California Regional Water Quality Control Board
Central Coast Region

CEQA Scoping Meeting – Summary Document

for

Development of a Basin Plan Amendment to the *Water Quality Control Plan for the Central Coastal Basin* To Incorporate Total Maximum Daily Loads (TMDLs) for Nutrients and Biostimulatory Substances in Streams of the Pajaro River Basin

PREFACE

This document provides background information to facilitate CEQA scoping for this TMDL project

California Environmental Quality Act (CEQA) Scoping Purpose

California Code of Regulations, title 23, section 377.5, subdivision (b) codifies the purpose of a CEQA scoping meeting. This type of early public involvement is helpful to the Water Board in identifying the range of actions, alternatives, mitigation measures, means of compliance and their impacts, and significant environmental effects staff will consider as part of the development of the proposed basin plan amendment. Scoping is an effective way to bring together and resolve the concerns of affected federal, State, and local agencies, the proponent of the actions, and other interested persons. Interested persons are specifically requested to provide information about:

- How they or responsible parties would foreseeably comply with the TMDL;
- The reasonably foreseeable significant environmental impacts associated with those means of compliance;
- Specific evidence supporting that such impacts are reasonably foreseeable, and describing the magnitude (how significant) of the impacts;
- Reasonable alternative means of compliance that would have less significant adverse environmental impacts;
- Reasonable mitigation measures that would minimize any unavoidable significant adverse environmental impacts associated with the means of compliance

This document provides background information on nutrient pollution of surface waters of the Pajaro River Basin, and outlines the anticipated actions the Central Coast Water Board may take to implement TMDLs intended to address polluted surface waters identified on the federal Clean Water Act section 303(d) list. Further, to facilitate discussion for this CEQA scoping meeting, this document provides tabulations of possible, or anticipated, management measures that could be implemented to comply with anticipated Water Board actions associated with an approved TMDL.

What is a Total Maximum Daily Load (TMDL)?

TMDLs are strategies or plans to address impaired waters identified on the federal Clean Water Act section 303(d) list. The 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 California 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

"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 project identifies the probable sources of pollution, establishes the maximum amount of pollution a waterbody can receive and still meet water quality standards, and establishes a plan to rectify the water quality impairments.

Why is a Basin Plan Amendment Required?

The Water Quality Control Plan for the Central Coastal Basin (Basin Plan) is a water quality control plan that establishes water quality standards and implementation policies for the Central Coast Region. Like most things in the Basin Plan, the water quality standards and regulatory thresholds therein do not self-implement. TMDLs are programs or plans to identify watershed pollutant sources and implement existing water quality standards established in the Basin Plan for waterbodies which are identified for impairments on the federal Clean Water Act Section 303(d) list.

TMDLs are often – but not universally – adopted through basin plan amendments. The State Water Resources Control Board's *Water Quality Control Policy for Addressing Impaired Waters: Regulatory Structure and Options* (State Water Board Resolution 2005-0050), hereafter referred to as the *Impaired Waters Policy,* provides policy and procedures for adopting TMDLs and addressing impaired waters in California. The *Impaired Waters Policy* states that the Regional Water Quality Control Boards have independent discretion, broad flexibility, numerous options, and some legal constraints that apply when determining how to address impaired waters. However, when the solution to a water quality impairment would require multiple actions of regional water boards – for example, actions that affect multiple regulatory measures, regulatory permits, or regulated entities – the regional boards must adopt the TMDL through a basin plan amendment.

TMDLs are generally not self-implementing, and thus TMDL implementation is achieved through compliance with existing, new, or planned regulatory measures. As such, TMDLs are not directly enforceable against dischargers and do not create new enforcement authorities apart from the existing water quality standards they implement. Regulatory tools implementing a TMDL are vehicles for enforcement – the TMDL is not. While TMDLs adopted with basin plan amendments become formal implementation policy for the regional boards, the regional board in fact implements TMDLs through existing or new regulatory measures such as permits, orders, and prohibitions.

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1 INTRODUCTION

This TMDL project is anticipated to result in a basin plan amendment to the Water Quality Control Plan for the Central Coast Basin[1]. The potential basin plan amendment would add total maximum daily loads for nutrients (nitrogen compounds and phosphorus) in streams of the Pajaro River Basin, and an implementation strategy to attain nutrient water quality standards in surface waters thereby rectifying the Clean Water Act section 303(d)-listed nutrient impairments of these streams.

1.1 POLLUTANTS ADDRESSED AND THEIR ENVIRONMENTAL IMPACTS

The pollutants addressed in this TMDL are nitrate, un-ionized ammonia, low dissolved oxygen, and chlorophyll *a*. In addition, to protect waters from biostimulatory substances, orthophosphate is included as a pollutant. Nitrate and un-ionized ammonia pollution of both surface waters and groundwater has long been recognized as a problem locally in the Pajaro River Basin. Elevated levels of nitrate or un-ionized ammonia can degrade municipal and domestic water supply, groundwater, and also can impair freshwater aquatic habitat. Some surface waterbodies in the Pajaro River Basin routinely exceed the water quality objective for nitrate in drinking water and may therefore degrade designated drinking water supplies (MUN) and impair designated groundwater recharge (GWR) beneficial uses[2].

Regarding nitrate-related health concerns, it has been well-established that infants below six months who are fed formula made with water containing nitrate in excess of the U.S. Environmental Protection Agency's safe drinking water standard (i.e., 10 milligrams of nitrate-N 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] The well-established linkage between nitrate and methemoglobinemia alone should be sufficient to warrant TMDL development. 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 addressed in this TMDL which is associated with nutrients is biostimulation. Biostimulation can result in eutrophication of the waterbody. While nutrients - specifically nitrogen and phosphorus – are essential for plant growth, and are ubiquitous in the environment, they are considered pollutants when they occur at levels which have adverse impacts on water quality; for example when they cause toxicity or eutrophication. Eutrophication is the excessive and undesirable growth of algae and aquatic plants that may be caused by excessive levels of nutrients. Eutrophication effects typically occur at somewhat lower nutrient concentrations than toxic effects. Either of these modes of water quality impairment can affect the entire aquatic food web, from algae and other

[1] Water Quality Control Plan for the Central Coastal Basin, online linkage: http://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/docs/basin_plan_2011.pdf

[2] "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.

[3] U.S. Environmental Protection Agency: http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm

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

microscopic organisms, through benthic macroinvertebrates (principally aquatic insect larvae), through fish, to the mammals and birds at the top of the food web. Additionally, several stream reaches in the project area are impaired by elevated levels of unionized ammonia in the water column. Unionized ammonia (a nitrogen compound) is highly toxic to aquatic species. Reducing the amount of nutrients that enters a water body will help to preserve and maintain the aquatic beneficial uses.

In addition to detrimental 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 (HABs) reported in the United States and worldwide is due to one group of algae, cyanobacteria (CyanoHABs, or 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[5]. 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, algal toxins have been implicated in the deaths of central California southern sea otters according to recent findings (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.

The U.S. Environmental Protection Agency (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[6]. Over half of the nation's streams, including most steams in the lower Salinas Valley, have medium to high levels of nitrogen and phosphorus. According to USEPA, nitrate drinking water standard violations have doubled nationwide in eight years, and it has been widely demonstrated that drinking water supplies in the Salinas Valley have been substantially impacted by nitrate. Algal blooms, resulting from the biostimulatory effects of nutrients, are steadily on the rise nationwide; related toxins have potentially serious health and ecological effects. Biostimulation of surface waters in the lower Salinas Valley are documented in this report; these water quality impairments are also having significant adverse downstream impacts to the ecologically sensitive Elkhorn Slough estuary as demonstrated by estuarine researchers and the peer-reviewed scientific literature.

It is important to recognize that documenting high nitrogen and phosphorus concentrations is not sufficient in and of itself to demonstrate a risk of eutrophication. Research has demonstrated the shortcomings of using ambient nutrient concentrations within a waterbody alone to predict eutrophication, particularly in streams (TetraTech, 2006). TetraTech (2006) notes that except in extreme cases, nutrients alone do not impair beneficial uses. Rather, they cause indirect impacts through algal growth, low dissolved oxygen, etc., that impair uses. These impacts are associated with nutrients, but result from a combination of nutrients interacting with other physical and biological factors. Other factors that can combine with nutrient enrichment to contribute to biostimulatory effects include light availability (shading and tree canopy), stream hydraulics, geomorphology, geology, and other physical and biological attributes (see Figure 1).

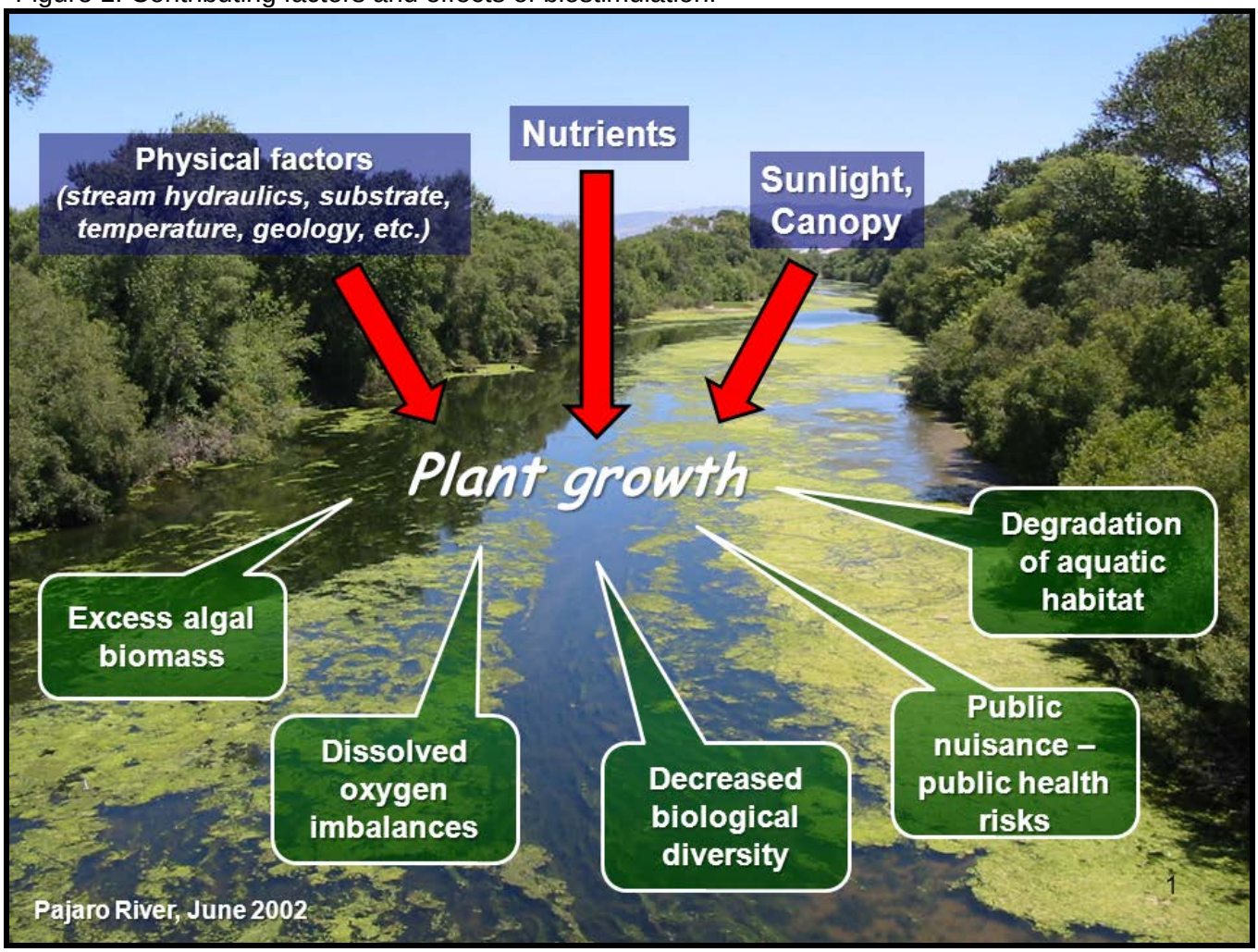
As such, nutrient criteria need to be developed to account for natural variation existing at the regional and/or watershed-scale. Nutrient water column concentration data by itself is generally not sufficient to

[5] California Department of Public Health website

[6] U.S. Environmental Protection Agency: Memorandum from Acting Assisstant 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".

evaluate biostimulatory conditions and develop numeric nutrient criteria. Waterbodies in the TMDL project area have substantial variation in stream hydraulics, stream morphology, tree canopy and other factors.

Figure 1. Contributing factors and effects of biostimulation.

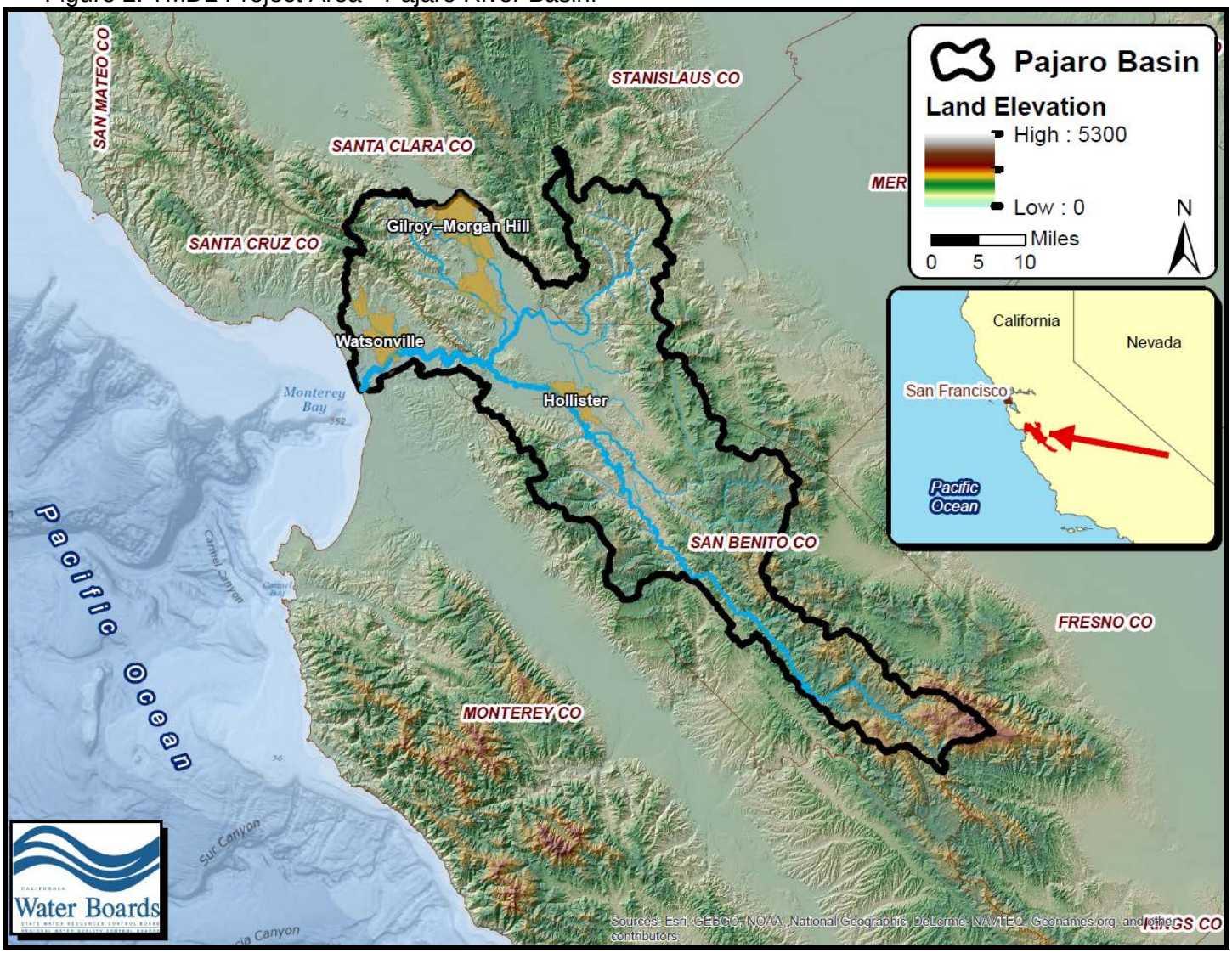


1.2 TMDL PROJECT LOCATION

The geographic scope of this TMDL project[7] encompasses approximately 1,300 square miles of the Pajaro River Basin located in parts of Santa Clara, Santa Cruz, San Benito, and Monterey counties (see Figure 2). The Pajaro River mainstem begins just west of San Felipe Lake (also called Upper Soda Lake. Major tributaries of the Pajaro River include the San Benito River, Pacheco Creek, Llagas Creek, Uvas Creek, and Corrilitos Creek.

