SWAMP Surface Water Ambient Monitoring Program

SWAMP Assessment Report for the Central Coast Region	2001-02

Central Coast Ambient Monitoring Program Hydrologic Unit Report for the 2001-02 San Antonio Watershed Rotation Area

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1 Introduction

1.1 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.

1.2 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 monthly on an ongoing basis, and serve for long-term trend monitoring and as "integrators" of upstream impacts.

One of the primary purposes of CCAMP is to support the Clean Water Act 303(d) listing process and the 305(b) water quality assessment report. Assessment is consistent with the State's 303(d) Listing Policy (2004), in following one of two decision-making approaches to determine if beneficial uses are supported: 1) percent exceedance of water quality criteria or other accepted standards, using a binomial distribution (10% exceedance with 90% certainty), or 2) a weight-of-evidence approach, where data from multiple types of monitoring (biological, physical and chemical) are considered to evaluate beneficial use support. This latter approach is particularly important when evaluating problems for which no water quality criteria exist.

CCAMP data is also heavily used by permit staff, enforcement staff, and others for regulatory and management decision-making. The CCAMP program addresses a wide variety of water quality parameters and beneficial use questions with the intent providing information to inform further action by agency staff. The sampling design strives to provide a maximal amount of information within one sampling framework to support this broad mission. Further follow-up through enforcement staff, TMDL staff or others provides additional detail to understand the full scope of problems identified by CCAMP.

1.3 Program Questions, Objectives and Decision-Making Criteria

General programmatic objectives of CCAMP 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); 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*

Interpretation: Minimum of five exceedances is required to determine impairment. If fewer than five exceedances, site is considered partially impaired. At least 10% of samples or the geomean must exceed the respective criterion to determine impairment.

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 (as N)
- 10% of pH samples under 6.5 or over 8.3

Interpretation: For nitrate and pH<6.5, a minimum of five exceedances is required to determine impairment. At least 10% of samples must exceed criterion for a site to be considered impaired. If fewer than five exceedances, site is considered partially impaired. Because of the naturally high pH levels in Region 3, no site will be listed as impaired based on high end pH exceedance alone.

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. In the absence of OEHHA criteria, use U. S. Food and Drug Administration Action Levels, or Median International Standards, in that order.

Interpretation: If there are two or more exceedances of a chemical criterion, from two or more separate samples site is considered impaired. If there is one exceedance, site is considered partially impaired.

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)
- 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 within scoring range of lower quality sites (above 0.4)

- Index of Biotic Integrity falls within scoring range of lower quality sites (below 3.0)

Interpretation: For toxicity, sediment chemistry or tissue chemistry**,** if there are two or more exceedances of any analyte criterion, site is considered impaired. If there is one exceedance, site is considered partially impaired. For ammonia, pH (<7.0) and dissolved oxygen, if there are five or more exceedances of any analyte criterion, site is considered impaired. If there are fewer than five exceedances, site is considered partially impaired. Because of the naturally high pH levels in Region 3, no site will be listed as impaired based on high end pH exceedance alone. Sites that fall within the scoring range of lower quality sites for Biostimulatory Risk or Index of Biotic Integrity are considered partially impaired. Professional judgment is used to determine whether multiple lines of evidence of partial impairment justify a determination of full impairment.

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 0.75 mg/L
- 10% of sodium samples over 69 mg/L
- 10% of nitrate samples over 30 mg/L as NO_3 as N

Interpretation: Minimum of five exceedances of any analyte criterion are required to determine impairment. If there are fewer than five exceedances, site is considered partially impaired.

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
- Filamentous algal cover persistently over 25%
- Scum, odor, trash, oil films persistently present

Interpretation: Minimum of five exceedances of any analyte criterion are required to determine impairment. If there are fewer than five exceedances, site is considered partially impaired. Because of the naturally high pH levels in Region 3, no site will be listed as impaired based on high end pH exceedance (>8.3) alone. Professional judgment is used to determine whether scum, odor, trash, or oil films are present at levels sufficient to represent a nuisance or hazard.

1.4 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. 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.

1.5 Scope of the Report

This report provides a data summary for watershed monitoring completed during the first two fiscal years of the SWAMP Program (2000-01 and 2001-02). This includes CCAMP watershed rotation monitoring of the San Antonio Creek Hydrologic Unit (313) between January 2001 and March 2002, as well as coastal confluences monitoring at one site in this Hydrologic Unit since April of 2001. The 2001 rotation area includes four sites on San Antonio Creek. The report provides an analysis of beneficial use support and determination of impairment for monitored waterbodies.

2 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 on a monthly basis 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.

3 Methods

3.1 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 (Puckett, 2002).

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 but no more than eight inches below the water's surface. 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 (Table 3.1a). 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 4° 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).

Table 3.1a. Laboratory analytes and typical methods

Analyte	Method
Nitrate as N	EPA 300.0
Nitrite as N	EPA 353.2
Total Ammonia as N	EPA 350.1
Total Phosphorus as P	EPA 365.4
Orthophosphate as P	EPA 365.1
Total Dissolved Solids	EPA 160.1
Fixed and Volatile Dissolved Solids	EPA 160.4
Hardness as CaCO3	SM 2340B
Total Suspended Solids	EPA 160.2
Fixed and Dissolved Suspended Solids	EPA 160.4
Calcium	EPA 200.7
Magnesium	EPA 200.7
Boron, dissolved	EPA 200.7
Sodium	EPA 200.7
Chloride	EPA 300.0
Total and Fecal Coliform	25-tube dilution
E. coli	Colilert

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.

3.2 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 has evaluated performance of the Index using data from the entire Region. 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 to screen monitoring data for biostimulatory risk. In Appendix A, we discuss the regional evaluation and determination of the risk threshold.

3.3 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 inter-calibrated for consistency prior to start of sampling.

<u>CCAMP Index of Biotic Integrity</u>

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." 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. This index is described in more detail in Appendix B.

3.4 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).

3.5 Sediment Chemistry and Toxicity

Bed sediment samples are 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.

3.6 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).

