Appendices

Appendix A: Stream Team Field and Lab Guide

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Appendix C: Fecal Indicator Bacteria Procedures

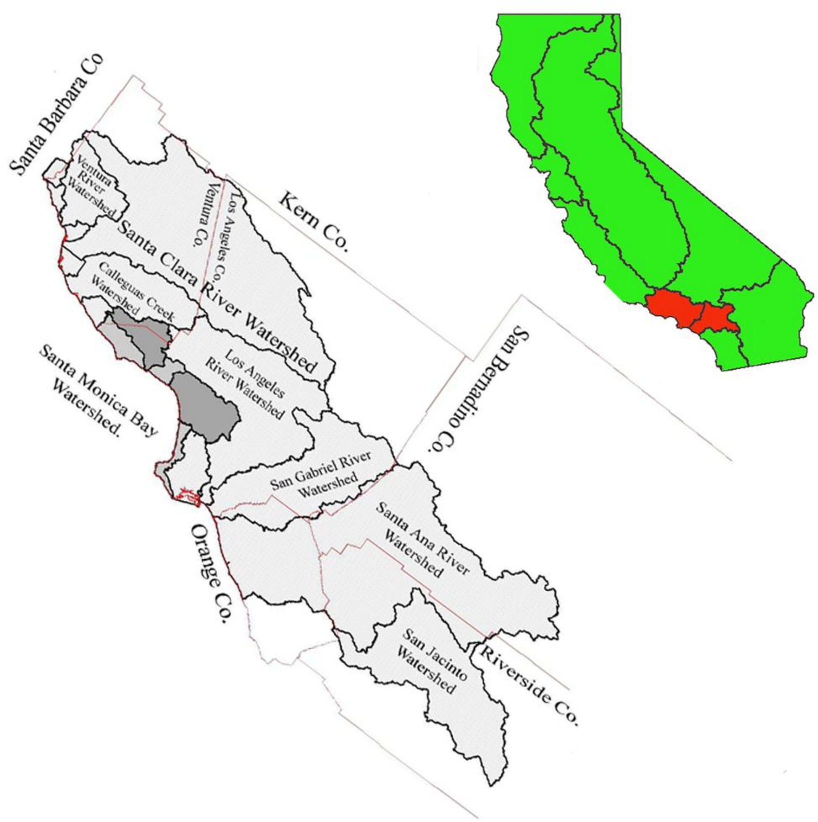
Heal the Bay

STREAM TEAM

Heal the Bay's Stream Team Citizen Monitoring Program

Citizen Guide for Field and Laboratory Protocol:

Water Chemistry Monitoring in the Santa Monica Mountains



The Santa Monica Bay Watershed

STREAM TEAM FIELD AND LAB GUIDE

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Section 1- Introduction to the Stream Team Program

Welcome to the Stream Team

You are about to become part of a very special and rewarding effort. The Stream Team is a coalition of volunteer monitoring organizations and citizen volunteers dedicated to collecting high quality, accurate data. The data we collect must be usable by resource managers, decision makers, environmental organizations, and citizens to protect and enhance the water quality in our freshwater environments. This effort partners the information needs of local, state, and federal government agencies in need of environmentally aware citizens who wish to actively work to protect and enhance the environment in the Malibu Creek Watershed.

As a Stream Team member, you can join other volunteers in the Malibu Creek Watershed Stream Team Program. Through this program, you, along with many other concerned citizens like yourself, can rise to the challenge of becoming citizen stewards of the Malibu Creek Watershed. You will be working in partnership with Heal the Bay and the State Coastal Conservancy (SCC), who are sponsoring and coordinating the program. The information you collect will provide baseline data needed by Heal the Bay, the State Coastal Conservancy, and other agencies to determine the current conditions of the watershed. The combined efforts of this partnership should ultimately help to enhance the ecological function and improve water quality throughout the watershed, which in turn will improve water quality at the Malibu Lagoon State Park and Surfrider Beach.

In the following pages, you can learn how this is possible. This Field Guide is designed to give you a background on watersheds, then lead you through the specific steps necessary to become a successful monitor. Get to know your Field Guide. It's yours to refer to again and again. Make this guide your own personal tool for watershed stewardship!

Why Water Quality Monitoring is Important

Poor water quality is a health concern for humans and wildlife, including birds and aquatic life. Pollutants, like sediments, nutrients, pesticides, and heavy metals originate upstream, somewhere within the watershed. Urban runoff carries these pollutants into streams and rivers, which ultimately flow into the ocean. Urbanization of watershed areas has altered the natural hydrology of southern California. The main purpose of this program is to determine to what extent upstream development is contributing to poor water quality in our rivers, streams, lakes, harbors, estuaries, and ocean.

This volunteer monitoring program will address the sources and causes of degradation to water quality. It is the program designer's hope that all volunteers understand how poor land use practices can negatively impact natural watershed processes, water quality, and environmental health.

Goals and Objectives of the Stream Team Program

Each local monitoring group will have specific goals and objectives that address the issues of concern in the area they are monitoring. The Stream Team program is a coordinated effort to help these local monitoring groups collect accurate and useful water quality information. The standardized equipment kit and field guide, expert training and frequent instrument testing ensure that local monitoring groups collect accurate and consistent data. Each piece of equipment in the field kit has been specially selected for ease of use, durability, accuracy, precision, and reliability. Both the equipment and data collection methods have been rigorously researched and tested to ensure the highest data quality. The information collected will be used to develop strategies to improve ecological health and water quality throughout southern California.

The overall goal of the monitoring program is to collect information that facilitates:

- Consistent and accurate water quality data collection by all volunteer monitoring groups within the Los Angeles Region.
- The identification of waters that do not meet current water quality standards.
- The use of data by regulators and decision makers to set appropriate and protective water quality standards.

Involvement by citizen volunteers in the monitoring program will allow the Stream Team to meet the following objectives:

- To determine the current water quality conditions (baseline data) in the region.
- To increase the amount of data collected by providing no-cost collection of water samples for analysis by specialized laboratories.
- To assess the effectiveness of restoration efforts and/or Best Management Practices (BMP's) that are implemented to protect against negative impacts to water quality.

The Inspiration Behind the Program

Influenced by the consistently poor water quality throughout southern California, the Southern California Marine Institute (SCMI) has contracted Heal the Bay to adapt their highly successful *Malibu Creek Watershed Stream Team Field Guide* for use by volunteer monitoring groups throughout Southern California. There is an urgent need to collect useable data for developing more protective water quality standards. In fact, the U.S. Federal Clean Water Act requires the Environmental Protection Agency to establish nationwide water quality standards that protect the designated beneficial uses of water bodies. The Clean Water Act (CWA) was created in 1972, and is the cornerstone of surface water quality protection in the United States. The overarching goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters to support "the protection and propagation of fish, shellfish, and wildlife."(http:// www.epa.gov/watertrain/cwa/).

Each state is obligated to adopt a list of designated beneficial uses and water quality standards for both marine and inland surface waters within their jurisdiction that are at least as strong as those created by the US Environmental Protection Agency (EPA). In California, The State Water Resources Control Board (State Board) is responsible for making sure this occurs. The State Board assigns water quality standards for marine waters within 3 miles of the coast. These water quality standards for the marine environment are contained in the California Ocean Plan. The California Ocean Plan can be viewed at http:// www.swrcb.ca.gov/plnspols/. For inland waters the State Board allocates this responsibility to the nine Regional Boards (Figure 1-1). Every surface water body is considered to have some use or uses that benefit the general public, wildlife, or aquatic life. Some examples of beneficial uses are: Commercial and Sport Fishing, Recreational Body Contact, Wildlife Habitat, Marine Habitat, and

Agricultural Water Supply. Each Regional Board creates a document known as a Basin Plan that specifically designates beneficial uses and water quality standards for all surface water bodies in the region. The Basin Plan also incorporates the water quality standards created in the California Ocean Plan. In the Los Angeles/Ventura Area (Region 4) there are 24 beneficial uses and in the Santa Ana Area (Region 8) there are 19 designated beneficial uses. You can view a copy of the Basin Plan for the Los Angeles/ Ventura Region on line at http://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/

And for the Orange County/Santa Ana Region, the Basin Plan can be viewed at http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/index.shtml

Figure 1-1 The 9 Regional Board Areas in California. Region 4 includes Los Angeles and Ventura Counties and Region 8 includes Orange and Riverside Counties. Image adapted from Basin Plan.

Once the beneficial uses for a water body are stated, we then need to determine if the water body is clean enough to support these uses. We accomplish this by testing the water and comparing the results to the water quality standards listed in the Basin Plan. Stream Team data will be compared to official standards to determine if your water body is supporting the designated beneficial uses. If the water body does not meet the standard it is considered impaired (unable to support its designated beneficial use). Water bodies that do not meet the minimum water quality standards are placed on a list of impaired water bodies known as the 303 (d) list. Throughout California more than 509 individual water bodies currently do not support their beneficial uses. One hundred and fifty five of these impaired water bodies, and more than 700 individual reaches are in the Los Angeles/ Ventura Counties region.

What Happens if Your Water Body is Impaired?

If your water body is impaired and is on the 303 (d) list, the CWA requires that a plan be created to reduce the pollution that is causing the impairment to a safe level. This plan is called a Total Maximum Daily Load (TMDL). A TMDL is the amount of a particular pollutant that a water body can handle and still support its designated beneficial uses.

How Does Volunteer Monitoring Help Protect the Water?

With the large number of impairments in our region, an incredible amount of water quality data needs to be collected to insure that TMDLs are developed in a way that will restore and protect beneficial uses. Your data will help show where water quality is poor, and what water quality in your water body should be. The best way to determine what the water quality should be is to find a section of stream, or ocean that has not been impacted by development. This is known as a reference condition. A reference condition tells us what pollution levels are without man-made input. These areas should be used to help set new water quality standards that will restore the beneficial uses of the impaired water body. In other words, you will help collect the data needed to create an appropriate TMDL.

Once a TMDL has been created, we will know the amount of a pollutant that can safely enter the water body. The Regional Board will then assign an allowable limit to all entities that contribute the specific pollutant into the water body. For example, if only five pounds a day of dirt can enter the stream before it starts to hurt aquatic life and we have two businesses that make and sell topsoil, neither business will be allowed to discharge more than 2.5 pounds into the stream. A large amount of data needs to be collected to determine if the TMDLs are being met.

How You Can Benefit from the Program

If you participate in the Stream Team effort to clean up the Malibu Creek Watershed, you will learn new skills and receive expert training in fields such as how to conduct water chemistry tests. The information you gather will be used by the Regional Board and other organizations interested in protecting and enhancing the water quality in southern California. By participating, you can be a part of the history of successful projects conducted by local organizations dedicated to improving water quality for people and marine life in southern California. Get to know your watershed including its beauty and its problem areas. In the Malibu Creek Watershed, Stream Team volunteers have found and reported two sewage spills. Because these volunteers quickly reported the incident, raw sewage was prevented from reaching our streams and ocean. Join us and become a steward for clean water.

How to Use the Guide

The Stream Team Field Guide is designed for use by citizen monitors who have been trained to conduct monitoring for their specific program. **The field guide is a companion to field training, and is not intended to be used on its own.**

Note to Program Leaders about the Field Guide:

1. Calibrate all instruments in a laboratory setting **(not in the field).**
2. Calibrations should be done by the program leader or specially trained representative of the program leader.
3. Calibrate instruments just prior to each monitoring event.
4. Test all instrument calibrations directly after they are used in the field to ensure the validity of field measurements. If the post collection calibration exceeds the criteria stated in the Quality Assurance Project Plan (QAPP) for that instrument, the data collected with that instrument must be discarded or measured again.

5. Program leaders must maintain a calibration log that details the date, time and person who calibrates each instrument and the date, time and person who tests the instrument when they return from the field.
6. Use only the appropriate NIST certified standards for each instrument calibration
7. Conduct every field measurement at least twice. Take a third field measurement if the first two measurements vary significantly.
8. Conduct one split sample and one replicate sample for nutrients and bacteria on every sampling day.
9. On each day of nutrient testing, the program leader must test a NIST certified standard (solution with a known value) for each nutrient being measured.
10. Remove all equipment references from this field guide that will not be used in your monitoring program, to avoid confusion among the volunteers.

Section 2- The Santa Monica Bay Watersheds

Defining a Watershed

Everyone lives in a watershed. A watershed, or drainage basin, is defined as the land area from which water, sediments, and dissolved materials are drained by a series of tributaries, streams, and creeks into a common outlet (Napa County Resource Conservation District 1998, pg.7). You can delineate a watershed by connecting all the high points surrounding a given water body (Figure 2-1). Any precipitation falling inside this boundary stays in the watershed, whereas precipitation falling outside this boundary flows into another watershed. Watersheds can vary greatly in size and shape.

The Los Angeles region contains seven large watersheds (Figure 2-2).

The **Santa Clara River Watershed** is approximately 1,200 square miles in area. It is the largest river system in southern California that remains in a relatively undisturbed state. The Santa Clara River flows nearly 100 miles. The river originates in the northern slopes of the San Gabriel Mountains and flows westward towards Ventura County. It eventually empties into the Pacific Ocean at the Santa Clara River Estuary between the cities of Oxnard and Ventura.

The **Ventura River Watershed** drains an area of 235 square miles. The 31-mile river flows south forming an estuary at its outlet with the Pacific Ocean near the city of Ventura. In 2000 the Ventura River was named the third most endangered river in the United States. (http://www.americanrivers.org/mostendangered/ventura2000.htm).

The **Calleguas Creek Watershed** is 343 square miles in area, comprised of 25% agricultural land use, 25% urban and residential land uses, and 50% open space. Calleguas Creek begins in the Santa Suzana Mountains in the North and the Santa Monica Mountains in the Southeast and flows 36 miles to its outlet at Mugu Lagoon. (Calleguas Creek Watershed Management Plan, http://www.calleguas.com/ccbrochure/introld.html). Mugu Lagoon is one of the few remaining salt-water wetland habitats in Southern California.

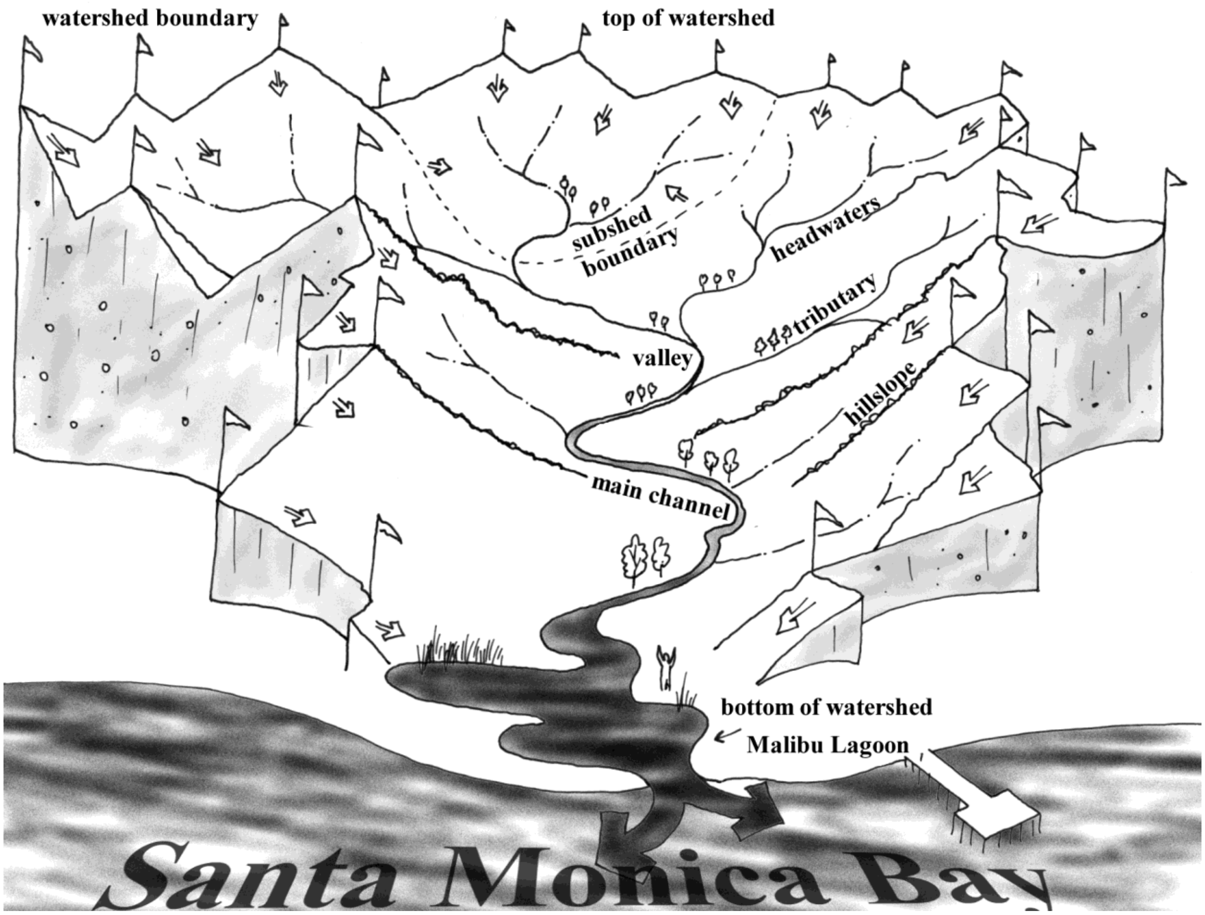


Figure 2-1. Delineating watersheds.

(http://dpw.co.la.ca.us/wmd/watershed/sc/).

The **Los Angeles River Watershed** covers a land area of 834 square miles from the eastern portions of the Santa Monica Mountains, Simi Hills, and Santa Suzana Mountains to the San Gabriel Mountains in the west. Forty-eight miles of the 51- mile river are lined with concrete. The river empties into San Pedro Bay near Long Beach at the Pacific Ocean. Approximately 475 square miles of the watershed are highly developed by commercial, industrial or residential land uses. Over 80% of the river's flow is made up of discharge from industrial uses and wastewater treatment plants. (http://dpw.co.la.ca.us/wmd/watershed/LA/).

The **San Gabriel River Watershed** is 640 square miles with approximately 26% of its total area developed. The San Gabriel River flows south from the San Gabriel Mountains, in the Angeles National Forest, until it enters the Pacific Ocean in Long Beach. The San Gabriel River may connect with the Los Angeles River during extremely strong winter storms at the Whittier

Narrows Dam and Reservoir (Common Ground from the Mountains to the Sea, pg. 20).

The **Dominguez Channel Watershed** is 110 square miles in area. Ninety-six percent of the total area has been developed. The channel starts at the Los Angeles International Airport and receives runoff from the cities Inglewood, Hawthorne, El Segundo, Gardena, Lawndale, Redondo Beach, Torrance, Carson and Los Angeles. The Dominguez Channel empties into Los Angeles and Long Beach Harbors. The harbor was once a series of mudflats and wetlands fed by the Los Angeles River. In the early 1900's marshes and wetlands were filled to accommodate large ships. The river was diverted and a breakwater was constructed to allow ships to easily unload their cargo. The entire Dominguez channel is lined with concrete (http://dpw.co.la.ca.us/wmd/watershed/dc/current_cond.cfm/).

The **Santa Monica Bay Watershed** drains an area of 414 square miles. Twenty-eight separate smaller watershed all drain into Santa Monica Bay, the two largest being the 126-square mile Ballona Creek Watershed and the 110-square mile Malibu Creek Watershed. Santa Monica Bay's natural boundaries extend from Point Dume to Palos Verdes Point. It has 50 miles of coastline with 22 separate public beaches that provide recreational opportunities for an estimated 45 million visitors each year (http://www.smbay.org/10.htm).

The Santa Ana region is made up of portions of two distinct watersheds that drain a combined area of 2,800 square miles (Figure 2-2).

The **Santa Ana River Watershed** covers 2,650 square miles of wildly varying terrain, which includes parts of San Bernardino, Riverside, and Orange Counties. Over 4.8 million people live in the watershed. The mainstem of the Santa Ana River is over 100 miles long and is the largest river system in southern California. The headwaters of the Santa Ana River and its tributaries are in the San Gabriel and San Bernardino Mountains to the north and the San Gorgonio and San Jacinto Mountains to the east. Peaks in these ranges are over 10,000 feet high. The Santa Ana River flows in a southwesterly direction to its mouth at the Pacific Ocean located on the boundary between Newport Beach and Huntington Beach. (http://eureka.regis.berkeley.edu/wrpinfo/).

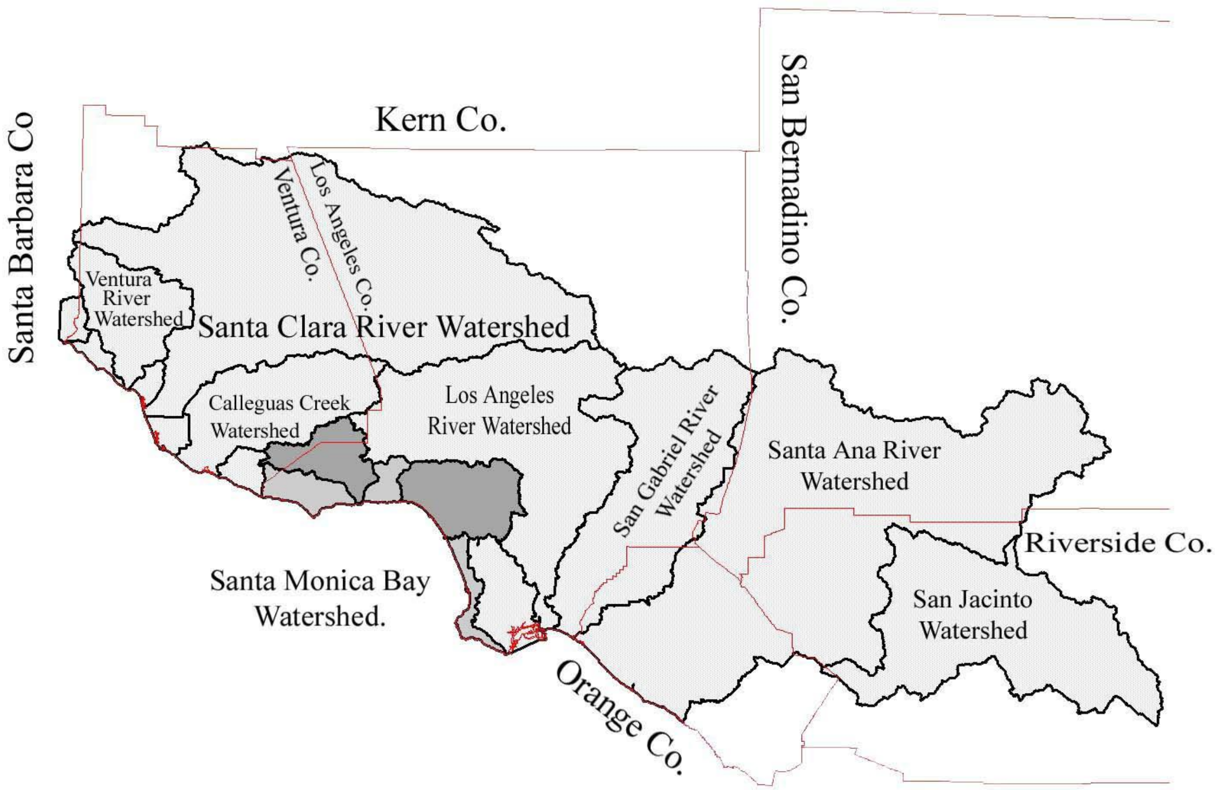


Figure 2-2. Major Watersheds of the Los Angeles and Santa Ana Regions (Region 4 and Region 8).

