SOUTH COAST WATERSHED CHARACTERIZATION STUDY

An Assessment of Water Quality Conditions in Four South Coast Creeks

County of Santa Barbara
County of Ventura
City of Santa Barbara
City of Carpinteria

August 1999

Prepared by:
URS Greiner Woodward-Clyde

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1.0 INTRODUCTION

1.1 STUDY SCOPE AND OBJECTIVES

The South Coast Watershed Characterization (SCWC) Study was initiated in 1998 by the Santa Barbara County Public Health Department (County) to characterize the water quality of several South Coast streams. The SCWC Study included the following creeks: Arroyo Burro, Mission, Carpinteria, and Rincon creeks (Figure 1). The first two creeks traverse the City of Santa Barbara, while lower Carpinteria Creek passes through the City of Carpinteria. Rincon Creek is located along the boundary of Santa Barbara and Ventura counties. Funds and technical assistance for this study were provided through a cooperative effort among the County, City of Santa Barbara, City of Carpinteria, and the County of Ventura.

The SCWC Study involved the collection of water samples from a minimum of ten locations along each creek during four sampling events. The set of first sampling occurred in August and October 1998, and represented a dry weather sampling. The second sampling occurred after the first rainfall in November 1998 to capture the first flush. The last two samplings occurred in the middle and end of the winter runoff period, in January and March 1999, respectively. The levels of coliform, fecal coliform, and enterococcus were measured at ten locations along each creek, while general mineral constituents and physical parameters were measured at three of the ten locations.

The objectives of the SCWC Study are listed below:

a) Describe and summarize the water quality in the watersheds under low flow and winter runoff conditions, comparing and contrasting the water quality among the watersheds, and with watersheds from other Southern California counties.

b) Identify elevated concentrations of pollutants in the watersheds as pollutants of concern, comparing the observed concentrations to regulatory levels.

c) Describe and summarize the extent of bacterial pollution in the watersheds. To the extent feasible, identify specific and general sources of bacterial pollution in the watersheds.

d) Identify Best Management Practices (BMPs) to address pollutants of concern, including BMPs that would likely be part of a future NPDES stormwater permit, as well as other BMPs.

e) Provide recommendations on future studies, agency coordination, BMP implementation, and institutional actions in order to prepare for the NPDES stormwater permit.

1.2 OVERVIEW OF NPDES STORMWATER REGULATIONS

In 1987, the National Pollution Discharge Elimination System (NPDES) was amended to create a national program to improve stormwater runoff quality in urbanized areas pursuant to regulations promulgated by the Environmental Protection Agency (EPA). The urban stormwater element of the program requires that municipalities acquire stormwater discharge permits by certain dates. The program was initiated in two phases. Phase I required that large and medium municipalities (populations over 100,000 people) acquire a permit by 1994. On January 8, 1998, EPA issued the draft Phase II regulations for small municipalities (under 100,000 people). Under the new regulations, owners and operators of municipal stormwater separate sewer systems in incorporated areas and in urbanized unincorporated areas (areas with populations over 50,000) must obtain a stormwater permit from the State's NPDES permitting authority. In California, EPA has delegated its permit authority to the State Water Resources Control Board, and in turn, to the Regional Water Quality Control Boards.

The Phase II NPDES municipal stormwater permit will require the development and implementation of a stormwater management program to reduce the discharge of pollutants from the municipal stormwater sewer system to the maximum extent practicable. The program must include the following minimum control measures:

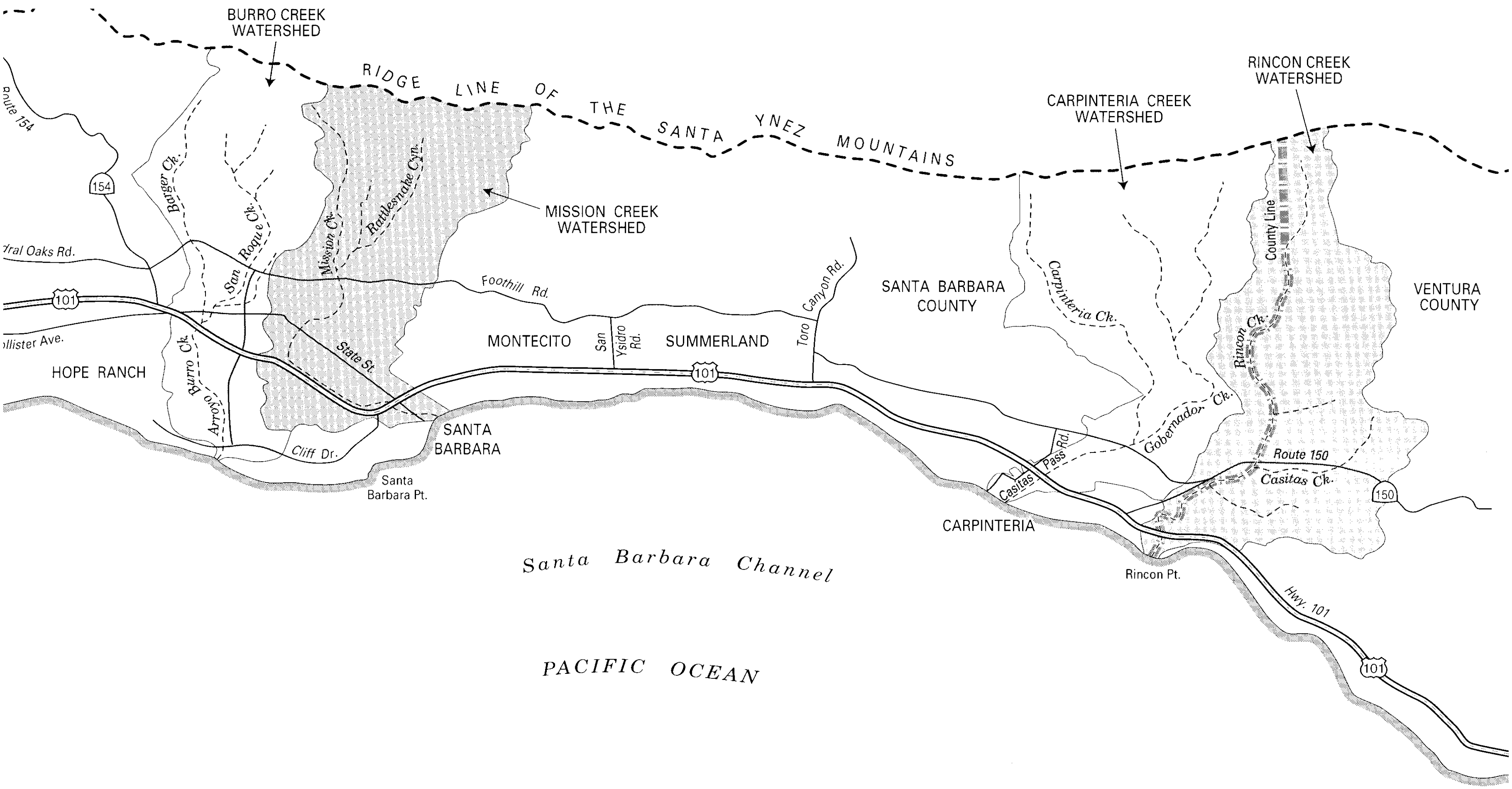
1. Public education and outreach on stormwater impacts
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post-construction stormwater management in new development and redevelopment
6. Pollution prevention and good housekeeping for municipal operations

The Phase II regulations would apply to the cities of Santa Barbara, Santa Maria, Lompoc, and Carpinteria; and to the urbanized portions of Santa Barbara County (e.g., Goleta, Montecito. Orcutt, and Vandenberg Village areas). The data developed in the SCWC Study will assist these South Coast permittees with the future NPDES permitting as follows:

- Potential pollutants of concern are identified in this report. These are pollutants that exceed water quality objectives in the Central Coast Water Quality Control Plan (Basin Plan), or that may adversely affect beneficial uses identified in the Basin Plan. By identifying the pollutants of concern at an early stage, the future permittees can develop Best Management Practices (BMPs) to addresses these pollutants prior to permit acquisition.

- Ambient water quality from stormwater is characterized in this report. The water quality data represent the "baseline conditions" that can be used to determine the effectiveness of BMPs over time.

Figure 1. South Coast Watersheds in the SCWC Study



The original deadline for finalizing the Phase II regulations was March 1999. The deadline for applying for a stormwater permit was three years and 90 days from the date of the final regulations. The current deadline for finalizing the regulations is October 29, 1999. Based on this new projected deadline for the final regulations, the County and other Phase II permittees in the County, would need to apply for a stormwater permit by January 2003. The draft regulations also state that programs and actions associated with Phase II stormwater permits must be implemented within five years of the permit application (i.e., January 2008).

The watershed of Rincon Creek does not qualify as an urbanized area under the proposed NPDES Phase II regulations. However, this watershed has been designated as an "impaired water" by the Central Coast Regional Water Quality Control Board (RWQCB) for pathogens, whose presence is typically determined through the occurrence of fecal coliform bacteria. Under Section 303(d) of the Clean Water Act, each state must designate waterbodies that do not meet state water quality objectives that are designed to protect beneficial uses. The Clean Water Act requires the development of a pollution control plan, called a Total Maximum Daily Load (TMDL) for each impaired waterbody on the 303(d) list. The TMDL is the quantity of a pollutant that can be safely assimilated by a waterbody without violating water quality standards. The TMDLs for pathogens (as measured by indicator bacteria) for Rincon Creek will be developed by the Central Coast RWQCB in the near future.

Arroyo Burro, Mission, and Carpinteria creeks have also been designated as "impaired waters" by the RWQCB for the following pollutants: pathogens for Arroyo Burro, Mission, and Carpinteria creeks, and "unknown toxicity" for Mission Creek. TMDLs will need to be developed by the RWQCB for these pollutants in each watershed, as noted above. The data from this report provide additional information on the levels of bacteria in these watersheds which may assist the RWQCB in developing a TMDL for pathogens in the future. The TMDL process is separate and distinct from the NPDES municipal stormwater program. The TMDL process provides for more stringent water quality-based controls when the technology-based controls under the NPDES program are inadequate to achieve water quality standards.

1.3 RELATED STUDIES

A related water quality investigation is being conducted by Santa Barbara County (through its Public Works Department, including the Flood Control District and County Water Agency), City of Carpinteria, and the City of Santa Barbara. This effort, called Project Clean Water, included an intensive field investigation of seven South Coast creeks in late 1998 to identify sources of bacterial contamination and actions (e.g., BMPs, remediation action, water treatment, etc.) that can be implemented to reduce beach closures. Project Clean Water also involved a sanitary survey of each watershed and the collection of water samples from specific locations along each creek, four times a week for 4 to 5 weeks. Samples were tested for coliform, fecal coliform, and enterococcus. Water quality and source identification data from this study are incorporated in this report for Arroyo Burro, Mission, Carpinteria, and Rincon creeks.
The County has also participated in a large regional study called "Bight 98," which was coordinated by the Southern California Coastal Water Research Project (SCCWRP). This study is a cooperative effort among 22 government and private agencies to assess beach water quality from Point Conception to south of the Mexican border. Samples were collected in the surf zone at over 300 sites during August 1998 and analyzed for total coliform, fecal coliform, and enterococcus. The bacteria concentrations measured

during the August 1998 survey are presented in this report. A follow-up study was conducted in February 1999, but results are not yet available.

2.0 STUDY METHODS

As noted in Section 1.0, the following watersheds were included in the SCWC Study: Arroyo Burro, Mission, Carpinteria, and Rincon creeks. The study was designed to collect water quality samples on four occasions that reflect the range of hydrologic conditions during the winter and spring. The first sampling occurred prior to the first rains to assess water quality conditions during low flows and after a prolonged dry period. The second sampling occurred after the first major storm event of the winter. The third and fourth sampling efforts occurred after rainfall events in the middle and at the end of the winter, respectively.

Weather forecasts were monitored during the course of the study to identify potential sampling events. The first flush is defined as over ¼ inch of precipitation during a 24-hour period. Sampling after other rain events only occurred if the rainfall exceeded 0.1 inches and was preceded by 72 hours of dry weather. Sampling events were designed to occur at least 30 days apart from one another.

County staff conducted the sampling within 24 hours of the end of the rainfall event. All personnel were trained by qualified County senior staff in sampling and transportation procedures, field measurements, and documentation. Grab samples were collected by lowering the sample container to approximately 6 inches below the surface water, whenever possible. The bottle was directed into the current, at least one foot from the bank. Appropriately treated and preserved sample bottles were provided by a certified laboratory. Samples were immediately stored in blue ice (40 F) and transported to the laboratory within six hours. Field measurements were conducted at most sampling locations, consisting of water temperature, pH, and dissolved oxygen using hand-held equipment. Additional information on sample documentation, transport and storage; laboratory procedures; personnel training; and quality control/quality assurance for this study are available from the County.

Ten sampling locations were established in each of the four watersheds that extended from the mid-point of the watershed to the mouths of the creeks. The sampling locations are shown on Figures 2a – 2d. Sampling locations were not established in the headwaters of each watershed because: (1) these areas are largely inaccessible; and (2) man-made pollutant sources are not present because the upper watersheds occur in the Los Padres National Forest and are undeveloped. Sampling water quality at the southern boundary of the National Forest would provide a representative characterization of water quality under natural conditions. Water quality samples from each location were analyzed for total coliform, fecal coliform, and enterococcus during each sampling event.

Three of the ten sampling locations on each creek were selected for general mineral, nutrient, and physical analyses – at the top, in the middle, and at the bottom of the sampling reach. The following constituents were measured at these sampling locations along Arroyo Burro, Mission, and Carpinteria creeks: dissolved oxygen (DO), pH, total organic carbon, ammonia – N, total Kjeldahl nitrogen, NO_3 – Nitrogen, NO_2 – Nitrogen, PO_4 – Phosphorus, PO_4 - PO_4, Cd, Cr, Cu, Ni, Pb, Hg, Zn, total petroleum hydrocarbons, total petroleum hydrocarbons (non soluble), biological oxygen demand (BOD), and carbon oxygen demand.

At Rincon Creek, only the following analyses were performed at the three sampling locations: dissolved oxygen (DO), pH, total organic carbon, ammonia – N, total Kjeldahl nitrogen, NO_3 – Nitrogen, NO_2 –

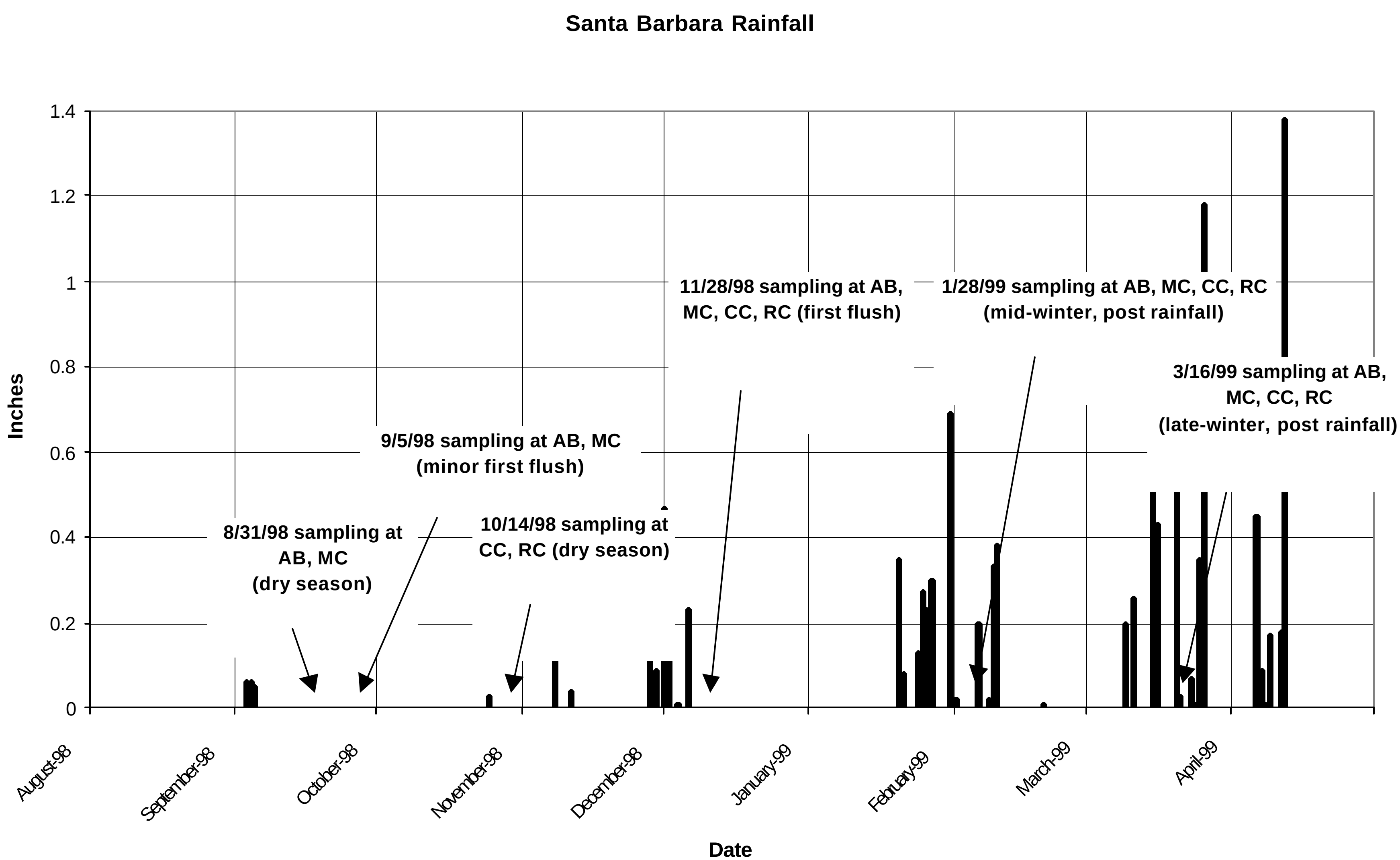
Nitrogen, PO_4 – Phosphorus, PO_4 - PO_4, and biological oxygen demand (BOD). In addition, total suspended solids (TSS) were measured at these locations during two sampling events.