4 San Antonio Creek Hydrologic Unit Description

San Antonio Creek watershed drains approximately 17,000 acres (Cal Water v. 2.2) in Santa Barbara County, and is the only watershed in the San Antonio Creek Hydrologic Unit. The creek flows to the ocean on Vandenberg Air Force Base (AFB) property, north of the Santa Ynez River. There are several small tributaries in the watershed, including Canada de las Flores and Harris Canyon Creek. Primary land uses include the residential and urban areas of the towns of Los Alamos and Vandenberg village, as well as irrigated agriculture and grazing upstream of Vandenberg AFB. San Antonio Creek is on the 303(d) list of impaired waterbodies due to sedimentation and is proposed for addition to the 2006 list for impairment due to ammonia, nitrate and boron. The Vandenberg AFB water quality program is monitoring several sites on this creek. However, that data is not yet available for inclusion in this report.

5 San Antonio Hydrologic Unit Assessment

In this section, the San Antonio Hydrologic Unit is evaluated according to questions posed in the SWAMP report to the Legislature (2000) and described in detail in Section 1.2. 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.

5.1 Summary of monitoring

Monitoring sites and types of monitoring activities are listed and identified in Table 5.1a and Figure 5.1a. An overall summary of findings is shown in Table 5.1b. Evidence of impairment is determined by comparing data to criteria described in Section 1.2.

Table 5.1a. Specific monitoring activities conducted at sites in the San Antonio Hydrologic Unit (HU 313). **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 & Tox	Tissue Chem
313SAC	San Antonio Creek at RR bridge	X		X	
313SAI	San Antonio Creek at San Antonio Road West	X		X	
313SAB	San Antonio Creek at Highway 135	X	X	X	
313SAN	San Antonio Creek Lagoon				X

Table 5.1b. Summary of findings related to monitoring questions for sites in the San Antonio Hydrologic Unit (HU 313). **Yes** – evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, dash symbol (-) - 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?**
313SAC	San Antonio Creek at RR bridge	**S**	No	**Yes**	-	**Yes**	**S**
313SAI	San Antonio Creek at San Antonio Road West	**Yes**	No	**Yes**	-	**Yes**	**S**
313SAB	San Antonio Creek at Highway 135	**Yes**	**S**	**S**	-	**Yes**	**S**
313SAN	San Antonio Creek Lagoon	-	-	**S**	**S**	-	-

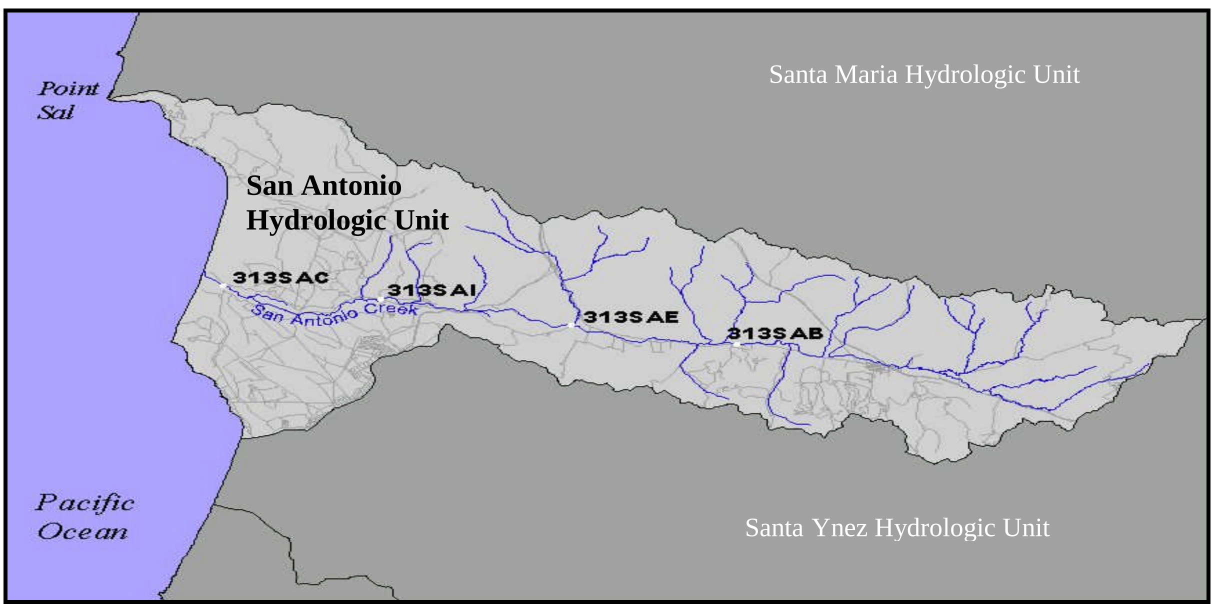

Figure 5.1a. CCAMP monitoring sites in the San Antonio Hydrologic Unit.

5.1.1 Is there evidence that it is unsafe to swim?

Fecal coliform levels in the San Antonio Hydrologic Unit ranged from 8 to 30,000 MPN/100ml. As summarized in Table 5.1.1a, the site at San Antonio Road West (313SAI) had eight fecal coliform samples that exceeded the Basin Plan objective (more than 10% of samples exceeding 400 MPN/100ml). Sites at San Antonio Road West (313SAI) and at Highway 135 (313SAB)had geomean values that exceeded 200 MPN/100 ml (the Basin Plan states that the geomean of 5 samples in 30 days is not to exceed 200 MPN/100ml). Minimum sample count requirements for assessment were not met for the site at Highway 135 (313SAB) where only 2 samples were collected. Land uses in the watershed are primarily agriculture and rangeland with no known point sources.

Table 5.1.1a. Site specific assessment of data used to assess impairment of water contact recreational uses in the San Antonio Hydrologic Unit (HU 313). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, dash symbol (-) - not assessed.

Constituent	Coliform, Fecal	Colifom, 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			
313SAC	**S**	No	**S**
313SAI	**Yes**	**Yes**	**Yes**
313SAB	**S**	**Yes**	**Yes**
313SAN	-	-	-

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

Nitrate levels in the San Antonio Hydrologic Unit were generally low, relative to the Basin Plan objective of 10.0 mg/L. A single sample collected at the Highway 135 site (313SAB) exceeded this objective; however, all other samples collected at this site had nitrate levels below 6.0 mg/L and did not exceed Basin Plan objectives

The pH in the Hydrologic Unit ranged between 6.6 and 8.5 pH units. The upper watershed site located at Highway 135 (313SAB) had pH levels ranging up to 8.3, the

Basin Plan upper limit for pH. Downstream at the San Antonio Road West site (313SAI) there was a wider range of pH observed (7.3 to 8.5). This site had one pH value that exceeded the upper Basin Plan objective. Each of these two sites have flowing water year round. The downstream-most site at the Railroad Bridge (313SAC) has characteristics which are more lagoon-like with observable flow only during and following storm events. The pH at this site was much lower during the summer months than the two upper watershed sites, and ranged between 6.7 and 8.3 pH units. No site in the San Antonio Hydrologic Unit exceeded Basin Plan objectives over 10% of the time (Table 5.1.2a).