[7] In the context of this report, the terms "TMDL project area" and "Pajaro River Basin" are used interchangeably and refer to the same geographic area.

Figure 2. TMDL Project Area - Pajaro River Basin.

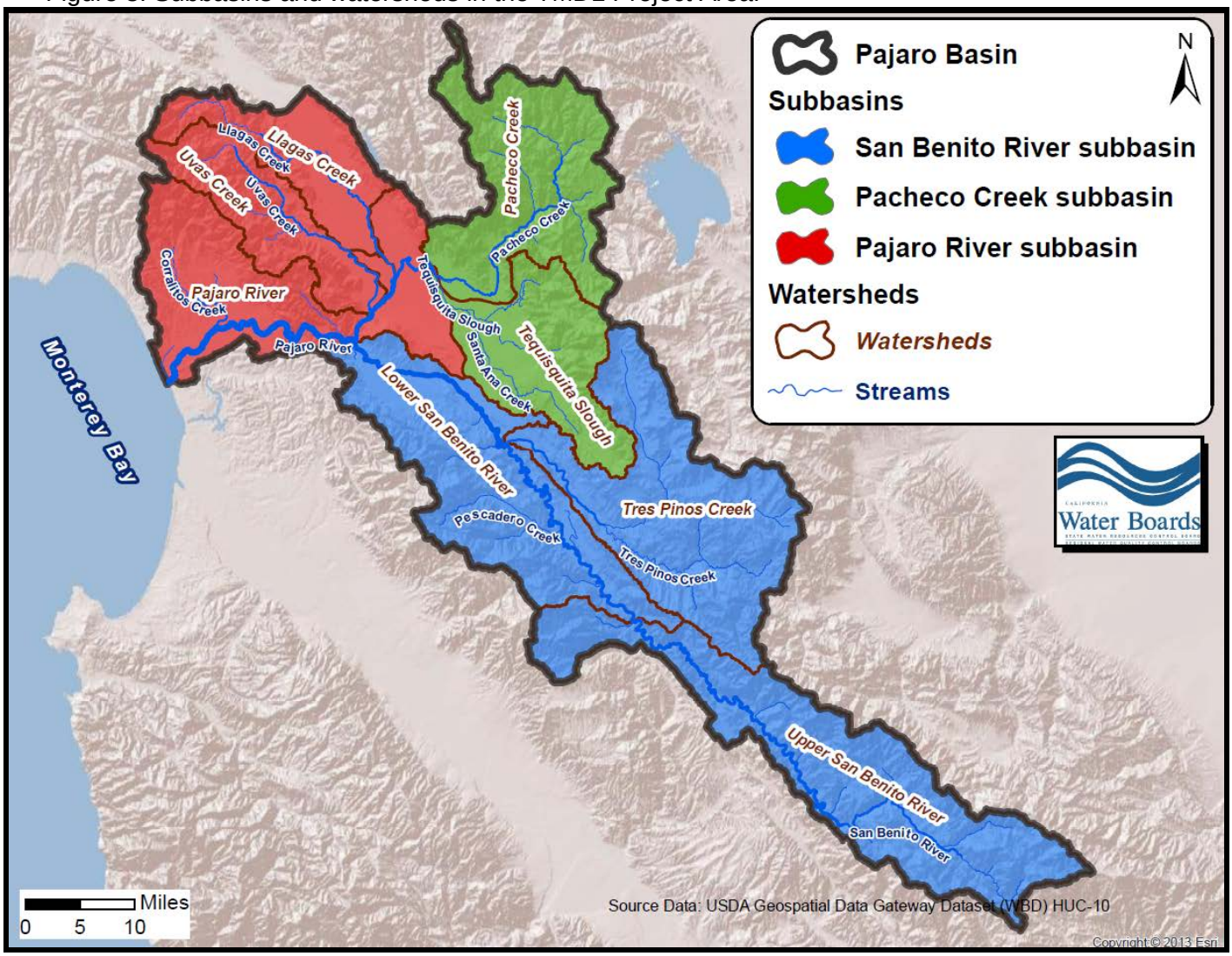


ESRI™ ArcMap® 10.1 can be used to create watershed layers for the TMDL project area. Drainage boundaries of the TMDL project area can be delineated on the basis of the Watershed Boundary Dataset[8], which contain digital hydrologic unit boundary layers organized on the basis of Hydrologic Unit Codes (HUCs).

The Pajaro River Basin is delineated at the HUC-8 hydrologic unit scale. Individual watersheds (HUC-10 hydrologic unit scale) nested within the Pajaro River Basin were delineated by digitally clipping HUC-10 watershed shapefiles using the Pajaro River Basin shapefile as a mask. Based on HUC-10 delineations, there are three distinct subbasins nested within the Pajaro River Basin: the 1) Pajaro River Subbasin; the 2) San Benito River Subbasin; the 3) Pacheco Creek Subbasin. There are eight distinct watersheds, delineated at the HUC-10 scale, located within these three subbasins, as shown in Figure 3.

[8] The Watershed Boundary Dataset (WBD) is developed by federal agencies and national associations. WBD contains watershed boundaries that define the areal extent of surface water drainage to a downstream outlet. WBD watershed boundaries are determined solely upon science-based principles, not favoring any administrative boundaries.

Figure 3. Subbasins and watersheds in the TMDL Project Area.



2 RIVER BASIN DESCRIPTION & PHYSICAL SETTING

2.1 LAND USE – LAND COVER

Agriculture is the current dominant land use in the Pajaro River, with increasing transition to urban use. Urbanized areas account for approximately 4 percent of the watershed's land use. Grassland, shrubland and forest also comprise substantial parts of the upland reaches of the watershed within an ecosystem characterized by annual grasslands, coastal scrub, oak woodland, and montane hardwood (source: National Land Cover Dataset, 2001; Calif. Dept. of Forestry and Fire Protection, 1977). Land use and land cover in the Pajaro River Basin is shown on the map in Figure 4. Table 1 presents a tabulation of land use and land cover in the Pajaro River Basin (source: FMMP, 2008 dataset).

Figure 4. Pajaro River Basin, land use and land cover (year 2008).

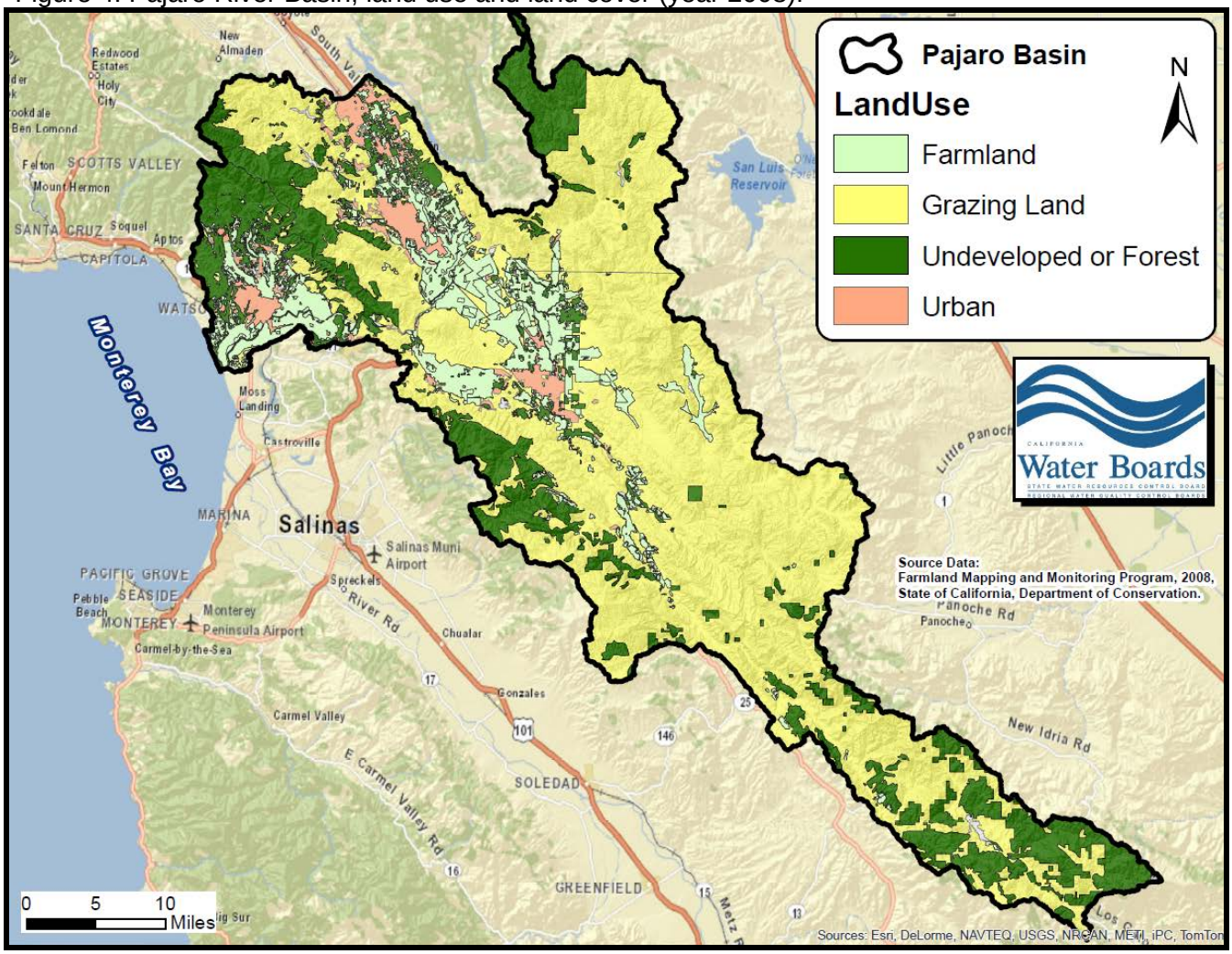


Table 1. Pajaro River Basin land use – land cover.

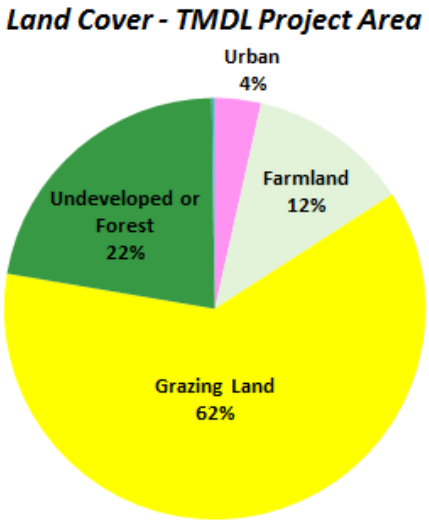
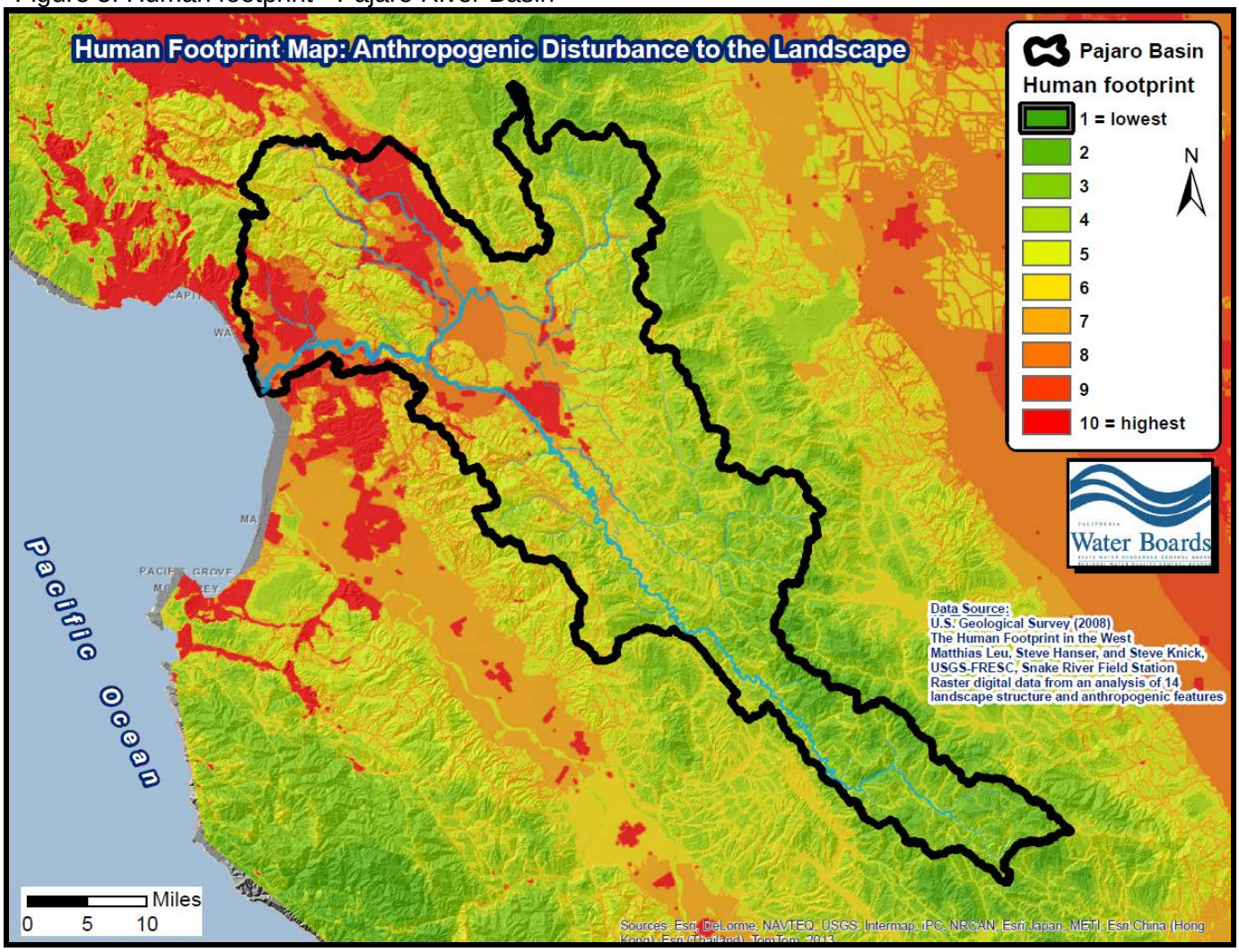
Land Cover	Acres	Land Cover Pie Chart
Urban	29,315	
Farmland	102,651	
Grazing Land	513,535	
Forest, Undeveloped, or Restricted	183,547	
Water	1,959	
Total	831,007	

Figure 5 illustrates a measure of the human footprint in the Pajaro River Basin. "Human footprint" is a measure of the degree of human disturbance to the landscape.

