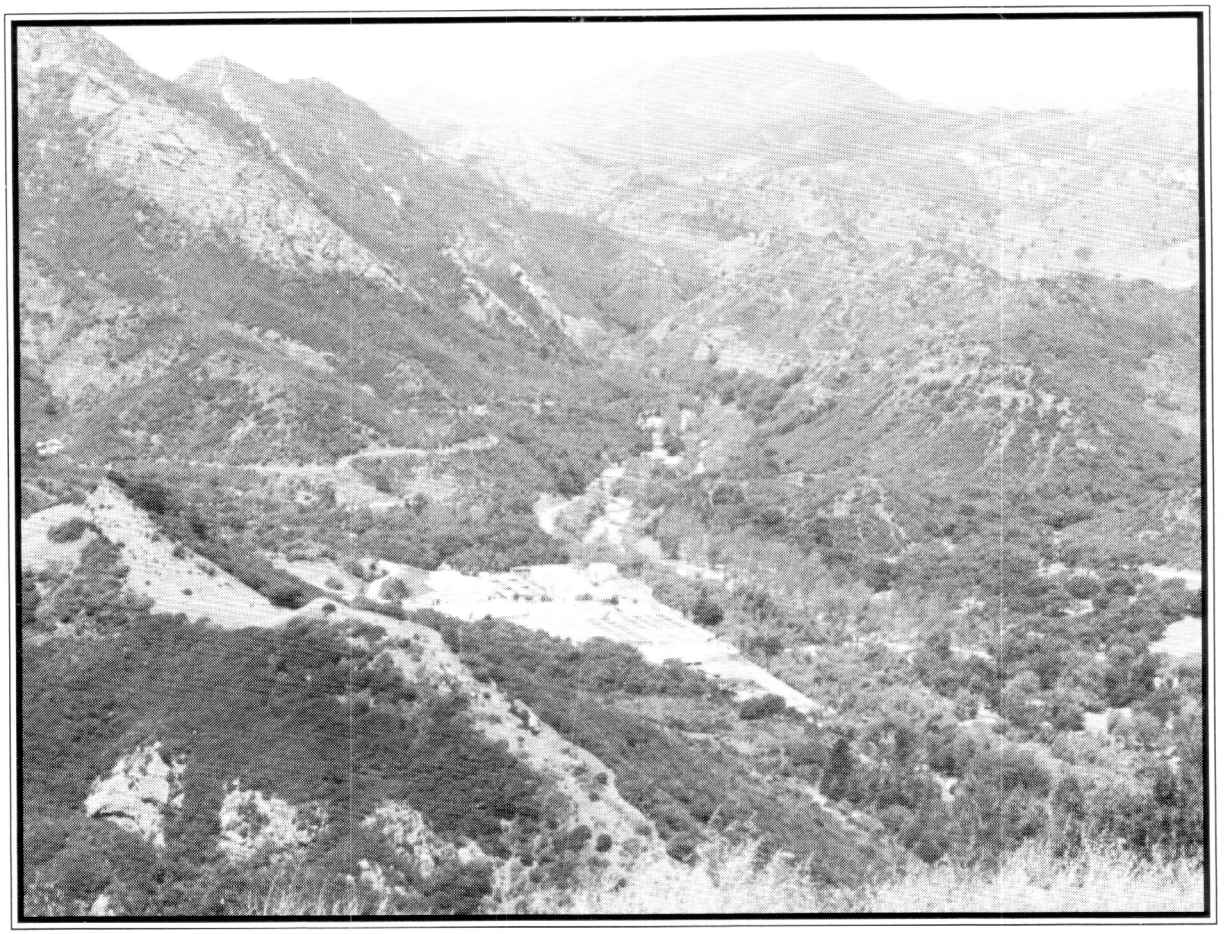
United States
Department of
Agriculture

Natural
Resources
Conservation
Service

July 1995

Malibu Creek Watershed Natural Resources Plan



Los Angeles and Ventura Counties, California

NATURAL RESOURCES PLAN

MALIBU CREEK WATERSHED
Los Angeles and Ventura Counties, California

Sponsored by:

Topanga-Las Virgenes Resource Conservation District

Assisted by
United States Department of Agriculture
Natural Resources Conservation Service
Davis, CA

JULY 1995

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SECTION 1 - INTRODUCTION

1.1 REQUEST AND AUTHORITY

Pollution of Malibu Lagoon has been a growing concern for many years. The Southern California Association of Governments prepared an Areawide Waste Treatment Management Plan for the South Coast area of California in the late 1970s. The plan listed the following known or suspected non-point sources to be contributing to an existing or potential water quality problem in Malibu Creek: urban runoff, rural runoff, agricultural activities, recreational activities, septic tank systems, and unsewered communities.

Nearly 20 years later these same sources are still contributing to water quality concerns in Malibu Creek and Malibu Lagoon. Recognizing this, the Topanga-Las Virgenes Resource Conservation District asked the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service, for assistance in preparing a natural resources plan for the Malibu Creek Watershed. The plan was to address resource problems and concerns, with emphasis on water quality and quantity.

The Topanga-Las Virgenes Resource Conservation District, Topanga, California, was formed under Division 9 of the Public Resources Code, State of California. As a legal subdivision of the state, the district is responsible for land and water resource conservation within its boundaries and, as such, is empowered to enter into agreements with federal, state, and local agencies and with individuals and private groups for securing and implementing plans for land and water conservation.

1.2 OVERVIEW OF STUDY

This natural resources plan:

1. Identifies and describes local problems associated with water quality and quantity (including altered flow regime).

   The combination of urbanization and imported water has changed the dynamics of the watershed's streams and the lagoon. Malibu Creek is an altered stream system which has been changed from a stream with summer flows of less than 0.3 cubic feet per second, to one with ten times that amount. The low flows will continue to rise due to increases in lawn irrigation and non-point sources as the population grows. Water quantity information is detailed further in Section 3.

   The inventory work also brought out the fact that the main water quality concerns are high levels of nutrients and bacteria causing eutrophication in some of the surface water bodies and inhibiting the beneficial uses. More details about water quality can be found in Section 4 of this report.

2. Develops, evaluates, and compares treatments that address resource concerns linked to surface runoff.

   Information about typical NRCS conservation practices which, when applied, can reduce non-point source pollution, erosion, sedimentation, and excess water runoff, can be found in Section 5 and Appendix C. Each individual treatment site will need to be evaluated separately; therefore, information regarding the conservation practices is provided in general terms.

3. Identifies possible implementation strategies and funding sources through local, state, and/or federal agencies, including NRCS.

   Implementation strategies are discussed in Section 6 while funding sources are listed in Appendix D.

1.3 EXPECTED USES OF THE STUDY

This report is a summary of resource conditions, concerns, and evaluations. It contains recommended conservation practices for select watersheds. It is expected to assist residents, groups, and agencies in the Malibu Creek Watershed in their efforts to:

- Reduce non-point source pollution that is degrading water quality.

- Prepare plans and actions to reduce effects of the alteration of the streamflow regime resulting from development.

- Evaluate the effects of the breaching of the lagoon entrance sandbar and, perhaps, implement practices that regulate breaching.

1.4 PREVIOUS PLANNING ACTIVITY

Numerous individuals, private and public groups, and public agencies have recognized the Malibu Creek Watershed's potential for recreation opportunities and for fish and wildlife habitat, and its influence on coastal water quality. Many individuals have recognized the watershed as an environmentally attractive place to live and work. They have expressed the desire to participate in a process aimed at improving and maintaining the environmental health and resources of the watershed. Several groups have been involved in the continually changing watershed planning efforts.

A Coordinated Resource Management Planning group was organized in July 1989. The group authored the "Malibu Watershed - Management Criteria Overview." Representatives of fifteen groups reviewed and approved the document.

A Malibu Creek Watershed Group, initiated by State Senator Gary Hart and sponsored by the California Coastal Commission, began meeting in March 1991. Twenty-nine organizations were represented at the six Group meetings. This process culminated in the preparation and distribution of a Mission Statement and a Scope of Work for Malibu Creek Watershed Studies.

The Topanga-Las Virgenes Resource Conservation District (TLVRCD) and the Santa Monica Bay Restoration Project (SMBRP) assumed leadership roles in coordinating efforts of all interested parties in preparing a natural resources plan for the watershed. An information meeting was held on September 16, 1991. Approximately 70 people attended, representing 40 different agencies, groups, and individuals. This effort led to the decision to prepare this plan. A companion plan has been prepared for Santa Monica Bay by the Santa Monica Bay Restoration Project.

Many other groups and agencies have prepared plans that affect portions of the Malibu Creek Watershed. Some of these led to the formation of the cities. Others include "The 101 Corridor" plan, an ongoing Trails Plan, ongoing scenic highways plans, and development plans, such as those for Ahmanson Ranch, Micor, Baldwin, Gillette Ranch, and others. Regional and large area planning is continual for the city and county general plans and development allowances within their spheres of influence. Other plans that affect large portions of the watershed are those of the National Park Service and the California Department of Parks and Recreation. These agencies are assisted in obtaining and managing public lands by the conservancy groups/agencies - Coastal Conservancy, Santa Monica Mountains Conservancy, and Mountains Recreation and Conservation Authority.

1.5 LOCAL PARTICIPATION IN PLANNING EFFORT

The residents, groups, and agencies in, or representing interests in, the watershed, participated actively in the effort. An advisory committee, chaired by the TLVRCD, provided a vehicle for broad participation. The committee included four technical subcommittees:

1. Fish and Wildlife/Soils/Geology/Geography/Monitoring and Modeling. This committee, commonly called the Monitoring and Modeling Subcommittee, met a number of times to develop monitoring goals, and it sponsored a February 1995 technical workshop to begin setting quantitative monitoring objectives.

2. Public Health/Recreation. This committee prepared and adopted a list of issues, concerns, and recommendations. This list is reproduced in Appendix B.

3. Media/Community Involvement/Public Education. This committee has begun publishing a newsletter on watershed activities.

4. Implementation/Land Use/Cultural Resources/Ordinances and Regulations. This committee has been formed and is awaiting the completion of this study report before taking further action.

The advisory committee and technical subcommittees have held a number of meetings. Those participants included on more than one attendance list are shown on Table 1 (TLVRCD, 1993).

1.6 FACILITATED ADVISORY COMMITTEE MEETINGS

During the course of the early meetings it became apparent to the TLVRCD and SMBRP that:

(1) more than 40, perhaps as many as 80 agencies, groups, and individuals would be involved in planning and decision making in the watershed;

(2) up to 100 divergent viewpoints would need to be considered and discussed before a consensus decision could be made; and

(3) many residents were politically aware and appreciated participatory decision making.

TABLE 1 - PUBLIC PARTICIPATION IN PLANNING PROCESS

Ahmanson Land Company
Agoura Hills, City of
American Oceans Campaign

Calabasas, City of
California Coastal Commission
California Coastal Conservancy
California Department of Conservation
California Department of Fish and Game
California Department of Parks and Recreation
California Department of Water Resources
California Regional Water Quality Control Board
California State Polytechnic University, Pomona
California State Senate
California State University, Northridge
California Trout
California Urban Forest Council

Endangered Habitats League
Environment Now

Friends of Caballero Canyon

Heal the Bay

Las Virgenes Homeowners Fed.
Las Virgenes Municipal Water District
Las Virgenes Unified School District
Los Angeles, County of

Malibou Lake Mountain Club
Malibu Boardriders
Malibu, City of
Malibu Surfriders
Malibu Surfing Association
Malibu Wastewater Study Group
Mountains Restoration Trust

National Park Service (Santa Monica Mountains National Rec. Area)
Natural Resources Defense Council

Santa Monica Bay Restoration Project
Santa Monica Mountains Conservancy
Santa Monica Mountains Task Force
Save Open Space
Save Our Coast
Sierra Club
Surfrider Foundation

Thousand Oaks, City of
Topanga Canyon Floodplain Management CAC
Topanga-Las Virgenes Resource Conservation District
Triunfo County Sanitation District

U.S. Department of Agriculture, Natural Resources Conservation Service (formerly Soil Conservation Service)
U.S. Environmental Protection Agency
U.S. House of Representatives (Anthony Beilenson's Rep.)
University of California, Los Angeles

Ventura, County of

Consultants and Individuals included:

Phil Chandler
Stan Fincham, Advanced Environmental Systems
Adam Gilbert
Norman Haynie, Developer/Consultant
Tony Knight, Reporter, Daily News
J. Pittman
Tom Sinclair, WWS
John Slezak
Peter Warshall, Consultant

The discussions led to a suggestion that a facilitated mediation effort be undertaken. At the second Advisory Committee meeting for the Natural Resources Plan study, the TLVRCD and SMBRP agreed to select a facilitator and to fund and manage the facilitation process.

Patricia Bidol-Padva, Ph.D. and Beth Greenwood, J.D. (Director) of Common Ground: Center for Cooperative Solutions of the University of California, Davis were selected to mediate the planning effort. Ms. Catherine Tyrell (SMBRP Director), Dr. Rainer Hoenicke (SMBRP Project Director), Mr. Dennis Washburn (TLVRCD President), and Mr. David Gottlieb (TLVRCD Vice-president) served on the mediation steering committee (Bidol-Padva, 1994).

The resulting Comprehensive Malibu Creek Watershed Mediation Effort was the first multi-party mediation in the study area to engage impacted parties from the upstream mountain area, the beachfront communities, and the Bay in joint planning for the total ecosystem and the watershed as a whole (Bidol-Padva, 1994).

The facilitation process resulted in a total of 234 action goals. These goals were refined, discussed, and voted on by the group. A smaller list of 111 action items resulted at the end of this mediation effort. Heather Trim of the Los Angeles Regional Water Quality Control Board reorganized and grouped these items to obtain a final list of 44 action items. These 44 items are listed in Appendix A.

While these items generally focus on the local action needed, some of the items also identify information gaps. The information provided in this report may help to begin to fill in the information gaps so the local people can move forward to accomplish the designated actions.

1.7 SUPPORTING DOCUMENTATION

Several supplemental reports were prepared during the course of the study and are available. These include an erosion and sediment yield report, a nitrogen and phosphorus analysis, a booklet on backyard ranches that contains horse management recommendations, and an extensive bibliography. The supplemental reports and review of the technical documentation files, including input disks for computer runs, may be arranged by contacting NRCS at 2121-C Second Street, Davis, CA 95616.

SECTION 2 - WATERSHED RESOURCES

2.1 BACKGROUND

Santa Monica Bay is one of three estuaries in California currently listed in the National Estuary Program. The program is an interagency effort administered by the U.S. Environmental Protection Agency for the purpose of improving and/or maintaining coastal water quality.

Malibu Lagoon provides valuable estuarine habitat that serves as an outdoor classroom and offers many recreational opportunities as well as habitat for rare and endangered species. The lagoon is one of the few lagoon-type estuaries on the south coast that drain into the Santa Monica Bay. Malibu Creek is home to the southern-most documented remaining steelhead run. Such runs at one time extended south to Baja California.

Malibu Beach is internationally known for its prime surfing conditions and is a popular destination for beachgoers and vacationers. The beach is part of the highly valued recreation areas along the Santa Monica Bay coastline and includes the Malibu Lagoon State Beach.

The Malibu Creek Watershed is famous for its movie studio sets and the hundreds of movies that have been filmed in the area.

2.2 LOCATION AND SIZE

The Malibu Creek Watershed is located roughly 35 miles west of Los Angeles. The creek and its tributaries drain a 109-square-mile area of the Santa Monica Mountains and adjacent Simi Hills (see Figure 1, Location Map). Malibu Creek drains into Malibu Lagoon and from there into Santa Monica Bay. Approximately two-thirds of the watershed is located in northwestern Los Angeles County, and the remaining third is in southeastern Ventura County. The watershed was subdivided into eight subwatersheds for the study. Figure 2 outlines these subwatersheds.

The watershed is crossed by U.S. Highway 101 (Ventura Freeway) and California Highway 1 (Pacific Coast Highway). Malibu Canyon Road/Las Virgenes Road forms the primary north-south route through the watershed. More than 150,000 people commute along the Highway 101 corridor each day (UCLA, 1994). It is estimated that another 20,000 persons use the Pacific Coast Highway and the Malibu Canyon-Mulholland Highway corridors for commuting, both within the watershed and between the cities of Ventura and Los Angeles.

2.3 CLIMATE

Located within the southern California coastal belt, the planning area has a Mediterranean-type climate. The average January air temperature is 53^{o} F while the average July air temperature is 71^{o} F. The average annual air temperature is 61^{o} F with an average frost free season of 275 to 325 days.

Average annual rainfall is about 24 inches in the southern half of the watershed and 14 inches in the northern half. Nearly all the rainfall occurs between November and April. The rainfall in any one year may range from near zero to five times the mean annual precipitation.

During the summer, the "marine layer" or ocean haze of water droplets may decrease visibility throughout the day. Coastal fog is common during the morning hours, but dissipates by early afternoon.

2.4 GEOLOGY

The Santa Monica Mountains are part of the Transverse Ranges, which are underlain primarily by marine sandstones and shales deposited roughly 70 to 20 million years ago. Elevations in the watershed range from over 3,100 feet at Sandstone Peak in Ventura County, to sea level at Santa Monica Bay.

In the western, upper-most reaches of the watershed, a wide valley floor consisting of Holocene alluvium up to 60 feet deep overlies and is surrounded by Miocene Conejo volcanics. The middle northern reaches of the watershed are Cretaceous and Tertiary sediments, with Tertiary sediments predominating towards the coast. Alluvial fills in the relatively steep canyons are shallow, being less than 30 feet thick in the bottom and stream terraces, and grading rapidly to less than four feet up the canyon slopes. Tertiary basaltic and andesitic flows, pillow breccias, intrusives, and dikes are found in the eastern reaches of the watershed. En route to the ocean, Malibu Canyon cuts through Tertiary sandstones, siltstones, and breccias interbedded with Tertiary volcanics. Quaternary landslides occur throughout the watershed but are especially noticeable near the coast and in the southwest area of the Cold Creek subwatershed.

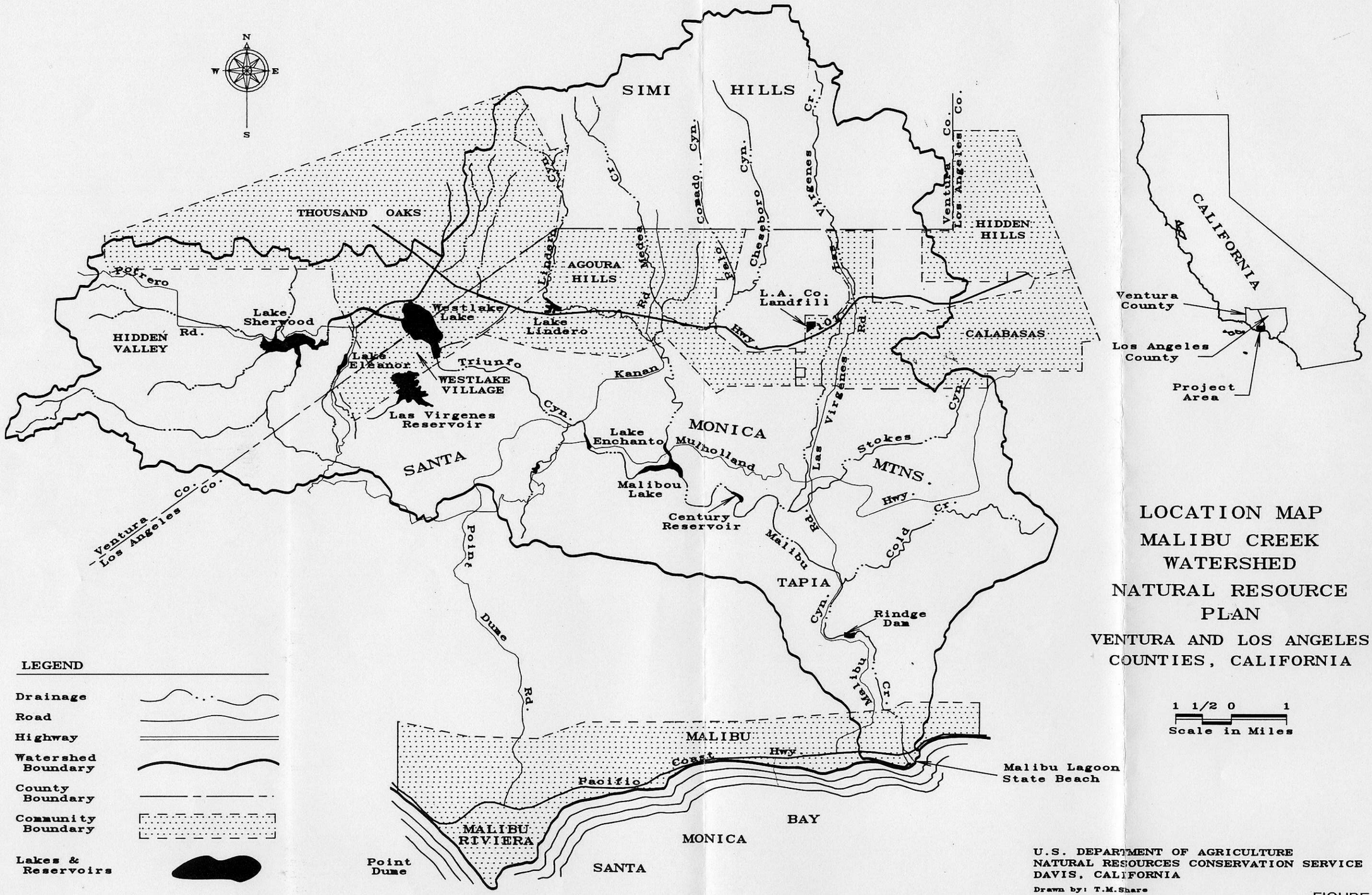
2.5 SEISMICITY

A high degree of tectonic activity exists in the area and local watersheds have been uplifted by as much as 24.9 feet per 1,000 years. Although the 1994 Northridge earthquake was not centered in the watershed, Oat Mountain in Ventura County was uplifted 18.1 inches. Uplift is partly counteracted by erosion, which lowers the landscape. The maximum extrapolated rate of denudation, measured over the available period of record, is 7.6 feet per 1,000 years, adjusted to a drainage area of 109 square miles (Scott and Williams, 1978).

The high rate of seismic activity is partly responsible for the landslides and slips throughout the watershed. Most of the lands are steep, with relatively shallow soils over bedrock. These soils slip readily, as evidenced by the many landslide and slip surfaces visible on the hill slopes. Earthquakes during periods of soil saturation cause the soil slippage to radically increase because of liquefaction along the contact zone, and cause landslides or slips occur almost instantaneously.

2.6 SOILS

Soils of the Malibu Creek Watershed area were formed in material weathered from sandstone, shale, and basic igneous rock, and in alluvium derived from mixed rock sources. Some of the mixed sources are marine and non-marine terrace deposits.



LOCATION MAP MALIBU CREEK WATERSHED NATURAL RESOURCE PLAN

VENTURA AND LOS ANGELES COUNTIES, CALIFORNIA

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
DAVIS, CALIFORNIA

Drawn by: T.M.Share

FIGURE 1

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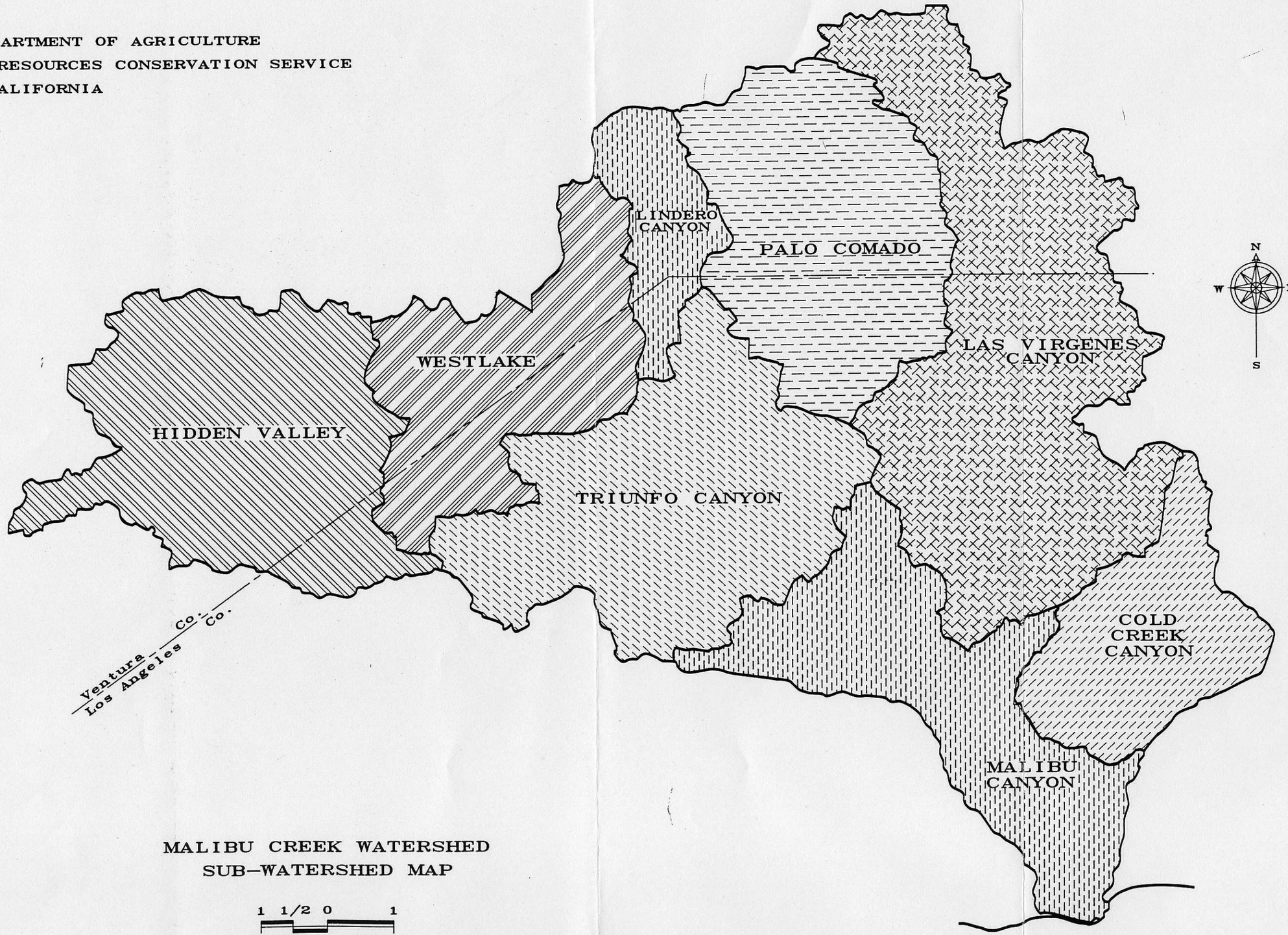
U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
DAVIS, CALIFORNIA



MALIBU CREEK WATERSHED
SUB-WATERSHED MAP

1 1/2 0 1
Scale in Miles

FIGURE 2

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Marine sandstone, shale, igneous rock, and semiconsolidated material occupy the major part of the uplands. Loamy, silty, and clayey soils, such as Castaic, Diablo, Nacimiento, and San Benito soils, formed in material weathered from shale. Sandy soils, such as Gaviota, formed in material weathered from sandstone.

The Malibu Creek Watershed contains 38 soil mapping units in the Ventura County portion and 40 soil mapping units in the Los Angeles County portion of the watershed. Details, descriptions, and soil mapping may be obtained from the appropriate soil surveys:

USDA-SCS and University of California, Agricultural Experiment Station; Soil Survey, Ventura Area, California; April 1970.

USDA-SCS and the Topanga-Las Virgenes RCD and the Los Angeles County Department of County Engineer; Soils of the Malibu Area, California, With Farm and Non-Farm Interpretations; October 1967.

2.7 SURFACE WATER RESOURCES

The larger tributaries to Malibu Creek have become perennial through most or all of the year since irrigation and the use of reclaimed water have become widespread. Prior to this, most of these streams were intermittent to ephemeral with the exception of Las Virgenes Creek, lower Medea Creek, and Cold Creek, which were historically perennial to intermittent. Since the use of irrigation and releases of reclaimed water began, Malibu Creek, from Westlake Lake to Malibu Lagoon, has had flows at nearly all times, including drought periods. The flows have also increased in average volume. Water has been imported into the watershed since the late 1960s.

Lakes in the watershed are mostly of relatively small surface area and depth. Most of the lakes were manmade, for water supply or recreation. The lakes, except for Las Virgenes Reservoir, are not currently used for regular water supply. Incidental recharge of ground water occurs and emergency water supply uses may occur.

Malibu Creek outlets to Santa Monica Bay through Malibu Lagoon. Malibu Lagoon is closed most of the year by a sand and gravel bar, opening only when large storm flows come down the creek or when the lagoon overflows from continuous smaller flows. The lagoon is breached mechanically when the low flows have occurred for a long period of time. The bar is replaced by the currents in the bay after only a few weeks.

2.8 GROUND WATER

Springs originating from bedrock aquifers and seepage emerging from stream alluvium were noted by Earl S. Flowers in 1972 (Flowers, 1972). With few exceptions, the noted springs emanate from the Lower Topanga Formation. The Lower Topanga Formation crops out along the crest of the Santa Monica Mountains, the southern boundaries of the basin, and along the lower reaches of Malibu Canyon. Surface water enters the steeply north-dipping strata and emerges as springs where the strata are cut by streams. The most important springs of this type are found in the upper reaches of Cold Creek, La Sierra Canyon, and an unnamed tributary due south of Century Reservoir.

Prior to the construction of dams and the importation of water, Malibu Creek and its tributaries were losing streams, meaning the water disappeared below the streambed surface. The exceptions were discontinuous stream segments associated with springs and Malibu Creek below its confluence with Las Virgenes Creek. Except for springs emanating from the Lower Topanga Formation, ground water fed by precipitation roughly paralleled the topography, converging in the valleys. The ground water then continued with a downstream gradient along the valleys towards the ocean, emerging as a gaining stream (with the water appearing on the surface) below the confluence of Las Virgenes Creek.

The advent of dams and imported water has produced additional upvalley gaining stream segments. Dams typically are secured in bedrock, intercepting downvalley movement of ground water, causing water storage within valley walls, water mounding, and upstream streambank storage. In addition, dams prolong flows, increasing streambank, floodplain, and valley wall storage downstream. An additional factor promoting increased gaining stream segments in the basin is the concrete lined channels. Concrete lined channels reduce streambed infiltration and intercept intra-flow waters that would have infiltrated into ground water through pervious streambeds.

Ground water is impacted by infiltrating surface and percolating ground waters, some of which contain contaminants. Septic systems can affect ground water by contamination with bacteria and nutrients. Ground water will ultimately surface and can then affect surface water quality. The combination of high water table and coarse soils and beach sands in the Malibu area may limit filtration capabilities from on-site sewage systems. Studies have not been done to document these impacts.

2.9 SOCIAL AND ECONOMIC CHARACTERISTICS

Although the Malibu Creek Watershed boundary does not directly coincide with the census tract boundaries, a general summary of the social and economic characteristics of the watershed population is possible (U.S. Dept. of Commerce, 1990). Data for 12 census tracts have been compiled and are shown in Table 2.

Census data shows that the population of the watershed is about 90,000. The population is largely white and more than 90 percent are so classified. Median household income of the population in the watershed is $69,000. More than 40 percent of the population have high-end white-collar jobs, such as executive or professional specialty jobs (UCLA, 1994).

Residents view the area as diverse. This diversity, however, is not social, economic, or racial; by and large it is physical. Though bound together by regional governance in schools and water supply, residents see little in common among the neighborhoods built in the region. Physically diverse as those areas may be, they are not diverse by any other standard. The communities are homogeneous, both racially and economically. Land values are extremely high, even by southern California standards, thus limiting affordability. The median home values in different parts of the watershed range from about $240,000 to $420,000, with enclaves and ocean view properties considerably higher. About 33 percent of the dwellings in the watershed are multi-family housing or high-cost condominiums. Home ownership rates are about 80 percent for the multi-family residences and higher for the single family homes (UCLA, 1994).

Table 2 - Census Data 1990

Population			
Urban	77,100	87%	
Rural	11,500	13%	
TOTAL	88,600		
Ethnicity			
Black	1,100	1%	
American Indian, Eskimo, Aleut	200	<1%	
Asian or Pacific Islander	5,200	6%	
White	81,000	92%	
Other	1,100	1%	
Proportion of population of Hispanic Origin	4,500	5%	
Percent Unemployed		3.4%	
Median Household Income			$69,400
Per Capita Income			$36,500
When Housing was constructed:			
Before 1950		3%	
1950 to 1959		4%	
1960 to 1969		17%	
1970 to 1979		35%	
1980 to 1990		41%	

2.10 LAND OWNERSHIP AND USE

Evidence indicates that the Malibu coast has been inhabited by humans for more than 10,000 years. Within recent history, grazing was the predominant land use in the watershed. Modern expansion of the Los Angeles metropolitan complex and consequent development pressures have significantly reduced grazing and increased recreational activities and urban development in the watershed.

The watershed contains about 69,900 acres. A breakdown of the acreages of land use types within each subwatershed is shown in Table 3. Figure 3 shows the distribution of land uses throughout the watershed.

The watershed is located near a major metropolitan area, yet includes large areas of open space. Despite the extensive urbanization, large areas remain undeveloped in the upper watershed. A significant portion of the watershed lies within the Santa Monica Mountains National Recreation Area and other park areas. The numerous parklands within the Recreation Area's boundary provide opportunities for hiking, mountain biking, fishing, horseback riding trails, camping, birdwatching, and other outdoor activities. A comparison of Figures 4 and 5 shows the changes in vegetative patterns between the 1930s and the present. (Maps provided by the National Park Service, Santa Monica Mountains National Recreation Area.)

TABLE 3: SUBWATERSHED LAND USE SUMMARY

SUBWTRSHED NAME	ORCHARDS	PASTURE	CONFINED ANIMALS	URBAN	RURAL RES.	FIELD CROP	NATURAL AREAS	GOLF COURSE	OTHER	WATER	TOTAL ACRES
Hidden Valley	0	1,439	149	124	64	0	8,879	156	15	149	10,975
Westlake	0	0	0	2,718	210	0	3,462	234	203	257	7,084
Lindero Cyn	0	0	0	896	227	0	1,202	138	0	0	2,463
Triunfo Cyn	10	7	89	991	314	0	9,889	0	0	49	11,349
Palo Comado	0	0	37	1,929	430	6	6,958	0	0	0	9,360
Las Virgenes	10	70	2	1,465	107	243	16,301	0	63	0	18,261
Cold Ceek	0	0	34	41	1,362	9	3,789	0	0	0	5,235
Malibu Cyn	6	0	9	149	92	0	4,817	10	98	0	5,181
TOTAL	26	1,516	320	8,313	2,806	258	55,297	538	379	455	69,908

Land ownership in the watershed has a large public component, with the National Park Service's Santa Monica Mountains National Recreation Area holding 6,740 acres and the California State Parks and Recreation Department holding 8,510 acres. Each of the counties and various cities also holds title to land for parks, schools, and other public uses.

Recent residential/urban development has resulted in the conversion of large blocks of middle and upper watershed open space to urban landscape. The watershed includes the Cities of Malibu, Calabasas, Agoura Hills, Westlake Village, and Thousand Oaks, all of which have expanded significantly in population since the 1990 census. Several additional large subdivision projects have been proposed and are now pending before the Ventura and Los Angeles County Planning Commissions. The City of Malibu lies along the Santa Monica Bay at the outlet of Malibu Creek.

More rural and unincorporated communities also exist within the watershed. In addition, a number of private parcels lying in and around the publicly owned lands are being developed to single family residences in a rural setting, or to an estate setting on steeper lands. The density of these developments ranges from one dwelling per 20 acres to one dwelling per acre, with the "development blocks" usually being less than 120 acres.

Most of the populated area is sewered and is served by the Las Virgenes Municipal Water District and the Triunfo County Sanitation District. Approximately 2,300 septic tanks are still used in the watershed. Concentrations of septic tanks occur in the City of Malibu, the Cold Creek Canyon area, the Malibou Lake area, and in the Seminole Hot Springs area. Other septic tank installations are located in relatively isolated areas or serve older homes just outside of service areas.

2.11 THE WATERSHED ECOSYSTEM

The increase in development has stressed and changed ecosystems. Buildings, pavement, lawns, and highways have replaced natural habitats. Imported water has allowed humans to increase their population beyond the natural sustainability. Increased stream flows have changed riparian and aquatic systems, and have increased opportunities for steelhead and other fresh water species. Even though these increased flows are thought to benefit the steelhead, they may also have adverse effects, such as elevated water temperatures from discharges, non-continuous stream discharges, and water quality impacts (Edmondson, 1991). Increased fresh water is altering the ecosystems of Malibu Creek and the lagoon, changing the biological diversity.