Table 5.1.2a. Site specific assessment of data used to assess impairment of municipal and domestic supply uses in the San Antonio Hydrologic Unit (HU 313). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, dash symbol (-) - not assessed.

Constituent	Nitrate as N	pH	**Evidence of Impairment**
Units	ppm	pH units	
Matrix	H20	H20	
Municipal Use Assessment Threshold	10	<6.5 or >8.3	
Sites			
313SAC	No	No	No
313SAI	No	No	No
313SAB	S	No	**S**
313SAN	-	-	-

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

Only one site in this Hydrologic Unit Area was monitored for bioaccumulation of metals, pesticides and petroleum products. A single sample of resident Pacific Staghorn Sculpin (*Leptocottus armatus*) were collected in San Antonio Creek Lagoon in August of 2000. Tissue analysis showed DDXs (mostly in the form of DDE), toxaphene and PCBs exceeded available criteria (Table 5.1.3a). Several metals were detected in the tissue of this sample but none exceeded available criteria.

Table 5.1.3a. Site specific assessment of data used to assess impairment of fish consumption use in the San Antonio Hydrologic Unit (HU 313). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist, dash symbol (-) - 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 levels of chemicals without published criteria (relative to EDLs)	**Evidence of Impairment**
Fish Consumption Use 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																
313SAC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
313SAI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
313SAB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
313SAN	No	No	No	No	No	No	No	No	No	**S**	No	No	No	**S**	**S**	**S**

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

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

Toxicity testing was conducted twice on water samples and once in sediment from each of the three sites in the Hydrologic Unit (Table 5.1.4a). No toxic effects (significantly lower survival of test organisms relative to the control sample) were reported in any of these tests. However, adverse biological effects (significantly reduced growth of larval fathead minnows and reproduction of *Ceriodaphnia* relative to the control) were reported at two sites. One water sample collected at the upstream site at Highway 135 (313SAB) resulted in significantly reduced weight in the fathead minnow (*Pimephales promelas*). In addition, the sediment sample from the San Antonio Road West site (313SAI) resulted in significantly reduced growth to the amphipod (*Hyallela azteca*). However, the toxicity test control failed to meet Quality Assurance Objectives and the test was rerun after the holding time had expired. These data will not be used to determine impairment for aquatic life beneficial uses (Table 5.1.4a).

Resident Pacific Staghorn Sculpin (*Leptocottus armatus*) collected in San Antonio Creek Lagoon in August of 2000 showed elevated levels of DDX's, toxaphene and PCB's relative to available criteria. However, there was only a single sample collected so data cannot be used alone to determine impairment (Table 5.1.4a).

Table 5.1.4a. Site specific assessment of data used to assess impairment of aquatic life uses in the San Antonio Hydrologic Unit (HU 313). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (i.e. a non threshold value is exceeded or only one exceedances observed, dash symbol (-) - not assessed.

Constituent	Ammonia as N, Unionized	Oxygen, Dissolved	Oxygen, Saturation	pH	Toxicity	Bio-stimulatory Risk	CCAMP IBI	Arsenic [1]	Chromium [1]	Copper [1]	Lead [1]	Mercury [1]	Selenium [1]	Zinc [1]	DDT, Total [2]	Dieldrin [2]	Endrin [2]	PCB,Total [2]	DDT, Total [3]	Dieldrin [3]	Organic Chemicals without criteria	**Evidence of impairment**
Aquatic Life Use Assessment Threshold	.025	<7 or <5	Median <85	<7 >8.5	<80% and significantly different than control	> 0.4	< 3	1.5	1	20	2	0.5	2	45	1000	100	100	500	46.1	8	> RL	
Units	ppm	ppm	%	pH	% survival			ppm	ppm	ppm	ppm	ppb	ppb	ppm	ppb	ppb	ppb	ppb	ppb	ppb	ppm	
Matrix	H20	H20	H20	H20	H20 or Sed	NA	NA	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Tis	Sed	Sed	Sed	
Sites																						
313SAC	No	**Yes**	**Yes**	**S**	No	**Yes**	-	-	-	-	-	-	-	-	-	-	-	-	No	No	**S**	**Yes**
313SAI	**Yes**	**S**	**S**	No	No	**Yes**	-	-	-	-	-	-	-	-	-	-	-	-	No	No	**S**	**Yes**
313SAB	No	No	**S**	No	No	**Yes**	**S**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**S**
313SAN	-	-	-	-	-	-	-	No	No	No	No	No	No	No	**S**	No	No	**S**	-	-	-	**S**

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

Sediment chemistry data was collected at the Railroad Bridge site (313SAC) and at the San Antonio Road West site (313SAI). Metal concentrations in sediments at this site were not elevated above NOAA ERM values. Several of the PCB congeners were detected at concentrations ranging from 0.211 (PCB congener 198 at 313SAI) to 9.18 ng/g (PCB congener 209 at the Railroad Bridge site, 313SAC). The sum of total quantified PCBs at 313SAC is 21.1 ug/g and at 313SAI is 26.1. Although no individual PCB congener was detected above the Probable Effects Level (PEL) or the Upper Effects Threshold (UET) as derived by through toxicity assays (MacDonald 1992 and Buchman 1999 respectively), the total PCB concentration at 313SAI is at the UET value for fresh water sediments (not shown in Table 5.1.4a). This is of concern, as PCBs are carcinogenic and have developmental impacts to aquatic life and humans.

DDT breakdown products DDD and DDE were the only organic pesticide chemicals detected in sediment samples. Presence of any detectable pesticides in sediment is a violation of the Basin Plan, which states "there shall be no increase in pesticide concentrations found in bottom sediments or aquatic life". Because there is only a single sediment sample, we are determining that these sites are partially impaired by DDX's. Additional samples will be necessary to determine full impairment. Both DDD and DDE concentrations ranged from 1.88 ng/g to 9.66 ng/g at 312SAC and 313SAI (Table 5.1.4b.)