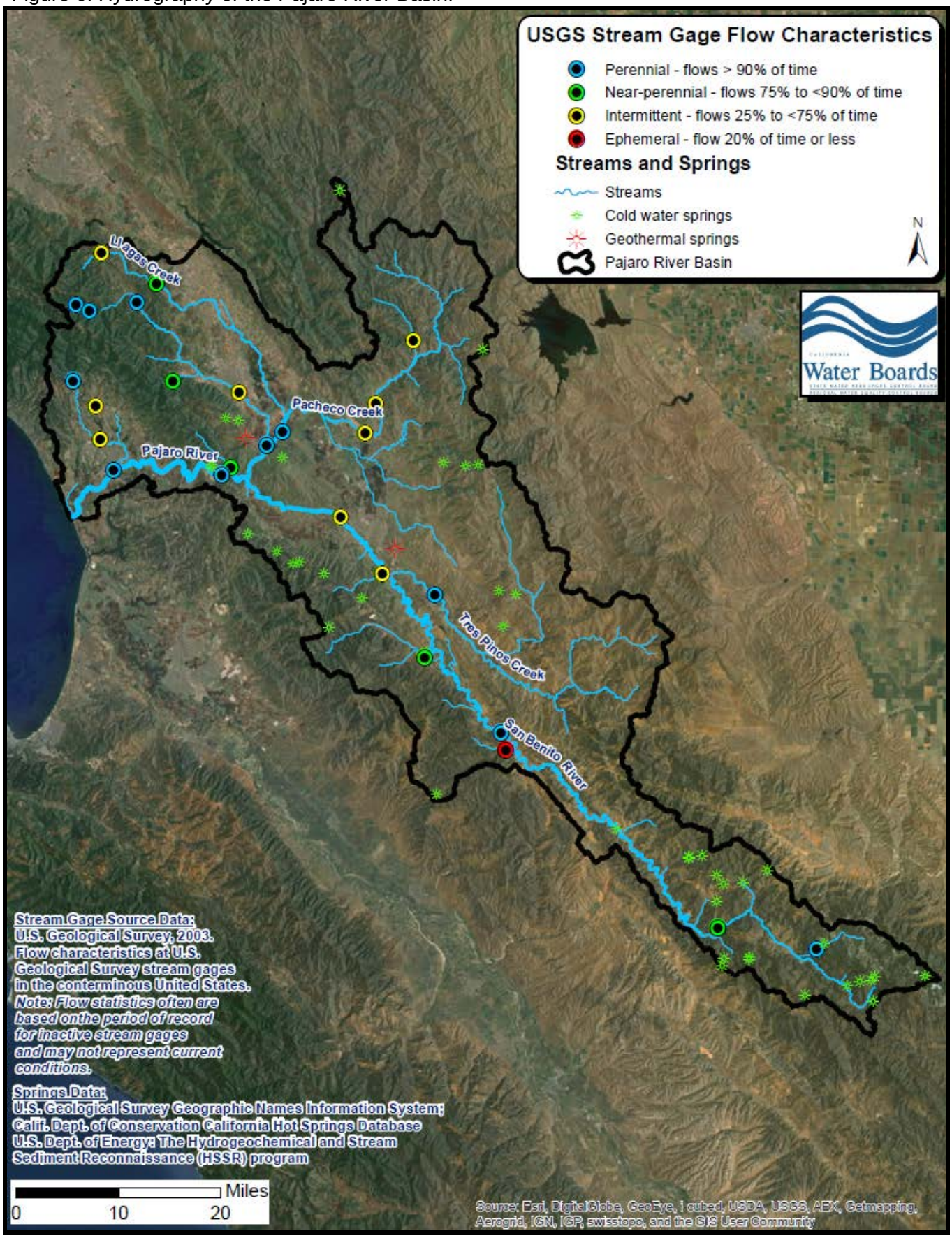
Figure 5. Human footprint - Pajaro River Basin



2.2 HYDROLOGY

Assessing the hydrology of a river basin is an important step in evaluating the magnitude and nature of pollutant transport and loading in waterbodies. Hydrography of the Pajaro River Basin is shown in Figure 6. The entire drainage area contributing to flow in the river basin encompasses 1,300 square miles. The nature of stream flow regimes throughout the river basin (perennial, intermittent, or ephemeral flows) are illustrated by information from current and historical U.S. Geological Survey stream gages as shown in Figure 6.

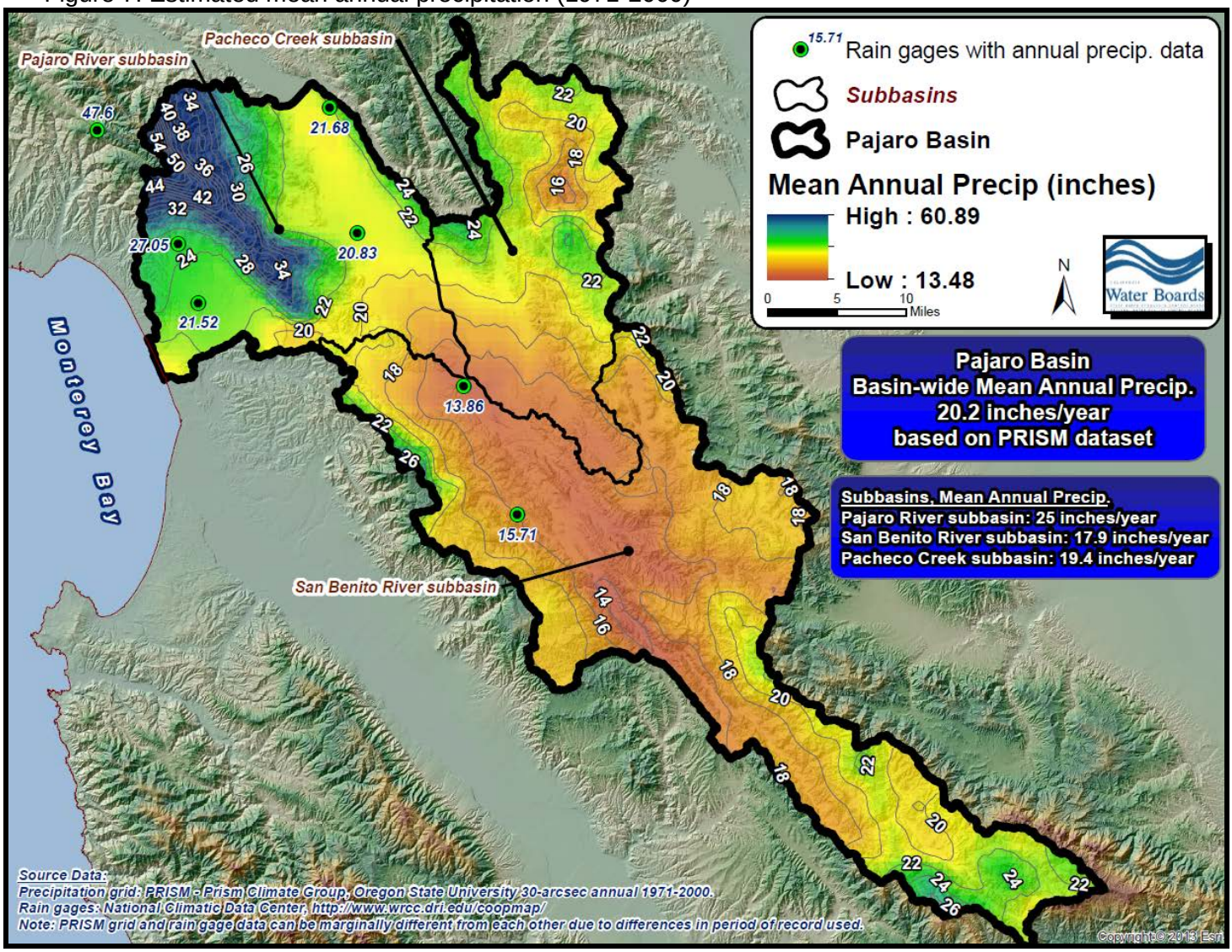
Figure 6. Hydrography of the Pajaro River Basin.



2.3 CLIMATE

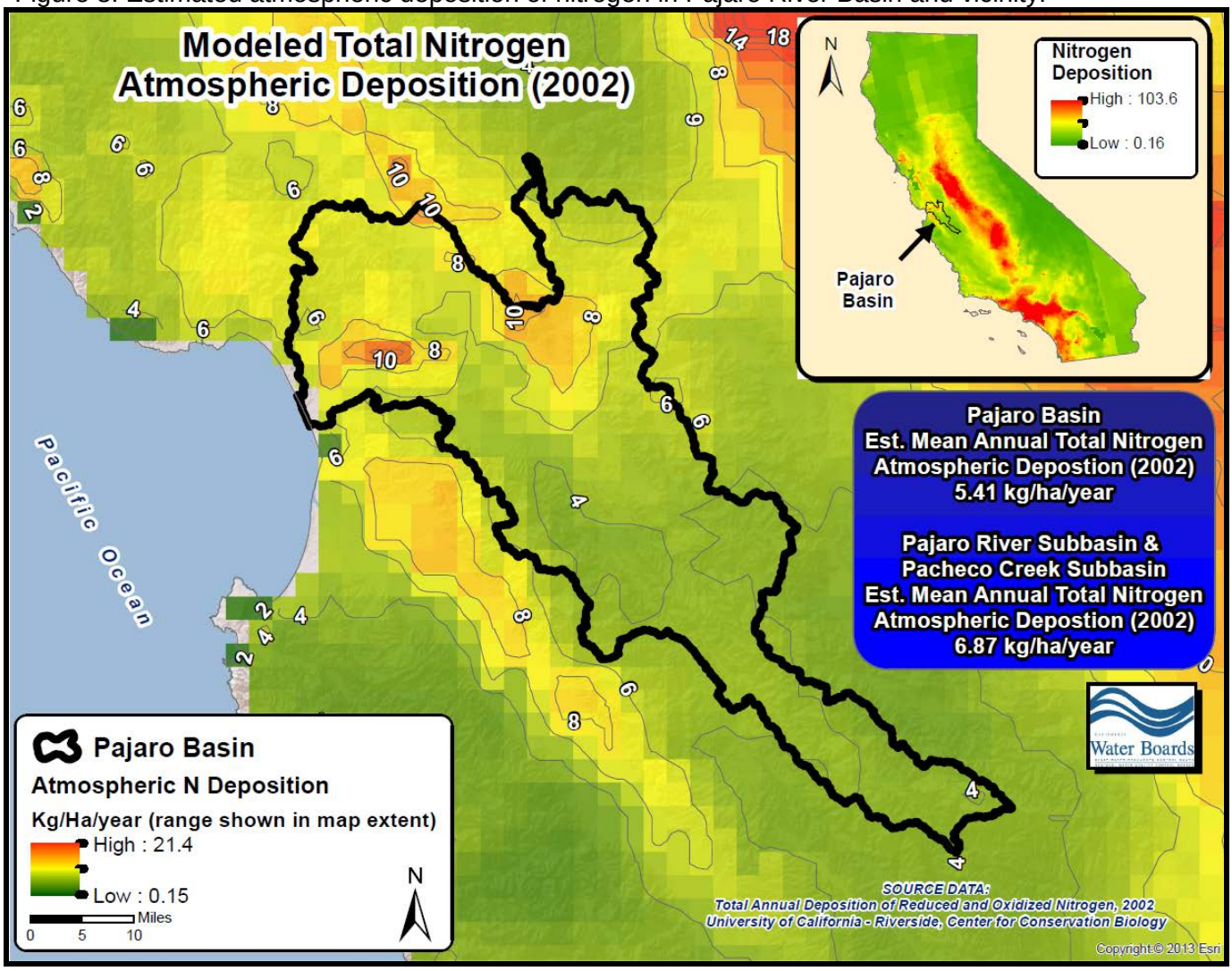
Climatological parameters, such as precipitation, are important in TMDL development for use in estimating runoff and to facilitate source assessment of pollutants. An isohyetal map for estimated mean annual precipitation in the Pajaro River Basin, with overlays of the hydrologic subbasin boundaries, is presented in Figure 7.

Figure 7. Estimated mean annual precipitation (1971-2000)



Additionally, from the climatological perspective, atmospheric deposition of nitrogen or phosphorus may often be considered in TMDL development or watershed studies. Figure 8 presented estimated atmospheric deposition of nitrogen in the Pajaro River Basin and vicinity (units = kg/hectare/year).

Figure 8. Estimated atmospheric deposition of nitrogen in Pajaro River Basin and vicinity.



2.4 GROUNDWATER

TMDLs do not directly address pollution of groundwater by controllable sources. However, shallow groundwater baseflow pollutant inputs to streams, and groundwater recharge designated beneficial uses of streams may be considered in the context of TMDL development. It is well known that groundwater inputs to surface waters can be a source of nutrients, salts, or other pollutants to any given surface waterbody. The physical connection between surface waters and groundwater is widely recognized by scientific agencies and resource professionals:

> *"Traditionally, management of water resources has focused on surface water or ground water as separate entities….Nearly all surface-water features (streams, lakes reservoirs, wetlands, and estuaries) interact with groundwater. Pollution of surface water can cause degradation of ground-water quality and conversely pollution of ground water can degrade surface water. Thus, effective land and water management requires a clear understanding of the linkages between ground water and surface water as it applies to any given hydrologic setting."*
>
> From: U.S. Geological Survey, 1998. Circular 1139: "Groundwater and Surface Water – A Single Resource"

"While ground water and surface water are often treated as separate systems, they are in reality highly interdependent components of the hydrologic cycle. Subsurface interactions with surface waters occur in a variety of ways. Therefore, the potential pollutant contributions from ground water to surface waters should be investigated when developing TMDLs."

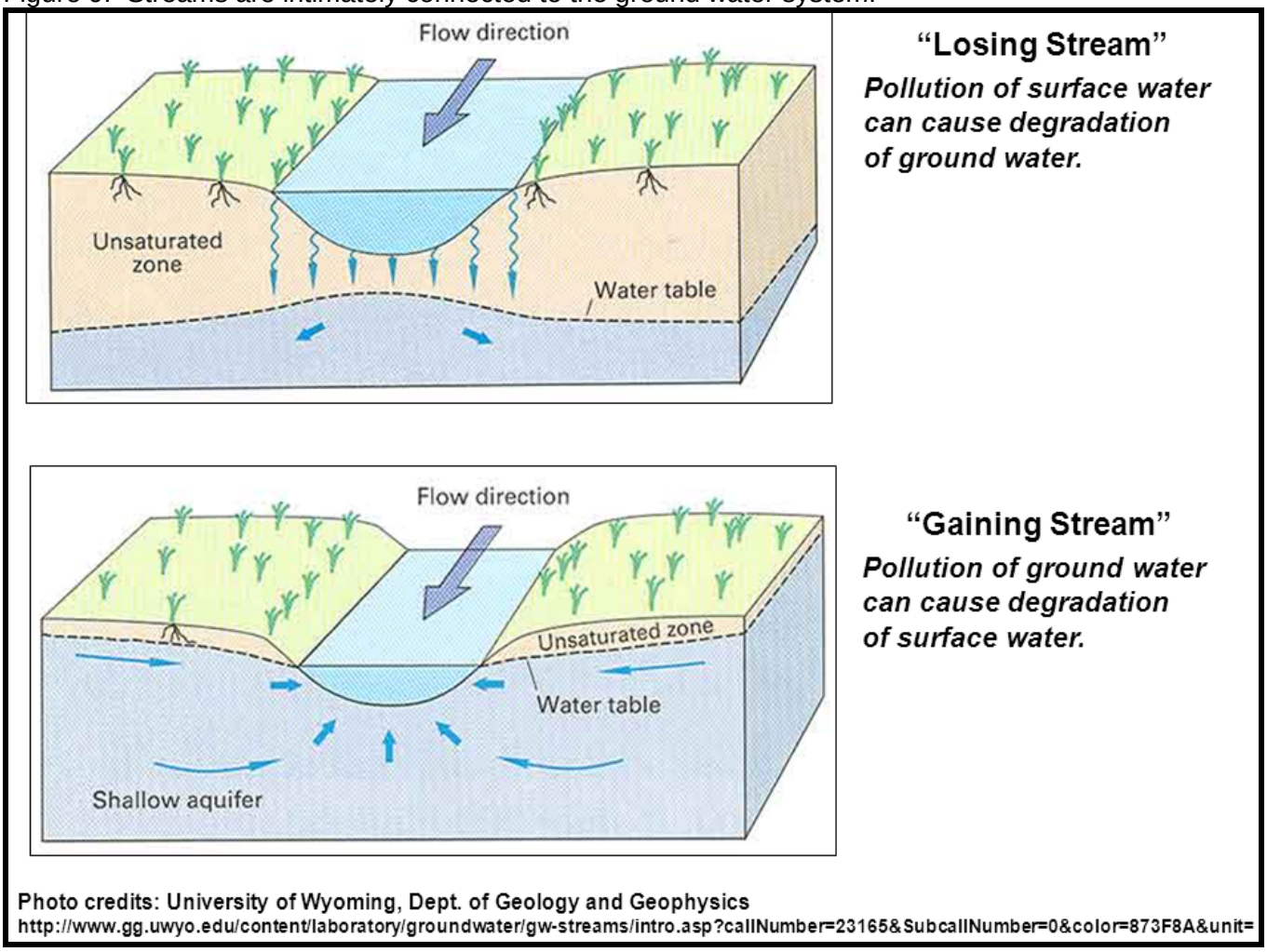
From: U.S. Environmental Protection Agency, Guidance for Water Quality-Based Decisions: The TMDL Process – Appendix B. EPA 440/4-91-001

"Although surface water and groundwater appear to be two distinct sources of water, they are not. Surface water and groundwater are basically one singular source of water connected physically in the hydrologic cycle…Effective management requires consideration of both water sources as one resource."

From: California Department of Water Resources: Relationship between Groundwater and Surface Water http://www.water.ca.gov/groundwater/groundwater_basics/gw_sw_interaction.cfm

As such, it is relevant to consider the nexus between groundwaters and surface water in this TMDL project – see Figure 9 which highlights this issue conceptually.

Figure 9. Streams are intimately connected to the ground water system.



For example, it should be recognized that fluvial systems and their associated alluvial basins are well-known to have substantial lateral and vertical hydrogeologic heterogeneity in the subsurface. This heterogeneity can result in the presence of shallow zones of saturation (perched groundwater) that exist vertically above the main water table, and which can locally be in hydrologic communication with nearby stream channels. This phenomena is conceptually illustrated in Figure 10

Figure 10. Stratigraphic interpretation of shallow subsurface, based on well log data in the lower Salinas Valley, illustrating the potential for shallow seasonal, intermittent, or perennial zones of saturation ("perched groundwater) that can occur vertically above the main water table.

