California Environmental Protection Agency

California Regional Water Quality Control Board
Central Coast Region

Total Maximum Daily Load for Nitrate in Arroyo Paredon Watershed in Santa Barbara County, California

Final Project Report

December, 2013

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Central Coast Region
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Documents also are available at:
http://www.waterboards.ca.gov/centralcoast/water_issues/programs/tmdl/303d_and_tmdl_projects.shtml

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LIST OF ACRONYMS AND ABBREVIATIONS

CCRWQCB	Central Coast Regional Water Quality Control Board
CCAMP	Central Coast Ambient Monitoring Program
CMP	Cooperative Monitoring Program
GIS	Geographic Information System
IBI	Index of Biological Integrity
MCLs	Maximum Contaminant Levels
mg/L	Milligram Per Liter
MUN	Municipal and domestic water supply beneficial use
N	Nitrogen
NO_3 as NO_3	Nitrate as nitrate
NO_3 as N	Nitrate as nitrogen
NO_3 + NO2 as N	Nitrate plus nitrite as nitrogen or joint nitrate/nitrite as nitrogen
NPDES	National Pollutant Discharge Elimination System
OEHHA	California Office of Environmental Health Hazard Assessment
PHGs	Public Health Goals
ppm	Parts per million
TMDL	Total Maximum Daily Load
UCSB	University California Santa Barbara
USEPA	United States Environmental Protection Agency
Water Board	Regional Water Quality Control Board, Central Coast Region
WDR	Waste Discharge Requirements
ºC	Degrees Centigrade
cm	Centimeter
ºF	Degrees Fahrenheit

EXECUTIVE SUMMARY

The following Total Maximum Daily Load Report (TMDL Report) for nitrate in Arroyo Paredon Watershed evaluates nitrate loading and assigns a TMDL for nitrate to Arroyo Paredon in Santa Barbara County.

Table 1. Arroyo Paredon TMDL for Nitrate – Summary

Arroyo Paredon TMDL For Nitrate – Summary **California Regional Water Quality Control Board, Central Coast Region**	
Waterbody Identification	Arroyo Paredon Watershed
Location	Santa Barbara County, California Hydrologic Unit Code # 180600130204
Area	2,791 acres
TMDL Pollutants of Concern	Nitrate
Pollutant Sources	Application of the nitrogen based fertilizers in agricultural operations
Beneficial Uses Impaired	Municipal and Domestic Supply (MUN)
TMDL	10 mg/L-N in receiving waters
Allocations	Load Allocations: 10 mg/L Nitrate as Nitrogen Wasteload Allocations: equal to current loading
TMDL Numeric Targets	Receiving water column nitrate must not exceed 10 mg/L-N
Implementation Strategy (Proposed Actions to Correct 303(d)-Listed Impairments):	Implement the Agricultural Order

Total Maximum Daily Load

This TMDL report presents a TMDL for nitrate in the Arroyo Paredon Watershed. TMDL is a term used to describe the maximum amount of pollutants, in this case, nitrate, that a waterbody can receive and still meet water quality standards. A TMDL 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. By "allocating" an amount to a contributing source, we are assigning responsibility to someone, an agency, group, or individuals, to reduce their contribution in order to meet water quality standards.

The federal Clean Water Act requires every state to evaluate its waterbodies and maintain a list of waters (303(d) Impaired Waters List) that are considered "impaired" either because the water exceeds water quality standards or does not achieve its designated use. For each waterbody on the Central Coast's 303(d) Impaired Waters 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 de-listed.

Arroyo Paredon was listed as impaired on the 2006 Clean Water Act Section 303(d) list because 14 of 16 samples exceeded the water quality standards for nitrate.

Impaired Waterbody

The geographic scope of this project includes the Arroyo Paredon Watershed, which encompasses approximately 2,791 acres in Santa Barbara County. The upper watershed includes some National Forest land, orchards, vineyards, and rural residential areas in the foothills. Vegetation in the upland reaches of the watershed are characterized by ceanothus, scrub oak, and chamise. The lower third of the watershed is below Highway 192. In this section the creek flows between greenhouse facilities and urban areas. Agriculture, including cropland, orchards, and greenhouses, is the dominant land use in the lower watershed.

Numeric Targets, TMDLs and Allocations

Numeric targets are water quality targets developed to ascertain when and where water quality objectives are achieved, and hence, when beneficial uses are protected. The numeric target for this TMDL is identical to the Basin Plan numeric water quality objective for nitrate protective of the municipal and domestic supply beneficial use.

Discharges of nitrate from irrigated agriculture exceed the water quality objectives for municipal and domestic supply. Owners and operators of irrigated lands are assigned allocations for nitrate to achieve the TMDL. Responsible parties are assigned allocations for nitrate equal to the numeric targets as represented in the Table 2 below.

This TMDL is a concentration-based TMDL equal to the numeric target and water quality objective.

Table 2. Numeric Targets, TMDL, and Load Allocations for Arroyo Paredon Watershed

Numeric Targets, TMDL, and LOAD ALLOCATIONS		
Waterbodies Assigned TMDLs	**Responsible Party Assigned Allocation (Source)**	**Receiving Water Numeric Target, TMDL, and Load Allocation**
• Arroyo Paredon	Owners/operators of irrigated agricultural lands in the Arroyo Paredon Watershed (Discharges from irrigated lands)	10 mg/L Nitrate as Nitrogen

TMDL Implementation, Monitoring, and TMDL Timeline

Owner and operators of irrigated lands in the project area are required to comply with the conditions and requirements of the current *Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands* (Agricultural Order) and any renewals, modifications or replacements thereof. Owners and operators are required to comply with the requirements described in this TMDL, Section 6, which could include:

- Enroll in the Agricultural Order.
- Implement monitoring and reporting requirements described in the Agricultural Order.
    - Current reporting requirements include a description of discharges leaving the growers field, including the concentration of nitrate discharges and the volume of

discharge. Reporting requirements also require a description of management practices used to mitigate nitrate loading.

- Implement, and update as necessary, management practices to reduce nitrate loading.
- Maintain existing, naturally occurring, riparian vegetative cover in aquatic habitat areas.
- Develop/update and implement Farm Plans. The Farm Plans should incorporate measures designed to achieve load allocations assigned in this TMDL.

Owners and operators of irrigated agricultural lands must perform monitoring and reporting in accordance with Monitoring and Reporting Program Orders R3-2012-0011-01, R3-2012-0011-02, and R3-2012-0011-03, as applicable to the operation.

The timeline to achieve this TMDL is by October 2016.

1 INTRODUCTION

1.1 Clean Water Act Section 303(d)

Section 303(d) of the federal Clean Water Act requires every state to evaluate its waterbodies and maintain a list of waters that are considered "impaired" either because the water exceeds water quality standards or does not achieve its designated use. For each water on the Central Coast's "303(d) Impaired Waters List," the Central Coast Water Board must develop and implement a plan to reduce pollutants so that the waterbody is no longer impaired and can be de-listed. Section 303(d) of the Clean Water Act states:

Each State shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 1314(a)(2) of this title as suitable for such calculation. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

The State complies with this requirement by periodically assessing the conditions of the rivers, lakes, and bays and identifying them as "impaired" if they do not meet water quality standards. These waters, and the pollutant or condition causing the impairment, are placed on the 303(d) List of Impaired Waters. In addition to creating this list of waterbodies not meeting water quality standards, the Clean Water Act mandates each state to develop TMDLs for each waterbody listed. The Central Coast Regional Water Quality Control Board (Water Board) is the agency responsible for protecting water quality consistent with the Basin Plan, including developing TMDLs for waterbodies identified as not meeting water quality objectives.

1.2 Project Area

The geographic scope of this TMDL (the project area) encompasses approximately 2,791 acres of the Arroyo Paredon Watershed (CalWater hydrologic sub-area 331534) located in Santa Barbara County. The watershed flows from the steep southern face of the Santa Ynez Mountains to the Pacific Ocean just northwest of Carpinteria.

1.3 Pollutants Addressed

This project addresses water body impairments due to nitrate.