Table 5.1.4b. Organic chemicals detected in sediment samples collected at sites in the San Antonio Hydrologic Unit, March 2002.

Site Tag	DDD(p,p')	DDE(p,p')	DDT, Total	Total PCB
313SAC	4.2	9.66	13.86	21.136
313SAI	1.88	5.66	7.54	26.113

Dissolved oxygen levels in the San Antonio Hydrologic Unit ranged between 3.9 mg/L at the Railroad Bridge site (313SAC) and 14.0 mg/L at the San Antonio Road West site (313SAI). The wide range of dissolved oxygen concentrations at both of these sites is of concern. Although pre-dawn dissolved oxygen measurements were never taken at the Railroad Bridge site (313SAC) this site still had the lowest dissolved oxygen levels in the watershed. Pre-dawn monitoring at the San Antonio Road West site (313SAI) showed two dissolved oxygen measurements below the cold water Basin Plan Objective (7.0 mg/l) in mid-summer. Figure 5.1.4c shows the time series of dissolved oxygen data collected at all three sites; persistently low dissolved oxygen levels (below the warm water Basin Plan Objective of 5.0 mg/L) at the Railroad Bridge site (313SAC) through the summer and fall are apparent.

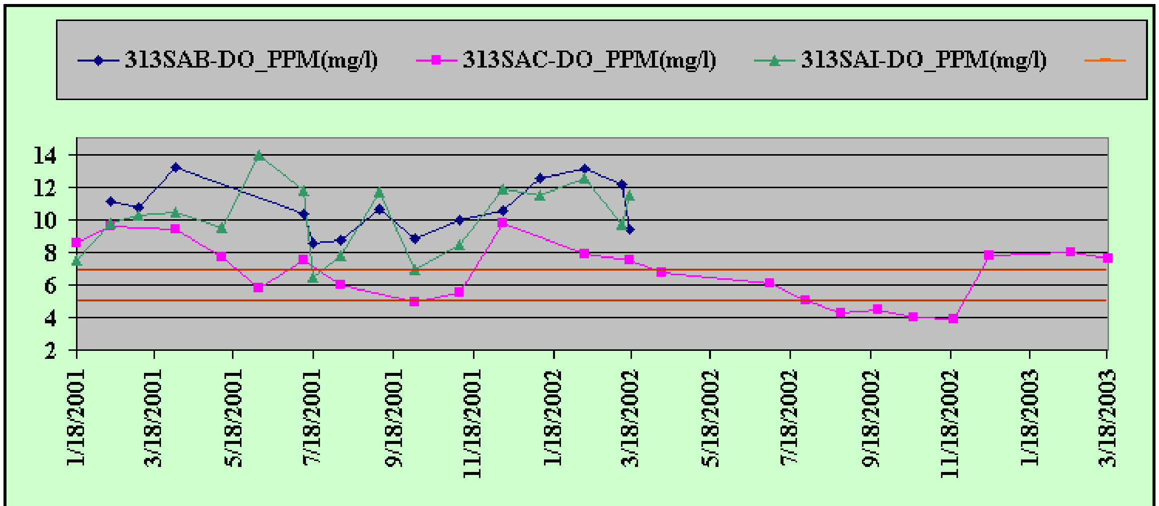

Figure 5.1.4c. Time series of dissolved oxygen data collected at sites in the San Antonio Hydrologic Unit between January 2001 and March 2002. Red lines indicate the Basin Plan Objectives for cold water habitat (7.0 mg/L) and warm water habitat (5.0 mg/L).

As was discussed in Section 5.1.2 on drinking water for the San Antonio Hydrologic Unit, pH levels were lowest at the Railroad Bridge site (313SAC) with one sample measurement below the Basin Plan Objective of 7.0 pH units. This is not surprising, as dissolved oxygen at this site was also persistently low through the summer and fall months. Like dissolved oxygen, pH can fluctuate in the water column as a result of photosynthesis and respiration of aquatic plants and microorganisms.

pH levels affects the amount of total ammonia that is in the unionized (and more toxic) form. Seven of the sixteen samples collected at the San Antonio Road West site (313SAI) exceeded the Basin Plan Objective for unionized ammonia (0.025 mg/L). These exceedances occurred throughout the year (both in winter and summer) and reached levels as high as 0.56 mg/L. No other site in the watershed exceeded the Basin Plan objective for unionized ammonia.

Sites in the San Antonio Hydrologic Unit all ranked in the upper 50th percentile of all sites in the Region, according to the Biostimulatory Risk Index, indicating higher risk for eutrophication. Sites with Biostimulatory Risk Index scores above 0.40 commonly show signs of impairment. The Highway 135 site (313SAB) score of 0.54 was primarily driven by nitrate and ortho-phosphate concentrations. Downstream at San Antonio Road West (313SAI) the average biostimulatory risk ranking was 0.87, with the greatest influence being nutrients and chlorophyll *a*. The coastal confluence site at Railroad Bridge (313SAC) is ranked among the top ten worst sites in the Region for biostimulatory risk, with an average rank of 0.97. In addition to having elevated phosphate and chlorophyll *a* concentrations, the range of dissolved oxygen and pH values at this site is of concern. Dense algal and duckweed growth at this site also indicates eutrophic conditions.

Benthic invertebrate community assemblage data was collected at only one site in the watershed, at Highway 135 (313SAB). CCAMP Index of Biotic Integrity (IBI) scores for this site ranged from 3.56 to 2.39. CCAMP IBI scores below 3.0 indicate sites that have benthic macroinvertebrate community assemblages that are in poor condition. These low scores from both 2001 and 2002 monitoring are not surprising, considering the in-stream habitat conditions and low flow conditions at this site. Although riffle habitat is present and the riparian corridor is intact, the flow at this site is very low and may be influenced by runoff from the adjacent agriculture operations.

5.1.5 Is there evidence that agricultural uses are not supported?

pH levels in the watershed were generally within the range identified in the Basin Plan to protect for agriculture use. Site specific assessments relative to Basin Plan Objectives are listed in Table 5.1.5a.