The **San Jacinto Watershed** covers approximately 760 square miles with elevations that range from 1,260 to 10,805 feet at San Jacinto Peak. The watershed is located within Riverside County with a small portion extending into Orange County. The watershed is bounded on the north by the San Timoteo Badlands and on the east by the San Jacinto Mountains. The watershed contains three reservoirs: Lake Hemet, Perris Reservoir, and Railroad Canyon Reservoir, which are used for municipal, industrial, and agricultural use. (http://eureka.regis.berkeley.edu/wrpinfo/).

The Hydrologic Cycle

The hydrologic cycle is the earth's process of water recycling. It is critical for understanding watersheds. The hydrologic cycle is a closed loop system driven by the energy of the sun, which continually transports water between the atmosphere and the earth's surface water. The three main processes of the hydrologic cycle are precipitation, evaporation, and transpiration. Once precipitation falls on to land, approximately two-thirds of this is evaporated back into the atmosphere. The remainder is either absorbed into the ground or flows over the land as surface water. Transpiration occurs when energy from the sun draws water from the leaves of plants back into the atmosphere in the form of water vapor (Figure 2-3).

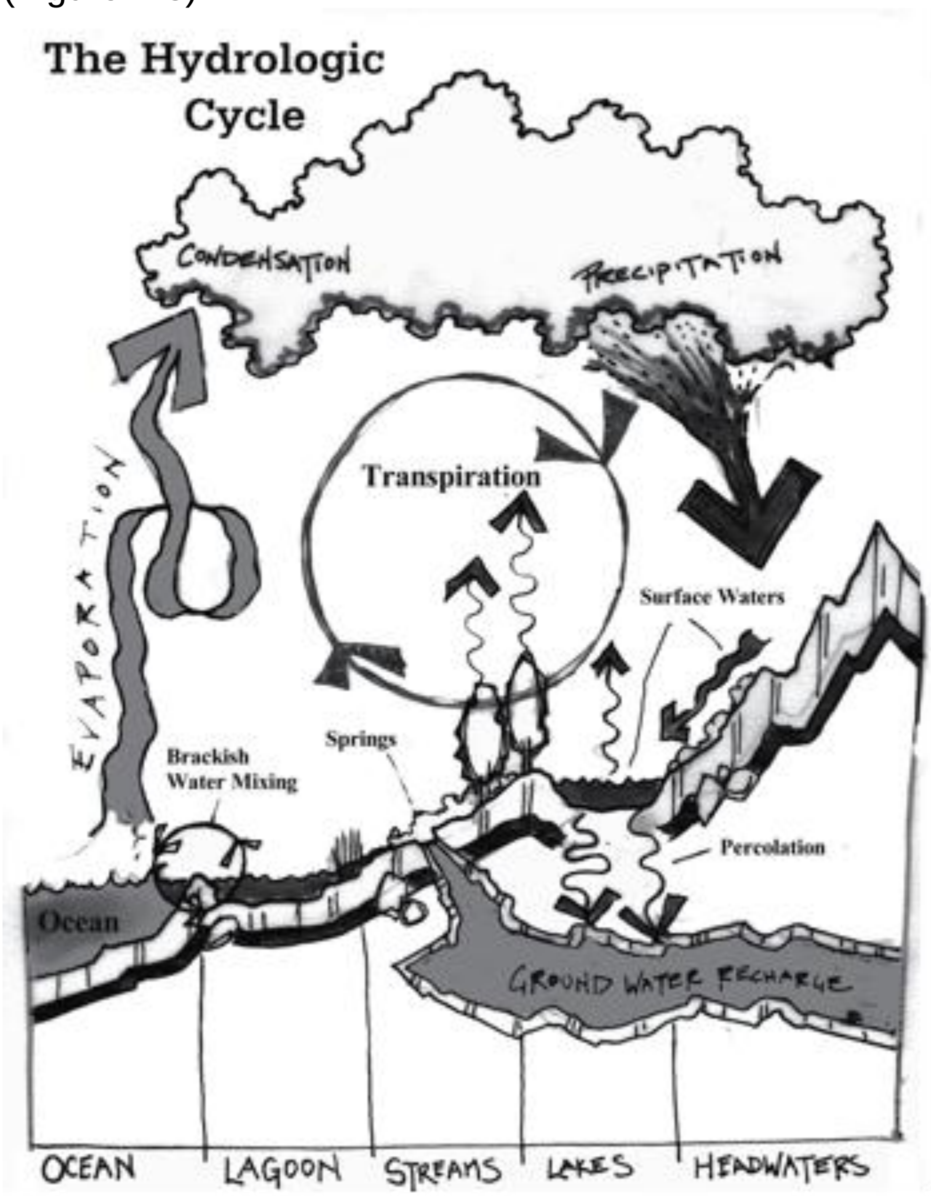


Figure 2-3. The Hydrologic Cycle.

The hydrologic cycle can be best explained by beginning with a discussion of surface water. Surface water in lakes, streams, lagoons, oceans and on the ground, is heated by the sun’s energy and turned into vapor through the process of evaporation. Transpiration occurs when plant roots absorb water stored in the soil. The water migrates up the stem or trunk until it eventually comes out from thousands of tiny holes on each leaf. The process of transpiration may produce more water vapor in the atmosphere than evaporation. A large oak tree transpires approximately 39,578 gallons per year (Leopold 1997, p.5). Warm air can hold more water vapor than cold air. When air cools down, the water vapor exceeds the carrying capacity of the air. The water vapor turns back into its heavier liquid form, and falls to earth as precipitation. The rain is again absorbed into the soil, or flows over the land and into the streams and eventually into wetlands, lakes, and the ocean.

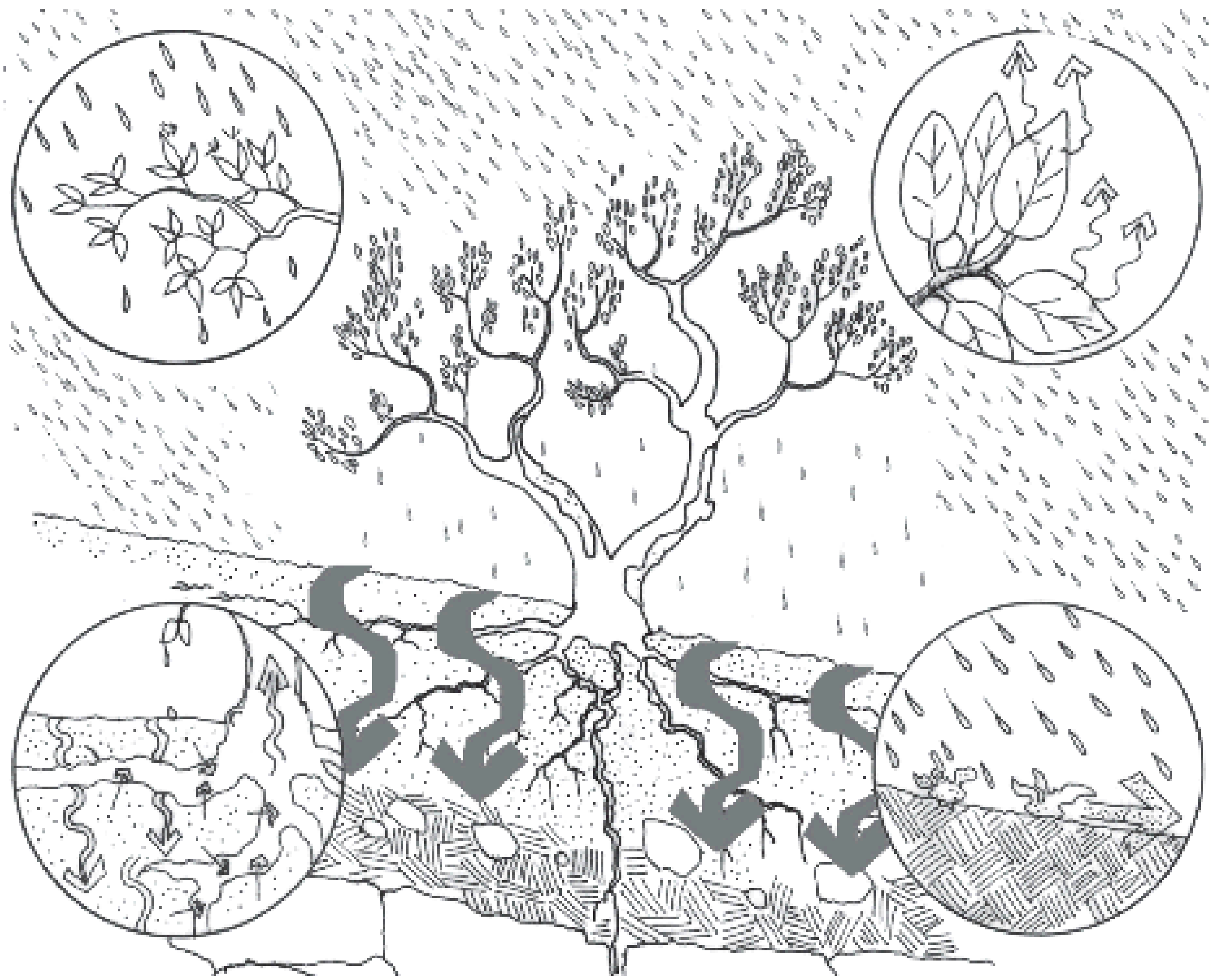


Figure 2-4. Vegetation helps infiltration and prevents erosion by: A) intercepting the rain and slowing down water flows, B) roots break up soils creating pore space for water to infiltrate, and C) water absorbed by roots can be transpired from the leaves. D) Rain loosening exposed soils and transporting sediments into receiving waters.

The hydrologic cycle is continually repeated. The sun evaporates surface waters, and plants transpire water into vapor, which eventually falls back to earth as rain. The total amount of water on the earth's surface is finite, and in essence, it is the same water cycling over and over again. Therefore it is critical to maintain non-polluted, high quality water.

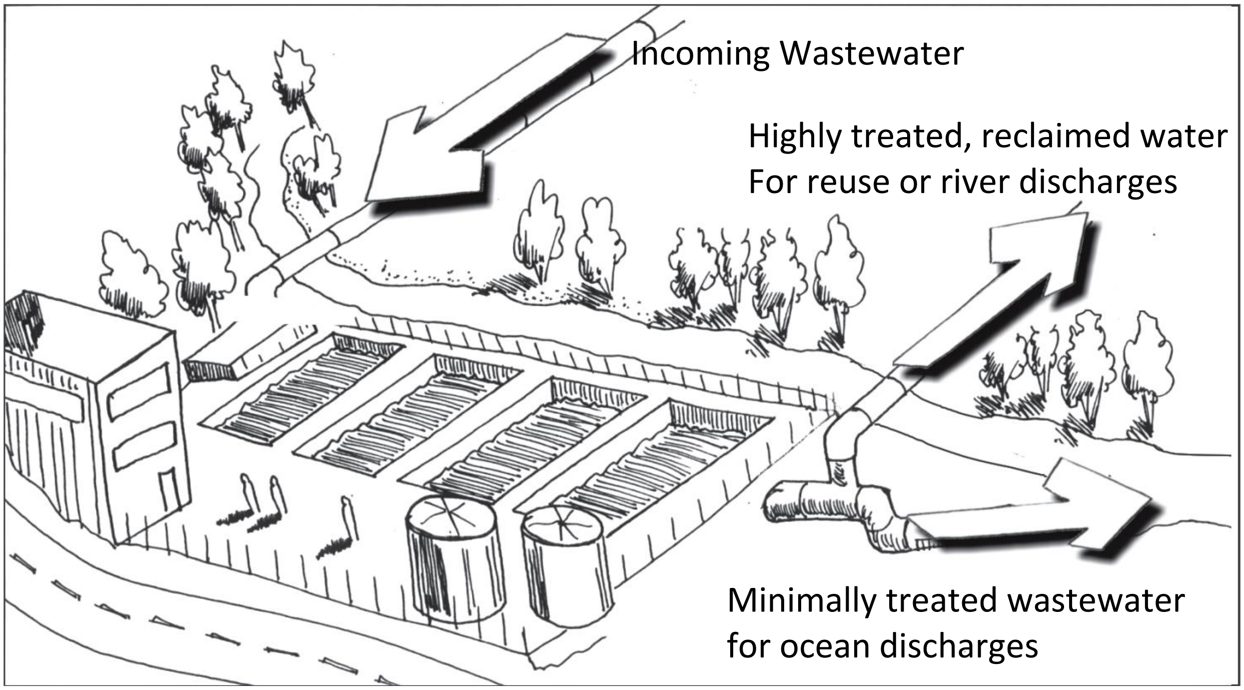


Figure 2-5. The discharge of treated wastewater from sewage treatment facilities contributes nutrients and increases flows to rivers.

One important aspect of the hydrologic cycle, in terms of watersheds, is the process of infiltration. The rate at which water is absorbed into the ground (infiltration) is influenced by two main factors: the characteristics of the soil material and the type and density of the vegetation growing or lying on the ground (Leopold 1997, p.10). Soil is composed of millions of tiny particles that have air spaces or pores separating each particle. Precipitation that falls onto the land is absorbed or infiltrated through these pores. Soils with bigger pores, like sand, allow precipitation to infiltrate more quickly. Conversely, soils with smaller pores, like clay, absorb water more slowly. When the rain falls faster than the pores can absorb, or when soil becomes saturated, the excess rain flows across the surface of the land. This surface runoff flows down the mountains into waterbodies.

On one plot, a third of the land had grass or other vegetation growing on it, and the other plot was bare ground. The land with vegetative cover infiltrated water at six times the rate of bare ground (Leopold 1997, p.12).

As watersheds in southern California become more urban, two major changes to the hydrologic cycle generally occur. The quantity of water circulating within the watershed increases. This is caused by the need to import water and the inability of the landscape to absorb rain and storm runoff because of the increasing amount of paved surfaces. The quality of water decreases due to the addition of nutrients, sediments, and pollutants in urban runoff. The resulting increase in water quantity and decrease in water quality is altering the chemical, biological, and physical characteristics of our rivers and oceans.

In order to accommodate our growing population, and the demands of domestic, commercial and industrial water users within watersheds, it has become necessary to import water. This water is supplied primarily from the California State Water Project, which collects and transports water from northern California rivers and the Colorado River. Imported water, storm runoff, and pollutants enter waterbodies in three ways. The first is by way of sewage treatment plants and/or industrial dischargers, second, by surface runoff via the storm drain network, and lastly through groundwater.

Sewage treatment plants receive wastewater from households and businesses (Figure 2-5). Sewage treatment plants that discharge into freshwater are required by law to filter and treat wastewater to a cleaner level than facilities that discharge to the ocean. Generally, treatment plants are located near rivers or the ocean because it is cheaper to discharge directly to a waterbody than to pipe the treated water long distances for disposal. Some freshwater treatment facilities reclaim wastewater by treating it until it is clean enough to be safely reused for irrigation. The reclaimed water is sold to cities for watering parks, public gardens, and highway medians. When freshwater treatment plants have more reclaimed water than they can sell, surplus water is discharged into our rivers. Most treatment facilities that have ocean discharges do not reclaim treated wastewater. They discharge poorer quality water at higher quantities than freshwater facilities.

One water treatment facility is the Tapia Water Reclamation Plant. Tapia receives wastewater from households and businesses in and out of the watershed (Figure 2-6). Tapia is located along Malibu Creek approximately

Agricultural irrigation runoff can carry pesticides, herbicides and fertilizers into the waterways. Organic farming practices prevent much of this type of pollution!

Channelized rivers carry water at higher volumes and intensities, which can contribute to flooding and streambank erosion downstream.

Stormwater can carry pollutants, trash and sediments into the waterways. Impermeable surfaces increase the volume and intensity of flows, which often overwhelm downstream riparian areas.

Runoff from improperly installed irrigation can carry nutrients, oils, sediments, and pollutants into streams.

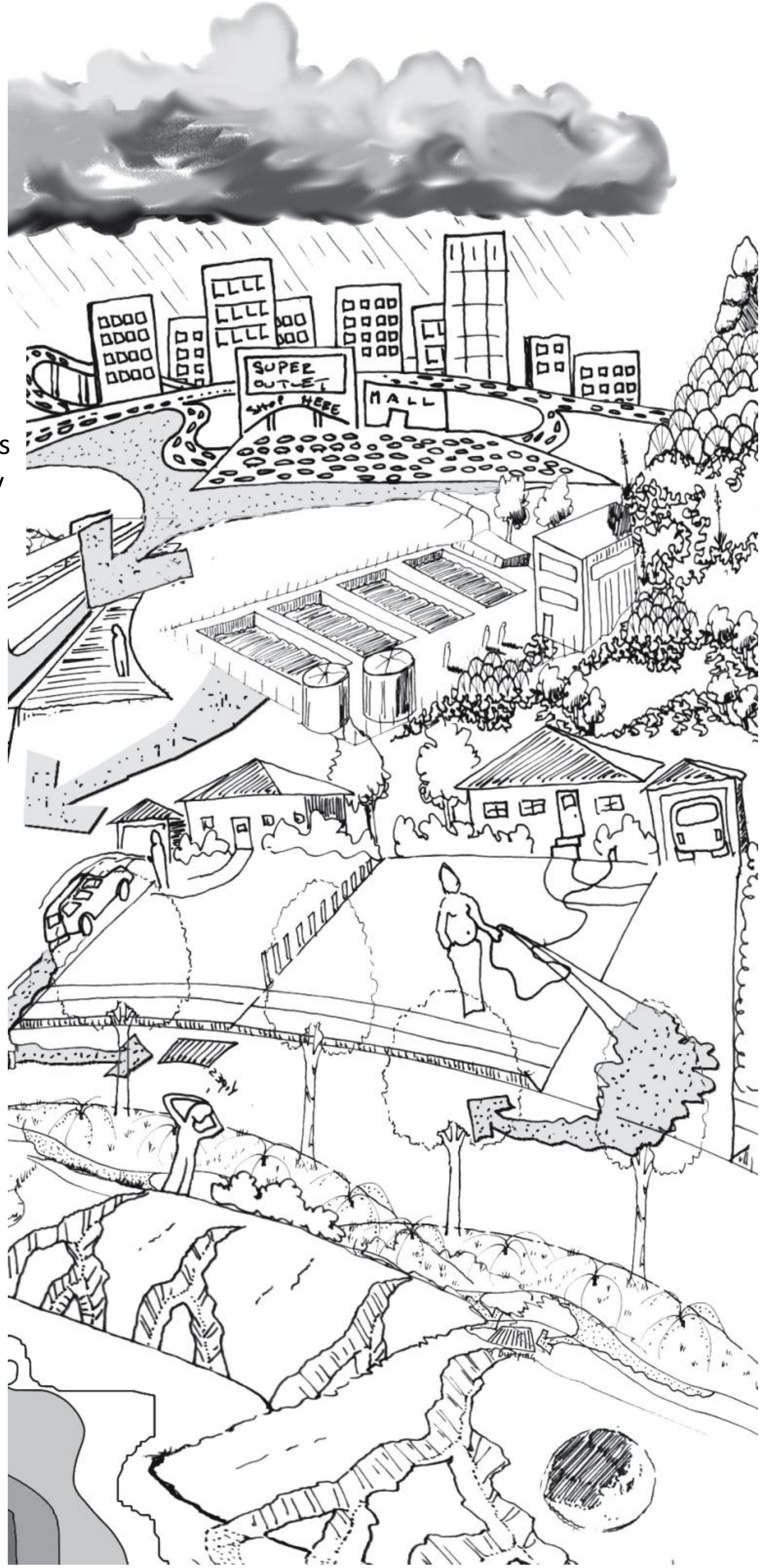


Figure 2-6.

five miles north of the Malibu Lagoon. Tapia filters and treats the wastewater reclaiming it to a condition that allows this water to be safely reused for irrigation.

Treated wastewater generally has high levels of nutrients (food for plants). When nutrient rich wastewater is discharged into rivers, the food supply for aquatic plants, such as algae, is increased. Algae are important sources of food for many aquatic animals, but when excess nutrients cause too much algae, it degrades water quality. This is because algae use up oxygen from the water. The effect is most severe at night when algae are not photosynthesizing, so oxygen in the water is not replaced. Too much algae can cause low levels of dissolved oxygen at night. When algae dies it decomposes in the water and this uses up even more oxygen. Without enough available oxygen in the water, other plants and animals cannot survive.

The treated water discharged to streams and the ocean is called a point source because it comes out of a single pipe. Other point sources include industrial users. For example, numerous power plants generate electricity in our region. These plants use clean water to cool the generating equipment and then discharge the water at a higher temperature back into the water body. Numerous manufacturing plants and other industries also generate liquid wastes and discharge them to surface waters. The Clean Water Act dictates that point source dischargers are regulated by the Regional Board through discharge permits. These permits limit both the concentration and total amount of pollutants that can be released.

Imported water, rainwater, and pollutants also enter the streams through surface runoff via the storm drain network. Surface runoff is that water, which is not evaporated, transpired, or infiltrated. The storm drain network captures water that flows over land from irrigation, rain, or any source that contributes water to the street. As surface water flows over the land, it washes nutrients, sediments, trash, and other pollutants from the land into storm drains and then to the rivers and ocean (Figure 2-6).

Paved surfaces and rooftops, also known as impermeable surfaces, replace vegetation and soils, thereby affecting the area's ability to clean and infiltrate surface runoff. An impermeable surface is one that prevents the penetration of water, resulting in stormwater rushing off of the surface, into the storm drain network, and eventually into a channel or creek. The increased quantity and intensity of surface water created by impervious surfaces often overwhelms plants growing along the sides of waterbodies and causes severe erosion of the streambanks. Further, impervious surfaces capture pollutants leaking from poorly maintained cars, settling air pollution, and litter. Each year, the first rainfall of the season carries several months' worth of urban pollutants, trash, sediments, and nutrients that are washed off the impervious surfaces directly into waterbodies, in what is known as the "first flush". The first flush washes these pollutants directly into lakes, rivers, streams, and ultimately the ocean.