2 PROBLEM IDENTIFICATION

2.1 Watershed Description

The geographic scope of this TMDL encompasses approximately 2,791 acres[1] of the Arroyo Paredon Watershed (within the CalWater Carpinteria Hydrologic Sub-area 331534) located in Santa Barbara County (Figure 1). The watershed flows from the steep southern face of the Santa Ynez Mountains to the Pacific Ocean just northwest of Carpinteria (Figure 2). Elevations within the watershed range from sea level to 3,400 feet at an unnamed peak in the Santa Ynez Mountains. The upper watershed is mostly in National Forest land and also has some rural residential areas in the foothills. Located in the upper reaches of the watershed, the Arroyo Paredon debris basin upstream of the Oil Canyon confluence has a 24,000 cubic yard capacity (Santa Barbara County 2010). Upland reaches of the watershed are characterized by ceanothus, scrub oak, and chamise (UCSB Department of Geography, 2012).

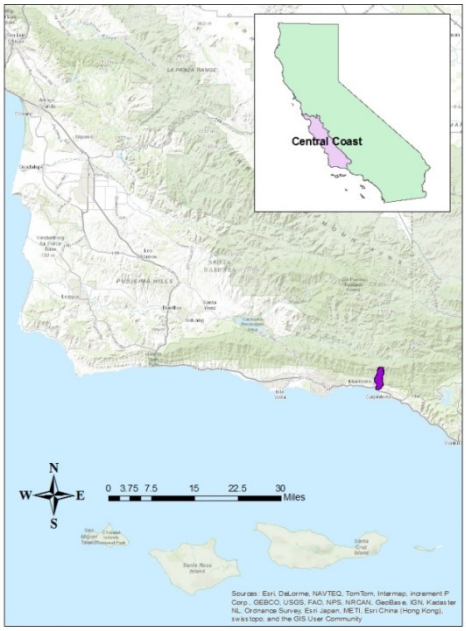

Figure 1. Location of the Arroyo Paredon Watershed

[1] In a previous report, Total Maximum Daily Load for Diazinon and Additive Toxicity with Chlorpyrifos in the Arroyo Paredon Watershed, Santa Barbara County, California (March 2013) staff reported the size of the watershed at 3,124 acres based on information contained in literature reviewed. Independent analysis using the Farmland Mapping and Monitoring Program (2008) data and NHD_Plus Catchment data shows the area draining directly to the Arroyo Paredon watershed is 2,791 acres.

Figure 2. The Arroyo Paredon Watershed

The upstream watershed is made up of approximately 75 percent undisturbed wilderness and 25 percent agriculture (mostly orchards), with a few rural residences. The reach has a fairly intact riparian corridor composed of approximately 80 percent native cover, and a natural stream bottom and banks composed mostly of boulders, cobble, gravel, and sand. Stream bottom cobble and gravel is cemented in most places by mineral deposits from nearby springs. Water quality is characterized by low water temperature (15.6 ºC), and moderately high conductivity (1,560 µS). The Index of Biological Integrity (IBI) score for a sampling site on Arroyo Paredon (AP1) was 19 (Poor) (Project Clean Water, 2010).

After crossing Highway 192, the creek flows between greenhouse facilities and urban areas. Agriculture, including cropland, orchards, and greenhouses, is the dominant land use in the lower watershed (UCSB Department of Geography, 2012). In the lower watershed the channel bottom is very rocky with various sized boulders and the substrate becomes more silty/sandy as the creek nears the ocean. The creek banks are well vegetated with willow, sycamore and oaks with an understory of mainly introduced cape ivy and blackberry along with species such as sagebrush, tree tobacco, and deerweed (Santa Barbara County, 2010).

Table 3 shows the approximate percentage of each land use type within the watershed. The land uses shown on this table, derived from the Farmland Mapping and Monitoring Program (FMMP 2008), indicate that 703 acres in the watershed are under agricultural use. As shown in Figure 3 below, agricultural land use in the Arroyo Paredon watershed is approximately 25 percent of the total watershed area.

Table 3. Percent of Land in the Arroyo Paredon Watershed (Farmland Mapping and Monitoring Program (FMMP), 2008)

Landcover	Percent of the watershed	Area in acres
Urban and Built-Up Land	3.9	110
Prime Farmland	3.8	107
Farmland of Statewide Importance	1.2	32
Unique Farmland	20.2	564
Other Land (Forested, mined, government lands)	70.9	1978
Total	100%	2,791

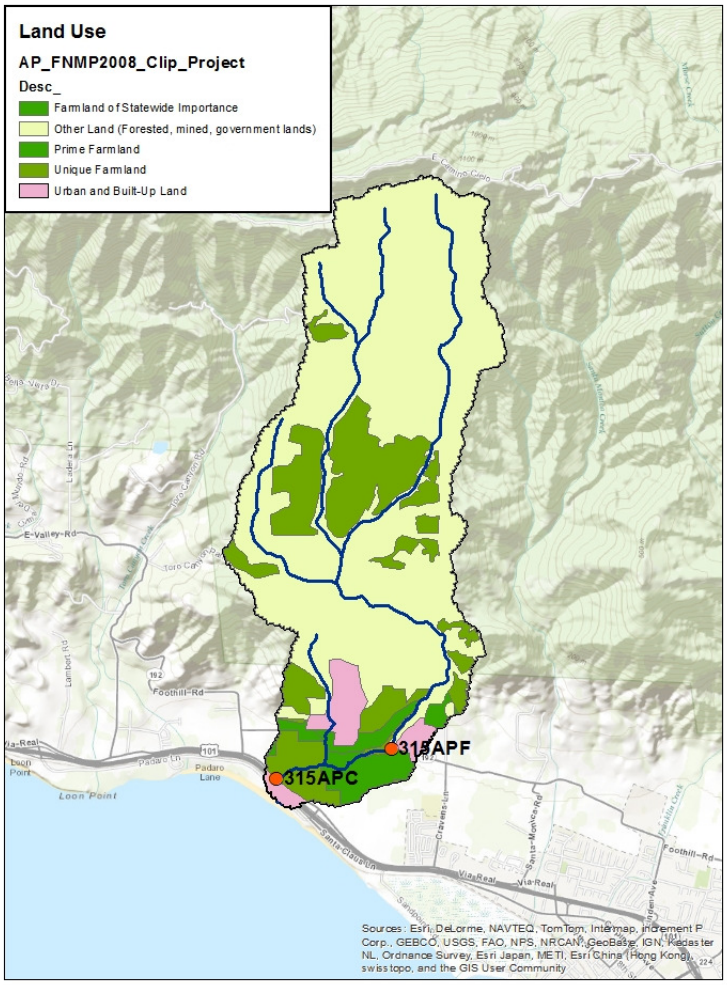

Figure 3. Land use in the Arroyo Paredon Watershed

Rainfall in the project area averages 18 inches of rain per year. On average, there are 282 sunny days per year and the July high is around 76ºF. The January low is 43ºF (Best Places, 2012). With regards to the hydrology of the Project Area, there is little or no flow in Arroyo Paredon except during the November to April wet season. During the summer months, the creek generally dries up except for flow supported by a spring that keeps the creek wet from the lagoon upstream approximately 1,000 feet (Santa Barbara County, 2010).

2.2 Beneficial Uses

The designated beneficial uses identified in the Basin Plan (CCRWQCB, 1994) for the Arroyo Paredon are shown in Table 4.

Table 4. Basin Plan designated beneficial uses

Waterbody Names	MUN	AGR	PRO	IND	GWR	REC1	REC2	WILD	COLD	WARM	MIGR	SPWN	BIOL	RARE	EST	FRESH	COMM	SHELL
Arroyo Paredon	X	X			X	X	X	X		X	X	X		X	X	X	X	

Beneficial uses are regarded as existing whether the water body is perennial or ephemeral or the flow is intermittent or continuous.

Municipal and Domestic Supply (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.

Agricultural Supply (AGR) - Uses of water for farming, horticulture, or ranching including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.

Ground Water Recharge (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.

Water Contact Recreation (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.

Non-Contact Water Recreation (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.

*Wildlife Habitat (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.

*Warm Fresh Water Habitat (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.

*Migration of Aquatic Organisms (MIGR) - Uses of water that support habitats necessary for migration or other temporary activities by aquatic organisms, such as anadromous fish.

*Spawning, Reproduction, and/or Early Development (SPWN) - Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

*Rare, Threatened, or Endangered Species (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.

*Estuarine Habitat (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 water bodies which would naturally fit the definition if not controlled by tidegates or other such devices.

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

Commercial and Sport Fishing (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.

* = Aquatic habitat beneficial use.