Table 5.1.5a. Site specific assessment of data used to assess impairment of agricultural beneficial uses in the San Antonio Hydrologic Unit (HU 313). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (i.e. a non threshold value is exceeded or only one exceedances observed, dash symbol (-) - 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	mg/L	
Agricultural Use Assessment Threshold	0.75	106	3000	30	<6.5 or >8.4	69	
Sites							
313SAC	**Yes**	**Yes**	**S**	No	No	**Yes**	**Yes**
313SAI	**Yes**	**Yes**	**S**	No	No	**Yes**	**Yes**
313SAB	**Yes**	**Yes**	No	No	No	**Yes**	**Yes**
313SAN	-	-	-	-	-	-	-

Conductivity at the lower watershed sites (313SAC and 313SAI) occasionally exceeded the Basin Plan objective for protection for agricultural use (3000 uS/cm) and these sites are considered partially impaired for agricultural use based on these data. The coastal confluences site at the Railroad Bridge (313SAC) exceeded the objective in one sample and had an average conductivity level of 1986 uS/cm. Upstream at San Antonio Road

West (313SAI) three samples also exceeded the objective and the average conductivity level was 2614 uS/cm. The Highway 135 site (313SAB), which is located in an area where agriculture is the primary land use, never exceeded the objective designated to be protective for use in irrigation.

At all three sites in the San Antonio Hydrologic Unit, chloride and sodium levels exceeded the Basin Plan agricultural objectives for these parameters in all but a single winter runoff sample. Boron levels also exceed Basin Plan Objectives for irrigation water in multiple samples from each site in the Hydrologic Unit.

Nitrate levels in the San Antonio Hydrologic Unit were never measured at levels that exceeded the Basin Plan objective to protect for agricultural uses (30 mg/L as N).

5.1.6 Is there evidence that aesthetic and non-contact recreation uses are not supported?

pH levels in the watershed were generally within the range identified in the Basin Plan to protect for non-contact recreational use, with the exception of one measurement at the San Antonio Road West site (313SAI) that exceeded the upper Basin Plan objective (8.3).

Twice at the Highway 135 site (313SAB) and once at the San Antonio Road West site (313SAI) the Basin Plan objective was exceeded for fecal coliform in waters that are used for non-contact recreation (Table 5.1.6a).

In this Hydrologic Unit, dry weather turbidity levels fluctuated around the 10 NTU informal screening level. All sites had some measurements above 10 NTU but rarely exceeded 30 NTUs. The Railroad Bridge site (313SAC) did exceeded 30 NTUs on 3 occasions during dry weather monitoring.

Table 5.1.6a. Site specific assessment of data used to assess impairment of non-contact recreational uses in the San Antonio Hydrologic Unit (HU 313). **Yes** - evidence that a problem exists, **No** - no evidence that a problem exists, **S** – some evidence that a problem may exist (i.e. a non threshold value is exceeded or only one exceedances observed, dash symbol (-) - 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	NTU	
Matrix	NA	NA	H20	H20	H20	H20	
Non-Contact Recreation Assessment Threshold	25%	25%	More than 10% of samples >4000	Geometric mean > 2000	<6.5 or >8.3	10	
Sites							
313SAC	**Yes**	No	No	No	No	**S**	**S**
313SAI	No	No	**S**	No	**S**	**S**	**S**
313SAB	No	No	**S**	No	No	**S**	**S**
313SAN	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Nuisance conditions caused by both filamentous algae and emergent vegetation was observed throughout the watershed during summer months. In mid-summer, filamentous algal cover was greater than 75% at the Railroad Bridge site (313SAC), as shown in Figure 5.1.6a. In winter, algae was removed by high flows and did not become reestablished until late spring. At the San Antonio Road West site (313SAI), algal cover was not observed to the same extent, but instream rooted vegetation covered up to 100% of the water surface. Photographs showing the extent of algal and instream plant growth at these sites can be seen on the CCAMP website (www.CCAMP.org).

Figure 5.1.6a. Algal cover at San Antonio Creek at the Rail Road Bridge (313SAC), September 2002.

6 Discussion

The flow characteristics documented at this Hydrologic Unit greatly influence water quality. The San Antonio Creek site at the Railroad Bridge (313SAC) generally has no observable flow, although there is flow out to the beach downstream of this site. Upstream of this site is a series of wetlands which function to filter nutrients and sediment. Eutrophic conditions are indicated by widely ranging dissolved oxygen and pH levels and elevated dry season turbidity recorded at this site. At this site, nitrate concentrations were much lower than at the upstream sites. However, ortho-phosphate levels at this site were higher than at upstream sites. There are not currently Basin Plan criteria for orthophosphate. For reference, the USEPA has recommended 0.1 as the 303(d) listing criterion for this parameter. Elevated orthophosphate levels were observed consistently at all sites in the San Antonio Creek Hydrologic Unit. Every sample collected in this watershed was elevated above the EPA recommended criterion, with average orthophosphate levels ranging from 0.98 – 1.56 mg/L as P. Low flow conditions, lack of riparian canopy and available nutrients are resulting in nuisance algal conditions, depressed dissolved oxygen and pH levels. Although bacteria levels were generally low at Railroad Bridge (313SAC), some samples did contain elevated levels of fecal coliform.

Sediment samples at Railroad Bridge (313SAC) and tissue samples from resident Staghorn sculpin in the lagoon downstream of 313SAC show that legacy pesticides are still persistent in this watershed. Concentrations of DDX's in sediment from 313SAC did not exceed criteria but in fish tissue DDT exceeded FDA standards.

Upstream sites have year round flow, although at times very low. At these sites, nitrate, orthophosphate and ammonia are often elevated and are the cause of impairment to several beneficial uses. At the San Antonio Road West site (313SAI) the channel is deeply incised with vertical banks over 30 feet high. Instream habitat consists of fines, sands and gravel with emergent vegetation. Upstream at Highway 135 (313SAB) the riparian corridor is well developed and the canopy is intact. Instream habitat here is primarily gravel with some periphyton.

No waterbody specific objectives are identified for San Antonio Creek in the Central Coast Basin Plan. However, salts such as chloride, sodium and boron are commonly elevated above the Basin Plan objectives for irrigation water at all sites in the watershed.

7 Conclusion

San Antonio Creek is currently proposed to be added to the Clean Water Act 303(d) list of impaired waters for boron, ammonia and nitrite. CCAMP data collected in this watershed was the basis for these listings and monitoring at the San Antonio Road West site (313SAI) continues to support this listing. Other salts such as chloride, and sulfate were observed at elevated concentrations downstream relative to the upstream monitoring sites. These data should be further investigated to determine if anthropogenic sources are the cause.