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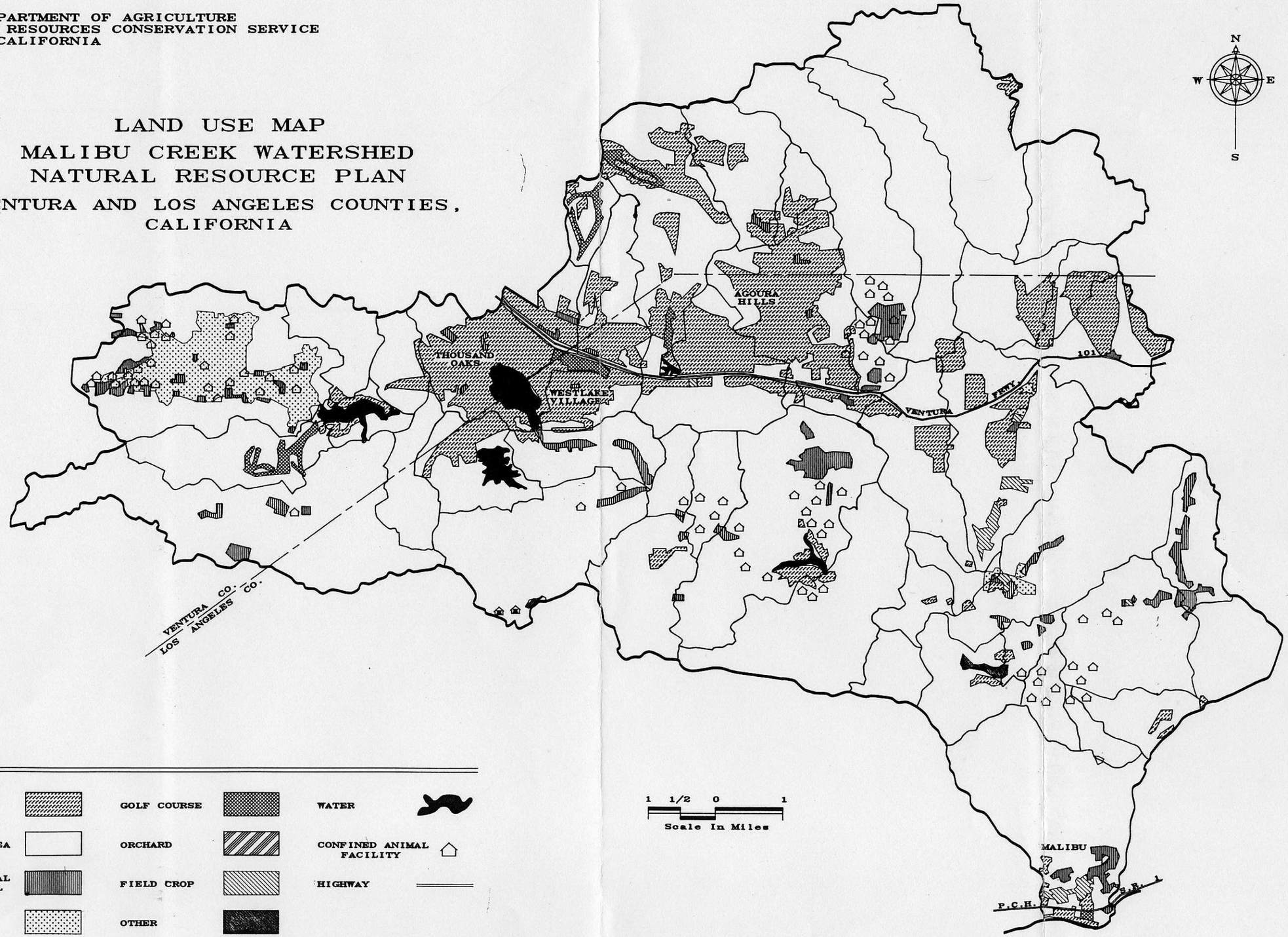
LAND USE MAP
MALIBU CREEK WATERSHED
NATURAL RESOURCE PLAN
VENTURA AND LOS ANGELES COUNTIES, CALIFORNIA



LEGEND

URBAN		GOLF COURSE		WATER	
NATURAL AREA		ORCHARD		CONFINED ANIMAL FACILITY	
SPACED RURAL RESIDENTIAL		FIELD CROP		HIGHWAY	
PASTURE		OTHER			

Drawn: T.M.Shaw

FIGURE 3

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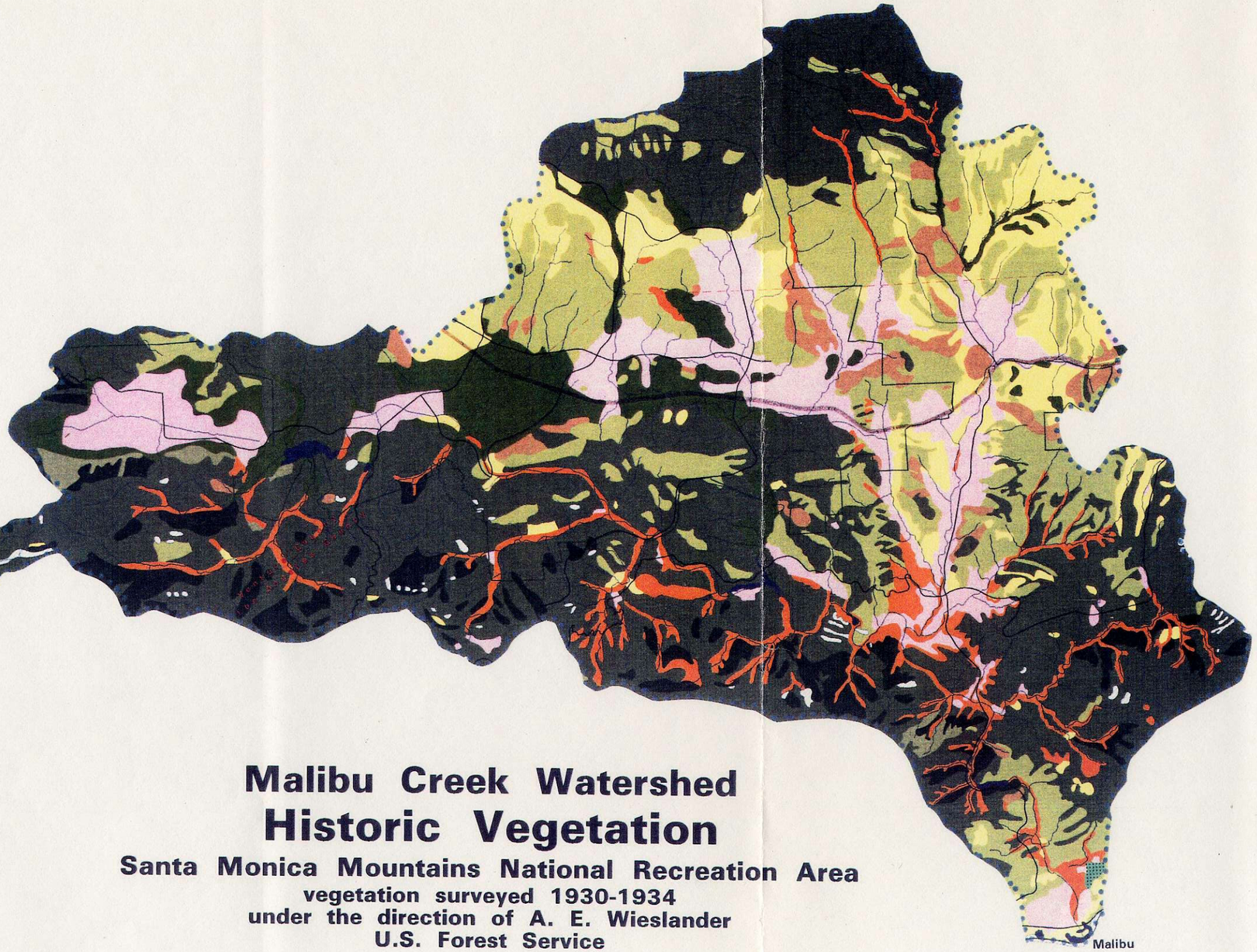

Malibu Creek Watershed
Historic Vegetation

Santa Monica Mountains National Recreation Area

vegetation surveyed 1930-1934
under the direction of A. E. Wieslander
U.S. Forest Service

Barren
Grassland
Cultivated/Urban Areas
Sagebrush
Chamise Chaparral
Chaparral
Woodland-Chaparral
Woodland-Sagebrush
Woodland-Grass
Woodland
Plantations
Water

National Recreation Area Boundary
Freeways
Major Roads

scale = 1:50000

0 1 2 3
miles

Plot produced by the National Park Service
Santa Monica Mountains National Recreation Area GIS
October 1994

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Figure 4

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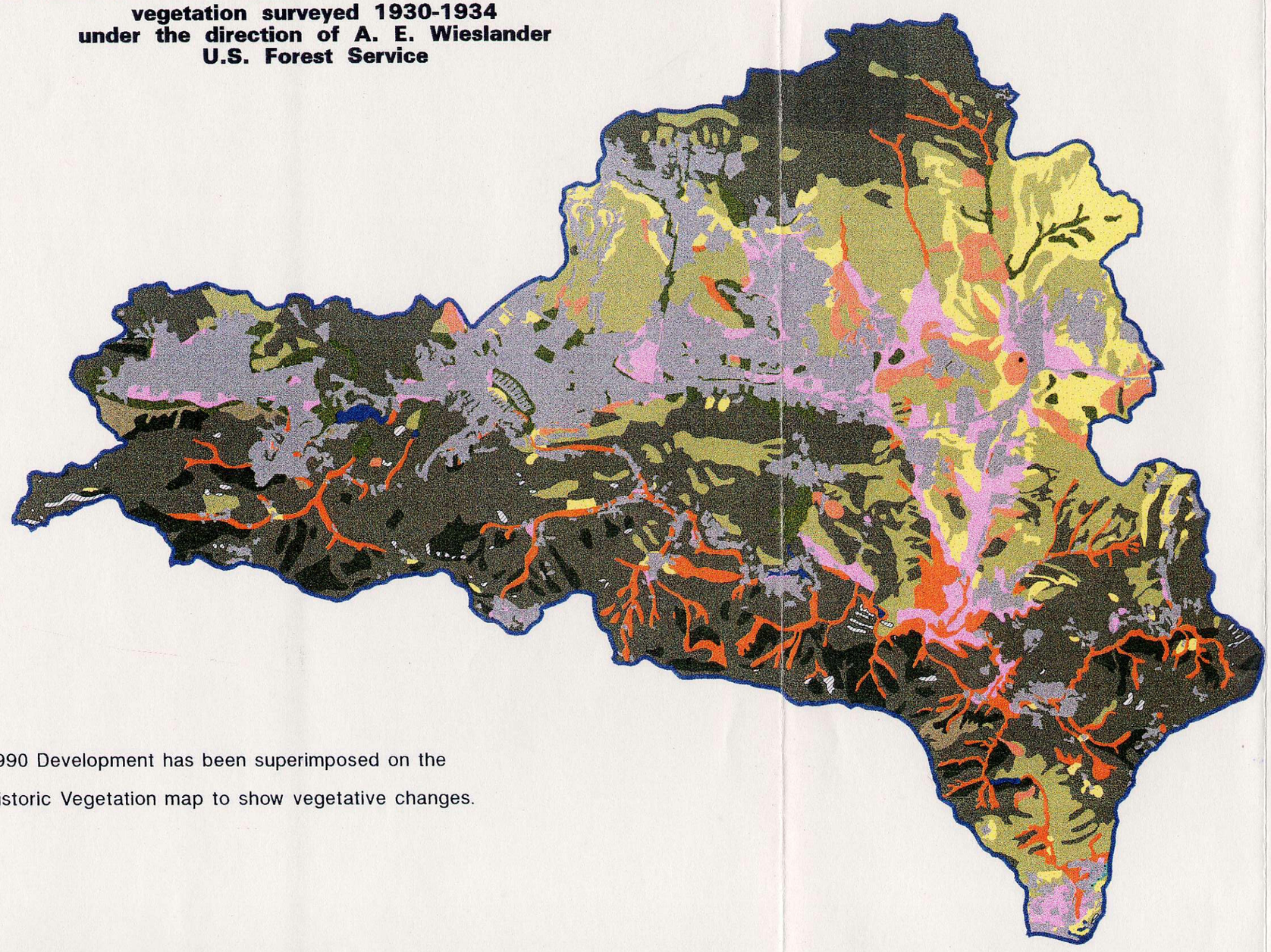
Santa Monica Mountains National Recreation Area
vegetation surveyed 1930-1934
under the direction of A. E. Wieslander
U.S. Forest Service



Current Development (1990)
Barren
Grassland
Cultivated/Urban Areas
Sagebrush
Chamise Chaparral
Chaparral
Woodland-Chaparral
Woodland-Sagebrush
Woodland-Grass
Woodland
Plantations
Water

0 1 2 3
miles

*1990 Development has been superimposed on the Historic Vegetation map to show vegetative changes.

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
DAVIS, CALIFORNIA

Development mapped in 1990 by
Southern California Association of Governments (SCAG)
Plot produced by the National Park Service
Santa Monica Mountains National Recreation Area GIS
October 1994

MALIBU CREEK WATERSHED
DEVELOPMENT EFFECTS ON HISTORIC VEGETATION*

FIGURE 5

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2.11.1 WILDLIFE HABITATS AND PLANT COMMUNITIES

The predominant habitat types in the watershed include woodland, valley oak savannah, mixed chaparral, coastal sage scrub, coastal salt marsh, and annual grassland, with inclusions of riparian and other habitat types. These habitat types are characteristic of the South Coast bioregion.

A wide variety of wildlife and localized plant communities can be found associated with the streams and waterbodies of the Malibu Creek Watershed. These include at least two populations of wild trout, including one of the southern most runs of steelhead in the United States. The arroyo chub is still found in Malibu Creek and the tidewater goby was recently reintroduced to the Malibu Lagoon. Non-native fish found in the waterways include goldfish, largemouth bass, and bluegill. An unknown number of aquatic insects and benthic organisms also inhabit the waterbodies and streams (USDI, 1993).

Riparian Habitats

Fresh emergent wetland communities are found near small ponds, lakes, and streams in localized areas throughout the watershed. The dominant plants are sedges, tules, and cattails. Fresh emergent wetlands are among the most productive habitats in California. Soils are very deep, stratified, sandy and silty materials.

Approximately 134 acres of intermittent wetlands and 95 acres of perennial wetlands have been found in the Malibu Watershed, accounting for approximately 20 percent of the fresh emergent wetlands in the Santa Monica Bay Watershed. The largest areas of freshwater wetland occur in upper Medea Creek, around the various reservoirs, and along creeks in the watershed (Josselyn et al., 1993).

Wildlife that utilizes this habitat includes the great blue heron, American peregrine falcon, red-winged blackbird, and western aquatic garter snake.

Riverine habitat consists of streams and rivers characterized by intermittent or continually running water. A total of 157 miles of riverine habitat occurs in the Malibu Watershed (Josselyn et al., 1993). Of this, the two-and-a-half miles downstream of Rindge Dam provide fish barrier-free access to the ocean and provide habitat for the southern-most documented continuous annual steelhead run on the west coast (McEwan, 1995).

The fish found in Malibu Creek include steelhead and rainbow trout, arroyo chub, Pacific lamprey, and various introduced species such as bluegill, green sunfish, and largemouth bass (Franklin, 1989). Other species dependent on this aquatic system are the southwestern pond turtle, California slender salamander, California newt, Monterey ensatina, arboreal salamander, California toad, and Pacific tree frog (Southwestern Herpetologists Society, 1987).

Lacustrine habitat includes standing water bodies such as ponds, lakes, and reservoirs. The fish species in this habitat are introduced warmwater fish such as largemouth bass, various sunfish, and mosquito fish. This habitat is important for a variety of birds, mammals, and southwestern pond turtles.

Saline emergent wetland in the Malibu Creek Watershed is also called coastal salt marsh in other inventories. The salt marsh habitat encompasses about 33 acres around Malibu Lagoon and is a component of the Pacific Flyway, an important habitat for migratory birds. This acreage represents 57 percent of the salt marsh habitat in the Santa Monica Bay Watershed (Josselyn et al., 1993). The plants in this community are adapted to a high concentration of salt, little wave action, and anaerobic soils. Some of the characteristic plants are sand verbena, saltbush, beach primrose, pickleweed, seepweed, salt grass, and sea blite.

Typical bird species include brown pelican, American avocet, willet, marbled godwit, and various other shorebirds.

Estuarine habitat occurs in Malibu Lagoon, one of the last remaining estuaries in Los Angeles County. Historically, it was much larger than present day and hosted a larger variety of native species. The adjacent land was developed in the 1900s and at one time the area was used as a general fill site, CalTrans dump site, and baseball field. It was sprayed on a regular basis with a mixture of 80 percent diesel oil and 20 percent pesticide for mosquito control (Manion and Dillingham, 1989).

In 1983, restoration began for Malibu Lagoon with the development of three channels and mudflat habitat, construction of trails and bridges, and management of water levels. The lagoon currently includes 13 acres of aquatic habitat and 22 acres of terrestrial habitat for a total of 35 acres (Topanga-Las Virgenes Resource Conservation District, 1989). The salinity gradient fluctuates widely owing to natural physical processes, release of imported water, and artificial breaching of the sandbar.

The lagoon serves as important habitat for 14 fish species including the tidewater goby, steelhead, California killifish, top smelt, and arrow goby. A total of 151 bird species are known to use the lagoon area, of which 78 are waterbirds and 73 landbirds. These include gulls, coots, ducks, geese, snowy plovers, sandpipers, and least terns.

Marine habitat extends from the upper limit of the unvegetated shore to the ocean. Malibu's marine habitat is part of the Santa Monica Bay. Vegetation is characterized by phytoplankton in the zone of light penetration. This habitat supports seven species of marine mammals, several pelagic birds including the brown pelican, and many fish species.

Riparian woodland/valley foothill riparian habitats occur along canyon and valley bottoms with ephemeral, intermittent, or perennial streams in nutrient-rich soils, or within protected drainages of very steep slopes. The riparian community has been highly impacted by human use.

Generally the riparian community is diverse and multilayered, with both an under-story and an over-story. Dominant plant species include arroyo willow, California black walnut, sycamore, Mexican elderberry, California bay laurel, and mule fat. There is also a remnant population of big leaf maples and some Fremont cottonwoods and alders (USDI, 1993).

Characteristic wildlife includes American goldfinches, black phoebes, warbling vireos, song sparrows, belted kingfishers, raccoons, ring-tailed cats, California mountain Kingsnake, ring-neck snake, California and Pacific tree frogs, crayfish, and other wildlife that use the riparian corridor for travel, water, and obtaining food (USDI, 1993). Lower Malibu Creek is an important component of the steelhead trout habitat. Feral animals, such as cats and dogs, reduce the native wildlife along the riparian corridors at a greater rate than elsewhere because of the distance between cover and water, and the necessary usage of the corridors by all species.

Upland Habitats

Seven major upland plant communities or habitats exist in the Malibu Creek Watershed. These habitats are coastal sage scrub, chaparral, coast live oak woodland, valley oak woodland/valley oak savanna, annual grassland/valley grassland, rock outcrop, and riparian woodland. The riparian woodland habitat has been discussed in the preceding sections.

The coastal sage scrub/coastal scrub habitat occurs in the lower Malibu Creek Canyon and coastal south-facing slopes, on drier sites within the watershed on moderately to very deep well-drained soils. This community is an important soil stabilizer. The soils of this community tend to be low in nutrients and highly erodible. Plants include many soft-leaved, grayish green, aromatic shrubs and include purple sage, California sagebrush, yucca, and coastal buckwheat. Trees and large shrubs include laurel sumac and lemonadeberry (USDI, 1993).

Characteristic wildlife includes Anna's hummingbirds, rufous-sided towhees, California quail, greater roadrunners, Bewick's wrens, coyotes, mule deer, rabbits, jackrabbits, California ground squirrels, mice, voles, moles, gophers, raccoons, skunks, and coast horned lizards (USDI, 1993). Coastal cactus wrens, Belding's savannah sparrows, and various raptors may also be found traversing the habitat area.

Chaparral habitat includes the mixed chaparral, ceanothus chaparral, red shank chaparral, and chamise chaparral/chamise-redshank chaparral habitats at various locations, elevations, and exposures. Chaparral is the dominant vegetative community in the watershed and is characterized by deep-rooted, drought- and fire-adapted evergreen shrubs growing on shallow to moderately deep coarse-textured soils. The overstory is a dense vegetative wall, 4-12 feet high. The chaparral plants grow densely on most sites or produce toxins or alleopaths which inhibit the growth of other plant species. As a result, the understory is absent, except for an occasional clump of foothill needlegrass or cluster of wildflowers in a small opening (USDI, 1993).

The plants, especially shrubs, of the chaparral habitat include scrub oak, spiny ceanothus, mountain mahogany, toyon, hollyleaf redberry, sugarbush, and manzanita. Also found, in large or small communities, are chamise, redshank, bigpod ceanothus, buckbrush ceanothus, hoary-leaved ceanothus, black sage, hollyleaf coffeeberry, and sugarbush (USDI, 1993).

Characteristic wildlife includes wrentits, bushtits, California towhees, California thrashers, bobcats, brush mice, dusky-footed woodrats, western fence lizards, and Southern Pacific rattlesnakes (USDI, 1993). Various raptors may also be found traversing the habitat area. An occasional mountain lion may also use this habitat zone.

Coastal oak woodland/coast live oak woodland habitat is found on north- and northeast-facing slopes and in shaded bottoms. This community is tolerant of salt-laden fog and may be found relatively near the ocean. The community is often found on the moderately to very deep well-drained soils of coastal plains and protected bluffs. Canopy cover varies from open to dense, allowing differing degrees of understory to grow. Groves are formed across valleys and along streams and intermittent watercourses, where permanent water is within reach of their roots. Woody species in the community include the coast live oak, hollyleaf cherry, California bay laurel, holly-leafed coffeeberry, and poison oak (USDI, 1993).

Characteristic wildlife includes acorn woodpeckers, plain titmice, northern flickers, Cooper's hawks, western screech owls, mule deer, gray foxes, ground squirrels, jackrabbits, and a variety of bats. Various hunting and migrating birds and animals may be found in the habitat zone. An occasional mountain lion may also use this habitat zone (USDI, 1993).

Valley oak woodland/valley oak savanna habitat is found in a few locations where broader valleys exist in the watershed. This watershed is at the southern-most edge of the valley oak range. Valley oaks reach ages of 400-600 years and historically had an understory of native grasses and forbs. Most of the oak colonies have been removed or thinned for agricultural or developmental purposes. Most of the grassland understory has been changed from the perennial natives to imported (invader) annual species. The oak seedlings have not survived in large numbers because of grazing and other factors, resulting in a habitat consisting of mostly large trees. Native understory species include purple needlegrass, Mariposa lily, coast goldfield, and other wildflowers. Imported species include wild oat and ripgut brome (USDI, 1993).

Characteristic wildlife includes American kestrels, scrub jays, acorn woodpeckers, gray foxes, and mule deer (USDI, 1993).

The valley grassland habitat occurs on rolling hills and bottoms where soils are not suitable for trees and shrubs because of clay content, limited depth, or droughtiness. The grasslands also occur adjacent to and as an understory to many of the other habitats. The original native grasslands were perennial bunchgrasses. The present grasslands are largely introduced annual grasses. Some of the grasslands may have been converted from chaparral or oak woodland to provide grazing for livestock or open-field recreation opportunities (USDI, 1993). Both annual and perennial species are present, including wild oats, red brome, needle grass, redstem filaree, and California poppy.

Characteristic wildlife includes turkey vultures, horned larks, western meadowlarks, longtailed weasels, and badgers (USDI, 1993).

The rock outcrop habitat exists on the cliffs and rock outcroppings of sedimentary, metamorphic, and volcanic rocks along the ridges and peaks of the hills and mountains. Chaparral is found in the crevices and small soil-holding areas. Lichens, club moss, and dudleyas are found on the rock faces in protected areas (USDI, 1993).

Characteristic wildlife includes turkey vultures, canyon wrens, common ravens, prairie falcons, voles, rabbits, coyotes, ring-tailed cats, mule deer, and skunks (USDI, 1993).

Other Habitats

The coastal salt marsh and coastal strand habitats occur only in the Malibu Lagoon area, as the remainder of the watershed frontage on the bay has been developed for urban uses. The coastal habitats include sandy beaches and shifting sands. Plants include dodder, salt grass, pickleweed, and sea blite on the strand. Plants further inland include sand verbena, silver beachweed, saltbush, and beach morning glory (USDI, 1993). Introduced species include the iceplant and various other landscaping plants, shrubs, and trees.

Characteristic wildlife includes brown pelicans, american avocets, willets, marbled godwits, sanderlings, western gulls, and a variety of other species that may be resident or transients (USDI, 1993). Nesting and feeding on the sands has been nearly obliterated because of the extensive development and use of the area for recreation and the development of the adjoining areas and the coastal strand for urban uses.

2.12 WILDLIFE

The Malibu Creek Watershed supports an abundant and diverse wildlife community, which reflects the diversity of the vegetative communities. More than 450 vertebrate species occur, including 50 mammals, 384 birds, and 36 reptiles and amphibians. The wildlife populations are unique in their proximity to one of the largest urban areas in the United States. As habitats become fragmented because of urban development, they lose their carrying capacity and wildlife population viability is affected. The continued maintenance of the wildlife populations in the watershed is dependent on the ability of public and private land managers to ensure adequate habitat and wildlife corridors for the most sensitive species. The long-term outlook for many species is uncertain because urban development continues to remove, isolate, and fragment habitats available to wildlife (USDI, 1993).

Mammals include both the large and small, predator and prey. The mammals include the mule deer, brush rabbit, Audubon's cottontail rabbit, black-tailed jackrabbit, gray fox, bobcat, badger, long-tailed weasels, and the occasional mountain lion. Also found in the watershed are California ground squirrel, fox squirrel, deer mouse, dusky-footed woodrat, Pacific kangaroo rat, pocket mouse, house mouse, meadow vole, pocket gopher, coyote, ring-tailed cat, raccoon, and spotted and striped skunk (USDI, 1993).

Birds include both residents and transients, predator and prey. More than 384 species of birds have been observed in the watershed and vicinity. More than 262 species have been recorded in Malibu Lagoon alone. It is estimated that about 117 species are resident in the watershed, at least to breed and raise young. Thirteen raptors are known to breed in the area. Raptors observed in the watershed include the golden eagle, red-tailed hawk, red-shouldered hawk, Cooper's hawk, prairie falcon, American kestrel, black-shouldered kite, barn owl, great horned owl, western screech owl, burrowing owl, short-eared owl, and turkey vulture (USDI, 1993).

Reptiles include 25 species, including two turtles, seven lizards, and sixteen snakes. The southwestern pond turtle is considered rare. Other reptiles that may no longer exist in the area are silvery legless lizard, and California red-sided garter snake. Common reptiles include the western fence lizard, side-blotched lizard, alligator lizard, coast horned lizard, southern Pacific rattler, gopher snake, California striped racer, and two-striped garter snake (USDI, 1993).

Amphibians include eleven species: five salamanders and six frogs or toads. Two species commonly listed for the watershed, the arroyo southwestern toad and the western spadefoot toad, probably do not exist in the watershed as there are no historical records of observations nor have there been any sightings in biological surveys. Other species, surveyed for and not found, that may no longer exist in the area are arboreal salamander, and California red-legged frog. Common amphibians include the California newt, California toad, California treefrog, and Pacific treefrog (USDI, 1993).

Fish include a remnant spawning population of steelhead trout and the more common arroyo chub, largemouth bass, bluegill, and goldfish (USDI, 1993) . The tidewater goby is found in the Malibu Lagoon, along with a limited number of other brackish water species.

Invertebrates are common throughout the watershed. Partial lists of invertebrates may be obtained from or used at the Topanga-Las Virgenes Resource Conservation District or National Park Service offices (USDI, 1993).

2.13 ENDEMIC PLANT SPECIES

Plant, shrub, and tree species in the Malibu Creek Watershed are numerous and plentiful. About 644 species of native plants and 236 species of introduced plants are found in the watershed. Communities of plant species are included in the sections on habitat (USDI, 1993). Partial lists or publications of plants, shrubs, and trees in the Malibu Creek Watershed may be obtained from or used at the Topanga-Las Virgenes Resource Conservation District or National Park Service offices.

2.14 THREATENED AND ENDANGERED SPECIES

Nine birds, one fish, and one plant that are permanent or seasonal resident species in the Malibu Creek Watershed are federally listed as threatened or endangered. Nineteen additional state-listed species may occur within the watershed. Another forty-nine species are candidates for federal listing or have been proposed for listing (USDI, 1993). The listing of species is shown in Table 4.

2.14.1 SOUTHERN STEELHEAD

Southern steelhead used to occur in coastal streams south of San Francisco Bay to the Santo Domingo River in northern Baja (McEwan and Jackson, 1994). At present, Malibu Creek is the southern-most stream known to contain a spawning population with up to 60 spawners. Habitat loss from damming, diversion, stream channelization, and estuary degradation has reduced distribution to about one percent of its former range (Moyle and Yoshiyama, 1993).

Southern steelhead are uniquely adapted to the warm intermittent streams of southern California. They typically spawn from January to March, but will enter Malibu Creek when the sand spit is open, spawn upstream and return to the ocean as soon as conditions allow. Juveniles will remain in the creek and lagoon for one to four years where rapid growth due to the warm water conditions allows the juveniles to reach smolt size at a younger age. Under natural conditions, the sand barrier between the lagoon and the ocean forces the steelhead to stay in the ocean for a longer time. This extra time is thought to be the reason southern steelhead reach larger sizes (9+ kg). Malibu Lagoon is an important area for juvenile rearing habitat. Artificial breaching of the lagoon sand spit can cause sudden changes in salinity and water temperature which can result in steelhead mortality.

Rindge Dam is the primary obstacle to the steelhead run on Malibu Creek. Providing passage at the dam would double the accessible stream habitat to about 5 miles. Additional habitat areas could be reached if passage were provided at several smaller barriers that have been identified farther upstream (Franklin and Dobash, 1989).

2.14.2 TIDEWATER GOBY

The tidewater goby was reintroduced into Malibu Lagoon in 1991 by the Topanga-Las Virgenes Resource Conservation District. Previously they had occurred in the lagoon until the late 1960s.

The statewide goby population has been reduced to 50 percent due to loss of its native habitat (Swift, et al., 1989). The goby is federally listed as endangered and State proposed for listing as threatened. It is found only in coastal, brackish water habitats in California, from the Tielas Slough in Del Norte County to Aqua Hedionda Lagoon in San Diego County.

The primary factors influencing the survival and reproduction of this species include silty sediments, nonseasonal imported water, pollution, non-native species, reduction of habitat, and breaching of the lagoon (Manion, 1993).

Table 4 - Federal and State listed threatened, endangered, and candidate species that may occur in the Malibu Watershed. Data from the U. S. Fish & Wildlife Service, National Park Service, and Natural Diversity Database. September 1994

NAME		FEDERAL STATUS	STATE STATUS
INVERTEBRATES			
Coelus globosus	globose dune beetle	C2	
Euphydryas editha quino	Wright's checkerspot butterfly	C2	
Lycaena arota nubila	clouded tailed copper butterfly	C2	
Panoquina errans	salt marsh skipper	C2	
Speveria callippe callippe	Callippe silverspot butterfly	C2	
Satyrium auretorum fumosum	Santa Monica Mtns. hairstreak	C2	
Brennania belkini	Belkins dune tabanid fly	C2	
Neduba longipennis	Santa Monica shieldback katydid	C2	
Proceratium californicum	valley oak ant	C2	
Trigonoscuta dorothea dorothea	Dorothy's El Segundo dune weevil	C2	
FISHES			
Eucyclogobius newberryi	tidewater goby	E	SC
Oncorhynchus mykiss	southern steelhead		SC
AMPHIBIANS			
Bufo microscapanus californicus	arroyo southwestern toad	C2	SC
Rana aurora draytoni	California red-legged frog	C1	SC
REPTILES			
Clemmys marmorata pallida	southwestern pond turtle	C1	SC
Phrynosoma coronatum blainvillei	San Diego horned lizard	C2	SC
Cnemidophorus tigris multiscutatus	coastal western whiptail	C2	
Diadophis punctatus modesto	San Bernardino ringneck snake	C2	
Lampropeltus zonata pulchra	San Diego mountain kingsnake	C2	
Lichanura trivirgata rosafusca	coastal rosy boa	C2	
Salvadora hexalepis virgultea	coast patch-nosed snake	C2	SC
Thamnophis hammondii	two-striped garter snake	C2	
BIRDS			
Ixobrychus exilis hesperis	western least bittern	C2	SC
Pelecanus occidentalis californicus	brown pelican	E	E
Histrionicus histrionicus	harlequin duck	C2	SC
Haliaeetus leucocephalus	bald eagle	E	E
Aquila chrysaetos	golden eagle	FP	SC
Buteo swainsoni	Swainson's hawk	C3	T
Falco peregrinus anatum	American peregrine falcon	E	E
Rallus longirostris levipes	light-footed clapper rail	E	E
Charadrius alexandrinus nivosus	western snowy plover	T	SC
Sterna antillarum browni	California least tern	E	E
Sterna elegans	elegant tern	C2	SC
Brachyramphus marmoratus	marbled murrelet	T	E
Empidonax traillii extimus	southwestern willow flycatcher	E	E
Coccyzus americanus occidentalis	western yellow-billed cuckoo		E
Eremophila alpestris actia	California horned lark	C2	SC
Riparia riparia	bank swallow		T
Campylorhynchus brunneicapillus couesi	coastal cactus wren	C2	SC
Polioptila californica	California gnatcatcher	E	SC
Lanius ludovicanus	loggerhead shrike	C2	SC
Vireo belli pusillus	least Bell's vireo	E	E
Agelaius tricolor	tri-colored blackbird	C2	SC
Aimophial ruficeps canescens	S. California rufous-crowned sparrow	C2	SC
Passerculus sandwichensis beldingi	Belding's savannah sparrow	C2	E
MAMMALS			
Euderma masulatum	spotted bat	C2	SC
Eumops perotis californicus	greater wetern mastiff bat	C2	SC
Marcrotus californicus	California leaf-nosed bat	C2	SC
Myotis lucifugus occultus	occult little brown bat	C2	SC
Plecotus townsendii townsendii	Pacific western big-eared bat	C2	SC
Sorex ornatus salicornicus	salt marsh ornate shrew	C2	SC
PLANTS			
Cordylanthus maritimus maritimus	salt marsh bird's beak	E	E
Astragalus pycnostachys lanosissimus	Ventura marsh milk vetch	C1	
Astragalus tener titi	coastal dunes rattleweed	C1	E
Berberis nevinii	Nevin's barberry	C1	
Chorizanthe parryi fernandina	San Fernando Valley chorizanthe	C1	

STATUS:

- **E** Endangered : Listed as Endangered
- **T** Threatened : Listed as Threatened
- **C1** Candidate 1 : Sufficient biological data to support a proposal to list as threatened or endangered.
- **C2** Candidate 2 : Existing information may warrant listing, but substantial biological support for listing is lacking.
- **SC** Special concern : California species that has either declined in numbers or its range reduced, population is monitored to see if more study is warranted.
- **FP** Federally Protected : Protected under federal law.

2.15 FIRE

Both the coastal sage scrub and the southern California chaparral vegetation types are very fire prone. Grasslands and oak woodlands usually have less available fuel but will also burn fiercely during the right conditions. All of these types become even more fire prone as the terrain becomes steeper. Add to this hazard the complexity of human development and the vagaries of the weather, and the fire risks in the study area are severe.

In their undeveloped condition without any fire protection, these areas can burn at natural intervals of 10 to 50+ years depending on a combination of local conditions. Studies of charcoal in sediments give longer fire intervals, while studies of vegetation ages or burn records give medium to short intervals. Minnich (1983) conducted a study which compared like areas in northern Mexico and southern California to gage the influence of fire suppression in chaparral vegetation. Wildlifes are routinely suppressed in southern California, and generally left to burn in northern Baja. During the eight-year study period both areas had fire burn over 8 percent of the acreage, or about 1 percent per year; in California, 203 fires burned an average of 1950 acres each, while in Baja 488 fires burned an average 480 acres each. In California over 70 percent of the fires occurred after September 1, versus only 20 percent in Baja. The implication is that even though both areas burned about 1 percent of the acreage each year, California's fires were less frequent, burned larger acreages and usually burned during the worst weather conditions. To make this scenario worse, the weather and development patterns in California leave watersheds and property prone to severe post-fire flood damages. This well-documented series of events is referred to as the fire/flood sequence, so the real impacts of a wildfire can only be seen over a period of several years. All of this means the well being of the area residents is closely reliant upon the overall condition of the watershed.

A detailed wildfire defense plan is beyond the scope of this study, but some general comments can be made. Because study results differ, and no one is really sure what is the best fire regime, fire planners usually aim at managing scrub and chaparral vegetation types on about 20-year cycles. This results in only 5 percent of an area being impacted by fuel treatment each year, and it avoids the heavy build-up of dead fuel which can lead to large fires with high burn intensities. While prescribed burning is very useful for treating large areas of hazardous fuels, the more developed an area becomes, the more difficult and expensive prescribed burning becomes; and the more important it is to have fire resistant landscaping and building construction. There is one thing that is becoming clear: it's not if an area will burn, but when it will burn. There is rarely a simple solution to a complex problem and in this case the only reasonable thing that can be done is to implement a mix of land management, fire/fuel management, development controls, and use management which is responsive to the reality of the fire regime.

One of the most frequently discussed parts of a balanced program is the use of prescribed burning. It is one of the most cost effective methods to manage vegetation, but it does require some preparation and has its limitations. It is best to have an established network of fuelbreaks, water developments, air and ground access, staging areas, environmental documentation, and an established inter-agency coordination system.

Other methods of vegetation management must be used where development, environment, or air quality restrictions preclude the use of fire. Some areas can be selectively treated with hand labor or machinery to cut, crush, or shred vegetation to reduce the fire hazard without impacting nearby protected species and their habitat or without endangering nearby residences. Domestic livestock can be used to reduce fuel loads by grazing. Roadsides can be hand cleared or treated with fire retardant. Special landscaping can be used which minimizes the fire hazard around developments. Building codes can emphasize fire resistant design. Zoning can limit development in fire prone areas. Areas can be closed to all use during periods of high fire danger, or specific uses can be limited to safer areas or conditions. In areas where options are limited, debris basins can be installed to trap sediment

from fires and reduce downstream impacts. All of these approaches can be used in whatever combination works for a specific area and is appropriate for a community's needs.

After the Old Topanga fire of 1993, the NPS and the Los Angeles County Fire Department developed a fire history map showing the number of fires in the area since 1925. This map is Figure 6. Appendix E provides additional details on fire history.

2.16 CULTURAL RESOURCES

The Santa Monica Mountains have one of the highest densities of archaeological sites for any mountain range in the world. Human habitation of the Santa Monica Mountains dates back at least 10,000 years; 12,000 years according to some reports. Human influences range from the Native Americans, including the canyon subcultures, to the latest developers. Some of the influence groups were Chumash, Gabrielino/Tongva, prehistoric traders, Aleutian Island raiders, Otter hunters (fur trappers/traders), Central Valley raiders (Mission period), Spanish, Mexican, Californianos, Blacks, Asians, Europeans, and the Canyon Cultures (Topanga, Malibu, Palisades, Coldwater, Beverly) (USDI, 1993).

