APPLICATION FOR RENEWAL OF
NPDES CA0107409 and
301(h) MODIFIED SECONDARY TREATMENT REQUIREMENTS

Point Loma Ocean Outfall

VOLUME V
APPENDICES G thru I

City of San Diego
Metropolitan Wastewater Department

November 2007

Application for Renewal of NPDES CA0107409

&

301(h) Modified Secondary Treatment Requirements for Biochemical Oxygen Demand and Total Suspended Solids

POINT LOMA OCEAN OUTFALL &

POINT LOMA WASTEWATER TREATMENT PLANT

Submitted under provisions of
Section 301(h) of the Clean Water Act

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Metropolitan Wastewater Department
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APPLICATION FOR RENEWAL OF NPDES CA0107409
&
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CITY OF SAN DIEGO
POINT LOMA OCEAN OUTFALL

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VOLUME V

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APPENDIX G

BENEFICIAL USE ASSESSMENT

For

CITY OF SAN DIEGO

APPLICATION FOR MODIFICATION OF SECONDARY TREATMENT REQUIREMENTS AT THE POINT LOMA TREATMENT FACILITY

To

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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INTRODUCTION

The term "beneficial uses" refers to the various ways water is beneficial to man and the environment. State and federal water quality standards are designed to protect existing and potential beneficial uses.

The California Water Quality Control Plan for Ocean Waters (Ocean Plan) identifies beneficial uses for California ocean waters, and establishes standards to protect them (SWRCB 2005). Beneficial uses specific to the San Diego Region are designated by the San Diego Regional Water Quality Control Board in the Basin Plan (SDRWQCB 2007a). The Regional Board also identifies beneficial uses in individual waste discharge orders or NPDES permits.

Thirteen beneficial uses are identified in the Point Loma Wastewater Treatment Plant NPDES permit (Table 1) (Regional Board Order No. R9-2002-0025, NPDES Permit No. CA0107409 (SDRWQCB 2003)).

Table 1. Point Loma Wastewater Treatment Plant NPDES Permit Beneficial Uses.

Water Contact Recreation (REC-1)	Recreational uses involving body contact with water, such as swimming, wading, water skiing, skin diving, windsailing, surfing, fishing from paddle craft, or other uses where ingestion of water is reasonably possible.
Non-Contact Water Recreation (REC-2)	Recreational uses involving the presence of water, but not necessarily requiring body contact, such as picnicking, sunbathing, hiking, beachcombing, sport fishing, pleasure boating, tide-pooling, marine life study and enjoyment.
Ocean Commercial and Non-freshwater Sport Fishing (COMM)	Commercial collection of fish and shellfish, including those collected for bait, plus sport fishing in the ocean, bays, estuaries, and similar non-freshwater areas.
Wildlife Habitat (WILD)	Provides a water or food supply (and supports a vegetative habitat) for the maintenance of wildlife.
Preservation of Rare and Endangered Species (RARE)	Provides an aquatic habitat which is necessary, at least in part, for the survival of identified rare and endangered species.
Marine Habitat (MAR)	Provides for the preservation of the marine ecosystem, including the propagation and sustenance of fish, shellfish, marine mammals, waterfowl, and marine vegetation.
Shellfish Harvesting (SHELL)	Collection of filter-feeding shellfish such as clams, oysters, and mussels for sport or commercial purposes.
Preservation and Enhancement of Biological	Waters support designated areas or habitats,

Table 1. Point Loma Wastewater Treatment Plant NPDES Permit Beneficial Uses.	
Habitats of Special Significance (BIOL)	including, but not limited to established refuges, parks, sanctuaries, ecological reserves or preserves, and Areas of Special Biological Significance (ASBS), where the preservation and enhancement of natural resources requires special protection.
Mariculture (MAR)	Promotes the culture of plants and animals in marine waters independent of any pollution source.
Migration of Aquatic Organisms (MIGR)	Supports and facilitates the migration of marine organisms.
Navigation (NAV)	Waters used for shipping, travel or other transportation by private, commercial or military vessels.
Spawning, Reproduction and/or Early Development (SPWN)	Waters supporting high quality habitats necessary for reproduction and early development of fish and wildlife.
Aesthetic Enjoyment (AE)	The appreciation of intangible assets associated with natural settings.

This Beneficial Use Assessment describes: 1) the existing environment at Point Loma, 2) beneficial uses in the vicinity of the Point Loma Wastewater Treatment Plant, 3) the effects of the existing Point Loma Wastewater Treatment Plant discharge on beneficial uses, and 4) the potential impacts of the proposed (future) operation of the Point Loma Wastewater Treatment Plant discharge. It also responds to the following specific questions in the Application for Modification of Secondary Treatment Requirements (Waiver Application):

- Are commercial or recreational fisheries located in areas potentially affected by the discharge?
- Have commercial or recreational fisheries been affected by the discharge?
- Do recreational activities take place in areas potentially affected by the discharge?
- Have recreational activities been affected by the discharge?
- Are there any Federal, State, or local restrictions on recreational activities in the vicinity of the discharge?

EXISTING ENVIRONMENT

Project Area

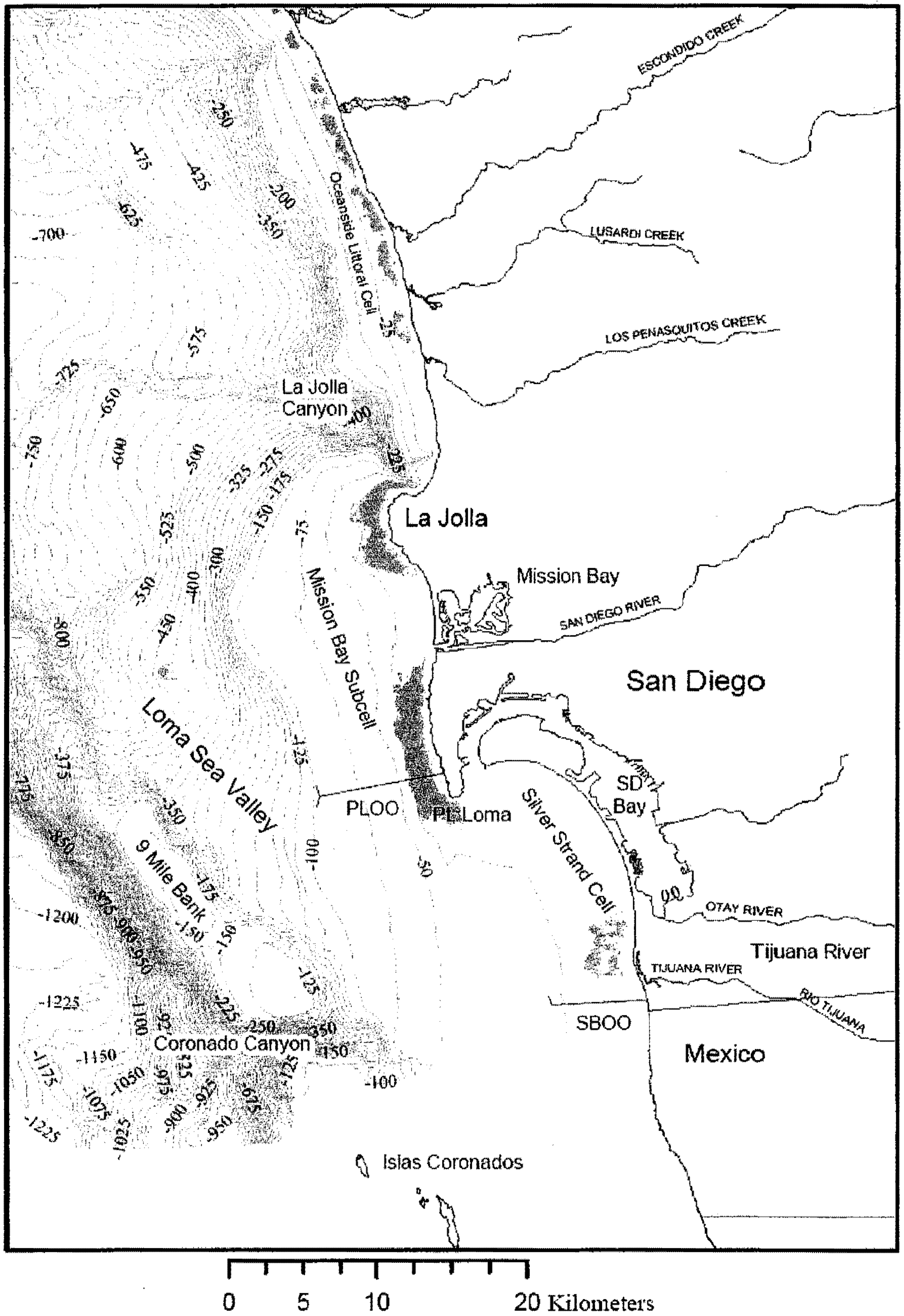
The marine waters off the Point Loma Wastewater Treatment Plant are located in the Southern California Bight - a broad ocean embayment created by an indentation of California's coastline south of Point Conception. The Southern California Bight extends from Point Conception south to Cabo Colnett, Baja California, Mexico, and west to the Santa Rosa-Cortes Ridge. The continental shelf in this area has several submarine valleys and submerged mountains, whose peaks form the offshore islands. Submarine ridges and troughs in the Southern California Bight generally run northwest to southeast; with the exception of the east-west trending Santa Barbara Channel.

The Southern California Bight's large urban population centers and busy harbors make it one of the most heavily utilized marine ecosystems on earth, yet the Southern California Bight supports a rich and varied assemblage of marine life and a wide diversity of habitats (Hood 1993, Schiff et al. 2000, CALTEC 2007).

Point Loma Wastewater Treatment Plant

The Point Loma Wastewater Treatment Plant treats approximately 170 million gallons per day (mgd) of wastewater, generated by more than 2.2 million residents and industries (with source controls) in a 450 square mile (mi^2) area. The Point Loma Wastewater Treatment Plant's overall capacity is 240 million gallons per day (mgd). Treated wastewater is discharged through the Point Loma Ocean Outfall 4.5 miles (mi) (7.2 kilometers (km)) offshore (Figure 1; note the grey areas off Point Loma and La Jolla represent kelp beds).

Figure 1. Location of the Point Loma Ocean Outfall.



The Point Loma Ocean Outfall is one of the longest and deepest ocean outfalls in the world. It was extended to its present location in 1993 and is buried in a trench from shore through the surf zone out to a distance of about 2,600 feet (ft) offshore. Over the next 400 ft the pipeline gradually emerges from the rock trench. Beyond 3,000 ft offshore, the remainder of the 4.5 mi pipeline rests on a bed of ballast rock on the sea floor. The end of the pipeline connects to a perforated "Y" diffuser section of two legs, each 2,500 ft long (762 meters (m)). Wastewater is discharged through diffuser ports ranging in depth from 306 ft (93.3 m) to 320 ft (97.5 m). Mathematical models of outfall operation indicate a median (50^{th} percentile) initial dilution of 338:1 at a discharge flow of 240 mgd (the maximum design flow) (see Volume I, Part 3, Chapter 4 - Large Applicant Questionaire). The minimum month initial dilution (the initial dilution as determined assuming zero ocean currents and using the worst case density conditions from over 13,000 density data profiles) is computed at 202:1.

The deep discharge and high initial dilution traps discharged, diluted wastewater at a depth of more than 130 ft (40 m) below the ocean surface. This keeps the outfall plume below the euphotic zone (the zone in which light penetrates) and away from the near-shore environment. Another favorable feature of the Point Loma Ocean Outfall is the location of the discharge near the break in the mainland shelf (Figure 1). The shelf drops precipitously immediately offshore from the diffuser, and a significant portion of the discharged solids are carried off into deep water.

The pipeline and diffusers with their supporting bed of ballast rock form an artificial reef. The pipe and rock, covered with encrusted organisms (tube worms, anemones, barnacles), provide food and shelter to a variety of fish and invertebrates. This artificial habitat covers an area of about 22 acres off Point Loma (assuming a 36 foot-width of pipe and ballast rock) (Wolfson and Glinski 1994).

Other Inputs

Besides the Point Loma Ocean Outfall, there are a number of other anthropogenic inputs to the continental shelf between La Jolla, California and the Mexico Border. The watershed of San Diego Bay covers ~ 415 mi^2 (1,074 square kilometers (km^2)) and includes Otay and Sweetwater Rivers as well as Telegraph Canyon, Chollas, Switzer, and Paradise Creeks. San Diego Bay is on the state's list of impaired water bodies, with sediments having high concentrations of polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) (EPA 2007a). Some areas of the bay are listed as impaired as a result of elevated coliform (indicator bacteria) levels. A rough estimate of San Diego Bay's daily water exchange is 24,000 mgd, approximately 130 times the volume of flow from the Point Loma Ocean Outfall (Bartlett et al. 2004).

Mission Bay receives runoff from approximately 56 mi^2 (145 km^2) of watershed. This includes the San Diego River system draining a very large watershed and contributing large flows. Approximately six square kilometers of Mission Bay have been identified by the San Diego Regional Water Quality Control Board as water-quality limited because of elevated concentrations of coliforms (EPA 2006). Other parts of the bay are also impaired as a result of elevated concentrations of lead. A rough estimate of the Mission Bay water exchange rate (not including San Diego River output) is 3,600 mgd, or roughly 20 times the volume of flow from the Point Loma Ocean Outfall (Bartlett et al. 2004).

