CLEAN STREAMS CITIZEN MONITORING PROGRAM

GAZOS CREEK WATERSHED FINAL ANNUAL REPORT MAY-NOVEMBER 2004

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COASTAL WATERSHED COUNCIL

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GAZOS CREEK WATERSHED
ANNUAL REPORT
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EXECUTIVE SUMMARY

The Coastal Watershed Council started its first 'Clean Streams' monitoring program in 1996. This was the original community outreach and volunteer participation program for the Coastal Watershed Council (CWC) and has continued under varying funding sources ever since. The Clean Streams Program is owned and managed by CWC and provides watershed and water quality monitoring in watersheds in the Monterey Bay region and along the Central Coast of California.

The goals of the Clean Streams monitoring program are:

- To work directly with the community to develop a strong sense of stewardship for watershed protection thru individual participation.
- To provide baseline data where watershed information and water quality data are lacking or absent.
- To support and inform ongoing watershed restoration action strategies, watershed assessments and enhancement plan development and ultimately provide effective monitoring for projects resulting from the assessment and enhancement plans.
- To support and inform local and state decision making around central coast watersheds by providing reliable water quality and habitat data and to develop and support stakeholder involvement in watershed initiatives and foster long-term watershed stewardship through the involvement of local citizens in watershed programs.

CWC has maintained a volunteer monitoring program in Gazos Creek since September 1997, and established the current Clean Streams Monitoring Program in May 2003. The Gazos Creek watershed is an 11 square mile watershed encompassing approximately 16 miles of drainages located in southern San Mateo County, just south of the town of Pescadero. It is one of the last viable coho salmon habitats south of San Francisco.

For the 2004 season, twelve volunteers spent a total of 160 hours in the field, at the community meeting, and at the in-field training from April – November. Results from the data collected during 2003-2004 suggest a continuation of monitoring efforts in the Gazos Creek watershed. Although Gazos Creek is perhaps the least impacted watershed covered by the Clean Streams Program, it provides important habitat for several threatened and endangered species and acts as a baseline for regional watershed health. Continued volunteer water quality monitoring will provide reliable data that can be used by regulatory organizations and citizen groups.

Water quality parameters measured include:

<u>In Field:</u>

- Air and water temperature
- Conductivity
- Dissolved oxygen
- pH
- Turbidity

<u>Lab Analysis:</u>

- Bacteria
- Nutrient

A total of 27 data collection events were completed between May-November 2004. This involved one monitoring trip through the watershed per week on average. Water quality measurements were taken on each field visit. Water samples were collected for laboratory chemical analysis during the months of May, July, October, and November. Results from the water quality sampling indicate excellent stream conditions. No sample results from the Clean Streams program exceeded water quality standards for dissolved oxygen, water temperature, pH or turbidity. Laboratory chemical analysis revealed

excellent stream conditions with the exception of 2 instances where ammonia concentrations exceeded CCAMP water quality objectives, and one instance of slightly elevated bacteria concentrations.

Volunteer water quality monitoring provides reliable data that can be used by regulatory organizations and citizen groups. Monitoring also provides volunteers with first-hand knowledge about water quality in Gazos Creek and the surrounding watershed.

Results from the data collected during 2003-2004 suggest a continuation of monitoring efforts in the Gazos Creek watershed. Although Gazos Creek is perhaps the least impacted watershed covered by the Clean Streams Program, it provides important habitat for several threatened and endangered species and acts as a baseline for regional watershed health.

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I. Clean Streams Citizen Monitoring Program

The Coastal Watershed Council (CWC) is a nonprofit organization committed to the preservation and protection of coastal watersheds through citizen-based conservation, education and community outreach. Serving as watershed advocates, CWC promotes the health of these ecosystems through stewardship, advocacy and proper management practices. Founded in 1996, the Coastal Watershed Council was formed in response to the declining health of the watersheds of the Monterey Bay region.

The mission of the Coastal Watershed Council is to preserve and protect watersheds through community stewardship, education, and monitoring of local creeks and streams throughout the Monterey Bay region.

CWC's program areas focus on:

- Watershed stewardship, research and restoration
- Watershed education and outreach through citizen monitoring programs
- Organizational support and training for other grassroots watershed groups

Clean Streams

Beginning in 1996, the 'Clean Streams' monitoring program was the original community outreach and volunteer participation program for CWC and has continued under varying funding sources ever since. The Clean Streams Program is managed by CWC and provides watershed and water quality monitoring in watersheds in the Monterey Bay region and along the Central Coast of California (see Figure 1).

The goals of the Clean Streams monitoring program are:

- To provide baseline data where watershed information and water quality data are lacking or absent.
- To support and inform ongoing watershed assessments and enhancement plan development and ultimately provide effective monitoring for projects resulting from the assessment and enhancement plans.
- To support and inform ongoing watershed restoration action strategies.
- To support and inform local and state decision making around central coast watersheds by providing reliable water quality and habitat data.
- To develop and support stakeholder involvement in watershed initiatives and foster long-term watershed stewardship thru the involvement of local citizens in watershed programs.

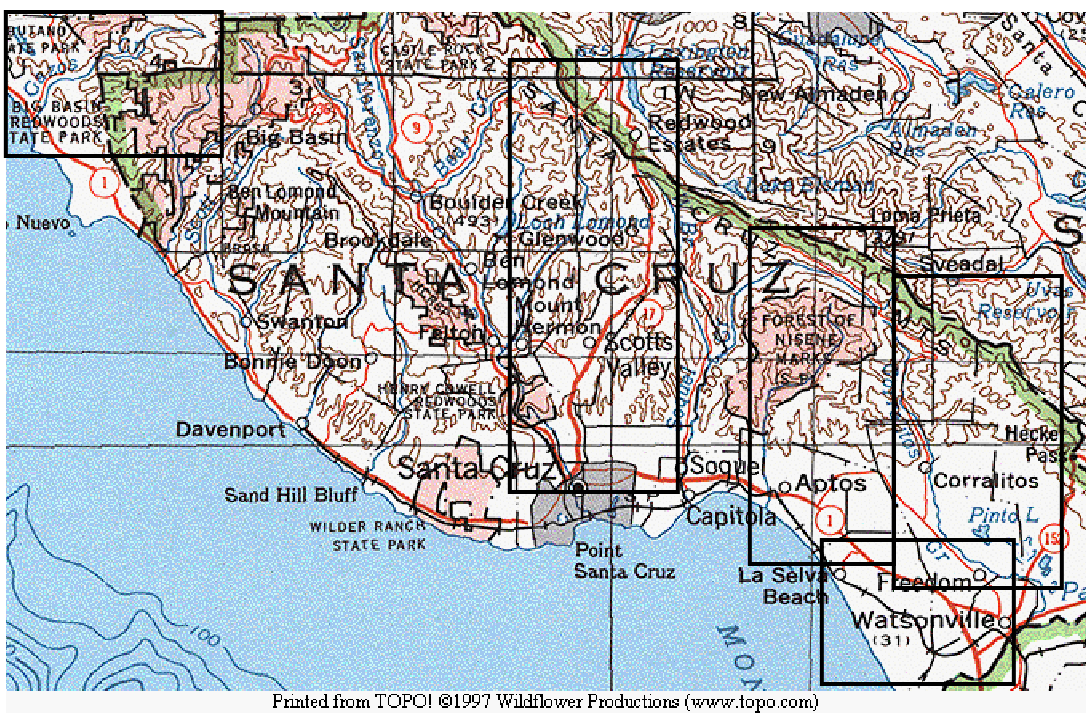

Figure 1. General location of Gazos Creek Watershed.

The Clean Streams Citizen Monitoring Program includes recruitment, all aspects of training, scheduling and supervision of volunteers, data entry, and draft and final data report completion. Watershed Coordinators work under the supervision and direction of the CWC's Watershed Program Managers.

II. DATA QUALITY, METHODS AND EQUIPMENT

Over the last five years CWC has worked with our regional partner the Monterey Bay Sanctuary Citizen Monitoring Network (Network) and the SWRCB citizen outreach team, the Clean Water Team, as well as the SWRCB and CC-RWQCB QA officers and staff, and Cal-EPA advisors, to devise and adopt methods to improve the quality of data produced by volunteers in central coast citizen water quality programs so this important information can be utilized by a greater audience.

CWC has worked to improve its data "reliability" through more complete programmatic documentation. CWC's Clean Streams program has adopted a number of the Quality Assurance-Quality Control (QA/QC) steps recommended to increase the use of the programs data by state level resource agencies. Primarily, standardized monitoring methodology is the foundation of these QA/QC steps, including: standardized equipment, monitoring methodology (a.k.a., Standard Operating Procedures—SOP), uniform documentation procedures, and uniform training of everyone involved.

CWC has developed a Quality Assurance Project Plan (QAPP) and Monitoring Plan with CC-RWQCB staff specifically for this grant, and all of the following steps are drawn directly from those documents (documents are available upon request).

Programmatic QA/QC steps

The following passages provide a brief review of a number of the QA/QC steps incorporated in the program:

Equipment Standardization

CWC has worked to devise a standard suite of equipment to be used by volunteers that provide high levels of *precision* when used by trained volunteers. Each team of volunteers in the program uses the same models of monitoring equipment and each piece of equipment owned or used by CWC in inventoried and assigned an equipment identification number. All equipment is calibrated no less than biannually and all non-adjustable-reading equipment used was *compared* to a certified state Standard to assess accuracy. All instances of equipment calibration or "standard comparison", as well as the use history of a particular instrument, are logged as the program's meta-data.