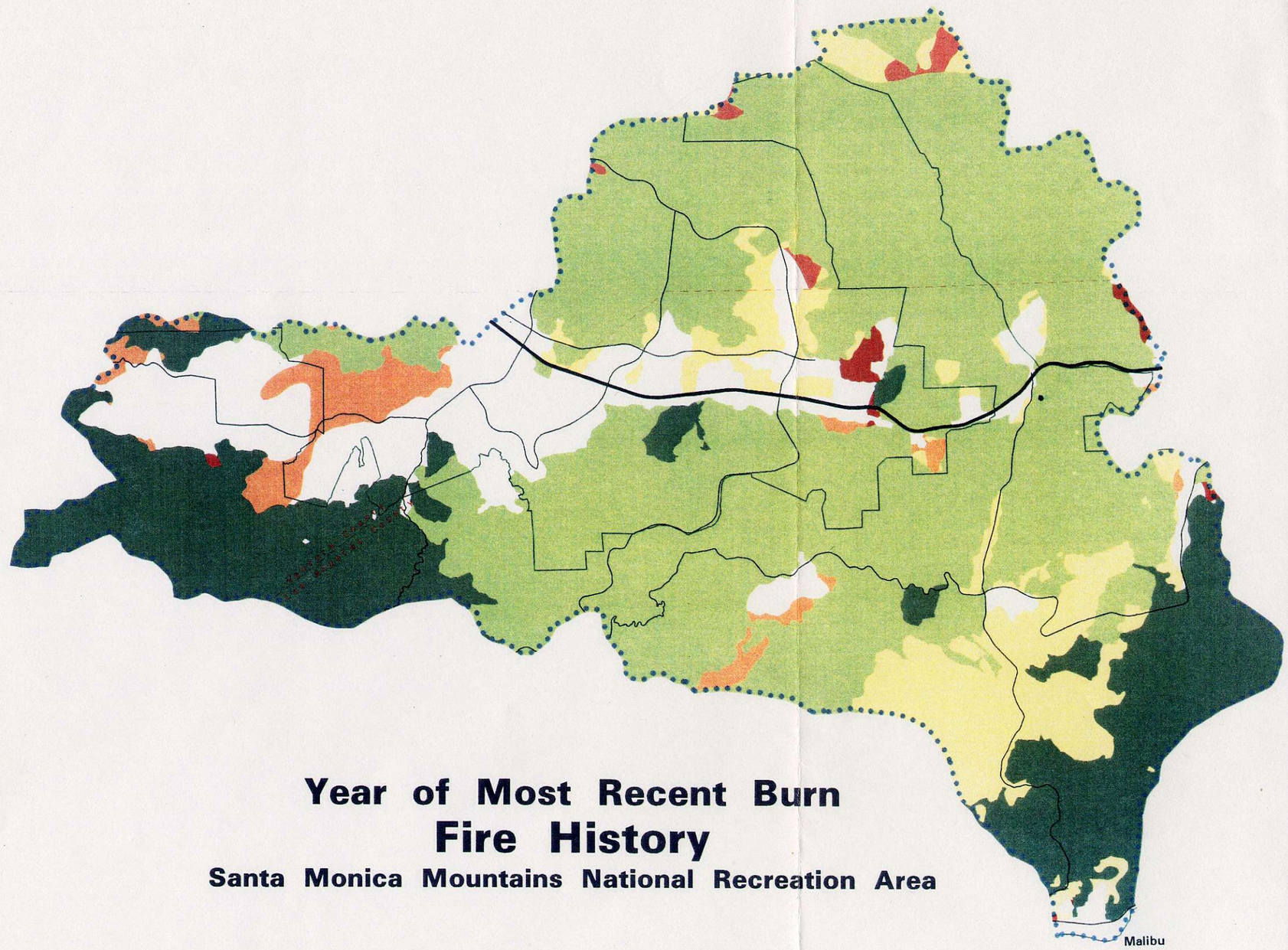
The Santa Monica Mountains are the boundary between the Chumash and Gabrielino/Tongva. These two complex societies shared many elements of material culture but had fundamentally different languages, religions, and social organization. These societies were also among the wealthiest and most powerful societies in what is today known as California. The boundary between these societies is a broad interface zone, including most of the Santa Monicas (USDI, 1993).

Archaeological sites in the watershed include Chumash pictographs. These pictographs have been described by one archaeologist as the most spectacular in the world. At least two of the pictograph sites are located in the watershed and more sites are likely. These sites are a subject of extreme public interest, yet are religious and sacred sites for the Native Americans. These dichotomies require sensitive management and responsibility (USDI, 1993).

There are numerous other archaeological sites in the watershed, perhaps more than 300 (USDI, 1993). Many of these sites are known, but not all are listed on the National Register or in the Archaeological Information Center at the University of California, Los Angeles. These would include sacred sites, bedrock mortar sites, villages, middens, and burial sites. Other religious/spiritual sites are likely because of the extreme topography of the area.

Paleontologic sites may exist in the watershed; though none are known at present, there are sites in adjacent valleys of the Santa Monica Mountains (USDI, 1993).

The Santa Monica Mountains have benefitted from a diversity of cultural influences. The narrow rugged canyons have lent themselves to development of unique enclaves or communities that maintain their distinctiveness over long time periods. The ability of the mountains to foster and tolerate cultural diversity may be one of their most important cultural aspects (USDI, 1993).



Year of Most Recent Burn
Fire History
Santa Monica Mountains National Recreation Area

1925-1944
1945-1954
1955-1964
1965-1974
1975-1984
1985-PRESENT

National Recreation Area Boundary
Freeways
Highways and Major Roads
Roads

scale = 1:50000

Roads from Thomas Bros. Maps
Plot produced by the National Park Service
Santa Monica Mountains National Recreation Area GIS
January 1995

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
DAVIS, CALIFORNIA

FIGURE 6

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SECTION 3 - WATER QUANTITY INFORMATION AND ISSUES

The Malibu Creek Watershed study area encompasses a rich diversity of physical resources and human activity. This is briefly described in Section 2. This section and the one following focus on the most significant resources of interest: water quantity and water quality.

3.1 SOURCES OF WATER

There are four sources of water in the Malibu Creek Watershed: precipitation, imported water, reclaimed water, and ground water.

3.1.1 PRECIPITATION

The watershed can be topographically divided into two parts, with the southern half being coastal mountains and the northern half being inland basins with small hills. The rainfall of the southern half of the watershed is influenced by the coastal mountains and averages 24 inches annually. The northern half has a basin rainfall effect and averages 14 inches annually.

3.1.2 IMPORTED WATER

Importation of water began in the late 1960s when heavy urban development began in the watershed. In 1992, about 20,000 acre-feet of water was imported into the watershed. The imported water is purchased from the Metropolitan Water District of Southern California. This water is brought into the watershed and distributed in a network of pipes, and only reaches the creek system after it has been used. The main uses are domestic, landscape irrigation, and some agricultural irrigation.

3.1.3 RECLAIMED AND TREATED WATER

The Tapia Wastewater Treatment Plant is the only sewage treatment plant in the watershed. It is operated as a joint venture by the Las Virgenes Municipal Water District (LVMWD) and the Triunfo County Sanitation District. The plant has the capacity to handle 16 million gallons per day (mgd) after completion of a recent expansion. Inflow to the plant presently varies from 6.6 to 10.6 mgd. The average is 7.75 mgd (1 mgd is 1,120 acre-feet per year).

The inflows for the years 1990, 1991, and 1992 were 8,500, 8,400, and 8,800 acre-feet respectively. Some of the water is reclaimed and sold for the irrigation of open space and landscaping. As much as 4,780 acre-feet of reclaimed water has been sold in one summer. An additional 4,000 acre-feet per year is treated and discharged to Malibu Creek.

The plant currently sells an average of 4,000 acre-feet of reclaimed water per year. There are plans to expand the system and sell an additional 1,300 acre-feet per year. The joint venture expects sales to reach 7,000 acre-feet by the year 2000. The LVMWD has considered constructing reservoirs for seasonal storage of reclaimed water, but has determined that they do not warrant the cost at the present time.

3.1.4 GROUNDWATER

There are at least four operating community wells, and a few private domestic wells are also in operation. Two of the community wells are operated by LVMWD and two are operated by the Westlake Lake management association. Water from the LVMWD wells is used to supplement reclaimed water for landscape irrigation during peak summer months. None of the community wells are used for potable water. The LVMWD's well capacity is about 1 million gallons per day.

3.2 STREAM FLOWS

There are flows from Lake Sherwood, Lake Eleanor, Westlake Lake, Lake Lindero, Malibou Lake, Century Reservoir, other small lakes, and four major tributaries that drain into the main channel of Malibu Creek. Malibu Creek drains into the lagoon at the outlet of the watershed and from there into Santa Monica Bay. Components of the stream flow are runoff from storms, excess water from subdivisions and businesses, septic tank seepage, flows from springs, and discharge from the wastewater treatment plant.

Stream gage 11105500 was installed on Malibu Creek just below Cold Creek in 1931. The drainage area at the gage is 105 sq. mi. The gage was operated by the Los Angeles County Flood Control District in conjunction with the U. S. Geological Survey (USGS) until 1979. The data was published by USGS from 1931 to 1978. The Los Angeles County Department of Public Works has maintained the gage since 1979.

For water years 1931 through 1965, the average annual flow at the stream gage was about 12,000 acre-feet. The flow for water years 1966 through 1992 averaged more than twice that, about 27,000 acre-feet. Annual flows during the latter period have ranged from about 4,000 to 120,000 acre-feet. The components of the 27,000 acre-feet are estimated to be roughly as follows:

Discharge from the Tapia Treatment Plant - 4,000 acre-feet

Runoff from home uses and lawn irrigation - 2,500 to 3,500 acre-feet

Seepage from septic tanks - 500 acre-feet

Storm runoff - 19,000 to 20,000 acre-feet

Tables 5 and 6 compare the water use and watershed yield for land use conditions in 1934 to the water use and watershed yield for present day conditions. Figure 7 depicts a typical water budget of 1934 and Figure 8 depicts the present. The average precipitation is assumed the same for both conditions. The change in yield is due to land use changes and imported water.

3.3 EFFECTS OF URBANIZATION ON STORM RUNOFF

Urbanization changes a watershed's response to precipitation. The most common effects are reduced infiltration and decreased travel time, which increase peak discharges and runoff. Runoff is determined primarily by the amount of precipitation and infiltration characteristics related to soil type, impervious surfaces, and surface retention. Travel time is determined primarily by slope, length of flow path, depth of flow, and roughness of flow surfaces. Peak discharges are based on the relationship of these parameters and on the total drainage area of the watershed, the location of the development, the effects of any flood control works or other natural or manmade storage, and the time distribution of rainfall during a given storm event.

TABLE 5:
1934 Water Budget – Typical Values

Water Uptake From Watershed			
Landuse	**1934 Acreage ACRES**	**Estimated Et INCHES**	**Total Use AC–FT**
Barren	328	1	27
Grassland	5,527	8	3,685
Cultivated/Urban	7,408	14	8,643
Sagebrush	12,164	17	17,233
Chamise Chapparral	30,141	20	50,202
Chapparral	3,488	21	6,104
Woodland–Chapparral	461	22	846
Woodland–Sagebrush	1,911	18	2,866
Woodland–Grassland	4,994	17	7,076
Woodland	4,026	23	7,716
Water	208	72	1,249
Orchards (Plantations)	46	24	93
Total	70,703		105,739

Water Yield to Watershed			
Precipitation	20	117,839	Acre–feet
Imported Water	0	0	Acre–feet
Gross Water Total		117,839	Acre–feet
Total Et		110,789	Acre–feet
Baseflow		205	Acre–feet
Stormflow		11,895	Acre–feet
TOTAL Outflow	Yield	12,100	Acre–feet

TABLE 6:
Present Water Budget – Typical Values

Water Uptake From Watershed			
Landuse	**1990 Acreage ACRES**	**Estimated Et INCHES**	**Total Use AC–FT**
Barren	313	1	26
Grassland	3,863	8	2,575
Cultivated/Urban	3,238	14	3,778
Sagebrush	11,207	17	15,877
Chamise Chapparral	27,442	20	45,706
Chapparral	3,376	21	5,908
Woodland–Chapparral	441	22	809
Woodland–Sagebrush	1,633	18	2,449
Woodland–Grassland	1,907	17	2,702
Woodland	3,592	23	6,885
Water	455	72	2,730
Orchards (Plantations)	15	24	30
Developed	13,221	19	21,314
Total	70,703		110,789

Water Yield to Watershed			
Precipitation	20	117,839	Acre–feet
Imported Water	18	20,000	Acre–feet
Gross Water Total		137,839	Acre–feet
Total Et		110,759	Acre–feet
Baseflow		2,050	Acre–feet
Treatment Plant		4,000	Acre–feet
Stormflow		21,000	Acre–feet
TOTAL Outflow	Yield	27,050	Acre–feet

ET = Evaporatranspiration

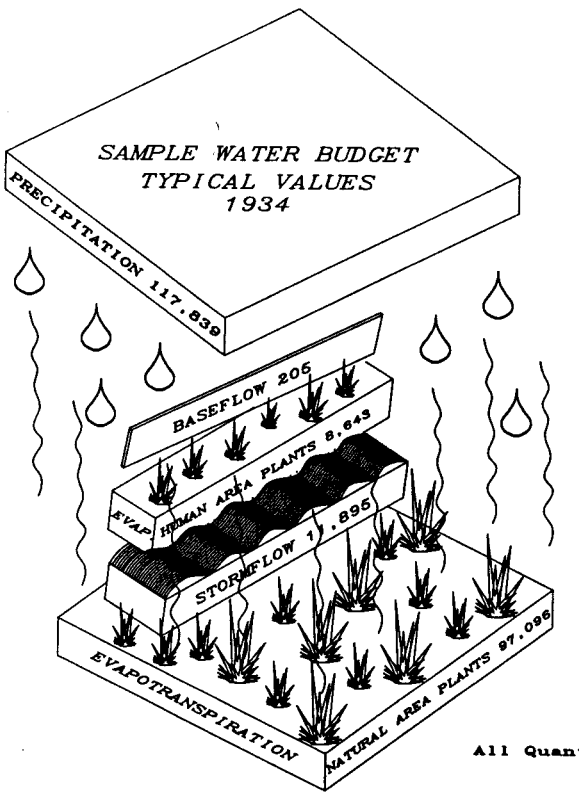
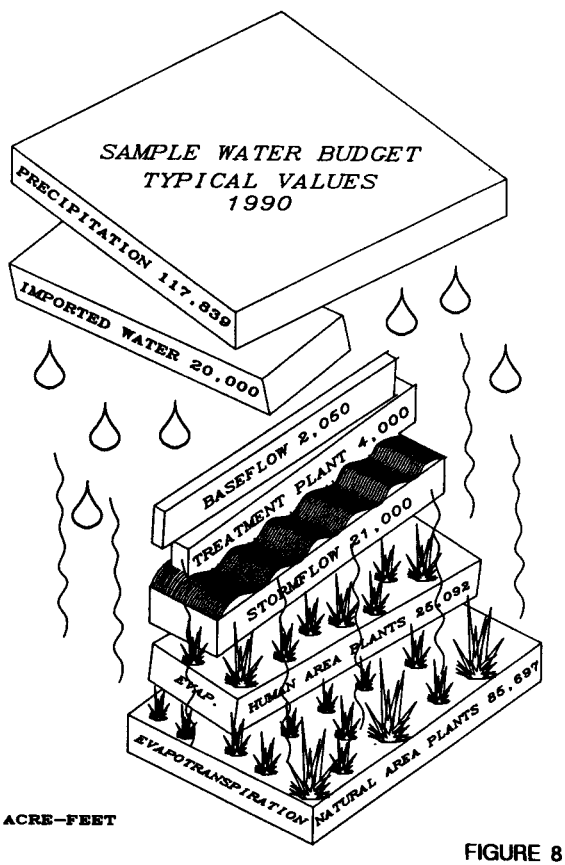


FIGURE 7



All Quantities in ACRE-FEET

FIGURE 8

The conversion of rural land to urban land temporarily increases surface erosion and permanently increases the discharge and volume of storm runoff in a watershed. An urban or urbanizing watershed is one in which impervious surfaces cover or will soon cover a considerable area. Impervious surfaces include roads, sidewalks, parking lots, and buildings. Natural flow paths in the watershed may be replaced or supplemented by paved gutters, storm sewers, or other elements of artificial drainage.

Hydrologic studies to determine runoff and peak discharge can be based on long-term streamflow records for an area. Such records are seldom available for small drainage areas. Even where they are available, accurate statistical analysis of them may be impossible because of the conversion of land to urban uses during the period of record. It is necessary to estimate peak discharges with hydrologic models based on measurable watershed characteristics. Only through an understanding of these characteristics and experience in using these models can sound judgments be made on how to alter model parameters to reflect changing watershed conditions.

3.4 PEAK FLOWS

Soil Conservation Service Technical Release 20 (TR-20), Computer Program for Project Formulation Hydrology, was used to model the storm runoff characteristics of the watershed. TR-20 modeled the entire watershed, using average antecedent runoff conditions and 24-hour precipitation amounts with return periods of 2, 5, 10, 25, 50, and 100 years. The model calculated flows for these return periods at 47 locations in the watershed, including the outlets of the eight subwatersheds described earlier and the stream gage location on Malibu Creek. The input values were adjusted until the model results at the gage location showed reasonable agreement with a flow-frequenency analysis of the gaged data.

Table 7 shows computed peak discharges for the eight subwatersheds. These are for existing land use and cover conditions. Additional runs could be made to evaluate the effects on peak flows of changes such as projected development or fires.

Table 7 - Estimated Peak Discharges In cfs.

Subwatershed	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
Hidden Valley	940	2,550	4,320	7,480	12,490	14,990
Westlake	1,300	3,590	6,220	11,110	18,990	23,110
Lindero*	70	300	590	1,160	1,980	2,390
Palo Comado*	530	1,950	3,690	7,080	11,890	14,320
Triunfo	2,150	6,340	11,600	21,970	37,270	45,670
Las Virgenes**	2,860	8,730	16,110	30,370	50,690	62,100
Cold Creek**	3,140	9,650	17,770	33,350	55,380	67,810
Malibu Canyon	3,240	9,980	18,410	34,500	57,430	70,290

* Tributaries to main channel.
** Flows in main stem below junction with subwatershed

3.5 EFFECTS OF URBANIZATION ON BASE FLOWS

Low flow summer conditions occur during the months of June through October, with September being representative of the period. The gage data shows that the average daily flow for September during the water years of 1931 to 1965 was 0.18 cubic feet per second (cfs). It then increased dramatically, averaging 4 cfs for the period from 1966 through 1992. Part of this is discharge from the Tapia plant. Another component is summer runoff from residential areas.

A 65-acre subdivision containing 400 homes was used to measure summer runoff. The subdivision was built on bedrock and has a single drainage outlet. The NRCS measured the stream flow leaving the subdivision on three separate occasions during the summer of 1993. The measured flows ranged from 48 to 50 gallons per minute. Flows in gutters in the subdivision were also observed. Inspection of the neighborhood showed that the sources of the water were activities such as watering lawns and washing driveways.

Observations in other subdivisions showed gutter flows of similar magnitude, and it was concluded that 50 gallons per minute per 400 homes is a reasonable estimate of summer runoff from residential areas. This amounts to about 7.4 cubic feet per second (cfs) from the approximately 26,000 homes in the watershed. About two-thirds of this is lost to evapotranspiration as the water goes through the system, so the base flow due to urbanization is about 2.4 cfs at the stream gage. Table 8 shows the relative contribution of each subwatershed, with the number of homes based on 1990 census data.

Table 8: Estimated Base Flows for Each Subwatershed (gpm)

Location	Homes	Gross Runoff* (gpm)	Contribution to Streamflow at Gage** (gpm)
Hidden Valley	625	78	0
Westlake	10,855	1,350	445
Lindero Canyon	2,801	350	115
Triunfo Canyon	2,978	370	120
Palo Comado	4,735	600	200
Las Virgenes	3,766	470	155
Cold Creek	93	100	30
Malibu Canyon	111	0	0

* Gross flow is total water from houses in the subwatershed.
** Flows at gage is the remaining flow after evapotranspiration.

The urban runoff has caused streams that once were ephemeral or intermittent to become perennial. Evidence of an example of this may be seen about 1,300 feet downstream from the point where the subdivision runoff was measured, where a 36-inch diameter oak tree in the creek bottom stands in a pool of water among cattails and willows. The oak is of a type that does not usually grow in water and the tree could not have achieved its size under the present conditions.

3.6 EFFECTS OF INCREASED FRESHWATER ON THE LAGOON

The increased amount of freshwater flow in the watershed has altered the riparian habitat along the creek and surrounding areas (Manion and Dillingham, 1989). This excess freshwater has also impacted the lagoon, primarily by changing the normal salinity gradient which results in the loss of micro-habitats and a decline in species diversity.

The decrease in salinity changes species composition to those populations of younger animals and fish with early maturity and prolonged spawning periods. These tend to be less desirable species (Zedler et al, 1992).

The degradation of the estuarine system impacts bivalve and fish populations in both the lagoon and ocean. These populations are an important component of the food chain and of importance to sport and commercial fishermen. Only one species of bivalve, the California jackknife clam, is found in Malibu Lagoon and other invertebrate occurrences are very low. Fish species numbers have also changed in both native diversity and productivity (Manion and Dillingham, 1989).

The increased freshwater flow stratifies the lagoon which causes the algal blooms to sink and decompose. This results in lower oxygen levels and increased sulfide levels causing benthic invertebrate and fish mortalities. This is further magnified by the resuspension of organic detritus, causing a further reduction in oxygen concentrations.

This excess water is also a concern to the surfers because it raises the water level in the lagoon and leads the state to artificially breach the lagoon, allowing water of poor quality to drain into the surf zone.

SECTION 4 - WATER QUALITY INFORMATION AND ISSUES

4.1 INTRODUCTION

Non-point source pollution has been identified by the U.S. EPA and by local and state governments as one of the major factors in the degradation of coastal water quality. Estimates indicate that up to 99 percent of suspended solids, and 50 to 90 percent of the other pollutants in our national waters come from Non-point sources of pollution.

The Malibu Watershed Coordinated Resource Management Planning (CRMP) group identified several water resource problems in the watershed, including degradation of the lagoon benthic communities, degradation of the creek aquatic habitat, degradation and loss of riparian habitat, and the sedimentation of surface water bodies. The natural resources of Malibu Creek and Malibu Lagoon are being degraded by both human generated and natural Non-point source pollution. The CRMP group identified the causes of these problems as being septic system malfunction, urban runoff, excess freshwater flow, and roadway runoff. The naturally fragile vegetation and soils of the upper watershed create conditions of rapid erosion. Large increases in urbanization in the watershed have substantially increased runoff and point and Non-point sources of pollution. Freshwater discharges into the creek have altered historic flow patterns into the lagoon altering both the quantity and quality of water.

It appears that the primary water quality concerns in the Malibu Creek area are high bacteria and nutrient levels which contribute to the degradation of the surface waters in the area. In some cases sediment eroded from natural areas or found in urban runoff sorbs nutrients or other pollutants. After finding their way to the lagoon and settling out, these sediments act as a sink and source of pollutants. The water quality parameters discussed in this section were chosen because consistent, detailed data was available for most of the watershed and because these parameters were either the primary water quality concerns or related to the primary water quality concerns.

Though the introduction of imported water into the area has enhanced riparian habitat along the streams and provides more summer flow for steelhead, there may be adverse effects as well. The increase in freshwater causes fluctuations of salinity levels in the lagoon resulting in the degradation of habitats and a decline in species diversity. Summer water levels in the lagoon have risen, causing situations where artificial breaching may create human health concerns.

Concerns have been raised about the effect of breaching on water quantity, quality, salinity, and temperature and, therefore, the plants and animals of the lagoon and near shore areas of the Santa Monica Bay. Questions have also been raised regarding the effect of allowing the poor quality lagoon water to be emptied into the surf zone, degrading the water quality of the surf zone where people swim and surf.

The Agricultural Non-point Source (AGNPS) model was used to analyze nitrogen and phosphorus stream runoff movement through the Malibu Creek Watershed. A soluble and sediment-sorbed nitrogen and phosphorus budget for the watershed was developed, accounting for user inputs of atmospheric nitrogen, soil nutrients, fertilizer, animal waste, tertiary treatment, and septic tanks. A comparison was made of baseline nutrient conditions, the addition of fertilizers and animal waste, and the addition of water from the treatment plant and septic tanks.

Some of the issues which surfaced during the facilitated meetings dealt with the need to know the quality of water throughout the watershed. The objective of the information provided in this report is to assist local groups to develop and implement solutions to these concerns.

To facilitate the presentation of the water quality data collected, the watershed was divided into eight subwatersheds. Water quality information is presented for each subwatershed and for the watershed as a whole.

Over the years, many agencies and organizations have tested and sampled the water in the watershed. The data available encompasses different time frames, sampling sites, and parameters. Data was used from records kept by the U.S. Geological Survey, Los Angeles Regional Water Quality Control Board, Los Angeles Department of Public Works, and the Las Virgenes Municipal Water District, among others. Actual data can be viewed at the NRCS office in Davis, CA.

4.2 WATER QUALITY OBJECTIVES

Water quality objectives for waters in the Malibu Creek Watershed are listed in the Water Quality Control Plan, Los Angeles Region (Basin Plan) published by the Los Angeles Regional Water Quality Control Board. The Basin Plan establishes designated beneficial uses for various water bodies. Table 9 shows them for the Malibu Creek Watershed. Objectives are set so that the designated beneficial uses do not become impaired.

The Basin Plan states that "waters shall not contain biostimulatory substances in concentrations that promote aquatic growths to the extent that such growths cause nuisance or adversely affect beneficial uses". The levels of nutrients such as nitrogen and phosphate need to be kept below levels promoting vegetative growth. Waters in the Malibu Creek Watershed shall not exceed 10 milligrams per liter (mg/l) nitrogen as nitrate-nitrogen plus nitrite-nitrogen. Also stated is that "pH shall not be less than 6.5 or more than 8.5 as a result of waste discharges and ambient pH levels shall not be changed more than 0.5 units from natural conditions as a result of waste discharges" (California Regional Water Quality Control Board, 1994).

For dissolved oxygen, the plan states that the mean annual concentration of all waters shall be greater than 7 mg/l, and no single determination shall be less than 5.0 mg/l, except when natural conditions cause lesser concentrations. The dissolved oxygen content of all surface waters designated as WARM shall not be depressed below 5 mg/l as result of waste discharges while the dissolved oxygen content of all surface waters designated as COLD shall not be depressed below 6 mg/l as a result of waste discharges. Surface waters designated as both COLD and SPWN shall not be depressed below 7 mg/l as a result of waste discharges (California Regional Water Quality Control Board, 1994).

Bacteria objectives are based on the recreation use. For contact recreation (REC-1), the fecal coliform count is based on a minimum of not less than four samples for any 30-day period. These samples shall not exceed a log mean of 200 most probable number (MPN)/100 milliliter. Neither shall more than 10 percent of samples during any 30-day period exceed 400 MPN/100. Bacterial levels for non-contact recreation (REC-2) is measured in the same manner except that the levels cited are 2,000 MPN/100 ml and 4,000 MPN/100 ml respectively (California Regional Water Quality Control Board, 1994).

Limiting concentrations of inorganic chemicals are also listed in the objectives. Two inorganic chemicals of possible concern in this watershed are cadmium and lead with recommended concentrations of 0.01 mg/l and 0.05 mg/l, respectively.

Table 9 - BENEFICIAL USES IN THE MALIBU CREEK HYDROLOGIC AREA

NAME OF WATER BODY	BENEFICIAL USE											
	MUN	REC-1	REC-2	WARM	COLD	GWR	WILD	MGR[a]	SPWN[a]	NAV	WET[b]	RARE[c]
Malibu Creek	P*	E	E	E	E		E	E	E		E	E
Malibou Lake	P*	E	E	E			E			E	E	E
Las Virgenes Creek	P*	(E)	(E)	(E)	P		(E)	P	P		(E)	
Lindero Creek	P*	I	I	I			(E)					
Triunfo Creek	P*	I	I	I			(E)					
Westlake Lake	P*	E	E	E			E			E		
Upper Medea Creek	P*	I	I	I	P	I	E				E	E
Lake Sherwood	P*	E	E	E		E	E		E	E	E	

MUN	Municipal and Domestic Use	COLD	Cold Freshwater Habitat	SPAWN	Fish Spawning
REC-1	Water Contact Recreation	GWR	Groundwater Recharge	NAV	Navigation
REC-2	Non-contact Water Recreation	WILD	Wildlife Habitat	WET	Wetland Habitat
WARM	Warm Freshwater Habitat	MGR	Fish Migration	RARE	Rare, Threatened, or Endangered Species

E = Existing beneficial use
I = Beneficial use in a watercourse with intermittent flow characteristics
P = Potential beneficial use

* = All inland surface and ground waters have been designated MUN in accordance with State Board Res. No. 8 effective in 1988 (Regional Board No. 89-03).
a = Aquatic organisms utilize all bays, estuaries, lagoons & coastal wetlands, to a certain extent, for spawning and early development
b = May have wetlands habitat asssociated with only a portion of the water body.
c = One or more rare species utilize all ocean bays, estuaries, a& coastal wetlands for foraging &/or nesting.

NOTE: Beneficial uses in parentheses are proposed in the updated Basin Plan.

4.3 WATER QUALITY ASSESSMENT

The 1994 State Water Resources Control Board Water Quality Assessment (California State Water Resources Control Board, 1994) catalogs the State's water bodies and their water quality condition. Bodies of water are listed as good, intermediate, impaired, or unknown. Good quality waters support and enhance the designated beneficial uses. Intermediate quality waters generally support designated uses with occasional degradation. Impaired waters do not attain or maintain applicable water quality standards to support beneficial uses. Waters are classified as unknown when there are limited or no direct observations available.

Table 10 shows the rating of the surface water bodies in the Malibu Creek Watershed as obtained from the 1994 Water Quality Assessment.

Malibu Creek ranked second on a study listing water bodies contributing contaminants to Santa Monica Bay (Santa Monica Bay Restoration Project, April 1993). Even though the creek ranked 8th in pollutant concentration, its high volume of annual water flow made it a large overall contributor.

It is thought by many local people that the beneficial uses of the waters of Malibu Creek Watershed, especially those of the lagoon, are being threatened by accelerated sedimentation, salinity, nutrients, and possibly pathogens (USDA Soil Conservation Service, 1992). For example, levels of bacteria in the Malibu area streams often reach concentrations higher than recommended for contact recreation, a designated beneficial use for Malibu Creek.

4.4 MALIBU LAGOON

In the early 1900s the lagoon was used as a fill area by CalTrans. It has also been used as a dump site and as baseball fields. Restoration of the lagoon back to a more natural state began in 1983. Historically, the lagoon was typical of other coastal brackish lagoons in which water conditions changed according to the season. Low flows in the summer allowed a sand bar to close the mouth of the lagoon until storm flows in the winter flushed open the mouth. This cycle has been altered by discharges into the creek from urban runoff and wastewater. This additional water causes the lagoon to fill in the summer and the sand bar is artificially breached. Concerns have been raised about the effect of breaching on the water quantity, quality, salinity, and temperature and, therefore, the plants and animals of the lagoon. Questions have also been raised regarding the effect of allowing the poor quality lagoon water to be emptied into the surf zone, degrading the water quality of the surf zone where people swim and surf.

The biological components of estuarine systems depend on some degree of variability in their environment. Salinity and temperature normally vary considerably in estuaries as a result of tidal influences. This situation is exaggerated in Malibu Lagoon by the irregular influx of freshwater from Malibu Creek and the changing status of the lagoon mouth. The lagoon is more like a brackish, rather than a salt water, ecosystem. It has a low diversity of invertebrates and fish which is characteristic of estuaries receiving high volumes of fresh water (Topanga-Las Virgenes Resource Conservation District, 1989). High levels of bacteria impair the lagoon's use for recreation, while the effects of eutrophication can impair the habitat usually provided by the lagoon.

When the opening into the lagoon is breached, the entire lagoon empties out within two hours even if the tide is rising. When the entrance is closed, the primary influence in the lagoon is the incoming fresh water from Tapia and surface runoff. This allows the lagoon to assume the characteristics found in enclosed bodies of water, such as increased temperatures, reduced dissolved oxygen, and low salinity (Topanga-Las Virgenes Resource Conservation District, 1989).

TABLE 10 - 1994 WATER QUALITY ASSESSMENT
WATER BODIES OF MALIBU CREEK WATERSHED

WATER BODY	IMPAIRMENT	SOURCE	FEDERAL LISTS
Malibu Lagoon	29 acres impaired from eutrophication, threat of recreation impacts, and fish kills	point and nonpoint	303.d, 304.l, 319
Malibu Creek	6 miles intermediate and 3 miles impaired from fish population decline, spawning impairment, and sedimentation	nonpoint	none listed
Lake Eleanor	8 acres intermediate from eutrophication , urban runoff	nonpoint	314, 319
Malibou Lake	55 acres intermediate from elevated fish tissue levels, suspected eutrophication, sedimentation	nonpoint	314
Lake Sherwood	184 acres intermediate suspected elevated fish tissue levels	nonpoint	314, 319
Westlake Lake	156 acres intermediate suspected elevated fish tissue levels and eutrophication	nonpoint	314, 319
Triunfo Canyon	7 miles intermediate suspected sedimentation	nonpoint	131.11
Lake Lindero	14 acres intermediate elevated fish tissue levels	nonpoint	

DESCRIPTIONS OF FEDERAL LISTS

314 - list of lake priorities for restoration

319 - list of impaired surface water bodies from nonpoint source pollution due to both toxic and nontoxic pollutants

131.11 - segments which may be affected by toxic pollutants, or segments with concentrations of toxic pollutants that warrant concern

303.d - list of water quality limited segments where numeric or narrative water quality objectives are not being maintained and/or where beneficial uses are not fully protected after application of Best Available Treatment/Best Control Technology (BAT/BCT)

304.l - so-called long list of waters designated as impaired because narrative or numeric objectives are violated or beneficial uses are impaired similar to Clean Water Act Section 303.d

4.5 POLLUTANTS IN STORM RUNOFF

Urbanization and stream channelization have increased the sediment load, inorganic constituents, heavy metals, organic materials, and bacteriological contaminants in the watershed's surface waters (USDI, 1984). Some of the parameters associated with urban runoff are nutrients, heavy metals, bacteria, and suspended sediment. Storm runoff carries pollutants such as trash and debris, oil and grease, nitrogen, phosphorus, hydrocarbons and other organic matter, heavy metals, bacteria, and suspended sediment.

Some of the factors influencing contaminant loadings to a water body are rainfall amount and pattern, drainage area, and the types of land uses in the drainage basin.

In Volume 1: Annual Pollutants Loadings to Santa Monica Bay From Stormwater Runoff, May 1993, single family residences are recognized as the top ranking contributor of nutrient pollutants and metal loading to the bay. Much of this is due to the large concentration of residential area found around the bay.

Sources of nutrients include fertilizers applied to agricultural land, lawns, and golf courses, nitrous oxides from automobile exhaust, animal waste, and surface soil erosion. Nutrients have been cited as a concern because of the eutrophication of Malibu Lagoon.

A study performed by the National Park Service in conjunction with U.S. Geologic Survey demonstrated the impacts of urbanization on surface waters. The study showed there was a definite shift in the chemical composition in downstream surface waters. This can be seen when comparing the chemical constituents between the undeveloped Cold Creek and the developed Malibu Creek. Chlorine and sulfate ions increased going downstream in Malibu Creek while the bicarbonate and calcium ions were higher in the undeveloped region (USDI, 1984).

High levels of fecal coliform bacteria often show up in stormwater runoff. Fecal coliform levels in urban runoff usually exceed public health standards for water contact recreation (U.S. Environmental Protection Agency, 1990). Other possible sources include domestic animal waste and malfunctioning septic systems.

Suspended sediment can sorb nutrients and metals and transport them from their source throughout the watershed creating concerns in other surface water bodies. Sediment with a high organic or clay content is also an efficient carrier of trace metals and toxicants. Sediment which has settled out in the lagoon may act as a sink and a source for nutrients.

4.6 WATER QUALITY PARAMETERS OF POSSIBLE CONCERN IN THE MALIBU CREEK WATERSHED

There is a substantial amount of water quality data obtained at various times and locations in the watershed. However, the only systematic long-term sampling program is that of the Las Virgenes Municipal Water District. The Regional Water Quality Control Board arranged an Intensive Survey in which samples were taken at a large number of locations at virtually the same time. Intensive Survey sampling has been done twice, once in May and once in September of 1993.

The following discussion includes data on concentrations of the parameters of most concern. This information is from a variety of sources and is presented to illustrate the range of values found. Additional data from the Intensive Survey sampling is presented in Section 4.8.

4.6.1 DISSOLVED OXYGEN

Dissolved oxygen (DO) is essential to the capacity of receiving waters to absorb and assimilate waste and to support aquatic life. In the absence of oxygen, taste and odor problems are created and fish will die due to hypoxia. The amount of oxygen dissolved in water decreases with an increase in temperature. Organisms generally oxidize the organic load in water using the dissolved oxygen that is present.

Dissolved oxygen levels in Malibu Creek are often registered below recommended concentrations. Depending on the site, dissolved oxygen levels will usually be measured below the recommended 6.0 mg/l from May through November. The sampling site located on Malibu Creek below Century Reservoir averaged a low of 2.9 mg/l in August 1990.

The levels of dissolved oxygen in the lagoon show seasonal variability with the lowest concentrations occurring in the fall and early winter followed by steadily increasing levels through late winter and spring (National Park Service, 1984). Ocean water is high in dissolved oxygen and this may affect lagoon levels through tidal intrusion and wind mixing. While dissolved oxygen levels vary depending on location in the lagoon, a range of 4.6 to 14.2 mg/l was measured in the channels. The range in the main body of the lagoon ranged from 2.1 to 20.0 mg/l.

4.6.2 TOTAL DISSOLVED SOLIDS

Total Dissolved Solids (TDS) may include high levels of certain types of salts, such as sodium sulfate, which can be extremely toxic to aquatic life. These salts occur naturally in waters in the western United States and it is not uncommon to find them in high levels in surface waters.

In 1972 much of the water in the Malibu area contained TDS in concentrations exceeding 1000 mg/l (Flowers, 1972). Lakes Sherwood and Westlake had the lowest TDS levels of waters in the area, 440 mg/l and 640 mg/l, respectively. These lakes have the same source of water, being fed by Potrero Creek. Malibu Creek TDS levels range from 44 to over 3,000 mg/l. Lake Lindero had a TDS concentration of 1952 and is fed by creeks flowing from the Las Virgenes Hills from the north. Malibu Lagoon also has high levels of TDS due to the higher concentrations of calcium and magnesium in the marine environment.