2.3 Water Quality Objectives

The Central Coast Region's Water Quality Control Plan (Basin Plan) contains specific water quality objectives that apply to all inland surface waters, enclosed bays and estuaries (CCRWQCB, 1994, pg. III-3). Relevant water quality objectives for this project include:

2.3.1 Basin Plan Water Quality Objective for Municipal and Domestic Supply (MUN)

Waters shall not contain concentrations of chemical constituents in excess of the limits specified in California Code of Regulations, Title 22, Article 4, Chapter 15, Section 64435, Tables 2 and 3 as listed in Table 3-2 (Region 3 Basin Plan, p III-3). In Table 3-2, the maximum contaminant level (MCL) for Nitrate (as NO_3) in Domestic or Municipal Supply is 45 milligrams per liter (mg/L).

The MUN water quality objective of 45 mg/L nitrate as nitrate (NO_3 as NO_3) is equivalent to 10 mg/L nitrate as nitrogen (NO_3 as N).

2.3.2 Basin Plan Water Quality Objectives for Toxicity

All waters shall be maintained free of nitrate 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.

Survival of aquatic life in surface waters subjected to a waste discharge or other controllable water quality conditions, shall not be less than that for the same water body in areas unaffected by the waste discharge or, when necessary, for other control water that is consistent with the requirements for "experimental water" as described in Standard Methods for the Examination of Water and Wastewater, latest edition. As a minimum, compliance with this objective shall be evaluated with a 96-hour bioassay.

In addition, effluent limits based upon acute bioassays of effluents will be prescribed where appropriate, additional numerical receiving water objectives for specific toxicants will be established as sufficient data become available, and source control of toxic substances is encouraged.

2.3.3 OEHHA Public Health Goals for Drinking Water

The California Office of Environmental Health Hazard Assessment (OEHHA) developed Public Health Goals (PHGs) 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 the U.S. Environmental Protection Agency's (USEPA's) Maximum Contaminant Levels (MCLs) promulgated in 1991.

2.4 Pollutants Addressed

Arroyo Paredon was listed on the 2006 Clean Water Act Section 303(d) list for nitrate in accordance with the State Water Resources Control Board Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) list, September 2004 (SWRCB, Listing Policy, 2004b). Table 3.2 of the Listing Policy specifies the minimum number of measured exceedances needed to place a water segment on the section 303(d) list for conventional

pollutants (SWRCB, 2004, pg. 10). Based on results from CCAMP monitoring (site 315APC), Arroyo Paredon exceeded the nitrate Basin Plan water quality objective for the MUN beneficial use in 14 of 16 samples, which met the minimum number of measured exceedances needed to place Arroyo Paredon on the 303(d) list (see APPENDIX A – Water Quality Data).

2.5 Data Analysis

This section provides information pertaining to data sources and the results of water quality data used to assess water quality conditions and impairment. Water quality data is also contained in APPENDIX A – Water Quality Data.

Staff used the following data for the development of these TMDLs:

- Central Coast Ambient Monitoring Program (CCAMP) site 315APC.
- Cooperative Monitoring Program (CMP) site 315APF.

The two monitoring sites are depicted in Figure 3.

2.5.1 Central Coast Ambient Monitoring Program (CCAMP)

The Central Coast Ambient Monitoring Program (CCAMP) collected water samples from one site (315APC) in the Arroyo Paredon watershed. The CCAMP monitoring site 315APC is located on Arroyo Paredon Creek at Via Real Road in the lower portion of the watershed (see Figure 3). CCAMP collected 16 samples between January 1, 2001 and March 19, 2002 and 12 samples between January 28, 2008 and December 16, 2008 (Appendix A).

Figure 4 shows that fourteen of 16 samples in 2001/2002 exceeded the Municipal & Domestic Supply Objective for Nitrate (10 mg/L NO_3 as N). Similarly in 2008 (Figure 5), 11 of 12 samples exceeded the Municipal & Domestic Supply Objective for Nitrate. Appendix A contains a summary of nitrate and nitrite data and joint nitrate/nitrite concentrations (e.g., sum of nitrate plus nitrite).

It is important to note that nitrite generally comprises less than one-half of one percent of the joint nitrate/nitrite concentrations. As a result, staff has concluded that nitrate as nitrogen is comparable to joint nitrate/nitrite as nitrogen concentrations. It is also important to note that nitrite concentrations do not exceed the OEHHA public health goal of 1 mg/L nitrite as nitrogen.

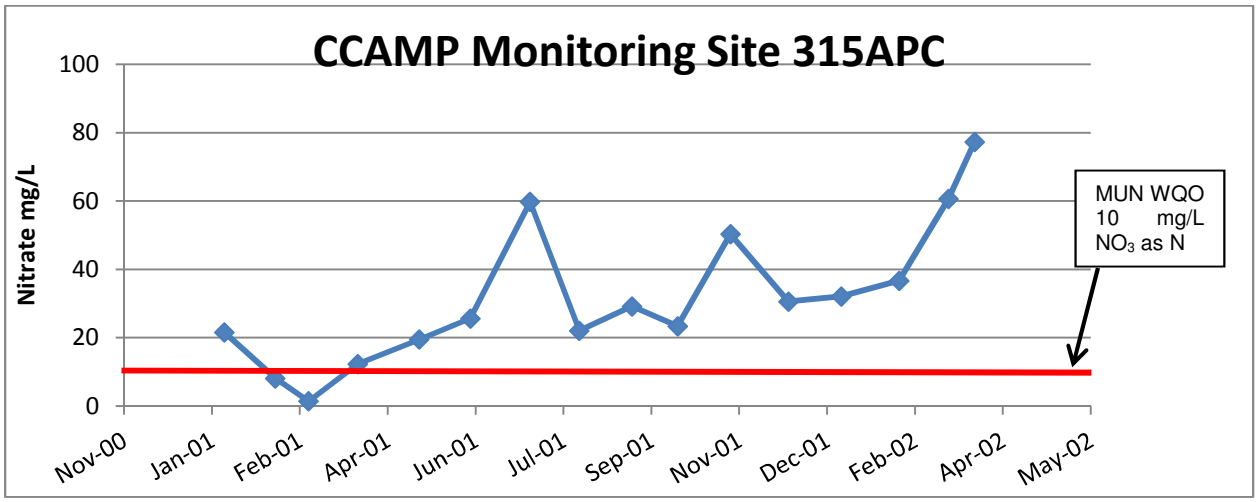

Figure 4. Nitrate as N (mg/L) for CCAMP Site 315APC (2001/2002)

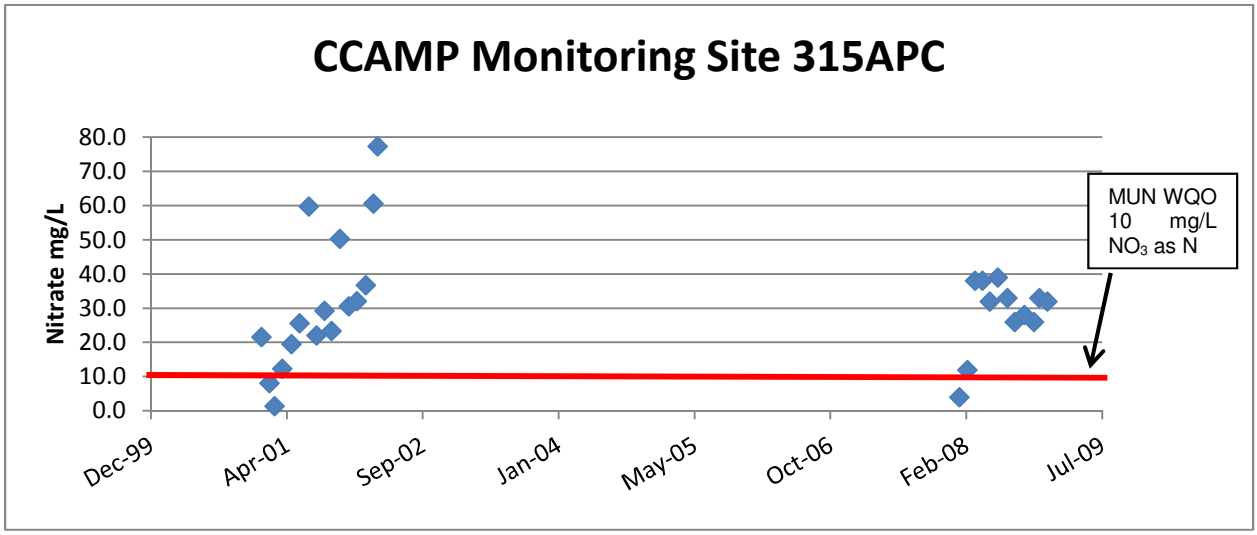

Figure 5. Nitrate as N (mg/L) for CCAMP Site 315APC (2001/2002 and 2008)

2.5.2 Central Coast Cooperative Monitoring Program (CMP)

The Central Coast Cooperative Monitoring Program (CMP) collected water quality samples from one site (315APF) in the Arroyo Paredon watershed. The CMP monitoring site 315APF is located on Arroyo Paredon Creek at Foothill Road in the middle portion of the watershed (see Figure 3). CMP collected 53 samples between January 25, 2006 and June 28, 2011 (Appendix A).