Once, our nation's beaches were littered only with the likes of seaweed, shells, driftwood, and stranded jellyfish. These days, the litter is more likely to include cigarette butts, grocery bags, scraps of fishing nets, pieces of foam coffee cups, fast food containers, and soda bottles. Rarely can a person visit a stream, lake, river, estuary, or ocean and fail to observe some form of trash. Trash and debris that are carried into waterbodies and ultimately the ocean impact human health and safety; pose an entanglement or ingestion threat to wildlife; and degrade critical habitats. Plastic debris such as, nets, fishing lines, and trash bags can snare boat propellers or clog cooling water intakes, damaging the motor. A disabled motor cannot only be costly to fix, but can leave boaters stranded in the water. Wildlife often fare even worse than humans. Marine debris can mean death to aquatic animals. One common cause of death by marine debris is entanglement. Many animals are caught in discarded fishing nets and lines, rope, six-pack rings, balloon ribbons, grocery bags, and other floating debris. Some animals die from marine debris ingestion, mistakenly eating the human-made materials. Endangered sea turtles, for example, consume floating trash bags and balloons, probably mistaking them for jellyfish. Several seabird species have been found to swallow plastic pieces and cigarette butts. These materials can damage the animals' digestive systems. Ironically, since the debris in their stomachs offers no nutritional value, these animals can eventually starve to death while feeling full.

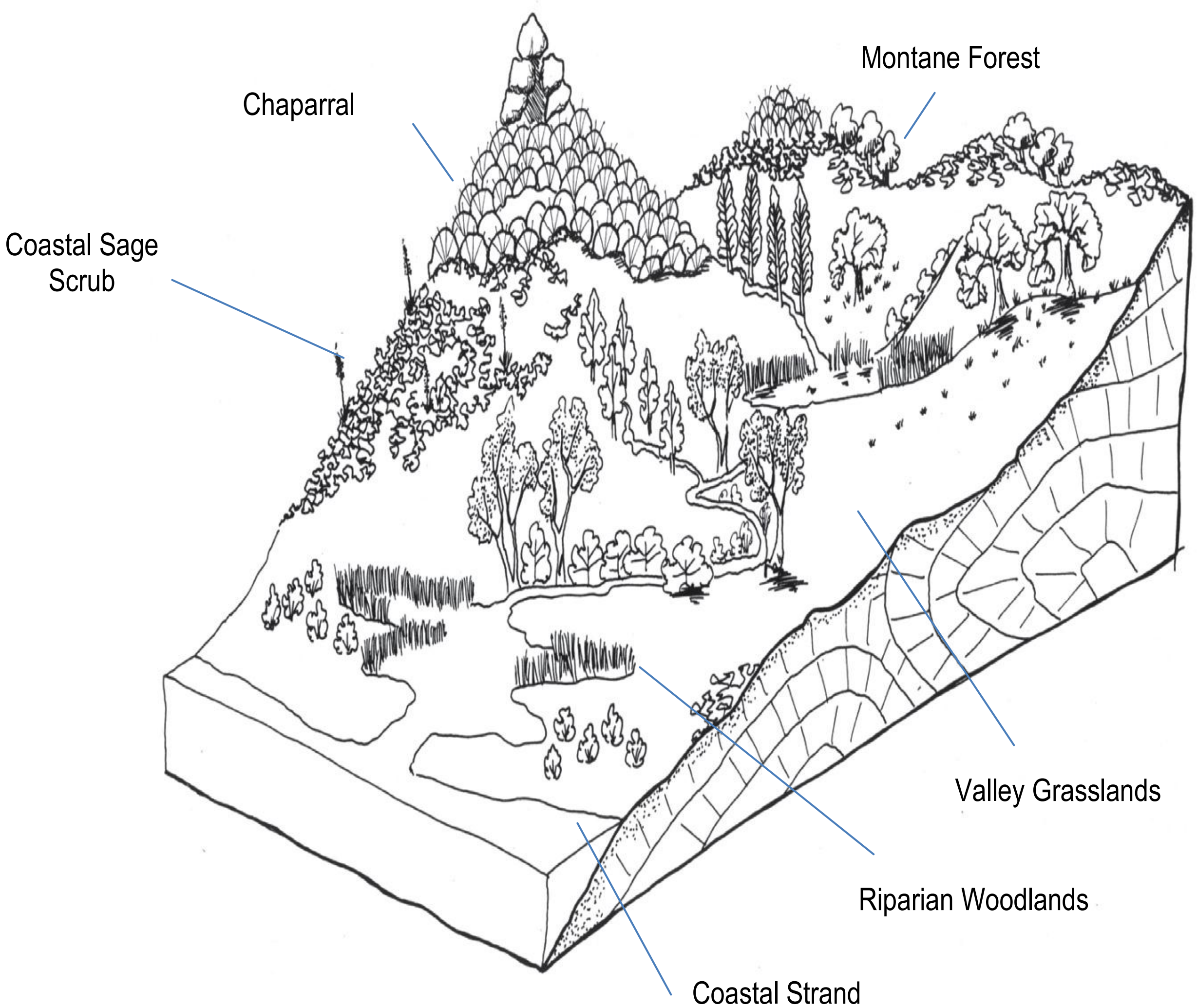


Figure 2-7. The image above represents the regional plant communities.

Imported water also reaches waterbodies through groundwater. Water from landscape irrigation or from septic systems infiltrates into the soils. Eventually, it can flow through underground channels and into streams. That water may carry excess nutrients from lawn and agriculture fertilizers, and improperly functioning septic systems.

Vegetation

This area of southern California is covered with plant communities that have evolved to fit the unique soils and climate of the region (Figure 2-7). Chaparral and Coastal Sage Scrub vegetative communities dominate in most areas. Both plant communities are adapted to the dry conditions of the summer months. For example, they have small glossy leaves to retain moisture, as well as the ability to drop their leaves in times of drought.

Chaparral plants such as Manzanita or Chamise, and Coastal Sage Scrub plants such as Black Sage and California Sagebrush are fire-adapted and depend on regular burning to remove old growth and rejuvenate the plants (Figure 2-8). Many of these plants have seeds that need fire to stimulate them to germinate and grow. Others have the ability to "crown sprout" directly from their roots after a fire. Fire suppression near developed areas has allowed plant communities to age unnaturally, thereby increasing the amount of wood available to fuel a fire, and decreasing wildlife habitat value. Older Chaparral and Coastal Sage Scrub stands result in more intense fires and increased soil erosion after the fire.

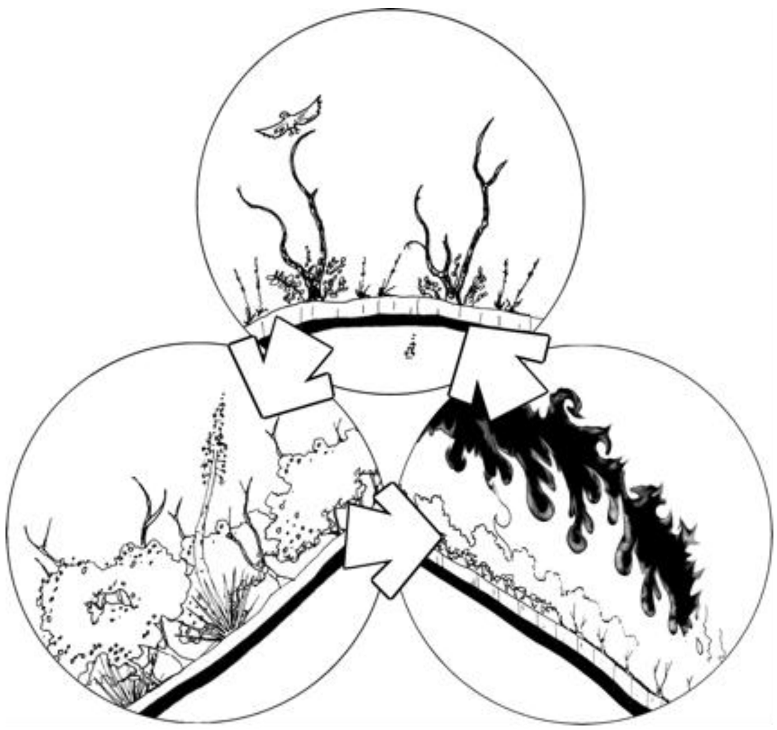


Figure 2-8. Fire plays an important role in the health of many plant communities. In this repeating cycle, fire burns an old stand of chaparral, the area quickly crown sprouts and grows back within a few years.

In areas that are above 4,000 feet elevation, such as the Angeles National Forest and San Gabriel Mountains, the Montane Forest vegetation begins to appear. The Montane Forest vegetative community generally has tall, closely spaced trees. Trees of this community are usually cone bearing, pyramid in shape, and have needle-type leaves. The indicator species are bigcone spruce, Canyon oak, Jeffrey pine, Coulter pine, and incense cedar.

The Riparian Zone

The riparian zone is the vegetated area on either side of a body of water (US EPA 841- B-97-003 1997, p. 203) (Figure 2-9). Riparian zones or corridors are important vegetation communities that help maintain water quality and stream health. Riparian vegetation generally has a higher need for water, and grows in areas with a high water table. The plants of a healthy riparian corridor are diverse and include shrubs, groundcover and trees such as oaks, sycamores, alders, cottonwoods, and willows. This area is unique because it is where the land-based (terrestrial) and aquatic ecosystems interface (Murdoch, Cheo, and O'Laughin, 1996, p. 60).

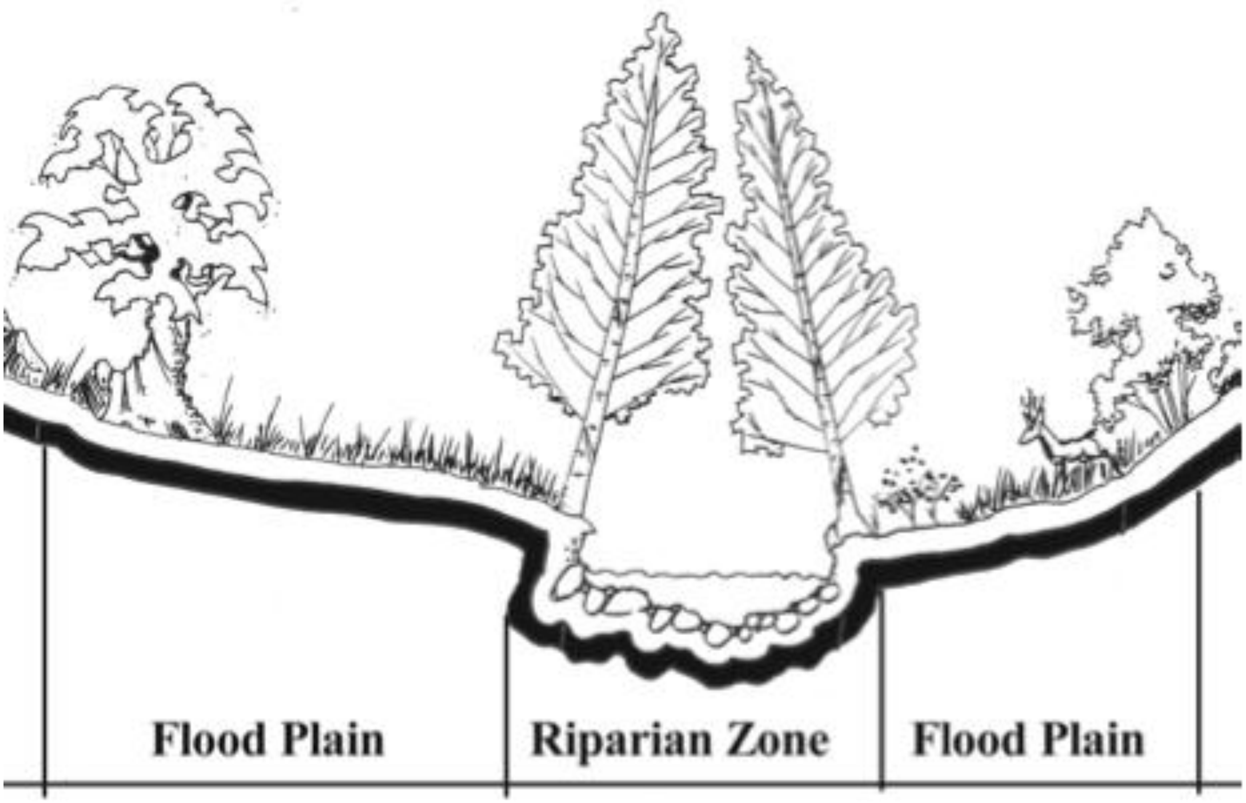


Figure 2-9. Riparian zones are areas of primary concern for this program. This cross section helps define the boundaries of a riparian area, here in relation to the flood plain.

A healthy riparian zone supports diverse wildlife, birds, and aquatic life. According to the Washington State Department of Wildlife, more than 85% of wildlife inhabit riparian areas at some time during their life cycles to find water, shelter, and food. Riparian trees are important because they provide shade that helps cools water temperatures to levels habitable for certain fish species like the steelhead trout. Shade also minimizes evaporation, so more water remains in streams, providing flow later in the hot summer season. Trees and other vegetation drop leaves, twigs, and branches that provide food for the aquatic organisms at the base of the food chain. This debris accumulates in the streams, providing both habitat and shelter for fish and other aquatic life.

Removing riparian plants has adverse effects on the physical, chemical, and biological characteristics of streams and rivers. Without riparian vegetation streams and rivers have increased water temperatures, making them too warm for some aquatic organisms. Without plants and their root systems, soil is less stable, and more prone to erosion. Streamside vegetation helps slow down the large flows associated with flood events, and provides areas for water storage. When a river overflows its banks, the water is slowed down by trees, shrubs, and rocks that the water encounters on the banks. Consider a smooth parking lot with no obstructions as compared to a natural landscape with ground cover, shrubs, rocks, trees, and depressions. Imagine the difference in the speed that water travels over these surfaces. In addition, plant roots and burrowing animals make holes in the earth that increase the ability of the soil to absorb water. As water moves slowly down through the soil, a myriad of pollutants are removed. Depressions in the landscape and the obstacles created by fallen trees and their branches allow water to be stored until it evaporates or infiltrates into the soil. Most importantly, vegetation utilizes water and nutrients to feed and grow. When vegetation is replaced with concrete, there are no plants and therefore no uptake of water or pollutants can occur.

The Stream Continuum

Streams and rivers are dynamic forces, both reflecting and changing the character of the surrounding landscape. There are three types of streams in the watershed. The first type of stream is ephemeral, flowing only during storms. Many of the upper watershed or headwater streams are ephemeral. The second stream type is intermittent, a type of stream, which flows only during the wet, season and dries up during the summer season. Intermittent streams are common in southern California. Intermittent streams converge and flow into perennial streams or rivers. Water runs year-round in the perennial streams, which are generally lower in a watershed (Figure 2-10).

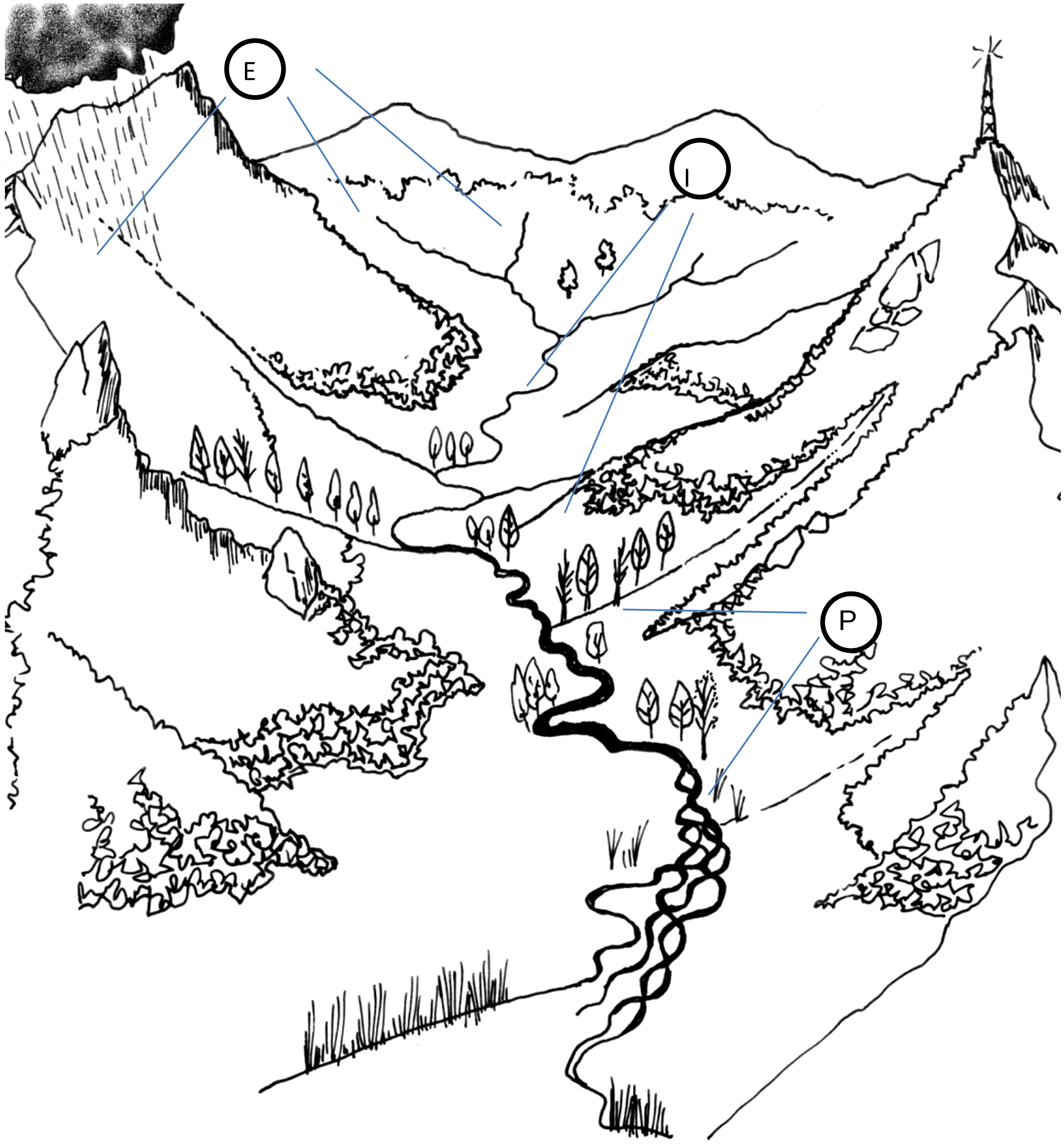


Figure 2-10. The Stream Continuum. The top of the watershed is characterized by ephemeral headwater streams (E) with steep gradients and large substrates. These are followed by intermittent (I) and perennial (P) streams with lower gradients and finer substrates. If the gradient becomes shallow enough, the stream can become braided with silty substrates (adapted from Fig. 1, USDA report rm-245).

Materials such as sand, gravel, cobbles, or boulders line each stream and are called the substrate. The type of substrate is a direct result of many factors including elevation, soils, geology, and slope. Substrate materials are generally larger in the upper reaches of a stream. These headwater streams are steep and narrow with substrates consisting of large cobble, boulders or bedrock that are hard to move. In middle stream sections, stream gradients decrease and water velocity slows, so the substrate is generally composed of medium-sized cobbles and gravel. As the river continues to flow downstream towards the ocean, the amount of water continues to increase while the stream gradient flattens out. This results in slower-flowing, wider stream channels. The water is too slow to transport even the smallest particles of gravel, sand and silt. These particles settle out and deposit along the stream channel. These deposits create large sandbars that give the river channels a braided appearance as they approach the ocean. The small particles eventually make their way to the beach to replenish sand washed away by the ocean waves.

Higher elevations are exposed to more rainfall and therefore have faced the greatest erosive forces throughout the watershed. Erosion wears away the loose rocks and soils, leaving only larger substrate materials or bedrock behind. Headwater areas generally have steeper gradients, causing stream flows to be faster with the power to move larger particles downstream. Along the way, these materials are swept downstream and are further broken down through the erosive force of water. The heavy material is left behind to form the stream bottom or substrate. Lighter materials are transported from the steeper sections, and as the gradient flattens out and the velocity of the water slows down, the larger sediments transported in the stream settle out.

A natural watershed drainage network changes continuously but maintains a balance between the shape of its stream channels and the amount and force of water running off the hillsides into the channels (Murdoch, Cheo, O'Laughin. 1996, p.63). Healthy streams are in a state of equilibrium, where the amount of sediment and water that enter the stream leave the stream. When a stream is in equilibrium, sand and gravel are scoured from the outside bend of one curve, and then are deposited on the inside of another curve. Stream currents are strongest on the outside parts of the curves. As a result, sand and gravel are eroded from the outside banks, creating pools. Conversely, this material is transported downstream to the inside bends and deposited where current is slowest, often creating gravel bars and sandbars (Figure 2-11). A meandering stream pattern forces water to travel over a longer distance and dissipates the erosive power of the water. The balance of erosion and sedimentation is part of the stream continuum concept, which explains how climate, geology, and topography interact to form healthy, natural streams. Unusual natural events, or permanent alterations in the stream continuum caused by development, can upset the balance of erosion and deposition of stream sediments.

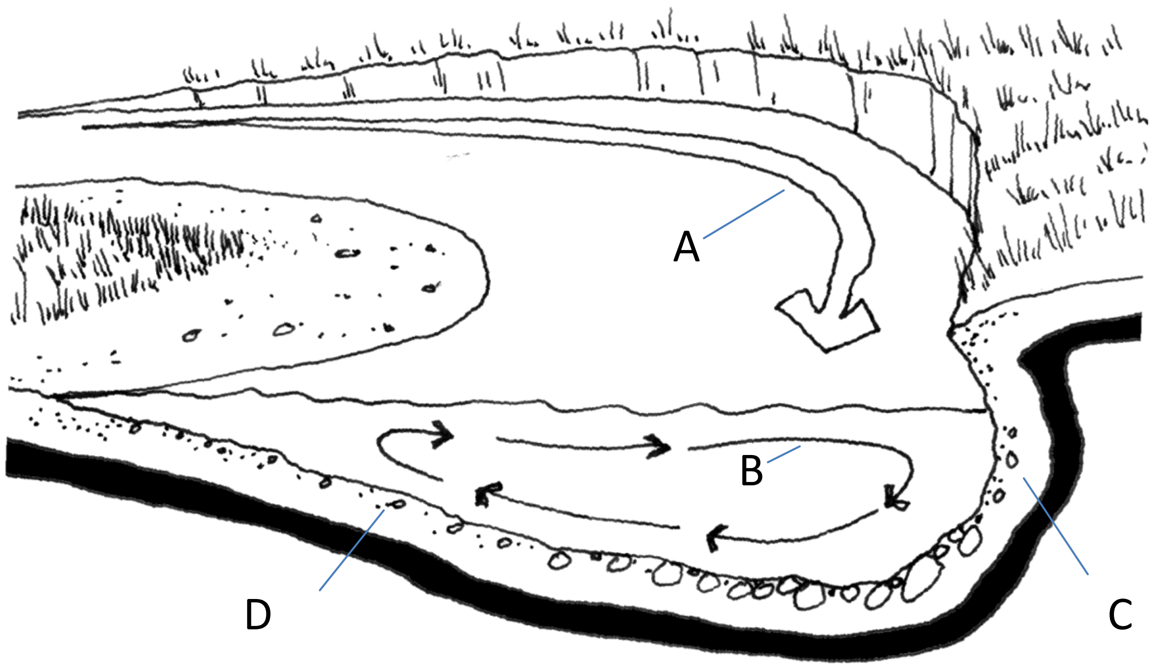


Figure 2-11. Erosion and deposition along stream curves: A) path of current around curve, B) circulatory current flowing around curve, C) area of erosion, D) area of deposition (from Figure 28, Leopold "Water, Rivers and Creeks" 1997).