4.6.3 NUTRIENTS

Nutrients are necessary for the growth of biota in natural water systems. Excessive levels of nutrients can cause overstimulation of algae growth, creating poor water conditions. While high nitrate concentrations may indirectly foster increased fish production by increasing plankton growth and the development of fish food organisms, levels which are too high can cause clouding of the water, a decrease of oxygen levels in the water, and objectionable odors.

In standing water bodies such as lakes, excessive nutrients can overstimulate growth and create poor water quality conditions leading to eutrophication. Generally, the most important nutrients causing accelerated algae production are nitrogen compounds and phosphorus. There has been concern expressed about eutrophication problems in Malibu Lagoon.

Eutrophication may involve the filling in of a water body due to excessive algal growth. Low dissolved oxygen levels will result from the algal growth, causing fish kills and foul odors. Persistent eutrophication can lead to changes in the composition of plant and animal species of the water body. This change is considered to be negative in the lagoon because it decreases biological diversity. For instance, the lagoon's erratically high pH is influenced by algal blooms and may be depressing the jackknife clam population (Warshall, 1992).

Phosphorus is used by algae and aquatic plants and may be stored in plant cells. When plant cells decompose, phosphorus may be released through bacterial action for recycling in the biotic community, with the remainder being deposited with sediments.

Phosphorus has many of the same sources as nitrogen. Domestic sewage has significant concentrations of phosphorus contributed by detergents and human wastes. Primary and secondary treatment processes usually eliminate only 20 or 30 percent of phosphorus from sewage.

Nitrate levels are generally low in the surface waters of the upper watershed with a peak in Palo Comado Creek above Highway 101 in September 1993 of 9.1 mg/l. Concentrations become higher below the Tapia Wastewater Treatment Plant. A range of NO_3-N concentrations above the Tapia plant average 1.4 to 9.1 mg/l. The range increased below the Tapia plant to 1.1 to 16.1 mg/l.

Nitrogen is one of the most important factors causing an acceleration in algae production. Major point sources of nitrogen compounds are municipal and industrial wastewater discharges. Non-point sources include lawn fertilizers, malfunctioning septic systems, confined animal areas, atmospheric fallout, nitrite discharges from automobile exhaust, natural sources such as mineralization of soil organic matter, and animal wastes.

4.6.4 BACTERIA

Bacteria is noted in the 1984 Santa Monica Mountains Water Resources Management Plan (USDI, 1984), which cites high bacteriological contamination as a "serious and health threatening" concern. During the last three years of its monitoring study in the 1980s, the greatest concentration of coliforms reached 60,000 fecal coliform per 100 ml of water sampled (USDI, 1984). The U.S. EPA criteria states that fecal coliform levels exceeding 200/100 ml in surface waters are a potential public health threat and unsafe for body contact. Stream courses on federal property in violation of these standards were posted with a public health notice. High levels of bacteria may degrade the use of designated uses of the lagoon such as contact and non-contact recreation.

The 1992 Heal the Bay Annual Beach Report Card (Santa Monica Bay Restoration Project, 1992) reports that during and up to three days after storm events, Malibu Creek and the other drainages and channels discharging into Santa Monica Bay generally have high indicator bacteria levels (Trim, 1993). Bacterial concentrations in Malibu Creek and its tributaries were well above levels of concern at ten monitoring stations throughout the watershed. Total coliform counts were high everywhere, while fecal coliform and enterococci densities were generally higher at the lagoon. (Topanga-Las Virgenes Resource Conservation District, 1989).

One potential bacteria source, the Tapia Water Reclamation Facility, showed very low levels of bacteria in its effluent. In over 90 percent of the sample; total coliforms were not detected in the Tapia effluent and in the remaining samples, all were within standards of less than 2 MPN/100 ml (Santa Monica Bay Restoration Project, 1992).

High levels of coliform bacteria have been found all up and down Malibu Creek. Potential sources of bacteria include septic systems, wild and domestic animals, birds, storm drains discharging into the lagoon and lower watershed, picnickers, and runoff from roads. Vegetation and soil may contribute to total coliform levels.

From Warshall's report: "The non-human sources of coliforms, fecal coliforms, and streptococci need emphasis. There are about 100 ducks and coots living near the bridge. In any one day, a single duck produces about five times the total coliforms and five times the fecal coliforms as a human and 300 times the fecal streptococci. The coliform numbers for shorebirds are not well studied. Even in much lower numbers than ducks, the population of terns, gulls, pelicans, and fall migrant shorebirds would easily overwhelm another source. The increase in coliforms near the creek's connection to the lagoon gives added validity to the importance of waterfowl contributions. In addition, horses and dogs contribute roughly equivalent orders of magnitude in coliform, fecal coliform, fecal streptococci, and enterococci" (Warshall, 1992).

Coliform levels in the lagoon frequently exceed recommended levels and the lagoon is considered contaminated for human contact. Coliforms do not tolerate high salinity and quickly die off in ocean water. The closed lagoon, however, provides the proper environment for rapid multiplying of coliform bacteria.

The Regional Board's Intensive Survey sampling results recorded fecal coliform levels in Palo Comado Creek of 5,000 and 9,000 MPN/100 ml in September 1993. Lindero Creek concentrations registered 2,200 and 8,000 MPN/100 ml in September 1993. Las Virgenes Creek showed a high of 2,400 MPN/100 ml fecal coliform in May 1993.

Random sediments from Malibu Lagoon collected by Dr. Jeff Harris confirm the presence of *Pseudomonas aeruginosa*, a cause of swimmer's ear, and *Citrobacter freudii*, a cause of sinusitis and gastrointestinal illnesses.

The bacteria samples taken near the Pacific Coast Highway Bridge over the years by various agencies were extremely variable with an average of 1100 MPN/100 ml, but ranges from 100 to 2000 MPN/100 ml were common.

Enteric viruses were discovered in Malibu Lagoon indicating the lagoon had been contaminated with human sewage. The type of viruses found were Coxsackie B, which are often found in contaminated waters. This virus is known to cause gastroenteritis and, on rare occasions, pericarditis and meningitis (Santa Monica Bay Restoration Project, 1992).

4.6.5 pH

pH (hydrogen/hydroxyl ionization) of water may affect the toxicity of certain chemicals and can affect the types and rates of chemical reactions taking place in the water. The types and amount of vegetation and organisms found in a water body will also be affected by the habitat created by the pH of the water.

Generally, pH needs to remain stable and have values between 6.5 to 8.5 to remain a viable habitat for aquatic life. The pH appears to remain relatively stable throughout the year, with some peaks in October and February. At these times, all water quality parameters showed unusual readings. The pH values generally ranged from 6.5 to 9.5. Some of the higher pH levels recorded in the lagoon are thought to be influenced by the nutrients trapped in the sediments on the lagoon bottom. The large amount of bird guano, which is high in uric acid, may serve to lower the pH in the more widely utilized roosting areas (Topanga-Las Virgenes Resource Conservation District, 1989).

4.6.6 SALINITY

Salinity has been affected by the influx of freshwater inflows into the lagoon altering the historic salinity patterns, creating a different habitat than existed in the past. While freshwater discharges are not directly a water quality issue, water quality and beneficial uses can be impacted.

The salinity levels in the lagoon change, corresponding to the tidal cycle, breaching, and the amount of fresh water flowing from Malibu Creek. Calcium and magnesium concentrations increase going downstream in Malibu Creek. Levels of these two parameters are the highest in Malibu Lagoon due to the marine influence. The deepest channel shows a well defined salt lens, while in other parts of the lagoon the salinity may vary at different depths.

4.6.7 TEMPERATURE

Temperature levels in a body of water will influence dissolved oxygen concentrations and can affect its suitability for aquatic life.

Water temperature in the lagoon is highly variable. The temperature increases through the summer and fall, and begins to decrease in early December. The deepest channel often exhibits a temperature inversion, with warmer water being found on the bottom of the lagoon. This frequently occurs prior to an incoming tide or when the entrance to the lagoon is closed. Temperature variability in the lagoon may be due to the shallowness of the lagoon and the strong influence of weather conditions. Temperatures in the lagoon range from 50 to 80 ^{0}F with an average of 65 ^{0}F.

4.6.8 TRACE ELEMENTS AND MINERALS

Trace elements and minerals considered essential for the healthy growth of plants and animals unless found in too high concentrations are boron, calcium, cobalt, copper, potassium, lithium, magnesium, manganese, sodium, nickel, phosphorus, selenium, vanadium, and zinc. Sources of these elements include domestic and industrial discharges, urban storm runoff, and direct atmospheric deposition.

These elements are found in the lagoon within the recommended limits. If anything, the extremely low levels of cobalt, lithium, and vanadium may be of concern for the continued health of the existing plants and animals. Manganese is consistently found at low levels (Topanga-Las Virgenes Resource Conservation District, 1989). A UCLA study indicated that the levels of trace elements and industrial/chemical pollutants are low to negligible in the lagoon.

The general trend shows that the concentrations of many elements increase during the summer months. Many of these elements may precipitate out of solution when levels of dissolved oxygen increase and are more likely to be found in solution during the summer months when the dissolved oxygen levels are lower.

Sampling showed elevated levels of lead in the streams of the upper watershed, but more testing needs to be done to determine if the sources can be pinpointed and to determine if the problem exists in the lower watershed. Copper and zinc were mentioned in the June 1993 Santa Monica Bay Restoration Plan (Santa Monica Bay Restoration Project, 1993) as occurring above the level of concern but consistent data demonstrating this was not found during the course of this study.

Data indicate occasional spikes of heavy metals in the lagoon, but persistent high levels have not been found (Warshall, 1992).

Table 11 shows the ranges of some of the important water quality parameters found at some of the sampling sites in the watershed. Figure 9 provides an overview of the general condition of the surface water bodies in the watershed.

TABLE 11 - RANGES OF PARAMETER CONCENTRATIONS FOUND IN MALIBU CREEK WATERSHED

Location	Dates tests Performed	Flow (cfs)	pH	Water Temp(^{O}F)	DO (mg/l)	NO_3-N (mg/l)	Fecal Coliform (MPN/100 ml.)
Lindero Cr.	5/93 & 9/93	0.14-3.7	7.7-8.1	59-77	---	.06-1.1	1,700-50,000
Medea Creek @ Paramount	3/82-8/92	0.3-2.0	7.9-8.2	51.8-84.2	7.0-10.6	---	---
Palo Comado Cr.	5/93 & 9/93	0.6-9.1	7.8-8.0	61-72	---	0.6-9.4	220-9,000
Triunfo Cr.	5/93 & 9/93	12-13	7.3-7.8	60-75	---	0.1-0.2	<20-80
Malibu Creek Below Century Reservoir	1/90-12/92	1.0-527	6.7-8.5	47.1-74.7	2.8-10.9	.08-1.7	20-7,275
Las Virgenes Cr. above LVMWD	1/90-12/92	0.68-0.71	7.3-7.5	52.5-66.7	4.2-7.4	1.4-9.1	120-3,000
Malibu Cr. Above Tapia	1/90-12/92	1-1,440	7.7-8.6	47.3-69.8	5.5-10.8	0.03-6.2	17-300
Malibu Cr. Below Tapia	1/90-12/92	2-971	6.5-8.1	55.0-72.3	5.2-10.0	0.2-16.1	40-500
Malibu Cr. Below Cold Cr.	1/90-12/92	1-1196	6.8-9.0	57.9-72.3	6.1-9.9	1.2-15.7	40-300
Malibu Cr. @ Cross Cr. Rd.	5/88-12/92	0-1018	7.3-8.8	46.0-75.9	7.5-14.8	0.5-11.3	8-19,000
Malibu Cr. @ PCH	1/52-5/88 1/90-12/92	4-400 3-21	--- 7.0-9.0	41-85 57.2-87.1	0.8-24.3 7.3-87.1	--- 0.4-16.8	--- 170-18,000

4.7 AGRICULTURAL NON-POINT SOURCE (AGNPS) MODEL

AGNPS is a single storm event, distributed, sequential model, allowing the simultaneous modelling of overland flow, wash load sediment, and nutrient transport from numerous locations in a watershed via shallow upland channel flows to streams (Young et al, 1987). A major benefit of a distributed model such as AGNPS is being able to inventory erosion and nutrient sources throughout the watershed. The model accounts for soluble and sediment sorbed N and P. The model does not account for suspended and colloidal N and P.

Version 4.02 of the model was used to track soluble nitrogen and phosphorus through the Malibu Creek Watershed for a 2.2-inch, 6-hour duration precipitation event. First, the watershed was divided into eight subwatersheds to preserve the integrity of the model and to facilitate data management. The eight subwatersheds were linked to make a basin model.

AGNPS runs were made for each subwatershed. Samples of nitrogen and phosphorus from lakes were taken in November 1993 to determine the concentrations of nutrients discharging into downstream subwatersheds. For those subwatersheds with no lakes at their outlets, AGNPS calculations were used to determine the soluble nutrients discharging downstream. Non-point source nutrients were entered as fertilizer and point source nutrients as point sources. Since the modeling of Non-point sources is based on surface runoff only, septic tanks were accounted for by entering their contributions as point sources.

4.7.1 INPUTS

Fertilizer inputs for the model were developed for agricultural land uses based on the crop grown. All land uses were incorporated into the model with principal crops being pasture and hay. Additional nutrients were included to account for the animals which graze the harvested fields. The number of animals and their sizes were estimated by counting the animals in the areas adjacent to streams and in pastures.

The amount of fertilizer applied to other identified land uses was calculated using typical application values for the different land uses. The acreage and type of fertilized area was developed from 1989 false color infrared aerial photography. The areal density of the lawn and landscaped areas was measured. Irrigation water contributions were developed based on two samples taken in May and August of 1993 in a 285-unit subdivision.

The 1990 census data was used to develop the density of septic tank systems in the study area. The amount of daily sewage was calculated for the number of households in the area. The average household contribution to the system is 150 gallons per day. The liquid portion of the sewage goes to the leach field where the portion lost to evapotranspiration is estimated to be 50 percent. The resulting net flow rate was entered as a point source at the outlet of each subwatershed. Chemical concentrations of soluble nitrogen of 18 mg/l and of soluble phosphorus of 0.5 mg/l were derived from tabular data sets.

The largest point source is the Tapia Wastewater Treatment Plant. A discharge of 7 cfs and soluble nitrogen and phosphorus levels of 24 and 7 mg/l, respectively, were entered into the cell downstream of the treatment plant. A more detailed discussion of inputs is provided in the Malibu Creek Watershed Technical Documentation Report "Nitrogen and Phosphorus Analysis" .

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
DAVIS, CALIFORNIA

PALO COMADO

LINDERO CANYON

WESTLAKE

LAKE LINDERO has intermediate impairment; little other data available.

WESTLAKE LAKE has intermediate impairment from eutrophication and some measured low dissolved oxygen levels.

Westlake Lake

Lake Sherwood

LAKE SHERWOOD has intermediate impairment and high nutrient levels.

Las Virgenes Reservoir

HIDDEN VALLEY

UPPER MALIBU CREEK has some measured low dissolved oxygen levels, high fecal and total coliform levels, high sulfate concentrations and sediment impairment

Lake Lindero

Lindero Cyn.

Cr.

Medea

MEDEA CREEK has tested high for salts and coliform levels.

Las Virgenes Cr.

LAS VIRGENES CANYON

MALIBU CREEK has some measured low dissolved oxygen levels, high fecal and total coliform levels and high sulfate concentrations.

Malibou Lake

Century Reservoir

Malibu

Stokes

Cyn.

COLD CREEK CANYON

Cold Cr.

MALIBU CREEK has high nitrate levels and high fecal and total coliform levels: nitrate concentrations are high below the COLD CREEK confluence.

Rindge Dam

Cr.

Ventura Co.
Los Angeles Co.

TRIUNFO CANYON

MALIBU CANYON

LOWER MALIBU CREEK has some measured low dissolved oxygen levels, high nitrate, high fecal and total coliform levels. High salts and total dissolved solids throughout sub-watershed.

N
W E
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SUB-WATERSHED \ WATER QUALITY ASSESSMENT MAP
MALIBU CREEK WATERSHED
NATURAL RESOURCE PLAN
VENTURA AND LOS ANGELES COUNTIES, CALIFORNIA

1 1/2 0 1
Scale in Miles

COMBINED SUB-WATERSHED FLOW DIRECTIONS TO MALIBU CREEK →

Drawn by: T.M.Share

FIGURE 9

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4.7.2 RESULTS

AGNPS-calculated soluble nutrient loadings to watershed lakes, subwatershed outlets, and Malibu Lagoon are shown in Table 12. Based on these calculations, the addition of fertilizer and animal waste accounts for a 43.7 percent increase in water soluble nitrogen and an 85.7 percent increase in water soluble phosphorus delivered to Malibu Lagoon. The addition of Tapia's treated effluent accounts for most of the calculated additional point source increases of 10.9 percent in soluble nitrogen and 7.7 percent in soluble phosphorus. Septic tank effluent was insignificant in these runs.

4.8 WATER QUALITY BY SUBWATERSHED

Detailed water quality data and AGNPS analyses are provided using the eight subwatersheds identified on Figure 2.

4.8.1 HIDDEN VALLEY SUBWATERSHED

Background

This subwatershed is predominantly rural with an approximate population of 1,200 people. There are many ranches in this area with a large acreage of pasture used for raising livestock. Much of the residential area is situated around Lake Sherwood, which is located at the bottom, or outlet, of the subwatershed.

Lake Sherwood was constructed in 1904 to serve as a source of water for use on the ranches in the area. The first homes were established in the 1930s, and current homeowners use the lake for recreation activities such as swimming and windsurfing. In the 1980s, the ownership of the lake changed. The new owners drained the lake in order to inspect the dam and deepen the lake. In addition, a golf course/housing development was started just above the lake.

Lake Sherwood is a shallow lake with the depth near the dam approximately 30 feet. The storage capacity is 2600 acre-feet and the reservoir area is 163 acres. The average annual inflow would take 1.35 years to replace the water stored in the lake.

Water Quality

The designated beneficial uses of Lake Sherwood, the major surface water body in the subwatershed, include contact and non-contact recreation, municipal and domestic supply, warm freshwater habitat, ground water recharge, wildlife habitat, and wetland habitat. These uses may be impacted by high levels of nutrients coming into the lake and the resulting accelerated algae growth.

An orthophosphate level of 0.28 mg/l and nitrate-N plus ammonia-N level of 1.13 mg/l was measured in a surface water sample collected November 15, 1993. The objective standard of soluble nitrogen is 10 mg/l and the sample falls well below this. Though there is some discussion as to the concentration of phosphorus needed to promote excessive algae growth, a threshold total phosphorus concentration of 0.025 mg/l was cited in the December 1985 document "A Review of Nutrient Standards for the Coastal Lagoons in the San Diego Region" as a level below which algae growth will not be stimulated. If this criteria is considered, the sample shows a soluble phosphorus level 11 times the recommendation.

Table 12. Summary of N & P loadings to Sub–Watershed Lakes & Outlets
Results of AGNPS Runs for a 2.2–inch, 6–hour duration storm.

Sub–watershed Outlets	BASELINE				FERTILIZER AND ANIMAL WASTE				FERTILIZER & ANIMAL WASTES + PT. SOURCES			
	Sediment Attached		Water Soluble		Sediment Attached		Water Soluble		Sediment Attached		Water Soluble	
	Nitrogen lbs	Phosphorus lbs	N ppm	P ppm	Nitrogen lbs	Phosphorus lbs	N ppm	P ppm	Nitrogen lbs	Phosphorus lbs	N ppm	P ppm
Hidden Valley [1]	1,485,400	524,300	0.38	0.07	1,485,400	524,300	4.17	0.7	1,485,400	524,300	4.17	0.7
Westlake [1]	319,200	172,800	0.23	0.07	319,200	172,800	2.3	0.87	319,200	172,800	2.3	0.87
Lindero [1]	223,400	109,200	0.34	0.08	223,400	109,200	3.03	1.1	223,400	109,200	3.03	1.1
Palo Comado [2, 3]	664,700	360,800	0.34	0.08	664,700	360,800	2.31	0.85	664,700	360,800	2.31	0.85
Triunfo Canyon [1]	1,756,000	1,306,700	0.3	0.08	1,756,000	1,306,700	1.32	0.47	1,756,000	1,306,700	1.32	0.47
Las Virgenes Cyn. [2]	1,000,200	811,900	0.34	0.07	1,000,200	811,900	1.03	0.34	1,000,200	811,900	1.03	0.34
Cold Creek Cyn. [2]	311,200	159,300	0.37	0.08	311,200	159,300	1.05	0.34	311,200	159,300	1.05	0.34
Malibu Canyon [2]	1,960,900	967,800	0.32	0.07	1,969,200	972,000	0.46	0.13	2,004,500	989,400	0.51	0.14

1 – Total stream loadings to lake.
2 – Stream loadings to sub–watershed outlets.
3 – No Identified Point Sources

NOTE: Weights and concentrations given are for this magnitude storm only.

The highest concentrations of soluble N and P have been measured during the winter months. The average calculated residence time of 1.35 years suggests that slug concentrations of these nutrients can impact the reservoir for significant periods of time. Winter inflows are likely to settle to the bottom of the reservoir. Even sediment sorbed phosphorus may experience anaerobic bottom conditions allowing release of soluble phosphorus to the reservoir's water.

AGNPS Water Quality Model

Lake Sherwood is the recipient of nutrients in transit, whether in solution or sorbed to sediments. Based on AGNPS calculations, an estimated 700 tons of sediment-sorbed nitrogen (N) and 300 tons of sediment-sorbed phosphorus (P) in an average year are delivered to Lake Sherwood. Average estimates, based on AGNPS calculations, of soluble N and soluble P concentrations of surface waters flowing into the lake are 4 ppm and 0.7 ppm, respectively.

AGNPS calculated levels for storm flows are above background levels. AGNPS calculated no difference in sediment-sorbed N and P between a baseline setting and a setting with added fertilizer and animal waste. However, AGNPS calculations of soluble N and P for baseline versus added nutrients showed almost a ten-fold increase for both. The areas with soluble N concentrations in excess of 1 ppm are coincident with the following land uses: pasture, rural residential, and golf course. The 40-acre cell with the highest showing of soluble N concentration is estimated to contain of over 300 horses.

Sources

Possible sources of the excess nutrients may be fertilizer from the golf course and residences around the lake, animal waste from confined animal facilities and application to pastures, and waste from the wildlife that uses the lake. Up until the mid-1980s the lake homes were also a source of excess nutrients because of the use of septic tank systems. These homes have since been hooked into a sewer system. A lake management program controls nuisance algae.

4.8.2 WESTLAKE SUBWATERSHED

Background

This subwatershed is predominantly urban with a large acreage of natural area. The majority of the population can be found in the cities of Thousand Oaks and Westlake Village, which is situated around Westlake Lake, the outlet of this subwatershed.

Lake Sherwood outlets into this subwatershed and Westlake Lake outlets into the Triunfo Canyon subwatershed. Other surface water bodies in this subwatershed include Las Virgenes Reservoir and Lake Eleanor. Las Virgenes Reservoir has a drainage area of 0.9 square miles and serves as water storage for imported waters and has little effect on Westlake Lake. Lake Eleanor is formed by a low head dam and is essentially a manmade pool in the stream system. Almost all of the channel between Lake Sherwood and Westlake Lake is riprapped and concrete lined.

Westlake Lake is a shallow lake with the depth near the dam approximately 18 feet. The storage capacity is 791 acre-feet with a reservoir area of 95 acres. The average annual water inflow would take approximately 40 days to replace stored water. Westlake Lake is required to discharge water from May 1 to September 1. In order to meet this requirement, surface discharges are augmented by groundwater pumping.

Water Quality

The designated beneficial uses of Westlake Lake are municipal and domestic supply, contact and non-contact water recreation, warm freshwater habitat, ground water recharge, navigation, and wildlife habitat. These uses may be impaired by high nutrient and bacteria levels. The 1994 State of California Water Quality Assessment states that Westlake Lake is impaired by suspected eutrophication.

An orthophosphate level of 0.27 mg/l and nitrate-N plus ammonia-N level of 0.50 mg/l was measured in a surface water sample collected November 15, 1993. Monthly monitoring performed from 1991 to 1993 by the owners demonstrated an average phosphate level of below 0.05 mg/l and an average range of nitrate levels from 0.05 to 0.2 mg/l. Phosphate concentrations peaked in the fall of 1991 at 0.15 mg/l. A maximum level of soluble nitrogen for municipal supply is 10 mg/l and the measured levels fall below this. Although there is some discussion as to the concentration of phosphorus that promotes excessive algae growth, a threshold total phosphorus concentration of 0.025 mg/l was cited in the December 1985 document "A Review of Nutrient Standards for the Coastal Lagoons in the San Diego Region" as a level below which algae growth is not stimulated. Coliform bacteria levels are generally low but became extremely high in January and February of 1993, possibly exceeding municipal supply and contact recreation standards.

While no relationship has been found between discharge and soluble N and P concentrations, the highest concentrations of these parameters have been measured during the winter months.

AGNPS Water Quality Model

Based on AGNPS calculations, an estimated 200 tons of sediment-sorbed N and 100 tons of sediment-sorbed P in an average year are delivered to Westlake Lake. Average AGNPS estimates of soluble N and soluble P concentrations of waters flowing into Westlake Lake are 2.3 ppm and 0.9 ppm, respectively.

AGNPS calculated no difference in sediment sorbed N and P between a baseline setting and a setting with added fertilizer and animal waste. However, AGNPS calculations of soluble N and P for baseline versus added nutrients show a ten-fold and twelve-fold increase, respectively. Concentrations of soluble N above the baseline level of one ppm are associated with the urban and golf course land uses.

Sources

This subwatershed is heavily urbanized, and nutrients and bacteria are two of the parameters associated with urban runoff. Urban sources of nutrients potentially include lawn fertilizers, nitrous oxides from automobile exhaust, animal waste, and surface soil erosion. High levels of fecal coliform bacteria often show up in stormwater runoff, many times exceeding standards for contact water recreation. Wildlife wastes, such as heavy bird populations using the lake, also contribute nutrients and bacteria.

The average calculated residence time of 40 days for Westlake Lake suggests an ever changing water quality totally dependent on inflowing waters. Sediments are likely to remain aerobic and chemicals sorbed to sediment will tend to stay sorbed. However, benthic organisms and bottom feeders can still recycle these chemicals into the overlying water column. The runoff from lawns and golf courses largely determines the lake quality during the summer months. Algae blooms will be largely dependent on inflowing waters.

4.8.3 LINDERO CANYON SUBWATERSHED

Background

The Lindero Canyon subwatershed consists of 2,463 acres and is predominantly natural and residential areas. This subwatershed outlets into the Triunfo Canyon subwatershed. There are also 138 acres of golf courses. Much of the residential development took place during the 1980s with the majority of homes adjacent to the lake.

The outlet of this subwatershed is the 14-acre Lake Lindero. This is a shallow lake with the depth near the dam being approximately ten feet. The storage capacity is 90 acre-feet with a reservoir area of 12 acres. The average annual water inflow would take about 30 days to replace stored water.

Water Quality

The beneficial uses of Lake Lindero are municipal and domestic supply, contact and non-contact water recreation, warm freshwater habitat, and wildlife habitat. These uses may be impaired by the potential problems with high levels of bacteria and sediment deposition.

It is suspected that much of the 4,700 tons per year of sediment being dredged out of the lake may have been deposited in the lake during the major construction period in the 1980s.

An orthophosphate level of 0.04 mg/l and nitrate-N plus ammonia-N level of 0.19 mg/l was measured in a surface water sample collected November 16, 1993. Intensive Survey sampling performed one day each in May and September of 1993 at the lake produced nitrogen levels of 0.83 mg/l and 1.2 mg/l, respectively, and phosphorus levels of 0.07 and 0.15 mg/l in May and 0.05 and 0.34 mg/l in September. Just below the lake outlet, nitrogen levels were 0.17 and 0.23 and phosphorus levels were <0.05 and 0.13 mg/l in September. Though phosphorus concentrations appear to be high enough to be causing algae problems, there has been no mention in literature or from interviews with lake managers of a nutrient problem in Lake Lindero. Two reasons for this might be regular maintenance of the lake to eliminate nutrient problems and the comparatively short residence time.

While no relationship in this study was found between discharge and soluble N and P levels, the highest concentrations of soluble N and P have been measured during the winter months. The calculated residence time of 30 days suggests a frequently changing water quality, totally dependent on inflowing waters. Sediments are likely to remain aerobic so chemicals sorbed to sediment will tend to stay sorbed. However, benthic organisms and bottom feeders can still recycle these chemicals into the overlying water column.

Of more concern are the high coliform bacteria levels found in the lake. During the Intensive Survey sampling in May, 1993, the total coliform level was $>16,000$ MPN/100 ml while the fecal coliform count was 2,400 MPN/100 ml, six times the contact recreation standard of 400 MPN/100 ml. The same sampling program in September documented total coliform concentrations of 17,000 and 24,000 MPN/100 ml and fecal coliform levels of 2,200 and 8,000 MPN/100 ml. These results are again much higher than the contact water recreation standard and also exceed the non-contact recreation standard of 4,000 MPN/100 ml.

AGNPS Water Quality Model

Based on AGNPS calculations, an estimated 100 tons of sediment-sorbed N and an estimated 50 tons of sediment-sorbed P are delivered to the lake in an average year. Average estimates of soluble N and P concentrations in surface waters flowing into the lake are 3 ppm and 1.1 ppm, respectively.

AGNPS calculated no difference in baseline versus fertilizer contributions for sediment-sorbed nutrients. However, concentrations of soluble N and P for the same condition show a nine-fold and fourteen-fold increase, respectively. Concentrations of soluble N above the baseline level of one ppm are associated with urban, residential, and golf course land uses.

Sources

In general, residential areas are leading sources of bacteria and nutrients. High levels of bacteria often show up in stormwater runoff, many times exceeding standards for water contact recreation. Wildlife wastes, such as large numbers of birds using the lake, also contribute to nutrient and bacteria levels. Runoff from lawns and golf courses will largely determine the quality of the lake during the summer months.

4.8.4 PALO COMADO SUBWATERSHED

Background

The Palo Comado subwatershed is predominantly natural area (74 percent) with residential uses making up 20 percent of the subwatershed acreage. The largest residential area is the city of Agoura Hills. The city was developed rather piecemeal and one concern has been the commercial development along the 101 Freeway corridor and its impact on the area.

The natural areas in this subwatershed are in very good condition and no management practices were analyzed for these areas. The confluence of Medea and Lindero Creeks defines the outlet boundary of this subwatershed.

Water Quality

Upper Medea and Palo Comado Creeks: The existing beneficial uses for the surface water bodies in the upper portion of this subwatershed are wildlife habitat, rare and endangered species habitat, and wetlands habitat. The potential uses are municipal and domestic supply and cold freshwater habitat. Intermittent uses include ground water recharge, contact and non-contact water recreation, and warm freshwater habitat. Beneficial uses labeled as intermittent occur on streams with intermittent flows. As a tributary to Medea Creek, Palo Comado Creek has the same beneficial uses as Medea Creek.

A monitoring study was conducted by the National Park Service from 1981 to 1984 to find the source of the high coliform bacteria levels detected in Medea Creek. The coliform levels monitored in the creek greatly exceeded public health values for contact (USDI, 1984). Results indicated that wildlife in the area was responsible for the high counts. Intensive Survey data in 1993 indicated total coliform levels are still high at the headwaters of Medea Creek, ranging from 9,000 to 16,000 MPN/100 ml. Fecal coliform levels were lower and ranged from 300 to 800 MPN/100 ml during the September and May sampling days. Fecal coliform levels in Palo Comado Creek were 220 MPN/100 ml in May and ranged from 5,000 to 9,000 MPN/100 ml in September with total coliform levels documented at 1,700 MPN/100 ml in May and 9,000 MPN/100 ml in September, indicating bacteria concerns in this creek as well.

Nitrogen concentrations at the headwaters of Medea Creek ranged from 0.83 to 1.3 mg/l in May 1993 to 1.0 to 1.1 mg/l in September 1993, while phosphorus levels ranged from 0.06 to 0.08 mg/l in May and 0.15 to 0.45 mg/l in September. While nitrogen levels were low, phosphorus levels are high enough to cause potential problems downstream. In Palo Comado Creek, while nitrogen concentrations were only 0.6 to 0.9 mg/l in May, levels reached 6.4 to 9.5 mg/l in September. While still under the standard of 10 mg/l, these levels serve as a warning of potential problems.

The large number of confined animal units in the vicinity of the lower end of Palo Comado Creek may be one reason for the high levels of nitrogen and bacteria in this creek system.

Lower Medea Creek: The existing beneficial uses for lower Medea Creek are contact and non-contact water recreation, warm freshwater habitat, wildlife habitat, and wetland habitat. Intermittent uses include municipal and domestic supply and ground water recharge.

Nitrogen concentrations at the confluence of Medea and Lindero Creeks measured 1.5 mg/l in September of 1993 while phosphorus levels stood at 0.75 mg/l. These phosphorus concentrations are high enough to cause algae and nutrient-related problems to downstream water bodies. The total coliform bacteria concentration at this time was 16,000 MPN/100 ml and the fecal coliform count was 500 MPN/100 ml.

AGNPS Water Quality Model

Based on AGNPS calculations, an estimated 300 tons of sediment-sorbed N and an estimated 200 tons of sediment-sorbed P are delivered to the outlet in an average year. Average estimates of soluble N and P concentrations in surface waters at the outlet are 2.3 ppm and 0.9 ppm, respectively.

The AGNPS model calculated no change in sediment-sorbed N and P with the addition of fertilizer, animal waste, and point source activities. AGNPS calculations produced a seven-fold increase in soluble N and an eleven-fold increase in soluble P with the addition of these human-induced activities. AGNPS calculations of soluble N above a baseline level of one ppm are associated with the urban, residential, and golf course land uses.

Sources

Probable sources of the high levels of nutrients and bacteria in this subwatershed are runoff from natural areas and wildlife, urban runoff which is prone to high bacteria levels, and confined animal units located near streams.

4.8.5 LAS VIRGENES SUBWATERSHED

Background

The 18,261-acre Las Virgenes subwatershed is predominantly natural area (89 percent), with residential area accounting for 8 percent of the total land use. There are also orchards (<1 percent), pasture (<1 percent), and field crops (1 percent). Over 300 out of the total 3,766 households are on septic systems. The residential areas are scattered throughout the subwatershed as opposed to being congregated in one large city area. Much of the residential development is multi-family style residences such as apartments. The majority of the residential septic systems are located in Stokes Canyon at the bottom of the subwatershed.

The outlet of this subwatershed is the confluence of Las Virgenes and Malibu Creeks.

Water Quality

The existing designated beneficial uses of Las Virgenes Creek are contact and non-contact water recreation, warm freshwater habitat, wildlife habitat, wetland habitat, and rare and endangered species habitat. Potential uses are listed as cold freshwater habitat, migration, and spawning. There is the potential for these uses to be negatively impacted by high nutrient and bacteria levels and low levels of dissolved oxygen though Las Virgenes Creek is one of the few surface water bodies in the Malibu Creek Watershed not listed as impaired by the 1994 California State Water Resources Control Board's Water Quality Assessment. High nutrient levels may be one of the reasons for low dissolved oxygen levels.

Upper Las Virgenes Creek: Soluble nitrogen and phosphorus concentrations in the upper Las Virgenes subwatershed were documented in the 1993 Intensive Survey sampling in May and September. In May nitrogen levels were measured at 1.2 mg/l and phosphorus levels ranged from 0.17 to 0.19 mg/l. September nitrogen values were slightly higher at 1.5 mg/l while phosphorus levels ranged from 0.06 to 0.24 in a one-day period. Bacteria concentrations were measured only in May and were documented at 170 MPN/100 ml for fecal coliform and 2,200 MPN/100 ml for total coliform. While bacteria and nitrogen were within standards for the designated uses, measured phosphorus levels are high enough to impact downstream water bodies.

Stokes Creek: Stokes Creek joins Las Virgenes Creek near its confluence with Malibu Creek. This is the area where the majority of the residential septic systems are found. Data from the 1993 Intensive Survey sampling program performed in September show high nitrogen rates averaging 8.5 mg/l and phosphorus levels ranging from 0.12 to 0.49 mg/l. These nitrogen levels almost exceed the recommended 10 mg/l for the beneficial uses and the phosphorus levels are high enough to cause concern to downstream water bodies. Fecal coliform concentrations at this time ranged from 80 to 500 MPN/100 ml while total coliform levels were measured at 5,000 MPN/100 ml. The measured level of 500 MPN/100 ml taken in September exceeds the 400 MPN/100 ml for a 30-day period standard set by the Los Angeles Regional Water Quality Control Board.

Lower Las Virgenes Creek: This section of this creek has more available data because there is a permanent Las Virgenes Municipal Water District (District) testing site as well as a 1993 Intensive Survey sampling site. The District provides monthly figures for soluble nitrogen, soluble phosphorus, and total coliform bacteria. The District's site is located above their offices while the Intensive Survey sampling was performed at the confluence of Las Virgenes and Malibu Creeks.

Soluble nitrogen concentrations are generally low at the District's site (1.4 to 3.4 mg/l) with slightly higher levels during the summer and occasional peaks in summer such as a level of 9.1 mg/l in August of 1990. This data corresponds to the Intensive Survey measurements which average 3.4 mg/l nitrogen during both the May and September sampling days. Phosphate levels showed a similar trend by being slightly higher during the summer months with a range of 0.58 to 0.96 mg/l than during the winter months with a range of 0.23 to 0.48 mg/l. Intensive Survey data shows a range of 0.17 to 0.25 mg/l for the May sampling versus a range of 0.09 to 0.14 mg/l for the September sampling. These levels are high enough to impact downstream water bodies.

Total coliform bacteria concentrations also ran higher during the summer months, with a range of 6,940 to 45,000 MPN/100 ml. Concentrations during the winter months ranged from 1,695 to 14,250 MPN/100 ml. Intensive Survey data documented lower total coliform levels with 2,400 MPN/100 ml in May and a range of 1,300 to 5,000 MPN/100 ml in September. Fecal coliform measurements taken at this time showed 2,400 MPN/100 ml in May and an average of 240 MPN/100 ml in September. The fecal coliform level in May is higher than the 400 MPN/100 ml 30-day standard set by the Los Angeles Regional Water Quality Control Board.

AGNPS Water Quality Model

Based on AGNPS calculations, an estimated 3,100 tons of sediment-sorbed N and an estimated 400 tons of sediment-sorbed P in an average year flows from Las Virgenes Creek into Malibu Creek. Average estimates of soluble N and P concentrations in Las Virgenes Creek to Malibu Creek are 1 ppm and 0.3 ppm, respectively.