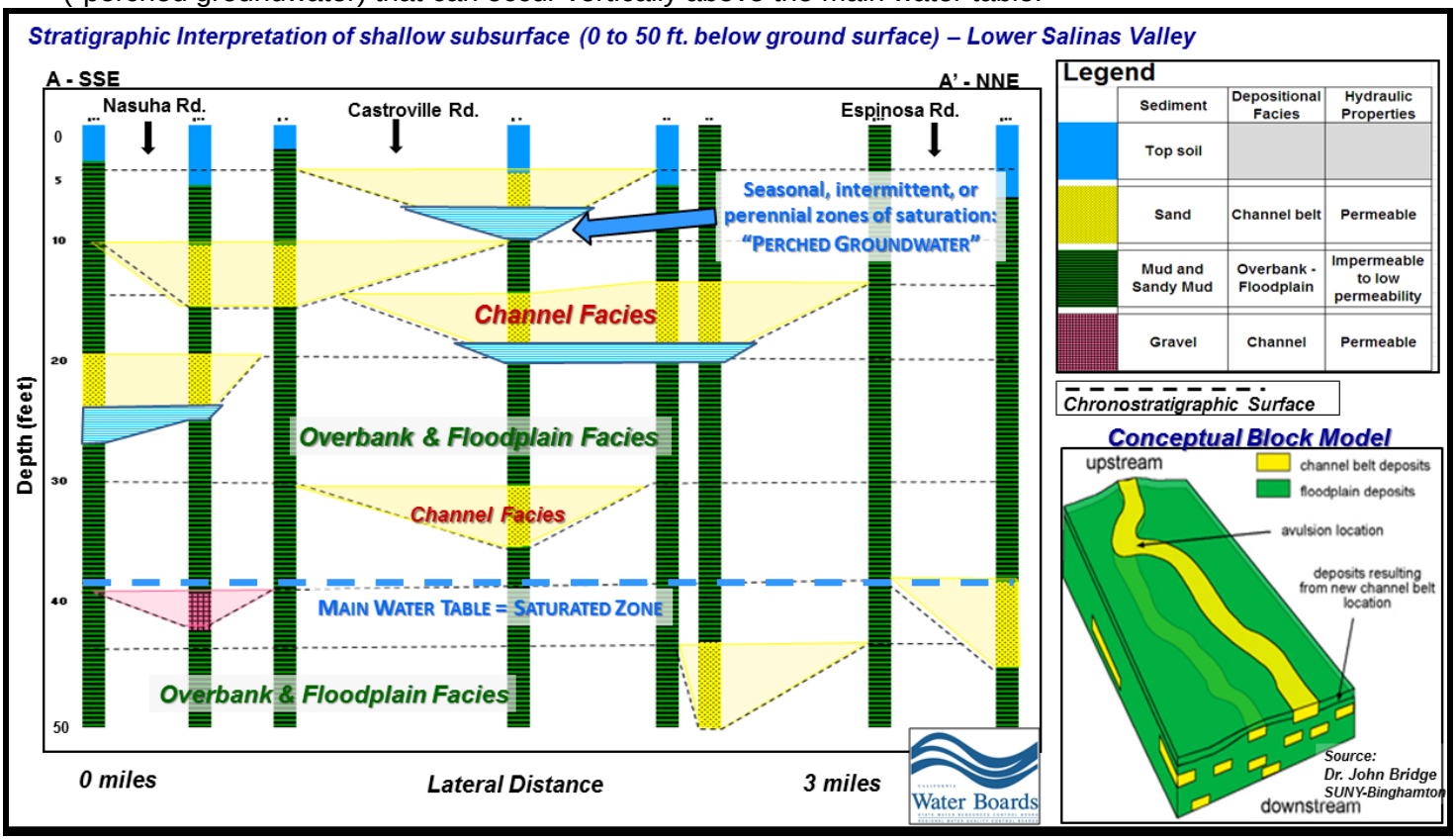


Figure 11 illustrates that first-encountered groundwater in the Gilroy-Hollister Valley groundwater subbasin is frequently quite shallow – often between zero to less than 20 feet below ground surface. These shallow groundwater horizons would thus be expected to be in hydrologic communication, locally, with creek beds.

Figure 11. Depth to first encountered groundwater, Gilroy-Hollister Valley groundwater subbasin.

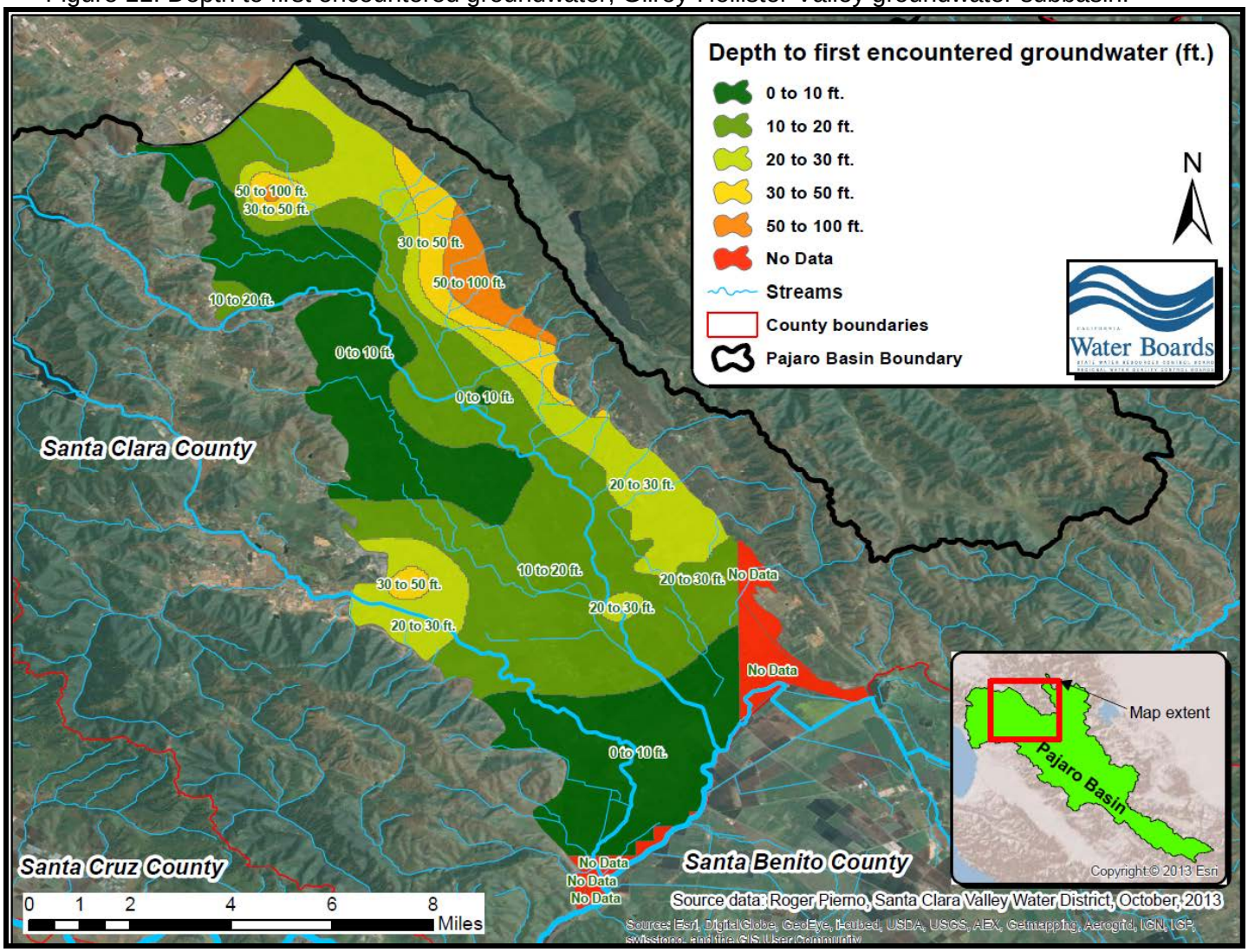
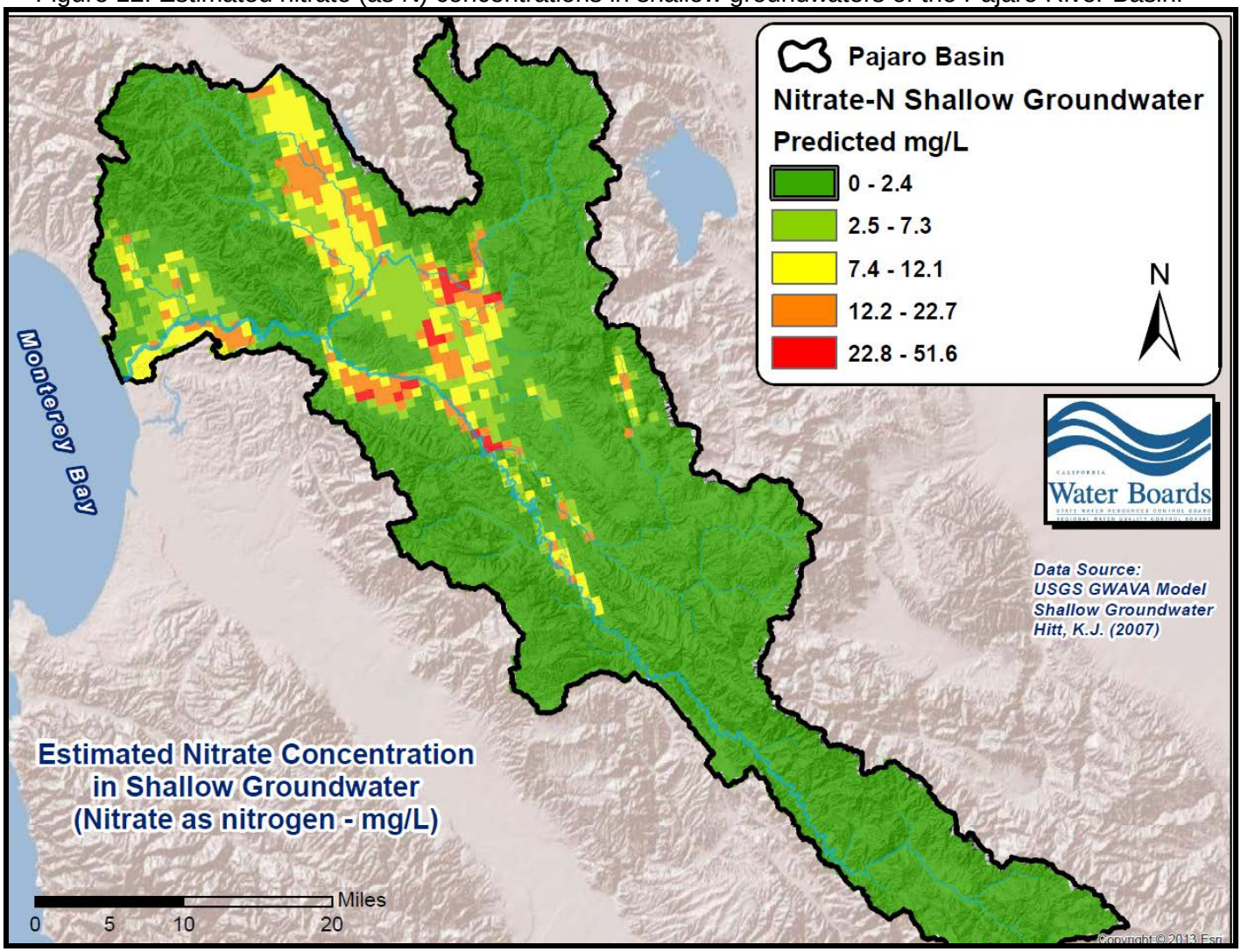


Figure 12 illustates estimated nitrate (as nitrogen) concentrations in shallow groundwaters (less than 15 meters below ground surface) in the Pajaro River Basin. These estimates were developed by the U.S. Geological Survey.[9] Shallow groundwaters which are high in nitrate and poteintally discharge to streams as baseflow would be expected to be a source of nitrate impairments in surface waters.

[9] The U.S. Geological Survey's 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 14 input parameters.. Online linkage: http://water.usgs.gov/GIS/metadata/usgswrd/XML/gwava-s_out.xml

Figure 12. Estimated nitrate (as N) concentrations in shallow groundwaters of the Pajaro River Basin.

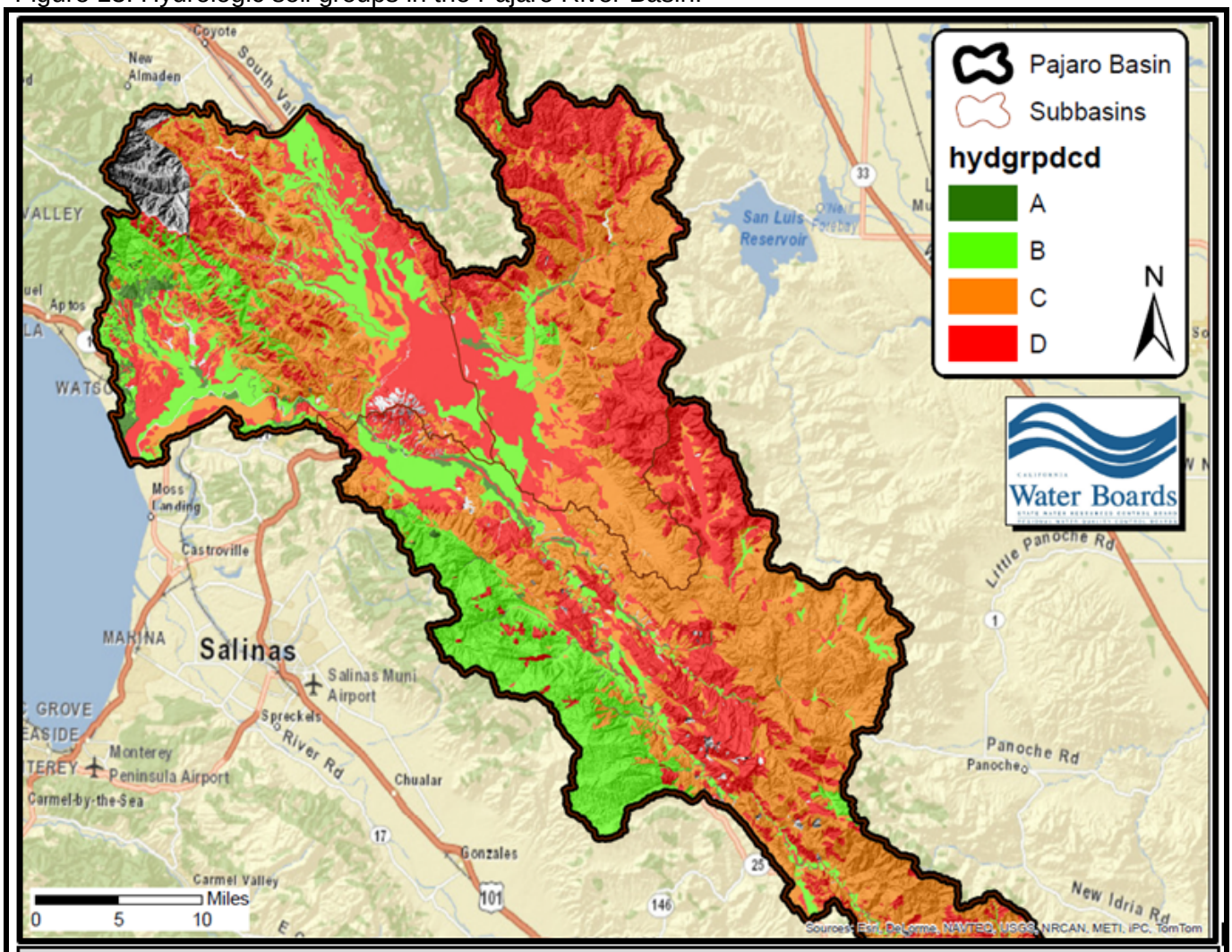


2.5 SOILS

Soils have physical and hydrologic characteristics which may have a significant influence on the transport and fate of nutrients. Watershed researchers and TMDL projects often assess soil characteristics in conjunction with other physical watershed parameters to estimate the risk and magnitude of nutrient loading to waterbodies.

Soils surveys have been compiled by the U.S. Department of Agriculture National Resources Conservation Service (NRCS) and are available online under the title of Soil Survey Geographic (SSURGO) Database. SSURGO has been updated with extensive soil attribute data, including Hydrologic Soil Groups. Hydrologic Soil Groups are a soil attribute associated with a mapped soil unit, which indicates the soil's infiltration rate and potential for runoff. Figure 13 illustrates the distribution of hydrologic soil groups in the project area along with a tabular description of the soil group's hydrologic properties.

Figure 13. Hydrologic soil groups in the Pajaro River Basin.