A summary of the dates of sampling events and preceding rainfall amounts is provided in Table 1. The timing of the sampling events relative to rainfall during the 1998-99 water year is provided on Figure 3. Total rainfall from September 1, 1998 through May 1, 1998 was only 10.85 inches, well below the annual average on the South Coast of 15 inches.

TABLE 1
SUMMARY OF SAMPLING EVENTS

Date	Purpose	Creeks Sampled	Preceding Rainfall
8/31/98	Dry season conditions prior to first rainfall	Arroyo Burro and Mission creeks	None
9/4/98	Following first minor rainfall of the year	Arroyo Burro and Mission creeks	0.12 inch on 9/3, 9/4
10/14/98	Dry season conditions prior to first rainfall	Carpinteria and Rincon creeks	None
11/28/99	Following first significant rainfall event	Arroyo Burro, Mission, Carpinteria and Rincon creeks	0.43 inches on 11/28
1/28/99	Mid-winter sampling	Arroyo Burro, Mission, Carpinteria and Rincon creeks	1.03 inches on 1/24-27
3/16/99	Late-winter sampling	Arroyo Burro, Mission, Carpinteria and Rincon creeks	1.00 inches on 3/15-16

Footnote: Runoff on 9/4/99 was greater than expected in light of the small amount of rain due to accumulated precipitation over two days. Sampling for first flush on Arroyo Burro and Rincon creeks was repeated on 11/28/99.



AB = Arroyo Burro, MC = Mission Creek
CC = Carpinteria Creek, RC = Rincon Creek

Figure 3. Sampling Events Relative to Rainfall

3.0 DESCRIPTIONS OF THE WATERSHEDS

A description of the major geographic, hydrologic, and land use characteristics of the four study watersheds is provided below. The boundaries of each watershed and major tributaries are shown on Figures 4a and 4b. Dominant land uses are shown on Figures 5a and 5b. A graphical summary of different land use types for each watershed is provided on Figures 6a and 6b.

3.1 ARROYO BURRO CREEK WATERSHED

Arroyo Burro Creek begins in the Santa Ynez Mountains and flows south until it empties into Arroyo Burro Beach (Hendry's Beach). The watershed encompasses about 6,217 acres. It extends about seven miles from the ocean to the ridge of the Santa Ynez Mountains at 3800 feet elevation. Tributaries to Arroyo Burro Creek consist of Las Positas Creek, Barger Creek, San Roque Creek, and Lauro Canyon Creek (Figure 4a). A small lagoon is present at the end of the creek at Arroyo Burro Beach. The lagoon has regular tidal influence.

The lower reach of the watershed extends from Cliff Drive to Highway 101. In this reach, the creek traverses medium density residential development interspersed with native and non-native bank vegetation. The urban reach of the creek begins from the point where the channel becomes lined at the crossing of Highway 101 until it splits into San Roque and Barger Canyon creeks near the La Cumbre Shopping Center. The predominant land use is open space of the National Forest, comprising 48 percent of the entire watershed (Figures 5a and 6a). Residential and commercial development combined account for about 31 percent of the watershed. Agriculture accounts for only eight percent of the total watershed.

There are two main tributaries that make up the upper reaches of the Arroyo Burro watershed. San Roque Creek makes up 48 percent of the watershed with its headwaters beginning above Lauro Canyon Reservoir. In its upper reaches, the creek runs from a low density residential area to the lower stretches where it passes through an increasingly dense urban area. Overall, the creek can be characterized by moderately vegetated banks, cobble and sand substrate, with trash throughout the lower reaches. The next main tributary, Barger Creek, which makes up 14 percent of the watershed begins in Barger Canyon above Foothill Road and passes through a medium density residential area before entering Arroyo Burro Creek. The creek is mostly dry, with some flow noted approximately 1,100 feet upstream of the confluence with the mainstem.

Arroyo Burro also has two smaller tributaries - Lauro and Las Positas creeks. Lauro Creek is a small creek that flows into Lauro Reservoir. The creek runs through a low density residential area. The bank vegetation is primarily dense native vegetation with substrate that is composed of cobbles, gravel and silt. Las Positas creek is located on the middle reach of the main stem between Las Positas Road and a low density residential area. The headwaters are located near Modoc Road and Highway 101. Flow is typically minimal throughout this creek.

3.2 MISSION CREEK WATERSHED

Mission Creek begins in the Santa Ynez Mountains above the Santa Barbara Botanical Gardens in Rattlesnake Canyon and winds its way down through the City of Santa Barbara until it reaches the ocean east of Stearns Wharf (Figure 4a). The watershed encompasses about 7,786 acres. It extends approximately 7.5 miles from the ocean to the ridge of the Santa Ynez Mountains at 3,985 feet elevation. There are two main tributaries, Rattlesnake Creek and Old Mission Creek. There is also a small tributary called Las Canoas Creek branching out from Rattlesnake Creek. The entire watershed encompasses a mixture of residential, urban and natural environments.

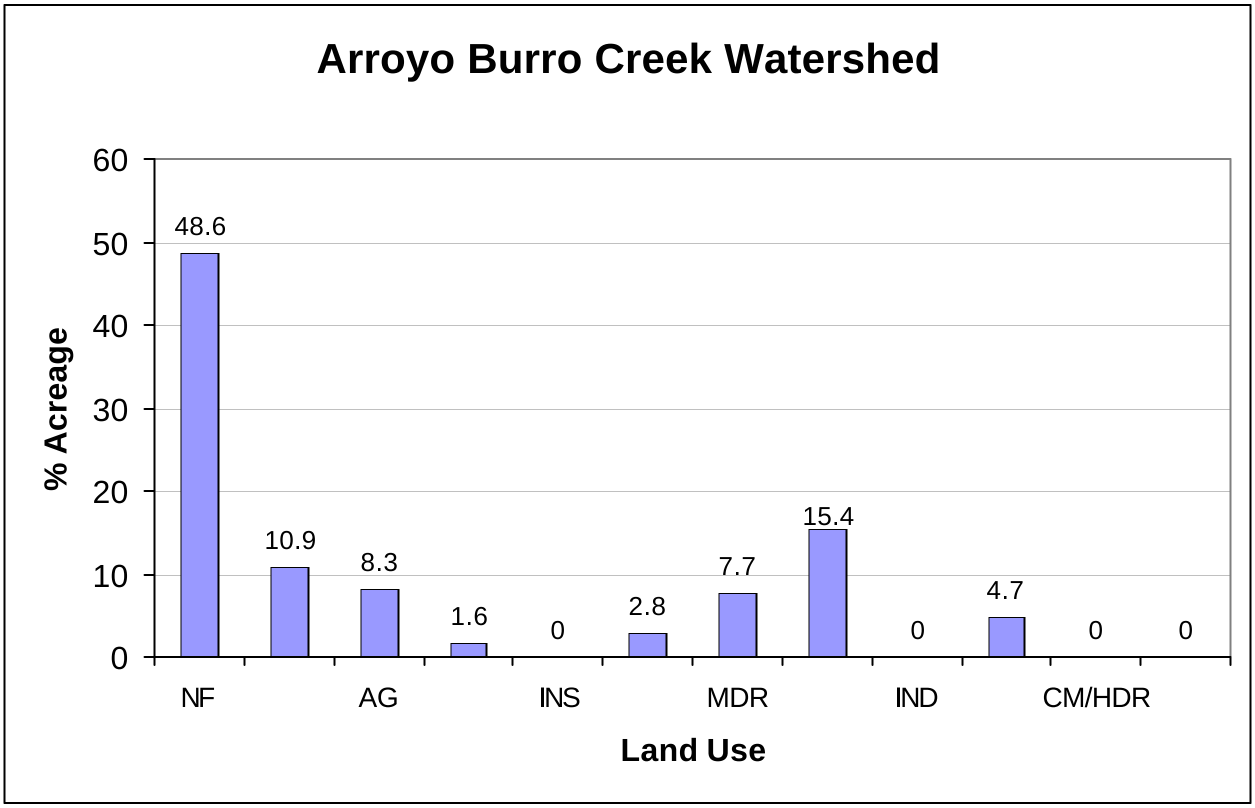
A lagoon is present at the creek mouth. Mission Creek lagoon extends from just east of Stearns Wharf to Yanonali Street, approximately 2,100 feet upstream from the bottom of the lagoon. The size of the lagoon is dependent on season, rainfall and tidal influx. A sand berm often forms preventing the mixing of creek and ocean water. Directly upstream of the lagoon the creek banks are stabilized by concrete walls or gabions. The amount of flow along this reach varies greatly depending on tidal conditions.

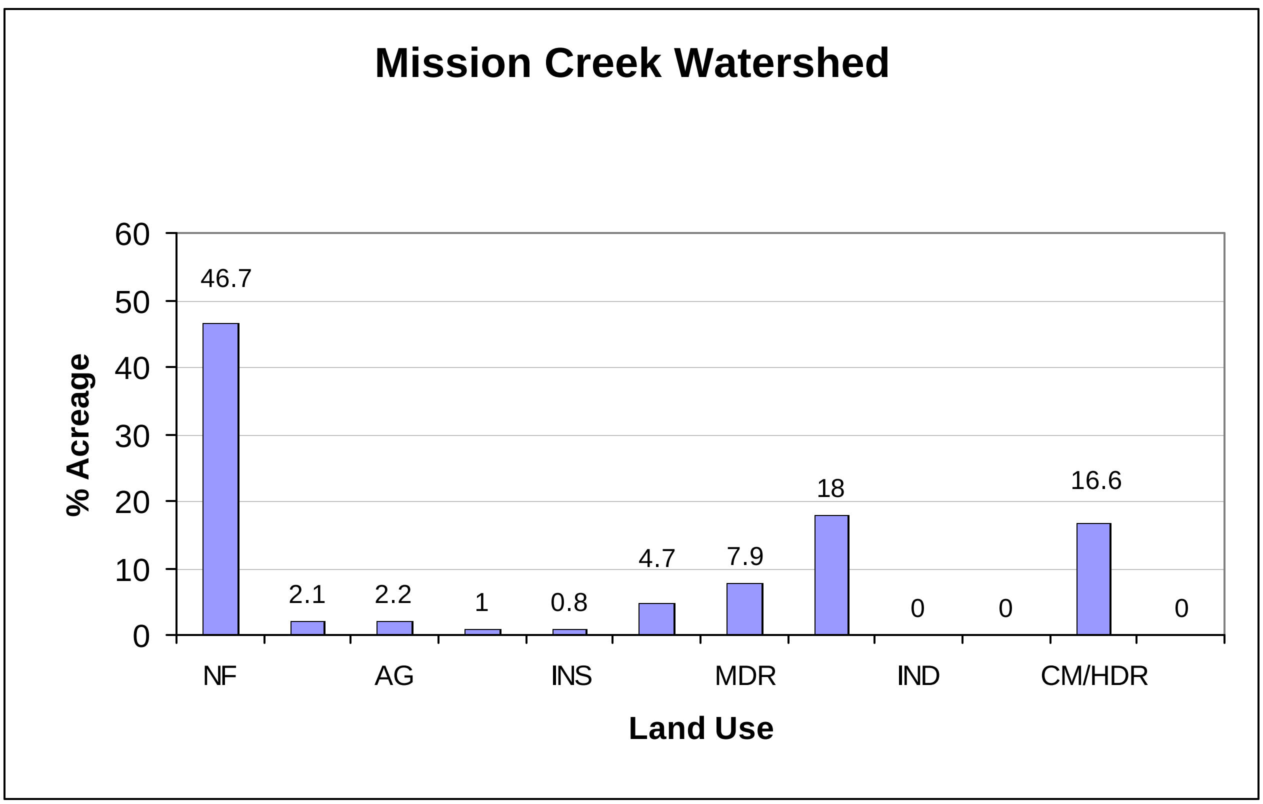
Moving further upstream, the middle reach of the creek has year-round flow and well-vegetated banks. This reach of the creek is characterized by urban development, which includes enormous amounts of trash, discarded blankets and clothing etc. At approximately 6,400 feet upstream of the ocean near Carrillo Street, the creek substrate changes from rocks, cobbles, sand and silt to a concrete lined channel.

The upper reach of the watershed begins upstream of State Street. The land use at this point changes into low density residential (Figure 5a). The surroundings are less urbanized and the creek assumes a more natural state. The substrate returns to cobbles, sand and silt, the vegetation density increases greatly and the turbidity is clear. The confluence of Rattlesnake Creek is also located in this stretch. Above the Botanical Garden, there are only scattered estates. Over the entire watershed, the open space of the National Forest comprises about 47 percent of the watershed, while residential and commercial land uses contribute about 31 and 17 percent, respectively (Figure 6a). Agriculture accounts for only two percent of the total watershed

Old Mission Creek and Rattlesnake Creeks are the two main tributaries in the Mission Creek main stem. Old Mission Creek originates in the west side of the city at Bohnett Park on San Pascual Street. The creek has dense vegetation, cobble and sand substrate for the entire stretch until it is channelized to meet with the main stem of Mission Creek.

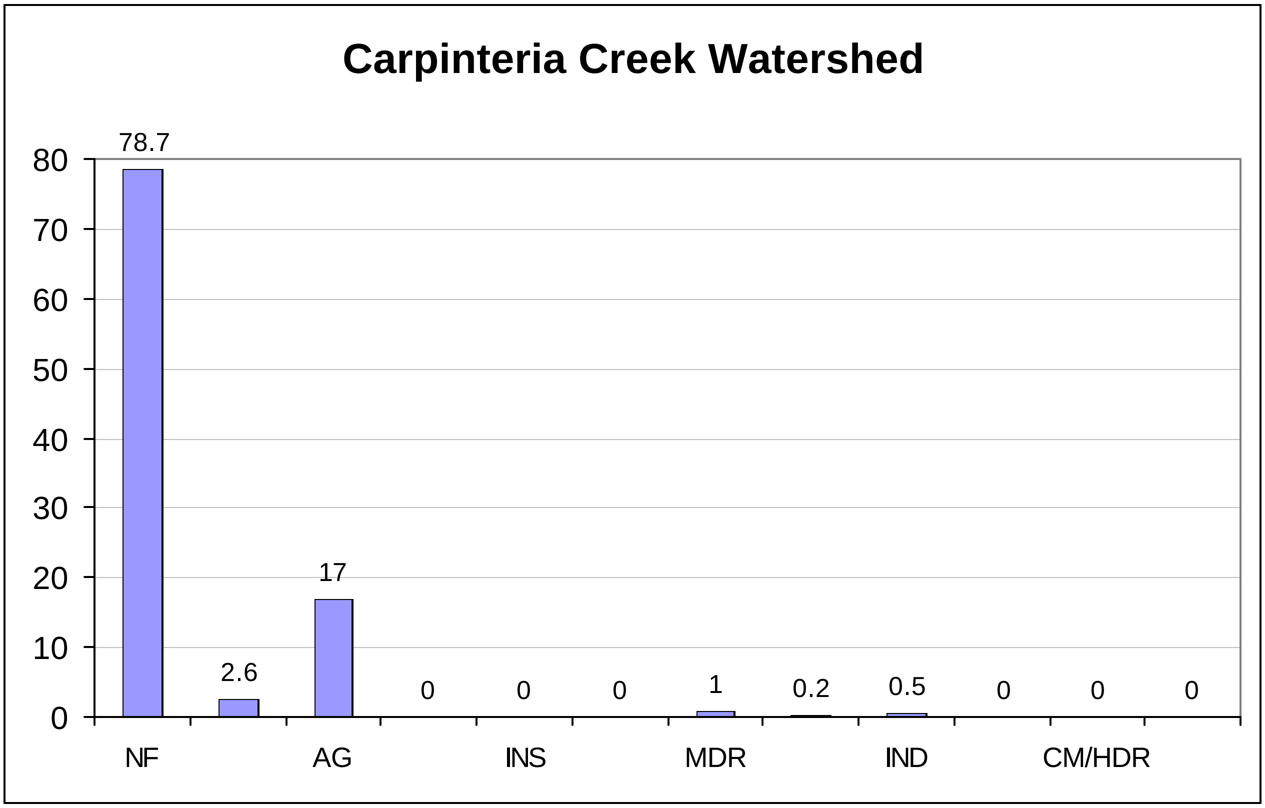
The confluence of Rattlesnake Creek occurs just below the Botanical Gardens in the Mission Canyon area. The creek flows through low density residential and undeveloped areas. There are several horse corrals that encroach on the creek. Las Canoas Creek is a small tributary that joins lower Rattlesnake Creek. Rattlesnake Creek makes up 27 percent of the entire watershed.