Standard Operating Procedure

Standard Operating Procedures (SOP) have been adopted as approved methodology for measuring conductivity, dissolved oxygen, pH, turbidity, and water temperature as well as sample collections by the State Water Resources Control Board (SWRCB) Clean Water Team (Table 1).

Table 1. SWRCB Clean Water Team Compendium Standard Operating Procedures adopted by the Clean Streams program.

Parameter	Equipment	SWRCB SOP
Conductivity	ECTestr Oakton ISO 9001	3.1.3.1
Dissolved Oxygen	Winkler Model EDO Code: 7414	3.1.1.2
pH	Non-bleeding pH strips Macherey-Nagel D-52348	3.1.4.2
Turbidity	Dual Cylinder turbidity kit Model TTM Code 7519	3.1.5.3
Water Temperature	Bulb Thermometer LaMotte Code 1066	3.1.2.1

In many cases CWC has composed brief, user-friendly versions of the SOPs for the layperson to follow in the field. These laminated sheets assure each volunteer follows the identical instructions across all watersheds with little or no interpretation of complex ancillary information.

Participant Trainings

The CWC Clean Streams program operates under the following hierarchy:

Program Manager→Watershed Coordinator→Team Leader→Volunteer Monitor

The Clean Streams Program Manager, Tamara Doan, has worked in citizen monitoring, and has managed volunteer programs for the Coastal Watershed Council since 2000. She has attended numerous SWRCB, RWQCB, EPA, RCD, NRCS and other professional trainings on watershed monitoring methodology, QA/QC, and data management over the last five years.

Watershed Coordinator Training

Watershed Coordinators received a minimum of 20 hours of classroom and in-field training on monitoring protocols and other more general training on the programmatic implementation of the Clean Streams program. CWC Program Manager, with assistance from Bridget Hoover of the Network, conducted these training sessions. Training topics covered include: administration, the Monitoring Plan, the QAPP and implementing quality assurance procedures, parameters, monitoring methods and SOPs, recruiting and managing volunteers, data collection, management and storage, and data and project reporting.

Volunteer Training

Each volunteer who participates in the Clean Streams Program receives a minimum of 10 hours formal training in monitoring protocols and equipment use, safety procedures, and data collection techniques. Volunteers attend an annual full-day training session and receive a program manual prior to the start of monitoring. Volunteer trainings were conducted by the Program Manager and the Watershed Coordinator. This formal volunteer training included a half-day classroom equipment and protocol review, and one half-day in-field training. Following the training, the Watershed Coordinator accompanied each team on their first three monitoring sessions to assure accurateness in the implementation of the monitoring protocols. Coordinators continued to perform QA spot-checks with the volunteers throughout the monitoring season to address any issues that may have arisen. Any late coming volunteer received one-on-one in-field training conducted by the Watershed Coordinator or the Program Manager, and was then placed on an existing monitoring team. The volunteer was then coached by the Watershed Coordinator and the team leader until that volunteer received at least 10 hours of formal oversight.

Volunteer training topics included: program purpose, safety, equipment orientation, in-field training on Standard Operating Procedures (SOP's), quality assurance steps, and datasheet completion. The Coordinator continued to supervise each team during the monitoring season as necessary. Volunteer teams were provided with a program manual, which included descriptions of parameters to be tested, parameter fact sheets, general watershed ecology, SOP's, data sheets, volunteer schedule, maps and directions to stations and a list of contact information for the Coordinator and program volunteers.

The in-field training provided creekside hands-on instructions on conducting field water quality tests, paying particular attention to Standard Operating Procedures (SOP'S) and protocols for each parameter to be tested. Program Manager Tamara Doan and Clean Streams Watershed Coordinators conducted these trainings.

Field monitoring teams were created at the training session and a schedule formed based on volunteer availability. Team leaders were chosen based on performance during field training, leadership, and willingness to commit to the additional volunteer time required for the position. Team leaders were responsible for kit pickup and checkout before monitoring events and for communication between the Watershed Coordinator and members of the teams. Leaders ensured that team members were aware of the monitoring schedule and communicated any needs and irregularities to the Coordinator.

Volunteer's conducted water quality monitoring 3-4 times per month at the selected monitoring stations within the watershed. The specific parameters sampled and station locations for monitoring were developed as part of the community outreach portion of this program and added to the monitoring plan prior to commencement of volunteer monitoring. At each station, volunteers were trained to collect water samples according to the appropriate protocol and to measure air/water temperature, conductivity, dissolved oxygen, pH, and turbidity.

Data Quality Objectives (DQO)

These Data Quality Objectives were derived for field kit equipment and stated in the QAPP. They are based on performance of CWC's other citizen monitoring programs as well as those of other organizations, and consideration of the specifications of the instruments, the methods planned for use, and how the data will ultimately be used. This section identifies how sensitive and representative, precise, accurate, and complete measurements are expected to be in the program (summarized in Table 2). See Appendix A for all Quality Assurance documentation forms.

Table 2. Data Quality Objectives for Clean Streams Program water quality methodology.

Parameter	Method/range	Units	Detection Limit	Sensitivity	Precision	Accuracy	Completeness
Conductivity	Conductivity Meter	µS/cm mS/cm	10	10 µS/cm 10 mS/cm	± 10%	± 10%	80%
Dissolved Oxygen	Micro-Winkler Titration	mg/L	0.2 mg/L	0.2 mg/L	± 10%	± 10%	80%
pH	Non-bleeding Strips (range 4.5-10.0)	pH units	4.5	0.5 unit	±0.5 units	± 0.5 units	80%
Temperature	Thermometer (-5 to 50)	^{o} C	-5	0.5 ^{o} C	± 0.5 ^{o} C	± 0.5 ^{o} C	80%
Turbidity	Dual Tube Optical	JTUs	5	5 JTUs	± 5 JTUs	NA	80%

NA: not applicable

- Note: Some test kits vary in sensitivity over the range of detection. The specific range of readings is noted in parentheses.
- DQO's are based on the manufacturer's enclosed accuracy information.

Detection Limit and Sensitivity

The Method Detection Limit is the lowest possible concentration an instrument or equipment can detect. Sensitivity is the ability of the instrument to detect one concentration from the next.

Precision

The precision objectives apply to replicate samples taken as part of a Quality Control session or as part of periodic in-field QC check. Precision describes how well *repeated measurements* agree. The evaluation of precision described here relates to repeated measurements taken by either different volunteers on the same sample (at quality control sessions) or the same volunteer analyzing replicate samples in the field. Sampling variability will not be covered in this section.

Accuracy

Accuracy describes how close a measurement is to its true value. Using standard solutions or comparative equipment, accuracy measurements compare the results of a sample of known value to its measured value. Accuracy checks were conducted twice per year on conductivity, pH, and temperature (accuracy measurements were also taken at each instance of battery changing in the case of the conductivity meters, or for any new pH or temperature equipment added to the program).

Completeness

Completeness is the fraction of planned data that must be collected in order to fulfill the statistical criteria of the project. This volunteer data will not be used for legal or compliance uses. There are no statistical criteria that require a certain percentage of data. However, it is expected that 80% of all measurements could be taken when anticipated. This accounts for adverse weather conditions, safety concerns, and equipment problems.

Quality Assurance

The following field measurement quality objectives were adopted to validate the quality of the data collected for the Clean Streams volunteer monitoring program:

1) Assure that each instrument had a unique identifying code (referred to as "Instrument ID") that was tracked with each measurement taken.

2) Assure that adjustable and non-adjustable equipment provided was calibrated every six months using a certified state Standard solution or comparative equipment to assess accuracy.
3) Assure accurate labeling of chemical reagents with expiration dates provided by the manufacturing company and that expired reagents were not used in the testing (dissolved oxygen and turbidity).
4) Assure that each instrument had at least one "replicate" measurement on each field day for the purpose of calculating 'precision'.
5) Assure that in-field measurements were taken appropriately by providing adequate instruction and written procedures for volunteers.

Laboratory

Samples were sent to Santa Cruz County Environmental Health Department, under the supervision of Steve Peters for bacteria and nutrient analyses. It is assumed that each laboratory will act under the guidelines of its own QAPP and authorization to operate as a professional water quality laboratory in the State of California.

In 2004 four sampling events occurred in Gazos Creek between May-November. In each event, two to four stations were chosen to represent the watershed. The samples were then sent to the lab to be analyzed for pathogens and nutrients.

The quality assurance steps were implemented during each 'trip' (i.e., per watershed) to assure quality samples were collected in the field and delivered to the laboratory were as follows:

- Field "Duplicates" (a second container filled at the same time in the same location) were collected for nutrient samples for laboratory analysis at one of the sampling locations in each watershed.
- One "Field blank" (a sample container filled with distilled water while in the field) was collected for conducting bacteria analysis at one of the sampling locations in each watershed.
- A temperature blank was kept in each sample storage cooler. This was used to record the temperature of the samples until they were turned over to the lab.

III. DESCRIPTION OF PARAMETERS AND RELEVANCE TO WATER QUALITY AND HABITAT

Conductivity

Conductivity is a general measure of water's ability to conduct an electrical current. There are no water quality objectives for conductivity for water bodies in the Central Coast Region. Generally, the conductivity of rivers in the United States ranges from 50-1500 ųS/cm and inland fresh water studies indicate a range between 150 to 500 ųS/cm for supporting good mixed fisheries (EPA, 2003). Industrial waters can range as high as 10,000 ųS/cm (EPA, 2003). However, baseline measurements in central coast watersheds are consistently found to be of elevated values normally, up to 1900 ųS/cm and beyond, as so much of the local geology consists of many mineral deposits and uplifted seafloor materials. Volunteers measure conductivity with a temperature-adjusted meter in the field.