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)

3 CWA Section 303(d) Listings and Pollutants Addressed

The final 2010 Update to the 303(d) List and 303(d)/305(b) Integrated Report for the Central Coast showing waterbodies with nutrient or potential nutrient-related impairments in the Pajaro River Basin are shown in Table 2. The locations of these surface waterbody impairments are graphically illustrated in Figure 14.

Table 2. Section 303(d) listings for nutrients and nutrient-related impairments in the Pajaro River Basin.

WATER BODY NAME	POLLUTANT NAME	LIST STATUS
Beach Road Ditch	Low Dissolved Oxygen	TMDL Required

WATER BODY NAME	POLLUTANT NAME	LIST STATUS
Beach Road Ditch	Nitrate	TMDL Required
Carnadero Creek	Low Dissolved Oxygen	TMDL Required
Carnadero Creek	Nitrate	TMDL Required
Furlong Creek	Nitrate	TMDL Required
Harkins Slough	Chlorophyll-a	TMDL Required
Harkins Slough	Low Dissolved Oxygen	TMDL Required
Llagas Creek (below Chesbro Reservoir)	Low Dissolved Oxygen	TMDL Required
Llagas Creek (below Chesbro Reservoir)	Nutrients	TMDL Required
McGowan Ditch	Nitrate	TMDL Required
Millers Canal	Chlorophyll-a	TMDL Required
Millers Canal	Low Dissolved Oxygen	TMDL Required
Pacheco Creek	Low Dissolved Oxygen	TMDL Required
Pajaro River	Low Dissolved Oxygen	TMDL Required
Pajaro River	Nitrate	TMDL Required
Pajaro River	Nutrients	TMDL Required
Pinto Lake	Chlorophyll-a	TMDL Required
Pinto Lake	Low Dissolved Oxygen	TMDL Required
Pinto Lake	Scum/Foam-unnatural	TMDL Required
Salsipuedes Creek (Santa Cruz County)	Low Dissolved Oxygen	TMDL Required
San Juan Creek (San Benito County)	Low Dissolved Oxygen	TMDL Required
San Juan Creek (San Benito County)	Nitrate	TMDL Required
Struve Slough	Low Dissolved Oxygen	TMDL Required
Tequisquita Slough	Low Dissolved Oxygen	TMDL Required
Uvas Creek (below Uvas Reservoir)	Low Dissolved Oxygen	TMDL Required
Watsonville Creek	Nitrate	TMDL Required
Watsonville Slough	Low Dissolved Oxygen	TMDL Required

Figure 14. 2010 Clean Water Act 303(d) nutrient and nutrient-related listings for year 2010.

4 WATER QUALITY STANDARDS

The Central Coast Region's Water Quality Control Plan (Basin Plan) contains specific water quality objectives that apply to nutrients and nutrient-related parameters. These water quality objectives are established to protect beneficial uses and are compiled in Table 3 on page 26.

4.1 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[10]." 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.)

[10] Federal Water Pollution Control Act (33 U.S.C. 1251 et seq.) Title 1, Section 101.(a)

- 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, and anti-degradation requirements that could pertain to this TMDL are presented below in Section 4.2, Section 4.3, and Section 4.4 respectively.

4.2 BENEFICIAL USES

California's water quality standards designate beneficial uses for each waterbody (e.g., drinking water supply, aquatic life support, recreation, etc.) and the scientific criteria to support that use. The California Central Coast Water Board is required under both State and Federal law to protect and regulate beneficial uses of waters of the state.

A narrative description of the designated beneficial uses of project area surface waters which are most likely to be potentially at risk of impairment by water column nutrients are presented below.

4.2.1 Municipal and Domestic Water 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 under certain conditions (see Basin Plan, Chapter 2, Section II.)*

The nitrate numeric water quality objective protective of the MUN beneficial use is legally established as 10 mg/L[11] nitrate as nitrogen (see Basin Plan, Table 3-2). This level is established to protect public health (refer back to Section 1.1 for a description of health risks related to nitrate).

4.2.2 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. (emphasis added) - (see Basin Plan, Chapter 2, Section II.)*

The groundwater recharge (GWR) beneficial use is recognition of the fundamental nature of the hydrologic cycle, and that surface waters and ground water are not closed systems that act independently from each other. Most surface waters and ground waters of the central coast region are both designated with the MUN beneficial use. The MUN nitrate water quality objective (10 mg/L) therefore applies to *both* the stream waters, and to the underlying groundwater. This numeric water quality objective and the MUN designation of underlying groundwater is relevant to the extent that portions project area streams recharge the underlying groundwater resource. The Basin Plan GWR beneficial use explicitly states that the designated groundwater recharge use of surface waters are to be protected to maintain groundwater quality. Note that surface waters and ground waters are often in direct or indirect hydrologic communication. As such, where necessary, the GWR beneficial uses of the surface waters need to be protected so as to support and maintain the MUN beneficial use of the underlying ground water resource. Indeed, protection of the GWR beneficial use of surface waters has been recognized in approved California TMDLs[12]. The Basin Plan does not specifically identify numeric water quality objectives to implement the GWR beneficial use, however a situation-specific weight of

[11] This value is equivalent to, and may be expressed as, 45 mg/L nitrate as NO3.

[12] for example, see RWQCB-Los Angeles Region, Calluguas Creek Nitrogen Compounds TMDL, 2002. Resolution No. 02-017, and approved by the State of California Office of Adminstrative Law, OAL File No. 03-0519-02 SR.

evidence approach can be used to assess if GWR is being supported, consistent with Section 3.11 of the California Listing Policy (SWRCB, 2004).

4.2.3 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 (see Basin Plan, Chapter 2, Section II.).

In accordance with the Basin Plan, interpretation of the amount of nitrate which adversely effects of the agricultural supply beneficial of waters of the State use shall be 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[13]. It should be noted that 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.

High concentrations of nitrates in irrigation water can potentially create problems for sensitive crops (e.g., grapes, avocado, citrus, sugar beets, apricots) by detrimentally impacting crop yield or quality. Nitrogen in the irrigation water acts the same as fertilizer nitrogen and excesses may cause problems just as fertilizer excesses cause problems[14]. For example, according to Ayers and Westcot (1985)[15] 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 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. 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[16] especially when the concentration exceeds 10 mg/L nitrate as N[17]. Should this be ignored, the resulting excess input of nitrogen could cause problems such as excessive vegetative growth and contamination of groundwater[18].

Further, the Basin Plan provides water quality objectives for nitrate which are protective of the AGR beneficial uses for livestock watering. While nitrate (NO3) itself is relatively non-toxic to livestock, ingested nitrate is broken down to nitrite ($NO2^-$); 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[19]. Death can occur when blood hemoglobin has fallen to one-third normal levels. Resource professionals[20] report that nitrate can reach dangerous levels for livestock in streams, ponds, or shallow wells that collect drainage from highly

[13] 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-N is the recommended uppermost threshold concentration for nitrate in irrigation supply water as identified by the Univ. of Californnia 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.

[14] 1 mg/L NO3-N in irrigation water = 2.72 pounds of nitrogen per acre foot of applied water.

[15] R.S. Ayers (Soil and Water Specialist, Univ. of Calif.-Davis) and D.W. Westcot (Senior Land and Water Resources Specialist – Calif. Central Valley Regional Water Quality Control Board) published in UN-FAO Irrigation and Drainage Paper 29 Rev.1

[16] 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.

[17] 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, USDA/NRCS area resource conservationist; and J.G. Davis, Extension soils specialist and professor, soil and crop sciences

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

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

[20] University of Arkansas, Division of Agriculture - Cooperative Extension. "Nitrate Poisoning in Cattle". Publication FSA3024.

fertilized fields. Accordingly, the Basin Plan identifies the safe threshold of nitrate-N for purposes of livestock watering at 100 mg/L[21].

4.2.4 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.

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 water bodies 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 and which is most relevant to nutrient pollution[22] is the biostimulatory substances objective and dissolved oxygen objectives for aquatic habitat. The biostimulatory substances objective is a narrative water quality objective that 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*."

The Basin Plan also 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. Further, since unionized ammonia is highly toxic to aquatic species, the Basin Plan requires that the discharge of waste shall not cause concentrations of unionized ammonia (NH3) to exceed 0.025 mg/L (as n) in receiving waters.

4.2.1 Water Contact Recreation (REC-1)

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. (see Basin Plan, Chapter 2, Section II.).

The Basin Plan water quality objective protective of water contact recreation beneficial uses and which is most relevant to nutrient pollution is the general toxicity objective for all inland surface water, enclosed

[21] 100 mg/L nitrate-N 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).

[22] 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.

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. The State of California Office of Environmental Health Hazard Assessment (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[23] (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.

4.3 WATER QUALITY OBJECTIVES & CRITERIA

The Central Coast Region's Water Quality Control Plan (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 compiled in Table 3

4.4 ANTI-DEGRADATION POLICY

In accordance with Section II.A. of the Central Coast Basin Plan, wherever the existing quality of water is better than the quality of water established in the Central Coast 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 water quality shall be maintained and further lowering of water quality is not allowed except under conditions provided for in the anti-degradation policy.

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

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Table 3. Compilation 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
Unionized Ammonia as N	Basin Plan numeric objective	0.025 mg/L	General Objective for all Inland Surface Waters, Enclosed Bays, and Estuaries *(toxicity objective)*
Nitrate as N	Basin Plan numeric objective	10 mg/L	MUN, GWR (Municipal/Domestic Supply; Groundwater Recharge)
Nitrate as N	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*
Nitrate (NO3-N) plus Nitrite (NO2-N)	Basin Plan numeric objective (Table 3-4 in Basin Plan)	100 mg/L *National Academy of Sciences-National Academy of Engineers guidelines*	AGR (Agricultural Supply - livestock watering)
Nitrite (NO2_N)	Basin Plan numeric objective (Table 3-4 in Basin Plan)	10 mg/L *National Academy of Sciences-National Academy of Engineers guidelines*	AGR (Agricultural Supply - livestock watering)
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 Freshwater Habitat, Warm Freshwater Habitat, Fish Spawning
	Basin Plan numeric objective AGR	Dissolved Oxygen shall not be depressed below 2.0 mg/L	AGR (Agricultural Supply)
pH	General Inland Surface Waters numeric objective	pH value shall not be depressed below 7.0 or raised above 8.5.	General Objective for all Inland Surface Waters, Enclosed Bays, and Estuaries.
	Basin Plan numeric objective MUN, AGR, REC1, REC-2	The pH value shall neither be depressed below 6.5 nor raised above 8.3.	Municipal/Domestic Supply, Agricultural Supply, Water Recreation
	Basin Plan numeric objective WARM, COLD	pH value shall not be depressed below 7.0 or raised above 8.5	Cold Freshwater Habitat, Warm freshwater habitat
Biostimulatory Substances	Basin Plan narrative objective[A]	Numeric targets likely to be 1.5 to 8 mg/L nitrate-N and 0.1 to 0.3 mg/L phosphate	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[A]	40 □g/L *Source: 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 □g/L *Calif. Office of Environmental Health Hazard Assessment Suggested Public Health Action Level*	REC-1 (water contact recreation)

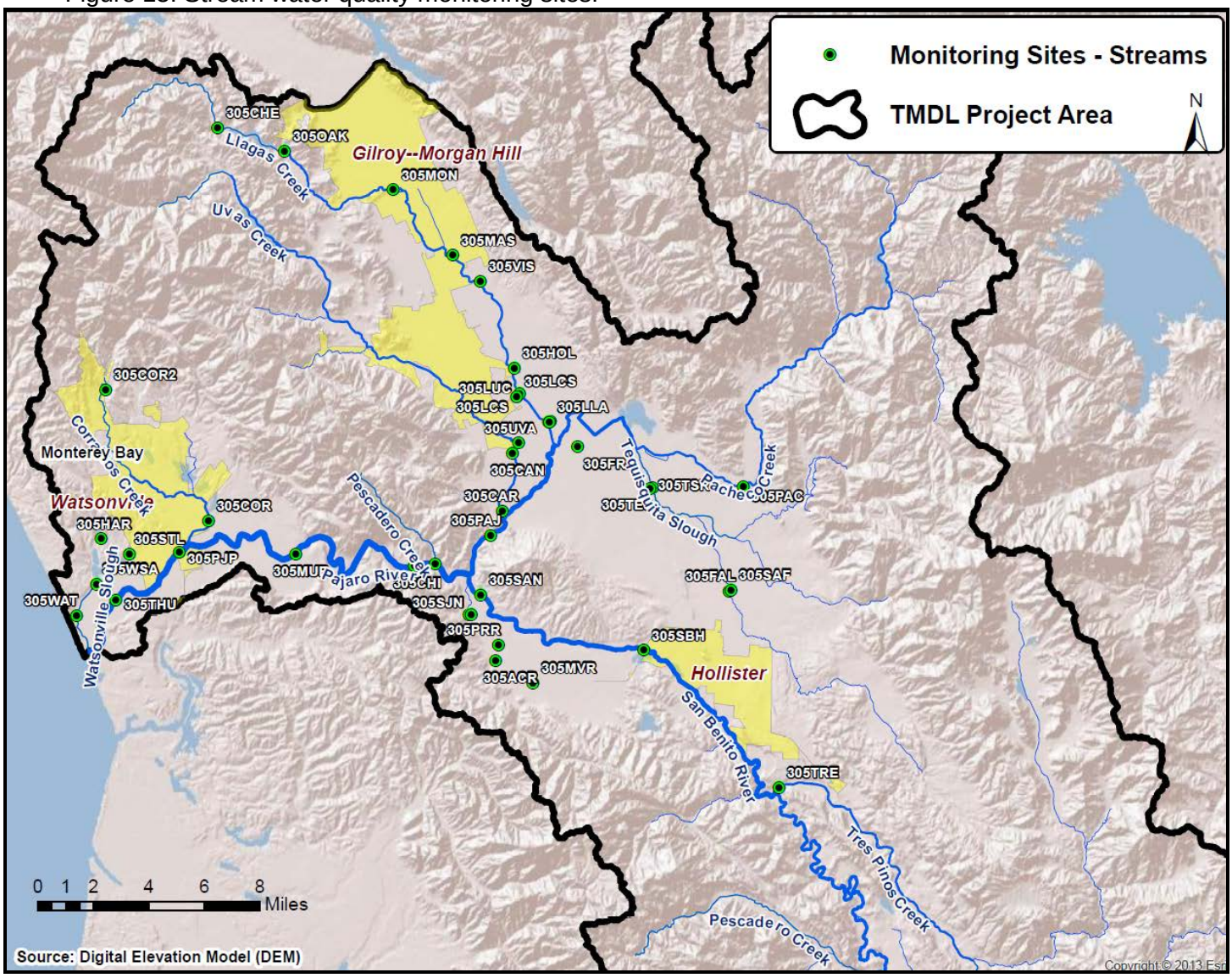
[A] ***The Basin Plan biostimulatory substances narrative objective states: "Waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses." (Biostimulatory Substances Objective, Basin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

[B] *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)*

5 WATER QUALITY DATA

5.1 STREAM MONITORING SITES

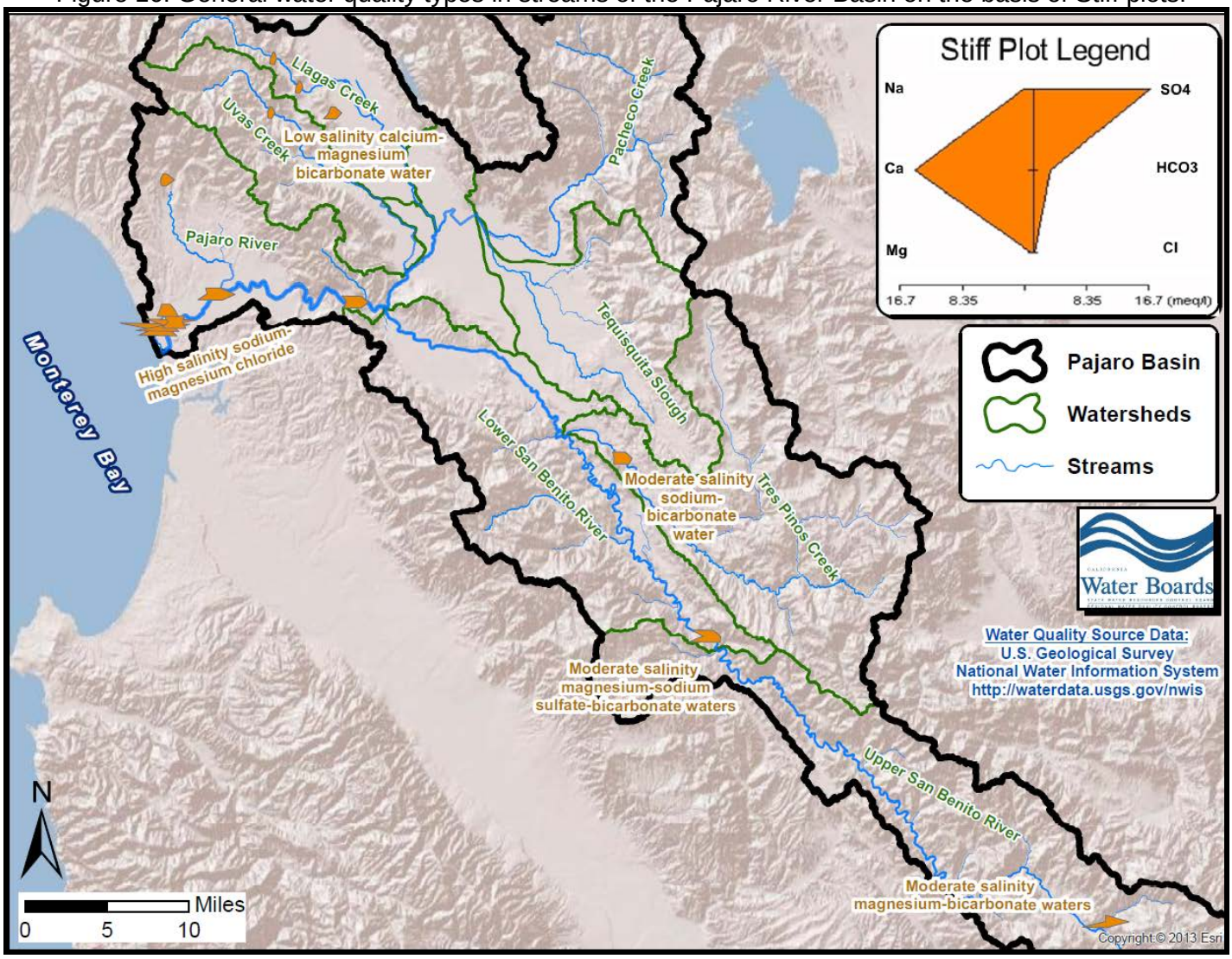
Figure 15. Stream water quality monitoring sites.



