintain the MUN or AGR beneficial uses of the underlying groundwater resource. Protection of the groundwater recharge beneficial uses of surface waters has been recognized in State Water Resources Control Board–approved California TMDLs[27]. USEPA also recognizes the appropriateness of protecting designated groundwater recharge beneficial uses in the context of California TMDLs (USEPA 2002, USEPA 2003). The Basin Plan does not specifically identify numeric water quality objectives to implement the GWR beneficial uses, however a situation-specific weight of evidence approach can be used to assess if GWR is being supported, consistent with Section 3.11 of the California Listing Policy (SWRCB, 2004, amended in February 2015).

5.1.4 *Water Contact Recreation (REC-1) and Non-Contact Water Recreation (REC-2)*

> *REC-1: Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.*

[27] See for example, Los Angeles Regional Water Quality Control Board, Calleguas Creek Nitrogen Compounds TMDL, 2002, Resolution No. 02-017, and approved by the California Office of Administrative Law, OAL File No. 03-0519-02 SR; or Central Coast Regional Water Quality Control Board, TMDLs for Nitrogen Compounds and Orthophosphate in the Lower Salinas River and Reclamation Canal Basin and the Moro Cojo Slough Subwatershed, Resolution No. R3-2013-0008 and approved by the California Office of Administrative Law, OAL File No. 2014-0325-01S.

REC-2: Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities

The relevant Basin Plan water quality objective protective of both water contact and non-contact recreation beneficial uses is the general toxicity objective for all inland surface water, enclosed bays, and estuaries (Basin Plan Chapter 3, Section II.A.2.a). The general toxicity objective is a narrative water quality objective that states:

"All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life. Compliance with this objective will be determined by use of indicator organisms, analyses of species diversity, population density, growth anomalies, toxicity bioassays of appropriate duration, or other appropriate methods as specified by the Regional Board."

Because illnesses are considered detrimental physiological responses in humans, the narrative toxicity objective applies to algal toxins. Possible health effects of exposure to blue-green algae blooms and their toxins can include rashes, skin and eye irritation, allergic reactions, gastrointestinal upset, and other effects including poisoning. Note that microcystins are toxins produced by cyanobacteria (blue-green algae) and are associated with algal blooms, elevated nutrients, and biostimulation in surface waterbodies. OEHHA has published peer-reviewed public health action-level guidelines for algal cyanotoxins (microcystins) in recreational water uses; this public health action-level for microcystins is 0.8 μg/L[28] (OEHHA, 2012). This public health action level can therefore be used to assess attainment or non-attainment of the Basin Plan's general toxicity objective and to ensure that REC-1 designated beneficial uses are being protected and supported.

5.1.5 *Aquatic Habitat (WARM, COLD, MIGR, SPWN, WILD, BIOL, RARE, EST)*

WARM: Uses of water that support warm water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish, or wildlife, including invertebrates.

COLD: Uses of water that support cold water ecosystems including, but not limited to, preservation or enhancement of aquatic habitats, vegetation, fish or wildlife, including invertebrates.

MIGR: Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

SPWN: Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

WILD: Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

[28] Includes microcystins LR, RR, YR, and LA.

BIOL: Uses of water that support designated areas or habitats, such as established refuges, parks, sanctuaries, ecological reserves, or Areas of Special Biological Significance (ASBS), where the preservation or enhancement of natural resources requires special protection.

RARE: Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

EST: Uses of water that support estuarine ecosystems including, but not limited to, preservation or enhancement of estuarine habitats, vegetation, fish, shellfish, or wildlife (e.g., estuarine mammals, waterfowl, shorebirds). An estuary is generally described as a semi-enclosed body of water having a free connection with the open sea, at least part of the year and within which the seawater is diluted at least seasonally with fresh water drained from the land. Included are waterbodies which would naturally fit the definition if not controlled by tidegates or other such devices.

The Basin Plan water quality objectives protective of aquatic habitat beneficial uses which are most relevant to nutrient pollution[29] are the toxicity objective for un-ionized ammonia, the biostimulatory substances objective, and dissolved oxygen objectives.

For un-ionized ammonia, the Basin Plan General Objective for all Inland Surface Waters, Enclosed Bays and Estuaries states that the discharge of wastes shall not cause concentrations of un-ionized ammonia (NH_3) to exceed 0.025 mg/L (as nitrogen) in receiving waters. Un-ionized ammonia is highly toxic to aquatic life.

For biostimulatory substances, the Basin Plan General Objective for all Inland Surface Waters, Enclosed Bays and Estuaries states that, "*Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses*." Excessive algal biomass and wide swings in dissolved oxygen concentrations are often indicative of biostimulatory conditions due to excessive nutrients.

Chlorophyll *a* is an algal biomass indicator. The numeric listing criteria to implement the Basin Plan biostimulatory substances objective for purposes of Clean Water Act Section 303(d) Listing assessments is 40 µg/L (Worcester et al., 2010).

For dissolved oxygen, the Basin Plan requires that in waterbodies designated for WARM habitat, dissolved oxygen concentrations shall not be depressed below 5 mg/L and that in waterbodies designated for COLD and SPWN, dissolved oxygen shall not be depressed below 7 mg/L. In addition, peer-reviewed research in California's central coast region (Worcester et al., 2010) has established an upper limit of 13 mg/L for dissolved oxygen to screen for excessive dissolved oxygen saturation indicative of biostimulatory conditions. For monitoring sites within the central coast region that support designated aquatic habitat beneficial uses and do not show signs of biostimulation, dissolved oxygen virtually never exceeded 13 mg/L at any time[30]. Note that the 13 mg/L dissolved oxygen saturation target is not a regulatory standard, but can

[29] Nutrients, such as nitrate, do not by themselves necessarily directly impair aquatic habitat beneficial uses. Rather, they cause indirect impacts by promoting algal growth and low dissolved oxygen that impair aquatic habitat uses.

[30] Of 2,399 samples at these reference sites, only about 1% of the samples ever exceeded 13 mg/L DO.

be used as a TMDL nutrient-response indicator target to assess primary biological response to nutrient pollution.

5.1.6 *Freshwater Replenishment (FRSH)*

FRSH: Uses of water for natural or artificial maintenance of surface water quantity or quality (e.g., salinity) which includes a waterbody that supplies water to a different type of waterbody, such as, streams that supply reservoirs and lakes, or estuaries; or reservoirs and lakes that supply streams. This includes only immediate upstream waterbodies and not their tributaries.

The Basin Plan does not contain specific water quality objectives for the FRSH beneficial use.

5.1.7 *Commercial and Sport Fishing (COMM)*

COMM: Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

The Basin Plan does not contain specific water quality objectives for the COMM beneficial use.

5.2 Summary of Water Quality Objectives & Criteria

The Basin Plan contains specific water quality objectives that apply to nutrients and nutrient-related parameters. In addition, the Central Coast Water Board uses established, scientifically-defensible numeric criteria to implement narrative water quality objectives, and for use in Clean Water Act section 303(d) listing assessments. These water quality objectives and criteria are established to protect beneficial uses and are summarized in Table 5-2.

Table 5-2. Summary of Basin Plan water quality objectives and numeric criteria for nutrients and nutrient-related parameters.

Constituent Parameter	Source of Water Quality Objective/Criteria	Numeric Target	Primary Use Protected
Un-ionized Ammonia as Nitrogen	Basin Plan numeric objective	0.025 mg/L	General Objective for all Inland Surface Waters, Enclosed Bays, and Estuaries *(toxicity objective)*
Nitrate as Nitrogen	Basin Plan numeric objective	10 mg/L	MUN, GWR (Municipal/Domestic Supply; Groundwater Recharge)
Nitrate as Nitrogen	Basin Plan numeric criteria (Table 3-3 in Basin Plan)	5 – 30 mg/L *California Agricultural Extension Service guidelines*	AGR (Agricultural Supply – irrigation water) *"Severe" problems for sensitive crops at greater than 30 mg/L* *"Increasing problems" for sensitive crops at 5 to 30 mg/L*
Joint Nitrate/Nitrite as Nitrogen	Basin Plan narrative objective[A]	10 mg/L *California Office of Environmental Health Hazard Assessment Suggested Public Health Goal*	Human Health
Nitrite as Nitrogen	Basin Plan narrative objective[A]	1 mg/L *California Office of Environmental Health Hazard Assessment Suggested Public Health Goal*	Human Health
Dissolved Oxygen	General Inland Surface Waters numeric objective	Dissolved Oxygen shall not be depressed below 5.0 mg/L Median values should not fall below 85% saturation.	General Objective for all Inland Surface Waters, Enclosed Bays, and Estuaries
	Basin Plan numeric objective WARM, COLD, SPWN	Dissolved Oxygen shall not be depressed below 5.0 mg/L (WARM) Dissolved Oxygen shall not be depressed below 7.0 mg/L (COLD, SPWN)	COLD (Cold Freshwater Habitat), WARM (Warm Freshwater Habitat_, SPWN (Fish Spawning)
	Basin Plan numeric objective AGR	Dissolved Oxygen shall not be depressed below 2.0 mg/L	AGR (Agricultural Supply)
Biostimulatory Substances	Basin Plan narrative objective[B]	Nutrient-related constituents that are normally developed based on reach scale characteristics. Values may vary.	General Objective for all Inland Surface Waters, Enclosed Bays, and Estuaries *(biostimulatory substances objective)* -- (e.g., WARM, COLD, REC, WILD, EST)
Chlorophyll *a*	Basin Plan narrative objective[B]	40 µg/L *North Carolina Administrative Code, Title 151, Subchapter 2B, Rule 0211*	Numeric listing criteria to implement the Basin Plan biostimulatory substances objective for purposes of Clean Water Act Section 303(d) Listing assessments
Microcystins *(includes Microcytins LA, LR, RR, and YR)*	Basin Plan narrative objective[B]	0.8 µg/L *California Office of Environmental Health Hazard Assessment Suggested Public Health Action Level*	REC-1 (water contact recreation), REC-2 (water non-contact recreation)

[A] *The Basin Plan toxicity narrative objective states: "All waters shall be maintained free of toxic substances in concentrations which are toxic to, or which produce detrimental physiological responses in, human, plant, animal, or aquatic life." (Toxicity Objective, Basin Plan, Chapter 3)*

[B] *The Basin Plan biostimulatory substances narrative objective states: "Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses." (Biostimulatory Substances Objective, Basin Plan, Chapter 3)*

5.3 Anti-degradation Policy

In accordance with Section II.A of the Basin Plan, wherever the existing quality of water is better than the quality of water established in the Basin Plan as objectives, **such existing quality shall be maintained** unless otherwise provided by provisions of the state anti-degradation policy. Practically speaking, this means that where water quality is *better* than necessary to support designated beneficial uses, such existing high water quality shall be maintained, and further lowering of water quality is not allowed except under conditions provided for in the anti-degradation policy.

USEPA has also issued detailed guidelines for implementation of federal anti-degradation regulations for surface waters (40 CFR 131.12). To ensure consistency, the State Water Resources Control Board has interpreted Resolution No. 68-16 (i.e., the state anti-degradation policy) to incorporate the federal anti-degradation policy. It is important to note that federal policy only applies to surface waters, while state policy applies to both surface and groundwaters.

USEPA recognizes the validity of using TMDLs as a tool for implementing anti-degradation goals:

> *"Identifying opportunities to protect waters that are not yet impaired: TMDLs are typically written for restoring impaired waters; however, states can prepare TMDLs geared towards maintaining a "better than water quality standard" condition for a given waterbody-pollutant combination, and they can be a useful tool for high quality waters."*
>
> From: USEPA, 2014. Opportunities to Protect Drinking Water Sources and Advance Watershed Goals Through the Clean Water Act: A Toolkit for State, Interstate, Tribal and Federal Water Program Managers. November 2014.

6 Water Quality Data Analysis

This section provides information pertaining to data sources and the analysis of water quality data used to assess water quality conditions and impairment for this project.

Staff used the following water quality data for waterbodies within the Carpinteria Salt Marsh watershed:

- Central Coast Ambient Monitoring Program (CCAMP) sites 315SMC, 315FRC.
- Irrigated Lands Regulatory Program, Cooperative Monitoring Program (CMP) site 315FMV.
- Santa Barbara Channelkeeper (SBCK) sites CM01, SM01, and FK00.

Water quality data from CCAMP and CMP is presented in Section 6.1 and data provided by SBCK is presented in Section 6.2.

6.1 CCAMP and CMP Water Quality Data

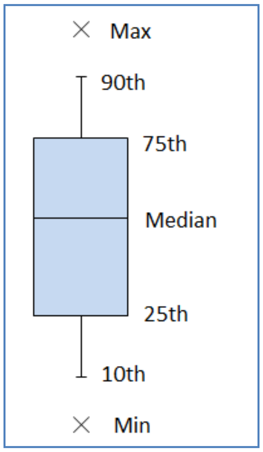
Locations of CCAMP and CMP water quality monitoring sites are shown in Figure 6-1 and a description of site locations are contained in Table 6-1.

Figure 6-1. Locations of CCAMP/CMP monitoring sites.

Table 6-1. CCAMP/CMP water qualtiy monitoring site informaton

Program	Site ID	Site Description
CCAMP	315SMC	Santa Monica Creek at Via Real
CCAMP	315FRC	Franklin Creek at Carpinteria Avenue
CMP	315FMV	Franklin Creek at Meadow View Lane

Staff used scatter plots to represent water quality data over time and box plots to present summary statistics for each monitoring station shown in Figure 6-1. Note that box plot graphics for the various monitoring stations also show the number of samples in parenthesis on the x-axis (see Figure 6-2 for an example).



For box plots, as shown in Figure 6-2, maximum and minimum values are depicted as exes at the top and bottom of the plot, respectively. Values representing the 90th and 10th percentiles are shown as whiskers, while the 75th, 50th (median), and 25th percentiles comprise the box.

Figure 6-2. Explanation of box plots.

6.1.1 *Un-ionized ammonia as nitrogen*

The Basin Plan General Objective for all Inland Surface Waters, Enclosed Bays and Estuaries states that the discharge of wastes shall not cause concentrations of un-ionized ammonia (NH_3) to exceed 0.025 mg/L (as nitrogen) in receiving waters. Staff used this objective to assess water quality impairment as presented below.

Table 6-2. Summary of CCAMP/CMP monitoring results for un-ionized ammonia as nitrogen (mg/L).

Station	Dates	Count	Count >0.025	% >0.025	Median	Mean	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	23	0	0	0.00313	0.00391	0.01900	0.00040
315FMV	1/25/06-6/23/15	101	7	6.9	0.00364	0.09494	8.63360	0.00006
315FRC	1/16/01-12/3/14	159	2	1.26	0.00222	0.00371	0.03719	0.00032

Figure 6-3. Box plots of un-ionized ammonia as nitrogen (mg/L) concentrations.
Note: Not shown 315FMV maximum concentration of 8.6 on 7/26/2011.

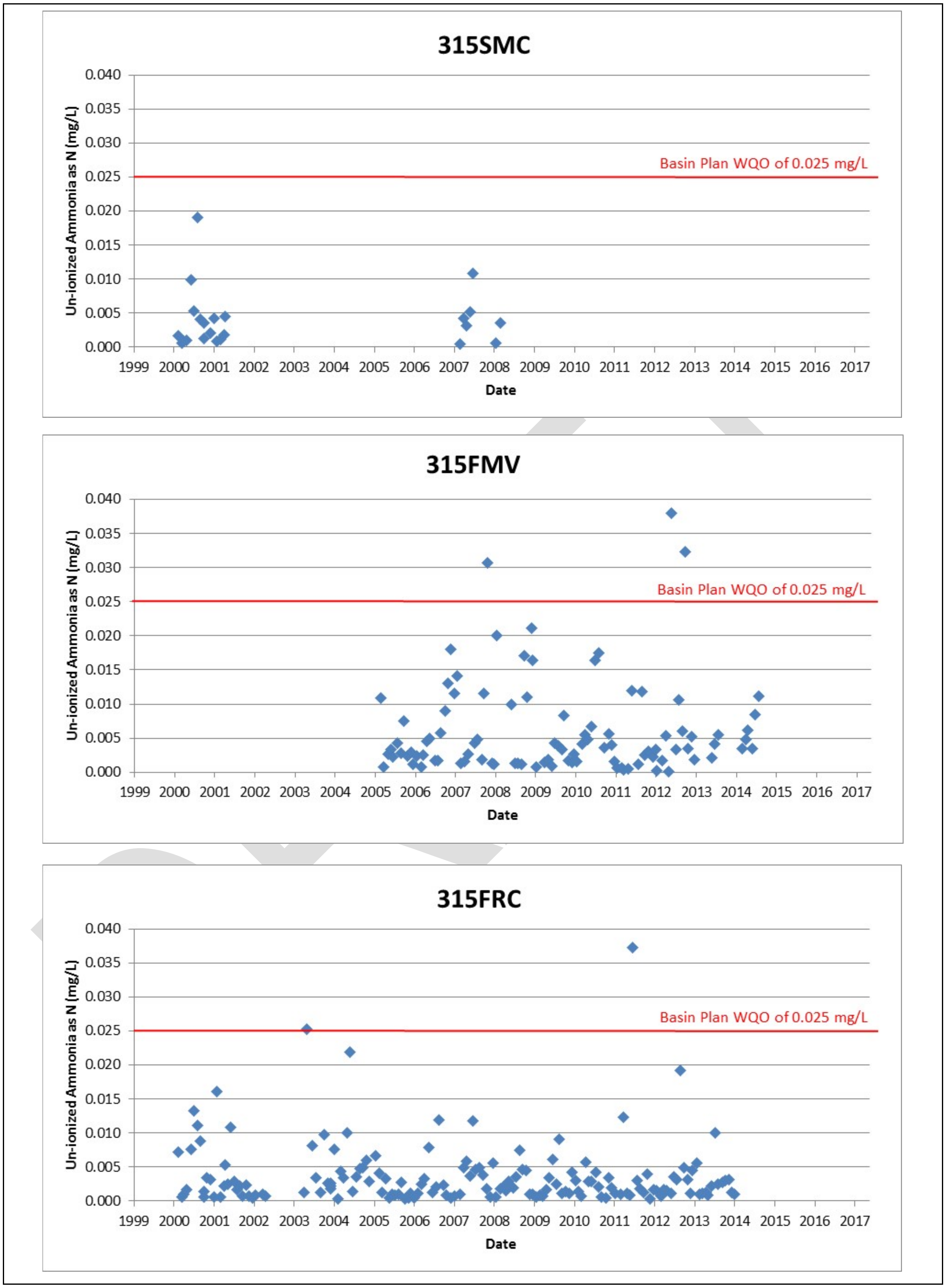


Figure 6-4. Scatter plots of un-ionized ammonia as nitrogen (mg/L) concentrations.
Note: Not shown for 315FMV are concentrations of 0.183151 mg/L on 4/28/08, 0.141003 mg/L on 1/20/2010, 8.6 mg/L on 7/26/2011, and 0.040575 mg/L on 5/29/2012.

Exceedance of the un-ionized ammonia water quality objective for toxicity (0.025 mg/L as nitrogen) occurs much less frequently when compared to nitrate exceedances. The uppermost monitoring station for Franklin Creek (315FMV) recorded the most exceedances with 7 out of 101 samples (7%), however this exceedance rate is not frequent enough to assert impairment. Santa Monica Creek site (315SMC) never exceeded the un-ionized ammonia water quality objective.

6.1.2 *Joint Nitrate/Nitrite as Nitrogen*

OEHHA developed PHGs of 10 mg/L for joint nitrate plus nitrite as nitrogen to protect the MUN beneficial use. The calculation of this PHG is based on the protection of infants from the occurrence of methemoglobinemia as discussed in Section 5.1.1.

Table 6-3. Summary of CCAMP/CMP monitoring results for joint nitrate/nitrite as nitrogen (mg/L).

Station	Dates	Count	Count >10	% >10	Count >30	% >30	Max	Min	Median	Mean
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	22	1	4.6	0	0	10.8	0.03	0.05	1.1
315FMV	1/25/06-3/30/16	112	106	94.6	31	27.7	322	0.3	25.5	28.2
315FRC	1/16/01-3/18/03 3/4/04-8/31/16	176	166	94.3	3	1.9	48.1	1.8	21.1	20.7

For the combined Franklin Creek sites (315FRC and 315FMV), 272 of 288 samples (94%) exceeded the joint nitrate plus nitrite as nitrogen water quality objective for the protection of human health (OEHHA PHGs), and 34 of 288 samples (12%) exceeded the water quality guideline for agricultural supply (AGR). It should be noted that the upper Franklin Creek site (315FMV) exceeded the AGR water quality guideline on more occasions than the lower creek site (28% exceedance compared to 1.9% exceedance for 315FRC). For Santa Monica Creek (315SMC), only 1 of 22 samples (4.6%) exceeded the water quality objective for human health and no samples exceeded the water quality guideline for AGR.

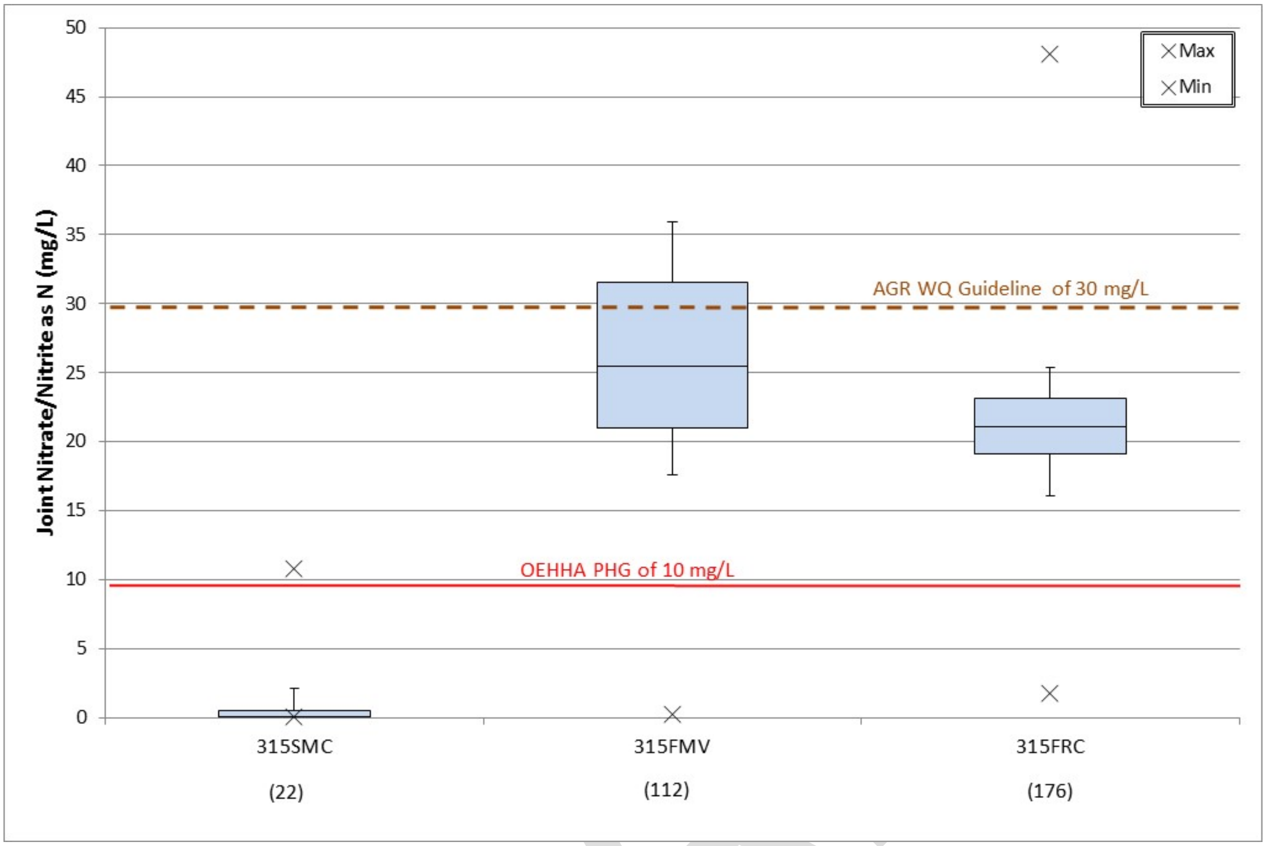


Figure 6-5. Box plots of joint nitrate/nitrite as nitrogen (mg/L) concentrations.
Note: Not shown 315FMV max of 322 mg/L on 5/14/2006.

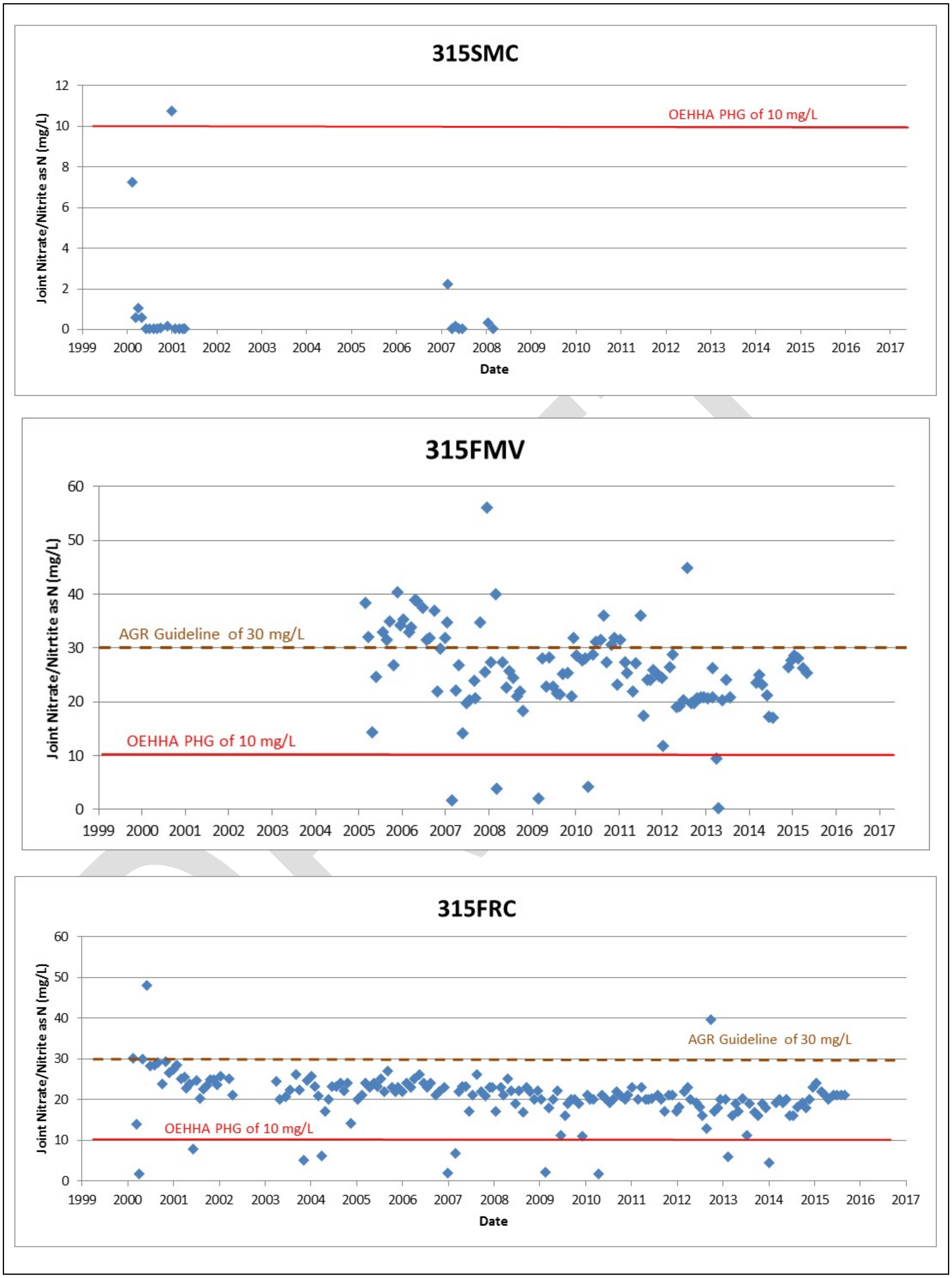


Figure 6-6. Scatter plots of joint nitrate/nitrite as nitrogen (mg/L) concentrations.
Note. Note that the vertical axis is different for Santa Monica Creek and Franklin Creek sites. Not shown 315FMV maximum concentration of 322 mg/L on 5/14/2006.

As shown in the figures above, the PHGs of 10 mg/L for joint nitrate plus nitrite as nitrogen water quality objective is frequently exceeded at Franklin Creek monitoring stations (315FMV and 315FRC), and rarely exceeded at Santa Monica Creek site (315SMC). Joint nitrate plus nitrite concentrations at the two Franklin Creek sites are often at least twice the water quality objective set to protect human health. The upper monitoring station (315FMV) has a median value of 25.5 mg/L joint nitrate plus nitrite as nitrogen and a maximum value of 322 mg/L where the lower monitoring station (315FRC) has a median value of 21.1 mg/L and a maximum value of 48.1 mg/L (Table 6-3). Both of these sites are located downstream of irrigated agricultural lands (orchards, nurseries, greenhouses).

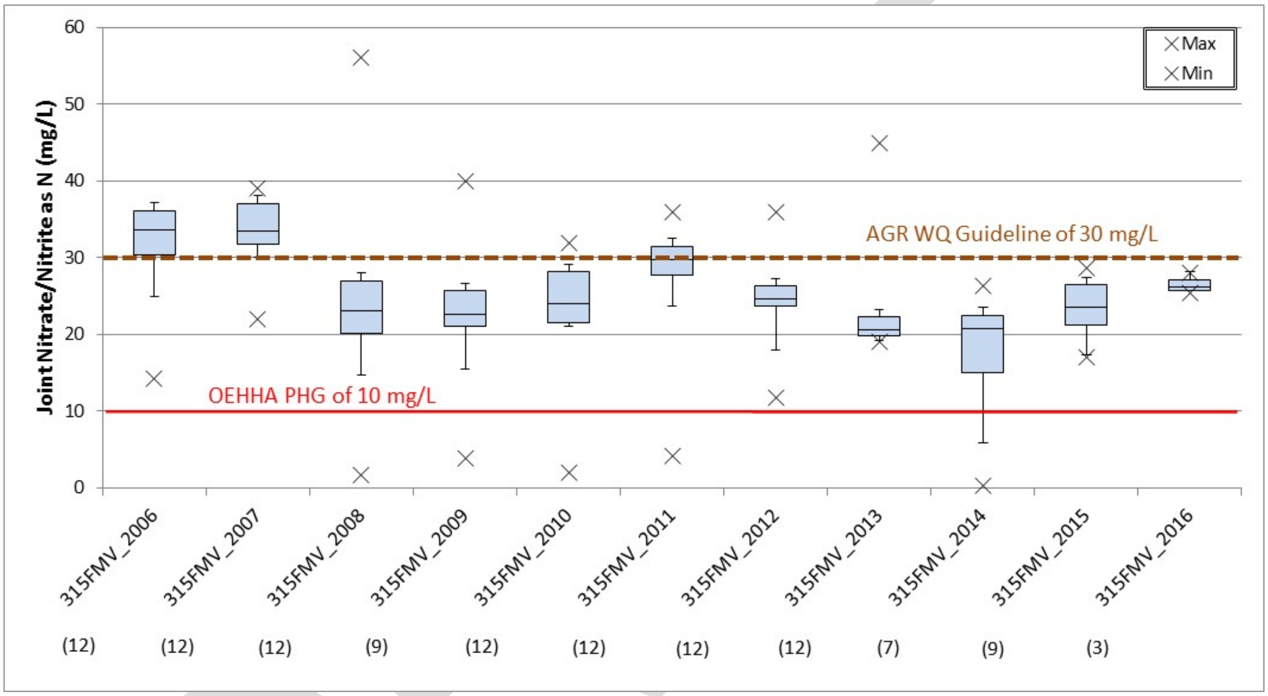


Figure 6-7. Annual box plots of joint nitrate/nitrite concentrations (mg/L) for upper Franklin Creek site 315FMV.
Note: Not shown 315FMV maximum concentration of 322 mg/L on 5/14/2006.

As shown in Figure 6-7, median concentrations in 2006 and 2007 for site 315FMV are greater than the agricultural water quality guideline of 30 mg/L and more than three times greater than the public health goal of 10mg/L. From 2008 to 2016 median concentrations are consistently between 20 and 30 mg/L.

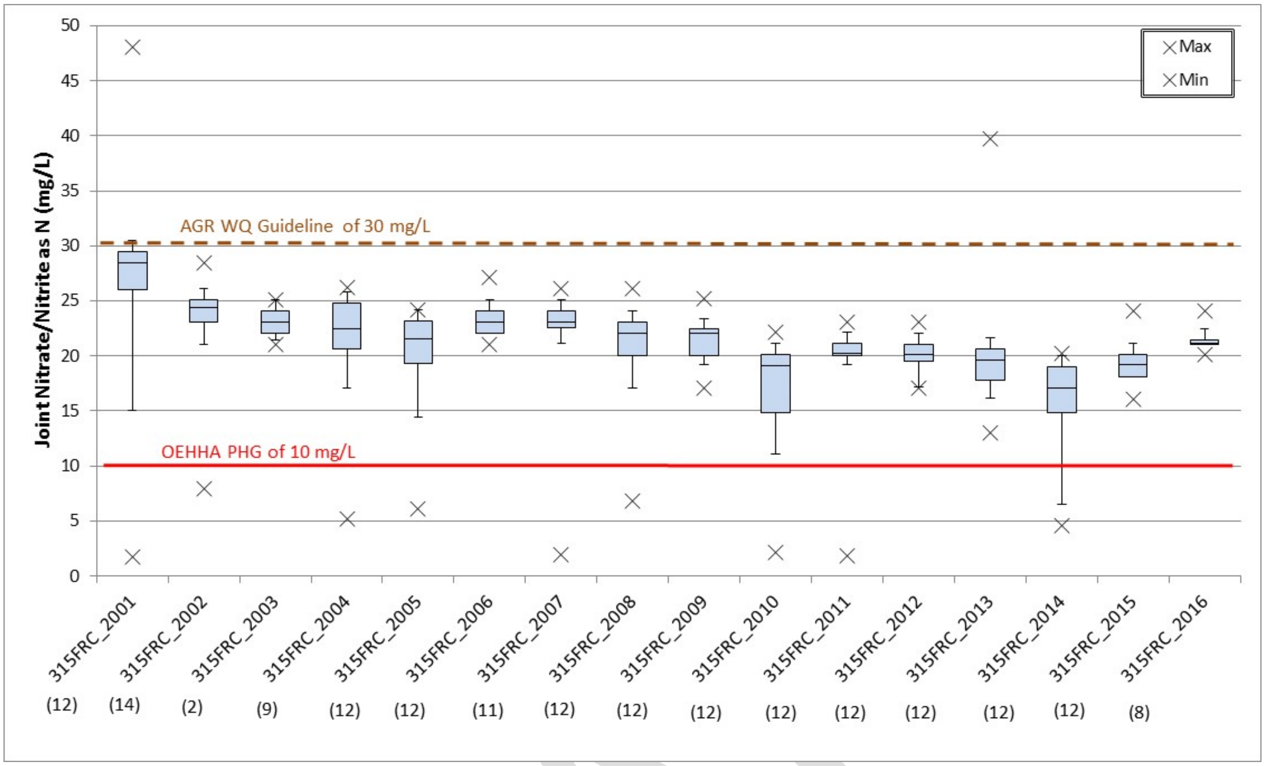


Figure 6-8. Annual box plots of joint nitrate/nitrite concentrations (mg/L) for lower Franklin Creek site 315FRC.

As shown in Figure 6-8, median concentrations in 2001 and 2002 for site 315FRC were higher that all subsequent years. From 2003 to 2009 median concentrations are consistently around a concentration of 23 mg/L. From 2001 to 2016 median concentrations are consistently around 20 mg/L, nearly twice the public health goal of 10 mg/L.

6.1.3 *Nitrate as nitrogen*

The nitrate numeric water quality objective protective of the MUN beneficial use is 10 mg/L nitrate as nitrogen. This level is established to protect public health as discussed in Section 5.1.1.

In accordance with the Basin Plan, interpretation of the amount of nitrate that adversely affects the agricultural supply (AGR) beneficial of waters of the state is derived from the University of California Agricultural Extension Service guidelines, which are found in Basin Plan Table 3-3. Accordingly, severe problems for sensitive crops could occur for irrigation water exceeding 30 mg/L as discussed in Section 5.1.2.

Table 6-4. Summary of CCAMP monitoring results for nitrate as nitrogen (mg/L).

Station	Dates	Count	Count >10	% >10	Count >30	% >30	Max	Min	Median	Mean
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	22	1	4.6	0	0	10.7	0.02	0.04	1.06
315FRC	1/16/01-3/18/03 3/4/04-8/31/16	176	166	94.3	3	1.7	47.9	1.7	21.0	20.6

For Franklin Creek (315FRC), 166 of 176 samples (94%) exceeded the water quality objective for municipal supply (MUN) and 3 of 176 samples (2%) exceeded the water quality guideline for agricultural supply (AGR). For Santa Monica Creek (315SMC), only 1 of 22 samples (4.6%) exceeded the water quality objective for municipal supply. It should be noted that the reduced sample count for Santa Monica Creek is in part due to periods of low to zero flow in the lower watershed where monitoring site 315SMC is located, and because this site is only monitored on a monthly basis in one out of five years. Conversely, Franklin Creek generally experiences year-round flow in the lower watershed (due to shallow groundwater and return flows from adjacent urban and agricultural areas) and is monitored monthly, regardless of the rotating sampling cycle.

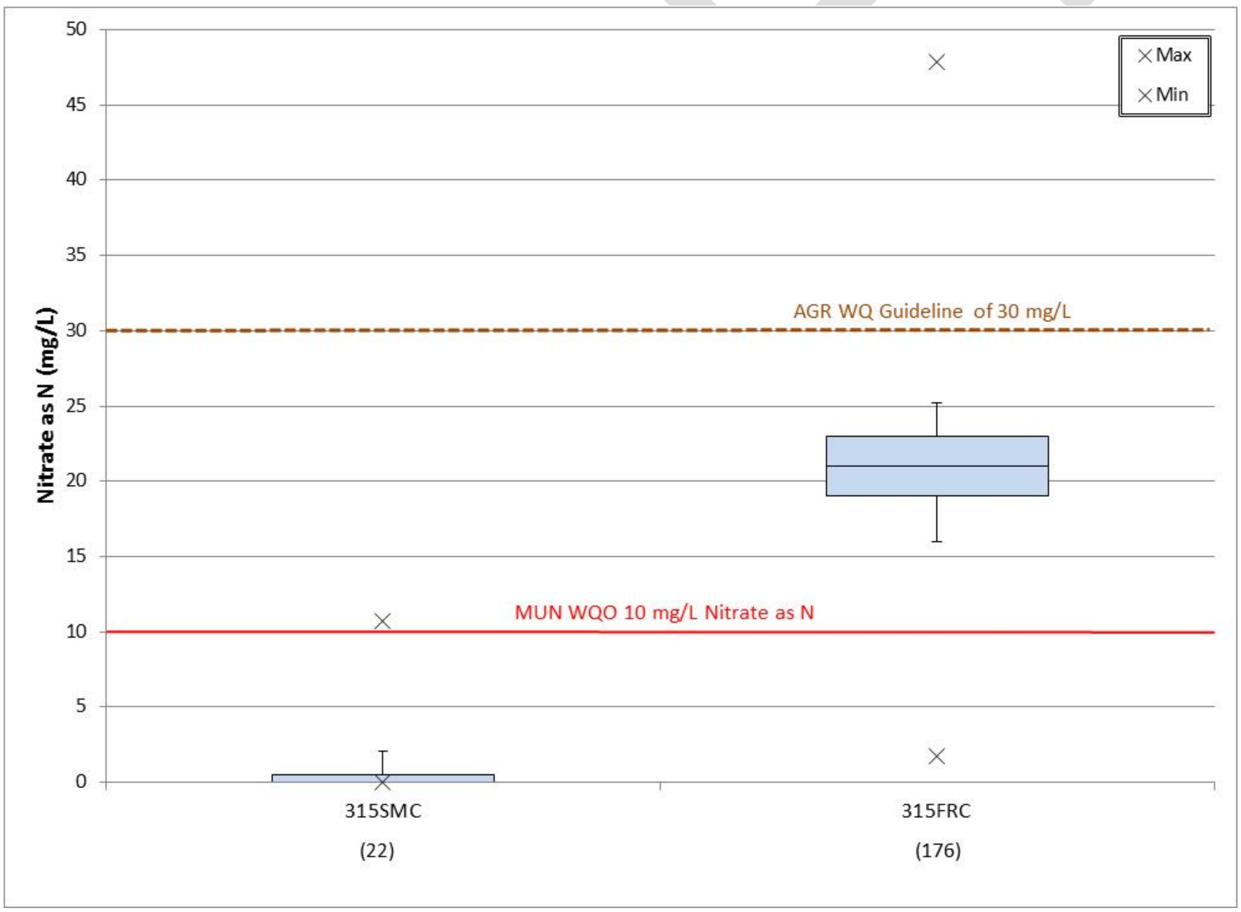


Figure 6-9. Box plots of nitrate as nitrogen (mg/L) concentrations.

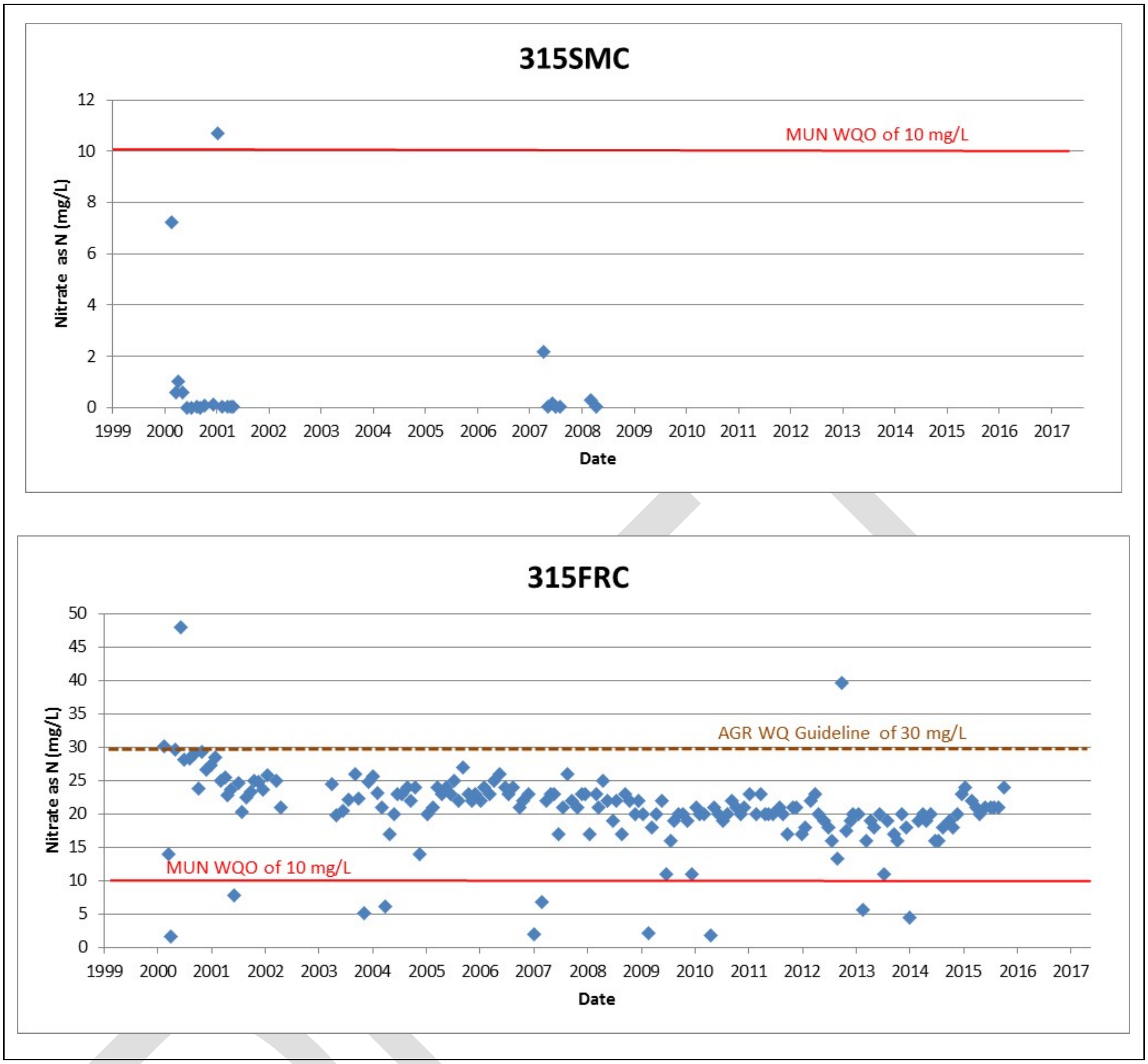


Figure 6-10. Scatter plot of nitrate as nitrogen concentrations (mg/L).
Note that the vertical axis is different for each site.

As shown in the figures above, the MUN beneficial use water quality objective (10 mg/L nitrate as nitrogen) is frequently exceeded at Franklin Creek monitoring station (315FRC) and rarely exceeded at Santa Monica Creek monitoring station (315SMC). Over the past 14 years, nitrate as nitrogen concentrations at Franklin Creek site 315FRC are nearly two times greater than the water quality objective for the MUN beneficial use with a median value of 21.0 mg/L and a maximum value of 47.9 mg/L (Table 6-4).

6.1.4 *Nitrate monthly trends*

Central Coast Water Board staff categorized nitrate as nitrogen data by month for sites 315FMV and 315FRC to evaluate potential monthly trends. As shown below, median values for each site are relatively consistent throughout all months.

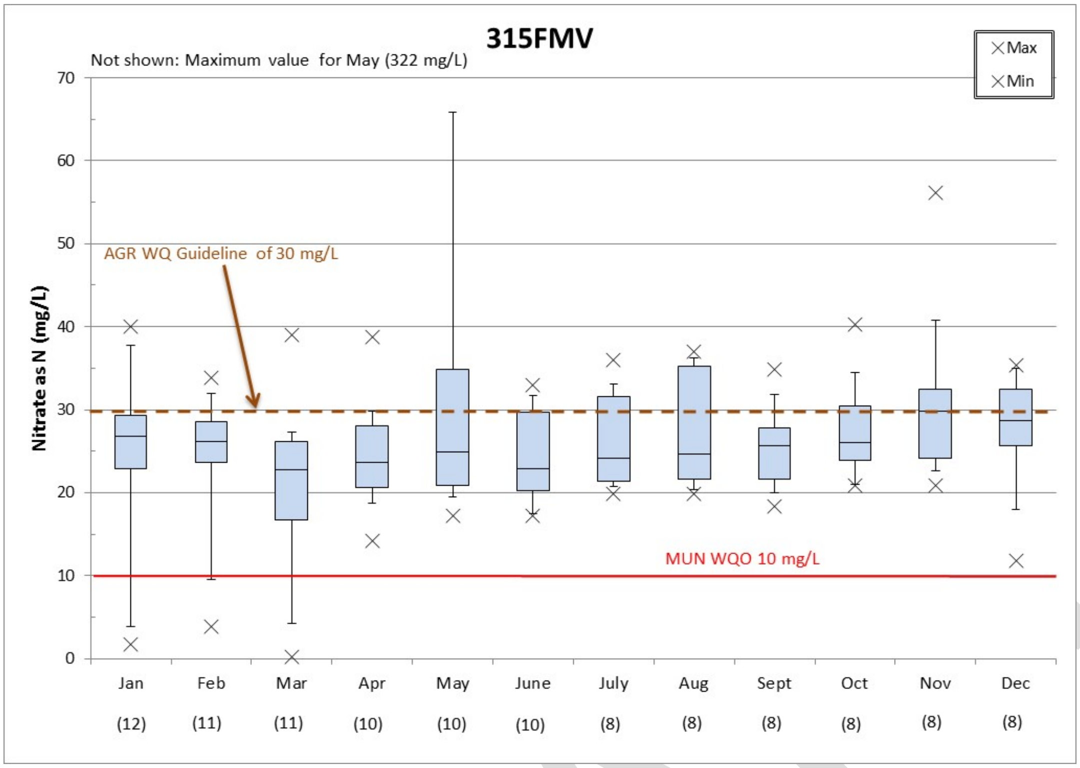


Figure 6-11. Monitoring site 315FMV monthly box plots for nitrate as nitrogen (mg/L).

