SWAMP
Surface Water
Ambient Monitoring
Program

SWAMP Assement Repot for the Central Coast Region	2000-01

Central Coast Ambient Monitoring Program Hydrologic Unit Report for the 2000-01 Santa Maria Watershed Rotation Area

2003

California Water Boards

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1 Introduction

Overview of the Surface Water Ambient Monitoring Program in California
California Assembly Bill 982 (Water Code Section 13192; Statutes of 1999) required that the State Water Resources Control Board (SWRCB) assess and report on State water monitoring programs and prepare a proposal for a comprehensive surface water quality monitoring program. In the SWRCB Report to the Legislature from November 2000, entitled "Proposal for a comprehensive ambient surface water quality monitoring program", the SWRCB proposed to restructure existing water quality monitoring programs into a new program, the Surface Water Ambient Monitoring Program (SWAMP). The SWAMP program is intended to provide comprehensive statewide environmental monitoring focused on information necessary to effectively manage the State's water resources. The program is designed to be consistent, cooperative, adaptable, scientifically sound, and to meet clear monitoring objectives. The program focuses on spatial and temporal trends in water quality statewide. It will facilitate reporting and categorizing of the State's water quality under Sections 305 (b) and 303 (d) of the Federal Clean Water Act. A Comprehensive Monitoring and Assessment Strategy (October, 2005), also know as the Ten-Point Strategy, elaborates on SWAMP goals, objectives, design, indicators, data management, quality control, and other program information. Specific program details can be found in the SWAMP Quality Assurance Management Plan (QAMP) (Puckett 2002).

Specifically, the statewide SWAMP is designed to meet four goals:

1. Create an ambient monitoring program that addresses all hydrologic units of the State.

2. Document ambient water quality conditions in potentially clean and polluted areas.

3. Identify specific water quality problems preventing the realization of beneficial uses of water in targeted watersheds.

4. Provide the data to evaluate the overall effectiveness of water quality regulatory programs in protecting beneficial uses of waters of the State.

Goals and Objectives of the Central Coast Ambient Monitoring Program
The Central Coast Regional Water Quality Control Board is responsible for water quality issues along the central coast of California. The region extends from southern San Mateo County in the north to northern Ventura County in the south, and includes Monterey, Santa Cruz, San Benito, San Luis Obispo, Santa Barbara and portions of Santa Clara counties. The Central Coast Ambient Monitoring Program (CCAMP) is the Central Coast Regional Water Quality Control Board's ambient monitoring program, and a major portion of its funding comes from SWAMP**.** The goal of monitoring in the Central Coast region is to provide a screening level assessment of water quality in all Hydrologic Units, based on a variety of chemical, physical and biological indicators. Monitoring data is used to evaluate beneficial use support in the surface waters of the Region. Monitoring approaches include conventional water quality, water toxicity, sediment chemistry and toxicity, tissue chemistry, rapid bioassessment for benthic invertebrates, and

habitat assessment. CCAMP uses a rotating basin approach where conventional water quality monitoring is conducted monthly at all sites, and at a subset of the sites other monitoring approaches are conducted annually or biannually. Coastal confluence sites, just above salt water influence, are monitored continuously, and serve for long-term trend monitoring and as "integrators" of upstream impacts.

It is the intent of the SWAMP program in the Central Coast Region to monitor and assess all the waters of the Region, using a weight-of-evidence approach. Data is intended for use in evaluating waterbodies for 305(b) reporting and 303(d) listing. General programmatic objectives of the monitoring program are to:

1. Determine the status and trends of surface, estuarine and coastal water quality and associated beneficial uses in the Central Coast Region
2. Coordinate with other data collection efforts
3. Provide information in easily accessible forms to support decision-making

The following sections address questions posed in the SWAMP Monitoring Guidance related to beneficial use support. The monitoring approach and the water quality criteria that address these beneficial uses are discussed.

Is there evidence that it is unsafe to swim?
Beneficial Use: Water Contact Recreation (REC-1)
Objective(s): At sites throughout water bodies that are used for swimming, or that drain to areas used for swimming, screen for indications of bacterial contamination by determining percent of samples exceeding adopted water quality objectives and EPA mandated objectives. CCAMP data as well as data collected by local agencies and organizations will be used to assess shoreline and creek conditions.
Monitoring Approach: Monthly monitoring for indicator organisms (e.g. *E. coli*, fecal coliform, *Enterococcus sp.*); compilation of other data sources
Assessment Limitations: CCAMP sampling for fecal and total coliform only; assessments are based on these parameters
Criteria:

- 10% of samples over 400 MPN/100 ml fecal coliform
- Geometric mean of fecal coliform samples greater than 200 MPN/100mL
- 10% of samples over 235 MPN/100 ml *E. coli*

Is there evidence that it is unsafe to drink the water?
Beneficial Use: Municipal and Domestic Water Supply (MUN)
Objective(s): At sites throughout water bodies that are sources of drinking water or recharge ground water, determine percent of samples that exceed drinking water standards or adopted water quality objectives used to protect drinking water quality. Screen for presence of chemical effects which may cause detrimental physiological response in humans using multi-species toxicity testing.
Monitoring Approach: Monthly sampling for nitrate and pH.

Assessment Limitations: CCAMP does not typically sample for metals or organic chemicals in water; assessment is based only on conventional parameters that have drinking water standards.
Criteria:

- 10% of nitrate samples over 10 mg/L (NO_3 as NO_3)
- 10% of pH samples under 6.5 or above 8.3

Is there evidence that it is unsafe to eat fish or other aquatic resources?
Beneficial Uses: Commercial and Sport Fishing (COMM), Shellfish Harvesting (SHELL)
Objective(s): At sites located near the lower ends of streams and rivers, and in lakes, enclosed bays and estuaries, screen for chemical pollutants by determining the concentration of chemical contaminants in fish and shellfish samples, and assessing whether samples exceed several critical threshold values of potential human impact (advisory or action levels).
Monitoring Approach: Fish and bivalve tissue collection and chemical analysis
Assessment Limitations: CCAMP is not routinely collecting bioaccumulation samples due to loss of funding.
Criteria:

- Exceedance of Office of Environmental Health Hazard Assessment Criteria for fish and shellfish tissue, U. S. Food and Drug Administration Action Levels, or Median International Standards, in priority order

Is there evidence that aquatic life uses are not supported?
Beneficial Uses: Cold Freshwater Habitat (COLD); Preservation of Biological Habitats (BIOL); Warm Freshwater Habitat (WARM); Wildlife Habitat (WILD); Rare and Endangered Species (RARE); Spawning (SPAWN)
Objective(s): At sites along the main-stem and at the lower ends of major tributaries of streams and rivers, screen for indications of water quality and sediment degradation for aquatic life and related uses, using several critical threshold values of toxicity, biostimulation, benthic community condition, habitat condition, and physical and chemical condition.
Monitoring Approach: Spring synoptic sampling for sediment and water column toxicity, sediment chemistry, benthic invertebrate assemblages, and associated habitat quality. Toxicity Identification Evaluation and/or chemistry follow-up for toxic sites. Monthly conventional water quality monitoring for nutrients, dissolved oxygen, pH, turbidity and water temperature. Pre-dawn or 24-hour continuous sampling for dissolved oxygen sags.
Assessment Limitations: CCAMP does not have the funding to sample all sites for benthic invertebrates, sediment chemistry or water and sediment toxicity. When sediment chemistry is analyzed, an array of metals and organic chemicals is sampled that does not contain all currently applied pesticides, pharmaceuticals, and numerous other synthetic organic chemicals. Habitat sampling is conducted only in association with benthic invertebrate sampling and is not comprehensive.
Critera:

- Sediment or water toxicity effects significantly greater than reference tests and survival, growth, or reproduction less than 80% of control
- Sediment concentrations over Probable Effects Levels (MacDonald, et al, 1996) for chemicals with available criteria. Sediment concentrations of other organic chemicals above detection limits.

- Tissue concentrations of organic chemicals over established U.S. Fish and Wildlife and National Academy of Sciences guidelines for protection of aquatic life. Tissue concentrations for chemicals without guidelines above detection limits.
- 10% of dissolved oxygen samples below 7.0 mg/L (cold water streams) or 5.0 mg/L (warm water streams)
- Median dissolved oxygen levels below 85% saturation
- 10% of pH samples under 7.0 or above 8.5
- 10% of un-ionized ammonia samples over 0.025 mg/L NH_3 as N
- Biostimulatory risk rank falls above scoring range of high quality sites (0.4)
- Index of Biotic Integrity falls within scoring range below high quality sites (3.0), for a given stream stratum

Is there evidence that water is unsafe for agricultural use?
Beneficial Use: Agricultural supply (AGR)
Objective(s): At sites throughout waterbodies that are used for agricultural purposes, determine percent of samples with concentrations of chemical pollutants above screening values or adopted water quality objectives used to protect agricultural uses.
Monitoring Approach: Monthly sampling for nutrients and salts.
Assessment Limitations: CCAMP does not typically sample for all of the parameters identified in the Central Coast Water Quality Control Plan for protection of agricultural beneficial uses.
Criteria:

- 10% of pH samples below 6.5 or above 8.3
- 10% of chloride samples over 106 mg/L
- 10% of electrical conductivity results over 3000 uS/cm
- 10% of boron samples over 5.0 mg/L
- 10% of sodium samples over 69 mg/L
- 10% of nitrate samples over 30 mg/L as NO_3 as N

Is there evidence of impairment to aesthetics or other non-contact recreational uses?
Beneficial Use: Non-Contact Water Recreation (REC-2)
Objective(s): At sites throughout waterbodies that are used for non-contact recreation, screen for indications of bacterial contamination by determining the percent of samples exceeding adopted water quality objectives and assess aesthetic condition for protection of non-contact water recreation.
Monitoring Approach: Monthly sampling for pathogen indicator organisms (*E. coli*, total and fecal coliform); monthly qualitative assessment of % algal cover, presence of scum, odor, etc.
Assessment Limitations: CCAMP does not currently conduct an assessment for trash. *E. coli* was not sampled in the Santa Maria watershed.
Criteria:

- 10% of pH samples under 7.0 or over 8.3
- 10% of samples over 400 MPN/100 ml fecal coliform
- 10% of samples over 409 MPN/100 ml *E. coli*
- Dry weather turbidity persistently over 10 NTU
- Algal cover persistently over 25%
- Scum, odor, trash, oil films persistently present

Overview of the CCAMP Approach

The CCAMP mission statement is to collect, assess and disseminate water quality information to aide decision makers and the public in maintaining, restoring and enhancing water quality and associated beneficial uses in the Central Coast Region. The CCAMP monitoring strategy calls for dividing the Region into five watershed rotation areas and conducting synoptic, tributary based sampling in one of the areas each year. Approximately thirty sites are monitored in each watershed rotation area. Over a five-year period all of the Hydrologic Units in the Region are monitored and evaluated. In addition to the rotational approach, thirty-one of the Region's coastal creeks and rivers are monitored continuously just upstream of their confluence with the Pacific Ocean.

The CCAMP strategy of establishing and maintaining permanent long term monitoring sites provides a framework for trend analysis and detection of emergent water quality problems and maintenance of high quality waters. CCAMP uses a variety of monitoring approaches to characterize status and trends of coastal watersheds, including conventional water quality analysis, benthic invertebrate bioassessment, analysis of tissue and sediment for organic chemicals and metals, and toxicity evaluation.

In order to develop a broad picture of the overall health of waters in the Central Coast Region, a similar monitoring approach is applied in each watershed area. This provides compatibility across the Region and allows for prioritization of problems across a relatively large spatial scale. However, additional watershed specific knowledge is incorporated into the study design, so that questions which are narrower in focus can also be addressed. For example, in watersheds where Total Maximum Daily Load assessments are being undertaken, other program funds can be applied to support additional monitoring for TMDL development. Special studies are undertaken as funding and staffing permits to further focus monitoring on questions of interest in individual watersheds.

Watershed characterization involves three major components: acquisition and evaluation of existing data, monitoring of surface water and habitat quality, and developing a watershed assessment based on findings.

<u>Evaluation of existing sources of data</u>

Existing sources of data are evaluated for pollutants of concern, historic trends, data gaps, etc. These include Department of Health Services, USGS, Department of Fish and Game, Department of Pesticide Regulation, Toxic Substances Monitoring Program, STORET, NPDES discharge data, and other sources. Data from County, City, and other selected programs are also acquired. Selected data is compiled into the CCAMP data base format and used along with data collected by CCAMP to evaluate standard exceedances, pollutant levels which warrant attention, beneficial use impairment, and other pertinent information. Basic GIS data layers, where available, describing land use, geology, soils, discharge locations, etc. are used in analysis and display of data, to further understanding of probable sources and causes of identified problems.

Monitoring approaches

The relationship between monitoring types and beneficial uses recognized in the Central Coast Basin Plan are identified in Table 1a. It is intended that the program become more comprehensive as funding allows for additional monitoring approaches, but the current suite of monitoring activities addresses all beneficial uses to some degree. Virtually all major rivers and streams and their immediate tributaries in Region 3 are designated for cold water fisheries, commercial and sport fishing, contact and non-contact recreation, groundwater recharge, municipal and domestic supply, spawning, and migration beneficial uses. Many also support threatened and endangered species and biological habitats of special significance. Because these important beneficial uses tend to be universal in the Region and require most stringent water quality objectives, the CCAMP suite of indicators targets these beneficial uses particularly, and is intended to be applied uniformly at all sites.

Table 1a. Relationship between beneficial uses and monitoring activities. X's are monitoring approaches currently employed by CCAMP and +'s are monitoring approches that are not.

	Conventional H_20 quality analysis	SedimentChemistry (organics and metals)	H2O Chemistry (organics and metals)	Tissue Chemistry (organics and metals)	Rapid Bioassessment	Toxicity	Geomorphology	Habitat	Remote Sensing	Flow	Sedimentation
Municipal & Domestic	X		+	X					+	X	
Estuarine Habitat	X	X	+	X	X	X	+	+	+	X	+
Marine Habitat	X	X	+	X	X	X	+	+	+		+
Wildlife Habitat	X	X	+	X	X	X	+	+	+	X	+
Biological Habitat of Special Significance	X	X	+	X	X	X	+	+	+	X	+
Rare & Endangered Species	X	X	+	X	X	X	+	+	+	X	+
Fish Migration	X	X	+	X	X	X	+	+	+	X	+
Fish Spawning	X	X	+	X	X	X	+	+	+	X	+
Shellfishing	X			X							
ASBS	X	X	+	X	X	X	+	+	+	X	+
Agricultural Supply	X	X	+			X				X	
Industrial Process Supply	X		+			X					
Industrial Service Supply	X								+		+
Groundwater Recharge	X		+			X	+		+	X	
Fresh Water Replenishment	X		+			X	+		+	X	
Navigation	X	X				X	+		+	X	+
Hydroelectric Power Generation	X						+		+	X	
Water Contact Recreation	X										
NonContact Recreation	X										
Commercial and Sport Fishing	X	X	+	X	X	X	+	+	+	X	
Aquaculture	X	X	+	X		X					
Warm Water Habitat	X	X	+	X	X	X	+	X	+	X	X
Coldwater Habitat	X	X	+	X	X	X	+	X	+	X	X

Scope of the Report
This report provides a data summary for watershed monitoring completed prior to and during fiscal year one (Jan 2000-June 2000 and July 2000 – April 2001 respectively) of the SWAMP Program. This includes the CCAMP watershed rotation area in the Santa Maria watershed (HU 312), including Santa Maria River, Cuyama River, Sisquoc River; and the Soda Lake basin (HU 311). The report provides an analysis of beneficial use support and determination of impairment for monitored waterbodies.

2 Hydrologic Unit Descriptions

Santa Maria Hydrologic Unit (312)
The Santa Maria River Hydrologic Unit includes all areas tributary to the Cuyama River, Sisquoc River, and Santa Maria River. At 1,880 square miles (1.2 million acres) the Santa Maria River watershed is one of the larger coastal drainage basins of California. The Cuyama River and Sisquoc River originate in wilderness areas of the Los Padres National Forest. The Santa Maria River is formed by the confluence of the Cuyama and Sisquoc approximately 7 miles southwest of Santa Maria. The Sisquoc River and Upper Cuyama (above Sierra Madre Road) are in a reasonably natural state with much of the watershed located in National Forest. Within the Los Padres Forest Service boundary, the upper 33 miles of the Sisquoc is listed as a National Wild and Scenic River.

Below Sierra Madre Road the channel of the Cuyama has been highly altered to better align with State Highway 166. Much of the upper Cuyama watershed is made up of sedimentary marine deposits that are naturally erosive. As a result, the river carries a heavy sediment load. The Twitchell reservoir (completed in 1958) is located on the Cuyama River six miles above the confluence with the Sisquoc River. The dam traps much of the sediment contained in the Cuyama flows.

The Santa Maria valley is a broad flat valley, protected from flooding by levees and a series of flood control channels and basins. The lower Santa Maria River Watershed, including the Santa Maria River, is highly altered. The river has a very sandy, braided channel and is leveed along much of its length. It is a "losing" stream, meaning that surface water flow tends to rapidly infiltrate into underlying permeable layers. The river is the major source of recharge to the Santa Maria groundwater basin. Urban runoff and associated pollutants also tend to infiltrate, rather than flow to the Santa Maria River.

Nipomo Creek drains the Nipomo Valley and joins the Santa Maria River just west of US Highway 101. Solomon (Orcutt) Creek drains the Orcutt area and joins the Santa Maria River near its outlet to the Pacific Ocean. Oso Flaco Lake and its drainage, though not part of the Santa Maria watershed, are included in Hydrologic Unit 312. Oso Flaco Lake is north of the Santa Maria Estuary.

Major activities in the Santa Maria watershed include irrigated and dryland agriculture, oil production, and urban development. Twitchell Reservoir serves important flood control and

water recharge functions. Sedimentation of this reservoir is reducing its water storage capacity, and if allowed to continue will affect the reservoir's flood control capacity. Pollutants of known concern in the watershed prior to this assessment include nitrates and total dissolved solids in groundwater, organochlorine pesticides in the estuary, and petroleum production byproduct (diluent) in ground and surface water of the Guadalupe Dunes and nearby areas. Several waterbodies in this Hydrologic Unit are now listed on the CWA section 303(d) list of impaired waterbodies (CCRWQCB 2002) as shown in Table 2a.1b. Prior to CCAMP monitoring, very little data was available for the Santa Maria Hydrologic Unit and no streams or river segments were included on the 303(d) list.

Table 2a. Impaired waterbody 303(d) listings in the Santa Maria Hydrologic Unit as of the time of this report writing in 2003 (CWA 303(d) List of Water Quality Limited Segments. CCRWQCB 2002.)

Water Body / Beach	**Listing**
Santa Maria River	Fecal Coliform, Nitrate
Bradley Canyon Creek	Fecal Coliform
Bradley Channel	Fecal Coliform
Blosser Channel	Fecal Coliform
Main Street Canal	Nitrate
Orcutt-Solomon Creek	Fecal Coliform, Nitrate, Boron
Nipomo Creek	Fecal Coliform
Oso Flaco Creek	Fecal Coliform, Nitrate
Oso Flaco Lake	Nitrate

3 Sampling Design

Watershed rotation area monitoring sites are placed at safe access locations along the main stem of each major creek and river, typically upstream of each major tributary input, and also at the lower end of each major tributary. Sampling locations frequently are located at public bridge crossings because of all-weather public access. Care is taken to ensure that samples are not influenced by the bridge structure itself. Approximately thirty sites are allocated within the sampling area; in addition, long-term coastal confluence sites are monitored continuously at thirty-three creek mouths throughout the Region.

The CCAMP program design includes monthly monitoring for conventional water quality (CWQ) at all selected sites. At a subset of sites, generally selected based on hydrogeomorphological considerations or local issues of concern, other monitoring approaches are applied. These include sediment chemistry and toxicity, fish and freshwater clam tissue chemistry, benthic macroinvertebrate assessment and habitat assessment.

4 Methods

Conventional Water Quality
CCAMP staff collects monthly grab samples and field measurements for conventional parameters at all watershed rotation area and coastal confluence sites. Sampling is conducted following the protocols outlined in CCAMP Standard Operating Procedures (CCAMP 2000).

Field measurements are taken using a multi-analyte Hydrolab DS4a. Measured values are stored in a Surveyor 4a and subsequently downloaded into the CCAMP data management system. Data are also recorded on field data sheets, and are used to verify electronically recorded values. Probes are lowered into flowing water, at least two inches below the waters surface but no more than eight inches. Probes are held at this depth and allowed to equilibrate for at least one minute prior to recording measurements. Field measurements include dissolved oxygen, pH, conductivity, salinity, water temperature, and turbidity. In addition, air temperature, percent algal cover, percent shading from canopy, presence of scum, trash, and foam, and several other field observations are noted.

Samples are collected for laboratory analysis at the Central Coast Region's contract laboratory, BC Laboratories in Bakersfield, California. Samples are collected in pre-cleaned bottles provided by the contract laboratory. Pre-cleaned 1-L plastic bottles are used to collect samples for nutrients, salts, dissolved and suspended solids analyses. Sterile and sealed 120ml plastic bottles containing sodium thiosulfate preservative are used to collect total and fecal coliform samples. Sample bottles are rinsed three times with stream water and then filled facing upstream. Once collected, samples are stored in ice chests at 4º C until they are transferred to the contract laboratory. Proper chain of custody documentation is maintained for all samples as described in the SWAMP QAMP (Puckett, 2002).

The laboratory analyzes samples for the following parameters:

nitrate as N	boron
nitrite as N	calcium
total ammonia	chloride
total Kjeldahl nitrogen	magnesium
total phosphate as P	sodium
ortho-phosphate as P	hardness
dissolved solids	total and fecal coliform
suspended solids	chlorophyll *a*

Three times during the summer months (July-September) CCAMP staff collect pre-dawn dissolved oxygen measurements to characterize oxygen sags, should they exist. CCAMP staff visit each site with safe 24 hour access between 3 a.m. and 30 minutes before sunrise to collect in-situ dissolved oxygen measurements using the Hydrolab DS4a.

Quality Assurance

Hydrolab probes (DS4a) are calibrated prior to and following each sampling event. Probes are calibrated using laboratory certified standards for pH, conductivity and turbidity, and are air calibrated for dissolved oxygen. Calibration data is recorded in an Excel spreadsheet and is used to evaluate instrument performance. The SWAMP QAMP has defined +/- 20% difference as the maximum allowable variation between the calibration standard and post calibration measurement of the standard (Puckett, 2002, Appendix C).