5.2 GENERAL WATER QUALITY TYPES IN STREAMS

U.S. Environmental Protection Agency guidance on development of water quality criteria for biostimulatory substances, such as nitrate, recommend that these criteria be developed taking into account spatial, physical, hydraulic, and chemical variation in streams within any given region or basin. Figure 16 illustrates generalized variations in water quality types in streams of the Pajaro River Basin on the basis of Stiff diagrams. Much of the data represented here are from pre-1990 sampling events, so these should be considered historical, or baseline conditions in the river basin.

Figure 16. General water quality types in streams of the Pajaro River Basin on the basis of Stiff plots.



Surface water quality in the upper San Benito and Tres Pinos watersheds can be characterized as moderate salinity, magnesium-bicarbonate waters (Mg-HCO_3) or sodium bicarbonate–sulfate (Na-HCO_3-SO_4) waters. Surface water quality in the Llagas, Uvas, and Upper Corrilitos Creek watersheds, draining the Santa Cruz Mountains, can be generally characterized as lower salinity, magnesium-bicarbonate (Mg-HCO_3) or calcium-bicarbonate waters (Ca-HCO_3). The lower reaches of the river basin, which includes the Pajaro River, can be characterized as higher salinity sodium–magnesium bicarbonate–sulfate waters (Na-Mg HCO_3-SO_4). Limited data from agricultural ditches in the lowermost reaches of the river basin, near Watsonville, were characterized by higher salinity sodium chloride waters (Na-Cl).

5.3 Nitrate Water Quality Trends in Streams

Table 4 and Figure 17 through Figure 19 illustrate nitrate concentrations and trends at various monitoring sites within the Pajaro River Basin.

Table 4. Average nitrate-N concentration at select sites.

Waterbody	Site Tag	Annual Average mg/L of Nitrate as N
Pajaro River	**305THU**	**5.420**
Pajaro River	**305PJP**	**6.295**

Waterbody	Site Tag	Annual Average mg/L of Nitrate as N
Pajaro River	**305MUR**	**6.372**
Pajaro River	**305CHI**	**7.755**
San Juan Creek	**305SJN****	**32.611**
Pajaro River	**305PAJ**	**6.371**
Llagas Creek	**305LLA***	**11.487**
Furlong Creek	**305FUF*****	**34.020**
Llagas Creek	**305LCS***	**15.479**
Pajaro River (Millers Canal)	**305FRA**	**0.348**

***** Tributary to main stem of the Pajaro River
****** Tributary to main stem of San Benito River
*** Tributary to main stem of Llagas Creek

Figure 17. Nitrate-N concentrations, Pajaro River at Porter Dr.

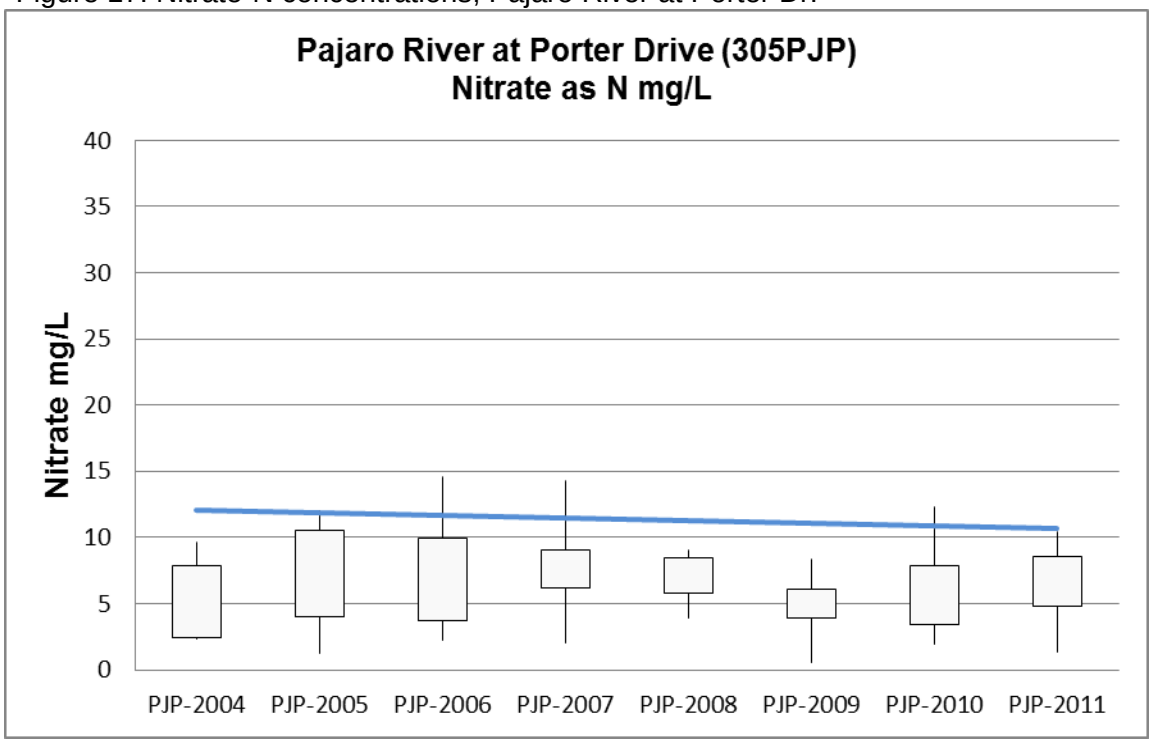


Figure 18. Nitrate-N concentrations, Llagas Creek at Southside.

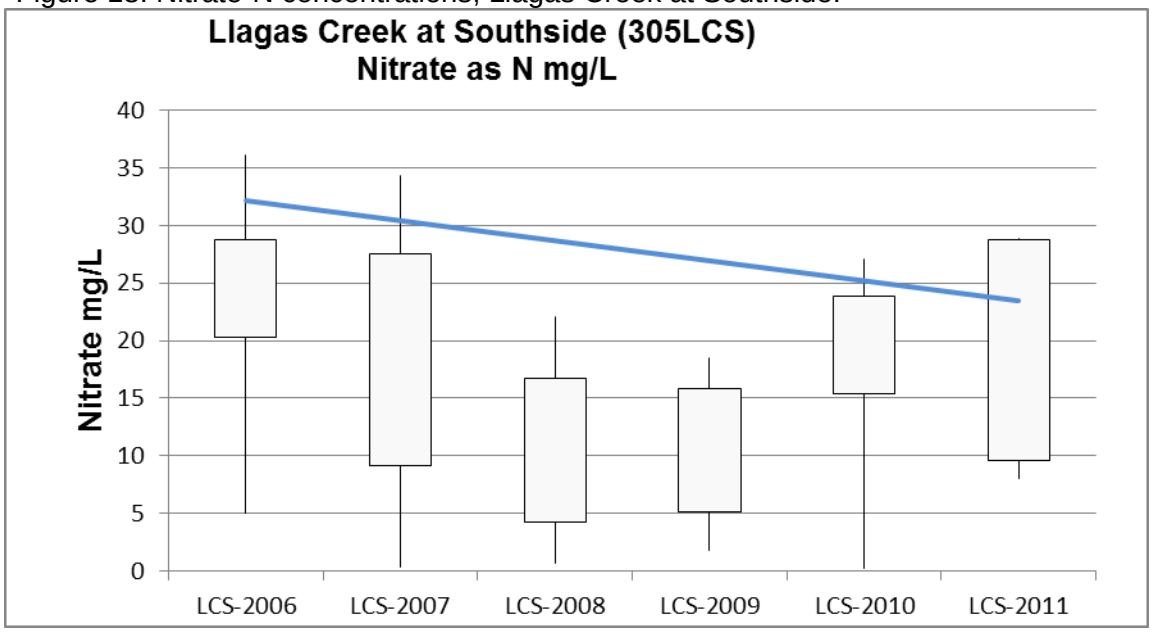
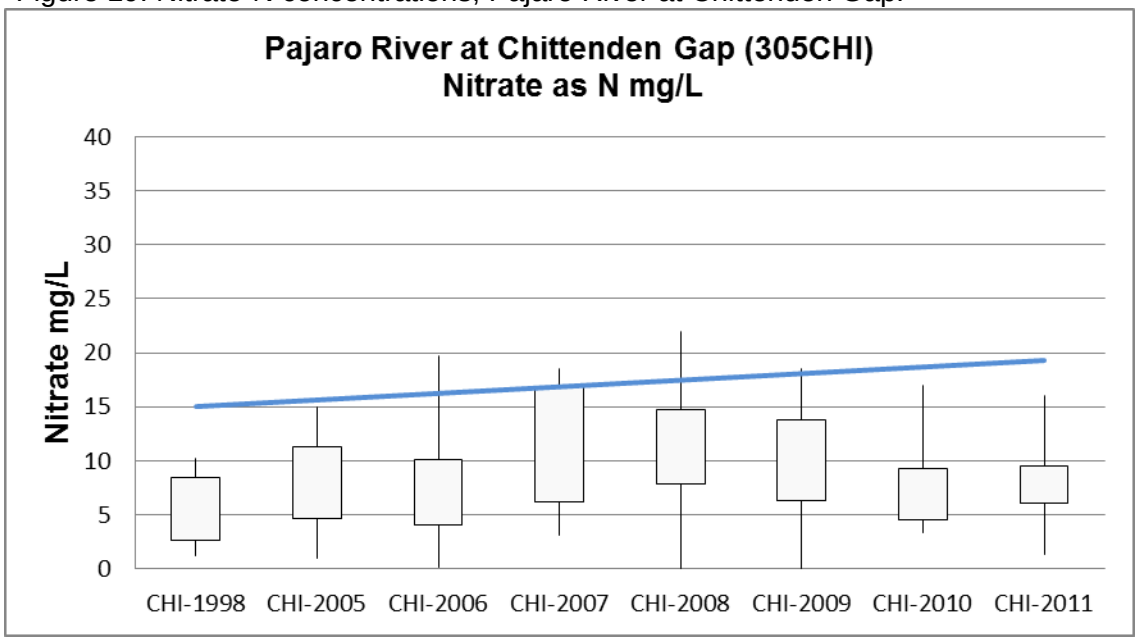


Figure 19. Nitrate-N concentrations, Pajaro River at Chittenden Gap.



6 POLLUTANT SOURCES

Staff has provisionally identified potential sources that are most likely to cause or contribute to impairment of the 303(d) listed waterbodies – Table 5.

Table 5. Pollutant Sources.

Source Category	Land Use Category
Fertilizer applications	Primarily farmland; some urban/non-farm component
Urban runoff	Urban – discharges from MS4 entities
Manure (domestic animals)	Rural residential, pasture, grazing lands

Source Category	Land Use Category
Wastewater	Point sources, such as wastewater treatment plants
Septic tanks	Residential areas
Natural background & atmospheric deposition	Watershed-wide

Natural background and atmospheric deposition are not generally considered controllable sources, and implementing parties are not expected or required to reduce pollutant loading from natural inputs. The Basin Plan defines controllable water quality conditions as: *"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."*

7 WATER QUALITY TARGETS & NUTRIENT LOAD REDUCTIONS NEEDED

7.1 PROVISIONAL NUMERIC WATER QUALITY TARGETS

Staff anticipates proposing that the TMDL project contain water column numeric targets for nitrate, unionized ammonia, dissolved oxygen, and biostimulatory substances (nitrogen and phosphorus). Targets are based on existing numeric or narrative water quality objectives found in the Central Coast Basin Plan.

Target for Nitrate

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 NO3 as N, 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.*

Target for Unionized Ammonia

The Basin Plan contains numeric water quality objective for un-ionized ammonia to protect against water column toxicity is as follows:

- *The discharge of wastes shall not cause concentrations of unionized ammonia (NH3) to exceed 0.025 mg/l (as N) in receiving waters.*

Targets for Dissolved Oxygen

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

- *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.*

Note that this TMDL is addressing biostimulatory impairments; as such only dissolved oxygen impairments that are credibly linked to biostimulation problems (i.e., elevated algal biomass, wide diel swings in DO/pH, and elevated nutrients) will be addressed in this TMDL. It is important to recognize that there are other factors that affect the concentration of dissolved oxygen in a waterbody. Oxygen can be introduced by additions of higher DO water (e.g., from tributaries); additions of lower DO water (groundwater baseflow), temperature (warm water holds less oxygen than cold water), and reductions in oxygen due to organic decomposition. Dissolved oxygen impairments that are not credibly linked to

biostimulation impairments will potentially be addressed in another TMDL process, or in a future water quality standards action.

Targets for Biostimulatory Substances

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.*

Water Board staff are required to develop technically defensible numeric water quality targets that are protective of the Basin Plan's narrative objective for biostimulatory substances, based on established methodologies or peer-reviewed numeric criteria. 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. Eutrophication 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.

Staff provisionally estimates that nitrate water quality targets protective of aquatic habitat in streams of the Pajaro River Basin could range from 1.5 mg/L to 8 mg/L nitrate as nitrogen.

Staff provisionally estimates that phosphorus water quality targets protective of aquatic habitat in streams of the Pajaro River Basin could range from 0.1 mg/L to 0.3 mg/L phosphate as phosphorus

7.2 Possible Load Reductions to Receiving Waters Needed to Attain Water Quality Standards

Table 6 and Table 7 illustrate estimated load reductions to meet water quality targets protective of drinking water and aquatic habitat (biostimulation impairments) in the lower Salinas Valley – these are provided for informational purposes only.

Based on existing water quality in the Pajaro River Basin, staff provisionally estimates that load reductions of nitrate in streams to attain water quality objectives for drinking water supply beneficial uses could be in the range of 0% to 40%, depending on stream reach. To attain water quality targets protective of aquatic habitat in streams of the Pajaro River Basin, we provisionally estimate that nutrient load reductions for streams in the range of 0% to 70% are possible, depending on stream reach.

Table 6. Estimated annual load reductions of nitrate to surface waters of the lower Salinas Valley needed to meet water quality targets (provided for informational purposes only).