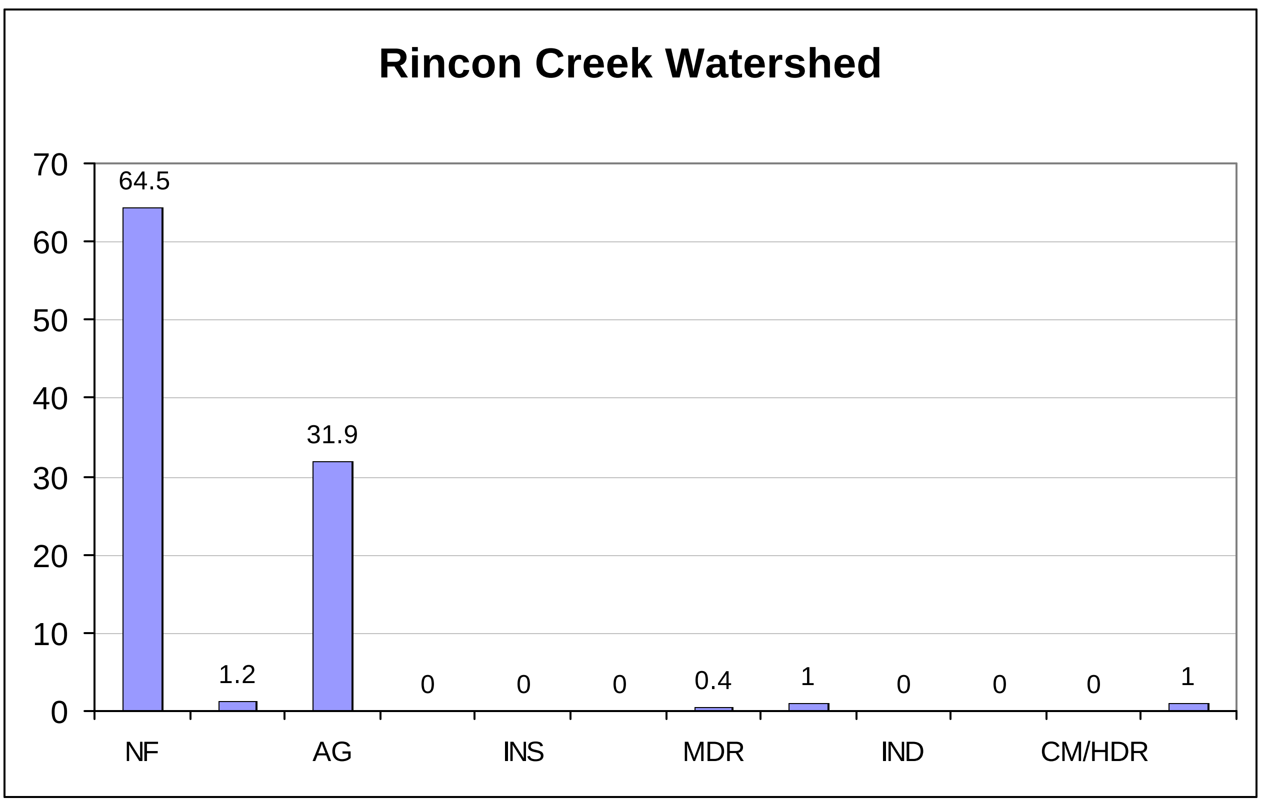




NF= National Forest; OS = open space
AG = agriculture; REC = recreational area
INS = institutional; LDR = low density residential
MDR = medium density residential; HDR = high density residential; IND = industrial ;CM = commercial; CI = commercial/industrial

Figure 6a. Summary of Land Uses Types - Arroyo Burro and Mission Creeks





NF= National Forest; OS = open space; AG = agriculture; REC = recreational area; INS = institutional LDR = low density residential; MDR = medium density residential; HDR = high density residential ; IND = industrial ;CM = commercial; CI = commercial/industrial

Figure 6b. Summary of Land Uses Types - Carpinteria and Rincon Creeks

3.3 CARPINTERIA CREEK WATERSHED

The Carpinteria Creek watershed is located in the southeastern portion of Santa Barbara County. The watershed encompasses 9,410 acres. It extends about seven miles from the ocean to the ridge of the Santa Ynez Mountains at 4568 feet elevation. Most of the watershed encompasses agricultural lands with scattered residences.

A lagoon is present at the creek mouth Carpinteria lagoon begins 50 feet above the ocean and extends 650 feet to the railroad tracks. The lagoon is located in Carpinteria State Beach Park. The size of the lagoon is dependent on season, rainfall and tidal influx. The lagoon narrows 50 feet above the ocean and creates a stream of constant outflow into the ocean. A sand berm usually occurs, depending on tidal conditions, which prevents a constant ocean inflow to the lagoon.

Most of the lower and middle sections of the watershed are dominated by residential and commercial development, particularly downstream of Highway 101 (Figure 5b). The upper watershed is comprised of greenhouses, orchards, scattered residences, and the open space of the National Forest. The latter comprises about 79 percent of the entire watershed (Figure 6b). Agricultural uses encompass about 17 percent, while the combined residential and commercial uses account for less than 2 percent of the entire watershed.

The upper portion of the watershed includes one tributary - Gobernador Creek. This portion of the watershed including the tributary consists mainly of avocado and citrus orchards with a few scattered residences.

3.4 RINCON CREEK WATERSHED

The Rincon Creek watershed occurs within both Santa Barbara and Ventura counties. The watershed encompasses 10,219 acres. It extends about 7.5 miles from the ocean to the ridge of the Santa Ynez Mountains at 4,800 feet elevation. Long Canyon and Casitas Creek are the two main tributaries to the mainstem of the watershed (Figure 4b). Land use in the watershed is predominantly agriculture with scattered residences. The watershed is generally undisturbed and its riparian corridors are mostly intact and dominated by native vegetation.

A small lagoon is present at the creek mouth. It is surrounded by a small gated residential community. The size of the lagoon varies according to season, rainfall and tidal influx. The lagoon narrows 100 feet upstream of the ocean where constant outflow into the ocean occurs. The upper portion of the lagoon is diverted into a culvert under Highway 101, a small private road, and the Rincon Beach parking lot. At the end of the culvert, the creek assumes its natural state, characterized by high banks and mostly native vegetation.

The upper region of the watershed is predominantly agricultural with adjacent estates and residences (Figure 5b). In addition, there are some horse corrals nearing the creek corridor in this area. The open space of the National Forest comprise about 64.5 percent of the watershed. Agricultural lands are the next dominant land use type, covering about 32 percent of the watershed (Figure 6b). Residential land uses only account for less than two percent, while commercial development is absent. Overall, the creek maintains its natural state with exception to the lower reaches of the watershed.

There are two tributaries to Rincon Creek - Long Canyon and Casitas Creek. The confluence of Long Canyon is located in the middle reach of mainstem. The confluence of Casitas Creek with the mainstem is located at the upper end of the watershed. There are avocado orchards scattered throughout both tributaries. In addition, there are many springs discharging into the creek throughout the watershed.

4.0 WATER QUALITY STANDARDS

4.1 WATER QUALITY STANDARDS

The Water Quality Control Plan for the Central Coast Region (Basin Plan) is the basis for the management of water quality by the Central Coast RWQCB. It lists the beneficial uses in the region and describes how water quality must be protected to maintain these uses. The Basin Plan also contains policies, programs, and actions necessary to achieve the standards established in the plan. The RWQCB implements the plan by issuing and enforcing waste discharge requirements, including NPDES stormwater permits.

The Basin Plan contains a list of beneficial uses for the creeks in the SCWC Study, as shown in Table 2. Beneficial uses are similar among the four creeks, with a few notable exceptions. For example, only Carpinteria and Rincon creeks have agriculture as a beneficial use. All creeks but Arroyo Burro Creek have cold water fisheries and aquatic organisms as beneficial uses.

The Basin Plan also includes water quality objectives, which are numeric or narrative standards considered necessary to protect beneficial uses. Water quality objectives are achieved through the RWQCB's permit actions and through the implementation of the Basin Plan. Applicable water quality objectives for the constituents addressed in the SCWC Study are presented in Table 3. Note that many objectives are expressed in a narrative form rather than in a numeric value, such as suspended sediments, biological oxygen demand, phosphate, nitrogen, and ammonia.

4.2 OVERVIEW OF STORMWATER POLLUTION

4.2.1 Sources

The major sources of stormwater pollution are listed below:

- Road and highway pavement – Road surfaces are continually degrading, resulting in the discharge of aggregate material and asphalt binders and fillers.

- Motor vehicles – Common constituents generated by motor vehicles include fuels, lubricants, and particles from tires and brake linings. Exhaust emissions collect on road surfaces and are washed away.

- Atmospheric fallout – Dust and particles from industrial processes, automobiles, and exposed lands are dispersed in the atmosphere and re-deposited on the land surface.

- Vegetation – Decomposing vegetation is a source of nutrients and organic compounds.

TABLE 2
BENEFICIAL USES OF WATERBODIES IN THE SCWC STUDY

Waterbody	MUN	AGR	GWR	REC1	REC2	WILD	COLD	WARM	MIGR	SPWN	BIOL	RARE	EST	FRESH	COMM	SHEL
Arroyo Burro Creek	X		X	X	X	X		X		X	X	X		X	X	
Arroyo Burro Estuary				X	X	X		X		X			X		X	
Mission Creek	X		X	X	X	X	X	X	X	X		X	X	X	X	
Carpinteria Creek	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
Rincon Creek	X	X	X	X	X	X	X	X	X	X		X	X	X	X	

MUN - Municipal and domestic supply
AGR - Agricultural supply
GWR - Groundwater recharge
REC1 - Water contact recreation
REC2 - Non-contact water recreation

WILD - Wildlife habitat
COLD - Cold freshwater habitat
WARM - Warm freshwater habitat
MIGR - Migration of aquatic organisms
SPWN - Spawning, reproduction and development

BIOL - Habitats of special significance
RARE - Rare, threatened or endangered species
EST- Estuarine habitat
FRESH – Freshwater replenishment
COMM – Commercial and sportfishing
SHEL – Shellfish harvesting

TABLE 3
SCWC STUDY CONSTITUENTS AND CORRESPONDING WATER QUALITY OBJECTIVES

SCWC Study Constituents	Corresponding Water Quality Objective from the Basin Plan (most restrictive objective only)
Total Coliform	None
Fecal Coliform	Concentration, based on a minimum of not less than 5 samples for any 30-day period, shall not exceed a long mean of 200/100 ml, nor shall more than 10% of total samples during any 30-day period exceed 400/100 ml. (REC-1)
Total organic compound (TOC)	Title 22 limitations for individual organic compounds (MUN)
Ammonia-N	None
Total Kjeldahl Nitrogen (TKN)	Narrative objective for biostimulatory substance: concentrations that promote algal growth that adversely affect beneficial uses (all beneficial uses)
PO_4-P	Narrative objective for biostimulatory substance: concentrations that promote algal growth that adversely affect beneficial uses (all beneficial uses)
PO_4-PO_4	Narrative objective for biostimulatory substance: concentrations that promote algal growth that adversely affect beneficial uses (all beneficial uses)
Cd	Not exceed 0.003 mg/l in hard water or 0.0004 mg/l in soft water at any time (SPWN)
Cr	Not exceed 0.05 mg/l in hard water or 0.05 mg/l in soft water (COLD, WARM)
Cu	Not exceed 0.03 mg/l in hard water or 0.01 mg/l in soft water (COLD, WARM)
Ni	Not exceed 0.4 mg/l in hard water or 0.1 mg/l in soft water (COLD, WARM)
NO_3-N	Not exceed 45 mg/l (MUN)
NO_2-N	Narrative objective for biostimulatory substance: concentrations that promote algal growth that adversely affect beneficial uses (all beneficial uses)
Pb	Not exceed 0.03 m/l in hard water or 0.03 mg/l in soft water (COLD, WARM)
Hg	Not exceed 0.0002 mg/l in hard water or 0.0002 mg/l in soft water (COLD, WARM)
Zn	Not exceed 0.2 mg/l in hard water or 0.004 mg/l in soft water (COLD, WARM)
Total petroleum hydrocarbons (TPH)	None
TPH NS	None

SCWC Study Constituents	Corresponding Water Quality Objective from the Basin Plan (most restrictive objective only)
Biological oxygen demand (BOD)	None for BOD. Biostimulatory substance narrative would apply, that is, waters shall be free of substances that result in increases in the BOD which adversely affect beneficial uses.
Chemical oxygen demand (COD)	None
TEMP	At no time or place shall the temperature of any water be increased by more than 5 degrees F above natural receiving temperature (COLD/WARM)
Dissolved oxygen (DO)	The dissolved oxygen concentration shall not be reduced below 5.0 mg/l at any time (WARM)
pH	The pH value shall not be depressed below 7.0 (WARM) or raised above 8.3 (REC-2)
Total suspended solids (TSS)	Waters shall not contain suspended material in concentrations that cause nuisance or adversely affect beneficial uses.
Sediments	The suspended sediment load and suspended sediment discharge rate of surface water shall not be altered in such a manner to cause nuisance or adversely affect beneficial uses.

- Urban and agricultural lands uses – A wide variety of pollutants are generated by urban land uses, depending upon the mix of commercial, industrial, and residential land use types. Pollutants are generated through the exposure of industrial activities to rainfall and runoff, septic fields, littering, landscape maintenance, animal waste, fuel dispensing, vehicle servicing, outdoor waste receptacles, and painting. Stormwater pollutants from agricultural operations consisted primarily of sediments, nutrients from fertilizers, pesticides, and herbicides.

- Construction Sites – Erosion from construction sites is a major source of sediments in stormwater runoff.

4.2.2 Types of Stormwater Pollutants

There are a wide variety of pollutants that are found in stormwater runoff. An overview of the major constituents of stormwater and the adverse health and ecological effects of each pollutant is provided below.

Sediment

Sediment is the largest contributor by volume to stormwater pollution. Suspended matter is primarily generated through erosion processes during rain events. Land erosion is the principle source of sediment; hence, the characteristics of the soils, landforms, and rainfall patterns are major factors determining the sedimentation potential. Non-point sources of suspended solids contribute to about 95 percent of the average daily loading of sediments in the United States. Sediments cause a decrease in light transmission through water, which in turn, cause a decrease in primary productivity of aquatic plants and phytoplankton upon which other species feed. Sediments also obscure spawning and feeding areas for fish and aquatic organisms and may directly interfere with respiration of aquatic species. Sediments increase water temperatures and can reduce oxygen levels in lower water layers. Sediments also decrease the value of receiving waters for recreational uses and drinking water supplies. It should also be noted that other stormwater pollutants are often absorbed to suspended solids, particularly phosphorus, heavy metals, and organic compounds.