Seven beaches in San Diego County are listed as bacteria-impaired waterbodies (EPA 2006) – all are located downstream of major watersheds (SDRWQCB 2007b). Ocean Beach is the closest of these bacteria-impaired beaches to the Point Loma Ocean Outfall, at a distance of seven miles away. San Diego River flows, dogs on the beach, and re-growth of indicator bacteria in wave-stranded kelp appear to be responsible for the prevailing impairment (see Beach Water Quality discussion in the Public Health Section).

Further south, the Tijuana River and Estuary have historically been a source of significant contamination of the ocean in the San Diego area. The watershed that flows into them is ~ 1,731 mi^2 (4,483 km^2) in area; nearly three quarters of this watershed is in Mexico. The City of Tijuana has had limited sewage treatment facilities, with resulting overflows that have drained into the River and Estuary. An average of 13–20 mgd of raw sewage flowed into the river during the 1980s (Bartlett et al. 2004). The Tijuana River and Estuary have elevated water and sediment levels of metals such as lead, zinc, copper, chromium (Pb, Zn, Cu, and Cr), and PCBs. These concentrations increased significantly in the 1990s, coinciding with the introduction and expansion of the maquiladora (industrialization) program in Mexico.

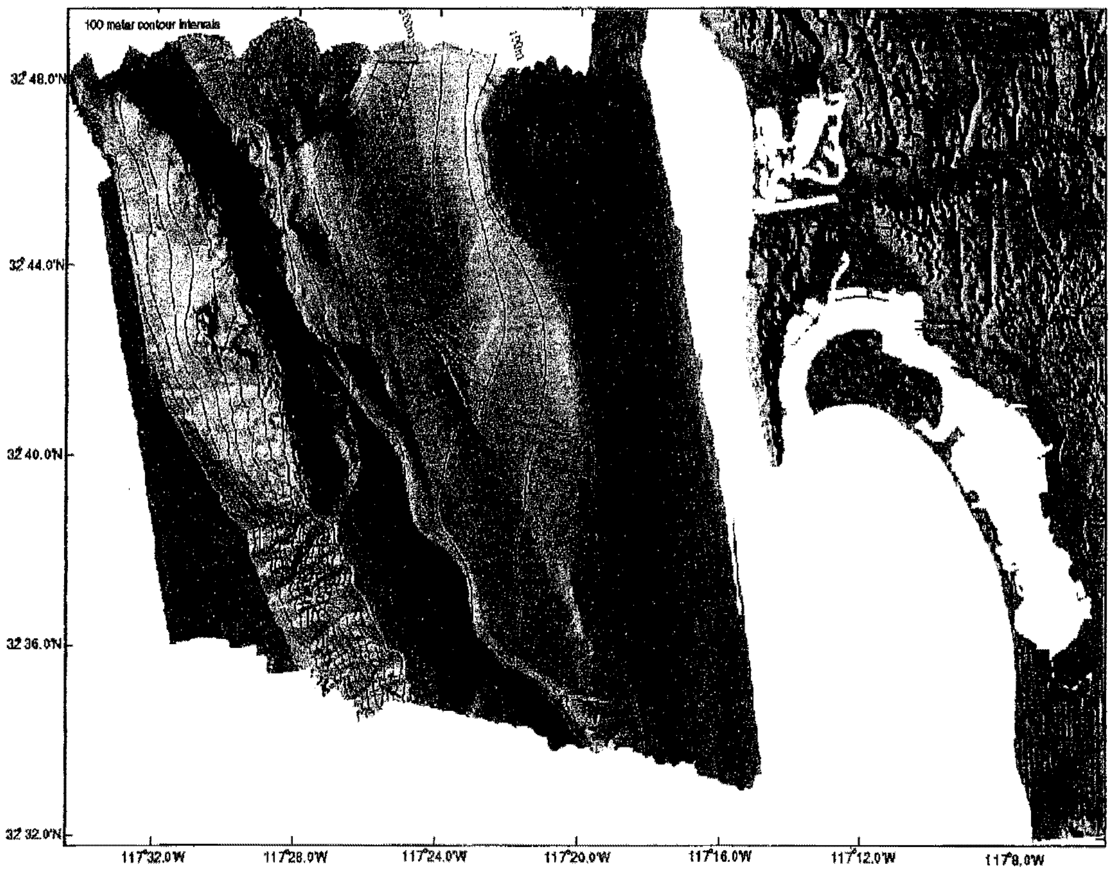
Offshore, the LA-5 dredge disposal site south of the Point Loma Ocean Outfall (Figure 1) ranges in depth from 100–125 m and was designed as a "non-dispersive" disposal site. Waste material is intended to remain stationary by virtue of being deep enough to limit resuspension by wave motion. The source of the material dumped at LA-5 is primarily sediments dredged from San Diego Bay. Because the material at LA-5 is from San Diego Bay, which has contaminated sediments, it is likely that sediments at the dredge disposal site are also contaminated. The results of a recent multibeam sonar survey indicate that waste material is not all located within the designated disposal area (Bartlett et al. 2004). A total of 252 mounds were observed outside the disposal site, many of these were elliptical, indicating that material was dumped while vessels were underway. Within LA-5, 10 mounds were observed covering ~54% of the area. Because this material was dumped inshore of the disposal site, these sediments may not remain stationary. The LA-5 site is just offshore of a ~50 m scarp, therefore, mounds dumped just inshore of the site are much shallower than intended. Resuspension from the shallower mounds constitute another source of contamination that could influence water quality and biological conditions in the vicinity of Point Loma. These illegal dumps could elevate sample contamination in the area that is unrelated to the Point Loma Ocean Outfall discharge.

Oceanographic Conditions

Bathymetry

Point Loma's shoreline is primarily rocky reef with an occasional cobble or sand pocket beach. The principal feature of the nearshore marine environment is a large kelp bed extending from the tip of Point Loma to the Mission Bay/San Diego River Jetty (6 mi). The kelp bed grows on a pavement-like mudstone/sandstone terrace from depths of about 25 ft to about 90 ft (between 1/2 mi from shore and 1 mi from shore). The terrace is incised by shallow surge channels and covered in parts by cobbles and boulders. The terrace edge, the remnant of a now submerged seacliff, lies in 100 ft depths. Here the bottom relief increases and pinnacles and large boulders tower above the fine gray bottom sands (CDFG 1968). In Figure 2 below, the demarcation between the white nearer shore areas and the darker gray offshore waters corresponds roughly to this break (off Point Loma only). This also corresponds with the outer limit of the kelp bed, or about 90 ft depth.

Figure 2. Seafloor Bathymetry off San Diego, California.



Map from: USGS 1998. Note: Each minute of latitude on the vertical axis represents 1 nautical mile.

Beyond the outer edge of the kelp bed, about 1 nautical mile (nm) from shore, the seafloor gradually slopes downward (at an angle of about 1.5 %) out to a shelf break at 350 ft, just outside of the 100 m contour line. Beyond the 100 m contour, the seafloor declines at an angle of 4% across the shelf break, then continues its gradual slope for another five miles out to a depth of 1,000 ft. This shelf area consists largely of unconsolidated bottom sediments.

Thermocline

The thermocline, a vertical transition zone of rapidly changing temperature that divides the upper layer of warmer water from the colder, deeper layer, is located between the surface and deepwater circulation zones. Because density is controlled largely by temperature, the thermocline coincides with the pycnocline, a vertical zone of rapidly changing density. The density gradient across the pycnocline causes resistance to vertical mixing, restricting exchange between the surface waters and the deeper, colder waters. This phenomenon is referred to as water column stratification.

Maximum sea surface temperatures occur from July to September with a sharp decline in temperature over the first 20 m of the water column (Dailey et al. 1993). From November to April, the water column becomes less stratified as upwelling mixes deeper waters into the surface (Dailey et al. 1993). Interannual variations in the depth of the thermocline appear to be correlated with long-term climatic changes, including El Niño and the Pacific Decadal Oscillation (Miller 1996, Benjamin and Carton 1999).

Water Circulation

The cold California Current is the major surface current in the area. This broad, slowly meandering, south-moving current extends from Vancouver, Canada to the southern tip of Baja California, Mexico from shore to several hundred miles offshore. In deep waters offshore of the continental shelf, flows are southward all year round; however, over the continental shelf, southward flows occur only in spring, summer, and fall. During winter months, flow over the shelf reverses, and water moves northward as the Davidson Current. The transitions between northward and southward flows on the shelf occur seasonally, in March/April and October/November, thus are termed the "spring transition and fall transition" (DON 2005).

Below the thermocline, the California Undercurrent flows northward with speeds ranging from 3 to 25 centimeters per second (cm/sec); the maximum water velocity occurs at a depth of 60 m (Jackson 1986, NRC 1990). This northward flow opposes the California Current at the surface and spans the entire mid-latitude eastern boundary of the North Pacific (Pierce et al. 2000). The California Undercurrent is typically found inshore of the California Current and is composed of water originating in the Equatorial Pacific (NRC 1990). The flow of the California Undercurrent is relatively weak; its maximum strength occurs during the summer months and a secondary maximum occurs in the winter (Hickey 1993, Perry et al. 2007). This water mass can be delineated from deep water contained farther offshore in the California Current because the water of the California Undercurrent contains higher nutrient concentrations and lower dissolved oxygen concentrations (Estrada and Blasco 1979, NRC 1990).

Deepwater circulation can be divided into three seasonal patterns (NRC 1990, DON 1999). From December to February, flow is strengthened and partially displaces the California Current to the west. From March to June, along-shore winds strengthen and drive the surface waters to create upwelling of deep cold water to the surface along the coast. The shift offshore creates a condition in which the California Current intensifies in localized areas due to bottom topography and current strength. July to November the California Current dominates, weakening the California Undercurrent (DON 1999). In general, the water contained in the California Undercurrent does not reach the surface. However, during periods of weak California Current flow (winter months or during an El Niño event), the California Undercurrent may reach the surface offshore of Los Angeles, join the California Countercurrent (known as the Davidson Current north of Point Conception), and flow as far north as Vancouver Island, Canada (NRC 1990).

Upwelling

Upwelling is a wind driven, dynamic process that brings nutrient-rich deep water to the surface and nutrient-poor surface waters offshore through the interaction of currents, density, or bathymetry (Mann and Lazier 1991). In wind driven upwelling, warmer surface waters are transported perpendicular to the direction of the wind. Deep, cold water moves vertically into the euphotic zone to replace the nutrient-poor surface water that was transported offshore (Burtenshaw et al. 2004).

Winds that promote upwelling are generally strong along the California coastline; upwelling in this region is variable in strength and occurs throughout the year with the strongest upwelling occurring in the spring and summer months (Schwing et al. 2000, Leet et al. 2001, Perry et al. 2007). In the Southern California Bight, however, upwelling tends to be limited to late winter and early spring due to a large reduction in wind stress (Perry et al. 2007). Coastal upwelling is arguably the dominant process affecting the physical and ecological structure of eastern boundary current systems, including the California Current System (Schwing et al. 2000). Coastal upwelling substantially affects regional and local oceanic circulation, thermohaline structure and stability, and water mass exchange between the coastal and deep ocean waters (Schwing et al. 2000, Perry et al. 2007). Intense upwelling has been correlated to recruitment success for commercially important fish stocks in coastal California waters.

Biological Environment

Marine life can be conveniently grouped into categories that reflect their spatial position in the ocean. Pelagic species occupy the water column. Epibenthic species live above the bottom, and benthic species live on the bottom or in the sediments. A general description of the food chain follows, beginning with the smallest organisms (plankton) and ending with the largest.

Plankton

Plankton float or drift passively with currents and water masses, they form the base of the oceanic food web. Plankton include a wide variety of bacteria (bacterioplankton), plant-like organisms and algae (phytoplankton), and animals (zooplankton) including fish larvae (ichthyoplankton). Although most planktonic species are microscopic, the term plankton is not synonymous with small size; some jellyfish can be as large as 10 ft (3 m) in diameter.

Phytoplankton

Phytoplankton are plant-like organisms that use sunlight and chlorophyll to photosynthesize organic matter. Phytoplankton floating in the ocean's surface layers produce most of the organic matter in the sea that is essential to overall ocean productivity; the distributions of most marine organisms are linked to phytoplankton productivity.

In general, the distribution of phytoplankton is patchy, occurring in regions with the optimal conditions for growth. Nearshore ocean waters typically have a higher nutrient content and foster greater primary productivity and plankton biomass, than open ocean waters (Hurlburt and Rodman 1963).

In the Southern California Bight, waters from both the north and the south mix and promote increased phytoplankton abundance and diversity (DON 1999). Over 280 species of phytoplankton have been reported in the vicinity (Abbott and Hollenberg

1976). The diversity of phytoplankton species in the region reflects the transition from subarctic waters in the north to more subtropical waters in the south (Hardy 1993). The highest levels of productivity occur in the spring/summer months and the lowest levels of production occur during the winter months (Burtenshaw et al. 2004). In regions where the overall nutrient concentrations are low, the phytoplankton communities are dominated by small nanoplankton and picoplankton that contribute substantially to the overall productivity in the region (Hardy 1993, Karl 1999, Higgins and Mackey 2000).