Also, all sites in this watershed had exceedances of Basin Plan criteria for fecal coliform. However, no site had more than five exceedances of the Basin Plan Objective and therefore we recommend collection of additional data prior to evaluating this watershed for impairment of recreational beneficial uses under the recently released 303(d) listing policy.

Several violations of Central Coast Basin Plan Objectives have been identified. In addition to 303(d) listing recommendations we recommend the following to address these issues:

- Follow up Monitoring
    - Evaluate potential sources of salts in the lower watershed
    - Evaluate nutrient sources throughout the watershed
    - Potential for impairment of recreation beneficial uses

- Basin Planning
    - Consider adding site-specific objectives for salts in San Antonio Creek watershed
    - Consider a adding a site-specific objective for ortho-phosphate in San Antonio Creek watershed

- Nonpoint Source Management
    - Work with the San Antonio Creek Technical Advisory Committee for the Comprehensive Management Plan to manage for increasing impairment by nutrients (ammonia, nitrate and orthophosphate) for lower San Antonio Creek.
    - Manage for reduction in biostimulatory risk in the lower end of San Antonio Creek, particularly through management of phosphate.
    - Manage to prevent impairment by fecal coliform throughout the watershed.

8 Quality Assurance

Evaluating field data

Field equipment is calibrated according to manufacturer specifications (Hydrolab Inc, 2002) 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 Quality Assurance Management Plan (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), MDL and/or 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 recovery (percent recovery) 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 required recovery is at least 50%.
- The batch precision violates the precision requirements defined in the SWAMP QAMP (Puckett 2002, Appendix C). These requirements are 80-120% precision for conventional parameters and 50-150% precision for organic chemicals in sediment and tissue.
- The method blank results exceed the MDL.
- The relative percent difference (RPD) between the blind field duplicate result and the original sample exceeds the allowable 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 if desired. 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. The contract laboratory submitted electronic QA/QC data for all results discussed in this report. They submitted data for twenty analytes per site sample, and attached flags to a number of sample analytes. These flags were reevaluated using the SWAMP measurement quality objectives (MQOs) where appropriate.

SWAMP acceptability criteria were generally less strict than that of the contract laboratory. Therefore, 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 104 flags generated during QA analysis of data collected from the San Antonio Hydrologic Unit. Flags include those generated by the Region 3 contract laboratory, such as matrix spike and continuing calibration exceedances, as well as for field duplicates and field equipment calibration. Of these104 flags, 29 were outside the MQOs identified in the SWAMP QAMP (Puckett 2002). Rejected data are maintained in the database with a flag identifying the data as disabled. These data are not used in any assessments.

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 MQOs and was greater than twice the TRL, as defined in the SWAMP QAMP (Puckett 2002). For each blind field duplicate pair, there are several different analytes.

Ten blind field duplicate samples pairs were collected, each with 20 analytes analyzed by the contract laboratory. We identified eighteen sample analytes that did not meet the QA criteria defined above. All of these field duplicate samples failed both the SWAMP MQO and the "twice the TRL" criteria.

The contract lab also analyzed blind field duplicate samples for total and fecal coliform on 10 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, there were four exceedances of the abovementioned criteria.

<u>MDLs / PQLs</u>
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. In the San Antonio Hydrologic Unit the following flags were assigned to data collected between January 2001 and March 2003.

- Results were reported between the MDL and PQL for twenty-nine analyte results. These results are considered estimated as they are detected but not quantified.
- Fifteen analyte results had elevated MDLs. No MDLs were elevated above SWAMP TRLs. Elevated MDLs were reported for two samples as a result of matrix interference.

<u>Matrix Spikes</u>
The contract laboratory identified a total of eighteen sample analytes for which there was a matrix spike recovery problem (being outside of the laboratory's quality control (QC) criteria. Reevaluation of these data using the SWAMP MQOs resulted in the rejection of only eleven analyte results and the acceptance, with a qualifying flag, of seven analyte results.

<u>Method Blanks</u>
No method blank flags were reported by the contract laboratory.

<u>Precision</u>
The contract laboratory did not report sample and batch precision flags for one sample's analytes. Otherwise, the precision requirements in the SWAMP QAMP were not exceeded.

<u>Field Data</u>
Field data collected using a Hydrolab DS4a were evaluated using calibration records. Data are evaluated to determine if measurements are outside of the calibration range. In the San Antonio HU, field measurements were recorded, each consisting of conductivity, pH, turbidity, dissolved oxygen, water temperature, salinity and chlorophyll_a. Six pH measurements were below the calibration range (< 7). Forty-three conductivity measurements and four turbidity measurements were above the upper calibration range (>1413 uS and 500 NTU respectively). These results are qualified with flags. Calibration records were also used to identify accuracy of the probes by comparing pre and post calibration data to identify drift. No measurements have been disqualified because of calibration drift.

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Appendix A. 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.

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 are used in developing the preliminary Index, and serve 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).

Biostimulatory Risk Index Development

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

Five metrics were developed and 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.

CCAMP staff evaluated performance of the index using data from the entire Region. 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.

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 A.1. shows the mean and range of nitrate concentrations at sites scored for biostimulatory risk. Sites whose scores fall below the threshold of 0.40 virtually never exceed the drinking water standard for nitrate. 89% of these samples have site nitrate averages under 1.0 mg/L-N. Also, sites with a risk score of 0.40 or greater never have benthic invertebrate community index scores in the highest quartile (over 6.0) (Figure A.2.).