Development has significantly influenced the hydrologic functions within watersheds. Of primary concern to the hydrology of the watershed are the influences of imported water and channelization of the waterways. The effects of imported water are manifold. Runoff from irrigation and the discharge of treated wastewater increases the overall volume of surface flows and introduces excess nutrients into the waterways. The increase of nutrients in water can trigger algal blooms. When the algal blooms die off, decomposition depletes the water of oxygen needed by other organisms for survival.

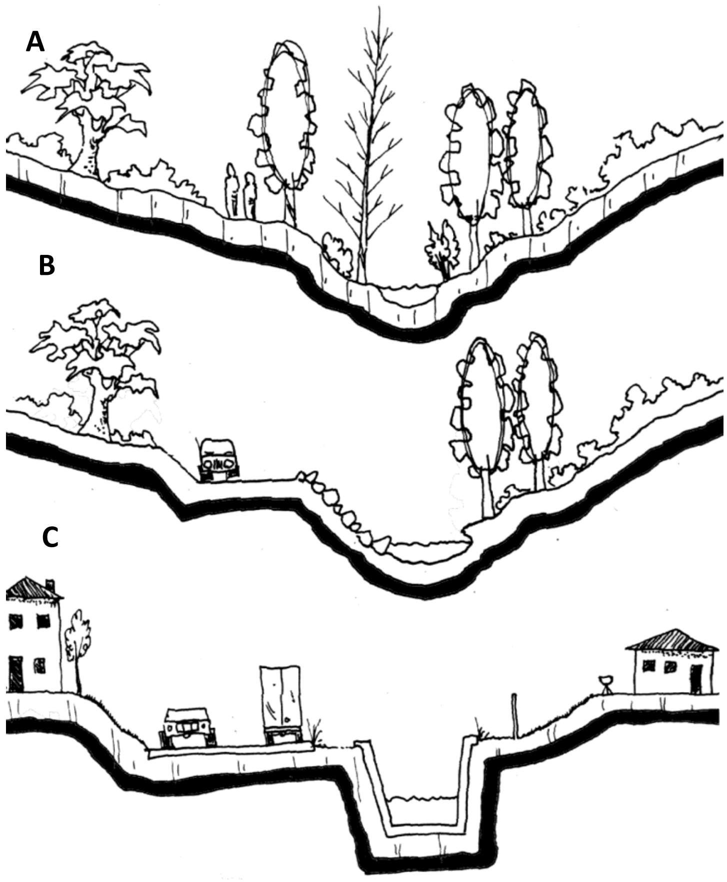


Figure 2-12. The transformation of the Riparian Corridor: A) pristine riparian zone, B) impacted riparian zone and C) channelization.

Channelization is another alteration with major impacts that affects a watershed's hydrologic function. Channelized streams are artificially lined with concrete for flood control purposes. They are designed to move water quickly out of the area. The result is a waterway that has few if any plants, and little wildlife habitat value (Figure 2-12). The channelization of a creek diminishes other benefits of riparian corridors such as water purification and slowing down the water flow. With no cobbles, boulders, plants, or streambank irregularities to slow down the rushing water, very fast flows result, which can overwhelm the slowing capacities of downstream riparian areas. Pollutants in storm water runoff are carried directly into the ocean.

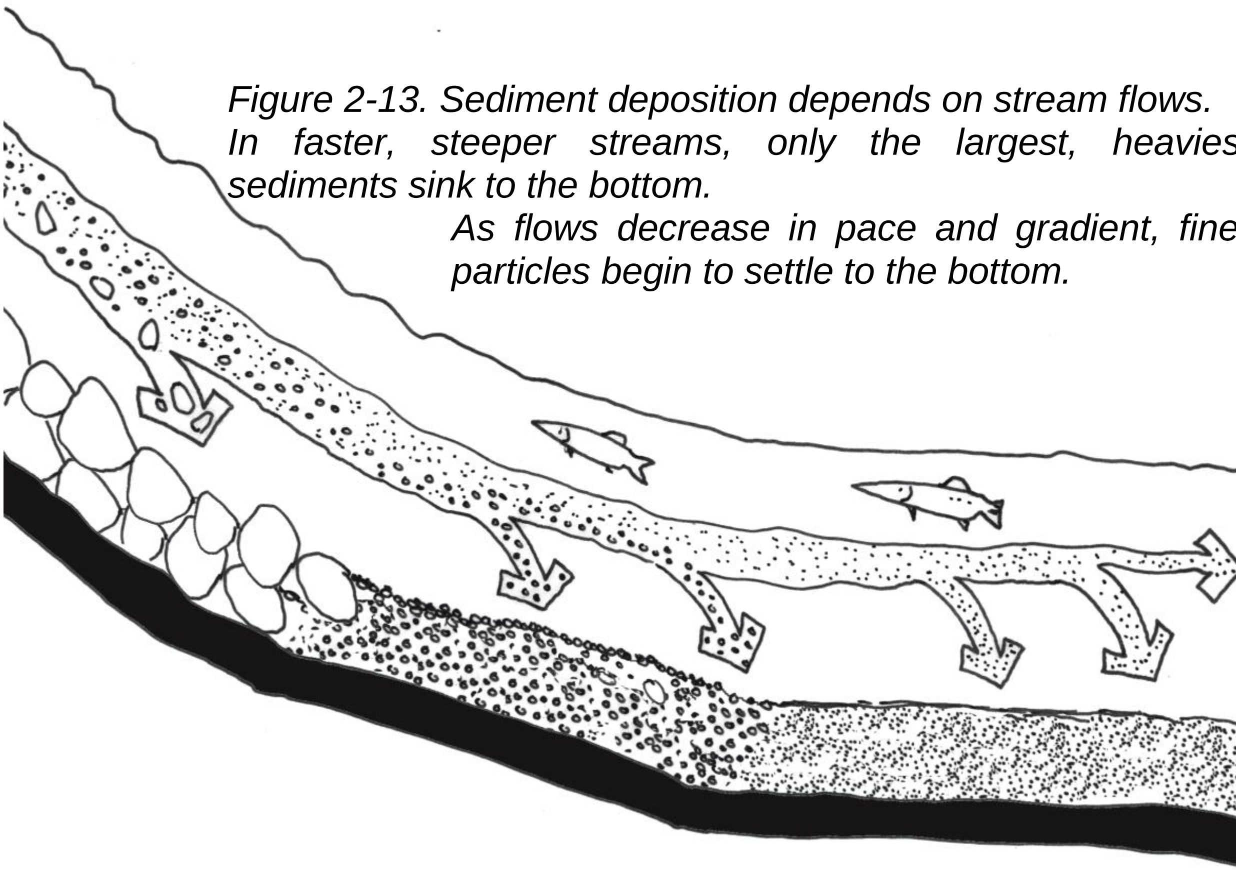


Figure 2-13. Sediment deposition depends on stream flows. In faster, steeper streams, only the largest, heaviest sediments sink to the bottom. As flows decrease in pace and gradient, finer particles begin to settle to the bottom.

Erosion and Sedimentation

Erosion and sedimentation are also important issues in our region. Erosion occurs when precipitation and surface runoff wash loose soils into waterways. Sedimentation is the process of eroded soils entering a waterway for downstream transport. Sedimentation is the downstream result of erosion. The insoluble particles carried by streams, such as sand, silts, and clays, are called sediments. Erosion is also part of the natural cycle of wildfires. However, in developed areas, fire suppression measures have resulted in older, unburned plants. This has increased the fuel loads, and therefore the intensity of a potential fire. The resulting erosion from these more intense fire events can lead to exaggerated sediment loading in the streams.

When eroded soil is carried into waterways, it then becomes part of the sedimentation process. The insoluble clay, sand, and silt particles are carried in the water as suspended solids. Suspended solids remain in the water as long as the flow has the velocity and force to transport these particles downstream. Pollutants attach to these suspended particles. As the water slows, the suspended solids begin to sink to the bottom (Figure 2-13). Slow moving stream and river sections, lakes, wetlands, lagoons, and near shore shallows, collect sediments on the bottom, which forms the substrate. The pollutants attached to these sediments may either resuspend back into the water column or stay attached to the substrate. Whether in the water column or attached to sediments these pollutants can impact aquatic life. In the natural process, much of the sediment washes into waterways during intense storm events. As a result, much of the sediment from our region is carried out to sea by high storm flows. It is deposited on the ocean floor or becomes beach sand.

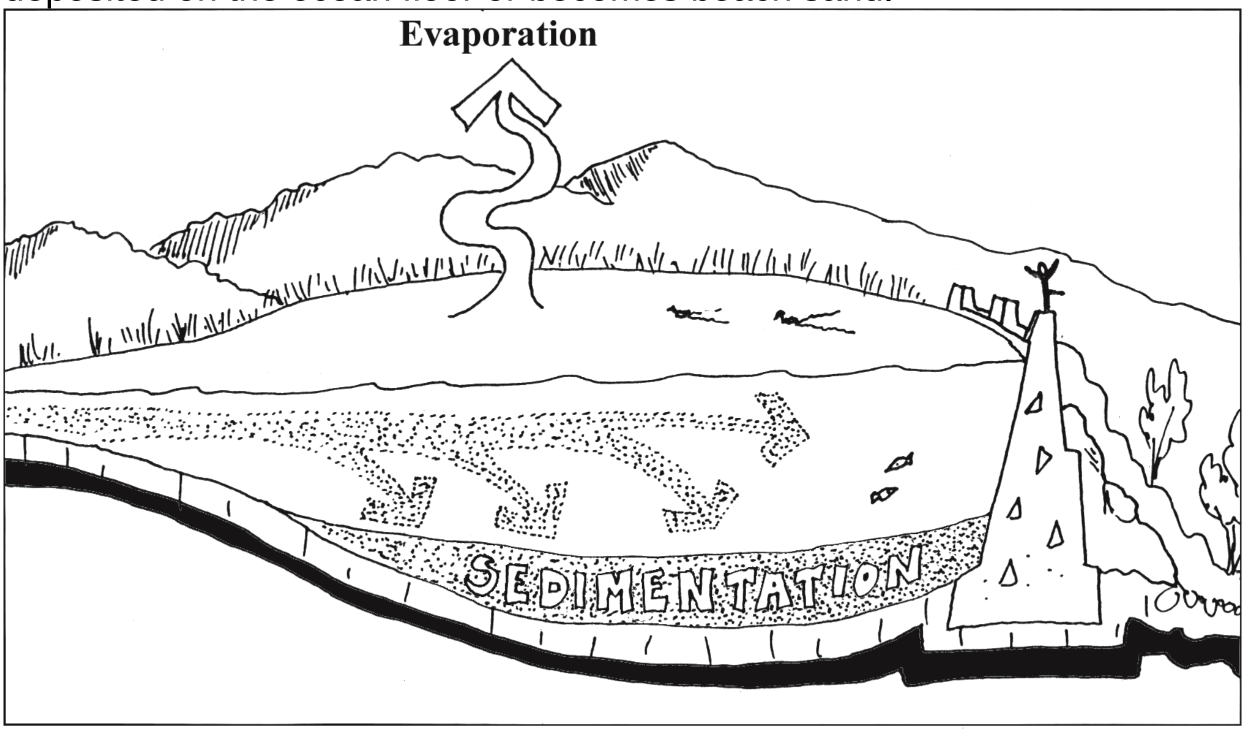


Figure 2-14. Sedimentation quickly fills in constructed lakes and reservoirs.

Increased sedimentation of waterways can have a significant effect on the instream habitat quality. Several factors have caused an increase in the sedimentation of streams, altering this natural process. Construction sites have exposed soils that erode, increasing sedimentation. These sediments can cover the stream bottoms altering the habitat for aquatic life. The local steelhead trout is particularly sensitive, since they need gravelly stream bottoms for reproduction. The construction of dams and reservoirs also disrupts sediment transport. Dams slow the water to the point that it will drop all the suspended solids. The dams then become sediment traps that quickly fill in, such as the Rindge Dam (Figure 2-14). Rindge Dam is located two and one- half miles north of the Malibu Lagoon. Many of the reservoirs and man-made lakes within the Malibu Creek Watershed need to be dredged regularly.

Malibu Lagoon

At the bottom of every watershed is an outlet, either into another watershed, or into a large body of water. The Malibu Creek Watershed flows into Malibu Lagoon. Lagoons act as large natural filters of water, cleaning out pollutants and debris before surface water makes it final journey out to sea. The maze of channels, the wetland plants, the tidal action, and the aquatic life contribute to the filtering and cleansing of water. The Santa Monica Bay Watershed, which contains Malibu Lagoon, is recognized as one of four estuaries in California currently listed in the U.S. EPA's National Estuary Program for the purpose of improving or maintaining coastal water quality (USDA NRCS MCWNRP 1995, p. 7). Adjacent to the lagoon is Malibu Surfrider Beach, one of the most heavily used beaches in southern California. It is world-renowned for its excellent surf break and is used year-round.

The lagoon is a critical estuarine habitat. Migrating birds use the Malibu Lagoon as a rest stop on their long journey. Currently it houses a population of the endangered tidewater goby that was reintroduced into the lagoon from the Ventura River Estuary. The lagoon also supplies critical rearing habitat for the endangered southern steelhead trout. Steelhead use the lagoon to make the transition from saltwater to fresh water before they begin their spawning runs up the Malibu Creek. Young steelhead use the brackish waters of the lagoon to adjust to saline conditions as they leave freshwater streams and migrate into the ocean.

A sandbar is a key feature of the lagoon ecosystem functioning. During the dry summer months, the closed sandbar separates the lagoon from the ocean. This is because less water reaches the lagoon due to the drying up of ephemeral or intermittent streams and lower volumes of reclaimed water are discharged into the stream from Tapia during the dry season. As the water flows diminish, sediments close the lagoon off from the ocean. This creates an important brackish or partially saline wetland condition that supports a large diversity of terrestrial and aquatic life. In the wet winter months, the high quantity of water flowing into the lagoon breaches or breaks open the sandbar. The lagoon ecosystem then adjusts to the direct tidal influence and the waters are flushed out.

Development throughout the watershed has also had a significant effect on the lagoon's ecosystem. Pollutants from urban runoff, sediments, nutrients, and debris collect in the lagoon, becoming a sink, or point of deposition. Although lagoons are excellent water purifiers, the additional quantity and lower quality of water has reduced the lagoon's capacity to effectively filter the water. Further, according to historical records, the lagoon is much smaller than it once was. In essence this smaller lagoon is being asked to treat more water of lower quality. Excess flows of wastewater discharge into Malibu Creek causes unseasonable breaching of the sandbar during the dry season (Figure 2-15). This has the potential to suddenly change the lagoon's salinity, unsettling the natural processes.

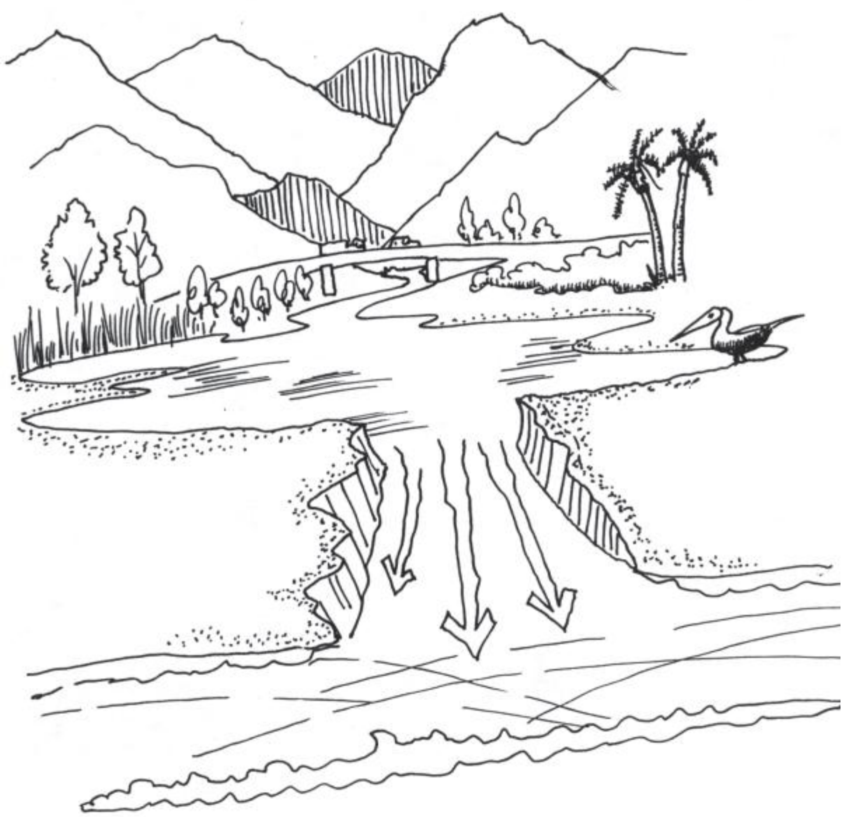


Figure 2-15. Summer lagoon breeching upsets the lagoon ecosystem. The lagoon is an important habitat for many endangered species.

Section 3- The Stream Team Volunteer Monitoring Program

Purpose

The Stream Team Volunteer Monitoring Program was designed by the Cal Poly team to take place in two phases. Phase 1, which is completed, involved two types of monitoring activities, Stream Walking, and Water Chemistry Testing. This was a fact-finding phase that helped Heal the Bay to ascertain the existing conditions of the watershed. Problem areas were identified and located for further investigation, elimination, and restoration. Phase 1 was the pilot phase of the project. The purpose of phase 1 was to provide useful monitoring information while at the same time to provide volunteers with meaningful hands-on participation in the work of the organization. Phase 2 includes ongoing Water Chemistry Testing, and it includes the additional activities of Physical Habitat Surveying and Macroinvertebrate Sampling.

All the information you collect will be entered into a Geographic Information System, a computer mapping and database program, which will be maintained at Heal the Bay. This GIS program allows the information to be analyzed by Heal the Bay and distributed to agencies throughout the area. The information collected from Stream Walking has been used to identify critical stream reaches and problem areas that will benefit from the more detailed information of the Stream Reach Survey. The following is a brief description of the activities that have or are occurring during each phase of the project.

Phase 1: Stream Walking

Stream Walking is the systematic visual observation of physical conditions along streams within the Malibu Creek Watershed. The focus includes locating all types of discharges flowing directly into streams, and areas of disturbance such as erosion and invasive plant species, barriers to fish passage, dump sites, and human alterations to the streambank. This is a down- and-dirty method for quickly collecting information on elements that are impacting the water quality and ecological functions of the stream. This procedure quickly alerted Heal the Bay to the locations of impacts within the Malibu Creek Watershed, so that problems within the watershed could be targeted for removal or restoration. Stream Walking provides valuable information that helps prioritize the more specific testing that occurs during phase 2. The goal of Stream Walking was to map all pollution sources and highly degraded areas in the watershed.

Phase 1 & 2: Water Chemistry Testing

The Water Chemistry Testing team uses physical, biological, and chemical testing to examine the water quality of a number of fixed stream sites throughout the watershed. These tests include pH, temperature, dissolved oxygen, turbidity, conductivity, nutrients (nitrates, ammonia, and phosphates), and bacteria. Once this data is compiled and analyzed, a picture of the existing conditions of the watershed is revealed. This procedure is designed to determine how much each subwatershed is contributing to downstream flows and water quality problems. This information is used to guide the expansion of the Water Chemistry Testing program, and it is shared with the Regional Water Quality Control Board, so that the sources of pollution can be identified and eliminated.

Phase 2: Physical Habitat Survey

Physical Habitat Surveying is the detailed measurement and assessment of physical characteristics of a 150-meter stream segment. This activity builds on the information collected in the phase 1 Stream Walk and assesses the quality and health of the riparian habitat. Further, the Stream Reach Survey involves walking some of the same tributaries as the Stream Walk procedure, and it is used to monitor the progress made during phase 1. Examining existing stream characteristics and comparing them against future observations, one can determine if habitat is being lost or degraded due to upstream development. Monitoring pristine stream reaches can yield baseline information that can be compared to areas impacted by land use activities in order to determine if those activities are affecting the conditions of the stream. These same locations can be monitored over time to determine the long term effects of upstream development and to determine degradation of the stream habitat.

Phase 2: Macroinvertebrate Sampling

Biological monitoring, known as Bioassessment, is an important monitoring tool for testing water quality and assessing the health of the watershed. Aquatic benthic macroinvertebrates live most or all of their lives in the water and in the benthic zone, or the bottom substrate, of the stream. These organisms react to pollutants, water temperature, and habitat conditions and are therefore continuous indicators of water quality. If a monitoring sample shows a great number of pollution-tolerant macroinvertebrates and very few, if any, of the pollution-sensitive macroinvertebrates, it can be an indication that water quality is poor. Monitors collect macroinvertebrates, identify them, and sort them into categories. A healthy stream should demonstrate excellent species diversity for the various types of aquatic macroinvertebrates in the watershed.

How the Program Works

Volunteers have a choice of taking part in one or more components of the Phase 2 monitoring program. These include Water Chemistry Testing or Bioassessment. You can be a part of one or more of these teams based upon your interests, skills, time, and the needs of the volunteer monitoring program. Water Chemistry Testing is conducted on a monthly basis, requiring a 4-8 hour commitment of one weekend day per month. Bioassessment is conducted once a year in the Spring. Space for volunteers varies on a yearly basis.

Stream Team volunteering is not a one-time event. Because this volunteer work requires training and much knowledge, volunteers interested in participating are asked to be regular participants in the program. Each volunteer will be asked to attend at least one training event. During this event you will be given the opportunity to learn the basic skills necessary to perform the monitoring tasks. Once you have acquired the necessary skills for monitoring, you can join the Stream Team.

Your team will be responsible for monitoring particular sites or a section within the Santa Monica Bay Watershed. Each Stream Team will have a team leader. Your team leader will have received additional training and will be responsible for your team. Team members report directly to the team leader. Note that responsibilities of the team leader will be italicized in the following sections.