The effects of El Niño on chlorophyll and phytoplankton communities are more difficult to quantify than trends in physical parameters because the long-term data set is limited (Hayward 2000). However, several trends have emerged. Along the California coast, there is a decrease in phytoplankton production in the surface waters due in part to a decrease of upwelling strength (Kahru and Mitchell 2000, Santamaria-del-Angel et al. 2002, Hernández de la Torre et al. 2004). This causes the chlorophyll maximum to occur deeper in the water column in conjunction with deeper nutrient concentrations (Fiedler 1984, McGowan 1984; Hayward 2000). In addition, El Niño conditions weaken the California Current and tend to favor an increase in subtropical species (Leet et al. 2001, Santamaria-del-Angel et al. 2002). Following an El Niño, coastal phytoplankton abundance increases to long-term average levels (Lavaniegos et al. 2003, Hernández de la Torre et al. 2004). Conversely, La Niña conditions cause a shift towards more subarctic phytoplankton species (Goes et al. 2001).

Like other coastal regions, southern California can experience large blooms of phytoplankton. Blooms of harmful algal species can pose serious public health threats; the economic impact of Harmful Algal Blooms can total hundreds of millions of dollars annually (DON 2005). In the Southern California Bight, Harmful Algal Blooms are associated with the widespread mortality of wildlife including birds, fish, and marine mammals (Scholin et al. 2000, Trainer et al. 2000). Major Harmful Algal Blooms of the diatom *Psuedo-nitchia* spp. and the dinoflagellates *Lingulodinium polyedrum*, *Gymondimium polyedra, G. splendis*, and *Prorocentrum micans* have been reported in southern California (Hardy 1993, Kudela et al. 2003). In many cases, these blooms form in the south and propagate to the north; however, it is difficult to monitor, predict, and understand the origins and fate of Harmful Algal Blooms (Kudela et al. 2003). In 1995, a large red tide of the non-toxic dinoflagellate *L. polyedrum* extended from the upper Baja peninsula in the south to Monterey Bay in the north and constituted the largest and most widespread red tide off the California coast since 1902 (Kudela et al. 2003). In the spring of 1998, the California coast harbored the toxic dinoflagellate *Pseudo-nitchia* spp. in relatively low abundances. Following 1998, a series of *Pseudo-nitchia* blooms occurred in 2000 and 2002 that extended along much of the California coastline (Kudela et al. 2003). Runoff events (Kudela and Cochlan 2000) and decreases in upwelling strength (Trainer et al. 2000, Kudela et al. 2003) are believed to be the main causes of these harmful phytoplankton blooms in the vicinity.

Zooplankton

Zooplankton cannot photosynthesize and therefore rely upon phytoplankton as a source of food. They are taxonomically and structurally diverse, ranging in size from microscopic unicellular organisms to large multicellular organisms. Zooplankton may be herbivorous (consuming plants), carnivorous (consuming animals), detrivorous (consuming dead organic material), or omnivorous (consuming a mixed diet). Examples of zooplankton include foraminifera, pteropods, copepods, and myctophid fish.

Along the California coast, zooplankton biomass has been shown to be unrelated to upwelling strength (Bernal and McGowan 1981). Rather, the abundance of zooplankton is related to the strength of the California Current such that high levels of flow result in high zooplankton biomass (Bernal and McGowan 1981, Dawson and Pieper 1993, Leet et al. 2001). The zooplankton biomass tends to reach its maximum in the summer months; this coincides with peak krill (*Euphausia pacifica*, i.e., euphausiid) biomass. The high abundance of euphasiids attracts whales to congregate and feed off the California and Mexico coastlines (Burtenshaw et al. 2004).

In the Southern California Bight, El Niño and La Niña conditions affect the distribution of zooplankton. During strong El Niño events, macrozooplankton biomass declines substantially (Roemmich and McGowan 1995a, b, McGowan et al. 1998); during the 1998 El Niño event, the macrozooplankton biomass was lower than ever documented in the 1951 to 1998 record (Hayward et al. 1999). In addition, southern, warm-water species become more abundant and northern, cool-water species decline (Hayward 2000, Leet et al. 2001).

During La Niña conditions, macrozooplankton biomass is anomalously high and subarctic species are more abundant (Schwing et al. 2000). Schwing et al. (2000) hypothesized that increased upwelling during a La Niña event can negatively impact the recruitment of benthic nearshore organisms (urchins, barnacles, and crabs); these organisms are dependant on relaxed upwelling conditions to transport planktonic larvae onshore for settlement (Schwing et al. 2000).

Nekton

Nekton are organisms that swim freely, are generally independent of currents, and range in size from microscopic to gigantic, such as whales. Nekton include invertebrates (e.g., squid) and vertebrates (marine mammals, sea turtles and fish).

FISHERIES

Introduction

The marine environment in the vicinity of Point Loma supports a wide variety of commercial and recreational fisheries. The following section begins with a description of commercial fisheries managed by federal and state agencies. These fisheries are protected and managed by the Magnuson-Stevens Fishery Conservation and Management Act through its "Essential Fish Habitat" provisions and by California's Nearshore Fishery Management Plan. Recreational fishing activity is described next. Commercial and recreational fisheries catch in the Point Loma area is then tallied for the period 2000-2006.

This assessment uses the term "fish" to include both cartilaginous species - sharks, skates, and rays - and bony species. Cartilaginous fish, as the name implies, have a skeleton of cartilage, which is partially calcified, but is not true bone. Bony fish also have cartilage, but their skeletons consist of calcified bone.

Essential Fish Habitat

Regulatory Background

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 established jurisdiction over marine fishery resources in the 200-nm (370-km) U.S. Exclusive Economic Zone. The Magnuson-Stevens Fishery Conservation and Management Act was reauthorized and amended by the Sustainable Fisheries Act of 1996 which provided a new habitat conservation tool: the Essential Fish Habitat (EFH) mandate. The Sustainable Fisheries Act requires that regional Fishery Management Councils (FMCs) identify EFH for federally Managed Species (i.e., species covered under Fishery Management Plans (FMPs).

Congress defined EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 United States Code [U.S.C.] 1802[10]). The term "fish" is defined in the Sustainable Fisheries Act as "finfish, mollusks, crustaceans, and all other forms of marine animals and plant life other than marine mammals and birds". The U.S. National Marine Fisheries Service (NMFS) in 2002 further clarified EFH with the following definitions (50 Code of Federal Regulations (CFR) 600.05–600.930): "Waters" include all aquatic areas and their associated biological, chemical, and physical properties that are used by fish and may include aquatic areas historically used by fish where appropriate; "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "Necessary" means the habitat required to support a sustainable fishery and the 'Managed Species' contribution to a healthy ecosystem; and "Spawning, breeding, feeding, or growth to maturity" covers a species' "full life cycle" (NMFS 2002a).

The Sustainable Fisheries Act requires that EFH be identified and mapped for each federally Managed Species. The NMFS and regional FMCs determine the species' distributions by life stage and characterize associated habitats, including Habitat Areas of Particular Concern (HAPC). HAPC are discrete areas within EFH that either play especially important ecological roles in the life cycles of Managed Species or are especially vulnerable to degradation from human-induced activities (50 CFR 600.815[a][8]). The Sustainable Fisheries Act requires federal agencies to consult with the NMFS on activities that may adversely affect EFH. For actions that affect a threatened or endangered species, or its critical habitat, and its EFH, federal agencies must integrate Endangered Species Act (ESA) and EFH consultations.

An Essential Fish Habitat Assessment (EFHA) is a critical review of the proposed project and its potential impacts to EFH. As set forth in the rules (50 CFR 600.920[e][3]), EFHAs must include (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the action on EFH, the Managed Species and associated species; (3) the federal agency's views regarding the effects of the action on EFH; and (4) proposed mitigation, if applicable. Once the NMFS learns of a federal or state activity that may have adverse effects on designated EFH, the NMFS is required to develop EFH consultation recommendations for the activity. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH (NMFS 2002a).

Environmental Setting

An indentation of California's coastline south of Point Conception creates a broad ocean embayment known as the Southern California Bight. The Southern California Bight encompasses the area from Point Conception south to Mexico, including the offshore Channel Islands, and is influenced by two major oceanic currents: the southward-flowing, cold-water California Current and the northward-flowing, warm-water California Countercurrent (DON 2005, Perry et al. 2007). These currents mix in the Southern California Bight and strongly influence patterns of ocean water circulation, sea temperatures, and distributional trends of marine flora and fauna assemblages along the southern California coast and Channel Islands (Folley et al. 1993).

The Southern California Bight is a region of diverse ichthyofauna. High species richness is a product of the region's complex oceanographic topography and the convergence of multiple, influential water masses (Cross and Allen 1993, DON 2005). The Southern California Bight is home to over 480 species of marine fish and more than 5,000 species of marine invertebrates (Cross and Allen 1993, Schiff et al. 2000, Allen et al. 2006). The diversity of species, fish and invertebrates, is greatest in southern California and declines as one moves north through the region (Horn and Allen 1978, Horn et al. 2006). The project area is located within a transitional zone between subarctic and subtropical water masses. Specifically, Point Conception, California (34.5° North (N)) is the distinguished ichthyofaunal boundary between subtropical species (i.e., species with preferences of temperatures above 50-68° F (10° to 20°) Centigrade (C)) of the San Diego Province and temperate fish species (i.e., species with temperature preferences below 59° F (15° C) of the Oregon Province (Horn and Allen 1978, Froese and Pauly 2004, Horn et al. 2006).

The California Current system is rich in microscopic organisms (i.e., diatoms, tintinnids, and dinoflagellates) which form the base of the food chain in the area (DON 2005). Small coastal pelagic fish and squid depend on this planktonic food supply and in turn are fed upon by larger species. Groundfish (e.g., flatfish, roundfish, skates/sharks/chimeras, rockfish, etc.) are important recreational and commercial species (Love 2006). The shelf and slope demersal rockfish are the most specious genus of fish off the western coast of North America (Love et al. 2000). These fish are typically the dominant species documented in many ichthyological surveys, in terms of abundance and diversity, especially between the 20 to 200 m isobaths (Mearns et al. 1980). Highly Migratory Species (HMS) (e.g., tuna, billfish, sharks, dolphinfish, and swordfish) and Coastal Pelagic Species (CPS) (e.g., anchovies, mackerels, sardines, and squids) support extensive fisheries in the area (Allen and Cross 2006).

The diverse habitats of the Southern California Bight greatly influence the distribution of fish and invertebrates in the area (Horn et al. 2006). Cross and Allen (1993) defined these habitats in three broad categories: the pelagic zone, soft substrate habitats (i.e., bays, estuaries, open coast), and hard substrate and kelp bed habitats (i.e., rocky habitats, reefs). The pelagic zone, relating to open water, is the largest habitat in the area with 40% of the fish species inhabiting this area. This zone is subdivided into three distinct regions: epipelagic (up to 50 m deep), mesopelagic (50 to 500 m deep), and bathypelagic regions (greater than 500 m deep) (Cross and Allen 1993). The epipelagic region is inhabited by small, planktivorous schooling fish (e.g., northern anchovy), predatory schooling fish (e.g., Pacific mackerel), and large solitary predators (e.g., blue shark). Abundance of all epipelagic species changes seasonally with fish moving offshore to spawn. The northern anchovy is the most abundant epipelagic species in the study area. The mesopelagic region is characterized by steep environmental gradients and fish that are small, slow growing, long-lived, and reproduce early and repeatedly (e.g., bigeye lightfish). The bathypelagic zone is a rather uniform region containing large, sluggish, fast growing, short-lived fish, that reproduce late and typically only once (e.g., bigscale and hatchetfish) (Cross and Allen 1993).

Typical fish utilizing soft substrates (sand, silt, and mud) include sharks, skates, rays, smelts, flatfish (flounders), gobies and northern anchovies (Pondella and Allen 2000)). Regions with hard substrates and kelp beds (*Macrocystis*) are not as abundant as other benthic habitats in the Southern California Bight, but they nevertheless provide important habitats for many species. Shallow reefs (i.e., <30 m depth) are the most common type of hard substrate (i.e., coarse sand, calcareous organic debris, rocks) found in the study area (Cross and Allen 1993, DON 2005). These reefs also support kelp beds, which provide nursery areas for various fish species. Rocky intertidal regions are often turbulent, dynamic environments, where organisms must cope with stresses associated with tides (e.g., changes in temperature, salinity, oxygen, and pH). Deep reef fish, found along deep banks and seamounts, are typically large, mobile species (e.g., rockfish and spiny dogfish). Kelp beds are regions with a high diversity of fish species. Smaller fish feed on high plankton densities in the area, while larger fish are attracted to these habitats to feed on smaller species. They are especially important habitats for young-of-the-year rockfish species, such as the kelp rockfish, whose densities correlate to the size of the kelp bed (McCain 2003).

Inshore areas (bays and estuaries) provide important nursery habitats and feeding grounds to a variety of species, some of commercial importance (e.g., California halibut) (Allen, L. G. et al. 2002). San Diego Bay's seagrass beds are used by schooling species, such as anchovies and topsmelt (Cross and Allen 1993) with the highest abundance and biomass of fish occurring in the spring (i.e., April) and summer (i.e., July) (Allen M. J. et al. 2002). Juvenile northern anchovy, topsmelt, and slough anchovy comprise up to 79% of the fish in the Bay (Allen, L. G. et al. 2002).