A blind field duplicate sample is collected once per sampling trip, resulting in 10% total field duplicates. For duplicates samples, two bottles are filled side by side and labeled with a unique site tag to remain anonymous to the contract laboratory. Data from duplicates is compared to original samples and evaluated using the SWAMP maximum for relative percent difference of 25% (Puckett 2002, Appendix C).

The quality control measures employed by the contract laboratory are also evaluated using SWAMP criteria. These measures include but are not limited to matrix spike recovery, laboratory control samples, calibration control samples, method blanks and lab duplicates.

CCAMP Biostimulatory Risk Index

CCAMP has developed a "Biostimulatory Risk Index" to serve as a screening tool to evaluate sites for risk of problems associated with eutrophication. A more complete description of the index and its use is found in Appendix A; however, it is briefly summarized in this section.

The Biostimulatory Risk Index simultaneously considers factors which serve as stimuli (nutrient concentrations), in parallel with those which act as responders (pH, dissolved oxygen, algal and plant cover, water column chlorophyll concentrations). The index is intended to characterize both in-situ monitoring site response to biostimulatory substances and the capacity of monitoring site water quality parameters to induce adverse biostimulatory responses in downstream areas. The index currently has no provision for addressing nutrient-poor waters, nor waters impacted by toxic effects associated with several of its components.

The Biostimulatory Risk Index is a combination of several different measures, or "metrics" of stimuli or response, which have been percentile ranked and combined to form a single value. CCAMP collects data on a number of parameters that serve as measures of biostimulation or response. Some of these measures, such as nutrient or chlorophyll concentrations, serve as metrics based on magnitude alone (where higher concentrations are considered "worse" than lower concentrations and are ranked accordingly). Others are more complex, particularly "double-ended" parameters such as dissolved oxygen and pH. For example, both supersaturated and depressed concentrations of dissolved oxygen can be indicative of eutrophication. For such parameters the departure of the measurement from the Regional median value is used to calculate the metric (where a larger departure ranks worse than a smaller departure). Various forms of plant cover are stimulated by nutrients and can create nuisance conditions. The Index utilizes the maximum value from three qualitative estimates of percent cover for rooted plants, filamentous algae and periphyton, to calculate a plant cover metric.

CCAMP staff evaluated performance of the index using data from the entire Region. Weighting factors for each metric were initially determined by confining the database under consideration to several Hydrologic Units well known to staff, and setting weighting factors to values that ranked sites in a sequence that was consistent with staff knowledge of the sites. Performance of the index was then examined in other Hydrologic Units not used to develop the weighting factors, using different staff, knowledgeable of site and waterbody characteristics in the new set of Hydrologic Units. Through iterative adjustment of weighting factors, index performance was tested until all staff agreed that site rankings best reflected overall staff knowledge of site conditions.

Staff evaluated the final site ranking for evidence of threshold values at which sites begin to show overall impairment or cause downstream problems. Staff agreed that above an average index score of 0.40, sites begin to commonly show signs of impairment, including algal blooms, widely ranging dissolved oxygen concentrations, and elevated nutrient concentrations. We are using this value as a threshold for screening monitoring data for biostimulatory risk. Figure 4a shows the mean and range of nitrate concentrations at sites scored for biostimulatory risk. Sites whose score falls below the threshold of 0.40 virtually never exceed the drinking water standard for nitrate. In fact, 89% of these have site nitrate averages under 1.0 mg/L-N. In contrast, sites with a risk score of 0.40 or greater never have benthic invertebrate community index scores in the highest quartile (over 0.60) (Figure 4b).

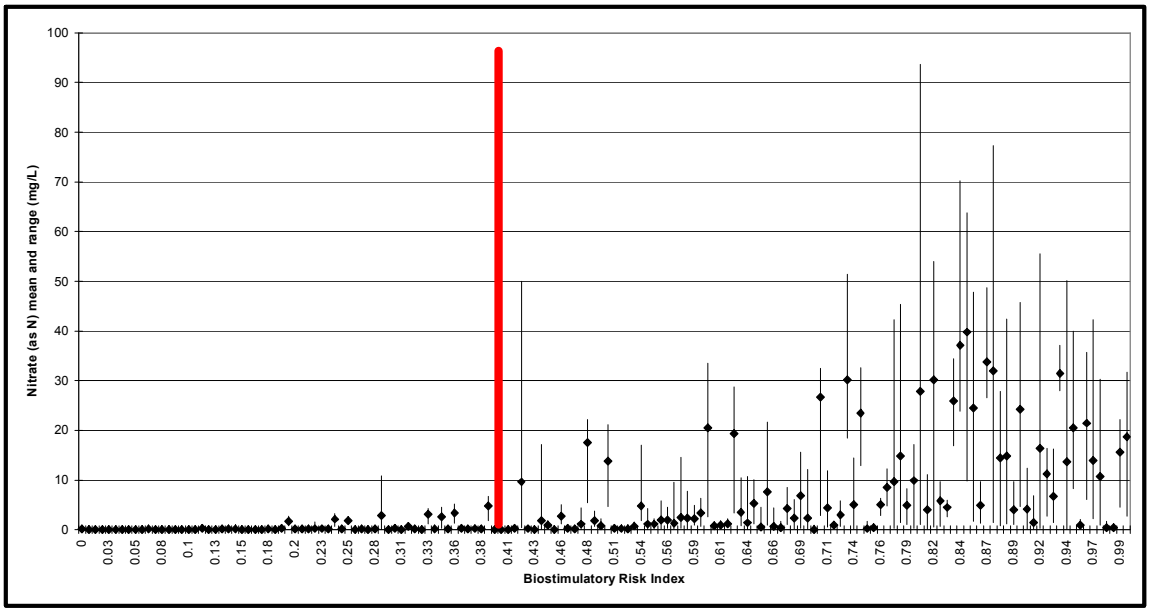


Figure 4a. Range and mean of Nitrate-N concentrations (mg/L) at sites scored for biostimulatory risk in the Central Coast Region. Biostimulatory risk threshold (0.40) indicated by red line.

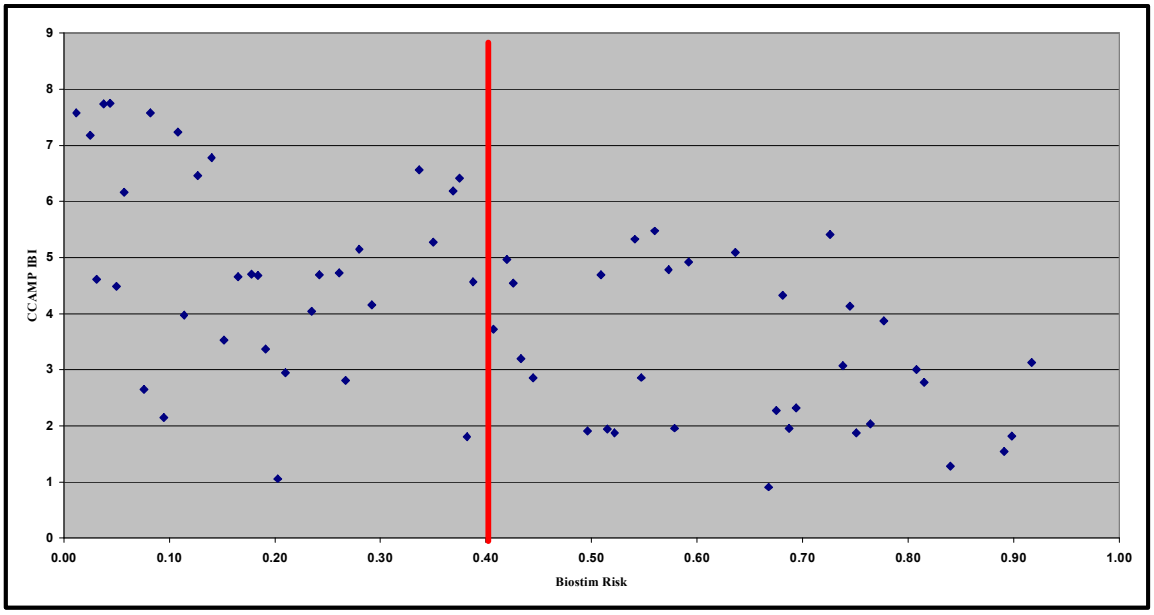


Figure 4b. Scatter plot of CCAMP-IBI scores against the Biostimulatory Risk Index for CCAMP sites. Biostimulatory risk threshold (0.40) indicated by red line.

Rapid Bioassessment
CCAMP staff collected benthic macroinvertebrates (BMIs) following California Stream Bioassessment Protocols (Harrington 1999 as cited in Puckett 2000, Appendix G) in two consecutive spring seasons at each site. All BMI samples are processed and identified to the lowest possible taxon at the California Department of Fish and Game Aquatic Bioassessment Laboratory (DFG-ABL).

Samples are collected during base-flow conditions. Sampling reaches are always selected in association with conventional water quality monitoring sites. When riffle habitat is present, a reach of stream containing riffles is selected for sampling. Riffles are typically the most taxonomically diverse microhabitats within streams, and are targeted for BMI sample collection. Three riffles within each stream reach are randomly selected for sampling. At each riffle, a transect location is randomly chosen from all possible meter marks along the upper third of the riffle. Three samples are collected along the transect, which is perpendicular to the direction of flow, using a D-shaped kick net. A 1x1 foot area of substrate upstream of the kick-net is disturbed for 1 minute at each site. The three samples from each transect are composited into a single sample. Each sample is preserved in 95% ethanol until analyzed.

When riffle habitat is not present, a representative 100m reach is measured out and three transect locations are chosen randomly from the 100 possible meter marks in the reach. At each transect location the two margins and thalweg are sampled by disturbing a 1 x 2-foot portion of substrate upstream of the kick-net to approximately 4-6 inches in depth. The three site collections per transect are composited to create one sample that is sieved to 0.5 mm and preserved in 95% ethanol. All samples are stored at the Central Coast Regional Board until they are transferred with the appropriate chain of custody forms to the DFG laboratory at Rancho Cordova for identification.

At the laboratory, BMI samples are randomly sub-sampled and sorted to obtain 300 individuals per sample. These individuals are stored in an ethanol-glycerin solution, identified to genus or the lowest possible taxonomic unit, and enumerated. Metrics calculated from individual count data include abundance, taxa richness and composition, taxa tolerant or intolerant of impaired conditions, and relative dominance of functional feeding groups. All organisms identified and included in the individual taxa list for each site are labeled with scientific name, date and location collected, and are returned to CCAMP for archiving.

Physical and habitat characteristics are estimated at each site based on visual observations, which score the following habitat parameters on a 1-20 scale: epifaunal substrate, embeddedness, velocity/depth regimes, sediment deposition, channel flow, channel alteration, riffle frequency, bank vegetation, bank stability, and riparian zone width. Field samplers are trained by CDFG staff to conduct this assessment, and scores are intercalibrated for consistency prior to start of sampling.

CCAMP Index of Biotic Integrity
The CCAMP Index of Biotic Integrity (CCAMP-IBI) is a sum of several ranked metric scores, including taxonomic richness, number of *Ephemeroptera* taxa, number of *Trichoptera* taxa, number of *Plecoptera* taxa, percentage of intolerant individuals (with tolerance scores of 0, 1, or

2), percentage of tolerant individuals (with tolerance scores of 8, 9 or 10), percent dominant taxon, and percent predators. This index includes all metrics utilized by Karr and Chu (1999) in their Index of Biotic Integrity, with the exception of "clinger taxa count" and "long-lived taxa count." The CCAMP program has been utilizing this index for a number of years for evaluating benthic invertebrate data in the Central Coast. Currently, an Index of Biotic integrity is being developed by DFG-ABL staff for the southern California coastal watersheds of Montereycounty south to San Diego County. This index includes percent collector-gatherer + collector-filterer, percent non-insect taxa, percent tolerant taxa, Coleoptera richness, predator richness, percent intolerant individuals, and EPT richness. Metrics selected for the Southern California IBI were screened using several selection criteria, including range of scoring, responsiveness to disturbance, and minimal inter-correlation. We will evaluate the performance of the CCAMP IBI against the Southern California IBI and in the future, we will incorporate the Southern California IBI into the analysis of our benthic data.

CCAMP-IBI scores range from 0 to 10. Sites in the lowest quartile of all CCAMP bioassessment data score below approximately 3.0, as a site average. Sites in the highest quartile score above 6.0. We have examined these quartile break points relative to other indices of water quality. Figure 4cshows that at 60% of all sites in the lowest quartile, multiple measures of toxicity were present; only 20% of these sites had no evidence of toxicity. At sites in the highest quartile, 60% were free of toxicity and the remaining sites showed only a single indication of toxicity (such as reduced growth or reproduction).

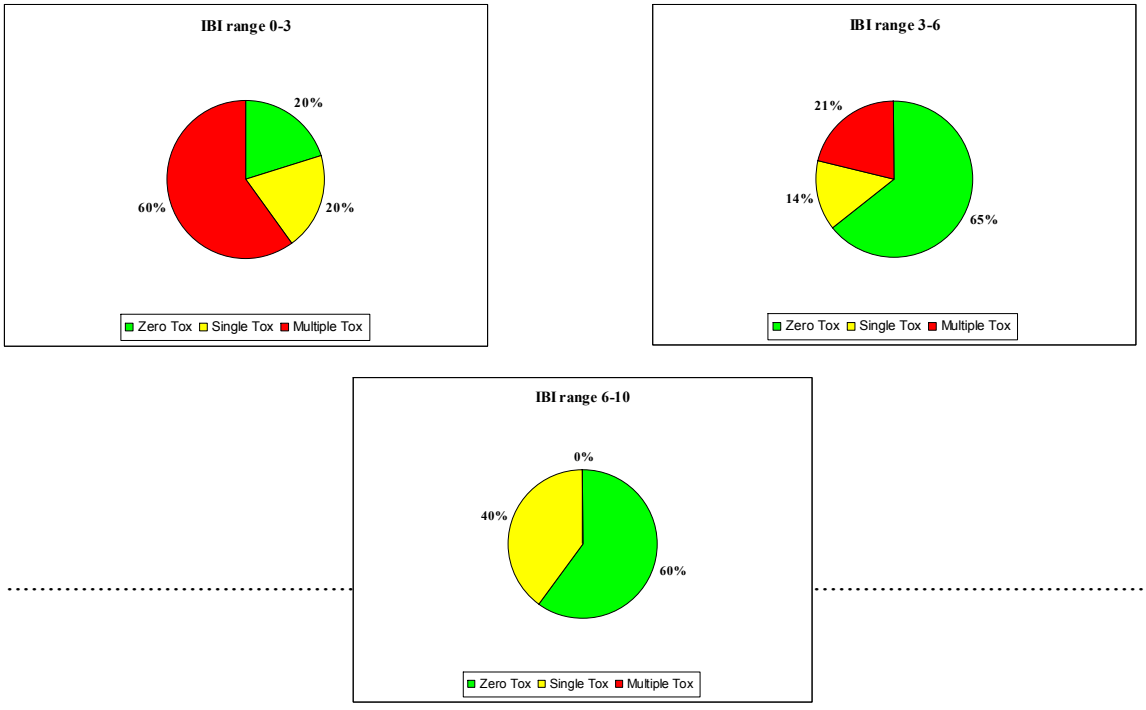


Figure 4c Percent of sites showing multiple toxic results, a single toxic result or zero toxicity, according to CCAMP-IBI quartile scores. Sites with high IBI scores (0-6) indicate relatively good water quality.

Water Toxicity

Sampling for toxicity to fathead minnow larvae (*Pimephales promelas*) and water fleas (*Ceriodaphnia dubia*) is conducted at a subset of watershed rotation area sites. Samples are collected in four 1-gallon amber glass bottles and are maintained at 4° C until delivery to the laboratory within 48 hours. Toxicity testing is performed at the University of California Davis Marine Pollution Studies Laboratory at Granite Canyon (UCD-GC). All tests are conducted for seven days, at 25ºC according to US EPA (1994) protocols. Water quality parameters including conductivity, hardness, alkalinity, pH, dissolved oxygen, and ammonia are measured at the beginning of each test. Test solutions are renewed daily; dissolved oxygen and pH are measured on the old solution and replacement solution. Temperature is monitored continuously by a temperature probe in an additional test solution placed in the controlled temperature room. Details of toxicity testing methods can be found in the SWAMP QAMP (Puckett 2002, Appendix F).

Larvae of the fathead minnow are purchased from an organism supplier and received on test initiation day (less than 24 hours old). Ten fish are randomly distributed to each of five test containers containing 250 mL of sample. Test containers are checked daily, and the number of living fish recorded; immobile fish that do not respond to a stimulus are considered dead. Survival and growth endpoints (as dry weight) are recorded for each test container at the end of seven days.

Water flea neonate individuals (<24 h old) are introduced singly into small cups containing 15 mL sample. Each sample includes ten replicates. Survival and reproduction are monitored daily in each replicate. Survival and reproduction endpoints (number of neonates and broods) were recorded for each test container at the end of seven days.

Samples are tested for chlorpyrifos and diazinon using Enzyme-Linked Immunosorbent Assay (ELISA). All ELISA analyses are performed at UCD-GC with kits from Strategic Diagnostics Inc. (Newark, DE). The lowest detectable doses are 30 ng/L for diazinon and 50 ng/L for chlorpyrifos (Sullivan and Goh 2000).

Quality Assurance

Field duplicate samples are tested to estimate the variability in results associated with sampling and laboratory procedures. All toxicity tests include both positive and negative controls. Positive control tests are conducted monthly at the laboratory and concurrently with test samples. (see the UCD-GC SOP document included in Puckett 2002 for more detailed QAQC information).

To verify accuracy of the ELISA method, an external standard is quantified with each batch. Accuracy of these measurements is considered acceptable if the measured value is within 20% of the known concentration. In addition, 5% of the samples measured using the ELISA method are also measured using an EPA analytical method for comparison. The measurement is considered acceptable if the relative percent difference between the results using the two methods is less than 50%. The SWAMP QAPP allows the program manager to determine control limits for external QA assessments (Puckett 2002).

Sediment Chemistry and Toxicity

Bed sediment samples were collected by CCAMP staff at a subset of watershed rotation area sites targeting fine-grained sediments within the wetted creek channel. A pre-cleaned Teflon™ scoop is used to collect the top 2 cm of sediment from five or more sub-sites into a pre-cleaned glass composite jar. After an adequate amount of sediment is collected, it is homogenized thoroughly and aliquoted into pre-cleaned, pre-labeled sample jars (glass or polyethylene, as appropriate) for organic chemical, metal or toxicological analysis. Once collected, samples are stored at 4°C and shipped with appropriate chain-of-custody and handling procedures to the analytical laboratories (MPSL-DFG, Rancho Cordova-DFG and UCD-GC). Field data sheets are completed for each sampling event to document conditions and sampling notes. Details on sediment sampling are described in the bed sediment procedures outlined in the SWAMP QAMP (Puckett 2002, Appendix D).

In sediment samples, analyses for metals, organic chemicals, polynuclear aromatic hydrocarbons, total organic carbon, and grain size were conducted at BC Laboratories in Bakersfield. Analysis and QC procedures used by BC Laboratories are outlined in their QAPP (BC Labs 1999).

Toxicity and ELISA analyses are conducted at UCD-GC. Ten-day sediment toxicity testing using *Hyalella azteca* (EPA 2000) is conducted using eight 100-mL replicates, each with 10 *Hyalella* individuals. Water quality parameters, including conductivity, hardness, alkalinity, pH, dissolved oxygen, and ammonia are measured in overlying water from one replicate of each sample at the beginning and end of each test. Dissolved oxygen is measured daily in one replicate of each sample. Temperature is monitored continuously by placing a probe in an additional test solution in the controlled temperature room. Endpoints recorded after ten days are survival and growth (as dry weight).

Quality Assurance

Sediment toxicity QA procedures such as field duplicates, and positive and negative controls are similar to those discussed in the section on water toxicity. See Puckett (2002) for a complete discussion on QAQC procedures. In sediment toxicity tests the positive control test consists of a dilution series of cadmium (from cadmium chloride). The negative control for *Hyalella* consists of reference sediment subjected to the same well-water renewals as the samples.

Tissue Bioaccumulation

Resident fish and transplanted freshwater clams (*Corbicula fluminea*) are used to assess bioaccumulation of organic chemicals and metals in streams and lakes throughout the watershed rotation areas.

MPSL-DFG staff performs deployment, collection and preparation of fresh water clams at a subset of watershed rotation sites. Clams are collected from Big Break Lake near the Sacramento River Delta, and tested for contamination prior to deployment. Clams are deployed for one month in anchored polypropylene mesh bags, approximately 15 cm above the streambed. Approximately 25 to 50 clams, 20 to 30 mm in diameter, are deployed at each site for each analysis (organics and metals). After a month-long deployment, clams are collected and sent to the laboratory for analysis. Clams intended for metals analysis are transported in plastic bags;

clams intended for organic analysis are bagged in aluminum, then plastic. All sample handling is performed with methods designed to minimize contamination. Details of clam collection, handling, deployment and retrieval can be found in the SWAMP QAMP (Puckett 2002, Appendix D).

Fish sampling in reservoirs and at watershed rotation area sites is conducted by the DFG-ABL through the Toxic Substances Monitoring Program (TSMP). Two to four composite samples containing four fish each are collected for each species. Within each composite the smallest fish is at least 75% the length of the largest fish. Larger, older fish are targeted. When the target species is a food fish, the minimum size is set at the legal angling size or practical eating size for that species.

Fish collection techniques include boat and backpack electro-fishing, gill netting and seine netting. Fish species and length are recorded. Fish are sacrificed and wrapped in aluminum foil or Teflon®. The heads and tails of fish larger than the wrapping material are removed prior to wrapping (gut contents are kept intact). Fish are kept on dry ice in the field, and then frozen at -20º C prior to analysis. Details of fish sampling methods used in the TSMP can be found in the CDFG-MPSL Standard Operating Procedure document, Method 102 (CDFG-MPSL 2001).