Waterbody-Site	Estimated Mean Annual Flow (cfs)	Mean Annual Conc. (mg/L)	Mean Annual Existing Load (lbs.)	Mean Annual Loading Capacity (lbs.)	% Reduction Goal[A]	NO3-N Numeric Target Used for Loading Capacity (mg/L)
Salinas River @ Spreckels-309 SSP	420	1.85	1,529,907	8,269,769	0%	MUN (10)
Salinas River @ Hwy 1 - 309SBR	350	13.29	9,158,769	5,513,179	40%	Wet Season Biostim (8.0)
Old Salinas Riv-OLS-MON	36.2	18.68	1,331,464	570,220	57%	Wet Season Biostim (8.0)
Tembladero Slough-309TDW	36	27.2	1,928,037	567,070	71%	Wet Season Biostim (8.0)

Waterbody-Site	Estimated Mean Annual Flow (cfs)	Mean Annual Conc. (mg/L)	Mean Annual Existing Load (lbs.)	Mean Annual Loading Capacity (lbs.)	% Reduction Goal[A]	NO3-N Numeric Target Used for Loading Capacity (mg/L)
Moro Cojo Slough-306MOR	6	5.3	62,614	94,512	0%	Wet Season Biostim (8.0)
Chualar Creek-309CRR	1.79	90.5	318,967	35,245	89%	MUN (10)
Quail Creek-309QUI	0.7	30.62	42,203	13,783	67%	MUN (10)
Esperanza Creek-ESZ-HWY	0.38	65.43	48,956	7,482	85%	MUN (10)
Blanco Drain-BLA-PUM	5.75	61.76	699,229	90,574	87%	Wet Season Biostim (8.0)
Lower Reclamation Canal-309JON	16.66	13.28	435,629	262,427	40%	Wet Season Biostim (8.0)
Upper Reclamation Canal-309ALG	10.47	16.48	339,741	164,923	51%	Wet Season Biostim (8.0)
Natividad Creek-309NAD	0.99	21.3	41,520	15,594	62%	Wet Season Biostim (8.0)
Gabilan Creek-309GAB	8.22	10.49	169,782	129,481	24%	Wet Season Biostim (8.0)
Alisal Creek – 309HRT & 309UAL	2.3	23.9	106,825	35,757	67%	Wet Season Biostim (8.0)
Alisal Slough – 309ASB	1.64	47.5	153,385	20,667	87%	Wet Season Biostim (8.0)
Santa Rita Creek-309SRTA-36	4.9	12.16	105,110	69,151	34%	Wet Season Biostim (8.0)
Merrit Ditch-309MER	3.7	20.98	111,122	58,282	48%	Wet Season Biostim (8.0)
Gabilan Creek-GAB-OSR	5.16	1.48	15.037	101,600	0%	MUN (10)

[A] Percent reduction goals are for informational purposes only, and should not be viewed as the TMDL.

Table 7. Estimated dry season load reductions of nitrate to surface waters of the lower Salinas Valley needed to meet water quality targets (provided for informational purposes only).

Waterbody-Site	Estimated Mean Dry Flow (cfs)	Mean Dry Season Conc. (mg/L)	Mean Dry Existing Load (lbs.)	Mean Dry Loading Capacity (lbs.)	% Reduction Goal [A]	NO3-N Numeric Target Used for Loading Capacity (mg/L)
Salinas River-309 DAV	5.98	17.24	101,497	8,242	92%	dry Season Biostim (1.4)
Salinas River-309SBR	26.3	19.02	492,471	36,249	93%	dry Season Biostim (1.4)
Salinas River-309SAC	57.33	1.59	88,664	564,412	0%	MUN
Old Salinas River-OLS-MON	7.08	19.47	135,711	21,608	84%	dry Season Biostim (3.1)
Tembladero Slough-309TEH	14.2	28.72	401,501	89,471	78%	dry Season Biostim (6.4)
Moro Cojo Slough-306MOR	4.15	4.5	18,386	6,946	62%	dry Season Biostim (1.7-TN)
Chualar Creek-309CRR	0.95	106.42	99,139	9,353	91%	MUN (10)
Quail Creek-309QUI	1.99	28.32	55,444	19,592	65%	MUN (10)
Blanco Drain-BLA-PUM	5.6	57.67	317,945	35,285	89%	dry Season Biostim (6.4)
Lower Reclamation Canal-309JON	3.73	7.72	28,349	23,502	17%	dry Season Biostim (6.4)
Upper Reclamation Canal-309ALG	2.4	18.06	42,667	15,122	65%	dry Season Biostim (6.4)
Natividad Creek-309NAD	0.33	25.91	8,418	650	92%	dry Season Biostim (2.0)
Gabilan Creek-309GAB	0.69	7.27	4,939	1,359	72%	dry Season Biostim (2.0)
Alisal Creek – 309HRT & 309UAL	0.5	23.1	11,371	984	91%	dry Season Biostim (2.0)
Alisal Slough-209ASB	1.29	42.13	53,505	16,256	70%	dry Season Biostim (6.4)
Espinosa Slough-309ESP	1.71	36.82	61,986	10,775	83%	dry Season Biostim (6.4)
Merrit Ditch-309MER	3.7	30.98	47,604	12,350	74%	dry Season Biostim (6.4)

[A] Percent reduction goals are for informational purposes only, and should not be viewed as the TMDL

PART TWO: POTENTIAL IMPLEMENTATION ALTERNATIVES FOR CEQA SCOPING

This section provides information on known management practices that could address nutrient pollution of surface waters and groundwaters. These are provided as informational background to facilitate discussion for CEQA scoping; they are not provided as examples current or anticipated requirements. Stakeholders and the interested public are also encouraged to share their own thoughts and expertise on how they or responsible parties would foreseeably comply with the proposed TMDLs by implementation of management practices, and what the reasonably foreseeable significant environmental impacts associated with those means of compliance could be.

Both nitrogen and phosphorus reach surface waters at an elevated rate as a result of human activities (USEPA, 1999). Staff has identified numerous alternative methods of compliance available for controlling nutrient loading to the Lower Salinas River and Reclamation Canal watersheds. The proposed project will require control of nitrogen and phosphorus to correct impairment of beneficial uses of surface waters.

The State Water Resources Control Board's (SWRCB) Nonpoint Source Management Program provides an on-line reference guide 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 on-line resource guide is to support the implementation and development of NPS total maximum daily loads (TMDLs) and watershed (action) plans with a goal of protecting high-quality waters and restoring impaired waters. Relevant information from the SWRCB Nonpoint Source (NPS) – Encyclopedia is reproduced below, and is available online at:

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

A. Implementation Alternatives – Agriculture: Nutrient Management

1.1 MANAGEMENT MEASURE

Develop, implement, and periodically update a nutrient management plan to (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.

1.2 MANAGEMENT PRACTICES

The purpose of this management practice is to reduce the nutrient loss from agricultural lands, which occurs through edge-of-field runoff or leaching from the root zone. An effective way to manage nutrients is to develop a nutrient management plan (NMP) in accordance with USDA NRCS Standard 590. NMPs should be updated at least once every 5 years or once per crop rotation period. Records of nutrient use and sources should be maintained for easy reference. Components of an NMP include the following:

- Farm and field maps with identified and labeled: acreage and type of crops, soil surveys, location of any environmental sensitive areas including any nearby water bodies 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 manure, 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 erodable 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 manure 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 this NPS Encyclopedia.

1.3 PROGRAMS

- Biologically Integrated Farming Systems (BIFS) is a program to help growers enhance environmental quality while maintaining yields and profits. BIFS projects use on-farm demonstrations and a collaborative model of outreach and extension involving public-private partnerships.
- California Certified Crop Advisors (CCA) can help producers grow economically and environmentally sound crops. The California CCA program is a voluntary certification program for individuals who provide advice to growers on crop management and inputs. Their Web site lists certified crop advisors for California. For more information contact the California CCA (Telephone: (916) 928-1625).
- California Dairy Quality Assurance (CDQA) Program was created to assist dairy producers with navigating and complying with the rules and regulations governing the industry. The CDQA program is a voluntary partnership between dairy producers, government agencies, and academia to address environmental stewardship, animal welfare, and food safety issues. The environmental stewardship module has three components: education, self-assessment, and third-party evaluation, terminating in certification, and focuses on compliance with federal, state, and local water quality regulations. A comprehensive checklist is used as the assessment tool in the certification process.

1.4 INFORMATION RESOURCES

- California Department of Food and Agriculture's Fertilizer Research and Education Program (FREP) was created to advance the environmentally safe and agronomically sound use and handling of fertilizer materials. FREP facilitates and coordinates research and demonstration projects by providing funding and developing and disseminating information. It funds research to develop information on crops, irrigation methods, and nitrate in the soil as well as other environmental issues related to fertilizer use, such as heavy metals.
- Fawecett, R., A Review of BMPs for Crop Nutrients and Conservation Tillage to Improve Water Quality. This paper is published on the Conservation Technology Information Center (CTIC) and provides information on nutrient management.
- Midwest Plan Services, Livestock and Poultry Curriculum: Module D Land Application and Nutrient Management is a national curriculum developed for U.S. livestock and poultry industry advisors and producers to help them acquire certification and achieve environmentally sustainable production systems.
- National Association of State Departments of Agriculture (NASDA) Research Foundation, Comprehensive Nutrient Management Plans provides guidance to agricultural producers in developing and writing CNMPs. The site provides visitors with national and state-specific information to complete the manure management, land application, and nutrient management planning required for animal feeding operations. The site includes news, events, case studies, tools, technologies, guidelines and regulations, and links to other pertinent information.
- UC Davis, Pomology Department: Nitrogen Fertilization Recommendation for Almond. This model calculates the nitrogen requirement for almond production based upon the yield history, current conditions, and previous nitrogen applications. This model can be used to calculate both timing and rate of fertilizer application required to maintain optimum yield. Site-specific information is required for accurate projection of nitrogen requirement; hence this model should be applied to each distinct management unit, such as a block or field. The data used in this model were derived from exhaustive tree-nitrogen budget determinations.

- University of California, Davis, Department of Animal Sciences: Dairy Waste Management offers tools for planning and designing dairy waste management facilities, estimating the nutrient application rate of dairy manure, and assessing the risk to ground and surface water resources.
- University of Purdue, Manure Management Planner is a Windows-based computer program developed at Purdue University that's used to create manure management plans for crop and animal feeding operations. The user enters information about the operation's fields, crops, storage, animals, and application equipment. MMP helps the user allocate manure (where, when and how much) on a monthly basis for the length of the plan (1-10 years). This allocation process helps determine if the current operation has sufficient crop acreage, seasonal land availability, manure storage capacity, and application equipment to manage the manure produced in an environmentally responsible manner. MMP is also useful for identifying changes that may be needed for a non-sustainable operation to become sustainable, and determine what changes may be needed to keep an operation sustainable if the operation expands.
- USDA NRCS, Nutrient Management: this Website contains planning tools, databases on comprehensive nutrient management planning.
- USDA NRCS, Soil Data Mart provides a mechanism to access our official SSURGO/STATSGO soil survey data. It does not physically store the pre-packaged datasets, but instead generates them in real-time as a request is made from a customer. The Soil Data Mart will only provide access to the current version of data for a soil survey area.
- USEPA National Agriculture Compliance Center, Crops: provides information about environmental requirements specifically relating to the production of many types of agricultural crops, including food, feed, and fiber crops, and specialty crops, such as tobacco, herbs, spices, mushrooms, seed crops, and aquatic plants.

1.5 REFERENCES

USDA. No date. *Electronic Field Office Technical Guide for California*. U.S. Department of Agriculture, Natural Resource Conservation Service. (http://efotg.nrcs.usda.gov/)

USEPA. 2002. Chapter 4: Management Measures. In *National Management Measures for the Control of Nonpoint Pollution from Agriculture*. U.S. Environmental Protection Agency, Washington, DC. (http://www.epa.gov/owow/nps/agmm/)

B. Implementation Alternatives - Urban Areas

With approximately 80 percent of the nation's population living in coastal areas, controlling polluted runoff in urban areas is a challenge. Negative impacts of urbanization on coastal and estuarine waters are well documented in a number of sources, including California's Clean Water Act section 305(b) and section 319 reports and the Nationwide Urban Runoff Program.

Major pollutants found in runoff from urban areas include sediment, nutrients, oxygen-demanding substances, road salts, heavy metals, petroleum hydrocarbons, pathogenic bacteria, viruses, trash, and plastics. Suspended sediments constitute the largest mass of pollutant loadings to receiving waters from urban areas. Construction is a major source of sediment erosion. Petroleum hydrocarbons result mostly from automobile sources. Nutrient and bacterial sources include garden fertilizers, leaves, grass clippings, pet wastes, and faulty septic tanks. As population densities increase, a corresponding increase occurs in pollutant loadings generated from human activities. Many of these pollutants enter surface waters via runoff without undergoing treatment.

The control of urban nonpoint source (NPS) pollution requires the use of two primary strategies: the prevention of pollutant loadings and the treatment of unavoidable loadings. California's urban management measures are organized to parallel the land use development process to address the prevention and treatment of NPS pollution loadings during all phases of urbanization; this strategy relies primarily on the watershed approach, which focuses on pollution prevention or source reduction practices. Pollution prevention and source reduction practices are favored over treatment practices because conducting education practices and incorporating pollution prevention practices into project planning and design activities are generally more effective, require less maintenance, and are more cost-effective in the long term than treatment strategies. Treatment strategies should be used only to address unavoidable loadings or where they are truly cost-effective.

The Urban land-use category went through a major reorganization and several new, draft Management Measures (MM) were added to the previous 2006 edition of the NPS Encyclopedia. MM categories in the 2006 edition were based on the following water quality issues: Runoff from Developing Areas, Runoff from Construction Sites, and Runoff from Existing Development. These categories were consolidated into two, new MM categories: 3.1 - Planning and Design and 3.2 - Construction Practices (including the construction of transportation infrastructure). The purpose for this reorganization was to use categories based on common urban development phases so the end user (land developer, urban planner, transportation planner, municipal public works agency, flood control agency, or other urban water user) could easily access this information when implementing a project and/or addressing a water quality issue. In these new MM categories are subgroupings that reflect common areas of interest for the end users of this encyclopedia.

The following describes some specific changes to the 2006 edition of the NPS Encyclopedia. Former MM 3.1A - Runoff from Developing Areas, Watershed Protection was renamed to 3.1A - Planning and Design, Watershed and Groundwater Protection (groundwater planning management practices were added). Three new, draft MM were added to MM category 3.1 - Planning and Design, they include: Flood Control, Impervious Surfaces, and Landscaping. These new, draft MM were added to include management practices that end users of this encyclopedia could easily access by using terms they are familiar with. Planning and design related management practices from the previous MMs, including erosion and sediment control plans were consolidated into MM 3.1E Land Development, which also includes planning and design of transportation infrastructure. Former MMs and associated management practices that are implemented during the construction phase of a project were included in MM 3.2 - Construction Practices which also includes construction of transportation infrastructure. MMs and associated management practices were then grouped based on common technologies and management practices, they include, 3.2A Structural/Permanent and 3.2B Groundskeeping/Chemical Control. Former MM 3.4A and B, Onsite Wastewater Treatment Systems (new and existing) were consolidated and renamed to MM 3.2C - Construction Practices, Onsite Wastewater Treatment Systems. A new, draft MM was added 3.2D - Construction Practices, Grading and Excavation which includes management practices that are designed to prevent pollution by limiting grading of natural drainages and reduce erosion during site grading activities.

These links provide more information for each of the following management measures

- **3.1 Planning and Design**
  - 3.1A Watershed and Groundwater Protection
  - 3.1B Flood Control (draft)
  - 3.1C Impervious Surfaces (draft)
  - 3.1D Landscaping (draft)
  - 3.1E Land Development, including Transportation Infrastructure
- **3.2 Construction Practices (includes construction of transportation infrastructure)**
  - 3.2A Structural/Permanent
  - 3.2B Groundskeeping/Chemical Control
  - 3.2C Onsite Wastewater Treatment Systems
  - 3.2D Grading/Excavation (draft)
- **3.3 Education and Outreach**
  - For Urban Areas

1.6 PROGRAMS

With respect to programs within the SWRCB and the RWQCBs, urban runoff is addressed primarily through the National Pollution Discharge Elimination System (NPDES) Permitting Program, although the SWRCB NPS Program will apply where the runoff is not regulated as a permitted point source discharge. The NPDES "point source" system of addressing urban runoff pollution is the result of the Water Quality Act of 1987, which amended the federal Clean Water Act to require NPDES permits for certain categories of storm water discharges. These "categories" of storm water discharges are described as follows:

- Phase I of the Storm Water Program, defined in federal regulation in 1990, includes storm water discharges associated with "industrial" activities (as defined by the regulations), construction activities that disturb five acres of land or more, and discharges from municipal separate storm sewer systems (MS4s) serving populations of 100,000 people or more.

- Phase II of the Storm Water Program, defined in federal regulations in 1999, expanded the program to require NPDES permits for discharges from construction sites disturbing between one and five acres, from small MS4s that serve populations of less than 100,000, from some other governmental facilities, and from industrial facilities owned by small municipalities. The expansion of the Storm Water Program through Phase II has therefore expanded the applicability of the NPDES point source program to a greater number of communities, businesses, government facilities, and industries. The result is that most urban runoff in California is now subject to NPDES permits.

The NPDES Program supersedes the SWRCB or RWQCB NPS Program in the areas where there is overlap. NPDES permits require implementation of management practices, which may or may not be similar to the management measures and management practices of the NPS Program. However, the SWRCB/RWQCB's NPDES Program does not supersede the planning and land-use activities of other State agencies, such as the California Coastal Commission or the San Francisco Bay Conservation and Development Commission, which they are responsible for implementing under their own regulatory authorities. The SWRCB/RWQCB NPDES permits are at least as stringent as the NPS Program and will ensure at least the same level of compliance and water quality protection as the NPS Program's management measures provide. Further, the authority of the SWRCB/RWQCB NPS Program will still apply for land use activities not covered by NPDES permits and for municipalities, construction sites, and industries that fall outside of the Phase I and Phase II Storm Water Programs.