The influence of the California Current on the physical and biological environment of the Southern California Bight undergoes significant year-to-year fluctuations (Horn and Stephens 2006). Its impact is also affected by larger-scale climate variations, such as El Niño-La Niña and the Pacific Decadal Oscillation (Hickey 1993). El Niño-La Niña (also called the El Niño Southern Oscillation) is the result of interannual changes in sea level pressures between the eastern and western hemispheres of the tropical Pacific; these events can initiate large shifts in the global climate, atmospheric circulation, and oceanographic processes (NOAA 2007a). El Niño conditions typically last 6 to 18 months although they can persist for longer periods of time. They are the main signs of global change over time scales of months to years (Benjamin and Carlton 1999, Schwing et al. 2000). Under normal conditions, rainfall is low in the eastern Pacific and is high over the warm waters of the western Pacific. El Niño conditions occur when unusually high atmospheric pressure develops over the western tropical Pacific and Indian Oceans and low sea level pressure develops in the southeastern Pacific. During El Niño conditions, the trade winds weaken in the central and west Pacific; thus, the normal east to west surface water transport and upwelling along South America decreases. This results in increased (sometimes extreme) rainfall across the southern U.S. and Peru and drought conditions in the western Pacific (NOAA 2007a). La Niña is the opposite phase of El Niño in the Southern Oscillation cycle. La Niña is characterized by strong trade winds that push the warm surface waters back across to the western Pacific increasing upwelling along the eastern Pacific coastline, causing unusually cold sea surface temperatures. The Pacific Decadal Oscillation is a longer-term climatic pattern than El Niño with similar warm and cool phases that may persist for 20 to 30 years (Miller 1996, Benjamin and Carton 1999).

During years experiencing an El Niño event, tropical species (i.e., species with temperature preferences above 68° F (20° C) begin to migrate into the study area, while temperate species, which normally inhabit the area, move north and out of the region (Froese and Pauly 2004). For example, two tropical species, the Mexican barracuda and scalloped hammerhead shark, were recorded off southern California for the first time during the 1997/1998 El Niño event (Moser et al. 2000). Rockfish are particularly sensitive to El Niño, with these events resulting in recruitment failure and adults exhibiting reduced growth. Ultimately, a decline in biomass results and a poor overall condition in the region becomes evident, such as landings of market squid being dramatically decreased during the 1997/1998 El Niño event (Hayward 2000).

During El Niño years, San Diego Bay often becomes a refuge for subtropical/tropical species that have a normal distribution further south than the study area (Allen, M. J. et al. 2002). For example, from April 1997 through July 1998, three new fish (bonefish, yellowfin goby, and longtail goby and three new invertebrate species (arched swimming crab, Mexican brown shrimp, and a bivalve species (*Petricola hertzana*) were recorded in the southern California estuaries of the San Diego coastal region (i.e., Tijuana Estuary and Los Peñasquito Lagoon), while northern anchovy, the dominant species in San Diego Bay, was virtually absent during the El Niño event (Allen, M. J. et al. 2002). Species moving into these areas are typically incapable of reproducing or establishing permanent populations due to the short-term nature of these events.

Past La Niña events have not had such a dramatic impact on ichthyofauna and marine invertebrate populations as El Niño events. Nevertheless, La Niña years can result in below normal recruitment for many invertebrate species (e.g., rock crabs), and larval rockfish abundance has been reportedly low during years experiencing La Niña events (Lundquist et al. 2000). Cooling trend years (i.e., 1999 La Niña event) have increased abundance and commercial landings of herring, anchovies, and squid populations (Hayward 2000; Lluch-Belda et al. 2003).

Fishery Management Plans

Under the Magnuson-Stevens Fishery Conservation and Management Act, the federal government has jurisdiction to manage fisheries in the U. S. Exclusive Economic Zone which extends from the outer boundary of state waters (3 nm (5.6 km) from shore) to a distance of 200 nm (370 km) from shore. Offshore fisheries in the Southern California

Bight are managed by the NMFS with assistance from the Pacific Fisheries Management Council (PFMC) (PFMC 2007a), and the Southwest Fisheries Science Center (National Oceanic and Fisheries Administration (NOAA)) (NOAA 2007b,c). Inshore fisheries (less than 3 nm (5.6 km)) from shore are managed by the California Department of Fish and Game (CDFG) (CDFG 2007) through the Nearshore Fishery Management Plan. However, in practice, state and federal fisheries agencies manage fisheries cooperatively and FMPs generally cover the area from coastal estuaries out to 200 nm (370 km) offshore.

Fishery Management Plans are extensive documents that are constantly revised and updated. The Pacific Coast Groundfish Fishery Management Plan, for example, originally produced in 1977, has been amended 19 times (PFMC 2006a). FMPs describe the nature, status, and history of the fishery, and, specify management recommendations, yields, quotas, regulations, and harvest guidelines. Associated Environmental Impact Statements (EISs) addresses the biological and socioeconomic consequences of management policies. Fishery Management Councils have web sites that present the various elements of their FMPs, current standards and regulations, committee hearings and decisions, research reports, source documents, and links to related sites (see, for example, PFMC 2007b). Further, recent coverage of the ecology of marine fish, fisheries, and environmental issues in California is presented in reviews by Allen 2006, Allen and Cross 2006, Pondella and Horn 2006, Horn and Stephens 2006, Horn et al. 2006, and Love 2006.

The Fisheries Management Plans (FMPs) with EFH for species that could be affected by the Point Loma discharge are the Pacific Groundfish FMP (83 species) (Pacific Fishery Management Council (PFMC 2006a), the Coastal Pelagic Species (CPS) FMP (6 species) (PFMC 2003, 2005), and the U. S. West Coast Fisheries for Highly Migratory Species (HMS) (13 species) (PFMC 2006b) (Table 2). Essential Fish Habitat for Pacific coast salmon is north of Point Conception and not found in the area.

The Pacific halibut (*Hippoglossus stenolepis*), a flat groundfish, is regulated by the United States and Canada through a bilateral commission, the International Pacific Halibut Commission (IPHC) (IPHC 2007) and is therefore not in a federal FMP. The usual range of Pacific halibut is from Santa Barbara, California to Nome, Alaska. It would not usually be found in the Point Loma area.

Table 2. Federal Fishery Management Plans Covering the Southern California Bight.

Groundfish Management Plan Species	**Groundfish Species cont.**
http://www.pcouncil.org/groundfish/gffmp.html.	Squarespot rockfish (*Sebastes hopkinsi*)
Flatfish	Starry rockfish (*Sebastes constellatus*)
Arrowtooth flounder *(Atheresthes stomias)*	Stripetail rockfish (*Sebastes saxicola*)
Butter sole *(Isopsetta isolepis)*	Swordspine rockfish (*Sebastes ensifer*)
Curlfin sole (*Pleuronichthys decurrens*)	Tiger rockfish (*Sebastes nigrocinctus*)
Dover sole (*Microstomus pacificus*)	Treefish (*Sebastes serriceps*)
English sole (*Parophrys vetulus*)	Vermillion rockfish (*Sebastes miniatus*)
Flathead sole *(Hippoglossoides elassodon)*	Widow rockfish (*Sebastes entomelas*)

Table 2. Federal Fishery Management Plans Covering the Southern California Bight.

Pacific sanddab (*Citharichthys sordidus*)	Yelloweye rockfish (*Sebastes ruberrimus*)
Petrale sole (*Eopsetta jordani*)	Yellowmouth rockfish (*Sebastes reedi*)
Rex sole (*Glyptocephalus zachirus*)	Yellowtail rockfish (*Sebastes flavidus*)
Rock sole (*Lepidopsetta bilineata*)	<u>Scorpionfish</u>
Sand sole (*Psettichthys melanostictus*)	Ca. scorpionfish (*Scorpaena guttatta*)
Starry flounder (*Platichthys stellatus*)	<u>Thorneyheads</u>
<u>Rockfish</u>	Longspine thornyhead (*Sebastolobus altivelis*)
Aurora rockfish (*Sebastes aurora*)	Shortspine thornyhead (*S. alascanus*)
Bank rockfish (*Sebastes rufus*)	<u>Roundfish</u>
Black rockfish (*Sebastes melanops*)	Cabezon (*Scorpaenichthvs marmoratus*)
Black-and-yellow rockfish (*S. chrysomelas*)	Kelp greenling (*Hexagrammos decagrammus*)
Blackgill rockfish (*Sebastes melanostomus*)	Lingcod (*Opiodon elongatus*)
Blue rockfish (*Sebastes mystinus*)	Pacific cod (*Gadus macrocephalus*)
Bocaccio (*Sebastes paucispinis*)	Pacific hake (*Merluccius productus*)
Bronzespotted rockfish (*Sebastes gilli*)	Sablefish (*Anoplopoma fimbria*)
Brown rockfish (*Sebastes auriculatus*)	<u>Skates, Sharks and Chimeras</u>
Calico rockfish (*Sebastes dallii*)	Big skate (*Raja binoculata*)
Canary rockfish (*Sebastes pinniger*)	California skate (*Raja inornata*)
Chameleon rockfish (*Sebastes phillipei*)	Finescale codling (*Antimora microlepis)*
Chilipepper (*Sebastes goodei*)	Leopard shark (*Triakis semifasciata*)
China rockfish (*Sebastes nebulosus)*	Longnose skate (*Raja rhina*)
Copper rockfish (*Sebastes caurinus*)	Pacific rattail (*Coryphaenoides acrolepis)*
Cowcod (*Sebastes levis*)	Soupfin shark (*Galeorhinus zyopterus*)
Darkblotched rockfish (*Sebastes crameri*)	Spiny dogfish (*Squalus acanthias*)
Dusky rockfish (*Sebastes ciliatus*)	Spotted ratfish (*Hydrolagus colliei*)
Dwarf-red rockfish (*Sebastes rufinanus*)	
Flag rockfish (*Sebastes rubrivinctus*)	**Coastal Pelagic Management Plan Species**
Freckled rockfish (*Sebastes lentiginosus*)	http://www.pcouncil.org/cps/cpsfmp.html
Gopher rockfish (*Sebastes carnatus*)	Jack mackerel (*Traxchurus symmetricus*)
Grass rockfish (*Sebastes rastrelliger*)	Krill (euphausiids)
Greenblotched rockfish (*Sebastes rosenblatti*)	Pacific mackerel (*Scomber japonicus*)
Greenspotted rockfish (*Sebastes chlorostictus*)	Pacific sardine(*Sardinops sagax*)
Greenstriped rockfish (*Sebastes elongatus*)	Market squid (*Loligo opalescens*)
Half-banded rockfish (*Sebastes semicinctus*)	Northern anchovy (*Engraulis mordax*)
Harlequin rockfish (*Sebastes variegates*)	
Honeycomb rockfish (*Sebastes umbrosus*)	**Highly Migratory Management Plan Species**
Kelp rockfish (*Sebastes atrovirensnus*)	http://www.pcouncil.org/hms/hmsfmp.html
Mexican rockfish (*Sebastes macdonaldi*)	<u>Sharks</u>
Olive rockfish (*Sebastes serranoides*)	
Pacific ocean perch (*Sebastes alutus*)	

Table 2. Federal Fishery Management Plans Covering the Southern California Bight.	
Pink rockfish (*Sebastes eos*)	Bigeye thresher shark (*Alopias superciliosus*)
Pinkrose rockfish (*Sebastes simulator*)	Blue shark (*Prionace glauca*)
Puget Sound rockfish (*Sebastes emphaeus*)	Common thresher shark (*Alopias vulpinus*)
Pygmy rockfish (*Sebastes wilsoni*)	Pelagic thresher shark (*Alopias pelagicus*)
Quillback rockfish (*Sebastes maliger*)	Shortfin mako shark (*Isurus oxyrinchus*)
Redbanded rockfish (*Sebastes babcocki*)	Tunas
Redstripe rockfish (*Sebastes proriger*)	Albacore tuna (*Thunnus alalunga*)
Rosethorn rockfish (*Sebastes helvomaculatus*)	Bigeye tuna (*Thunnus obesus*)
Rosy rockfish (*Sebastes rosaceus*)	Northern bluefin tuna (*Thunnus orientalis*)
Rougheye rockfish (*Sebastes aleutianus*)	Skipjack tuna (*Katsuwonus pelamis*)
Semaphore rockfish (*Sebastes melanosema*)	Yellowfin tuna (*Thunnus albacares*)
Sharpchin rockfish (*Sebastes zacentrus*)	Billfish
Shortbelly rockfish (*Sebastes jordani*)	Striped marlin (*Tetrapturus audax*)
Shortraker rockfish (Sebastes borealis)	Swordfish
Silvergray rockfish (*Sebastes brevispinis*)	Broadbill swordfish (*Xiphias gladius*)
Speckled rockfish (*Sebastes ovalis*)	Dolphin-fish
	Dorado (mahi mahi) (*Coryphaena hippurus*)
Source: NMFS 2005a, PFMC 2003, 2005, 2006a, b.	