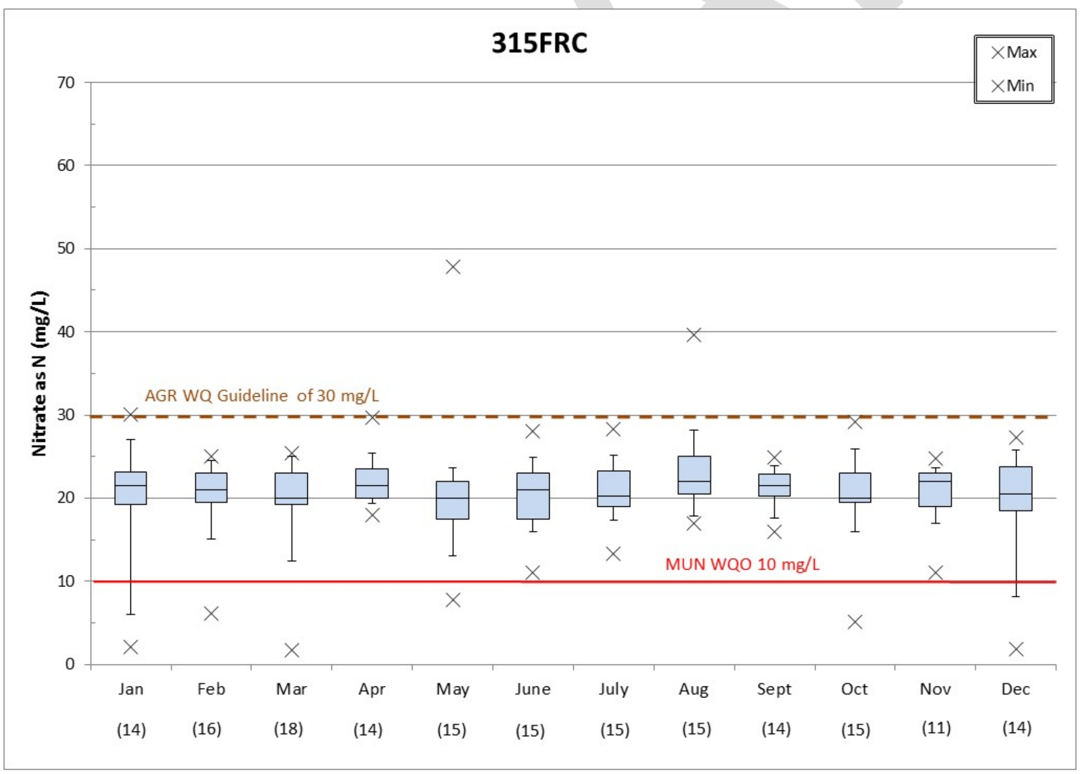


Figure 6-12. Monitoring site 315FRC monthly box plots for nitrate as nitrogen (mg/L).

It is difficult to discern any monthly trends in nitrate concentrations for the two Franklin Creek sites. The uppermost monitoring site (315FMV) displays slightly greater monthly variability than the lowermost site (315FRC), however monthly concentrations are very consistent at both sites indicating very little or no seasonal variability.

6.1.5 *Nitrate wet/dry seasonal trends*

Central Coast Water Board staff categorized nitrate as nitrogen data into wet season (November-April) and dry season (May-October) to evaluate potential seasonal trends. As shown below, seasonal trends for each monitoring site is not evident.

Table 6-5. Summary of seasonal monitoring results for nitrate as nitrogen (mg/L).

Site (Season)	Count	Median	25th	75th	90th	10th	Max	Min	Mean
315SMC (Wet)	15	0.16	0.02	0.81	5.22	0.02	10.70	0.02	1.53
315SMC (Dry)	7	0.02	0.02	0.07	0.11	0.02	0.14	0.02	0.05
315FMV (Wet)	60	26.36	21.20	28.83	34.86	11.58	56.10	0.26	24.96
315FMV (Dry)	52	25.00	20.98	31.53	36.00	19.80	322.0	17.10	32.03
315FRC (Wet)	87	21.0	19.4	23.0	25.0	1.78	30.11	1.72	20.03
315FRC (Dry)	89	21.0	19.0	23.0	26.0	16.0	47.87	5.17	21.20

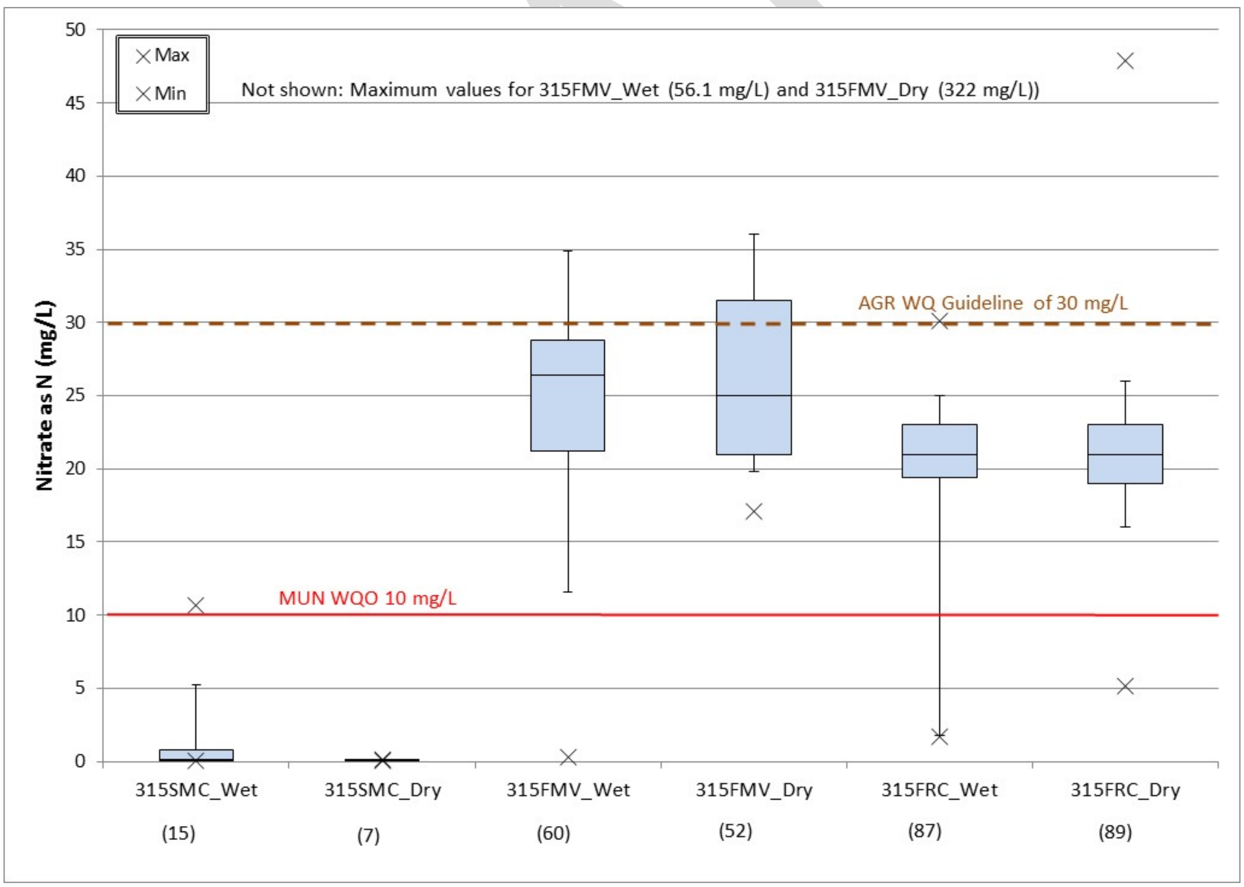


Figure 6-13. Wet and dry season box plots of nitrate as nitrogen concentrations (mg/L).
Note: Wet season (Nov-Apr) and dry season (May-Oct).

6.1.6 *Total nitrogen (mg/L)*

The following data summaries for total nitrogen are provided for informational purposes only because there are no water quality objectives or criteria available for comparison. However the concentrations depicted in this section may be used to evaluate or estimate load calculations.

Table 6-6. Summary of CCAMP/CMP monitoring results for total nitrogen (mg/L).

Station	Dates	Count	Mean	Median	10th	25th	75th	90th	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	20	2.9	0.6	0.16	0.3	1.52	8.17	25.4	0.14
315FMV	1/24/06-3/30/16	36	22.87	24.41	17.15	20.3	26.42	28.0	36.91	0.97
315FRC	1/16/01-9/22/15	137	21.93	22.59	16.85	20.46	24.82	26.95	50.16	2.16

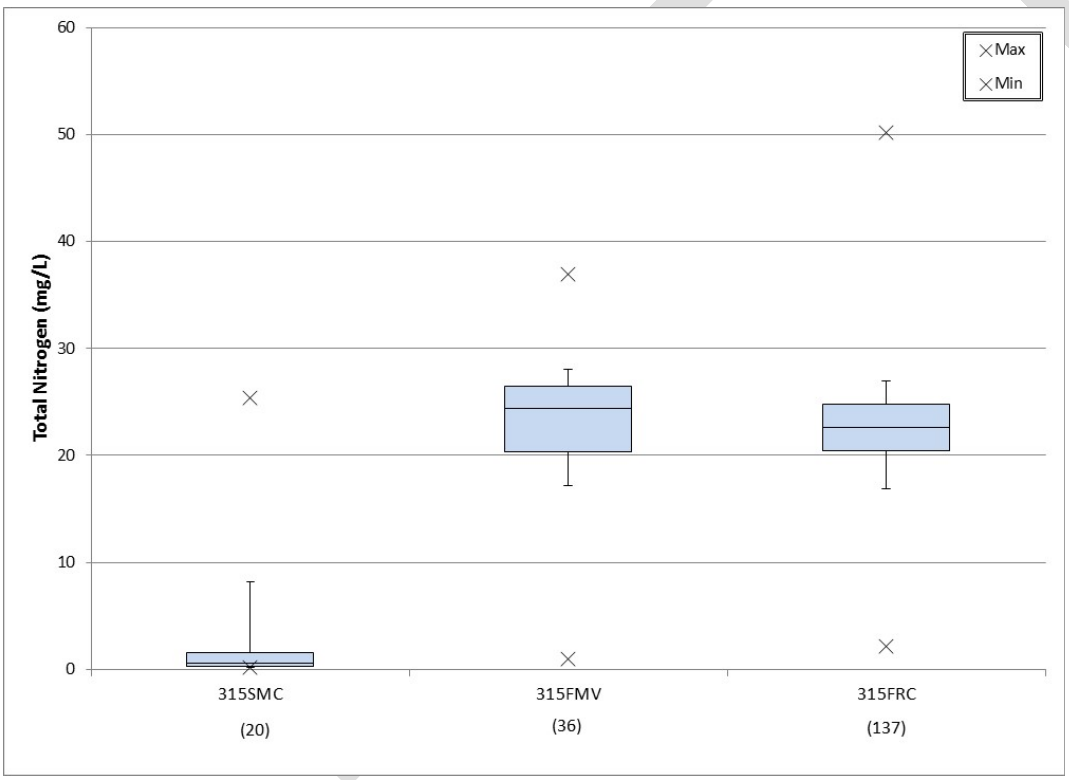


Figure 6-14. Box plots of total nitrogen (mg/L) concentrations

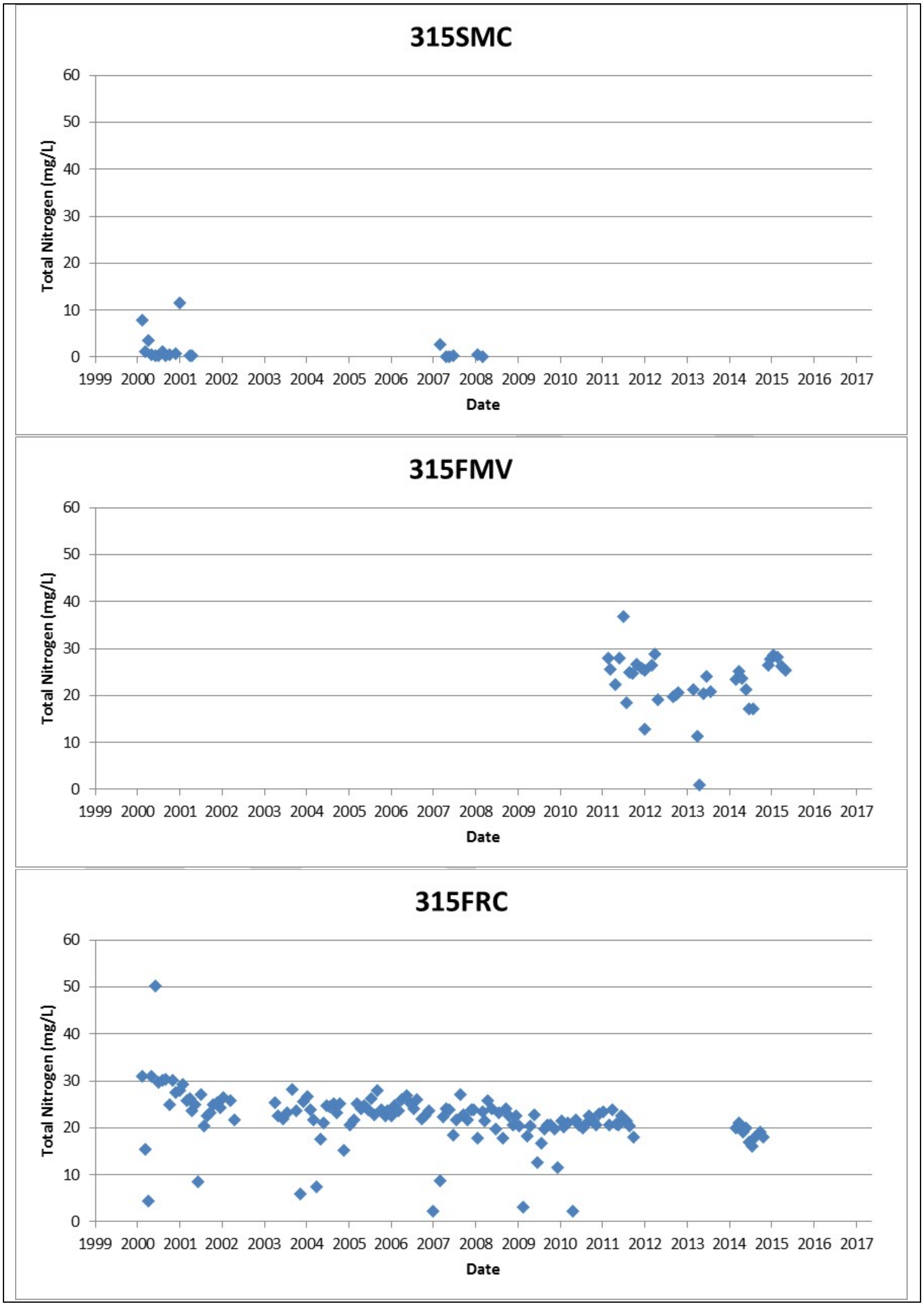


Figure 6-15. Scatter plot of total nitrogen (mg/L) concentrations

6.1.7 *Total nitrogen monthly trends*

Central Coast Water Board staff categorized total nitrogen data by month for site 315FRC to evaluate potential monthly trends. Monthly sample counts for site 315FMV ranged from three to five, too few to be presented in a separate box and whisker graph. As shown below, median values for are relatively consistent throughout all months.

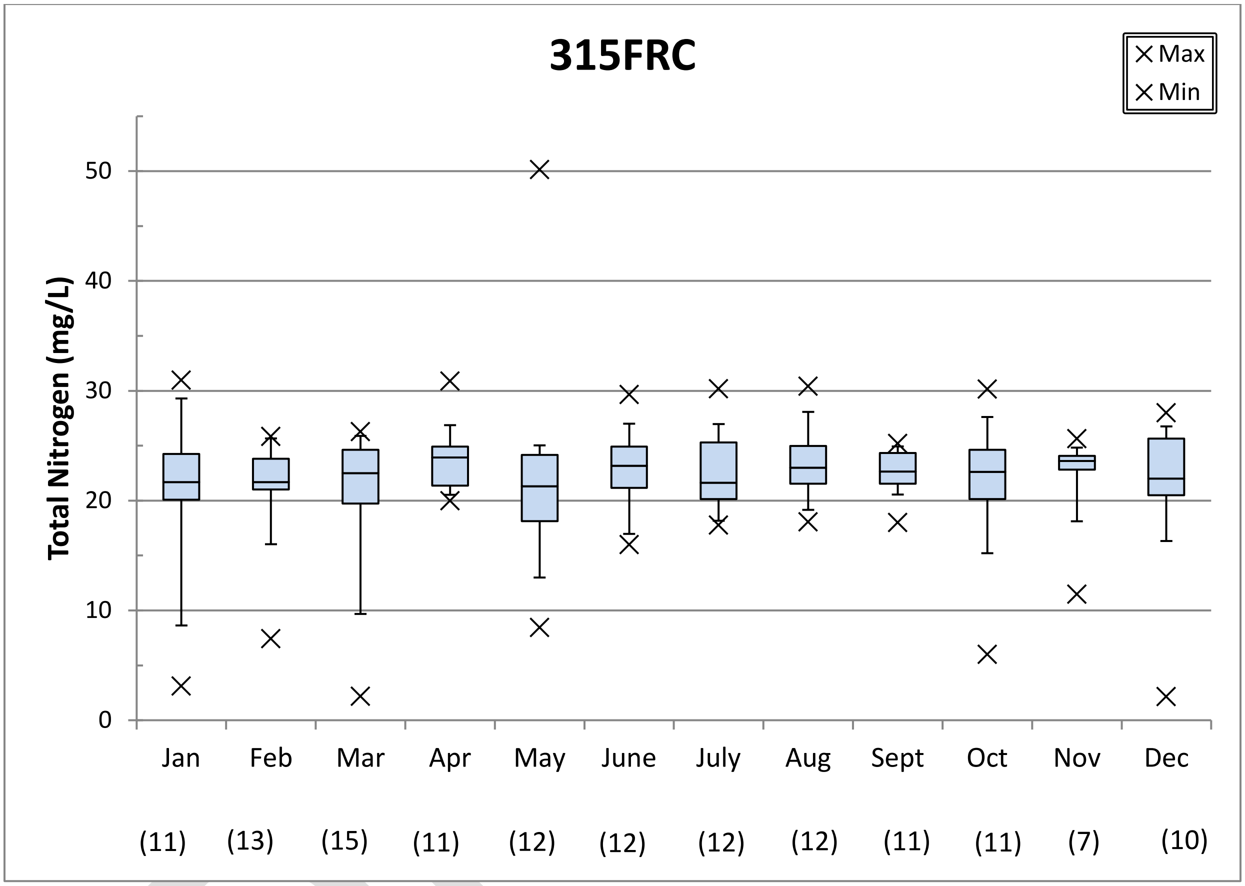


Figure 6-16. Monitoring site 315FRC monthly box plots for total nitrogen (mg/L).

6.1.8 *Orthophosphate as phosphorus (mg/L)*

The following data summaries for orthophosphate are provided for informational purposes only because there are no water quality objectives or criteria available for comparison.

Table 6-7. Summary of CCAMP/CMP monitoring results for orthophosphate as phosphorus (mg/L).

Station	Dates	Count	Mean	Median	10th	25th	75th	90th	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	22	0.164	0.022	0.009	0.010	0.052	0.245	1.538	0.007
315FMV	1/25/06-3/30/16	116	0.323	0.137	0.008	0.030	0.296	0.592	6.240	0.002
315FRC	1/16/01-9/22/15	155	0.147	0.054	0.010	0.018	0.165	0.356	1.900	0.003

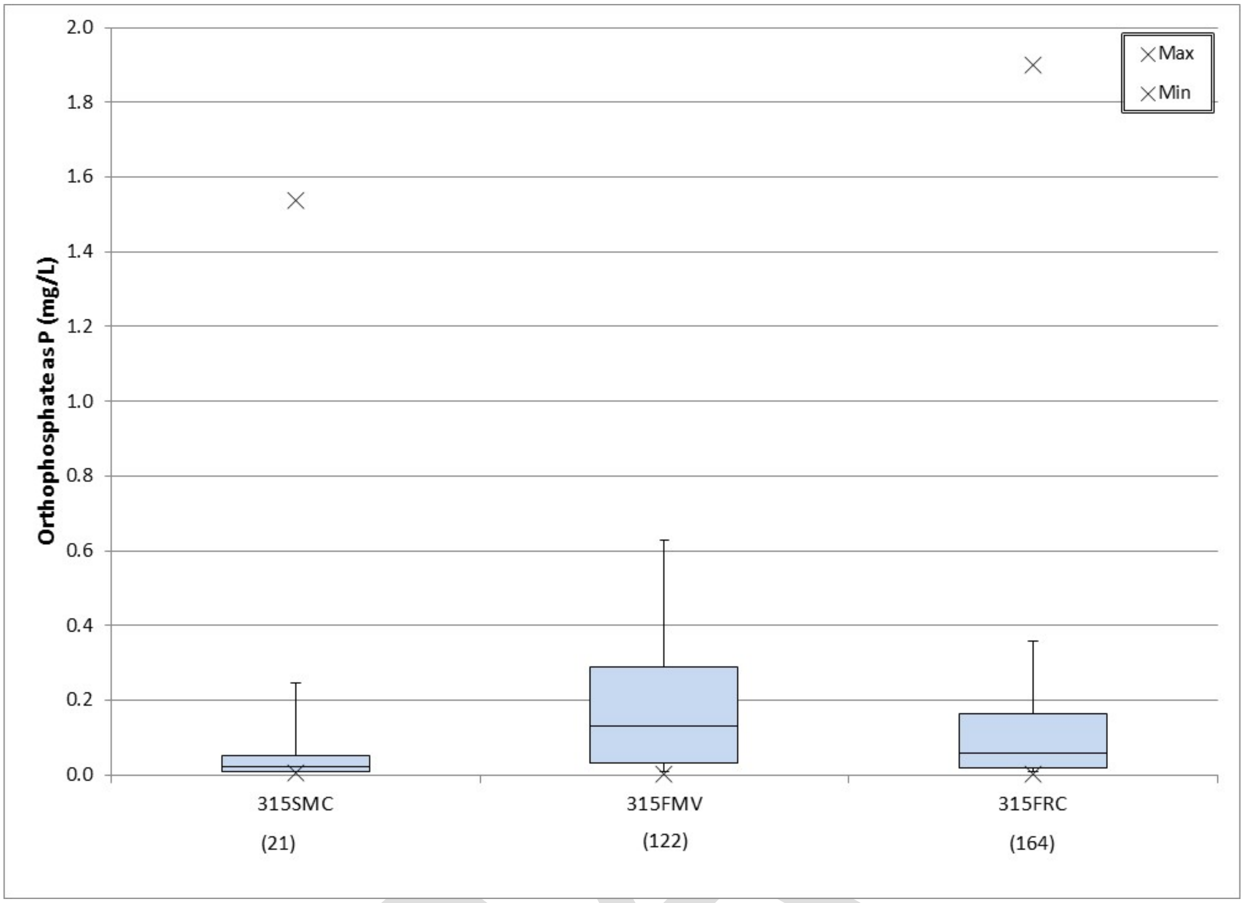


Figure 6-17. Box plots of orthophosphate as phosphorus (mg/L) concentrations.
Not shown for 315FMV: Maximum of 6.24 mg/L on 2/28/2014.

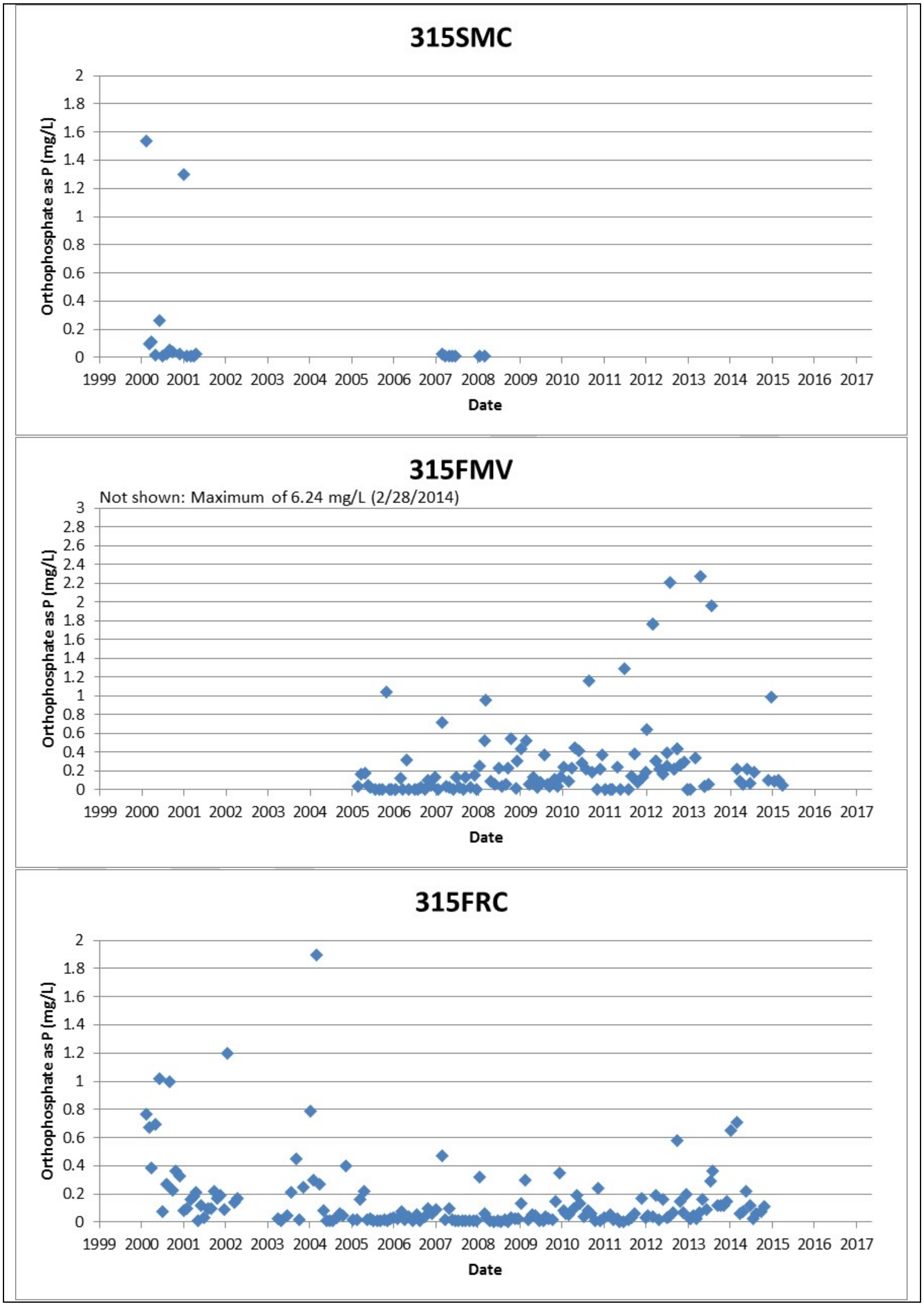


Figure 6-18. Scatter plot of orthophosphate as phosphorus (mg/L) concentrations.

6.1.9 *Total Phosphorus (mg/L)*

The following data summaries for total phosphorus are provided for informational purposes only because there are no water quality objectives or criteria available for comparison. However the concentrations depicted in this section may be used to evaluate or estimate load calculations.

Table 6-8. Summary of CCAMP/CMP monitoring results for total phosphorus (mg/L).

Station	Dates	Count	Mean	Median	10th	25th	75th	90th	Max	Min
315SMC	10/31/01-3/19/02 1/28/08-1/28/09	10	0.187	0.025	0.025	0.025	0.065	0.239	1.5	0.025
315FMV	1/24/06-3/30/16	33	0.415	0.144	0.053	0.083	0.302	1.37	2.61	0.032
315FRC	10/31/01-9/22/15	123	0.219	0.13	0.05	0.075	0.235	0.504	2.3	0.025

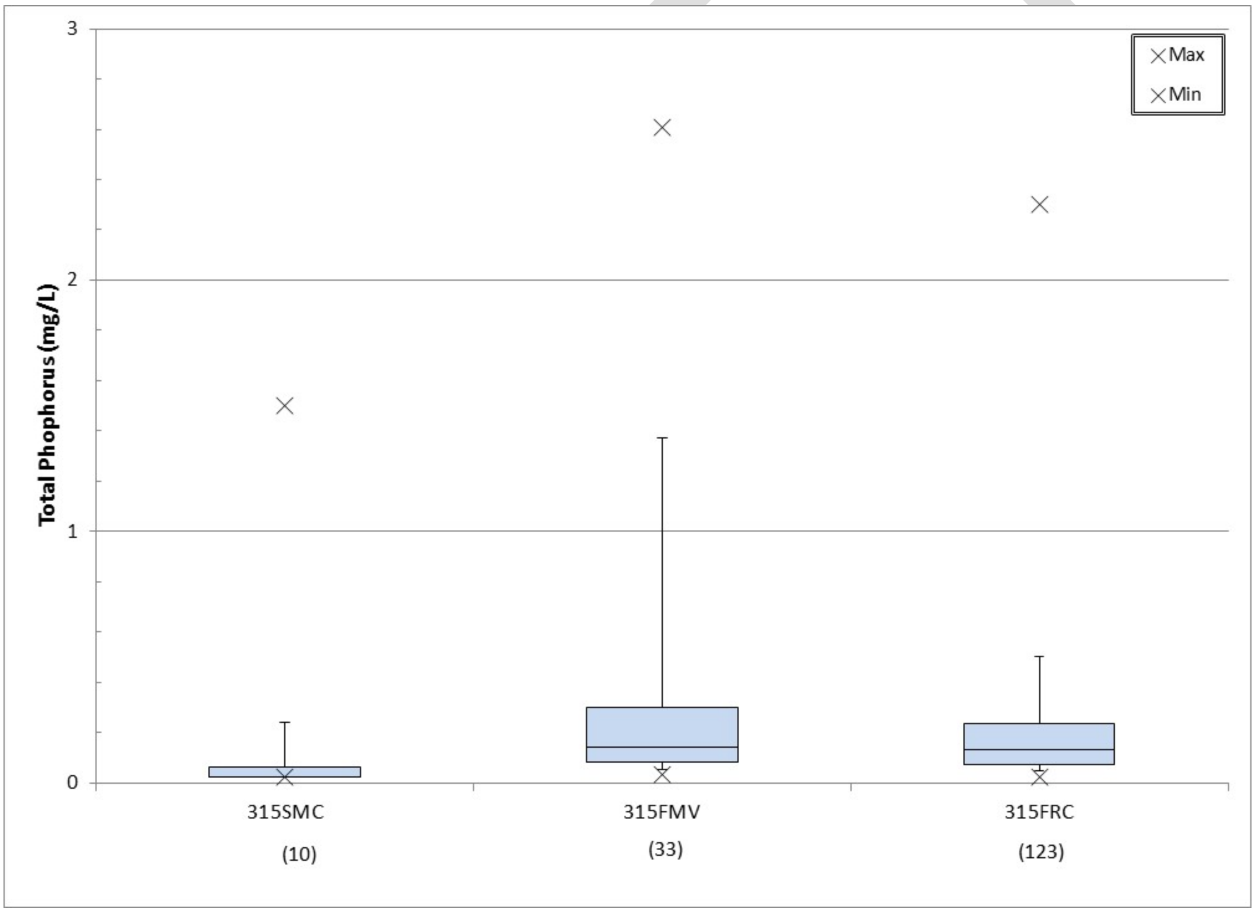


Figure 6-19. Box plots of total phosphorus (mg/L) concentrations.

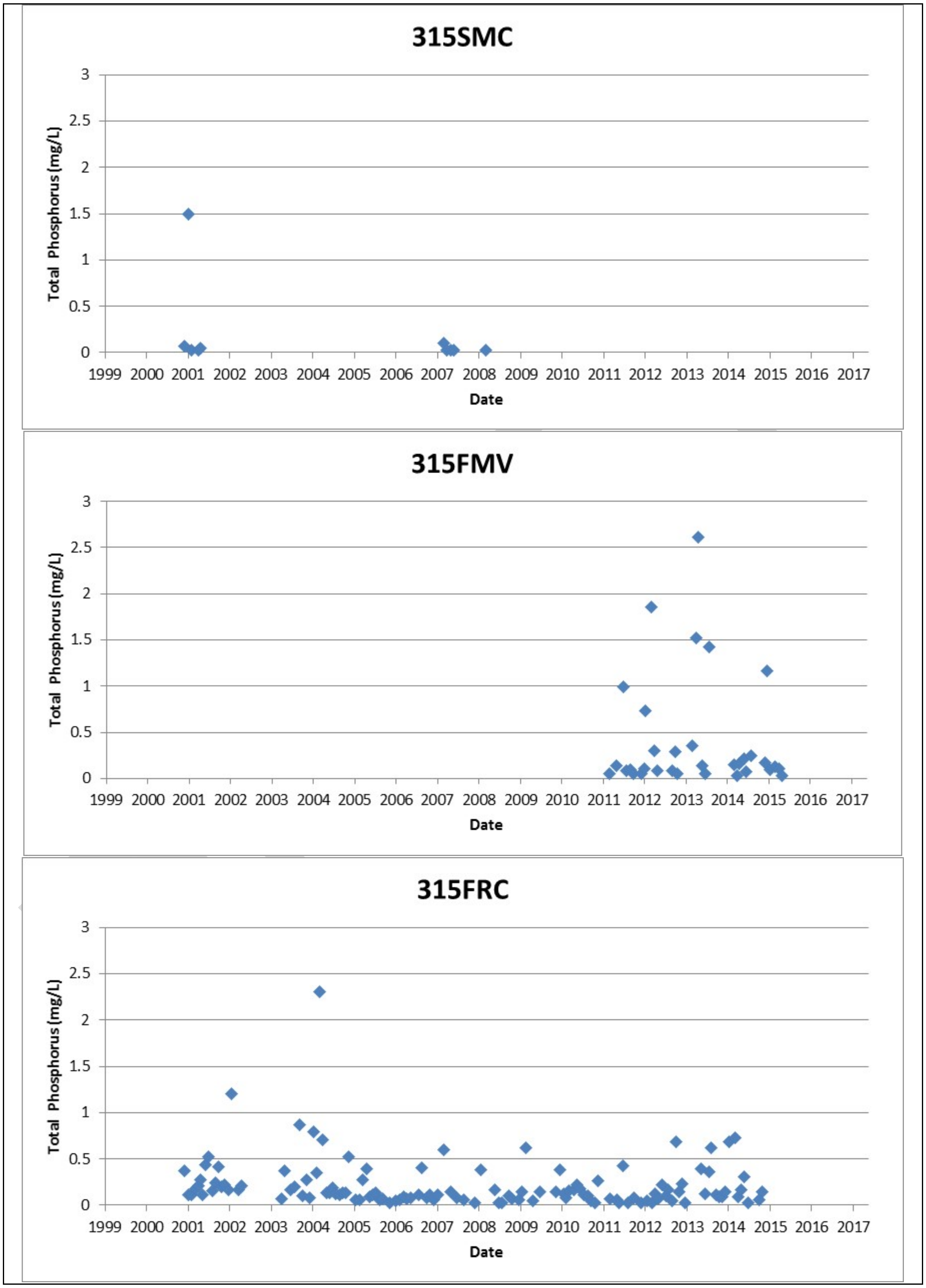


Figure 6-20. Scatter plot of total phosphorus (mg/L) concentrations

6.1.10 *Dissolved oxygen (mg/L)*

As discussed in Section 5.1.5, the Basin Plan requires that in waterbodies designated for WARM habitat, dissolved oxygen concentrations shall not be depressed below 5 mg/L and that in waterbodies designated for COLD and SPWN, dissolved oxygen shall not be depressed below 7 mg/L. In addition, peer-reviewed research in California's central coast region (Worcester et al., 2010) has established an upper limit of 13 mg/L for dissolved oxygen to screen for excessive dissolved oxygen saturation indicative of biostimulatory conditions.

Staff used the above objectives and screening levels to assess dissolved oxygen water quality conditions.

Table 6-9. Summary of CCAMP/CMP monitoring results for dissolved oxygen (mg/L).

Station	Dates	Count	Count < 5 Warm	% < 5 Warm	Count < 7 Cold	% <7 Cold	Count >13	% >13	Median	Mean	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	75	0	0	1	1.3	4	5.3	11.1	11.2	14.4	6.9
315FMV	1/25/06-3/30/16	130	0	0	7	5.4	46	35.4	11.1	12.1	23.9	5.1
315FRC	1/16/01-12/22/16	177	1	0.6	4	2.3	118	66.7	15.3	15.4	28.2	4.7

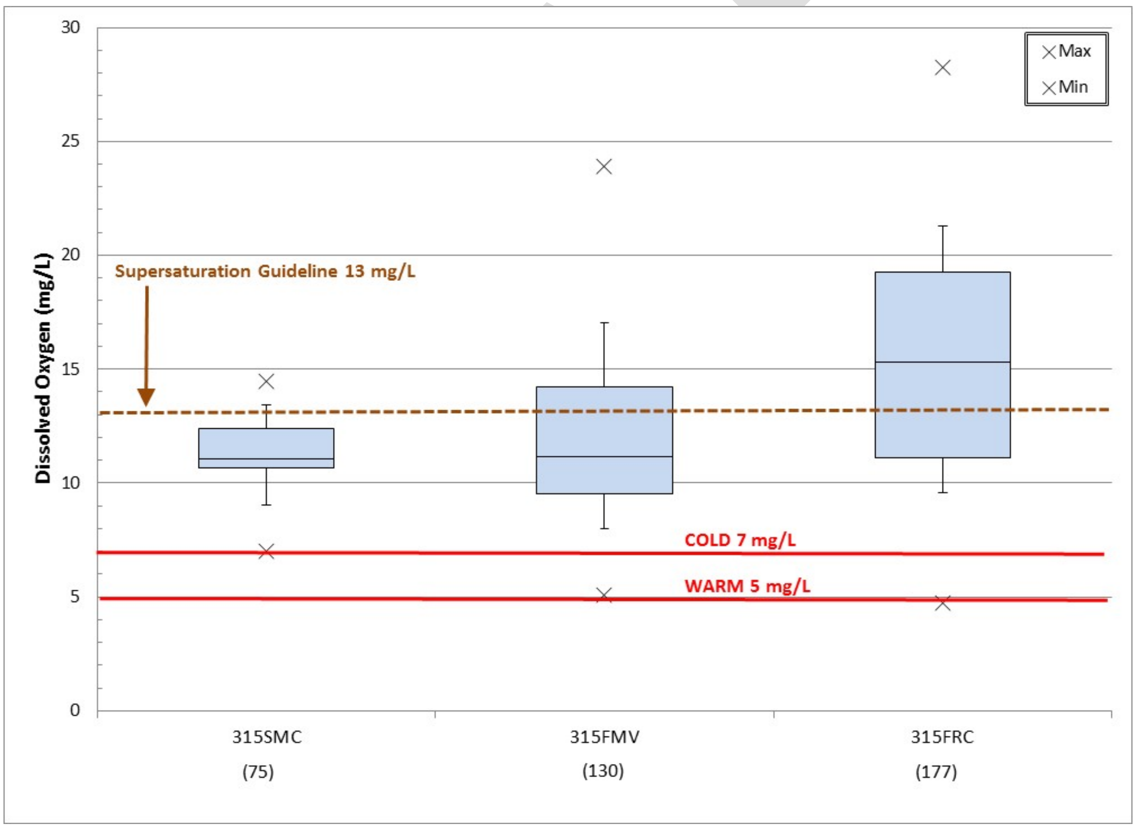


Figure 6-21. Box plots of dissolved oxygen concentrations (mg/L).

Note: Upper and lower red horizontal lines represent dissolved oxygen water quality objectives for COLD (7 mg/L) and WARM (5 mg/L) beneficial uses respectively. Dashed brown horizontal line represents screening level guideline for oxygen supersaturation (13mg/L), above which may be indicative of biostimulatory conditions.

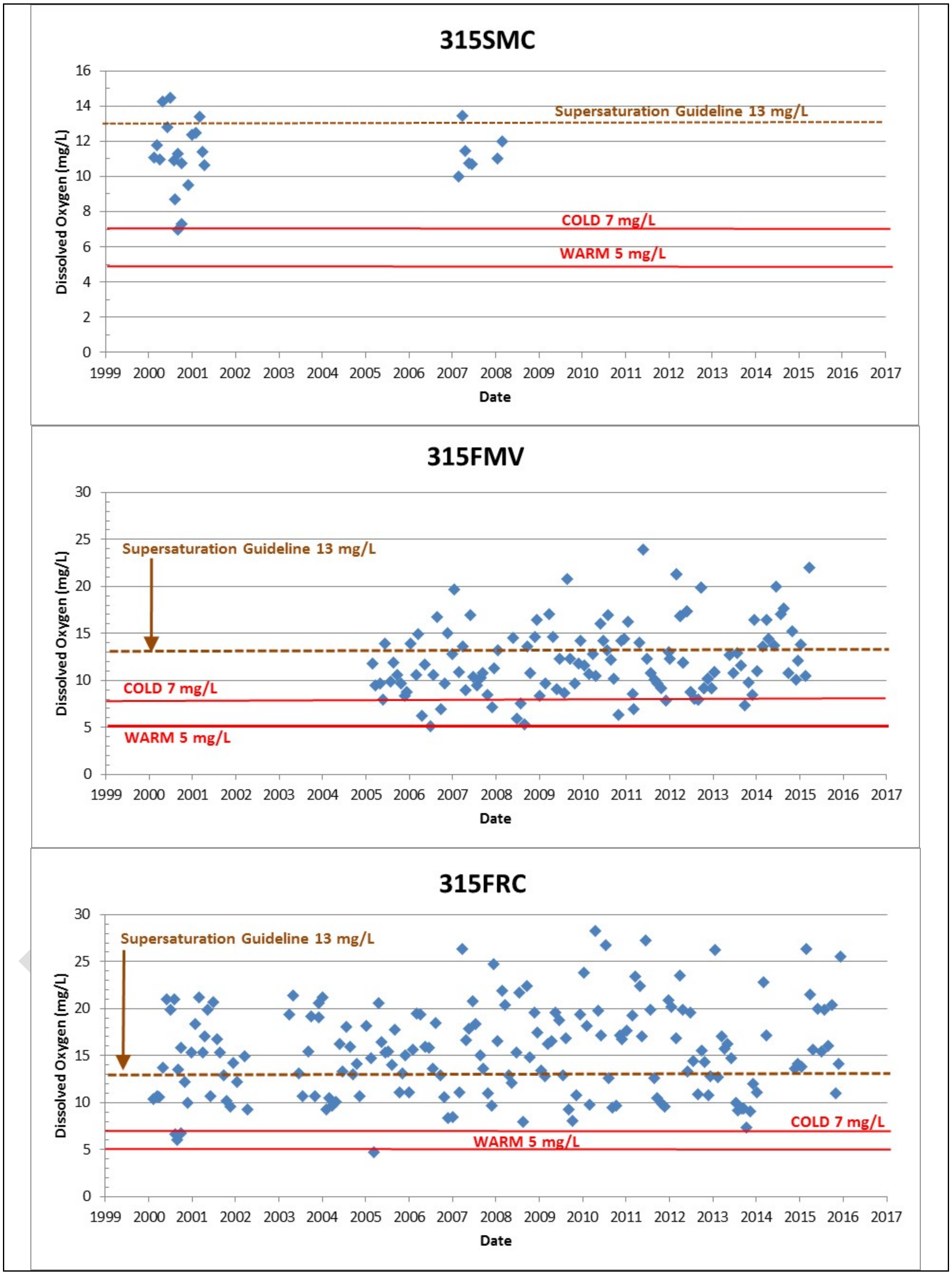


Figure 6-22. Scatter plot of dissolved oxygen concentrations (mg/L).
Note: Upper and lower red horizontal lines represent dissolved oxygen water quality objectives for COLD (7 mg/L) and WARM (5 mg/L) beneficial uses respectively. Dashed brown horizontal line represents screening level guideline for oxygen super-saturation (13mg/L), above which may be indicative of biostimulatory conditions.

Low dissolved oxygen concentrations that are below either the WARM beneficial use water quality objective of 5 mg/L or the COLD beneficial use objective of 7 mg/L are rarely observed at monitoring stations within the Carpinteria Salt Marsh watershed. However, dissolved oxygen super-saturation levels greater than the 13 mg/L screening level are frequently observed at monitoring sites 315FMV and 315FRC. For monitoring site 315FMV the dissolved oxygen super-saturation screening level of 13 mg/L was exceeded in 44 of 124 samples (35%) and for site 315FRC in 104 of 162 samples (64%).

6.1.11 *Dissolved oxygen (% saturation)*

The Basin Plan General Objective, Chapter 3, Section II.A.2 General Objectives for all Inland Surface Waters, Enclosed Bays and Estuaries states the following: Median values for dissolved oxygen should not fall below 85% saturation as a result of controllable conditions.

Although the Basin Plan does not contain water quality objectives associated with dissolved oxygen super-saturation, U.S. EPA has recommended an upper limit of 110% total dissolved gas saturation to protect fish from gas bubble trauma. Gas bubble trauma is sometimes a fatal condition, which occurs when gas bubbles, primarily nitrogen and/or oxygen, are released into the bloodstream and accumulate in the skin, eyes, and gills of fish. It is usually considered a problem for fish in discharge waters from dams, but can also be associated with biostimulatory conditions (Canadian Council of Ministers of the Environment, 1999; Fidler and Miller, 1994). Edsall and Smith (2008) showed gas bubble trauma could be induced with oxygen super-saturation alone.

Table 6-10. Summary of CCAMP monitoring results for dissolved oxygen saturation (%).

Station	Dates	Count	Mean	Median	Max	Min
315SMC	1/16/01-3/19/02 1/28/08-1/28/09	25	117.7	122.8	154.0	72.9
315FMV	1/25/06-3/30/16	130	128.3	114.6	278.6	52.2
315FRC	1/16/01-12/22/16	185	166.8	164.3	357.7	48.1

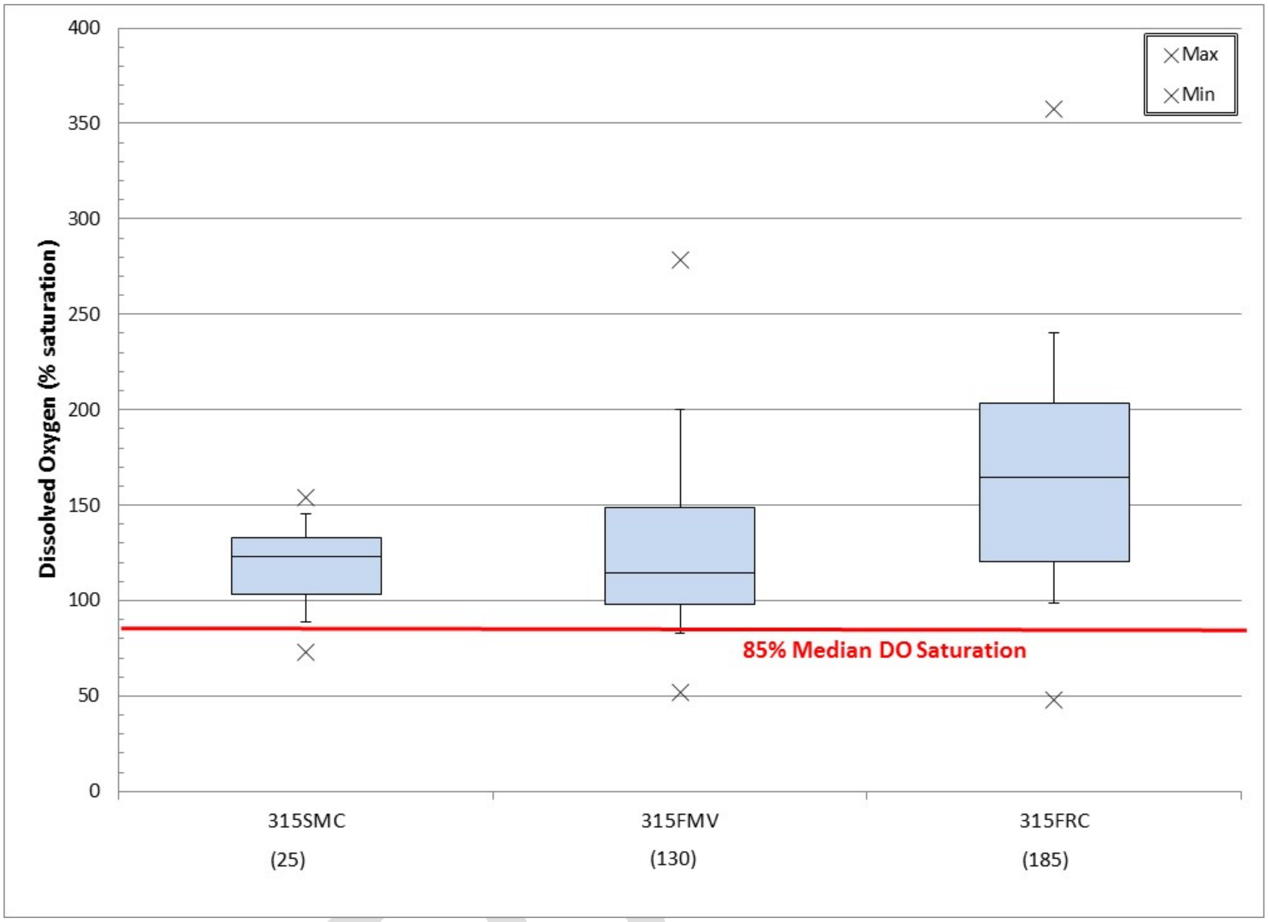


Figure 6-23. Box plots of dissolved oxygen concentrations (% saturation).