AGNPS calculated no difference in sediment-sorbed N and P between baseline conditions and added fertilizer and animal wastes. However, AGNPS calculations of soluble N and P for these conditions shows a three-fold and five-fold increase, respectively. Concentrations of soluble N above the baseline level of one ppm are primarily associated with urban land use.

Sources

Possible sources of the high nutrient levels include urban runoff, fertilizers, septic systems, and wildlife wastes. With the exception of fertilizers, the potential sources of the high bacteria levels are the same. Generally, high levels of fecal coliform bacteria are very common in stormwater runoff and often exceed the standards for contact water recreation.

4.8.6 TRIUNFO CANYON SUBWATERSHED

Background

The largest land use in this 11,349-acre subwatershed is natural area with 9,889 acres, followed by residential areas and confined animal units. Most of the residential areas are located adjacent to the creek systems or around Malibou Lake. Of the 2,978 households in the subwatershed, 625 are on private septic systems.

The Westlake, Lindero, and Palo Comado subwatersheds flow into the Triunfo subwatershed. The outlet to this subwatershed is Malibou Lake which is fed by Triunfo Creek from the west and Medea Creek to the north.

Water Quality

The existing designated beneficial use for Triunfo Creek is wildlife habitat. Intermittent uses include contact and non-contact water recreation and warm freshwater habitat. A potential use is municipal and domestic supply. Existing uses for Malibou Lake are contact and non-contact water recreation, warm freshwater habitat, wildlife habitat, wetland habitat, rare and endangered species habitat, and navigation. A potential use is municipal and domestic supply. Lower Medea Creek has the following listed existing uses: contact and non-contact water recreation, warm freshwater habitat, wildlife habitat, and wetland habitat. Intermittent uses include municipal and domestic supply and ground water recharge. Uses labeled as intermittent occur on streams with intermittent flows.

Besides 1993 Intensive Survey sampling sites on Triunfo and lower Medea Creeks, there is some available nutrient and fecal coliform bacteria data obtained by the U. S. Geological Survey (USGS) in the 1980s on Triunfo Creek and at Malibou Lake. A one-time sampling of nutrients was also performed in November 1993.

Triunfo Creek is identified in the 1994 California State Water Quality Assessment as being intermediately impaired by suspected sedimentation. An intermediate impairment listing indicates that beneficial uses are impaired at least some of the time. Though Intensive Survey data measured soluble nitrogen at the low average of 0.2 mg/l for both May and December, phosphorus levels averaged 0.13 mg/l in May and 0.1 mg/l in September. USGS data documented phosphorus levels ranging from 0.07 to 0.14 mg/l over a two-year period from November 1985 to December 1987. These levels of phosphorus are high enough to affect water quality in Malibou Lake.

Fecal coliform levels have also been measured at high concentrations. Though Intensive Survey data ranged at a low 20 to 80 MPN/100 ml in May and September, USGS information over a two year period from 1985 to 1987 ranged from 670 to 5,600 MPN/100 ml. The latter figures are higher than the recommended standard for contact water recreation. Total coliform counts were higher in May than September with 1,100 MPN/100 ml in May and 200 MPN/100 ml in September.

A 1993 Intensive Survey sampling station in lower Medea Creek measured low nitrogen levels (0.8 mg/l in May and 0.3 mg/l in September) and higher phosphorus levels (0.07 and 0.13 mg/l in May and 0.05 and 0.09 mg/l in September). Fecal bacterial sampling indicated a high 500 MPN/100 ml while the total coliform count was 2,400 MPN/100 ml.

Malibou Lake itself also indicated high phosphorus and fecal coliform concentrations. A surface water sample from Malibou Lake on November 15, 1993, measured 0.06 mg/l orthophosphorus and 0.08 mg/l ammonia-N plus nitrate-N. USGS sampling performed between January 1982 and July 1983 produced an average phosphorus reading of 0.13 mg/l and a range of coliform from 370 to 4,700 MPN/100 ml. The phosphorus levels may be high enough to explain the suspected eutrophication impairment rating received in the 1994 State Water Quality Assessment. The lake was also rated impaired from sedimentation.

AGNPS Water Quality Model

Based on AGNPS calculations, an estimated 900 tons of sediment-sorbed N and 700 tons of sediment-sorbed P are delivered to Malibou Lake in an average year. Average estimates of soluble N and P concentrations in surface water inflows to Lake Malibou are 1.3 ppm and 0.5 ppm, respectively.

AGNPS calculated no difference in the amount of sediment-sorbed N and P between the baseline setting and nutrient contributions from human and animal activities. However, calculations of soluble N and P for these two settings show a four-fold and six-fold increase, respectively, from baseline to nutrient additions. The higher soluble N concentrations in Triunfo Creek are due to higher soluble N levels in waters flowing out of Westlake Lake. Concentrations of soluble N above the baseline level of one ppm are associated with urban, residential, and orchard land uses.

While no relationship in this study was found between discharge and soluble N and P concentrations, the highest concentrations of soluble N and P have been measured during the winter months.

Sources

Some of the sediment and nutrients may be coming from the subwatershed above, but other contributors could also be septic systems, streambank and natural area erosion, fertilizers, residential runoff, road runoff, wildlife wastes, and confined animal units.

4.8.7 COLD CREEK SUBWATERSHED

Background

The 5,235-acre Cold Creek subwatershed consists of 3,789 acres of natural area with 1,403 acres of scattered rural residences on private septic systems and 34 acres of confined animal units concentrated in the lower portion of the subwatershed.

The outlet of this subwatershed is the confluence of Cold and Malibu Creeks.

Water Quality

The existing designated beneficial uses are contact and non-contact water recreation, warm freshwater habitat, cold freshwater habitat, wildlife habitat, migration, spawning, wetlands habitat, and rare and endangered species habitat while a potential use is municipal and domestic supply.

Sampling sites include two U. S. Geological Survey sites along Cold Creek and one 1993 Intensive Survey testing site just above the confluence of Cold and Malibu Creeks. The USGS sampled for fecal coliform at both of its sites and for soluble phosphorus at its lower site.

Soluble nitrogen levels from the Intensive Survey data in May averaged 0.75 mg/l and in September 0.28 mg/l while phosphorus concentrations averaged 0.75 mg/l in May and 0.055 mg/l in September. Phosphorus levels documented in the USGS sampling, which took place from January 1982 through August 1988, averaged 5.6 mg/l. These levels are high enough to impact downstream water bodies.

Though fecal coliform bacteria levels in the May Intensive Survey values measured only 300 MPN/100 ml, the USGS levels peaked at 6,400 MPN/100 ml during the six-year period from 1982 to 1988. This value is much higher than the 400 MPN/100 ml standard for contact recreation set by the Los Angeles Regional Water Quality Control Board. Total coliform levels in the May sampling measured 5,000 MPN/100 ml.

AGNPS Water Quality Model

Based on AGNPS calculations, an estimated 200 tons of sediment-sorbed N and 100 tons of sediment-sorbed P flow from Cold Creek to Malibu Creek in an average year. Average estimates of soluble N and P concentrations in Cold Creek flows to Malibu Creek are 1 ppm and 0.3 ppm, respectively.

AGNPS shows no difference in sediment-sorbed N and P between the baseline and nutrient additions from human and animal sources. However, AGNPS calculations for soluble N and P for baseline versus added nutrients show a three-fold increase in N and a four-fold increase in P. Concentrations of soluble N above the baseline level of one ppm are primarily associated with residential land use.

While no relationship was found in this study between discharge and soluble N and P concentrations, the highest concentrations of soluble N and P have been measured during the winter months.

Sources

Runoff from natural and wildlife areas will contribute nutrients and bacteria to surface water bodies. Malfunctioning septic systems and confined animal units are also possible contributors. Applying fertilizers, both natural and chemical, in excess of plant needs will add nutrients to surface waters.

4.8.8 MALIBU CREEK SUBWATERSHED

Background

Though the predominant land use in the Malibu Creek subwatershed is natural area, there is the city of Malibu at the outlet of the subwatershed into Malibu Lagoon and scattered rural residences with horse facilities. The Tapia Water Reclamation Facility is located in this subwatershed changing the dynamics of the surface water quality and quantity. The subwatershed also has a large number of private septic systems.

Century Reservoir is found in the Malibu Creek subwatershed. This area was first populated by people unable to locate closer to the urban centers. Around 1900, a group of wealthy men formed a country club and built a dam to provide water and recreation for the club. Since that time, the reservoir has decreased in capacity due to deposited sediment. In 1936 the club was purchased by 20th Century-Fox Studios and used as a filming location for many films and television shows. In 1974 the property was acquired by the State of California to be used as a state park.

Malibu Canyon is the recipient of runoff and associated chemicals from the upper watershed and serves as a natural funnel to Malibu Lagoon and Santa Monica Bay.

Water Quality

The current designated beneficial uses for Malibu Creek include contact and non-contact water recreation, warm freshwater habitat, cold freshwater habitat, wildlife habitat, migration, spawning, wetlands habitat, and rare and endangered species habitat. One potential use is municipal and domestic supply.

Malibu Creek is listed with intermediate impairments in the 1994 California State Water Quality Assessment. An intermediate impairment means that the beneficial uses are impaired at least part of the time. The impairments are fish population decline, spawning impairment, and sedimentation.

There are numerous testing sites on Malibu Creek with the principal sampling agencies being the Las Virgenes Municipal Water District (District), Los Angeles Regional Water Quality Control Board (Board), Los Angeles Department of Public Works (LADPW), and the 1993 Intensive Survey.

Malibu Creek Between Century Reservoir and Tapia: The District maintains a sampling site in this location and tests monthly throughout the year. Measured are nitrate-nitrogen, phosphorus, and total coliform levels. Nitrate concentrations remained low over the two year period from 1990 to 1992 ranging from 0.01 to 1.7 mg/l and not having much seasonal variation. Intensive Survey data taken at the same site also indicate low (0.05 to 0.2 mg/l) nitrate concentrations in May and September.

Total coliform levels, however, appear to peak in the summer months, achieving a high in August 1990 of 13,100 MPN/100 ml and ranging from 80 to 590 MPN/100 ml through the winter months, according to the District's data. Intensive Survey information showed levels of 800 and 2,200 MPN/100 ml taken at the site in September. Fecal coliform levels documented by the Intensive Survey were 20 and 40 MPN/100 ml in September.

Phosphorus concentrations were also fairly consistent throughout the year, ranging from 0.06 to 0.14 mg/l with the District's testing and 0.07 to 0.12 mg/l in May and 0.05 to 0.08 mg/l in September with the Intensive Survey testing. These levels are high enough to impact downstream water bodies.

Though it seems as if many of the nutrients from the Triunfo Canyon subwatershed are being contained in Malibou Lake, some of these nutrients and coliforms may still be contributing to Malibu Creek. Other sources in this part of the subwatershed include natural and wildlife runoff, septic systems, and residential runoff.

Malibu Creek Above Tapia: The District and the Intensive Survey also maintain testing sites above the Tapia Treatment Plant. The same parameters were monitored.

During 1990 the District values for nitrate-nitrogen remained low but peaked during the winter months achieving a range of 0.37 to 1.4 mg/l in the winter versus 0.03 to 0.17 mg/l during the summer months. Maximums and minimums in 1991 and 1992 were 0.3 and 1.2 mg/l and 0.2 and 6.2 mg/l, respectively. All values are below the 10 mg/l recommended level for municipal and domestic supply. Intensive Survey sampling also indicated low nitrate levels of 1.1 mg/l in May and 1.4 mg/l in September.

Total coliform bacteria concentrations again peaked in the summer months with levels of 1,040 to 3,525 MPN/ml being found in 1990 District records. Intensive Survey information shows 170 MPN/100 ml in May and a large variation from morning and afternoon samples in September of 2,800 and 9,000 MPN/100 ml. Fecal coliforms at these times were measured at 70 MPN/100 ml in May and averaged 30 MPN/100 ml in September which is below standard levels.

Phosphorus concentrations were fairly consistent throughout the year and on the high side ranging from 0.09 to 0.29 mg/l in the year 1990. Intensive Survey data recorded phosphorus at 0.09 to 0.13 mg/l in May and 0.1 to 0.78 mg/l in September.

Sources of the high phosphorus in this stretch of stream would correspond to those of the section below Century Reservoir.

Malibu Creek Below Tapia: The same parameters were monitored by the District and the Intensive Survey.

Nitrate levels in Malibu Creek are much higher after Tapia Park. Nitrate concentrations are generally lower in summer and rise during the winter months reaching ranges of 8.1 to 16.0 mg/l. Summer levels ranged from 1.1 to 3.3 mg/l. Measurements taken by the Intensive Survey were 0.8 and 1.5 mg/l in May and 1.1 and 2.1 mg/l in September, much lower than the regular monitoring program by the District. Some of these figures were higher than the recommended 10 mg/l.

Total coliform levels were similar to those taken above Tapia Park with a summer range of 1,950 to 4,500 MPN/100 ml and a winter range of 360 to 650 MPN/100 ml from the District records. Intensive Survey data shows a total coliform level of 3,000 MPN/100 ml for May. The fecal coliform count in May was 130 MPN/100 ml, well below the 400 MPN/100 ml for contact recreation, a designated beneficial use.

Phosphate levels dropped in summer during low-flow situations but rose during the winter months, ranging from 0.78 to 1.3 mg/l during the summer and 3.5 to 5.0 mg/l during the winter months. Intensive Survey data shows high soluble phosphorus levels of 0.21 and 0.47 mg/l in May and 0.05 to 0.96 mg/l in September. These levels are considered to be very high and could easily influence downstream water bodies.

The Tapia Water Reclamation Facility contributes to the nutrient level of Malibu Creek. Other sources of nutrients include septic systems, wildlife, runoff from natural areas, and runoff from residential areas.

Malibu Creek Below Rindge Dam: Nitrate concentrations below Rindge Dam are still high. Monthly records from the 1990 District report show no consistent seasonal or flow pattern for nitrate levels. Throughout the year 1990 levels ranged from 1.9 mg/l in January to 10.1 mg/l in March. Ranges in 1991 and 1992 were 0.2 to 12.4 mg/l and 1.6 to 9.0 mg/l, respectively. These ranges at times exceed the 10 mg/l nitrate-nitrogen standard. No Intensive Survey data was available for this site.

Total coliform concentrations averaged the same as other sites long the creek with levels lower in the summer than the winter months. Ranges in 1990 in the summer went from 400 to 800 MPN/100 ml while winter levels were from 1,060 to 3,200 MPN/100. No fecal coliform counts were available. Maximums and minimums in 1991 and 1992 were 10,750 and 433 MPN/100 ml and 15,400 and 170 MPN/100 ml, respectively.

Phosphate levels were lower in summer, ranging from 1.5 to 2.2 mg/l. Winter concentrations ranged from 1.6 to 3.3 mg/l in 1990. No other data was available for this site. These levels are high and could impact downstream water bodies.

Sources of the nutrients are essentially the same as for the other sections of the creek - natural and residential runoff, septic systems, and Tapia discharges.

Malibu Creek At Malibu: Nitrate concentrations taken at Cross Creek Road in 1990 were only measured from December to June because the creek ran dry during the remaining months. During the sampling period rates ranged from 4.2 to 8.6 mg/l with a very low 0.5 mg/l in January with a flow of 21 cfs. USGS data at this site measured 13.5 mg/l nitrate-nitrogen and 43 mg/l nitrate on December 12, 1986. LADPW documented a high of 11.0 and a low of 1.4 mg/l from May 1988 to June 1990. Ranges in 1991 and 1992 were 4.5 to 11.3 mg/l and 0.8 to 8.6 mg/l, respectively. This information indicates that levels of nitrates can become very high and may exceed set standards on occasion.

Total coliform counts from December 1989 to June 1990 were fairly low, ranging from 450 to 1,190 MPN/100 ml. However, in November 1990 after the creek had been dry for four months, the count reached a peak of 13,000 MPN/100 ml. Total coliform levels in 1991 and 1992 ranged from 565 to 19,000 MPN/100 ml and 400 to 51,500 MPN/100 ml, respectively. Fecal coliform levels from 1988 to 1990 ranged from 8 to 14,000 MPN/100 ml.

Phosphate levels were similar to the other sites along the creek, being slightly lower in the summer and ranging from 1.6 to 3.1 mg/l in 1990. These are high levels and may impact downstream water bodies.

This stretch of the creek runs through an intensively urbanized area and nutrients and bacteria are commonly found in urban runoff. Other sources are septic systems and contributions from sections of creek above.

AGNPS Water Quality Model

Based on AGNPS calculations, an estimated 1000 tons of sediment-sorbed N and 500 tons of sediment-sorbed P flow to Malibu Lagoon in an average year. Average estimates of soluble N and P concentrations flowing into Malibu Lagoon are 0.5 ppm and 0.1 ppm, respectively.

AGNPS calculated no difference in sediment-sorbed N and P between the baseline and additional nutrients from human and animal contributions. Concentrations of soluble N associated with urban land uses, above the baseline level of one ppm, were identified by the AGNPS model for drainage within a 360-acre tract in the southwest corner of the subwatershed. Additions of fertilizer and animal wastes in the subwatershed account for a 44 percent increase in water soluble N and an 86 percent increase in water soluble P. Addition of Tapia's treated effluent accounts for an additional 11 percent increase in water soluble N and an 8 percent increase in water soluble P. Septic tank effluent in these runs was insignificant.

While no relationship was found in this study between discharge and soluble N and P concentrations, the highest levels of soluble N and P have been measured during the winter months.

4.9 CONCLUSIONS

The primary water quality concerns in the watershed are high bacteria and nutrient levels which contribute to the degradation of the surface waters. In some cases sediment eroded from natural areas or found in urban runoff will transport nutrients or other pollutants. After finding their way to reservoirs or the lagoon and settling out, these sediments act as a sink and source of pollutants.

The sources of the bacteria and nutrients are virtually all of the land uses in the watershed. Urban runoff and septic systems contribute bacteria and, along with effluent from the Tapia plant, high levels of nutrients. Even naturally vegetated areas contribute nutrients and suspended sediment which can carry pollutants to the lagoon. Horse corrals along streambanks, domestic animals, wild animals, and birds also contribute their share of bacteria and nutrients. All land uses are, to some extent, responsible for the degradation of the water quality in the Malibu Creek Watershed.

One of the major problems in analyzing the existing water quality data is that, while much monitoring and sampling has been done, there needs to be a clearinghouse to process, combine, and analyze the data as it is developed. Much of the collected data is stored in its raw form. It would be useful if all data could be sent to one place to be processed. This would make it much easier to identify trends in the water quality of the watershed. This idea has also been suggested in many of the existing reports.

SECTION 5 - OPPORTUNITIES FOR NON-POINT SOURCE POLLUTION REDUCTION

5.1 THE WATERSHED APPROACH

Malibu Lagoon is one of the few remaining wetlands and lagoons along the Santa Monica Bay in southern California. It provides nesting habitat for several endangered, sensitive, and rare species and at least a hundred other species. This wetland is threatened by sediment loads transported in during periods of heavy rains and by freshwater flows during dry periods. Contaminants from Non-point source pollutants and nutrients are contained in the water during all flow periods, though in higher levels during the first flush storm flows.

There are multiple sources of sediment, nutrients, and other Non-point source pollution entering the waterways and lagoon from urban developments, agriculture, residential uses, and public services such as roads and recreation facilities. Controlling these contaminants will require a long-term commitment, and a combination of practices and measures, both structural and management, and actions, both political and private.

The use of a "watershed approach" is now being emphasized by the U.S. Department of Agriculture, the U.S. Environmental Protection Agency, the California Department of Water Resources, California Department of Conservation, and others. This approach involves looking at the entire landscape within a drainage basin. Critical to this is the involvement of the residents living in the watershed.

The reduction of Non-point source pollution can be accomplished by the implementation of conservation practices. Though a practice, or a group of practices, may be implemented individually, each recommended practice needs to be evaluated for its effect on the watershed as a whole.

5.2 CONSERVATION PRACTICES

Conservation practices are measures or actions commonly used to meet a specific need in planning and carrying out resource management programs. The conservation practices used by the NRCS have standards and specifications for their use and design. The NRCS standards and specifications are found in the Field Office Technical Guide at the Somis Field Office.

Examples of the land uses evaluated for conservation practices in the Malibu Creek Watershed are: confined animal facility, single family residential, spaced rural residential, natural areas, landfills, and rural parks. The selected conservation systems and practices are those that are commonly and widely used to reduce the stated problems. The selected systems and practices are shown as examples and are not intended to be either complete or to fit every specific site needing treatment.

An example conservation system for a confined animal facility could include conservation practices to reduce nutrients, sediment, and fresh water leaving the site.

Single family residential areas have widely mixed uses. Conservation management systems for this land use would need to reduce erosion, sediment, and runoff from roads and nutrients, sediment, and excess water leaving horse paddocks, lawns, and other landscaped areas.

Spaced rural residential areas also have widely mixed uses. The conservation practices for single family residential could also be used in the spaced rural residential areas to reduce erosion, sedimentation, nutrients, and excess fresh water reaching the lagoon.

Landfills, construction sites, and human activities in natural areas are examples of areas where the soil surfaces have been disturbed. Conservation practices used would need to reduce erosion and sediment caused by runoff from roads and other disturbed areas.

Much of the erosion in rural residential, urban, and natural areas can be attributed to deficiencies in design, placement, and maintenance of improved and unimproved roads and trails. Deficiencies in design can range from no curbs and gutters to concentrated flows directed into unprotected areas to extremely steep cut or fill slopes of mineral soil. The system of conservation practices to reduce erosion on access roads can be used with modifications adaptable to the specific site conditions.

5.3 TYPICAL LAND USE CONDITIONS AND TREATMENTS

Following are brief discussions of the problems and solutions by land uses. The typical land use conditions that are assumed in this study and the type of practices to address the contaminant problems are described. More detailed descriptions of the suggested conservation practices may be found in Appendix C. The NRCS has developed specific standards and criteria for the practices. In the following discussion, the numbers in parentheses are the NRCS practice specification numbers.

5.3.1 CONFINED ANIMAL FACILITIES

Conditions

The major problem associated with confined animal facilities is the collection, management (handling), and disposal of waste products from the animals, plus the proximity of these facilities to water bodies. Waste products may include urine, feces, litter or bedding, and water which has come into contact with any of these materials. The handling characteristics and volume of the material is widely variable and different systems are required depending on the type, age, and number of animals in the operation.

Confined animal facilities are usually sparsely vegetated because large numbers of animals or large animals on a small area remove or trample plant material in that area. Nutrients from manure deposited on the ground surface in these areas will not only leach into the ground water but will also be transported offsite by wind and water along with manure and soil particles. The problem is even greater when the confinement area is part of the creek system. Pastures and small facilities should consider minimum setback requirements from waterways for buildings and corrals. If there is enough vegetation in the creek or pasture, the transport of manure and soil materials is greatly reduced because the water flowing off the area is slower and a portion of the material settles out before reaching the channel. Care still needs to be taken to insure that excess waste from corrals and pastures is removed or controlled and not lost to deep percolation or surface waters.

Treatments

An example of a complete conservation system that could be used to reduce nutrients, sediment, and fresh water leaving a confined animal facility could be made up of the following system of conservation practices:

1. Waste Management System (312) - To properly store, handle, and dispose of wastes.
2. Waste Utilization (633) - To properly apply animal wastes to adjacent lands at proper rates.

3. Roof Runoff Management (558) - To control excess water runoff on roofs or other impervious areas from coming into contact with corral waste by using storm gutters and drains.
4. Filter Strips (393) - To reduce runoff and associated sediment and nutrients from leaving the site.
5. Critical Area Planting (342) - On eroding cut banks associated with roads and other disturbed areas.

Rainfall on roofs and other impervious areas needs to be kept from contact with waste. This reduces the volume to be disposed of in the waste system. It also reduces the flows which can transport the manure offsite.

Erosion associated with these facilities can be reduced by insuring that a certain amount of plant material remains on the soil surface in non-irrigated pastures, stream vegetation is allowed to remain, animals are removed to properly sited corrals when the specified cover amount is still in place, and animals are kept out of and away from the creeks.

Corrals, composting, and storage facilities for manure should be located in areas away from creeks and waterways. Pastures used for disposal should be managed for maximum stand vigor and water use efficiency, in order to reduce nutrient and water losses to the surface and ground water basin by as much as 80 percent. It is not possible to obtain greater reductions due to unavoidable volatilization, wind, and higher rainfall events. The costs associated with this control will vary as shown on Table 13. The cost will vary depending on what management practices and facilities are present, what additional facilities need to be installed, and the annual operating costs including labor, water, and replacement costs.

The road density for confined animal facilities is assumed to be the same as for the open space areas in the study area (5.7 miles per square mile). Road-associated erosion can be addressed by the typical practices shown in Table 13.

5.3.2 SINGLE FAMILY RESIDENTIAL AREAS

Conditions

Nutrient use on lawns and landscaping is estimated to be two to three times what is necessary for optimal plant growth. This is often due to lack of information. Water use in the residential areas is also excessive for the same reason. The excess water and nutrients are either delivered directly into the stormwater system and into the creek or into the local ground water bodies. Reductions in nutrient and water use through better management and education are cost effective for the landowner.

Residential streets are storage and deposition areas for air- and precipitation-carried dust; nutrients; sediment; aerosols; tire and brake dust, hydrocarbons, and coolant from vehicles; yard wastes; pet and bird droppings; and other pollutants. These materials need to be removed from streets before rainfall carries them into the storm sewer system. More contaminants may be carried in stormwater runoff during the first hour of a storm than might be found in a city's untreated sewage during the same time. Recommended stormwater practices use both structural and vegetative methods to detain and improve stormwater quality before it is released into surface water bodies.

Table 13: Malibu Creek Watershed Recommended Practices By Land Use and Subwatershed

Landuse	Recommended Practices	Estimated Installation Costs $ Dollars Per Unit	Practice Effect. Percent Soluble N Reduction	Practice Effect. Percent Soluble P Reduction
HIDDEN VALLEY				
Rural Residential				
Confined Animals	Waste Mgt. System (312)	$750– $25,000/Syst.	80	80
	Waste Utilization (633)	$10–$35/ ac		
	Waste Transfer (193)	$400–$12,500/Sys.		
	Livestock Exclusion (472)	$1–$8/ Lf		
	Pasture and Hayland Mgt. (510)	$11–$20/ac		
	Fencing (382)	$400–$1500/ac		
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Urban				
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Natural Areas	In good condition – No Treatment Recommended	In good Condt No treat. Recomm	---------	
Golf Courses	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
WESTLAKE				
Rural Residential & Urban				
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Golf Courses				
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Natural Areas	In good condition – No Treatment Recommended	In good Condt No treat. Recomm	---------	
LINDERO CANYON				
Rural Residential & Urban				
Critically Eroding Areas	Access Road (560)			
	– Road Paving	$2–$4/Sq Yd		
	– Rolling Dips	$15–$135 Ea.		
	– Cross Sloping	$1–$4/ LF		
	– Increased Road Width	$4–$5/Ft. ea. side		
	– Paved Driveways	$2–$4/Sq Yd		
	– Paved Parking	$1–$2/Sq Yd		
	– Drainage Structure Maintenence	$2–$4/LF		
	Critical Area Planting (342)	$400/ac.		
	Sediment Basin (350)	$700–1,000,000 ea		
	Runoff Management (570)	Variable		
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Golf Courses				
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Natural Areas	Access Roads (560)			
	– Rolling Dips	$15–$20 Ea.		
	– Cross–sloping	$1–$4/ LF		
	– Water Bars	$5–$35 Ea.		
	– Paved Roads	$95–$100/Sq Yd		
	– Drainage Structure Maintenence	$2–$4/LF		
	Critical Area Planting (342)	$400/ac.		
	Sediment Basins (350)	$700–1,000,000 ea		
PALO COMADO				
Rural Residential				
Confined Animals	Waste Mgt. System (312)	$750– $25,000/Syst.	80	80
	Waste Utilization (633)	$10–$35/ ac		
	Waste Transfer (193)	$400–$12,500/Sys.		
	Livestock Exclusion (472)	$1–$8/ Lf		
	Pasture and Hayland Mgt. (510)	$1–$5/ac		
	Fencing (382)	$340–$1400/ac		
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Urban				
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Natural Areas	In good condition – No treatment Recommended	In good Condt No treat. Recomm	---------	---------

Table 13 Continued: Malibu Creek Watershed Recommended Practices By Land Use and Subwatershed

Landuse	Recommended Practices	Estimated Installation Costs $ Dollars Per Unit	Practice Effect. Percent Soluble N Reduction	Practice Effect. Percent Soluble P Reduction
LAS VIRGENES CANYON				
Rural Residential				
Pasture & Confined Animal Facilities	Waste Mgt. System (312)	$750– $25,000/Syst.	80	80
	Waste Utilization (633)	$10–$35/ac		
	Waste Transfer (193)	$400–$12,500/Sys.		
	Livestock Exclusion (472)	$1–$8/Lf		
	Pasture and Hayland Mgt. (510)	$1–$5/ac		
	Fencing (382)	$340–$1400/ac		
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Urban				
Lawns & Shrubs	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	Nutrient Mgt. (590)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
		$34/ac		
Natural Areas	In good condition – No Treatment Recommended	In good Condt No treat. Recomm	---------	
Orchards	Filter Strip (393)	$145–$230/ac	67 (Ground Cover)	77 (Ground Cover)
	IWM (449)	$50–$750/ac		
	Nutrient Mgt. (590)	$34/ac		
TRIUNFO CANYON				
Rural Residential & Urban	Access Road (560)			
Lawns, Shrubs & Critically Eroding Areas	– Road Paving	$95–$100/Sq Yd		
	– Rolling Dips	$15–$20 Ea.		
	– Cross Sloping	$1–$4/LF		
	– Increased Road Width	$4–$5/Ft. ea. side		
	– Paved Driveways	$2–$4/Sq Yd		
	– Paved Parking	$1–$2/Sq Yd		
	– Drainage Structure Maintenence	$2–$4/LF		
	Critical Area Planting (342)	$400/ac.		
	Sediment Basin (350)	$700–1,000,000 ea		
	Runoff Management (570)	Variable		
	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Rural Residential				
Pasture and Confined Animal Facilities	Waste Mgt. System (312)	$750– $25,000/Syst.	80	80
	Waste Utilization (633)	$10–$35/ac		
	Waste Transfer (193)	$400–$12,500/Sys.		
	Livestock Exclusion (472)	$1–$8/Lf		
	Pasture and Hayland Mgt. (510)	$1–$5/ac		
	Fencing (382)	$340–$1400/ac		
	Filter Strip (393)	$145–$230/ac		
Orchards	Filter Strip (393)	$145–$230/ac	67 (Ground Cover)	77 (Ground Cover)
	IWM (449)	$50–$750/ac		
	Nutrient Mgt. (590)	$34/ac		
Natural Areas	In good condition – No treatment Recommended	In good Condt No treat. Recomm	---------	---------
COLD CREEK CANYON				
Rural Residential				
Confined Animal Facilities	Waste Mgt. System (312)	$750– $25,000/Syst.	80	80
	Waste Utilization (633)	$10–$35/ac		
	Waste Transfer (193)	$400–$12,500/Sys.		
	Livestock Exclusion (472)	$1–$8/Lf		
	Pasture and Hayland Mgt. (510)	$1–$5/ac		
	Fencing (382)	$340–$1400/ac		
Rural Residential & Urban	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
Lawns and Shrubs	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Natural Areas	In good condition – No treatment Recommended	In good Condt No treat. Recomm	---------	---------
MALIBU CANYON				
Rural Residential & Urban	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
Lawns & Shrubs	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Rural Residential				
Pasture & Confined Animal Facilities	Waste Mgt. System (312)	$750– $25,000/Syst.	80	80
	Waste Utilization (633)	$10–$35/ac		
	Waste Transfer (193)	$400–$12,500/Sys.		
	Livestock Exclusion (472)	$1–$8/Lf		
	Pasture and Hayland Mgt. (510)	$1–$5/ac		
	Fencing (382)	$340–$1400/ac		
	Filter Strip (393)	$145–$230/ac		
Golf Course				
Lawn & Shrub	Filter Strip (393)	$145–$230/ac	25 (Lawns)	69 (Lawns)
	IWM (449)	$50–$750/ac	67 (Shrubs/Trees)	77 (Shrubs/Trees)
	Nutrient Mgt. (590)	$34/ac		
Natural Areas	In good condition – No treatment Recommended	In good Condt No treat. Recomm	---------	---------

Erosion in this land use tends to be controlled by the individual landowners, unless a deficiency exists in the original subdivision design. Deficiencies can range from no curbs and gutters, concentrated flows directed into unprotected areas, and extremely steep cut or fill slopes of mineral soil. A high percentage of landowners install small (< 0.25 acre) paddocks for horses or recreational livestock where zoning permits. Roads, drainageways, unprotected slopes, and horse paddocks are estimated to be the source of 70 percent of the sediment generated from single family residential areas. It is estimated that 20 percent of the land in this use needs treatment.

Treatments

An example of a conservation management system that can be used to reduce erosion, sediment, and runoff from roads plus nutrients, sediment, and excess water leaving horse paddocks, lawns, and other landscaped areas could be made up of the following systems of conservation practices:

1. Access Road (560) - To provide a fixed route for travel and access, while controlling runoff to prevent erosion and maintain or improve water quality and may include:
    a. Road paving - including paved shoulders.
    b. Rolling Dips (Valley Gutters) - to waterway or inlet.
    c. Cross sloping - crown for drainage to waterway.
    d. Added R/W Width - to allow for curb and gutter or lined ditch.
    e. Paved driveways - for water and erosion control.
    f. Paved parking/Use Areas with berm or gutter water control.
2. Critical Area Planting (342) - Grass and shrub plantings on steep road cut and fill slopes to reduce erosion and runoff.
3. Filter Strip (393) - A grassed and vegetated strip 20 to 30 feet wide, depending on site needs, downslope from site drains or from house and between road and natural waterway to trap sediment and nutrients carried in runoff water.
4. Waste Management System (312) - Horse paddock animal waste management system to store, use, or dispose of animal wastes in an appropriate and environmentally safe manner.
5. Waste Transfer (193) - Animal Waste Removal - To remove stored or collected animal waste from horse paddocks for use or disposal in an environmentally safe manner.
6. Residential Street Waste Management - To remove pollutants from streets before rainfall deposits them into the storm drain systems which usually empty into stream channels reaching the lagoon. Management includes:
    a. Street sweeping
    b. Refuse collection
    c. Hazardous waste collection
7. Irrigation Water Management (449) - Proper water use on landscaping, lawns, and erosion-control plants to reduce excess water runoff and deep percolation losses.
8. Nutrient Management (590) - To minimize the amounts of excess nutrients from reaching surface and ground water by using minimum fertilizer rates at proper time and in proper manner.
9. Sediment Basin (350) - Runoff retention basin, small basin or dip in the landscape to hold runoff for slow release and to retain sediment originating from new construction or previously developed urban home sites.

The expected reduction of erosion from critically eroding areas is 60 percent. The installation of the treatments could reduce sediment from single family residential areas by 40 percent. The background rate from well-designed single family residential areas on hillsides is less than the rate from vacant land if the critical areas and paddocks are subtracted. Paddock treatment would include a corral placed a reasonable distance from any waterway, manure storage area out of the waterway, and a diversion ditch to keep runoff out of the corral area.

5.3.3 SPACED RURAL RESIDENTIAL

Conditions

Spaced Rural Residential housing is found throughout the study area. Some agricultural units also include a large house, landscaped grounds, a horse paddock, and home orchards which are not associated with the agricultural operation. Horse paddocks averaging one-half acre or more are common in the spaced rural residential area. These horse paddocks tend to be on the low portion (next to waterways) of the property to facilitate the removal of sediment and waste away from other improvements.

The road density is 11.4 miles per square mile. The road net is assumed to have equal amounts of steep sections and level sections. Most road nets in this area also have driveways to residences. Many of the critically eroding areas are associated with poor subdivision layout and maintenance.

Water and nutrient use on lawns and landscaping is the same as in single family residential areas. The total volume of nutrients and water is higher because there is a larger area to landscape. The percentage of landowners who have gardening services is higher than for single family residential areas.

Treatments

The system of practices described for single family residential areas could also be used in the spaced rural residential areas to reduce erosion, sedimentation, nutrients, and excess fresh water reaching the lagoon from the activities described above.

The horse paddock improvements include distancing the paddock from streams or watercourses, controlling water from upslope areas and roofs, leaving cover on the soil surface, animal waste management and storage, and sediment control.

5.3.4 NATURAL AREAS, LANDFILLS, RURAL PARKS

Conditions

Erosion from roads and trails in natural areas of the watershed have been identified as the source of 70 percent of the sediment from land in this use. Similar rates are also associated with landfills and with the roads and trails in the parks.

The road density of vacant land was estimated by the team geologist to be 5.7 miles per square mile. This is approximately 50 feet of road per acre. This does not include driveways, or access to isolated buildings or other facilities.

Treatments

An example of a conservation management system that can be used to reduce erosion and sediment caused by runoff from roads and other disturbed areas such as landfills could be made up of the following system of conservation practices:

1. Access Road (560) - To provide a fixed route for travel.
   a. Rolling Dips (Valley Gutters) - to waterway or inlet.
   b. Cross-Sloping - drainage to waterway.
   c. Water Bars - direct flow to waterway or inlet.
   d. Paved Roads - paved or surfaced roads for water and erosion control plus parking and use areas and driveways associated with the roads.
   e. Maintenance of culverts, drains, ditches and inlet structures.
2. Critical Area Planting (342) - Plantings of grasses, trees, and shrubs on cut and fill slopes along roads and on other disturbed areas to reduce erosion, sediment, and runoff.
3. Sediment Basins (350) - To catch and retain sediment and debris originating on site.
4. Controlled Burn Program - To reduce vegetative fuel loads which pose a threat of wildfire causing burned areas to become susceptible to erosion.

It is estimated that ten percent of the rural road system needs paving, and all the roads need additional water control and culverting provisions plus maintenance of the improvements. An additional 15 percent reduction could be obtained by control of wildfire in the natural areas. This would be the development of a controlled burn program to reduce the size and impact of large wildfires. The controlled, cooler fire results in less soil loss due to protection of streamside vegetation, and reduced mass wasting from hydrophobicity in soil layers. The estimated reduction in sediment from the combination of road improvements and a controlled burn program is 50 percent.