Nutrients

Plant nutrients such as nitrogen and phosphorus are common constituents of stormwater. The introduction of nutrients to receiving waters stimulates the growth of algae and other aquatic plants. Nutrients enter runoff from sources such as fertilizers, plant matter, animal waste, seepage from septic systems, and detergents. Nutrients may occur in both dissolved and particulate form. An excess of nutrients will accelerate the process of eutrophication in receiving waters. Algal blooms will occur and the resulting decay of organic material will create turbid conditions that eliminate aquatic vegetation and destroy food for fish and aquatic species. Some algal blooms can produce toxic substances. Excess algal growth will encourage the dominance of non-native fish and aquatic species. It will also inhibit recreational uses of the receiving water, and reduce the suitability of water for drinking water supplies.

Heavy Metals

Heavy metals in stormwater originate from the operation of motor vehicles, direct atmospheric fallout, and the degradation of highway pavement materials. Transportation related sources of metals include gasoline (Pb), diesel fuel (Cd), exhaust emissions (Pb, Ni), crankcase and lubricating oils (Pb, Ni, Zn), grease (Zn, Pb), tire wear (Cd, Zn), wear on moving parts (Cu, Pb), decorative and protective coatings (Al, Cd, Cu, Zn, Ni, Fe), braking lining wear (Cu, Cd, Ni), moving engine parts (Fe, Mn, Cr, Co), and asphalt paving wear (Ni). The most abundant heavy metals in stormwater are lead, zinc, and copper which typically account for 90 percent or more of heavy metal concentrations. Except for copper and cadmium, metals are present in particulate form. Hence, they can be removed readily through stormwater retention systems. Heavy metals accumulate in bottom sediments and adversely affect benthic organisms. In addition, heavy metals can bioaccumulate in animal tissues and result in chronic toxic effects. Dissolved metals can be toxic to fish and aquatic species. The presence of heavy metals can adversely affect commercial fishing, recreational activities, and drinking water supplies.

Oxygen Demanding Substances

Oxygen demanding substances include numerous organic compounds which are decomposed by microorganisms, thereby creating a need for oxygen. Organic compounds are used by many microorganisms as sources of energy and chemicals for growth. The biochemical reaction by the microorganisms creates a biological oxygen demand (BOD) on dissolved oxygen which is in limited amounts in water. The amount of BOD depends on the types of organic compounds present, types of microorganisms, water temperature, and presence of nutrients for growth. A high BOD caused by the present of oxygen demand substances will cause oxygen depletion in the receiving water and kill fish, alter the aquatic species composition, and increase the number of anaerobic microorganisms that produce unpleasant odors.

Oils, Grease, and Hydrocarbons

Other types of organic compounds are problematic in stormwater because they cannot be easily decomposed by microorganisms and will persist for a long time. Examples include hydrocarbon fractions of oils and greases from transportation sources, benzene from gasoline, synthetic detergents, pesticides, herbicides, wood preservatives, and synthetic industrial products. Many of these compounds are toxic to fish and aquatic organisms, exhibiting both acute and chronic toxic effects. They may also inhibit reproduction, respiration, and development of fish and aquatic species, and in many cases, are mutgenic and carcinogenic. The presence of these compounds in contaminated fish and water can pose a human health risk. Many chlorinated hydrocarbons are very persistent and bioaccumulate in the food chain. They also create adverse aesthetic impacts due to oily sheens on the water.

Pathogens

Pathogens include bacteria, fungi, viruses, and protozoas capable of transmitting disease and affecting human health. The primary sources in stormwater include animal wastes, illegal wastewater connections to storm drains, and leaking septic systems or sewer lines. The principal indicator of pathogen contamination is coliform bacteria, particularly when the source of contamination is sanitary sewer. Pathogens pose a human health risk for recreational users.

4.2.3 Pollutants Associated with Certain Land Uses

Different land use types often exhibit a characteristic suite of stormwater pollutants. An overview of the types of pollutants expected from selected land uses is provided below.

Undeveloped Areas

Pollutant types from such areas will depend on the background levels present in natural soils and rocks underlying the area. Generally, trace metals at ug/L (ppb) levels, TSS, TOC, BOD, and bacteria will be present. BOD levels may be elevated in areas where natural vegetation detaches and is in contact with creek waters (due to biodegradation and composting processes). Bacteria probably originate from wild animals and recreational domestic animal sources (e.g., dogs on trails).

Orchards

Pollutants in stormwater will depend on the types of fertilizers and pesticides that are being applied in the watershed. "Round-up" is probably the most common pesticide used. Orchards often are treated with Princep and Krovar. Deadline (for snails) and Agrimek are the main pesticides for citrus. If fertilizers are used, elevated nutrients such as phosphates and nitrates may be present. Sediment and bacteria are also likely to be present in the runoff from agricultural areas.

Residential and Urban

Typical pollutants from urban areas include: heavy metals, oil and grease, nitrates, phosphates, bacteria, BOD, and bacteria. Heavy metals (copper and zinc, in particular) are derived from the use, parking, and maintenance of vehicles. Brake pads contain copper, and copper residue is released onto streets. Galvanized metal and other building products may contain a lot of zinc. Oil and grease from leaking parked cars may accumulate in driveways and along residential streets where cars are parked nightly. Phosphates, nitrates, pesticides, and herbicides wash off lawns and landscaping during rains and due to overwatering. In particular, the pesticides Diazanon and Chlorpyrifos (common active ingredients in ant poison and termite poison) have been found in urban runoff from residential areas (these pesticides have been linked to aquatic toxicity at the ng/L – part per trillion – level). Phosphates, nitrates, and oil and grease may also be released when soaps are used in residential car washing. BOD may be elevated due to degradation of lawn and landscape clippings. Bacterial sources include (among others) animal waste, sewer line breaks, illicit connections, and leaking septic tanks.

Commercial and Industrial

Many of the same pollutants observed in runoff from residential areas are also seen in runoff from commercial and industrial areas (heavy metals, oil and grease, nitrates, phosphates, bacteria, BOD, and bacteria). Elevated levels of lead are often measured in soils in industrial areas, particularly in areas directly adjacent to freeways. When it rains, the soils erode, contributing to high total lead in the runoff. This is likely due to lead in leaded gasoline combustion emissions (lead was removed from gasoline in the early 1980s). Other types of pollutants present depend on what types of products are being used, stored, or manufactured. Various other heavy metals, solvents, PCBs, organics, and other products used in industrial processes may be used, handled, or stored outdoors such that they contact storm water. In particular, petroleum products such as fuels, oils, and lubricants are commonly observed in runoff from these areas.

4.2.4 Summary of Stormwater Pollutants

A tabular summary of stormwater pollutant sources, indicators, and adverse effects is presented below in Table 4.

TABLE 4
SUMMARY OF STORMWATER POLLUTANTS

Category	Parameter	Possible Sources	Adverse Effects
Sediments	Total suspended solids Turbidity Dissolved solids	Construction sites Urban runoff Agricultural runoff	Turbidity Harm to fish and aquatic species Aquatic habitat degradation Reduce recreational value
Nutrients	Nitrate and nitrite Ammonia Organic nitrogen Phosphate Total phosphorus	Urban runoff Agricultural runoff Septic systems Illicit connections Plant waste	Algal blooms Harm to fish and aquatic species Odors Reduced recreational value
Toxic pollutants	Heavy metals Organic compounds	Urban runoff Motor vehicles and highways Agricultural runoff Hazardous waste sites Industrial discharges Dumping	Acute and chronic toxicity to fish and aquatic organisms Human health impacts

Category	Parameter	Possible Sources	Adverse Effects
Oxygen demanding substances	Biological oxygen demand Chemical oxygen demand Total organic carbon Dissolved oxygen	Urban runoff Agricultural runoff Illicit connections Septic systems	Fish kills Odors
Pathogens	Total and fecal coliform Enterococcus Viruses *E. coli*	Urban runoff Agricultural runoff Septic systems Illicit connections Animal waste	Illnesses and disease Reduced recreational value

5.0 RESULTS OF THE STUDY

5.1 GENERAL AND MINERAL WATER QUALITY

5.1.1 Results

A summary of the water quality data for physical conditions and general/mineral constituents is presented in Table 5. These data include the mean, median, and maximum values for all constituents except for bacteria and total suspended solids (on Rincon Creek only). The raw data for all constituents are presented in Appendix A. In general, these data do not indicate any water quality problems for the study watersheds. Metals were either not detected (Cd, Cr, and Hg) or were measured at very low levels (Cu, Ni, Pb, and Zn). Nutrient levels were also very low, particularly ammonia-nitrogen.

Data on total suspended sediments along Rincon Creek are presented below in Table 6. The total suspended sediment values for Rincon Creek displayed a wide variation between dates and sampling locations.

TABLE 6
TOTAL SUSPENDED SEDIMENTS ALONG RINCON CREEK (mg/l)

Sampling Location	1/28/99	3/16/99
RC 007+00 (lower watershed)	Non-detected	6.7
RC 137+00 (upper watershed)	Non-detected	40
RC-CC 012+00 (tributary)	15	120

5.1.2 Exceedances of Water Quality Objectives

The only water quality objective with a numeric value that was exceeded was dissolved oxygen (DO) along Arroyo Burro Creek (see Table A-1, Appendix A). Four of the 12 samples collected on this creek during the study had DO levels below 5.0 mg/l, the Basin Plan objective. DO levels in this creek during other sampling events were only slightly higher than 5.0 mg/l.

5.1.3 Comparison Among Watersheds

All watersheds exhibited very low to non-detectable levels of metals, total petroleum hydrocarbons, and total nitrogen, and nitrite. A comparison of other water quality constituents that showed variation among watersheds is provided on Figure 7. Key differences are listed below:

TABLE 5

SUMMARY OF WATER QUALITY DATA

	Mean Values (mg/l)				Median Values (mg/l)				Maximum Values (mg/l)			
	Arroyo Burro	Mission	Carpinteria	Rincon	Arroyo Burro	Mission	Carpinteria	Rincon	Arroyo Burro	Mission	Carpinteria	Rincon
DO (mg/ml)	6.06	9.84	11.44	9.01	5.45	10.00	10.82	9.55	11.1	12.9	13.06	9.95
pH (pH units)	8.73	8.04	8.48	8.15	8.65	8.07	8.14	8.35	10	8.3	10.1	8.5
TOC	21.37	21.64	6.56	12.19	14.00	14.00	5.7	12	95	83	19	17
Ammonia-N	0.17	0.18	0.07	0.01	0.10	0	0	0	0.8	1.1	0.6	0.1
TKN	0.79	0.92	0.37	0.69	0.70	0.80	0	0.6	2	2.1	1.7	1.9
NO3-N	0.67	0.83	0.64	2.26	0.80	0	0	2.25	1.7	3.9	2.6	4.3
NO2-N	0.19	0.14	0	0	0	0	0	0	1.6	1.8	0	0
PO4-P	0.37	0.26	0.26	0.94	0.12	0.14	0.01	0.25	2.5	0.80	2.4	5.7
PO4-PO4	1.11	0.81	0.80	2.81	0.37	0.43	0.03	0.77	7.6	2.50	7.4	17
Cd	0	0	0	ND	0	0	0	ND	0	0	0	ND
Cr	0	0	0	ND	0	0	0	ND	0	0	0	ND
Cu	0	0.01	0	ND	0	0	0	ND	0.02	0.02	0.01	ND
Ni	0	0	0	ND	0	0	0	ND	0.02	0	0	ND
Pb	0	0	0	ND	0	0	0	ND	0	0.014	0.011	ND
Hg	0	0	0	ND	0	0	0	ND	0	0	0	ND
Zn	0.01	0.04	0.02	ND	0	0.04	0	ND	0.07	0.09	0.15	ND
TPH	0.08	0.11	0	0	0	0	0	0	1	1	0	0
TPH NS	0.28	0.50	0.19	0	0	0	0	0	2.4	2.3	1.3	0
BOD	8.43	6.36	2.17	1.82	3.00	5.60	0	0	60	20	10	0
COD	59.60	48.23	22.27	ND	17.00	41.00	0	ND	301	140	130	ND
ND = no data												

- Arroyo Burro Creek exhibited the lowest DO values among the creeks
- Carpinteria Creek exhibited substantially lower total organic carbon, total nitrogen, and phosphate values than in other watersheds
- Ammonia nitrogen was very low to non-detectable in all but Arroyo Burro Creek
- Nitrate is very low to non-detectable in Mission and Carpinteria creeks, but very high in Rincon Creek compared to other creeks in the study
- Biological oxygen demand (BOD) was very low to non-detectable in Carpinteria and Rincon creeks, but measurable on the other two creeks

The data in Table 4 and on Figure 7 indicate that Arroyo Burro Creek may exhibit the poorest overall water quality relative to the other creeks, and that Carpinteria Creek may exhibit the best water quality relative to other creeks.

5.1.4 Comparison Between Sampling Events

In general, mineral and nutrient levels increased in the November 28, 1998 sampling event which occurred immediately after the first significant rainfall. For example, concentrations of the following constituents were generally higher than in the dry weather samples: TOC, TKN, NO3-N, BOD, COD, PO4-P, and PO4-PO4. Pb and Cu were detectable for the first time in Carpinteria Creek after the first flush. Higher values were observed because the rainfall and runoff mobilized sources in the watershed.

5.1.5 Comparison with Several Other Counties

It is instructive to compare the water quality data from the SCWC Study with comparable data from other counties of California. Data from two studies in other counties were utilized for this comparison. The first study is a long-term monitoring study conducted by Ventura County as part of the Ventura Countywide Stormwater Quality Management Program. As part of the program, the County has been monitoring stormwater quality downstream of selected land uses types. These discharge characterizations monitoring sites include residential, agricultural, and commercial land uses. Data from 1993-1998 are presented in Tables 7 through 9 for general and mineral constituents for agricultural, commercial, and residential sites (Ventura County, 1999). The median concentrations of the selected constituents are compared to the SCWC watershed that has the most similar land uses types. Based on a review of these data, the water quality in the SCWC watersheds is better, and often significantly better, than observed in Ventura County.

A similar comparison is presented in Table 10 for mean concentrations of metals in stormwater from residential areas of Ventura County, and from the San Francisco Bay Area where a comprehensive stormwater quality monitoring program has been conducted since 1987 (BASMAA, 1996). The comparison illustrates the general absence of elevated levels of metals in the SCWC creeks compared to other locations in California.

TABLE 7
COMPARISON OF WATER QUALITY FROM AN AGRICULTURAL AREA OF VENTURA COUNTY

Constituent	Median Values (mg/l)		
	Ventura Co. Wood Rd. (Site A-1)*	Rincon Creek	Carpinteria Creek
BOD	15	0	0
COD	165	ND	0
PH	7.4	8.35	8.14
TOC	7.6	12	5.7
Ammonia N	1.8	0	0
TKN	7.8	0.6	0
PO4-P	3.0	0.94	0.01
PO4-PO4	1.1	0.77	0.03
NO3-N	13.8	2.25	0
TSS	1160	0-120	ND

* Data from Ventura County (1999).

TABLE 8
COMPARISON OF WATER QUALITY FROM A COMMERCIAL AREA OF VENTURA COUNTY

Constituent	Median Values (mg/l)	
	Ventura Co. Via Del Norte (Site C-1)*	Mission Creek
BOD	17	5.6
COD	115	41
pH	6.8	8.07
TOC	17	14
Ammonia N	0.25	0
TKN	2.4	0.8
PO4-P	0.45	0.14
PO4-PO4	0.30	0.43
NO3-N	0.42	0
NO2-N	0.0.026	0

* Data from Ventura County (1999).

TABLE 9
COMPARISON OF WATER QUALITY FROM A RESIDENTIAL AREA OF VENTURA COUNTY

Constituent	Median Values (mg/l)	
	Ventura Co. Swan Street (Site R-1)*	Arroyo Burro Creek
BOD	15.5	3
COD	87.5	17
pH	7.1	8.65
TOC	15	14
Ammonia N	0.4	0.1
TKN	3.1	0.7
PO4-P	0.59	0.12
PO4-PO4	0.4	0.37
NO3-N	0.57	0.8
NO2-N	0.011	0

* Data from Ventura County (1999).

TABLE 10
COMPARISON OF METAL CONCENTRATIONS FROM OTHER COUNTIES

Constituent	Mean Values (ug/l) from Residential Areas		
	Ventura Co. 1993-1998	BASMAA	SCWC Study Data (highest value, all creeks)
Total Cadmium	1.15	1.66	0
Total Chromium	7.6	22	0
Total Copper	25	45	1.0
Total Lead	23.8	51.7	0
Total Nickel	17.7	35.5	0
Total Zinc	134	188	4.0

5.2 BACTERIA LEVELS

Bacteria levels measured during the sampling events are presented in Appendix A. Median values for total coliform, fecal coliform, and enterococcus are summarized on Figures 9a,b for each sampling event and creek.