1.7 OTHER PROGRAMS

- California Department of Transportation (Caltrans), Statewide Storm Water Management Program integrates appropriate stormwater control activities into ongoing activities, thus making control of stormwater pollution a part of Caltrans normal business practices.
- Surface Transportation Policy Project (STPP) provides assistance to local transportation agencies, elected officials, and citizen groups to help stakeholders take advantage of the new opportunities available under the federal transportation bill to link transportation to land use, housing, social equity, livable communities, and smart growth.
- SWRCB, Clean Water Act section 401 Certification Program, RWQCBs review projects that require a federal permit under CWA section 404 or involve dredge or fill activities that may result in a discharge to waters of the United States. This is to ensure that the State's interests are protected on any federally permitted activity occurring in or adjacent to waters of the State.
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1.8 INFORMATION RESOURCES

- Caltrans Environmental Handbook, provides guidance on the identification and evaluation of the environment, including cultural resources (Volume 2), biological resource (Volume 3), community impact assessment (Volume 4), and guidance on storm water management (Volume 5) which is still in preparation.
- Caltrans, Statewide Storm Water Management Plan was approved by the SWRCB in March 2003, describes procedures and practices Caltrans uses to manage pollutants discharged from storm water drainage systems.
- Caltrans Stormwater Water Quality Planning Tool is a database of water quality standards and possible pollutants from Caltrans facilities. This unique tool is another valuable resource being used by Caltrans in its continuing commitment to prevent storm water pollution.
- Center for Watershed Protection, Urban Stormwater Retrofit Practices, August 2007, outlines the basics of retrofits, describes the 13 unique locations where they can be found, and presents rapid methods to find, design and deliver retrofits to meet a wide range of subwatershed objectives.
- Community Conservancy International (CCI), Green Solutions Project is a GIS-based collaborative project that determined areas with LID development opportunities for the Greater Los Angeles Area.
- Environmental Enhancement and Mitigation Program offers financial assistance to government agencies and nonprofit organizations to fund projects aimed at reducing pollution associated with new or modified State transportation facilities.
- G. Fred Lee and Associates, Stormwater Runoff Science/Engineering Newsletter is devoted to stormwater-runoff water quality issues in managing urban and agricultural stormwater runoff water quality impacts. The newsletter can be searched by topic or volume, and publications on other topics, including landfills, watersheds, contaminated sediment, reclaimed waters, hazardous chemicals, water quality, domestic water, and excess fertilization, can also be found on this site.

- International Stormwater Best Management Practices (BMP) Database Project Website, features a database of over 300 BMP studies, performance analysis results, tools for use in BMP performance studies, monitoring guidance and other study-related publications. The overall purpose of the project is to provide scientifically sound information to improve the design, selection and performance of BMPs. Continued population of the database and assessment of its data will ultimately lead to a better understanding of factors influencing BMP performance and help to promote improvements in BMP design, selection and implementation.
- Los Angeles County Structural BMP Prioritization Methodology is a new, systematic tool to prioritize structural BMP projects within Los Angeles County watersheds. This GIS-based method is designed to help watershed planners, managers, and stakeholders throughout LA County in strategic, conceptual planning of structural BMP placement. Funding for development of the Methodology was provided in part through an agreement with the State Water Resources Control Board (SWRCB) pursuant to the Costa-Machado Water Act of 2000 (Proposition 13) and any amendments thereto for the implementation of California's Nonpoint Source Pollution Control Program. The project was conceived by Don Wolfe, Director of Public Works for the County of Los Angeles; Dr. Mark Gold, Executive Director of Heal the Bay; and Eric Strecker, Principal with GeoSyntec Consultants.
- North American Lake Management Association (NALMA). 2007, Fundamentals of Urban Runoff Management is available to the public exclusively on the NALMS Website. You may download it in two versions: low-resolution and high-resolution. The low-resolution document is suitable for on-screen reading and lower-quality printing. The high-resolution version contains higher-quality graphics and is suited towards printing. T here is no printed copy planned at this time. If you have questions about the document or would like to be put into contact with one or more of the authors, please contact the NALMS staff.
- Source Water Collaborative (SWC), Your Water.Your Decision guide is intended as a quick source of key information on local options for protecting drinking water, including development, stewardship, and budgeting. Using the theme, "how you govern can determine what you drink," the guide was developed as a tool to enable local officials to take action within their communities and with neighboring communities.
- UC Davis Extension Center for Water and Land Use, mission is to increase awareness and understanding of the relationships between water resources and land use policies and practices through education, training, applied research, collaboration and dissemination of information.
- USEPA Urban BMP Performance Tool provides stormwater professionals with easy access to approximately 220 studies which assess the performance of over 275 stormwater BMPs. The tool provides access to studies covering a variety of traditional and low impact BMP types, including retention and detention ponds, biofilters, grassed filter strips, porous pavement, wetlands, and others. Users will also find a series of essays aimed at improving understanding of BMP performance and the importance of volume reduction/infiltration in these assessments. EPA plans to add more studies over the coming year, focusing on expanding the collection of studies of low impact development or green infrastructure BMPs.
- USEPA, Stormwater Case Studies provides a series of storm water case studies to help communities with municipal separate storm sewer systems (MS4s) regulated under the NPDES Phase II Rule get started on or improve their storm water management programs. Each case study description includes links to additional materials for the relevant storm water program area.
- USEPA, Nonpoint Source News-Notes is an online bulletin published by EPA that covers a wide range of topics, including nonpoint source pollution control, watershed restoration, and ecosystem-driven management. The Web interface allows users to search current and back issues of News-Notes by keyword.
- USEPA, BASINS: Better Assessment Science Integrating Point and Nonpoint Sources is used for managing watersheds, integrates national watershed data and state-of-the-art environmental assessment and modeling tools into a geographic information system. The EPA Web site allows users to download the application and access documentation, metadata, frequently asked questions, training, an online forum, and other tools and utilities.
- USEPA Storm Water Management Model (SWMM) is a dynamic rainfall-runoff simulation model used for single event or long-term (continuous) simulation of runoff quantity and quality from primarily urban areas. The runoff component of SWMM operates on a collection of subcatchment areas that receive precipitation and generate runoff and pollutant loads. The routing portion of SWMM transports this runoff through a system of pipes, channels, storage/treatment devices, pumps, and regulators. SWMM tracks the quantity and quality of runoff generated within each subcatchment, and the flow rate, flow depth, and quality of water in each pipe and channel during a simulation period comprised of multiple time steps.
- U.S.Geological Survey (USGS) Hydrologic Simulation Program – Fortran (HSPF) simulates for extended periods of time the hydrologic, and associated water quality, processes on pervious and impervious land surfaces and in streams and well-mixed impoundments.
- Washington State Department of Transportation (WSDOT), Soil Bioengineering provides information from designing projects to costs, funding, contractors, and native plant supplies. The site also showcases past projects and provides links to several online information sources.

- WSDOT, Roadside and Site Development Unit began in 1990 with a review of state roadside policies and procedures by the Washington State Department of Transportation (WSDOT) Landscape/Roadside Reorganization Task Force. The Task Force recommended the development of clear policies and guidelines, and the coordination of planning, design, construction, and maintenance activities. The RCP provides those roadside policies and guidelines in coordination with the Transportation Policy Plan for Washington State, the Statewide Multimodal Transportation Plan, and Federal Highway Administration policies.
- WSDOT, Roadside Manual provides guidance on roadside maintenance, including planning, design, construction, and maintenance. The manual has information on sustainable roadsides, environmental functions, wetlands, water quality, parking area design, erosion control, contour grading, soil bioengineering, and vegetative restoration concepts

C. Implementation Alternatives – Livestock and Grazing Management

1.9 MANAGEMENT MEASURE

Protect range, pasture, and other grazing lands by:

1. Implementing one or more of the following to protect sensitive areas (such as streambanks, wetlands, estuaries, ponds, lake shores, and riparian zones): (a) exclude livestock, (b) provide stream crossings or hardened access to watering areas, (c) provide alternative drinking water locations away from surface waters, (d) locate salt and additional shade, if needed, away from sensitive areas, or (e) use improved grazing management (e.g., herding) to reduce the physical disturbance and reduce direct loading of animal waste and sediment caused by livestock; and
2. Achieving either of the following on all range, pasture, and other grazing lands not addressed under (1) above: (a) implement the range and pasture components of a CMS as defined in the USDA NRCS *Field Office Technical Guide* by applying the progressive planning approach of the USDA NRCS to reduce erosion, or (b) maintain range, pasture, and other grazing lands in accordance with activity plans established by the Bureau of Land Management of the U.S. Department of the Interior or the USDA Forest Service or the California Rangeland Water Quality Management Plan.

1.10 MANAGEMENT PRACTICES

The purpose of this management measure is to protect sensitive areas in range, pasture, and other grazing lands. California-approved USDA NRCS standards required for a conservation management systems should be applied to the entire grazing area. These components include erosion control, adequate pasture stand density, and rangeland condition. Recommended practices include the following:

- Carefully plan the use of grazing areas by developing a grazing management plan with the goal of improving or maintaining water quality. Use prescribed grazing techniques to harvest vegetation in a controlled manner by managing the intensity, frequency, and duration of grazing.
- Prevent erosion from wind or water by maintaining sufficient vegetative cover to stabilize soils. Where feasible, consider installing windrows or wind fences to reduce wind velocity and erosion.
- Keep animals out of surface waters: exclude animals, people, or vehicles to protect and maintain plant and water quality and prevent or minimize direct loading of animal waste and sediment into surface waters. Install alternative drinking sources (e.g., pipelines, ponds, troughs, tanks, and wells) to keep animals away from sensitive waters and install hardened access points so animals have access to drinking water sources. Use fences, hedgerows, moats, and other practices to keep animals away from sensitive areas and place mineral supplements and additional shade away from sensitive areas.
- Provide designated, stabilized stream crossings for livestock and equipment to minimize impacts on stream habitat and water quality.
- Use structural range improvements like access roads, grade stabilizers, sediment ponds, stalk trails or walkways, troughs and tanks, pipelines, and streambank protection to maintain vegetation and slopes and prevent waterway degradation.

- Use non-structural practices such as planting of native vegetation, especially along channels or in critical areas; prescribed burning; range seeding; brush management; stream corridor improvement; and wetland and upland wildlife management to manage vegetation, prevent erosion, and protect wildlife habitat.
- Allow for a vegetative buffer strip/filter strip to remain around sensitive areas (such as streambanks, ponds, lake shores, and riparian zones) to help facilitate infiltration and ultimately prevent polluted runoff from directly entering surface waters.
- Periodically monitor the conditions of grazing lands to ensure that management practices are effective, and if not, implement new practices or modify existing practices to maintain vegetation and protect soils and waterways.

1.11 PROGRAMS

- Bureau of Land Management (BLM) has begun implementing the standards for rangeland health and guidelines for livestock grazing that apply to public lands administered by BLM in central and northern California and northwestern Nevada.
- California Board of Forestry's California Rangeland Water Quality Management Plan is a voluntary plan developed by the California Cattlemen's Association, in collaboration with University of California Cooperative Extension and USDA NRCS. The plan was officially approved in 1995 and includes rangeland water quality management strategies, policy and coordination mechanisms, as well as sample plans and sources of assistance. The California Board of Forestry is responsible for administering the plan.
- California Cattlemen's Association's Rangeland and Water Quality provides access to the California Rangeland Water Quality Management Plan, which addresses both governmental policy and management strategies. The Grazing for Change booklet features nine California rancher's range and watershed management success stories. The ongoing Riparian Grazing Project serves as another useful tool for range managers.
- California Grazing Academy is a unique and exciting program emphasizing practical application of controlled grazing principles to improve the environment and increase ranch profit. This challenging course consists of a minimum of lecture and a maximum of hands-on experience and learning.
- Department of Pesticide Regulation (DPR), Pest Management Alliance and Planning Program provides funding support, when funds become available, to encourage increased implementation of biologically intensive, reduced-risk pest management. This program is designed to create a collaborative, interdisciplinary team that uses a systems approach—the assumption is that team members have already solved pest problems and other specialized components through applied research. The Alliance is part of a problem-solving continuum, taking the data collected from research and preparing for the next stage—education through demonstration, and ultimately implementation.
- NRCS, Conservation of Private Grazing Land initiative will ensure that technical, educational, and related assistance is provided to those who own private grazing lands. It is not a cost share program. This technical assistance will offer opportunities for: better grazing land management; protecting soil from erosive wind and water; using more energy-efficient ways to produce food and fiber; conserving water; providing habitat for wildlife; sustaining forage and grazing plants; using plants to sequester greenhouse gases and increase soil organic matter; and using grazing lands as a source of biomass energy and raw materials for industrial products.
- NRCS, Grassland Reserve Program (GRP) is a voluntary program which helps landowners restore and protect grassland, rangeland, pastureland, shrubland and certain other lands and provides assistance for rehabilitating grasslands. The program will conserve vulnerable grasslands from conversion to cropland or other uses and conserve valuable grasslands by helping maintain viable ranching operations.

1.12 INFORMATION RESOURCES

- Burns, R.T., and M.J. Buschermohle (2002) Selection of Alternative Livestock Watering Systems this publication describes livestock watering system alternatives available to producers. These systems can be divided into three basic types: direct access, gravity flow and pressure systems. The best system type for a particular producer will depend on many factors, including site layout, water requirement, availability and cost of utility water and electricity, as well as water source type and location. This publication provides basic descriptions of some livestock watering system alternatives and discusses some of the positive and negative aspects of each.
- California Cattlemen's Association Grazing for Change, Range and Watershed Management Success Stories in California. For information about ordering a copy of this booklet, call or e-mail at (Telephone: (916) 444-0845; e-mail: staff@calcattlemen.org).

- Galt, D., F. Monlinar, J. Navarro, J. Joseph, and J. Holecheck (2000) Grazing Capacity and Stocking Rate this study outlines the benefits of conducting grazing capacity studies and describes procedures for establishing grazing capacity and setting stocking rates.
- Montana Department of Natural Resources and Conservation, Best Management Practices for Grazing presents grazing management practices for a water quality demonstration project.
- National Agriculture Compliance Center, Pasture, Grazing, and Rangeland Operations provides information about environmental requirements specifically relating to livestock production in pastures and rangeland, as well as other grazing operations.
- National Sustainable Agriculture Information Service, Managed Grazing in Riparian Areas provides information and technical assistance to farmers, ranchers, educators, and others involved in sustainable agriculture. Managed Grazing in Riparian Areas is designed to help farmers and ranchers identify and use locally appropriate grazing practices to protect riparian resources, including keeping livestock from streambanks, properly resting pastures to restore degraded land, and determining the proper duration and season for grazing pastures. Other relevant publications to which this Website links include the following:
    - Assessing the Pasture Soil Resource
    - Grazing Networks for Livestock Producers
    - Matching Livestock and Forage Resources in Controlled Grazing
    - Nutrient Cycling in Pastures
    - Protecting Riparian Areas: Farmland Management Strategies
    - Rotational Grazing
    - Pastures: Sustainable Management
- U.S. Department of Agriculture, Natural Resources Conservation Service, Grazing Lands Technology Institute, National Range and Pasture Handbook this manual covers inventorying, monitoring, and managing grazing lands as well as livestock nutrition, behavior, and husbandry. Special sections deal with the economics of grazing, wildlife management, and hydrology.
- University of California (UC) Sustainable Agriculture Research and Education Program (SAREP) crop and livestock production provides research and information to help California producers develop and manage production systems in ways that meet the demands of society, address concerns for the natural environment, and provide economic security for their families and businesses.
- UC Davis, California Rangelands Research Information Center the purpose of this center is to develop research and extension education initiatives and to foster collaboration between California rangeland researchers and educators.
- USDA NRCS, Grazing Land Conservation Initiative (GLCI) is a nationwide collaborative process of individuals and organizations working to maintain and improve the management, productivity, and health of the nation's privately owned grazing land. This process has formed coalitions that represent the grassroots concerns that impact private grazing land. The coalitions actively seek sources of funding to increase technical assistance and pursue public awareness activities that maintain or enhance grazing land resources.
- USEPA, National Management Measures to Control Nonpoint Source Pollution from Agriculture, Chapter 4E: Grazing Management Chapter 4E covers grazing management topics including an overview of grazing issues, environmental impacts of grazing, grazing management practices, factors to be considered when selecting management practices, and costs/savings of practices. The document also refers readers to additional resources on grazing management.

1.13 REFERENCES

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