5.4 TREATMENTS FOR THE EIGHT SUBWATERSHEDS

Conservation practices have been suggested for each subwatershed to treat the problems specific to that subwatershed. The practices were selected for their ability to keep excess nutrients from reaching water bodies. The potential percent reduction of pollutants and an estimated participation rate have also been included. Each of the subwatersheds should have a plan that fits into the overall plan and goals of the watershed. Education should be included to enable people to properly install, maintain, and manage the practices.

The following discussion of the various subwatersheds includes estimates of nutrient reductions that may be achieved. These estimates were made using the AGNPS model. Many of the inputs to the model are estimates. For a detailed discussion of input data, see the "Erosion and Sediment Yield Report" and the "Nitrogen and Phosphorus Analysis" technical documentation reports.

Reductions in soluble nitrogen (N) and soluble phosphorus (P) that could be achieved by treating land with various cover types were estimated to be as follows:

Cover Type	Percent Reduction in N	Percent Reduction in P
Pasture	80	80
Lawns, golf courses	25	67
Shrubs, trees, ground cover, orchards	69	77

Based on these estimates for individual cover types, the model calculated the reductions for each subwatershed if 40 percent of the land with each cover type were treated. The 40 percent participation rate is believed to be reasonable for a voluntary program in this area. The calculations were based on estimated runoff from 2.2 inches of rainfall in a 6-hour period.

5.4.1 HIDDEN VALLEY

In the past algae in Lake Sherwood has been addressed by using copper sulfate to control growth. More recently the owners have relied on physically raking the weeds out of the water at the shoreline. At some point in the future a harvesting machine may need to be used.

Sediment issues have not been addressed on a regular basis because sediment has not been perceived to be major problem. When the lake was deepened, in the mid-1980s, the historical sediment deposition was removed. There has been some discussion of the use of siltation basins in the future. However, no formal sediment control plan has been established.

Treatment practices were selected to keep excess nutrients from reaching water bodies by recommending proper fertilizer usage and proper handling of animal waste. High levels of nutrients are found in the runoff from animal units and animal waste is often seen in surface waterways.

Typical conservation practices for the land uses in this subwatershed are:

Pasture - waste management system (312), waste utilization (633), horse paddock filter strips (393), livestock exclusion (472), pasture and hayland management (510), fencing (382);

Lawns and golf courses - nutrient management (590), irrigation water management (449);

Shrubs, trees, and groundcover - nutrient management (590), irrigation water management (449).

AGNPS calculated no reduction of sediment-sorbed N and P, a 26 percent reduction in soluble N, and a 27 percent reduction in soluble P with implementation of these practices at a 40 percent participation rate.

5.4.2 WESTLAKE

Conservation practices were selected to reduce nutrients and storm runoff. Typical practices for the land uses in this subwatershed are:

Residential and urban - irrigation water management (449) and nutrient management (590);

Urban stormwater - detention basins (350), filter strips (393), and constructed wetlands (657.

AGNPS calculated no reduction in sediment-sorbed N and P, a 21 percent reduction in soluble N, and a 31 percent reduction in soluble P for implementation of these practices at a 40 percent participation rate. The effectiveness of stormwater practices depends on design and site selection criteria. Potential removal rates of nutrients and bacteria vary from 20 to 80 percent based on these considerations.

5.4.3 LINDERO CANYON

Conservation practices were selected to reduce nutrients and storm runoff. Typical practices for the land uses in this subwatershed are:

Urban - irrigation water management (449), constructed wetlands, filters, detention basins, access roads (560), critical area planting (342), filter strips (393), nutrient management (590);

Natural areas - access roads (560), critical area planting (342), sediment basins (350).

AGNPS calculations show an 11 percent reduction in sediment-sorbed N and P, a 16 percent reduction in soluble N, and a 26 percent reduction in soluble P for implementation of recommended practices at a 40 percent participation rate. The effectiveness of stormwater practices depends on design and site selection criteria. Potential removal rates of nutrients and bacteria vary from 20 to 80 percent based on these considerations.

5.4.4 PALO COMADO

Conservation practices were selected to reduce nutrients and storm runoff. Typical practices for the land uses in this subwatershed are:

Confined animal units - waste management system (312), waste utilization (633), waste transfer (193), livestock exclusion (472), pasture and hayland management (510), fencing (382);

Residential - filter strips (393), irrigation water management (449), nutrient management (590);

Urban - filter strips (393), constructed wetlands (657), detention basins (350).

AGNPS calculated no reduction in sediment-sorbed N and P, a 15 percent reduction in soluble N, and a 26 percent reduction in soluble P for implementation of these practices at a 40 percent participation rate.

5.4.5 LAS VIRGENES

Conservation practices were selected to reduce nutrients, storm runoff, and animal waste. Typical practices for the land uses in this subwatershed are:

Confined animal units - waste management system (312), waste utilization (633), waste transfer (193), livestock exclusion (472), pasture and hayland management (510), fencing (362);

Residential and orchards - filter strips (393), irrigation water management (449), nutrient management (590);

Urban - filter strips (393), detention basins (350), constructed wetlands (657).

AGNPS calculated no reduction in sediment-sorbed N and P, an 11 percent reduction in soluble N, and a 24 percent reduction in soluble P for implementation of these practices at a 40 percent participation rate.

5.5.6 TRIUNFO CANYON

Conservation practices were selected to reduce nutrients, sediment, and animal waste. Typical practices for the land uses in this subwatershed are:

Residential and urban - access road (560), critical area planting (342), sediment basins (350), filter strips (393), irrigation water management (449), nutrient management (590);

Confined animal units - waste management system (312), waste utilization (633), livestock exclusion (472), fencing (362), pasture and hayland management (510), waste transfer (193);

Orchards - filter strip (393), irrigation water management (449), nutrient management (590).

AGNPS calculated a 15 percent reduction in sediment-sorbed N and a 16 percent reduction in sorbed P, with a 13 percent reduction in soluble N, and a 23 percent reduction in soluble P for implementation of these practices at a 40 percent participation rate.

5.4.7 COLD CREEK

Conservation practices were selected to reduce nutrients and animal waste. Typical practices for the land uses in this subwatershed are:

Confined animal units - waste management system (312), waste utilization (633), waste transfer (193), livestock exclusion (472), pasture and hayland management (510), fencing (362);

Residential and urban - filter strips (393), irrigation water management (449), nutrient management (590);

AGNPS calculated no reduction in sediment-sorbed N and P, a 10 percent reduction in soluble N, and a 24 reduction in soluble P for implementation of the conservation practices at a 40 percent participation rate.

5.4.8 MALIBU CREEK

Conservation practices were selected to reduce nutrients, sediment, and animal waste. Typical practices for the land uses in this subwatershed are:

Residential areas - access road (560), runoff management (570), critical area planting (342), sediment basin (350), filter strip (393), irrigation water management (449), nutrient management (590);

Confined animal units - waste management system (312), waste utilization (633), waste transfer (193), livestock exclusion (472), pasture and hayland management (510), fencing (382), filter strip (393);

Urban - filter strips (393), detention basins (350), constructed wetlands (657).

AGNPS calculated no reduction in sediment-sorbed N and P, a 6 percent reduction in soluble N, and a 7 percent reduction in soluble P for implementation of the conservation practices at a 40 percent participation rate.

Table 13 shows the estimated costs and percent reduction expected by the implementation of the conservation practices recommended for each of the eight subwatersheds, while Table 14 shows the effect of the practices as calculated by the AGNPS model.

5.5 WATER QUANTITY TREATMENT MEASURES

The treatment measures discussed above deal mainly with water quality and erosion and sediment concerns. During the course of this study, solutions to the water quantity concerns were discussed, but no consensus was reached. Some possibilities are described here. As the communities in the watershed continue to work toward reaching a consensus as to the appropriate environmental balance and uses of the lagoon, components of these measures could be implemented.

1. The Tapia Wastewater Treatment Plant could develop additional upper watershed storage basins to provide additional treated water for reuse. This idea appears to be economically feasible, but the environmental and local community acceptability has not been established. This measure would reduce base flows somewhat, but flows from subsurface water sources would continue.

2. Establishing additional wetlands upstream of the lagoon appears to be environmentally and locally acceptable, but the economic feasibility is not known. This measure could significantly reduce summer base flows into the lagoon and act as a filter. Acquiring the necessary property would be extremely difficult.

3. Significantly reducing upland irrigation would significantly reduce summer flows to the lagoon and appears environmentally and economically feasible. Local acceptance is unknown.

4. Another option for water management of the lagoon would be to pump three to six cfs of creek flow into a combination non-potable irrigation supply system and fire hydrant system for the City of Malibu. Tanks would be required to store the water until it is needed. There may be several advantages to this option. The water will have already provided the benefits to the freshwater fishery before it is extracted from the creek system, lagoon water levels may be returned to historic levels, and the use of potable high quality water for irrigated landscaping would be reduced. The pump location and design should be such that there is no impairment of fish passage in the creek. Other environmental impacts should be studied in detail. The City of Malibu would need to obtain water rights. Local groups may want to look into this option further.

5.6 SUMMARY OF OPPORTUNITIES

This section has summarized conservation practices according to land use type. The practices were then specifically organized and recommended based on the needs of each subwatershed. The identified practices are in addition to the 44 action items recommended by the facilitated group process and listed in Appendix A. The action items resulting from the facilitated group process primarily involve agencies or regulatory groups in their implementation. The conservation practices identified in this section are generally actions which are applied locally by land users through voluntary implementation.

During the course of this study, it was determined by NRCS that the main resource problems in the Malibu Creek Watershed that can be reduced by NRCS conservation practices were an excess of fresh water, sediment, bacteria, and nutrients. When implemented, singly and in combination, the recommended practices have proven effective in reducing these problems in other watersheds.

Table 14. Summary of N & P loadings to Sub–Watershed Lakes & Outlets
Results of AGNPS Runs for a 2.2–inch, 6–hour duration storm.

Sub–watershed Outlets	BASELINE				FERTILIZER AND ANIMAL WASTE			
	Sediment Attached		Water Soluble		Sediment Attached		Water Soluble	
	Nitrogen lbs	Phosphorus lbs	N ppm	P ppm	Nitrogen lbs	Phosphorus lbs	N ppm	P ppm
Hidden Valley 1	1,485,400	524,300	0.38	0.07	1,485,400	524,300	4.17	0.7
Westlake 1	319,200	172,800	0.23	0.07	319,200	172,800	2.3	0.87
Lindero 1	223,400	109,200	0.34	0.08	223,400	109,200	3.03	1.1
Palo Comado 2, 3	664,700	360,800	0.34	0.08	664,700	360,800	2.31	0.85
Triunfo Canyon 1	1,756,000	1,306,700	0.3	0.08	1,756,000	1,306,700	1.32	0.47
Las Virgenes Cyn. 2	1,000,200	811,900	0.34	0.07	1,000,200	811,900	1.03	0.34
Cold Creek Cyn. 2	311,200	159,300	0.37	0.08	311,200	159,300	1.05	0.34
Malibu Canyon 2	1,960,900	972,000	0.32	0.07	1,969,200	972,000	0.46	0.13

Sub–watershed Outlets	FERTILIZER & ANIMAL WASTES + POINT SOURCES				RECOMMENDED PRACTICES			
	Sediment Attached		Water Soluble		Sediment Attached		Water Soluble	
	Nitrogen lbs	Phosphorus lbs	N ppm	P ppm	Nitrogen lbs	Phosphorus lbs	N ppm	P ppm
Hidden Valley 1	1,485,400	524,300	4.17	0.7	1,485,400	524,300	3.07	0.51
Westlake 1	319,200	172,800	2.3	0.87	319,200	172,800	1.82	0.6
Lindero 1	223,400	109,200	3.03	1.1	197,700	97,900	2.56	0.81
Palo Comado 2, 3	664,700	360,800	2.31	0.85	664,700	360,800	1.97	0.63
Triunfo Canyon 1	1,756,000	1,306,700	1.32	0.47	1,490,400	1,101,600	1.15	0.36
Las Virgenes Cyn. 2	1,000,200	811,900	1.03	0.34	1,000,200	811,900	0.92	0.26
Cold Creek Cyn. 2	311,200	159,300	1.05	0.34	311,200	159,300	0.94	0.27
Malibu Canyon 2	2,004,500	989,400	0.51	0.14	2,004,500	989,400	0.48	0.13

1 – Total stream loadings to lake.
2 – Stream loadings to sub–watershed outlets.
3 – No Point Sources

The technical documentation reports "Nitrogen and Phosphorus Analysis" and "Erosion and Sediment Yield Report" can be used to identify suspected hotspots of excessive nutrients and sediment from surface runoff. Consistently throughout the watershed, concentrations of soluble N above one ppm were associated with developed land uses. The maps in these reports can be used to prioritize the NRCS practices discussed in this section. For example, comparison of figures 10 and 11 shows striking relationships between elevated N concentrations ($>$ 1 ppm) and certain land uses: pasture, rural residential, and golf courses. The documentation reports contain similar maps for all subwatersheds.

While the monitoring of chemical constituents in the surface waters of the watershed may be effective, it may also be costly and difficult to obtain consistent and accurate results. One alternative may be to initiate a biological monitoring program. The NRCS publication "Water Quality Indicators Guide: Surface Waters" provides methods for monitoring sediment, nutrients, animal wastes, and other parameters in surface waters. This method utilizes onsite observations and macroinvertebrate sampling to monitor the overall health of the water body rather than pinpointing concentrations of chemical parameters. This approach may confirm a suspected Non-point source pollution problem or may lead to the suspicion of the presence of a particular problem. If needed, more detailed chemical analysis could then be performed to confirm the suspicion. When available, dissolved oxygen meters and other equipment can be used to supplement the Guide.

This type of monitoring has been successfully accomplished throughout the United States by volunteer groups. Environmental interest groups, schools, and community organizations have joined forces to perform monitoring on a regular basis. Where properly trained by Save Our Streams instructors or other knowledgeable individuals, these groups have produced accurate results that have been used by federal and state agencies.

Successful watershed restoration efforts require the development of sound technical knowledge about the resources as well as an understanding of the activities and interests of the people in the watershed. Throughout the years, a significant volume of technical information about the Malibu Creek Watershed has been compiled. Unfortunately, this effort has not led to significant resource enhancement. Limited involvement of the land owners and land users in this watershed may be one reason. The public needs to be involved in directing and guiding the technical information gathering process so they will take an active role in the implementation process.

Although there are clearly additional scientific data needs in this watershed, such as a hydrodynamic model of the lagoon, we recommend a more concerted effort to involve local communities in identifying the future direction of data collecting. One way to help facilitate this action would be to identify a subwatershed and focus attention on involving the community in the monitoring and evaluation of treatments. It is the large scale application of conservation practices that will reduce the Non-point source pollution problems in this watershed.

NRCS recommends that citizens in each subwatershed form a task force that can prioritize that subwatershed's problems and solutions. While the facilitated group can begin implementing the 44 action items, the concerned local citizens in each subwatershed can take steps to target problems, implement conservation practices, and monitor the results. Successful implementation has been shown to occur locally through education and voluntary efforts.

Figure 10: Hidden Valley Subwatershed
Land use and Streams

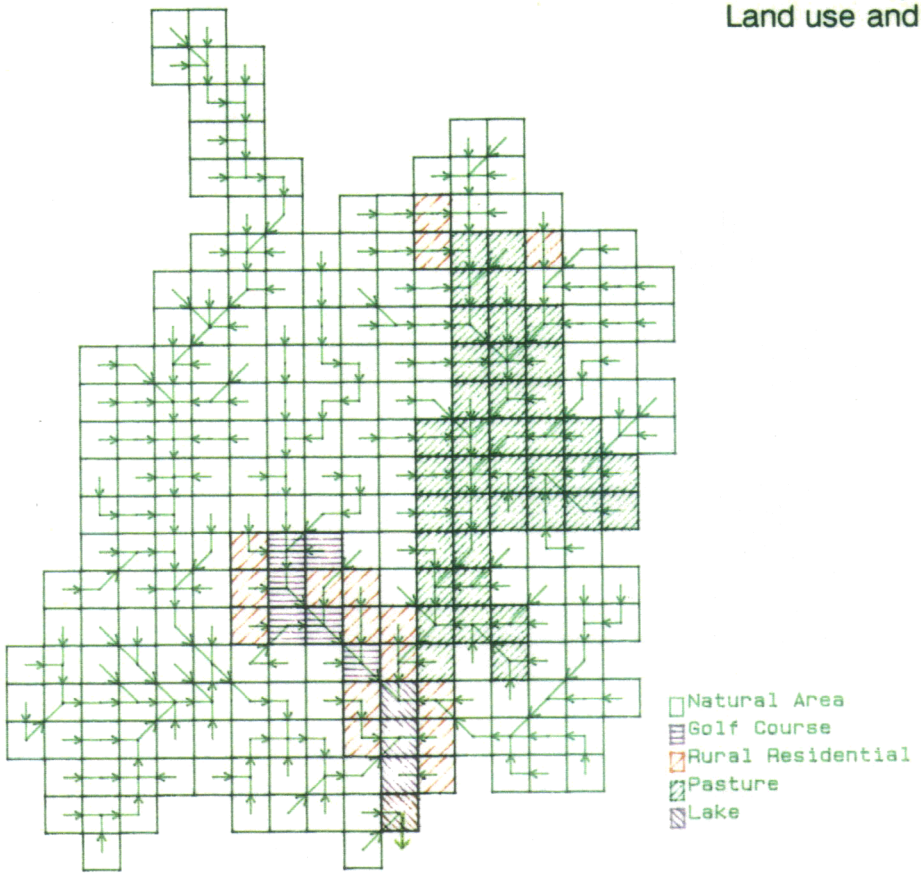
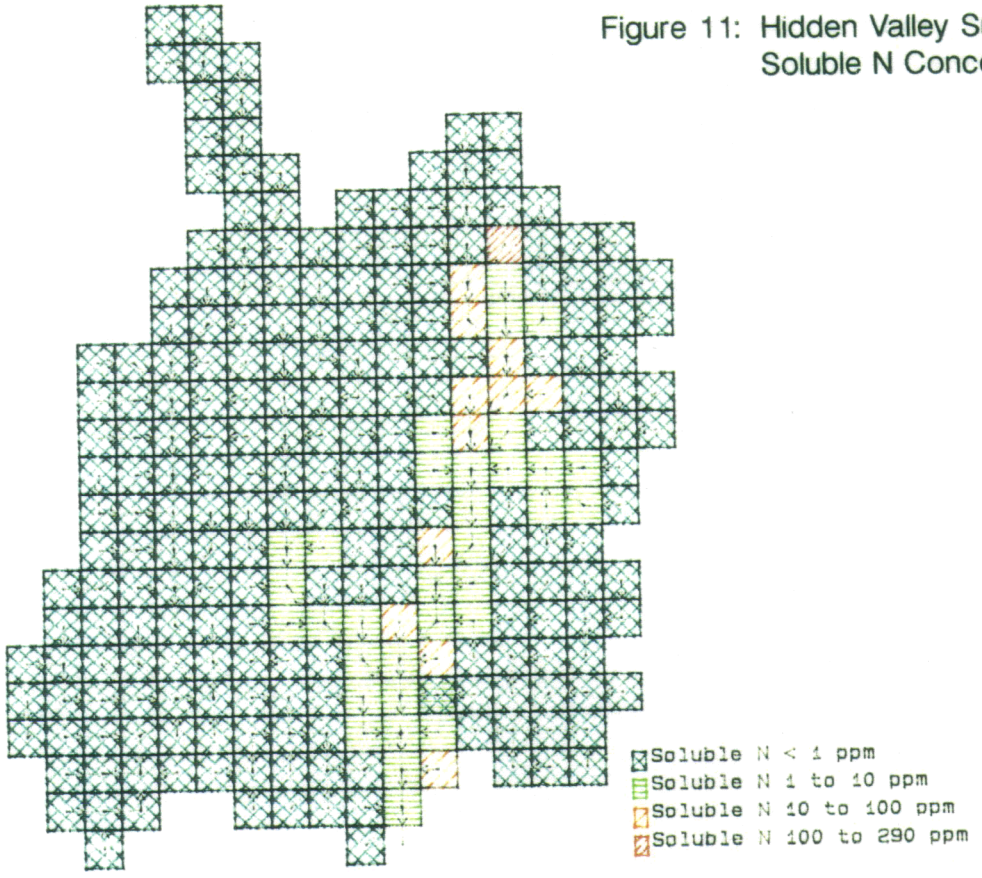


Figure 11: Hidden Valley Subwatershed
Soluble N Concentrations



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SECTION 6 - IMPLEMENTATION STRATEGIES

6.1 LOCAL IMPLEMENTATION AGENCIES/GROUPS/INDIVIDUALS

There are a number of individuals and organized groups and agencies that have provided invaluable assistance in developing a specific watershed plan. These groups have formed a Natural Resources Plan (NRP) Organization consisting of an Executive Committee, an Advisory Council, and Technical Sub-Committees under the auspices of the Topanga-Las Virgenes RCD. The NRP Organization has brought together all interested agencies, organizations, and individuals and has begun to manage the elements of the NRP. The NRP Organization has the ability to manage the resources on an integrated and ecological basis

The involved agencies with appropriate powers to implement the suggested works are the: Cities (4), Counties (2), State Department of Parks and Recreation and National Park Service on their lands, CALTRANS on its lands, homeowners associations on "their" lands, Las Virgenes MWD and Triunfo County SD, Topanga-Las Virgenes RCD, RWQCB, and Santa Monica Mountains Conservancy. The RWQCB, California Coastal Commission, and California State Coastal Conservancy, along with the U.S. EPA, California Department of Fish and Game, and the County Public Health Departments can use regulatory actions to enforce installation of a project or measures to reduce Non-point source pollution. These agencies, in some cases, can be sources of funding to carry out selected treatment.

Groups or agencies implementing conservation practices to reduce Non-point source pollution should use only a plan that has been developed through a public participation process. The plan should also be part of an overall plan that has been developed to meet specific watershed goals and which will be monitored to observe effects.

6.1.1 INTERRELATIONSHIP BETWEEN WATER QUALITY AND QUANTITY CONCERNS

The results of this study point to the complexities of the Malibu Creek Watershed. No longer is the watershed in a completely natural state as there have been many modifications for many years by the people living in the watershed. The lagoon itself is the focal point in the watershed because all streams lead there. Unfortunately, the lagoon system is not completely understood.

This study shows that certain actions to prevent upper watershed nutrients could have some impact on the lagoon. In addition, there are measures that could be taken to reduce the amount of freshwater that is transported through the lagoon to the ocean. With the current level of understanding of the system and the different points of view of interest groups there is no single combination of water quality and quantity treatment options that can be recommended.

The following are three items that need to be addressed:

1. A clear understanding of all sources and amounts of contaminants in the watershed needs to be established.

2. The effort to reach consensus on what resource conditions and uses in the watershed are acceptable needs to continue.

3. Implementation of components that are not controversial needs to begin as soon as possible.

6.1.2 STRATEGIES

The NRP Organization should use the plan elements and discussions of the facilitated advisory committee and the contents of this document to identify priority subwatersheds and the general Non-point source pollution goals that need to be met. The actions could then be along the following lines.

1. Identify the priority actions for installation of a plan.
2. Form an advisory subcommittee to set unit goals and plan needs; include landowners of the unit in all priority setting and solution finding sessions.
3. Identify the measures, actions, and practices to be used in the priority unit and set the unit priorities of action.
4. Target groups of landowners and others for education on needs, goals, and methods.
5. Begin intensive education program to inform watershed population and political entities on the resource values, problems, and proposed solutions. The program should include information that encompasses the area from the watershed boundaries to the surf zone in the bay. The information could be sent out with utility bills and appear as a weekly column in the newspapers.
6. Identify potential funding sources and make initial contacts; prepare plans and grant applications; obtain political support and implementation assistance for each project area.
7. Initiate monitoring program to track implementation of measures and practices and to determine baseline conditions for the expanded monitoring program.
8. Install demonstration projects in the subwatersheds, using priority practices/measures/actions.
9. Expand the education program throughout the watershed and to all residents and interested parties.
10. Publicly announce and reward successful community efforts.

The NRP Organization should coordinate the overall program and recommend actions to the implementing entities. All individual agency and entity inputs should be routed through the coordination group before implementing portions of the overall plan.

6.1.3 LOCAL IMPLEMENTATION PROGRAM

It has been suggested that the plan for the watershed be developed through the public participation process. The process should include all interested parties from the watershed, and public entities with regulatory or funding authorities from outside the watershed. In this way, a locally developed plan that is agreed to and generally accepted by the residents will be implemented. Local support is needed to implement a program to reduce Non-point source pollutants and the public process is needed to obtain that support.

Programs and plans instituted and regulated by outside agencies are not likely to be fully supported or adequately implemented. The goals, plans, and support must be from within the watershed, including the legal entities that may need to provide funding or implementation authorities.

6.1.4 FINANCING

A listing of some of the agencies and programs involved in funding Non-point source pollutant reduction projects is located in Appendix D. These federal and state funding sources are likely to be severely limited during the foreseeable future because of the overall budget reorganization and reductions. It is suggested that a listing of private groups and agencies that fund projects be developed.

The NRP Organization should select the appropriate funding source for each of the practices/measures, or select the agency that may have the funds available. The watershed group should also fill out grant applications for submission by the applicable implementation authority. The grant funds will require additional inputs and technical/financial support from the requesting agencies. This local input should be estimated and the appropriate support obtained by the watershed group before the grant request is made.

6.1.5 OPERATION, MAINTENANCE, AND REPLACEMENT

Operation, maintenance, and replacement are integral parts of any project. Agreements to perform and fund these actions should be made with all involved parties before anything is installed. A user fee or tax may be needed for funding.

6.2 MONITORING

Monitoring is recommended as an integral part of each plan. Agreements to perform and fund monitoring should be made with all involved parties before the project is installed. A user fee or tax may be needed for funding. Regulatory agencies may have staff to do monitoring, but may not have the sampling or testing funds. Or they may have the sampling and testing funds, but no staff. The watershed agencies and groups should be able to work out an effective way to carry out an adequate monitoring plan.

Monitoring programs are currently being carried out by a number of agencies in the watershed. Most of the monitoring is involved in determining water quality, sediment loads, impairments, or biological quality in the water bodies and waterways. Major programs for this monitoring are funded by several agencies, including: Las Virgenes MWD/Tapia, with five monitoring programs; TLVRCD; County Sanitation District of LA County/Calabasas Landfill; LA County Department of Public Works; LA County Department of Health Services; City of Los Angeles, Department of Public Works, Bureau of Sanitation, Environmental Monitoring Division; and RWQCB, with the Surface Water Monitoring Program, Mussel Watch Program, Toxic Substances Monitoring Program, and Compliance Monitoring Program.

Numerous other agencies or groups conduct monitoring programs in the watershed on a regular basis, including weed abatement inspections, water level inspections, and small scale water quality maintenance. Other monitoring may be done on an irregular basis, including septic tank operation, fire suppression, fishery populations, algae growth, sediment accumulation, and quantities of flow.

6.3 MODELING

Models allow users to simulate conditions that might take years to capture with intensive monitoring. Simultaneously, monitoring data can be used to improve models through calibration and verification. The watershed model AGNPS is already set-up for the Malibu Creek Watershed. It is recommended that AGNPS be maintained and used to gage watershed improvements. It may be desirable to implement other models and site specific models to capture the effects of treatments on specific water quality parameters, habitats, and species.

Estimates of excess nutrient, sediment and freshwater loading to Malibu Lagoon have been made. The AGNPS watershed model has been set up for the entire Malibu watershed through the linking of AGNPS runs for the eight subwatersheds. A scenario of recommended practices was run to assess the reduction of nutrient and sediment loadings to the lagoon. It is recommended that the following tasks be carried out to further calibrate and perfect the use of the model.

1. Field verify the AGNPS extrapolated input data. Maintain the model by updating input data. Calibrate the model by individual subwatersheds and for the entire watershed.

2. Determine additional loadings of sediment, freshwater, and nutrients not identified in this study. Obtain low-level temporal infra-red photos of the lagoon. The minimum number of photos should include mean, high, and low tides for the four seasons of the calendar year.

3. Develop a dynamic lagoon (estuary) model to calculate the continuous simulation of pertinent physical and chemical parameters.

6.4 SUCCESSFUL IMPLEMENTATION TIPS

Information that has been collected, collated, and consolidated from landowners, local agency personnel, and previous studies provides common components of a successful implementation plan.

1. Voluntary programs are important; involvement of landowners and local government agencies at the outset can lead to project-area ownership of the program and acceptable solutions for the project.

2. Information distribution and education efforts are essential throughout the life of the project.

3. Cost-share funding is important to the success of the project, especially for those practices that affect the public or which need to have their effectiveness demonstrated or when incentives are needed to increase the participation rate to a level that reaches an agreed goal.

4. A long lag time may be needed to see the results of resource improvement or to confirm the monitoring trend. This lag time is more than probable and needs to be clearly understood by the residents and participants.

5. A reasonable monitoring program is crucial to any resource improvement effort.

6. A follow-up evaluation several years after a "project" is completed should be done to determine if the practices are still performing well and, if not, why. It should also be determined what the perception of the project is and what the actual voluntary participation rate was.

6.5 IMPORTANCE OF LOCAL INVOLVEMENT

General land use alone is not the source of contaminants in the waterways, waterbodies, and lagoon. Management practices determine whether contaminants will originate from a given land use. The activities of the people using the land must also be addressed. Residents' familiarity with the region in which they live and awareness of the resource problems is important. A key ingredient in any Non-point source pollution control project is for all residents to be aware that their actions and activities can and do affect others.

Local persons representing the watershed's groups and stakeholders would benefit from the establishment of task forces of the NRP Organization for each subwatershed. This would be particularly effective for prioritizing implementation practices in each of the eight subwatersheds. The parent organization would provide the overall watershed prioritization and the political efforts with the various boards for implementation actions. The task forces and parent organization should have active roles in developing implementation strategies and having the responsibility for initiating the strategies. These task forces would also have the responsibility of preparing individual implementation plans for each subwatershed with each plan tailored to meet the appropriate resource and social needs of the residents.

It is important for each landowner to have the knowledge necessary to make decisions for proper conservation planning, especially for his/her property. It is also important to develop an integrated area-wide plan for successful implementation of works to reduce or control Non-point source pollution in a watershed. Non-point source pollution controls are a combination of political actions and structural, vegetative, and management measures or practices that must be applied continuously and in an integrated manner. This problem may be solved by breaking the watershed into several smaller pieces, such as the eight subwatersheds used for this report. This division allows a watershed oversight group a means to: (1) target groups of landowners, (2) identify the needs of the targeted group/land, and (3) find ways to meet those needs through the group's participation in the watershed project.

6.6 LOCAL OWNERSHIP AND PRIDE

Malibu Lagoon has a very high exposure to the public because of its location in a State Beach/Park. As a valuable natural resource, it is well known among watershed residents and to persons in the greater Los Angeles area.

The NRP Organization should take steps to show watershed residents and local entities (boards) the problems threatening the watershed's waterbodies and lagoon to garner active, effective community support for resource management activities throughout the watershed. Local ownership, pride, and responsibility for the watershed and its resources is an essential prerequisite for successful watershed management.

6.7 PUBLIC EDUCATION AND INFORMATION

A public education and information campaign needs to be a part of any watershed program. There are many ways to educate and inform the public.

Area-wide brochures on different aspects of water quality protection need to be developed. They should explain why erosion and sedimentation, nutrients, and other Non-point source pollutants are a problem and what people can do to prevent the pollution. The brochures can be handed out or mailed along with local utility bills. Goal-oriented information should be provided so everyone knows what is necessary for a successful program.

Developing a local video about the problems and solutions which can be shown at public meetings and meetings of homeowners will help get the word out to large groups of people at one time. Education programs should also be developed for use in the local schools.

Involving the local governments at the beginning will help to reduce red tape in the future. The newly-formed NRP Organization task forces can assist in the development of on-site conservation plans to formulate political, management, vegetative, or structural solutions to meet watershed goals.

A cooperative effort between USDA agencies and the Resource Conservation Districts resulted in the "Neighbor-to-Neighbor" program. The program is based on the fact that landowners most often seek information and advice from neighboring landowners. The program recruits cooperators who have implemented conservation practices and puts their project areas on display. Self-guided, drive-by tours of roadside demonstration sites are encouraged. A sign provides information about the conservation practices.

In one state, a guide book was developed and distributed in stores and restaurants throughout the state. By using the guide, people can check out the farms, communities, and individual properties demonstrating the practices they are interested in learning more about. The guide book provides general water quality and soil conservation information, and names, phone numbers, and directions to the demonstration sites.

6.8 ENCOURAGING THE USE OF RECOMMENDED SOLUTIONS

Landowners, specifically, want to reduce the risks associated with trying new or different practices by seeing the problems for themselves, being presented with alternative ways to solve the problems, and then deciding for themselves the best solutions to implement for their management methods.

The recommended solutions must be socially acceptable and desirable. For successful voluntary implementation each conservation practice must be perceived to have:

1. The **relative advantage** of being better than the practices currently being used.
2. **Compatible** and consistent with current practices, past experiences, needs, and social and cultural values.
3. A low level of **complexity**; simple and easy to adopt.
4. A high level of **trialability** and can be experimented with on a limited basis.
5. A high level of **observability**, with results that are easily observed and communicated to others.

6.9 ESTIMATING PARTICIPATION RATE

Research has resulted in the development of methods to gauge what level of involvement of people can be expected in a voluntary approach program. These methods rely on the evaluation of specific targeted landowner characteristics, characteristics of the agricultural land, characteristics of the practices the landowners are being asked to implement, and an evaluation of community-wide characteristics. A primary source of information for procedures to estimate landowner participation was developed by the National and Regional USDA Soil Conservation Service sociologists and is documented in a SCS Social Science Technical Note titled: Guide For Estimating Participation in Conservation Operations and Hydrologic Area Protection Projects, Feb. 3, 1989. Table 15 summarizes the major characteristics that previous research studies have shown to be important in whether or not landowners will be receptive to implementing pollution control measures.

Table 15: Important Conservation Adoption Characteristics [1]

I. Characteristics associated with landowner adoption of practices:
- high income.
- high use of mass media.
- high education.
- high number of contacts with private organizations.
- high number of contacts with government agencies.
- willingness to take risks.
- high awareness of resource problems.
- desire to pass ranch or property to children.

ii. Characteristics of conservation practices/management systems that are associated with adoption of practices:
- inexpensive.
- simple and easy to use.
- results are easy to see.
- can implement on a small scale.
- consistent with existing ideas, beliefs & management styles.
- flexible enough to fit into existing system.
- installed/managed by readily available equipment.

iii. Community characteristics that are likely factors of importance associated with conservation adoption:
- existence of conservation clubs/organizations.
- healthy local economy.
- high support of district activities & high use of services.
- high level of cooperation between private/public organizations.
- consistently high use of cost-sharing funds.
- high support of educational activities.
- high requests for technical assistance.
- high number of volunteers.
- existence of district-paid employees.

[1] The primary source of this information was compiled by the National and Regional USDA Soil Conservation Service sociologists, and is documented in a SCS social science technical note titled: Guide For Estimating Participation In Conservation Operations and Hydrologic area Protection Projects, Feb. 3, 1989.

It is unrealistic to expect that 100 percent of the landowners can or would be willing to install all of the necessary practices or change their management style to obtain the maximum Non-point source pollution reduction to the waterways and lagoon. A reduction of pollutants from the subwatersheds and land uses will be dependent on how acceptable the recommended solutions are to the people who live on or use the land.

The participation estimation procedure is based on an evaluation of the adoption characteristics of the targeted landowners in specific subwatersheds. To determine the viability of successfully targeting particular land uses or groups of landowners, the probability of the landowners to voluntarily participate, perhaps with technical and/or financial assistance, can be estimated. The variation of the range generally found in the estimate reflects differences in landowner acceptability of the treatment or treatments for different land uses and locations.

Also important is identifying the reasons for non-adoption. Dr. Pete Nowak in Why Farmers Adopt Technologies points out two categories of reasons for non-adoption: 1) the landowner is unable to adopt the practices or 2) the landowner is unwilling to adopt the practices. Table 16 summarizes the major reasons for non-adoption under these two categories.

Ideally, the promoter of the technology should first identify those landowners that cannot adopt the practices and attempt to remove the barriers, then work with those landowners that have been identified as unwilling. With a good understanding of the reasons for non-adoption, delivery of more accurate and necessary information is possible.

Table 16: Reasons For Non-Adoption [1]

I. Unable to Adopt Because:
- Information is lacking.
- Costs of obtaining information is too high.
- Complexity of system is too great.
- Too expensive a management system.
- Labor requirements are considered excessive.
- Planning horizon is too short.
- Limited availability and accessibility of supporting resources.
- Inadequate managerial skills.
- Little or no control over the adoption decision.

II. Unwilling to Adopt Because:
- Information conflicts or is inconsistent.
- Poor applicability and relevance of information.
- Conflicts between current goals and the new technology.
- Lack of knowledge on the part of landowner or sponsor of contaminant reduction practices or technology.
- Practice is inappropriate for the physical setting.
- Practice increases risk of negative outcomes.
- Belief in traditional practices.
- Limited capital

[1] Summarized from a paper presented at "Crop Residue Management For Conservation" conference Aug. 9, 1991 in Lexington, KY; Author is Dr. Pete Nowak, Dept. of Rural Sociology, Environmental Resources Center, University of Wisconsin-Madison.

Table 17 is a checklist of issues that the implementation team should consider before implementation.

Table 17: Checklist of Issues to Consider before Implementation

Checklist of Ideas	Status With this Project Yes	No
* Have a clearly stated goal, supported by realistic assessment of the problem, and the feasibility of solving it.	❑	❑
* Stress voluntary participation through education, technical assistance, and incentives, and emphasize project benefits.	❑	❑
* Stress target audience involvement at project initiation.	❑	❑
* Target areas where realistic water quality benefits can be maintained and/or obtained. It should be recognized that because of forces of nature or the natural environment, some areas may not respond to water quality treatments.	❑	❑
* Concentrate on one-to-one education and demonstration programs.	❑	❑
* Have full funding for the project committed up front.	❑	❑
* Include necessary cost-share funds.	❑	❑
* Be long term (10 years) in order to understand causes of Non-point source pollution and the effects best management practices (BMPs) have on water quality.	❑	❑
* Have a clear understanding of BMPs already in place prior to the study.	❑	❑
* Have adequate pre-implementation assessment and monitoring.	❑	❑
* Have a written, agreed upon, plan and time lines.	❑	❑
* Have sufficient funding to accomplish scientific assessment and evaluation.	❑	❑
* Have a separate, independent group of recognized experts/ professionals overseeing design and implementation of monitoring and analyses procedures, and evaluation of data.	❑	❑
* Measure participating and non-participating landowner and other interested groups attitudes and perceptions	❑	❑

6.10 GOALS/POLICIES

At some point it will be essential to set a goal or standard for the landowners to meet. The goal may be a voluntary or regulatory policy. The goal might be to achieve a set participation rate or to establish the number of practices implemented during a certain period of time. These goals should be tailored to meet the overall Non-point source pollutant reduction goal that provides an acceptable level of water quality in the watershed.