Testing for conductivity provides ways to:

- Identify different water sources (for example, rain water, agricultural runoff, municipal waste water).
- Identify potential sources of pollution.
- Monitor seasonal changes in the water table.
- Monitor effects of salt water intrusion (salt water typically has higher conductivity than fresh water because of the presence of salts in the water).
- Infer the local geology of the area (baseline conductivity varies depending upon which minerals are present as surface water flows over the local substrate).

Dissolved Oxygen

Dissolved oxygen (DO) refers to the amount of oxygen captured within the water column. Factors that affect the concentration of dissolved oxygen include temperature, DO sources (such as photosynthesis that adds oxygen to the water), DO sinks (such as respiration that consume oxygen), breakdown of organic material, sewage, yard waste, oil and grease, and salinity. Low dissolved oxygen levels usually result from water temperature increases, algal blooms, or the presence of human and animal waste.

Aquatic organisms, such as fish and amphibians, require adequate amounts of dissolved oxygen for their continued health and survival. Reduced dissolved oxygen levels in freshwater systems can cause problems with reproduction and incubation, egg or larval failure, retarded growth, and, in extreme cases, death in salmonids.

Anadromous fish require high DO levels (>9.0 mg/l) during their reproductive phases (San Francisco Estuary Institute 1997). During the juvenile growth period (in the summer and fall), DO levels must remain at 8.0 mg/l or higher to prevent impairment. When DO levels fall to 6.5-7.0 mg/l, sharp decreases in performance have been observed. Embryos and larvae require even higher DO levels (State Water Resources Control Board 1996). The Water Quality Objective minimum for DO for supporting coldwater fish has been set at not less than 7.0 mg/l (Basin Plan).

pH

pH is a measure of how acidic or basic (alkaline) the water is. On a scale of 0-14, a pH value of 7 is said to be neutral, (neither acidic nor basic). As the pH decreases, water becomes more acidic; as the pH increases, water becomes more basic. Changes in pH may also alter the concentrations of other substances in the water to a more toxic form. In freshwater systems, pH usually ranges between 6.5 and 8.5 (San Francisco Estuary Institute 1997). In fresh water, increasing temperature decreases pH. In the Central Coast Region for waters that are designated municipal and domestic water supply, water contact recreation, and non-contact water recreation, it is recommended that pH not fall below 6.5 or rise above 8.5 (Basin Plan).

Most fish species can tolerate pH values between 6.0 to 9.0. However, on the Central Coast, in streams that support salmon and steelhead, the pH values must fall between 7.0 and 8.5. Extreme pH values (<5 or >9) can be detrimental to fish survival and may cause physical damage to their gills, exoskeleton, and fins, and, in some cases, death (Basin Plan).

Temperature

Water temperature is one of the most important water quality parameters that has direct affects on water chemistry and the functions of aquatic organisms. Temperature influences the dissolved oxygen content of the water, conductivity and pH levels, the rate of photosynthesis by algae and other aquatic plants, the metabolic rates of organisms, the sensitivity of organisms to toxic wastes, parasites and diseases, and the timing of reproduction, migration and aestivation of aquatic organisms.

Factors that can affect water temperature include sunlight energy, seasonal and daily changes, shade, air temperature, streamflow, water depth, inflow of groundwater or surface water, and the color and turbidity (cloudiness) of the water. Other factors that can affect temperature include soil erosion, stormwater runoff, removal of riparian vegetation, water diversions, cooling water discharges from power plants, and alterations to stream morphology, substrate, and flow. Water temperature is reported in degrees Celsius (°C).

Upstream migration of salmon and steelhead can occur when stream temperatures are between 3 °C and 20 °C; higher temperatures can inhibit migration, inducing salmonids to remain at sea until temperatures decrease (Reiser and Bjornn 1979). Water temperatures of 11.8-14.6 °C are optimal for coho salmon rearing, temperatures over 20 °C stop growth, and temperatures over 26 °C are lethal to coho salmon. Steelhead prefer lower temperatures of 7.3-14.6 °C for rearing, temperatures over 20 °C stops growth, and temperatures above 24 °C can result in mortality. Low water temperatures are imperative for successful salmonid reproduction and rearing.

Turbidity

Turbidity is a measure of the amount of suspended particles in the water. Watersheds have a natural turbidity level given the effects of natural erosion, organic decay, and algae. There has been no determination of the natural turbidity level in most of the local watersheds within the Central California Coast. Turbidity can be an indicator of erosion, excessive nutrient loading, and algal growth. Because of the number of suspended plants and animals (plankton) found within stream systems, turbid water can also be considered natural. The baseline level of turbidity will vary from stream to stream depending on the nutrient loading, geology and stream dynamics. Turbidity increases caused by discharge of sediment or nutrients should not exceed 10% of natural levels. In the absence of a numeric data quality objective, a turbidity level of >20 JTU (Jackson Turbidity Units) was adopted for this program.

Salmon and steelhead need clear-running streams with minimal sediment. High turbidity levels can indicate high sedimentation within the system. If a creek or river is heavily sedimented, spawning gravels and deep-water rearing habitat can become silted in. Also, highly turbid waters can increase the chance for redds (nests with egg sacks) to be washed away during storm events. Excessively turbid waters can also impair feeding. Coho salmon redds are highly susceptible to destruction caused by early storms (Smith 1998).

Pathogens

The coliforms are a broad class of bacteria, which live in the digestive tracts of humans and many animals. Among the health problems that contamination can cause are diarrhea, cramps, nausea, and vomiting. Together, these symptoms comprise a general category known as gastroenteritis. Gastroenteritis is not usually serious for a healthy person, but it can lead to more serious problems for people with weakened immune systems, such as the very young, elderly, or immuno-compromised.

Total Coliform count provides an indicator of pathogen conditions in the water. Testing for "indicator" bacteria monitors the potential presence of disease-causing organisms. Indicator bacteria are types of bacteria not normally found in high numbers in oceans, rivers, or creeks but always found in sources of fecal contamination. Though they are not typically disease-causing organisms themselves, they can be indicative of the presence of such organisms. Studies have shown that when concentrations of indicator bacteria exceed certain levels in waters used for water body contact recreation, individuals exposed to these waters may have a greater chance of getting sick (www.ccamp.org).

Fecal coliforms are bacteria that are associated with human or animal wastes. They usually live in human or animal intestinal tracts, and their presence in drinking water is a strong indication of recent sewage or animal waste contamination.

E. coli is a type of fecal coliform bacteria commonly found in the intestines of animals and humans. *E. coli* is short for *Escherichia coli*. The presence of *E. coli* in water is a strong indication of recent sewage or animal waste contamination, although sewage may contain many types of disease-causing organisms.
During rainfalls, snow melts, or other types of precipitation, *E. coli* and Fecal coliforms may be washed into creeks, rivers, streams, lakes, or groundwater (http://www.epa.gov/safewater/ecoli.html).

Nutrients

Nitrate, orthophosphate, and ammonia are nutrients that occur naturally in water bodies and promote aquatic plant growth, however, excessive nutrient levels can lead to algal blooms and extensive aquatic weed growth that in turn depletes the amount of oxygen available in the water column. Runoff containing detergents, fertilizers, animal waste, industrial waste, or sewage contribute to elevated nutrient levels.

Nitrate is the most oxidized form of nitrogen, and is the primary form of biologically available nitrogen. Toxicity is the result of reduction of NO3 to Nitrite (NO2), which reacts with hemoglobin and prevents the blood cells from transporting oxygen to tissues. Concentrations >10mg/L can cause Methemoglobinemia (Blue Baby Syndrome) in infants. Relationships with other health effects, including bladder cancer and non-Hodgkins Lymphoma, have been documented.

Excessive nitrate and resulting nitrite concentrations have been shown to be toxic to aquatic life such as frogs and marine invertebrates. High concentrations of nitrate stimulate growth of algae and aquatic plants which can negatively affect creek health, and extensive growth of algae increases decaying vegetative material, resulting in low or fluctuating dissolved oxygen levels. Low dissolved oxygen can be lethal to fish and other aquatic species.

Excessive nitrate can also originate from direct discharge from treated wastewater and sewer overflows, and non-point sources such as agriculture and urban runoff. Specific sources include fertilizers, confined livestock/animal wastes, septic systems and sewage treatment systems, and atmospheric deposition. Nitrate does not adhere readily to sediments and is transported primarily in the dissolved phase in surface runoff and through the substrate into ground water (http://www.ccamp.org/ca/3/Cwq/NO3_N_H2O.htm).

The CCAMP Attention Level of less than 2.25 mg/L has been adopted for the Clean Streams Program (http://www.ccamp.org/ca/3/Cwq/NO3_N_H2O.htm).

Orthophosphate, as Phosphorus (P), is the dissolved, inorganic fraction of phosphorus that is biologically available for uptake. Natural background levels of orthophosphate usually range from .005 to 0.05 mg/L.

Increasing concentrations of available phosphate allows plants to assimilate more nitrogen before phosphate is depleted. Therefore, if sufficient phosphate is available, elevated concentrations of nitrates lead to algal blooms. Algal blooms influence daily oxygen fluctuations, as well as light penetration and photosynthesis of aquatic plants, and decaying organic matter induces microbial processes that alter oxygen levels.

There is no Basin Plan objective for orthophosphate (PO4). The CCAMP attention level of less than 0.12 mg/L orthophosphate as P has been adopted by the Clean Streams program data from the Central Coast Region (http://www.ccamp.org/ca/3/Cwq/OP_P_H2O.htm).

Analysis for ammonia by the local lab was performed for unionized ammonia (NH3 as N). The term unionized (undissociated) ammonia refers to NH3, the most toxic form of ammonia. Temperature and pH are the most important conditions that control the equilibrium between ammonia (NH3) and ammonium (NH4+) in the water column. Sources of ammonia include fertilizers, irrigation, livestock and faulty septic systems.