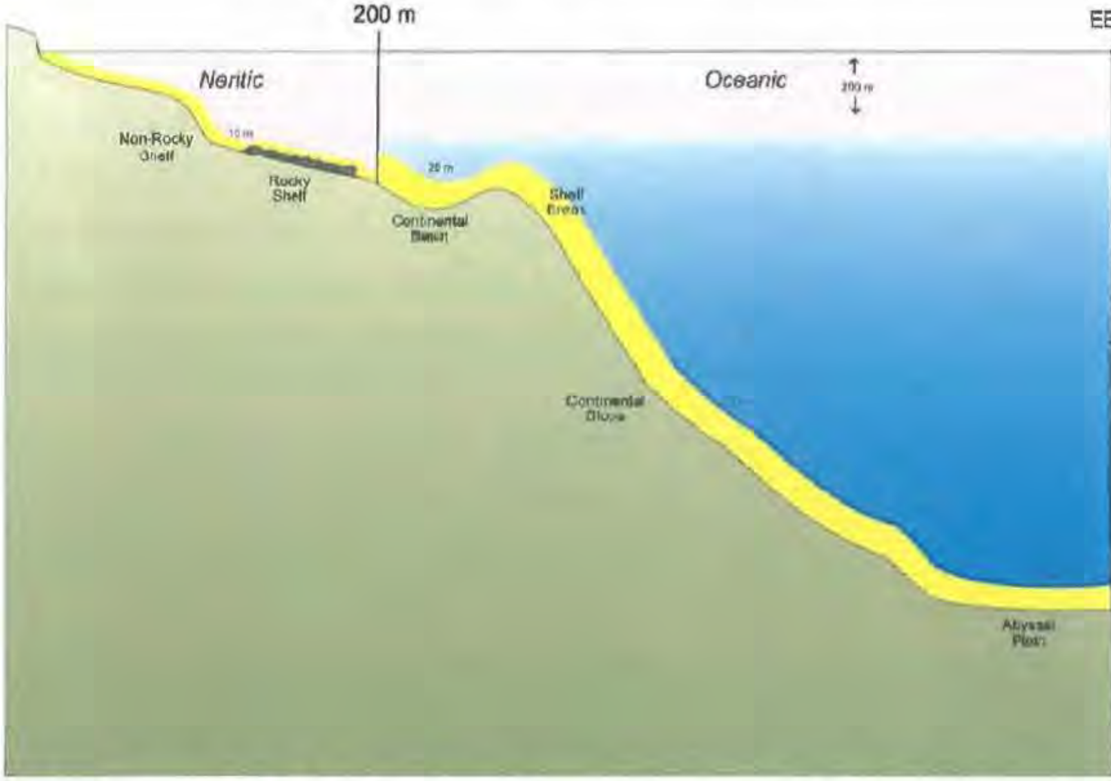
EFH Descriptions and Identifications

The National Marine Fisheries Service and the Pacific Fishery Management Council designate Essential Fish Habitat and develop Fishery Management Plans for all fisheries occurring within the Southern California Bight from Point Conception to the U.S./Mexico border. The Sustainable Fisheries Act contains provisions for identifying and protecting habitat essential to federally Managed Species. The FMPs identify EFH, describe EFH impacts (fishing and non-fishing), and suggest measures to conserve and enhance EFH. The FMPs also designate Habitat Areas of Particular Concern (HAPCs) where one or more of the following criteria are demonstrated: (a) important ecological function; (b) sensitivity to human-induced environmental degradation; (c) development activities stressing the habitat type; or (d) rarity of habitat.

With respect to EFH, nearshore areas are considered to be shallower than 120 ft (36 m) with offshore areas beyond that depth. The continental shelf is considered to begin at the 656 ft (200 m) contour (Figure 3: from DON 2005).

Fish are generally categorized as pelagic (living in the water column), benthic (living on or near the ocean bottom), or demersal (associated with the ocean bottom, but also feeding in the water column). Pelagic species may be further distinguished by the depth at which they are typically found: epipelagic (0-656 ft (0-200m)), mesopelagic (656-2,296 ft (200-700 m)), bathypelagic (2,296-6,561 ft (700-2,000 m)), or abyssopelagic (more that 6,561 ft (2,000 m)) (DON 2005).

Figure 3. Pacific Coast Groundfish Locations.



The Pacific Groundfish FMP divides EFH into seven composite habitats including their waters, substrates, and biological communities: 1) estuaries - coastal bays and lagoons, 2) rocky shelf - on or within 33 ft (10 m) of rocky bottom (excluding canyons) from the high tide line to the continental shelf break, 3) nonrocky shelf - on or within 33 ft (10 m) of unconsolidated bottom (excluding the rocky shelf and canyons) from the high tide line to the continental shelf break, 4) canyon - submarine canyons, 5) continental slope/basin - on or within 66 ft (20 m) of the bottom of the continental slope and basin below the shelf break extending to the westward boundary of the Exclusive Economic Zone, 6) neritic zone - the water column more than 33 ft (10 m) (narrow yellow band above) above the continental shelf, and 7) oceanic zone - the water column more than 66 ft (20 m) (wide yellow band above) above the continental slope and abyssal plain, extending to the westward boundary of the Exclusive Economic Zone (PFMC 2006a).

The groundfish species managed by the Pacific Groundfish FMP range throughout the Exclusive Economic Zone and occupy diverse habitats at all stages in their life histories (Table 3). Some species are broadly dispersed during specific life stages, especially those with pelagic eggs and larvae. The distribution of other species and/or life stages may be relatively limited, as with adults of many nearshore rockfish which show strong affinities to a particular location or substrate type.

Table 3. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * = Associated with macrophytes, algae, or seagrass. (From DON 2005).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope/Basin	Ocean
Flatfish							
Curlfin Sole			A, SA	E		A, SA	E
Dover Sole			A, SA, J	L, E		A, SA, J	L, E
English Sole	A*, SA, J*, L*, E	A*, SA, J*	A*, SA, J*	L*, E		A*	
Petrale Sole			A, J	L, E		A, SA	L, E
Rex Sole	A		A, SA	E		A, SA	L, E
Rock Sole		A*, SA*, J*, E*	A*, SA*, J*, E*	L		A*, SA*, J*, E*	
Sand Sole			A, SA, J	L, E			
Pacific Sanddab	J, L, E		A*, SA, J	L, E			L, E
Rockfish							
Aurora Rockfish			A, MA, LJ			A, MA, LJ	L
Bank Rockfish		A, J	A, J		A, J	A, J	
Black Rockfish	A*, SJ*	LJ*	LJ*	A*, SJ*			A*
Black-and-yellow Rockfish		A*, MA, LJ*, SJ*, P		L*			
Blackgill Rockfish		LJ		SJ, L		A, LJ	S, LJ
Blue Rockfish		A*, MA, LJ*	LJ*	SJ*,L			
Bocaccio	SJ*, L	A*, LJ*	A*, LJ*	SJ*, L	LJ*	A*, LJ*	
Bronzespotted Rockfish						A	
Brown Rockfish	A*, MA, J*, P	A*, MA, J*, P					
Calico Rockfish	A, J	A, J	A, J				
Canary Rockfish		A, P		SJ*, L		A, P	SJ*, L
Chilipepper		A, LJ, P	A, LJ, P	SJ*, L		A, LJ, P	
China Rockfish		A, J, P		L			
Copper Rockfish	A*, LJ*,	A*, LJ*		SJ*, P			

Table 3. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * = Associated with macrophytes, algae, or seagrass. (From DON 2005).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope/Basin	Ocean
	SJ*, P						
Cowcod		A, J	J	L			
Darkblotched Rockfish		A, MA, LJ, P	A, MA, LJ, P			A, MA, P	SJ, L
Flag Rockfish		A, P					
Gopher Rockfish		A*, MA, J*, P	A*, A, J*, P				
Grass Rockfish		A*, J*, P					
Greenblotched Rockfish		A, J, P	A, J, P		A, J, P	A, P	
Greenspotted Rockfish		A, J, P	A, J, P				
Greenstriped Rockfish		A, P	A, P				
Honeycomb Rockfish		A, J, P			J		
Kelp Rockfish	SJ*	A*, LJ*, P		SJ*			
Mexican Rockfish		A	A	L			L
Olive Rockfish		A*, J*, P			A*, P		
Pacific Ocean Perch		A, LJ	A, LJ	SJ	A	A, P	SJ, L
Pink Rockfish		A	A			A	
Redbanded Rockfish			A			A	
Redstripe Rockfish		A, P				A, P	
Rosethorn Rockfish		A, P	A, P			A, P	
Rosy Rockfish		A, J, P					
Rougheye Rockfish		A	A			A	
Sharpchin Rockfish		A, P	A, P			A, P	L
Shortbelly Rockfish		A*, P	A*, P		A*, P	A*, P	
Silverygray Rockfish		A*	A*			A*	
Speckled Rockfish		A, J, P			A, P	A, P	
Splitnose Rockfish			A, J*, P			A, P	
Squarespot Rockfish		A, P			A, P		
Starry Rockfish		A, P				A, P	
Stripetail Rockfish			A, P			A, P	
Tiger Rockfish		A				A	

Table 3. Groundfish Species Essential Fish Habitat.							
Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * = Associated with macrophytes, algae, or seagrass. (From DON 2005).							
Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope/Basin	Ocean
Treefish		A					
Vermilion Rockfish		A, J*	J*		A	A	
Widow Rockfish		A, MA, LJ,P	A, MA, LJ, P	SJ*, L	A, MA, LJ, P	A, MA, P	SJ*, L
Yelloweye Rockfish		A, P				A, P	
Yellowtail Rockfish		A, MA, LJ, P	A, MA, LJ, P	SJ*		A, MA, P	SJ*
Scorpionfish							
California Scorpionfish	E	A, SA, J	A, SA, J	E			
Thornyhead							
Longspine Thornyhead						A, SA, J	L, E
Shortspine Thornyhead			A			A, SA	L, E
Roundfish							
Cabezon	A, SA, LJ, SJ*, L, E	A, SA, LJ, E		SJ*, L			SJ*, L
Kelp Greenling	A*, SA, LJ*, SJ*, L, E	A*, SA, LJ*, E		SJ*, L			SJ*, L
Lingcod	A*, SA, LJ*, SJ*, L, E	A*, SA, LJ*, E	A*, LJ*	SJ*, L		A*	
Pacific Cod	A, SA, J, L, E		A, SA, J, E	A, SA, J, L		A, SA, E	A, SA, J, L
Pacific Hake (Whiting)	A, SA, J, L, E			A, SA, J, L, E			A, SA, L, E
Pacific Flatnose					A	A	
Pacific Grenadier			A, SA, J			A, SA, J	L
Sablefish	SJ	A	A, LJ	SJ, L	A, LJ	A, SA	SJ, L, E

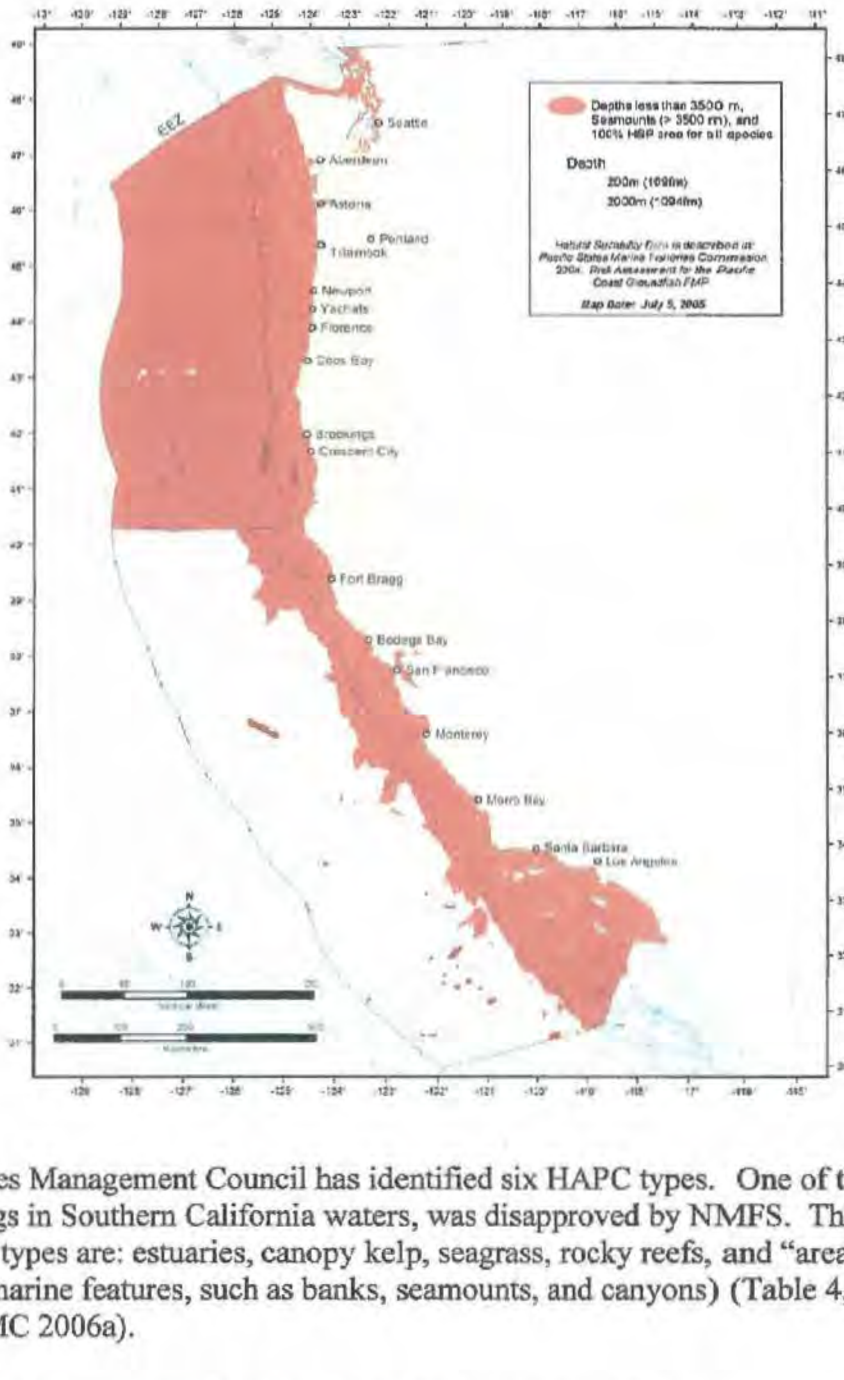
Table 3. Groundfish Species Essential Fish Habitat.