As goals are set, political or management actions, management measures, or conservation practices should be tracked as they are applied. Tracking will provide the information needed to determine whether the practices have been implemented, operated, and maintained adequately. This information will supplement and assist in fully interpreting available water quality data. The information could also be used to verify the monitoring program.

The NRP Organization may want to set goals or policies on a subwatershed or subwatersheds basis. Ideally policies should be based on the following principles:

1. Non-point source pollutant control policies need to be determined through a planning process that involves landowners, residents, the beneficiaries of water quality improvements, and the responsible local, state, and federal agencies. Landowners and residents should be given some incentive to implement the control policies.

2. Regulations or policies should be addressed at the subwatershed or subwatersheds level.

3. There must be a long-term local, state, and federal commitment to Non-point source pollution control and watershed management. Flexibility for solutions, monitoring progress, and a time schedule needs to be allowed for in local watershed management in order to successfully implement control strategies.

4. Long-term monitoring and enforcement to achieve explicit water quality improvements consistent with local, state, and federal objectives should be required.

The problem needs to be solved locally. As in any implementation strategy, one of the most important and cost-effective steps is to work with the individual landowner or resident and provide information about the pollution problem and low-cost solutions. Positive steps in erosion and sediment, nutrient, and other Non-point source pollutant reduction can be taken by promoting cost-effective implementation strategies consistent with long-term local, state, and federal watershed objectives.

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APPENDICES

APPENDIX A

DRAFT - MALIBU CREEK WATERSHED PLAN ACTION ITEMS

DRAFT--MALIBU CREEK WATERSHED PLAN-ACTION ITEMS
44 Action Goals (May 11, 1995)

These recommendations were agreed upon by consensus during a series of facilitated meetings among over 40 stakeholder groups in the watershed. Each individual item was approved by over 70% of the voting stakeholders. The original action list contained 111 items; these items have been consolidated into 44 items here. Original language is shown in bold. The original number of the item is indicated in brackets.

CPR *California Parks and Recreation*
NPS *National Parks Service-Santa Monica Mountains National Recreation Area*
RWQCB *Regional Water Quality Control Board*
LVMWD *Las Virgenes Municipal Water District*
LVMWD-TJoint Venture
SMBRP *Santa Monica Bay Restoration Project*
HTB *Heal the Bay*
Surf *Surfrider Foundation*
DPW *LA County Department of Public Works (in LA County portion of watershed only)*
RCD *Topanga-Las Virgenes Resource Conservation District*
SCS *Soil Conservation Service*
CLB *City of Calabasas*
MAL *City of Malibu*
AH *City of Agoura Hills*

SW is Los Angeles County Municipal Stormwater Permit. 319 are potential items for 319 grant proposal.

SMBRP Action Plan	Malibu Creek Watershed Plan-Action Items	Implementing Agencies [intend]
OVERALL WATER QUALITY AND QUANTITY GOALS		
MCW-1	1. PROTECT BENEFICIAL USES: **Develop and set water quality objectives to prevent point and nonpoint pollutant sources and pathogens from adversely affecting the beneficial uses of the watershed and nearshore (including nutrients, pathogens, toxic chemicals, salinity, pH, DO, etc.)** [10][12].	RCD, LVMWD, RWQCB, CLB, [MAL]
MCW-1	2. PROTECT RECREATION: **Ensure swimming, surfing, and fishing without adverse health effects posed by poor water quality** [4]. **Protect appropriate recreational opportunities such as surfing, swimming, sports fishing, sailing, and hiking in the creek, lagoon and surfsystem as long as it doesn't impact beneficial uses** [73].	CPR, LVMWD, NPS, RWQCB, [MAL]
MCW-4 4.1	3. PROTECT ECOSYSTEM/ENDANGERED SPECIES: **Enhance and protect lagoon, creek, beach and intertidal habitats for threatened and endangered species** [55], **native biodiversity** [56], **riparian habitat** [62], **by**	LVMWD,CPR, RWQCB, NPS RCD, [MAL]
	a) **Attain and maintain water and sediments of sufficient quality to support a healthy creek, lagoon and surfzone, taking into account interactive impacts** [7].	LVMWD, [MAL]
	b) **Prevent any increased input of substances in toxic concentrations into the watershed and surfzone** [15].	LVMWD, MAL
	c) **Reduce habitat degradation caused by road/bridge building encroachments and dumping of road materials** [59] **and adopting ordinances and watershed-wide joint-powers agreements to do so** [65].	CPR, NPS, LVMWD, [MAL]
1.4	4. ELIMINATE OR REDUCE SOURCES: **Eliminate or reduce, by-subwatershed area, sources of harmful pathogens, toxic chemicals, sediments and nutrients** [6].	LVMWD, CLB, [RWQCB], [MAL] [AH]
4.1	5. BIOLOGICAL STANDARDS: **Establish minimal viable habitat standards to support native species of locality** [64].	RCD, NPS

SMBRP Action Plan	Malibu Creek Watershed Plan-Action Items	Implementing Agencies [intend]
1.4	6. MONITOR PATHOGENS: **Use appropriate testing techniques to determine the presence of pathogens and test for compliance with established standards** [11]. **Pathogen testing should be implemented when and where bacteria counts are high** [24].	LVMWD, MAL
	7. REDUCE PATHOGENS: **Reduce human pathogens input into watershed** [17].	LVMWD, [MAL]
	8. STUDY NUTRIENTS: **Determine and establish achievable nutrient standards to maintain natural populations** [14].	LVMWD, RWQCB
1.5	9. REDUCE NUTRIENTS: **Reduce nutrient loads into the watershed** [16. **Reduce nutrient levels to natural background levels (i.e., Big Sycamore Canyon levels)** [21]. **Tapia Plant employ state-of-the-art technology** to remove nutrients from their discharge [22].	LVMWD-T, [RWQCB], [MAL]
2.2	10. REDUCE ACCELERATED SEDIMENTATION: **Historical seasonal sediment flow to beaches should be allowed** [43]. **Human-augmented sediment discharges into watershed should be reduced** [20] by:	LVMWD
	a) **enforcing erosion control regulation on a subwatershed basis** [19].	CLB, MAL, AH
	b) **all cities and counties adopting ordinances of no net increase in sediment from any development in the watershed** [18].	LVMWD, [MAL]
	c) **watershed-wide adoption of ordinances which would reduce sediment runoff from private property** [44].	RCD, MAL, [LVMWD]
2.2, MCW-3	d) **minimization of loss of topsoil in developing areas** [47] **through implementation and enforcement of Best Management Practices** [33].	LVMWD, NPS, MAL, CLB, AH
	e) **elimination of dumping of dirt on road shoulders** [49][59].	NPS, CPR, MAL
	f) **elimination of massive grading within the watershed** [54].	LVMWD, MAL
	11. FIRE REGULATION-EROSION CONTROL: **Modify fire regulation practices and weed abatement programs to reduce erosion** [45]. One method is to require **mowing rather than discing** of weed setback zones [48].	CPR, NPS, CLB, RCD
	12. TEMPERATURE: **Establish water temperature policy for fishery** [63].	
1-10	13. STORMDRAINS: **Employ appropriate Best Management Practices (BMPs) for stormdrains throughout the watershed** [23]. **Stencil all catch-basin inlets (storm drains)** [87].	DPW, AH, CLB, HTB, MAL,[RWQCB]
	14. MOBILE CAR WASHES: **Regulate mobile car washes to prevent discharges from reaching creek and lagoon** [35].	LVMWD, [MAL]
	15. ILLEGAL DRAINS: **Eliminate known illegal storm drains entering the watershed** [1].	[MAL]
1.4	16. SEPTIC SYSTEMS: **Implement dye study of the septic systems in the vicinity of the lagoon, creek and surfzone** [3b]. **Study all identified septic systems and replace all malfunctioning septic system** [8].	MAL
	17. TRASH/PARK SANITATION: **Maintain sanitary conditions in parklands. Link to education in English and Spanish to prevent trashing of resource** [70]. **Manage and eliminate the harmful impacts of day use, including campers, picnickers and transients on water quality** [72a][72b].	LVMWD, NPS, CPR

SMBRP Action Plan	Malibu Creek Watershed Plan-Action Items	Implementing Agencies [intend]
	18. CONFINED ANIMALS: **Develop Best Management Practices (BMPs) for livestock waste management** [37].	RCD, CPR,
	a) **Conduct survey of existing locations and amounts of animal waste within the watershed** [32].	[MAL]
	b) **Prohibit dumping of horse manure along creek. Enforce set-backs of horse corrals and horse manure storage** [5].	NPS, [MAL]
	c) **Set limits on number of livestock per acre to protect the resource from overuse by large domestic animals** [53].	LVMWD, [MAL]
	19. HOUSEHOLD IRRIGATION RUNOFF: As an example of potentially large quantities of household irrigation runoff, **survey households in upper Medea Creek development to determine reasons and solutions for extraordinary water runoff and report to advisory committee** [27].	SCS
MALIBU LAGOON AND SURFZONE ONLY		
4.5, 4.6	20. RESTORE/ENHANCE: **Restore and/or enhance Malibu Lagoon** [58], including **threatened and endangered species** [55].	NPS, RCD, CPR, MAL
1.11, 1.6	21. ASSESS SOURCES/CHARACTERISTICS: a) **Conduct a thorough and definitive study of lagoon water quality, identify all pollution sources, and develop remediation** [9] strategy.	LVMWD, MAL
1.6	b) **Develop a comprehensive picture of the hydrology, circulation, the biota of the lower creek and lagoon and surfzone for policy decision-making** [61].	RCD, CPR, [MAL]
	c) **Perform quarterly toxic chemical tests in Malibu Lagoon and surfzone** [105].	[MAL]
1.4, 1.7	22. ILLEGAL DRAINS: **Eliminate known illegal storm drains entering the lagoon** [1] and particularly **investigate sources emptying the unclaimed storm drain (Mystery Pipe) in Malibu Lagoon** [2].	[MAL]
1.4 all watershed	23. SEPTIC SYSTEMS: **Implement dye study of the septic systems in the vicinity of the lagoon and surfzone** [3a][3b]. **Study all identified septic systems and replace all malfunctioning septic system** [8].	MAL
1.1, 1.2, 1.9	24. LAGOON WATER LEVEL/BREACHING: **Evaluate options for regulating lagoon levels without artificial breaching of lagoon** [13]. **Prevent the unnatural breaching of creek** [68].	CPR, [MAL]
	25. PUBLIC NOTICES-Breaching/Public Health: a) **Regular notices to inform public and agencies about breaching times of lagoons** [91].	Surf, CPR
	b) **Encourage Los Angeles newspapers to publish weekly monitoring bacteria results at beach entrances** [95].	Surf, HTB, [SMBRP]
	c) **Implement public notification and education about potential health problems at beach** [96].	Surf, HTB
	26. MALIBU LAGOON BRIDGE: **Caltrans should set up a mitigation fund to cover the costs of any impacts to the Malibu Lagoon and surfzone resulting from reconstruction of Malibu Lagoon Bridge** [42].	[MAL]
WATERSHED SOLID WASTES AND OTHER WASTES		
	27. LANDFILL: **Expand the understanding of the impact of Calabasas Landfill on water quality** [106] and especially ensure that **Calabasas landfill to install monitoring wells which they were directed to construct in February 1990 and report monitoring results of findings to advisory committee** [101].	

SMBRP Action Plan	Malibu Creek Watershed Plan-Action Items	Implementing Agencies [intend]
1.12	28. WATER IMPORTS AND DISCHARGE: **Maximize environmentally acceptable reuse of reclaimed wastewaters (household and treatment plant) and greywater and reduce the importation of potable water [25][26]. Encourage use of reclaimed water for irrigation of landscaping and community open space [34]. Price reclaimed water more competitively [82]. Harmoniously implement water conservation efforts and greywater ordinances between cities [94]. Ultimate long-term goal of no waste discharges into waters used for recreation and/or for sources of food [28].**	LVMWD-T, NPS, RWQCB, CLB, MAL, AH (34)
	29. COMPOSTING/RECYCLING/CONSERVATION: **Implement improved recycling efforts [86]. Maximum treatment and reuse potential of all aspects of the watershed's waste disposal operations (septic, sewer, sludge farming, septage, and landfill operations) [38].**	DPW, LVMWD, MAL
	a) **Encourage composting and other forms of recycling for waste management [29].**	LVMWD, CPR, NPS, DPW, CLB, MAL, AH
	b) **Encourage recycling and reuse efforts to reuse water, household hazardous wastes, plastics, paper, glass, cardboard, tin and aluminum [92][93].**	DPW, LVMWD, CPR, NPS, CLB, MAL, AH
	30. PUBLIC EDUCATION-Conservation: **Develop individual support for conservation practices through education, training, and workshops which would reduce sediment and stormwater runoff from private property [31] [44].**	CLB, MAL, AH
LAND USE		
	31. RUNOFF REDUCTION: **Develop land use decision-making approaches (including land use zoning and ordinances) which reduce point and non-point source pollution [39][46].** Specifically, **new development within the watershed should employ on-site reuse of reclaimed water so that there is no net increase of water into the watershed [41]. Develop and implement guidelines for minimizing and mitigating ecological disturbances related to point and nonpoint water flows into "unimproved" coastal streams [110]. Watershed-wide ordinances which would reduce stormwater runoff from private property [44].**	LVMWD, NPS, RCD, CLB, AH [MAL]
	32. RECREATIONAL USE IMPACTS: **Reconcile demands for public access and resource protection regarding trails and roads [52].**	LVMWD, NPS, RCD, CLB
HABITAT PROTECTION		
4.4	33. LAND PURCHASES: **Purchase high priority watershed protection areas [36].**	NPS, CPR, LVMWD,
4.3	34. BUFFER ZONES: **Develop and mandate site specific buffer zones for sensitive areas [40][50].**	NPS, CPR, AH LVMWD, CLB
	35. HABITAT FRAGMENTATION: **Develop and implement land use policy that will eliminate any additional habitat fragmentation [51][66]. Support existing corridors between isolated open lands and establish alternatives where feasible [60].**	NPS, CPR, LVMWD, RCD, CLB, AH
4.6	36. FISH BARRIERS: **Remove barriers to fish migration, especially Rindge Dam [67].**	
	37. EXOTIC VEGETATION: **Support control of the intrusion of exotic plants into the wilderness areas of the watershed [57].**	SMBRP, CPR, NPS, RCD, [MAL]
1.3, 1.8, 4.7	38. WETLANDS: **Maintain, restore, create and enhance wetlands (natural and created) [69].**	LVMWD, NPS, CPR, [MAL]

SMBRP Action Plan	Malibu Creek Watershed Plan-Action Items	Implementing Agencies [intend]
COORDINATION AND OUTREACH		
MCW-5	39. COORDINATE ON WATERSHED BASIS: **Create and implement a regional and subwatershed approach to the coordination of land use and water quality decisions [77] for ongoing implementation concerns and to reduce unnecessary overlap of ordinances and streamlining of regulation [80].**	LVMWD
	a) Develop guidelines to reconcile the attainment of water quality objectives and resource protection with other, possibly conflicting public service goals, such as fire protection, flood control, mosquito abatement, and geologic stability [78].	LVMWD, [NPS]
	b) Build support for the implementation of the mediation recommendations (research studies, ordinances, joint agreements, etc.) among the agency staff and non-agency stakeholders who are working on management plans which affect the watershed: RCD/SCS Natural Resources Plan, SMBRP Comprehensive Conservation and Management Plan, LA County NPDES permit for stormwater, City of Malibu Wastewater Management Plan, General Plans of Area Cities and the LA County 101 Corridor/Cities Area Plan Update [79].	SMBRP, [NPS]
	c) **Establish mechanisms,** including **joint powers authorities, watershed commissions, special districts or other cooperative integration efforts, for the integration efforts aimed at coordinating, planning and/or implementation where multiple general-purpose jurisdictions exist [81][83].**	SMBRP, LVMWD
	d) Develop and field-test interactive models to facilitate systems-based watershed planning and management decisions [108].	[NPS]
	e) Identify and create appropriate financing options which work and are cost effective [74], including joint financing options so duplication is avoided [75].	SMBRP, LVMWD
	40. ENFORCEMENT-General: **Develop effective means to enforce pollutant reduction programs [76].**	LVMWD, [MAL]
	41. ENFORCEMENT-Camping: **Enforce existing camping restrictions within the watershed [90].**	CPR, NPS
MCW-6, 6.2	42. PUBLIC EDUCATION: **Emphasize and encourage ongoing public education [71] [85]**	Surf, LVMWD, CPR, SMBRP, RWQCB, DPW, MAL
	a) Create a non-point source pollution education program for the watershed occupants [84].	SMBRP, AH, [MAL] CLB, [RWQCB]
	b) Develop Adopt-a-Watershed Program that is watershed-wide [88].	[MAL]
6.1	**c) Implement effective education programs about the need for urban and non-urban preservation of open space and buffer zones [89].**	CPR, NPS, AH, LVMWD, CLB, [SMBRP]
MCW-7	43. WATERSHED MONITORING: **Develop and implement coordinated and integrated watershed monitoring program [30].**	RCD, [NPS], [RWQCB]
	a) Create a centralized database of water quality and resource data accessible to all parties [97].	RWQCB, NPS, [LVMWD]
	b) Develop a coordinated GIS Database network, including a detailed land use map [102] and all septic systems and stormdrains [109], which is accessible to all parties [98].	[LVMWD], NPS

SMBRP Action Plan	Malibu Creek Watershed Plan-Action Items	Implementing Agencies [intend]
	44. WATERSHED ASSESSMENT: **Identify, by-subwatershed area, sources of harmful pathogens, toxic chemicals, sediments and nutrients** [6].	[MAL]
	a) **Expand an understanding of the hydrology of the watershed and near-shore bathymetry** [100]. **Agree on needed research on what appropriate and attainable seasonal flows should be for the creek, lagoon and near shore areas** [107].	LVMWD
	b) **Identify and apply suitable models to help target and prioritize pollution prevention, reduction, and abatement measures** [103].	CLB, [NPS]
1.13	c) **Raise funding for and implement study on health effects of urban runoff on surfers, incorporating Surfrider Beach into the design** [104].	SMBRP
1.5	d) **Establish a Total Maximum Daily Load Model for all inputs to the watershed** [111].	[RWQCB]
2.1	e) **Develop a research agenda to expand understanding about impacts of land use practices in watershed** [99].	[LVMWD]
2.2 EROSION		

APPENDIX B

ISSUES, CONCERNS, AND RECOMMENDATIONS OF THE PUBLIC HEALTH/RECREATION SUBCOMMITTEE

MASTER OUTLINE OF THE ISSUES, CONCERNS, AND RECOMMENDATIONS

October 19, 1993

1. AN EPIDEMIOLOGICAL STUDY - focusing on Malibu Creek, Malibu Lagoon, Malibu Surfriders Beach and surfzone, to be incorporated in both the NATURAL RESOURCES PLAN study and the SANTA MONICA BAY RESTORATION PROJECT action plan: the objective of such a study would be to assess the impact on human health of the alleged pollution of the Malibu Creek Watershed.

It is suggested that this study could be implemented in three stages, over an estimated five years' period.

STAGE ONE: recover approximately three dozen pathogens, including Poliovirus,

Echovirus and Rotavirus, at the input into Las Virgenes Municipal Water District/Triunfo County Sanitation District Tapia Water Reclamation Facility. As a control, the same viruses should be tested immediately past Tapia, and further downstream.

STAGE TWO: Study permanent residents at the lower part of Malibu Creek and in Malibu

Colony, using a control group from a "non-polluted" area.

STAGE THREE: Survey the users of the Malibu Surfriders Beach area.

The human study could be approached in two ways, concurrently or sequentially, depending on the constraints of time and money available.

First, a retrospective study could identify the problem, if any, by recording and medically documenting past and recent complaints from a required number of beach-goers and permanent Malibu residents, establishing, when possible, a specific diagnosis with regard to the pathogen involved. A retrospective diagnosis may be attained by specific antibody determinations **if performed by a laboratory well-versed in this type of investigation.**

Secondly, a prospective study, most decisive in answering the concern about human health would be to identify specific groups at risk (habitues of the Malibu Creek recreational areas, including the transient encampments along the stream). This study would be disease-oriented and look at complaints/illnesses as they occur. Proper demographic data and medical background should be obtained, and proper medical diagnoses of these occurrences would have to be attempted, again, with laboratory backup. A matched control group from an allegedly non-polluted

area would have to be included, as well. Such study should demonstrate demonstrate the differences in outcomes, if any, between the two groups, and relate these differences to pathogens concurrently studied in the Malibu Creek Watershed itself.

The sophistication and design of epidemiologic study may vary, but, whatever the approach chosen, THE ULTIMATE STUDY MUST BE DISEASE-ORIENTED AND LABORATORY SUPPORTED, in order to establish any possible association between human health and alleged pollution.

2. Quantify General Plan land uses and past practices in development approvals for each of the cities and unincorporated areas within the watershed:
   A. Predict impacts on public health and recreational benefits.
   B. Look at regional impact assessment models to evaluate the developments with regional impacts. At a minimum, impacts should include:
      1. man-made debris, pesticides, petroleum products, heavy metals, etc.
      2. excess sedimentation from construction.
      3. nutrient loading from various sources, including livestock.

3. Interference With Natural Processes, such as:
   A natural replenishment of beach area
   B. spawning and spawning areas.

4. Contamination of Aquatic, Estuarine, and Marine Resources.

5. Contamination of Terrestrial Resources through Non-Point and Point Pollution.

6. Hydrological Imbalance:
   A. amount of flow
   B. force of flow
   C. rate of flow.

7. Need for Bathymetric Data and Topographic Map to Document Flow Patterns and Changes.

8. Need for Changes in Lifestyles and Alternatives to Accepted Procedures.

9. Need for Ongoing Announcements to Increase Public Awareness of Problems.

10. The Conversion of lower Malibu Creek and Lagoon vicinity <u>filled land</u> to Multi-function, Productive Wetlands.

APPENDIX C

CONSERVATION PRACTICE DESCRIPTIONS

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APPENDIX C

CONSERVATION PRACTICE DESCRIPTIONS

The Conservation Practices are listed alphabetically according to NRCS (SCS) usage and nomenclature. Common names of practices that fit into these categories are included for each SCS Conservation Practice. A very short description for each of the practices is added to each entry. The listing does not include special practices that may apply to a site - i.e.: reinforced fill or crib walls, landslide stabilization, area requirements, road widths, etc.

The practices shown are to be used as part of a SYSTEM, designed for each site, to meet the goals set for use, stability, safety, environmental quality, health, and water quality. Few sites or goals will allow one practice to comprise a system. A system normally may be comprised of a number of practices to meet one goal for the site. A system to meet multiple goals is likely to need many individual practices. For this study, the systems generally address stability, safety, water quality and quantity, health and environmental quality by controlling water flows and reducing erosion and reducing the quantities of sediment and other pollutants reaching surface waters.

Maintenance and Upkeep

Road Ditch Maintenance, Increased from present
Mower, not grader, maintenance of ditches and slopes
Culvert Maintenance, Increased from present
Storm Drain Maintenance, Increased from present
Design Standards, Increased level from present
Construction Standards, Increased level from present
Culvert and drain maintenance.
Ditch and drop inlet maintenance.

Access Road (560)

A travelway to provide a fixed route for travel and access, while controlling runoff to prevent erosion and maintain or improve water quality.

Road Paving - including paved or surfaced shoulders
Rolling Dips (Valley Gutters) - to waterway or inlet.
Cross-Sloping - for drainage to waterway or vegetated slope.
Added R/W Width - to allow for reduced bank toe removal by grader.
Water Bars - to waterway or inlet or protected slope.
Earth Retaining Berm - low earth berm to keep runoff on roadway.
Paved Driveways - paved or surfaced drives for water and erosion control.
Paved Parking/Use Areas - parking and use areas associated with the roads paved or surfaced, with berm or gutter water control.
Curb and Gutter - convey runoff to storm drain or waterway.

Channel Vegetation (322)

Establishing and maintaining adequate plants on channel banks, berms, spoil, and associated areas to stabilize slopes and reduce erosion and sedimentation. To maintain or enhance the quality of the environment, including visual aspects and fish and wildlife habitat. (Horses and other livestock must be fenced out of channels)

Channel vegetation - vegetate waterway to reduce erosion.

Critical Area Planting (342)

Planting vegetation, such as trees, shrubs, vines, grasses, or legumes, on highly erodible or critically eroding areas to stabilize the soil, reduce damage from sediment and runoff, and improve wildlife habitat and visual resources.

Erosion Control Planting - grass, also shrubs, on cut and fill slopes; special effort or equipment may be needed.
Landscaping - includes "orderly" arrangement of shrubs and trees to meet aesthetic or other goals and includes xeriscaping.

Cut Bank Stabilization (195)

Stabilize and treat cut or fill banks of bare earth with vegetation and/or structural measures to protect against erosion by wind or water. Also to stabilize cut or fill banks from failure by sliding or other failures caused by construction oversteepening of slopes.

Retaining Walls - along cut bank slopes, as needed.
Rock Toe Protection - along cut and fill slopes, as needed for stability, drainage, and flow protection.
Bank Sloping (Flatten Slopes) - flatten cut and fill slopes for stability, reducing erosion, and improve vegetative stands.
Slope Benches - benches in fill slopes each 15-20 feet of vertical height; increase slope stability; includes diversion.
Bank Berms - Benches in cut slopes each 15-20 feet of vertical height; increase slope stability; includes diversion.
Slope Vegetation - may be grass, Critical Area Planting (342), landscaping, or xeriscaping as needed to stabilize the slope, reduce erosion, and meet aesthetic or other goals.
Grassed Waterway (412) - waterway planted to suitable vegetation; includes low flow armor.
Lined Waterway or Outlet (468) - includes all linings, except vegetation.
Diversion (362) - divert flows away from upper slopes and from toe of bank.
Underground Outlet (620)- water conveyance system to protected outlet, including inlets, outlets, and piping.

Diversion (362)

A channel constructed across the slope with a supporting ridge on the lower side, to divert water for safe disposal.

Diversion - divert flows away from upper slopes and from toe of bank.
Lined Ditch - diversion ditch lined with concrete or PAM or asphaltic concrete.

Filter Strip (393)

A strip or area of vegetation for removing sediment, organic matter, and other pollutants from runoff and waste water.

Filter Strip - Grass or vegetated strip 10-60 feet wide downslope of overbank flows or downslope of road drain flow spreader or between site waterway/ditch and work areas or neighbor or corrals and stables and exercise areas and waterway.
Buffer Strip - Filter strip that also uses trees and shrubs or is used to reduce noise or wind.
Landscaping - Vegetation in a filter or buffer strip; planned to include visual and other effects.

Firebreak (394)

A strip of bare land or fire-retarding vegetation.

Firebreak between property and wildlands.
Clear vegetation for 30 feet away from house.
Plant low fire hazard (Succulent) vegetation.
Increase access width around buildings for fire protection.
Install Firebreaks around perimeter, adjacent to wildlands.

Grade Stabilization Structure (410)

A structure used to control the grade and/or reduce head cutting in natural or artificial channels.

Ditch Grade Stabilizers - low structures to control grade in erosive ditches or to drop from one gradient to another. Materials may be any of the following permanent materials: rock, grouted rock, concrete, concrete block, and asphaltic concrete.
Drop Structure - mainly to drop the grade of crossing waterways down to the level of the road waterways; concrete or block.
Waterway Grade Stabilizers - sills constructed in waterways to reduce downgrading erosion that may be caused by adding road drainage or revising natural drainage to fit the road needs.
Ford - concrete, pipe and surfaced structure to provide a roadway during periods of low water flow over the structure. The structure may function as a grade stabilizer and drop structure also.

Grassed Waterway (412)

A natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff.

Grassed Waterway, Vegetated Waterway, Vegetated Ditch, Protected Waterway (Road Median) - earth lined ditches planted to annual and perennial grasses and maintained with a good cover. Most grassed waterways are shaped to carry water and be vegetated and maintained in vegetation.

Heavy Use Area Protection (561)

Protecting heavily used areas by establishing vegetative cover, by surfacing with suitable materials, or by installing needed structures.

Gravelled, retained sand barrier, paved, or sodded protection for heavy use areas, such as play areas, playgrounds, trails, cart parking, practice tees, water and feed troughs, stables, etc.

Hillside Bench (192)

An excavated ledge, earth embankment, or a combination excavated ledge and earth embankment constructed on a hillside. May be used for houses on narrow terraces and access roads.

Hillside Ditch (423)

A channel that has a supporting ridge on the lower side constructed across the slope at definite vertical intervals and gradient, with or without a vegetative barrier. Mainly used for diverting runoff flows originating above a hillside development to a protected outlet.

Irrigation System: Trickle (441)

A planned irrigation system in which all necessary facilities are installed for efficiently applying water directly to the root zone of plants by means of applicators operated under low pressure. The applicators can be placed on or below the surface of the ground.

Micro Spray Irrigation - landscaping plants.
Drip Irrigation - landscaping Plants.

Irrigation Water Management (449)

Determining and controlling the rate, amount, and timing of irrigation water in a planned and efficient manner.

Proper Water Use - on landscaping and erosion control plants.
Irrigation Water Management - on landscaping and erosion control plants.

Land Clearing (460)

Removing trees, stumps, and other vegetation from wooded or heavily vegetated areas in an manner that maintains the integrity of the soil and water resources.

Land Grading (202)

Altering the surface of the land to meet the requirements of the planned facilities, or the planned use of the land.

Lined Waterway or Outlet (468)

A waterway or outlet having an erosion-resistant lining of concrete, stone, or other permanent material. The lined section extends up the side slopes to a designed depth. The earth above the permanent lining may be vegetated or otherwise protected.

Lined Ditches, Lined Channels, Paved Ditches, Protected Waterway (Road Median), Lined Drainage Ditch - ditches or waterways lined with permanent materials to prevent erosion, reduce size, or provide safety.

Road Edge Berms - asphaltic concrete or concrete berms, usually less than 12-inches high, to keep runoff on the paved section of the road and prevent overbank or toe of slope erosion. Earth berms to control overbank flow are part of Access Road practices.

Livestock Exclusion (472)

Excluding livestock from an area not intended for grazing.

Fencing - to exclude animals from the waterways, from landscaping, and from development.

Nutrient Management (198)

Managing the amount, form, placement, and timing of applications of plant nutrients.

Fertilizer Management - use minimum of fertilizers, at proper time and in proper manner (all on vegetated area, not paved areas).

Pasture and Hayland Management (510)

To maintain an adequate vegetative cover on pastures and hayland to reduce erosion, maintain vigor, and ensure reseeding.

Pasture Management - retain proper cover on pastures.

Pesticide Management (199)

Managing the type, amount, placement, and timing of applications of pesticides needed to reduce plant cover and to improve plant growth or crop production.

Pesticide Management - use minimum of approved materials, at proper times.

Roof Runoff Management (558)

A facility for collecting and disposing of runoff water from roofs that reduces pollution, erosion, and flooding and improves water quality and drainage.

Runoff Management System (570)

A system for controlling excess runoff caused by construction operations at development sites, changes in land use, or other land disturbances.

Sediment Basins - small basins constructed to catch and retain sediment and debris.
Infiltration Trenches - a rock filled trench designed to store and percolate runoff.
Parking Lot Storage - a area of the parking lot designed to store and slowly release a depth of about 6-inches of runoff.
Rooftop Storage - constructing a roof structurally capable of holding detained storm water and releasing it slowly, over a period of 24-hours.
Underground Tanks - a tank capable of retaining storm runoff for a release period of 5-days.
Filter Strips - a 25-foot, minimum, wide grass strip used to filter storm flows before they enter an infiltration trench or before the flows enter an off-site waterway.
Sediment Traps - a temporary sediment basin used during construction or an oversized drop inlet box for a storm drain.
Filter Traps - a wide or large grassed area that is nearly flat, used to trap and remove sediment from flowing water.

Sediment Basin (350)

A basin constructed to collect and store debris or sediment.

Runoff Retention Basin - small basin to hold runoff for slow release and to catch and retain sediment and debris. May be in landscaped or parking area,

Stream bank and Shoreline Protection (580)

Using vegetation or structures to stabilize and protect banks of streams, lakes, estuaries, or excavated channels against scour or erosion.

Stream Corridor Improvement (204)

Restoration of a modified or damaged natural stream to a more natural state using bioengineering techniques to protect the banks and to re-establish the riparian vegetation.

Stream Corridor Improvement - sites along waterways should restore damaged or modified stream and stream banks to more natural conditions.

Structure for Water Control (587)

A structure in a water management system that conveys water, controls the direction or rate of flow, or maintains a desired water surface elevation.

Subsurface Drain (606)

A conduit installed beneath the ground surface to collect and/or convey drainage water.

Subsurface drain - if needed, to drain slopes for stability or to drain high water table for foundation stability.

Underground Outlet (620)

A conduit installed beneath the surface of the ground to collect surface runoff and convey it to a suitable outlet.

Culverts - to convey water under the road surface.
Culvert Inlet - shaped or formed inlet to culvert.
Culvert Outlet - shaped or formed outlet for culvert.
Drop Inlet - box inlet designed to drop water from waterway grade to culvert or storm drain grade.
Drop Inlet, w/Sediment Storage - a drop inlet with capacity to store a small volume of coarse sediment, usually the annually predicted amount from the subwatershed.
Down Drain - a culvert or steeply sloping lined waterway from the road surface or road culvert to a natural waterway. The down drain should end in a protected outlet, spreader basin, or a drop into the waterway that reduces the erosive energy of the road drainage. Road drainage should not be released onto slopes at the road R/W.
Storm Drain - a system of pipes to collect and convey runoff from (mainly) urban areas to natural or constructed waterways.
Storm Drain Inlet - a street inlet to collect surface runoff and drop it into the storm drain. A variation of drop inlet.

Wetland Development or Restoration (657)

Construction or restoration of a wetland facility to provide the hydrological and biological benefits of a wetland.

Waste Management System (312)

A planned system in which all necessary components are installed for managing liquid and solid waste, including runoff from concentrated waste areas, in a manner that does not degrade air, soil, or water resources.

Animal Waste Management - to store, use or dispose of animal wastes in an appropriate and environmentally safe manner.

Waste Storage Pond (425)

An impoundment made by excavation or earthfill for temporary storage of animal or other agricultural waste.

Waste Storage Structure (313)

A fabricated structure for temporary storage of animal wastes or other organic agricultural wastes.

Waste Transfer (193)

Structures, conduits, or equipment installed or used for the movement or transfer of animal wastes or other organic agricultural wastes to storage, treatment, or disposal.

Animal Waste Removal - remove stored or collected animal waste and move it to the use or disposal site in an environmentally safe manner.

Windbreak Renovation (650)

A closely planted strip of trees and shrubs used to reduce the force and velocity of the wind.

Windbreak Renovation - to provide protection from wind.

Waste Management

The removal, storage, transfer, handling, and disposal of urban or household wastes in a manner that does not degrade air, soil, or water resources.

Street Sweeping - remove surface dusts and debris. Intervals vary, but should occur at least monthly in low traffic areas and more frequently in high traffic areas.

Pollutant Traps at Drain Outlets or Inlets - variation of drop inlet, designed to trap and hold floating pollutants; oil, grease, organic material, trash, etc.; to prevent their entry to the waterways or to recharge basins.

Refuse Collection - collect and remove refuse discarded along roads.

Yard Waste Collection - collect and remove woody vegetation, clippings, and earth materials that are discarded or are produced during maintenance along roads.

"Hazardous" Waste Collection - collect and remove "hazardous" wastes that are discarded in and adjacent to the roads.

Improve On-Site Waste Disposal - increase septic tank leach field requirements in sandy soils over shallow ground water and in clay soils over impermeable layers. A residential density of greater than 2 homes per acre should be sewered to protect ground water. A commercial or light industrial density of greater than 1 business per acre should be sewered to protect ground water. No hazardous, controlled, or polluting substances should be put into septic systems. Purchase and Wreck polluting vehicles - purchase and remove from use all internal combustion vehicles that cannot meet air quality standards or which have excessive oil leaks (not readily repairable).

Floodproofing

The reduction of flood damages by reducing the entrance of flood waters into buildings or property, on an individual basis.

First Floor Level 12-inches above 100-year flood level.
Berms to direct flows away from dwelling.
Ditching to convey flow away from dwelling.

Education

Develop a watershed-wide brochure on water quality protection. Handout or mailed. Explain why storm water pollution and irrigation runoff is a problem and what people can do to prevent it. In another brochure, explain why petroleum wastes, garbage, chemicals, animal wastes, yard wastes, etc. should be kept out of the water resources and what the downstream results could be, including the ground water.

Develop a program to educate architects, landscape architects, and engineers about friendly designs for storm water control and erosion control, and design practices to reduce the need for fertilizers, herbicides and pesticides.

Develop or review education programs related to use of pesticides, herbicides, and fertilizers, focusing on residential/commercial/public lands uses. The programs should address low volume uses and water quality impacts and the use of alternative products or methods.

Expand the program to educate the public about the storm water pollution impacts that result from littering. Include water quality, instream biota, and ocean biota.

Work with citizen groups to reduce littering by providing waste receptacle, litter bags in cars, etc. Continue to provide and maintain waste receptacles in strategic public areas and for public events. Expand programs as appropriate.

Promote public involvement in "adopt a creek" programs for specific waterways or waterway segments.

Promote public involvement on transportation, planning, packaging, pollution control, waste management, etc. issues.

Educate the public, commercial and industrial users of the effects of oils and greases on water quality and other environmental effects. Focus on "housekeeping" practices, oil/grease traps, absorbents, cleaning compounds, and other techniques for controlling oil and grease spills and leaks. The importance of vehicle inspection and maintenance to reduce leakage of oil, antifreeze, hydraulic fluids, etc. should receive separate focus.

Educate landowners about the need for and practical methods for erosion and sediment control, nutrient management and irrigation water management. The control of off-trail activities should be an integral part of the program.

Educate the public about the relationship between air pollution and storm water quality problems. Educate the public and cooperate with programs to reduce air emissions from individual, commercial, public and industrial sources, including reduction of automobile use.