Zero of 53 (Figure 6) samples exceeded the Municipal & Domestic Supply Objective for Nitrate (10 mg/L NO_3 as N). This site is located upstream of a majority of the agriculture activity in the watershed.

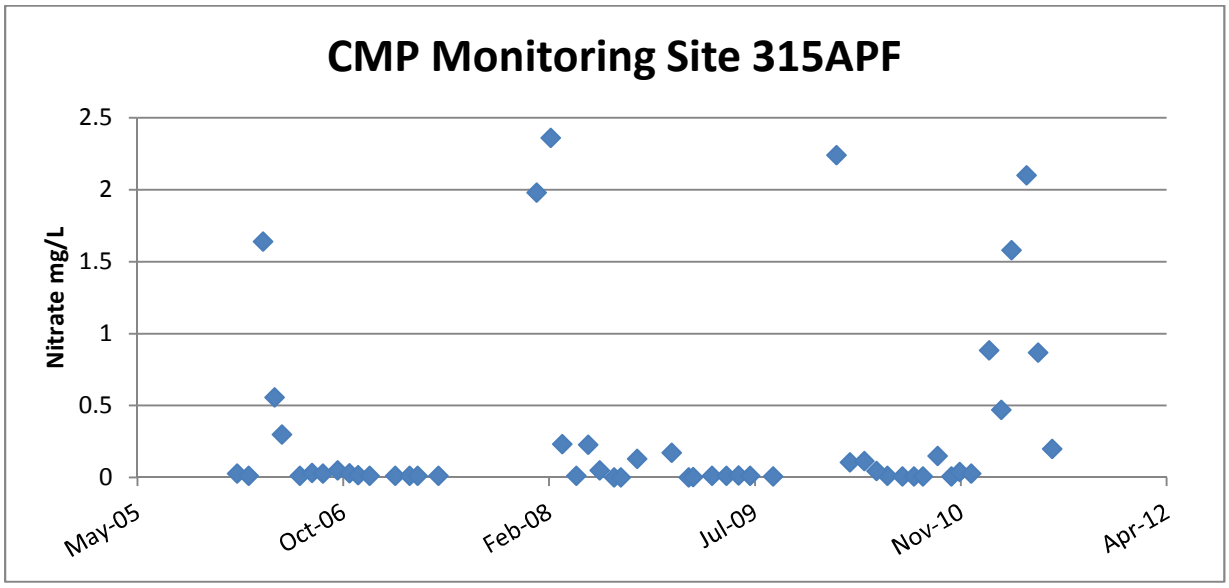

Figure 6. Nitrate as N (mg/L) for CMP Site 315APF (2006 through June 2011)

2.6 Problem Statement

The lower portion of the Arroyo Paredon is impaired due to exceedance of the MUN water quality objective for nitrate. This project identifies the causes of impairment and describes solutions to achieve water quality objectives and protection of beneficial uses.

3 NUMERIC TARGETS

This section describes the numeric targets used to develop the TMDL. Numeric targets are water quality targets developed to ascertain when and where water quality objectives are achieved and when beneficial uses are protected.

3.1 Water Column Numeric Targets

Staff selected water column numeric target values for nitrate as a direct measure of water quality conditions for the protection of municipal and domestic supply (MUN) beneficial use. 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:

- *Receiving water column nitrate must not exceed 10 mg/L-N.*

4 SOURCE ANALYSIS

4.1 Introduction: Source Assessment Using STEPL Model

Excessive levels of nitrogen may reach surface waters as a result of human activities (USEPA, 1999). In this TMDL project report, nutrient source loading estimates were accomplished using the US Environmental Protection Agency's STEPL model. STEPL (Spreadsheet Tool for

Estimating Pollutant Load) allows the calculation of nutrient loads from different land uses and source categories. STEPL provides a Visual Basic (VB) interface to create a customized, spreadsheet-based model in Microsoft (MS) Excel. STEPL calculates watershed surface runoff; nutrient loads, including nitrogen, phosphorus based on various land uses and watershed characteristics. For preliminary source assessment purposes, STEPL was used to estimate nutrient loads at the project area-scale. STEPL has been used previously in USEPA-approved TMDLs to estimate source loading[2].

For source assessment purposes, STEPL is used to estimate nutrient loads at the project area-scale. STEPL can also be used to allow for subwatershed-scale loading estimates. The annual nutrient loading estimate in STEPL is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution, precipitation data, soil characteristics, groundwater inputs, and management practices. Additional details on the model can be found at: http://it.tetratech-ffx.com/stepl/.

To estimate nitrate loads, STEPL requires area estimates for the following four land use classifications; urban, cropland, pastureland, and forest. Staff aggregated the FMMP land use/land cover classification to derive land use acreage required for STEPL as shown in Table 5.

Table 5. Aggregation of FMMP, 2008 land use/land cover classifications for STEPL

FMMP Name	Acres	STEPL Land Use Classification
Urban and Built-Up Land	110	Urban
Prime Farmland	107	Cropland
Farmland of Statewide Importance	32	Cropland
Unique Farmland	564	Cropland
Other Land (Forested, mined, government lands)	1978	Forest

Aggregated STEPL Land Use Classification	
STEPL Land Use Classification	**Acres**
Urban	110
Cropland	703
Pastureland	0
Forest	1978

STEPL input parameters used in this nitrate source assessment is shown in Table 6 and the spreadsheet results are presented in APPENDIX B – STEPL Spreadsheets. It should be emphasized that nutrient load estimates calculated by STEPL are 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.

[2] For example, see USEPA, 2010: Decision Document for Approval of White Oak Creek Watershed (Ohio) TMDL Report. February 25, 2010; and Indiana Dept. of Environmental Management, 2008. South Fork Wildcat Creek Watershed Pathogen, Sediment, and Nutrient TMDL.

Table 6. STEPL Input Data

Input Category	Input Data	Sources of Data
Mean Annual Rainfall	18.68 inches/year	Santa Maria WSO Airport as provided in STEPL
Mean Rain Days/Year	42.3 days/year	Santa Maria WSO Airport as provided in STEPL
Weather Station (for rain correction factors)	0.865 Mean Annual Rainfall- 0.418 Mean Rain Days/Yr	Santa Maria WSO Airport as provided in STEPL
Land Cover	FMMP (see Table 6)	Aggregated FMMP land use/ land cover as represented in Table 6
Urban Land Use Distributions (impervious surfaces categories)	STEPL default values	STEPL
Septic system discharge and failure rate data	84 Systems 2.43 persons/system 8% failure rate	Estimated 84 systems based on 2003 Sanitary Survey of Santa Barbara County. Population per system = 2.43 persons/system (National Average contained in STEPL). Failure rate of 8% systems cited in 2003 Sanitary Survey of Santa Barbara County.
Hydrologic Soil Group (HSG)	HSG "D"	HSG based on SSURGO soil data for TMDL project area
Soil N and P concentrations (%)	N = 0.10%	• N (%) – estimated national median value from information in GWLF User's Manual, v. 2.0 (Cornell University, 1992 - http://www.avgwlf.psu.edu/Downloads/GWLFManual.pdf).
NRCS reference runoff curve numbers	STEPL default values	NRCS default curve numbers provided in STEPL
Nutrient concentration in runoff (mg/L)	1.5 – 2.5 mg/L (urban) 13.8 mg/L (cropland) 0.2 mg/L (forest)	• Urban lands – Used STEPL default values that contain a range of N runoff concentrations based on specific urban land use type (e.g., commercial, industrial, residential. Transportation, etc.). • N Concentration data for farmland from Southern California Coastal Water Research Project, Technical Report 335 (Nov. 2000), Appendix C. • Forest N and P runoff concentration: used STEPL default values
Nutrient concentration in shallow groundwater (mg/L).	1.52 mg/L (ag and urban) 1.44 mg/L (grazing lands) 0.11 mg/L (forest)	• NO_3-N (ag and urban) – mean value for project area using USGS GWAVA model dataset. http://water.usgs.gov/GIS/metadata/usgswrd/XML/gwava-s_out.xml • NO_3-N (grazing Lands and forest N default values from STEPL

Staff ran the STEPL model for the Arroyo Paredon watershed; results are discussed below.