5.2.1 Exceedances of Freshwater Contact Standard

The four watersheds have a "water contact recreation (REC-1)" beneficial use designation in the Basin Plan. It is defined as recreational uses of involving water contact where ingestion of water is possible, including swimming, surfing, scuba diving, wading, fishing, etc. The most common water recreation activities along the four watersheds are hiking and casual water play (e.g., wading in shallow water, partial body immersion in small pools) in the upper reaches outside the urbanized areas in the National Forest. In addition, there is occasional water play and wading in creek water at the mouths of Arroyo Burro, Mission, and Carpinteria creeks. The Basin Plan includes a numeric water quality standard for fecal coliform for waters with a REC-1 designation that would apply to all four creeks:

> *The concentration [of fecal coliform], based on a minimum of not less than 5 samples for any 30-day period, shall not exceed a long mean of 200/100 ml, nor shall more than 10% of total samples during any 30-day period exceed 400/100 ml.*

The SCWC Study did not involve the frequency of sampling necessary to evaluate compliance with this objective. However, the number of bacteria samples (10 per each watershed on four or five different occasions) provides a sufficiently large database to determine if the REC-1 water quality objective would be met if an intensive sampling program for a 30-day period were undertaken. The data presented in Appendix A indicate that the 200 and 400 water quality objectives noted above were exceeded most of the time. The median fecal coliform concentrations for each sampling event exceeded the 200 water quality objective on each sampling date for Arroyo Burro and Mission creeks, and on half of the sampling dates for Carpinteria and Rincon creeks.

These results indicate that the REC-1 beneficial use is being impaired by elevated bacteria levels in the four creeks, particularly in Arroyo Burro and Mission creeks. All four creeks have been designated as "impaired waters" for pathogens in EPA's 303(d) list of impaired waters in California. The designation of "impaired waters" due to pathogens is supported by the results of the SCWC Study.

5.2.2 Exceedances of Public Beach Health Standards

Health and Safety Code Section 115880 authorizes the Department of Health Services (DHS) to establish sanitation standards at public beaches for total coliform, fecal coliform, and enterococcus bacteria. The local public health officer must test waters adjacent to public beaches for bacteria on at least a weekly basis from April 1 through October 31 of each year if the beach is visited by 50,000 or more people per year and is located adjacent to a storm drain that flows in the summer. If the standards are exceeded, the local public health office must issue an advisory and post the beach with warning signs to inform the public of the nature of the problem and the possibility of risk to public health.

Health and Safety Code Section 115880 was established by Assembly Bill 411 in 1997. Final regulations implementing the provisions of this section of the Code were issued in July 1999. The minimum standards under the regulations are as follows:

1. Based on a single sample, the density of bacteria in water from each sampling location at a public beach shall not exceed:

   (a) 1,000 total coliform bacteria per 100 milliliters, if the ratio of fecal/total coliform bacteria exceeds 0.1; or
   (b) 10,000 total coliform bacteria per 100 milliliters; or
   (c) 400 fecal coliform bacteria per 100 milliliters; or
   (d) 104 enterococcus bacteria per 100 milliliters.

2. Based on the mean of the logarithms of the results of a least five weekly samples during any 30-day sampling period, the density of bacteria in water from any sampling station at a public beach or public water contact sports area, shall not exceed:

   (a) 1,000 total coliform bacteria per 100 milliliters; or
   (b) 200 fecal coliform bacteria per 100 milliliters; or
   (c) 35 enterococcus bacteria per 100 milliliters.

As a point of reference, the above public beach standards can be used in this study to assist in evaluating the extent of bacteria contamination in the creeks. Although the above standards are only applicable to the mixture of creek and ocean water in the surf zone at public beaches, these standards have become well known with the local community and provide a widely recognized point of reference when discussing potential bacteria contamination. Hence, for illustration purposes only, the frequency that bacteria levels exceeded the above single standards for total coliform, fecal coliform, and enterococcus at public beaches is summarized in Table 11. It should be noted that an exceedances of the state beach standards in the creek does not indicate that the standard would be exceeded in the surf zone once the creek water has mixed with ocean water.

TABLE 11
FREQUENCY OF EXCEEDANCES OF PUBLIC BEACH BACTERIA STANDARDS

Watershed	No. of Samples	No. of Samples that Exceeded the DHS Beach and Water Contact Single Event Standards (No. per 100 ml)		
		Total Coliform	Fecal Coliform	Enterococcus
Arroyo Burro	47	35	39	43
Mission	45	27	27*	39
Carpinteria	36	11	10	18
Rincon	45	25	21	15

* Total samples for fecal coliform was 35.

The above data indicate the presence of elevated levels of bacteria in all watersheds during the 1998-99 winter. Arroyo Burro Creek exhibited the greatest frequency of exceedances, while Carpinteria Creek exhibited the lowest relative frequency.

5.2.3 Comparison Among Watersheds

The variation in the frequency of exceedances of the bacteria standards (see Table 10) among watersheds is not unexpected and suggests that the sources and loading of bacteria vary between watersheds. A more detailed comparison of the different levels of bacteria among watersheds is presented on Figures 8a,b which show median fecal coliform levels during each sampling event for the four watersheds. These data indicate that Arroyo Burro Beach generally exhibited the highest concentrations during each sampling event, and that concentrations at Carpinteria Creek were very low during all but one sampling event. Concentrations at Mission and Rincon creeks were intermediate.

5.2.4 Comparison Between Sampling Events

There was a notable increase in bacteria concentrations after the November 28, 1999 first flush rainfall of the winter, as shown on Figures 8a,b. Concentrations of total coliform, fecal coliform, and enterococcus increased several orders of magnitude for all watersheds. Bacteria levels greatly exceeded the levels observed during the dry season sampling in September and October 1998 for the same creeks. Elevated coliform levels are typical in runoff following storm events. This result has routinely been observed in the course of municipal stormwater monitoring programs conducted in other parts of the state. The reason is that during rain events, the surface area of the entire watershed is flushed out, mobilizing bacteria from all sources present in the area. During dry periods, sources are more likely to be located immediately adjacent to streams or at points where conduits enter into them.

5.2.5 Comparison Among Sampling Stations

The concentration of bacteria varied considerably from station to station within each watershed due to site-specific variability in bacteria sources, creek conditions, and possible sampling errors or

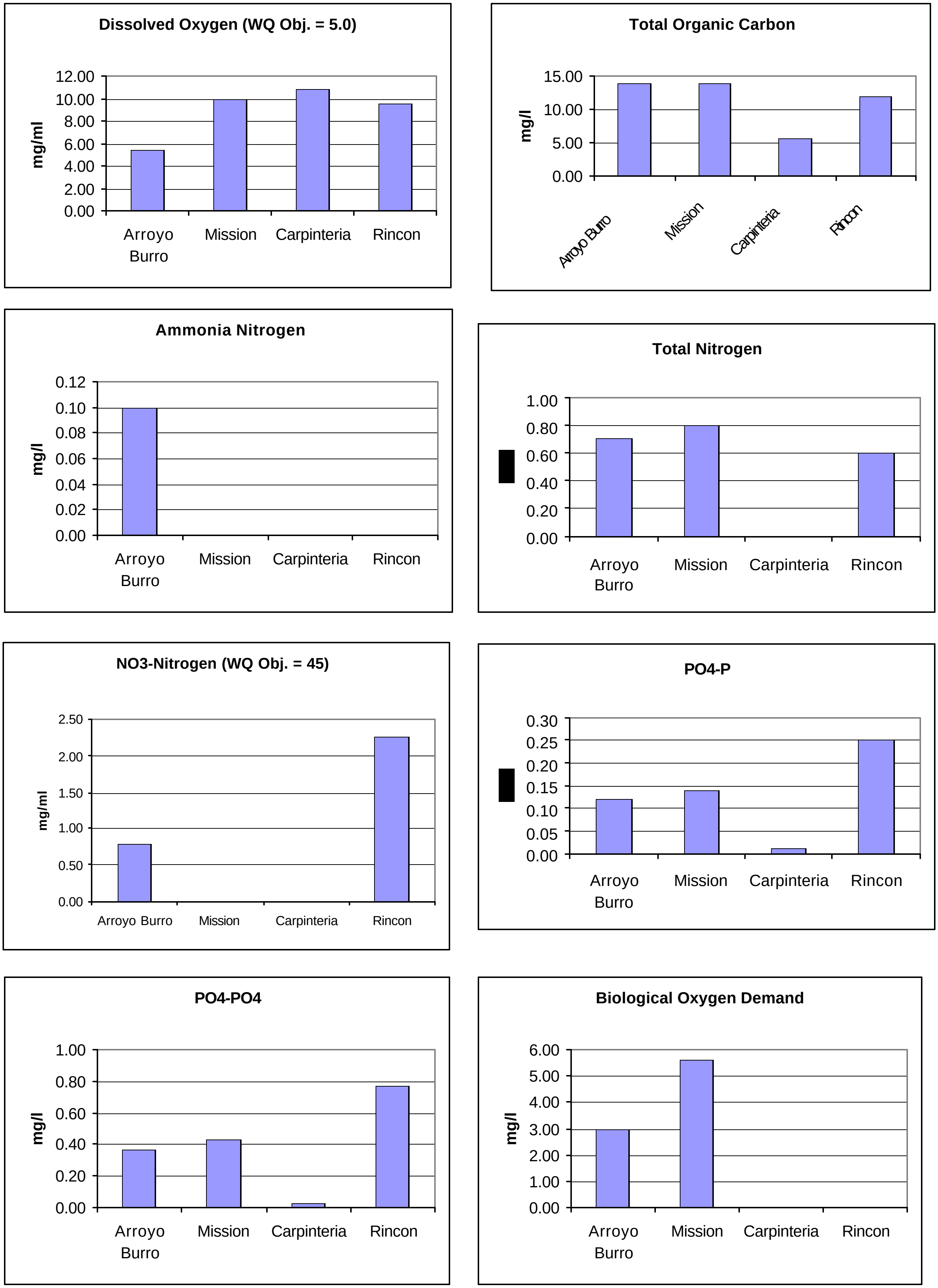
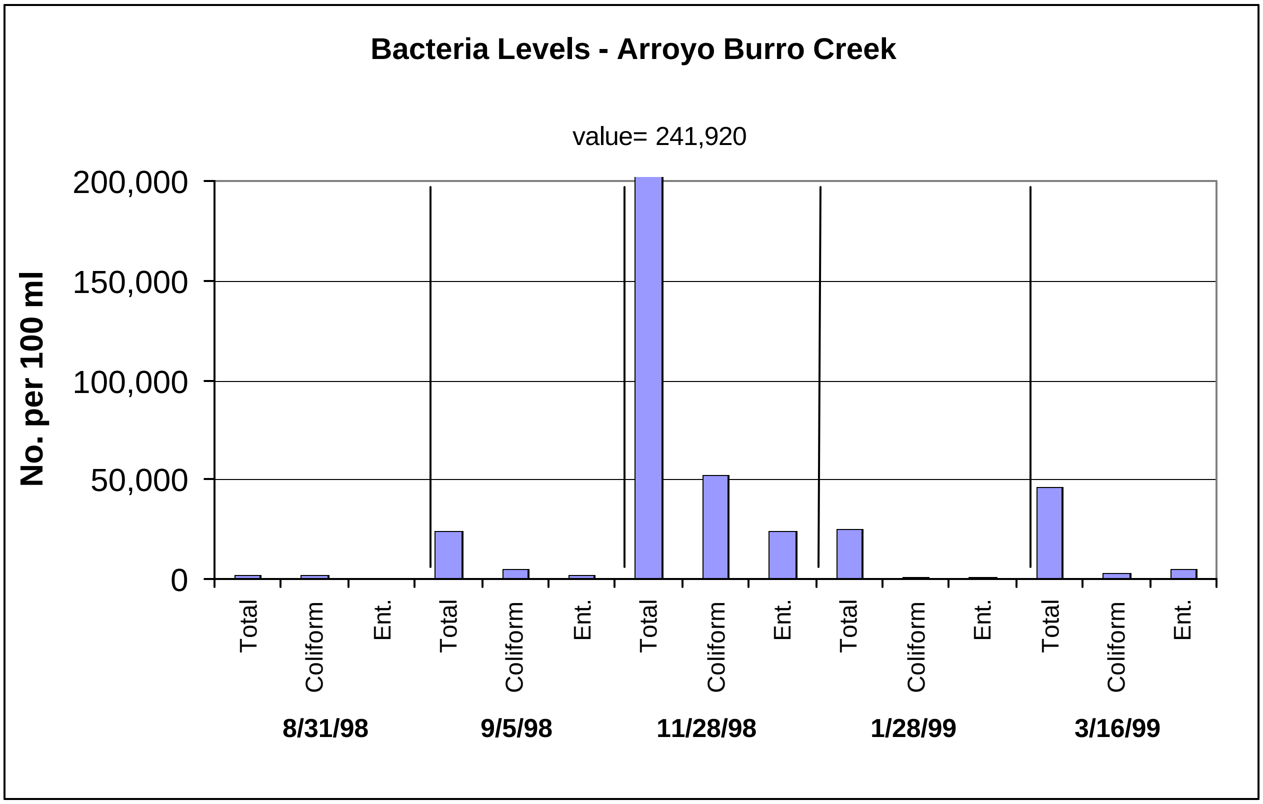


Figure 7. Comparison of Median Water Quality Values Among Watersheds



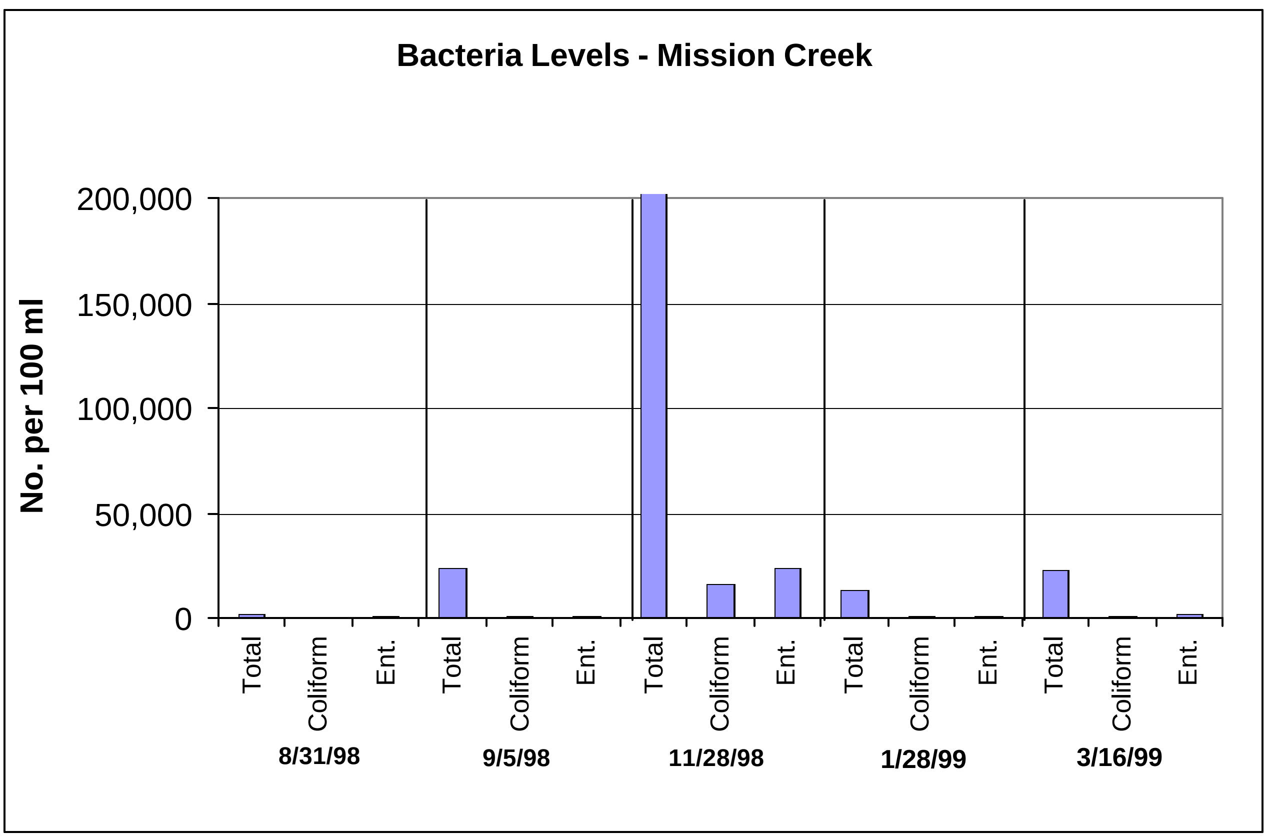
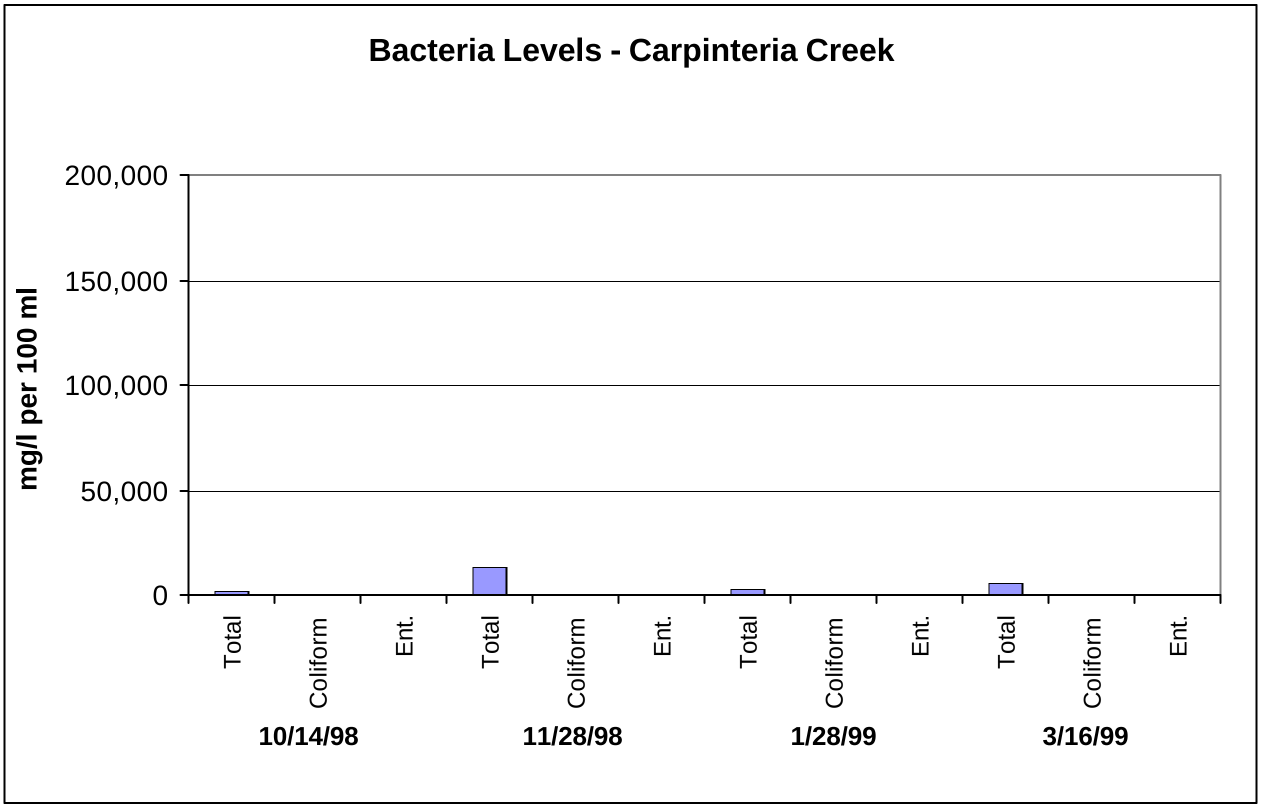