5 Hydrologic Unit Assessments

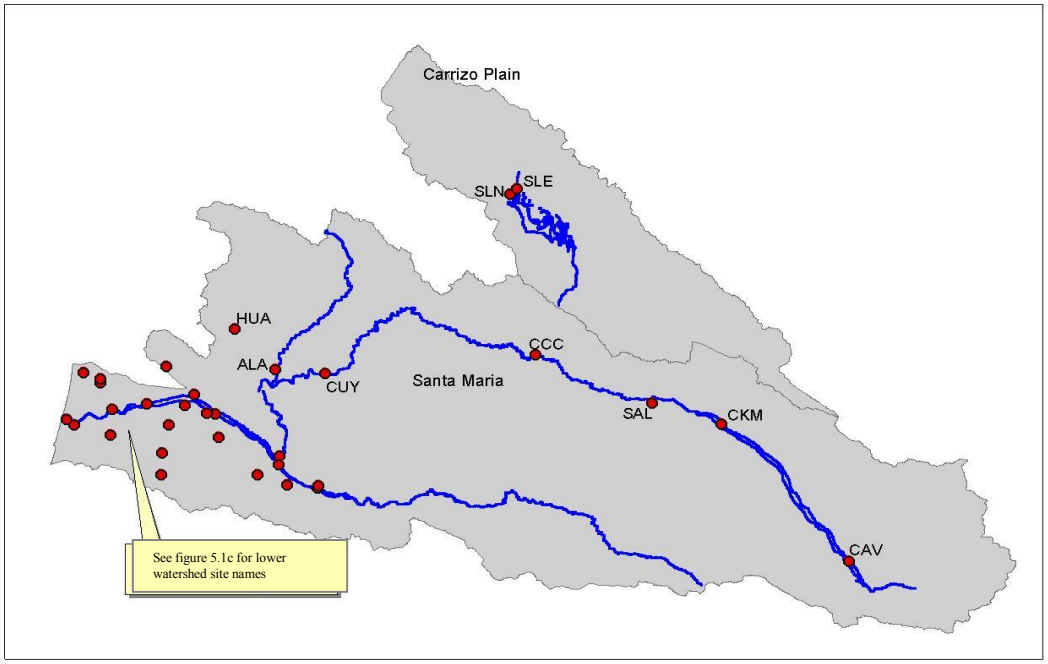
In this section, each Hydrologic Unit is evaluated according to questions posed in the SWAMP report to the Legislature (2000). It is only possible to address these questions in terms of analytes actually evaluated, for the given sampling period and sampling frequency. For example, from the standpoint of assessing whether water is of adequate quality to drink, only a few of the many chemicals with drinking water standards have been evaluated. However, when violations of standards and criteria are found, they support conclusions of water quality impairment.

Santa Maria River Hydrologic Unit (312)

5.1.1 Summary of monitoring

The Santa Maria Hydrologic Unit was the focus of CCAMP monitoring from January 2000 through April 2001. Monthly conventional water quality monitoring was conducted at 26 sites in the Hydrologic Unit (Figure 5.1b and Figure 5.1c). Additional monitoring was conducted at a subset of these sites (Table 5.1a) and included toxicity, benthic macroinvertebrates, tissue and sediment chemistry.

Figure 5.1.1a. Central Coast Region and the Santa Maria Hydrologic Unit.



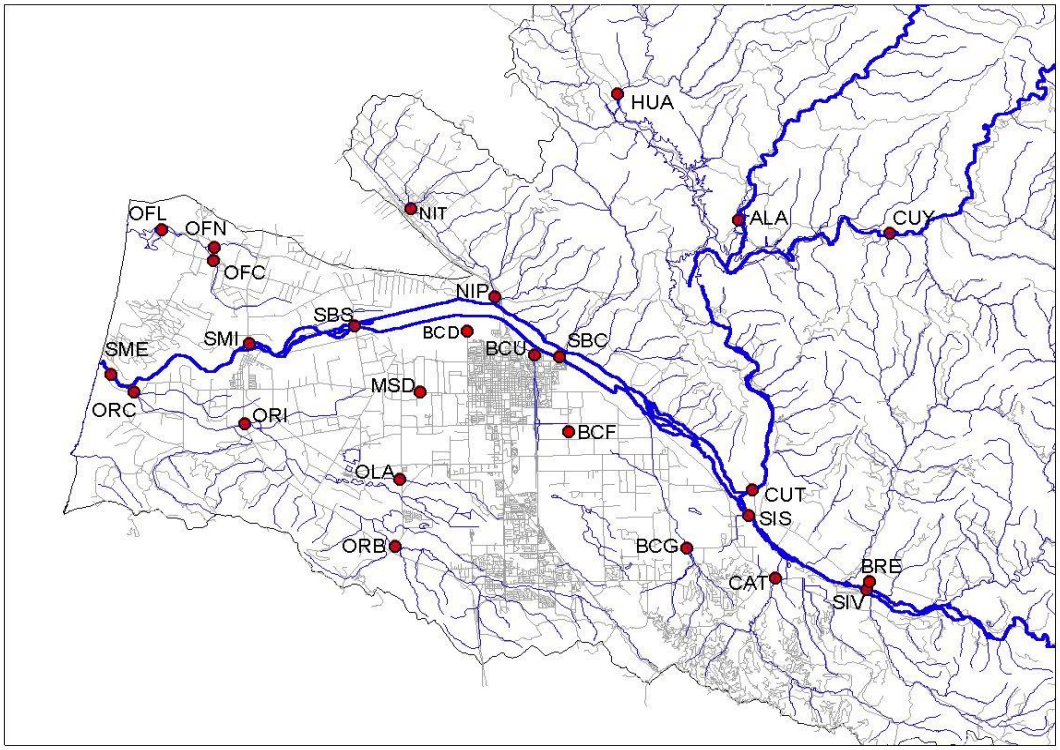


Figure 5.1.1b and 5.1.1c. Watershed rotation area sites in the Santa Maria Hydrologic Unit. Figure 5.1.1b shows the Santa Maria Hydrologic Unit watershed area sites and 5.1.1c shows lower watershed area sites.

Table 5.1.1a. Specific monitoring activities conducted at sites in the Santa Maria River Hydrologic Unit (HU312). **CWQ** - Conventional Water Quality; **BMI** - Benthic Macroinvertebrate Assessment; **Sed Chem & Tox** - Sediment Chemistry and Toxicity; **Tissue Chem** - Tissue Chemistry analysis.

Site Tag	Monitoring Site	CWQ	BMI	Sed Chem	Toxicity	Tissue Chem
312ALA	Alamo Creek at Alamo Creek Road	X	X	X		
312BCD	Blosser Channel down stream of ponds	X				
312BCU	Bradley Channel up stream of ponds	X				
312BCF	Bradley Canyon Channel @ Foxen Canyon	X		X		
312MSD	Main Street Canal at Main Street	X			X	
312CAV	Cuyama 11 mi. south of 166	X	X	X		
312CCC	Cuyama at Cottonwood Canyon	X	X	X		
312CUY	Cuyama below Buckhorn Road	X				
312CUT	Cuyama below Twitchell at White Rock Lane	X	X	X		
312HUA	Husana River at Husana Townsite Road	X				
312BRE	LaBrea Creek at Private Property Access	X	X			
312NIT	Nipomo Creek at Tefft Street	X				
312NIP	Nipomo Creek at Hwy 166	X				
312ORB	Orcutt-Solomon Creek at Black Road	X				
312OLA	Betteravia Lakes @ Ray Road Culvert	X				
312ORI	Orcutt-Solomon Creek at Highway 1	X			X	X
312ORC	Orcutt-Solomon Creek at Sand Plant	X	X	X	X	
312OFN	Little Oso Flaco Creek at railroad crossing	X		X		
312OFC	Oso Flaco Creek at Oso Flaco Lake Road	X			X	
312OFL	Oso Flaco Lake at culvert	X				
312SAL	Salisbury Creek at Branch Canyon Wash	X				
312SBC	Santa Maria River at Bull Canyon Road	X	X	X		
312SMA	Santa Maria River above the Estuary	X	X	X	X	
312SMI	Santa Maria River at Highway 1	X	X	X	X	X
312SIS	Sisquoc River @ near Fugler Point	X	X	X		X
312SIV	Sisquoc River at Private Access	X	X	X	X	

Table 5.1.1b. Findings related to monitoring questions for sites in the Santa Maria River Hydrologic Unit (HU312). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, **(-)** = not assessed

Site Tag	Monitoring site	Unsafe to Swim?	Unsafe to drink?	Are aquatic life uses impaired?	Unsafe to eat fish?	Are agriculture uses impaired?	Are non-contact recreation activities impaired?
312ALA	Alamo Creek at Alamo Creek Road	**Yes**	**S**	**S**	-	**S**	**Yes**
312BCD	Blosser Channel down stream of ponds	**Yes**	**S**	**Yes**	-	**S**	**Yes**
312BCU	Bradley Channel up stream of ponds	**Yes**	**S**	**Yes**	-	**S**	**Yes**
312BCF	Bradley Canyon Channel @ Foxen Canyon	**Yes**	**Yes**	**Yes**	-	**S**	**Yes**
312MSD	Main Street Canal at Main Street	**Yes**	**Yes**	**Yes**	-	**S**	**Yes**
312CAV	Cuyama 11 mi. south of 166	No	**S**	No	-	**S**	**Yes**
312CCC	Cuyama at Cottonwood Canyon	**Yes**	**S**	**S**	-	**Yes**	**Yes**
312CUY	Cuyama below Buckhorn Road	**Yes**	**S**	No	**Yes**	**S**	**Yes**
312CUT	Cuyama below Twitchell at White Rock Lane	**Yes**	**S**	**S**	-	**Yes**	**S**
312HUA	Husana River at Husana Townsite Road	No	**No**	No	-	No	**Yes**
312BRE	LaBrea Creek at Private Property Access	**Yes**	**S**	**S**	-	**S**	**Yes**
312NIT	Nipomo Creek at Tefft Street	**Yes**	**No**	**S**	-	No	**Yes**
312NIP	Nipomo Creek at Hwy 166	**Yes**	**No**	**S**	-	No	**Yes**
312ORB	Orcutt-Solomon Creek at Black Road	**Yes**	**S**	**Yes**	-	**Yes**	**Yes**
312OLA	Betteravia Lakes @ Ray Road Culvert	**Yes**	**Yes**	**Yes**	-	**S**	**Yes**
312ORI	Orcutt-Solomon Creek at Highway 1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
312ORC	Orcutt-Solomon Creek at Sand Plant	**Yes**	**Yes**	**Yes**	-	**Yes**	**Yes**
312OFN	Little Oso Flaco Creek at railroad crossing	**Yes**	**Yes**	**S**	-	**Yes**	**Yes**
312OFC	Oso Flaco Creek at Oso Flaco Lake Road	**Yes**	**Yes**	**Yes**	-	**Yes**	**Yes**
312OFL	Oso Flaco Lake at culvert	**Yes**	**Yes**	**S**	**Yes**	**Yes**	**Yes**
312SAL	Salisbury Creek at Branch Canyon Wash	-	-	-	-	-	-
312SBC	Santa Maria River at Bull Canyon Road	**Yes**	**S**	**S**	-	**S**	**S**
312SMA	Santa Maria River above the Estuary	**Yes**	**Yes**	**Yes**	**Yes**	**S**	**S**
312SMI	Santa Maria River at Highway 1	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
312SIS	Sisquoc River @ near Fugler Point	No	**S**	**Yes**	**Yes**	**S**	**S**
312SIV	Sisquoc River at Private Access	No	**S**	No	-	**Yes**	**Yes**
312-448 (below SMA)	Santa Maria River Estuary (Lagoon)	-	-	**Yes**	**Yes**	-	-

5.1.2 Is there evidence that it is unsafe to swim?

Fecal coliform levels exceeded the Basin Plan objective for body contact recreation (more than 10% of total samples exceeding 400 MPN/100ml) at most sites in the Santa Maria Hydrologic Unit. Figure 5.1.2a shows percent exceedances of this objective at sites in the Santa Maria Hydrologic Unit. At many sites geometric mean for fecal coliform data were over 200 MPN/100ml (the Basin Plan Objective states that geometric mean shall not exceed 200 MPN/100ml for 5 samples in a 30 day period). Figure 5.1.2b shows the range and geometric mean of fecal coliform data collected monthly at sites in the Santa Maria Hydrologic Unit January 2000 through March 2001.

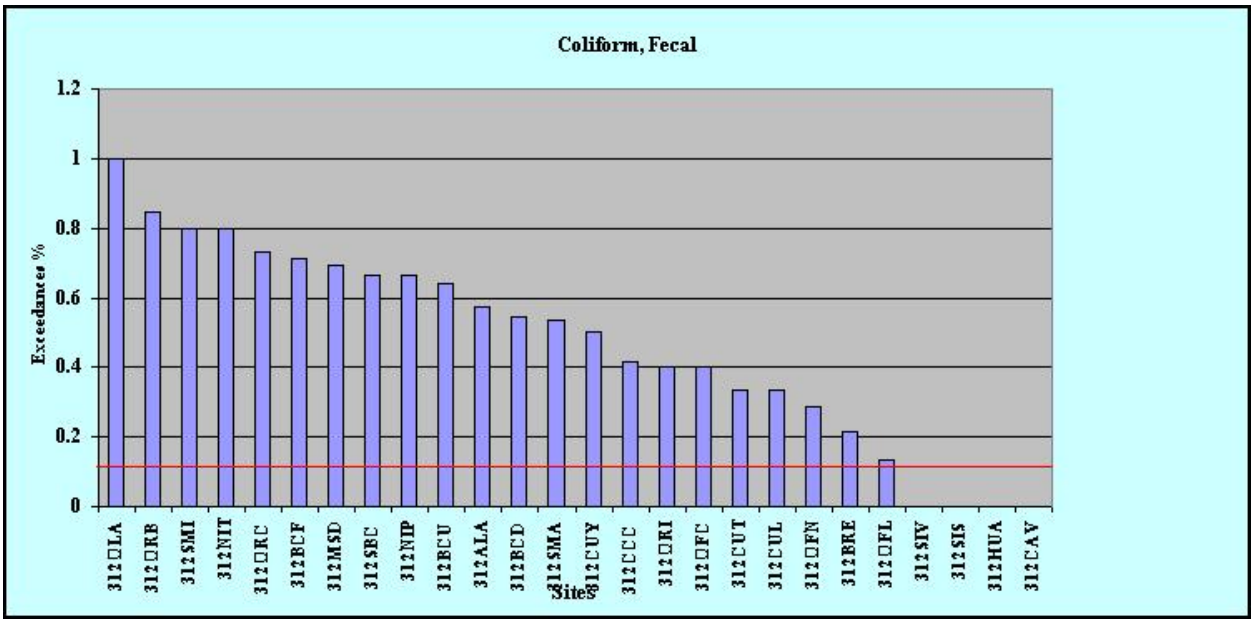


Figure 5.1.2a Percent exceedances of the Basin Plan fecal coliform objective of 400 MPN/100ml at sites in the Santa Maria Hydrologic Unit, January 2000 through March 2001. Red line is at the threshold for exceedance.

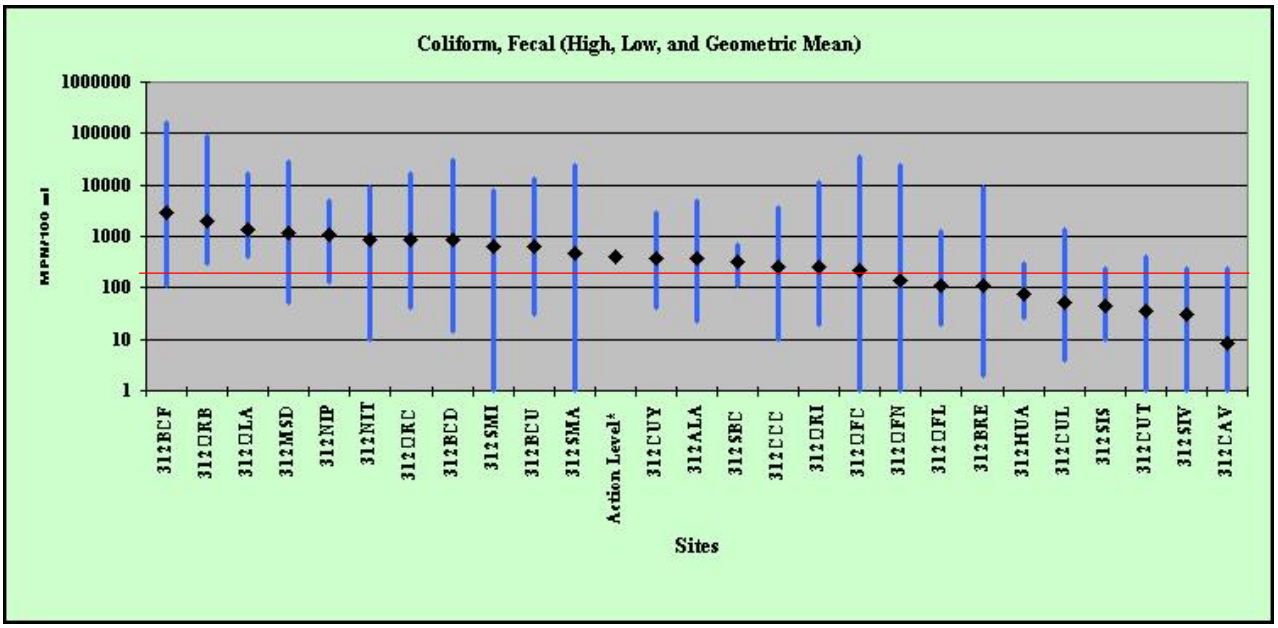


Figure 5.1.2b. Range and geometric mean of fecal coliform data collected monthly at sites in the Santa Maria Hydrologic Unit, January 2000 through March 2001. Red line corresponds to Basin Plan objective: geometric mean should not exceed 200 MPN/100mL.

The Central Coast Basin Plan identifies two water quality objectives for fecal coliform (Table 5.1.2a). Exceedances of either of these criteria can result in inclusion of a waterbody on the Clean Water Act Section 303(d) list of impaired waterbodies. Site-specific assessments of these two criteria, are listed in Table 5.1.2a.

Table 5.1.2a. Site specific assessment of data used to assess impairment of water contact recreational uses in the Santa Maria River Hydrologic Unit (HU312). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, (-) = not assessed

Constituent	Coliform, Fecal	Coliform, Fecal Geomean	**Evidence of Impairment**
Units	MPN/100 ml	MPN/100 ml	
Matrix	H20	H20	
Water Contact Recreation Assessment Threshold	More than 10% of samples >400	Geometric mean > 200	
Sites			
312ALA	**Yes**	**Yes**	**Yes**
312BCD	**Yes**	**Yes**	**Yes**
312BCU	**Yes**	**Yes**	**Yes**
312BCF	**Yes**	**Yes**	**Yes**
312MSD	**Yes**	**Yes**	**Yes**
312CAV	No	No	No
312CCC	**Yes**	**Yes**	**Yes**
312CUY	**Yes**	**Yes**	**Yes**
312CUT	**S**	**S**	**Yes**
312HUA	No	No	No
312BRE	**S**	**S**	**Yes**
312NIT	**Yes**	**Yes**	**Yes**
312NIP	**Yes**	**Yes**	**Yes**
312ORB	**Yes**	**Yes**	**Yes**
312OLA	**Yes**	**Yes**	**Yes**
312ORI	**Yes**	**Yes**	**Yes**
312ORC	**Yes**	**Yes**	**Yes**
312OFN	**S**	**S**	**Yes**
312OFC	**Yes**	**Yes**	**Yes**
312OFL	**S**	**S**	Yes
312SAL	-	-	-
312SBC	**S**	**S**	**Yes**
312SMA	**Yes**	**Yes**	**Yes**
312SMI	**Yes**	**Yes**	**Yes**
312SIS	No	No	No
312SIV	No	No	No
312-448 (below SMA)	-	-	-

Fecal coliform levels were repeatedly elevated at most sites throughout the watershed rotation area. Only sites in the upper reaches of the Sisquoc River (312SIS and 312SIV), Huasna Creek (312HUA) and Cuyama River (312CAV) did not show signs of impairment due to fecal coliform (Figure 5.1.2c). Major land uses in these areas include rangeland, rural residential and vineyards.

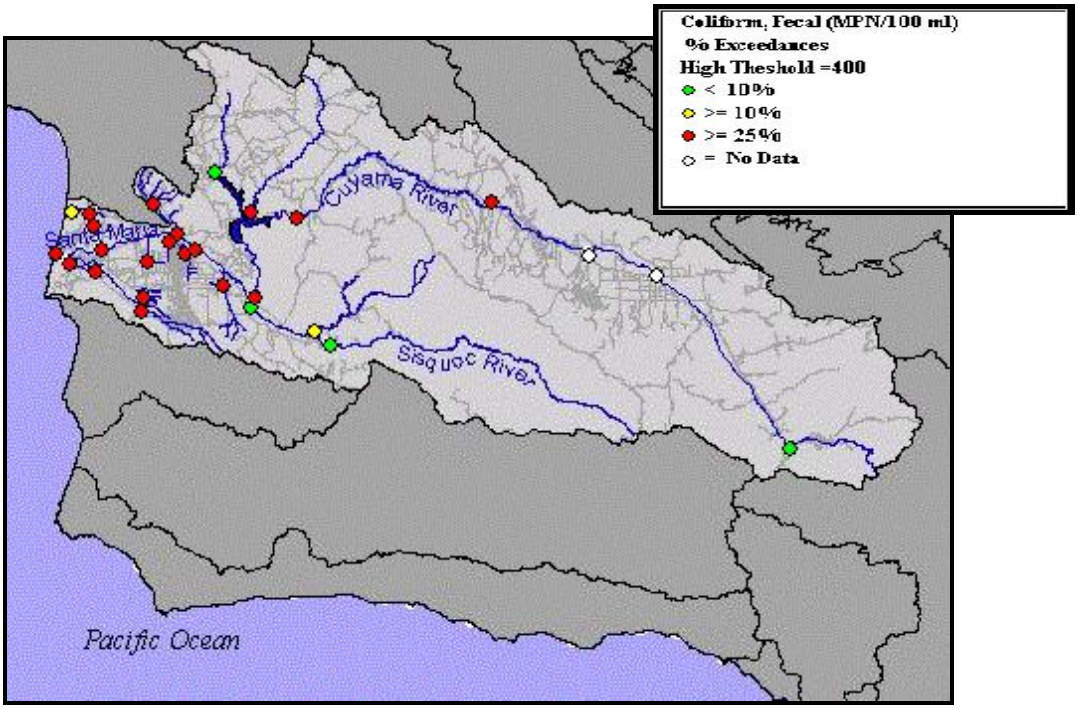


Figure 5.1.2c. Percent exceedances of 400 MPN/100mL for fecal coliform samples collected in the Santa Maria Hydrologic Unit between January 2000 and March 2001.