4.1.1 Urban Runoff

Urban runoff can be a contributor of nutrients to waterbodies. Within residential areas, potential controllable nutrient sources can include lawn care fertilizers, grass clippings, organic debris from gardens, other garden greenwaste, trash, and pet waste (Tetratech, 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 water bodies.

There is a wealth of data, both nationwide and from the central coast region, that characterizes nitrate-nitrogen concentrations in urban runoff (see Figures 7 and 8). These data (438 total samples) illustrate that nitrate concentrations in urban runoff virtually never exceed the 10 mg/L nitrate as nitrogen water quality objective protective of the MUN beneficial use. In fact, the

central coast-specific urban runoff data (Santa Cruz and Monterey County) shown in Figure 8 infrequently exceed nitrate-N concentrations of 2 mg/L.

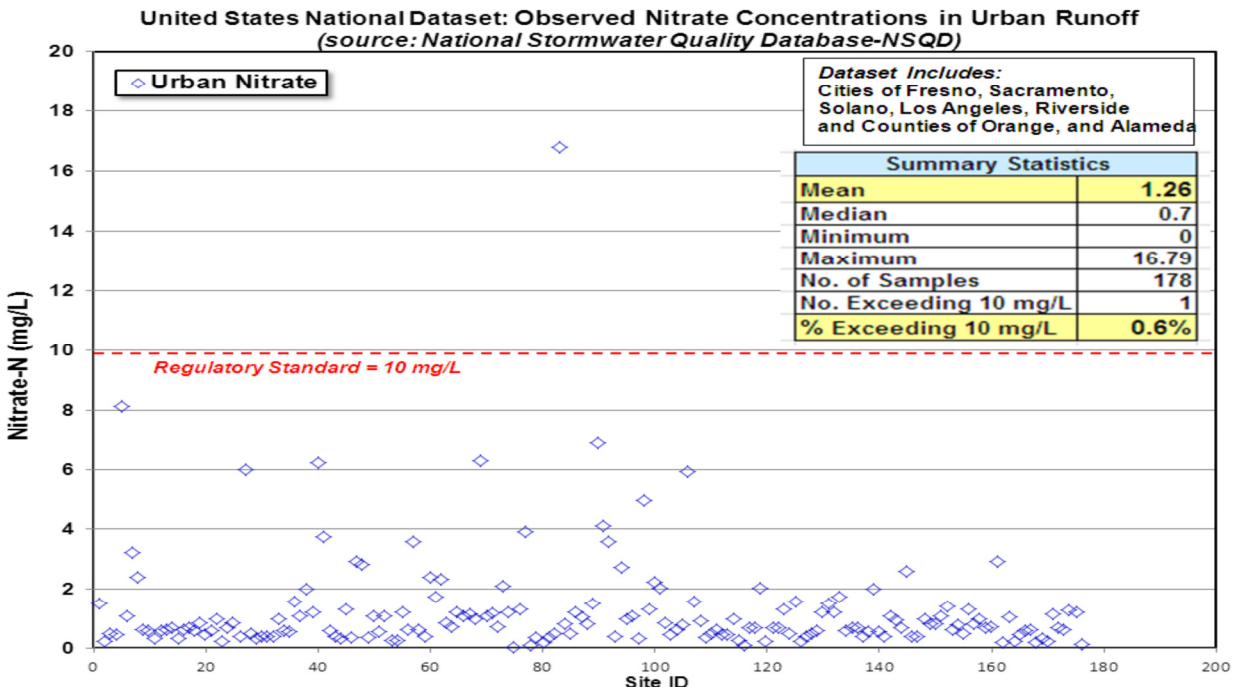

Figure 7. Nitrate concentration in urban runoff: national, California, and Central Coast Regional Data

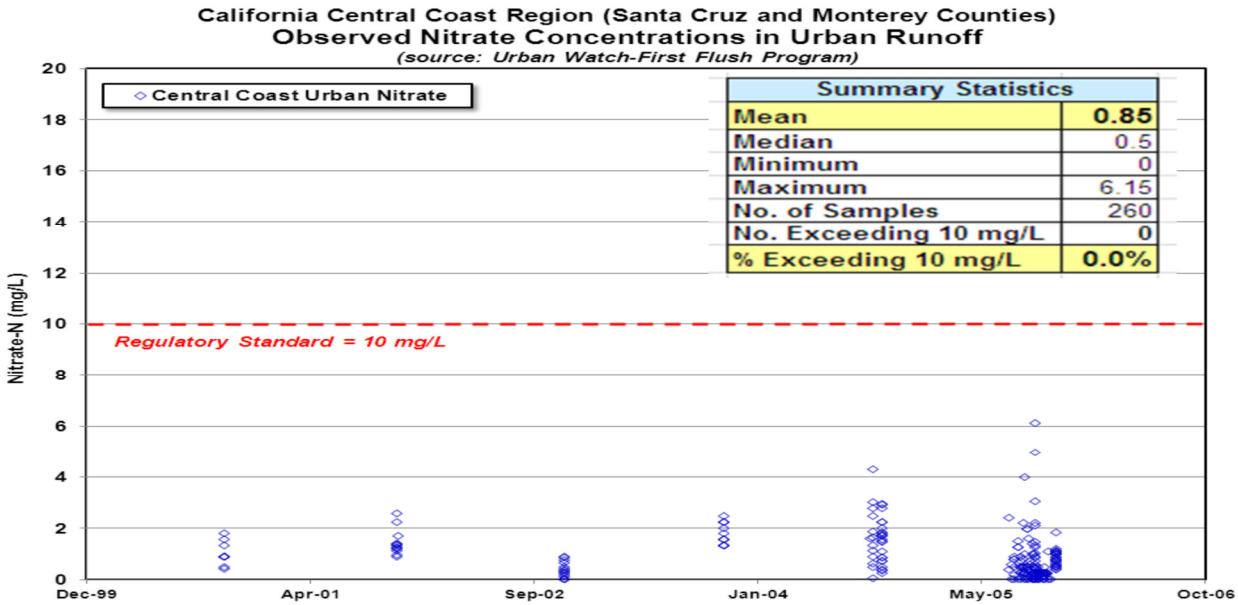

Figure 8. Nitrate concentration in urban runoff: Central Coast Regional Data

Less than five percent of the acreage in the Arroyo Paredon watershed is urbanized (3.9 percent). Using values generated by STEPL to conduct a load analysis, urban runoff

contributes approximately 1.26 percent of the load. Given the relatively low observed nitrate concentrations in urban runoff (typically ≤ 2mg/L), staff concludes that discharges of nitrate-nitrogen from urban lands to Arroyo Paredon are negligible and are not causing or contributing to impairment from nitrate-nitrogen.

States are to establish TMDLs at levels necessary to attain and retain numeric and narrative water quality standards.[3] As will be discussed in the following section, discharges from agricultural lands are the single source causing impairment of water quality standards for protection of the MUN beneficial use. Therefore, wasteload allocations for urban stormwater are not needed to retain and maintain water quality standards addressed in this TMDL.

Using the parameter inputs identified in Section 4.1 the estimated annual nutrient load from urban runoff in the project area as calculated by STEPL is shown in Table 7.

Table 7. Urban Annual Load (lb/year)

Source	N Load (lb/yr)
Urban	373

As stated above, staff concludes that discharges of nitrate-nitrogen from urban lands to Arroyo Paredon are negligible and are not causing or contributing to impairment from nitrate-nitrogen.

Staff considers impairments to water quality when implementing permits, including stormwater permits. If a discharger is assigned a wasteload allocation in a TMDL, that wasteload allocation is implemented through an NPDES permit. If, however, staff concludes that a point discharger is not causing or contributing to the impairment, and therefore not assigned a wasteload allocation, staff implements existing regulation to ensure that current loading is maintained. For example, staff ensures that best management practices are implemented to maintain current loading.

Therefore, although urban runoff is not contributing to the impairment for nitrate in the Arroyo Paredon and dischargers will not be assigned a wasteload allocation, staff will take the steps necessary to ensure that current nitrate loading is maintained and that urban stormwater is not causing impairment.

4.1.2 Agricultural Sources

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 or forage areas 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 (Tetratech, 2004).

Figure 9 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

[3] 40CFR130.7(c)(1)

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.