Pacific Groundfish Species EFH and Lifestages Associated With the Seven EFH Designations. A = Adults, SA = Spawning Adults, MA = Mating Adults, LJ = Large Juveniles, SJ = Small Juveniles, J = Juveniles, L = Larvae, E = Eggs, P = Parturition (PFMC 2006a). * = Associated with macrophytes, algae, or seagrass. (From DON 2005).

Group/Species	Estuarine	Rocky Shelf	Non-Rocky Shelf	Neritic	Canyon	Continental Slope/Basin	Ocean
Skates/Sharks/ Chimeras							
Big Skate			A, MA, J, E			A, MA	
California Skate	A, MA, J, E		A, MA, J, E			A, MA, J, E	
Longnose Skate			A, MA, J, E			A, MA, J, E	
Leopard Shark	A, MA, J, P	A, MA, J, P	A, MA, J, P	A, MA, J, P			
Soupfin Shark	A, MA, J, P	A, MA, J	A, MA, J, P	A, MA, J, P	A, MA, J		A, MA, J
Spiny Dogfish	A, LJ, SJ, P	A, MA, LJ	A, LJ, P	A, LJ, SJ	A	A, MA	A
Spotted Ratfish	A, MA, J	A, MA, J E	A, MA, J E			A, MA, J, E	

The Groundfish Management Plan designates EFH for Managed Species (i.e., those covered under FMPs) as: all waters and substrate within the following areas; 1) depths less than or equal to 11,483 ft (3,500 m) to mean higher high water level or the upriver extent of saltwater intrusion, 2) seamounts in depths greater than 11,483 ft (3,500 m), and 3) areas designated as HAPCs not already identified by the above criteria (Figure 4, from PFMC 2006a).

Figure 4. Groundfish Essential Fish Habitat.



The Pacific Fisheries Management Council has identified six HAPC types. One of these types, certain oil rigs in Southern California waters, was disapproved by NMFS. The current five HAPC types are: estuaries, canopy kelp, seagrass, rocky reefs, and "areas of interest" (e.g., submarine features, such as banks, seamounts, and canyons) (Table 4, Figure 5, from PFMC 2006a).

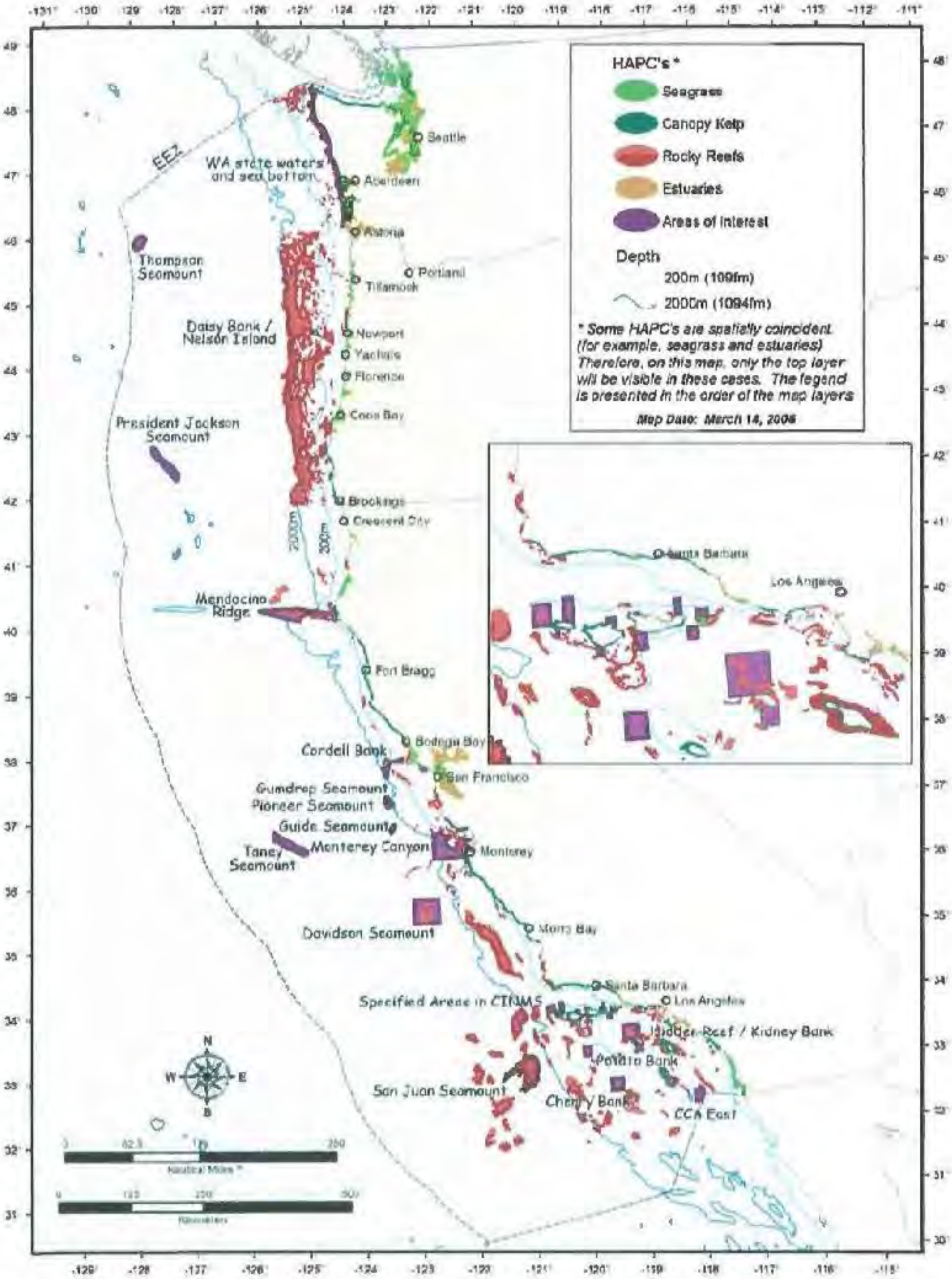
Table 4. Essential Fish Habitat in the Southern California Bight.

Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPCs) (NMFS 2005a, PFMC 2003, 2005, 2006a,b).

	EFH	HAPCs
Pacific Groundfish	Marine and esturarine waters less than or equal to 11,483 ft (3,500 m) to mean higher high water	Estuaries, canopy kelp, sea grass,

Table 4. Essential Fish Habitat in the Southern California Bight.		
	level or the upwater extent of seawater intrusion, seamounts in depths greater than 3,500 m, and areas designated as HAPCs not identified by the above criteria.	rocky reefs, and other areas of interest.
Coastal Pelagic Species	All marine and estuarine waters above the thermocline from the shoreline offshore to 200 nm offshore.	No HAPCs designated.
Highly Migratory Species	All marine waters from the shoreline offshore to 200 nm offshore.	No HAPCs designated.
Pacific Coast Salmon	North of project area.	North of project area.

Figure 5. Groundfish Habitat Areas of Particular Concern.



EFH identified for Managed Coastal Pelagic Species is wide-ranging. It includes the geographical range where they are currently found, have been found in the past, and may be found in the future (PFMC 2003, 2005). In the Southern California Bight, the CPS EFH constitutes all marine and estuarine waters above the thermocline from the shoreline offshore to the limits of the Exclusive Economic Zone with no HAPCs designated (PFMC 2005). The thermocline is an area in the water column where water temperature changes rapidly, usually from colder at the bottom to warmer on top. The CPS live near the surface primarily above the thermocline, and within a few hundred miles of the coast, so their designated EFH (Table 5) is less complex than for Groundfish Managed Species.

Table 5. Coastal Pelagic Species Essential Fish Habitat.			
Coastal Pelagic Species and Lifestages Associated with EFH designations. A = Adults, J = Juveniles, L = Larvae, E = Eggs. (PFMC 2003, 2005).			
Group/Species	Coastal epipelagic	Coastal mesopelagic	Coastal benthic
Krill	E, L, J, A		
Northern anchovy	E, L, J, A		
Mackerels	E, L, J, A		
Sardine	E, L, J, A		
Market Squid	L, J, A		E

Only market squid are significantly associated with benthic environments; the females lay their eggs in sheaths on sandy bottom in 33-165 ft (10-50 m) depths (PFMC 2003). The CPS are found in shallow waters and within bays and even brackish waters, but are not considered dependent upon these habitats. They prefer temperatures in the 50-82.4 °F (10-28 °C) range with successful spawning and reproduction occurring from 57.2-60.8 °F (14-16 °C). Larger, older individuals are generally found farther offshore and farther north than younger, smaller individuals. Northern areas tend to be utilized most often when temperatures and abundance is high. All lifestages of all CPS species are found in the Southern California Bight.

EFH for Highly Migratory Species (Table 6) such as tuna, sharks and billfish is even more extensive than for CPS (PFMC 2006b). HMS range widely in the ocean, both in terms of area and depth. They are usually not associated with the features typically considered fish habitat (estuaries, seagrass beds, rocky bottoms). Their habitat selection appears to be less related to physical features and more to temperature ranges, salinity levels, oxygen levels, and to currents. For the U.S. West Coast Fisheries for Highly Migratory Species, EFH occurs throughout the Southern California Bight (PFMC 2006b). The PFMC has currently identified no HAPC for HMS.

Table 6. Highly Migratory Species Essential Fish Habitat.				
Highly Migratory Species and Lifestages Associated with EFH Designations. A = Adults, SA = Sub-Adults, LJ = Late Juveniles, N= Neonate, EJ = Early Juveniles, J = Juveniles, L = Larvae, E = Eggs. (PFMC 2006b, 2007b).				
Group/Species	Coastal epi-pelagic	Coastal meso-pelagic	Oceanic epi-pelagic	Oceanic meso-pelagic
Sharks				
Blue Shark			N, EJ, LJ, SA, A	
Shortfin Mako			N, EJ, LJ, SJ, A	
Thresher Sharks	LJ, SA, A	LJ, SA, A	LJ, SA, A	LJ, SA, A

Table 6. Highly Migratory Species Essential Fish Habitat.				
Tunas				
Albacore			J, A	
Bigeye Tuna			J, A	J, A
Northern Bluefin			J	
Skipjack			A	
Yellowfin			J	
Billfish				
Striped Marlin			A	
Swordfish				
Broadbill Swordfish			J, A	J, A
Dolphinfish				
Dorado			J, SA, A	

Managed Species

Groundfish Managed Species are found throughout the Southern California Bight. As indicated above, EFH for groundfish includes all waters from the high tide line (and parts of estuaries) to 11,483 ft (3,500 m; 1,914 fathoms (fm)) in depth (Figure 4) (PFMC 2006a).

The Pacific coast groundfish fishery is the largest, most important fishery managed by the Pacific Fishery Management Council in terms of landings and value (PFMC 2006a). The 83 species managed under the Pacific Groundfish Management Plan are usually found on or near the bottom; rockfish - 63 species including widow, yellowtail, canary, shortbelly, and vermilion rockfish; bocaccio, chilipepper, cowcod, yelloweye, thornyheads, and Pacific Ocean perch; roundfish - six species: lingcod, cabezon, kelp greenling, Pacific cod, Pacific whiting (hake), and sablefish; flatfish - 12 species including various soles, starry flounder, and sanddab; sharks and skates - six species: leopard shark, soupfin shark, spiny dogfish, big skate, California skate, and longnose skate; and three other species: ratfish, finescale codling, and Pacific rattail grenadier (Table 3) (PFMC 2006a).

Rockfish are found from the intertidal zone out to the deepest waters of the Exclusive Economic Zone (Love 1996, Love et al. 2002, Leet et al. 2001, CDFG 2000). For management purposes, these species are often placed in three groups defined by depth range and distance offshore: nearshore rockfish, shelf rockfish, and slope rockfish (Table 7, from CDFG 2007b).

Table 7. Rockfish Distribution in the Southern California Bight.