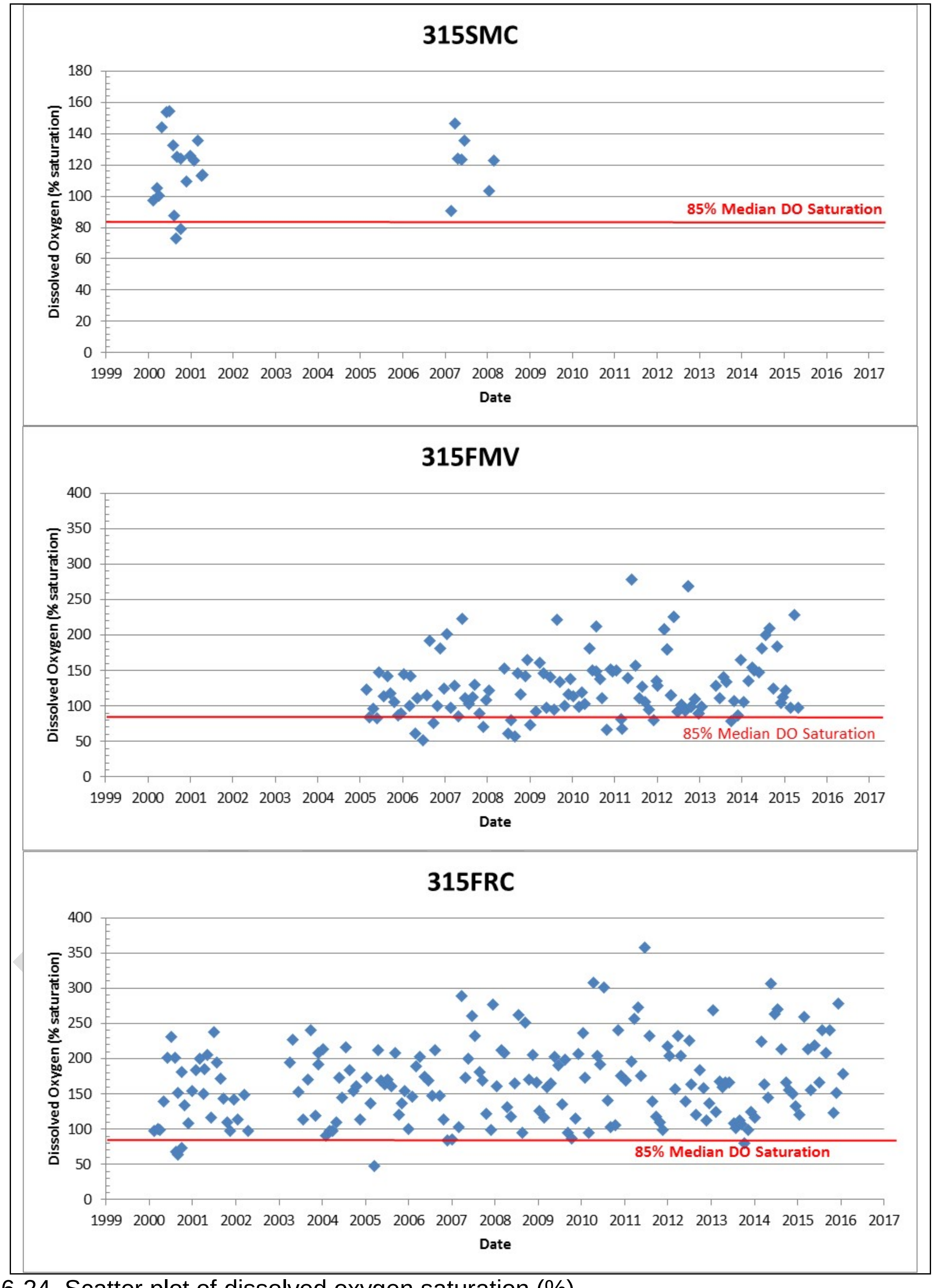


Figure 6-24. Scatter plot of dissolved oxygen saturation (%).

The general water quality objective of 85% median dissolved oxygen saturation is attained for all monitoring sites (see median values in Table 6-10). Single-sample results that exceed (are below) the median water quality objective occur infrequently at Santa Monica Creek site 315SMC and

Franklin Creek site 315FRC and most frequently at the upstream Franklin Creek site 315FMV. The U.S. EPA-recommended upper limit of 110% total dissolved gas saturation is frequently exceeded at the Franklin Creek sites, often double the U.S. EPA upper limit, suggesting oxygen super-saturation associated with biostimulatory conditions.

6.1.12 *Chlorophyll a*

Chlorophyll *a* is an algal biomass indicator however, the Basin Plan does not include numeric water quality objectives or criteria for chlorophyll *a*. Staff considered a range of published numeric criteria. The State of Oregon uses an average chlorophyll *a* concentration of greater than 15 micrograms per liter (μg/L) as a criterion for nuisance phytoplankton growth in lakes and rivers[31]. The state of North Carolina has set a maximum acceptable chlorophyll *a* standard of 15 μg/L for cold water (lakes, reservoir, and other waters subject to growths of macroscopic or microscopic vegetation designated as trout waters), and 40 μg/L for warm water (lakes, reservoir, and other waters subject to growths of macroscopic or microscopic vegetation not designated as trout waters)[32]. A chlorophyll *a* concentration of 8 μg/L is recommended as a threshold of eutrophy for plankton in EPA's Nutrient Criteria Technical Guidance Manual for Rivers and Streams (USEPA, 2000a). Central Coast Water Board staff currently uses 40 μg/L as stand-alone evidence to support chlorophyll *a* listing recommendations for the 303(d) list.

Table 6-11. Summary of CCAMP monitoring results for chlorophyll *a* (µg/L) concentrations.

Station	Dates	Count	Count > 40	% > 40	Median	Mean	Max	Min
315SMC	1/16/01-3/4/02 1/28/08-1/28/09	21	0	0	2	3.7	19.5	0.0
315FMV	1/25/06-3/30/16	111	4	3.6	4.3	8.8	65.2	0.0
315FRC	1/16/01-9/22/15	159	6	3.8	3.3	8.9	209.8	0.0

Chlorophyll *a* concentrations exceeding the 40 µg/L criteria are rarely observed at the monitoring sites.

[31] Oregon Administrative Rules (OAR). 2000. Nuisance Phytoplankton Growth. Water Quality Program Rules, 340-041-0150.
[32] North Carolina Administrative Code 15A NCAC 02B .0211(3)(a).

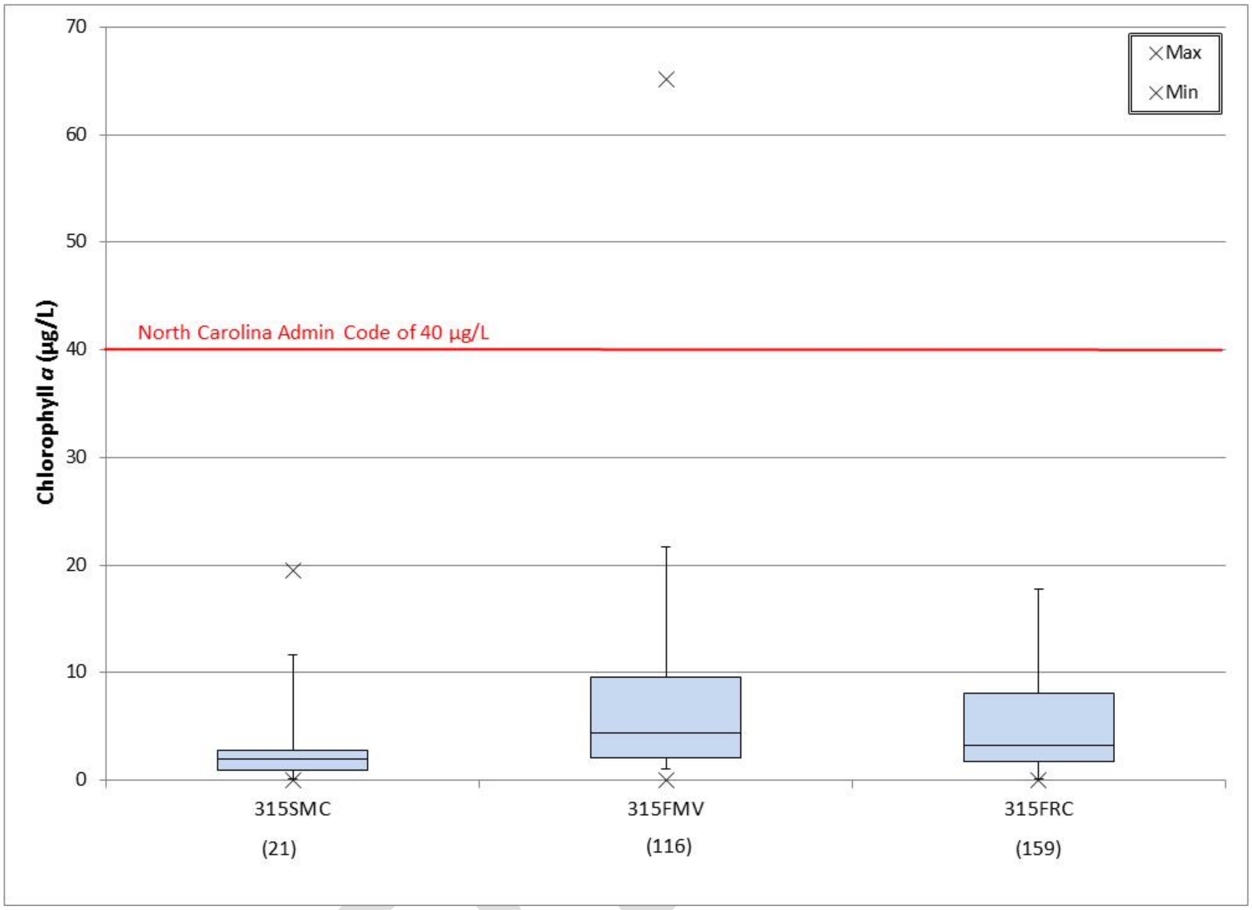


Figure 6-25. Box plots of chlorophyll *a* (µg/L) concentrations.
Note: Not shown for 315FRC is a maximum concentration of 209.8 µg/L.

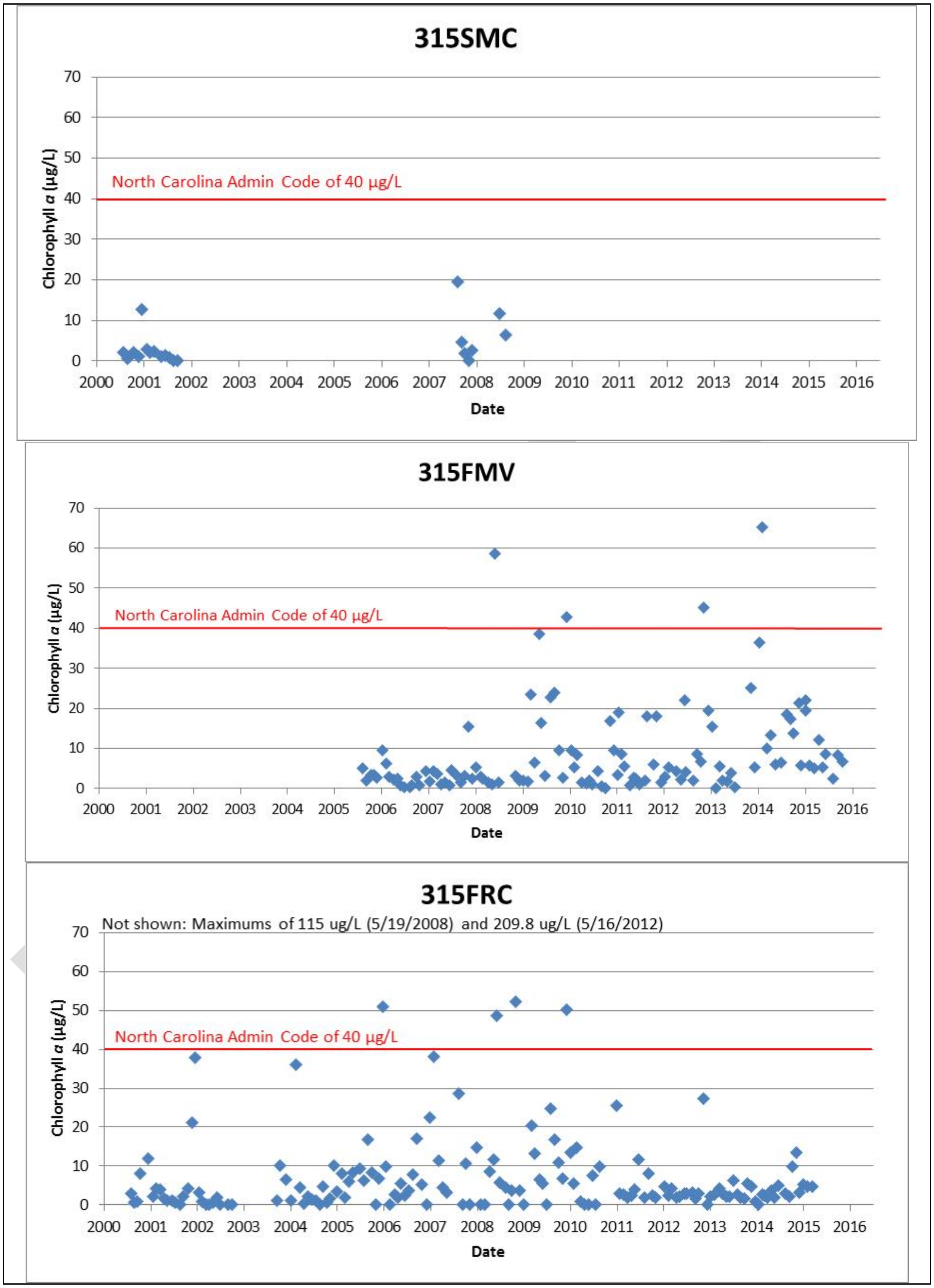


Figure 6-26. Scatter plot of chlorophyll *a* concentrations (µg/L).
Not shown for 315FRC: Maximums of 115 µg/L (5/19/2008) and 209.8 µg/L (5/16/2012).

6.1.13 *Floating algae*

CCAMP records a visual estimate of floating algae (% coverage) which may be used as an indicator of algal biomass. One or more observations of 50% cover or greater may be used as supporting evidence of potential nutrient over-enrichment and biostimulation (Worcester et al., 2010).

Table 6-12. Summary of CCAMP monitoring results for floating algae (% coverage).

Station	Dates	Count of observations	Count floating algae observed	Count observed floating algae =>50% coverage	Mean algae % coverage	Max algae % coverage
315SMC	1/28/08-1/28/09	7	1	0	1.4	10
315FMV	1/25/06-12/17/13	60	52	30	43	95
315FRC	1/6/05-2/25/15	119	56	13	13.5	85

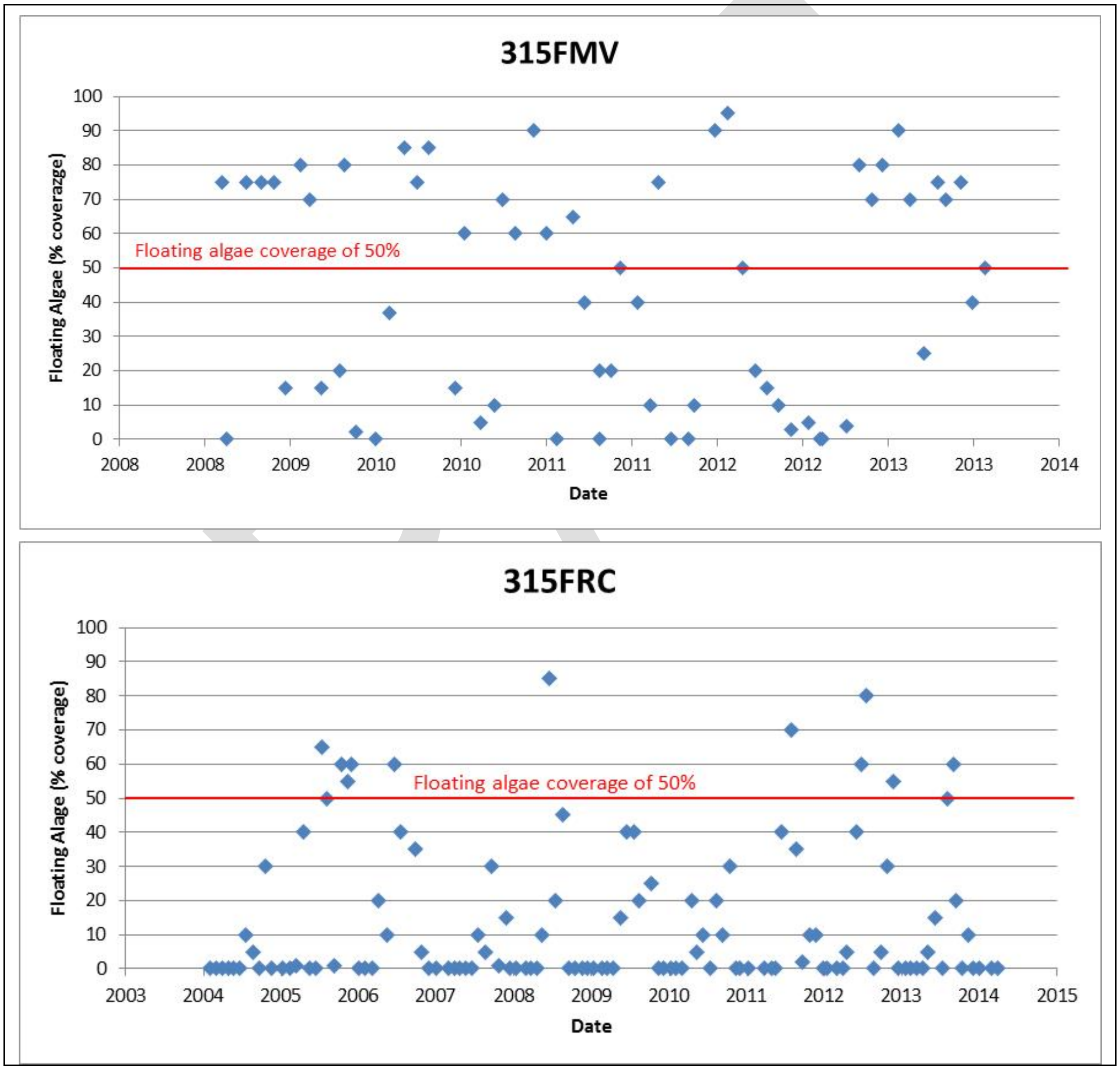


Figure 6-27. Scatter plot of floating algae (% coverage).

Note: Santa Monica Creek site 315SMC not shown due to few observations.

Estimates of floating algae exceeded the 50% coverage in 30 of the 60 observations (50% of observations) for monitoring site 315 FMV and in 13 of 119 observations (11% of observations) for site 315FRC, providing supporting evidence of potential nutrient over-enrichment and biostimulatory conditions.

6.1.14 *Photo Documentation of CCAMP/CMP Monitoring Sites*

August 2012 (upstream)


July 2013 (upstream)


July 2013 (downstream)


August 2014 (downstream)

Figure 6-28. Photos of Franklin Creek monitoring site 315FMV.
Photo credits: Tetra Tech, Inc. staff

September 2010 | May 2013 | October 2014 | September 2015

Figure 6-29. Photos of Franklin Creek monitoring site 315FRC.
Photo credits: CCAMP staff

6.2 Santa Barbara Channelkeeper Water Quality Data

Locations of Santa Barbara Channelkeeper (SBCK) water quality monitoring sites are shown in Figure 6-30 and a description of site locations are contained in Table 6-13. Note that SBCK monitoring site CM01 represents a culvert discharge south of Highway 101 and north of the railroad (see Figure 6-31 for photograph of monitoring site CM01). Water from the Highway 101 culvert then enters a railroad culvert before discharging into the Carpinteria Salt Marsh. Staff is currently investigating the origin of this culvert discharge due to extremely high nitrate concentrations.

Figure 6-30. Locations of SBCK monitoring sites.

Table 6-13. Description of SBCK monitoring site locations.

Program	Site ID	Site Description	Locational Notes
SBCK	CM01	Carpinteria Marsh at Railroad	Culvert discharge location
SBCK	SM01	Santa Monica Creek at Via Real	Same as CCAMP site 315SMC
SBCK	FK00	Franklin Creek at Carpinteria Avenue	Same as CCAMP site 315FRC

Figure 6-31. Photo of SBCK site CM01.
Photo Credit: Water Board staff on December 1, 2015.

6.2.1 *SBCK nitrate as nitrogen (mg/L)*

Table 6-14. Summary of SBCK monitoring results for nitrate as nitrogen (mg/L).

Station	Dates	Count	Count >10	% >10	Count >30	% >30	Median	Mean	Max	Min
CM01	4/30/11 - 10/30/12	12	9	75.0	9	75.0	51.7	52.9	122.6	0.0
SM01	4/30/11 - 6/20/12	10	1	10.0	0	0	0.0	2.1	21.0	0.0
FK00	3/7/10 - 10/30/12	12	10	83.3	0	0	20.3	18.1	25.8	0.0

For the Carpinteria Marsh culvert site (CM01), 9 of 12 samples (75%) exceeded the water quality objective for municipal supply (MUN) and the water quality guideline for agricultural supply (AGR). For Santa Monica Creek (SM01), 1 of 10 samples (10%) exceeded the water quality objective for municipal supply. Finally, for Franklin Creek (FK00), ten of 12 samples (83%) exceeded the water quality objective for municipal supply (MUN).

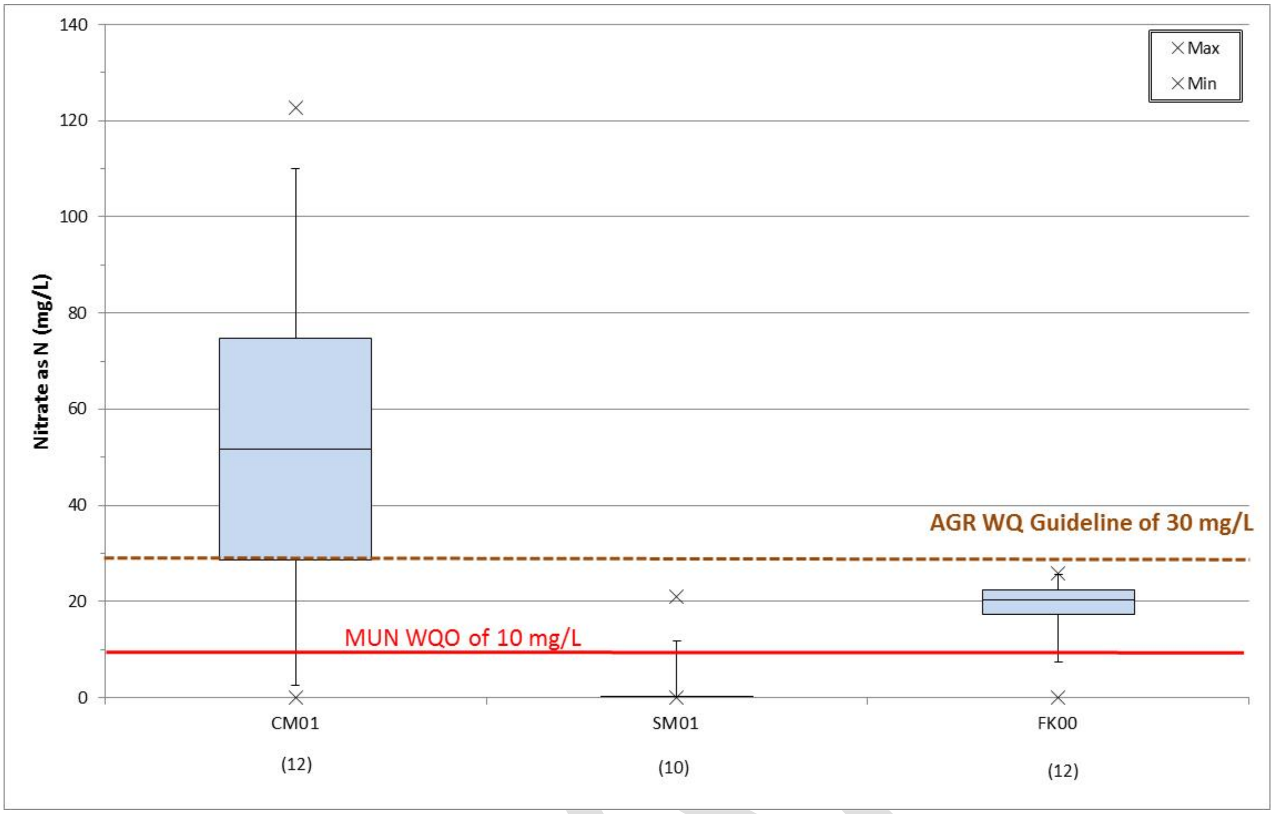


Figure 6-32. Box plots of SBCK nitrate as nitrogen concentrations (mg/L).

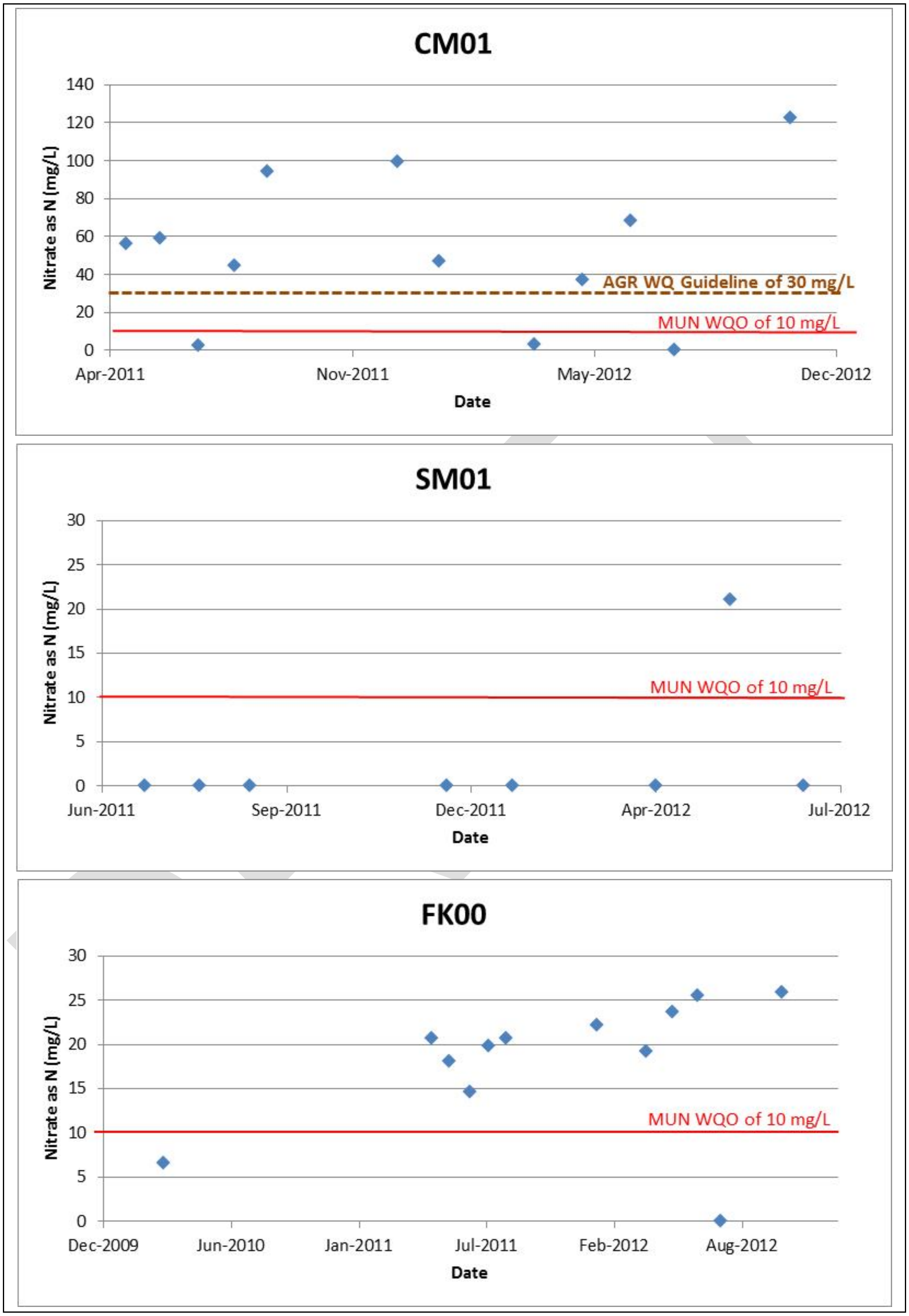


Figure 6-33. Scatter plot of SBCK nitrate as nitrogen concentrations (mg/L).
Note. Note that the vertical axis is different for the marsh and creek sites.

As shown in the figures above, the MUN beneficial use water quality objective (10 mg/L nitrate as nitrogen) is often exceeded at the Carpinteria Marsh culvert site (CM01) and Franklin Creek (FK00) monitoring stations, and only once exceeded at Santa Monica Creek site (SM01). Though the frequency of exceedances occurred more often for the Franklin Creek site (83% compared to 75% for FK00 and CM01 respectively), the magnitude of exceedances of nitrate as nitrogen concentrations was much greater for the marsh culvert site (median value 51.7 mg/L, maximum value 122.6 mg/L) compared to the creek site (median value 20.3 mg/L, maximum value 25.8 mg/L) suggesting a higher input at the marsh culvert site (Table 6-14 and Figure 6-32). Furthermore, when an exceedance was measured, the nitrate as nitrogen concentrations at the Carpinteria Marsh culvert site (CM01) were at least three times greater than the water quality objective for the MUN beneficial use (Figure 6-33).

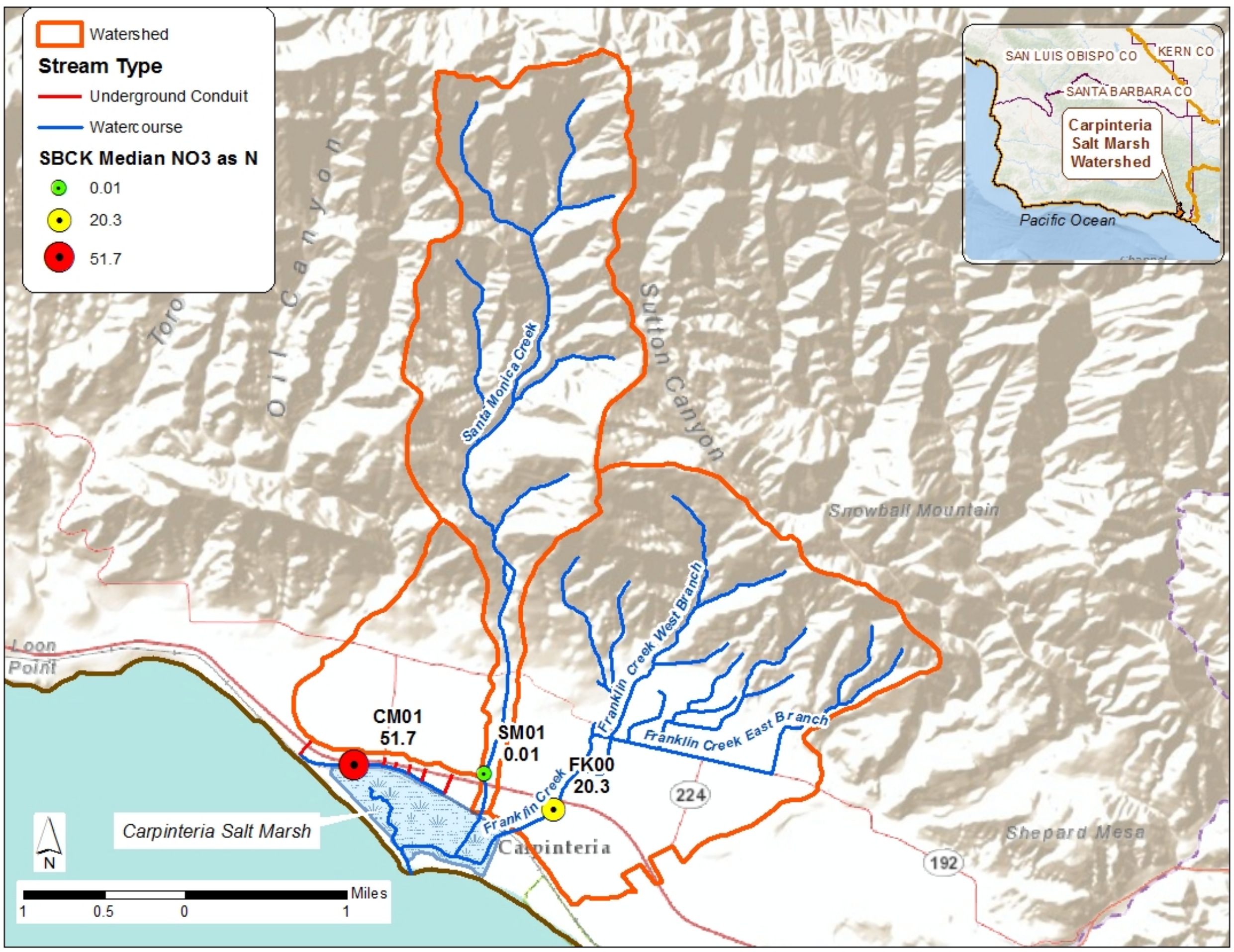


Figure 6-34. Median nitrate as nitrogen concentrations for SBCK monitoring sites.

6.2.2 *SBCK dissolved oxygen concentrations (mg/L)*

Staff evaluated dissolved oxygen conditions based on water quality objectives for COLD (no less than 7 mg/L), WARM and SPWN (no less than 5 mg/L), and the oxygen saturation guideline (Worcester et al., 2010) of no greater than 13 mg/L. For more information on the dissolved oxygen evaluation criteria see Sections 5.1.5 and 6.1.10.

Table 6-15. Summary of SBCK monitoring results for dissolved oxygen (mg/L).

Station	Dates	Count	Count < 5 Warm	% < 5 Warm	Count < 7 Cold	% <7 Cold	Count >13	% >13	Median	Mean	Max	Min
CM01	1/16/01-3/19/02 1/28/08-1/28/09	42	7	16.67	14	33.33	4	9.52	8.55	8.71	20.8	1.87
SM01	1/25/06-9/30/15	27	0	0	1	3.70	4	14.81	11.45	10.85	15.2	6.85
FK00	1/16/01-2/25/15	46	1	2.17	7	15.22	31	67.39	16.59	15.80	36.2	0.37

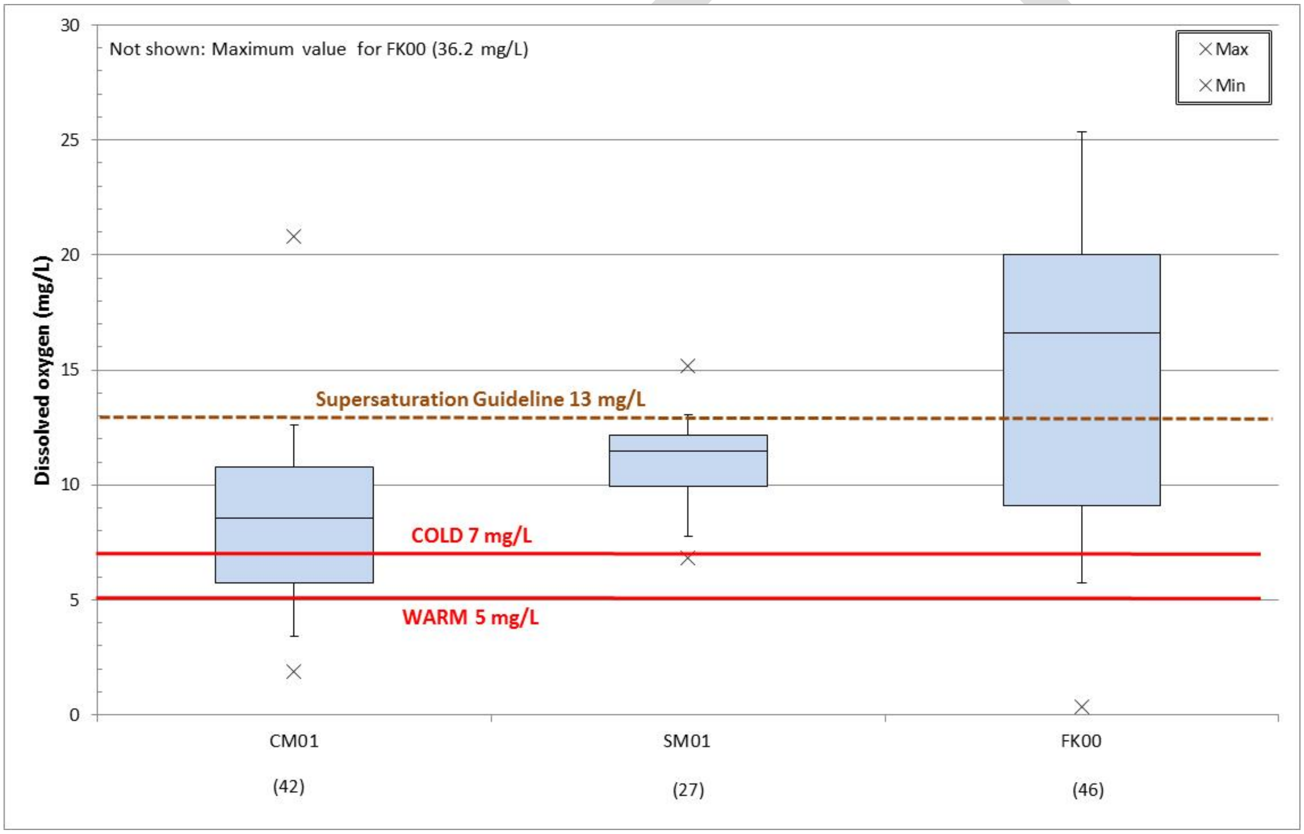


Figure 6-35. Box plots of SBCK dissolved oxygen concentrations (mg/L).

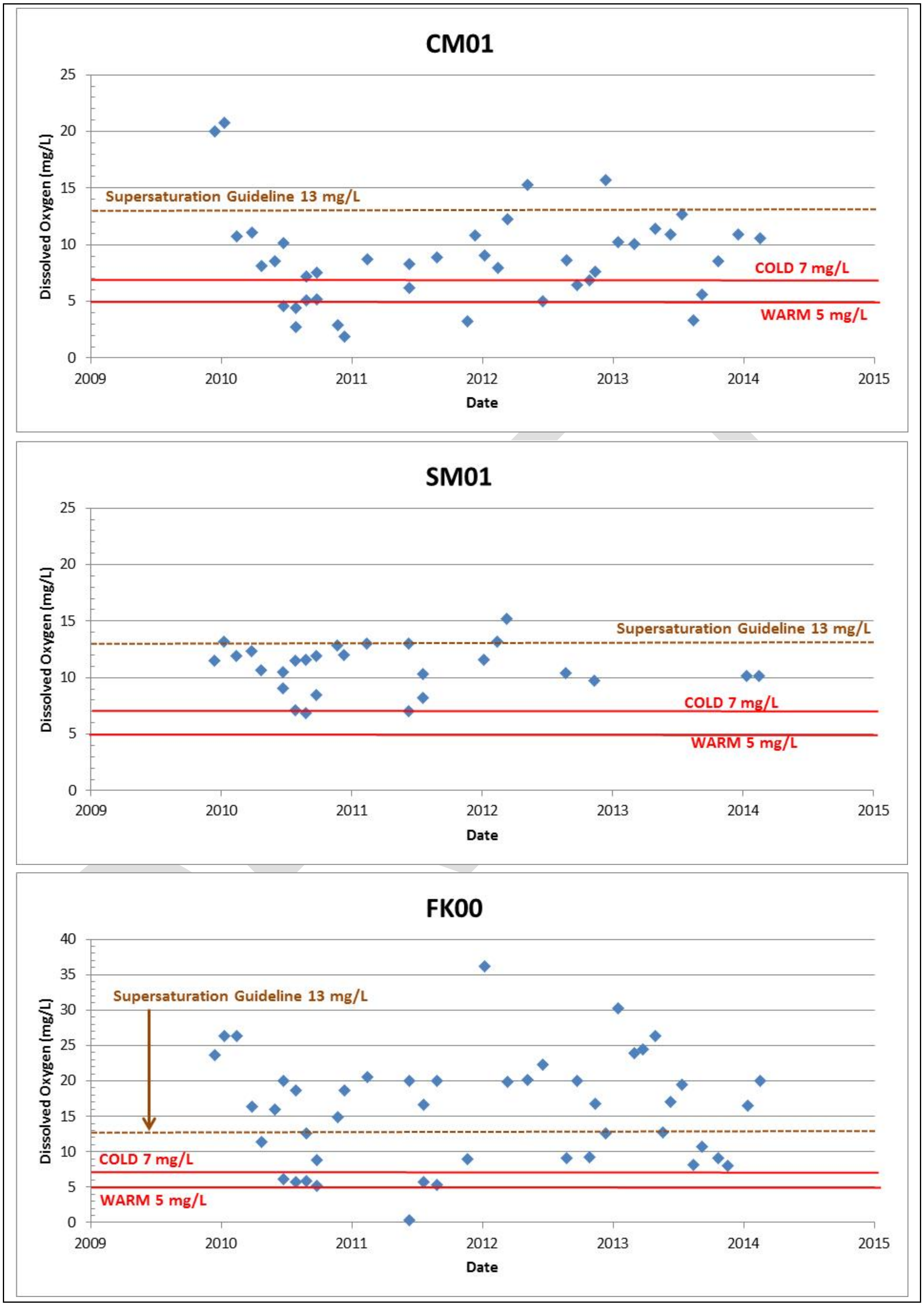


Figure 6-36. Scatter plot of SBCK dissolved oxygen concentrations (mg/L).

Low dissolved oxygen concentrations that do not meet (are below) both the WARM beneficial use water quality objective of 5 mg/L and the COLD beneficial use objective of 7 mg/L are observed at the Carpinteria Marsh culvert site CM01 whereby 7 out of 42 samples (17%) do not meet (are below) the WARM objective of 5 mg/L and 14 out of 42 samples (33%) do not meet (are below) the COLD objective of 7 mg/L. Franklin Creek site FK00 does not meet (is below) the COLD beneficial use objective of 7 mg/L for 7 out of 46 samples (15%).

Dissolved oxygen supersaturation levels greater than the 13 mg/L screening level guideline are frequently observed at Franklin Creek monitoring site FK00 where 31 out of 46 samples (67%) exceeded this screening level.

6.2.3 *SBCK dissolved oxygen (% saturation)*

The Basin Plan General Objective, Chapter 3, Section II.A.2 General Objectives for all Inland Surface Waters, Enclosed Bays and Estuaries states the following: Median values for dissolved oxygen should not fall below 85% saturation as a result of controllable conditions.

Although the Basin Plan does not contain water quality objectives associated with dissolved oxygen supersaturation, U.S. EPA has recommended an upper limit of 110% total dissolved gas saturation to protect fish from gas bubble trauma (see Section 6.1.11).

Table 6-16. Summary of SBCK monitoring results for dissolved oxygen saturation (%).

Station	Dates	Count	Count <85	% <85	Median	Mean	Max	Min
CM01	11/13/10-11/15/14	43	17	39.5	94.5	96.4	239.9	19.0
SM01	11/13/10-1/17/15	28	3	10.7	115.7	122.9	296.7	73.0
FK00	11/13/10-12/13/14	44	7	15.9	181.3	176.1	396.6	3.8

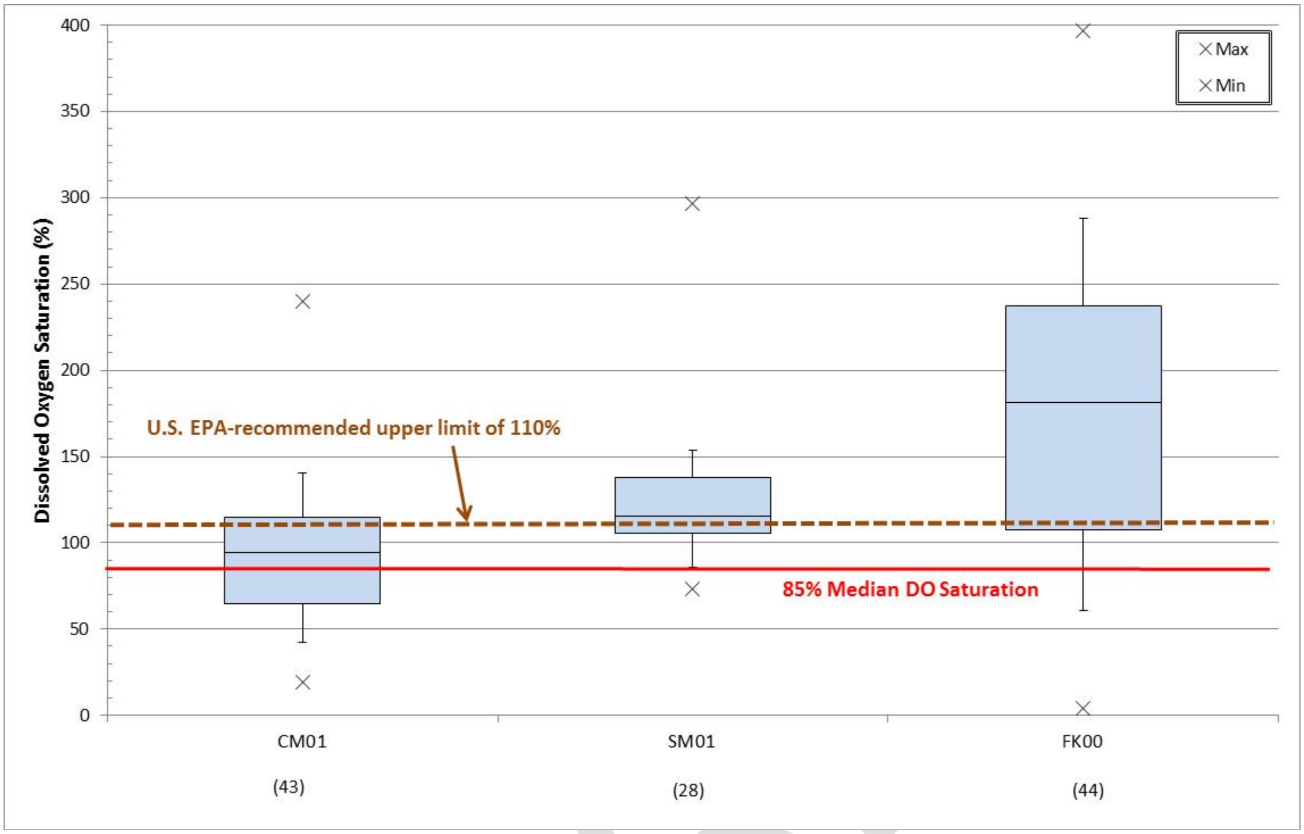


Figure 6-37. Box plots of SBCK dissolved oxygen concentrations (% saturation).