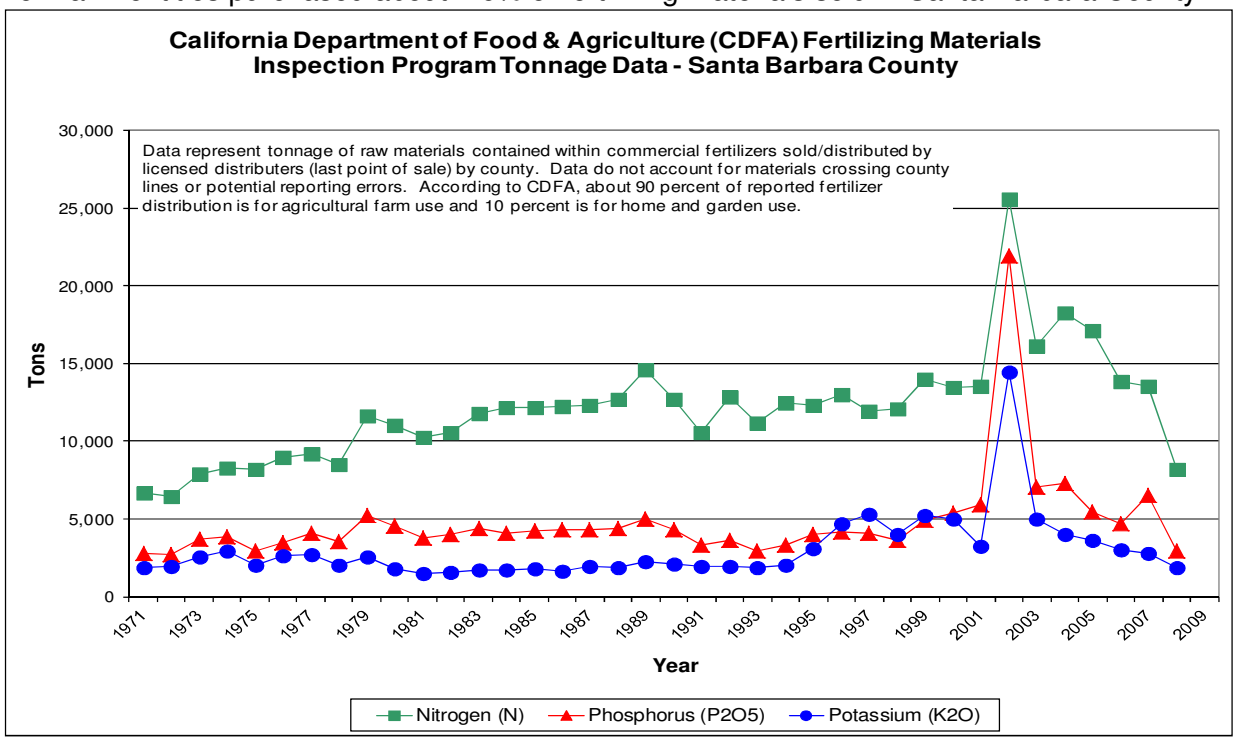

Figure 9. Fertilizer Sales in Santa Barbara County

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.

Table 8. 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

Crop	Application Rate per Crop Year in California (pounds per acre)			Source
	Nitrogen	Phosphate	Potash	
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

Based on staff observations in the project area, cropland in the Arroyo Paredon watershed is comprised of orchards (avocado, apple, and lemon) in the upper and middle parts of the watershed, with the lower part of the watershed dominated by greenhouse operations (flowers) and some row crops.

The estimated annual nutrient load from cropland in the project area as calculated by STEPL is shown in Table 9.

Table 9. Cropland Annual Load (lb/year)

Source	N Load (lb/yr)
Cropland	26,674[4]

4.1.3 Forest and Undeveloped Lands

The estimated annual nutrient load from forest in the project area as calculated by STEPL is shown in Table 10. Note that the load from these lands represents loading from natural sources of nitrate.

Table 10. Forest Annual Load (lb/year)

Source	N Load (lb/yr)
Forest	1014

4.1.4 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 11. Staff used the Septic System Sanitary Survey for Santa Barbara County California (March 2003) that identified approximately 84 OSDS within the Arroyo Paredon watershed. Based on this information, staff has concluded that OSDS discharges to surface waters within the project area are not significant and not causing or contributing to surface water impairment for nitrate. 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 limited as compared to agricultural fertilizer impacts (University of California-Davis, 2012).

[4] This allots 25 percent efficiency for greenhouses that have impervious floors.

The estimated annual nitrate load from OSDS in the project area as calculated by STEPL is shown in Table 11.

Table 11. OSDS Annual Load (lb/year)

Source	N Load (lb/yr)
Septic	209

4.1.5 Groundwater

Shallow groundwater provides the base flows to streams and can be a major source of surface water flows during the summer season. Therefore, dissolved nutrients in groundwater can be important nitrate source during dry periods. Ground water contamination from nitrate can occur from various sources, including septic systems, fertilizer application, animal waste, waste-lagoon sludge, and soil mineralization (USEPA, 1999).

The estimated annual nitrate load from groundwater in the project area as calculated by STEPL is shown in Table 12.

Table 12. Groundwater Annual Load (lb/year)

Source	N Load (lb/yr)
Groundwater	1416

4.2 Summary of Sources

It is worth reiterating that these 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 13 and Figure 10 summarize estimated loads of nitrate based on information provided in Section 4.1.

Table 13. Summary of Estimated Loads

Sources	N Load (lb/yr)	Percent of Load
Urban	373	1.26
Cropland	26,674[5]	89.85
Forest	1014	3.42
Septic	209	0.70
Groundwater	1,416	4.77
Total	**29,686**	**100**

[5] This allots 25 percent efficiency for greenhouses that have impervious floors.

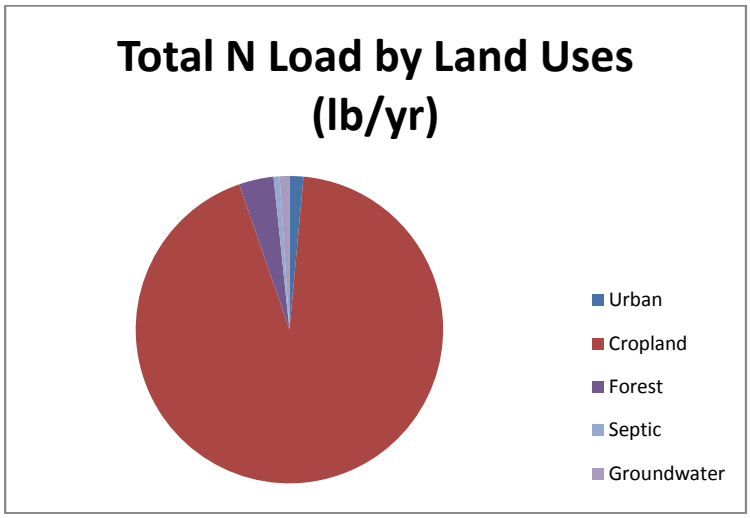

Figure 10. Summary of Estimated Nitrate Loads

4.3 Conclusions from Source Analysis

Staff concludes that discharges of nitrate from agricultural lands are the sole source of nitrate causing impairment for nitrate.

5 LOADING CAPACITY AND ALLOCATIONS

5.1 Introduction

TMDLs are "[t]he sum of the individual waste load allocations for point sources and load allocations for nonpoint sources and natural background. TMDLs can be expressed in terms of either mass per time, toxicity, or other appropriate measure" in accordance with Code of Federal Regulations, Title 40, §130.2[i].

Staff proposes the establishment of concentration-based TMDLs in accordance with this provision of the Clean Water Act.

5.2 Loading Capacity (TMDL)

The TMDLs are set equal to the loading capacity. The loading capacity for the Arroyo Paredon Creek watershed is the amount of nitrate that can be assimilated without exceeding the water quality objectives. The allowable nitrate water column concentration that will achieve the water quality objectives for the municipal and domestic supply (MUN) beneficial use is equal to the numeric target.

The loading capacity, or Total Maximum Daily Load, for nitrate is a receiving water column concentration-based Total Maximum Daily Load and is applicable to each day of all seasons as indicated in Table 14.

Table 14. Concentration-based TMDL for Nitrate

Impaired Waterbody Assigned TMDL	TMDL
	Nitrate as Nitrogen
Arroyo Paredon Creek (including all tributaries)	10 mg/L

5.3 Linkage Analysis

The goal of the linkage analysis is to establish a link between pollutant loads and desired water quality. This ensures that the loading capacity specified in the TMDLs will result in attaining the desired water quality. For these TMDLs, this link is established because the load allocations are equal to the numeric targets, which are the same as the TMDLs. Therefore, reductions in nitrate loading will result in achieving the water quality standards.