The Basin Plan general objective for maximum concentration of unionized ammonia of less than 0.025 mg/L has been adopted for the Clean Streams program (http://www.ccamp.org/ca/3/Cwq/NH3U_N_H2O.htm).

Water Quality Objectives (WQO)

A Water Quality Objective (WQO) is the acceptable range of values for a particular parameter that constitutes *healthy* water quality conditions based on the *beneficial* use of that water. The Regional Water Quality Control Board (RWQCB) has created a Basin Plan to show how the quality of the surface and ground waters in the Central Coast Region should be managed to provide the highest water quality reasonably possible (Basin Plan).

The Central Coast RWQCB has established the Central Coast Ambient Monitoring Program (CCAMP), a regionally scaled water quality monitoring and assessment program whose purpose is to provide scientific information to Regional Board staff and the public, to protect, restore, and enhance the quality of the waters of central California (CCAMP, 2004). The CCAMP program has set “action levels” for the water quality parameters, which are specific to this geographic area. As every parameter may or may not have a regulatory limit set for it an action level is an indicator or flag assigned to the data indicating that it is above or below an acceptable range. The Clean Streams program has adopted these action levels as our WQO for dissolved oxygen, pH, and water temperature, as well as for bacteria (*E. coli*, total coliform) and nutrient (orthophosphate, nitrate and ammonia) analysis.

After the monitoring was completed, and the data verified, WQOs were then applied to the results. If a result at a particular station did not meet its WQO, it was identified as having 'exceeded' its criteria. The phrase "exceedence" was adopted to discuss the values that were out of the acceptable range for "good" water quality as defined by the WQO. Based on the WQO for an individual parameter, exceedence values can be either higher or lower than the WQO.

All of the parameters with WQO have a significant impact on water quality and habitat value for wildlife and fishes in coastal California, as well as indicate concerns for human health (Table 3).

Table 3: Water Quality Objectives (WQO) applied to the results of the Clean Streams monitoring program.

Parameter	Water Quality Objectives	Source of Objective
Dissolved Oxygen (mg/l)	≥ 7.0 mg/l	CCAMP Action Level
pH	Not <7.0 or > 8.5	CCAMP Action Level
Temperature (Water) (°C)	< 22.0 °C	CCAMP Action Level
Turbidity	< 20 JTU	NA
Total coliform (MPN/100-ml)	≤ 10,000 MPN/100-ml	CCAMP Action Level
E. coli (MPN/100-ml)	≤ 400 MPN/100-ml	EPA Ambient WQ standard
Nitrate-N (mg/l)	< 2.25 mg/l	CCAMP Action Level
Orthophosphate-P (mg/l)	≤ 0.12 mg/l	CCAMP Action Level
Ammonia as N, Total	< 0.025 mg/l	CCAMP Action Level

CCAMP Action Levels are based on appropriate state and federal regulatory laws: Clean Water Act, AB411.

IV. Description and results of Gazos Creek Watershed Monitoring Program

The Gazos Creek watershed is an 11 square mile watershed encompassing approximately 16 miles of drainages located in southern San Mateo County, just south of the town of Pescadero. It is one of the last viable coho salmon habitats south of San Francisco (Figure 6). A relatively small watershed, Gazos Creek provides habitat for several federally protected species including coho salmon (*Oncorhynchus kisutch*), steelhead trout (*Oncorhynchus mykiss*), California red-legged frog *(Rana aurora draytoni*), and marbled murrelet (*Brachyramphus marmoratus*). Initially, a watershed assessment was conducted to identify problems within the watershed (Coastal Watershed Council 1997).

Volunteer water quality monitoring by CWC began in September 1997 with a Clean Streams program funded by the Packard Foundation. The current Clean Streams Watershed Monitoring Program for Gazos Creek, funded by State Water Resource Control Board (SWRCB), started in June 2003. Volunteer outreach methods included flyers and posters, community outreach notices, press releases and public service announcements in both Santa Cruz and San Mateo County area. On April 10, 2004, a public meeting was held at the Beach House Restaurant to provide information about the Coastal Watershed Council and the Clean Streams program, its goals, and the volunteer time commitment required. Following the meeting, a three-hour field training was conducted along Gazos Creek for volunteers.

Twelve volunteers collected bi-monthly water quality data at four monitoring stations in the Gazos Creek Watershed (Figure 2). Monitoring was conducted between May 15, 2004 and November 16, 2004.

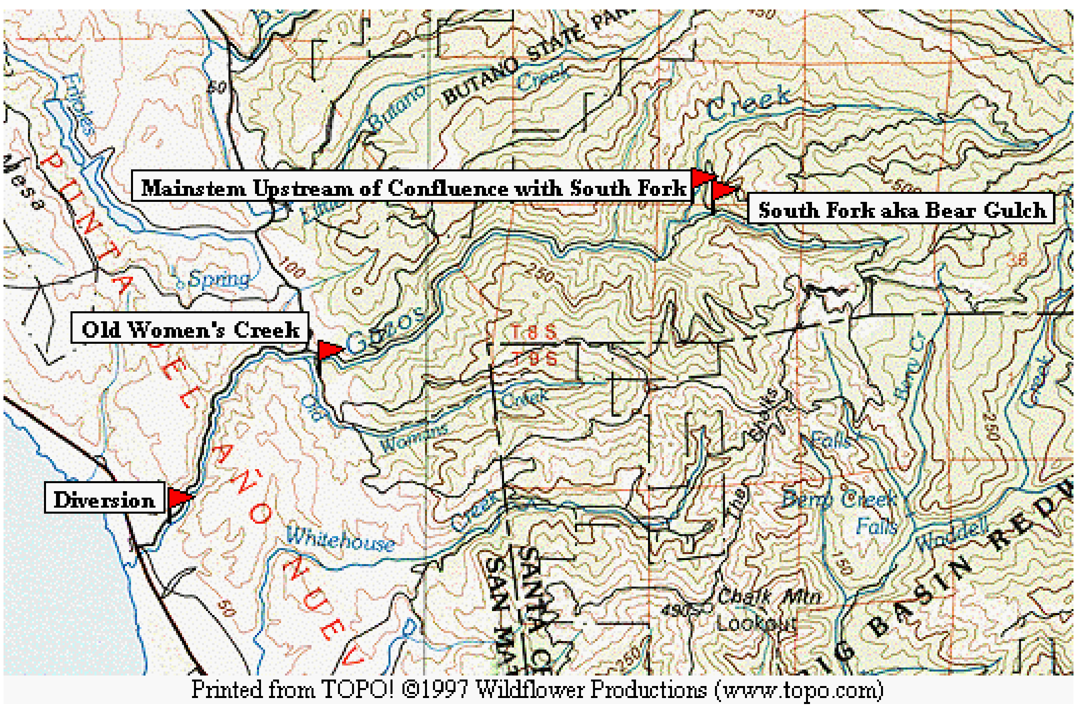

Figure 2. Monitoring locations of Gazos Creek Watershed stations.

Figure 2 shows the monitoring stations on Gazos Creek:

Diversions	Station ID: 202-GAZOS-14
Old Woman's Creek	Station ID: 202-GAZOS-15
Bear Gulch	Station ID: 202-BEARG-11
Mainstem	Station ID: 202-GAZOS-16

Volunteer Participation

A total of 160 hours were spent by Gazos Creek volunteers in the field, at the community meeting, and at the in-field training from April 10 to November 16, 2004, with the majority of the hours spent in the field.

A volunteer recognition party was held at Bonesio's in Santa Cruz on November 14, 2004 for volunteers from all current CWC programs. Two Gazos creek volunteers, Michelle Fuller and Dave Fitchner, were able to attend the party.

Participating volunteers during the 2004 season included:

Marion Blair	Mary Dunlop	Dave Fitchner
Michelle Fuller	Jacquy Griffith	Shelley Hoeft
Moira Hutchins-Fuhr	Keith Landrum	Heidi Moore
Adam Romero	Chantell Royer	Steve Spinella

GAZOS DATA RESULTS

Twelve volunteers conducted 26 water quality field data monitoring trips at four stations in the Gazos Creek watershed from May 15 to November 16, 2004. In addition, a trip was made to three sites in the watershed in conjunction with Snapshot Day on May 1, 2004; These sites were GAZOS-11 (under the Highway 1 bridge), GAZOS-13 (Just below the confluence of Bear Gulch and the North fork of Gazos creek), and GAZOS-15 (Old Woman's Creek). The monitoring trips were conducted between 8:05 am-6:04 pm with two or three volunteers working together. The basic water quality measurements taken were as follows: air and water temperature, dissolved oxygen, pH, turbidity and conductivity. Water samples were collected from 2-4 stations in the watershed for laboratory analysis of bacteria and nutrient concentrations in May, July, October, and November, and samples were sent to the Santa Cruz Department of Environmental Health for analysis.

During the May-November 2004 monitoring season, a total of 103 water quality monitoring efforts were recorded at four stations on Gazos creek. Two additional monitoring efforts were recorded at two stations associated with Snapshot day on May 1, 2004.

Table 4 summarizes the water quality data by parameter for all of the four stations sampled within the Gazos Creek watershed. The table reflects the parameters tested, the Water Quality Objectives (WQO, Table 3, page 9), the total number of samples collected, the total number of exceedences, and the minimum, maximum and mean value of each parameter. Raw water quality data are presented in Appendix B of this report.

Table 4: Gazos Creek Watershed Water Quality Result Summary table.