All three sites on Orcutt-Solomon Creek had more than 25% of total samples exceeding 400 MPN/100ml. Mixed land use patterns through the watershed include urban and rangeland in the upper watershed, tile drainage from adjacent irrigated row crop fields in the middle and lower watershed and some rangeland in the lowest reaches of the watershed. Rangeland is the primary land use in both Alamo Creek (312ALA) and around the Santa Maria Estuary (312SMA). Each of these sites exceeded the Basin Plan objective in more than 50% of total samples collected. Urban areas of the City of Santa Maria also are influential on waters in the Main Street Canal (312MSD), Bradley Channel (312BCU), Blosser Channel (312BCD), and both sites on Nipomo Creek (312 NIT and 312NIP). In addition to having more than 10% of total sample exceeding the Basin Plan objective of 400 MPN/100ml, the above mentioned sites also have geometric mean values which exceed 200 MPN/100ml. Waters that are heavily influenced by tile drain agriculture include Main Street Canal (312MSD), lower Orcutt-Solomon Creek (312ORC and 312ORI), Santa Maria River at Highway 1 (312SMI), Oso Flaco Creek (312OFC) and Little Oso Flaco Creek (312OFN).

These data were considered in the 2002 CWA 303(d) list of impaired water segments data assessment. As shown in Table 2a, several sites in the Santa Maria Hydrologic Unit were listed on the 2002 303(d) list for impairment due to fecal coliform based on this data. One obvious exception to this is the Betteravia Lakes culvert site adjacent to Ray Road (312OLA). All eight

of the samples collected exceeded the Basin Plan Objective of 400 MPN/100ml. However, this site was frequently pooled adjacent to the road culvert, with no observed flow into or out of the pool. Staff recommended not to list this site, as it is not representative of the Betteravia Lakes area and therefore should not be used to infer water quality in the Lakes.

5.1.3 Is there evidence that it is unsafe to drink the water?

All waterbodies in the Central Coast Region are assigned the Municipal Supply beneficial use designation unless it is specifically excluded in the beneficial use table of the Basin Plan (Basin Plan Table 2-1). Oso Flaco Lake is the only waterbody in the assessment area specifically identified in the Basin Plan as not supporting this beneficial use. Although surface waters in this basin are not used directly for drinking water, all waters in the Santa Maria Hydrologic Unit assessed in this report can and do filter to ground water.

To determine if there is evidence of impairment to the municipal and domestic supply beneficial use staff evaluate surface water exceedances of pH and nitrate criteria (see section 1 and table 5.1.3a). Staff does not use pH alone as evidence of impairment of municipal supply; however, if nitrate data show a problem these sites are identified as having evidence of impairment.

Nitrate levels exceeded the drinking water standards at several sites in the Santa Maria Hydrologic Unit, particularly in the lower reaches of watersheds. Figure 5.1.3a shows the percent exceedances at sites in the lower watershed. No sites in the Cuyama or Sisquoc watersheds (not shown in figure 5.1.3a) had more than 10% of total samples exceeding 45mg/L NO_3 as NO_3.

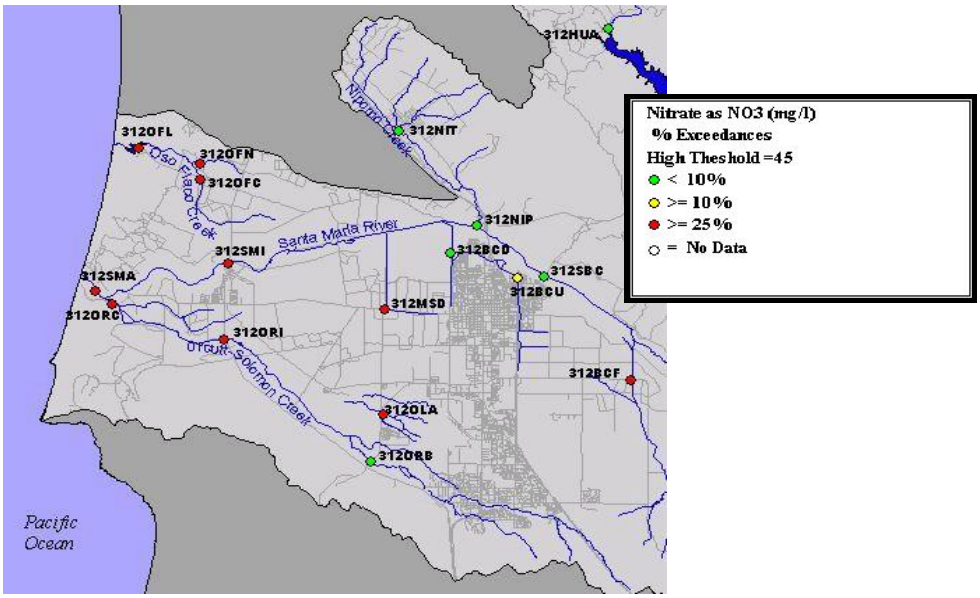


Figure 5.1.3a. Percent exceedances of the nitrate objective (45mg/L NO_3) at sites in the lower Santa Maria River Watershed rotation area, January 2000 through March 2001.

As shown in Figure 5.1.3a, chronic exceedances of the nitrate objective for drinking water were observed at all Oso Flaco watershed sites (312OFC, 312OFN and 312OFL) and in the lower Santa Maria River upstream of the Estuary (312SMA) and at Highway 1 (312SMI). Orcutt-Solomon Creek flows into Santa Maria River upstream of the estuary and the 312SMA site. In the dry season this creek contributes approximately 90% of the total flow to the estuary (SAIC 2004). The monitoring site located upstream of this confluence on Orcutt-Solomon Creek (312ORC) also had extremely high nitrate concentrations year round, ranging from 75 – 153 mg/L NO_3 as did the upstream site at Highway One (312ORI). At each of these sites 100% of the sample collected between January 2000 and March 2001 exceeded the drinking water standard of 45 mg/L NO3. Elevated nitrate concentrations were also measured regularly at sites located at Main Street Canal (312MSD) and Bradley Canyon at Foxen Canyon Road (312BCF). Each of theses sites had mean nitrate values that exceeded the Basin Plan objective, and maximum nitrate concentrations greater than 200 mg/L NO_3. The above-mentioned waterbodies have since been added to the 2002 CWA 303(d) list for impairment of beneficial uses due to nitrate.

Additional sites with elevated nitrate levels that were not proposed for inclusion on the 2002 303(d) list include Betteravia Lakes at the Ray Road Culvert (312OLA) and Little Oso Flaco Creek (312OFN). Central Coast Region staff did not recommend listing Betteravia Lakes in 2002 based on site characteristics which were not representative of the waterbody. We did not recommend listing Little Oso Flaco Creek as it is a small tributary to Oso Flaco Creek, which was listed. Therefore, Little Oso Flaco Creek will be evaluated in the TMDL for Oso Flaco Creek. In addition, staff has recommended that Oso Flaco Lake be removed form the 303(d) list for impairment due to nitrate; this waterbody is not identified in the Central Coast Basin Plan as supporting municipal and domestic supply.

pH

The Geology of the Central Coast tends to result in surface water pH levels that are near or greater than the upper Basin Plan Objective for drinking water (8.3 pH units). However, most of the sites in the Santa Maria Hydrologic Unit did not have elevated pH levels. Average pH at Blosser Channel (312BCD) and Sisquoc River at Mesa Drive (312SIS) exceeded this objective. Most other sites in the Hydrologic Unit had maximum measured values that were greater that 8.3 pH units but average pH at these sites was lower (Figure 5.1.3b). For this assessment elevated pH was not used alone to determine impairment.

Table 5.1.3a. Determining if the water is unsafe to drink in the Santa Maria River Hydrologic Unit (HU312). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, (-) = not assessed.

Constituent	Nitrate as N	pH	Evidence of Impairment
Units	ppm	pH units	
Matrix	H20	H20	
Water Contact Recreation Assessment Threshold	10	<6.5 or >8.3	
Sites			
312ALA	No	**S**	**S**
312BCD	No	**Yes**	**S**
312BCU	**S**	**Yes**	**S**
312BCF	**Yes**	**S**	**Yes**
312MSD	**Yes**	**S**	**Yes**
312CAV	No	**S**	**S**
312CCC	No	**S**	**S**
312CUY	No	**S**	**S**
312CUT	No	**S**	**S**
312HUA	No	No	**No**
312BRE	No	**S**	**S**
312NIT	No	No	**No**
312NIP	No	No	**No**
312ORB	No	**S**	**S**
312OLA	**Yes**	No	**Yes**
312ORI	**Yes**	No	**Yes**
312ORC	**Yes**	No	**Yes**
312OFN	**Yes**	No	**Yes**
312OFC	**Yes**	**S**	**Yes**
312OFL	**Yes**	**S**	**Yes**
312SAL	-	-	-
312SBC	No	**S**	**S**
312SMA	**Yes**	No	**Yes**
312SMI	**Yes**	No	**Yes**
312SIS	No	**S**	**S**
312SIV	No	**Yes**	**S**
312-448 (below SMA)	-	-	-

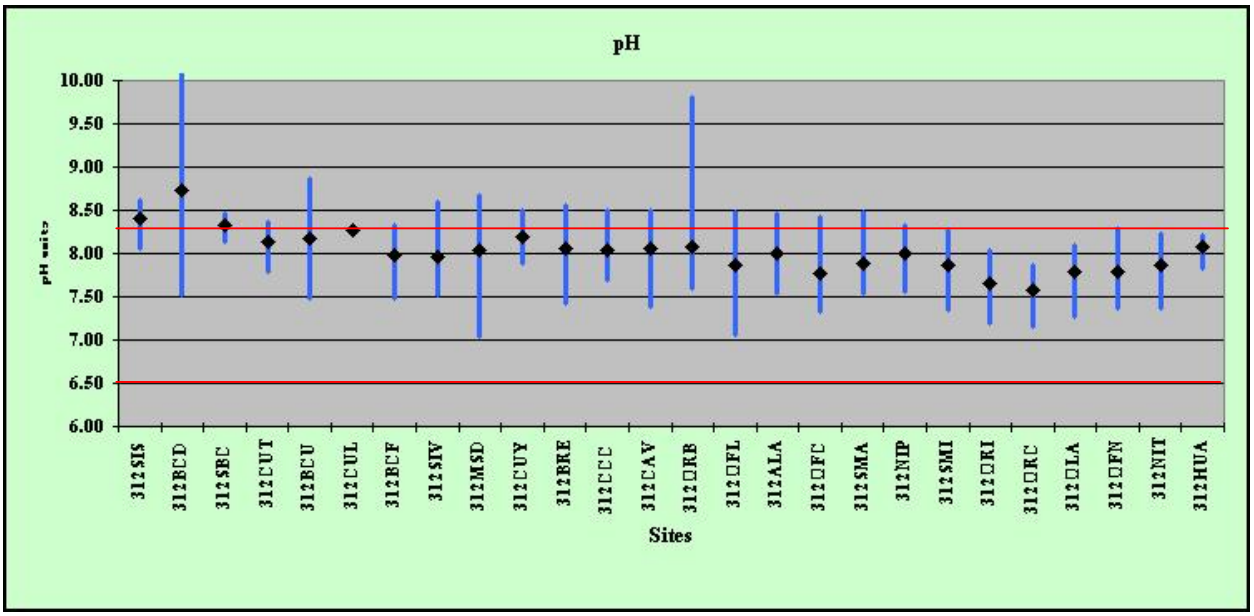


Figure 5.1.3b. Range and mean pH levels measured in monthly sampling at sites in the Santa Maria Hydrologic Unit, January 2000 through March 2001. Red line corresponds to Basin Plan objectives; pH should not be lower than 6.5 nor exceed 8.3.

5.1.4 Is there evidence that it is unsafe to eat the fish? .....

Table 5.1.4a. Site specific assessment of data used to assess impairment of water contact recreational uses in the Santa Maria River Hydrologic Unit (HU312). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, (-) = not assessed

Constituent	Arsenic [1]	Cadmium [1]	Chromium [3]	Copper [3]	Lead [3]	Mercury [1]	Selenium [1]	Zinc [3]	Aldrin [2]	DDT, Total [1]	Dieldrin [1]	Endrin [1]	Heptachlor Epoxide [1]	PCB, Total [1]	Elevated levles of chemicals without published criteria (relative to EDLs)	**Evidence of Impairment**
Water Contact Recreation Assessment Threshold	1.0	3.0	1.0	20.0	2.0	0.3	2.0	45	300	100	2.0	1000	4.0	20		
Units	ppm	ppm	ppm	ppm	ppm	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppb	
Matrix	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	
Sites																
312ALA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312BCD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312BCU	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312BCF	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312MSD	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312CAV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312CCC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312CUY	**Yes**	No	**Yes**	**Yes**	No	No	No	No	No	No	No	No	No	No	No	**Yes**
312CUT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312HUA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

312BRE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312NIT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312NIP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312ORB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312OLA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312ORI	**Yes**	No	**Yes**	No	No	No	No	No	No	**Yes**	**Yes**	No	No	**Yes**	**Yes**	**Yes**
312ORC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312OFN	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312OFC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312OFL	No	No	No	No	No	No	No	No	No	**Yes**	**Yes**	No	No	No	No	**Yes**
312SAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312SBC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312SMA	**Yes**	No	**Yes**	No	No	No	No	No	No	**Yes**	**Yes**	No	No	**Yes**	No	**Yes**
312SMI	**Yes**	No	**Yes**	**Yes**	No	No	No	No	No	No	No	No	No	**Yes**	No	**Yes**
312SIS	**Yes**	No	**Yes**	No	No	No	No	No	No	No	No	No	No	No	No	**Yes**
312SIV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312-448 (below SMA)	**Yes**	No	**Yes**	No	No	No	No	No	No	**Yes**	**Yes**	No	No	**Yes**	No	**Yes**

[1] Criteria based on OEEHA standards
[2] Criteria based on FDA standards
[3] Criteria based on MIS standards

Tissue Bioaccumulation

Bioaccumulation of metals and organic chemicals was assessed in the Santa Maria Hydrologic Unit using transplanted freshwater clams (*Corbicula fluminea*) and resident fish (*Gasterosteus aculeatus* and *Lavinia exilicauda*) in surface water streams and lagoons and using sand crabs (*Emerita analoga*) on the sandy beach at the River mouth. Freshwater clams (*C. fluminea*) were deployed and retrieved by California Department of Fish and Game Staff working with the State Mussel Watch Program at five sites in the Hydrologic Unit in February and March 2000 and previously at the site upstream from the estuary (312SMA) in 1999. Resident fish were also collected at the two sites in the Hydrologic Unit by California Department of Fish and Game staff working with the Toxic Substances Monitoring Program. Three-spined stickleback (*G.aculeatus*) was collected at Santa Maria River lagoon in September 1999 and Hitch (*L.exilicauda*) was collected at Oso Flaco Lake in August 2001. Sand crabs were collected from 20 locations from the beach within 900 feet north and south of the river mouth by researchers from the University of Santa Barbara and California Department of Fish and Game staff in July 2000 (Dugan et al. 2004). Although sand crabs are not a potential food source for humans, they are the primary prey for popular game species such as surf perch (Family Embiotocidae). Tables 5.1.4b-5.1.4d show metal and organic chemical concentrations from these tissues. For fish and bivalve samples threshold exceedances are identified in table 5.1.4a.

Metals in tissue samples

Metals data are compared to California's Office of Environmental Health Hazard Assessment (OEHHA) fish tissue criteria (1999), U.S Food and Drug Administration Action Levels, and Median International Standards (MIS) published by the Food and Agriculture Organization of the United Nations (1983). MIS and FDA values are used in the absence of OEHHA criteria, and also are specific to shellfish, whereas OEHHA values are for fish tissue. Metal concentrations reported here are total concentrations, and do not differentiate between specific metal species (i.e. Chromium III and VI). Both arsenic and chromium have very toxic forms (inorganic arsenic and chromium VI respectively). However, most studies of dietary intake of arsenic show that in fish and shellfish the primary form of arsenic is the relatively non toxic organic form (ASTDR Tox Facts) and chromium VI is quickly converted in the body to chromium III, an essential nutrient in low concentrations.

In transplanted freshwater clam tissues, arsenic and chromium levels exceeded MIS or OEHHA criteria at all sites. The Santa Maria site at Highway One (312SMI) had higher concentrations than any other site for every metal tested and exceeded MIS values for arsenic, chromium, copper and selenium. Although concentrations were lower downstream above the Santa Maria estuary (312SMA) in both 1998 and in 2000, samples at this location also exceeded criteria for arsenic, chromium and selenium. Additionally, the Cuyama River sample from above Twitchell Reservoir (312CUY) had several metal concentrations that exceeded MIS and OEHHA criteria (Table 5.1.4b).

Resident fish tissue samples (from Oso Flaco Lake and Santa Maria River Lagoon) did not have any metal concentrations which exceeded published Median International or OEHHA Standards.

Table 5.1.4b. Metal concentrations (ug/g or ppm) from transplanted freshwater clams (*Corbicula fluminea*) at sites in the Santa Maria Hydrologic Unit. Bold values indicate exceedances of Median International Standards (MIS) or OEHHA fish tissue standards.

Site	Date	AG	AL	AS	CD	CR	CU	HG	MN	NI	PB	SE	ZN
below SMA	02/16/99	0.018	136	**1.9**	0.34	**4.33**	13.94	0.0233	9.37	0.64	0.07	**0.51**	13.8
below SMA	02/03/00	0.011	70.2	**1.5**	0.27	**3.97**	12.56	0.0179	4.77	0.72	0.05	**0.36**	9
SIS	03/22/00	0.007	38.9	**1.2**	0.25	**2.61**	8.38	0.0117	1.99	0.55	0.03	**0.29**	7.1
CUY	03/22/00	0.021	161.7	**1.6**	0.39	**6.57**	**24.95**	0.0236	5.5	0.62	0.1	**0.46**	13.4
ORI	02/03/00	0.012	190.4	**1.5**	0.26	**3.76**	12.48	0.017	5.23	0.5	0.1	**0.35**	9.3
SMI	02/03/00	0.033	1384.8	**2.2**	0.54	**162.22**	**28.07**	0.0359	105.39	122.86	0.81	**0.53**	15.6
MIS				**1.0**	**1.0**	**1.0**	**20.0**	**0.5**			**2.0**	**0.3**	**70.0**
OEHHA				**1.0**	**3.0**			**0.3**				**2.0**	

Organic chemicals in tissue samples

Organic chemical analyses were conducted on tissue samples of transplanted freshwater clam (*Corbicula fluminea*) from sites at Santa Maria Estuary (downstream of 312SMA), Orcutt-Solomon Creek at Highway 1 (312ORI) and Sisquoc River at Mesa Way (312SIS) in March 2000. Several organic chemicals were present however; very few criteria are available to evaluate the level of contamination with respect to human consumption. National Academy of Sciences guidelines (NAS), OEHHA, and U.S. Food and Drug Administration action levels (FDA) are used as assessment thresholds (Table 5.1.4c). Sites at Orcutt-Soloman Creek (312ORI) and the Santa Maria River at Highway 1 (312SMI) had clam tissue levels that exceeded OEHHA criteria for fish tissue, for DDT, Dieldrin, and PCBs. The Sisquoc River site also showed slight elevation of PCB concentrations in clam tissue.

Also shown in Table 5.1.4c are the chemical concentrations of the 95th percentile for all published State Mussel Watch Program data through 1997 ($N_{samples}$=111 throughout the State). These values are not regulatory and are provided for reference, relative to all other data collected in the State. Although there are no criteria currently available to evaluate chlorpyrifos concentrations in shellfish, clams collected from the Orcutt-Solomon Creek site at Highway 1 (312ORC) are higher than 95% of all samples collected in the State by the SMW program. Toxicity monitoring conducted in 2002 confirms elevated levels of both chlorpyrifos and diazinon in water and sediment samples from this watershed (Anderson et al. 2005).

Table 5.1.4c. Organic chemical concentrations from transplanted freshwater clams at sites in the Santa Maria Hydrologic Unit with NAS, OEHHA and FDA criteria for shellfish (ng/g or ppb). Elevated data levels at the 95th percentile of Mussel Watch Program data (EDL95) are also shown.

Site	Date	Chlorpyrifos	Total DDT	Diazinon	Dieldrin	Endrin	Total PCBs
below 312SMA	2/16/1999	34.4	**527.0**	19.3	**12.5**	7.6	**26.5**
below 312SMA	2/3/2000	63.9	**371.5**	ND	**22.4**	ND	**46.1**
312ORI	2/3/2000	**80.3**	**422.5**	ND	**36.5**	ND	**44.6**
312SIS	3/22/2000	1.8	37.1	ND	1.2	ND	**24.9**
NAS	**Shellfish**		**1000.0**				**500.0**
FDA	**Shellfish**				**300.0**	**300.0**	**2000.0**
OEHHA	**Fish**	**10,000**	**100**	**300**	**2.0**	**1000**	**20**
EDL 95	**Shellfish**	**72.0**	**2493.7**	**23.2**	**196.9**	**29.3**	**151.6**

Organic chemical analyses of resident fish were conducted at two sites in the Hydrologic Unit. California Department of Fish and Game staff working with the Toxic Substances Monitoring Program collected fish samples. Three-spined stickleback (*G. aculeatus*) was collected at Santa Maria River lagoon in September 1999 and Hitch (*L. exilicauda*) was collected at Oso Flaco Lake in August 2001. Available criteria and chemical concentrations in samples are shown in Table 5.1.4c

Several organic chemicals were detected in these samples; however, few criteria are available to evaluate the level of contamination with respect to human consumption. For example, there are currently no criteria available for chlorpyrifos or diazinon, two currently applied organophosphate pesticides. However, conference proceedings presented by Jarvinen at the National Sediment Bioaccumulation Conference stated that the following chlorpyrifos concentrations in tissues above 2.55ppb and above 5.11ppb (in large mouth bass and fathead minnow respectively) are correlated with significant effects to survival of the test species. In the Santa Maria River lagoon, chlorpyrifos in whole fish tissues measured 25.8 ppb. This is higher than 95% of all samples taken state wide (N= 751 samples collected by the Toxic Substances Monitoring Program (TSMP 1995).

In stickleback collected from the Santa Maria estuary, concentrations of total DDT and toxaphene greatly exceeded OEHHA and NAS guidelines for whole fish. In *L. exilicauda* filet tissues from Oso Flaco Lake, toxaphene levels exceeded OEHHA and FDA action levels for edible portions. Each of these chemicals are no longer applied in the watershed however, residual levels are still very high and are exceeding assessment threshold criteria (Table 5.1.4d).

Table 5.1.4d. Organic chemical concentrations in whole fish from Santa Maria River lagoon September 1999 (ng/g or ppb). National Academy of Sciences (NAS) and Food and Drug Administration (FDA) criteria for freshwater fish are shown as exceedances threshold values. Exceedances are bold.