5.4 Load Allocations

Table 15 shows load allocations[6] assigned to responsible parties. The allocations are equal to the TMDLs. The allocations are receiving water allocations.

Table 15. Load allocations for Arroyo Paredon Watershed

LOAD ALLOCATIONS	
Responsible Party Assigned Allocation (Source)	**Receiving Water Allocation**
Owners/operators of irrigated agricultural lands in the Arroyo Paredon Creek Watershed (Discharges from irrigated lands)	10 mg/L Nitrate as Nitrogen
Natural Sources	10 mg/L Nitrate as Nitrogen

5.5 Margin of Safety

This TMDL incorporates an implicit margin of safety. The water column nitrate numeric target is derived from promulgated USEPA MCLs and OEHHA PHGs protocols. Therefore the loading capacity has the same conservative assumptions used in these procedures.

5.6 Critical Conditions, Seasonal Variation

A critical condition is the combination of environmental factors resulting in the water quality standard being achieved by a narrow margin, i.e., that a slight change in one of the environmental factors could result in exceedance of the water quality standard. Such a phenomenon could be significant if the TMDL were expressed in terms of load, and the allowed load was determined on achieving the water quality standard by a narrow margin. However,

[6] There are no Wasteload Allocations for the Arroyo Paredon Watershed

this TMDL is expressed as a concentration, which is equal to the desired water quality condition. Consequently, there are no critical conditions and the TMDL is applicable during all seasons.

6 IMPLEMENTATION AND MONITORING

6.1 Introduction

This TMDL is being implemented by the Conditional Waiver of Waste Discharge Requirements for Discharges from Irrigated Lands (Agricultural Order[7]); this includes the order currently in effect and renewals or modifications thereof. Central Coast Water Board staff will conduct a review of implementation activities when monitoring and reporting data is submitted as required by the Agricultural Order. Central Coast Water Board staff will pursue modification of Agricultural Order conditions or other regulatory means (e.g. waste discharge requirements), as necessary, to address remaining impairments during the TMDL implementation phase.

Note that the current Agricultural Order requires dischargers to comply with applicable TMDLs. If the Agricultural Order did not provide the necessary requirements to implement this TMDL, staff would propose modifications of the Agricultural Order in order to achieve this TMDL. Staff has concluded that the current Agricultural Order provides the requirements necessary to implement this TMDL. Therefore, no new requirements are proposed as part of this TMDL.

Note that the Agricultural Order states that compliance is determined by: a) management practice implementation and effectiveness, b) treatment or control measures, c) individual discharge monitoring results, d) receiving water monitoring results, and e) related reporting. The Agricultural Order also requires that dischargers comply by implementing and improving management practices and complying with the other conditions, including monitoring and reporting requirements, which is consistent with the Nonpoint Source Pollution Control Program (NPS Policy, 2004). Finally, the Agricultural Order states that dischargers shall implement management practices, as necessary, to improve and protect water quality and to achieve compliance with applicable water quality objectives. Therefore, compliance with this TMDL is demonstrated through compliance with the Agricultural Order, which provides several avenues for demonstrating compliance, including management practices that improve water quality that lead to ultimate achievement of water quality objectives.

[7] Note: Agriculture Order does not waive Waste Discharge Requirements (WDRs) for commercial nurseries, nursery stock. The Order regulates (1) discharges of waste from irrigated lands, including, but not limited to, land planted to row, vineyard, field and tree crops where water is applied for producing commercial crops; (2) discharges of waste from commercial nurseries, nursery stock production, and greenhouse operations with soil floors that do not have point-source type discharges and are not currently operating under individual WDRs; and (3) discharges of waste from lands that are planted to commercial crops that are not yet marketable, such as vineyards and tree crops (Order Finding 22).

The Agriculture Order does not waive WDRs for commercial nurseries, nursery stock production and greenhouse operations that have point-source type discharges, and fully contained greenhouse operations (those that have no groundwater discharge due to impervious floors). These operations must eliminate all such discharges of wastes or submit a Report of Waste Discharge to apply for individual WDRs as set forth in Water Code section 13260 (Order Finding 31).

The Agricultural Order should prioritize implementation and monitoring efforts in stream reaches or 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 human health in receiving waters
3) Crops that are grown that require high fertilizer inputs (see for example Table 8);
4) Other information such as proximity to water body; soils/runoff potential; irrigation and drainage practices, or relevant information provided by stakeholders, resource professionals, and/or researchers indicate a higher risk of nitrate impacts to receiving waters.

The implementation strategies and monitoring and reporting requirements strategies below are actions recommended to achieve and demonstrate progress toward achieving the TMDL. The strategies identified below are not additional requirements above and beyond those described in the Agricultural Order and are not intended to be an exhaustive list of actions necessary to achieve the TMDL; the implementation and monitoring requirements described in the Agricultural Order are sufficient to achieve and demonstrate progress.

The parties with allocations for this TMDL include any agricultural operation that uses nitrate on their crops. Please see section 6.5, Timelines and Milestones for the timeline and milestones associated with complying with this TMDL.

6.2 Implementation Requirements for Dischargers from Irrigated Agricultural Lands

Implementing parties must comply with the Conditional Waiver of Waste Discharge Requirements for Irrigated Lands (Order R3-2012-0011) and the Monitoring and Reporting Programs in accordance with Orders R3-2012-0011-01, R3-2012-0011-02, and R3-2012-0011-03., or its renewals or replacements to meet load allocations and achieve the TMDL. The requirements in these orders, and their renewals or replacements in the future, will implement the TMDLs and rectify the impairments addressed in this TMDL.

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 and update and implement Farm Plans. The Farm Plans should incorporate measures designed to achieve load allocations assigned in this TMDL.
d. Implement monitoring and reporting requirements described in the Agricultural Order.

6.3 Monitoring and Reporting Requirements

Owners and operators of irrigated agricultural lands must perform monitoring and reporting in accordance with Monitoring and Reporting Program Orders R3-2012-0011-01, R3-2012-0011-02, and R3-2012-0011-03, as applicable to the operation.

Table 16. Recommended Receiving Water Monitoring Sites

Impaired Waterbody	Recommended Monitoring Sites
Arroyo Paredon	315APC (CCAMP coastal confluences site) 315APF (CMP agriculture monitoring site)

CCAMP is currently scheduled to conduct rotational sampling in the Arroyo Paredon Watershed in 2014. The CMP samples annually.

6.4 Determination of Compliance with Load Allocations

Demonstration of compliance with the load allocations is consistent with compliance with the Agricultural Order. Load allocations will be achieved through a combination of implementation of management practices and strategies to reduce nitrate loading and water quality monitoring. Flexibility to allow owners and operators from irrigated lands to demonstrate compliance with load allocations is a consideration; additionally, staff is aware that not all implementing parties are necessarily contributing to or causing surface water impairments. However, it is also important to recognize that impacting shallow groundwater with nutrient pollution may also impact surface water quality via baseflow loading contributions to the creek.

To allow for flexibility, Central Coast Water Board staff will assess compliance with load allocations using one or a combination of the following:

A. Attaining the load allocations in receiving waters.
B. Demonstrating quantifiable receiving water mass load reductions;
C. Implementing management practices that are capable of achieving load allocations identified in this TMDL;
D. Providing sufficient evidence to demonstrate that they are and will continue to be in compliance with the load allocations; such evidence could include documentation submitted by the owner or operator to the Executive Officer that the owner or operator is not causing waste to be discharged to impaired waterbodies resulting or contributing to violations of the load allocations.

6.5 Timeline and Milestones

The discharge of nitrate at toxic levels is a serious water quality problem. As such, implementation should occur at an accelerated pace to achieve the allocations and TMDL in the shortest time-frame feasible.

The target date to achieve the allocations, numeric targets, and TMDL in the impaired waterbodies addressed in this TMDL is October 1, 2016. This date coincides with the time schedule of milestones described in Table 4 of the Agricultural Order. Additionally, staff concludes that the TMDL is achievable by this date because the results of best management practices will be realized quickly. Best management practices will benefit water quality quickly because groundwater is not significantly contributing to surface water nitrate loading (4.77 percent of the total load). Also, available information suggests that a relatively low number of agricultural operations are contributing to the impairment.

Water Board staff will reevaluate impairments caused by nitrate when monitoring data is submitted and during renewals of the Agricultural Order. Water Board staff will modify the conditions of the Agricultural Order, if necessary, to address remaining impairments.