CLEAN STREAMS 2004 **Gazos Creek Watershed**

Parameter	WQO	Number of Samples per Watershed	Number of Exceedences	Percent of Exceedences	Minimum	Maximum	Mean
Air Temp °C	None	129			8.0	26.0	16.2
Conductivity (ųS)	None	129			180	430	
D.O. (mg/l)	≥ 7.0 mg/l	126	0	0%	7.8	11.0	9.0
pH	Not < 7.0 or > 8.5	129	1	0.7%	6.5	7.5	7.2
Turbidity (JTU)	< 20 JTU	128	3	2.3%	5	70	
Water Temp °C	< 22.0°C	129	0	0%	8.0	18.0	13.5

Temperature

Air temperature

Temperature readings were taken 129 times at four stations on 27 field-trips. The mean air temperature for all four stations was 16.2°C with a range of 8.0-26.0°C. The minimum temperature (8.0°C) was recorded at Mainstem on October 28 at 10:45 am, and the high temperature (26.0°C) was recorded at Old Woman's Creek on September 4 at 10:45 am.

Water temperature

Temperature readings were taken 129 times at four stations on 27 field-trips. The mean water temperature at all four stations was 13.5°C with a range of 8.0 to 18.0 °C. The minimum temperature (8.0°C) was recorded at Mainstem on October 28 at 10:45 am, and the high temperature (18.0°C) was recorded twice at Mainstem on July 27 at 1:15 pm, and on August 25 at 3:15 pm. All 129 water temperature values were within CCAMP water quality standards.

Conductivity

Conductivity was measured 129 times at four stations on 27 field-trips. Conductivity values at all four stations had a range of 180 ųS to 430 ųS. The low was recorded at Bear Gulch on October 19, and the high was recorded at Mainstem on October 7, November 9, and November 16.

Dissolved Oxygen

Dissolved oxygen was measured 126 times at four stations on 27 field-trips. Three readings were discarded due to a procedural error, and thus the number of DO samples is less than that of pH, conductivity, and temperature. Dissolved oxygen levels at the four stations ranged from 7.8mg/L to 11.0 mg/L. The lowest reading was recorded both at Old Woman's Creek at 10:36 am on June 23, and at Diversions at 9:45 am on August 22. The highest reading was recorded at three stations, Bear Gulch, Old Woman's Creek, and Mainstem, between 10:15 am and 11:00 am on October 28.

All DO values for the four stations were within CCAMP water quality standards and are acceptable for both salmonid juvenile growth and reproductive-larval phases. The mean values for all four sites indicate that sufficient DO levels are present for rearing steelhead and coho salmon.

pH

pH was measured 129 times at four stations on 27 field-trips. The pH values were very consistent with a mean of 7.2, and a range of 6.5 to 7.5. All values are within the CCAMP water quality standards with the exception of a pH of 6.5 recorded at Old Woman's Creek on May 1, 2004.

Turbidity

Turbidity was measured 128 times at four stations on 27 field-trips. Turbidity levels exceeded the acceptable limit of 20 JTU on only one occasion during the May to November 2004 monitoring season. On October 19, after two days of heavy rainfall, the turbidity reached 70 JTU at Diversions and 30 JTU at Old Woman's Creek. The turbidity levels dropped to 5 JTU or less at all stations in the watershed by October 25.

Table 5 summarizes water quality data by individual stations in the Gazos Creek Watershed. The table reflects the parameters tested, the Water Quality Objectives (WQO, Table 3, page 9), the total number of samples collected, the total number of exceedences, and the minimum, maximum and mean value of each parameter.

Table 5 A-D: Summary table for the Gazos Creek Watershed water quality results by station.

A) Diversions GAZOS-14

Parameter	WQO	Number of Samples	Number of Exceedences	Percent Exceedences	Minimum Result	Maximum Result	Mean Result
Air Temp (°C)	None	39			8	24	16
Conductivity (ųS)	None	39			360	420	
DO (mg/l)	≥ 7.0 mg/l	38	0	0%	7.8	10.2	8.7
pH	Not < 7.0 or > 8.5	39	0	0%	7	7.5	7.2
Turbidity (JTU)	< 20 JTU	39	1	1.4%	5	70	
Water Temp (°C)	< 22.0°C	39	0	0%	8.5	17.5	13.8

B) Old Woman's Creek GAZOS-15

Parameter	WQO	Number of Samples	Number of Exceedences	Percent of Exceedences	Minimum Result	Maximum Result	Mean Result
Air Temp (°C)	None	30			9	26	16
Conductivity (ųS)	None	30			300	400	
DO (mg/l)	≥ 7.0 mg/l	29	0	0%	7.8	11	8.8
pH	Not < 7.0 or > 8.5	30	1	3.3%	6.5	7.5	7.2
Turbidity (JTU)	< 20 JTU	29	1	3.4%	5	30	
Water Temp (°C)	< 22.0°C	30	0	0%	9	16.4	13.7

C) Bear Gulch BEARG-11

Parameter	WQO	Number of Samples	Number of Exceedences	Percent Exceedences	Minimum Result	Maximum Result	Mean Result
Air Temp (°C)	None	30			8	22	16
Conductivity (ųS)	None	30			180	250	
DO (mg/l)	≥ 7.0 mg/l	29	0	0%	8.6	11	9.5
pH	Not < 7.0 or > 8.5	30	0	0%	7	7.5	7.2
Turbidity (JTU)	< 20 JTU	30	0	0%	5	15	
Water Temp (°C)	< 22.0°C	30	0	0%	10	16.5	13.4

D) Mainstem		GAZOS-16					
Parameter	**WQO**	**Number Of Samples**	**Number of Exceedences**	**Percent Exceedences**	**Minimum Result**	**Maximum Result**	**Mean Result**
Air Temp (°C)	None	30			8	23	17
Conductivity (µS)	None	30			340	430	
DO (mg/l)	≥ 7.0 mg/l	29	0	0%	8	11	9.2
pH	Not < 7.0 or > 8.5	30	0	0%	7	7.5	7.4
Turbidity (JTU)	< 20 JTU	30	0	0%	5	15	
Water Temp (°C)	< 22.0°C	30	0	0%	8	18	13.7

Laboratory Analysis

Water samples were collected for laboratory analysis of bacteria and nutrient levels on May 1, May 26, July 6, October 7, and November 9, 2004 from 2-4 stations at Gazos creek. Table 6 A-D and the following paragraphs reflect the results of these samples. The table includes parameters, WQO, and stations sampled.

Bacteria

E. coli

Results for the sampling period of May-November 2004 indicated no exceedences of the CCAMP water quality objective with respect to *E. coli* of "≤ 400 MPN/100-ml." Results for the four stations were as follows: samples from Diversions ranged from 10-285 MPN/100-ml, samples from Old Woman's Creek ranged from non detectable- 72 MPN/100-ml, samples from Bear Gulch ranged from non detectable-10 MPN/100-ml, and samples from Mainstem ranged from non detectable -20 MPN/100-ml.

Total Coliform

Total coliform levels fell within the CCAMP water quality objective of "≤10,000 MPN/100-ml" for all samples collected in the Gazos Creek watershed in 2004. Totals ranged from 121 MPN/100-ml at Diversions on November 9, to 2224 MPN/100-ml at Diversions on October 7, 2004.

Nutrients

Orthophosphate

Orthophosphate was not detected in any samples collected from the Gazos Creek watershed during the May-November 2004 monitoring season.

Nitrate

Nitrate levels fell within the CCAMP water quality objective of "< 2.25 mg/l" in all samples collected during the May-November monitoring season. Results ranged from non-detectable to 0.180 mg/l.

Ammonia

Results for ammonia exceeded the CCAMP Water Quality Objective of "< 0.025 mg/l" at two stations on July 6, and at all four stations on November 9, 2004. On July 6, Old Woman's Creek and Bear Gulch recorded ammonia concentrations of 0.295 mg/l and 0.029 mg/l respectively. On November 9, ammonia concentrations ranged from 0.027 mg/l at Mainstem to 0.048 mg/l at Old Woman's Creek.

Table 6 A-D: Gazos Creek Bacteria and Nutrient Summary tables.

A) May 26, 2004		GAZOS-14	GAZOS-15	BEARG-11	GAZOS-16
Parameter	**WQO**	**Diversions**	**Old Woman's Creek**	**Bear Gulch**	**Mainstem**
E. coli (MPN/100ml)	≤ 400	30	n.d.	20	n.d.
Total Coliform (MPN/100ml)	≤ 10000	480	464	292	455
Orthophosphate (mg/l)	≤ 0.12	n.d.	n.d.	n.d.	n.d.
Nitrate-N (mg/l)	< 2.25	0.048	0.055	0.082	n.d.
Ammonia (mg/l)	< 0.025	0.003	0.003	0.003	0.003

B) July 6, 2004		GAZOS-14	GAZOS-15	BEARG-11	GAZOS-16
Parameter	**WQO**	**Diversions**	**Old Woman's Creek**	**Bear Gulch**	**Mainstem**
E. coli (MPN/100ml)	≤ 400	63	72	n.d.	20
Total Coliform (MPN/100ml)	≤ 10000	1112	475	379	410
Orthophosphate (mg/l)	≤ 0.12	n.d.	n.d.	n.d.	n.d.
Nitrate-N (mg/l)	< 2.25	0.034	0.025	0.063	n.d.
Ammonia (mg/l)	< 0.025	0.022	0.295	0.029	0.02

C) October 7, 2004		GAZOS-14	GAZOS-15	GAZOS-16
Parameter	**WQO**	**Diversions**	**Old Woman's Creek**	**Mainstem**
E. coli (MPN/100ml)	≤ 400	285	10	20
Total Coliform (MPN/100ml)	≤ 10000	2224	472	1354
Orthophosphate (mg/l)	≤ 0.12	n.d.	n.d.	n.d.
Nitrate-N (mg/l)	< 2.25	n.d.	n.d.	n.d.
Ammonia (mg/l)	< 0.025	n.d.	n.d.	n.d.