An important part of the monitoring program is keeping volunteers informed of the results of their efforts. Quarterly or biannual update events will be held where all volunteers can come together to learn results and share issues and concerns they may have. These gatherings should help you understand how your individual efforts are being combined with others to give an overall picture of the health of the Malibu Creek Watershed. The information you collect will be analyzed by the science staff at Heal the Bay and the results of your work will be posted on a web page to enable you and the larger community to follow the progress of the monitoring program.

Safety

- Be careful not to fall. You may be traversing slippery rocks, hillsides, and steep erodable streambanks. Wear tennis shoes or boots that provide good support and that you don’t mind getting wet.
- Be prepared! Pack for all types of weather, if possible bring a cellular phone.
- Never take it upon yourself to conduct your own monitoring. Inform the program coordinator of any unscheduled monitoring event you wish to conduct and let someone at home know where you plan to go. Two heads are better than one, particularly for monitoring. Always work with a partner!
- When crossing or wading through a stream be aware of fast moving current. Use your walking stick for balance and to judge the depth. If possible look for areas shallower than knee depth to wade across.
- Don’t drink the water!
- If you suspect high levels of pollution protect yourself. Wear rubber gloves and avoid exposure.
- Within the watershed, rattlesnakes can be a concern. They really don’t want to bother you, especially if you don’t bother them. Keep a respectable distance from them and they will probably leave you alone. Be careful where you step, wear high hiking boots, and be careful of where you put your hands if you are climbing over rocks. If bitten, try to remain calm and seek prompt medical attention.
- Also be aware of Poison Oak. Get to know this plant’s characteristics. It changes through the seasons and the physical characteristics can vary from plant to plant. Avoid contact with this plant as secretions from this plant can cause severe blistering and itching. Even secondary contact such as petting a dog or washing someone else’s laundry that had direct contact with poison oak can cause adverse reactions. See Appendix 1 (Section 7-1).

- Ticks also can be found in the watershed usually in grassy or bushy places. They wait for some warm blooded creature, someone like you, to come walking by. They can attach to you, burying their heads under the skin for a nice drink of blood. The best way to deal with this parasite problem is to wear clothing that restricts access to your body such as wearing your pants tucked into your socks. Also wearing light colored clothing may make it easier for you to see them. Tick repellent can be used to help deter ticks from climbing onto you. When you get back from a monitoring site make sure you check your body carefully for any ticks you may have brought home. If you do find a tick, carefully remove the tick, mouthparts first, with forceps, making sure to remove any buried parts.

Treading Lightly

- Take only measurements and pictures. Monitors should never collect or remove natural items from the environment like whole plants, eggs, nests, dead branches, or animals. These are part of the natural processes that make an area healthy and may be important as home or food for wildlife.
- You will experience more of the watershed and the diverse wildlife if you are quiet and observant.
- Members of the Stream Team cannot drive off road unless otherwise specified by the program coordinator. Driving off road can disturb wildlife and seriously degrade habitat. The best way to learn about an area is to become part of that environment, and explore the area as wildlife does, on foot. Use existing paths wherever possible. This will minimize the chances of getting lost and keep disturbances to a minimum.
- While dogs are man’s best friend, they may scare animals or injure wildlife or may be injured by wildlife themselves. Leave them at home or with a friend.
- Minimize contact with the stream and streambanks, look ahead and choose a path that will cause the least disturbance to the area.
- Replace any rocks or woody debris removed for monitoring purposes.
- If we pack it in we pack it out! If you bring a bag lunch or bottled water please bring it out of the area and recycle it!

Invasive Species

There are various invasive species in the Santa Monica Bay Watershed that can cause great damage if transferred to pristine streams. One of the most problematic species is the New Zealand Mudsnail. This species is so small that it can be mistaken for sand, and it is easily transferred from stream to stream on your shoes or boots. It is important to know that the snail can be transferred from streambanks, not only through contact with the water. Also, recent research shows that the snail can survive up to three months even if completely dried out. For these reasons the Heal the Bay Stream Team adheres to protocols described by the California Department of Fish and Game. It is most important that you follow all methods taught by Heal the Bay staff or your team leader; because, specific methods are implemented to conserve the natural state of the watersheds where we work.

Section 4
Water Chemistry Testing

Purpose

Malibu Lagoon and Surfrider Beach consistently have poor water quality, which is a concern for the health of humans and the wildlife that frequent these areas. Your mission is to analyze the waters throughout the watershed for a variety of pollutants. In doing so, you may help locate areas in the watershed that contribute possible pollutants to the lagoon.

Water pollution is the chemical and physical alteration of surface waters that were of good water quality before human interaction with the watershed. Good water quality can be defined as waters that support abundant native aquatic plant and animal species in a balanced ecosystem. In areas where people come in contact with the water for recreation, excellent water quality is needed. Channelized streams such as those in Agoura Hills and Westlake Village cannot support plants and animals, whereas Cold Creek Preserve is much more capable of supporting a variety of species.

Agencies like the Regional Water Quality Control Board and the EPA are charged with maintaining safe levels of water quality for both humans and wildlife. In many instances, these agencies have set certain water quality thresholds for the Malibu Creek Watershed that may not be exceeded. As a member of the Water Chemistry Team you will collect the data to determine if these thresholds or safe levels are exceeded. You are the first line of defense for the Malibu Creek Watershed. Your tools will be a specially designed water chemistry field kit. The information you collect will be distributed by Heal the Bay to the appropriate agencies, so that actions can be taken to correct the problem.

Good luck Stream Team member!

Why Water Chemistry Testing is Important

If the overall goal of the monitoring program is to improve water quality, then Water Chemistry Testing provides us with the springboard of data from which further action can be taken. Specifically, the objectives include:

- To establish current baseline conditions within the various subwatersheds of the Malibu Creek Watershed
- To determine how much each subwatershed contributes to poor downstream water quality.
- To explore the ability of streams to support native plants and aquatic wildlife, such as steelhead trout.

Water quality that is good for aquatic life is often good for humans as well. The overall goal of this program is to improve water quality throughout the watershed.

What to Expect When Water Chemistry testing

Water chemistry testing requires some visual observation skills and a lot of patience. It would be best if you familiarize yourself with the first half of this section up to the "Procedures" before you arrive at the monitoring event site. Please read the following sections in the field guide so that you are familiar with the water chemistry testing issues: "What to Monitor," "What to Expect When Water Chemistry Testing," "When to Monitor," and "How the Data Can Be Used."

The components of these chemical tests are self-contained in a testing kit that your X-Stream Team Captain will provide. Each test is to be conducted twice. If the second result does not closely coincide with the first result, a third test must be performed. Double-checking results in this way will ensure higher quality data. Further, in an effort to improve the quality of the data you collect and to make information collection easy, Heal the Bay, with funding from Environment Now, has purchased meters for Dissolved Oxygen and Turbidity. These devices greatly improve the quality of the information collected and reduce the time it takes to sample for water chemistry.

What to Monitor

The specific parameters you will be monitoring have been selected for the Malibu Creek Watershed by Heal the Bay. Detecting the presence of pollutants and their potential sources should lead to actions that improve the water quality throughout the Malibu Creek Watershed.

As a volunteer, you will be measuring and testing the following parameters for the Malibu Creek Watershed Volunteer Monitoring Pilot Project:

Physical Parameters

1. Site Conditions (weather conditions, debris, stream properties like color and odor)
2. Stream Flow
3. Air Temperature
4. Water Temperature

Chemical Parameters

5. Dissolved Oxygen
6. pH
7. Turbidity
8. Conductivity
9. Phosphorous
10. Nitrate-Nitrogen
11. Ammonia-Nitrogen
12. Bacteria

This list is not exhaustive. Some citizen groups may sample other pollutants that are of interest in their area. Other commonly tested pollutants are detergents, chlorine, herbicides, pesticides, and metals. These chemical parameters may require very expensive equipment to analyze, which is beyond the means of citizen groups. For many of these tests, citizen groups collect the field samples, which are then transported to a state certified laboratory for analysis. Utilizing citizen groups to collect the field samples provides a substantial cost savings.

For purposes of the program, Site Conditions are visual observations that do not require quantitative measurements, but do require a general agreement on observation conclusions. Items three through eight are either measured chemically or with meters, and require patience and acute attention to detail. Water Chemistry Teams will collect water samples for items nine through eleven, but will not perform the actual tests. Measuring phosphorous, nitrogen, and ammonia concentrations involve complicated procedures. To insure high quality information these measurements will be performed by Heal the Bay’s Program Coordinator or a field biologist. Your training and future monitoring events should further reinforce the steps involved. The best results are achieved when these parameters are sampled and tested in this order.

1. Site Conditions

The site conditions of the monitoring location will aid Heal the Bay in analysis of the data. These parameters are generally brief but careful observations should be noted on the “Site Conditions” Field Sheets. Included among these are *Weather* conditions, presence of *Debris*, and *Properties* of the Stream like, presence of algae, and water color, appearance, and odor. Observations can be noted at any time during the monitoring event.

2. Stream Flow

Stream flow is another important characteristic that you will be measuring. Stream flow is the volume of water that moves past a fixed point in a specific interval of time. The amount of water (volume) and how fast it is traveling (velocity) determines the flow of a stream.

Stream flow is an important indicator of water quality. It affects the available oxygen level in water that fish and other aquatic wildlife depend on to live. Generally streams with higher flows have more oxygen available for aquatic wildlife. Stream flow also controls the amount of sediment that is transported in a stream. Streams with higher velocities and larger flows transport greater amounts of sediments than streams with lower flows. In addition, stream flow determines how pollution is transported downstream and influences the ability of a stream to dilute pollution. Large, swift rivers have a greater ability to dilute and degrade runoff pollutants, unlike smaller streams. You will measure the flow of the stream at each monitoring event. This can help determine how much each subwatershed is contributing to downstream flows and the extent to which development is changing the natural hydrology in the watershed.

3. Air Temperature

Air temperature is an important determinant of water temperature. Take an air temperature measurement at the beginning and end of the monitoring event.

4. Water Temperature

Temperature of the water directly affects biological and chemical processes. Some fish species prefer colder waters than other species. Benthic macroinvertebrates will move in the stream in order to find their optimal temperature. Take water temperature twice, once at the beginning of the monitoring event, and once at the end.

5. Dissolved Oxygen (DO)

Aquatic organisms rely on the presence of oxygen in streams. In water, oxygen is in a dissolved form. Water temperature and altitude, time of day, and seasons can all affect the amount of dissolved oxygen. Oxygen is both produced and consumed in a stream. Because of constant churning, running water, particularly riffles, dissolves more oxygen than the still water often found in a lake or stream pool (US EPA 841-B-97-003 1997, p.139). The presence of aquatic plants also affects dissolved oxygen concentrations. Green plants release oxygen underwater during photosynthesis. Maximum amounts of DO are produced with the energy of the late afternoon sun. By early morning, the same plants may have taken up the oxygen, making levels of DO lowest at this time. Because DO is lowest in the morning hours it is one of the first tests you will perform when you arrive at the sampling station.

6. pH

pH is a measure of how acidic or alkaline the water is at the time of testing. The pH of a stream affects the ability of plants and wildlife to function and live. pH is measured on a scale from 1.0 to 14.0. Neutral pH is 7.0. Acidic pH is less than 7.0, and alkaline is greater than 7.0. A wide variety of aquatic animals prefer a range of 6.5-8.0 pH. A pH meter measures the electric potential of water in millivolts or pH units.

7. Turbidity

Turbidity is a measure of water clarity. Insoluble solids or suspended particles such as clay, silt, sand, algae, plankton and other substances affect the clarity of the water. High levels of turbidity affect the ability of steelhead trout and other aquatic organisms to survive. Water temperature is increased because suspended particles absorb more heat. Also, when turbidity is high, photosynthesis is reduced due to the decrease in the amount of light traveling through the water. Sources of turbidity include soil erosion, waste discharge, urban runoff, eroding streambanks, large numbers of bottom feeders that stir up sediments, and excessive algal growth.

8. Conductivity (Total Dissolved Solids)

Conductivity measures the ability of water to pass an electrical current. The concentration of dissolved solids, or the conductivity, in streams is directly affected by the substrate or stream bottom material. Conductivity indirectly measures the presence of inorganically dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, iron, and aluminum (Murdoch, Cheo, and O-Laughin. 1996, p. 181). These substances enable the water to conduct electricity at a higher level. Failing septic tanks, sewage spills, and agricultural runoff containing phosphates and nitrates are indicated by high conductivity measurements. In general conductivity is higher in areas with clay soils because these soils tend to dissolve in water. Conversely, organic substances like oil, alcohol, and grease are poor conductors of electricity and will yield low conductivity measurements. Excessive amounts of dissolved solids leads to poor tasting drinking water with laxative effects (Murdoch, Cheo, and O-Laughin. 1996, p. 181).

9. Nutrients: Phosphorus, Nitrate-Nitrogen & Ammonia-Nitrogen

Phosphorus and nitrogen are both nutrients occurring naturally in streams and are essential for plants and animals in an aquatic ecosystem. These nutrients originate from both naturally occurring sources and from areas of human development. Naturally occurring sources include soils, eroding rocks, and terrestrial animal and plant waste washing into the streams. Problems occur when large amounts of phosphorous and nitrogen are introduced into the stream ecosystem. As a result, there can be excessive algal growth, which will deplete the available oxygen in the stream that fish and other aquatic organisms depend upon. Sources of nutrients from human development include wastewater treatment plants, runoff from fertilized agricultural lands, lawns, and golf courses, runoff from grazing animals, and commercial cleaning activities.

Phosphorous is a useful indicator of potential problems associated with excessive plant growth. High amounts of dissolved phosphorous may indicate a pollution source such as chemical fertilizers or a leaking septic system. Insoluble phosphorous can be due to excessive erosion, animal waste, or sewage (Murdoch, Cheo, and O-Laughin 1996, p.180). Two field tests are used to measure the nitrogen content in streams: nitrate-nitrogen (N_2 + NO_3), and ammonia-nitrogen. Nitrogen (N_2) is the gas that composes 80% of the air we breath most plants can not use nitrogen in this form. N_2 is converted into a form that can be used by plants to build proteins, called nitrates. It is this form of nitrogen that the Stream Team will measure. In streams with low levels of dissolved oxygen, nitrogen will be found in the form of ammonia. Ammonia is extremely toxic to aquatic life as compared to nitrates. Sources of nitrates include wastewater treatment plants, runoff from animal manure storage areas, runoff from fertilized lawns and croplands, failing or improperly maintained septic systems, and industrial discharges containing corrosion inhibitors.

10. Bacteria (*Total coliform, Escherichia Coli (E. Coli), and Enterococcus*)

Bacteria are microscopic single-celled organisms that function as decomposers by breaking down plant and animal remains. This releases nutrients previously locked up in the organic matter. Certain bacteria convert ammonia to nitrite, which is then converted by other bacteria to the nitrate form, which can be used by plants. Bacteria can live in surface water, in the sediments at the bottom of a stream, estuary, or ocean, on dead organic material, and in or on the bodies of plants and animals (http://www.epa.gov/owow/estuaries/monitor/chptr17.html).

Human activities often transport disease-causing bacteria or pathogens into the ecosystem. The fecal waste from humans or warm-blooded animals is the largest concern for human health. Sources of fecal bacterial contamination include livestock areas, landfills, faulty septic systems, fecal waste from pets, sewage sludge, sewage discharge that has not been disinfected, leaky sewage pipes, and stormwater runoff. Wildlife also add bacteria to water bodies through feces. Direct testing for pathogens is very expensive and impractical because pathogens are hard to find in waterbodies. We monitor for *Total coliform, Escherichia Coli (E. Coli), and Enterococcus* because their presence indicates the existence of other pathogens that do pose a health risk to humans. Water contaminated with these bacteria can cause stomach flu, ear infection, upper respiratory infection, and skin rash to swimmers or surfers (http://www.healthebay.org/brc/warningsigns.asp). In addition, tests for these bacteria can be done quickly and cheaply.

Total coliform, which means coliform bacteria of all types, originates from many sources, including soil, plants, animals and humans. *E. Coli* and *Enterococcus* bacteria are found in the fecal matter of mammals and birds. Studies by the Santa Monica Bay Restoration Project (SMBRP) demonstrated that there is a significant possibility of sewage contamination in the Santa Monica Bay storm drain runoff at any given time http://www.healthebay.org/brc/gradingsystem.asp. In 1986, EPA revised its bacteriology ambient water quality criteria recommendations to include *E. Coli* and *Enterococcus*, as they are better indicators or the risks of swimmers getting sick than fecal coliforms (http://www.epa.gov.owow/estuaries/monitor/chptr17.html).

The state of California has passed Assembly Bill 411, which requires summertime bacteria testing of every beach that is adjacent to a flowing storm drain and receives in excess of 50,000 visitors per year. In addition, if these tests do not meet the bathing water standards, the beach must be posted as unsafe to swim. You can check the water quality of your favorite beach by visiting Heal the Bay's Beach Report Card™ at www.healthebay.org. The Report Card grades local beaches on an A-F scale based on daily and weekly water quality monitoring data collected by County and City public agencies throughout the State. Sample locations include most public beaches from Sonoma to San Diego County, specifically targeting popular beaches. Heal the Bay grades over 450 beaches throughout the state of California. Heal the Bay also provides beach water quality data to the Los Angeles Times, which is published every Saturday in the Los Angeles and Orange County editions in the weather section.

The bacteria water quality standards as stated in AB-411 are defined as MPN, the most probable number of bacteria per 100 ml of sample analyzed. The standards for a single sample and the 30-day geometric mean are:

AB-411 Standards for single sample

Indicator	Marine Water	Fresh Water
Total Coliform	< 10,000 MPN	No Standard
Fecal Coliforms	< 400 MPN	No Standard
Enterococcus	< 104 MPN	< 61 MPN
E. Coli	No Standard	< 235 MPN
Ratio of total to fecal	< 10	

(Ratio is applicable only if Total coliforms are greater or equal to 1000 MPN per 100 ml of sample.)

AB-411 Standards for 30 day geometric mean

Indicator	Marine Water	Fresh Water
Total Coliforms	< 1,000 MPN	No Standard
Fecal Coliforms	< 200 MPN	No Standard
Enterococcus	<35 MPN	< 33 MPN
E. Coli	No Standard	< 126 MPN

Shellfish such as mussels, clams, and oysters may contain bacteria that cause health problems when people consume them. According to the California Ocean Plan 2001: "At all areas where shellfish may be harvested for human consumption, as determined by the regional board, the following bacterial objectives shall be maintained throughout the water column: the median Total coliform density shall not exceed 70 MPN per 100 ml per sample, and not more than 10 percent of the samples shall exceed 230 MPN per 100 ml.

Where to Monitor

The long-term goal of the program is to have monitoring locations in each of the seven subwatersheds within the larger Malibu Creek Watershed. Monitoring sites will be at a minimum of two fixed locations in each subwatershed of concern. Of these two sites, one will be upstream and one downstream of pre-determined land use impacts. The fixed monitoring location above the pre-determined land use will be in a relatively pristine section of the stream. The second fixed monitoring site will be located at the base of the subwatershed, where a stream leaves that particular subwatershed and enters another one.

Comparing the results from these sampling sites should help Heal the Bay determine the effects of land uses and impermeable area on water quality, and to what extent a given subwatershed is contributing to downstream pollution. Based on the results of your work, Heal the Bay and other agencies should be able to determine which subwatersheds require immediate attention and future action. Because each subwatershed has its own unique natural features and land uses, the impacts to water quality differ between them. For example, the impacts to water quality may be more obvious in the highly developed Westlake and Agoura Hills subwatersheds than in the largely rural Malibu Lake and Cold Creek subwatersheds.

When to Monitor
Water Quality Monitoring will occur once a month at each monitoring station. To accurately sample for trends over time, monitoring must take place at the same location, and at the same time of day. This is because concentrations of the substances you'll be testing for vary according to season, time of day, and temperature. A schedule of Water Chemistry Testing events, including the dates and times will be created. If for some reason you cannot attend the event(s), call the program coordinator so alternative arrangements can be made. Your Stream Team will have at least three members on a testing day, including the captain.

How the Data Can Be Used

Your data should be very useful to local government agencies and organizations such as Heal the Bay, the Regional Water Quality Control Board, the California Department of Fish and Game, the California Department of Parks and Recreation, the National Park Service, the Resource Conservation District of the Santa Monica Mountains, and other stakeholder agencies working to protect the natural environment. They are very interested in using the collected data to track trends in water quality. For example, in some of the upper watershed monitoring stations, the data you collect may demonstrate optimal water quality for that subwatershed. This baseline information can assist local planning agencies in developing future water quality protection goals and land use management strategies.

Water Chemistry Testing Procedures

Safety

General Safety Guidelines (adapted from LaMotte's instruction cards included in the testing kit)

- Store reagents in a cool, dry place to prolong shelf life.
- Read all instructions to familiarize yourself with the test procedure before you begin. Note any precautions in the instructions.
- Read the label on each container prior to use. Some containers include precautionary notices and first aid information.
- Keep all equipment and reagent chemicals out of the reach of young children.
- Properly dispose of chemicals. X-Stream Team Captains will be informed of disposal protocol. Never pour chemicals into the creek or onto the ground near the creek.

In the event of an accident or suspected poisoning, immediately call the Poison Center phone number in the front of the local telephone directory or call your physician. Be prepared to give the name of the reagent in question, and its LaMotte code number. LaMotte reagents are registered with POISINDEX, a computerized poison control information system available to all local poison control centers.

Protect Yourself & Your Equipment (adapted from LaMotte's instruction cards included in the testing kit)

- Avoid contact between reagent chemicals and skin, eyes, nose, and mouth.
- Wear safety goggles or glasses when handling reagent chemicals.
- Use the test tube caps or stoppers, not your fingers, to cover test tubes during shaking or mixing.
- When dispensing a reagent from a plastic squeeze bottle, hold the bottle vertically upside-down (not at an angle) and gently squeeze it (if a gentle squeeze is not sufficient, the dispensing cap or plug may be clogged).
- Wipe up any reagent chemical spills, liquid or powder, as soon as they occur. Rinse area with wet sponge and then dry.
- Thoroughly rinse test tubes before and after each test. Dry your hands and the outside of the tube.

- Tightly close all reagent containers immediately after use. Do not interchange caps from different containers.
- Avoid prolonged exposure of equipment and reagents to direct sunlight. Protect them from extremely high temperatures, and from freezing.

Equipment Care

Your X-Stream Team Captain will bring to the monitoring site a LaMotte Test Kit, specially designed for Heal the Bay and the Malibu Creek Watershed monitoring program. Each parameter you will be testing for has its corresponding equipment contained within the test kit. Please familiarize yourself with the equipment care guidelines, as well as the safety measures in the following section.