Figure 8a. Median Bacteria Levels on Different Dates - Arroyo Burro and Mission Creeks



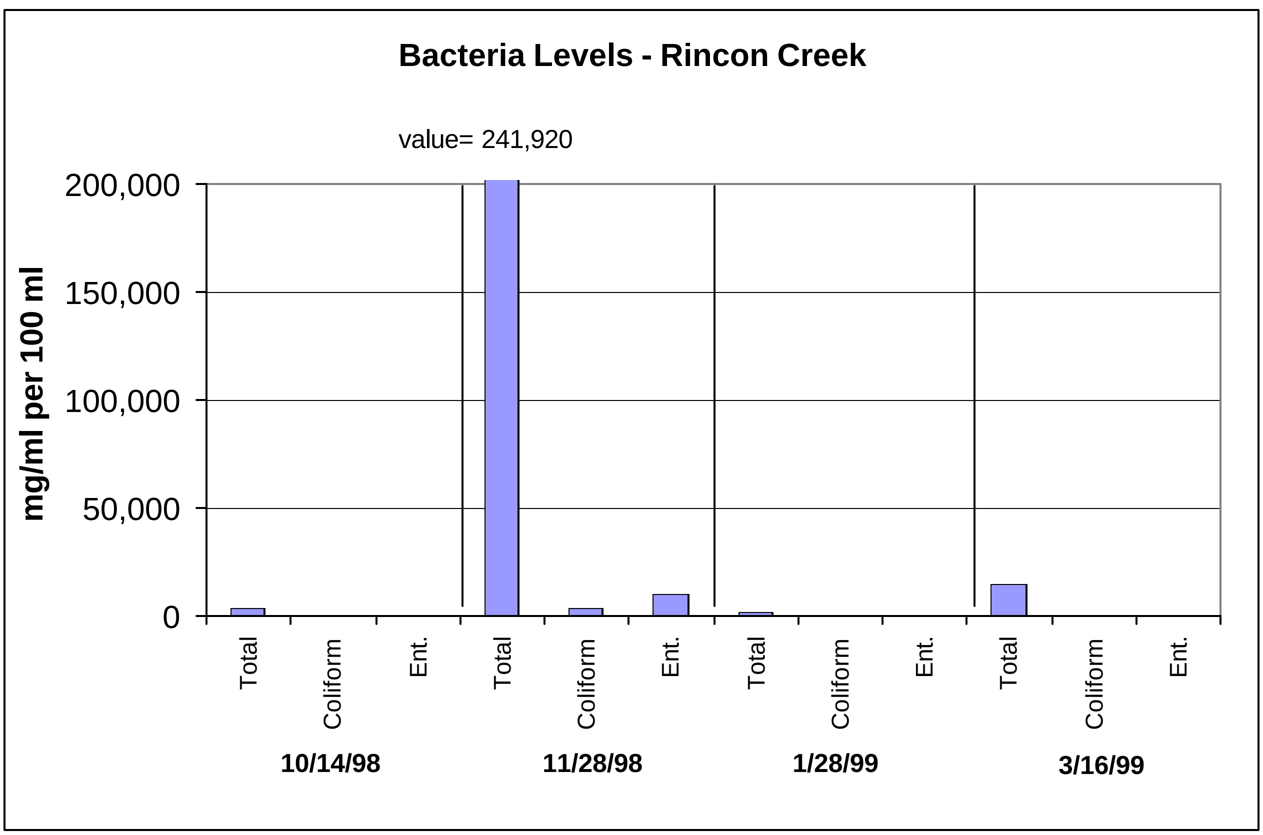


Figure 8b. Median Bacteria Levels on Differrent Dates - Carpinteria and Rincon Creeks

contamination. A summary of median fecal coliform concentrations at the various sampling stations along each creek is presented on Figures 9a,b. These data indicate the following:

- *Arroyo Burro Creek* – Bacteria concentrations are the highest in the middle of the watershed, i.e., the urbanized area between State Street and immediately below Highway 101.

- *Mission Creek* – There is a distinct pattern of increasing bacteria concentrations from the top of the watershed to the mouth of the creek, as the creek traverses increasingly dense urban development.

- *Carpinteria Creek* - There is a weak pattern of increasing bacteria concentrations from the top to the bottom of the watershed. The mouth of the creek exhibits consistently high bacteria levels relative to the rest of the sampling stations.

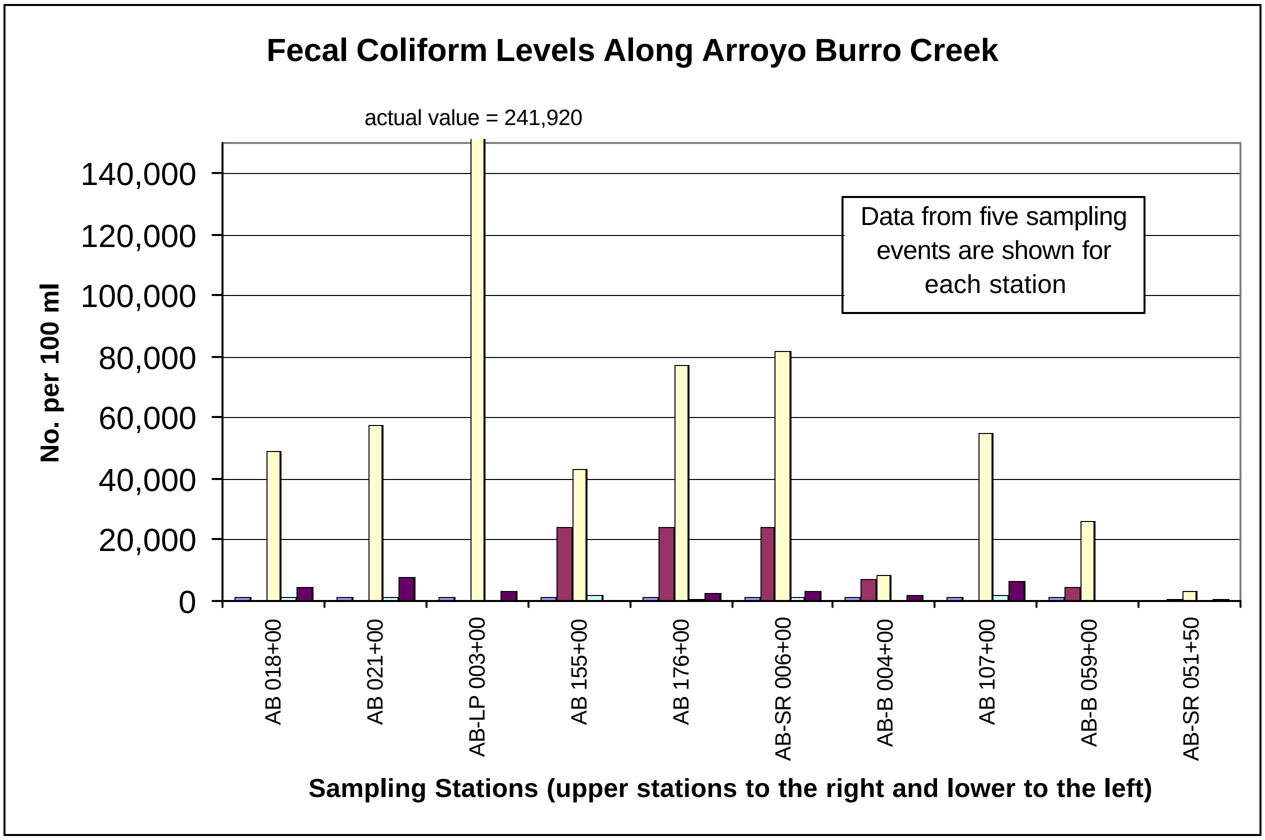
- *Rincon Creek* – No pattern is discernible from the data shown on Figure 9b. The occurrence of high bacteria levels varied among sampling stations with each event.

5.3 BACTERIA DATA FROM SCCWRP STUDY

Levels of total coliform, fecal coliform, and enterococcus observed in the surf zone on August 31, 1998 are shown in Table 12. These levels are generally very low. The only exceedance of the state beach standard was for total coliform at the mouth of Arroyo Burro Creek. All other concentrations were very low compared to the standards, and to the bacteria levels in the creeks.

TABLE 12
BACTERIA DATA FROM SCCWRP STUDY

Site	SCCWRP No.	Concentration (No. per 100 ml)		
		Total Coliform	Fecal Coliform	Entero-coccus
Arroyo Burro Creek Mouth	3223	24,192	552	364
Arroyo Burro, west 42 m	3181	<10	<10	<10
Mission Creek Mouth	3224	637	171	10
Mission Creek, west 81 m	3182	1,019	233	53
Mission Creek, east 70 m	3183	576	146	<10
Carpinteria Creek Mouth	3226	20	<10	10
Carpinteria Creek, west 42 m	3185	10	<10	<10
Rincon Creek Mouth	3227	1,354	52	87
Rincon Creek, east 90 m	3186	324	30	31



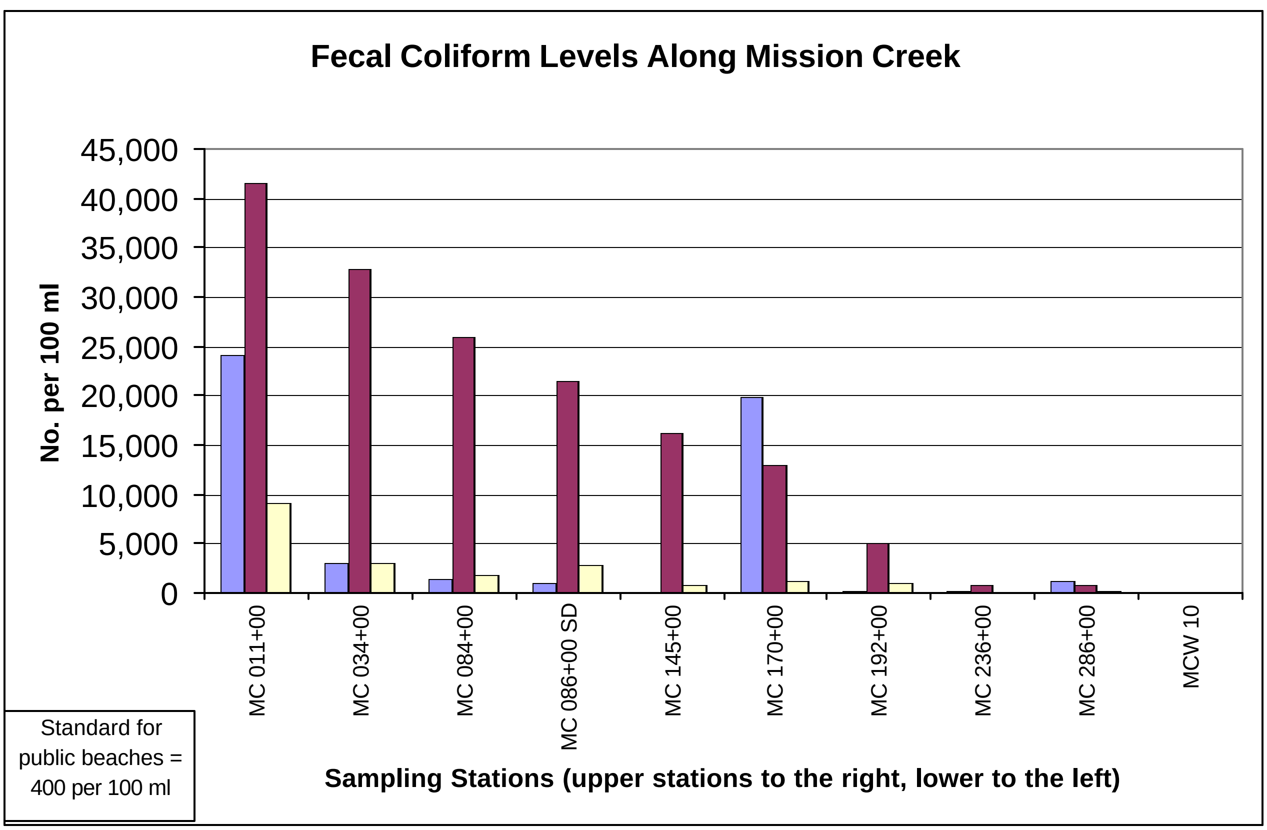
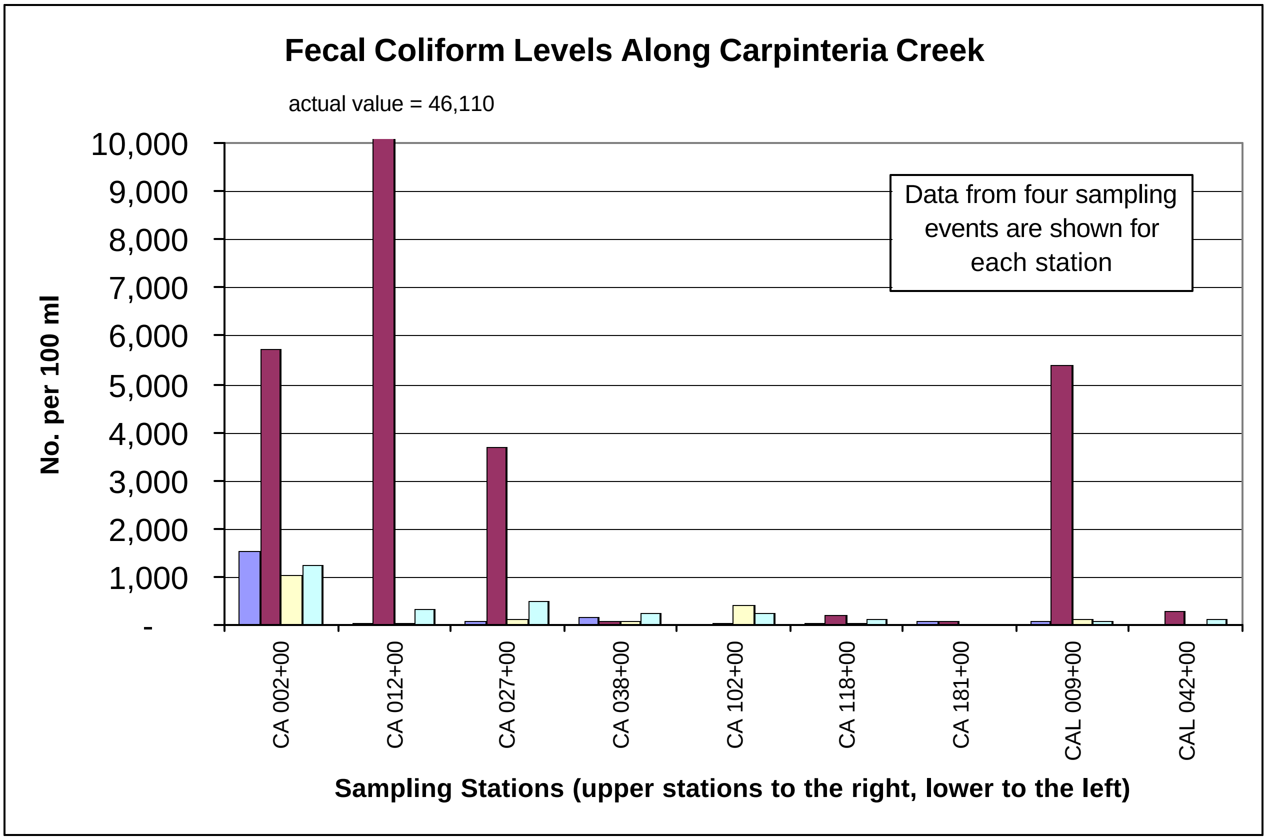