D) November 9, 2004		GAZOS-14	GAZOS-15	BEARG-11	GAZOS-16
Parameter	**WQO**	**Diversions**	**Old Woman's Creek**	**Bear Gulch**	**Mainstem**
E. coli (MPN/100ml)	≤ 400	10	31	10	20
Total Coliform (MPN/100ml)	≤ 10000	121	231	183	317
Orthophosphate (mg/l)	≤ 0.12	n.d.	n.d.	n.d.	n.d.
Nitrate-N (mg/l)	< 2.25	n.d.	n.d.	0.180	n.d.
Ammonia (mg/l)	< 0.025	0.045	0.048	0.031	0.027

n.d. indicates a non-detection of bacteria or nutrient in the sample.
Shaded numbers indicate exceedences of the Water Quality Objectives set forth by CCAMP.

V. Discussion

The Clean Streams Program at Gazos Creek began field-monitoring efforts much earlier in the season in 2004 than in 2003. Additionally, the number of volunteers participating in the program increased from last year. As a result, the length of the monitoring season as well as the frequency of field visits nearly doubled that in 2003. This allowed for a much broader view of water quality conditions in the Gazos Creek watershed than was previously possible.

Water quality conditions were generally excellent in Gazos creek during the 2004 monitoring season. Water temperatures and dissolved oxygen concentrations never exceeded CCAMP water quality objectives. Dissolved oxygen levels averaged 8.7 mg/L or higher at all four stations. The maximum water temperature recorded in the watershed was 18.0°C. The only pH reading to exceed CCAMP water quality objectives was a pH of 6.5 recorded on Snapshot day at Old Woman's Creek. This may have been a reflection of the level of training and supervision received by Snapshot Day volunteers. Turbidity levels exceeded water quality objectives on only one occasion, October 19, 2004, when turbidity readings of 70 JTU and 30 JTU were recorded at Diversions and Old Woman's Creek, respectively. Gazos creek swelled with runoff as a result of a series of strong storms delivering several inches of rainfall during the previous 48 hours. Even with this high flow event, turbidity levels at the two stations in the upper watershed did not exceed 15 JTU. The results of this data point to Old Woman's creek as a likely source of sediment in the lower watershed. Despite the high readings on October 19, turbidity levels dropped to 5 JTU or less at all four stations in the watershed by the following week.

Results for bacteria and nutrient sampling at Gazos Creek indicate generally excellent water quality conditions. For the May 26 and October 7 sampling efforts, data from all four stations met the CCAMP water quality objectives adopted for the Clean Streams program with respect to all parameters measured. For the samples collected on July 6, all four stations met the water quality objectives for all parameters except ammonia. Ammonia levels at Old Woman's Creek and at Bear Gulch exceeded water quality objectives. Results from the sampling efforts conducted November 9 met water quality objectives for all parameters except ammonia. Concentrations of ammonia slightly exceeded objectives at all four stations in the watershed, ranging from 0.027mg/l-0.048 mg/l.

VI. Recommendations

Although Gazos Creek is likely the least impacted watershed included in the Clean Streams program, it provides important habitat for several threatened and endangered species and acts as a baseline for regional watershed health. Recommendations for the 2005 season are to continue the monitoring of basic water quality parameters and to increase the frequency of nutrient and bacteria sampling in the Gazos Creek watershed. Recruitment and training of additional volunteers, including residents of the watershed, will increase the educational value of the program.

VII. References

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APPENDICES

APPENDIX A

Quality Assurance
Documents and Summary Text

GAZOS CREEK—QUALITY ASSURANCE (QA) SUMMARY TEXT

Quality Assurance Steps

Accuracy

Percent accuracy is calculated from the drift (the difference between the post-event reading and the value of the Standard), divided by the "true" value of the Standard, times 100. An acceptable value for percent accuracy is less than 10%.

The percent accuracy was calculated for the conductivity meter used in the Gazos Creek watershed and found to be 0.2%, an acceptable value based on the data quality objectives set forth for water quality parameters.

The pH strips from the beginning of the season were not calibrated at the end of the monitoring season, as all the pH strips had been used by that time. Percent accuracy for the pH strips used for the remainder of the monitoring season was calculated and found to be 0%, an acceptable value based on the data quality objectives set forth for water quality parameters.

Three temperature instruments were used in the Gazos Creek watershed. Separate bulb instruments for air and water temperature were used most frequently, while a digital instrument was used for both air and water temperature on occasion. Percent accuracy was calculated for both bulb temperature instruments used in the Gazos Creek watershed. The air temperature instrument was found to be 100% accurate and the water temperature instrument was found to be 94.7% accurate. Both of these instruments produced acceptable values based on the data quality objectives set forth for water quality parameters.

Completeness

There were a total of 26 monitoring events scheduled for this season's monitoring program. Gazos Creek was monitored 26 times during the season, however, one monitoring trip involved sampling at only two of the four stations. In terms of monitoring effort, completeness was 98% in 2004.

On a parameter-by-parameter basis, air and water temperature, conductivity, and pH, were all analyzed 129 out of 131 times (98%), turbidity was analyzed 128 out of 130 times (98%), and dissolved oxygen samples were collected and analyzed 126 out of 131 times (95%). One data set for Old Woman's Creek was collected on Snapshot Day, when transparency was measured instead of turbidity. This explains why there was one less data point overall for turbidity than for the other parameters measured. Dissolved oxygen samples were not fixed properly on one occasion during the 2004 monitoring season, as a result, dissolved oxygen readings were discarded for all sites in the watershed with the exception of Mainstem on that particular monitoring trip.

Precision

The percent precision was calculated using the formula: the absolute value of A minus B, divided by the average of A and B, times 100, where A equals the parameter result and B equals the replicate results (|A-B|x100/AVG(A+B)). For dissolved oxygen samples (n=25), all values met the precision objective with a range of 0.0-9.8%. For conductivity samples (n=26), all values met the precision objective with a range of 0.0-2.7%. For temperature, pH, and turbidity, the difference between the parameter result and its replicate were compared to the precision objective for each parameter. One of the air temperature replicates (n=26) exceeded the ± 0.5 °C objective, at 8.0 °C and 9.0°C (1.0 °C difference), as did one of the water temperature replicates (n=26), at 13.0°C and 14.0°C (1.0 °C difference). All of the pH and turbidity replicates (n=26) met the precision objective with 100% precision.

Volunteer Participation

A total of twelve people participated as volunteers in the Clean Streams program at Gazos Creek during the 2004 monitoring season. Half of these people took part in one or two monitoring efforts, while the other half contributed throughout the season. Three teams consisting of two people conducted the majority of the monitoring at Gazos Creek in 2004. The coordinator substituted for each team at least once, but not more than twice, during the season. Initially, a fourth team was created at the beginning of the season but was dissolved due to a lack of consistent participation. The coordinator substituted for this team (team D) throughout the monitoring season. The six regular Clean Streams volunteers from teams A, B, and C, participated with great enthusiasm, dedication, and a willingness to work together. These teams required very little supervision or guidance from the coordinator.

APPENDIX B

Clean Streams 2004 Data Table

Gazos Creek – Result Data

Site ID	Site description	Date	Time	Rain in last 24 hrs?	Replicate	AIR_TEMP	H2O_TEMP	PH	D.O.	COND_US	TURB-IDITY
202-BEARG-11	Bear Gulch	5/15/2004	12:00 PM	NO	NO	15.6	12.9	7	9.4	190	5
202-BEARG-11	Bear Gulch	5/26/2004	11:32 AM	NO	NO	19	13	7	9.2	190	5
202-BEARG-11	Bear Gulch	6/5/2004	11:31 AM	NO	NO	20	13.5	7	8.8	200	5
202-BEARG-11	Bear Gulch	6/11/2004	8:05 AM	NO	NO	12.1	12.6	7.5	8.8	200	5
202-BEARG-11	Bear Gulch	6/23/2004	11:20 AM	NO	NO	18	14	7	9	190	5
202-BEARG-11	Bear Gulch	6/26/2004	11:15 AM	NO	NO	19.5	14.5	7.5	9.2	190	5
202-BEARG-11	Bear Gulch	7/6/2004	10:20 AM	NO	NO	16.5	13.5	7	9.2	200	5
202-BEARG-11	Bear Gulch	7/10/2004	12:00 AM	NO	YES	19.2	14.2	7.5	10	200	5
202-BEARG-11	Bear Gulch	7/10/2004	12:00 AM	NO	NO	19.2	14.2	7.5	10	200	5
202-BEARG-11	Bear Gulch	7/17/2004	9:55 AM	NO	NO	18	14	7	9.6	200	5
202-BEARG-11	Bear Gulch	7/20/2004	10:40 AM	NO	NO	17	15	7		200	5
202-BEARG-11	Bear Gulch	7/27/2004	12:30 PM	NO	NO	18.5	16.5	7	8.6	200	5
202-BEARG-11	Bear Gulch	8/13/2004	5:30 PM	NO	YES	18	14.9	7.5	9.4	200	5
202-BEARG-11	Bear Gulch	8/13/2004	5:30 PM	NO	NO	18	15	7.5	9.4	200	5
202-BEARG-11	Bear Gulch	8/22/2004	11:43 AM	NO	NO	18	15	7.5	8.6	200	5
202-BEARG-11	Bear Gulch	8/28/2004	10:25 AM	NO	NO	18.5	14	7.5	9.2	200	5
202-BEARG-11	Bear Gulch	9/4/2004	10:15 AM	NO	YES	16	13	7.5	9	210	5
202-BEARG-11	Bear Gulch	9/4/2004	10:15 AM	NO	NO	15.5	13	7.5	9	210	5
202-BEARG-11	Bear Gulch	9/11/2004	3:30 PM	NO	NO	21.5	14.1	7.5	9.2	200	5
202-BEARG-11	Bear Gulch	9/15/2004	10:45 AM	NO	YES	19.5	13.5	7	9	200	5
202-BEARG-11	Bear Gulch	9/15/2004	10:45 AM	NO	NO	19	13.5	7	9	200	5
202-BEARG-11	Bear Gulch	9/22/2004	10:40 AM	NO	NO	15	11	7	10	200	5
202-BEARG-11	Bear Gulch	10/7/2004	11:20 AM	NO	NO	17.5	12.5	7	9	210	5
202-BEARG-11	Bear Gulch	10/19/2004	3:45 PM	YES	NO	13	14	7.5	9.4	180	15
202-BEARG-11	Bear Gulch	10/25/2004	10:25 AM	NO	NO	14	14	7	10.6	230	5