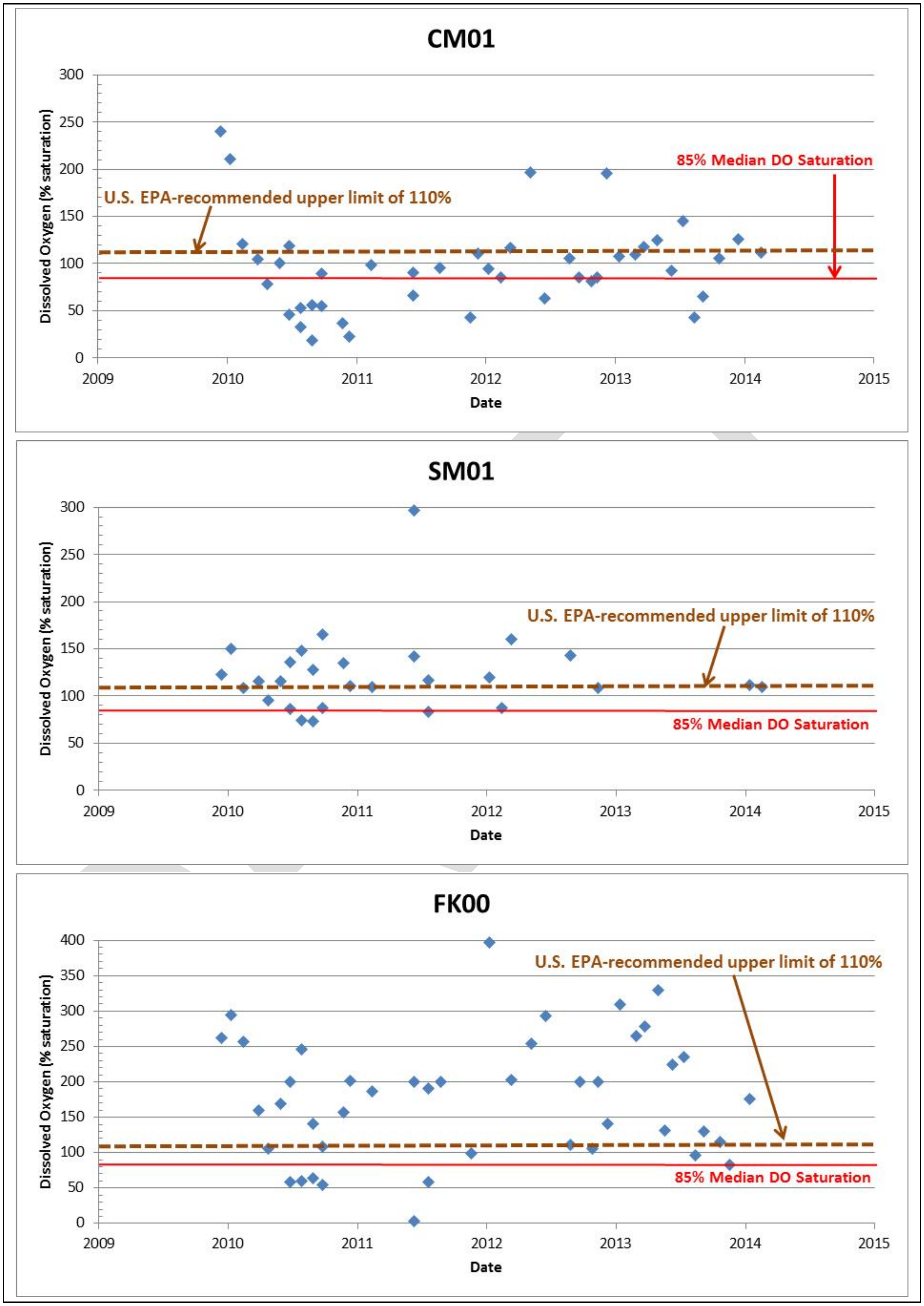


Figure 6-38. Scatter plot of SBCK dissolved oxygen concentrations (mg/L).

The general water quality objective of 85% median dissolved oxygen saturation is attained for all monitoring sites (see median values in Table 6-16). However all three sites maintain single-sample results that exceed (are below) the water quality objective. The U.S. EPA-recommended upper limit of 110% total dissolved gas saturation is most often exceeded at the Franklin Creek site FK00, suggesting oxygen supersaturation associated with biostimulatory conditions.

6.3 Groundwater Quality

Central Coast Water Board staff obtained nitrate groundwater quality data from the irrigated lands regulatory program (ILRP) and from the groundwater ambient monitoring and assessment program (GAMA). Maximum groundwater nitrate concentrations reported through the ILRP monitoring program are shown in Figure 6-39 while maximum nitrate concentrations in drinking water supply wells are shown in Figure 6-40.

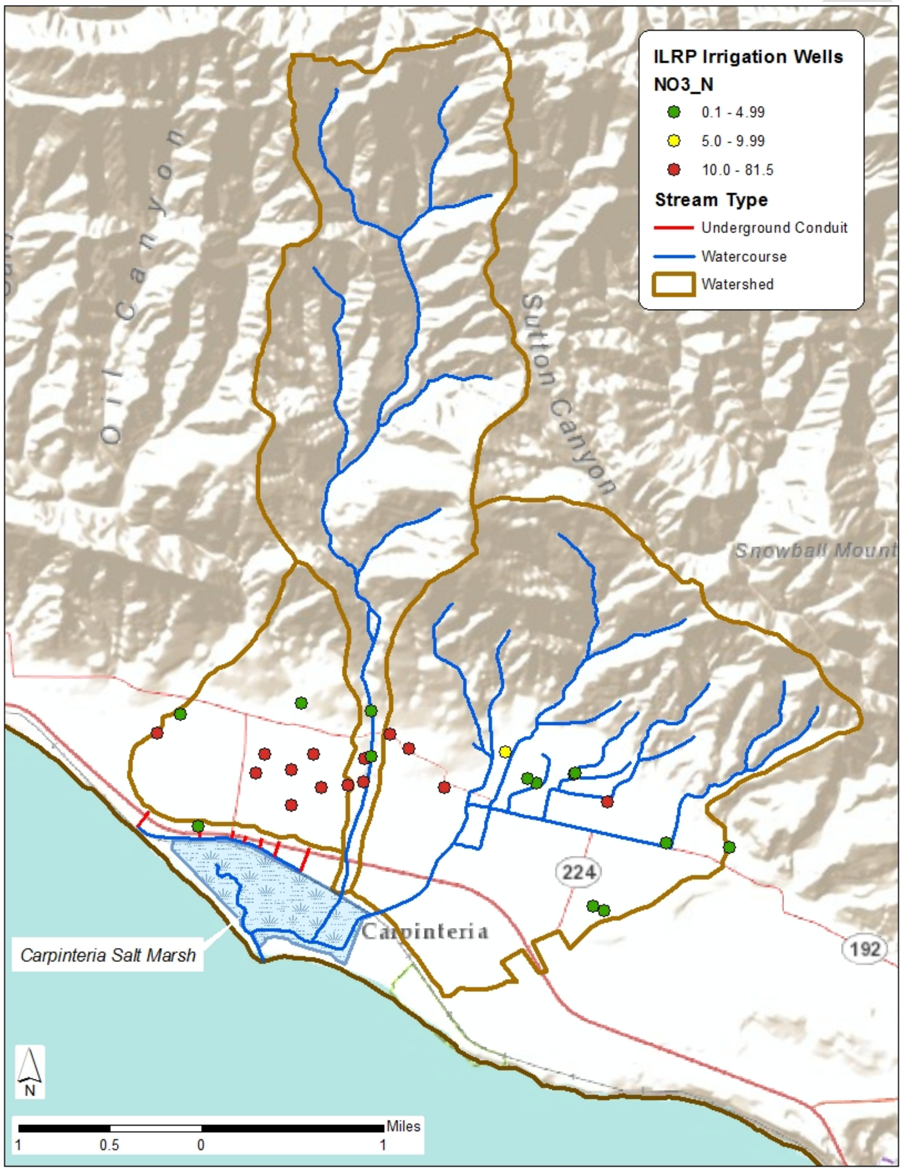


Figure 6-39. Maximum groundwater nitrate concentrations (ILRP).

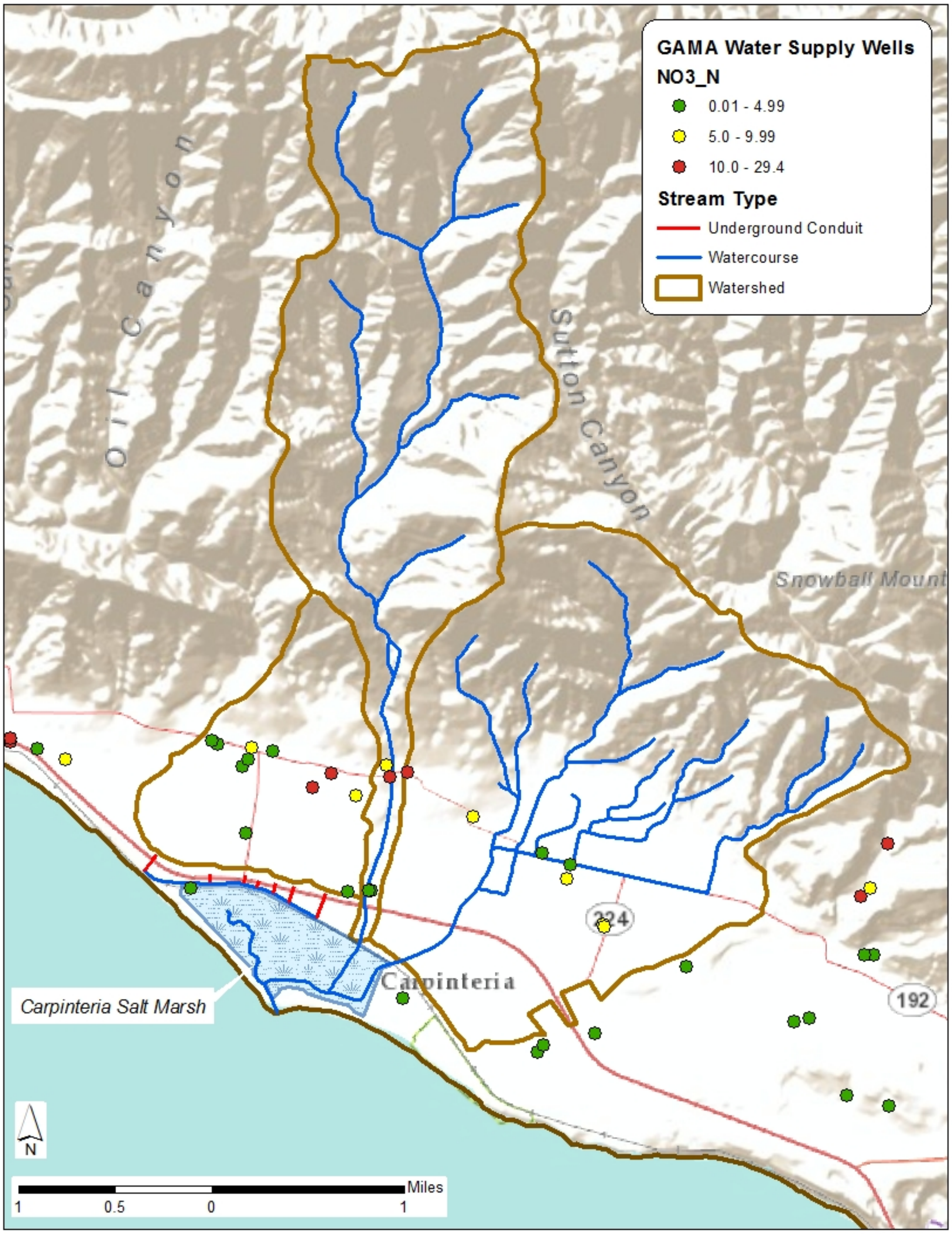


Figure 6-40. Maximum groundwater nitrate concentrations (GAMA).

As shown in Figure 6-39 and Figure 6-40, nitrate concentrations in groundwater exceed water quality objectives for drinking water (10 mg/L), indicating that land use practices have impacted groundwater supply beneficial uses.

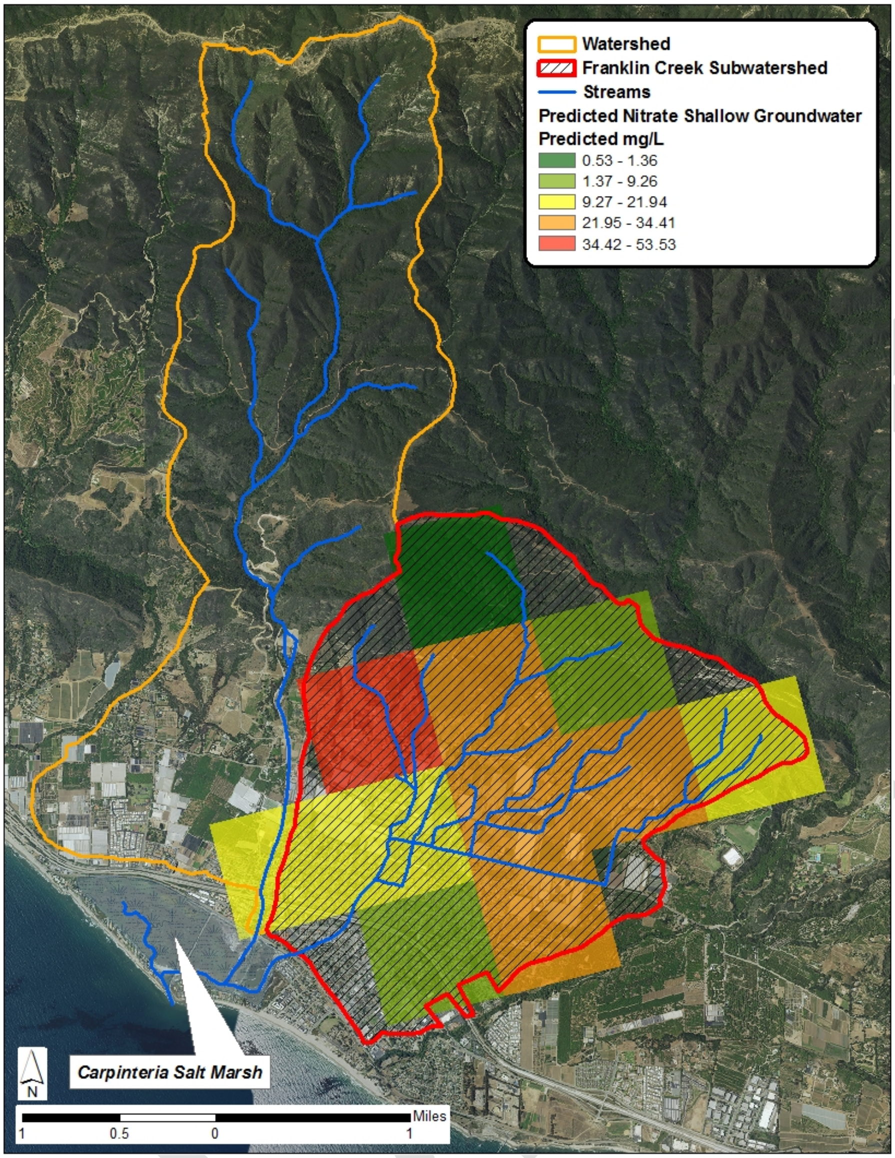


Figure 6-41. GWAVA predicted shallow groundwater nitrate concentrations (mg/L)

Groundwater (as baseflow) can be a source of nutrient loads to surface waters (USEPA, 1999). In addition, although TMDLs do not directly address groundwater quality problems, many surface waters are in fact designated for groundwater recharge beneficial use in the Basin Plan. Excessive nutrient concentrations in surface waters can contribute to elevated nitrate concentrations in groundwater under conditions of direct hydrologic connectivity. Figure 6-41 shows estimated nitrate as nitrogen concentrations in shallow (less than 15 feet) groundwater based on the USGS Groundwater Vulnerability Assessment (GWAVA)[33]. The GWAVA model predicted a mean nitrate nitrogen concentration of 19.5 mg/L in shallow groundwater.

[33] The GWAVA dataset represents predicted nitrate concentration in shallow, recently recharged groundwater in the conterminous United States, and was generated by a national nonlinear regression model based on 16 input parameters. Online linkage: http://water.usgs.gov/GIS/metadata/usgswrd/XML/gwava-s_out.xml

As stated in Section 4.5, previous studies have reported the presence of shallow groundwater within portions of the Carpinteria coastal plain (Page, 1993; Page, et. al., 1994; Page 1999; Robinson, 2006). Nitrate as nitrogen surface water concentrations near groundwater seeps in the upper reaches of Franklin Creek ranged from 28 to 99 mg/L (Page, 1994). Ground water seeping from a crack in the concrete channel upstream of S8N was found to be an important source of nitrate as nitrogen to Franklin Creek with concentrations greater than 100 mg/L (Page, 1993). Water seeping from this crack and water of 30 mg/L nitrate as nitrogen, emerging from a pipe in the bottom the concrete channel often formed the northern-most upstream water source for Franklin Creek (Page, 1993).

Figure 6-42. Photos of groundwater seepage into Franklin Creek.
Photo Credit: Central Coast Water Board staff June 16, 2014.

7 WATER QUALITY NUMERIC TARGETS

7.1 Target for Nitrate (Human Health Standard)

The purpose of this target is to meet the water quality objective for nitrates in municipal and domestic drinking water sources (MUN: Municipal/Domestic Supply; GWR: Groundwater Recharge). The Basin Plan numeric water quality objective for nitrate (as nitrogen) is 10 mg/L, therefore the nitrate target is set at the Basin Plan water quality objective as follows:

- *10 mg/L nitrate as nitrogen to ensure that these surface waters are protected as drinking water sources and to assure compliance with the numeric water quality objective at all times.*

7.2 Targets for Biostimulatory Substances (Nitrogen and Phosphorus)

The Basin Plan contains the following narrative water quality objectives for biostimulatory substances:

- *Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses.*

Under most circumstances, compliance with all applicable water quality objectives, including narrative objectives is required (State Water Board, 2011a). Further, according to USEPA guidance, a TMDL and associated wasteload allocations and load allocations must be set at levels necessary to result in attainment of all applicable water quality standards, including narrative water quality objectives (USEPA, 2000b). A narrative objective may be interpreted with respect to a specific pollutant or parameter by selecting an appropriate numeric threshold that meets the conditions of the narrative objective (State Water Board, 2011a). Therefore, to implement the Basin Plan's narrative objective for biostimulatory substances, the Central Coast Water Board needs to develop technically defensible numeric water quality criteria to assess attainment or non-attainment of the narrative water quality objective:

> *"For waterbodies listed because of failure to meet a narrative water quality objective,* ***the numeric target will be a quantitative interpretation of the narrative objective*****. For example, if a waterbody fails to achieve a narrative objective for settleable solids, the TMDL could include targets for annual mass sediment loading." (State Water Board, 1999a)*
>
> *-State Water Resources Control Board, Office of Chief Counsel (1999)*
>
> *"In situations where applicable water quality standards are expressed in narrative terms or where 303(d) listings were prompted primarily by beneficial use or antidegradation concerns****, it is necessary to develop a quantitative interpretation of narrative standards*****. "*
>
> *-U.S. Environmental Protection Agency (2000b)*
>
> ***** emphasis added

To implement the Basin Plan's biostimulatory substances narrative objective, staff evaluated available data, studies, established methodologies, technical guidance, peer-reviewed numeric criterion, and other information to estimate the levels of nitrogen and phosphorus that can be present without causing violations of this objective. It is important to recognize that definitive and unequivocal scientific certainty is not necessary in a TMDL process with regard to development of nutrient water quality targets protective against biostimulation. Numeric targets should be scientifically defensible, but are not required to be definitive. USEPA guidance (USEPA, 2000a) provides for methodologies which USEPA explicitly states will result in nutrient numeric targets of “greater scientific validity”; therefore it is clearly recognized that scientific certainty is not a requirement for nutrient targets. Biostimulation is an ongoing and active area of research. If the water quality objectives and numeric targets for biostimulatory substances are changed in the future, then any TMDLs and allocations that are potentially adopted for biostimulatory substances pursuant to this project may sunset and be superseded by revised water quality objectives.

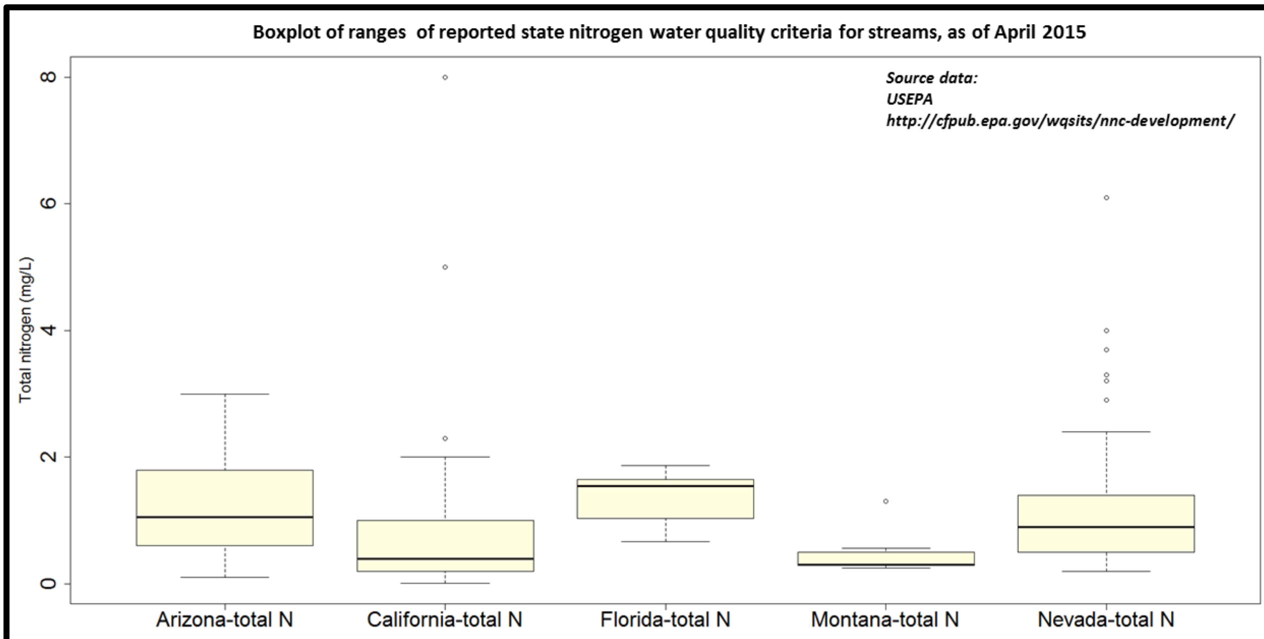
Recent research on biostimulation on inland surface waters from agricultural watersheds in the California central coast region indicates that the existing nutrient numeric water quality objectives to protect drinking water standards found in the Basin Plan (i.e., the 10 mg/L nitrate as nitrogen MUN objective) is unlikely to reduce benthic algal growth below even the highest water quality benchmarks. This is because aquatic organisms respond to nutrients at lower concentrations[34,35]. Therefore, the 10 mg/L nitrate as nitrogen objective is insufficiently protective against biostimulatory impairments. Consequently, it is typically necessary to set biostimulatory numeric water quality targets at more stringent levels than the existing numeric objectives found for nitrate in the Basin Plan (i.e., the 10 mg/L MUN objective).

USEPA recently stated that total nitrogen concentrations in streams which are protective against biostimulatory effects should generally be expected to be in an acceptable range of 2 mg/L to 6 mg/L, see the text box below and see Figure 7-1. Noteworthy is that the aforementioned concentrations ranges are substantially lower than the 10 mg/L drinking water quality standard for nitrate as nitrogen.

> *“(A)n excess amount of nitrogen in a waterway may lead to low levels of oxygen and negatively affect various plant life and organisms…An acceptable range of total nitrogen is* ***2 mg/L to 6 mg/L****, *though it is recommended to check tribal, state, or federal standards…”*
>
> *From USEPA, 2013a, “Total Nitrogen” fact sheet, revised June 4, 2013*
>
> *******emphasis added by Central Coast Water Board staff*

[34] University of California, Santa Cruz. 2010. Final Report: Long-term, high resolution nutrient and sediment monitoring and characterizing in-stream primary production. Proposition 40 Agricultural Water Quality Grant Program. Dr. Marc Los Huuertos, Ph.D., project director.

[35] Rollins, S., M. Los Huertos, P. Krone-Davis, and C. Ritz. 2012. Algae Biomonitoring and Assessment for Streams and Rivers of California’s Central Coast. Final Report for Proposition 50 Grant Agreement No. 06-349-553-2



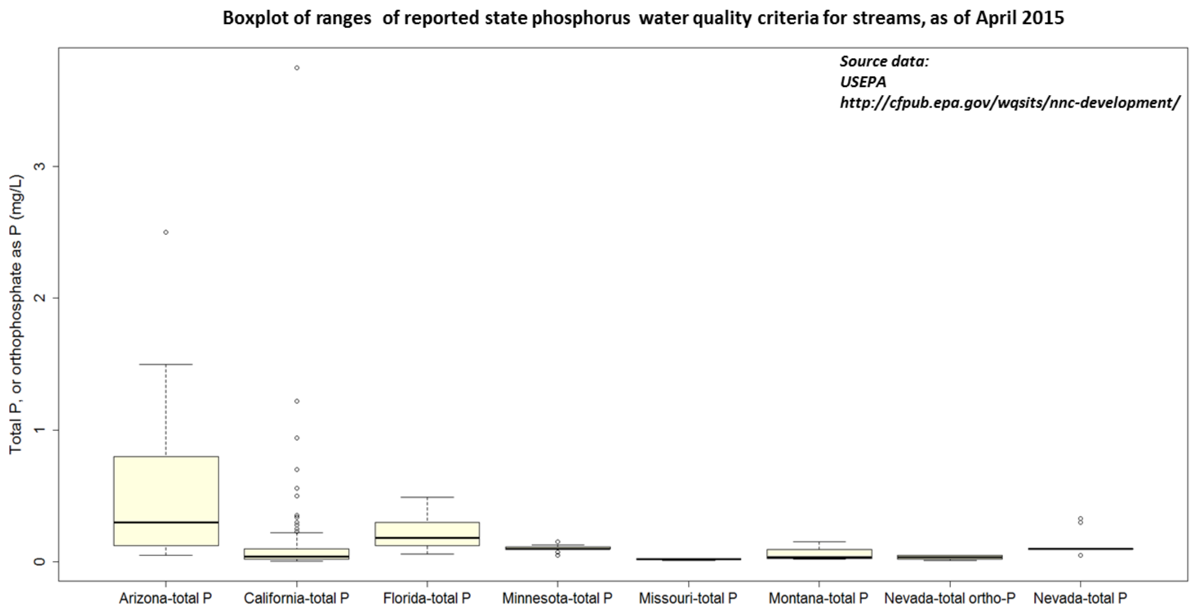
Numerical summary of reported state nitrogen water quality criteria for streams, as of April 2015

	mean	0%	10%	25%	50%	75%	90%	100%	data:n
Arizona-total N	1.24	0.10	0.32	0.60	1.0	1.7	2.5	3.0	22
California-total N	1.25	0.01	0.15	0.20	0.4	1.0	5.0	8.0	115
Florida-total N	1.35	0.67	0.81	1.03	1.5	1.6	1.8	1.9	5
Montana-total N	0.51	0.25	0.28	0.29	0.3	0.5	1.3	1.3	11
Nevada-total N	1.17	0.20	0.30	0.50	0.9	1.4	2.4	6.1	111

Figure 7-1. Boxplot and numerical summary of ranges of state nitrogen water quality criteria for streams (as of April, 2015).

At this time, USEPA generally expects nutrient TMDLs to have dual nutrient criteria, for both nitrogen and for phosphorus. As reported by USEPA (2007b), while controlling one nutrient may potentially prevent productivity, control of both nutrients (nitrogen and phosphorus) in upstream waters can also provide additional assurance that excess productivity will remain in control. For example, under conditions of nitrogen limitation, even if local excess primary productivity is ultimately controlled to a large extent by nitrogen reduction alone, there will be consequent export of the excess nutrient, phosphorus, because the excess of that nutrient would not have the opportunity for uptake into biomass. The larger the excess of phosphorus in upstream systems is, the greater the contribution to potential phosphorus-sensitive downstream systems. Therefore, concurrent reduction of both nitrogen and phosphorus in a basin is often warranted in order to protect downstream use. More recently, USEPA provided further guidance and scientific support on why the development of dual numeric criteria for both nitrogen and phosphorus can be an effective tool to protect beneficial uses of the nation’s streams, lakes, estuaries, and coastal systems (USEPA, 2015).

Since dual nutrient criteria are being developed for this TMDL project, it is worth reviewing phosphorus and orthophosphate as P water quality criteria for streams developed previously in California and in other states (see Figure 7-2). In general, phosphorus and orthophosphate as P stream water quality criteria developed by the states are generally less than 0.3 mg/L, and often around 0.1 mg/L or less.



Numerical summary of reported state phosphorus water quality criteria for streams, as of April 2015

	mean	0%	10%	25%	50%	75%	90%	100%	data:n
Arizona-total P	0.58	0.050	0.10	0.12	0.30	0.80	1.00	2.50	21
California-total P	0.14	0.005	0.01	0.02	0.04	0.10	0.26	3.75	98
Florida-total P	0.23	0.060	0.08	0.12	0.18	0.30	0.41	0.49	5
Minnesota-total P	0.10	0.050	0.07	0.10	0.10	0.11	0.12	0.15	11
Missouri-total P	0.02	0.012	0.01	0.02	0.02	0.03	0.03	0.03	6
Montana-total P	0.06	0.020	0.02	0.02	0.03	0.09	0.11	0.15	11
Nevada-total ortho-P	0.03	0.010	0.01	0.02	0.04	0.05	0.05	0.05	6
Nevada-total P	0.12	0.050	0.10	0.10	0.10	0.10	0.10	0.33	171

Figure 7-2. Boxplot and numerical summary of ranges of state phosphorus water quality criteria for streams (as of April, 2015).

The proposed numeric targets for biostimulatory substances for Franklin Creek is presented in Table 7-1. Appendix B contains all the data, assessments, and information used to derive numeric targets for biostimulatory substances. Note that the proposed numeric targets comport reasonable well, and within similar ranges, of nutrient stream water quality criteria developed previously throughout the nation (refer back to Figure 7-1 and Figure 7-2). Central Coast Water Board staff used USEPA guidance in developing draft targets with the goal being to account for physical and hydrologic variation within the TMDL project area (see *Nutrient Criteria Technical Guidance Manual, River and Streams* - USEPA July 2000). The USEPA nutrient criteria guidance manual recommends that nutrient criteria need to be developed to account for natural variation existing at the regional and basin level-scale.

Numeric target development in this TMDL is consistent with policy recommendations outlined in the draft State Water Resources Control Board's Statewide Nutrient Policy (State Water Board, 2011b). The draft Statewide Nutrient Policy recognizes both the California Nutrient Numeric Endpoints (CA NNE) approach and the USEPA percentile-approach as the two valid alternatives under consideration for a statewide policy for nutrient policy. Indeed, Central Coast Water Board staff evaluated and utilized both the CA NNE and the USEPA percentile approach in development of numeric targets. Further background on development of numeric targets are presented in Section 7.2.1 and Section 7.2.2. As noted previously, Appendix B presents detailed information and the full scope of data and methods used for the evaluation and development of nutrient numeric targets. A brief summary of technical guidance used by staff in nutrient target development is presented below:

Summary of published technical guidance used by staff in nutrient target development:

- ✓ Using a combination of recognized approaches (i.e., literature values, statistical approaches, predictive modeling approaches) result in criteria of greater scientific validity *(guidance source: USEPA, 2000a. Nutrient Criteria Guidance Manual*);
- ✓ Classify and group streams needing nutrient targets, based on similar characteristics *(guidance source: USEPA, 2000a. Nutrient Criteria Guidance Manual);*
- ✓ Targets should not be lower than expected concentrations found in background/natural conditions *(guidance source: California NNE Approach guidance – Tetra Tech, 2006).*

Also worth noting, nutrient targets here are developed consistent with methodologies that previously underwent independent scientific peer review in the TMDLs for nitrogen compounds and orthophosphate in the Salinas River and Reclamation Canal Basin and the Moro Cojo Slough Subwatershed (Resolution No. R3-2013-0008).

Table 7-1. Numeric targets for biostimulatory substances

Stream Reaches Assigned Total Nitrogen and Total Phosphorus Water Quality Targets			
Stream Reaches	**Allowable Total Nitrogen (mg/L)**	**Allowable Total Phosphorus (mg/L)**	**Methodology for Developing Numeric Target**
Franklin Creek (All reaches and tributaries)	**1.1** **Dry Season Samples (May 1-Oct. 31)** **8.0** **Wet Season Samples (Nov. 1-Apr. 30)**	**0.075** **Dry Season Samples (May 1-Oct. 31)** **0.3** **Wet Season Samples (Nov. 1-Apr. 30)**	Statistical Analysis (USEPA percentile-based approaches) Supplemented by California NNE approach (NNE benthic biomass model tool) Wet-season targets based on Central Coastal Basin Plan nitrate objective and State of Nevada phosphate criteria for streams

7.2.1 *Background Information*

Central Coast Water Board staff are required to develop scientifically-valid numeric nutrient water quality targets that are protective of the Basin Plan's narrative biostimulatory water quality objective. Table 7-2 summarizes the USEPA-recommended approaches for assessing and developing numeric nutrient criteria that will be protective of the Basin Plan's narrative biostimulatory water quality standard. USEPA (2000) reports that a weight of evidence approach to developing nutrient criteria that ***"combines any or all three of the recommended of the approaches will produce criteria of greater scientific validity."*** Consistent with this USEPA guidance, staff evaluated and utilized multiple USEPA-recognized methodologies in the evaluation and development of nutrient numeric targets (see Appendix B).

Table 7-2. USEPA-recommended approaches for developing nutrient criteria.

USEPA-Recommended Approaches	Methodology	Notes
Use of **Predictive Relationships** (modeling)	California NNE Approach	Staff used the California NNE benthic biomass model tool to supplement and corroborate targets based on USEPA-recognized statistical approaches.
Statistical Analysis of Data to estimate reference conditions	USEPA-recommended statistical analysis: 25th percentile of nutrient data for stream population and an evaluation of reference stream (headwater) conditions	Staff used USEPA-recognized statistical approach in development of nutrient numeric criteria.
Use of established concentration **thresholds from published literature**	USEPA published nutrient criteria for Ecoregion III, Subecoregion 6	Staff evaluated USEPA ecoregional criteria. Staff concluded that subecoregion III-6 criteria are inappropriate because they are over-protective. The ecoregional criteria aggregate streams that represent significantly different characteristics: headwater streams, alluvial valley streams, coastal confluence streams, etc. USEPA itself recognizes ecoregional criteria may not sufficiently account for local variation.

Biostimulatory numeric target development in this TMDL is consistent with policy recommendations outlined in the draft State Water Resources Control Board's Statewide Nutrient Policy (State Water Board, 2011b). The draft Statewide Nutrient Policy recognizes both the California Nutrient Numeric Endpoints (CA NNE) approach and the USEPA percentile-approach as the two valid alternatives under consideration for a statewide policy for nutrient policy. Consistent with this draft policy staff evaluated and utilized both the CA NNE and the USEPA percentile approach in development and refinement of numeric targets.

With regard to statistical approaches to developing nutrient targets, USEPA's Technical Guidance Manual for Developing Nutrient Criteria for Rivers and Streams (2000) describes two ways of establishing a reference condition. One method is to choose the upper 75th percentile of a reference population of streams. The 75th percentile was chosen by EPA since it is likely associated with minimally impacted conditions, will be protective of designated uses, and provides management flexibility. With regard to identifying reference streams USEPA defines a reference stream "as a least impacted waterbody within an ecoregion that can be monitored to establish a baseline to which other waters can be compared. Reference streams are not necessarily pristine or undisturbed by humans."

USEPA proposed that the 75th percentiles of all nutrient data of these reference stream(s) could be assumed to represent unimpacted reference conditions for each aggregate ecoregion, and also provided a comparison of reference condition for the aggregate ecoregion versus the subecoregions.

Alternatively, when reference streams are not identified, the second method USEPA recommends is to determine the lower 25th percentile of the population of all streams within a region. The 25th percentile of the entire population was chosen by EPA to represent a surrogate for an actual reference population. To further clarify this point, USEPA (2000) reports that "(d)ata analyses to date indicate that the lower 25th percentile from an entire population roughly approximates the 75th percentile for a reference population (see case studies for Minnesota lakes in the Lakes and Reservoirs Nutrient Criteria Technical Guidance Document [U.S. EPA, 2000a], the case study for Tennessee streams in the Rivers and Streams Nutrient Criteria Technical Guidance Document [U.S. EPA, 2000b], and the letter from Tennessee Department of Environment and Conservation to

Geoffrey Grubbs [TNDEC, 2000]). New York State has also presented evidence that the 25th percentile and the 75th percentile compare well based on user perceptions of water resources (NYSDEC, 2000)."

These 25th percentile values are thus characterized as criteria recommendations that could be used to protect waters against nutrient over-enrichment (USEPA, 2000a). This is because the 25th percentile of the entire population was chosen by EPA to represent a surrogate for an actual reference population.

It is important to note that the USEPA Science Advisory Board (2010) and Worcester et al. (2010) report that draft numeric targets for nutrients may need to be supported with a weight of evidence approach, rather than stand-alone statistical methods. The weight of evidence approach could use other evidence of eutrophication; for example, presence and abundance of floating algal mats, water column chlorophyll a concentrations, evidence of oxygen depression and/or supersaturation, and pH over 9.5.

Also, because nutrient loads, and nutrient effects can vary substantially in different seasons, refinements may include developing a temporal, seasonal (e.g., summer versus winter targets), or statistical component (e.g., annual or seasonal mean value of a suite of water quality samples) that may be embedded in the final numeric targets.

7.2.2 *Nutrient Numeric Endpoint Analysis*

An additional line of evidence for establishing nutrient water quality targets in the TMDL project area was provided by an application of the California NNE approach (Tetra Tech 2006) (see Appendix B of this report). The California NNE approach was developed as a methodology for the development of nutrient (nitrogen and phosphorus) numeric endpoints for use in water quality programs of the California State Water Board and Regional Water Quality Control Boards (Regional Water Boards).

The California NNE approach is a risk-based approach in which algae and nutrient targets can be evaluated based on multiple lines of evidence; the intention of the NNE approach is to use nutrient response indicators to develop potential nutrient water quality criteria. The California NNE approach also includes a spreadsheet scoping tool for application in river systems to assist in evaluating the translation between response indicators (e.g. algal biomass) and nutrient concentrations. It is noteworthy that another important tenet of the California NNE approach (Tetra Tech 2006) is that targets should not be set lower than the value expected under natural conditions. The models used in the spreadsheet tool and their application are described extensively in Appendix 3 of the California NNE Approach (Creager, 2006). They include empirical models (Dodds, 1997 and 2002) and the QUAL2K simulation models (Chapra and Pelletier, 2003), including the standard model, a revised model that provides a better fit to Dodd's empirical data, and a revised model that adjusts for algae accrual time between scour events. The revised QUAL2K simulation model also predicts the anticipated maximum algal contribution to oxygen deficit. This is the maximum amount of dissolved oxygen expected to be removed from the water as a result of predicted benthic algal growth. The outputs can then be evaluated using the numeric targets for secondary indicators, established by the California NNE Approach to determine the risk of impairment at a given site from nutrient over-enrichment.

As part of the development of biostimulatory nutrient targets for this TMDL project, multiple lines of evidence were used including the use of the California NNE scoping tools. Consequently, the California NNE approach scoping spreadsheet tool is used in this TMDL project to evaluate and support the appropriateness of targets staff developed based on the USEPA 25th percentile statistical approach. Reasonably close agreement between California NNE spreadsheet tool nutrient targets with USEPA 25th percentile approach nutrient targets is taken to indicate a higher level of scientific validity and confidence in the proposed targets, consistent with nutrient criteria guidance provided by USEPA (refer back to Section 7.2.1 and Table 7-2).

7.3 Targets for Nutrient-Response Indicators

Low dissolved oxygen, chlorophyll *a.* and algal toxins (microcystins) are nutrient-response indicators and represent both a primary biological response to excessive nutrient loading in waterbodies which exhibit biostimulatory conditions, and a direct linkage to the support or impairment of designated beneficial uses. The justification for their inclusion as numeric targets in this TMDL can conceptually be emphasized with the following technical guidance published as part of California's nutrient numeric criteria approach:

> *"As a first and critical step, it is proposed in this study that **nutrient criteria not be defined solely in terms of the concentrations of various nitrogen and phosphorus species**, **but also include consideration of primary biological responses to nutrients***. It is these biological responses that correlate to support or impairment of uses. It is proposed that the consideration of biological responses be **in addition to*** chemical concentrations in the final form of the nutrient criteria. Further, the development of chemical concentration criteria should be closely linked to the evaluation of biological responses."*
>
> *Progress Report - Development of Nutrient Criteria in California: 2003-2004 (Tetra Tech, Inc., October 2004, prepared for U.S. EPA Region IX)*
>
> *(***** emphasis added by Central Coast Water Board staff)*

Further, the U.S. Environmental Protection Agency likewise recognizes biological response indicators are a necessary component of measuring and tracking nutrient pollution:

> *The purpose of these guiding principles is to offer clarity to states about an optional approach for developing a numeric nutrient criterion that integrates causal (nitrogen and phosphorus) **and response parameters*** into one water quality standard…These guiding principles apply when states wish to rely on **response parameters to indicate that a designated use is protected***, even though a nitrogen and/or phosphorus level is/are above an adopted threshold.*
>
> *U.S. Environmental Protection Agency (USEPA, 2013b). Guiding Principles on an Optional Approach for Developing and Implementing a Numeric Nutrient Criterion that Integrates Causal and Response Parameters. EPA-820-F-13-039.*
>
> *(***** emphasis added by Central Coast Water Board staff)*

7.3.1 *Dissolved Oxygen*

The Basin Plan contains the following water quality objectives for dissolved oxygen (DO):

- *For warm beneficial uses and for waters not mentioned by a specific beneficial use, dissolved oxygen concentrations shall not be reduced below 5.0 mg/L at any time.*
- *For cold and spawning beneficial uses, dissolved oxygen concentrations shall not be reduced below 7.0 mg/L at any time.*
- *Median values for dissolved oxygen should not fall below 85% saturation as a result of controllable conditions.*

In addition, because daytime monitoring programs are unlikely to capture most low DO crashes, it is prudent to identify a numeric guideline that can measure daytime biostimulatory problems on the basis of DO super-saturation. Peer-reviewed research in California's central coast region (Worcester et al., 2010) has established an upper limit of 13 mg/L for DO to screen for excessive

DO saturation, and addresses the USEPA "Gold Book" water quality standard for excessive gas saturation. Of monitoring sites evaluated in the central coast region that are supporting designated aquatic habitat beneficial uses and do not show signs of biostimulation, DO virtually never exceeded 13 mg/L at any time[36]. Note that the 13 mg/L DO saturation target is not a regulatory standard, but can be used as a TMDL nutrient-response indicator target to assess primary biological response to nutrient pollution reduction. Accordingly, staff proposes the numeric target for DO super-saturation indicative of biostimulatory conditions as follows:

- *Dissolved oxygen concentrations not to exceed 13 mg/L.*

7.3.2 *Chlorophyll a*

Chlorophyll *a* is an algal biomass indicator. The Basin Plan does not include numeric water quality objectives or criteria for chlorophyll *a*. Staff considered a range of published numeric criteria. The State of Oregon uses an average chlorophyll a concentration of > 15 μg/L as a criterion for nuisance phytoplankton growth in lakes and rivers[37]. The state of North Carolina has set a maximum acceptable chlorophyll *a* standard of 15 μg/L for cold water (lakes, reservoir, and other waters subject to growths of macroscopic or microscopic vegetation designated as trout waters), and 40 μg/L for warm water (lakes, reservoir, and other waters subject to growths of macroscopic or microscopic vegetation not designated as trout waters)[38]. A chlorophyll *a* concentration of 8 μg/L is recommended as a threshold of eutrophy for plankton in EPA's Nutrient Criteria Technical Guidance Manual for Rivers and Streams (USEPA, 2000a). The Central Coast Region has used 40 μg/L as stand-alone evidence to support chlorophyll *a* listing recommendations for the 303(d) Impaired Water Bodies list.

A recent peer-reviewed study conducted by CCAMP reports that in the California central coast region inland streams that do not show evidence of eutrophication all remained below the chlorophyll *a* threshold of 15 μg/L (Worcester et al., 2010). As this value is consistent with several values reported in published literature and regulations shown above, and as the CCAMP study by Worcester et al. is central coast-specific, staff proposes the numeric target for chlorophyll *a* indicating biostimulatory conditions as follows:

- *Water column chlorophyll a concentrations not to exceed 15 μg/L.*

7.3.3 *Microcystins*

Microcystins are toxins produced by cyanobacteria (blue-green algae) and are associated with algal blooms and biostimulation in surface waterbodies[39]. The Basin Plan does not contain numeric water quality objectives for microcystins. However, the California Office of Environmental Health Hazard Assessment has published final microcystin public health action levels[40] for human recreational uses of surface waters. These are not regulatory standards, but are suggested public health action

[36] Of 2,399 samples at these reference sites, only about 1% of the samples ever exceeded 13 mg/L DO.
[37] Oregon Administrative Rules (OAR). 2000. Nuisance Phytoplankton Growth. Water Quality Program Rules, 340-041-0150.
[38] North Carolina Administrative Code 15A NCAC 02B .0211(3)(a).
[39] See: U.S. Environmental Protection Agency. Drinking Water Treatability Database.
[40] California Office of Environmental Health Hazard Assessment (OEHHA). 2012. *Toxicological Summary and Suggested Action Levels to Reduce Potential Adverse Health Effects of Six Cyanotoxins* (Final, May 2012).

levels. This public health action level is 0.8 μg/L for human recreational uses of water. Therefore, staff proposes the numeric water quality target for microcystins[41] as follows:

- *Microcystins concentrations not to exceed 0.8 μg/L.*

These targets are therefore protective of the REC-1 designated beneficial uses of surface waters. Currently, there are no identified impairments due to algal toxins. However, numeric targets identified for microcystins in the TMDL will be used as an indicator metric to assess primary biological response to future nutrient water column concentration reductions and to ensure compliance with the Basin Plan's biostimulatory substances objective and designated REC-1 beneficial uses.

It should be noted that implementing parties are not required to collect microcystin data, unless they choose to do so voluntarily. The Central Coast Water Board is currently funding microcystin data collection which may be used for future assessments of biostimulatory problems in the Central Coast region.

8 SOURCE ANALYSIS

8.1 Introduction: Source Assessment Using STEPL Model

Excessive levels of nitrogen and phosphorus may reach surface waters as a result of human activities (USEPA, 1999). For this TMDL project report, nutrient source loading estimates were accomplished using the US Environmental Protection Agency's Spreadsheet Tool for Estimating Pollutant Loads, version 4.0 (STEPL). STEPL is a watershed-scale water quality spreadsheet model developed by Tetra Tech, Inc. for the USEPA. This spreadsheet tool can be used for estimating watershed pollutant loads for nutrients (Nandi et al., 2002). STEPL can also be used to evaluate load reductions that could result from the implementation of various management practices. STEPL was selected for its relative ease in application, the minimal amount of required input data, and because of its endorsement by the USEPA. STEPL employs simple algorithms to calculate long-term average annual watershed nutrient loads from different land uses and source categories. STEPL provides a Visual Basic interface to create a customized, spreadsheet-based model in Microsoft Excel. STEPL calculates watershed surface runoff, nutrient loads, including nitrogen and phosphorus based on various land uses and watershed characteristics. STEPL has been used previously in USEPA-approved TMDLs to estimate source loading[42]. It should be recognized that, as with any relatively simple watershed model, STEPL outputs are subject to significant uncertainties and the model pollutant load estimates should not be considered definitive or conclusive. However, STEPL is a useful tool for estimating long-term average loads from various source categories (Nejadhashemi et al., 2011).