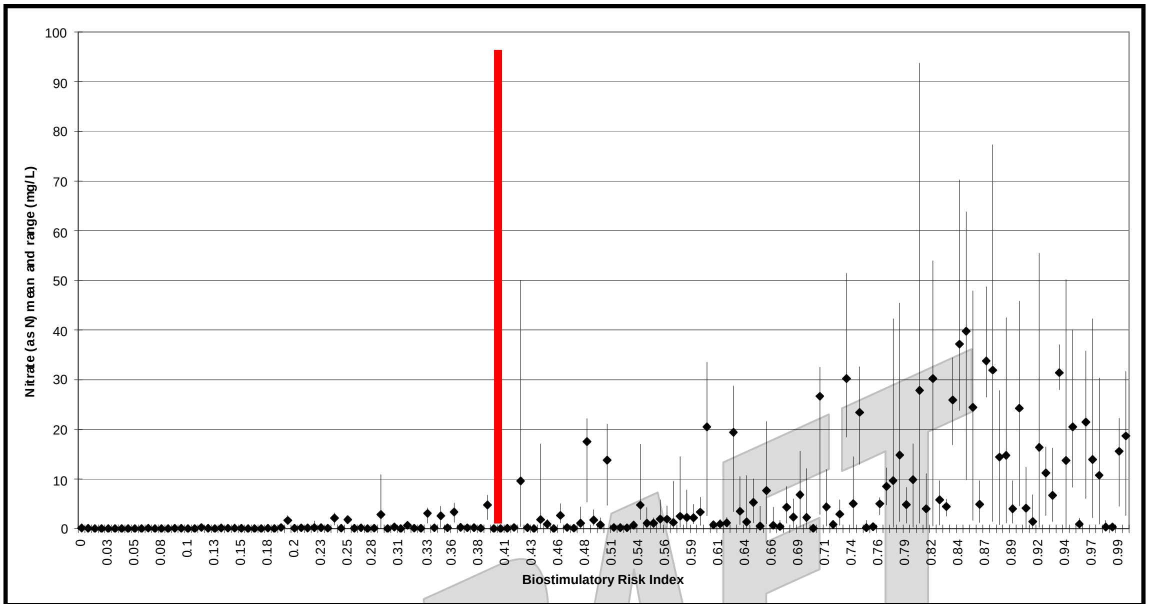


Figure A.1. Range and mean of Nitrate-N concentrations (mg/L) at sites scored for biostimulatory risk in the Central Coast Region. Biostimulatory risk threshold (0.40) indicated by red line.

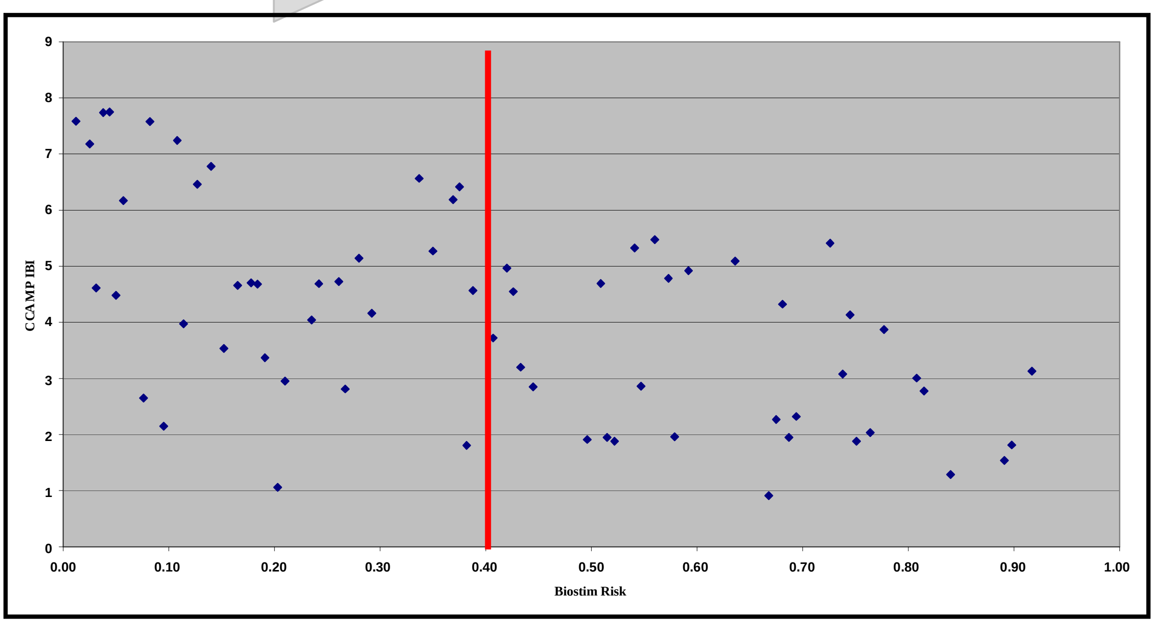


Figure A.2. Scatter plot of CCAMP-IBI scores against the Biostimulatory Risk Index for CCAMP sites. Biostimulatory risk threshold (0.40) indicated by red line.

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

Figure A.3. shows the quartile rank of BioStim scores for all sites monitored by the Central Coast Ambient Monitoring Program. 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. 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.

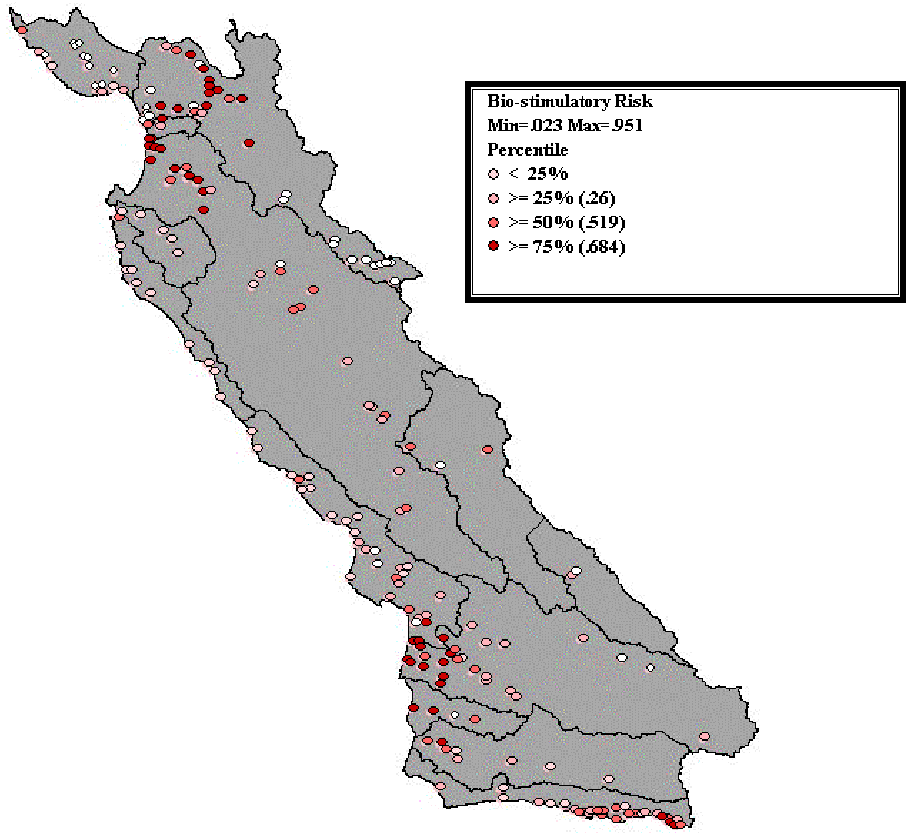


Figure A.3. Biostimulatory Risk Index scores for all sites monitored by CCAMP in the Central Coast Region between January 1998 and July 2005. Site scores are shown in quartiles, with sites ranked in the 75th quartile and above having the highest risk for eutrophic conditions.