Figure 9a. Median Fecal Coliform Levels at Different Locations - Arroyo Burro and Mission Creeks



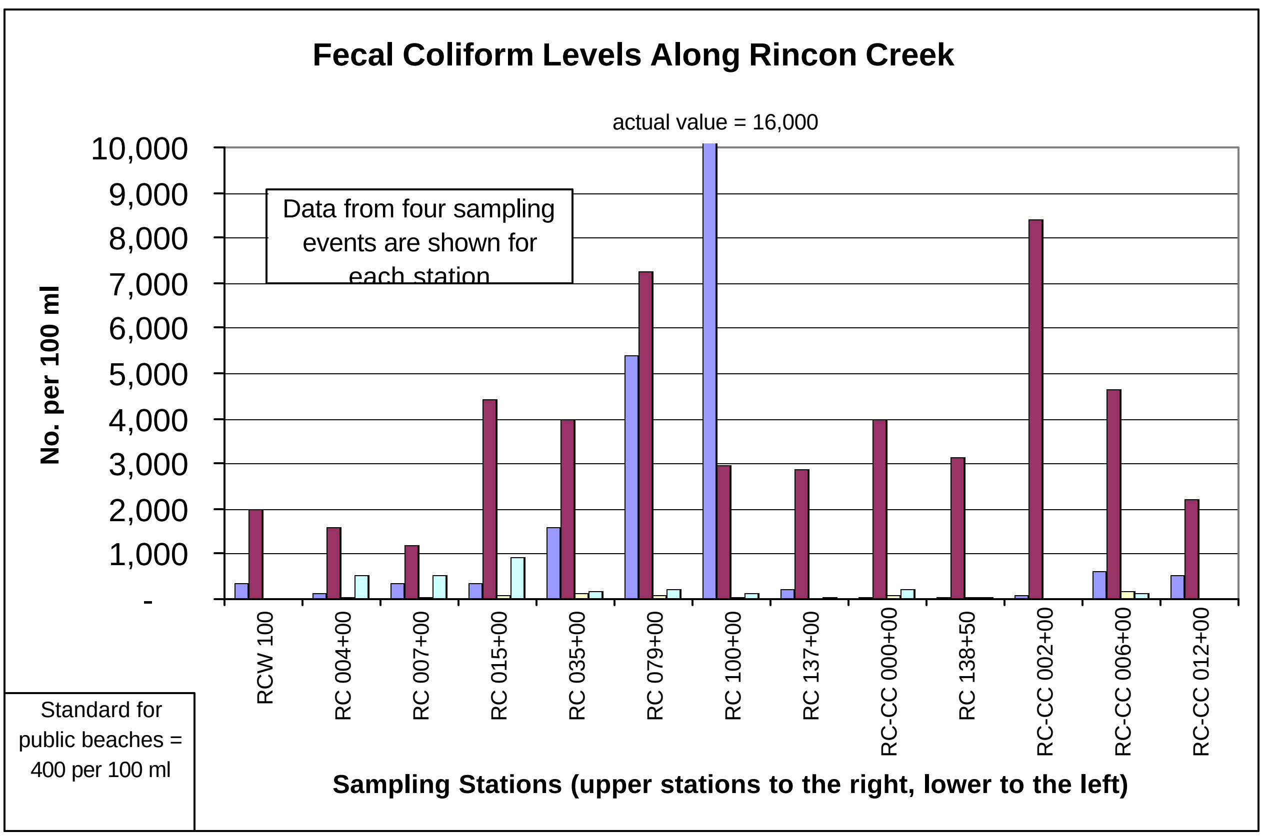


Figure 9b. Median Fecal Coliform Levels at Different Locations - Carpinteria and Rincon Creeks

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL WATER QUALITY

1. The water quality data for minerals, nutrients, or physical conditions generally exhibited low to very low levels in all four watersheds. The general water quality of the four watersheds does not indicate significant or substantial water quality problems, either as a whole or for any particular sampling location. Metals were either not detected (Cd, Cr, and Hg) or were measured at very low levels (Cu, Ni, Pb, and Zn). Nutrient levels were also very low, particularly ammonia-nitrogen.

2. Concentrations of constituents with numeric water quality objectives in the Central Coast Basin Plan were below the applicable objectives in all creeks. Only one exceedance of a water quality objective was noted. Dissolved oxygen levels were depressed on several sampling events along Arroyo Burro Creek.

3. The overall water quality in the four watersheds appears to be representative of coastal streams of southern California. The concentrations of key mineral and nutrient constituents were well below those measured in similar watersheds in Ventura County, and in more urbanized watersheds in the San Francisco Bay area.

4. The data indicate that Arroyo Burro Creek exhibits the poorest overall water quality relative to the other creeks, and that Carpinteria Creek exhibits the best water quality.

5. The first flush rainfall resulted in only a minor increase in most mineral and nutrient concentrations.

6. There is no distinct pattern of increasing or decreasing water quality along each watershed, except for bacteria pollution, as discussed below.

6.2 BACTERIA POLLUTION

1. The study results indicate elevated levels of bacteria in all watersheds that exceed state health standards for water contact beaches in 30 to 90 percent of the samples. Arroyo Burro Creek exhibited the greatest frequency of exceedances, while Carpinteria Creek exhibited the lowest relative frequency. The frequency of exceedances along Mission and Rincon creeks was intermediate.
2. There was a notable increase in bacteria concentrations after the first flush rainfall of the winter. Concentrations of total coliform, fecal coliform, and enterococcus increased several orders of magnitude for all watersheds.
3. The concentration of bacteria varied considerably from station to station within each watershed due to site-specific variability in bacteria sources, creek conditions, and possible sampling errors or contamination. Arroyo Burro Creek exhibits a distinct pattern of high bacteria concentrations, possibly indicating specific sources of contamination. Mission Creek exhibits increasing bacteria concentrations from the top to the bottom of the watershed.

Project Clean Water included detailed field investigations to identify possible sources of bacteria pollution. Data from the “creek walks” are presented in Appendix B, and consist of narratives and summary tables describing possible sources for each creek. A summary of the Project Clean Water conclusions about bacterial pollution in each creek is presented below:

Arroyo Burro Creek

- Numerous sources of bacteria occur throughout the watershed
- Much of the uppermost watershed has acceptable levels of bacteria
- Storm drains and creek encampments are probable sources of high levels in the middle portions of the watershed
- Storm drains and lagoon fauna, such as birds, are probable sources of high levels in the lower watershed
- No direct link between septic systems and beach closures has yet been established
- Stormwater carries several times the low flow levels of bacteria

Mission Creek

- Bacteria are the principal pollutants of concern
- Much of the uppermost watershed has acceptable levels of bacteria
- Storm drains, creek encampments, and lagoon fauna, such as birds, are probable sources of high levels in the lower watershed
- No direct link between septic systems and beach closures has yet been established
- Stormwater carries several times the low flow levels of bacteria

Carpinteria Creek

- Much of the upper watershed has acceptable levels of bacteria
- Bacteria are the principal pollutants of concern
- Storm drains and lagoon fauna, such as birds, are probable sources of high levels in the lower watershed
- Stormwater carries several times the low flow levels of bacteria

Rincon Creek

- Bacteria are the principal pollutants of concern
- Numerous sources of bacteria occur throughout the watershed
- No direct link between septic systems and beach closures has yet been established
- Stormwater carries several times the low flow levels of bacteria

6.3 IMPLICATIONS FOR NPDES MUNICIPAL STORMWATER PERMIT

6.3.1. Focus of Future Stormwater Management Program

To qualify for the NPDES Phase II permit, the County and South Coast municipalities must develop a stormwater management program to reduce the discharge of pollutants from the regulated stormwater systems to the maximum extent practicable, and include minimum control measures described in the final Phase II permit regulations. Under the draft regulations, implementation of appropriate best management practices (BMPs) will meet these minimum control measures requirements and reduce pollutants to the maximum extent practicable. The data from the SCWC Study, combined with results of the Project Clean Water, indicate that the only pollutant of concern on the South Coast is bacteria. Levels of mineral, nutrients, metals, and sediments are well below applicable water quality objectives.
Hence, the County and South Coast municipalities should focus their efforts on the development and implementation of BMPs for bacteria and other pathogens, in anticipation of the upcoming permit requirements.

The proposed Phase II permit program provides significant flexibility for permittees to obtain permit coverage and to satisfy the requirement minimum control measures. For example, the local NPDES permit authority (i.e., RWQCB) can incorporate by reference existing local water quality programs in the NPDES permit, and recognize existing responsibilities among different governmental agencies for the implementation of BMPs. Hence, if the current multi-agency watershed characterization study and Project Clean Water program result in the implementation of BMPs for bacterial pollution, these efforts may be incorporated in the future NPDES permit, facilitating coverage under the permit and reducing costs.

The requirements under the NPDES permit can be waived for certain pollutants if a TMDL process is being implemented by the RWQCB. Hence, if the RWQCB develops TMDLs for the SCWC Study watersheds prior to the issuance of the NPDES Phase II permits, then the County and South Coast municipalities would not have to address bacteria pollution in the stormwater permit, as it would have already been addressed through the more stringent TMDL process.

6.3.2 Need for Continued or Future Monitoring

The Proposed Regulations for Revision of the Water Pollution Control Program Addressing Storm Water Discharges published in the Federal Register on January 9, 1998 (Phase II Proposed Rule) does not require extensive monitoring by permittees. EPA has identified a significantly different approach to monitoring and BMP implementation in the Proposed Phase II Rule from that required under the Phase I rule. The Phase I rule requires implementation of a monitoring program for source identification and to characterize stormwater runoff. Based, in part, on the findings of the monitoring program, Phase I permittees are required to develop and implement BMP programs to control the identified water quality problems. Ongoing monitoring to assess the effectiveness of the control programs is then required.

In the first two to three rounds of permit issuance (each round is a five-year permit term), EPA anticipates that the BMP-based program will be sufficient to meet the stormwater permit requirements for most permittees. EPA assumes that implementation of required control measures would meet applicable water quality standards because the minimum control measures described in the proposed rule should significantly reduce pollutants in urban stormwater.

The key language in the proposed rule concerning monitoring requirements is provided on page 1580 of the proposed rule (attached). EPA states *"For purposes of today's proposal, EPA recommends that, in* *general, small municipal separate storm water systems not be required to conduct in the first permit term any additional monitoring beyond any they may be already performing. In the second and subsequent permit terms, EPA expects that some limited ambient monitoring might be appropriately required for perhaps half of the regulated small municipal separate storm water systems. EPA expects that such monitoring would only be done in several discrete locations for relatively few pollutants of concern. EPA does not anticipate "end of pipe" monitoring requirements for regulated small municipal separate storm water systems*."

EPA acknowledges that the NPDES authority (i.e., Central Coast RWQCB) may require monitoring, but that any such monitoring would be required after the first term of the permit. In addition, future monitoring should consider a combination of biological, chemical, and physical monitoring or environmental indicators, and should be based on specific objectives.

The SCWC Study represents a pro-active program to identify urban surface water quality problems and their sources prior to an application for a permit. Although permittees are not required to conduct additional water quality monitoring under the Proposed Phase II Rule, the data are useful in providing an initial screening of water quality and the identification of focussed control measures to address specific water quality problems in the South Coast watersheds.

Continued monitoring to characterize and identify the sources of bacterial contamination, an identified water quality problem impacting beneficial uses of receiving waters, would be consistent with the objectives of the Proposed Phase II Rule. However, development and implementation of an ongoing water quality monitoring program is not required by the Proposed Phase II Rule. The Proposed Phase II Rule presumes that water quality standards will be met with implementation of the six minimum control measures and water quality monitoring will not be needed to further identify water quality problems or to evaluate the effectiveness of BMPs.
In light of the above considerations, we recommend that the County only continue bacteria monitoring in the four watersheds. The need, if any, to expand monitoring to other constituents will depend on the monitoring requirements in the final Phase II rule.

6.4 BEST MANAGEMENT PRACTICES

6.4.1 Current Efforts to Develop BMPs

The NPDES Phase II permit will require permittees to develop, implement, and enforce a stormwater management program designed to reduce pollutants to the maximum extent practicable through the implementation of the six minimum control measures listed below:

1. Public education and outreach on stormwater impacts
2. Public involvement and participation
3. Illicit discharge detection and elimination
4. Construction site stormwater runoff control
5. Post construction stormwater management in new development
6. Pollution prevention and good housekeeping for municipal operations

Under the draft regulations, implementation of appropriate BMPs will meet these minimum control measures requirements and reduce pollutants to the maximum extent practical. EPA assumes that implementation of required control measures would meet applicable water quality standards.

Prior to issuing the Phase II permit, the RWQCB must provide a menu of regionally appropriate and field-tested BMPs that the RWQCB has determined to be cost-effective. The purpose of the menu is to provide small municipalities with guidance in implementing their stormwater management programs. The permittees may select from this menu, or develop their own BMPs. The stormwater management program by the permittees must include appropriate BMPs to be performed and measurable goals to be achieved. The menu would be augmented by the issuance of a "tool box" to be developed by EPA in later 1999 that will include resources and guidance to implement a stormwater management program, including information clearinghouse, fact sheets, technological guidance, training material, and demonstration projects. Measurable goals in the permit will not be enforceable until the RWQCB has issued its menu of regional BMPs.

The County, through the efforts of Project Clean Water, has developed a suite of BMPs to address stormwater pollutants, with an emphasis on the reduction in bacterial pollution. The development of the BMPs is an ongoing process in coordination with the Stakeholders Group, comprised of community groups and organizations with interest and expertise in stormwater pollution reduction and prevention. The current set of BMPs developed by the County and Stakeholders is intended to form the basis of the BMPs for the future NPDES municipal permit. At this time, the BMPs on the list are being independently considered by County, City of Santa Barbara, and City of Carpinteria for possible adoption and implementation.
The list contains a wide range of measures developed from Phase I permittee manuals and permits, consultation with experts, and innovative local solutions. The current BMP list is presented in Appendix C. It is a dynamic list that will be refined and updated by the County prior to applying for a NPDES stormwater permit in the year 2003. A summary of the categories of BMPs is provided below. A list of typical BMPs identified by Project Clean Water is provided in Table 13.

Public Outreach and Involvement

Education of the community as to the problem of stormwater pollution will increase awareness and possibly lead to changes in behavior and practices that contribute to stormwater pollution. The success of a stormwater management program will be facilitated by the involvement of the community in developing and implementing acceptable solutions. Finally, it is important to gather support of the community in ongoing pollution abatement efforts and to assist in monitoring and enforcement.