Site	Date	Aldrin	Chlordane	Total DDT	Dieldrin	Endrin	Heptachlor	Tot PCB	TOXAP
Santa Maria lagoon	Whole Fish	-1.0	43.6	**7523.2**	**188.0**	**148.0**	-2.0	248.0	**7593.0**
Oso Flaco Lake	Filet		2.2	**345.1**	**25.5**	10.5	-2.0	NA	**243.0**
NAS	**Whole Fish**	**100**	**100**	**1000**	**100**	**100**	**100**	**500**	**100**
FDA	**Filet**	**300**	**300**	**5000**	**300**	**300**	**300**	**2000**	**5000**
OEHHA	**Filet**		**30**	**100**	**2**	**1000**	**4**	**20**	**30**

Sand Crab tissue samples collected from the sandy beaches adjacent to the River mouth also showed elevated levels of organochlorine pesticides. Resident sand crabs (*Emerita analoga*) were collected from 20 locations within 900 feet north and south of the Santa Maria River mouth by researchers from UC Santa Barbara. This collection effort was part of a Region-wide study that looked at 19 sandy beaches adjacent to creek and river mouths between Santa Cruz and Santa Barbara. Criteria are not currently available for sand crab tissues; the criteria cited are for marine and freshwater fish. However, sand crabs are an important source of food for several game fish such as several species of surf perch. The following is a brief summary of the results for the beach north and south of the Santa Maria River mouth from Dugan et al. (2004).

The highest concentration of DDT and its metabolites in the Region were found in sand crab samples collected from Santa Maria beaches. Samples from this beach had the highest DDT for all samples in the Region with maximum concentration exceeding 650 ng/g (dry weight). Dugan et al. (2004) found a significant relationship between DDT concentration and distance of sample from the River mouth, indicating the watershed is the source. Toxaphene was also detected in all samples collected from this beach. Not only are these chemicals persistent in the watershed, they are also affecting the adjacent nearshore environment. Persistent organochlorine pesticides in these habitats are of concern for aquatic organisms and their predators (humans, wild mammals and birds of prey). Beach fishing is popular at both Santa Maria River Mouth and Oso Flaco Lake. Osprey (*Pandion haliaetus*) and Peregrine falcons (*Falco peregrinus*) have been observed hunting in and around Santa Maria River lagoon and Oso Flaco Lake by CCAMP staff. Birds of prey were devastated in the 1970's by pesticide bioaccumulation in their prey items. Eggshell thinning and improper embryo development had been widely documented in Osprey, Peregrine falcons and Bald Eagles (Wiemeyer *et al.* 1988, Poole 1989 and Wegner 2005). Human symptoms of exposure to high levels of DDT and it metabolites include seizures and tremors. In women reproductive effects such as premature birth and reduced lactation in new mothers may also occur (ATSDR web site).

Santa Maria River mouth sand crabs have the highest concentrations of petroleum aromatic hydrocarbons (PAHs) in the Region. Sample concentrations ranged from 310-2117 ng/g. More than 90% of the total PAHs measured in these samples are substituted PAHs, which are derived from crude or refined oil products. Sources could include oil leaks and spills from the adjacent Guadalupe oil fields and up stream from the Bradley Canyon oil production area. There was no pattern between distance from the River mouth and concentration of PAHs, suggesting that the

River is not the source. However, within-beach variability in PAH concentrations was much higher than for DDT resulting in lower statistical power to detect trends.

5.1.5 Is there evidence that aquatic life uses are not supported?

Several lines of evidence are evaluated to determine if water quality supports aquatic life beneficial uses. These include some measures that are used to directly assess impairment such as toxicity or exceedances of Basin Plan objectives. Numeric Basin Plan objective for un-ionized ammonia or dissolved oxygen can show evidence of impairment. Interpretation of narrative Basin Plan objectives for toxicity, and presence of organic chemicals are also used to determine threshold exceedances. Other measures such as the CCAMP Biostimulatory Risk Index and the CCAMP Index of Biotic integrity are used to evaluate water quality but are not used alone to determine evidence of impairment. If additional lines of evidence of impairment are available these criteria can support assessment of threshold exceedances.

Table 5.1.5a. Site specific assessment of data used to assess impairment of aquatic life uses in the Santa Maria River Hydrologic Unit (HU312). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (ie a non threshold value is exceeded or only one exceedances observed, (-) = not assessed. * less than 80% survival and significantly different than control.

Constituent	Ammonia as N, Unionized	Oxygen, Dissolved	Oxygen, Saturation	pH	Toxicity	Bio-stimulatory Risk	CCAMP IBI	Arsenic	Chromium	Copper	Lead	Mercury	Selenium	Zinc	DDT, Total	Dieldrin	Endrin
Water Contact Recreation Assessment Threshold	0.03	<7 or <5	Median <85	<7 >8.5	<80% *	0.4	<3.0	1.5	1	20	2	0.5	2	45	1000	300	300
Units	ppm	ppm	%	pH	% survival			ppm	ppm	ppm	ppm	ppb	ppb	ppm	ppb	ppb	ppb
Matrix	H20	H20	H20	H20	H20 or Sed	NA	NA	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis
Sites																	
312ALA	No	**No**	**S**	No	-	**Yes**	No	-	-	-	-	-	-	-	-	-	-
312BCD	**Yes**	**Yes**	**S**	**Yes**	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312BCU	**S**	**Yes**	**S**	No	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312BCF	**Yes**	**S**	**Yes**	No	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312MSD	**Yes**	**S**	**S**	No	**Yes**	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312CAV	No	No	**S**	No	-	**S**	**S**	-	-	-	-	-	-	-	-	-	-
312CCC	No	No	No	No	-	**Yes**	**S**	-	-	-	-	-	-	-	-	-	-
312CUY	No	No	No	No	-	**S**	-	**S**	**S**	**S**	No	No	**S**	No	No	No	No
312CUT	No	No	No	No	-	**S**	**Yes**	-	-	-	-	-	-	-	-	-	-
312HUA	No	No	**S**	No	-	**S**	-	-	-	-	-	-	-	-	-	-	-
312BRE	No	**S**	**S**	No	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312NIT	No	**S**	**S**	No	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312NIP	**S**	**S**	**S**	No	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312ORB	**Yes**	**S**	**S**	No	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312OLA	**S**	**S**	**S**	No	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312ORI	**Yes**	No	S	No	**Yes**	**Yes**	-	**S**	**S**	No	No	No	**S**	No	No	No	No
312ORC	No	No	No	No	**Yes**	**Yes**	**Yes**	-	-	-	-	-	-	-	-	-	-

Constituent	Ammonia as N, Unionized	Oxygen, Dissolved	Oxygen, Saturation	pH	Toxicity	Bio-stimulatory Risk	CCAMP IBI	Arsenic	Chromium	Copper	Lead	Mercury	Selenium	Zinc	DDT, Total	Dieldrin	Endrin
Water Contact Recreation Assessment Threshold	0.03	<7 or <5	Median <85	<7 >8.5	<80% *	0.4	<3.0	1.5	1	20	2	0.5	2	45	1000	300	300
Units	ppm	ppm	%	pH	% survival			ppm	ppm	ppm	ppm	ppb	ppb	ppm	ppb	ppb	ppb
Matrix	H20	H20	H20	H20	H20 or Sed	NA	NA	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis
Sites																	
312OFN	No	**S**	**S**	No	-	**Yes**	-	-	-	-	-	-	-	-	-	-	-
312OFC	**Yes**	No	S	No	**Yes**	**Yes**	**Yes**	-	-	-	-	-	-	-	-	-	-
312OFL	No	**S**	**S**	No	-	**Yes**	-	No	No	No	No	No	No	No	No	No	No
312SAL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
312SBC	No	No	No	No	-	S	**Yes**	-	-	-	-	-	-	-	-	-	-
312SMA	**Yes**	No	No	No	**Yes**	**Yes**	**Yes**	-	-	-	-	-	-	-	-	-	-
312SMI	**Yes**	**S**	**S**	No	**Yes**	**Yes**	**Yes**	**S**	**S**	**S**	No	No	**S**	No	No	No	No
312SIS	No	No	No	**Yes**	-	**S**	**S**	No	**S**	No	No	No	No	No	No	No	No
312SIV	No	**S**	**S**	No	NO	**S**	No	-	-	-	-	-	-	-	-	-	-
312-448 (below SMA)	-	-	-	-	**-**	-	-	**Yes**	**Yes**	No	No	No	**Yes**	No	**S**	No	**S**

Toxicity

Toxicity bioassays are used to determine if waters and streambed sediments are toxic to or produce detrimental physiological responses in aquatic life as is specifically prohibited in the Central Coast Basin Plan (CCRWQCB 1995). Sediment and water toxicity analysis was conducted at seven sites in the Santa Maria watershed rotation area in 2002 and 2003 (Table 5.1.5a) by staff from the Granite Canyon Marine Pollution Study Laboratory under contract with the Regional Board. The following summarizes results published by Anderson et al. (2005).

Seven-day chronic toxicity tests were conducted using *Ceriodaphnia dubia* to assess toxicity of water samples from all seven stations (Table 5.1.5a). Samples were collected from each site on July 2002, September 2002, March 2003 and May 2003. Survival of the test organisms in water samples from Main Street Canal (312MSD) and Sisquoc River (312SIV) were never significantly reduced relative to the control sample. All other sites in this study had significantly reduced survival in more than one sample and are identified as having impaired aquatic life uses in Table 5.1.5b. Samples from two sites (312ORC and downstream at 312SMA) resulted in 100% mortality to *C. dubia* in samples collected September 2002 and May 2003. Zero survival was also observed in the Orcutt-Solomon Creek site at Highway One (312ORI) in July 2002 and at the Santa Maria River at Highway One (312SMI) in September 2002. Survival was reduced to 30% in the sample from Oso Flaco Creek (312OFC) in May 2003. Each of these samples contained chlorpyrifos levels that are known to exceed acute toxicity threshold for *C. dubia.*

Toxicity Identification Evaluations (TIE's) were conducted on water samples collected May 2003 in Orcutt-Solomon Creek (312ORC) and the Santa Maria River (312SMA). Each of these samples resulted in 100% mortality to test organisms. In this analysis the survival of *C. dubia* was restored in both samples (to above 85%) when chlorpyrifos concentrations were reduced to non-detect levels. Toxic units (the concentration of toxicants expressed as units of the LC50 concentration) of chlorpyrifos and diazinon were calculated for all water samples. Both sites had over seven toxic units (or seven times the LC50) of chlorpyrifos in the May 2003 sample.

Table 5.1.5b. Percent survival of *C. dubia* and *H. azteca* in toxicity tests conducted in the Santa Maria Hydrologic Unit July 2002 through May 2003. Bold numbers indicate survival is significantly different from the control value @ $p<0.05$. NA=not analyzed.

Site	*C.dubia* survival Jul-02	*C.dubia* survival Sept-02	*C.dubia* survival Mar-02	*C.dubia* survival May-02	*H. azteca* survival June-02	*H. azteca* survival May-03
312SIV	100	90	90	100	98	98
312MSD	100	100	100	100	**0**	**78**
312SMI	100	**0**	90	100	83	**74**
312ORI	**0**	100	100	100	93	88
312ORC	100	**0**	100	**0**	**6**	**0**
312SMA	100	**0**	100	**0**	**6**	**0**
312OFC	80	100	100	**30**	**71**	N/A

Sediment toxicity tests using *Hyalella azteca*, a resident species in theses watersheds, resulted in toxic effects in both sediment samples from three sites; lower Santa Maria River (312SMA), Orcutt-Solomon Creek (312ORC) and Main Street Canal (312MSD). One of two sediment samples collected from Orcutt-Solomon at Highway 1 (312ORI) and Santa Maria River at Highway 1 (312SMI) were toxic to this test species.

Sediment toxicity was assessed at each station in June, 2002 and May, 2003 using the 10-d survival and growth toxicity test with *H. azteca*, a genus that occurs in the Santa Maria River watershed. In all samples where survival of *H. azteca* was less than 70%, the pore water chlorpyrifos concentration was higher than the LC_{50} for this species (0.086 ug/L as cited in Phipps et al. 1995). TIE analysis conducted on the Santa Maria River sites above the estuary (312SMA) showed that survival of *H. azteca* was restored (to above 85%) when chlorpyrifos concentrations were reduced to non-detect levels; this indicates that chlorpyrifos was responsible for the toxicity. Similar results were found in the water toxicity TIE at this site.

Sites in the lower Santa Maria River, Orcutt-Solomon Creek had multiple toxicity tests results showing significantly reduced survival of the test organisms relative to the control samples. These sites have been recommended for inclusion on the Clean Water Act section 303(d) list. For the sites at Main Street Canal and Oso Flaco Creek there is evidence of impairment (as shown by a single test result having significant reduction in survival to the test organism); however, additional data is required for 303(d) listing assessment.

Organic chemicals and metals in tissue
Organic chemical analyses were conducted on tissue samples of transplanted freshwater clam (*Corbicula fluminea*) from sites at Santa Maria Estuary (downstream of 312SMA), Orcutt-Solomon Creek at Highway 1 (312ORI) and Sisquoc River at Mesa Way (312SIS). These data are discussed in section 5.1.4 and summarized in Table 5.1.4b. Organic chemical analyses were also conducted using resident fish were at the two sites in the Hydrologic Unit. California Department of Fish and Game staff working with the Toxic Substances Monitoring Program collected three-spined stickleback (*G. aculeatus*) at Santa Maria River lagoon in September 1999 and Hitch (*L. exilicauda*) at Oso Flaco Lake in August 2001. These data are summarized in section 5.1.4 and in Table 5.1.4c with available criteria. Finally, resident sand crabs (*Emerita analoga*) were collected from 20 locations within 900 feet north and south of the Santa Maria River mouth by researchers from UC Santa Barbara (Dugan et a. 2004) also showed elevated levels of organochlorine pesticides. Samples from this beach had the highest DDT for all samples in the Region with maximum concentration exceeding 650 ng/g (dry weight).

Organic chemicals in sediment
The Central Coast Basin Plan (CCRWQCB 1995) states "there shall be no increase in pesticide concentration found in bottom sediment or aquatic life." Therefore, any organic chemical measured is above background levels. Below, we compare concentrations measured in these samples to available and relevant criteria (assessment thresholds).

Historically, sediment has been collected and analyzed for metal and chemical contamination on several occasions at and very near the Santa Maria River Estuary site (312SMA). In a 1998 study, conducted by the Bay Protection and Toxic Clean Up Program, this site was identified as

having sediment DDT concentrations among the highest five percent project wide (including the Sacramento Delta, Los Angeles and Monterey Harbor watersheds) (SWRCB 1998). Our data is consistent with the tissue bioaccumulation data discussed above. This site also had elevated levels (relative to ERM and PEL values) of dieldrin and endrin in sediment. These results are consistent with elevated levels of these chemicals in tissue samples.

CCAMP staff collected sediment samples in June 2000 at 13 sites throughout the watershed. In addition, sediment chemistry analysis was conducted at the upper Sisquoc River site in 2002 and in the lower Santa Maria River in 1998. No chemicals were detected in the Sisquoc sample. Organic chemicals detected at sites, along with available and relevant criteria, are shown in Table 5.1.5c. As shown in the 1998 sediment study, the Santa Maria Estuary site (312SMA) has elevated DDT and DDT metabolites relative to freshwater and marine sediment criteria. Upstream at sites on Orcutt-Solomon Creek (312ORC) and at Santa Maria River at Highway 1 (312SMI) DDT, dieldrin and endrin also exceeded criteria.

Table 5.1.5c. Organic chemicals detected in the sediment sample collected at 13 sites in June 2000 and two additional samples from 1998 and 2002. Available criteria are shown for reference. Units of measurement are ppb (ug/kg). ND is non-detect. Criteria exceedances are bold.

Site Tag	DDD(p,p')	DDE(p,p')	DDT, Total	Dieldrin	Endrin	Chlorpyrifos	Total PCB
312OFN 2000	1.0	5.3	9.3	2.6	1.4	ND	ND
312SMI 2000	3.1	**40.0**	**86.1**	4.5	13.0	1.7	ND
312SMA 2000	3.5	**15.0**	16.8	1.0	2.4	1.6	ND
312SMA 1998	**35.0**	**76.0**	**157.0**	**14.0**	6.0	N/A	ND
312ORC 2000	**8.7**	**38.0**	**65.7**	1.80	6.30	ND	ND
312CAV 2000	ND	ND	ND	ND	ND	ND	ND
312CCC 2000	ND	ND	ND	ND	ND	ND	ND
312ALA 2000	ND	ND	ND	ND	ND	ND	ND
312SBC 2000	0.50	**3.6**	5.9	ND	ND	ND	ND
312BCF 2000	1.2	**7.2**	12.1	1.5	ND	4.7	ND
312SIS 2000	1.3	**8.6**	18.4	0.40	ND	1.7	ND
312CUT 2000	ND	0.80	0.80	ND	ND	ND	ND
312SIV 2000	ND	0.20	0.02	ND	ND	ND	ND
312SIV 2002	ND	ND	ND	ND	ND	ND	ND
ERM (marine)	**2**	**2.2**	**46.1**	**8**			**22.7**
PEL (freshwater)	**8.51**	**6.75**	**4450**	**6.67**	**62.4**		**277**

Dissolved oxygen
The Central Coast Basin Plan (CCRWQCB 1995) identifies Santa Maria River and Cuyama River as both cold and warm water habitat. The Sisquoc River is identified as cold-water habitat. Specific dissolved oxygen criteria apply to each beneficial use. Waters designated as cold-water habitat are not to have oxygen levels below 7.0 mg/L at any time; Warm-water habitats are to have dissolved oxygen concentrations above 5.0 mg/L.

Dissolved oxygen data was collected by CCAMP staff monthly at sites throughout the watershed between January 2000 and March 2001. In addition pre-dawn dissolved oxygen measurements were taken at most sites (those safely accessible between 3 am and 5 am) during summer months to target lowest probable levels. The Santa Maria River site up-stream of the estuary (312SMA) and Oso Flaco Lake (312OFL) were not accessible as they are behind locked gates after sunset.

Dissolved oxygen levels were below the assessment thresholds (more than 10% of total dissolved oxygen samples below 5.0 mg/L) at sites in the Cuyama and Santa Maria watersheds, including Bradley Channel (312BCU) and Blosser Channel (312BCD). In the Sisquoc River the cold water objective is used to evaluate depressed oxygen levels. Three of seventeen samples collected at the upper Sisquoc watershed site during pre-dawn monitoring in the summer measured below 7.0 mg/L. This site began drying up in July. Notes from field personnel state that pre-dawn samples were collected less than 100 feet upstream of where the river was going dry, due to lack of access to the upstream reach in the dark. Staff does not believe that these results are representative of the river in this vicinity, nor do we feel the river is impaired for aquatic life in the upper reaches.

An additional Basin Plan objective that applies to all waterbodies states that "median values shall not fall below 85% saturation as a result of controllable water quality conditions". The only site in the Hydrologic Unit with median oxygen saturation levels below 85% was Bradley Canyon Creek at Foxen Canyon Road (312BCF), which has intermittent summer flows and standing water through the fall. These low measurements are a result of flow conditions and are not representative of the creek as a whole.

Un-ionized Ammonia
The un-ionized form of ammonia can be toxic to aquatic organisms at elevated concentrations. The Central Coast Basin Plan includes a general water quality objective that does not permit discharges to cause concentrations of un-ionized ammonia to exceed 0.025 mg/L as N in receiving waters. This criterion applies to all waters of the State and was exceeded at several sites in this Hydrologic Unit (Figure 5.1.5a). Two sites on the lower Santa Maria River (at Highway One (312SMI) and above the estuary (312SMA)) exceeded this assessment threshold in two of twelve samples. In Orcutt–Solomon Creek all sites had at least one exceedance of the criteria. However, to consider a site impaired by un-ionized ammonia concentrations, more than ten percent of the total samples must exceed the criteria. Two Orcutt-Solomon Creek sites, Highway One (312ORI) and Black Road (312ORB), exceeded the criteria multiple times. Main Street Canal, which flows to Santa Maria River downstream of the City of Santa Maria, exceeded this criterion in eleven of twelve samples at 312MSD. Other tributaries to the Santa Maria River with more than ten percent of the total un-ionized ammonia samples elevated

include Bradley Canyon Creek at 312BCF and Blosser Channel at 312BCD. These waters only flow to the River during the wet season.

Un-ionized ammonia was also elevated in Oso Flaco Creek at Oso Flaco Creek Road (312OFC) in nine of twelve samples collected between January 2000 and March 2001. This creek joins Little Oso Flaco Creek and flows to Oso Flaco Lake year round. This lake is important habitat for several migrant birds and recreational fishing. No exceedances of the ammonia criterion were observed at the lake site (312OFL).

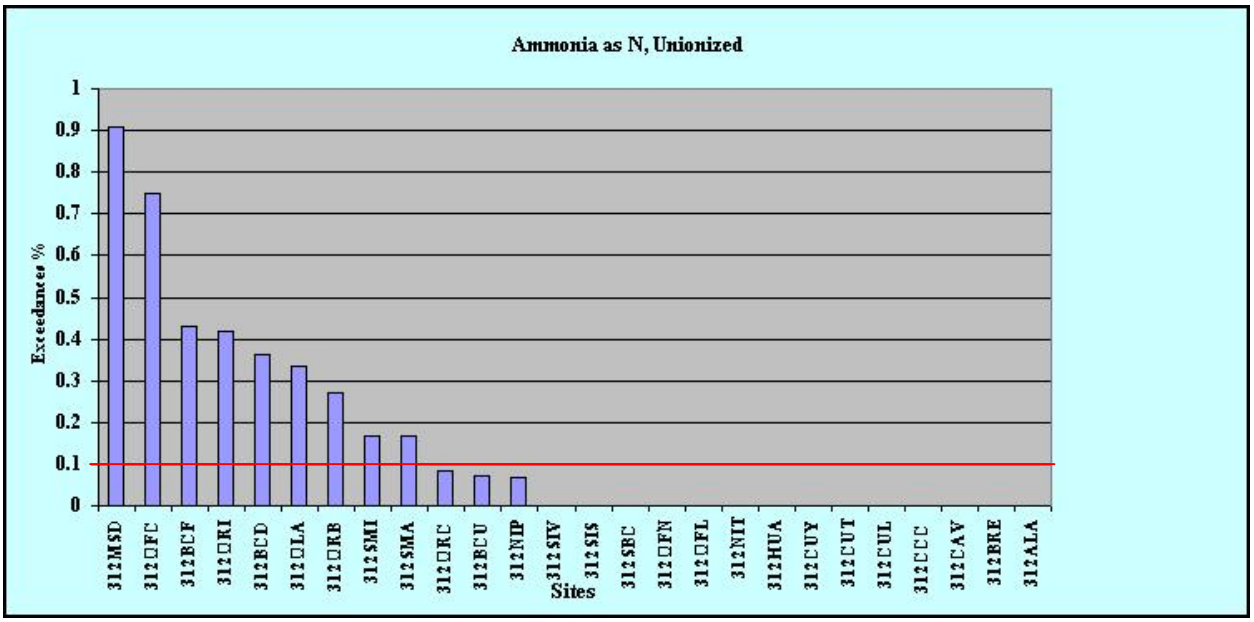


Figure 5.1.5a. Percent of sample exceeding the un-ionized ammonia Basin Plan objective at Santa Maria Hydrologic Unit sites between January 2000 and March 2001. Red line is at the threshold for exceedance.