- Carefully wash out the test tubes after each test.
- Tighten the reagent container caps immediately after use. Do not interchange caps.
- Avoid prolonged exposure of equipment to direct sunlight.
- Avoid extremely high temperatures and protect the equipment from freezing.
- Report any reagents that are running low to the Captains.
- Report any malfunctioning of electronic equipment (error messages, etc.) to the Captains.

X-Stream Captain: You will be provided a field kit by Heal the Bay that you will bring to the site. Check all equipment. Turn on all electronic meters and check them for low batteries. Familiarize yourself with the guidelines on equipment care and understand the procedures. By reading the Protect yourself and your equipment section from above. The following checklist should be used to verify that the equipment necessary for measuring Stream Flow is included in the field kit. Heal the Bay requests that X-Stream Captains bring an orange for the velocity calculations.

Figure 4-1.
Stream Team Field Kit.

Water Chemistry Team Equipment Checklist:

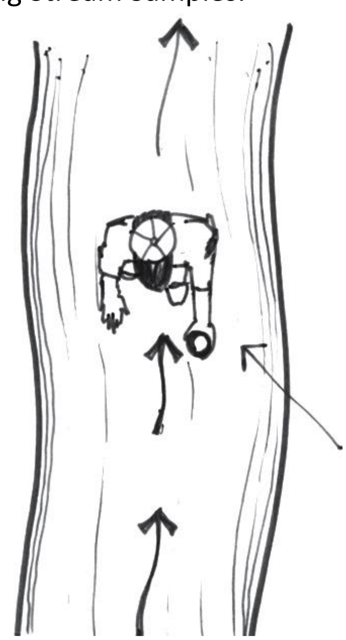
Water Chemistry Stream Team Field Kit (Figure 4-1)
Tape measure (50 feet)
Calculator
Stopwatch
First aid kit
Small ice chest

Field Sheets
Please record your data onto the Field Sheets immediately after each procedure. To insure that testing procedures are done properly and the quality of the data collected is good, each procedure will be conducted two or three times, depending on the results. Each result will be recorded, and then averaged on the data sheet. Please turn in field notes and field sheets to the X-Stream Team Captain at the end of each monitoring session. He or she will return these to Heal the Bay, where the data will be recorded in their GIS database.

In the testing section that follows, all instructions are taken from LaMotte's Instruction Cards, which are provided with each testing kit. Other references include EPA's Volunteer Stream Monitoring: A Methods Manual.

How to Conduct Water Chemistry Testing

Figure 4-2.
Collecting Stream Samples.



Collecting Stream Samples
The best place to collect samples from shallow streams is in the center, away from streambanks. Collect water in an area of the stream that is fast flowing but does not have turbulence or white water and is at least 6-8" deep. Do not collect water in stagnant water or in rapids, for the results may not represent he average concentration of the parameter being measured. Slowly wade to the center, so as not to kick up sediments and face upstream. (Figure 4-2)

- For nutrient samples, fill and empty the bottle three times, then fill one last time. Ensure that there are no air bubbles by filling the bottle and capping it underwater. Any air bubbles remaining in the cap will alter the results of the testing.

- For bacteria samples, open the sterile sample bottle underwater and fill once. Bring the sample bottle above the water level and pour a very small amount out of the bottle (the water level should be approximately at the neck of the bottle) so as to leave room around the cap. Close the bottle

1. Site Conditions

Site Conditions are general observations that will be recorded when your team first arrives at the monitoring site. The following general observations should be recorded on the Site Conditions Field Sheet: the color of the stream water, the weather conditions, the air temperature, the general flow conditions of the stream, appearance of the water, the odor of the stream, and if their is trash in the stream. These different conditions should provide Heal the Bay and other agencies with clues regarding the source of pollutants in the stream.

2. Stream Flow

To measure stream flow, assess the amount of water and the velocity with which it s flowing. Circle the option listed on the field guide that is the predominant flow for the stream.

3. Air Temperature

Air Temperature is taken twice at each sampling station and recorded on the Site Conditions Field Sheet.

Note: Each line is equal to 1 degree Celsius

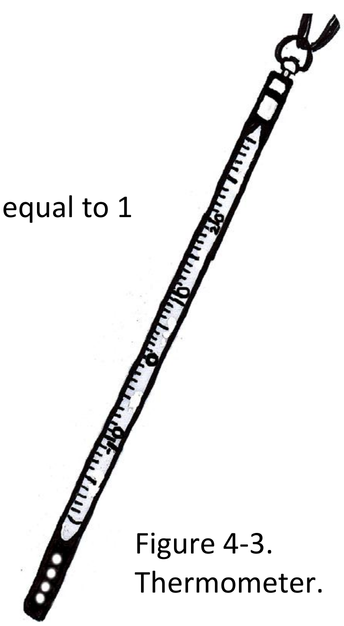


Figure 4-3. Thermometer.

Pull from the test kit the following item that you will need:

1. Plastic-encased thermometer CODE 1066

Air Temperature Sampling Procedure

1. Using the water temperature thermometer, take the air temperature twice, once at the beginning of the testing period, and once at the end.
2. Record both readings.

Field Sheet:
When your team first arrives at the monitoring site please fill out the Site Conditions Field Sheet. Circle the answers that best describe the conditions at your monitoring site.

4. Water Temperature

Obtain water temperature readings from OAKION pH and Conductivity meter when taking those two measurements (Figure 4-6).

5. Dissolved Oxygen (DO)

Dissolved oxygen is either in milligrams per liter (mg/L), or percent saturation. You will be using the YSI ProODO System (DO Meter) to take this measurement (Figure 4-4). The first part of testing for dissolved oxygen is to calibrate the meter. This calibration procedure must be done every time you use the meter.

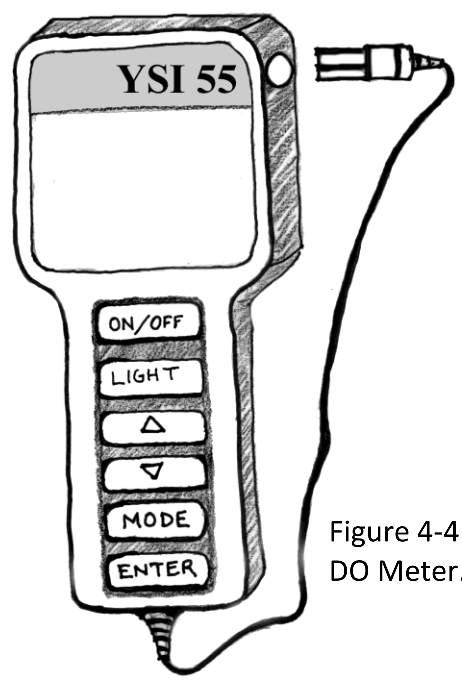
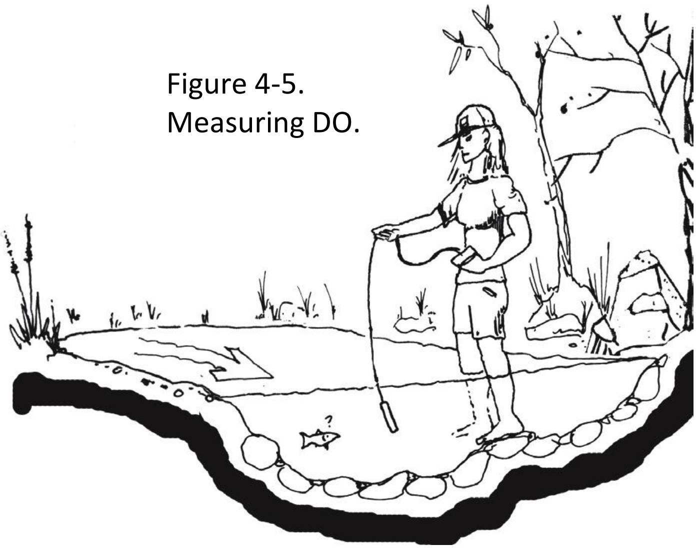


Figure 4-4
DO Meter.

Measuring Dissolved Oxygen Using the DO Meter

1. Remove the probe from the chamber.
2. Lower the probe in the water halfway between the surface and the bottom of the creek**. Be careful not to let the probe hit the bottom of the stream.**
3. Rapidly move the probe tip through the stream at a rate of one foot per second. Gently bob the probe up and down vertically or back and forth horizontally to achieve this. **Again, Be careful not to let the probe hit the bottom of the stream; this may cause damage to the meter.**
4. Let the reading on the meter stabilize and record the temperature and dissolved oxygen measurement on the Chemical Parameters Field Sheet. The measurement will either be recorded in milligrams per liter

Figure 4-5.
Measuring DO.



(mg/l) or percent saturation use the appropriate area in the dissolved oxygen section on the field sheet.

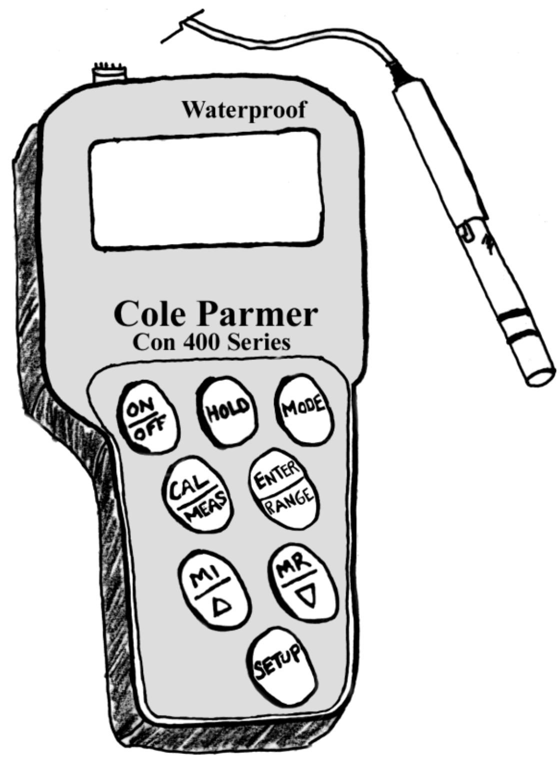
5. Press the mode button and wait for the meter to stabilize this will give you a dissolved oxygen reading of the opposite measurement. If the first reading was in mg/l when you press the mode button the second reading will be percent saturation. Record the second reading on the field sheet.
6. Remove the probe from the water and repeat steps 1-6, record the results on the field sheet.

6. pH Testing

Pull from the test kit the following items that you will need:

1 OAKTON pH and Conductivity Meter

Figure 4-6.
OAKTON pH and Conductivity Meter.



Maintenance Prior to Field Testing

The pH probe must be calibrated prior to each field use in a lab setting.

1. Turn on the meter.
2. Place the pH probe in pH 4.00 standard.
3. Allow the reading to stabilize.
4. Press the Cal/Meas button.
5. Allow the reading to stabilize.
6. Press Enter/Range
7. Repeat for pH 7.00 and 10.01.

pH Testing Procedure

1. Turn the meter on by pressing the **ON/OFF** button.
2. Lower the probe into the water halfway between the surface and the bottom of the creek. **Be careful not to let the probe hit the bottom of the stream.** Wait for the value to stabilize.
3. Note the pH and record it on the field sheet.

4. Repeat steps 1-3 in a location upstream from the first location.
5. Turn off the electrode by pressing the **ON/OFF** button.
6. Rinse the electrode with deionized water or tap water.
7. Keep a small piece of sponge or towel moistened with clean tap water (not deionized) in the cap to keep the electrode from drying out.

7. Turbidity

Pull from the test kit the following items that you will need:

QTY	CONTENTS	CODE
1	2020 Turbidimeter	26856
1	Turbidity tubes, set of 4	0286-4
	Kimwipes, several	

Figure 4-7. 2020 Turbidimeter.

Turbidity Testing Procedure

(Adapted from the LaMotte 2020 Turbidimeter Instruction Manual)

Maintenance Prior to Field Testing

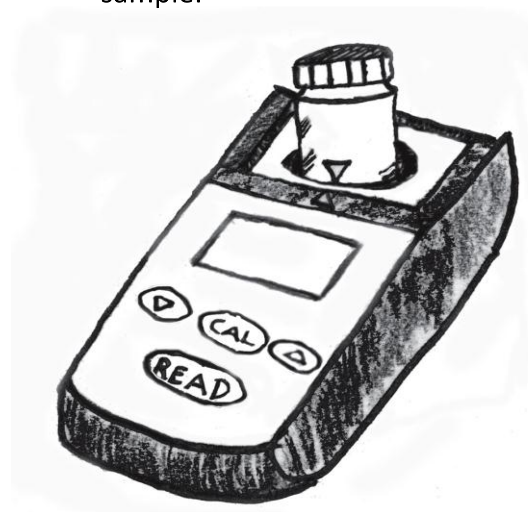
The 2020 Turbidmeter must be calibrated prior to each use in the field.

1. Turn on the Turbidmeter.
2. Place the 1.00 NTU standard in the chamber and press READ. Wait for the reading to appear on the screen.
3. Press CAL and manually adjust, using the arrows, to read 1.00 NTU. Remove the standard.
4. Place the 10.00 NTU standard in the chamber and press READ. Wait for the reading to appear on the screen.
5. Press CAL and manually adjust to read 10.00 NTU. Remove the standard.
6. Repeat steps 2-5 until the 1.00 NTU standard reads 1.00 ± 0.01 and the 10.00 NTU standard reads 10.00 ± 0.01 without recalibration.

Note: the turbidity meter has two operating modes, the standard operation mode and the EPA mode. We will be operating in the EPA mode. The meter can only be switched from one mode to the other while turning the

2020 on, from the **OFF** state. The 2020 will remain in which ever mode it was last used in, even if the meter has been turned off.

Figure 4-8. Measuring a turbidity sample.



1. Turn off the 2020 if it is on.
2. Press **CAL** button and hold it down while pressing the **READ** button to turn the meter on.
    a. Note: While in the EPA mode, a triangle will be displayed.
3. Fill a turbidity bottle to the neck with sample water. Pour it out.
4. Repeat three times.
5. Set sample aside to allow sample to equilibriate to the air temperature and let gas escape. Avoid contaminants. Analyze as soon as possible.
6. Cap the tube and wipe bottle dry with a clean Kimwipe.
    a. The turbidity bottle may be wiped on a 100% cotton shirt to remove excess liquid from the outside of the bottle.
7. Open the 2020 lid. Align the indexing arrow on the bottle with the indexing arrow on the meter. Insert the turbidity bottle into chamber.
8. Close the lid. Push the **READ** button. The turbidity in NTU units will be displayed within 5 seconds.
9. Repeat steps 3-8 for a second sample.
    a. Note: The 2020 will turn off automatically one minute after the last button pushing. To turn the meter **OFF** manually, hold the **READ** button down for at least 2 seconds. Release the button when **OFF** is displayed.
    b. Note: If the sample is higher that 1100 NTU, it must be diluted and retested with dilution noted on the field sheet.

Information Regarding the Keypad for the 2020 Turbidimeter

- When the **READ** button is first pushed, a number will be briefly displayed that indicates the software version number.
- Three dashes "—-" will be displayed when turbidity measurement is taking place.

- The display will flash after the **CAL** button has been pushed during the standardization procedure until the **CAL** button has been pushed again to enter the adjusted value.
- "**OFF**" will be displayed after the **READ** button has been held down for 2 seconds. The button should be released and the meter will turn off.
- "**Er1**" will be displayed when the battery voltage is very low.
- "**Er2**" will be displayed when measured turbidity is over range (1100 NTU).
- "**Er3**" will be displayed when the bulb has burned out or the tube is misaligned.
- "**BAT**" will be displayed when the battery voltage is getting low. Readings are reliable. Replace battery as soon as possible.

8. Conductivity (Total Dissolved Solids)

Pull from the test kit the following items that you will need:
1 OAKTON pH and Conductivity Meter (Figure 4-6).

Maintenance Prior to Field Testing

The OAKTON pH and Conductivity Meter must be calibrated prior to each use in the field.

1. Turn the probe on.
2. Place the conductivity probe in the 700 µS standard.
3. Wait for the reading to stabilize.
4. Press the Cal/Meas button.
5. Allow the reading to stabilize.
6. Adjust to 700 µS.
7. Remove the probe from the 700 µS solution and rinse with deionized (DI) water.
8. Place the conductivity probe in 7000 µS (7.00 mS) standard
9. Wait for the reading to stabilize.
10. Press the Cal/Meas button.
11. Allow the reading to stabilize.
12. Adjust to 7000 µS.
13. Remove the probe and rinse with DI water.

14. Repeat steps 2-13 until the probe reads both standards correctly without recalibration.

Conductivity Testing Procedure

1. Turn the meter on by pressing the **ON/OFF** button.
2. Lower the probe into the water halfway between the surface and the bottom of the creek. **Be careful not to let the probe hit the bottom of the stream.** Wait for the value to stabilize.
3. Note the Conductivity and record it on the field sheet. It will either be reported in µS (a value such as 1600) or in mS (a value such as 1.60)
4. Repeat steps 1-3 in a location upstream from the first location.
5. Turn off the electrode by pressing the **ON/OFF** button.
6. Rinse the electrode with deionized water and replace the cap.

9. **Nutrients: Phosphorous, Nitrate-nitrogen, Ammonia-nitrogen**

1. Remove the sample bottle labeled "***Nutrient Testing*** "it should have the name of the monitoring site printed on the front.
2. At the selected stream sample location, in an area of the stream that is fast flowing but does not have turbulence or white water and is at least 6-8" deep, lower the sample container with the cap tightly secured, facing upstream.
3. With the bottle submerged, uncap the container and allow the bottle to fill, then empty it. Repeat this two more times, then fill the bottle for the last time.
4. Replace the cap with the bottle still submerged. Ensure that there are no air bubbles in the bottle.
5. Write the date, time, your name, and the name of the site on the field sheet.
6. Place the water sample immediately in the ice chest full of ice.

10. Bacteria

1. Remove the sterile bacteria sample bottle (it should have plastic wrapping around the cap) for the site you are at.
2. Collect sample in the same place as the nutrient sampling.
3. With the bottle submerged, fill it only once.
4. Pour a little of the water out to leave some room in the neck of the bottle and cap it.

5. Write the date, time, your name, and the name of the site on the field sheet.
6. Place the water sample immediately in the ice chest.

Bacteria are measured using the IDEXX system. Special reagents to measure coliforms, E. Coli, and Enterococcus are added to 100 ml water samples. The water samples with the reagents are then placed in a special tray with premeasured wells, or compartments. The trays are then placed in an incubator at a specific temperature to grow any bacteria present in the sample. The result of the bacteria tests are reported as the Most Probable Number (MPN) of bacteria per 100 ml of sample. **Bacteria samples must be transported to the lab and analyzed within six hours of the time they were first collected.**

Summary

Congratulations Stream Team member! You have successfully completed the important task of Water Chemistry Testing. Your data will be compiled and analyzed by Heal the Bay and recorded on their GIS mapping database. This information will be made available to all interested agencies that work in this watershed. Further, this information will be loaded on a regional water-monitoring database maintained by the Regional Water Quality Control Board (RWQCB). This database can be accessed by interested public and private organizations throughout the country. Ultimately, areas with water quality problems can be traced to their sources and the problems corrected. In other words, your efforts are going to be rewarded with action towards improving water quality in the Malibu Creek Watershed.

Section 5
Beyond Monitoring

The Future of the Watershed

Generations from now, will streams in the Malibu Creek Watershed support a wide variety of fish, plants, and invertebrates? Or will the streams be void of many of the watershed's threatened and endangered species? Will the lagoon continue to attract large flocks of birds? Or will the lagoon be unable to cleanse and purify our urban runoff? Will swimmers and surfers enjoy clean waters all year-round? Or will they be exposed to harmful pollutants at Surfrider Beach? These are the questions addressed by your work in the Stream Team Volunteer Monitoring Program.

Through monitoring, you can learn new skills, meet people with similar interests, and gain a sense of environmental stewardship. This program is a great example of the popular bumper sticker adage, "Think globally, act locally." Stream Team members are really Watershed Stewards. What you accomplish by becoming a Stream Team member is only the beginning of the effort to restore watershed health. We will encourage local organizations and agencies to take our data and put it to good use. However, there is more that can, and must be done, to prevent pollution and restore degraded habitats.

Thank you for joining the Malibu Creek Watershed Stream Team!!! Together we can achieve the goal of clean waters for all to enjoy at Surfrider Beach, Malibu Lagoon, and throughout the watershed. Most importantly, we can ensure a healthy watershed that, in the years to come, can sustain all its inhabitants, from plants and animals, to people. Remember, as a Stream Team member, the most important things you can bring to your monitoring event is enthusiasm and the desire to make a difference in the Malibu Creek Watershed.

Section 6
Appendices and References

Appendix 1
COMMON RIPARIAN PLANTS OF THE MALIBU CREEK WATERSHED

Purpose
The purpose of this Field Guide is to help volunteers involved in the Stream Team monitoring program identify exotic and/or invasive plant species that are found near riparian areas in the Malibu Creek Watershed. Further, the Field Guide will help volunteers locate unstable stream banks and degraded areas throughout the watershed. The long term goal is to identify and map significant patches of exotic and/or invasive vegetation, and areas that are degraded which may contribute excess sediments into the receiving waters throughout the Malibu Creek Watershed. The information collected will be stored on a GIS system at Heal the Bay and made available to all agencies that work in this watershed. Ideally, maps that accurately locate degraded habitat and large patches of exotic and/or invasive vegetation can be used by local agencies and organizations to develop restoration strategies, and improve water quality throughout the watershed.

The Riparian Zone within the Malibu Creek Watershed
Within the Malibu Creek Watershed there are many areas that can be described as riparian. These riparian areas are commonly found adjacent to intermittent or perennial sources of water. These can be creeks, streams, ponds, lakes, springs, or seeps. This Field Guide covers plants found in riparian habitats and includes plants found along streams, lakes, ponds, and freshwater marshes.

Specific types of plants have evolved within riparian and wetland environments. These plants need access to the additional soil moisture that is available in these areas for their survival. Within the riparian zone, plants have their preferences as to how much water they need or can tolerate. Some plants may be located in soil that is saturated with water (cattails), or on soil that is seasonally saturated with water (alders, sycamores). Others will be located where the soil does not stay saturated (oaks, walnuts). A profile of a stream in the Malibu Creek Watershed may show willows and alders closest to the stream, sycamores a little farther away, and oaks up on the bank away from the stream. Intermixed among these trees may be a variety of shrubs, perennials, or annuals, each having special needs for location. The arrangement of plants along the riparian profile is never exact and there can be much variation depending upon soils, moisture, aspect, slope, geology, and other factors.

Riparian Vegetation and Stream Ecosystems

Riparian vegetation plays a vital role in the health of a watershed. Plants lessen erosion during rainstorms by breaking the direct impact of rain onto the soil with their canopies. Their roots bind and hold the soil together. Vegetation also slows down the flow of water allowing water to infiltrate deeper down into the soil. When rainfall infiltrates deeper into the soil, water can be released more slowly thus, helping to sustain the watershed with moisture over a longer period of time.