Shallow Nearshore Rockfish

black-and-yellow (*S. chrysomelas*)

China (*S. nebulosus*)

gopher (*S. carnatus*)

grass (*S. rastrelliger*)

kelp (*S. atrovirens*)

Deeper Nearshore Rockfish

black (*Sebastes melanops*)
blue (*S. mystinus*)
brown (*S. auriculatus*)
calico (*S. dalli*)
copper (*S. caurinus*)
olive (*S. serranoides*)
quillback (*S. maliger*)
treefish (*S. serriceps*)

Shelf Rockfish

bocaccio (*Sebastes paucispinis*)
bronzespotted (*S. gilli*)
canary (*S. pinniger*)
chameleon (*S. phillipsi*)
chilipepper (*S. goodei*)
cowcod (*S. levis*)
dwarf-red (*S. rufinanus*)
flag (*S. rubrivinctus*)
freckled (*S. lentiginosus*)
greenblotched (*S. rosenblatti*)
greenspotted (*S. chlorostictus*)
greenstriped (*S. elongatus*)
halfbanded (*S. semicinctus*)
honeycomb (*S. umbrosus*)
Mexican (*S. macdonaldi*)
pink (*S. eos*)
pinkrose (*S. simulator*)
pygmy (*S. wilsoni*)
redstriped (*S. proriger*)
rosethorn (*S. helvomaculatus*)
rosy (*S. rosaceus*)
silvergrey (*S. brevispinis*)
speckled (*S. ovalis*)
squarespot (*S. hopkinsi*)
starry (*S. constellatus*)
stripetail (*S. saxicola*)
swordspine (*S. ensifer*)
tiger (*S. nigrocinctus*)
vermilion (*S. miniatus*)
widow (*S. entolemas*)
yelloweye (*S. ruberrimus*)
yellowtail (*S. flavidus*)

Slope Rockfish

aurora (*S. aurora*)
bank (*S. rufus*)
blackgill (*S. melanostomus*)
darkblotched (*S. crameri*)
Pacific ocean perch (*S. alutus*)
redbanded (*S. babcocki*)
rougheye (*S. aleutianus*)
sharpchin (*S. zacentrus*)
shortraker (*S. borealis*)
splitnose (*S. diploproa*)
yellowmouth (*S. reedi*)

The nearshore rockfish spend most of their lives in relatively shallow water. This group is often subdivided into a shallow component and a deeper component. Shelf rockfish are found along the continental shelf (Figure 3). Slope rockfish occur in the deeper waters of the shelf and down the continental slope. The roundfish, flatfish, sharks, and skates covered under the Groundfish FMP are generally concentrated in shallow water while the ratfish, finescale codling, and Pacific rattail are deepsea fish (Eschmeyer et al. 1985, CDFG 2000, Leet et. al. 2001).

A variety of different fishing gear is used to target groundfish including troll, longline, hook and line, pots, gillnets, and other types of gear (bottom trawls were banned in March 2006 out to a depth of 3,500 m) (Table 8 (from NMFS 2005b)). The West Coast groundfish fishery has four components: limited entry - which limits the number of vessels allowed to participate; open access - which allocates a portion of the harvest to fishers without limited entry permits; recreational; and tribal - fishers who have federally recognized treaty rights (PFMC 2006a).

Table 8. Gear Types Used in the West Coast Groundfish Fishery.

	Trawl and Other Net	Longline, Pot, Hook & Line	Other
Limited Entry Fishery (commercial)	Mid-water Trawl, Whiting trawl, Scottish Seine	Pot, Longline	
Open Access Fishery Directed Fishery (commercial)	Set Gillnet Sculpin Trawl	Pot, Longline, Vertical hook/line, Rod/Reel, Troll/dinglebar, Jig, Drifted (fly gear), Stick	
Open Access Fishery Incidental Fishery (commercial)	Exempted Trawl (pink shrimp, spot and ridgeback prawn, CA halibut, sea cucumber), Setnet, Driftnet, Purse Seine (Round Haul Net)	Pot (Dungeness crab, CA sheephead, spot prawn) Longline, Rod/reel Troll	Dive (spear) Dive (with hook and line) Poke Pole
Tribal	as above	as above	as above
Recreational	Dip Net, Throw net (within 3 miles)	Hook and Line methods Pots (within 3 miles) from shore, private boat, commercial passenger vessel	Dive (spear)

The Coastal Pelagics FMP includes four finfish (northern anchovy, Pacific sardine, Pacific (chub) mackerel, jack mackerel), and two invertebrates, market squid and krill (Table 5). The CPS inhabit the pelagic realm, i.e., live in the water column, not near the sea floor. They are usually found from the surface to 3,281 ft (1,000 m) deep (PFMC 2003).

Northern anchovy (*Engraulis mordax*) are small, short-lived fish that typically school near the surface. They occur from British Columbia to Baja California. Northern anchovies are divided into northern, central, and southern sub-populations. The central sub-population were the focus of large commercial fisheries in the U.S. and Mexico. Most of this sub-population is located in the Southern California Bight between Point Conception, California and Point Descanso, Mexico. Northern anchovy are an important part of the food chain for other species, including other fish, birds, and marine mammals.

Pacific sardine (*Sardinops sagax*), also a small schooling fish, have been the most abundant fish species managed under the Pacific Groundfish FMP. They range from the tip of Baja California to southeastern Alaska. Sardines live up to 13 years, but are usually captured by their 5th year.

Pacific (chub) mackerel (*Scomber japonicus*) are found from southeastern Alaska to Mexico, and are most abundant south of Point Conception, California within 20 mi (32 km) from shore. The "northeastern Pacific" stock of Pacific mackerel is harvested by fishers in the U.S. and Mexico. Like sardines and anchovies, mackerel are schooling fish, often co-occurring with other pelagic species like jack mackerel and sardines. As with other CPS, they are preyed upon by a variety of fish, mammals, and sea birds.

Jack mackerel (*Trachurus symmetricus*) grow to about 2 ft and can live up to 35 years. They are found throughout the northeastern Pacific, often well outside the Exclusive Economic Zone. Small jack mackerel are most abundant in the Southern California Bight, near the mainland coast, around islands, and over shallow rocky banks. Older, larger fish range from Cabo San Lucas, Baja California, to the Gulf of Alaska, offshore into deep water and along the coast to the north of Point Conception. Jack mackerel in southern California usually school over rocky banks, artificial reefs, and shallow rocky reefs (PFMC 2003).

Market squid (*Loligo opalescens)* range from the southern tip of Baja California to southeastern Alaska. They are most abundant between Punta Eugenio, Baja California, and Monterey Bay, California. Usually found near the surface, market squid can occur to depths of 2,625 ft (800 m) or more. Squid live less than a year and prefer full-salinity ocean waters. They are important forage foods for fish, birds and marine mammals (PFMC 2003).

In 2006, the PFMC included krill in the CPS and adopted a complete ban on commercial fishing for all species of krill in West Coast federal waters (PFMC 2006e). Krill (euphausiids) are small shrimp-like crustaceans that are an important basis of the marine food chain. They are eaten by many Managed Species, as well as by whales and seabirds. The PFMC is presently considering identifying EFH and possibly HAPCs for two individual krill species, *Euphausia pacifica* and *Thysanoessa spinifera,* and for other species of krill.

Coastal pelagic species are harvested directly and incidentally (as bycatch) in other fisheries. Usually targeted with "round-haul" gear including purse seines, drum seines, lampara nets, and dip nets, they are also taken as bycatch in midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs. Market squid are fished nocturnally using bright lights to attract the squid to the surface. They are pumped directly from the sea into the hold of the boat, or taken with an encircling net (PFMC 2003).

Most of the CPS commercial fleet is located in California, mainly in Los Angeles, Santa Barbara-Ventura, and Monterey. About 75 percent of the market squid and Pacific sardine catch are exported, mainly to China, Australia (where they are used to feed farmed tuna), and Japan (where they are used as bait for longline fisheries).

The U.S. West Coast Fisheries for HMS covers 13 free-ranging species; 5 tuna - Pacific albacore, yellowfin, bigeye, skipjack, and northern bluefin; 5 sharks - common thresher, pelagic thresher, bigeye thresher, shortfin mako, and blue shark; 2 billfish - striped marlin and Pacific swordfish; and dorado (also known as dolphinfish or mahi-mahi) (Table 2) (PFMC 2006b). HMS have a wide geographic distribution, both inside and outside the Exclusive Economic Zone. They are open-ocean, pelagic species, that may spend part of their life cycle in nearshore waters. HMS are harvested by U.S. commercial and recreational fishers and by foreign fishing fleets, with only a fraction of the total harvest taken within U.S. waters (PFMC 2006b). HMS are also an important component of the recreational sport fishery, especially in southern California.

The PFMC has developed stock rebuilding plans for seven overfished, depleted species; Bocaccio, Canary Rockfish, Cowcod, Darkblotched Rockfish, Pacific Ocean Perch, Widow Rockfish, and Yelloweye Rockfish (PFMC 2006d). Conservation Areas, closed to fishing, have also been established to protect sensitive Pacific Coast Groundfish habitat (Figure 6, from PMFC 2006a). Bottom trawling was prohitited in March 2006 out to depths of 11,482 ft (3,500 m). Bottom trawling and other bottom fishing activities have been prohibited in Cowcod Conservation Areas (Figures 6 and 7, PMFC 2006a).

Figure 6. Essential Fish Habitat Conservation Areas.

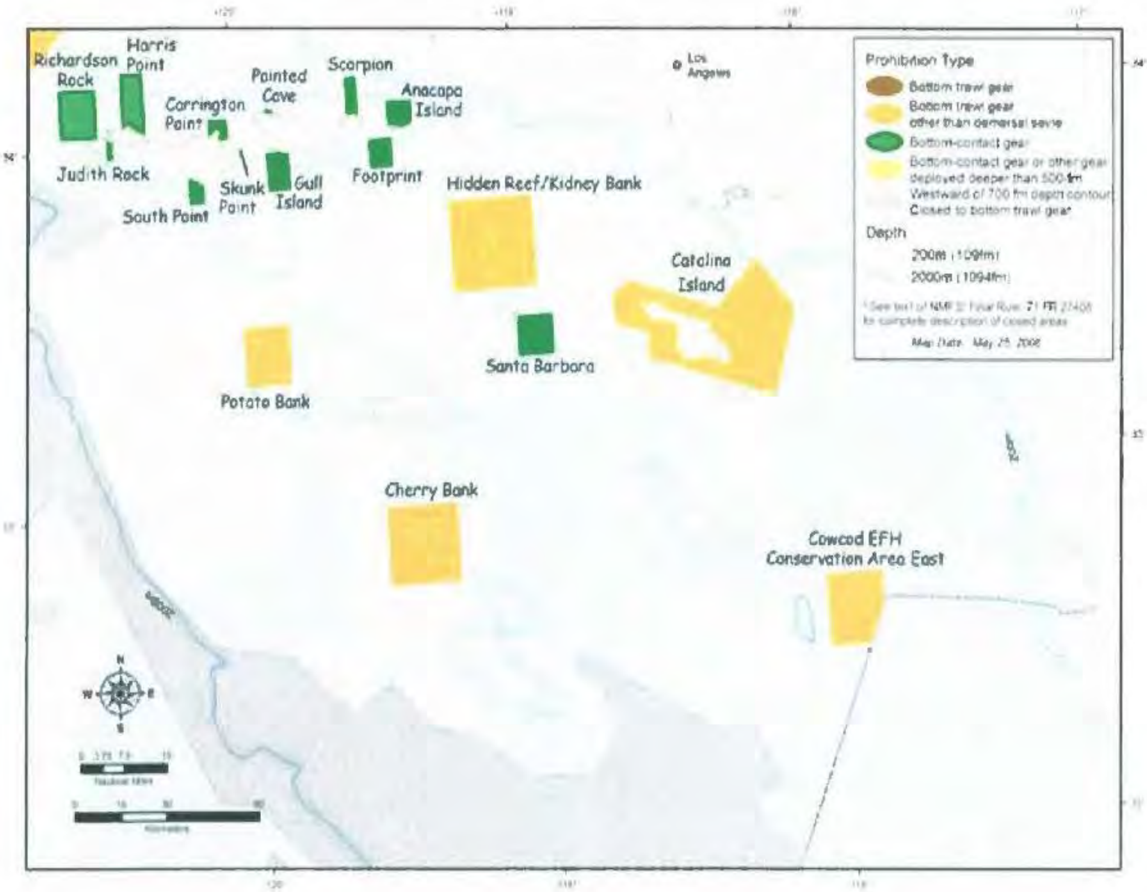
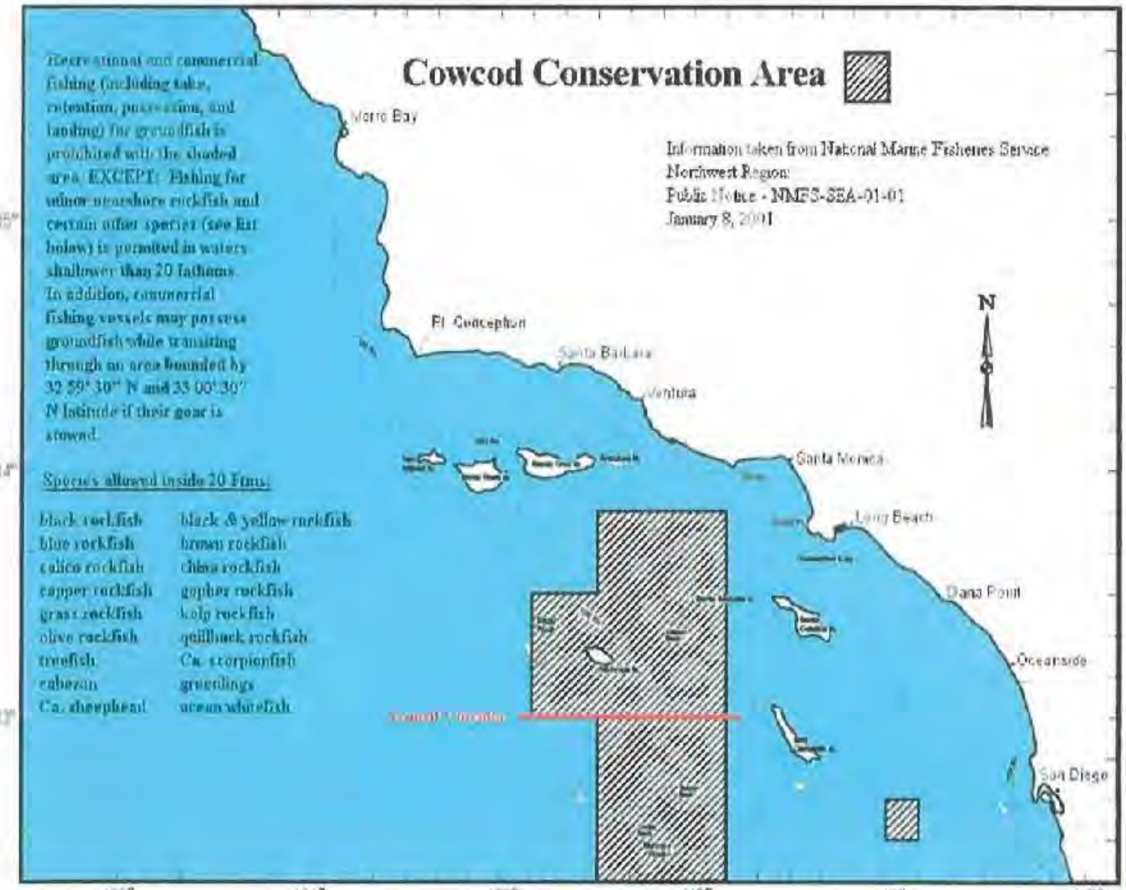


Figure 7. Cowcod Conservation Areas.