A description of the STEPL input parameters used in this nutrient source assessment are shown in Table 8-1 and screen captures of the loading spreadsheets are shown in Appendix C. It is important to note that staff adjusted some of the default input parameters provided in STEPL to capture some of the unique characteristics of the Franklin Creek watershed. For example, there is only one agricultural land use category within STEPL ("Cropland") that would normally contain all of the

[41] Includes microcystins LA, LR, RR, and YR

[42] For example, see USEPA Decision Document for Approval of White Oak Creek Watershed (Ohio) TMDL Report, February 25, 2010; Indiana Dept. of Environmental Management, 2008, South Fork Wildcat Creek Watershed Pathogen, Sediment, and Nutrient TMDL; as well as Central Coast Water Board nutrient TMDLs for Lower Salinas River (2015), Santa Maria River (2016), and Pajaro River (2016).

irrigated lands such as orchards, nurseries, and greenhouses. Because loading rates may vary between these irrigated lands, staff utilized a “User Defined” land use type that is designed to specifically represent nurseries and greenhouses. Staff used the “Cropland” land use category to estimate nutrient loading from orchards (avocado) and the “User Defined” land use category to estimate nutrient loading from nurseries and greenhouses.

Staff made another adjustment by changing the STEPL default soil erosion factor (K) value for all land use categories to a value of 0.240 as represented in the SSURGO soil database (see Figure 4-13). The soil erosion factor (K) is one parameter in the Universal Soil Loss Equation (USLE). Staff also adjusted the USLE parameter for the cover and management factor (C) to values reported in a study titled, “Analysis of Alternative Watershed Management Strategies for the Lauro Canyon Watershed, Santa Barbara County California” (UCSB, 2000). The cover and management factor (C) values for chaparral (STEPL forest) was set at 0.036, for avocado orchards (STEPL cropland) the value was set at 0.090, and 0.14 was assigned for nurseries and greenhouses (STEPL user defined category).

The spreadsheet nutrient loading results are presented in Table 8-23 . It should be emphasized that nutrient load estimates calculated by STEPL are merely estimates and subject to uncertainties; actual loading at the local stream-reach scale can vary substantially due to numerous factors over various temporal and spatial scales.

Table 8-1. STEPL input data.

Input Category	Input Data	Sources of Data
Mean Annual Rainfall	18.68 inches/year	Santa Maria Airport as provided in STEPL
Mean Rain Days/Year	42.3 days/year	Santa Maria Airport as provided in STEPL
Weather Station (for rain correction factors)	0.865 Mean Annual Rainfall- 0.418 Mean Rain Days/Yr.	Santa Maria Airport as provided in STEPL
Land Cover	USGS (see Table 4-4) and Santa Barbara County parcel use descriptions for detailed cropland classification (see Section 8.1.2)	USGS, 2006. Land use/ land cover as represented in Table 4-4. Land use codes 11-14 aggregated to represent Urban lands, code 22 for Agricultural land, and codes 32-76 for Forested lands. Note that 1,065 acres of agricultural land was divided into 788 acres for avocado orchards (STEPL cropland) and 277 acres was allocated to nurseries and greenhouses (STEPL user defined land use category). Santa Barbara County Assessor parcel use descriptions (2012) to detail cropland land uses into orchards (avocado), nurseries and greenhouses (see Section 8.1.2)
Urban Land Use Distributions (impervious surfaces categories)	STEPL default values	STEPL version 4,1 default values for urban land use category distributions.
Agricultural Animals	No agricultural animals reported in Tetra Tech database	Estimates of quantities of agricultural animals by individual subwatersheds from information developed and reported by Tetra Tech, Inc. for use in STEPL version 4.1. See: http://it.Tetra Tech-ffx.com/steplweb/steplweb.html. No agricultural animals reported. Verified by staff using visual assessment of aerial imagery.
Septic system discharge and failure rate data	110 Systems 2.43 persons/system 2% failure rate	Estimated 110 systems based on visual assessment using aerial imagery and Santa Barbara County Assessor parcel data. 2.43 persons/system (National Average contained in STEPL). Failure rate of 2% (Typical range between 1 and 5%/year. De Walle, 1981 as cited in USEPA Preventing Septic system Failure)
Universal Soil Loss Equation (USLE) parameters	STEPL default values for parameters R, LS, and P	K factor for all land uses modified to 0.240 based on values reported by UCSB, 2000. Cover and management C factor values for chaparral (STEPL forest) was set at 0.036, for avocado orchards (STEPL cropland) the value was set at 0.090, and 0.14 was assigned for

Input Category	Input Data	Sources of Data
		nurseries and greenhouses (STEPL user defined category) based on UCSB, 2000.
Hydrologic Soil Group (HSG)	HSG “D”	HSG based on SSURGO soil data for Franklin Creek TMDL project area and information developed and reported by Tetra Tech, Inc. for use in STEPL version 4.1.
Soil N and P concentrations (%)	N = 0.068% P = 0.038%	Data available from the International Geosphere–Biosphere Programme Data Information System; Post and Mann (1990); and the Kearney Foundation of Soil Science–University of California, Davis. Refer back to report Section **Error! Reference source not found.**
NRCS reference runoff curve numbers	STEPL default values	NRCS default curve numbers provided in STEPL except avocado orchards (STEPL Cropland) modified to 85 from 89 (UCSB, 2000)
Nutrient concentration in runoff (mg/L)	<u>Avocado orchards (STEPL Cropland)</u> N = 2.6 mg/L P = 0.6 mg/L <u>Urban lands</u> N = 1.5 to 3.6 mg/L (range) P = 0.15 to 0.61 mg/L (range) <u>Pastureland (grazing)</u> N = 4.0 mg/L P =0.3 mg/L <u>Chaparral (STEPL Forest)</u> N = 0.287 mg/L P = 0.062 mg/L <u>Nursery/Greenhouses (STEPL User Defined)</u> N = 22 mg/L P = 1.9 mg/L	• Avocado orchards (STEPL Cropland). Nitrate and phosphate volume weighed mean concentrations for water years 2002 and 2003. From Robinson, 2006. • Urban lands N runoff concentrations from commercial, industrial, residential, transportation, and open space land categories were derived from the arithmetic means of N concentrations reported in the National Stormwater Quality Database (version 3, Feb. 2, 2008) – see Table 8-3. Urban N runoff concentrations for institutional, urban-cultivated, and vacant land categories are the default valued provided in STEPL version 4.1. • Urban lands P runoff concentrations from commercial, industrial, residential, transportation, and open space land categories were derived from the arithmetic means of P concentrations reported in the National Stormwater Quality Database (version 3, Feb. 2, 2008) – see Table 8-4. Urban P runoff concentrations for institutional, urban-cultivated, and vacant land categories are the default valued provided in STEPL version 4.1. • Pastureland (grazing) N and P runoff concentration are the default values provided in STEPL version 4.1. Note that pastureland and grazing lands are not present in the Franklin Creek watershed so these values do not apply to load estimates. • Chaparral (STEPL Forest). Nitrate and phosphate volume weighed mean concentrations for water years 2002 and 2003. From Robinson, 2006. • Nursery and Greenhouses (STEPL User Defined). Nitrate and phosphate volume weighed mean concentrations for water years 2002 and 2003. From Robinson, 2006.
Nutrient concentration in shallow groundwater (mg/L)	<u>Avocado orchards (STEPL Cropland)</u> N = 19.5 mg/L P = 0.063 mg/L <u>Urban Lands</u> N = 19.5 mg/L P = 0.063 mg/L <u>Pastureland (grazing)</u> N = 1.44 mg/L P = 0.063 mg/L <u>Chaparral (STEPL Forest)</u> N = 0.11 mg/L P = 0.009 mg/L <u>Nursery/Greenhouses (STEPL User Defined)</u> N = 19.5 mg/L P = 0.063 mg/L	• P concentrations in groundwater for all land uses are provided as default values contained in STEPL version 4.1. • N concentrations in groundwater for avocado orchards (STEPL Croplands), urban lands, and nursery/greenhouses (STEPL User defined) provided as a mean value for project area using USGS GWAVA model dataset. http://water.usgs.gov/GIS/metadata/usgswrd/XML/gwava-s_out.xml. • N concentrations in groundwater for pastureland (grazing) and chaparral (STEPL forest) are provided as default values contained in STEPL version 4.1. Note that pastureland and grazing lands are not present in the Franklin Creek watershed so these values do not apply to load estimates.

Staff ran the STEPL model for the Franklin Creek watershed and the results are discussed in the following sections.

8.1.1 *Urban Runoff*

Urban runoff, in the form of municipal separate storm sewer system (MS4) discharges, can be a contributor of nutrients to waterbodies. USEPA policy explicitly specifies that National Pollutant Discharge Elimination System (NPDES)-regulated urban stormwater discharges are point source discharges and, therefore, must be addressed by the wasteload allocation component of a TMDL.[43] The Central Coast Water Board is the permitting authority for NPDES urban stormwater permits in the Central Coast region. According to the U.S. Environmental Protection Agency and the State Water Resources Control Board, all NPDES-permitted point sources identified in a TMDL must be given a wasteload allocation, even if their current load to receiving waters is zero[44, 45] (refer to report Section 10.2.4 Implementation Strategy, Legal & Regulatory, Point Sources (NPDES-permitted entities) for further clarification).

NPDES-permitted stormwater dischargers in the project area include the City of Carpinteria and the County of Santa Barbara (NPDES General Permit CAS000004). Figure 8-1 illustrates the locations and extent of currently enrolled MS4 permit entities. Within residential areas, potential controllable nutrient sources can include lawn care fertilizers, grass clippings, organic debris from gardens and other green waste, trash, and pet waste (Tetra Tech, 2004). Many of these pollutants enter surface waters via runoff without undergoing treatment. Impervious cover characterizes urban areas and refers to roads, parking lots, driveways, asphalt, and any surface cover that precludes the infiltration of water into the soil. Pollutants deposited on impervious surface have the potential of being entrained by discharges of water from storm flows, wash water, or excess lawn irrigation, etc. and routed to storm sewers, and potentially being discharged to surface waterbodies.

[43] See 40CFR 130.2(g) & (h) and USEPA Office of Water Memorandum (Nov. 2002) *"Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs"*

[44]Personal communication, February 18, 2015, Janet Parrish, Central Coast Regional Liason, U.S. Environmental Protection Agency, Region 9.

[45] Communication, August 2014, Phil Wyels, Assistant Chief Counsel, State Water Resources Control Board.

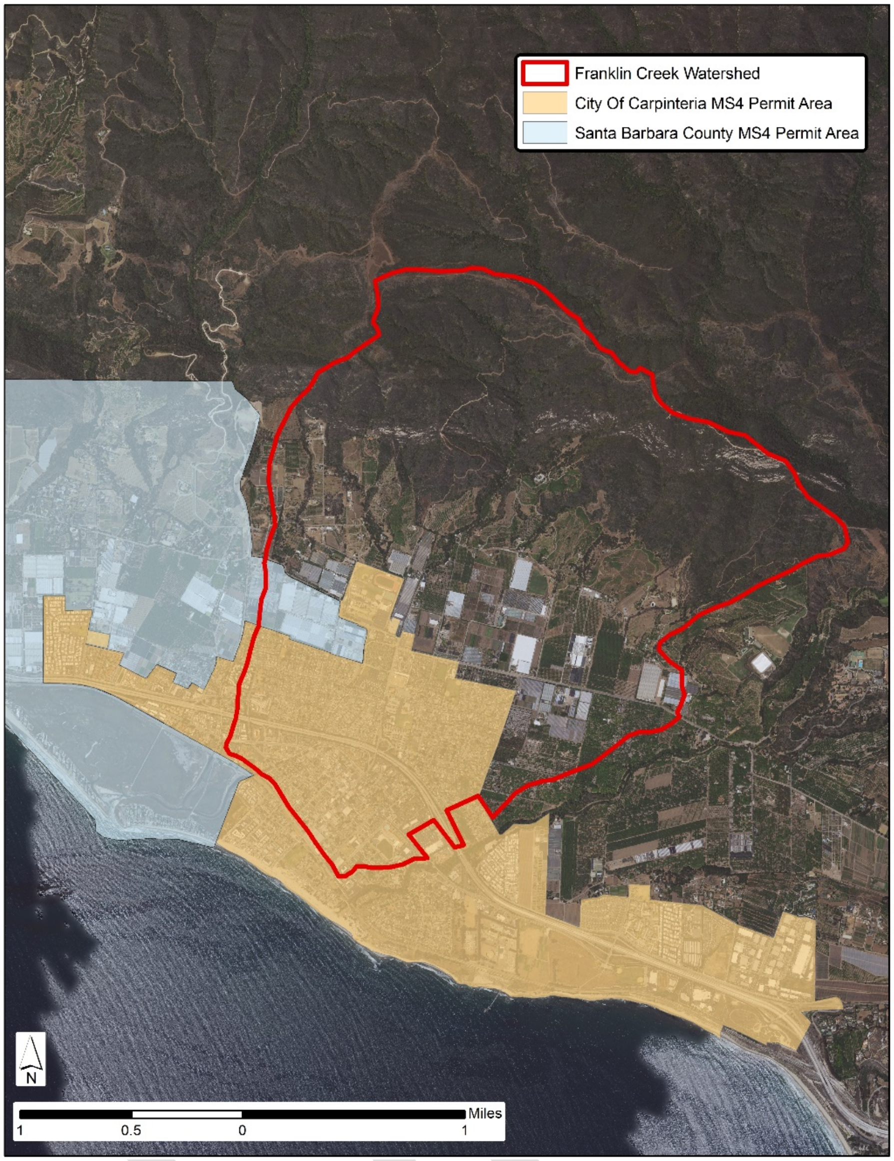


Figure 8-1. Approximate boundaries of MS4-permitted entities.

Table 8-2. Tabulation of enrolled municipal stormwater permit entities [A].

Type	Status	Responsible Entity
Phase II Small MS4	Active	City of Carpinteria
Phase II Small MS4	Active	County of Santa Barbara

[A] On the basis of reporting from the: State Water Resources Control Board, Storm Water Multiple Application and Report Tracking System (SMARTS)

Site-specific urban stormwater runoff and storm drain outfall nutrient concentration data for Franklin Creek is not available, so staff estimated nutrient loading based on plausible approximations and indirect evidence. It should be noted that there is a large quantity of nationwide and California-specific data characterizing nutrient concentrations in urban runoff (see Figure 8-2). Staff filtered the available data to include only data regionally from California and other arid western states. These data (> 1,000 total samples) illustrate that total nitrogen concentrations in urban runoff virtually never exceed the 10 mg/L drinking water regulatory standard for nitrate as N[46] (see Table 8-3). However, the available data suggest that urban runoff nutrient concentrations can be episodically greater than natural background and potentially contribute to a risk of biostimulation in surface waters (e.g., the data show urban runoff total nitrogen concentrations is episodically > 4 mg/L, and total phosphorus concentrations > 0.5 mg/L) – see Table 8-3, Figure 8-2, Table 8-4, and Figure 8-3.

Table 8-3. Total nitrogen concentrations in urban runoff (mg/L).
Note: Data from National Stormwater Quality Database (NSQD version 3) for sites in NSQD rain zones 5, 6, and 9 (arid west and southwest [A]). Temporal range of data is December 1978 to July 2002. Note that the nitrate as N drinking water quality standard is not necessarily directly comparable to total nitrogen aqueous concentrations shown here[B], but the nitrate as N water quality standard is shown in the table for informational purposes.

Stormwater Runoff Category	Predominant land use at monitoring site location	No. of Samples	Arithmetic Mean	Min	25%	50% (median)	75%	90%	Max	No. Exceeding Drinking Water Standard (>10 mg/L)	% Samples Exceeding 10 mg/L
Urban runoff	**All Sites**	1,085	3.08	0.03	1.30	2.03	3.62	6.50	68.03	35 of 1,085	**3.2%**
	commercial	162	2.71	0.50	1.18	1.80	3.28	5.53	15.90	–	Not calculated for individual land use types
	freeways	322	2.51	0.03	1.10	1.71	2.80	5.25	36.15	–	
	industrial	198	3.53	0.26	1.34	2.15	4.65	7.86	17.90	–	
	open space	68	2.75	0.73	1.45	1.98	3.34	5.30	9.14	–	
	residential	335	3.62	0.20	1.51	2.64	4.39	7.10	68.03	–	

[A] Includes central and southern California, Arizona, Colorado, central and west Texas, and western South Dakota and includes monitoring locations from cities of Arlington (TX), Aurora (CO), Austin (TX), Castro Valley (CA), Colorado Springs (CA), Dallas (TX), Denver (CO), Fort Worth (TX), Fresno (CA), Garland (TX), Irving (TX), Los Angeles (CA), Maricopa City (AZ), Mesquite (TX), Orange County (CA), Plano (TX), Sacramento (CA), Rapid City (SD), Riverside (CA), San Bernardino (CA), San Diego (CA), Tucson (AZ).

[B] Total nitrogen measured in aqueous systems includes nitrate as well as other compounds and phases of nitrogen, such as ammonia and organic nitrogen. Often, but not always, nitrate makes up the largest fraction of the nitrogen compounds found in total nitrogen measurements from stream waters.

[46] Elevated nitrogen levels in urban runoff can, however, locally contribute to biostimulatory impairments of receiving waters where eutrophication has been identified as a water quality problem regardless of whether or not the nitrogen levels exceed the drinking water quality standard.

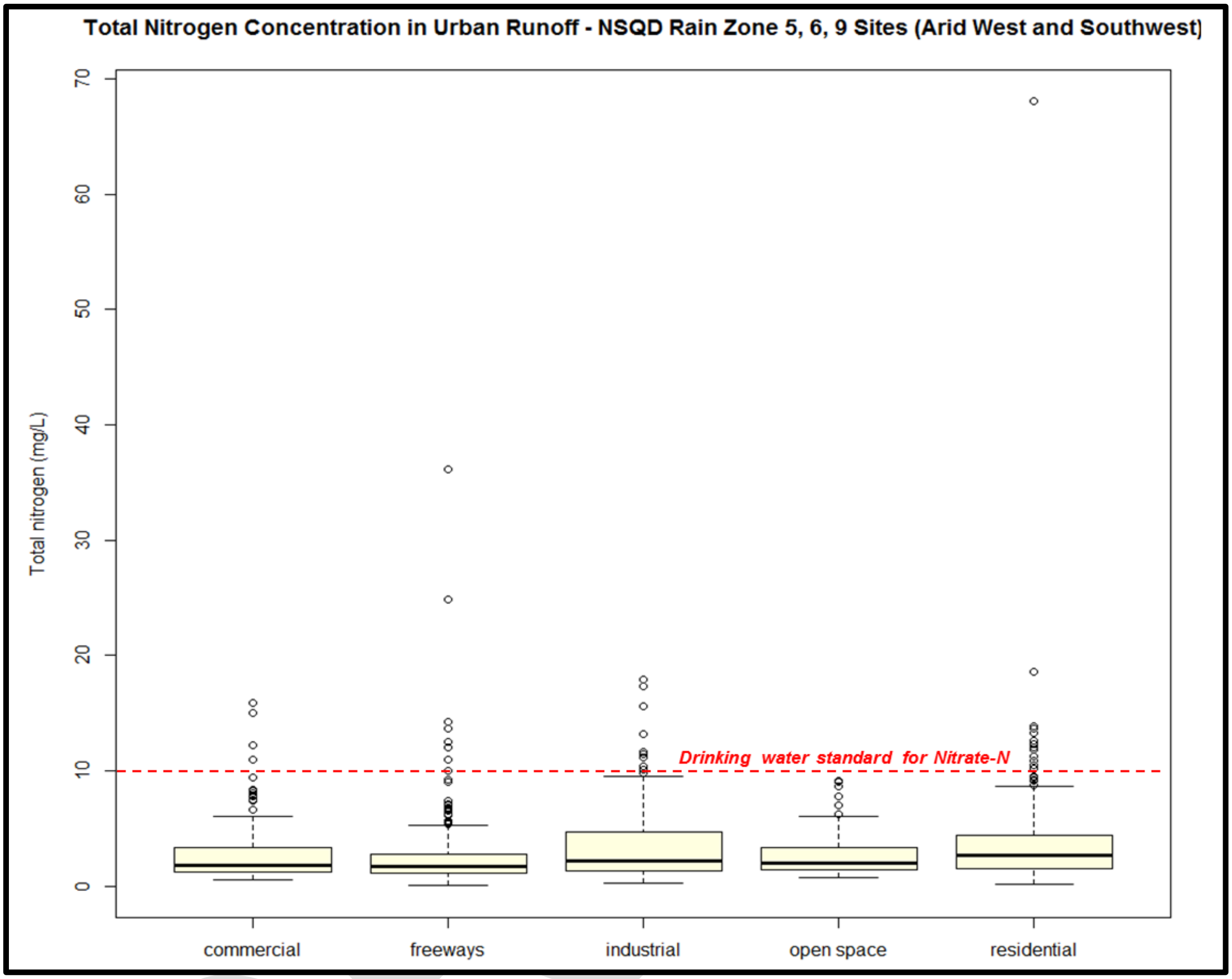


Figure 8-2. Box plot of total nitrogen concentrations in urban runoff from National Stormwater Quality Database (NSQD).

Note: Monitoring locations in NSQD rain zones 5, 6, and 9 (arid west and southwest). Raw statistics for this dataset were previously shown in Table 8-3. Note that the nitrate as N water quality standard is not necessarily directly comparable to total nitrogen aqueous concentrations shown here, but the water quality standard is shown on the graph for informational purposes. Temporal range of data is December 1978 to July 2002.

Table 8-4. Total phosphorus as P concentrations (mg/L) in urban runoff.
Note: Monitoring locations in NSQD rain zones 5, 6, and 9[A] (arid west and southwest). Temporal range of data is December 1978 to July 2002.

Stormwater Runoff Category	Predominant land use at monitoring site location	No. of Samples	Arithmetic Mean	Geometric Mean	Min	25%	50% (median)	75%	90%	Max
Urban runoff	**All Sites**	1,160	0.550	0.287	0.01	0.16	0.29	0.49	0.92	80.2
	commercial	381	0.590	0.24	0.01	0.11	0.22	0.46	0.80	15.60
	freeways	192	0.525	0.21	0.01	0.14	0.20	0.34	0.54	80.20
	industrial	76	0.614	0.34	0.01	0.16	0.28	0.78	1.46	7.90
	open space	348	0.401	0.24	0.01	0.17	0.28	0.48	0.96	2.29
	residential	381	0.555	0.42	0.08	0.27	0.40	0.64	1.00	6.42

[A] Includes central and southern California, Arizona, Colorado, central and west Texas, and western South Dakota and includes monitoring locations from cities of Aurora (CO), Austin (TX), Carlsbad (CA), Castro Valley (CA), Colorado Springs (CA), Dallas (TX), Denver (CO), Encinitas (CA), Fort Worth (TX), Garland (TX), Fresno (CA), Garland (TX), Irving (TX), Maricopa City (AZ), Mesquite (TX), Plano (TX), Rapid City (SD), San Diego (CA), Tucson (AZ).

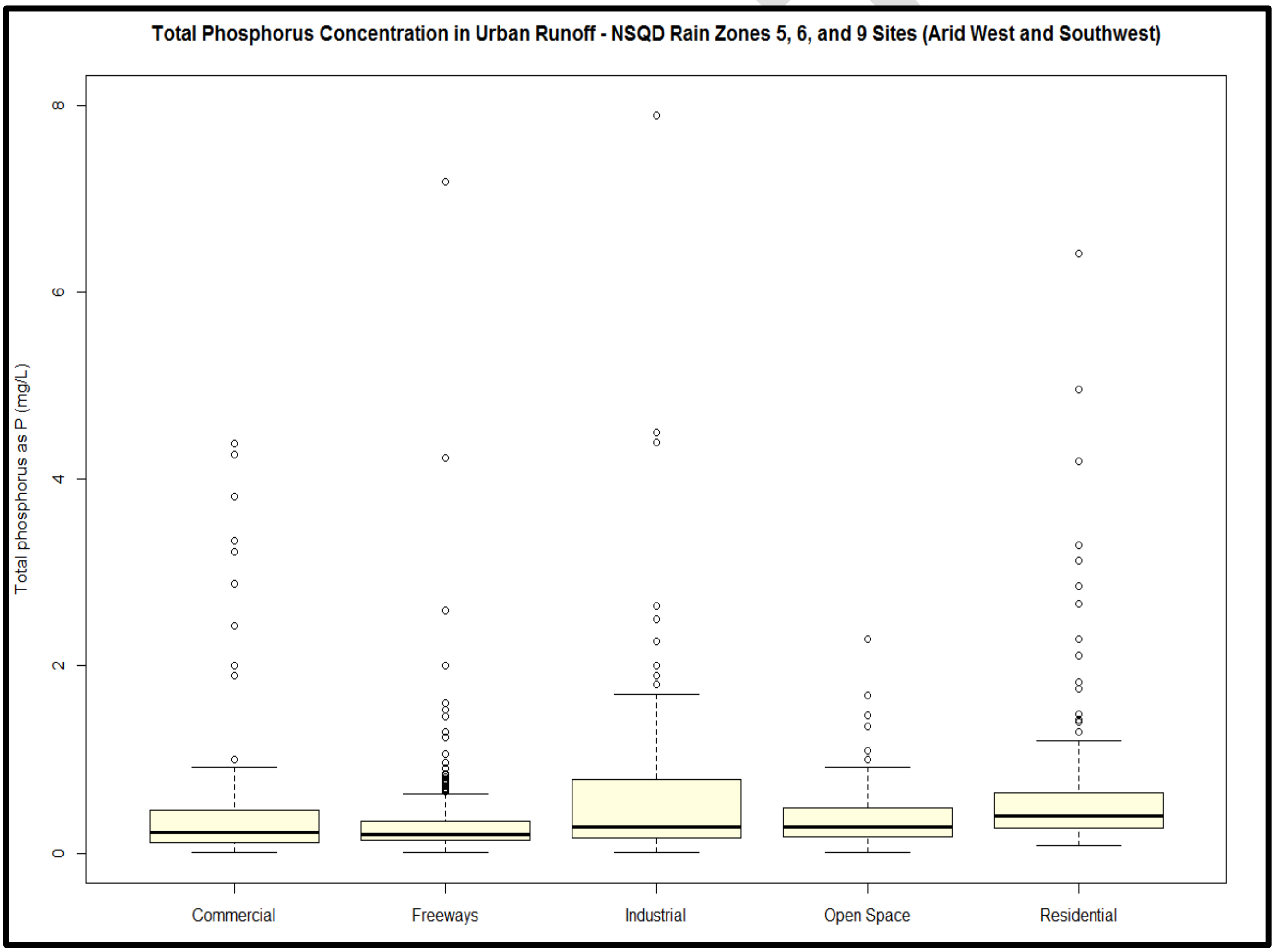


Figure 8-3. Box plot of total phosphorus as P concentrations in urban runoff from National Stormwater Quality Database (NSQD).
Note: Monitoring locations in NSQD rain zones 5, 6, and 9 (arid west and southwest). Raw statistics for this dataset were previously shown in Table 8-4. Temporal range of data is December 1978 to July 2002.

Average annual nutrient loads delivered to Franklin Creek from urban runoff were estimated on the basis of the STEPL input parameters previously identified in Section 8.1. Urban runoff estimated loads are tabulated in Table 8-5.

Table 8-5. Estimated average annual loads (lbs./year) from urban runoff (i.e., municipal stormwater)

Source	N Load (lbs/yr)	P Load (lbs/yr)
Urban Runoff (i.e., municipal stormwater system discharges)	3,760	654

Based on the aforementioned information, stormwater from MS4s are estimated to be a relatively minor source of nutrient loading to streams of the Franklin Creek watershed. However, because MS4 stormwater sources can potentially have significant localized effect on water, wasteload allocations will be assigned to NPDES MS4 stormwater permittees in the Franklin Creek watershed.

8.1.1.1 *Industrial & Construction Stormwater*

According to guidance from the State Water Resources Control Board, all NPDES point sources should receive a wasteload allocation (communication from Jonathan Bishop, Chief Deputy Director and Phil Wyels, Assistant Chief Counsel, State Water Resources Control Board, August 2014), and thus NPDES–permitted industrial stormwater and construction stormwater entities should be considered during TMDL development. Similarly, USEPA guidance recommends disaggregating stormwater sources in the wasteload allocation of a TMDL where feasible, including disaggregating industrial stormwater discharges (USEPA, 2014b).

As of August 28, 2017 there are seven active NPDES stormwater-permitted industrial facilities in the Carpinteria area, and eight active NPDES stormwater-permitted construction sites[47]. Table 8-6 and Table 8-7 present a tabulation of stormwater-permitted industrial facilities and construction sites, respectively.

Table 8-6. List of active NPDES stormwater-permitted industrial facilities located in the Carpinteria area as of August 28, 2017.

Site/Facility Name	Facility City
4482U4 Linden-Casitas (Highway Interchange Project)	Carpinteria
Santa Barbara County Reliability Project Segment 4B North (Linear Utility Project)	Carpinteria
CalProp	Carpinteria
SBCRP Carpinteria Yard B	Carpinteria
Rancho Monte Alegre Phase 6	Carpinteria
Santa Barbara Reliability Project Segment 3A North	Carpinteria
SBCRP Carpinteria Yard A	Carpinteria

[47] From information publically available in the State Water Resource Control Board's Storm Water Multiple Applications & Report Tracking System (SMARTS).
https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.jsp

Table 8-7. List of active NPDES stormwater-permitted construction site facilities located in the Carpinteria area as of August 28, 2017.

Site/Facility Name	Facility City
Astro Aerospace	Carpinteria
Venoco Inc Carpinteria Gas Pla	Carpinteria
Gigavac	Carpinteria
Carpinteria Facilities Yard	Carpinteria
Alewright LLC	Carpinteria
NuSil Investments LLC	Carpinteria
Santa Barbara Polo Racquet Club	Carpinteria
Freudenberg Medical	Carpinteria

Site specific industrial and construction stormwater runoff nutrient data for the Franklin Creek watershed is not available, so direct inferences about nutrient loading to surface waters from these facilities is not possible. However, there is a large amount of statewide stormwater runoff nitrate water quality from a wide range of industrial facilities, and also from some construction sites providing a plausibly good spatial representation of a variety of these types of sites within California. These data can give some insight into expected nitrate and nitrogen concentrations typically found in stormwater runoff from industrial and construction sites throughout California (see Table 8-8, Table 8-9, Table 8-10, and Figure 8-4). Based on the available data, stormwater runoff from industrial and construction facilities throughout California typically have relatively low nitrogen concentrations averaging less than 2 mg/L for nitrate as nitrogen and for total nitrogen. Further, as the large number of samples collected statewide indicate, the nitrate concentrations in stormwater runoff from these facilities almost never exceed or even approach the numeric threshold for the drinking water standard = 10 mg/L nitrate as nitrogen.

Therefore, indirect and anecdotal evidence suggests that NPDES stormwater-permitted industrial facilities and construction sites in the Franklin Creek watershed would not be expected to be a significant risk or cause of the observed nutrient water quality impairments, and these types of facilities are generally expected to be currently meeting wasteload allocations identified in this report. To maintain existing water quality and prevent any further water quality degradation, these permitted industrial facilities and construction operators shall continue to implement and comply with the requirements of the statewide Industrial General Permit or the Construction General Permit, respectively.

The information outlined above does not conclusively demonstrate that stormwater from all industrial facilities and construction sites are meeting proposed wasteload allocations. More information will be obtained during the implementation phase of these TMDLs to further assess the level of nutrient contributions to surface waters from these source categories, and to identify any actions needed to reduce nutrient loading.

Table 8-8. Nitrate as nitrogen concentrations in industrial stormwater runoff (mg/L).
Note: From permitted California facility sites as reported in the State Water Resources Control Board's Stormwater Multiple Application & Report Tracking System. Site specific data for the Franklin Creek watershed are not available, so statewide data are presented for informational purposes. Temporal range of data is October 2005 to November 2014.

Stormwater Runoff Category	No. of Samples	Geometric Mean	Min	10%	25%	50% (median)	75%	90%	Max	No. Exceeding Drinking Water Standard (>10 mg/L)	% Samples Exceeding 10 mg/L
Industrial stormwater runoff	1,906	0.78	0	0.1	0.25	0.72	2.1	6	13,100	119 of 1,906	**6.2%**

Table 8-9. Total nitrogen concentrations in industrial stormwater runoff (mg/L).
Note: From permitted California facility sites as reported in the State Water Resources Control Board's Stormwater Multiple Application & Report and Tracking System. Site specific data for the Franklin Creek watershed are not available, so statewide data are presented for informational purposes. Temporal range of data is from October 2005 to November 2014.

Industrial Stormwater: Type of Facility	No. of Samples	Arithmetic Mean	Min	10%	25%	50%	75%	90%	Max	No. of samples.
All industrial stormwater facilities	76	1.53	0.01	0.02	0.08	0.32	1.30	3.85	22.00	76
Aircraft Parts and Auxiliary Equipment	8	0.48	0.21	0.28	0.33	0.37	0.60	0.79	0.97	8.00
Aluminum Die-Castings	12	0.13	0.02	0.06	0.08	0.12	0.17	0.21	0.24	12.00
Chemicals and Allied Products	2	0.43	0.40	0.41	0.42	0.43	0.45	0.45	0.46	2.00
Coating Engraving and Allied Services	7	2.67	0.01	0.01	0.01	0.01	4.33	8.92	10.00	7.00
Electroplating Plating Polishing Anodizing and Coloring	5	0.05	0.02	0.02	0.03	0.04	0.05	0.08	0.10	5.00
Fabricated Plate Work (Boiler Shops)	3	0.15	0.07	0.08	0.08	0.09	0.19	0.24	0.28	3.00
Fertilizers Mixing Only	4	1.58	0.10	0.13	0.18	0.31	1.72	4.05	5.60	4.00
General Warehousing and Storage	1	9.50	9.50	9.50	9.50	9.50	9.50	9.50	9.50	1.00
Industrial Valves	1	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	1.00
Pesticides and Agricultural Chemicals	6	2.48	0.72	0.79	0.91	1.70	2.45	4.95	7.40	6.00
Plastics Material and Synthetic Resins and Nonvulcanizable Elastomers	2	0.06	0.02	0.03	0.04	0.06	0.08	0.09	0.10	2.00
Poultry Slaughtering and Processing	1	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.00
Prepared Feed and Feed Ingredients for Animals and Fowls	2	13.00	4.00	5.80	8.50	13.00	17.50	20.20	22.00	2.00
Printed Circuit Boards	2	0.02	0.01	0.01	0.02	0.02	0.03	0.03	0.03	2.00
Refuse Systems	4	0.47	0.05	0.16	0.34	0.46	0.59	0.79	0.92	4.00
Sheet Metal Work	2	0.10	0.07	0.07	0.08	0.10	0.11	0.12	0.13	2.00
Soaps and Other Detergents Except Specialty Cleaners	10	2.66	0.51	1.13	1.73	3.20	3.47	3.75	4.20	10.00
Trucking Except Local	2	1.43	0.16	0.41	0.80	1.43	2.07	2.45	2.70	2.00
Wood Office Furniture	2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	2.00

Table 8-10. Nitrate as nitrogen concentrations in construction stormwater runoff (mg/L).
Note: From permitted California construction sites as reported in the State Water Resources Control Board's Stormwater Multiple Application & Report Tracking System. Site specific data for the Franklin Creek watershed are not available, so statewide data are presented for informational purposes. Temporal range of data is from July 2010 to February 2014.

Stormwater Runoff Category	No. of Samples	Arithmetic Mean	Min	10%	25%	50% (median)	75%	90%	Max	No. Exceeding Drinking Water Standard (>10 mg/L)	% Samples Exceeding 10 mg/L
Construction stormwater runoff	21	1.64	0.06	0.32	0.65	0.9	2.8	4.5	4.8	0 of 21	**0%**

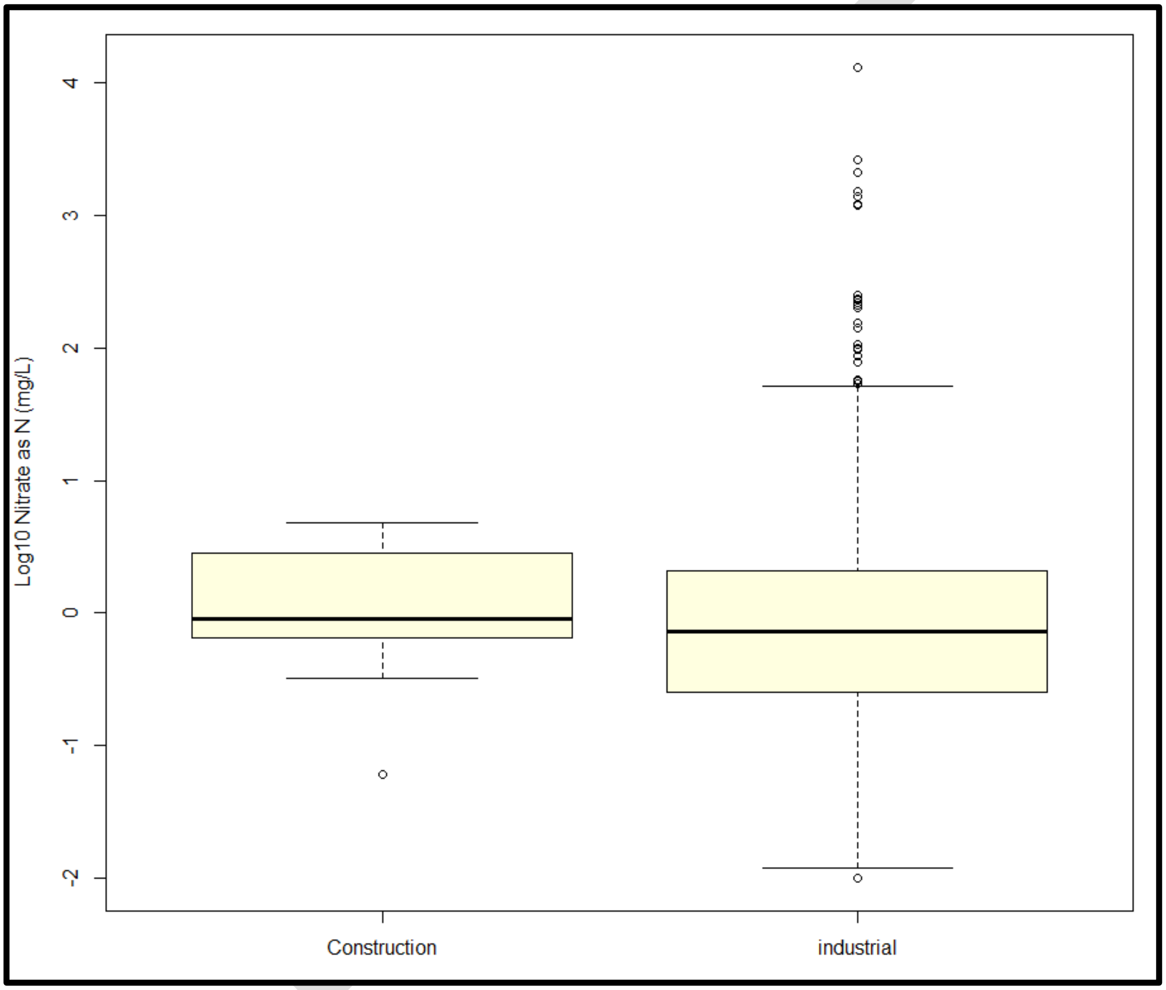


Figure 8-4. Boxplot of reported nitrate as N concentrations observed in California industrial and construction stormwater sites (mg/L).
Note: Site specific data for the Franklin Creek watershed is not available, so statewide data are presented for informational purposes. Note the vertical axis is log concentrations, thus log10 value of one represents a concentration of 10 mg/L nitrate at nitrogen; a log10 value of 0 represents a concentration of 1 mg/L nitrate as nitrogen; a log10 value of (negative) one represents a nitrate as nitrogen concentration of 0.1 mg/L, etc.

8.1.1.2 Wastewater Treatment Facilities

Treated municipal wastewater can potentially be a source of nutrient loads to streams in any given watershed. The Carpinteria Sanitation District municipal wastewater treatment facility is located outside of the project area as shown in Figure 8-5. The facility maintains an ocean discharge point and is not authorized to discharge to surface waters under NPDES-permitted conditions (Order No. R3-2017-0032, NPDES No. CA0047364). Because the Carpinteria Sanitation District municipal wastewater treatment facility is outside the TMDL project area and does not discharge to streams of the Franklin Creek watershed, wasteload allocations are not warranted.

Figure 8-5. Location of Carpinteria Sanitation District municipal wastewater treatment facility.

8.1.2 *Cropland*

Fertilizers or manure applied to cropland can constitute a significant source of nutrient loads to waterbodies. The primary concern with the application fertilizers on crops is that the application can exceed the uptake capability of the crop. If this occurs, the excess nutrients become mobile and can be transported to either nearby surface waters, the groundwater table, or the atmosphere (Tetra Tech, 2004).

The land use categories presented in Section 4.2 do not provide adequate detail to help characterize specific agricultural uses within the watershed because orchard, nursery, groves, and vineyards land uses are generalized into one agricultural land use classification. To better characterize agricultural land use, staff used 2012 Santa Barbara County parcel data for the Franklin Creek watershed (see Appendix A). As shown in Table 8-11 and Figure 8-6, irrigated orchards (primarily avocados), comprise the largest area of agricultural land use (37%) within the Franklin Creek watershed. Flowers, nurseries and greenhouses combine to make up around 10% of the watershed. Note that areas for each agricultural use type are based on the size of the parcel, rather than actual cultivated area within each parcel. As a result, parcel use areas are likely to be overestimated for each agricultural use type.

Table 8-11. Agricultural Parcels within the Franklin Creek watershed.

Parcel Use Description	Parcel Count	Parcel Use Area (acres)	% Area of Franklin Creek Watershed	% Area of Irrigated Agriculture in Franklin Creek Watershed
Irrigated Orchards (avocado)	84	995.8	37.2	77.5
Flowers	12	138.8	5.2	10.8
Nurseries, Greenhouses	17	138.7	5.2	10.8
Vineyards	1	5.9	0.2	0.5
Truck Crops, Irrigated	1	5.0	0.2	0.4

For the STEPL model, staff aggregated the flower, nursery, greenhouses, vineyards, and irrigated truck crops into one land use category titled nurseries and greenhouses. The nursery and greenhouse land use processes are represented in STEPL as “User Defined”. The irrigated orchards (avocado) are represented in STEPL as “Cropland”. It is important to note that nearly all flower, nursery, and greenhouse parcels in the watershed are within enclosed and covered greenhouse structures.

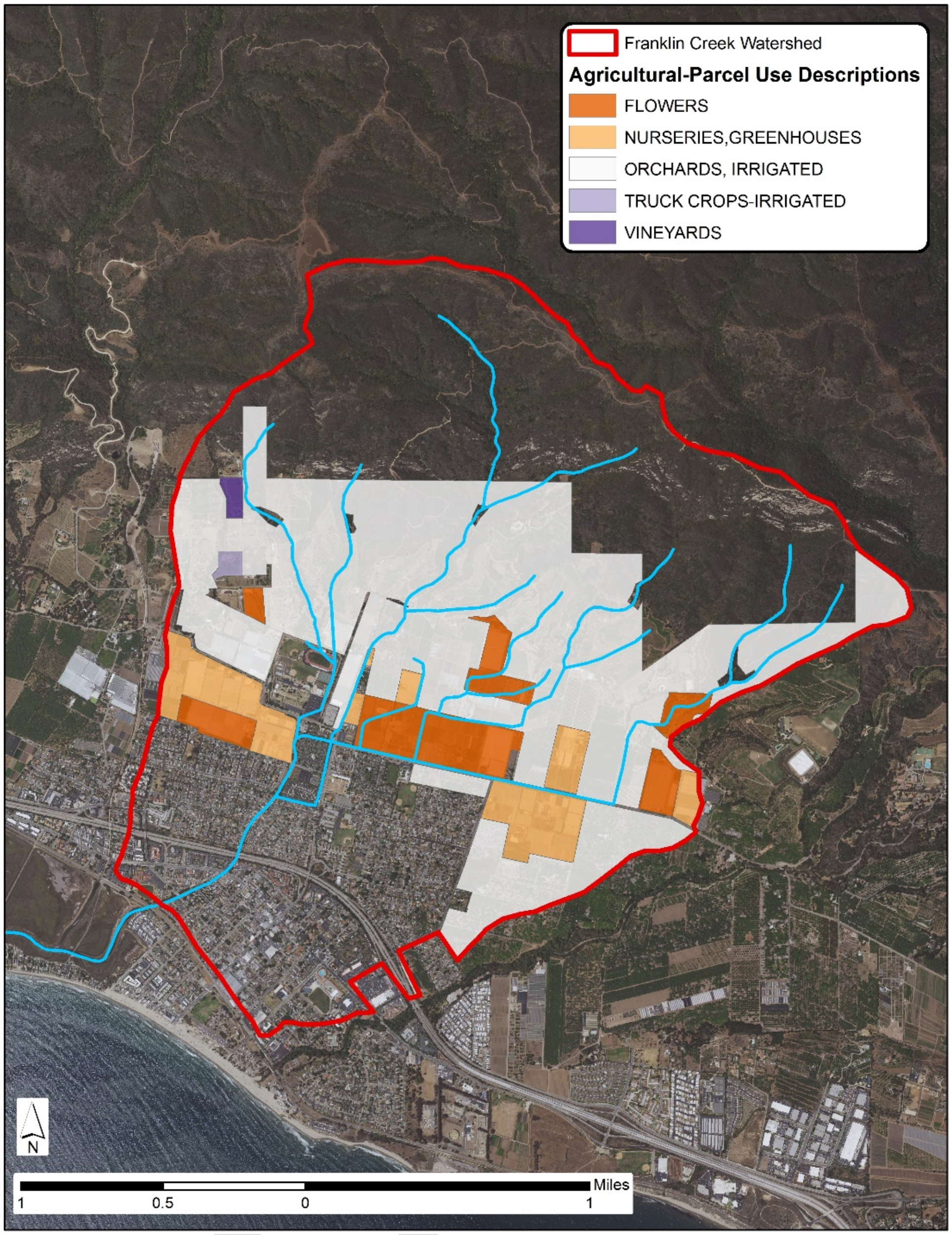


Figure 8-6. Agricultural uses based on Santa Barbara county parcel data (2012).

Figure 8-7 illustrates temporal trends of fertilizer sales in Santa Barbara County. It is important to recognize that fertilizer sales in a county does not necessarily mean those fertilizers were actually applied in that same county. Recorded sales in one county may actually be applied on crops in other, nearby counties. However, Krauter et al. (2002) reported fertilizer application estimates that were obtained from surveys, county farm advisors and crop specialists; these data indicated that in the Central Coast region, county fertilizer recorded sales correlated well with estimated in-county fertilizer applications (within 10 percent). Also, it is important to recognize that not all fertilizing material is sold to or applied to farm operations. The California Department of Food and Agriculture reports that for the annual period July 2007 to June 2008, non-farm entities purchased about 2.6% of fertilizing materials sold in Santa Barbara County[48].