Biostimulatory risk

Evaluation of biostimulatory risk for all sites monitored by CCAMP in the Central Coast Region has resulted in the identification of a threshold score for determining risk of eutrophic conditions (Appendix I). A Biostimulatory Risk Index score above 0.40 is considered to indicate risk for eutrophication and impairment of aquatic life uses. Several sites in the Santa Maria Hydrologic Unit had Biostimulatory Risk scores which average above 0.4 (Figure 5.1.5b and c) including all sites in the lower Santa Maria watershed with the exception of the Santa Maria River at Bull Canyon crossing (312SBC). Sites in the Sisquoc and Cuyama River watershed did not show evidence of eutrophication risk, as identified by the Biostimulatory Index. This index is not used alone as an assessment threshold.

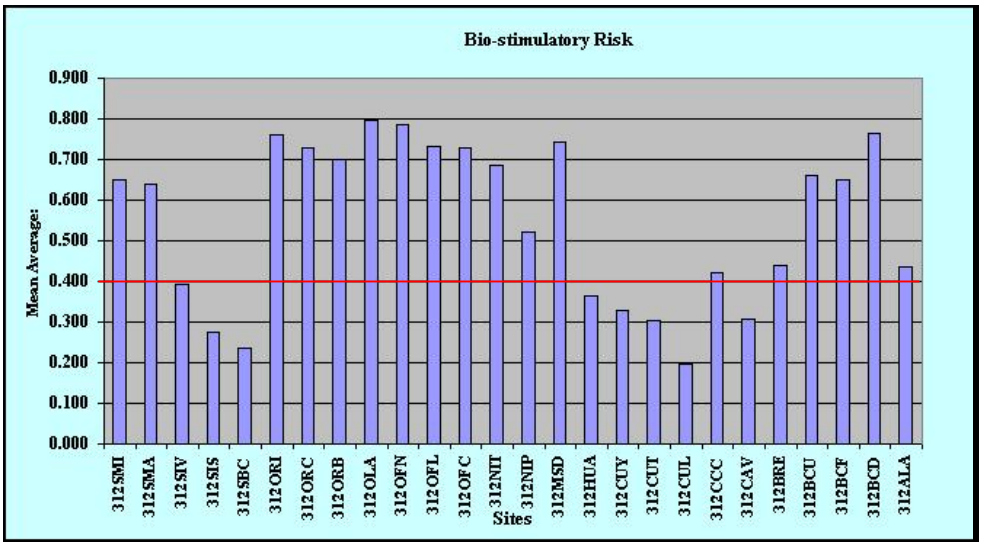


Figure 5.1.5b. Average Biostimulatory Risk Index score for sites in the Santa Maria Hydrologic Unit, January 2000 through March 2001. Red line is at the threshold for exceedance.

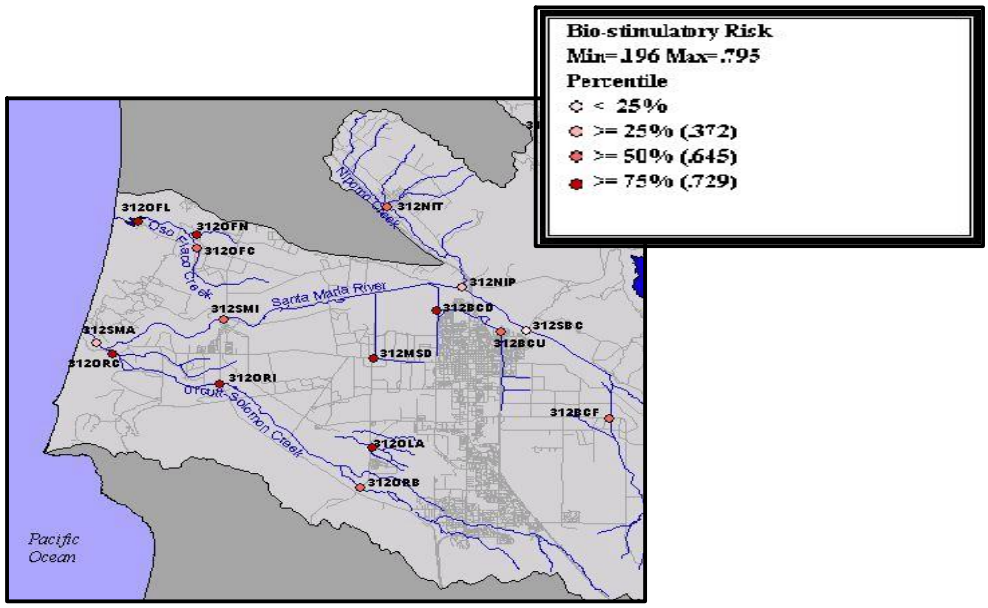


Figure 5.1.5c. Percent quartile rank of the Biostimulatory Risk Index scores at sites in the Lower Santa Maria River Hydrologic Unit. Low risk sites score 0.40 or less (light pink shades) and high risk sites score 0.60 or higher (dark red shades).

CCAMP Index of Biotic Integrity (CCAMP IBI)

Benthic macroinvertebrates were collected from ten sites in the Santa Maria Hydrologic Unit in spring of 2000 and 2001. CCAMP IBI scores are a relative ranking and sites which score less than 3.0 on the CCAMP IBI are considered to be in poor condition based on macroinvertebrate assemblages. Because samples were collected at all sites in two consecutive years and each year the sampling effort consists of 3 composite samples per site (as specified by the CSPB protocol, Harrington 1999), the mean CCAMP IBI score for a site represents six samples. Although this

index may indicate impairment of aquatic life uses at some sites it is not used alone as an assessment threshold.

At all sites sampled on the Santa Maria River (312SMA, 312SMI and 312SBC), Orcutt-Solomon Creek (312ORC) and at one site on the Cuyama River below Twitchell (312CUT), average CCAMP IBI scores are below 3.0. The substrate at each of these sites is either sand or mud dominated and riparian vegetation is relatively sparse on the wetted banks. In addition, nutrient and organic chemical concentrations in the lower Santa Maria and Orcutt-Solomon Creeks may impact aquatic invertebrate communities.

Relatively healthy benthic invertebrate communities were found at both sites on the Sisquoc River (312SIV and 312SIS) and at the upper most Cuyama River site at Highway 33 (312CAV). At each of these sites gravel and cobble habitats are dominant and samples were collected following the riffle protocol.

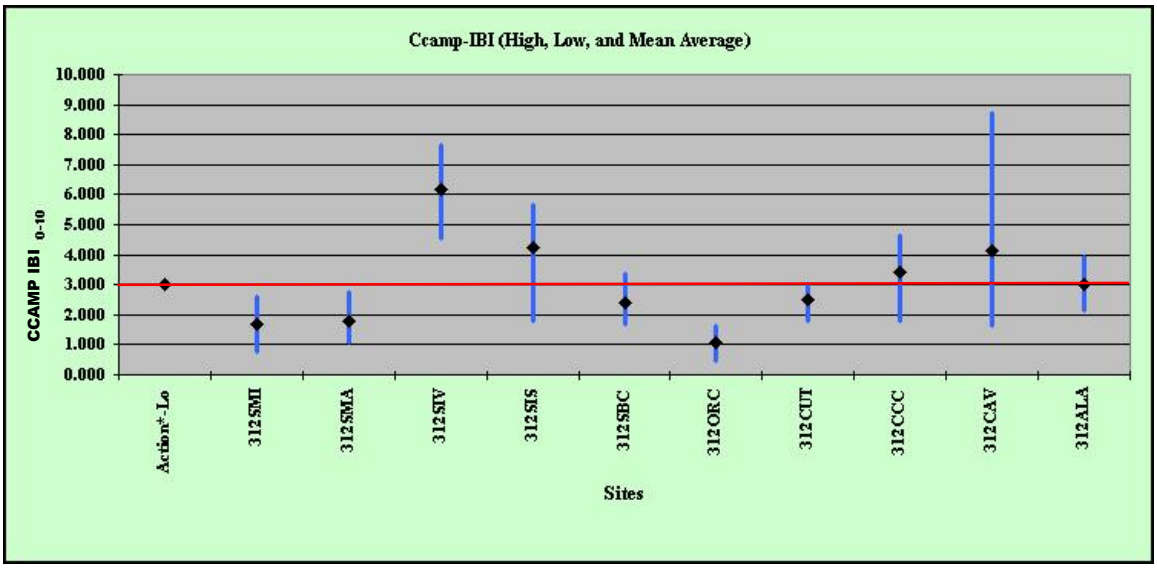


Figure 5.1.5d. Range and average CCAMP IBI scores for sites in the Santa Maria Hydrologic Unit between April 2000 and May 2001. Red line is at 3.0, the score below which macroinvertebrate assemblages are considered in poor condition.

5.1.6 Is there evidence that agricultural uses are not supported?

Table 5.1.6a. Site specific assessment of data used to assess impairment of agricultural beneficial uses in the Santa Maria River Hydrologic Unit (HU312). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (ie a non threshold value is exceeded or only one exceedances observed, (-) = not assessed.

Constituent	Boron	Chloride	Conductivity (Us)	Nitrate as N	pH	Sodium	**Evidence of Impairment**
Matrix	H20	H20	H20	H20	H20	H20	
Units	mg/L	mg/L	mg/L	mg/L	pH Units	mg/L	
Water Contact Recreation Assessment Threshold	2	106	3000	30	<6.5 or >8.4	69	
Sites							
312ALA	No	No	No	No	**S**	No	**S**
312BCD	No	No	No	No	**Yes**	No	**S**
312BCU	No	No	No	No	**Yes**	No	**S**
312BCF	No	No	No	No	**S**	No	**S**
312MSD	No	No	No	No	**S**	No	**S**
312CAV	No	No	No	No	**S**	No	**S**
312CCC	**Yes**	No	**Yes**	No	**S**	No	**Yes**
312CUY	No	No	No	No	**S**	No	**S**
312CUT	No	**Yes**	No	No	**S**	**Yes**	**Yes**
312HUA	No	No	No	No	No	No	No
312BRE	No	No	No	No	**S**	No	**S**
312NIT	No	No	No	No	No	No	No
312NIP	No	No	No	No	No	No	No
312ORB	**Yes**	No	**Yes**	No	**S**	No	**Yes**
312OLA	S	No	No	**S**	No	No	**S**
312ORI	No	No	**S**	**Yes**	No	No	**Yes**
312ORC	No	No	No	**Yes**	No	No	**Yes**
312OFN	No	No	No	**Yes**	No	No	**Yes**
312OFC	No	No	No	**Yes**	**S**	No	**Yes**
312OFL	No	No	No	**Yes**	**S**	No	**Yes**
312SAL	-	-	-	-	-	-	-
312SBC	No	No	No	No	**S**	No	**S**
312SMA	No	No	**S**	No	No	No	**S**
312SMI	No	No	**S**	**Yes**	No	No	**Yes**
312SIS	No	S	No	No	**S**	**S**	**S**
312SIV	No	Yes	No	No	**Yes**	**Yes**	**Yes**
312-448 (below SMA)	-	-	-	-	-	-	-

The following text discusses site specific exceedances of various criteria which apply to assessment of agricultural beneficial uses. Table 5.1.6a summarizes threshold exceedances of these criteria.

pH and conductivity

The pH of irrigation water is of concern for watering crops and at several sites, pH exceeded the upper limit for protection of irrigation uses. pH levels measured throughout the watershed rotation area are discussed in section 5.1.3. The electrical conductivity is also of concern for watering of crops. The conductivity in Orcutt-Solomon Creek was elevated above 3000 uS/cm on several occasions. This creek flows through several miles of irrigated agriculture land. Both lower sites on the Santa Maria River (312SMI and 312SMA) had elevated conductivity on two occasions; however conductivity was typically below 2000 uS/cm.

Salts

Most crops are sensitive to high concentrations of salts such as chloride, sodium and boron. The Central Coast Basin Plan identifies levels of these salts above which crops are negatively affected in irrigation water (chloride should not exceed 106 mg/L, sodium should not exceed 69 mg/L and boron should not exceed 0.75 mg/L). There are several sites found within areas dominated by irrigated agriculture with average chloride levels above 106 mg/L. These include Santa Maria River sites (312SMA and 312SMI), Orcutt-Solomon Creek (312ORB, 312ORI and 312ORC) and Nipomo Creek at Highway 166 (312NIT). All sites in agriculture areas have sodium levels above 60 mg/L. Orcutt-Solomon Creek at Black Road (312ORB) also has elevated boron levels, yet downstream where agriculture is the primary land use this criterion was not exceeded.

Nitrate

In waters that are to be used for irrigation purposes the Central Coast Basin Plan states that nitrate above 30 mg/L as NO_3 as N could have negative effects on sensitive crops. Average nitrate concentration at Santa Maria River at Highway 1 (312SMI), Orcutt-Solomon Creek at Highway 1 (312ORI), Oso Flaco Creek (312OFC) and Little Oso Flaco Creek (312OFN) and Oso Flaco Lake (312OFL) exceed this criterion (Figure 5.1.6a).

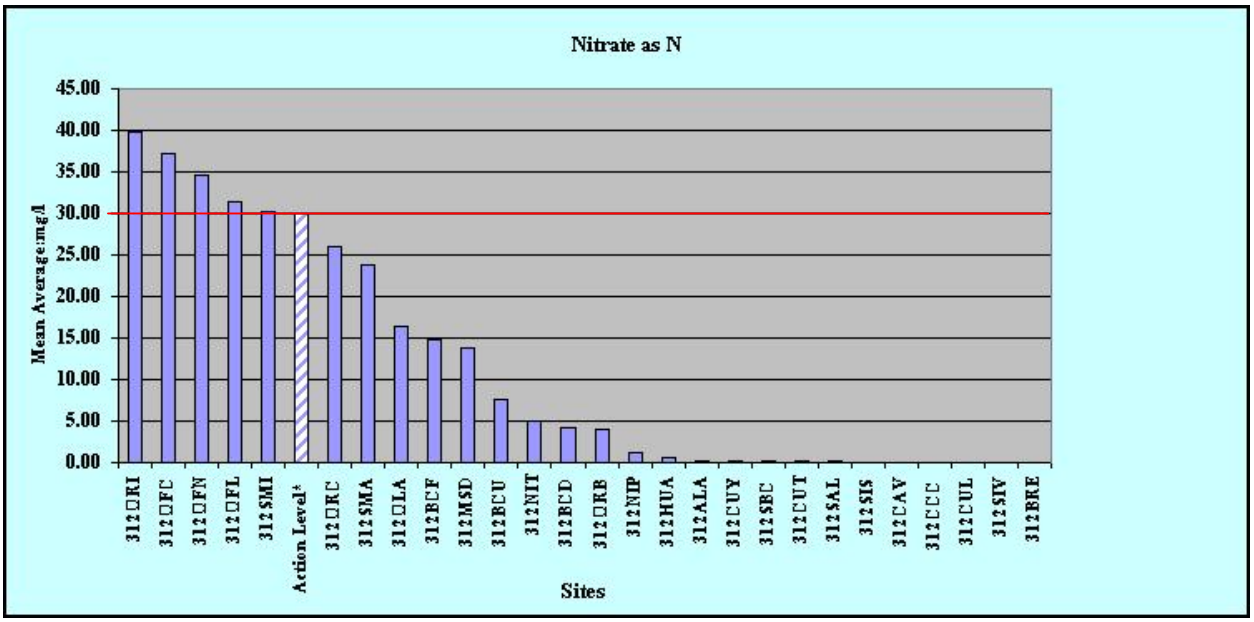


Figure 5.1.6a. Average nitrate concentration (NO_3 as N) for sites in the Santa Maria Hydrologic Unit relative to the irrigated agriculture beneficial use objective (red line and striped bar), January 2000 to March 2001.

5.1.7 Is there evidence that non-contact recreation uses are not supported?

Table 5.1.7a. Site specific assessment of data used to assess impairment of water contact recreational uses in the Santa Maria River Hydrologic Unit (HU312). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (ie a non threshold value is exceeded or only one exceedances observed, (-) = not assessed.

Constituent	% Algal Cover	% Algal Cover, filamentous	Coliform, Fecal	Coliform, Fecal	pH	Turbidity (NTU)	**Evidence of Impairment**
Units	%	%	MPN/100 ml	MPN/100 ml	pH units	NTU	
Matrix	NA	NA	H20	H20	H20	H20	
Water Contact Recreation Assessment Threshold	25%	25%	More than 10% of samples >4000	Geometric mean > 2000	<6.5 or >8.3	10	
Sites							
312ALA	No	No	No	**Yes**	**S**	No	**Yes**
312BCD	**S**	**Yes**	**S**	**Yes**	**Yes**	No	**Yes**
312BCU	**S**	No	No	**Yes**	**Yes**	**Yes**	**Yes**
312BCF	No	No	**S**	**Yes**	**S**	**Yes**	**Yes**
312MSD	**S**	**S**	**Yes**	**Yes**	**S**	**Yes**	**Yes**
312CAV	**S**	No	No	No	**S**	**S**	**Yes**
312CCC	**S**	No	No	**S**	**S**	No	**Yes**
312CUY	No	**S**	No	No	**S**	No	**Yes**
312CUT	No	No	No	No	**S**	No	**S**
312HUA	**S**	No	No	No	No	**Yes**	**Yes**
312BRE	**Yes**	**Yes**	No	No	**S**	No	**Yes**
312NIT	**S**	**Yes**	**Yes**	**Yes**	No	No	**Yes**
312NIP	No	No	**Yes**	**Yes**	No	No	**Yes**
312ORB	**S**	**S**	**Yes**	**Yes**	**S**	**S**	**Yes**
312OLA	**Yes**	No	**S**	**Yes**	No	No	**Yes**
312ORI	No	**S**	No	No	No	**Yes**	**Yes**
312ORC	No	**S**	No	**S**	No	**Yes**	**Yes**
312OFN	**Yes**	**S**	**S**	**Yes**	No	**S**	**Yes**
312OFC	No	No	**S**	**Yes**	**S**	**Yes**	**Yes**
312OFL	No	No	No	No	**S**	**S**	**Yes**
312SAL	-	-	-	-	-	-	-
312SBC	No	No	No	No	**S**	No	**S**
312SMA	No	No	No	No	No	**Yes**	**S**
312SMI	**S**	No	No	No	No	**Yes**	**Yes**
312SIS	No	No	No	No	**S**	No	**S**

The following text discusses site specific exceedances of various criteria which apply to assessment of non-contact recreation beneficial uses. Table 5.1.7a summarizes threshold exceedances of these criteria.

Recreational fishing is common at Oso Flaco Lake and on the beach at Santa Maria River Mouth. Although unlikely, recreation activities are possible at most other sites throughout the rotation area. Elevated coliform levels and the presence of nuisance algae, trash, scum and odors can negatively affect recreation at these sites or downstream at the beaches.

Fecal coliform
Fecal coliform levels were measured above 4000 MPN/100 mL (ten times the contact recreation criteria) in at lease one sample at several different sites. Santa Maria Estuary (312SMA) and all Orcutt-Solomon Creek sites (312ORB, 312ORI and 312ORC) had maximum values above this criterion. Oso Flaco Creek (312OFC) and Little Oso Flaco Creek (312OFN) also showed elevated levels in at least one sample. Downstream at Oso Flaco Lake (312OFL) there were no samples with fecal coliform above this level.

Turbidity
Sites with dry water turbidity higher than 10 NTUs are considered to be impaired for non-contact recreational uses. Several lower watershed sites including Oso Flaco Creek (312OFC), Little Oso Flaco Creek (312OFN), Santa Maria River above the estuary (312SMA), Orcutt-Solomon Creek at the sand plant (312ORC) and at Highway One (312ORI) all have dry weather turbidity levels above 200NTUs on several occasions. Primary land uses in these areas are rangeland and irrigated agriculture.

Algae
Algal mats, which persist throughout the summer months, can be detrimental to non-contact beneficial uses. Algae at Oso Flaco Lake interfered with fishing and wildlife viewing throughout the summer. Algae were not present at most other sites, likely due to lack of substrate for attachment.

Presence of trash, scum or odor
Trash and litter on the banks and in the wetted channel is problematic at several sites in the watershed. Santa Maria River above the estuary (312SMA) is a deposition zone for trash and dumped items from the upstream reaches. High flows during the winter months have brought appliances, tires, culverts, and beverage containers downstream to this site. There is currently no access without a guide into the sampling location, as it is within the Estuary Reserve and is protected for endangered nesting birds. Other sites in the watershed where trash and dumping is a chronic problem include Santa Maria River at Highway One (312SMI), Orcutt-Solomon Creek at Highway One (312ORI), Oso Flaco Creek (312OFC), Bradley Channel (312BCU), Blosser Channel (312BCD) and Santa Maria River at Bull Canyon (312SBC).

Strong odors, cattle waste and hoof prints were observed on multiple sampling events in Santa Maria River at Highway One (312SMI) and above the estuary (312SMA) as well as in Alamo Creek (312ALA) and Cuyama River at Cottonwood Creek (312CCC). At each of these sites cattle are grazing in the creek channel year round.

5.1.8 Discussion

Beneficial use designations for most waters in the Santa Maria Hydrologic Unit are impaired to some degree. Of the 26 sites monitored between January 2000 and March 2001 only two did not have evidence of impairment. These are the upper watershed sites on the Sisquoc River (312SIV) and Huasna River (312HUA), a tributary to the Cuyama River. Additional sites which have some evidence of impairment but are at least partially supportive of all beneficial uses include the following: Sisquoc River on Mesa Road (312SIS), La Brea Creek (312BRE) and Cuyama River below Twitchell at White Rock Lane (312CUT) and at Highway 33 (312CAV). All of the above mentioned sites have relatively good water quality.