Water quality is improved by a plant's ability to slow runoff and filter water as it flows across the surface or infiltrates deeper into the soil. The vegetation also influences sedimentation flow. Along stream banks the roots of plants help hold and stabilize the soil. Vegetation and woody debris within the riparian area also creates places where insects and other aquatic animals live and reproduce. Streamside vegetation and debris helps moderate the flow of water, creating diverse habitats where water flow is varied and aquatic life can find protected places. Organic matter that vegetation drops into the water also provides nourishment for a wide variety insects and aquatic wildlife. Foliage canopies of larger trees or shrubs help shade creeks or ponds. This helps keep the water cool, increases dissolved oxygen, and makes the water more hospitable to the plants and animals that live in this environment.

The Malibu Creek riparian ecosystem has evolved over time to create beneficial relationships between plants and animals and has adapted to the geology and other natural forces of the Santa Monica Mountains. Today, great change is taking place as human development of the watershed continues. Changes in the natural, seasonal flow of streams and creeks takes place because of the year-round use and runoff of water into the watershed by humans. Plants not native to the area have been introduced and many of these, for example Giant Reed and Algerian Ivy, are out competing and displacing native plants. Riparian areas are especially vulnerable to the invasive character of some non-native plant species, because these species choke up streams, transpire great amounts of water, change water temperature by not providing adequate shading, and create monocultures and non-supportive habitats for animals. These changes disrupt the unique balance of the ecosystem and alter the beneficial aspects of the native plant/animal relationship that has evolved over time.

COMMON RIPARIAN PLANTS OF THE MALIBU CREEK WATERSHED

The plants are arranged alphabetically by their botanical name (genus and species). Common names for plants are also included. It is important for volunteers to list a plant by its botanical name on the monitoring form. A plant will have only one botanical name but may have numerous common names that have arisen over time. Knowing the botanical name will also help you find additional information on these plants since most reference books list plants by their botanical name.

A comprehensive listing of **Key Species and Non-Native** riparian and related plant species found in the Malibu Creek Watershed.

Exotic and/or Invasive Plants
The following is a listing of some of the non-native plants that you will likely come across during your stream walk. Most of these are aggressive plants that can out compete and displace native plants.

RIPARIAN AND RELATED PLANT SPECIES LIST

To help supplement the illustrated section of this handbook, the following is a comprehensive listing of plants found in riparian areas or nearby zones of the Malibu Creek Watershed. Plants with an asterisk (*) indicates that this plant is not native and has been introduced to the Malibu Creek Watershed.

Botanical name	Common Name
Acer macrophyllum	Big Leaf Maple
Acer negundo	Box Elder
Adiantum capillus-veneris	Venus Hair Fern
*Agrostis viridis	*Bent Grass
Alnus rhombifolia	White Alder
Anemopsis californica	Lizardtail
*Apium graveolens	*Celery

Apocynum cannabinum	Indian Hemp
*Artemisia biennis	*Biennial Sagewort
Artemisia douglasiana	Mugwort
*Arundo donax	*Giant Reed
Aster subulatus var. ligulatus	Slim Aster
Azolla filiculoides	Duckweed Fern
Baccharis douglasii	Douglas Baccharis
Baccharis salicifolia	Mule Fat
Barbarea othoceras	Winter-Cress
Berula erecta	Water Parsnip
Bidens laevis	Bur-Marigold
Carex species	Sedge
Castilleja stenantha	Stream Paint Brush
*Chenopodium ambrosioides	*Mexican Tea
Chenopodium macrospermum	Coast Goosefoot
Clematis ligusticifolia	Western Virgin's Bower
Cornus glabrata	Brown Stem Dogwood
*Cotula coronopifolia	*Brass Buttons
Cuscuta campestris	Field Dodder
Cyperus species	Umbrella Sedge
*Cyperus involucratus	*Umbrella Plant
Datisca glomerata	Durango Root
*Echinochloa crusgalli	*Barnyard Grass
Echinodorus berteroi	Bur Head
Elatine californica	California Waterwort
Eleocharis species	Spike Rush
Epipactis gigantea	Stream Orchid
Equisetum laevigatum	Smooth Scouring Rush
Equistetum telmateia	Giant Horsetail
Euphorbia serpyllifolia	Thyme-Leaf Spruge
*Festuca arundinacea	*Tall Fescue
*Festuca pratensis	*Meadow Fescue
*Ficus carica	*Edible Fig
Fraxinus velutina var. coriacea	Arizona Ash, Velvet Ash
Glycyrrhiza lepidota	Wild Liquorice
Gnaphalium palustre	Lowland Cudweed
*Hedera canariensis	*Algerian Ivy
Helenium puberulum	Sneezeweed
*Ipomoea purpurea	*Common Morning Glory
Juglans californica	S. California Black

	Walnut
Juncus species	Rush, Wire Grass
Lemna species	Duckweed
Lepidaspartum squamatum	Scale Broom
*Lepidium latifolium	*Perennial Pepper Grass
Leptochloa uninervia	Sprangle Top
Lilium humboldtii var. ocellatum	Humboldt Lily
Lonicera hispidula var. vacillans	California Honeysuckle
*Lotus corniculatus	*Bird's Foot Lotus
Ludwigia peploides	Yellow Water-Weed
Madia elegans	Common Madia
*Melilotus albus	*White Sweet Clover
*Mentha pulegium	*Pennyroyal
*Mentha spicata	*Spearmint
Mimulus cardinalis	Scarlet Monkey Flower
Mimulus guttatus	Creek Monkey Flower
*Nicotiana glauca	*Tree Tobacco
*Nuphar luteum	*Yellow Pond Lily
Paspalum distichum	Knot Grass
Petunia parviflora	Wild Petunia
Phacelia ramosissima	Branching Phacelia
Phyla lanceolata	Mat Grass
*Phyla nodiflora	*Mat Grass
*Plantago major	*Common Plantain
Platanus racemosa	Western Sycamore
*Polypogon monspeliensis	*Rabbit's Foot
Polypodium californicum	California Polypody
Populus balsamifera ssp. trichocarpa	Black Cottonwood
Populus fremontii	Fremont Cottonwood
*Potamogeton crispus	*Curled-Leaf Pondweed
Potamogeton pectinatus	Fennel-Leaf Pondweed
Psilocarphus tenellus	Woolly-Heads
Psoralea macrostachya	Leather Root
Pteridium aquilinum var. pubescens	Western Bracken Fern
Quercus agrifolia	Coast Live Oak
*Ricinus communis	*Castor Bean
Rorippa curvisiliqua	Yellow Cress
*Rorippa naturtium-aquaticum	*Water Cress
Rosa californica	California Wild Rose
Rubus ursinus	California Blackberry

Rumex salicifolius	Willow Dock
Salix species	Willow
Salix exigua	Narrow-Leaved Willow
Salix laevigata	Red Willow
Salix lasiolepis	Arroyo Willow
Sambucus mexicana	Blue Elderberry
Scirpus species	Bulrush, Tule
Scirpus americanus	(no common name)
Scirpus californicus	California Bulrush
Scirpus maritimus	(no common name)
*Senecio mikanioides	*German Ivy
Solidago occidentalis	Western Goldenrod
*Sonchus asper	*Prickly Sow Thistle
Stachys albens	White Hedge Nettle
Stachys rigida	Rigid Hedge Nettle
Symphoricarpos mollis	Dwarf Snowberry
Toxicodendron diversilobum	Poison Oak
Trifolium obtusiflorum	Clammy Clover
Trifolim variegatum	White Tip Clover
Typha species	Cat-Tail
Typha domingensis	Slender Cat-Tail
Typha latifolia	Cat-Tail
Umbellularia californica	California Bay Laurel
Urtica dioica ssp. holosericea	Stinging Nettle
*Veronica anagallis-aquatica	*Great Water Speedwell
*Vinca major	*Periwinkle
Woodwardia fimbriata	Giant Chain Fern

Appendix 2
STREAM REACH SURVEYING

Purpose

The Stream Reach Survey is the detailed charting of the physical characteristics of a small stream segment. It is structured to collect very specific information about the conditions of a particular stream. This procedure samples small segments or reaches of a stream and makes the assumption that these samples are representative of the entire stream. This is done because the Malibu Creek Watershed has hundreds of miles of stream, and to survey the entire watershed would take decades. The quantifiable results may be used for future restoration activities and other projects to enhance the ecological function of streams in the Malibu Creek Watershed.

By examining the existing habitat and comparing that against future observations, it can be determined if habitat is being lost or degraded due to upstream development. Similarly, pristine areas along a specific stream can be compared with areas that may be impacted by land use activities in order to determine if those activities are affecting the conditions of the stream.

WHY STREAM REACH SURVEYING IS IMPORTANT

The goal of the Stream Reach Survey is to collect information about the physical nature of a small stream segment. Using this method to chart "change over time," this monitoring activity would allow Heal the Bay to discern the effects of development upon the physical character of a stream. The objectives include:

- To accurately map the physical properties of a stream
- To establish current baseline conditions within the various subwatersheds of the Malibu Creek Watershed.
- To compare areas upstream and downstream of urbanization to help determine impacts associated with urbanization.

WHAT TO EXPECT WHEN STREAM REACH SURVEYING

The procedures for Stream Reach Surveying are related to land surveying, and require patience, attention to detail, and persistence. Your initial training sessions will be critical to the comprehension of the survey tasks.

Stream Reach Surveying will occur monthly following the completion of the phase one Stream Walk. The event will most likely take place on a Saturday morning, and last about four hours. You and two other Stream Team volunteers will be joining an X-Stream Team Captain. At least four people are needed to perform Stream Reach Surveying. Some of the tasks involve working in pairs so good communication will be important.

WHAT TO SURVEY

Many of the tasks involve getting your feet wet, so it is important to read the following section on preparation. Depending on the difficulty of the stream reach, expect to get a fair amount of exercise. The procedures include:

1. Stream Reach Mapping
2. Stream Profiling and Finding Bankfull
3. Stream Flow
4. Riparian Corridor Transects
5. Mapping Significant Natural Features And Adjacent Land Uses
6. Habitat Assessment
7. Vegetation Assessment

1. Stream Reach Mapping

The initial objective of Stream Reach Surveying is to create an accurate map, which is done in two parts. First, a 100 foot. stretch of stream will be measured, then a base map is created. This map will be used to record the approximate location and types of vegetation, the habitat in the stream where fish and other aquatic wildlife live, the profile and bankfull level of the stream, and adjacent land uses that may impact the stream reach. Tracking the stream's course and flow over time may reveal interesting patterns about the nature of the stream reach.

2. Stream Profiling And Finding Bankfull

The stream profile is a picture of the cross-section of a stream at a particular point. Healthy streams exhibit certain characteristics that may be altered in a degraded system. Measuring the stream profile over time may allow Heal the Bay to detect changes to the stream. Bankfull is the highest level the water in a stream can reach before it spills over the banks and flows onto the floodplain. The largest amount of sediment is carried by discharges at or near bankfull and nearly all the transport of bedload or coarse materials occurs at bankfull (Leopold 1997, p. 85).

There are two reasons why the width and depth of bankfull discharge are measured. First, bankfull discharge should be fairly consistent. Past watershed studies have confirmed that water diversions, forest clear cutting, vegetation conversions, building of roads, overgrazing, and urban development will change the bankfull channel dimension due to increases in the amount of flow and the number of flows that reach the bankfull level (Rosgen 1994, pg. 2-5). Second, bankfull width and depth allows the calculation of width to depth ratio and the entrenchment ratio, which helps to better classify stream reaches so that the stream's behavior may be more accurately predicted.

3. Riparian Corridor Transect

The riparian corridor transect will allow Heal the Bay to determine the zone of streamside vegetation along a stream reach. Riparian vegetation includes trees, shrubs, and ground cover that need an ample water supply to survive. The presence of a healthy riparian corridor is an indication that the stream is probably functioning at an acceptable level.

Many riparian plants live in the water or along the edge of streams where water is abundant. Riparian plants may also root very deeply so they can reach the underground water supply to serve their needs. This corridor acts as a buffer to protect the banks of the stream reach from eroding into the stream. The riparian zone is an extremely valuable habitat area for wildlife that hides in the dense cover of the plants and feed off the seeds and fruits produced by those plants. Streamside vegetation provides a cool shady microclimate that animals use to cool down in the heat of the day. Finally because the riparian corridor is located at the waters edge, wildlife comes to drink the water with the ability to find refuge among the plants. In order for a stream to be healthy the riparian zone must also be healthy with a wide range of plants to support a wide variety of wildlife.

4. Mapping Significant Natural Features and Adjacent Land Uses

Significant natural features are landmarks, and provide memorable characteristics of a stream experience. They may also serve many other purposes, critical for the stream's ability to function at its peak. Large boulders shade and cool water, provide a lookout point, and serve as a landmark. Other natural features of note could include significant woody debris like fallen trees with trunks bigger than two feet in diameter. In addition to the natural features, it is important to understand the land use context of the stream, for possible impacts. If there are houses next to the stream, agriculture, shopping centers, trails, or roads please locate these land uses on the map. This will help us detect changes, and assess potential problems in and around the stream channel.

5. Habitat Assessment

Streams are made up of a variety of different types of features in and along the channel. These features provide valuable habitat for aquatic wildlife and other organisms that live in the stream. Instream habitat is generally characterized by the way water is flowing or the shape of how that water is contained. Pools are areas in the stream of slow-moving deeper water. Pools provide areas for fish to rest from a long fight with the current of the stream. Deep pools that are shaded by the canopies of trees can also provide the cooler water temperatures preferred by some types of fish, like steelhead trout.

Riffles are usually characterized as faster moving stretches of water with a turbulent flow. Generally shallow, it is common for riffles to have exposed rocks in the flow. The substrate of riffle sections consists generally of large material such as cobbles or boulders.

Substrate is the material that makes up the stream bottom. It is important because the spineless critters (macroinvertebrates) that live in streams feed on fungi, bacteria, and benthic algae that grow in the stream bottom. These spineless critters also use the stream bottom as shelter, this is where macroinvertebrates grow and develop. Macroinvertebrates are food for fish and other invertebrates. Stream sections that cannot support these spineless creatures will not support fish and invertebrates that eat these creatures. Fish use certain types of substrate to lay their eggs and allow them to develop and hatch. The steelhead trout utilizes gravel and small cobble substrate to spawn and lay their eggs. These eggs hatch and the tiny juvenile fish continue to live and feed under the substrate until they are strong enough to enter the main stream. It is crucial that there is enough oxygen and food supply to sustain juvenile fish as well as the other animals like frogs and salamanders that uses the substrate to raise their young.

6. Vegetation Assessment

(Vegetation and habitat assessment have been adapted from The Coyote Creek Riparian Station: Santa Clara County Citizens Monitoring Stream Inventory Project, California Salmonid Habitat Restoration Manual prepared by the California Department of Fish and Game, and the Streamkeeper's Field Guide.)

The collected information may help Heal the Bay and other stake holders determine the quality of in-stream habitat and the suitability of this habitat for use by the endangered steelhead trout and other aquatic wildlife. The basic types and quality of vegetation will be mapped as well as identifying areas of degraded streambanks. The team will map other significant natural features that characterize the stream reach and the land uses adjacent to the stream that may be impacting the water quality of the stream reach. When the survey is complete, there will be a map that shows all these things and from that map Heal the Bay can determine how developments upstream are affecting the water quality and environmental conditions of this stream reach over time.

SUMMARY

The information that you have collected will be stored in a geographic information system (GIS) maintained by Heal the Bay and this information will be shared with local, state, and federal agencies that make decisions that affect the Malibu Creek Watershed. The more Heal the Bay and those agencies know about the problems the better the solutions to these problems.

This is very useful information that will be used to track changes of the stream reaches over time. In understanding the changes, the causes of these alterations may be determined. The reason for change in the stream channel may be a natural process. Alternatively, increased urban runoff, or other human influences may cause changes in a stream channel. Either way, involvement on the Stream Reach Survey team will contribute to the data needed to understand existing physical conditions of the streams in the Malibu Creek Watershed. The information collected during the Stream Reach Survey can be used by local agencies to develop restoration strategies that address the specific needs and conditions of a stream. Restoration strategies that address the needs and conditions of a stream have proven more successful in past restoration and enhancement efforts.

Specific field procedures will be designed and incorporated into phase 2 field guide. These procedures should be based on the informational needs of the Malibu Creek Watershed at that time.

Appendix 3
MACROINVERTEBRATE SAMPLING

Purpose

Biological monitoring is an important monitoring tool for testing water quality and assessing the health of the watershed. Biological testing depicts water quality over a longer period of time since the biological components of a stream live in direct contact with water and are affected by the quality of that water. These organisms are the continuous indicators of water quality. An integrated approach using chemical testing, biological testing and assessing the physical components of a stream can result in a more comprehensive evaluation of stream and watershed health.

WHY MONITORING FOR MACROINVERTEBRATES IS IMPORTANT

A common way that volunteers can test the biological health of a stream is by monitoring for aquatic macroinvertebrates. Macroinvertebrates are organisms that have no backbone and can be seen with the unaided eye. These can be aquatic clams, snails, worms, and insects. Since riparian macroinvertebrates are largely immobile and spend part or all of their life within water, they are good indicators of water quality over a longer period of tme. Collecting a sample of benthic macroinvertebrates can tell you a lot about the water quality of a stream. Some macroinvertebrates are highly pollution-sensitive while others are more pollution-tolerant. They can react to changes in water temperature, dissolved oxygen levels, chemical and organic pollution, and sedimentation. If a monitoring sample shows a great number of pollution-tolerant macroinvertebrates and very few, if any, of the pollution-sensitive macroinvertebrates, it can be an indication that water quality is poor.

As a volunteer monitor you will be assigned to collect macroinvertebrates, identify them, and sort them into categories. A healthy stream should show excellent species diversity for the various types of aquatic macroinvertebrates in the watershed.

What are Macroinvertebrates?
Many of the macroinvertebrates that you will be monitoring live the majority of their life within water. For many this is their aquatic stage. These include organisms such as mayflies, dragonflies, and caddisflies. Once they enter the adult stage they develop wings and are able to fly, mate, and deposit eggs for another generation to form and develop. The aquatic stage can last a few weeks or up to a few years, depending upon the organism. Other types of macroinvertebrates, such as aquatic worms and snails, live most of their life within water.

The macroinvertebrates you will be monitoring for are benthic macroinvertebrates. These are macroinvertebrates that live on the bottoms of streams and water courses. Benthic macroinvertebrates can be divided into functional feeding groups. These are: collectors, shredders, scrapers, and predators. Collectors feed on tiny pieces of organic material. Collectors can be further divided into collector-filterers and collector-gathers. Shredders feed on coarser pieces of organic material such as leaves, algae, and twigs. Shredders break down these larger pieces which other macroinvertebrates can then feed on. Scrapers feed on algae attached to stones and other surfaces found on the stream bottom. Predators directly feed on other aquatic organisms found within the aquatic environment. Each of these functional feeding groups plays a vital role in breaking up organic material and contributing food and nutrients along the food chain.

WHAT TO EXPECT WHEN MACROINVERTEBRATE SAMPLING

Monitoring sites will be sampled at least two times a year. Monitoring times will be during late fall and late spring.

Selecting Monitor Sites

Two types of sites monitored in the watershed. These are reference sites and monitoring sites. A reference site is needed to compare other monitoring sites against. These sites are minimally impacted by human use and similar in characteristics to the monitoring site. Since the reference site is minimally impacted it should show what a healthy stream in the watershed looks like and the mixture and diversity of macroinvertebrates that can be expected. Monitoring sites are picked because of their strategic location and their ability to tell a lot about what is happening in various parts of the watershed.

Monitoring for macroinvertebrates is normally done in areas of the stream that have riffles. Riffles are areas where water flows rapidly over rocks in a shallower part of the stream. This is a good area to monitor because macroinvertebrates find this environment a favorable place to live. The fast moving water captures oxygen from the air increasing the dissolved oxygen content of the water. The large stones and rocks create niches where macroinvertebrates attach their homes or find shelter from predators in the rapidly moving stream. This environment also creates nooks and crannies where organic material and other food can be trapped. The riffle part of a stream is where you can expect a great degree of diversity in the types of macroinvertebrates found living there.

Most organisms have been categorized into the following six functional feeding groups based on their method of acquiring food; shredders (SH), predators (P), scrapers (SC), filtering collectors (FC), collector gathers (CG) and piercers (PI). The composition of functional feeding groups will change depending on the type and degree of disturbance to the stream. For example, absence of riparian canopy will allow more sunlight to enter the stream producing more periphyton and more scrapers, which eat periphyton. Macroinvertebrate abundance varies with the type of pollution affecting the stream.

Creating a Monitoring Protocol.

Currently the California Department of Fish and Game (CDFG) is revising their protocol to be more user friendly and geared towards volunteer monitoring programs. Further, CDFG will be publishing a key for macroinvertebrates in the Malibu Creek Watershed. Heal the Bay should use the protocol and the watershed key for Phase 2 of the Stream Team Program.

Appendix 4
ALGAE

Floating Algae

There are two major types of floating algae that are regularly observed in the field:
Enteromorpha and floating diatoms.

Enteromorpha (EN) is light green to dark green in color and when examined closely has a hollow tube shape that resembles an intestine or sausage casing.

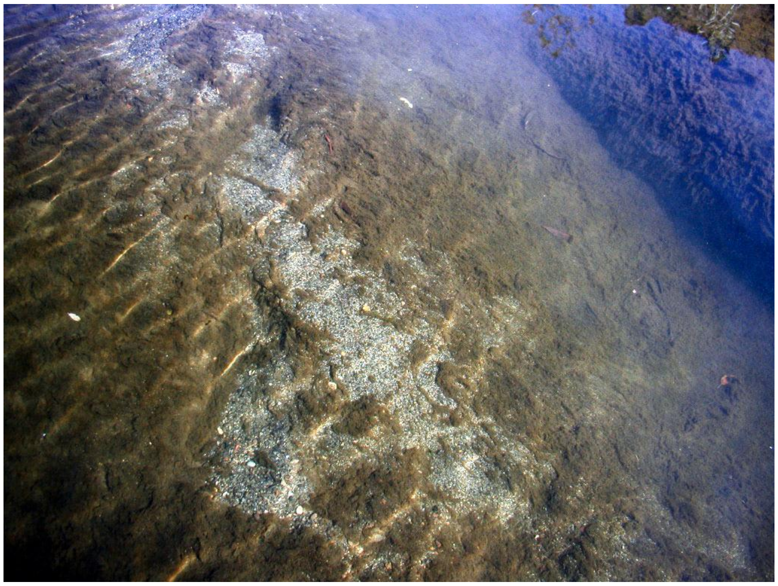
Floating Diatoms (DT) can be lime green to brown n color. Floating diatoms almost always have bubbles or air pockets present n their floating state. Diatoms disintegrate when disturbed.