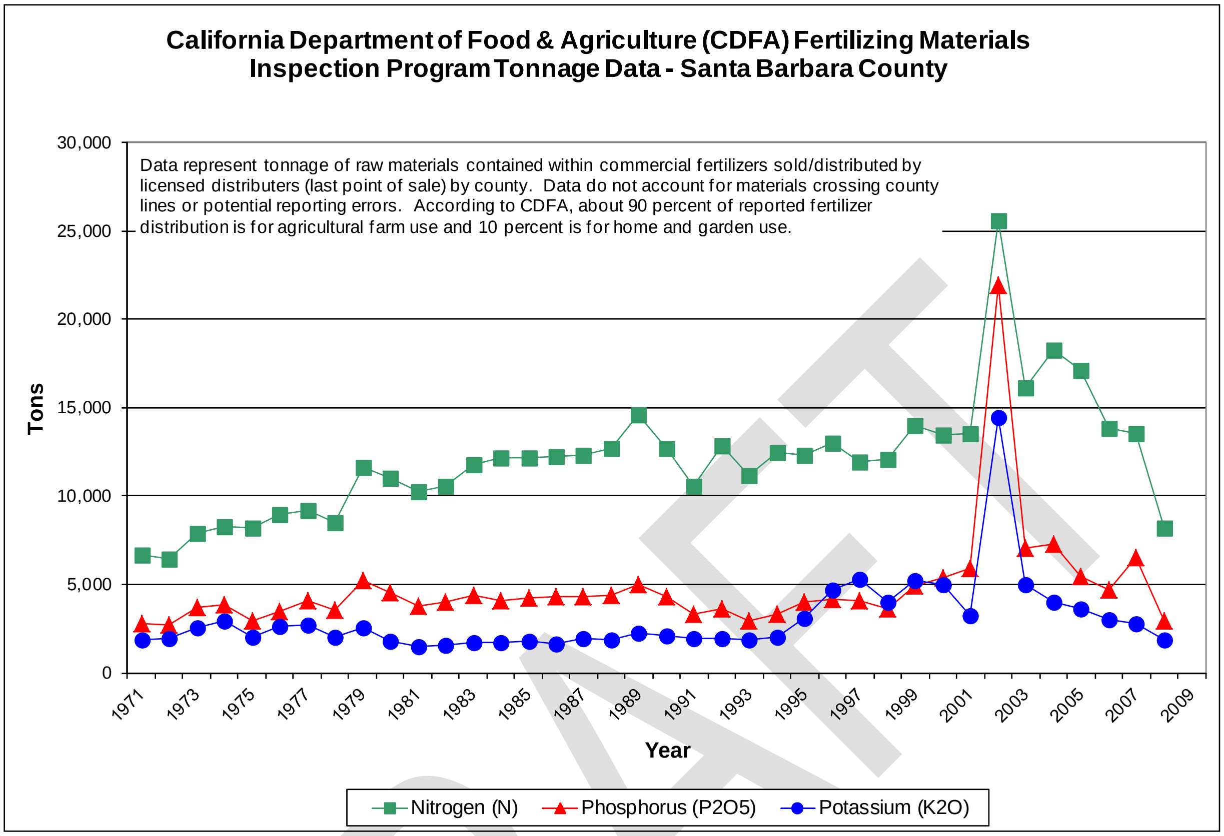


Figure 8-7. Fertilizer sales in Santa Barbara County.

California fertilizer application rates on specific crop types are available from the U.S. Department of Agriculture, National Agricultural Statistics Service (NASS), as shown in Table 8-12.

[48] California Department of Food and Agriculture, Fertilizing Materials Tonnage Report, January – June 2008, pg. 10.

Table 8-12. California fertilizer application rates.

Crop	Application Rate per Crop Year in California (pounds per acre)			Source
	Nitrogen	Phosphate	Potash	
Tomatoes	243	133	174	2007 NASS report
Sweet Corn	226	127	77	2007 NASS report
Rice	124	46	34	2007 NASS report
Avocado	63	25	45	2009 NASS report
Lemon	67	39	59	2009 NASS report
Cotton	123	74	48	2008 NASS report
Barley	73	19	7	2004 NASS report
Oats[1]	64	35	50	2006 NASS report
Head Lettuce	200	118	47	2007 NASS report
Cauliflower	232	100	43	2007 NASS report
Broccoli	216	82	49	2007 NASS report
Celery	344	114	151	2007 NASS report
Asparagus	72	20	46	2007 NASS report
Spinach	150	60	49	2007 NASS report
Strawberries[2]	155	88	88	University of Delaware Ag, Nutrient Recommendations on Crops webpage

[1]insufficient reports to publish fertilizer data for P and potash; used national average from 2006 NASS report for P and K.
[2] median of ranges, calculated from table 1, table 4, and table 5 @ http://ag.udel.edu/other_websites/DSTP/Orchard.htm

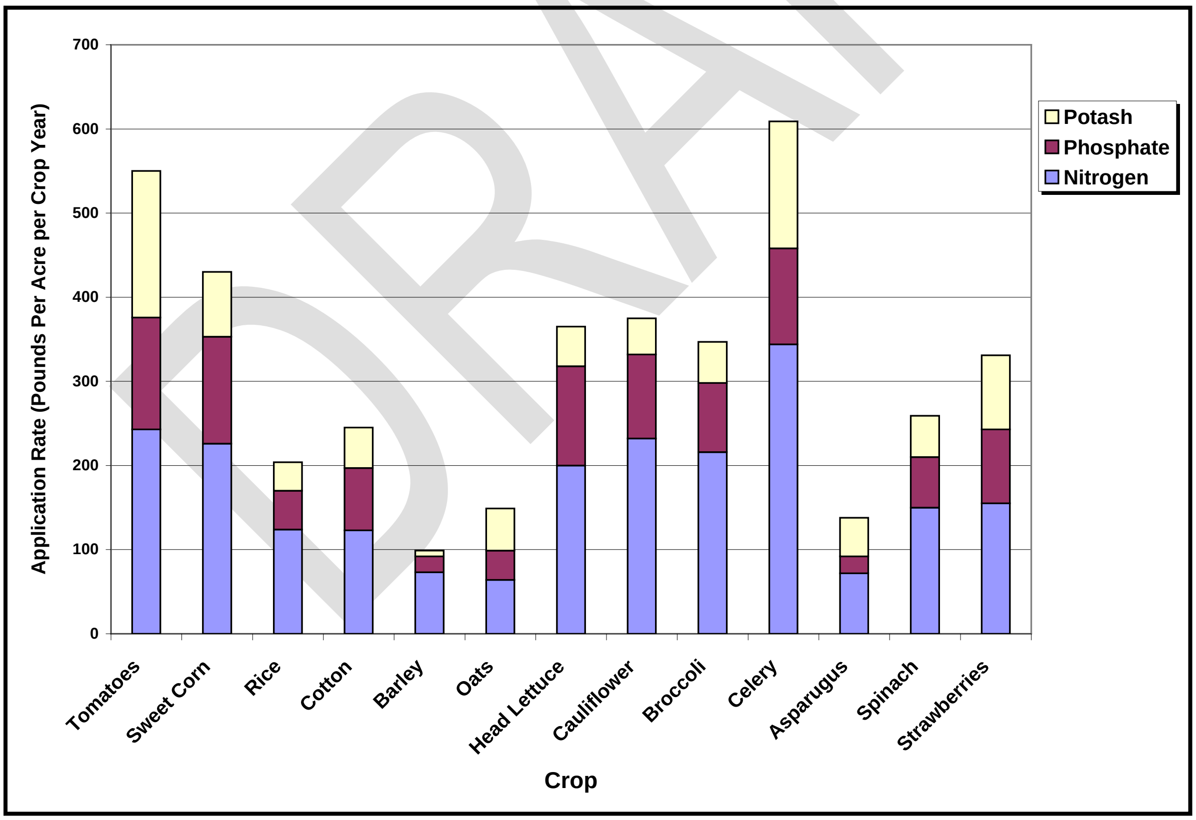


Figure 8-8. California fertilizer application rates on crops.
Source: USDA-NASS, 2004-2008

Table 8-13. Nitrogen application rates on California crops, reported by California resource professionals and agencies.

Crop Type	Estimated Crop Application Rates (lbs N/acre)	Source of Application Estimate (see notes below)
Lettuce	150	4, 6
Broccoli	200	5
Celery	275	1
Misc. Vegetables	150	2
Strawberries	180	8
Raspberries	60	3
Grapes	20	9
Citrus	170	7
Avocados	50	2
Nuts	200	10
Misc. Fruit	151	11
Seed	150	2
Flowers	300	2
Nurseries	300	2
Field Crops	50	2

Notes:
1. Tim Hartz, Fertilizer Symposium presentation, Santa Maria, November 2008
2. Peter Meertens, Central Coast Water Board staff, based on similar crop type.
3. Univ. of Calif. Cooperative Extension (UCCE), 2005 Sample Cost to Produce Fresh Market Raspberries, Santa Cruz & Monterey Counties
4. UCCE, 2009 Sample Costs to Produce Romaine Hearts, Central Coast Region - Monterey County
5. UCCE, 2004 Sample Costs to Produce Fresh Market Broccoli, Central Coast Region - Monterey County
6. UCCE, 2009 Sample Costs to Produce Iceberg Lettuce, Central Coast Region - Monterey County
7. UCCE, 2005 Sample Cost to Produce Mandarins, Ventura County (170 trees/ acre 1lbs N/ tree)
8. UCCE, 2005 Sample Costs to Produce Strawberries, Santa Barbara County
9. UCCE, 2004 Sample Cost to Establish and Produce Wine Grapes, Chardonnay, North Coast Region - Sonoma County
10. UCCE, 2007 Sample Cost to Establish a Walnut Orchard and Produce Walnuts, Sacramento County (N rate for established orchard)
11. UCCE, 2004 Sample Cost to Establish and Produce Fresh Market Nectarines, San Joaquin Valley

Because of variability in nitrogen and phosphorus application rates noted above, undoubtedly the estimated magnitude of nutrient loads to land and to streams from agricultural lands can vary substantially based on crop type (Harmel et al., 2006). Nutrient loads refer to the amount of nitrogen or phosphorus exported from an area or specific land use over a specific time period (e.g., typically, kilograms per hectare per year). Harmel et al. (2006) report nutrient loading values that range from a national median of 21.9 kg/ha nitrogen for soybean crops, to a national median of 3.02 kg/ha nitrogen for sorghum. Therefore, it is important to be cognizant of local agricultural conditions and crop types to gage a plausible level of risk of nutrient loading to surface water from these sources.

Predominant crops in the Franklin Creek watershed are avocado orchards, flowers, nurseries, and greenhouses. As shown in Table 8-13, nitrogen application are highest for flowers and nurseries.

Because of the relative intensity of fertilizer applications on many types of cultivated crops as outlined previously, nutrient concentrations in agricultural surface runoff are often expected to be higher than nutrient concentrations in municipal and residential runoff, as illustrated in Figure 8-9 (data is from Geosyntec Consultants, 2008).

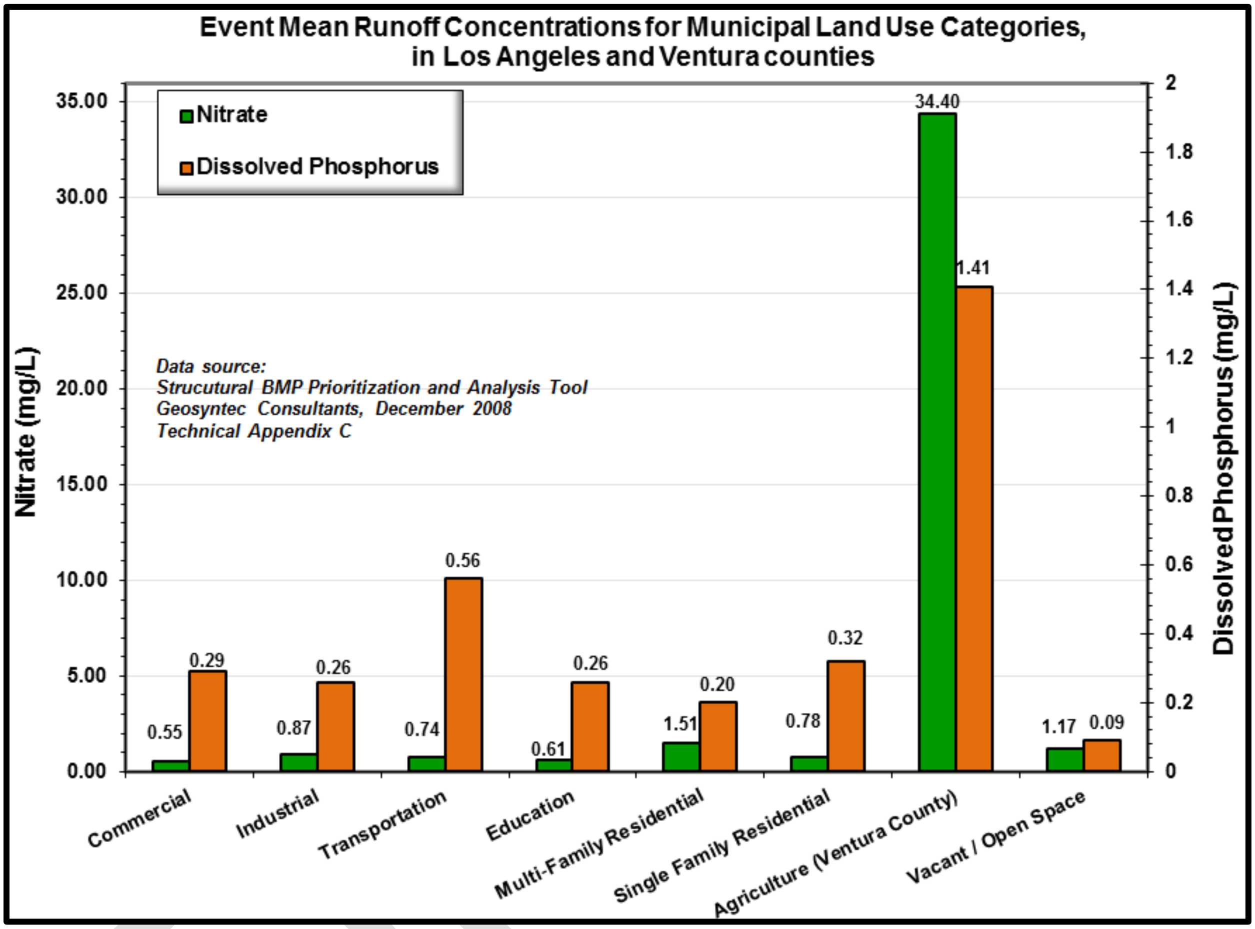


Figure 8-9. Runoff event mean nutrient concentration data for municipal land use categories, Los Angeles and Ventura counties

To develop nutrient loading estimates for agricultural land uses in the Franklin Creek watershed, staff used volume weighted mean concentrations as reported by Robinson in 2006. Robinson collected surface water samples from locations that receive runoff from various land use types. Water samples were collected in 2002 which was a dry year (7.5 inches precipitation) and in 2003 which was a wet year (21.6 inches precipitation). Staff used the wet year and dry year mean values as shown in Table 8-14.

Table 8-14. Nitrate and orthophophate volume weighted mean (VWM) concentrations in runoff from various land uses.

		VWM Concentration (uM) [A]			VWM Concentration (mg/L)
Land use	Nutrient	Dry year WY2002	Wet year WY2003	Mean Dry/Wet year	Mean Dry/Wet year
Greenhouse	Nitrate	1542	1045	1293.5	18.1
Nursery	Nitrate	2490	1271	1880.5	26.3
Avocado	Nitrate	233	139	186	2.6
Chaparral	Nitrate	6	35	20.5	0.28
Greenhouse	Orthophosphate	135	94	114.5	3.5
Nursery	Orthophosphate	10	16	13	0.4
Avocado	Orthophosphate	34	9	21.5	0.6
Chaparral	Orthophosphate	2	2	2	0.062

[A] Volume weighted mean concentrations micromoles (uM) as reported in Robinson, 2006.

Table 8-15. Nutrient concentrations in runoff (mg/L) used for agriculture and chaparral lands in STEPL.

Land use	Nitrogen (mg/L)	Phosphorus (mg/L)
Nursery and Greenhouse [A]	22	1.9
Avocado	2.6	0.6
Chaparral	0.28	0.062

[A] Mean value for nursery and greenhouse land use combined.

The estimated annual nutrient load from cropland in the project area as calculated by STEPL is shown in Table 8-16.

Table 8-16. Cropland Annual Load (lbs./year)

Source	**N Load (lbs/yr)**	**P Load (lbs/yr)**
Cropland	8,719	3,889

8.1.3 *Pastureland*

Livestock and other domestic animals that spend significant periods of time in or near surface waters can contribute significant loads of nitrogen and phosphorus because they use only a portion of the nutrients fed to them and the remaining nutrients are excreted (Tetra Tech, 2004). For example, in a normal finishing diet, a yearling cattle will retain only between 10 percent and 20 percent of the nitrogen and phosphorus it is fed. The rest of the nutrients are excreted as waste, and are thus available for runoff into nearby waterbodies or into the groundwater (Koelsch and Shapiro, 1997 as reported in Tetra Tech, 2004).

Staff used National Agricultural Imagery Program (NAIP, 2014) aerial imagery to identify livestock and other domestic animals that would forage within the Franklin Creek watershed. Based on an evaluation of aerial imagery staff has concluded that livestock and other large domestic animals are not present in the Franklin Creek watershed. As such, nutrient loading from this activity does not occur.

8.1.4 *Forest and Undeveloped Lands (Chaparral)*

Streams in lightly disturbed or undeveloped woodlands and open space are generally characterized by low concentrations of nutrients in surface waters on the basis of water quality data collected from undeveloped stream basins across the conterminous United States – see Table 8-17. For the Franklin Creek watershed this type of land use may be characterized as chaparral. Thus, surface waters and surface runoff from chaparral upland areas of the watershed would be expected to have quite low nutrient concentrations relative to other types of land use categories which are more influenced by human activities.

Table 8-17. Mean annual flow-weighted nutrient concentrations observed in streams in undeveloped basins of the conterminous United States.

Water Quality Parameter	No. of sampled streams	Arithmetic Mean	Min	25%	50% (median)	75%	90%	Max	No. Exceeding Drinking Water Standard (>10 mg/L)	% Samples Exceeding 10 mg/L
Nitrate as N	82	0.15	0.00	0.03	0.09	0.20	0.44	0.77	0 of 82	0%
Total nitrogen	63	0.39	0.10	0.17	0.25	0.50	0.72	2.57	N.A.	N.A.
Total phosphorus	63	0.04	0.02	0.02	0.02	0.04	0.08	0.20	N.A.	N.A.

Source data: Clark et al. (2000). Nutrient Concentrations and Yields in Undeveloped Basins of the United States.

Staff estimated the average annual nutrient loads delivered to Franklin Creek from forest and undeveloped lands (chaparral) on the basis of the STEPL input parameters listed in Table 8-15. The resulting estimated loads are tabulated in Table 8-18.

Table 8-18. Forest and Undeveloped (Chaparral) Land Annual Load (lbs./year)

Source	N Load (lbs/yr)	P Load (lbs/yr)
Forested/Undeveloped Lands (chaparral)	3,737	1,954

8.1.5 *Onsite Disposal Systems (OSDS)*

The estimated annual nitrate load from OSDS (i.e., septic systems) to surface waters in the project area as calculated by STEPL is shown in Table 8-19. Staff used National Agricultural Imagery Program (NAIP, 2014) aerial imagery to identify approximately 110 OSDS within Franklin Creek watershed. While the impacts of OSDS to underlying groundwater may be locally significant, researchers have concluded that at the basin-scale and regional-scale of agricultural valleys, OSDS impacts to groundwater are insignificant relative to agricultural fertilizer impacts (University of California-Davis, 2012).

The estimated annual nitrate load from OSDS in the project area as calculated by STEPL is shown in Table 8-19.

Table 8-19. OSDS (Septic) Annual Load (lbs./year)

Source	N Load (lbs/yr)	P Load (lbs/yr)
OSDS (Septic)	68	27

8.1.6 *Shallow Groundwater*

Shallow groundwater provides the base flows to streams and can locally provide a substantial source of surface water flows, especially during low flow conditions or during the dry season. Nitrate in groundwater can occur from both leaching of anthropogenic sources at the land surface, and from natural sources. Note that controllable phosphorus leaching to groundwater is presumed to be negligible in this TMDL report; phosphorus readily binds to sediment, is relatively insoluble, and is generally not expected to be leached to groundwater from surface sources in significant amounts. Phosphorus in groundwater is generally expected to result from leaching of geologic materials in the subsurface.

Staff used data provided in the USGS GWAVA dataset to estimate STEPL input parameters for nutrient concentrations in shallow groundwater (see Figure 6-41).

The estimated annual nitrate load from shallow groundwater in the project area as calculated by STEPL is shown in Table 8-20.

Table 8-20. Groundwater Annual Load (lbs./year)

Source	N Load (lbs/yr)	P Load (lbs/yr)
Groundwater	6,984	25

8.2 Direct Atmospheric Deposition

Atmospheric inputs of nutrients in rainfall are a source of loading in any watershed. Because nitrogen can exist as a gaseous phase (while phosphorus cannot), nitrogen is more prone to atmospheric transport and deposition. It is important to recognize however that atmospheric deposition of nutrients is typically more significant in lakes and reservoirs, than in creeks or streams (USEPA, 1999). This is because the surface area of a stream is typically small compared to the area of a watershed. Atmospheric deposition also occurs on the land surfaces throughout any given watershed and these loads could ultimately be transported to a waterbody if entrained in runoff. These loads would be considered part of the ambient background load, in contrast to the direct atmospheric deposition onto the surfaces of streams and lakes being addressed here.

The STEPL spreadsheet model staff used in source analysis does not estimate atmospheric inputs of nutrients to surface waterbodies. Consequently, staff used available information of atmospheric nutrient loading, and river basin parameters to develop estimates independent of the STEPL spreadsheet (see Table 8-21). The total summed length of all NHDplus digitized surface water flowlines in the Franklin Creek watershed is approximately 66,286 feet. Based on an average stream width of 5 feet, the total surface area of streams within the watershed is approximately 3.1 hectares. With an estimated average annual total nitrogen atmospheric deposition rate of 19.2 kg of nitrogen/ha/year (see Figure 8-10), the typical annual load from atmospheric deposition in the river basin would therefore be 59.5 kg of nitrogen/year, or equivalent to 131 pounds of nitrogen/year.

Atmospheric phosphorus can be found in organic and inorganic dust particles. The general atmospheric deposition rate for total phosphorus can be estimated as 0.6 kg of phosphorus/ha/year (USEPA 1994, as reported in San Diego Regional Water Quality Control Board, 2006). Accordingly, using the summed total stream surface area presented above, the typical annual load of phosphorus would therefore be 1.9 kg of total phosphorus/year, or equivalent to 4.2 pounds/year (see Table 8-22).

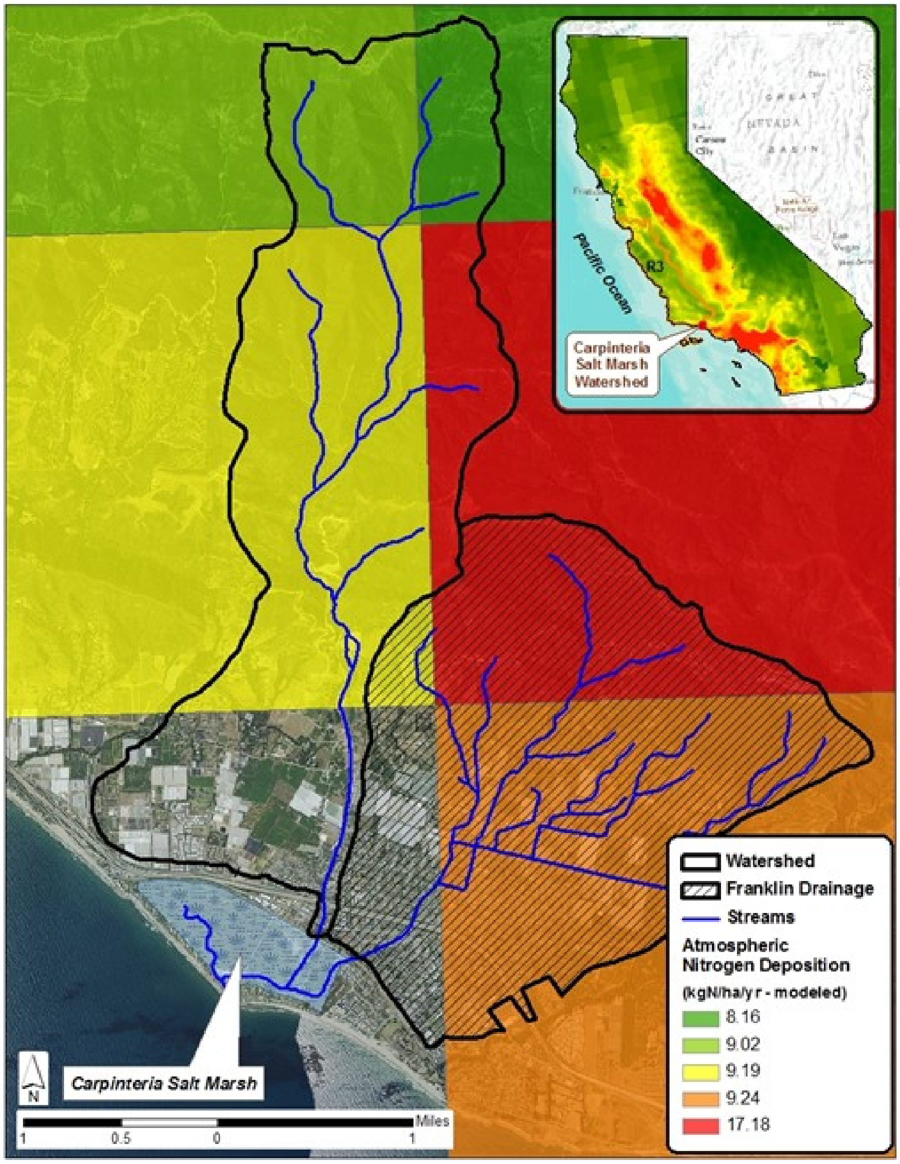


Figure 8-10. Estimated annual atmospheric deposition of nitrogen-N (units=kg/ha/year).
Source: [1] Tonnesen, G., Z. Wang, M. Omary, and C. J. Chien. 2007. University of California-Riverside. Assessment of Nitrogen Deposition: Modeling and Habitat Assessment. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2006-032.

Table 8-21. Nutrient atmospheric deposition in the Franklin Creek watershed.

Parameters Considered	Estimates
Total summed length of all streams in the Franklin Creek watershed	66,286 ft. [A]
Total summed surface area of all streams in the Franklin Creek watershed	3.1 hectares [B]
Estimated average annual atmospheric deposition rate of total nitrogen to streams in the Franklin Creek watershed	19.2 kg/hectare per year
Estimated average annual atmospheric deposition rate of total phosphorus to streams in the Franklin Creek watershed	0.6 kg/hectare per year

[A] Calculated from the total summed length of NHD stream flowlines in the Franklin Creek watershed.
[B] Area calculated based on a stream width of 5 feet.

Table 8-22. Annual load estimates from atmospheric deposition (lbs./year).

Source	**N Load (lbs/yr)**	**P Load (lbs/yr)**
Atmospheric deposition	131	4

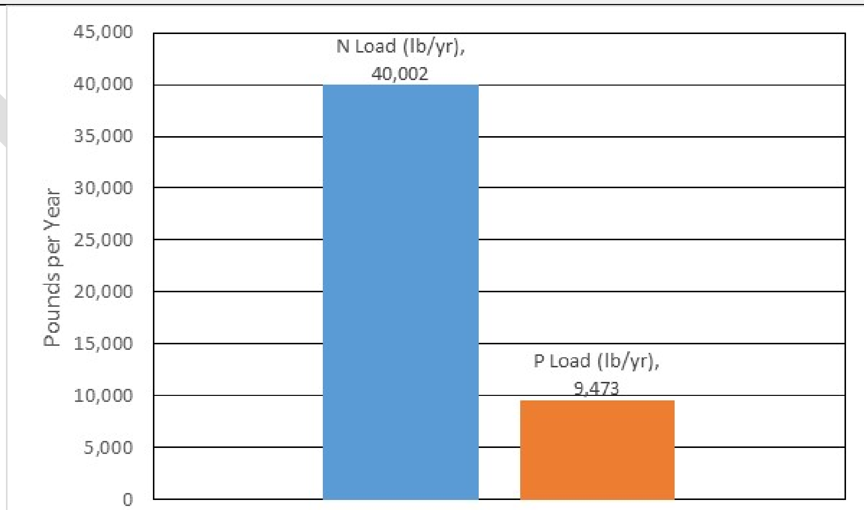
8.3 Summary of Estimated Loads by Source

It is worth reiterating that these loads are estimates for the TMDL project area. It is understood that there will be substantial variation due to temporal or local, site specific conditions. More information will be collected during TMDL implementation to assess controllable sources of nitrate. Table 8-23 and Figure 8-11 summarize estimated loads of nitrogen and phosphorus.

Table 8-23. Summary of estimated loads by source (lbs./yr.).

Sources	N Load (lb/yr)	P Load (lb/yr)
Urban	3,760	654
Orchards	8,720	3,889
Nurseries, Greenhouses (User Defined)	16,603	2,919
Pastureland	0	0
Chaparral	3,737	1,954
OSDS Septic	68	27
Groundwater	6,984	25
Atmospheric deposition	131	4
Total	40,002	9,473

Bar Chart – Total Nitrogen and Phosphorus Annual Load



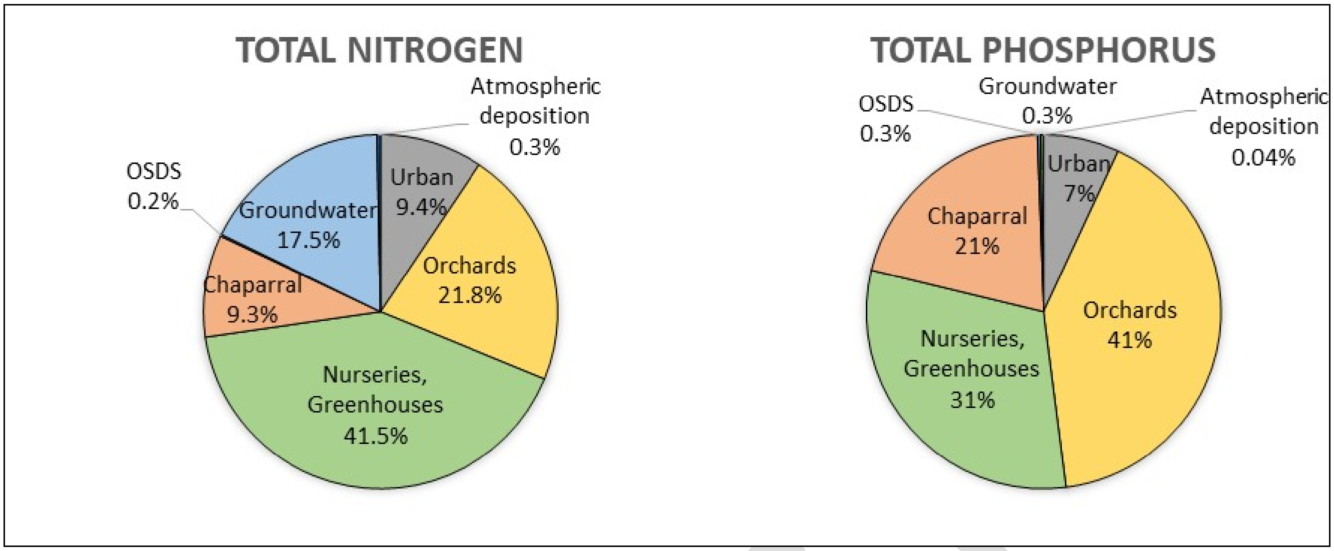


Figure 8-11. Summary of estimated loads (%).

As shown in Figure 8-11 around 42% of the estimated nitrogen loading in the watershed is from nurseries and greenhouses, followed by orchards (22%), and groundwater (18%). For phosphorus the primary load sources were estimated to originate from orchards (41%), nurseries and greenhouses (31%), and chaparral (21%). Staff derived nutrient loading rates per land use acre using the land use areas entered into the STEPL model and the STEPL estimated loads shown in Table 8-23. Estimated nutrient yields in pounds per acre per year are shown in Table 8-24. Loading rate per acre is highest for nurseries and greenhouses, followed by the avocado orchards.

Table 8-24. Estimated annual nutrient loads and yields.

		Estimated Nutrient Loads (lbs./yr.)		Estimated Nutrient Yields (lbs./acre/yr.)	
Land Cover	Land Cover (acres)	N Load	P Load	N Yield	P Yield
Urban	640	3,760	654	5.9	1.0
Orchards	788	8,720	3,889	11.1	4.9
Nurseries, Greenhouses	277	16,603	2,919	59.9	10.5
Chaparral	1,149	3,737	1,954	3.3	1.7

8.4 Comparison of Load Estimates

Staff estimated existing mean annual loads using a simple averaging method where the load is calculated as the average concentration of samples multiplied by the mean flow. The calculation is as follows:

Nitrate Load (lbs./year) = Discharge (cfs) * 5.394 (conversion factor)* Nutrient Concentration (mg/L) * 365

Staff used CCAMP water quality monitoring data and the USGS mean discharge data to derive estimated mean annual nutrient loads as shown in Table 8-25. Using the simple averaging method, the mean annual total nitrogen load is 37,854 pounds while the mean annual total phosphorus load is 445 pounds.

Table 8-25. Estimated mean annual total nitrogen and total phosphorus loads.

Waterbody	Estimated Mean Annual Flow (cfs) [A]	Total Nitrogen		Total Phosphorus	
		Mean Annual Total Nitrogen Concentration. (mg/L) [B]	Estimated Mean Annual Total Nitrogen Load (lbs.)	Mean Annual Total Phosphorus Concentration. (mg/L) [B]	Estimated Mean Annual Total Phosphorus Load (lbs.)
San Antonio Creek above Barka Slough [C]	0.87	22.1	37,854	0.26	445

[A] USGS average daily flow based on streamflow characteristics dataset (Wolock, 2003) containing data up through November 2001. See Table 4-3.
[B] Mean annual concentration from sites 315FMV and 315FRC combined.

A previous nutrient study of drainages entering Carpinteria Salt Marsh reported nitrate as nitrogen loading rates of 38,820 pounds per year and an orthophosphate loading rate of 739 pounds per year from Franklin Creek in 2002 (Robinson 2006). Figure 8-12 illustrates a comparison of estimated loads derived from the STEPL model (see Table 8-23), the simple averaging method (see Table 8-25), and as reported by Robinson in 2006.

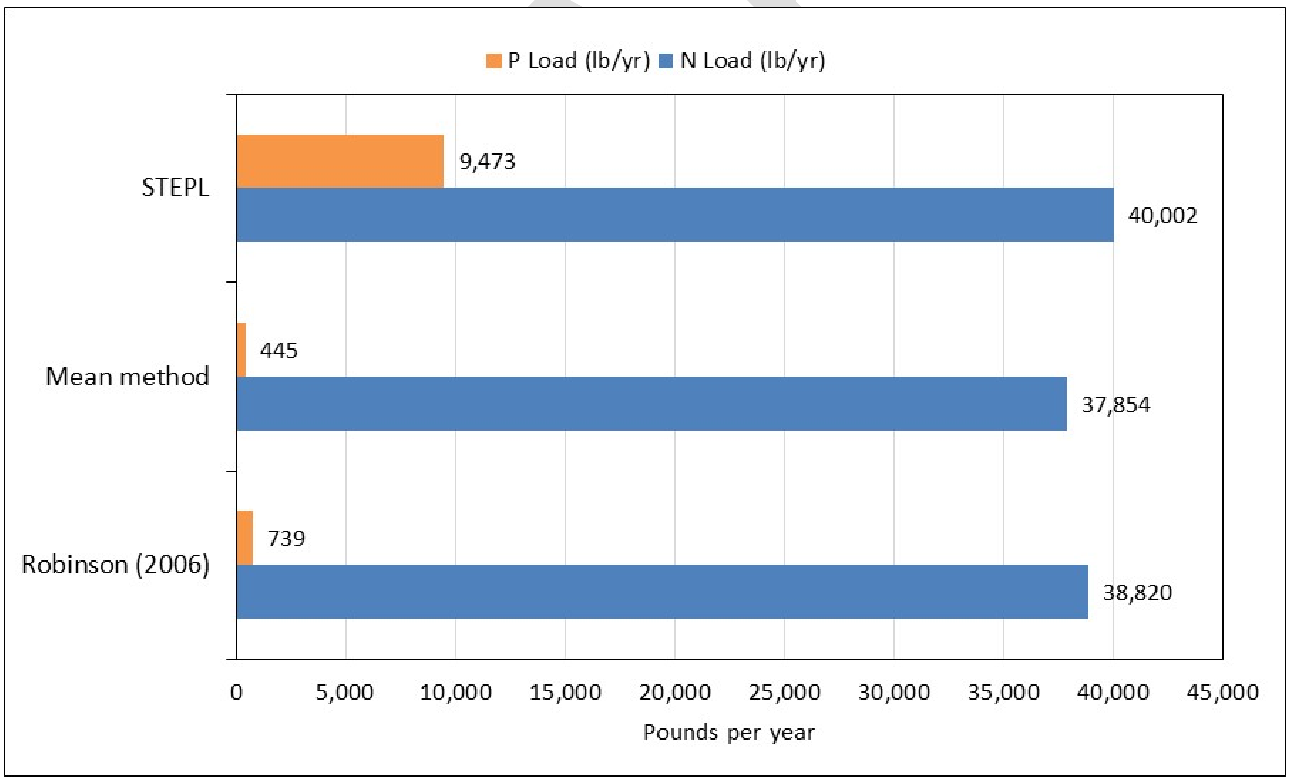


Figure 8-12. Comparison of estimated loading rates (lbs./year).

The mean annual nitrogen loads are in reasonably good agreement with each other, thus providing a measure of confidence in the STEPL spreadsheet tool that was used to estimate source loading for this TMDL project.

However, total phosphate loading rates predicted by the STEPL model far exceed the total phosphate loading rate estimated by the simple averaging (mean) method and orthophosphate loads reported by Robinson. Unlike nitrate, which is soluble and highly mobile in the environment and in aqueous systems, phosphorus readily binds to sediment and is not as mobile in the environment as nitrogen. As such, measurements of aqueous phosphorus in the water column does not account for phosphorus being transported in detrital matter in the stream bedload, nor does it account for phosphorus that is sequestered within sedimentary materials or organic matter. In particular, sediment-sequestered phosphorus loads from headwater reaches may periodically be released from sediments when reduction-oxidation conditions change, or they may be episodically flushed out of the watershed during abnormally wet years when large quantities of sediment can be mobilized and transported. Alternatively, the discrepancy between observed load and predicted load could result from inadequate input parameters for the STEPL spreadsheet tool. In particular, STEPL results are quite sensitive to input parameters for nutrient concentrations in runoff and the universal soil loss equation. Staff does expect, however, that STEPL provides a plausible gross approximation of *relative* source contributions of phosphorus at the watershed scale.

9 TOTAL MAXIMUM DAILY LOADS AND ALLOCATIONS

9.1 Existing Loading & Loading Capacity

Mean annual existing loads were estimated by a simple averaging technique (for example, see Etchells et al., 2005) where the annual load is calculated as the average concentration of samples multiplied by the mean annual flow. The loading capacity is the greatest amount of a pollutant that a water can receive and still meet water quality standards for that pollutant. Table 9-1 presents a tabulation of estimated mean annual existing nitrate loads and estimated percent reductions from the existing load to attain the loading capacity of the stream. Table 9-2 presents a tabulation of estimated existing dry season (May 1-October 30) loads and estimated percent reductions from the existing dry season loads to attain the loading capacity of the stream.

Table 9-1. Tabulation of estimated mean annual total nitrogen loads, loading capacity, and percent reductions.

Stream Reach and Monitoring Site	Total Nitrogen Numeric Target Used for Calculating Loading Capacity and Reduction Goal	Estimated Mean Annual Flow (cfs) [A]	Mean Annual Conc. (mg/L) [B]	Mean Annual Existing Load (lbs.)	Mean Annual Loading Capacity (lbs.)	Estimated Load Reduction Necessary (lbs.)	Percent Reduction Goal [C]
Franklin Creek at Carpinteria Avenue 315FRC	MUN standard = 10 Anti-degradation requirements apply – maintain existing Water quality	0.87	21.93	37,563	17,128	20,435	54%
Franklin Creek at Carpinteria Avenue 315FRC	Wet season biostimulation target = 8	0.87	21.93	37,563	13,703	23,860	64%

[A] USGS average daily flow based on streamflow characteristics dataset (Wolock, 2003) containing data up through November 2001.
[B] Mean annual concentration 315FRC.
[C] Percent reduction goals are for informational purposes only, and should not be viewed as the TMDL

A tabulation of estimated dry season (May 1 to October 31) total nitrogen loading is presented in Table 9-2 (including percent reduction from the existing load to meet the loading capacity of the waterbody).

Table 9-2. Tabulation of estimated mean dry season (May 1 – Oct. 31) total nitrogen loads, dry season loading capacity, and percent reductions.

Stream Reach and Monitoring Site	Total Nitrogen Biostimulation Numeric Target Used for Calculating the Loading Capacity and Reduction Goal	Estimated Mean Dry Season Flow (cfs) [A]	Mean Dry Season Conc. (mg/L) [B]	Mean Dry Season Existing Load (lbs.)	Mean Dry Season Loading Capacity (lbs.)	Estimated Load Reduction Necessary (lbs.)	Percent Reduction Goal [C]
Franklin Creek at Carpinteria Avenue 315FRC	dry season total nitrogen biostimulation water quality target = 1.1	0.31	22.5	13,732	671	13,061	95%

[A] USGS average dry season (May – October) see Table 4.2
[B] Mean dry season (May-October) concentration 315FRC.
[C] Percent reduction goals are for informational purposes only, and should not be viewed as the TMDL

9.2 Linkage Analysis

The goal of the linkage analysis is to establish a link between pollutant loads and water quality. This, in turn, supports that the loading capacity specified in the TMDLs will result in attaining the numeric target. The linkage analysis therefore represents the critical quantitative link between the TMDL and attainment of the water quality standards.

The proposed TMDLs will result in the attainment of the biostimulatory substances water quality objective, the water quality objective for unionized ammonia, and the water quality objective for municipal and domestic water supply, and therefore the restoration of beneficial uses of waterbodies in the TMDL project area. This is because the numeric targets are set equal to the nutrient water quality objectives, expressed as concentrations of nutrients that will prevent aquatic plant nuisance in flowing waters. The numeric targets are used directly to calculate the loading capacity (TMDLs). Requiring the responsible parties for nitrogen compounds and orthophosphate loading to reduce nitrate discharges to the numeric water quality objectives and targets will establish a direct link between the TMDL target and sources.

If the biostimulatory substances water quality objectives change in the future, the numeric targets would be equal to the new water quality objectives, and a new loading capacity would be calculated to meet the new numeric targets.

9.3 TMDLs & Allocations

Practically speaking, a TMDL is basically a pollutant budget[49] (aka, the "loading capacity"[50] in Clean Water Act terminology) for a surface waterbody. The TMDL distributes, or "allocates" the waterbody's loading capacity among the various sources of that pollutant. Pollutant sources that

[49] See: Water Research Foundation in collaboration with USEPA, 2010. *Drinking Water Source Protection Through Effective Use of TMDL Process.*

[50] Loading capacity – the greatest amount of a pollutant that a water can assimilate and still meet water quality standards.

can be characterized as point sources receive wasteload allocations[51], nonpoint sources of pollution receive load allocations[52] . TMDLs also include a margin safety to account for uncertainty.

For this TMDL, owners and operators of irrigated lands, NPDES–permitted municipal stormwater entities, NPDES–permitted industrial and construction stormwater entities, and natural sources are assigned total nitrogen and total phosphorus allocations equal to the water quality numeric targets outlined previously in this staff report.

The proposed TMDLs are concentration–based. This means the TMDLs are equal to the receiving water numeric water quality targets described in the numeric target section above. Unlike a mass load-based TMDL, the concentration-based allocations do not add up to the TMDL because concentrations of individual pollution sources are not additive. Therefore, since the TMDLs are concentration-based, the allocations are not additive. Concentration–based TMDLs are an appropriate expression of TMDLs and meet USEPA requirements for TMDL approval[53]. Concentration-based allocations are also the most appropriate linkage to the loading capacities of streams because drinking water and aquatic habitat beneficial uses are supported on the basis of concentration-based thresholds. Therefore, each wasteload allocation and load allocation for these TMDLs are equal to the concentration-based total nitrogen and total phosphorus numeric receiving water targets. However, consistent with USEPA guidance, Central Coast Water Board staff also developed alternative mass load pollutant loading expressions. Mass-based, non-daily load expressions may provide a meaningful connection with on-the-ground implementation efforts where expressions other than receiving water concentrations may provide a basis for water quality-based management strategies.

These TMDLs propose final wasteload allocations and load allocations that are to be attained by 25 years after the TMDL is approved by the Office of Administrative Law (OAL). To assess progress towards achieving the final allocations, Central Coast Water Board staff is proposing that some allocations be attained sooner than others. Nitrate allocations protective of the MUN beneficial use shall be attained in 10 years, wet-season total nitrogen and total phosphate allocations protective of biostimulatory substances shall be attained in 15 years, and the more stringent dry-season total nitrate and orthophosphate allocations protective of biostimulatory substances shall be attained in 30 years.

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[51] The portion of a receiving water's loading capacity that is allocated to NPDES-permitted point sources of pollution.

[52] The portion of the receiving water's loading capacity attributed to (1) nonpoint sources of pollution and (2) natural background sources.

[53] According to USEPA guidance, states should report TMDLs on a *daily* time step basis (e.g.,, allowable pounds of pollutant per *day*). Concentration-based TMDLs may be appropriate where there is only limited amounts of daily flow data, which thus limits the ability to calculate a reliable daily time-step allowable pollutant load in stream reaches. There could also be a high degree of error associated with trying to estimate daily flows from limited amounts of instantaneous flow measurements. According to USEPA, the potential for error in flow estimates is particularly pronounced in arid areas, in areas with few USGS stream gages, and in areas where flows are highly modified by human activities (e.g., impoundments, regulated flows, and irrigation return flows). Therefore, according to USEPA TMDLs based on instantaneous concentration-based loads can satisfy the federal guidance to incorporate a daily time-step pollutant load.

9.3.1 *Summary of TMDLs*

The following TMDLs will result in attainment of water quality standards and are expected to rectify the identified nutrient and nutrient-related impairments. The TMDLs are considered achieved when water quality conditions meet all regulatory and policy requirements necessary for removing the impaired waters from the Clean Water Act section 303(d) list of impaired waters.

The nitrate TMDL for all reaches of Franklin Creek required to support MUN beneficial uses is:

- Nitrate concentration shall not exceed 10 mg/L as nitrogen in receiving waters.

The total nitrogen and total phosphorus TMDLs for all reaches of Franklin Creek are:

- For dry season (May 1 to October 31): Total nitrogen concentration shall not exceed 1.1 mg/L in receiving waters; total phosphorus concentration shall not exceed 0.075 mg/L in receiving waters; and
- For wet season (November 1 to April 30): Total nitrogen concentration shall not exceed 8.0 mg/L in receiving waters; total phosphorus concentration shall not exceed 0.3 mg/L in receiving waters.

9.3.2 *Summary of Allocations*

As noted previously, a TMDL is basically a pollutant budget for a surface waterbody. The TMDL distributes, or "allocates" the waterbody's loading capacity among the various sources of that pollutant. Pollutant sources that can be characterized as point sources receive wasteload allocations[54], nonpoint sources of pollution receive load allocations.[55] Table 9-3 presents a summary tabulation of the final wasteload allocations (WLAs) and load allocations (LAs) for pollutant source categories associated with relevant stream reaches. The final allocations are equal to the TMDLs and should be achieved 25-years after the TMDL effective date

Recognizing that achievement of the more stringent dry season biostimulatory target allocation embedded in Table 9-3 may locally require a significant amount of time to achieve, Table 9-4 therefore presents interim allocations. Interim allocations may be used as benchmarks is assessing TMDL implementation progress and gauging ultimate achievement of the final allocations.

[54] The portion of a receiving water's loading capacity that is allocated to NPDES-permitted point sources of pollution.

[55] The portion of the receiving water's loading capacity attributed to (1) nonpoint sources of pollution and (2) natural background sources.

Table 9-3. Final wasteload allocations and final load allocations (receiving water allocations).