Site ID	Site description	Date	Time	Rain in last 24 hrs?	Replicate	AIR_TEMP	H2O_TEMP	PH	D.O.	COND_US	TURB-IDITY
202-BEARG-11	Bear Gulch	10/28/2004	11:00 AM	NO	NO	8	10	7	11	240	5
202-BEARG-11	Bear Gulch	11/9/2004	12:05 PM	YES	NO	13	11	7.5	10.2	240	5
202-BEARG-11	Bear Gulch	11/13/2004	11:20 AM	NO	YES	13	12.5	7	10.4	230	5
202-BEARG-11	Bear Gulch	11/13/2004	11:20 AM	NO	NO	13	12.5	7	10.6	230	5
202-BEARG-11	Bear Gulch	11/16/2004	11:25 AM	NO	NO	11	10.5	7	10	250	5
202-GAZOS-14	Diversions	5/15/2004	11:00 AM	NO	NO	14.1	13.3	7	9.2	360	5
202-GAZOS-14	Diversions	5/26/2004	9:45 AM	NO	NO	15	12.5	7	8.4	360	5
202-GAZOS-14	Diversions	6/5/2004	10:15 AM	NO	YES	17	13.5	7	8.4	370	5
202-GAZOS-14	Diversions	6/5/2004	10:15 AM	NO	NO	17	13.5	7	8.6	360	5
202-GAZOS-14	Diversions	6/11/2004	8:50 AM	NO	NO	14.1	13.5	7.5	8	370	5
202-GAZOS-14	Diversions	6/23/2004	9:45 AM	NO	NO	14.5	13.5	7	8.4	380	5
202-GAZOS-14	Diversions	6/26/2004	9:50 AM	NO	YES	13	14	7.5	8.6	370	5
202-GAZOS-14	Diversions	6/26/2004	9:50 AM	NO	NO	13	13.5	7.5	9	370	5
202-GAZOS-14	Diversions	7/6/2004	8:35 AM	NO	YES	13	13	7	8.8	380	5
202-GAZOS-14	Diversions	7/6/2004	8:35 AM	NO	NO	13	13.5	7	9	380	5
202-GAZOS-14	Diversions	7/10/2004	1:00 PM	NO	NO	17.2	15.7	7	8	360	5
202-GAZOS-14	Diversions	7/17/2004	9:00 AM	NO	NO	19.5	14.5	7	9.4	380	5
202-GAZOS-14	Diversions	7/20/2004	9:30 AM	NO	NO	16.5	16	7.5		380	5
202-GAZOS-14	Diversions	7/27/2004	11:00 AM	NO	YES	15.5	15.5	7	8.2	380	5
202-GAZOS-14	Diversions	7/27/2004	11:00 AM	NO	NO	15.5	15	7	8	380	5
202-GAZOS-14	Diversions	8/13/2004	6:04 PM	NO	NO	16.3	16.3	7.5	9.2	370	5
202-GAZOS-14	Diversions	8/22/2004	9:45 AM	NO	YES	17.5	14.5	7.5	7.8	380	5
202-GAZOS-14	Diversions	8/22/2004	9:45 AM	NO	NO	17.5	14.5	7.5	8	380	5
202-GAZOS-14	Diversions	8/25/2004	2:30 PM	NO	YES	21.5	17.5	7.5	8.2	380	5
202-GAZOS-14	Diversions	8/25/2004	2:30 PM	NO	NO	21.5	17	7.5	8.2	380	5
202-GAZOS-14	Diversions	8/28/2004	9:35 AM	NO	YES	16.5	13.5	7	9	380	5
202-GAZOS-14	Diversions	8/28/2004	9:35 AM	NO	NO	16	13.5	7	9	380	5

Site ID	Site description	Date	Time	Rain in last 24 hrs?	Replicate	AIR_TEMP	H2O_TEMP	PH	D.O.	COND_US	TURB-IDITY
202-GAZOS-14	Diversions	9/4/2004	11:35 AM	NO	NO	23.5	13.5	7.5	8.8	380	5
202-GAZOS-14	Diversions	9/11/2004	5:00 PM	NO	NO	16.5	15.5	7.5	8.8	390	5
202-GAZOS-14	Diversions	9/15/2004	9:30 AM	NO	NO	16	14	7	8.2	390	5
202-GAZOS-14	Diversions	9/22/2004	9:50 AM	NO	YES	14.5	10	7.5	8.6	380	5
202-GAZOS-14	Diversions	9/22/2004	9:50 AM	NO	NO	14	10	7.5	8.8	380	5
202-GAZOS-14	Diversions	10/7/2004	11:00 AM	NO	YES	19	14	7	8.4	390	5
202-GAZOS-14	Diversions	10/7/2004	11:00 AM	NO	NO	18.5	14	7	8.4	390	5
202-GAZOS-14	Diversions	10/19/2004	2:55 PM	YES	NO	15.5	13	7.5	8.2	380	70
202-GAZOS-14	Diversions	10/25/2004	1:00 PM	NO	YES	14	13	7	9.4	410	5
202-GAZOS-14	Diversions	10/25/2004	1:00 PM	NO	NO	14	13	7	9.6	400	5
202-GAZOS-14	Diversions	10/28/2004	9:30 AM	NO	YES	9	8.5	7	8	420	5
202-GAZOS-14	Diversions	10/28/2004	9:30 AM	NO	NO	8	8.5	7	8.2	420	5
202-GAZOS-14	Diversions	11/9/2004	10:55 AM	YES	YES	14	10	7	9.6	420	5
202-GAZOS-14	Diversions	11/9/2004	10:55 AM	YES	NO	14	10	7	9.8	420	5
202-GAZOS-14	Diversions	11/13/2004	12:20 PM	NO	NO	16	12	7	10.2	410	5
202-GAZOS-14	Diversions	11/16/2004	10:00 AM	NO	YES	12	10	7.5	9.6	420	5
202-GAZOS-14	Diversions	11/16/2004	10:00 AM	NO	NO	11.5	10	7.5	9.6	420	5
202-GAZOS-15	Old Womans Creek	5/1/2004	12:15 PM	NO	NO	19.5	12	6.5	10	300	
202-GAZOS-15	Old Womans Creek	5/15/2004	11:30 AM	NO	NO	14.5	13.4	7	8.6	340	5
202-GAZOS-15	Old Womans Creek	5/26/2004	10:51 AM	NO	NO	15.5	13	7	8.2	340	5
202-GAZOS-15	Old Womans Creek	6/5/2004	10:56 AM	NO	NO	18	14	7	8.8	350	5
202-GAZOS-15	Old Womans Creek	6/11/2004	8:35 AM	NO	YES	14.1	13.8	7	8	360	5
202-GAZOS-15	Old Womans Creek	6/11/2004	8:35 AM	NO	NO	14.1	13.8	7	8	360	5
202-GAZOS-15	Old Womans Creek	6/23/2004	10:36 AM	NO	YES				7.8		
202-GAZOS-15	Old Womans Creek	6/23/2004	10:36 AM	NO	NO	16.5	14	7	8.6	360	5
202-GAZOS-15	Old Womans Creek	6/26/2004	10:40 AM	NO	NO	17	14.5	7.5	8.6	350	5
202-GAZOS-15	Old Womans Creek	7/6/2004	9:30 AM	NO	NO	13.5	14	7	9	360	5