Municipal Operations and Control

An operations and maintenance program must be developed to reduce pollutants from municipal operations, such as park and open space maintenance, vehicle maintenance, building and parking lot oversight, road construction and maintenance, and storm drain system maintenance. In addition, practices and procedure for handling and storage of trash and hazardous materials must be reviewed. Finally, there must be an employee training program on stormwater pollution prevention.

Development and Redevelopment Design and Monitoring

New and extensively modified development projects will need to meet minimal control standards under the Phase II permit. These measures will apply during both site development (e.g. construction phase erosion control) and operations phase (e.g. incorporation of retention ponds or catchment basins to attenuate pollution in parking lot runoff). Currently, both the City of Santa Barbara and the County require such measures on a case by case basis. New BMPs will require a more systematic approach.

Commercial Facilities Controls

Commercial facilities have the potential to inadvertently cause degradation of stormwater. Trash receptacles, accumulations of waste or surplus materials and minor spills may all degrade stormwater from a commercial site. New source control BMPs have been developed by the County and Stakeholders for most major classes of commercial operations such as standards for vehicle maintenance and improved trash control.

Industrial Facilities Controls

Under the Phase I NPDES permits, most industrial operations were required to acquire a stormwater runoff permit from the appropriate Regional Water Control Board and implement a Stormwater Runoff Plan. Evaluation and ongoing monitoring of these plans under Phase II will be necessary to further improve stormwater runoff. The responsibility for the monitoring and evaluation may remain with the RWQCB and require no local agency action under Phase II regulations.

Illicit Connections and Discharges

Cross connections between sewer lines and storm drains are illegal; their elimination will be a mandatory BMP. Sewer system operators must currently inspect systems for these illegal connections. Under the Phase II permit, the local sewer system operators may increase the level of their inspection programs.

Watershed Restoration

Creating new or enhanced wetlands and other native habitats will help reduce stormwater pollutants that enter stream courses. A systematic evaluation, selection, and implementation of potential watershed restoration projects are recommended as long-term BMPs.

TABLE 13
EXAMPLES OF BMPs BEING CONSIDERED

Pollutant Source	Example of Best Management Practice
Miscellaneous Sources	
General	1. Investigate techniques for better identification of bacteria sources. 2. Establish and support ongoing Wetland and Riparian Restoration Working Group.
Human Feces	1. Install portable toilets at recommended locations. 2. Facilitate & promote toilet sponsorship program. Evaluate trial project & make recommendation for future efforts.
Homeless	1. Homeless outreach 2. Development of a year-round, all purpose shelter.
Septic Systems	1. Adopt countywide maintenance ordinance. 2. Investigate and implement solutions in problem areas. 3. Develop map and database of all septic systems in county.
Sewer	1. Smoke and dye testing of sewer lines. 2. Testing of groundwater adjacent to sewer lines.
Animal Waste	1. DNA testing. 2. Ongoing inspection of creeks for illegal dumping and disposal of pet waste and targeted educational campaign about pet waste. 3. Review of coastal zoning ordinance related to equestrian and cattle grazing
Storm Drain System	1. Conduct periodic visual inspections and clean if necessary. Inspect and clean all inlets, basins and storm drain pipelines before onset of wet season.
Vehicle Service Facilities	
Facility Maintenance & Management	1. Use drip pans under leaking vehicles to capture fluids and while changing vehicle fluids. Regularly sweep or vacuum the shop floor and other paved surfaces at your facility. Mopping as an alternative to hosing down or washing work areas. Any spills will be immediately cleaned 2. All hazardous waste will be labeled accordingly. Wastes are separated to increase waste recycling/disposal options and to reduce your costs. A double-contaminated system is used on all bulk fluids and wastes to prevent accidental discharges. Storage areas will be kept clean and dry.
Equipment Cleaning, Maintenance and Storage	1. Inspect equipment for leaks 2. Any refueling or repairing will be done on-site away from storm drains & creeks.
Changing Oil	1. Change vehicle fluids indoors and use caution when transferring, storing or recycling fluids to prevent spills from reaching the streets.
Cleaning Engine Parts, Flushing Radiators and Vehicle Exteriors	1. Keep all discharge into sanitary sewer and storm drains after adequate treatment has occurred. Keep all discharges in designated areas and recycle fluids whenever possible. 2. Designate a vehicle washing area and wash cars and trucks in that area only. 3. While cleaning vehicle exteriors keep wash pad bermed, so as to prevent discharge into storm drains. Keep all solvents out of storm drains. Discharge is allowed into sanitary sewers after appropriate treatment has occurred or recycle wash water if possible.
Body Repair and Painting	1. Whenever possible conduct all body repair and painting indoors. 2. Brush off loose debris and use rags to wipe down parts. Use dry-clean up methods wherever possible Minimize waste paint thinner and overspray and do not use water to control it. Do not discharge wash water unless treated into sanitary sewer system
Fuled Dispensing	1. Use dry-clean up methods to maintain fuel dispensing areas. Wash water if used must be discharged into sanitary sewer system. Make sure that all overfill, automatic shutoff measures are in place.
Shopping Centers	

Pollutant Source	Example of Best Management Practice
Landscaping and Grounds Maintenance	1. Enforce federal, state and local laws governing the use, storage, and disposal of pesticides/herbicides. If use is warranted use sparingly and cautiously. 2. Compost or chip clippings, pruning waste and tree trimmings
Landscaping and Grounds Maintenance	1. Enforce federal, state and local laws governing the use, storage, and disposal of pesticides/herbicides. If use is warranted use sparingly and cautiously. 2. Compost or chip clippings, pruning waste and tree trimmings
Outdoor Waste Receptacles Areas	1. Spot clean leaks and drips routinely to prevent runoff or spillage and prevent future by taking necessary measures either by altering waste receptacles or the area surrounding it.
Fountain/Cooling Equipment Maintenance	1. Never discharge fountain water to a street or storm drain. Make sure chlorinated water is disposed of properly
Maintenance (Sidewalks, Plazas And Driveways))	1. Sweep, collect and dispose of debris and trash; then wash. Okay to discharge to storm drain.
Masonry	1. If acid washing, then seal storm drains. Rinse treated area w/ alkaline soap and direct washwater to a landscaped or dirt areas.
Education And Training	1. Train all maintenance employees, and post instructional and informational signs for customers and employees.
Construction Sites	
Construction Activities	1. Plan the development to fit the topography, soils, drainage pattern and natural vegetation of the site 2. Delineating clearing limits, easements, setbacks, sensitive or critical areas, trees, drainage courses, and buffer zones to prevent excessive or unnecessary disturbances and exposure. 3. Phase grading operations to reduce disturbed areas and time of exposure.
Concrete Installation and Repair and Construction Projects Involving Cement and Concrete Work	1. Avoid mixing excess amounts of fresh concrete or cement mortar on-site. 2. Protect dry and wet materials from rainfall or runoff. 3. Wash concrete transit mixers only in designated wash out areas. Pump water from settling ponds to the sanitary sewer, where allowed
Soil Movement	1. Install cover materials or other erosion control measures 2. Use soil stabilizers
Tracking	1.Construct stabilized access roads and entrances 2. Use dry sweeping methods when possible, avoid infiltration into storm drain inlets.
Sediment	1.Use erosion/sediment control measures to reduce runoff velocity and trap sediment 2. Protect storm drain inlets from sediment laden runoff.
Roadwork/Pavement Construction	1. Apply concrete, asphalt, and seal coat, slurry seal fog seal etc. during dry weather to prevent contaminants from contacting stormwater runoff or storm water drain inlets and manholes. 2. Wash water from rinsing of aggregate concrete or when making saw cuts in pavement should be directed into the sanitary sewer or disposed of properly.
Paint Work	1. Non-hazardous paint chips and dust from dry stripping and sand blasting may be collected and disposed of properly. 2. Dispose of wash water in sanitary sewer whenever possible.
Municipal Operations	
Sidewalks, Plazas, Structures, and Parking Lot Cleaning	1. Establish frequency of parking lot sweeping based on usage and field observations of waste accumulations. Sweep all parking lots at least once before the onset of the wet season. 2. Use dry methods and clean up spills and dispose of them appropriately

Pollutant Source	Example of Best Management Practice
Storage of Hazardous Materials	1. Store hazardous materials and wastes where they are protected from rain and in a way that prevents spills from reaching the sanitary sewer or storm drain. 2. All hazardous waste will be labeled accordingly. Wastes are separated to increase waste recycling/disposal options and to reduce your costs. A double-contaminated system is used on all bulk fluids and wastes to prevent accidental discharges. Storage areas will be kept clean and dry.
Streets, Medians, Parks, and Other Municipal Landscaped Areas (Erosion Control)	1. Maintain vegetative cover on medians and embankments to prevent soil erosion. Apply mulch or leave clippings in place to serve as additional cover. 2. Provide energy dissipaters (e.g. riprap) below culvert outfalls to minimize potential for erosion.
Vegetation Management/ Irrigation	1. Remove clipped or pruned vegetation from gutter, paved shoulder and area around storm drain. 2. Avoid loosening soil when weeding and minimize excess watering and repair leaks.
Pesticides, Diazinon, Chlorpyrifos and Other Similar Products, Herbicides and Fertilizers	1. Enforce federal, state and local laws governing the use, storage, and disposal of pesticides/herbicides. If use is warranted use sparingly and cautiously 2. Replace existing vegetation with fire resistant and native vegetation to reduce the need for herbicides. 3. Check irrigation system to ensure that over watering and in turn run off is not occurring.
Repair and Maintenance of City Surfaces (Asphalt/Concrete Demolition)	1. Schedule asphalt and concrete removal activities for dry weather. 2. Protect and cover nearby storm drains before breaking up asphalt and concrete, sweep up all remaining debris and recycle if possible.
Municipal Swimming Pools, Fountains, Lakes and other Water Bodies (Alternative Discharge Options for Chlorinated Water)	1. Test water for chlorine level, irrigation in landscaped area or for dust suppression at a city construction project site. Discharge of all other chlorinated water into appropriate facilities- (i.e. sanitary sewer etc.) 2. For control of algae reduce fertilizer use, discourage feeding of birds, introduce fish species that consume algae.
Patching, Resurfacing and Surface Sealing	1. Schedule activities during dry weather, ensuring that all storm drain inlets, manholes are covered and sealed 2. Stockpile materials away from streets, gutter areas etc. 3. Use as little water as possible and make sure that all excess materials are disposed of properly.
Graffiti Removal	1. Protect nearby storm drain inlets prior to graffiti removal. Use dry clean up methods or use absorbent and dispose of properly/ 2. Direct runoff from sandblasting and high pressure into appropriate areas such as landscaped or dirt areas
Residential Uses	
General Home Maintenance	1. Dispose of all wash waters from household cleaning into sink or toilets. 2. Discharge chlorinated water into soil or sanitary sewer. 3. Sweep walkways and driveways before washing.
Weed and Pest Control	1. Use pesticides sparingly and cautiously. 2. Do not use when rain is expected.
Landscaping, Irrigation, Yard, and other Waste Disposal	1. Use fertilizers sparingly and cautiously as to not contact storm drains due to over watering. 2. Do not blow or rake leaves etc. into street.
Home Automobile Maintenance & Repair	1. Wash cars on unpaved surfaces, use non-toxic / biodegradable soap. 2. Check vehicles for leaks and recycle automotive fluids at a recycling center
Minor Concrete, Masonry, and Asphalt Repair	1. Place dropcloths under or near activity 2. Do not apply asphalt sealant during wet weather.

6.4.2 Lessons Learned from Phase I Permittees

Although the NPDES Phase I stormwater program has been in place for several years, it is too early to provide a scientific evaluation of the effectiveness of the various BMPs being implemented. However, since the initiation of the NPDES stormwater program, there has been a considerable amount of information developed on the technological aspects of structural BMPs (e.g., wetland filters, grassy swales), including design criteria and maintenance requirements. In addition, there is an increasing number of scientific studies on the effectiveness of structural BMPs, particularly wet and dry stormwater detention basins. In contrast, little information has been developed on the effectiveness of non-structural BMPs (e.g., storm drain stenciling, public education). Despite the lack of a scientific assessment of the Phase I BMPs, there are several general observations about the use of BMPs in the Phase I program that provide guidance on the development of BMPs for the Phase II permittees, as follows:

- The search for gross pollutant sources (e.g., illegal dumping, illicit connections) during the early stages of the Phase I program yielded significant and immediate reductions in pollutant loading. This result emphasized the importance of an initial inventory and inspection of municipal facilities. The County and City of Santa Barbara have implemented a similar effort under Project Clean Water. It should be continued with a strong ongoing inspection program for the NPDES Phase II permit.

- The initial efforts by Phase I permittees to implement structural solutions were largely experimental and led to many failures, both in terms of design and maintenance. Over the past several years, the design of these facilities has improved, and expectations on pollutant removal rates have become more realistic. The results of the new scientific and engineering studies and the lessons learned by the Phase I permittees will ensure a more effective application of the structural BMPs. It also appears that numerous small site treatment control BMPs may be more effective that than a few large treatment controls in the lower watershed.

- The public education efforts by the Phase I permittees appear to be fruitful. It is difficult to measure how public education and outreach lead to pollution reduction. However, the Phase I programs were successful in reaching a large audience, developing interest beyond the initial targeted public groups, and generating independent programs and efforts by the public. As such, there appears to be an interest in developing a more comprehensive and sophisticated public education and outreach programs under the Phase II program that will provide the community with more tangible roles in reducing pollutant loading.

- The incorporation of source reduction and site treatment controls for new development was, and still is, difficult for many Phase I permittees. The problems involve the bureaucratic obstacles for incorporating water quality considerations in the planning, design, and permitting stages of private development. Many planning and building departments do not have the expertise and experience with water quality management, and there are few incentives for developers to explore innovative BMPs. This problem will likely continue with the Phase II permittees, although to a lesser degree.

- The Phase I permittees did not vigorously pursue "end of pipe" treatment BMPs, and instead, focused on source reduction and site control treatment. This emphasis will undoubtedly continue with the Phase II permittees because it is more efficient and cost effective.

- Appropriate and effective BMPs have been developed and implemented for construction sites under the Phase I program. However, there have been difficulties with inspection, monitoring, and reporting that have resulted in poor performance and compliance. Under the Phase II program, greater emphasis on these elements will be needed, rather than on the BMPs themselves.

6.4.3 BMPs for Bacterial Pollution

The County and other Phase II permittees on the South Coast have already begun implementing many of these BMPs, primarily focussed on reduction in bacteria sources to reduce beach closures in 1999. In addition, there is community and political support for implementing other BMPs in advance of the Phase II permit to address stormwater quality issues in a pro-active manner. The following general BMPs would be appropriate to implement in advance of the NPDES Phase II permit because they are likely to be effective at reducing bacterial pollution and acceptable to the RWQCB under the future NPDES Phase II permit:

1. Ongoing inspections and investigations into possible sewer systems leaks, illicit connections, and septic system failures

2. Ongoing creek inspections for illegal dumping

3. Periodic creek and storm drain clean up to remove animal waste, plant material, trash, human feces, and horse manure

4. Continuing public education concerning dumping into the creek and storm drains, and controlling animal waste

5. Permanent programs to address needs of homeless for toilet facilities and to control illegal encampments along creeks

6.5 RECOMMENDATIONS

Based on the results of the SCWC Study and progress to date on Project Clean Water, we recommend the following actions to prepare for the Phase II NPDES municipal stormwater permit:

1. Continue the monitoring of bacteria levels in the four watersheds to further define sources and to evaluate the effectiveness of BMPs being implemented to reduce bacteria sources

2. Continue field investigations to identify bacteria sources along the creeks in the four watersheds

3. Implement short-term BMPs to reduce bacteria sources, as described in the current Project Clean Water program for 1999-2000

4. Terminate water quality sampling for metals, minerals, and nutrients along the four SCWC Study creeks.

5. Conduct a similar characterization study in 1999-2000 for creeks in the urbanized portion of Goleta which will be included in the Phase II permit

6. Continue to evaluate and develop BMPs in advance of the permit application date, and to the extent feasible, implement these BMPs to: (1) facilitate acquisition of a stormwater permit in a timely

manner; and (2) allow time to evaluate the effectiveness of the early BMPs prior to the issuance of a permit in order to determine if certain BMPs are effective and feasible.

7.0 REFERENCES

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Ventura County, 1999. Stormwater Management Plan: Application for Reissuance of Waste Discharge Requirements and National Pollutant Discharge Elimination System Permit. February 1999.