FINAL WASTELOAD ALLOCATIONS[A,B] FOR RECEIVING WATERS
(NPDES-permitted discharges shall attain the following wasted load allocations in receiving surface waters. Attainment of wasteload allocations may be assessed using a variety of methodologies as outlined in report Section 10.3.3)

Waterbody[C]	**Party Responsible for Allocation & NPDES/WDR number**	**Receiving Water Nitrate as N WLA (mg/L)**	**Receiving Water Total Nitrogen as N WLA (mg/L)**	**Receiving Water Total Phosphorus as P WLA (mg/L)**
Franklin Creek	City of Carpinteria (Storm drain discharges to MS4s) Storm Water Permit NPDES No. CAS000004 County of Santa Barbara (Storm drain discharges to MS4s) Storm Water General Permit NPDES No. CAS000004 Industrial stormwater general permit (storm drain discharges from industrial facilities) NPDES No. CAS000001 Construction stormwater general permit (storm drain discharges from construction operations) NPDES No. CAS000002	10 Year-round	1.1 Dry season (May 1 – October 31) 8 Wet season (November 1 - April 30)	0.075 Dry season (May 1 – October 31)[t] 0.3 Wet season (November 1 - April 30)

FINAL LOAD ALLOCATIONS [A,B] FOR RECEIVING WATERS
(Nonpoint source discharges shall attain the following load allocations in receiving surface waters. Attainment of load allocations may be assessed using a variety of methodologies as outlined in report Section 10.3.3)

Waterbody[C]	**Party Responsible for Allocation (Source)**	**Receiving Water Nitrate as N LA (mg/L)**	**Receiving Water Total Nitrogen as N LA (mg/L)**	**Receiving Water Total Phosphorus as P LA (mg/L)**
Franklin Creek	Owners/operators of irrigated agricultural lands (Discharges from irrigated lands)	10 Year-round	1.1 Dry season (May 1 – October 31) 8 Wet season (November 1 - April 30)	0.075 Dry season[D] (May 1 – October 31)[t] 0.3 Wet season (November 1 - April 30)
	No responsible party (Natural sources)			

[A] Federal and state anti-degradation requirements apply to all wasteload and load allocations.
[B] Achievement of final wasteload and load allocations to be determined on the basis of the number of measured exceedances and/or other criteria set forth in Section 4 of the *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List,* September 2004, amended February 2015 (Listing Policy).
[C] Waterbody name includes all reaches of named waterbody and waterbodies that are tributary to named waterbody.

Table 9-4. Proposed interim wasteload allocations and interim load allocations.

INTERIM WASTELOAD ALLOCATIONS (WLAs)			
Waterbody	**Party Responsible for Achieving Wasteload Allocation (Source)**	**First Interim WLA**	**Second Interim WLA**
Franklin Creek	City of Carpinteria (Storm drain discharges to MS4s) Storm Water General Permit NPDES No. CAS000004 County of Santa Barbara (Storm drain discharges to MS4s) Storm Water General Permit NPDES No. CAS000004 Industrial stormwater general permit (storm drain discharges from industrial facilities) NPDES No. CAS000001 Construction stormwater general permit (storm drain discharges from construction operations) NPDES No. CAS000002	10 years after effective date of the TMDLs Achieve MUN standard-based allocations: 10 mg/L Nitrate as Nitrogen	15 years after effective date of the TMDLs Achieve Wet Season (Nov. 1 to Apr. 30) Biostimulatory target-based TMDL allocations: 8 mg/L Total Nitrogen 0.3 mg/L Total Phosphorus
INTERIM LOAD ALLOCATIONS (LAs)			
Waterbody	**Party Responsible for Achieving Load Allocation (Source)**	**First Interim LA**	**Second Interim LA**
Franklin Creek	Owners/operators of irrigated agricultural lands (Discharges from irrigated lands)	10 years after effective date of the TMDLs Achieve MUN standard-based allocations: 10 mg/L Nitrate as Nitrogen	15 years after effective date of the TMDLs Achieve Wet Season (Nov. 1 to Apr. 30) Biostimulatory target-based TMDL allocations: 8 mg/L Total Nitrogen 0.3 mg/L Total Phosphorus

9.3.3 *Anti-degradation Requirements*

It is important to emphasize that state water quality standards, and thus the receiving water-based allocations identified in Table 9-3 are subject to anti-degradation requirements. Recall that beneficial uses of waterbodies, water quality objectives, and anti-degradation policies collectively constitute water quality standards. For a discussion of anti-degradation policies, refer to Section 10.2.3. State and federal anti-degradation policies require, in part, that where surface waters are of higher quality than necessary to protect beneficial uses, the high quality of those waters must be maintained unless otherwise provided by the policies. Therefore, anti-degradation requirements are a component of every water quality standard. Accordingly, anti-degradation requirements apply to the nutrient water quality criteria, and hence to the proposed wasteload and load allocations, and can be characterized as follows:

> Wherever the existing quality of water in a stream reach or waterbody is better than necessary***** to support the designated beneficial uses, that water quality shall be maintained and protected, unless and until warranted pursuant to provisions in federal and state anti-degradation policies *(See Section II.A, Anti-degradation Policy in the Central Coast Basin Plan)*
>
> ***** *i.e., better-lower than the numeric water quality objective/criteria/allocation*

Practically speaking, this means that, for example, stream reaches or waterbodies that have a concentration-based TMDL allocation of 10 mg/L nitrate as N, and if current or future identified water quality in the stream reach is in fact *well under* 10 mg/L nitrate as N, the allocation does not give license for controllable nitrogen sources to degrade the water resources all the way up to the maximum allocation = 10 mg/L nitrate as N. This is because anti-degradation requirements are a part of every water quality standard.

Non-compliance with anti-degradation requirements may be determined from trends in declining water quality consistent with the methodologies provided in Section 3.10 of the California 303(d) Listing Policy (State Water Board, 2004).

9.4 Margin of Safety

The Clean Water Act and federal regulations require that TMDLs provide a margin of safety to account for uncertainty concerning the relationship between pollution controls and water quality responses (see 40 CFR 130.7(c)(1)). These proposed TMDLs provide both implicit and explicit margins of safety to account for several types of uncertainty in the analysis. This section discusses analytical factors that are uncertain and describes how the TMDL provides the requisite margin of safety.

Relationship between algae growth and nutrient loading. Although there is strong evidence of excessive algal growth in Franklin Creek during the summer and some evidence of excessive algal growth in winter, the degree of algae-related impairment in winter and the degree to which nitrogen, phosphorus, or both are limiting factors in algae production throughout the year are uncertain.

The dry season TMDLs and allocations account for this uncertainty by setting conservative numeric target values for nitrate and orthophosphate. Staff review of the available data suggests that there is a closer relationship between nutrient levels and algae production in summer than was observed in the winter. Attainment of these conservative summer target values should ensure that nitrogen and phosphorus are not critical limiting factors in algae production and should result in reductions in algae growth.

The wet season numeric targets, associated TMDLs and allocation are less stringent than the dry season targets and allocations because available data and research studies do not clearly demonstrate that wet season nutrient levels are likely to cause excessive algae growth. The wet season targets and allocations are designed to ensure implementation of the Basin Plan numeric objective for nitrate while acknowledging uncertainty concerning winter algae problems and associated attainment of the narrative objective for biostimulatory effects. The TMDLs account for this winter period uncertainty by incorporating a 20% margin of safety (setting the nitrate numeric target at 8 mg/l instead of 10 mg/l, which is the applicable numeric objective).

Nutrient loading during the wet season period, stream flows, and nutrient loading capacity vary more during the winter period than the summer period because most precipitation related changes in runoff, loads, and flows occurs during the winter period. Wet season period loads and flows change quickly in response to unpredictable precipitation events. High velocity stream flows are likely to scour filamentous algae and carry it out of the watershed; these high flows also flush nutrient compounds through the watershed and into the ocean. Staff has accounted for the uncertainty associated with winter season variability in loads, flows, and loading capacity by setting the winter season TMDLs and allocations on a concentration basis instead of a mass-loading basis.

Staff has outlined a monitoring and assessment plan to evaluate the effectiveness of implemented management practices and source load reductions. Existing monitoring programs in conjunction with proposed monitoring requirements in these TMDLs can be used synergistically to provide for long-term water quality monitoring and improve our understanding of the relationship between nutrient levels in the watershed and algal growth. Based on results from these data and studies, staff will review and, if necessary, revise the TMDLs, allocations, and/or implementation provisions.

Additional studies of loadings from nonpoint source categories would be warranted in the future to better characterize loadings during wet weather periods from polluted runoff as well as loads associated with septic system operation.

9.5 Critical Conditions & Seasonal Variation

Critical conditions refer to a combination of environmental factors (e.g., flow, temperature, etc.) during which the waterbody is most vulnerable and has the lowest pollutant assimilative capacity. The condition is considered critical because any unknown factor regarding environmental conditions or the calculation of the load allocation could result in not achieving the water quality standard. Therefore, critical conditions are particularly important with load-based allocations and TMDLs. However, this TMDL is a concentration-based TMDL. As such, the numeric targets and allocations are the concentrations equal to the water quality objectives. While critical conditions shall be considered even in concentration-based TMDLs, once the concentration-based allocations are met over all flow conditions (seasonal conditions or other critical conditions) then there is no uncertainty whether the allocations and TMDLs will result in achieving water quality objectives.

Staff determined there are patterns of seasonal and flow-based variation based on review of the monitoring data. While exceedances were found at monitoring sites year round, temporal and seasonal analysis suggests that algal growth is greater during the dry season months (May 1 to October 31) and during low flow conditions. Seasonal or flow-based variability is accounted for and addressed by use of the allocations equal to the water quality objectives and concentration-based allocations which assures the loading capacity of the waterbody be met under all flow and seasonal conditions.

10 IMPLEMENTATION PLAN: RECOMMENDED ACTIONS TO CORRECT THE 303(D)-LISTED IMPAIRMENTS

10.1 Introduction

The purpose of the proposed TMDL Implementation Plan is to describe the steps necessary to reduce nutrient loads and to achieve these TMDLs. The TMDL Implementation Plan provides a series of actions and schedules for implementing parties to implement management practices to comply with the TMDL. The TMDL Implementation Plan is designed to provide implementing parties flexibility to implement appropriate management practices and strategies to address nitrate and biostimulatory impairments. Implementation consists of 1) identification of parties responsible for taking these actions; 2) development of management/monitoring plans to reduce controllable sources of nitrogen and phosphorus compounds in surface waters; 3) mechanisms by which the Central Coast Water Board will assure these actions are taken; 4) reporting and evaluation requirements that will indicate progress toward completing the actions; 5) and a timeline for completion of implementation actions.

10.2 Legal & Regulatory Framework

This section presents information on the legal authority and regulatory framework which provides the basis for assigning specific responsibilities and accountability to implementing parties for implementation and monitoring actions. The laws and policies pertaining to point sources and nonpoint sources are identified. The legal authority and regulatory framework are described in terms of the following:

- Controllable Water Quality Conditions
- Manner of Compliance
- Anti-degradation Policies
- Point Source Discharges (NPDES-permitted discharges)
- Nonpoint Source Discharges

10.2.1 *Controllable Water Quality Conditions*

In accordance with the Water Quality Control Plan for the Central Coastal Basin (Basin Plan), controllable water quality shall be managed to conform or to achieve the water quality objectives and load allocations contained in this TMDL. The Basin Plan defines controllable water quality conditions as follows:

> *"Controllable water quality conditions are those actions or circumstances resulting from man's activities that may influence the quality of the waters of the State and that may be reasonably controlled."*
>
> Source: Basin Plan, Chapter 3.3, Water Quality Objectives, page 29.

Examples of non-controllable water quality conditions may include atmospheric deposition of nitrogen and phosphorus, and non-controllable natural sources of nutrient compounds.

10.2.2 *Manner of Compliance*

In accordance with Section 13360 of the Porter-Cologne Water Quality Control Act (California Water Code, Division 7) the Water Board cannot specify or mandate the specific type, manner, or design of on-site actions necessary to reduce nutrient loading, or to meet allocations by the various responsible parties. Specific types of potential management practices identified in this TMDL Report constitute examples or suggestions of management practices known to mitigate or reduce nutrient loading to waterbodies. Stakeholders, local public entities, property owners, and/or resource professionals are in the best position to identify appropriate management measures, where needed, to reduce nutrient loading based on site-specific conditions, with the Water Board providing an oversight role in accordance with adopted permits, waivers, or prohibitions.

10.2.3 *Anti-degradation Policies*

State and federal anti-degradation policies require, in part, that where surface waters are of higher quality than necessary to protect designated beneficial uses, the high quality of those waters must be maintained unless otherwise provided by the policies. The beneficial uses of waterbodies, water quality objectives, and anti-degradation policies collectively constitute water quality standards. Therefore, anti-degradation requirements are a component of every water quality standard. High quality waters are determined on a “pollutant-by-pollutant”/”parameter-by-parameter” basis, by determining whether water quality is better than the criterion for each parameter using chemical or biological data[56].

Both the U.S. Environmental Protection Agency (40 CFR 131.12) and the State Water Board (Resolution 68-16) have adopted anti-degradation policies as part of their approach to regulating water quality. Both state and federal anti-degradation policies apply to point source and nonpoint source discharges that could lower water quality (refer to footnote 56). Although there are some differences, where the federal and state policies overlap they are consistent with each other. Further, state anti-degradation policy incorporates the federal policy where applicable. The Central Coast Water Board must ensure that its actions are consistent with federal or state anti-degradation policies. These policies acknowledge that minor, or repeated activities, even if individually small, can result in violation of anti-degradation policies through cumulative effects.

- ***Federal Anti-degradation Policy***

The federal anti-degradation policy, 40 CFR 131.12(a), states in part:

(1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
(2) Where the quality of waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State’s continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located…
(3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected.

[56] See: State Water Resources Control Board (2008), *Water Quality Standards Academy, Basic Course, Module 14*. Presented by U.S. Environmental Protection Agency, Region 9 – Office of Science and Technology (May 12, 2008).

➢ *State Anti-degradation Policy*

Anti-degradation provisions of State Water Board Resolution No. 68-16 ("Statement of Policy With Respect to Maintaining High Quality Waters in California") state, in part:

> (1) Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.

Also noteworthy, Section 3.2 of the Basin Plan explicitly references anti-degradation requirements, and states:

> 3.2 Anti-degradation Policy
>
> "Wherever the existing quality of water is **better than the quality of water established herein as objectives**, **<u>such existing quality shall be maintained</u>*** unless otherwise provided by the provisions of the State Water Resources Control Board Resolution No. 68-16, "Statement of Policy with Respect to Maintaining High Quality of Waters in California," including any revisions thereto."
>
> ***** *emphasis added*

Accordingly, anti-degradation policies apply to the proposed concentration-based wasteload and load allocations proposed in these TMDLs, and can be summarized as follows in Text Box 10-1.

Text Box 10-1. Anti-degradation expectations for the TMDLs proposed in this report.

> **Summary of TMDL Anti-degradation Expectations**
>
> Where the quality of water in a stream reach or waterbody is better than necessary (i.e., lower/better than the water quality objective/criteria/allocation) to support the designated beneficial uses, that existing water quality shall be maintained and protected, unless and until a lowering of water quality is warranted pursuant to provisions in federal and state anti-degradation policies.

During TMDL implementation, compliance with anti-degradation requirements may be determined on the basis of trends in declining water quality in applicable waterbodies, consistent with the methodologies and criteria provided in Section 3.10 of the Listing Policy. Section 3.10 of the Listing Policy explicitly addresses the anti-degradation component of water quality standards as defined in 40 CFR 130.2(j), and provides for identifying trends of declining water quality as a metric for assessing compliance with anti-degradation requirements.

Section 3.10 of the Listing Policy states that pollutant-specific water quality objectives need not be exceeded to be considered non-compliance with anti-degradation requirements *"if the water segment exhibits concentrations of pollutants or water body conditions for any listing factor that shows a trend of declining water quality standards attainment"*[57] (State Water Board, 2004b).

10.2.4 *Point Sources (NPDES-permitted entities)*

The National Pollutant Discharge Elimination System (NPDES) permit is the mechanism for translating wasteload allocations (WLAs) into enforceable requirements for point sources. Under Clean Water Act §402, discharges of pollutants to waters of the United States are authorized by

[57] Section 3.10 of the California Impaired Waters 303(d) Listing Policy (adopted, Sept. 20, 2004, amended in 2015)

obtaining and complying with the terms of an NPDES permit. USEPA policy explicitly specifies NPDES-regulated stormwater discharges are point source discharges and, therefore, must be addressed by the WLA component of a TMDL.[58] The Central Coast Water Board is the permitting authority for NPDES permits in California's central coast region.

USEPA regulations require that a TMDL include WLAs which identify the portion of the loading capacity allocated to existing and future point sources. Thus, the WLA is the maximum amount of a pollutant that may be contributed to a waterbody by point source discharges[59] of the pollutant to attain and maintain water quality objectives and restore beneficial uses. 40 CFR 122.44(d)(1)(vii)(B) requires effluent limits to be consistent with the WLAs in an approved TMDL. The State Water Board Office of Chief Counsel has indicated that permit conditions are not necessarily required to contain a literal incorporation of the TMDL's numeric allocations, and that the Regional Boards have discretion to implement the assumptions of a TMDL and its allocations through methodologies other than a direct, literal translation of the numeric WLA, as long as they are "consistent with the assumptions" of the TMDL[60].

According to the U.S. Environmental Protection Agency and the State Water Board, all identified NPDES-permitted point sources identified in a TMDL must be given a wasteload allocation, even if their current loading to receiving waters is zero[61, 62] otherwise their TMDL allocation is assumed to be zero and no discharges of the identified pollutant(s) would be allowed[63]. Also, a wasteload allocation for identified NPDES sources is needed for potential permit renewal issues[64].

10.2.5 *Nonpoint Sources*

Nonpoint sources (NPS) refer to pollution that is not released through pipes but rather originates from multiple sources over a relatively large area. Nonpoint sources are assigned the load allocation component of a TMDL. The load allocation is the portion of the receiving water's pollutant loading capacity attributed to (1) the existing or future nonpoint sources of pollution and (2) natural background sources. Control of nonpoint source pollution is controlled by state programs developed under state law. California's Porter-Cologne Water Quality Control Act applies to both point and nonpoint sources of pollution and serves as the principle legal authority in California for the application and enforcement of TMDL load allocations for nonpoint sources.

In July 2000 the State Water Board and the California Coastal Commission developed the Plan for California's Nonpoint Source Pollution Control Program to reduce and prevent nonpoint source pollution in California, expanding the State's nonpoint source pollution control efforts. The NPS Program's long-term goal is to improve water quality by implementing the management measures identified in the California Management Measures for Polluted Runoff Report (CAMMPR) by 2013.

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[58] See 40CFR 130.2(g) & (h) and USEPA Office of Water Memorandum (Nov. 2002) *"Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs"*

[59] See 40 CFR 130.2(h). A wasteload allocation is the portion of the receiving water's loading capacity that is allocated to its point sources of pollution.

[60] State Water Resources Control Board, Office of Chief Counsel Memo dated June 12, 2002. Subject: The Distinction Between a TMDL's Numeric Target and Water Quality Standards.

[61]Personal communication, February 18, 2015, Janet Parrish, Central Coast Regional Liaison, U.S. Environmental Protection Agency, Region IX.

[62] Communication, August 2014, Phil Wyels, Assistant Chief Counsel, State Water Resources Control Board.

[63] Personal communication, February 25, 2015, Jamie Marincola, Water Division, U.S. Environmental Protection Agency, Region IX.

[64] Personal communication, February 26, 2015, Janet Parrish, Central Coast Regional Liaison, U.S. Environmental Protection Agency, Region IX.

Under the California NPS Program Pollution Control Plan, TMDLs are considered one type of implementation planning tool that will enhance the State's ability to foster implementation of appropriate NPS management measures.

The Policy for Implementation and Enforcement of the Nonpoint Source Pollution Control Program adopted in August 2004 (State Water Board, 2004a), explains how Water Board authorities granted by the Porter-Cologne Water Quality Control Act will be used to implement the California NPS Program Plan. The Nonpoint Source Implementation and Enforcement Policy requires the Regional Water Boards to regulate all nonpoint sources of pollution using the administrative permitting authorities provided by the Porter-Cologne Act. Nonpoint source dischargers must comply with Waste Discharge Requirements (WDRs), waivers of WDRs, or Basin Plan prohibitions by participating in the development and implementation of Nonpoint Source Pollution Control Implementation Programs. NPS dischargers can comply either individually or collectively as participants in third-party coalitions. The "third-party" Programs are restricted to entities that are not actual discharges under Regional Water Board permitting and enforcement jurisdiction. These may include Non-Governmental Organizations, citizen groups, industry groups, watershed coalitions, government agencies, or any mix of these. All programs must meet the requirements of the following five key elements described in the NPS Implementation and Enforcement Policy. Each program must be endorsed or approved by the Regional Water Board or the Executive Officer (if the Water Board has delegated authority to the Executive Officer).

Key Element 1:	A Nonpoint Source Pollution Control Implementation Program's ultimate purpose must be explicitly stated and at a minimum address NPS pollution control in a manner that achieves and maintains water quality objectives.
Key Element 2:	The program shall include a description of the management practices (MPs) and other program elements dischargers expect to implement, along with an evaluation program that ensures proper implementation and verification.
Key Element 3:	The program shall include a time schedule and quantifiable milestones, should the Regional Water Board require these.
Key Element 4:	The program shall include sufficient feedback mechanisms so that the Regional Water Board, dischargers, and the public can determine if the implementation program is achieving its stated purpose(s), or whether additional or different MPs or other actions are required.
Key Element 5:	Each Regional Water Board shall make clear, in advance, the potential consequences for failure to achieve a Program's objectives, emphasizing that it is the responsibility of individual dischargers to take all necessary implementation actions to meet water quality requirements.

10.3 Implementation for Discharges from Irrigated Lands

Owners and operators of irrigated agricultural land must comply with the Conditional Waiver of Waste Discharge Requirements for Irrigated Lands (Order R3-2017-0002; the "Agricultural Order") and the Monitoring and Reporting Programs in accordance with Orders R3-2017-0002-01, R3-2017-0002-02, and R3-2017-0002-03, or their renewals or replacements, to meet load allocations and achieve the TMDLs. The requirements in these orders, and their renewals or replacements in the future, will implement the TMDLs and rectify the impairments addressed in the TMDLs.

Current requirements in the Agricultural Order that will achieve the load allocations include:

A. Implement, and update as necessary, management practices to reduce nutrient loading.

B. Maintain existing, naturally occurring riparian vegetative cover in aquatic habitat areas.
C. Develop/update and implement Farm Plans.
D. Properly destroy abandoned groundwater wells.
E. Develop and initiate implementation of an Irrigation and Nutrient Management Plan (INMP) or alternative certified by a Professional Soil Scientist, Professional Agronomist, or Crop Advisor certified by the American Society of Agronomy, or similarly qualified professional.

The current Agricultural Order provides the requirements necessary to implement this TMDL. Therefore, no new requirements are proposed as part of this TMDL.

Central Coast Water Board staff will conduct a review of implementation activities as monitoring and reporting data are submitted as required by the Agricultural Order, or when other monitoring data and/or reporting data are submitted outside the requirements of the Agricultural Order. Central Coast Water Board staff will pursue modification of Agricultural Order conditions, or other regulatory means, if necessary, to address remaining impairments resulting from nitrogen compounds or orthophosphate during the TMDL implementation phase.

10.3.1 *Implementing Parties*

Table 10-1 presents the implementing parties responsible for implementation load allocations for discharges of nutrients from irrigated lands.

Table 10-1. Implementing parties for discharges of nutrients from irrigated lands.

Source Category	Implementing Parties
Irrigated lands	Owners/operators of irrigated lands

10.3.2 *Priority Areas & Priority Pollutants*

The Agricultural Order should prioritize implementation and monitoring efforts areas where:

1) Water quality data and land use data indicate the largest magnitude of nutrient loading and/or impairments;
2) Reductions in nutrient loading, reductions in-stream nutrient concentrations, and/or implementation of improved nutrient management practices that will have the greatest benefit to aquatic habitat and/or human health in receiving waters and also with consideration to mitigation of downstream impacts;
3) Crops that are grown that require high fertilizer inputs; particularly nursery and greenhouse operations;
4) Other information such as proximity to waterbody; soils/runoff potential; irrigation and drainage practices, or relevant information provided by stakeholders, resource professionals, and/or researchers indicate a higher risk of nutrient and/or biostimulatory impacts to receiving waters.

➢ *Priority Pollutants*

With regard to pollutant prioritization, reporting by Tetra Tech, Inc. indicates that currently control of nitrogen in streams of the California central coast region may be considerably more important than control of phosphorus. Tetra Tech scientists found that streams in the California chaparral and oak nutrient subecoregion (subecoregion III-6) are more often limited by nitrogen than by phosphorus[65].

[65] See Tetra Tech (2004). *2004 Overview of Nutrient Criteria Development and Relationship to TMDLs*

Accordingly, staff maintains that at this time the focus of resources and implementation should be directed with respect to nitrogen loading reduction.

However, as reported by USEPA (2007b), while controlling one nutrient may potentially prevent productivity, control of both nutrients (nitrogen and phosphorus) can also provide additional assurance that excess productivity will remain in control. For example, under conditions of nitrogen limitation, even if local excess primary productivity is ultimately controlled to a large extent by nitrogen reduction alone, there will be resultant export of the excess nutrient, phosphorus, because the excess of that nutrient would not have the opportunity for uptake into biomass. The larger the excess of phosphorus in upstream systems is, the greater the contribution to potential phosphorus-sensitive downstream systems. Therefore, concurrent reduction of both nitrogen and phosphorus in a basin is often warranted in order to protect downstream use. More recently, USEPA provided further guidance on why the development of dual numeric criteria for both nitrogen and phosphorus can be an effective tool to protect beneficial uses of the nation's streams, lakes, estuaries, and coastal systems (USEPA, 2015).

Also, noteworthy is that research has shown that in some areas of the nearby Salinas Valley, phosphorus-fertilization is ineffective in improving lettuce growth in areas that have high phosphorus content, rendering the need for P-fertilization unnecessary:

"P fertilization was ineffective in improving lettuce growth in either field 1 or 2. Both fields had soil test P > 50 PPM (bicarbonate, or 'Olsen', extraction procedure), above the agronomic response threshold we established in prior research in the Salinas Valley (Johnstone et al., 2005). These results provide additional evidence to convince growers that P fertilization of soils at or above 50 PPM Olsen P is not necessary for lettuce production. Whole leaf sampling at mid-season showed leaf P concentration in the no-P treatment to be 0.52 and 0.65% in field 1 and 2, respectively; this was well above the 0.43% sufficiency threshold established in earlier research (Hartz et al., 2007), and statistically equal in both fields to the treatment receiving P application.

From: *"Reducing nutrient loading from vegetable production"* (field trials – Salinas Valley).
University of California, Davis and University of California Cooperative Extension – Project Leaders: T.K. Hartz, R. Simth and M. Cahn. 2007.

10.3.3 *Determining Progress & Attainment of Load Allocations*

Load reductions are proposed for discharges of nitrogen and phosphorus compounds from irrigated lands. It is estimated that nutrient loads from nurseries and greenhouses overwhelmingly comprise the largest source category of nutrient loading to waterbodies in the Franklin Creek watershed (refer back to Section 8). Therefore, implementation of management measures will be needed to implement the proposed load allocations for irrigated lands.

Load allocations will be achieved through a combination of implementation of management practices and strategies to reduce nitrogen compound and orthophosphate loading, and water quality monitoring. For nonpoint source load allocations, USEPA guidance generally expects that the state's, territory's, or authorized tribe's Clean Water Act Section 319 nonpoint source management programs will be the basis for implementing load allocations[66]. California's Nonpoint Source Pollution Control Program was previously described in Section 10.2.5. In practical terms, this means load allocations are addressed though the implementation of management practices (e.g., land, irrigation, and nutrient management practices)[67]. It is important to note that although

[66] See USEPA, "Establishing and Implementing TMDLs" at
http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/TMDL-ch3.cfm

[67] See USEPA, Protocol for Developing Nutrient TMDLs. EPA 841-B-99-007 (November, 1999)

load allocations are typically addressed by adoption of specific management practices, it is not always easy to evaluate the effectiveness of management practices. As this TMDL is heavily dependent on nonpoint source loading reductions through load allocations, long-term watershed water quality monitoring is proposed to evaluate the effectiveness of implemented management practices and nonpoint source load reductions. Existing monitoring programs in conjunction with proposed monitoring requirements in this TMDL can be used synergistically to provide for long-term water quality monitoring.

Biostimulatory impairments result from nutrients acting in combination with other factors to contribute to dissolved oxygen imbalances, algal biomass problems, and degradation of aquatic habitat. The proposed nitrogen and phosphorus allocations to address biostimulation are predictors of the nutrient water quality level necessary to restore beneficial uses. However, it should be recognized that the main concern with biostimulatory impairments is a need to restore dissolved oxygen and algal biomass to acceptable levels consistent with designated beneficial uses, and to mitigate downstream biostimulatory nutrient impacts to receiving waterbodies. As such, nutrient-response indicator targets (dissolved oxygen, chlorophyll *a*, microcystin) proposed in this TMDL can be used to assess water quality standards attainment over the long term. Staff is proposing flexibility in allowing owners/operators of irrigated lands to demonstrate progress towards and attainment of load allocations; additionally, staff is aware that not all implementing parties are necessarily contributing to or causing surface water impairments. However, it is important to recognize that impacting shallow groundwater with nutrient pollution may also impact surface water quality via baseflow loading contributions to streams.

To allow for flexibility, attainment of load allocations can be demonstrated and determined in several ways, using one or a combination of the following:

Text Box 10-2. Demonstrating progress towards and attainment of load allocations.

Central Coast Water Board staff will assess progress towards and attainment of load allocations using one or a combination of the following:

a) Owners/operators of irrigated lands may show progress towards attaining load allocations by implementing management practices that are capable of achieving interim and final load allocations identified in this TMDL;
b) Demonstrating quantifiable receiving water mass load reductions;
c) Attaining the nutrient load allocations in the receiving water;
d) Attaining receiving water TMDL numeric targets for nutrient-response indicators (i.e., dissolved oxygen water quality objectives, chlorophyll *a* targets and microcystin targets) and mitigation of downstream nutrient impacts to receiving waterbodies may constitute a demonstration of attainment of the nitrate, nitrogen and phosphorus-based seasonal biostimulatory load allocations. Note that implementing parties are strongly encouraged to maximize overhead riparian canopy, where and if appropriate, using riparian vegetation, because doing so could result in achieving nutrient-response indicator targets before allocations are achieved;
e) Owners/operators of irrigated lands may provide sufficient evidence to demonstrate that they are and will continue to attain the load allocations; such evidence could include documentation submitted by the owner/operator to the Executive Officer that the owner/operator is not causing waste to be discharged to impaired waterbodies resulting or contributing to violations of the load allocations.

10.4 Implementation for Discharges from MS4 Stormwater Entities

Wasteload allocations for this source category will be implemented by NPDES MS4 stormwater permits. Municipal separate storm sewer systems (MS4s) are considered relatively minor loads of nitrogen compounds and orthophosphate in the Franklin Creek watershed based on the source analysis presented in Section 8. However, because these sources can potentially have a significant localized effect on water quality they are allocated wasteload allocations. The Central Coast Water Board will address nitrogen and phosphate compounds discharged from MS4s by regulating the MS4 entities under the provisions of the State Water Resource Control Board's General Permit for the Discharges of Storm Water from Small Municipal Separate Storm Sewer Systems (General Permit, Water Quality Order No. 2013-0001-DWA, NPDES CAS000004), or subsequent General Permits. To address the MS4 wasteload allocations, the Central Coast Water Board will require MS4 enrollees that discharge to surface waterbodies impaired by excess nutrients or by biostimulation to address these impairments by developing and implementing a Wasteload Allocation Attainment Program. The elements of a Wasteload Allocation Attainment Program are described in report section 10.4.3 and in Text Box 10-3.

The Central Coast Water Board will require MS4 entities to develop and submit for Executive Officer approval a Wasteload Allocation Attainment Program consistent with the requirements of the General Permit, or with any subsequent General Permits. The Wasteload Allocation Attainment Program shall include descriptions of the actions that will be taken by the MS4 entity to attain the TMDL wasteload allocations. Specifics of the Wasteload Allocation Attainment Program are detailed in Section 10.4.3.

10.4.1 *Implementing Parties*

Table 10-2 presents the implementing entities responsible for implementation of wasteload allocations for the municipal stormwater source category. In the context of this report, TMDL implementation refers to actions to correct impaired surface waters, as well as to actions to address anti-degradation concerns and maintain existing water quality.

Table 10-2. Implementing Parties for Discharges from MS4 Entities.

Owner/Operator Name	**Permit Type**	**General Permit Status**
City of Carpinteria	Phase II Small MS4	Active
County of Santa Barbara	Phase II Small MS4	Active

10.4.2 *Priority Areas and Priority Pollutants*

Municipal stormwater entities and local resource professionals are in the best position to ultimately assess implementation priorities and problem areas. Central Coast Water Board staff did not have municipal storm drain outfall water quality data for urban areas of the watershed. Based on information developed in this report, Central Coast Water Board staff at this time expect that all areas within the watershed would be a focus of priority for municipal stormwater implementing parties. Regional and national municipal stormwater runoff data suggest that exceedances of proposed nutrient water quality criteria may be localized, but not pervasive in urbanized areas.

- *Priority Pollutants*

With regard to pollutant prioritization, reporting by Tetra Tech, Inc. indicates that currently control of nitrogen in this system may be considerably more important than control of phosphorus. Tetra Tech scientists found that streams in the California chaparral and oak nutrient subecoregion

(subecoregion III-6) are more often limited by nitrogen than by phosphorus[68]. Accordingly, staff maintains that at this time the focus of resources and implementation should be directed with respect to nitrogen. However, controlling both nitrogen and phosphorus discharges can also provide additional assurance that excess aquatic biological productivity will remain in control.

10.4.3 *Implementation Actions*

The Wasteload Allocation Attainment Program will be required by the Central Coast Water Board to address each of these TMDLs that occur within the MS4 entities' jurisdictions. MS4 entities will submit Wasteload Allocation Attainment Programs consistent with current, of future conditions specified in the General Permit (Water Quality Order No. 2013-0001-DWA, NPDES CAS000004), or subsequent General Permits. The overall goal of developing a Wasteload Allocation Attainment Program is to implement management practices capable of achieving interim and final Wasteload Allocations identified in this TMDL.

The Wasteload Allocation Attainment Programs shall include the elements identified in Attachment G of the General Permit (Water Quality Order No. 2013-0001-DWQ, NPDES CAS000004), as reproduced below in Text Box 10-3.

Text Box 10-3. Required components of Wasteload Allocation Attainment Programs.

1. A detailed description of the strategy the MS4 will use to guide BMP selection, assessment, and implementation, to ensure that BMPs implemented will be effective at abating pollutant sources, reducing pollutant discharges, and achieving wasteload allocations according to the TMDL schedule.
2. Identification of sources of the impairment within the MS4's jurisdiction, including specific information on various source locations and their magnitude within the jurisdiction.
3. Prioritization of sources within the MS4's jurisdiction, based on suspected contribution to the impairment, ability to control the source, and other pertinent factors.
4. Identification of BMPs that will address the sources of impairing pollutants and reduce the discharge of impairing pollutants.
5. Prioritization of BMPs, based on suspected effectiveness at abating sources and reducing impairing pollutant discharges, as well as other pertinent factors.
6. Identification of BMPs the MS4 will implement, including a detailed implementation schedule. For each BMP, identify milestones the MS4 will use for tracking implementation, measurable goals the MS4 will use to assess implementation efforts, and measures and targets the MS4 will use to assess effectiveness. MS4s shall include expected BMP implementation for future implementation years, with the understanding that future BMP implementation plans may change as new information is obtained.
7. A quantifiable numeric analysis demonstrating the BMPs selected for implementation will likely achieve, based on modeling, published BMP pollutant removal performance estimates, best professional judgment, and/or other available tools, the MS4's wasteload allocation according to the schedule identified in the TMDL. This analysis will most likely incorporate modeling efforts. The MS4 shall conduct repeat numeric analyses as the BMP implementation plans evolve and information on BMP effectiveness is generated. Once the MS4 has water quality data from its monitoring program, the MS4 shall incorporate water quality data into the numeric analyses to validate BMP implementation plans.
8. A detailed description, including a schedule, of a monitoring program the MS4 will implement to assess discharge and receiving water quality, BMP effectiveness, and progress towards any interim targets and ultimate attainment of the MS4s' wasteload allocation. The monitoring program shall be designed to validate BMP implementation efforts and quantitatively demonstrate attainment of interim targets and wasteload allocations.
9. If the approved TMDL does not explicitly include interim targets, the MS4 shall establish interim targets (and dates when stormwater discharge conditions will be evaluated) that are equally spaced in time over the TMDL compliance schedule and represent measurable, continually decreasing MS4 discharge concentrations or other appropriate interim measures of pollution reduction and progress towards the wasteload allocation. At least one interim target and date must occur during the five-year term of this

[68] See Tetra Tech (2004). *2004 Overview of Nutrient Criteria Development and Relationship to TMDLs*

Order. The MS4 shall achieve its interim targets by the date it specifies in the Wasteload Allocation Attainment Program. If the MS4 does not achieve its interim target by the date specified, the MS4 shall develop and implement more effective BMPs that it can quantitatively demonstrate will achieve the next interim target.

10. A detailed description of how the MS4 will assess BMP and program effectiveness. The description shall incorporate the assessment methods described in the CASQA Municipal Storm water Program Effectiveness Assessment Guide.
11. A detailed description of how the MS4 will modify the program to improve upon BMPs determined to be ineffective during the effectiveness assessment.
12. A detailed description of information the MS4 will include in annual reports to demonstrate adequate progress towards attainment of wasteload allocations according to the TMDL schedule.
13. A detailed description of how the MS4 will collaborate with other agencies, stakeholders, and the public to develop and implement the Wasteload Allocation Attainment Program.
14. Any other items identified by Integrated Report fact sheets, TMDL Project Reports, TMDL Resolutions, or that are currently being implemented by the MS4 to control its contribution to the impairment.

10.4.4 *Determining Progress & Attainment of Wasteload Allocations*

USEPA guidance[69] states that if the state or USEPA establishes a TMDL for impaired waters that include wasteload allocations for stormwater discharges, permits for MS4 discharges must contain effluent limits and conditions consistent with the requirement and assumptions of the wasteload allocations in the TMDL[70]. Determining progress and attainment of wasteload allocations can be demonstrated in several ways; the permitting authority (Central Coast Water Board) has the discretion to express the effluent limitations in the applicable stormwater permits as numeric water quality-based limits consistent with the wasteload allocations (if and where feasible), or the effluent limitations may be expressed as a measureable, objective Best Management Practices (BMPs) that are anticipated to be capable of achieving the wasteload allocation[71]. USEPA states that where a BMP-based approach to permit limitations is selected, the BMPs required by the permit will be sufficient to implement applicable wasteload allocations, including adequate monitoring, numeric benchmarks, or specific protocols to determine if the BMPs are performing as necessary.

As stated earlier, the main concern with biostimulatory impairments is to restore dissolved oxygen and algal biomass to acceptable levels consistent with designated beneficial uses, and to mitigate downstream biostimulatory nutrient impacts to receiving waterbodies. As such, nutrient-response indicator targets (dissolved oxygen, chlorophyll *a*, microcystin) proposed in this TMDL can be used to assess water quality standards attainment over the long term. Determining progress and attainment of wasteload allocations can be demonstrated and determined in several ways, as follows:

[69] USEPA Memorandum, Nov. 12, 2010, *Revisions to the November 22, 2002 Memorandum "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) from Storm Water Sources and NPDES Permit Requirements Based on Those WLAs"*
[70] See 40 CFR 122.44(d)(1)(vii)(B).
[71] USEPA Memorandum, Nov. 26, 2014, *Revisions to the November 22, 2002 Memorandum "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) from Storm Water Sources and NPDES Permit Requirements Based on Those WLAs".*

Text Box 10-4. Demonstrating progress towards and attainment of wasteload allocations.

Central Coast Water Board staff will assess progress towards and attainment of wasteload allocations using one or a combination of the following:

a) Demonstrate progress toward and attainment of wasteload allocations by measuring concentrations in stormdrain outfalls;
b) Demonstrate progress toward and attainment of wasteload allocations by measuring load reductions on mass basis at stormdrain outfalls;
c) Attaining the wasteload allocations in the receiving water;
d) Attaining receiving water TMDL numeric targets for nutrient-response indicators (i.e., dissolved oxygen water quality objectives, chlorophyll a targets and microcystin targets) and mitigation of downstream nutrient impacts to receiving waterbodies may constitute a demonstration of the attainment of the nitrate, nitrogen, and orthophosphate-based seasonal biostimulatory wasteload allocations. Note that implementing parties are strongly encouraged to maximize overhead riparian canopy using riparian vegetation, where and if appropriate, because doing so could result in achieving nutrient-response indicator targets before allocations are achieved (resulting in a less stringent allocation);
e) MS4s may demonstrate progress toward and attainment of wasteload allocations through implementation and assessment of pollutant loading reduction projects and assessment of BMPs capable of achieving interim and final wasteload allocations identified in this TMDL in combination with water quality monitoring for a balanced approach to determining program effectiveness; and
f) Any other effluent limitations and conditions which are consistent with the assumptions and requirements of the wasteload allocations.

10.5 Implementation for Industrial & Construction Stormwater Discharges

Based on evidence and information provided in this TMDL report (refer back to report Section 8.1.1.1), NPDES stormwater-permitted industrial facilities and construction sites in the Franklin Creek watershed would not be expected to be a significant risk or cause of the observed nutrient water quality impairments, and these types of facilities are generally expected to be currently meeting proposed wasteload allocations. Therefore, at this time, additional regulatory measures for this source category are not warranted.

To maintain existing water quality and prevent any further water quality degradation, these permitted industrial facilities and construction operators shall continue to implement and comply with the requirements of the statewide Industrial General Permit (Order No. 2014-0057-DWQ, NPDES No. CAS000001) or the Construction General Permit (Order No. 2012-0006-DWQ, NPDES No. CAS000002), or any subsequent Industrial or Construction General Permits.

Available information does not conclusively demonstrate that stormwater from all industrial facilities and construction sites are meeting wasteload allocations. More information will be obtained during the implementation phase of these TMDLs to further assess the level of nutrient contributions to surface waters from these source categories, and to identify any actions needed to reduce nutrient loading.

10.6 Potential Management Measures

10.6.1 *Potential Management Measures for Agricultural Sources*

The State Water Board, California Coastal Commission, and other State agencies have identified management measures to address agricultural sources of nutrient pollution that affect state waters. These are provided here for informational value; they are not provided as examples of current or anticipated requirements, nor are they an exhaustive list of all possible, effective management measures.

The agricultural management measures include practices and plans installed under various NPS programs in California, including systems of practices commonly used and recommended by the U.S. Department of Agriculture as components of Resource Management Systems (RMS), Water Quality Management Plans, and Agricultural Waste Management Systems. These RMSs are planned by individual farmers and ranchers using an objective-driven planning process outlined in the NRCS National Planning Procedures Handbook.

As described in Section 10.2.2, the Central Coast Water Board cannot specify the specific type or design of onsite actions necessary to reduce nutrient loading to waterbodies; however the California Nonpoint Source Pollution Control Program contains information on the general expectations and types of MMs (see Management Measure 1C – Nutrient Management) that will reduce nutrient loading; this information may be viewed at the following link:

http://www.swrcb.ca.gov/water_issues/programs/nps/docs/cammpr/cammpr_agr.pdf

Further, the State Water Board's Nonpoint Source Management Program provides an on-line encyclopedia designed to facilitate a basic understanding of nonpoint source (NPS) pollution control and to provide quick access to essential information from a variety of sources. The purpose of this encyclopedia is to support the implementation and development of NPS TMDLs and watershed action plans with a goal of protecting high-quality waters and restoring impaired waters. Relevant information from the State Water Board Nonpoint Source encyclopedia for nutrient management is available online at:

http://www.swrcb.ca.gov/water_issues/programs/nps/encyclopedia.shtml

The California Department of Food and Agricultural Fertilizer Research and Education Program (FREP) funds and coordinates research to advance the environmentally safe and agronomically sound use and handling of fertilizer materials. FREP serves growers, agricultural supply and service professionals, extension personnel, public agencies, consultants, and other interested parties. FREP is guided by the Technical Advisory Subcommittee (TASC) of the Fertilizer Inspection Advisory Board (FIAB). This subcommittee includes growers, fertilizer industry professionals, and state government and university scientists. The TASC directs FREP activities, and reviews, selects and (after peer review) recommends to the FIAB funding for FREP research and education projects. Information on FREP and nutrient management research and education can be found at: http://www.cdfa.ca.gov/is/ffldrs/frep.html.

➢ *Nutrient Management Plans*

Implementation of nutrient management plans either voluntarily or as required through enrollment in the Agricultural Order (or future revisions of the Order), may be an effective management option to reduce nitrate loads to waters of the state. The California Nonpoint Source Pollution Control Program states that development and implementation of a nutrient management plan should include the following goals:

1) Apply nutrients at rates necessary to achieve realistic crop yields,
2) Improve the timing of nutrient application, and

3) Use agronomic crop production technology to increase nutrient use efficiency.

The California Nonpoint Source Pollution Control Program states that core components of a nutrient management plan should include:

- Farm and field maps with identified and labeled: acreage and type of crops, soil surveys, location of any environmental sensitive areas including any nearby waterbodies and endangered species habitats.
- Realistic yield expectations for the crop(s) to be grown based primarily on the producer's yield history, State Land Grant University yield expectations for the soil series, or USDA NRCS Soils-5 information for the soil series.
- A summary of the nutrient resources available to the producer, which (at a minimum) include (a) soil test results for pH, phosphorus, nitrogen, and potassium; (b) nutrient analysis of compost, sludge, mortality compost (birds, pigs, etc.), or effluent (if applicable); (c) nitrogen contribution to the soil from legumes grown in rotation (if applicable); and (d) other significant nutrient sources (e.g., irrigation water).
- An evaluation of the field limitations and development of appropriate buffer areas, based on environmental hazards or concerns such as (a) sinkholes, shallow soils over fractured bedrock, and soils with high leaching potential; (b) lands near or draining into surface water; (c) highly erodible soils; and (d) shallow aquifers.
- Use of the limiting nutrient concept to establish a mix of nutrient sources and requirements for the crop based on realistic yield expectations.
- Identification of timing and application methods for nutrients to (a) provide nutrients at rates necessary to achieve realistic yields, (b) reduce losses to the environment, and (c) avoid applications as much as possible to frozen soil and during periods of leaching or runoff.
- Provisions for the proper calibration and operation of nutrient application equipment.
- Provisions to ensure that, when compost from confined animal facilities (excluding CAFOs) is to be used as a soil amendment or is disposed of on land, subsequent irrigation of the land does not leach excess nutrients to surface or ground waters.
- Vegetated Treatment Systems are discussed in Management Measure 6C of the NPS encyclopedia. Recent peer-reviewed literature has examined the efficacy and efficiency of agricultural solutions to reducing nitrogen pollution. As reported in Davidson et al. (2012), many existing mitigation strategies[72] for farms have been demonstrated to potentially reduce nitrogen losses within the existing agricultural system by 30 to 50% or more. However, Davidson et al. (2012) note that improved fertilizer management, better education and training of crop advisors, and willingness by farmers to adopt these practices are needed. An ecologically intensive approach that integrates complex crop rotations, cover crops, perennials could also reduce nitrogen loses by as much as 70 to 90%.

10.6.2 *Potential Management Measures for Urban Sources*

Potential management measures are provided here for informational value; they are not provided as examples of current or anticipated requirements, nor are they an exhaustive list of all possible, effective management measures. As described in Section 10.2.2, the Central Coast Water Board cannot specify or mandate the specific type or design of onsite actions (e.g., best management practices) necessary to reduce nutrient loading to waterbodies; however the California Nonpoint

[72] Davidson et al. (2012) define existing mitigation strategies as those that could be accomplished under the current agricultural subsidy system.