The majority of the sites in the lower Santa Maria watershed and lower Cuyama watershed (above Twitchell reservoir) have multiple beneficial use impairments as evident by CCAMP monitoring.

Cuyama watershed

Fecal coliform is a primary pollutant of concern in the Cuyama River above the reservoir. In the summer months as the river dries up and flow is very low, dissolved oxygen and water temperature are also of concern for aquatic life. Because of the flash flooding that is characteristic in this watershed and the instream grazing of young shrubs and trees there is very little riparian cover.

Site-specific objectives have been identified for the Cuyama River below the reservoir for total dissolved solids and salts (chloride, boron and sodium). CCAMP monitoring at the site on White Rock Lane (312CUT) show that on average the TDS, chloride and sodium levels are exceeding the site-specific objectives. Considering the geology in this watershed it may be appropriate to revaluate and possible revise these objectives.

Tributaries to the Cuyama River that are also monitored by CCAMP include Salisbury Creek near Cuyama (312SAL), Alamo Creek near Twitchell (312ALA) and Huasna River at Huasna Town Site (312HUA). Salisbury Creek was only monitored once as it only has flows during rain events. This site will not be monitored in subsequent rotation years due to flow characteristics.

Alamo Creek watershed is influenced by viticulture, rural residential development and rangeland. Pathogen indicators are elevated in this creek, and this waterbody is currently identified on the CWA section 303(d) list for fecal coliform. Alamo Creek also shows potential for biostimulatory risk. Its CCAMP Biostimulatory Risk Index score averaged 4.3, driven primarily by widely ranging dissolved oxygen measurements and persistent algal cover throughout the summer. The Alamo Creek site also scored low on the CCAMP Index of Biotic Integrity (IBI), with scores ranging between 2.1 and 4.0, indicating poor benthic invertebrate community structure. Alamo Creek would benefit from riparian corridor restoration and re-establishment of corridor shading.

Sisquoc River

Based on CAMP monitoring data there is no evidence to show that beneficial uses in the Sisquoc River watershed are impaired. CCAMP data was collected at two sites on the Sisquoc River and in La Brea Creek, a tributary to the River. Steelhead trout were observed on numerous occasions in both waterbodies during the monitoring year. The upper Sisquoc River site (312SIV) appears to be in very good condition. There were no exceedances of water quality objectives with the exception of dissolved oxygen as the river was drying up. La Brea Creek (312BRE) is also relatively healthy, with a few incidences of elevated coliform levels and low pre-dawn dissolved oxygen during the monitoring year. Downstream in the Sisquoc River at Mesa Road (312SIS) flows dried up in late spring. Aquatic invertebrate monitoring at this site resulted in a wide range of IBI scores, from poor to good. Instream habitat at this site includes gravel, sand and cobble, with riffle habitat present. The range of IBI scores indicate that this reach of the River may be only partially supporting aquatic life beneficial uses. Staff recommends additional monitoring to determine the extent and magnitude of this condition.

Site specific objectives have been identified in the Central Coast Basin Plan for total dissolved solids, chloride, boron and sodium. At both sites on the Sisquoc River, the average of all results for these constituents slightly exceeded the site-specific objectives for TDS, chloride and sodium.

Orcutt-Solomon Creek

Orcutt-Solomon Creek drains the southern edge of the Santa Maria watershed and flows to the Santa Maria River less than one-half mile above the estuary. In 2004, work commissioned by the Water Board, Coastal Commission and the Dune Center showed that during the dry season this creek contributes approximately 90% of the flow that enters the estuary (SAIC 2004). Based on monitoring conducted by CCAMP between January 2000 and April 2001, Orcutt-Solomon Creek beneficial uses are impaired by several pollutants. This waterbody is currently listed on the Clean Water Act section 303(d) list for ammonia, nitrate, fecal coliform and boron. Staff plans to recommend listing for pesticides and toxicity based on the data described in this report. CCAMP monitoring supports many of these listings, based on monitoring data collected from three sites on this creek; Black Road (312ORB), Highway One (312ORI) and at the sand plant above the confluence with Santa Maria River (312ORC). Above certain concentrations, ammonia in the un-ionized form is toxic to aquatic life. At sites on this creek un-ionized ammonia levels exceeded Basin Plan criteria in 9 of 35 or 39% of total samples. Nitrate levels in this creek were persistently above the Basin Plan objective for drinking water; 31 of 43 samples measured above the criteria in monthly samples. Another major pollutant of concern is fecal coliform, which is an indication fecal contamination and risk to for human health. In samples collected at sites in Orcutt-Solomon Creek, 28 of 43 exceeded the Basin Plan objective of 400 MPN/100mL. Multiple land uses in the watershed, including rangeland, irrigated agriculture and rural residential development, are potential sources of these pollutants. The TMDL for nitrate and fecal coliform in this creek is scheduled for development in 2008. At that time sources and relative contribution from the various land uses will be determined. Staff will consider addressing un-ionized ammonia at the same time as nitrate, as management actions may be the same.

Pesticides and toxicity are also problematic in Orcutt-Solomon Creek and these issues are also persistent in the Santa Maria Estuary, downstream of the confluence with Orcutt-Solomon Creek. Sediment chemistry and tissue bioaccumulation data from both transplanted bivalves and resident fish show that organochlorine pesticides as well as currently applied chemicals are present. Toxicity data shows severe effects to test organisms with no more than 6% of test organisms surviving in any water or sediment samples. Although organochlorine pesticides persist in this watershed, chemistry analysis conducted with the toxicity samples shows that the concentration of chlorpyrifos alone is high enough to explain the toxicity. These results show that currently applied pesticides are present in concentrations high enough to have negative effects on aquatic life. The creek is not currently listed for pesticides or toxicity. However, these data warrant listing and development of a TMDL and staff will submit the data for recommended listing in 2006. Due to the influence of this creek on the Santa Maria River estuary, especially in the dry season, staff recommends that once listed this TMDL be made a high priority for action. We further recommend that staff work with the Cooperative Monitoring Program for Agriculture to ensure that follow-up activities with landowners in this watershed begin as soon as possible. .

Santa Maria River and smaller tributaries

The Santa Maria River flows from the confluence of Sisquoc and Cuyama Rivers to the Ocean at Guadalupe Dunes Reserve. CCAMP monitoring was conducted at three main-stem sites and at sites on several tributaries including Bradley Canyon Creek, Blosser Canal, Main Street Canal and Orcutt-Solomon Creek. Both Bradley Canyon Creek and Main Street Canal are specifically identified on the Clean Water Act section 303(d) list of impaired waterbodies for ammonia, nitrate and fecal coliform. CCAMP data support these listings and associated TMDLs are scheduled for development in 2008. Sources of these pollutants will be identified at that time. Flows from each of these creeks reach the River intermittently in the summer months. The Santa Maria River itself is a dry river bed for the majority of the year; however, near the town of Guadalupe agricultural return water provides some year round flows to the River.

CCAMP monthly monitoring at both Highway One (312SMI) and above the estuary (312SMA) identified multiple pollutants causing impairment of beneficial uses. Ammonia, nitrate, fecal coliform, and pesticides in sediment and in fish and clam tissues are all exceeding criteria levels. In addition, indices used to evaluate risk of biostimulation (algal blooms) and the health of instream invertebrate communities indicate that both sites in the lower Santa Maria watershed are in poor condition. Not only is the lower river and estuary impaired for recreational and aquatic life beneficial uses, this influence has extended to the near shore marine environment. Guadalupe beach is a popular beach fishing location, particularly for surf perch. Tissue bioaccumulation studies using sand crabs (surf perch prey items) have shown that pesticides and petroleum products are present and for some constituents (total PAH and DDT), concentrations are elevated above all other sites in the Region.

Oso Flaco Watersehd

The Oso Flaco Watersehd has been highly modified to align with roads and agriculture fields along its course. Oso Flaco Creek has one main tributary, Little Oso Flaco Creek, and flows from the base of the Nipomo Mesa to Oso Flaco Lake in the Guadalupe Dunes area. Currently Oso Flaco Creek is listed on the 303(d) list for beneficial use impairment due to nitrate, ammonia

and fecal coliform. The lake is listed for dieldrin and is being delisted for nitrate (the lake is not specifically identified as having the municipal and domestic supply beneficial use). Oso Flaco Lake is an important wildlife area, and provides habitat for migratory waterfowl. The lake is also a popular spot for wildlife viewing and fishing. Fish tissue samples collected in 1999 show that several pesticides are present and are bioaccumulating in fish in the lake. The source of the pesticides is likely the upstream watershed. Data collected in the watershed showed elevated nutrient and coliform concentrations, several pesticides at elevated levels in sediment, and toxicity in both water and sediment. This waterbody is not currently listed on the 303(d) list for toxicity, however staff recommend that this be revised and that the pesticide TMDL be made a higher priority due to the severity of the impairment. We also recommend that Regional Board staff work with the Cooperative Monitoring Program for Agriculture to ensure that follow-up activities with landowners in this watershed begin as soon as possible.

5.1.9 Conclusion

To address these issues staff recommends the following Regional Board actions:

- Basin Planning
    - Evaluate existing site-specific Basin Plan objectives for total dissolved solids and salts for appropriateness.
    - Evaluate appropriateness of Basin Plan objectives for pH.
    - Review and revise beneficial use designations for each waterbody in the Hydrologic Unit.
- Nonpoint Source Management
    - Identify and manage nutrient sources. Priority for this action should be nitrate sources in Orcutt-Solomon Creek, Santa Maria River and Oso Flaco watershed.
    - Identify and manage fecal coliform sources in the lower Cuyama River, Alamo Creek and the entire Santa Maria and Oso Flaco watersheds.
    - Identify and manage pesticide and other toxins in the lower Santa Maria and Orcutt-Solomon watershed.
    - Revise the 303(d) list to add toxicity for Oso Flaco Creek, Orcutt-Solomon Creek and Santa Maria River.
- Follow up Monitoring
    - Agricultural program staff need to ensure that the Cooperative Monitoring Program for Agriculture conducts followup monitoring of sediment chemistry and toxicity in the lower reaches of the Santa Maria River, Orcutt-Solomon Creek, tributaries to these waterbodies and in the Oso Flaco watershed. Once sources are determined, growers need to adjust practices to eliminate toxicity in this area.
    - Additional bioaccumulation monitoring should be conducted in areas used for recreational fishing such as Santa Maria Beach and Estuary, Oso Flaco Lake, Oso Flaco Beach to ensure that fish are safe to eat and that aquatic life is protected. Use multiple species such as sand crabs, bivalves and resident game fish.
- Habitat Assessment
    - Multiple reaches in the Santa Maria Hydrologic Unit have riparian corridor areas that have either been degraded or eliminated entirely. Most of the reaches also show elevated water temperatures and evidence of biostimulation, including algal growth or elevated chlorophyll concentrations throughout the summer. In most

cases, these conditions result in wide ranges of dissolved oxygen levels. Habitat restoration of riparian corridors could reduce this impact and improve habitat for aquatic life in the Hydrologic Unit.

Quality Assurance

Evaluating field data

Field equipment is calibrated prior to and following each sampling event. Field data is qualified with a flag and disabled from use in data calculations and determination of beneficial use impairment if the following is true:

- Post calibration measurements differ from the calibration standard values by more than 20% as identified in the SWAMP QAMP (Puckett 2002, Appendix C).

Evaluating laboratory data

Data is qualified with a flag if it meets one of the following criteria:

- Analyte of interest is not detected (non-detect), the minimum detection limit (MDL) and/or practical quantifiable limit (PQL) is higher than the SWAMP target reporting limit (TRL), and the MDL does not exceed levels of concern or Basin Plan objectives.
- The result is between the MDL and the PQL and these values are below the appropriate water quality criterion.
- The difference between the results from a blind field duplicate and an original sample exceeds the allowable relative percent difference (RPD) defined in the SWAMP QAMP (Puckett 2002, Appendix C). The maximum RPD for conventional parameters, synthetic organics and metals is 25%.
- Blind field duplicates for coliforms exceed the 95% confidence interval values.
- Holding time requirements are not met.

Data is qualified with a flag and disabled from use in calculations and determination of beneficial use impairment if it meets one of the following criteria.

- Analyte of interest is not detected (non-detect), the minimum detection limit (MDL) and/or practical quantifiable limit (PQL) is higher than the SWAMP target reporting limit (TRL), and the non-detect value is near or exceeding a criterion.
- The surrogate spike recovery levels exceed the allowable range of acceptance as identified by the contract laboratory's quality assurance program (BC Labs, 2002). The acceptable levels vary between analytes.
- Matrix spike recovery values exceed the allowable RPD as defined in the SWAMP QAMP (Puckett 2002, Appendix C). The maximum variation in percent recovery for conventional parameters and metal in sediment is 25%. For synthetic organics in sediment the RPD is 50%.
- The batch precision violates the precision requirements defined in the SWAMP QAMP (Puckett 2002, Appendix C). These requirements are 80-120% recovery for conventional parameters and 50-150% recovery for organic chemicals in sediment and tissue.
- The method blank results exceed the method detection limits (MDL).

- The RPD between the blind field duplicate result and the original sample exceeds the allowable relative percent difference defined in the SWAMP QAMP (Puckett 2002, Appendix C) and the difference between the two results is greater than twice the analyte's SWAMP TRL.

All data was evaluated relative to the SWAMP QA criteria. Flags that have been accepted are included in the database as qualifiers. These data are used by CCAMP in analyses but can be excluded by other users such as TMDL staff. Data, which are rejected because they are outside of the QA criteria defined in the SWAMP QAMP, are disabled from all analyses.

CCAMP field and laboratory data was evaluated using the SWAMP QAMP and CCAMP acceptability criteria outlined above. This resulted in qualified data as summarized in Table 7a. Because the SWAMP acceptability criteria were generally less strict than that of the contract laboratory, several of the data were flagged by the contract laboratory and remained flagged in the CCAMP database but are acceptable for use in some data analyses using SWAMP criteria. Data that did not meet SWAMP acceptability criteria were flagged with the appropriate code and the term "reject". Rejected data was not included in any of the analyses discussed in this document.

There were a total of 468 flags attached to Santa Maria Hydrologic Unit data collected between January 2000 and March 2001 (Table 5.1.9a). Of these there are 241 results that were flagged but not disqualified from use because they meet data quality objectives identified in the SWAMP QAMP (Puckett 2002). However, 277 data results are outside of these criteria and therefore were rejected from use in analyses of these data. Rejected data are in the database but, are identified with a flag and "reject" in the disposition.

Field Duplicates

Blind field duplicate results were compared to original sample data. Data pairs were compared in terms of relative percent difference and determined to be unacceptable if the difference between duplicate pairs exceeded the analyte's specific data quality objective (DQO) and was greater than twice the target reporting limit (TRL), as defined in the SWAMP QAMP (Puckett 2002). For each blind field duplicate pair, there are several different analytes. Blind field duplicate samples were collected on 26 occasions between January 2000 and March 2006. Samples sent to the laboratory are analyzed for 20 different analytes by the contract laboratory. When results from the blind field duplicates are compared to the original sample results and RPD is calculated, two criteria must be met. The RPD must be within the SWAMP DQO as defined in the SWAMP QAPP (Puckett 2002), and the RPD must be less that two times the TRL. This second criteria is added to assess variation when results are low or near the detection limit. For these 26 samples, each with 20 analytes, 17 sample analytes did not meet the SWAMP allowable RPD; however, the difference was less than the TRL. For these results the flag is attached but data is still used for analysis. There were 174 sample analytes that failed to meet both criteria. The majority of these were fixed dissolved solids and fixed suspended solids (145 of the 174 results). These resulted in the rejection of the duplicate result and a qualifying flag attached to the original sample analyte.

The contract lab also analyzed blind field duplicate samples for total and fecal coliform on 26 occasions. Because analysis of these data is not discussed in the SWAMP QAMP, we compared the duplicate result to the original sample using the 95% confidence interval table from Standard Methods (1999) for multiple tube dilutions. For these data, 6 fecal and 4 total coliform blind field duplicate samples failed to be within the 95% confidence interval. CCAMP staff determined that because of the natural variability known to be associated with these analyses that these data should be qualified but not disabled from analyses. A flag was attached to these sample batches.

In the case of chlorophyll *a*, field measurements were taken using a Scufa Probe. These field measurements were compared to samples sent to the laboratory and analyzed using Standard Method 10200H. This QAQC scenario is not covered specifically in the SWAMP QAMP and Region 3 has not yet made a decision on appropriate evaluation of these data. Of the 26 samples sent to the lab only one exceeded the field duplicate criteria noted above. A flag noting exceedance of SWAMP DQOs is attached to the chlorophyll data; however, no data has been disabled from analyses as a result of the comparison between field and laboratory data. The appropriate QA procedure to analyze the accuracy of the Chlorophyll probe is to compare pre- and post-calibration values. Unfortunately, post-calibration measurements were not regularly taken prior to 2003. Region 3 is now consistently recording both pre- and post-sampling calibration data.

Reporting Limits

Comparison of reported MDLs and PQLs relative to the target values defined in the SWAMP QAMP (Puckett 2002) can result in several flags including the following: result between MDL and PQL, MDL above TRL and PQL above TRL. Additional qualifying flags related to MDL and PQL results include the following: elevated MDL/PQL due to matrix interference and elevated MDL/PQL due to sample dilution. For data discussed in this report a total of 354 samples, each with 20 analytes, were screened. We identified 16 sample analytes that had MDLs or PQLs elevated above the SWAMP TRL. Of these 11 were rejected as a result of the elevated level; each of these was for chlorophyll *a* samples. This evaluation is based on comparison of the reported MDL/PQL and the appropriate analyte's water quality criteria. Additionally 96 sample analytes had results between the MDL and PQL values. Of these, none were rejected and all were simply qualified with a flag.

The contract laboratory did not submit QAQC data for results discussed in this report. However, the contract laboratory did evaluate data relative to the quality control criteria outlined in the BC Labs QAPP (1999). For conventional analysis the QC criteria used by the lab are stricter than those listed in the SWAMP QAPP. For example, the matrix spike QC criteria for nitrate percent recovery at the lab is 80-120%, where as the SWAMP criteria is 75-125%. BC Labs did submit flags that were assigned to data as a result of their analysis of the QC data. These flags were accompanied with the relevant QC data and were re-evaluated by CCAMP staff using the SWAMP criteria. BC Labs submitted 7080 results, of which 267 had attached flags. These flags were reevaluated using the SWAMP data quality objectives where appropriate. A count of all flags attached to data discussed in this report are listed in Table 7a.

Matrix Spikes

The contract laboratory identified a total of 85 sample analytes for which there was a matrix spike recovery problem (being outside of the laboratory's QC criteria). Reevaluation of these data using the SWAMP DQOs resulted in the rejection of 19 sample analytes and the acceptance, with a qualifying flag, of 66 sample analytes. Interestingly, 18 of the rejected sample analytes were analyses done for TKN.

Method blank flags reported by the contract laboratory were also reevaluated using the SWAMP DQOs. The Laboratory reported only 1 method blank sample analyte for which the detection of the analyte of interest exceeded the lab's reporting limit. Samples in this batch were flagged and disqualified from use.

Table 5.1.9a. Summary of flags and flag codes in the CCAMP database. Dispositions (i.e. accept and reject) qualify the data as to its usability in analyses for this report.

CCAMP Flag	SWAMP Flag	Analyte	Disposition	Count	Flag Text
4	PG	Chloride	Accept	9	CCV problem
4	PG	Ortho Phosphate as P	Accept	1	CCV problem
7	DF	Dissolved Boron	Accept	1	Elevated MDL, PQL due to matrix interference
7	DF	Nitrate as N	Accept	1	Elevated MDL, PQL due to matrix interference
7	DF	Nitrate as NO3	Accept	15	Elevated MDL, PQL due to matrix interference
8	D	Nitrate as N	Accept	5	Elevated MDL, PQL due to sample requiring dilution
10	FDP	Fecal Coliform	Accept	6	Field Dup. Coliform count fails DQO check
10	FDP	Total Coliform	Accept	4	Field Dup. Coliform count fails DQO check
12	FDP	Fixed dissolved solids	Accept	4	Field duplicate exceeds SWAMP percentage limit (RPD)
12	FDP	Turbidity	Accept	3	Field duplicate exceeds SWAMP percentage limit (RPD)
12	FDP	Fixed dissolved solids	Reject	4	Field duplicate exceeds SWAMP percentage limit (RPD)
12	FDP	Ortho Phosphate as P	Reject	2	Field duplicate exceeds SWAMP percentage limit (RPD)
12	FDP	Total Dissolved Solids	Reject	2	Field duplicate exceeds SWAMP percentage limit (RPD)
12	FDP	Turbidity	Reject	2	Field duplicate exceeds SWAMP percentage limit (RPD)
26	GB,IL	Ammonia as NH3	Accept	11	Matrix spike recovery problem
26	GB,IL	Ortho Phosphate as P	Accept	1	Matrix spike recovery problem
26	GB,IL	Ortho Phosphate as PO4	Accept	5	Matrix spike recovery problem
26	GB,IL	Phosphate as P	Accept	9	Matrix spike recovery problem
26	GB,IL	Total Kjehdahl Nitrogen as N	Accept	40	Matrix spike recovery problem
26	GB,IL	Ammonia as N	Reject	1	Matrix spike recovery problem
26	GB,IL	Total Kjehdahl Nitrogen as N	Reject	18	Matrix spike recovery problem
27	IP	Phosphate as P	Accept	1	Method Blank problem
32	H	Nitrate as NO3	Accept	5	Sample or extract held beyond acceptable holding time.
32	H	Ortho Phosphate as P	Accept	1	Sample or extract held beyond acceptable holding time.
33		Fixed dissolved solids	Accept	6	Sample precision is not within established limits.
33		Total Dissolved Solids	Accept	10	Sample precision is not within established limits.
33		Volatile Suspended Solids	Accept	1	Sample precision is not within established limits.
33		Volatile Dissolved Solids	Reject	13	Sample precision is not within established limits.
50	DNQ	Dissolved Boron	Accept	9	Result between MDL and PQL
50	DNQ	Fixed dissolved solids	Accept	8	Result between MDL and PQL

CCAMP Flag	SWAMP Flag	Analyte	Disposition	Count	Flag Text
50	DNQ	Ammonia as NH3	Accept	7	Result between MDL and PQL
50	DNQ	Nitrite as N	Accept	7	Result between MDL and PQL
50	DNQ	Nitrite and NO2	Accept	13	Result between MDL and PQL
50	DNQ	Nitrate as N	Accept	17	Result between MDL and PQL
50	DNQ	Nitrate as NO3	Accept	8	Result between MDL and PQL
50	DNQ	Ortho Phosphate as P	Accept	8	Result between MDL and PQL
50	DNQ	Ortho Phosphate as PO4	Accept	8	Result between MDL and PQL
50	DNQ	Phosphate as P	Accept	8	Result between MDL and PQL
50	DNQ	Total Kjehdahl Nitrogen as N	Accept	2	Result between MDL and PQL
50	DNQ	Volatile Suspended Solids	Accept	1	Result between MDL and PQL
52		Phosphate as P	Accept	5	MDL above SWAMP Reporting Limit
52		Chlorophyll a	Reject	11	MDL above SWAMP Reporting Limit
55		Fixed dissolved solids	Accept	1	MDL/PQL elevation (of no consequence)
56		Chlorophyll a	Reject	1	Difference between sample and field duplicate is > TRL
56		Fixed dissolved solids	Reject	45	Difference between sample and field duplicate is > TRL
56		Fixed dissolved solids	Reject	100	Difference between sample and field duplicate is > TRL
56		Ortho Phosphate as P	Reject	2	Difference between sample and field duplicate is > TRL
56		Turbidity	Reject	26	Difference between sample and field duplicate is > TRL

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Appendix 1. CCAMP Biostimulatory Risk Index

Introduction

Nutrients, such as nitrate, ammonia and phosphate, are often found at elevated concentrations in waterbodies of the Central Coast Region, and elsewhere in the State of California. Some nutrients have numeric objectives associated with particular beneficial uses. Specifically, to protect for municipal and domestic water supply, nitrate as N cannot exceed 10 mg/L. To protect against general toxicity, ammonia concentrations cannot exceed 0.025 mg/L. However, there are no numeric objectives that protect surface waters from the biostimulatory effects of excessive nutrients. Eutrophication results from a complex interaction of multiple nutrients, sunlight, substrate, water velocity, and other factors. It is difficult to identify specific nitrate or phosphate concentrations that represent thresholds over which problems will certainly occur. Consequently, the Central Coast Basin Plan narrative objective for biostimulatory substances is as follows:

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

Understanding how to manage surface waters for biostimulation is complex, as interactions and effects of excessive nutrients are not always readily apparent. For example, a site that has excessive concentrations of phytoplankton or other algae may not display elevated concentrations of dissolved nutrients, as the nutrients may have already been taken up by plant material. This interplay of chemical, physical, and biological factors complicates assessment of overall water quality.