6.6 Cost Estimate

Existing regulatory requirements are sufficient to attain water quality standards for nitrate in the project area. The Regional Board is not approving any new activity, but merely finding that ongoing activities and regulatory requirements are sufficient. Therefore, this TMDL is not a "project" that requires compliance with the California Environmental Quality Act (California Public Resources Code § 21000 et seq.) and the Central Coast Water Board is not directly undertaking an activity, funding an activity or issuing a permit or other entitlement for use by this action (Public Resources Code § 21065; 14 Cal. Code of Regs. §15378).

6.7 Existing Implementation Efforts

Many growers in the Arroyo Paredon Creek watershed are enrolled in the Agricultural Order. Therefore, these growers are implementing management practices aimed at addressing impaired waters. At the time of this document preparation, some growers were not yet enrolled in the Agricultural Order. Staff has ongoing efforts to enroll these growers in the Order.

7 PUBLIC PARTICIPATION

Staff conducted stakeholder outreach efforts during TMDL development. Staff conducted a public workshop in Carpinteria in September 2013, and staff engaged with stakeholders during the development of the TMDL.

The Staff Report, Resolution, and technical project reports were made available for a 30-day public comment commencing on October 1, 2013. Water Board staff solicited public comment from a wide range of stakeholders including owners/operators of agricultural operations, agricultural representatives, environmental representatives, public agencies and City and County Storm Water Program representatives.

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9 APPENDIX A - WATER QUALITY DATA

CCAMP Data – Nitrate/Nitrite as N for Site 315APC

Site Tag	Sample Date	Nitrate as N, mg/L	Nitrite as N (mg/L)	Nitrate, Nitrite as N, mg/L	Average Nitrate as N, mg/L
315APC	1/16/2001	21.6	0.066	21.7	25
315APC	2/14/2001	8.1	0.0198	8.2	
315APC	3/5/2001	1.4	0.0276	1.4	
315APC	4/2/2001	12.3	0.036	12.4	
315APC	5/7/2001	19.5	0.099	19.6	
315APC	6/5/2001	25.6	0.102	25.7	
315APC	7/9/2001	59.8	0.219	60.0	
315APC	8/6/2001	22.1	0.153	22.2	
315APC	9/5/2001	29.2	0.0198	29.2	
315APC	10/1/2001	23.4	0.066	23.4	
315APC	10/31/2001	50.3	0.18	50.5	
315APC	12/3/2001	30.6	0.061	30.7	
315APC	1/2/2002	32.1	0.048	32.1	52
315APC	2/4/2002	36.7	0.042	36.7	
315APC	3/4/2002	60.6	0.17	60.8	
315APC	3/19/2002	77.3	0.16	77.5	
315APC	1/28/2008	4.0	0.017	4.0	28
315APC	2/26/2008	12.0	0.13	12.1	
315APC	3/25/2008	38.0	0.39	38.4	
315APC	4/22/2008	38.0	0.26	38.3	
315APC	5/19/2008	32.0	0.22	32.2	
315APC	6/17/2008	39.0	0.24	39.2	
315APC	7/22/2008	33.0	0.16	33.2	
315APC	8/19/2008	26.0	0.049	26.0	
315APC	9/23/2008	28.0	0.11	28.1	
315APC	10/28/2008	26.0	0.044	26.0	
315APC	11/17/2008	33.0	0.086	33.1	
315APC	12/16/2008	32.0	0.17	32.2	

CMP Data – Nitrate/Nitrite as N for Site

Site Tag	Sample Date	Nitrate, Nitrite as N, mg/L	Average Nitrate, Nitrite as N, mg/L
315APF	1/25/2006	0.029	0.23
315APF	2/22/2006	0.014	
315APF	3/29/2006	1.64	
315APF	4/26/2006	0.558	
315APF	5/14/2006	0.3	
315APF	6/27/2006	0.014	
315APF	7/26/2006	0.034	
315APF	8/22/2006	0.028	
315APF	9/26/2006	0.051	
315APF	10/25/2006	0.032	
315APF	11/15/2006	0.018	
315APF	12/13/2006	0.014	
315APF	2/13/2007	0.014	0.014
315APF	3/20/2007	0.014	
315APF	4/9/2007	0.014	
315APF	5/29/2007	0.014	
315APF	1/23/2008	1.98	0.52
315APF	2/26/2008	2.36	
315APF	3/25/2008	0.233	
315APF	4/28/2008	0.014	
315APF	5/27/2008	0.228	
315APF	6/24/2008	0.052	
315APF	7/29/2008	0.0024	
315APF	8/14/2008	0.0024	
315APF	9/23/2008	0.132	
315APF	12/16/2008	0.174	
315APF	1/26/2009	0.0024	0.011
315APF	2/6/2009	0.005	
315APF	3/24/2009	0.014	
315APF	4/28/2009	0.014	
315APF	5/27/2009	0.016	
315APF	6/24/2009	0.014	
315APF	10/28/2009	0.259	
315APF	11/8/2009	0.095	
315APF	12/7/2009	0.451	
315APF	1/20/2010	2.24	0.23
315APF	2/22/2010	0.107	
315APF	3/29/2010	0.115	
315APF	5/24/2010	0.014	
315APF	4/27/2010	0.047	
315APF	6/29/2010	0.0091	
315APF	7/27/2010	0.0091	
315APF	8/18/2010	0.0091	
315APF	9/23/2010	0.15	
315APF	10/26/2010	0.0091	
315APF	11/15/2010	0.039	
315APF	12/13/2010	0.029	
315APF	1/26/2011	0.885	1.02
315APF	2/24/2011	0.472	
315APF	3/21/2011	1.58	
315APF	4/27/2011	2.1	
315APF	5/25/2011	0.87	
315APF	6/28/2011	0.2	

10 APPENDIX B - STEPL SPREADSHEETS

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom. You entered 1 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to change.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Table 4.

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2; (c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in row 10 to display optional input tables.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table 6; (c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6**: View the estimates of loads and load reductions in Total Load and Graphs sheets.

Show optional input tables? Yes No ☑ **Treat all the subwatersheds as parts of a single watershed** ☑ **Groundwater load calculation**

State	County	Weather Station (for rain correction factors)
California	Santa Barbara	CA SANTA MARIA WSO ARPT

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

									Rain correction factors		
									0.865	0.418	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1	109.7	703.4	0	1977.5	0	0	0-24%	2790.6	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	84	2.43	8	0	0

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

Watershed	Cropland					Pastureland					Forest				
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P
W1	62.886	0.269	9.274	0.200	0.998	62.886	0.269	9.274	0.040	1.000	62.886	0.269	9.274	0.003	1.000

Optional Data Input:

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					B	0.080	0.031	0.160

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	50	70	80	85

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
Transportatior	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	**13.81**	**0.3**	**4**
1a. w/ manure	8.1	2	12.3
2. M-Croplan	**13.81**	**0.4**	**6.1**
2a. w/ manure	12.2	3	18.5
3. H-Croplan	**13.81**	**0.5**	**9.2**
3a. w/ manure	18.3	4	24.6
4. Pasturelan	**4**	**0.3**	**13**
5. Forest	**0.2**	**0.1**	**0.5**
6. User Defin	**0**	**0**	**0**

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

Landuse	N	P	BOD
Urban	1.5	0.063	0
Cropland	1.44	0.063	0
Pastureland	1.44	0.063	0
Forest	0.11	0.009	0
Feedlot	6	0.07	0
User-Defined	0	0	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	109.7	15	10	10	10	10	30	5	5	5	100

9. Input irrigation area (ac) and irrigation amount (in)

Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before BMP	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	703.4	0	0	0	0

Input Ends Here.

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	28289.0	6635.0	37463.1	4956.9	2561.1	0.0	0.0	0.0	25727.9	6635.0	37463.1	4956.9	9.1	0.0	0.0	0.0
Total	28289.0	6635.0	37463.1	4956.9	2561.1	0.0	0.0	0.0	25727.9	6635.0	37463.1	4956.9	9.1	0.0	0.0	0.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	373.00	57.45	1444.16	8.56
Cropland	22876.09	6071.80	33352.98	4747.78
Pastureland	0.00	0.00	0.00	0.00
Forest	853.53	352.95	1812.89	200.58
Feedlots	0.00	0.00	0.00	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	208.91	81.82	853.06	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	1416.41	70.94	0.00	0.00
Total	25727.94	6634.97	37463.09	4956.92