Source Pollution Control Program[73] contains information on the general expectations and types of management measures that will reduce urban nutrient loading; this information may be viewed at the following link:

http://www.swrcb.ca.gov/water_issues/programs/nps/docs/cammpr/cammpr_urb.pdf

As discussed in Section 10.6.1, the State Water Board's Nonpoint Source Management Program provides an on-line encyclopedia designed to facilitate a basic understanding of nonpoint source pollution control and to provide quick access to essential information from a variety of sources. Relevant information from the State Water Board Nonpoint Source encyclopedia for nutrient management is available online at:

http://www.swrcb.ca.gov/water_issues/programs/nps/encyclopedia/3_0_urb.shtml

The International Stormwater BMP Database is a comprehensive source of BMP performance information. The BMP Database is comprised of carefully examined data from a peer reviewed collection of studies that have monitored the effectiveness of a variety of BMPs in treating water quality pollutants for a variety of land use types. The Stormwater BMP Database is available online at:

http://www.bmpdatabase.org/

10.7 Recommended Water Quality Monitoring

Water quality monitoring in the Franklin Creek watershed is currently active with monthly samples collected from Franklin Creek at Carpinteria Avenue (315FRC). Thus, at this time Central Coast Water Board staff are not recommending additional receiving water quality monitoring above and beyond what is currently being collected. Current monitoring efforts in the Franklin Creek watershed, including the Central Coast Ambient Monitoring Program, the Cooperative Monitoring Program, the Santa Barbara Channelkeepers, and others may be used by implementing parties to help demonstrate progress towards and attainment of water quality standards.

The Agricultural Order, and any renewals or revisions thereof, shall include monitoring and reporting requirements that assess progress toward achieving load allocations. It should be noted that the Cooperative Monitoring Program (CMP) - the entity that collects data on behalf of growers - currently is collecting samples on a monthly basis. At this time, staff anticipates that the current CMP monitoring efforts are adequate to assess receiving water quality and TMDL progress on behalf of irrigated agriculture.

Applicable NPDES-permitted entities that have wasteload allocations associated with this TMDL need to incorporate effluent limits, conditions, and monitoring and reporting elements consistent with the requirements and assumptions of the wasteload allocations in the TMDL (refer back to Section 10.4.3 for information on implementation of wasteload allocations).

[73] While MS4 permitted municipal stormwater is considered a "point source" requiring WLAs under EPA regulation, urban runoff management measures are identified in California's Nonpoint Source Pollution Plan.

Staff are proposing that total nitrogen (rather than nitrate) and total phosphorus (rather than orthophosphate) be monitored for the following reason:

While monitoring of nitrate is recommended, ***monitoring of total nitrogen and total phosphorus is recommended for assessing nutrient input into the Carpinteria Salt Marsh.*** *This is because water column nitrate and orthophosphate concentrations in coastal environments generally does not adequately represent the collective total amount of water column nitrogen and phosphorus that is potentially available to contribute to internal loading[74]. Similarly,* ***numeric criteria developed for Franklin Creek is based on total nitrogen and total phosphorus targets and allocations.***

Note that is widely recognized by researchers that locally, waterbodies can have low levels of bioavailable nutrients (nitrate, orthophosphate) in the water column but still have high levels of biomass because the bioavailable nutrient is assimilated in the algae. These nutrients can later become biologically available upon decay or release. Indeed, one of the scientific peer reviewers for a Central Coast Water Board TMDL project provided a comment which conceptually highlights this well-established understanding of nutrient cycling:

"While orthophosphate is the biologically available form of phosphorus, it does not account for phosphorus in organic matter or bound to inorganic particulates, which can be biologically available upon decay or release. Water can have low orthophosphate, yet contain substantial algal biomass which has assimilated most of the available orthophosphate."

Dr. Marc Beutel, Washington State University, Scientific Peer Review Comments provided to Water Board Staff, 3 May 2012., TMDLs for Nitrogen Compounds and Orthophosphate for the Lower Salinas River and Reclamation Canal Basin, and the Moro Cojo Slough Subwatershed, Resolution No. R3-2013-0008.

Also, from an efficacy standpoint for MS4 entities, implementation of source control measures for solids (e.g., total phosphorus) typically have lower unit costs and are more cost effective than bioretention strategies generally anticipated for dissolved phosphorus (e.g., orthophosphate) – (personal communication, Brandon Steets, P.E., Geosyntec Consultants, September 25, 2012). Also, USEPA and researchers often recommend collection of total phosphorus data to demonstrate attainment or non-attainment of water quality standards. Therefore, it may ultimately be prudent in the future to revise wasteload allocations on the basis of total phosphorus rather than orthophosphate wasteload allocations, assuming adequate total phosphorus water quality data becomes available. This will require the more systematic and routine collection of total phosphorus water quality data, as current monitoring programs focus on dissolved phosphorus (orthophosphate).

Additionally, while microcystin water quality targets have been identified in this project report, to limit the burden of monitoring, staff are not currently recommending that responsible parties conduct microcystin monitoring. Responsible parties may voluntarily collect microcystin data if they choose to do so. The State Water Resources Control Board and the Central Coast Water Board may fund additional collection of baseline microcystin data for the central coast region as the need arises.

[74] Monitored lagoons and estuaries of the central coast region appear to indicate that nitrate is generally only about half or less of all water column total nitrogen. See: Total Maximum Daily Loads for Nitrogen Compounds and Orthophosphate for the Lower Salinas River and Reclamation Canal Basin, and the Moro Cojo Slough Subwatershed (California Central Coast Water Board, Resolution No. R3-2013-0008).

10.8 Timeline & Milestones for TMDL Implementation

Discharges of nitrogen compounds and orthophosphate are occurring at levels which are impairing a wide spectrum of beneficial uses and, therefore, constitute a serious water quality problem. As such, implementation should occur at a pace to achieve the allocations and TMDL in the shortest time-frame feasible. Central Coast Water Board staff recognizes that immediate compliance with water quality standards is not feasible, and are proposing milestones as follows.

Table 9-4 presents temporal interim water quality benchmarks to demonstrate progress towards achievement of the final wasteload allocations and load allocations previously presented in Table 9-3. These benchmarks can be summarized as follows:

- First Interim Wasteload and Load Allocations: Achieve the nitrate MUN nitrate standard (10 mg/L nitrate as nitrogen in receiving waters that are designated MUN) within 10 years of the effective date of the TMDL (which is upon approval by the Office of Administrative Law);
- Second Interim Wasteload and Load Allocations: Achieve the less stringent wet-season (November 1 to April 30) biostimulatory target-based allocations within 15 years of the effective date of the TMDL;
- Final Interim Wasteload and Load Allocations: Achieve the more stringent dry-season (May 1 to October 31) biostimulatory target-based allocations within 25 years of the effective date of the TMDL.

The ten year timeframe is based on the expectation that nearly all landowners and operators of irrigated agricultural activities should have completed Farm Water Quality Plans and should have been implementing management practices by the end of the first five-year Agricultural Order cycle, back in the year 2012. These efforts should be continuing. Water quality benefits resulting from implementing nutrient-control management measures (e.g., grass swales and riparian buffers, etc.) may take a few years to be realized. Central Coast Water Board staff believes 10 years for the first interim wasteload and load allocations is a reasonable timeframe to implement management measures and reduce nitrate levels consistent with the allocations and the numeric target. The 10 year benchmark is also consistent with making progress towards the Water Board's vision for the central coast region of healthy, functioning watersheds by the year 2025.

The 15 year timeframe to achieve the second interim wasteload and load allocations (which are based on the less stringent wet-season biostimulatory targets) was identified as a reasonable time frame and intermediate benchmark prior to achieving the final, more-stringent final allocations. The basis for this timeline is that source controls (nutrient and irrigation efficiency improvements) and surface water treatment (e.g., constructed wetlands, buffer strips) are anticipated to result in improvements to surface water quality more rapidly that mitigation measures to reduce nitrate pollution in shallow groundwater. As noted previously, shallow groundwater is a contributing source of nutrients to surface waters; shallow groundwater moves slowly; and shallow groundwater will require longer time frames to respond to the full effects of source control measures.

The 25-year timeline to meet more-stringent dry-season biostimulatory substances allocations are based on the estimate that legacy nutrient loads, which are unrelated to current practices and are originating from groundwater and baseflow, may locally continue to contribute elevated nutrients to some streams of the Franklin Creek watershed over a substantial period of time.[75,76] Therefore,

[75] For example, the U.S. Geological Survey (U.S. Geological Survey) reports that in spite of many years of efforts to reduce nitrate levels in the Mississippi River Basin, concentrations have not consistently declined during the past two decades. U.S. Geological Survey concludes that elevated nitrate in groundwater are a substantial source contributing to nitrate concentrations in river water. Because nitrate moves slowly through

staff anticipates that it will take a significant amount of time for legacy pollutant loads in shallow groundwater, and the subsequent baseflow pollutant loads to stream reaches, to attenuate. Refer back to Section 6.3 for information on groundwater quality, shallow groundwater, and residence time of baseflow in the subsurface.

Evaluating progress towards these milestones and the attainment of load allocations and wasteload allocations will be consistent with the benchmarks and methodologies previously identified in Section 10.3.3 and Section 10.4.4.

10.9 Evaluation of TMDL Implementation Progress

For specific types of pollutant discharge source categories, methodologies for implementing parties to measure and demonstrate progress towards attainment of water quality standards were outlined previously in report Section 10.3.3 and report Section 10.4.4. It is also worth recognizing there are uncertainties including, but not limited to, extreme inter-annual variability in pollutant loading to surface waters based on climatic conditions, flows, water management practices, uncertainties about the nexus between receiving water pollutant concentrations and leachate concentrations, etc. Measures of TMDL implementation progress will not necessarily be limited to receiving water column concentration-based metrics and/or time-weighted average concentrations of water column pollutants. Some information and literature are available suggesting that decreasing nutrient loads to creeks by improving agricultural management practices may actually locally raise instream nutrient concentrations[77,78,79]. Thus, locally there could be a possibility that implementation of improved management practices could, in the short term, result in non-attainment of water quality standards. Cahn and Hartz (2010) noted that concentration data in creeks of agricultural watersheds may not always accurately reflect the progress individual farmers are making towards achieving water quality goals.

Therefore, the approach proposed in these TMDLs is to strive for pollutant load reduction strategies while continuing to collect additional data on receiving water concentrations, while recognizing that there may not always be a direct linkage between mass-based load reductions and instream concentrations of pollutants in grab samples. Regardless of the short or intermediate–term effects

groundwater systems to rivers, the full effect of management strategies designed to reduce loading to surface waters and groundwaters may not be seen in these rivers for decades. (see *"No Consistent Declines in Nitrate Levels in Large Rivers of the Mississippi River Basin"* U.S. Geological Survey News Release dated 08/09/2011).

[76] In a recent national study USGS researchers reported that legacy nutrients present in shallow groundwater may sustain high nitrate levels in some streams which are characterized by substantial groundwater inputs for decades to come (see Tesoriero, Duff, Saad, Spahr, and Wolock, 2013, *Vulnerability of Streams to Legacy Nitrate Sources.* Environmental Science and Technology, 2013, 47(8), pp. 3623-3629.).

[77] Pilot-scale field trials in Monterey County suggests that while substantial reduction in nitrogen loss from cropland are achievable with BMPs, there was not a corresponding reduction in nitrate leachate on a concentration (ppm) basis. Source: Michael Cahn, 2010, University of California Cooperative Extension, Monterey County, *Optimizing Irrigation and Nitrogen Management in Lettuce for Improving Farm Water Quality, Northern Monterey County*, Grant No. 20080408 project report.

[78] In a Utah TMDL, Tetra Tech, Inc. hypothesized that decreasing total dissolved solids (TDS) loads might actually raise instream TDS concentrations as a result of less dilution from surface return flows or more concentrated TDS in shallow groundwater (see Tetra Tech, Inc. 2002, *Uinta River, Deep Creek and Dry Gulch Creek TMDLs for Total Dissolved Solids*, prepared for: USEPA Region 8, State of Utah Department of Environmental Quality, and Ute Indian Tribe).

[79] Central Coast Water Quality Preservation, Inc. has noted that *"Reductions in farm discharges may first show reduced loading in tributaries, with reduced concentrations only in higher order streams"* (see CCWQP, 2012).

on instream flows and instream pollutant concentrations, pollution control efforts, such as improved nutrient and irrigation management, will ultimately have environmental and water quality benefits.

In recognition of the uncertainties highlighted above, other metrics that can provide insight on interim progress to reduce nutrient pollution may be utilized by staff, for example:

- assessments of mass-based load reductions (e.g., tons of pollutant load reduced per year);
- improvements in flow-weighted concentrations;
- estimates of the scope and extent of implementation of improved management practices capable of ultimately achieving load allocations;
- improvements in receiving water nutrient-response indicators (i.e., dissolved oxygen, chlorophyll *a*, microcystins), independent of nutrient concentrations.

Central Coast Water Board staff may conclude in future reviews that ongoing implementation efforts may be insufficient to ultimately achieve the allocations and numeric target. If this occurs, Central Coast Water Board staff will recommend revisions to the implementation plan. Central Coast Water Board staff may conclude and articulate in the reviews that implementation efforts and results are likely to result in achieving the allocations and numeric target, in which case existing and anticipated implementation efforts should continue. If allocations and numeric targets are being met, Water Board staff will recommend the waterbody be removed from the 303(d) list.

10.10 Optional Special Studies & Reconsideration of the TMDLs

Additional monitoring and voluntary optional special studies would be useful to evaluate the uncertainties and assumptions made in the development of these TMDLs. The results of special studies may be used to reevaluate wasteload allocations and load allocations in these TMDLs. Implementing parties may submit work plans for optional special studies (if implementing parties choose to conduct special studies) for approval by the Executive Officer. Special studies completed and final reports shall be submitted for Executive Officer approval. Additionally, eutrophication is an active area of research. Consequently, ongoing scientific research on eutrophication and biostimulation may further inform the Central Coast Water Board regarding wasteload or load allocations that are protective against biostimulatory impairments, and help assess implementation timelines, and/or downstream impacts. At this time, staff maintains there is sufficient information to begin to implement these TMDLs and make progress towards attainment of water quality standards and the proposed allocations. However, in recognition of the uncertainties regarding nutrient pollution and biostimulatory impairments, staff proposes that the Central Coast Water Board reconsider the wasteload and load allocations, if merited by optional special studies and new research, eight years after the effective date of the TMDLs, which is upon approval by the OAL. A time schedule for optional studies and Central Coast Water Board reconsideration of the TMDL is presented in Table 10-3.

Further, the Central Coast Water Board may also reconsider these TMDLs, the nutrient water quality criteria, or other TMDL elements on the basis of potential future promulgation of a statewide nutrient policy for inland surface waters in the State of California.

Based on relevant future information, data, and research, the Central Coast Water Board has the discretion to conduct a water quality standards review which may potentially include one or more of the following:

- The Central Coast Water Board may designate critical low-flow conditions below which numerical water quality criteria do not apply, as consistent with federal regulations and policy[80].

- The Central Coast Water Board may authorize lowering of water quality to some degree if and where appropriate, if the Water Board finds water quality lowering to be necessary to accommodate important economic or social development. In authorizing water quality lowering the Water Board shall make any such authorizations consistent with the provisions and requirements of federal and state anti-degradation policies.

- The Central Coast Water Board may authorize revision of water quality standards, if appropriate and consistent with federal and state regulations, to remove a designated beneficial use, establishing subcategories of uses, establishing site specific water quality objectives, or other modification of the water quality standard[81]. When a standards action is deemed appropriate, the Water Board shall follow all applicable requirements, including but not limited to those set forth in part 131 of Title 40 of the Code of Federal Regulations and Article 3 of Division 7, Chapter 4 of the California Water Code.

Table 10-3. Proposed time schedule for optional studies and Water Board reconsideration of wasteload allocations and load allocations.

Proposed Actions	Description	Time Schedule-Milestones
Optional studies work plans	Implementing parties shall submit work plans for optional special studies (if implementing parties choose to conduct special studies) for approval by the Executive Officer	By four years after the effective date of the TMDL
Final optional studies	Optional studies completed and final report submitted for Executive Officer approval.	By six years after the effective date of the TMDL
Reconsideration of TMDL	If merited by optional special studies or information from ongoing research into eutrophication issues, the Central Coast Water Board will reconsider the wasteload and load allocations and/or implementation timelines adopted pursuant to this TMDL.	By eight years after the effective date of the TMDL

10.11 TMDL Achievement & Future Delisting Decisions

Staff maintains it is prudent to allow for flexibility, adaptation, and re-assessment as appropriate. It also should be noted that immediate compliance with water quality objectives are not contemplated or required by TMDLs. Staff are proposing interim wasteload and load allocations and benchmarks, and periodic re-consideration of the TMDL and appropriateness of the biostimulatory numeric water quality targets based on new research and information.

[80] See: U.S. Environmental Protection Agency, Water Quality Handbook, March 2012. EPA-823-8-12-002.

[81] See: Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options. California State Water Resources Control Board, June 16, 2005. Adopted by Resolution 2005-0050.

In terms of ultimately assessing TMDL achievement in waterbodies, evaluating exceedances of TMDL numeric targets identified herein, and assessing future de-listing decisions to remove waterbodies from the Clean Water Act Section 303(d) list, staff will use the de-listing criteria and methodologies identified in Section 4 (California Delisting Factors) of the State Water Resources Control Board's Listing Policy.

10.11.1 *An Important Note about Nutrient Water Quality Targets & Allocations*

The proposed nutrient water quality biostimulatory targets developed in this TMDL are predictions of the nutrient concentration levels necessary to be protective against biostimulation *based on current conditions*. However, recall that biostimulation is the result of a *combination of factors* (nutrients, flow and aeration, shading, canopy, etc.). Therefore, note that increased canopy shading, increased flow and aeration of stream water, and better water management can potentially achieve the same goal (better dissolved oxygen conditions, flushing of algae, etc.) regardless of whether the predicted biostimulatory nutrient targets and allocations herein are achieved. In other words, it is not necessary to be singularly focused on attempting to achieve the nutrient numeric water column concentration targets proposed in this TMDL, while disregarding other important factors that can limit the risk of biostimulation. A holistic approach to improve aquatic habitat and water quality can have corollary benefits in reducing the risk of biostimulation.

A goal of this TMDL is to address and mitigate biostimulatory impairments (as expressed by dissolved oxygen imbalances, excess algal biomass, and associated downstream impacts). In the future, if watershed conditions change (increased riparian canopy shading, better aeration of water column, better dissolved oxygen conditions in the water columns), it will be prudent to potentially reconsider proposed nutrient numeric targets proposed herein. Less stringent nutrient numeric targets are generally merited in cases where increased canopy shading and/or water column aeration in a stream are attained[82].

Additionally, attainment of receiving water TMDL numeric targets for nutrient-response indicators (i.e., dissolved oxygen water quality objectives, chlorophyll *a* targets and microcystin targets) may constitute a proxy demonstration of the attainment of the nitrate, nitrogen and orthophosphate-based seasonal biostimulatory wasteload and load allocations.

10.12 Cost Estimates

10.12.1 *Preface*

Note that in the case of this TMDL, impairments due to exceedances of *existing* state water quality objectives are being addressed. Although the state must consider a variety of factors in establishing the different elements of a TMDL, considering the economic impact of the required level of water quality is not among them. The State Water Board Office of Chief Counsel notes that the economic impact was already previously determined when the water quality standard was adopted[83] consistent with Water Code Section 13241 and pursuant to the basin planning process. The statutory directive under the federal Clean Water Act to adopt TMDLs to "implement the applicable water quality standards" is not qualified by the predicate "so long as it is economically desirable to

[82] Regardless of the levels of nutrients are appropriate protect against biostimulation and downstream biostimulatory impacts, nitrate water quality objectives must still be met to protect other beneficial uses (e.g., MUN-drinking water standards, GWR-groundwater recharge)
[83] State Water Resources Control Board, Office of Chief Counsel, memo June 12, 2002: *"The Distinction Between a TMDL's Numeric Targets and Water Quality Standards"*

do so." This conclusion is not altered when a TMDL is established to implement a narrative water quality objective (State Water Board, Office of Chief Counsel, 2002). Therefore, not only would an in-depth economic analysis be redundant, it would be inconsistent with federal law (State Water Board, Office of Chief Counsel, 2002). Further, the State Water Board Office of Chief Counsel states that under the Porter-Cologne Water Quality Control Act §13141 (i.e., implementation of agricultural water quality control programs), the Regional Boards "are not required to do a formal cost-benefit analysis" under the statute. This statute focuses only on costs and financing sources (State Water Board, Office of Chief Counsel, 1999).

10.12.2 *Cost Estimates for Irrigated Agriculture*

In accordance with §13141 of the Porter-Cologne Water Quality Control Act, prior to implementation of any agricultural water quality control program the Water Boards are required to estimate the *total* cost of such a program and potential sources of funding (see Section 10.13 for an outline of potential funding sources). It should be noted that the statute does not require the Water Boards to do, for example, a cost-benefit analysis or an economic analysis (see section above).

Load allocations for irrigated cropland are proposed to be implemented using an existing regulatory tool – the Agricultural Order. As such, the extent this TMDL would incur incremental costs – if any – above and beyond what is already required in the Agricultural Order is uncertain.

Further, it is should be recognized that implementation measures to reduce nutrient pollution from irrigated agriculture is already required in the Franklin Creek watershed basin by compliance with an existing regulatory program [Agricultural Order No. R3-2017-0002, including any pending and future renewals of the Order]. Compliance with these implementation measures are required *with or without* the TMDL and are therefore not attributable to TMDL implementation As outlined in Section 10.3, this TMDL is relying on the Agricultural Order for TMDL implementation, and this TMDL is not proposing the adoption of new regulatory tools for irrigated cropland. To a significant extent, the proposed TMDL can be considered an informational tool to focus and facilitate implementation, and assist the Central Coast Water Board in making its plan to implement state water quality standards.

These estimates contained herein constitute gross expenses and they do not contemplate potential net cost-savings associated with TMDL implementation measures (for example long-term savings associated with improved irrigation and nutrient efficiency).

In addition, some of the implementation costs likely will not constitute direct out-of-pocket expenses to growers, as the state and federal government have made funding sources, incentive payments, and grants available to address nonpoint sources of pollution and to implement TMDLs. For example, recently just one grant funding source (i.e., the Proposition 50 Agricultural Water Quality Grant Program) made $1,250,000 available to assist growers with irrigation and nutrient management in the Pajaro River basin which is within the Central Coast region.

Indeed, the State Water Resources Control Board recently issued a draft Water Quality Order explicitly concluding that generally, TMDL implementation does not incur additional costs above and beyond what is already in the Agricultural Order:

> *"[A] discharger's implementation of the Agricultural Order will constitute compliance with certain applicable TMDLs.* ***In other words, the TMDL provision does not lead to any costs above and beyond what is already required by the Agricultural Order. In addition, the Agricultural Order is simply the implementation vehicle for TMDL compliance**** *– it does not require dischargers to do anything more than would be required of them under the applicable TMDLs"*
>
> * *emphasis added*
>
> *From: California State Water Resources Control Board, Draft Water Quality Order, Change Sheet #1 (Circulated 09/19/12) In the Matter of the Petitions Of Ocean Mist Farms And Rc Farms; Grower-Shipper Association Of Central California, Grower-Shipper Association Of Santa Barbara And San Luis Obispo Counties, And Western Growers For Review of Conditional Waiver of Waste Discharge Requirements Order No. R3-2012-0011 Discharges from Irrigated Lands*

However, because of the magnitude and scope of nutrient pollution in the Franklin Creek watershed, staff anticipates a higher degree and scope of nutrient pollution mitigation measures will need to occur - either voluntarily, due to targeted grant funding, or due to TMDL implementation - relative to other areas of California's central coast region. Therefore, staff concludes it would be prudent to develop estimates associated with potential incremental costs pertaining to attainment of water quality standards for nutrients and TMDL implementation.

Cost estimates to comply with the existing Agricultural Order have previously been developed (Central Coast Regional Water Quality Control Board, 2011). It should be noted that these were scoping level assessments because it is difficult to estimate precise costs due to the absence of information about the current extent of management practices implementation, and how the costs of the Agricultural Order would represent incremental increases above current costs. Central Coast Water Board Agricultural Program staff therefore applied best professional judgment and conservative assumptions in constructing an estimate of total cost for management practice implementation for the Agricultural Order. The assumptions and information that went into developing the Agricultural Order cost estimates can be found in: *Central Coast Regional Water Quality Control Board. 2011. Technical Memorandum: Cost Considerations Concerning Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands; in: Appendix F – Staff Recommendations for Agricultural Order (March, 2011).* Table 10-4 presents the cost estimates to implement the Agricultural Order throughout the entire Central Coast Region.

Table 10-4. Cost estimates to implement Agricultural Order for Central Coast Region (2011).

Table 7: Estimation of Cost to Implement Management Practices

Management Practice Category	Area Basis (Acres)	Acres/ Operation	Acres	Correction Factor	Acres Practice Applied to:	Cost/Acre [d]	Cost Year 1	% Year 1 Cost in Yrs 2-4	Cost Years 2-4	Cost 5 Years
Sediment / Erosion Control & Stormwater Management	Total irrigated farm acreage[a]	NA	539,284	5%	26,964	$992	$26,748,486	25%	$26,748,486	$53,496,973
Irrigation Management	Operations with tailwater[b]	NA	74,121	50%	37,061	$903	$33,465,632	10%	$13,386,253	$46,851,884
Nutrient & Salt Management	Total Vegetable Crop acreage[c]	NA	444,443	20%	88,889	$56	$4,977,762	25%	$4,977,762	$9,955,523
Pesticide Runoff / Toxicity Elimination	102 Operations on toxicity impaired streams	20	2,040	50%	1,020	$72	$73,440	50%	$146,880	$220,320
Aquatic Habitat Protection	10 Large Operations on temp. & turbidity impaired streams	1,000	10,000	50%	5,000	$1,184	$5,920,000	10%	$2,368,000	$8,288,000
						One Year	**$71,185,320**		**Five Years**	**$118,812,700**
						Per Operation	**$23,728**		**Per Operation**	**$39,604**

[a] State Farmland Mapping Program (FMMP) data consists of farmland classifications that include Prime Farmland, Farmland of Statewide Importance, Unique Farmland, and Farmland of Local Importance.

[c] Total Vegetable Crop acreage from County Crop Reports, Table 12. Staff assumed these crops have high potential to discharge nitrogen to groundwater.

[b] Amount of irrigated acreage that has tailwater and is enrolled and active. Source: Central Coast Regional Water Quality Control Board Agricultural Regulatory Program Database, December 2009. While the number of operations is dynamic, staff has not made a broad effort to verify the accuracy of reported irrigated acreage and tailwater acreage. Growers can continually update their irrigated acreage and tailwater acreage to reflect seasonal growing changes. The Water Board officially requested acreage updates in 2007 and 2008.

[d] Median of high end of cost range/acre, or, unit cost/acre, whichever is higher from Table 5.

Staff endeavored to estimate incremental costs associated with implementing the proposed TMDLs, by using the cost estimate information in Table 10-4. Accordingly staff: (1) scaled acreage in Table 10-4 requiring implementation down to the scale of the Franklin Creek watershed; and (2) staff scaled up some of the correction factors[84] found in Table 10-4 in recognition of the fact that the magnitude of nutrient pollution in the Franklin Creek watershed exceeds most other areas of the central coast region and likely will require more concerted and sustained efforts to address, and thus is not necessarily comparable to an "average" estimate for the central coast region at large. These scalar modifications are presented in Table 10-5.

[84] Correction factors are an estimate of the ratio of irrigated acres that might be subject to actual management to reduce pollutant discharges.

Table 10-5. Farmland acreage and correction factors for Central Coast Region vs. TMDL project area.

	Amount of farmland (acres)	Central Coast Regional Correction Factor [A] Used for Agricultural Order	Correction Factor used for Franklin Creek Wateshed	Basis for Scaling Up Correction Factor in Franklin Creek Watershed
Central Coast Region (Region 3)	738,429	50%	**50%**	Not scaled up: Growers in the Franklin Creek watershed have reportedly already substanitally improved irrigation efficiency in recent years.
Franklin Creek Watershed	1,064	20%	**60%**	Scaled up by factor of 3 Magnitude of nutrient pollution in surface waters and groundwater in the TMDL project area will require more concerted efforts to address than in many other central coast watersheds.
Farmland Acreage Ratio: Farmland in Franklin Creek Watershed compared to all of Region 3	.0014% Ratio: TMDL Project Area compared to Region 3	50%	**100%**	Scaled up by factor of 2 Magnitude of nutrient pollution in surface waters and groundwater in the TMDL project area will require more concerted efforts to address than in many other central coast watersheds.

[A] correction factors are an estimate of the ratio of irrigated acres that might be subject to actual management to reduce pollutant discharges.

Based on geographically scaling the 2011 Agricultural Order's regional compliance costs estimates to the scale of the Franklin Creek watershed, as outlined above, Table 10-6 presents the estimated compliance costs associated with the Agricultural Order that may be incurred for farmland within the Franklin Creek watershed.

Table 10-6 illustrates estimated summed costs are that are associated with compliance with the Agricultural Order, plus incremental costs potentially attributable to TMDL implementation.

Table 10-6. Cost estimates associated with Agricultural Order compliance and nutrient TMDL implementation in the Franklin Creek watershed (2011 dollars).

Management Practice Category	Area Basis (Acres)[A]	Acres	Correction Factor	Acres Practice Applied to:	Cost per Acre	Cost - Year 1 of TMDL Implementation	% Year 1 Cost in Yrs 2-5	Cost Years 2-5	Compliance Cost 5 Years
Irrigation Management	0.0014% of corresponding acreage from Table 10-4	104	50%	52	$903	$46,956	10%	$18,782	$65,738
Nutrient Management	0.0014% of corresponding acreage from Table 10-4	622	60%	373	$56	$20,888	25%	$20,888	$41,776
Aquatic Habitat Protection	0.0014% of corresponding acreage from Table 10-4	14	100%	14	$1,184	$16,576	10%	$6,630	$23,206

[A] The 0.0014% fraction in this column is the ratio (%) of farm acres in the Franklin Creek watershed to farm acres in all of the central coast region as shown in Table 10-5.

Based on the information presented in Table 10-6, the total costs associated with agricultural order compliance and TMDL implementation for a period of five years is approximately $130,000. As discussed previously, this estimate is subject to significant uncertainty, however staff endeavored to use available information to develop these estimates in an effort to inform the interested public and decisions makers.

Based on information in the 2011 technical documentation for the Agricultural Order and information developed in this section, an estimated cost attributable to compliance with the Agricultural Order and TMDL implementation in the Franklin Creek watershed over 5 years is approximately **$130,720.** This represents, on average, an estimated unit-area gross cost of **$123 per acre of farmland*** (2011 dollars) in Franklin Creek watershed over a period of five years of compliance and implementation.

***** *as represented by the California Department of Water Resource's 2010 farmland mapping and monitoring spatial dataset*

10.12.3 *Cost Estimates of BMPs for MS4 Entities*

Anticipating incremental costs attributable specifically to TMDL implementation with any accuracy is challenging for several reasons. Many of the actions, such as review and revision of policies and ordinances by a governmental agency, could incur no significant costs beyond the program budgets of those agencies. However, other actions, such as establishing nonpoint source implementation programs and establishing assessment workplans carry discrete costs.

Cost estimates are further complicated by the fact that some implementation actions are necessitated by other regulatory requirements (e.g., the Phase II Stormwater permit) or are actions anticipated regardless of whether or not the TMDL is adopted. Therefore assigning all of these costs to TMDL implementation would be inaccurate. It also is important to note that reported MS4 program costs are not all attributable to compliance with MS4 permits. Many program components, and their associated costs, existed before any MS4 permits were issued. For example, street sweeping and trash collection costs cannot be solely or even principally attributable to MS4 permit compliance, since these practices have long been implemented by municipalities. Therefore, true program cost resulting from MS4 permit requirements is some fraction of reported costs.

Guidance and information on preparing scoping-level cost estimations were provided to staff by Brandon Steets, P.E. of Geosyntec Consultants. Geosyntec Consultants is an engineering firm with substantial experience assisting MS4 entities in California with TMDL implementation. Estimated BMP capital and O&M costs are available in Technical Appendix C of the Strategic BMP Planning and Analysis Tool (SBPAT)[85]. SBPAT is a public domain, water quality analysis tool intended to facilitate the selection of BMP project opportunities and technologies in urban watersheds. These estimated unit BMP capital costs and annual maintenance costs are presented in Figure 10-1 and Figure 10-2, respectively. These tables are from the SBPAT technical appendix C.

Unit-area costs are based on cost per treated acre for a specific management practice. It would be highly speculative for staff to identify what percentage of the area of the MS4 footprint would require implementation, and what percentage of this area will receive implementation with or without a TMDL, due to to permits which exist independent of the TMDL and/or other ongoing environmental projects. Implementation over 100% of the MS4 footprint is clearly impractical and cost-prohibitive. Implementation will undoubtedly be focused on areas or land uses that are identified as water quality risks and require implementation. Therefore, it is presumed that implemenation, on a unit-area basis, will occur over catchement areas that are substantially smaller than the footprint of the MS4.

[85] Online linkage: http://www.sbpat.net/

Geosyntec consultants suggested that for urban nutrient pollution control, Central Coast Water Board staff should primarily focus on unit-area costs associated with bioretention and wetland treatement strategies (refer again to Figure 10-1 and Figure 10-2.

Some these management strategies could represent entirely new practices associated with TMDL implementation that might not occur under existing permit requirements or as associated with other non-regulatory watershed improvement projects. Therefore, some unit-area costs potentially associated with strategies to implement the TMDL can be estimated. This approach is consistent with legal guidance from the State Water Resources Control Board's Office of Chief Counsel, whom have stated that economic considerations in a TMDL should determine: 1) what methods of compliance are reasonably foreseeable to attain the allocations; and 2) what are the *costs of these methods* (State Water Board, 1999b).

	Best Management Practice	Reference Catchment Size (acres)	Normalized Capital Cost $ / ac-ft	Normalized Capital Cost $ / cfs	Normalized Capital Cost $ / ft²
Distributed	Cisterns	1	$122,000 - $203,000	NA	NA
Distributed	Bioretention	1	$361,000 - $602,000	NA	$3.80 - $6.30
Distributed	Vegetated Swales	10	NA	$12,600 - $21,000	$5.30 - $8.90
Distributed	Green Roofs	1	$3,490,000 - $5,800,000	NA	$20 - $35
Distributed	Permeable Pavement	1	NA	$153,000 - $255,000	$3.00 - $5.00
Distributed	Gross Solids Separators	10	NA	$50,000- $84,000	NA
Distributed	Catch Basin Inserts	10	NA	$5,400 - $9,000	NA
Distributed	Media Filters	10	NA	$47,000 - $78,000	NA
Regional	Infiltration Basins	100	$58,000 - $97,000	NA	$3.30 - $5.50
Regional	Dry Detention Basins	100	$32,000 - $54,000	NA	$1.80 - $3.00
Regional	SSF Wetlands	100	NA	$140,000 - $233,000	NA
Regional	Constructed SF Wetlands	100	$36,000 -$48,000	NA	$1.80 - $3.00
Regional	Treatment Plants	100	NA	$400,000 - $670,000	NA
Regional	Hydrodynamic Devices	100	NA	$50,000- $84,000	NA
Regional	Channel Naturalization	100	NA	NA	$1.80 - $3.00

Figure 10-1. Estimated unit BMP capital costs by design volume, flow rate, and footprint area (2008 dollars).

	Best Management Practice	Reference Catchment Size (acres)	Normalized Annual Maintenance Cost $ / ac-ft	Normalized Annual Maintenance Cost $ / cfs	Normalized Maintenance Cost $ / ft^2
Distributed	Cisterns	1	$1,400 - $2,300	NA	NA
	Bioretention	1	$7,300 - $12,200	NA	$0.08-$0.13
	Vegetated Swales	10	NA	$200 - $300	$0.85-$1.40
	Green Roofs	1	$6,500 - $10,900	NA	$0.04-$0.06
	Permeable Pavement	1	NA	$300 - $400	$0.01-$0.02
	Gross Solids Separators	10	NA	$20 -$40	NA
	Catch Basin Inserts	10	NA	$1,300 - $2,200	NA
	Media Filters	10	NA	$6,500 - $10,900	NA
Regional	Infiltration Basins	100	$1,200 - $1,900	NA	$0.07 - $0.11
	Dry Detention Basins	100	$300 - $500	NA	$0.02 - $0.03
	SSF Wetlands	100	NA	$1,600 - $2,700	NA
	Constructed SF Wetlands	100	$1,100 - $1,800	NA	$0.05 - $0.09
	Treatment Plants	100	NA	$500 - $800	NA
	Hydrodynamic Devices	100	NA	$20 -$40	NA
	Channel Naturalization	100	NA	NA	$0.02 - $0.03

Figure 10-2. Estimated unit BMP annual maintenance costs by design volume, flow rate, and footprint area (2008 dollars).

Therefore, for implementation of these TMDLs by MS4 entities, a range of unit costs to implement bioretention and vegetated and wetland treatments strategies are estimated to range as shown in Table 10-7.

Table 10-7. Unit costs for MS4 TMDL implementation (2008 dollars)

Implementation Strategy Methods	Costs of Method
SSF wetlands (subsurface flow wetlands)	➢ Estimated Normalized Capital Costs ($/cfs): $140,000 - $233,000 ($/cfs) to treat 100 acres of catchment size. ➢ Estimated Annual Maintenance Cost ($/cfs): $1,600 - $2,700 ($/cfs) to treat 100 acres of catchment size.
Constructed SF wetlands (surface flow wetlands)	➢ Estimated Normalized Capital Costs ($/ft^2): $1.80 - $3.00 ($/ft^2) to treat 100 acres of catchment size. ➢ Estimated Annual Maintenance Cost ($/ft^2): $0.05 to $0.09 ($/ft^2) to treat 100 acres of catchment size.
Channel Naturalization	➢ Estimated Normalized Capital Costs ($/ft^2): $1.80 - $3.00 ($/ft^2) to treat 100 acres of catchment size. ➢ Estimated Annual Maintenance Cost ($/ft^2): $0.02 to $0.03 ($/ft^2) to treat 100 acres of catchment size

10.13 Sources of Funding

In accordance with §13141 of the Porter Cologne Water Quality Control Act, prior to implementation of any agricultural water quality control program the Central Coast Water Board is required to identify potential sources of funding. Accordingly, in this section, staff provides some examples of funding sources. Potential sources of financing to TMDL implementing parties include the following:

10.13.1 *Federal Clean Water Act 319(h) Program*

The Federal Clean Water Act 319(h) program is administered by the State Water Board, Division of Financial Assistance. The 319(h) program is an annual federally-funded nonpoint source pollution control program that is focused on controlling activities that impair beneficial uses and on limiting pollutant effects caused by those activities. Project proposals that address TMDL implementation and those that address problems in impaired waters are favored in the selection process. There is also a focus on implementing management activities that lead to reduction and/or prevention of pollutants that threaten or impair surface and ground waters.

More information about the 319(h) Grant Program is available from the California State Water Resources Control Board site at SWRCB 319(h) NPS Grant Program, or contact Jeanie Mascia, State Board Division of Water Quality, 319(h) Grants Program at (916) 323-2871.

10.13.2 *Proposition 1 (2014 Water Bond)*

Proposition 1 authorized billions of dollars for water projects including surface and groundwater storage, ecosystem and watershed protection and restoration, and drinking water protection. The State Water Resources Control Board will administer Proposition 1 funds for five programs. Stakeholders specifically interested in ecosystem and watershed restoration and protection aspects of Prop 1, should consider the Ocean Protection Council (OPC), State Coastal Conservancy, Wildlife Conservation Board, and Department of Fish and Wildlife administered funds.

10.13.3 *Other Sources of Funding for Growers and Landowners*

The local Resource Conservation District (RCD) offices can provide access to and/or facilitate a land owners application for federal cost-share assistance through various local, state, and federal funding programs. For certain projects the RCD may also be able to apply for other grant funds on behalf of a cooperating landowner, grower or rancher. More information is available from the Cachuma RCD.

11 PUBLIC PARTICIPATION

11.1 Public Meetings & Stakeholder Engagement

Public outreach and public involvement are a part of TMDL development and the basin planning process. Over the past two years, staff of the Central Coast Water Board has implemented a process to inform and engage interested persons about this TMDL project. We provided regular TMDL updates and solicited public feedback via our stakeholder email subscription list consisting of 70 stakeholders representing a wide range of interests. We periodically posted interim TMDL progress reports on the Central Coast Water Board's website with the intent of sharing our progress with stakeholders as we moved forward with TMDL development. We conducted public workshops in the City of Carpinteria on February 2016, June 2016, and September 2017 and California Environmental Quality Act (CEQA) stakeholder scoping meetings on June 10th, 2016 and September 20th, 2017. Central Coast Water Board staff addressed questions and comments from attendees.

Individuals and entities Central Coast Water Board staff engaged with during public workshops, CEQA scoping meetings, or during TMDL development included representatives of the following:

- City of Carpinteria staff
- County of Santa Barbara staff
- Representatives Santa Barbara Channelkeepers
- Representatives from University of California Natural Reserve System
- Representatives of commercial farms, orchards, greenhouses, nurseries, and ranches
- Other individuals and local residents interested in Franklin Creek and Carpinteria Salt Marsh water quality

In particular, staff would like to thank staff of the City of Carpinteria, Santa Barbara Channelkeepers, Cooperative Monitoring Program, and University of California Natural Reserve System for providing data and information used to develop this TMDL

Central Coast Water Board staff's efforts to inform and involve the public included a public comment period. The staff report, resolution, basin plan amendment, and TMDL report were made available for a 45-day public comment period commencing on December XX**, 2017.** This provided interested parties an opportunity to provide comment prior to any Central Coast Water Board hearing regarding these TMDLs. Staff solicited public comments from a wide range of stakeholders including owners/operators of agricultural operations, representatives of the agricultural industry, representatives of environmental groups, academic researchers and resource professionals, representatives of local, state, and federal agencies, representatives of municipal wastewater treatment facilities, representatives of city and county stormwater programs, representatives of NPDES–permitted industrial and construction facilities, ranchers and representatives of the livestock industry, managers and representatives of local golf courses, representatives of Native American tribal groups, representatives of environmental justice groups, and other individuals and groups interested in the water quality of streams in the Franklin Creek watershed.

Central Coast Water Board staff received comment letters from:
1). XXXXX

The public comments received and Central Coast Water Board staff responses are included in the documentation of this TMDL project.

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APPENDIX A – SANTA BARABARA COUNTY PARCEL USE (2012)

Parcel Use Description	Parcel Count	Parcel Use Area (acres)	% of Watershed
ORCHARDS, IRRIGATED	84	995.77	37.22
IRRIGATED FARMS, MISC	9	528.00	19.74
PASTURE OF GRAZING, DRY	10	347.85	13.00
SINGLE FAMILY RESIDENCE	1287	237.27	8.87
FLOWERS	12	138.76	5.19
NURSERIES,GREENHOUSES	17	138.68	5.18
SCHOOLS	6	51.79	1.94
VACANT	50	28.45	1.06
APARTMENTS, 5 OR MORE UNITS	33	25.87	0.97
CHURCHES, RECTORY	16	23.88	0.89
RESIDENTIAL INCOME, 2-4 UNITS	129	22.65	0.85
RANCHO ESTATES (RURAL HOME SITES)	3	18.54	0.69
INSTITUTIONAL (MISC)	1	11.26	0.42
RETAIL STORES, SINGLE STORY	41	11.12	0.42
MISCELLANEOUS	9	9.72	0.36
PARKS	6	7.35	0.27
CONDOS,COMMUNITY APT PROJS	249	6.94	0.26
VINEYARDS	1	5.89	0.22
TRUCK CROPS-IRRIGATED	1	5.03	0.19
UTILITY,WATER COMPANY	4	4.13	0.15
RESTAURANTS,BARS	12	4.11	0.15
WATER RIGHTS,PUMPS	3	3.79	0.14
SHOPPING CENTERS (NEIGHBORHOOD)	4	3.11	0.12
RIGHTS OF WAY,SEWER,LAND FILLS,ETC	11	3.07	0.11
OFFICE BUILDINGS, MULTI-STORY	5	3.03	0.11
HOTELS	3	2.95	0.11
VINES AND BUSH FRUIT-IRRIGATED	1	2.82	0.11
PARKING LOTS	8	2.78	0.10
RIVERS AND LAKES	2	2.53	0.09
COMMERCIAL AND OFFICE CONDOS,PUDS	17	2.50	0.09
WAREHOUSING	6	2.49	0.09
PACKING PLANTS	1	2.13	0.08
OFFICE BUILDINGS, SINGLE STORY	7	1.96	0.07
COMMERCIAL (MISC)	5	1.82	0.07
AUTO SALES, REPAIR, STORAGE, CAR WASH, ETC	6	1.70	0.06
PUBLIC BLDGS,FIREHOUSES,MUSEUMS,POST OFFICES,ETC	3	1.65	0.06
CLUBS, LODGE HALLS	3	1.62	0.06
RECREATION	1	1.55	0.06
INDUSTRIAL, MISC	5	1.35	0.05
SERVICE STATIONS	4	1.20	0.04
MOBILE HOME PARKS	2	1.15	0.04
WHOLESALE LAUNDRY	1	1.08	0.04
RECREATIONAL OPEN (MISC)	1	1.01	0.04
STORE AND OFFICE COMBINATION	3	0.99	0.04
LUMBER YARDS, MILLS	1	0.84	0.03
BANKS, S&LS	3	0.73	0.03
LIGHT MANUFACTURING	5	0.73	0.03
MIXED USE-COMMERCIAL/RESIDENTIAL	3	0.49	0.02
MOBILE HOMES	53	0.41	0.02
PROFESSIONAL BUILDINGS	2	0.33	0.01
PIPELINES,CANALS	2	0.25	0.01
HOSPITALS	1	0.13	0.01
Sum	**2,152**	**2,675**	

APPENDIX B – NUTRIENT TARGET DEVELOPMENT

This document is provided as a separate attachment

APPENDIX C – STEPL SPREADSHEETS

☐ Treat all the subwatersheds as parts of a single watershed ☑ Groundwater load calculation

State	County	Weather Station
California	Santa Barbara	CA SANTA MARIA WSO ARPT

1. Input watershed land use area (ac) and precipitation (in)

Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
									Rain correction factors		
									0.865	0.418	
W1	640	788	0	1149	277	0	0-24%	2854	18.68	42.3	0.914

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied
W1	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	110	2.43	2	0	0

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest					User Defined				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1	62.886	0.240	9.274	0.090	0.998	62.886	0.269	9.274	0.040	1.000	62.886	0.240	9.274	0.036	1.000	62.886	0.240	9.274	0.140	1.000

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%
W1	○	○	○	●	D	0.068	0.038	0.136

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	85
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	83	89	92	93

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportation	98	98	98	98
Multi-Family	77	85	90	92
Single-Family	57	72	81	86
Urban-Cultivat	67	78	85	89
Vacant-Devel	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l)

Land use	N	P	BOD
1. L-Croplan	**2.6**	**0.6**	**4**
1a. w/ manure	0	0	12.3
2. M-Croplan	**2.6**	**0.6**	**6.1**
2a. w/ manure	0	0	18.5
3. H-Croplan	**2.6**	**0.6**	**9.2**
3a. w/ manure	0	0	24.6
4. Pasturelar	**4**	**0.3**	**13**
5. Forest	**0.287**	**0.062**	**0.5**
6. User Defin	**22**	**1.9**	**0**

7a. Nutrient concentration in shallow groundwater (mg/l) (may be modified)

Landuse	N	P	BOD
Urban	19.5	0.063	0
Cropland	19.5	0.063	0
Pastureland	1.44	0.063	0
Forest	0.11	0.009	0
Feedlot	6	0.07	0
User-Defined	19.5	0.063	0

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated	Vacant (developed)	Open Space %	Total % Area
W1	640	15	10	10	10	10	30	5	5	5	100

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	3760.15	654.24	11348.92	66.33
Cropland	8719.50	3889.43	16079.59	2122.84
Pastureland	0.00	0.00	0.00	0.00
Forest	3736.56	1953.85	7379.63	1240.42
Feedlots	0.00	0.00	0.00	0.00
User Defined	16602.66	2919.04	6326.35	1162.93
Septic	68.39	26.79	279.28	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	6983.61	25.29	0.00	0.00
Total	39870.88	9468.64	41413.77	4592.52

APPENDIX D – WATER QUALITY DATA

This document is provided as a separate attachment