Educate the public and commercial/industrial/public owner users of the need to keep irrigation, rainfall and runoff from contacting or transporting potential contaminants. Include methods of separation and other solutions.

Educate the public, commercial, industrial and public owners of practical alternatives to reduce roof and paved area peak runoff rates of discharge contributed to storm drains and waterways.

Provide education and guidance encouraging architects, engineers, developers and building departments to implement systems of temporary rainfall peaks on-site, for slow release to the storm drain or waterway system.

Educate the public on the need to minimize the total volume of runoff from a given area. Provide basic principles and suggest practical alternative means to enhance surface retention and infiltration. Include water quality effects, ground water effects, and on-site effects.

Educate the public about the advantages of composting and proper composting techniques.

Educate the public and landowners about the effects of pet and animal wastes, including suburban livestock (especially horses) on the environment. Provide practical methods of cleaning up and disposing of these wastes. Dispense litter bags in public places.

Educate the public and landowners on the proper operation and maintenance of septic tank systems. Recommend a maintenance schedule and ways to determine if improper operation or failure is eminent.

Regulatory - Regulation or Ordinance

Assist developers, builders, commercial, industrial and other landowners to comply with general and specific permits. Provide workshops on permit requirement, installation of appropriate practices, and the needs to meet overall requirements of State Laws, such as the Storm Water Pollution Prevention Plan.

Develop uniform enforcement procedures. Educate the public, developers, builders, contractors, engineers, inspectors, and enforcement personnel in the plan requirements, enforcement procedures, costs, and the underlying regulations/ordinances. The procedures should outline the appropriate actions for violations.

Conduct above and below ground inspections for illicit connections to and illegal discharges into the storm drain system. Trace the results to sources. Procedures for training, inspection and implementation should be included.

Provide recycling or safe disposal collection sites for used petroleum products, chemicals, oils, greases, and hazardous materials. Educate the public about use of these sites, provide the necessary funds (including possible fees) and maintain the sites. Sites should be convenient and open seven days a week, during afternoon and evening hours.

Develop a guidance manual for the construction industry, including new development, that contains the Storm Water Pollution Prevention Plan requirements, practical means of installing and maintaining practices, practical control practices, and guidance in developing a plan.

Restrict or regulate the use of fertilizers, pesticides and herbicides on all non-agricultural lands. May include regulating the sale of these products and those specifically noted to be for household use.

Strengthen the ordinances and the enforcement of the ordinances to control littering and illicit or illegal discharges or dumping.

Develop a comprehensive plan to collect, reduce, recycle, and control trash and yard debris.

Develop a program to ensure that municipal, county, state, or commercial trucks hauling bulk materials or wastes do not leak, spill, or otherwise release contaminants onto roadways or open spaces, where they may be subsequently washed into the storm drains or waterways.

Develop appropriate regulations to require (at least some) auto supply, service and repair businesses to provide collection and disposal services for used vehicle fluids.

Enforce regulations that require oil and grease controls in areas that are significant sources.

Restrict livestock, domestic animals, and pets from entering or being corralled in waterways or damaging stream banks.

Restrict the use of off-road vehicles to specific locations that have an erosion control plan in place to reduce environmental damages.

Require O&M plans and maintenance plans for all new sewers and storm drains to be a part of development plans.

Require O&M plans, inventories, and maps of all sewers and storm drains be kept up-to-date.

Develop and implement intensified street sweeping programs for all streets and roads. The intensity should reflect the use of the facility, but should not be less than once per month. Private and public paved areas (parking, storage, etc.) should be included in the program.

Develop, implement and enforce regulations to install systems that retain storm runoff on site for slow release to the storm drain or waterway system, minimizing the peak discharge rates.

Develop and implement plans to retrofit storm sewers and waterways with structures to remove sediment and oils/greases from small storms and early portions of large storms (first 0.5 inch).

Develop, implement and enforce regulations to install structures to remove sediment and oils/greases from small storms and early portions of large storms (first 0.5 inch) for parking areas and other paved areas. Include maintenance requirements and practical solutions, as well as incentives.

Develop a program to provide financial incentives, such as tax reductions, to property owners who protect natural areas or wetlands on their property that has valuable water quality characteristics or storm water treatment characteristics.

Determine the feasibility of and implement a plan for retrofitting storm drainage and flood control facilities to also function as water quality facilities (ie.- wetlands, sedimentation basins, etc.).

Develop an overall plan for the installation or retention of wetlands along the waterway system. Include provisions for implementation and maintenance, also financing and evaluation.

APPENDIX D

IMPLEMENTATION SOURCES

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The Implementation Sources listed in this appendix are further explained in the Catalog of Federal Domestic Programs and the Catalog of California State Funding Sources. The sources in the appendix are Federal and State programs listed by alphabetical order according to program titles.

The purpose of these catalogs is a government and state-wide compendium of programs, projects services, and activities which provide assistance or benefits to the public. They contain financial and nonfinancial assistance programs administered by departments and establishments of the Federal and State governments.

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Program Title	Agricultural Conservation Program
Objectives	Control erosion and sedimentation and to encourage voluntary compliance with federal/state requirements to solve point and non-point source pollution. Water quality improvement is an allowable purpose and is presently receiving special emphasis.
Type of Assistance/ Available Funds	Financial assistance. Direct payments for specified uses.
Requirements/Limitations	The County ASCS Committee sets conservation need priorities. The local Soil and Water Conservation District identifies appropriate conservation practices. Technical assistance is provided by NRCS Field Office staff. ASCS provides financial assistance upon certification by NRCS of practice installation.
Eligibility	Farmers, ranchers, owners and associated groups who bear a part of a cost of an approved conservation practice are eligible for cost share assistance.
Further Information	State and local ASCS office or. Agricultural Stabilization and Conservation Service U. S. Department of Agriculture P.O. Box 2415 Washington, D.C. 20013 (202) 447-6221

Program Title	Agriculture Preservation Projects
Objectives	Work with property owners, local governments, and state agencies within the coastal zone to establish long-term protection of agricultural lands threatened by development. Tools such as transfer of development rights, purchase of development rights, and realization of supplemental land uses are used to implement this goal. Funding also provides for the purchase of easements.
Type of Assistance/ Available Funds	Grants, loans, land acquisitions, project/program development assistance
Requirements/Limitations	Sites must be in the coastal zone or in the jurisdiction of the San Francisco Bay Conservation And Development Commission.
Eligibility	State, local or federal public agencies or nonprofit organizations.
Further Information	State Coastal Conservancy Carol Arnold 1330 Broadway, Suite 1100 Oakland, CA 94612-2530 (510) 286-4173

Program Title	Assessment and Watershed Protection Support
Objectives	Assessment and watershed protection support activities, can include all levels of government and private organizations.
Type of Assistance/ Available Funds	Grants - Part of Clean Water Act
Requirements/Limitations	Grants - Funds determined annually
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	California Traffic Safety Programs
Objectives	Assist state and local agencies in implementing programs to reduce traffic accidents and/or improve traffic safety-related activities.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	Funds to supplement not substitute for ongoing expenditures.
Eligibility	Any state agency or local political subdivision.
Examples	Complete program manuals are available upon request.
Further Information	Office of Traffic Safety Marilyn Sabin, Planning & Operations Manager 7000 Franklin Blvd, Suite 440 Sacramento, CA 95823 (916) 445-9734

Program Title	Capitalization Grants for State Revolving Funds
Objectives	Create State Revolving Fund for local financing of municipal wastewater treatment facilities.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	To provide loans to local governments
Eligibility	States
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	Civil Works Projects
Objectives	To provide help to communities with a variety of water resource problems and opportunities including flood control, coastal and shoreline erosion, outdoor recreation, environmental restoration and water quality control.
Type of Assistance/ Available Funds	Planning, engineering, and other technical assistance and financial assistance with cost sharing. Cost sharing percentages vary by type.
Requirements/Limitations	Six steps for projects. Local sponsors enter into two agreements with the CORPS.
Eligibility	State and local agencies
Further Information	Corps District and Division Office U.S. Army Crops of Engineer Washington D.C. 20314-1000 (202) 272-0144

Program Title	Clean Lakes
Objectives	Prepare identification and classification surveys of all publicly owned lakes.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	Matching funds required.
Eligibility	States
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	Coastal Restoration Projects
Objectives	The Conservancy may award grants to restore areas that are adversely affecting the coastal environment or are impeding orderly development because of scattered ownerships, poor lot layout, inadequate parks and open spaces, incompatible land uses, or other conditions. Up to $100,000 is available to prepare a required coastal restoration plan.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	Sites must be in the coastal zone or in the jurisdiction of the San Francisco Bay Conservation And Development Commission.
Eligibility	Local public agencies or nonprofit organization.
Examples	Reports of funded projects are available for review.
Further Information	State Coastal Conservancy Steve Horn, Program Manager 1330 Broadway, Suite 1100 Oakland Ca 94612-2530 (510) 286-1015

Program Title	Coastal Wetlands Planning, Protection and Restoration Act
Objectives	Funds are used for acquisition of interests in coastal lands or waters, and for restoration, enhancement, or management of coastal wetland ecosystems. Projects must provide for the long-term conservation of such lands or waters and the hydrology, water quality, and the fish and wildlife dependent on them.
Type of Assistance/ Available Funds	Project Grants
Requirements/Limitations	Project must provide for long-term conservation of coastal lands or waters and the hydrology, water quality, and fish and wildlife dependent on them. Additional requirements are a performance report, audits, and cost records maintained separately for each project.
Eligibility	Available to states bordering on the Pacific.
Examples	New Program
Further Information	Colombus H. Brown Fish and Wildlife Service Division of Federal Aid 4401 Fairfax Dr. Room 322 Arlington, VA (703) 358-2156

Program Title	Coastal Zone Management Program
Objectives	Assist federally approved coastal states in promoting the effective management of the Nation's coastal zone by balancing competing demands of resource protection, protection of public health and safety, provision for public access, and economic development.
Type of Assistance/ Available Funds	Formula grants and oversight of stat CZMA programs.
Requirements/Limitations	Funds must go toward implementing state Coastal Zone Management Programs or toward development of management plans.
Eligibility	Coastal states with an approved Coastal Zone Management Program.
Examples	Kings County, WA has used CZM funds in a multiphased research program to investigate the viability of using freshwater wetlands for urban surface water management and non-point source pollution control. The project involves collecting baseline data, sampling, analyzing, and monitoring the wetlands and interpreting the results to devise policy and management guidelines that protect wetlands and downstream waterbodies.
Further Information	Chief, Coastal Programs Division Office of Ocean and Coastal Resource Management National Oceanic and Atmospheric Administration U.S. Department of Commerce 1825 Connecticut Ave., NW Washington, D.C. 20235

Program Title	Conservancy Nonprofit Organization Assistance Program
Objectives	Technical assistance to nonprofit organizations and land trusts for the promotion of public access restoration of coastal wetlands, or agricultural and viewshed protection.
Type of Assistance/ Available Funds	Technical Assistance
Requirements/Limitations	Organization must have obtained tax-exempt status and have articles of incorporation that identify the purposes of organization as being the preservation of land for scientific, historic, educational, ecological, recreational, agricultural, scenic or open space opportunities. Sites must be in the coastal zone or in the jurisdiction of the San Francisco Bay Conservation and Development Commission.
Eligibility	Qualified nonprofit organizations.
Examples	Reports of funded projects are available for review.
Further Information	State Coastal Conservancy Joan Cardellino, Program Manager 1330 Broadway, Suite 1100 Oakland, CA 94612-2530 (510) 268-4093

Program Title	Emergency Conservation Program
Objectives	Enables farmers to perform emergency conservation measures to rehabilitate farmlands damaged by natural disasters and to carry out emergency water conservation or water enhancing measures during periods of drought, also wind erosion on farmlands.
Type of Assistance/ Available Funds	NRCS provides technical assistance to plan and construct the measures, and ASCS provides the payments.
Further Information	County or state ASCS offices. Agricultural Stabilization and Conservation Service U.S. Department of Agriculture P.O. Box 2415 Washington D.C. 20013 (202) 720-6221

Program Title	Enhancement
Objectives	Enhance and restore coastal habitat through a variety of measures and physical enhancement of the sites either through grants or directly by the Conservancy.
Type of Assistance/ Available Funds	Grants, loans, project development by the Conservancy *Note: Plan preparation is 50% match, funding for implementation varies.
Requirements/Limitations	Sites must be in the coastal zone or in the jurisdiction of the San Francisco Bay Conservation And Development Commission, or a coastal watershed that directly affects a significant downstream coastal resource or relates to the environmental quality or public enjoyment of San Francisco Bay.
Eligibility	State or local public agencies and nonprofit organizations
Examples	Reports of funded projects and annual reports available upon request.
Further Information	State Coastal Conservancy Reed Holderman, Program Manager 1330 Broadway, Suite 1100 Oakland, CA 94612-2530 (510) 268-4183

Program Title	Environmental Education
Objectives	Educational programs for students K-12 relating to the wise use of natural resources and protection of environmental quality.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	Applicant must contribute matching funds or other equivalent in-kind services and materials. They must also use community resources such as volunteers, free materials, and services available from various government and private agencies.
Eligibility	School districts, county offices of education, local or state governments, nonprofit associations, colleges and universities that maintain teacher training programs, and Univ. of California and California state colleges and universities.
Examples	
Further Information	California Department of Education Environmental Education Coordinator P.O. Box 944272 Sacramento, CA 94244-2720 (916) 657-5374

Program Title	Environmental Enhancement and Mitigation Program (EEM)
Objectives	Provides additional mitigation and natural resources enhancement to offset the environmental impact of new or modified public transportation facilities.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	Government agencies and nonprofit organizations for Highway Landscape and Urban Forestry, Resource Lands, or Roadside Recreational projects.
Eligibility	Local, state, federal agencies and nonprofit entities.
Further Information	Resources Agency MaryLou Shurteff, EEM Program Coordinator 1416 9th Street, Suite 1311 Sacramento, CA 95814 (916) 344-3596

Program Title	Environmental License Plate Fund
Objectives	Suppports a variety of projects that help to preserve or protect California's environment.
Requirements/Limitations	Projects are funded in one-year increments; projects must be separate, distinct with a clearly defined benefit.
Eligibility	State Agencies, boards, or commissions; city or county agencies; University of California, private nonprofit environmental and land acquisition organization, and private research organizations.
Further Information	Resource Agency Donna Gonder, Secretary to Harold Waraas 1416 9th Street, Room 1311 Sacramento, CA 95814 (916) 653-9709

Program Title	Financial Assistance for Ocean Resources Conservation and Assessment Program
Objectives	To determine the long-term consequences of human activities that affect the coastal and marine environment; to assess the consequences of these activities in terms of ecological, economic, and social impacts on human, physical and biotic environments, and to define and evaluate management alternatives that minimize adverse consequences of human use of coastal and marine environments and resources.
Type of Assistance/ Available Funds	Project grants (cooperative agreements)
Eligibility	Universities, colleges, technical schools, institutes, laboratories, state and local government agencies, public and private, profit and nonprofit entities, or individuals are eligible for these funds.
Examples	Development of a data set of characteristics of the Nation's coasts and oceans including erosion rates, coastal vulnerability indices, and coastal hazards for incorporation into a geographic information system and other microcomputer desktop information systems for further analyses.
Further Information	National Ocean Service Office of Ocean Resources Conservation and Assessment (N/ORCA) 1305 East-West Highway Silver Springs, MD 20910

Program Title	Flood Control Projects (Small Flood Control Projects)
Objectives	Reduction of flood damages through projects not specifically authorized by Congress. The Corps of Engineers designs and constructs the project. The local sponsor shares equally in the cost of feasibility studies and project costs and provides a cash contribution for project features other than flood control.
Type of Assistance/ Available Funds	Provision of specialized services. Limit of $5 million.
Further Information	Corps and Division Offices. U. S. Army Corps of Engineers Attn: CECW-PM Washington, D.C. 20314-1000 (202) 272-0144

Program Title	National Pollutant Discharge Elimination System Related State Program Grants
Objectives	Implement new requirements relating to NPDES program.
Type of Assistance/ Available Funds	Grants
Eligibility	States
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	National Water Quality Assessment Program (NAWQA)
Objectives	Investigations of surface water and groundwater resources of major regional hydrologic systems will be conducted on a rotating basis for 60 key areas located throughout the nation. The program will address a wide range of major water-quality issues.
Type of Assistance/ Available Funds	Provides water resources information.
Requirements/Limitations	Work must be consistent with the mission of the Water Resources Division of USGS.
Eligibility	Information available to anyone interested.
Examples	Study showed elevated levels of the pesticide DDT in fish in the Yakima River which prompted the Washington Department of Public Health to begin additional studies to determine whether a public health advisory is warranted.
Further Information	Office of the Deputy Assistant Chief Hydrologist for the Nation Water-Quality Assessment Program, Water Resources Division Geological Survey 407 National Center Reston, VA. 22092 (703) 648-5716

Program Title	Near Coastal Waters
Objectives	Improving the environmental condition of near coastal waters.
Type of Assistance/ Available Funds	Grants and Cooperative Agreements
Eligibility	States, other public and nonprofit agencies, institutions, organizations, and individuals.
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	Non-point Source (NPS) Water Quality Implementation Grant
Objectives	Controlling non-point source pollution in California water bodies.
Type of Assistance/ Available Funds	Grants *Note: 319 Funding - Federal
Requirements/Limitations	40% Match, Three years maximum
Eligibility	Public agencies, nonprofit organizations, and universities.
Examples	Erosion, sedimentation, hydrologic modification, etc.
Further Information	State Water Resources Control Board Division of Water Quality and Water Rights Non-point Source Unit Pablo Gutierrez P.O. Box 944213 Sacramento, CA 94244-2130 (916) 322-8342

Program Title	Plant Materials for Conservation
Objectives	Assemble, evaluate, select, release, introduce into commerce, and promote the use of new and improved plant materials for soil, water, and related resource conservation and environmental improvement programs both internationally and domestically.
Type of Assistance/ Available Funds	Provision of specialized services.
Further Information	National Technical Centers, state and field NRCS offices Deputy Chief for Technology Soil Conservation Service U. S. Department of Agriculture P.O. Box 2890 Washington D.C. 20013 (202) 720-3905

Program Title	Public Access Program
Objectives	Provide facilities that are suitable for wildlife associated recreational purposes.
Requirements/Limitations	Program to develop state projects in cooperation with local governmental agencies.
Eligibility	Any public agency of the state, or other state or federal agencies.
Examples	Fishing piers and floats, access roads, parking areas, etc.
Further Information	Department of Fish and Game Wildlife Conservation Board W. John Schmidt, Executive Director 801 K Street, Suite 806 Sacramento, CA 95814 (916) 445-8448

Program Title	Public Water System Supervision
Objectives	Carry out public water systems supervision programs.
Type of Assistance/ Available Funds	Formula Grants - 25 % Match
Program Title	Public Water System Supervision
Objectives	Carry out public water systems supervision programs.
Type of Assistance/ Available Funds	Formula Grants - 25 % Match
Eligibility	States and Indian Tribes
Further Information	Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	River Basin Surveys and Investigations (River Basin Planning)
Objectives	NRCS provides planning assistance to federal/state/local agencies for development of coordinated water and related land resources programs.
Type of Assistance/ Available Funds	Provision of specialized services.
Further Information	State NRCS offices. Deputy Chief for Programs Natural Resources Conservation Service U.S. Department of Agriculture P.O. Box 2890 Washington D.C 20013 (202) 720-4527

Program Title	Rivers, Trails and Conservation Programs
Objectives	Assist citizens to conserve rivers and establish trails on lands outside national parks and forests. The Park Service, in cooperation with citizens and government agencies is involved in the early phases of projects in setting up goals.
Type of Assistance/ Available Funds	Resource and planning expertise to help state and local partners.
Further Information	Recreation Resources and Assistance Division National Park Service U.S Department of the Interior P.O. Box 37127 Washington, D.C. 20013

Program Title	Soil and Water Conservation
Objectives	Plan and carry out a national soil and water conservation program, and to provide leadership in conservation, development, and productive use of the Nation's soil, water, and related resources.
Type of Assistance/ Available Funds	Advisory services and counseling to provide technical assistance to the general public through total resource planning and management to improve water quality and natural resources and to reduce point and non-point source pollution. Technical soil and water conservation resource assistance is provided to state and local governments.
Requirements/Limitations	Resource assistance needed is usually reviewed with the conservation district governing body.
Eligibility	General public, state governments, and local governments.
Further Information	State and field NRCS offices. Deputy Chief for Program Natural Resources Conservation Service U. S. Department of Agriculture P.O. Box 2890 Washington D.C. 20013 (202) 720-4527

Program Title	Stewardship Incentives Program
Objectives	Encourage individual landowners to improve the long term management and condition of their lands.
Type of Assistance/ Available Funds	Up to 75 percent cost share with a $10,000 limit per landowner per year.
Requirements/Limitations	Either 10 percent tree cover of capable of growing trees
Eligibility	Landowners with less than 1,000 acres (up to 5,000 with waiver)
Examples	Windbreak/Shelter break plantings, fish and wildlife improvement, agroforestry, riparian plantings, streambank stabilization, erosion reduction projects, woodland improvements
Further Information	Local California Department of Forestry and Fire Protection Forestry Advising Specialist

Program Title	Underground Injection Control
Objectives	Carry out underground injection control programs.
Type of Assistance/ Available Funds	Formula Grant - 25% Match
Eligibility	States and Indian Tribes
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	Urban Forestry Grant Program
Objectives	Planting trees along streets, dedicated open spaces, public parking lots, and school yards.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	90% of funds must be used for trees. 10% for public awareness and education.
Eligibility	Cities, counties, districts, and nonprofit organizations.
Examples	
Further Information	Department of Forestry and Fire Protection Resource Management Division James R. Geiger, Urban Forester 1416 9th Street, Room 1540-36 Sacramento, CA 95814 (916) 653-9448

Program Title	Urban Streams Restoration Grants
Objectives	Assist local government agencies and citizens groups to solve flooding and bank erosion problems in urban areas, using techniques which help restore the natural environmental value of the stream.
Type of Assistance/ Available Funds	Grants, Technical Assistance
Requirements/Limitations	Maximum grant of $200,000
Eligibility	Joint applications only from cooperating citizens groups and local government agencies.
Further Information	Department of Water Resources Division of Local Assistance Earle Cummings, Sara Denzler, Terrie Brown-Resse 1025 P Street P.O. Box 942836 Sacramento, CA. 94236-0001 (916) 327-1656, 327-1664, 323-9544

Program Title	Water Pollution Control State and Interstate Program Support
Objectives	To assist states, tribes, and interstate agencies in establishing and maintaining adequate measures for prevention and control of surface and groundwater pollution.
Type of Assistance/ Available Funds	Formula Grants
Requirements/Limitations	Funds cannot be used for construction, operation, or maintenance of waste treatment plants, nor can they be used for costs financed by other Federal grants.
Eligibility	States
Examples	Grants to states for the prevention, reduction, and control of pollution.
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	Water Quality Management Planning
Objectives	Provide water quality management planning to correct/prevent a wide variety of surface and groundwater problems. Agencies must have the capacity to perform and complete the proposed work.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	Funding for planning only and requires 25% non-federal match.
Eligibility	State, local or regional agencies.
Further Information	State Water Resources Control Board Division of Water Quality Water Quality Planning Program Paul Lillebo, Chief 901 P Street P.O. Box 100 Sacramento, CA 95801-0100 (916) 657-1031

Program Title	Watershed Protection and Flood Prevention (Small Watershed Program, PL-566 Program)
Objectives	Provide technical and financial assistance to state agencies and units of local governments in planning and carrying out works of improvement and to protect, develop and utilitize the land and water resources in small watersheds, less than 250,000 acres, including total resources Management and planning to improve water quality and solve problems caused by flooding, erosion and sediment damage, conservation, development, utilization, and disposal of water.
Type of Assistance/ Available Funds	Project grants, advisory services, counseling
Requirements/Limitations	Must meet set criteria.
Eligibility	State agencies, counties, municipality, soil and water conservation districts, flood prevention or flood control district, Indian tribe or tribal organization, or any other nonprofit agency with authority under state law to carry out, maintain, and operate watershed works of improvement.
Examples	Development of multipupose facilities for such uses as recreation, improvement of fish and wildlife habitat, irrigation, and water supply to municipal and industrial users.
Further Information	State NRCS Offices Deputy Chief for Programs Natural Resources Conservation Service U.S Department of Agriculture P.O. Box 2890 Washington D.C. 20013 (202) 720-4527

Program Title	Wetlands Protection Program
Objectives	Wetland protection activities, can involve other federal agencies, state agencies
Type of Assistance/ Available Funds	Grants - Part of the Clean Water Act
Eligibility	Other Federal Agencies, State Agencies
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

Program Title	Wetland Protection - State Development Grants
Objectives	Grant funds can be used to develop new wetland protection programs or refine existing wetland protection programs.
Type of Assistance/ Available Funds	Grants
Requirements/Limitations	Cost Share Program
Eligibility	States
Examples	
Further Information	US Environmental Protection Agency Region IX Mike Schulz, Chief 1235 Missouri Street Grants and Policy Branch San Francisco, CA 94105 (415) 744-1623

APPENDIX E
FIRE HISTORY

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COUNTY OF LOS ANGELES FIRE DEPARTMENT
REVEGETATION PROGRAM
MALIBU - SANTA MONICA MOUNTAINS AREA
1919 - 1990

DATE	NAME OF FIRE	ACRES BURNED
10/14 1985	**Piuma**	**5,120**
	Decker	**6,526**
	Piuma Fire caused by short circuit of power lines during high wind conditions. Damages: 2 single family dwellings; 2 vehicles and 1 commercial nursery. Loss estimated at $850,000. Acres: L.A. Co.-5,115; National Park lands-5. Decker Fire damages: 2 single family dwellings destroyed; 1 single family dwelling damaged; 4 guest houses destroyed; 2 mobile homes destroyed; 8 outside structures destroyed; and 3 vehicles destroyed. Losses estimated at $589,000.	
6/30 1985	**Sherwood**	**3,823**
10/9 1982	**Dayton**	**42,540**
	Damages: 34 dwellings destroyed; 17 dwellings damaged; 71 vehicles destroyed; 5 vehicles damaged; 54 mobile homes destroyed; 7 mobile homes damaged; 32 miscellaneous structures destroyed; 4 miscellaneous structures damaged.	
11/24 1980	**Las Virgenes**	**2,665**
	Fire caused by wind blowing power lines together and causing a short circuit. Sec.29,T1N,R17W.	
10/23 1978	**Mandeville**	**6,130**
	Thirty dwellings were damaged or destroyed. Watershed fuel estimated to be over 17 years of age at time of incident.	
10/23 1978	**Kanan**	**25,385**
	One long-time Malibu resident was caught in the open in firestorm conditions and was killed. In addition, there were 4 civilian injuries and 21 firefighter injuries. 230 dwellings were damaged or destroyed. Cause: Incendiary. Watershed fuel estimated to be over 43 years of age at time of incident.	

COUNTY OF LOS ANGELES FIRE DEPARTMENT
REVEGETATION PROGRAM
MALIBU - SANTA MONICA MOUNTAINS AREA
1919 - 1990
Page 2

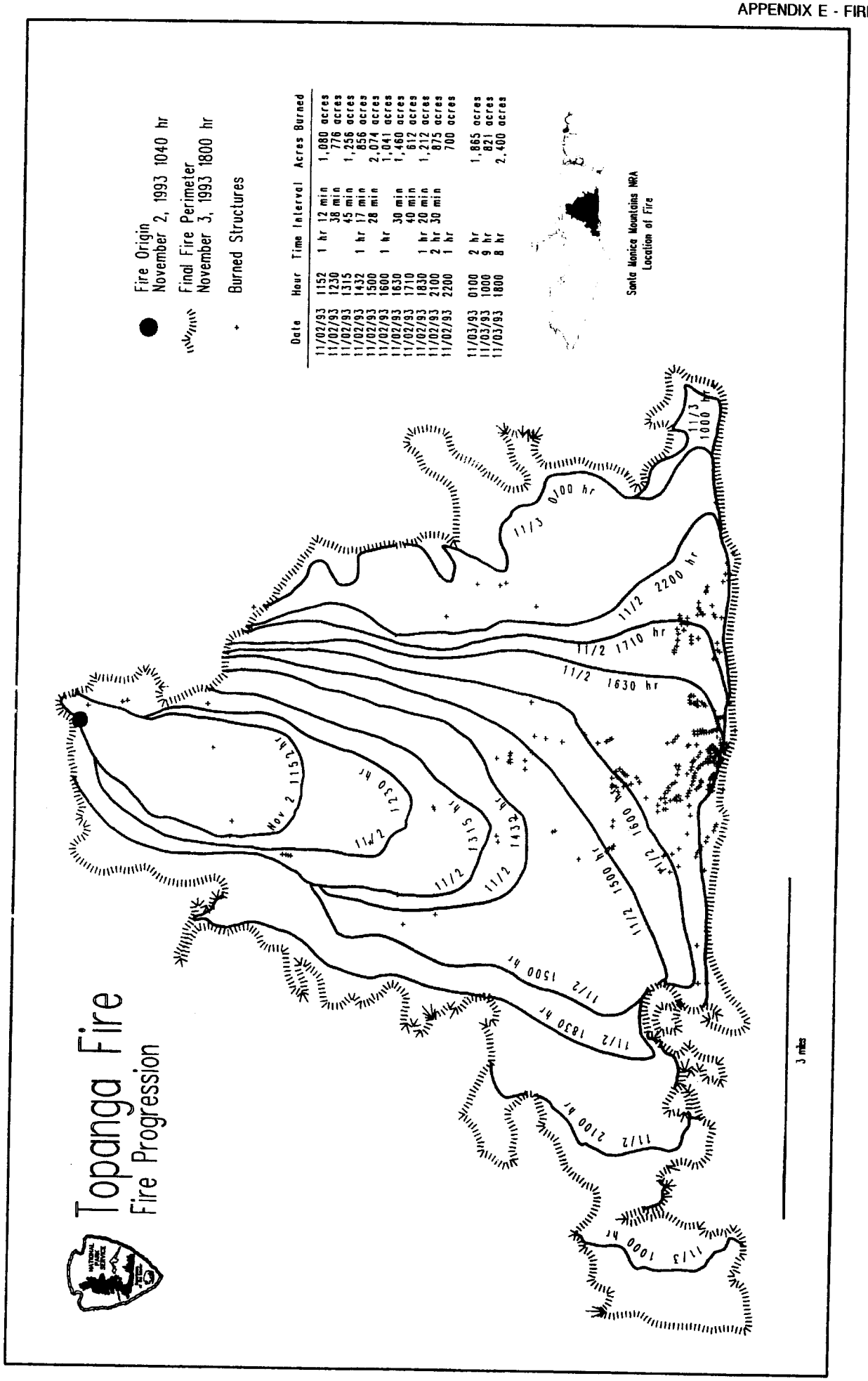
DATE	NAME OF FIRE	ACRES BURNED
11/17 1977	**Canyon**	**1,115**
	Damage to 5 single family dwellings, 5 vehicles, 1 barn, 1 bridge, 2 sheds, 1 garage, 1 miscellaneous building, and 1 power pole.	
11/15 1977	**Carlisle**	**1,360**
	Damages: One single family dwelling, two boats, and two power poles.	
10/30 1973	**Trippet**	**2,770**
	Sec.8,T1S,R16W. Acreage: 1,980-L.A.Co. & 790-L.A.City.	
9/27 1970	**Golf Course**	**200**
	T1N,R17W. Cause: Incendiary.	
9/25 1970	**Wright**	**27,925**
	103 dwellings were damaged or destroyed. T1S,R17W. Fire contained at 1800 hours on 9/27/70. Property damage estimated at $6,823,225. Fire caused by burning debris dropped along roadside. Watershed fuel was determined to be over 12 years of age at time of fire.	
10/30 1967	**Latigo**	**2,870**
	5 dwellings and 17 miscellaneous buildings destroyed.	
10/29 1967	**Junction**	**640**

COUNTY OF LOS ANGELES FIRE DEPARTMENT
REVEGETATION PROGRAM
MALIBU - SANTA MONICA MOUNTAINS AREA
1919 - 1990

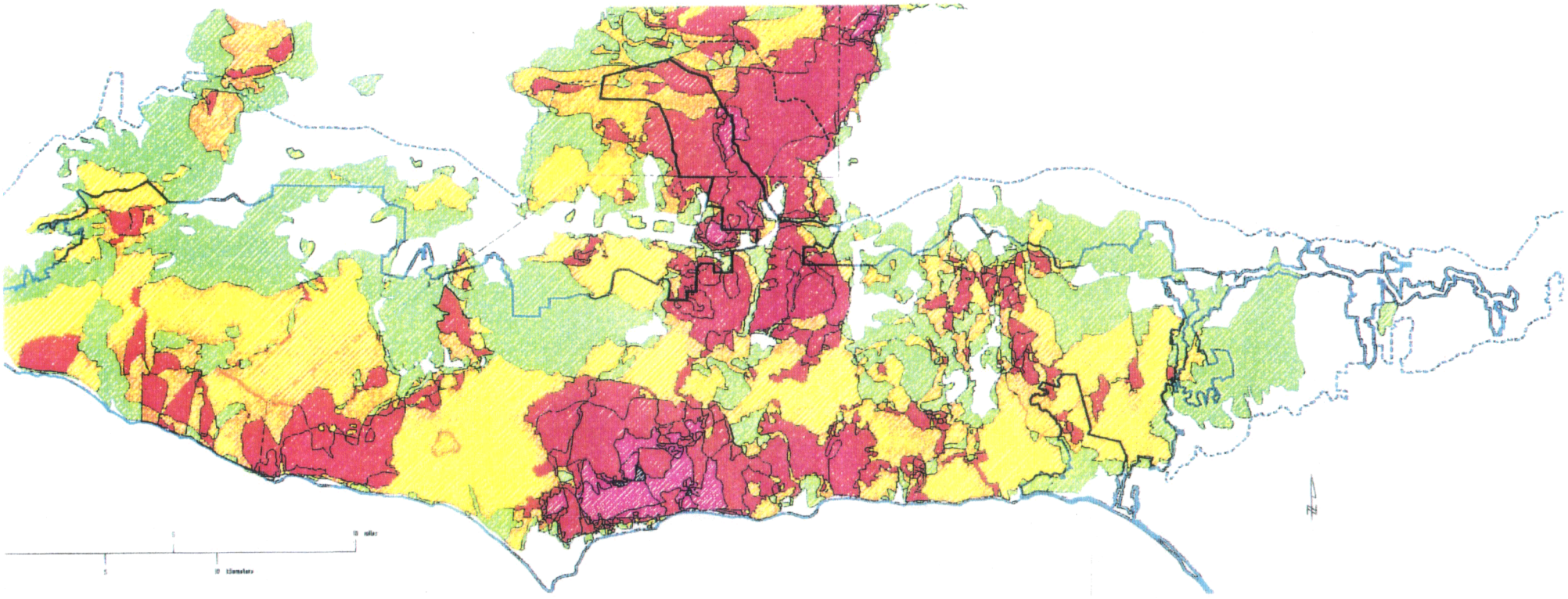
DATE	NAME OF FIRE	ACRES BURNED
11/6 1961	**Topanga**	**8,715**
	4 dwellings were destroyed and 6 damaged. Sec.29,T1n,R16W. Watershed fuel estimated to be over 23 years of age at time of incident. Weather: Temp.-78 degrees; Humidity-5%; Wind-NE @ 54 MPH; Dead Fuel Moisture-1.5%	
7/10 1959	**Laurel**	**300**
	38 structures damaged or destroyed.	
12/31 1958	**Mullholland**	**4,982**
	74 dwellings and 31 miscellaneous structures destroyed and 8 dwellings damaged. Watershed fuel estimated to be over 20 years of age at time of incident.	
12/2 1958	**Liberty**	**17,860**
	25 dwellings and 12 miscellaneous structures destroyed. 6 dwellings damaged. 8 burn injuries. Watershed fuel estimated to be over 15 years of age at time of incident.	
12/28 1956	**Sherwood**	**9,428**
	2,060 acres in Malibu & 7,368 acres in Ventura County. 13 dwellings destroyed. 1 fatality. Watershed fuel estimated to be over 21 years of age at time of incident.	
12/27 1956	**Hume**	**1,940**
	9 dwellings destroyed. Weather: 74 degrees, Wind-NE @ 36 MPH, & Humidity-17%. Watershed fuel estimated to be 14 years of age at time of incident.	

COUNTY OF LOS ANGELES FIRE DEPARTMENT
REVEGETATION PROGRAM
MALIBU - SANTA MONICA MOUNTAINS AREA
1919 - 1990

DATE	NAME OF FIRE	ACRES BURNED
12/26 1956	**Newton**	**26,170**
	24,120 acres in L.A. County & 2,050 acres in Ventura County. 1 civilian fatality. 69 single family dwellings were damaged or destroyed. Fire caused by burning material dropped by roadway. Watershed fuel estimated to be over 21 years of age at time of incident.	
11/4 1948	**Topanga**	**3,155**
10/20 1942	**Las Flores**	**5,924**
9/7 1936	**Cold Creek**	**2,561**
10/23 1935	**Las Flores Canyon**	**2,185**
TOTALS =	**25 Fires**	**212,289 Acres**
Averages/Fire =		8,491.6 Acres



Date	Hour	Time Interval	Acres Burned
11/02/93	1152	1 hr 12 min	1,080 acres
11/02/93	1230	38 min	776 acres
11/02/93	1315	45 min	1,256 acres
11/02/93	1432	1 hr 17 min	856 acres
11/02/93	1500	28 min	2,074 acres
11/02/93	1600	1 hr	1,041 acres
11/02/93	1630	30 min	1,460 acres
11/02/93	1710	40 min	612 acres
11/02/93	1830	1 hr 20 min	1,212 acres
11/02/93	2100	2 hr 30 min	875 acres
11/02/93	2200	1 hr	700 acres
11/03/93	0100	2 hr	1,865 acres
11/03/93	1000	9 hr	821 acres
11/03/93	1800	8 hr	2,400 acres



one
two
three to four
five to six
seven to eight

National Recreation Area Boundary
Santa Monica Mountains Zone
Los Angeles/Ventura County Line

Fires mapped by Los Angeles & Ventura County Fire Depts.
Plot produced by National Park Service October 1993
Santa Monica Mountains National Recreation Area GIS
(818) 597-1036 ext. 236

Fire History

Number of Fires since 1925

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