Mat Algae or Benthic Algae
Mat or benthic algae is attached to the sand, rocks or gravel on the bottom of the stream. There are four types of mat algae regularly observed in the field: Cladaphora, Rhizoclonium, Chara, and mat diatoms.

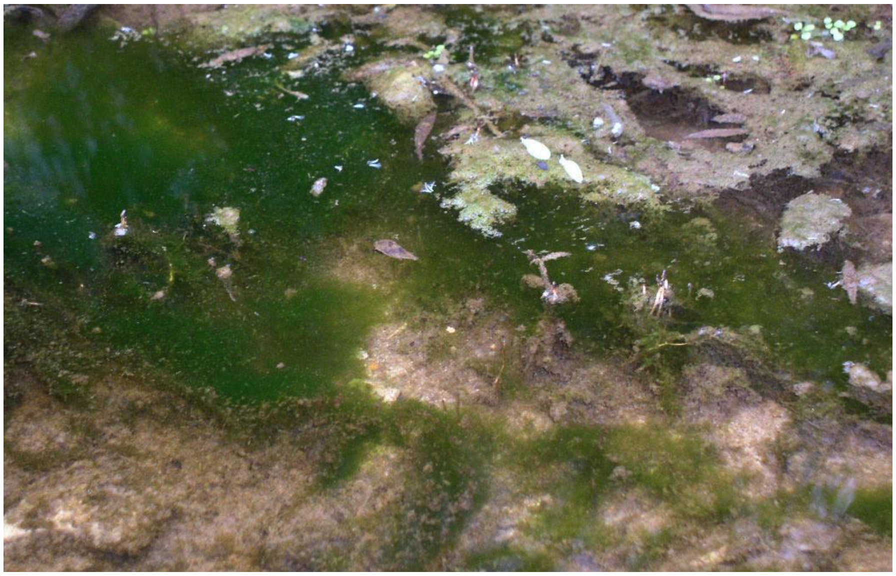
Cladophora (CL/RZ) "Hair Algae" is fine and stringy, or filamentous. It may appear to float on the surface but it is attached by a stalk to the stream bottom (substrate). Cladophora is generally found in shallow well-oxygenated riffle parts of the stream.

Rhizonclonium (CL/RZ) is usually attached to the bottom or rocks, and grows like a turf or mat. It has a similar appearance as Cladophora, but we generally find it in the deeper slower flowing water of glides and pools. Because Cladophora and Rhizoclonium are hard to distinguish between, we record them both as CL/RZ.

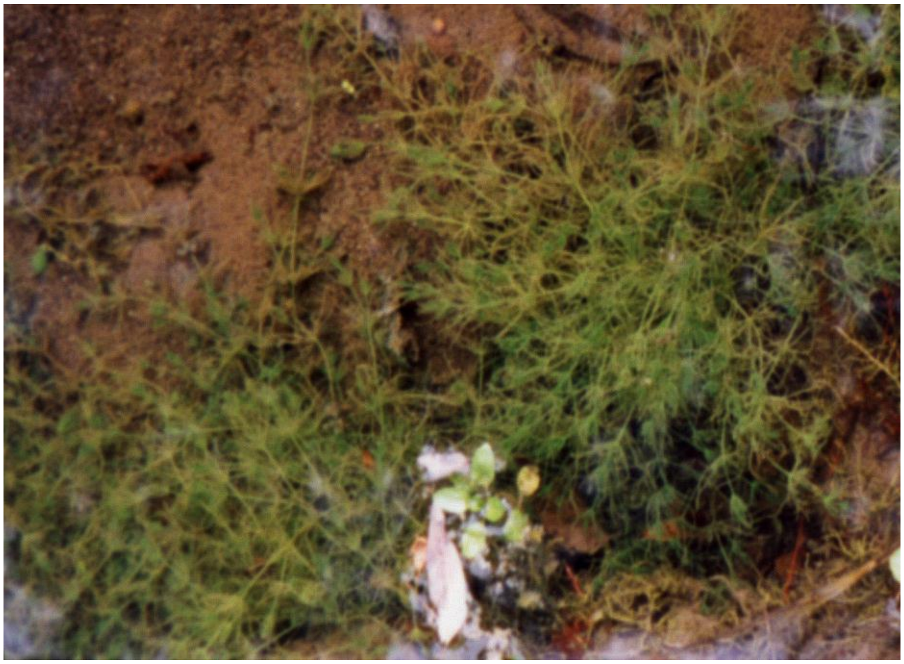
Mat Diatoms (DT) are attached to the bottom of the stream (substrate) as mats. They are brown and may be a thin film on the rocks and sandy bottoms. We record thick diatoms, which are greater than 2 mm thick. Thick diatoms look like a fuzzy coating on the rocks, plants or sandy stream bottom. Diatoms break apart and disintegrate easily if you disturb them.



Spyrogyra (SP) is similar to Cladophora but is very slimy (feels like snot) and usually s lighter green. It often takes on a wispy or cloudy appearance in the water column. Spyrogyra s not well anchored to rock and may appear to float in the water column. Spyrogyra is usually found in slow or stagnant areas of the stream. It often takes on a wispy or cloudy appearance in the water column.



Chara (CH) has a stalk with thin branches along its rings. It could be mistaken for a vascular plant. It attaches to the bottom and grows up toward the surface. Usually indicates clean or hard water.



Appendix 5
REFERENCES

American Rivers Website. Most Endangered Rivers. http://www.americanrivers.org/mostendangered/ventura2000.htm Visited February 2003.

California Resources Agency et al. Common Ground from the Mountains to the Sea Watershed and Open Space Plan San Gabriels and Los Angeles Rivers. October 2001.

California State Coastal Conservancy website. Southern California Coastal Watershed Inventory Santa Ana River Watershed. http://eureka.regis.berkeley.edu/wrpinfo/. Visited June 2003.

California State Coastal Conservancy website. Southern California Coastal Watershed Inventory San Jacinto River Subwatershed. http://eureka.regis.berkeley.edu/wrpinfo/. Visited June 2003.

Calleguas Creek Watershed website. Watershed Profile. http://www.calleguas.com/ccbrochure/introld.html. Visited July 2003.

Center for Watershed Protection. Teacher's Guide for Creating a Water Monitoring Program. Silver Spring, MD.

Chesepeake Bay Program Website. Plankton. http://www.chesapeakebay.net/info/plankton.cfm. Visited July 2003.

Coyote Creek Riparian Station. Santa Clara County Citizens' Monitoring/Stream InventoryProject: Protocols and Procedures. 1995.

Dale, Nancy. Flowering Plants of the Santa Monica Mountains. Santa Barbara: Capra Press, 1985.

Dole, Jim W. and Betty B. Rose. Shrubs and Trees of the Southern California Coastal Region and Mountains. North Hills, CA: Foot-loose Press, 1992.

Department of Agriculture. Malibu Creek Watershed Natural Resources Plan. July 1995.

Estuaries.gov Website. Estuaries: Where the River Meets the Sea About Estuaries. http://estuaries.gov/about.html. Visited June 2003.

Faber, Phyllis M. and Robert F. Holland. Common Riparian Plants of California. Mill Valley, CA: Pickleweed Press, 1996.

Faber, Phyllis M. Common Wetland Plants of Coastal California. Mill Valley, CA: Pickleweed Press, 1993.

Firehock, Karen. Save Our Streams: Volunteer Trainer's Handbook. April 1994. The Izaak Walton League of America. Gaithersburg, MD.

Heal the Bay website Warning Signs for Beach Water Quality. http://www.healthebay.org/brc/warningsigns.asp Visited February 2003.

Heal the Bay website Grading System. http://www.healthebay.org/brc/gradingsystem.asp Visited February 2003.

Hickman, James C., ed. The Jepson Manual. Berkeley: University of California Press, 1993.

Larry Walker and Associates. Calleguas Creek Nurient TMDL. April 2001.

Leopold, Luna B. Water, Rivers, and Creeks. 1997. University Science Books. Sausalito, CA.

Lenz, Lee W. and John Dourley. California Native Trees & Shrubs. Claremont, CA: Rancho Santa Ana Botanic Garden, 1981.

Levy, Louis and John Korkosz. Water Resources Management Plan, Santa Monica Mountains National Recreational Area. National Park Service, April 1997.

Los Angeles County Department of Public Works Website. Los Angeles County Wattershed Management Santa Clara River Watershed. http://dpw.co.la.ca.us/wmd/watershed/sc/. Visited February 2003.

Los Angeles County Department of Public Works Website. Los Angeles County Wattershed Management Los Angeles River Watershed. http://dpw.co.la.ca.us/wmd/watershed/LA/. Visited February 2003.

Los Angeles County Department of Public Works Website. Los Angeles County Wattershed Management Dominguez Watershed.http://dpw.co.la.ca.us/wmd/watershed/dc/current_cond.cfm. Visited February 2003.

McAuley, Milt. Wildflowers of the Santa Monica Mountains. Canoga Park, CA: Canyon Publishing Co., 1985.

Mill Valley Watershed Project. The Mill Valley Watershed: Volunteer Stream Survey Manual. January 1997. Mill Valley, CA.

Muns, Bob. Malibu Creek State Park Flora. January 1983.

Murdoch, Tom, Martha Cheo, and Kate O'Laughlin. Streamkeeper's Field Guide: Watershed Inventory and Stream Monitoring Methods. 1996. Adopt-A-Stream Foundation. Everett. WA.

Napa County Resource Conservation District. Napa River Watershed Monitoring, Stream Gauge Protocol Draft. February 1998.

Olson, Jeffrey K. Unpublished. Plant Database, 1998.

Raven, Peter H. and Henry J. Thompson and Barry A. Prigge. Flora of the Santa Monica Mountains, California. Los Angeles, University of California, 1986.

Resource Conservation District of the Santa Monica Mountains. Biological Overview of the Malibu Creek Watershed Proposed Channel Clearing Sites. October 20, 1997.

Santa Monica Bay Restoration Project. State of the Bay 1993: Characterization Study of the Santa Monica Bay Restoration Plan. January 1994. Monterey Park, CA.

Sawyer, John O. and Todd Keeler-Wolf. A Manual of California Vegetation. Sacramento: California Native Plant Society, 1995.

St. John, Ted. The Willows of Southern California. San Juan Capistrano, CA: Tree of Life Nursery, 1994.

State Water Resources Control Board. California Ocean Plan. December 3, 2001. Sacramento, CA.

United State Department of Agriculture (USDA). Malibu Creek Watershed Natural Resources Plan. July 1995. USDA Natural Resources Conservation Service. Davis, CA.

United States Environmental Protection Agency (USEPA) Introduction to the Clean Water Act. http://www.epa.gov/watertrain/cwa/. VisitedFebruary2003.

United States Environmental Protection Agency (USEPA) National Estuary Program Chapter 11 pH and Alkaliniity. http://www.epa.gov/owow/estuaries/monitor/chptr11.html#ph.VisitedFebruary2003.

United States Environmental Protection Agency (USEPA). Volunteer Estuary Monitoring: A Methods Manual. EPA 842-B-93-004. December 1993. USEPA Office of Wetlands, Oceans and Watersheds. Washington, D.C.

United States Environmental Protection Agency (USEPA). Volunteer Stream Monitoring: A Methods Manual. EPA 841-B-97-003. November 1997. USEPA Office of Wetlands, Oceans and Watersheds. Washington, D.C.

United States Environmental Protection Agency (USEPA). Streamwalk Manual. EPA 910- B-94-002. July 1994 (Rev.). USEPA Water Division, Region 10. Seattle, WA.

Wilson, Bert. A Manual of California Native Plants. Santa Margarita, CA: Las Pilitas Nursery, 1993.

Yates, Steve. Adopting A Stream: A Northwest Handbook. 1991. The Adopt-A-Stream Foundation. Everett, WA.

Volunteer Instructions for Freshwater Swimming Study

1. Sign up for sampling at:
   https://docs.google.com/spreadsheet/ccc?key=0Ai9MW4I_IKdzdEZTb1BQWXk4ang1b2I5bTVXdnhMelE&usp=sharing
   Sign up in pairs for safety
   Sampling will take place on Wednesday and Sunday
   Three sites: Rock Pools in Malibu Creek SP, Las Virgenes Bridge at Malibu Creek SP, Solstice Canyon

2. Pick up equipment from Heal the Bay office (1444 9th St. Santa Monica, CA) before sampling
   Coordinate with partner for pick up arrangement
   Pick up M-Thursday 9-5pm or Friday 9-2pm
   Equipment
      Backpack: clipboard, instructions, datasheets, parking permits, gloves, air/water thermometer, hand sanitizer, clickers, pens, Sharpies, first aid kit
      Cooler: ice packs/ice, sterile bacteria bottles (3 or 4 if duplicate)

3. Go to site(s) on specified day with your partner
   Aim to go late morning to late afternoon when most people will be there
   Directions will be given to you
   Take precautions: wear sunscreen, bring water, avoid poison oak, rattlesnakes, stay on trails, be sensible!
   If you are sampling on a weekend, call or text Frankie or Katherine with an estimated time that you will bring the sample back to the lab
   Katherine: 213-631-8495; Frankie 310-801-1327

4. Collect data
   a) Record basic info: date, Site name (Rock Pools or Century Lake), Start time, Recorders (both names), Weather conditions

   b) Collect site condition data
      Water temp: Record water temperature at two different locations
         Immerse the thermometer in water for ~1minute and read
      Air temperature: hang in a shady spot, record temp at end of survey
      Flow: circle most appropriate category
      Water clarity: circle most appropriate category, tip – look at the water in bacteria bottle to assess clarity
      Water color: circle most appropriate category, tip - look at water in bacteria bottle to assess color
      Water odor: circle most appropriate category

   d) Debris/trash: survey the area (in the water and approximately 10m/30ft away from water on all visible banks), count number of items and circle most appropriate category

Trashcans: count and record the number of trashcans that you see, record whether they have lids, and whether they are filled/overflowing

e) Bathroom Conditions: the bathroom nearest the site has been previously determined and is noted on the data sheet; note if there are any changes or unusual conditions of bathroom (out of order, cleanliness, not open, etc.)

f) Animal Use

Count the number of dogs, aquatic birds, and horses in and out of the water. This is a **snapshot in time** – if more animals arrive to the site while you are counting, you can add them to the data. If you are finished and more animals arrive, do not count them. You can make a note of this.

Record and count any other animals and make a note of type of animal

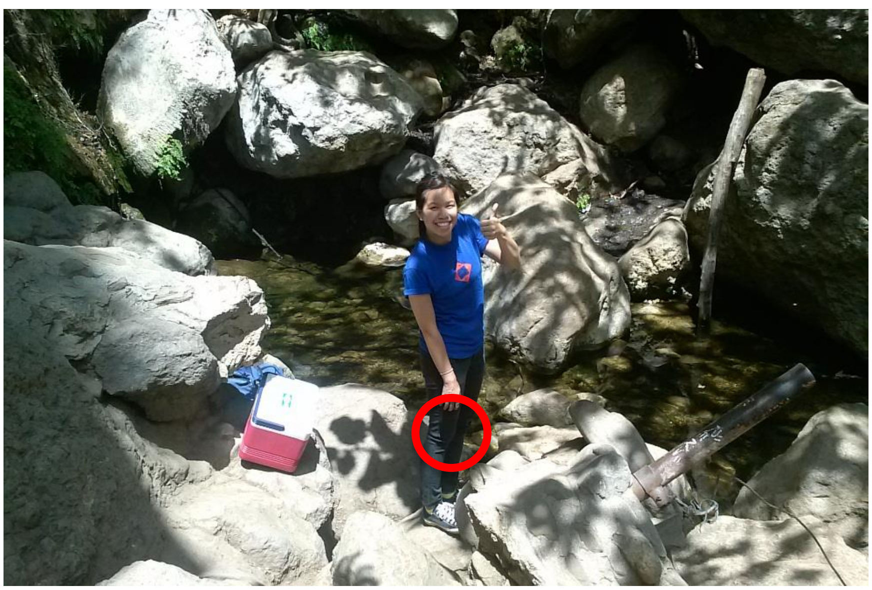
g) Collect bacteria sample near end of survey

Collect from specified spot:

Rock Pools: Near area where people are entering and exiting the pool to the left of the tree

Las Virgenes: On the downstream side of the bridge in the middle of "beach" area

Solstice: Around rocks near entrance to the waterfall



How to sample:

Wear gloves (not required)

Remove plastic seal from bottle and discard properly

Collect sample in approximately knee depth water

Take sample 6 inches below surface – **do not just skim the surface** as sunlight kills bacteria at the surface and this won't give an accurate representation of bacteria levels

Do not rinse bottle – just fill once

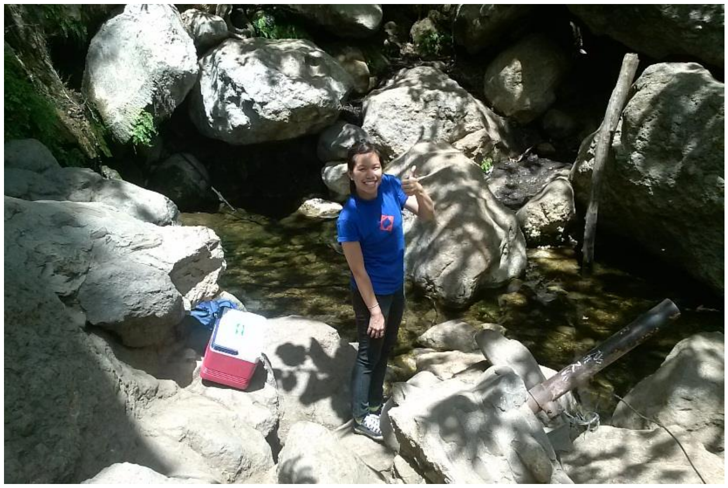
Fill bottle to line (100ml) – air bubbles are fine
Place bottle in cooler immediately
Record time sampled and on ice on datasheet
Sample must be processed within 6 hours

h) Photographs(s)- Take at designated spot(s)

Rock Pools: Take 2 photographs approximately mid-way between the trash cans and the water. Take one photo facing the water and one photo facing the trashcan.

Las Virgenes: Take 2 photographs from the middle of the “beach” where you sampled. Take one photo facing upstream (the bridge) and one photo facing downstream.

Solstice: Take 1 photograph of the pool.



Please text or email the pictures to Katherine as soon as possible at (213) 631-8495 or kpease@healthebay.org.

i) Human Use

You will be counting and recording visitors to the area, their use of the water, and visitor demographics. This is a **snapshot in time** – if more people arrive to the site while you are counting, you can add them to the data. If you are finished and more people arrive, do not count them. You can make a note of this.

You will be recording the age, race, and gender of individuals and marking whether they are out of the water or in the water. You can do a total count or hash marks under the appropriate column. If the area is crowded, work with your partner and do your best. Start at one side and work your way to the other side or end. Tip – if the area is crowded, you may take a photograph of the area and record human use based on the picture.

Age categories – estimate to the best of your ability

Infant – 0 to 2 years
Child – 3 to 12 years
Young adult – 13 to 21years
Adult – 22 years and over

Race categories – use your best judgement

Caucasian
Hispanic
Asian

Black
Other/unsure
Gender
M – male
F – female
U – unsure (baby or hard to tell)

Location
Out of the water – currently out of the water
In the water – differentiate among 3 categories below
Wader – in water less than knee depth
Swimmer non-submerge – in deeper than knee depth but head is or has not gone under water
Swimmer submerge – in deeper than knee depth or greater you see their head go under or their hair is wet

j) Record air temperature
Remove thermometer and place in backpack

k) Fill in any notes
Evidence of toilet paper
Evidence of animals (feces, droppings, etc.)
Anything different, unusual, or interesting

5. Repeat for all sites

6. Return to car and bring samples to the Heal the Bay: 1444 9th St. Santa Monica 90401
Contact Katherine or Frankie for access to lab on weekend
Call or text designated person when you are headed back to the lab

7. Process samples or hand off to Katherine, Frankie, or other designated person
Turn on incubators immediately
Follow instructions in lab
Be sure to run a negative control (lab water)

Helpful information to say if a visitor asks what you are doing:
- We don't know the current levels of bacteria in these swimming sites yet
- Taking part in a citizen science program for Heal the Bay – measuring human use and water and bacterial conditions of popular swimming sites in the Malibu Creek Watershed
- Testing bacteria (E. coli, coliform, enterococcus) levels in the water
- For more information go to www.healthebay.org

Bacteria Lab Procedure

1) Turn on incubators: Top - 41° Bottom - 35°

2) Line up water samples for bacteria in numerical order:

Label Idexx Quanti-Trays – 2 per sample + 2 blanks with:
Site #
Bacterial test: E (for Enterolert) or C (for Colilert/Coliform)
Date

3) Label Hardy Diagnostics dilution buffer – 2 per sample + 2 blanks
Site #
Bacterial test: E (for Enterolert) or C (for Colilert/Coliform)

4) Add 1 packet of Colilert (in fridge) to each of the bottles labeled as "C"
Add 1 packet of Enterolert (in fridge) to each of the bottles labeled as "E"
Shake/spin the bottles to mix and dissolve

5) Using 10ml sterile pipettes (1/sample), add 10ml sample to each dilution bottle

6) Pour liquid into Quanti-Trays labeled as "C" or "E"
Pinch trays so open and pour slowly along back silver wall
Try to minimize bubbles as much as possible, tap them out

7) Seal trays in Quanti-tray sealer and label trays with time of seal

8) Put trays in incubator, can stack them on their side
Enterolert: top incubator at 41°, read in 24 hours
Colilert: bottom incubator at 35°, read in 24 hours

Next Day Bacteria

Reading Colilert Trays

1) Take Quanti-trays out of incubator after 24 hours and take control tray out of fridge

2) Turn off incubator

3) To read total coliform, compare the 49 large and 48 small wells to the coloration of the control. If darker than the control, mark as positive. Mark total positives on back of tray

4) To read E.coli, look for fluorescence under UV light. Mark all positives and record on back of tray. Make sure that if well fluoresces, it is also yellow for total coliform, if not, false positive and don't count.

5) On back of trays, write: Time analyzed
   # large and small wells positive for total coliform
   # large and small wells positive for E. coli

6) Record data on datasheets and use matrix to determine bacteria MPN

Reading Enterolert Trays

1) Take Quanti-trays out of incubator after 24 hours

2) Turn off incubator

3) To read Enterococcus, looking for fluorescence under UV light. Count the number of positive wells.

4) On back of trays, write: Time analyzed
   # large and small wells positive for Enterococcus

5) Record data on datasheets and use matrix to determine bacteria MPN

**Note: if the values are maxed out, make a note of this and next month, test two dilutions (10ml sample + 90ml dilution buffer <u>and</u> 1ml sample + 99ml dilution buffer). **