The Central Coast Ambient Monitoring Program has developed a "Biostimulatory Risk Index" to serve as a screening tool to simultaneously consider factors which serve as stimuli (nutrients), in parallel with those which act as responders (algal and plant cover, pH, dissolved oxygen and water column chlorophyll concentrations). The index is intended to characterize both in-situ monitoring site response to biostimulatory substances and the capacity of monitoring site water quality parameters to induce adverse biostimulatory responses in downstream areas. The index currently has no provision for addressing nutrient-poor waters, nor waters impacted by toxic effects associated with several of its components.

Biostimulatory Risk Index Development

The Biostimulatory Risk Index is a combination of several different measures, or "metrics" of stimuli or response, which have then been ranked and combined to form a single value. The Central Coast Ambient Monitoring Program collects data on a number of parameters that serve as measures of biostimulation or response. In developing the preliminary Index, several of these parameters have been evaluated for use as metrics. Some of these measures, such as nitrate concentration, may serve as metrics based on

magnitude alone (where higher concentrations are considered "worse" than lower concentrations and are ranked accordingly). Others are more complex, particularly "double-ended" parameters such as dissolved oxygen and pH. For example, both supersaturated and depressed concentrations of dissolved oxygen can be indicative of eutrophication. Thus, one possible indicator of dissolved oxygen impairment is the departure of the measurement from the median value (where a larger departure ranks worse than a smaller departure).

Index development included testing of a number of metrics that reflect various measures of nutrient stimulus and response. Candidate components included ranked concentrations of individual nutrient forms (such as un-ionized ammonia, orthophosphate, etc.), measures of dissolved solids, turbidity, various characterizations of percent vegetative cover and other measures. A subset of these candidates was selected for use.

Selected Components

- Chemical composite
    - Nitrate as N
    - Ammonia as N
    - Nitrite as N
    - Ortho-Phosphate as P
- Oxygen Saturation
- pH
- Chlorophyll *a*
- Plant Cover composite
    - Algal cover
    - Algal cover periphyton
    - Algal cover filamentous
    - Instream plant cover

Five metrics were developed using the selected components. They were calculated as follows:

1) c = Chemical composite metric = Sample percentile rank of summed concentrations (mg/L) of NO2-N + NO3-N + NH3-N + (PO4-P * 10)

This metric assumes that dissolved nutrients of various forms can all contribute to biostimulation, either at the site or downstream from it, and that they can be summed to represent overall nutrient availability, once adjustments have been made for the typical uptake ratio of phosphorus to nitrogen in plant tissue (1:10).

2) p = pH metric = Sample percentile rank departure from median of entire CCAMP dataset (8.2)

This metric reflects fluctuations in pH levels in response to photosynthetic and respiration activity by plants. Photosynthetic activity uses up carbon dioxide, causing bicarbonate ions to dissociate to create more CO2 and OH^-; this process increases alkalinity. The opposite is true during respiration and decay. This process assumes that pH that diverges widely from

the median can be a measure of excessive plant activity, either as photosynthesis or respiration, and thus an indicator of biostimulation.

3) o = Oxygen metric = Sample percentile rank departure from median of entire CCAMP dataset for percent saturation (92.6)

The assumption driving this metric is that both depressed and supersaturated oxygen levels are indications of biostimulation. Samples taken in association with significant amounts of aquatic plant and algae growth may be supersaturated in late afternoon, and depressed in pre-dawn samples. Oxygen levels may remain depressed throughout the day when plant decay is prevalent. Percent saturation is used instead of dissolved oxygen concentration because it takes into account the confounding effects of water temperature and salinity.

4) a = Chlorophyll *a* component = Sample percentile rank of water column concentration of chlorophyll *a* (ug/L)

This metric assumes that higher concentrations of water column chlorophyll *a* are indications of phytoplankton abundance and hence of biostimulatory activity.

5) f = Flora component = Sample percentile rank of the maximum of one of the following: (Filamentous, Periphyton, or total Algal cover, instream plant cover)

This metric assumes that various forms of plant and algal cover represent uptake of nutrients from the stream system and hence indicate biostimulatory activity. Light availability, substrate and other factors affect which form of plant predominates; therefore this metric calculates rank based on the maximum value of the various forms quantified. This metric is not weighted highly because the quantified values are extremely subjective in nature and are highly variable.

Metrics are weighted and summed for each sampling event at each site, as follows:

$$a = 2^{(f1*c + f2*p + f3*o + f4*a + f5*f)}$$

Where:

f1=chemical composite weight = 6
f2= pH weight = 7
f3=oxygen weight = 5
f4=chlorophyll *a* weight = 9
f5=flora weight = 1

The mean percentile rank of 'a' for each site is utilized as the Biostimulatory Index for that site.

Weighting factors f1, f2, f3, f4, and f5 were initially determined by confining the database under consideration to several hydrologic units well known to staff, and setting weighting factors to values that ranked sites in a sequence that was consistent with staff knowledge of the sites. Performance of the index was then examined in other hydrologic units not used to develop the weighting factors, using different staff, knowledgeable of site and waterbody characteristics in the new set of hydrologic units. Through iterative

adjustment of weighting factors, index performance was tested until all staff agreed that site rankings best reflected overall staff knowledge of the sites.

Index development assumptions

The Bioassessment Risk Index is not based on bio-chemical process modeling. The only component of the index that deals with plant uptake of nutrients is the chemical composite component that assumes that phosphate concentration impacts occur at levels 10 times lower than nitrogenous compounds. The factor of ten was selected based on the typical ratio of these two nutrients in plant tissue. Freshwater systems tend to be limited by phosphorus. If the N:P ration is above 10:1 N:P a system will likely experience an algal bloom, the severity of which will be dictated by the amount of available phosphorus. (Schindler 1978 and Jaworski 1981). Examination of the data indicates that nitrogen is rarely the limiting nutrient in streams and rivers that exhibit problems with bio-stimulatory substances on the Central Coast of California. For this reason we selected a multiplier on the high end of literature values.

Since the Index is intended for use in moving water, it does not rely upon the assumption that effects will be located at the same place or time as causes.

Ranking of nutrient concentrations assumes that oligotropic conditions do not exist in the Central Coast Region and that a straight ranking of nutrient concentration from low to high reflects conditions moving from "good" (i.e. low concentrations) to "bad" (i.e. high concentrations). We have not documented conditions which appeared to be nutrient-poor in this Region.

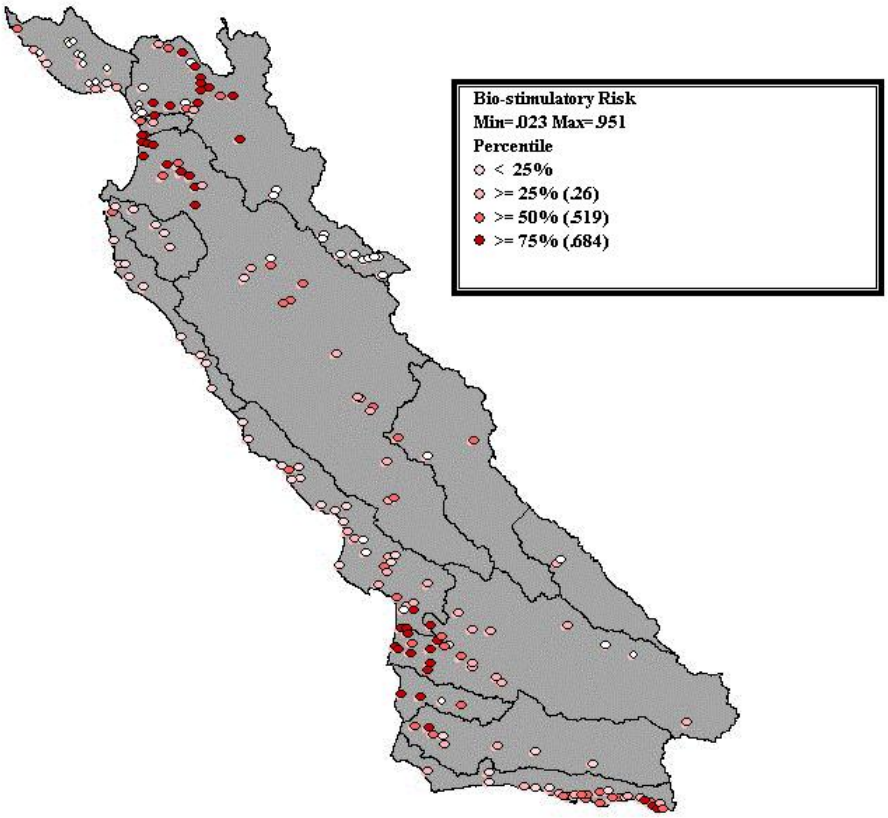
The Index does not rely upon mass loading calculations (e.g. total pounds of a stressor delivered to a monitoring site). Biostimulatory impacts in stream and river systems are more related to concentrations found within a given reach than to nutrient loads moving through the reach. For example, during storm events very large quantities of nutrients move rapidly through river and stream systems with little or no impact on the streams and rivers. The true impacts of these nutrients are not manifest until they reach a 'terminal water body' such as a lake or the near shore ocean.

Biostimulatory Risk in the Central Coast Region

In general, Biostimulatory Risk Index scores are highest in areas of the Central Coast Region already known to suffer from very high levels of nutrients. Most of these areas are associated with intensive irrigated agricultural activity (Figure 1). Sites in the upper quartile of ranked scores are primarily in watersheds that have already been 303(d) listed as impaired by nutrients. Many are smaller tributaries that enter impaired rivers, such as Quail Creek (tributary to Salinas River), Little Oso Flaco Creek (tributary to Oso Flaco Creek), Main Street Canal, Orcutt-Solomon Creek and Blosser Channel (tributary to Santa Maria River), and Salsipuedes and Llagas Creeks (tributary to Pajaro River).

Many of these tributaries have exceptionally high concentrations of nutrients and serve as major nutrients sources to the main stem systems. For example, Quail Creek concentrations have ranged as high as 94.7 mg/L for nitrate (as N) and 2.8 mg/L for orthophosphate (as P). Other waterbodies scoring in the top quartile are slow moving terminal waterbodies, such as Tembladero Slough, Moro Cojo Slough, and the Old Salinas River. These types of systems tend to have relatively high scores for pH, oxygen, and chlorophyll *a*, in addition to chemistry. Though much less common, some chemical scores are driven more by elevated phosphate concentrations than by nitrate. These include San Antonio and Carneros Creek sites. Santa Ynez River, Chorro Creek and San Luis Obispo Creek also have relatively high phosphate levels downstream of their respective wastewater treatment plant discharges. A few waterbodies not currently 303(d) listed for nutrients also scored in the top quartile. These include Franklin Creek, Arroyo Paradon Creek, Los Berros Creek and San Antonio Creek. They will be considered for 303(d) listing in the next listing cycle.

Waterbodies which fall in the lowest risk quartile include all of the Carmel River watershed, all creeks in the Santa Lucia Hydrologic Unit (along the Big Sur coast), most creeks in northern San Luis Obispo County (excluding San Simeon Creek), and small creeks in relatively undisturbed watersheds, such as Scott Creek (Santa Cruz County), Toro Creek, Old Creek above the reservoir, and Coon Creek (San Luis Obispo County), and El Capitan Creek and Gaviota Creek (Santa Barbara County). Several waterbodies which do not score in the lowest quartile overall have upper watershed sites with scores in the lowest quartile. These include San Luis Obispo Creek, Santa Ynez River, and San Simeon Creeks above their respective wastewater treatment plants.



Several of the creeks that score in the lowest quartile are dry in the summer, so scoring is calculated only from wet weather samples, which do not typically represent the worst case conditions relative to biostimulation. These include Montecito and San Ysidro Creeks in Santa Barbara County, both of which are channelized drainages passing through urban and agricultural land uses, and Villa Creek in San Luis Obispo County, which supports upstream irrigated agriculture.

Biostimulatory Risk Index and Waterbody Impairment

RWQCB staff have evaluated sites rankings alongside water quality and habitat data and subjectively made a determination of the Index score for creeks beginning to show "impairment". The value 0.40 was selected, as a site average. Sites in this range begin to show somewhat elevated nutrient concentrations, occasional algal blooms, and depressed dissolved oxygen concentrations.

Appendix II. CCAMP Index of Biotic Integrity

The CCAMP Index of Biotic Integrity (CCAMP-IBI) is a sum of several ranked metric scores, including taxonomic richness, number of Ephemeroptera taxa, number of Trichoptera taxa, number of Plecoptera taxa, percentage of intolerant individuals (with tolerance scores of 0, 1, or 2), percentage of tolerant individuals (with tolerance scores of 8, 9 or 10), percent dominant taxon, and percent predators. This index includes all metrics utilized by Karr and Chu (1999) in their Index of Biotic Integrity, with the exception of "clinger taxa count" and "long-lived taxa count". The CCAMP program has been utilizing this index for a number of years for evaluating benthic invertebrate data in the Central Coast.

CCAMP-IBI scores range from 0 to 10. Sites in the lowest quartile of all CCAMP bioassessment data score below approximately 3.0, as a site average. Sites in the highest quartile score above 6.0. We have examined these quartile break points relative to other indices of water quality as shown in the following figures.

Figure 1 shows the mean CCAMP IBI score Southern California IBI score for each site. The Southern California IBI was developed for coastal watersheds in Monterey County south to San Diego County (Ode et al. 2005). The high correlation between scores is likely due to the similarity in the metrics that make up each IBI. The SoCal IBI includes coleoptra richness and percent non-insect taxa; these metrics are not included in the CCAMP IBI.

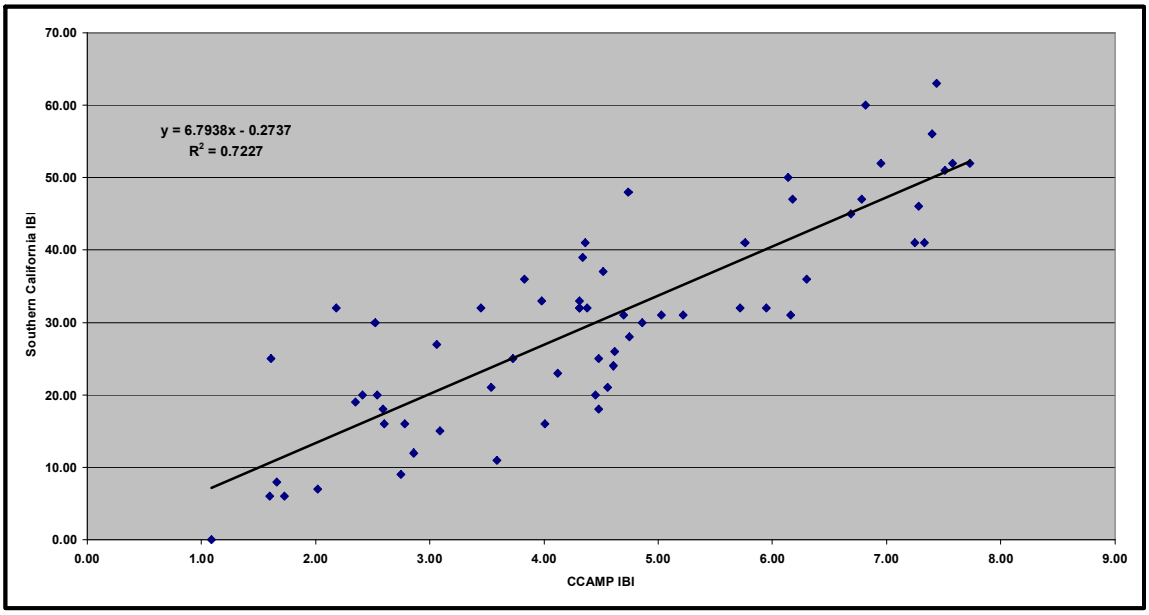


Figure 1. Regression of Southern California Index of Biotic Integrity scores against Central Coast Ambient Monitoring Program Index of Biotic Integrity scores for the Central Coast Region.

When the CCAMP IBI scores are compared to the toxicity data (Figure 2) we see that 60% of all sites in the lowest quartile (CCAMP IBI score less than 3), multiple measures of toxicity were present; only 20% of these sites had no evidence of toxicity. At sites in the highest quartile (CCAMP IBI score 6 or higher), 60% were free of toxicity and the remaining sites showed only a single indication of toxicity (such as reduced growth or reproduction).

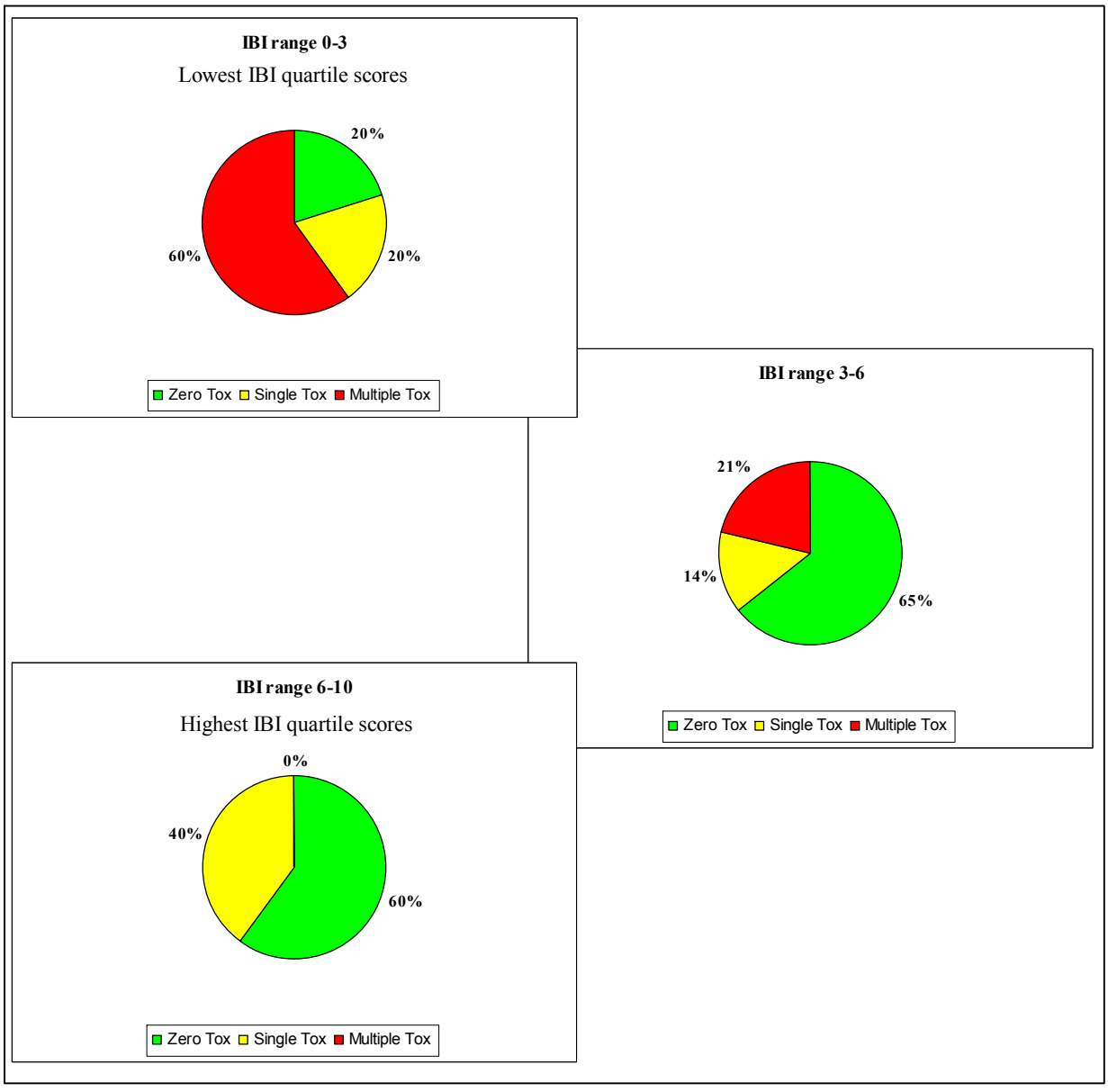


Figure 2. Percent of sites showing zero toxicity, a single toxic result or multiple toxic results, arranged according to CCAMP-IBI quartile scores. Toxicity tests include results from *C. dubia*, *P. promelas* and *H. azteca* tests.