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". 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 B. 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 B.1. shows 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).

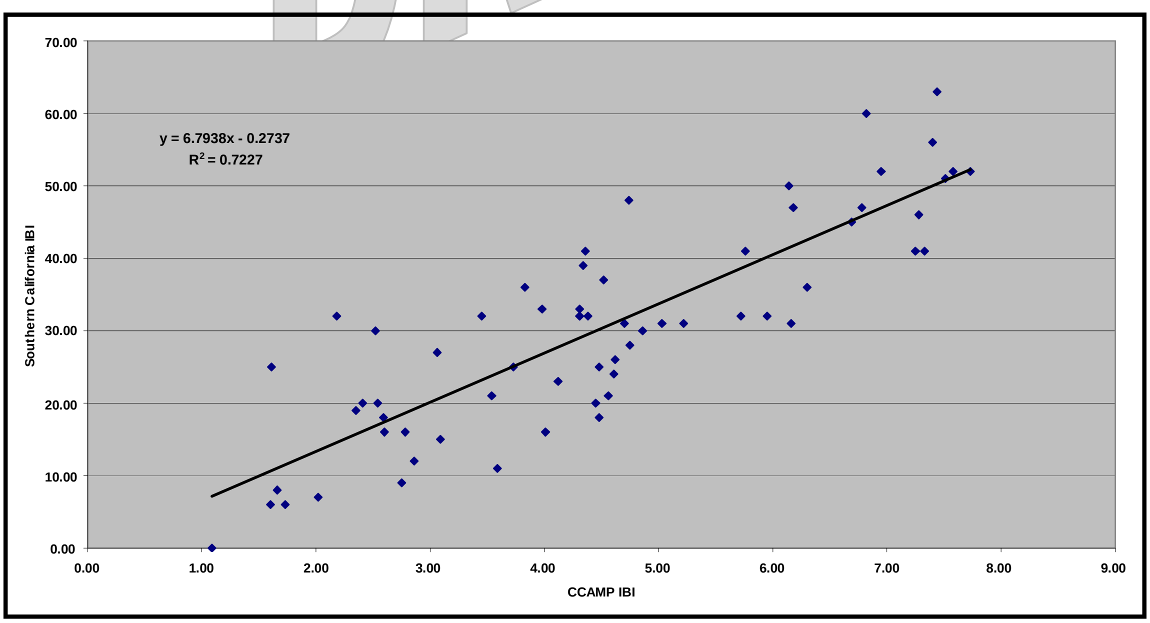
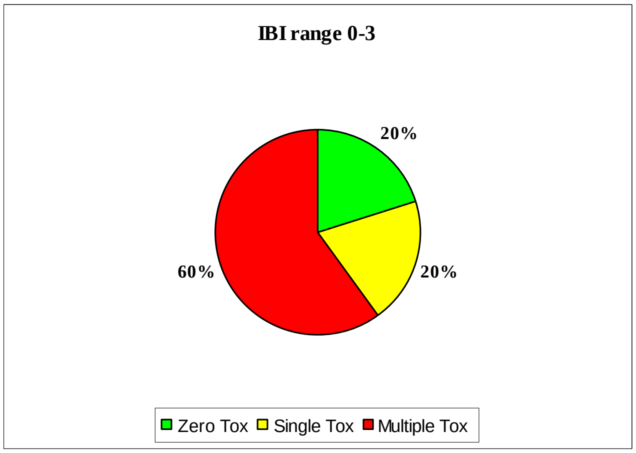
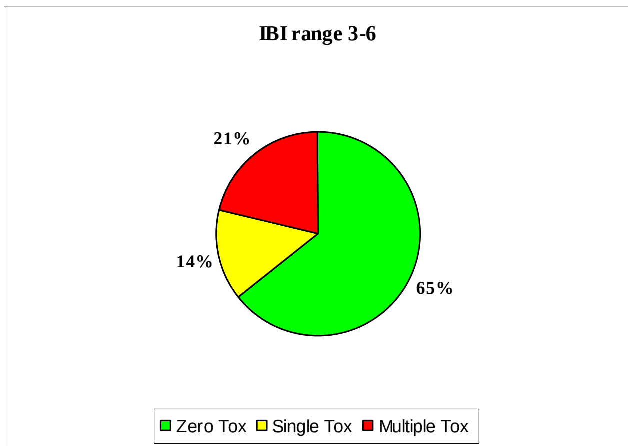
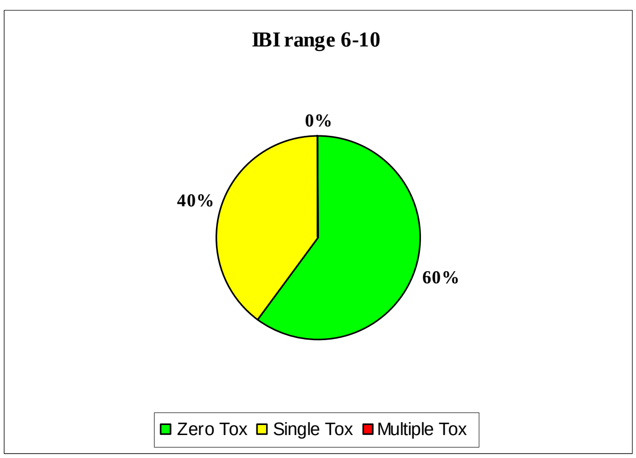


Figure B.2. Regression of Southern California Index of Biotic Integrity scores against Central Coast Ambient Monitoring Program Index of Biotic Integrity scores for the Central Coast Region.



Lowest IBI quartile scores





Highest IBI quartile scores

Figure B.3. Percent of sites showing zero toxicity, a single toxic result or multiple toxic results, according to CCAMP-IBI quartile scores.