Site ID	Site description	Date	Time	Rain in last 24 hrs?	Replicate	AIR_TEMP	H2O_TEMP	PH	D.O.	COND_US	TURB-IDITY
202-GAZOS-15	Old Womans Creek	7/10/2004	12:40 PM	NO	NO	17.6	15.3	7	8.6	350	5
202-GAZOS-15	Old Womans Creek	7/17/2004	9:30 AM	NO	YES	19.5	15	7	9	360	5
202-GAZOS-15	Old Womans Creek	7/17/2004	9:30 AM	NO	NO	19.5	15	7	9	360	5
202-GAZOS-15	Old Womans Creek	7/20/2004	10:10 AM	NO	YES	16	16	7.5		360	5
202-GAZOS-15	Old Womans Creek	7/20/2004	10:10 AM	NO	NO	16	16	7.5		360	5
202-GAZOS-15	Old Womans Creek	7/27/2004	11:45 AM	NO	NO	16.5	16	7	8.6	360	10
202-GAZOS-15	Old Womans Creek	8/13/2004	5:50 PM	NO	NO	18	16.4	7.5	8.2	370	5
202-GAZOS-15	Old Womans Creek	8/22/2004	11:15 AM	NO	NO	18	15.5	7.5	8.4	370	5
202-GAZOS-15	Old Womans Creek	8/28/2004	9:55 AM	NO	NO	17	14	7.5	8.8	370	5
202-GAZOS-15	Old Womans Creek	9/4/2004	10:45 AM	NO	NO	26	14	7.5	8.8	370	5
202-GAZOS-15	Old Womans Creek	9/11/2004	4:35 PM	NO	NO	20.6	14.9	7.5	8.8	370	5
202-GAZOS-15	Old Womans Creek	9/15/2004	10:00 AM	NO	NO	17	14	7	8.2	380	5
202-GAZOS-15	Old Womans Creek	9/22/2004	10:15 AM	NO	NO	14	11	7	9.2	380	5
202-GAZOS-15	Old Womans Creek	10/7/2004	11:50 AM	NO	NO	17.5	13.5	7	8.6	380	5
202-GAZOS-15	Old Womans Creek	10/19/2004	3:20 PM	YES	YES	15	12.5	7.5	8.8	380	30
202-GAZOS-15	Old Womans Creek	10/19/2004	3:20 PM	YES	NO	15	13	7.5	8.8	380	30
202-GAZOS-15	Old Womans Creek	10/25/2004	1:15 PM	NO	NO	15	14	7	9.4	380	5
202-GAZOS-15	Old Womans Creek	10/28/2004	10:15 AM	NO	NO	9	9	7.5	11	380	5
202-GAZOS-15	Old Womans Creek	11/9/2004	11:35 AM	YES	NO	13.5	10	7	9.8	400	5
202-GAZOS-15	Old Womans Creek	11/13/2004	12:00 PM	NO	NO	15	12	7	9.1	380	5
202-GAZOS-15	Old Womans Creek	11/16/2004	10:30 AM	NO	NO	12.5	10	7.5	9.8	400	5
202-GAZOS-16	Mainstem	5/15/2004	12:15 PM	NO	YES	15.9	13.5	7.5	9.8	360	5
202-GAZOS-16	Mainstem	5/15/2004	12:15 PM	NO	NO	16	13.5	7.5	10	360	5
202-GAZOS-16	Mainstem	5/26/2004	12:10 PM	NO	YES	17.5	13	7	9	370	5
202-GAZOS-16	Mainstem	5/26/2004	12:10 PM	NO	NO	18	13	7	9.2	360	5
202-GAZOS-16	Mainstem	6/5/2004	11:52 AM	NO	NO	20.5	13.5	7.5	8.8	370	5
202-GAZOS-16	Mainstem	6/11/2004	8:20 AM	NO	NO	12.7	12.7	7	8.8	360	5

Site ID	Site description	Date	Time	Rain in last 24 hrs?	Replicate	AIR_ TEMP	H2O_ TEMP	PH	D.O.	COND _ US	TURB-IDITY
202-GAZOS-16	Mainstem	6/23/2004	11:40 AM	NO	YES	17.5	14	7.5		380	5
202-GAZOS-16	Mainstem	6/23/2004	11:40 AM	NO	NO	17.5	13	7.5	8.6	380	5
202-GAZOS-16	Mainstem	6/26/2004	11:30 AM	NO	NO	19	14.5	7.5	9	380	5
202-GAZOS-16	Mainstem	7/6/2004	10:50 AM	NO	NO	16	13.5	7	9.6	390	5
202-GAZOS-16	Mainstem	7/10/2004	12:20 AM	NO	NO	18.4	15.1	7.5	9.5	380	5
202-GAZOS-16	Mainstem	7/17/2004	10:10 AM	NO	NO	17	15.5	7	9.4	390	5
202-GAZOS-16	Mainstem	7/20/2004	11:00 AM	NO	NO	17	15.5	7.5	8	390	5
202-GAZOS-16	Mainstem	7/27/2004	1:15 PM	NO	NO	19	18	7	8.4	370	5
202-GAZOS-16	Mainstem	8/13/2004	5:40 PM	NO	NO	17	16.5	7.5	9.4	400	5
202-GAZOS-16	Mainstem	8/22/2004	12:00 AM	NO	NO	18	15	7.5	8.2	400	5
202-GAZOS-16	Mainstem	8/25/2004	3:15 PM	NO	NO	23	18	7.5	8.6	400	5
202-GAZOS-16	Mainstem	8/28/2004	10:45 AM	NO	NO	19.5	14	7.5	9.4	410	5
202-GAZOS-16	Mainstem	9/4/2004	9:50 AM	NO	NO	16.5	13	7.5	9.2	420	5
202-GAZOS-16	Mainstem	9/11/2004	4:05 PM	NO	YES	21	15.5	7.5	8.4	420	5
202-GAZOS-16	Mainstem	9/11/2004	4:05 PM	NO	NO	21	15.5	7.5	8.4	420	5
202-GAZOS-16	Mainstem	9/15/2004	10:30 AM	NO	NO	18.5	14	7.5	8	420	5
202-GAZOS-16	Mainstem	9/22/2004	11:15 AM	NO	NO	14.5	11	7	9.6	410	5
202-GAZOS-16	Mainstem	10/7/2004	12:40 PM	NO	NO	19.5	13	7	8.8	430	5
202-GAZOS-16	Mainstem	10/19/2004	4:15 PM	YES	NO	14	13	7.5	9.2	340	15
202-GAZOS-16	Mainstem	10/25/2004	1:40 PM	NO	NO	15.5	13	7.5	10.2	410	5
202-GAZOS-16	Mainstem	10/28/2004	10:45 AM	NO	NO	8	8	7.5	11	400	5
202-GAZOS-16	Mainstem	11/9/2004	12:30 PM	YES	NO	10	12.5	7.5	10	430	5
202-GAZOS-16	Mainstem	11/13/2004	11:45 PM	NO	NO	13	11.5	7.5	9.6	400	5
202-GAZOS-16	Mainstem	11/16/2004	11:05 AM	NO	NO	11	9.5	7.5	9.8	430	5
202-GAZOS-11	Hwy 1Bridge	5/1/2004	12:37 PM	NO	NO	27.5	14	6.5	10	300	128
202-GAZOS-13	Below Bear Gulch	5/1/2004	11:58 AM	NO	NO	20	12	6.5	10	100	

BOLD NUMBERS INDICATE EXCEEDENCES OF THE WATER QUALITY OBJECTIVES SET FORTH BY CCAMP.

BACTERIA AND NUTRIENT RAW DATA

Gazos Watershed	400	10000	2.25	0.1	0.025	>/=
Site	**E. coli**	**Total Coliform**	**Nitrate**	**Ortho-Phosphate**	**Ammonia**	**Date**
Bearg-11	20	292	0.082		0.003	5/26/04
Gazos14	30	480	0.048		0.003	5/26/04
Gazos14FB						5/26/04
Gazos15		464	0.055		0.003	5/26/04
Gazos16		455			0.003	5/26/04
BEARG-21		379	0.063		**0.029**	7/6/04
GAZOS-14	63	1112	0.034		0.022	7/6/04
GAZOS-14FD1	20	1178	0.034		0.018	7/6/04
GAZOS-14FD2	41	1112	0.034		0.015	7/6/04
GAZOS-14FB					0.014	7/6/04
GAZOS-15	72	475	0.025		**0.295**	7/6/04
GAZOS-16	20	410			0.02	7/6/04
GAZOS14	285	2224				10/7/04
GAZOS14ND						10/7/04
GAZOS14FB						10/7/04
GAZOS15	10	472				10/7/04
GAZOS16	20	1354				10/7/04
BEARG-11	10	183	0.18		**0.031**	11/9/04
GAZOS14	10	121			**0.045**	11/9/04
GAZOS14FDN					**0.027**	11/9/04
GAZOS14-FB						11/9/04
GAZOS15	31	231			**0.048**	11/9/04
GAZOS16	20	317			**0.027**	11/9/04
Light grey = No Sample or Specific analysis not run on this sample						
Med grey = N.D. or non-detect						
Dark grey = Missing value						

APPENDIX C

Participating Community Organizations

Participating Agencies and Donor List

Funding Agency:

State Water Resources Control Board

Participating Governmental Agencies, Governments and Organizations

Monterey Bay National Marine Sanctuary
Ocean Conservancy
Santa Cruz County
Santa Cruz County Department of Environmental Health Services
Santa Cruz County Parks
San Mateo County
San Mateo County Department of Environmental Health
City of Capitola
City of Capitola Public Works Department
City of Half Moon Bay
City of Monterey Public Works Department
City of Pacific Grove Public Works Department
City of Santa Cruz
City of Watsonville Parks Department - Ramsey Park Nature Center
City of Watsonville Public Works Department
City of Watsonville Waste Water Treatment Facility
State Water Resources Control Board - Clean Water Team
California Environmental Protection Agency
Agricultural & Land based Training Association (ALBA)
Monterey Bay Sanctuary Citizen Watershed Monitoring Network
Surfrider Foundation
Save Our Shores
Natural Bridges State Park
Nisene Marks State Park
Happy Valley Elementary School
Harbor High School (Santa Cruz)
Valencia Elementary
Monarch School (Santa Cruz)
Sewer Authority Mid-Coastside, San Mateo County

Business Donors

Aptos Grange
Beach House Restaurant, San Mateo County
Kelly's Bakery
LuLu Carpenter's, Santa Cruz
Noah's Bagels, Capitola
Pacific Coffee Roasting Company, Aptos
REI, Saratoga, CA
Safeway, Aptos
Safeway, Mission St., Santa Cruz
San Gregorio General Store, San Gregorio
Santa Cruz Coffee Roasting Company
Starbuck's Coffee, Half Moon Bay
The Farm Bakery & Cafe, Aptos
Trader Joes, Capitola