Under the HMS FMP, the PFMC monitors other species for informational purposes. In addition, some species-including great white sharks, megamouth sharks, basking sharks, Pacific halibut, and Pacific salmon - are designated as prohibited catch. If fishers targeting highly migratory species catch these species, they are required to immediately release them (PFMC 2006b). The HMS fishery, with the exception of the swordfish drift gillnet fishery off California, is one of the only remaining open access fisheries on the West Coast. However, the PFMC is currently considering a limited entry program to control excess capacity (PFMC 2006b).

Many different gear types are used to catch HMS in California (PFMC 2006b). These include; 1) trolling lines - fishing lines with jigs or live bait deployed from a moving boat, 2) drift gillnets - panels of netting weighted along the bottom and suspended vertically in the water by floats that are attached to a vessel drifting along with the current, 3) harpoon - a small and diminishing fishery mainly targeting swordfish, 4) pelagic longlines - baited hooks on short lines attached to a horizontal line (the HMS FMP now prohibits West Coast longliners from fishing in the Exclusive Economic Zone due to concerns about the take of endangered sea turtles), 5) coastal purse seines - encircling nets closed by synching line threaded through rings on the bottom of the net (usually targeting sardines, anchovies, and, mackerel but also target tuna where available), 6) large purse seines - used in major fisheries in the eastern tropical Pacific and the central and western Pacific (this fishery is monitored by the Inter-American Tropical Tuna Commission, and, in the Exclusive Economic Zone by NMFS); and, 7) recreational fisheries - HMS recreational fishers in California include private vessels and charter vessels using hook-and-line to target tunas, sharks, billfish, and dorado (NMFS2005b).

Pacific halibut (*Hippoglossus stenolepis*) is managed by the International Pacific Halibut Commission (IPHC 2007). This large species of halibut is mainly encountered well north of the Point Loma area, and, its harvest is prohibited in the area. A smaller relative, the California halibut (*Paralichthys californicus*), is found along the coast of southern California, but is not included in a FMP.

Although EFH mandates are stipulated in federal legislation, EFH habitat defined in FMPs includes state waters. These areas in California (i.e., inshore of 3 nm) are managed under the California Marine Life Management Act (CMLMA) (CDFG 2007c). Four California FMPs have been produced covering market squid, white seabass, nearshore finfish, and abalone (CDFG 2007d,e,f,g).

Market squid (*Loligo opalescens*), discussed previously under the Coastal Pelagics FMP, is the state's largest fishery by tonnage and economic value (CDFG 2007d). Market squid are also important to the recreational fishery as bait and as forage for fish, marine mammals, birds, and other marine life. Squid belong to the class Cephalopoda of the phylum Mollusca. They have large eyes and strong parrot-like beaks. Using their fins for swimming and jets of water from their funnel they are capable of rapid propulsion forward or backward. The squid's capacity for sustained swimming allows it to migrate long distances. The state Market Squid Fishery Management Plan (MSFMP) includes seasonal catch limitations, weekend closures, gear restrictions, restricted access and monitoring programs (CDFG 2007d).

White seabass (*Atractoscion nobilis*), large members of the croaker family, occur in ocean waters off the west coasts of California and Mexico. This highly-prized species is recovering from reduced population levels in the late 1900s. The current California management strategy of the White Seabass Fishery Management Plan (WSFMP) provides for moderate commercial harvests while protecting young white seabass and spawning adults through seasonal closures, gear provisions, and size and bag limits (CDFG 2007e). The WSFMP also has a recreational fishery component with size and bag limits, and season closures. Finally, there is an ongoing white seabass hatchery program at Carlsbad, Hubbs-Sea World Research Institute. The hatchery provides juvenile white seabass to other field-rearing systems operated by volunteer fishermen throughout southern California.

The California Nearshore Fishery Management Plan (NFMP) (CDFG 2007f) covers both commercial nearshore fisheries and recreational fishers. The five goals of the NFMP are to 1) ensure long-term resource conservation and sustainability 2) employ science-based decision-making 3) increase constituent involvement in management 4) balance and enhance socio-economic benefits 5) identify implementation costs and sources of funding. Five management approaches form the basis for integrated management strategies that over time will meet the goals and objectives of the NFMP and Marine Life

Management Act (MLMA). They are: the Fishery Control Rule, Restricted Access, Regional Management, Marine Protected Areas (MPAs), and Allocation (Table 9).

Table 9. Key Management Goals and Objectives.

NFMP Goal or Objective	Fishery Control Rule		Management Measures	Restricted Access	Regional Management	MPAs	Allocation
	Stage I	Stage II					
Conserve ecosystems		Stock assessments completed					
Allow only sustainable uses		Setting TACs based on NFMP fishery control rule; inseason monitoring	Size limits on species that survive release; trip limits match capacity; limit gear				
Adjust catch allowance to reflect uncertainty	TAC[2] at 50% of recent landings	TACs based on stock assessments (black & gopher rockfish, cabezon, CA scorpionfish)	Trip limits				
Match fish harvest capacity to sustainable catch levels				RA program for NFP species; DNSFP program			
Allocate restrictions and benefits fairly and equitably			FGC guidance to Council for regulation development		Regional discussions with constituents on proposed regulation changes		Revised as updated information is available
Minimize/limit bycatch and mortality			Match seasons and depths for co-occurring species	Bycatch permit with trip quota; bimonthly trip limits			
Maintain, restore and preserve habitat				Allowable gear limited to hook & line, traps and dip nets		Identify appropriate habitat for 19 species; NFMP MPA criteria in MLPA Master plan design criteria	

NFMP Goal or Objective	Fishery Control Rule		Management Measures	Restricted Access	Regional Management	MPAs	Allocation
	Stage I	Stage II					
Identify, assess, and enhance habitats						Identify appropriate habitat for 19 species	
Identify and minimize fishing that destroys habitat			CA input into Council EFH designations	NFP program gear endorsements			
Employ science-based decision-making		OYs/TACs based on stock assessments					
Conduct collaborative research		CRANE					
Collect data on spatial distribution of habitats and organisms		CRANE EFI collection			Initial focus on southern California and south central regions	CRANE & Channel Islands MPA monitoring	

The NFMP contains 19 species that frequent kelp beds and reefs generally less than 120 ft (36 m) deep off the coast of California and the near offshore islands (Table 10).

Table 10. Managed Species - California Nearshore Fisheries Management Plan.

Black rockfish - *Sebastes melanops*	Gopher rockfish - *Sebastes carnatus*
Black & yellow rockfish - *Sebastes chrysomelas*	Grass rockfish - *Sebastes rastrelliger*
Blue rockfish - *Sebastes mystinus*	Kelp greenling – *Hexagrammos decagrammus*
Brown rockfish - *Sebastes auriculatus*	Kelp rockfish – *Sebastes atrovirens*
Cabezon - *Scorpaenichthys marmoratus*	Monkeyface prickleback – *Cebidichthys violaceus*
Calico rockfish - *Sebastes dallii*	Olive rockfish - *Sebastes serranoides*
California scorpionfish - *Scorpena guttata*	Quillback rockfish - *Sebastes maliger*
California sheephead – *Semicossyphus pulcher*	Rock greenling - *Hexagrammos lagocephalus*
China rockfish - *Sebastes nebulosus*	Treefish - *Sebastes serriceps*
Copper rockfish - *Sebastes caurinus*	

Thirteen of these species are rockfish - all of which are included in the federal Pacific Groundfish FMP. Three of the remaining six species are also covered under the Pacific

Groundfish FMP. The three species not covered by the Pacific Groundfish FMP are the California sheephead (*Semicossyphus pulcher*), the rock greenling (*Hexagrammos lagocephalus*), and the monkeyface prickleback (*Cebidichthys violaceus*). These species are actively managed by the CDFG (CDFG 2007f) through catch limits, gear restrictions and In-season (In-Year) monitoring.

The California sheephead is a large, colorful member of the wrasse family (Love 1996). Male sheephead reach a length of 3 ft, a weight of 36 lbs, and have a white chin, black head, and, a pink to red body. Females are smaller, with a brown-colored body (Eschmeyer et al. 1985). Sheephead populations off southern California have declined because of fishing pressure. Large males are now rare because they are sought by recreational spear fishermen. Sheephead are taken commercially by traps and kept alive for display in restaurant aquaria where patrons select a specific fish for preparation (Leet et al. 2001). The rock greenling is a smaller member of the lingcod family. The monkeyface prickleback, also called the monkeyface eel, is more closely related to rockfish than eels. Its elongate shape is an adaptation to living in cracks, crevices, and under boulders (Love 1996).

The Abalone Recovery and Management Plan (CDFG 2007g) provides a cohesive framework for the recovery of depleted abalone populations in southern California. All of California's abalone species are included in the plan: red abalone, *Haliotis rufescens*; green abalone, *H. fulgens*; pink abalone, *H. corrugata*; white abalone, *H. sorenseni*; pinto abalone, *H. kamtschatkana* (including *H.k. assimilis*); black abalone, *H. cracherodii*; and flat abalone, *H. walallensis*. The recovery and management plan for these species implements measures to prevent further population declines throughout California, and to ensure that current and future populations will be sustainable.

The decline of abalone is due to a variety of factors, primarily commercial and recreational fishing, disease, and natural predation. The recovery of a near-extinct abalone predator, the sea otter, has further reduced the possibility for an abalone fishery in most of central California. Withering syndrome, a lethal bacterial infection, has caused widespread decline among black abalone in the Channel Islands and along the central California coast. As nearshore abalone populations became depleted, fishermen traveled to more distant locations, until stocks in most areas had collapsed. Advances in diving technology also played a part in stock depletion. The advent of self-contained underwater breathing apparatus (SCUBA) in the mid-1900s gave birth to the recreational fishery in southern California, which placed even more pressure on a limited number of fishing areas.

Following stock collapse, the California Fish and Game Commission closed the southern California pink, green, and white abalone fisheries in 1996 and all abalone fishing south of San Francisco in early 1997. The southern abalone fishery was closed indefinitely with the passage of the Thompson bill (AB 663) in 1997. This bill created a moratorium on taking, possessing, or landing abalone for commercial or recreational purposes in ocean waters south of San Francisco, including all offshore islands.

EFH regulations require analysis of potential impacts that could have an adverse effect on EFH and Managed Species (NMFS 2002a). Adverse effect is defined as any impact which reduces the quality and/or quantity of essential fish habitat (NMFS 2004a,b).

Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components. Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (NMFS 2004a,b).

The EFH regulations in 50 CFR 600.815(a)(2)(ii) (NMFS 2002a) establish a threshold for determining adverse effects (NMFS 2002b). Adverse effects are more than minimal and not temporary in nature. Temporary effects are those that are limited in duration and allow the particular environment to recover without measurable impact (NMFS 2002b). Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions. Whether an impact is minimal will depend on a number of factors including: the intensity of the impact at the specific site being affected, the spatial extent of the impact relative to the availability of the habitat type affected, the sensitivity/vulnerability of the habitat to the impact, the habitat functions that may be altered by the impact (e.g., shelter from predators), and the timing of the impact relative to when the species or life stage need the habitat.

Thus, for Essential Fish Habitat and Managed Species an adverse effect is: 1) more than minimal, 2) not temporary in nature, 3) causes significant changes in ecological function, and, 4) does not allow the environment to recover without measurable impact.

EFH Impacts

The Point Loma ocean outfall could have two types of effects on fisheries: physical impacts associated with the presence of the pipeline and diffusers on the ocean bottom, and biological impacts associated with the discharge of treated wastewater.

Physical Impacts

The Point Loma outfall pipeline is buried in a trench through the surf zone out to a distance of about 2,600 ft offshore. Over the next 400 ft it gradually emerges from the trench and beyond 3,000 feet offshore it lies in a bed of ballast rock on the ocean floor. At its terminus, the pipeline connects to the diffuser section with two legs, each 2,500 ft long. The outfall pipe and diffusers with their supporting bed of ballast rock form an artificial reef. The pipe and rock, covered with encrusting organisms (tube worms, anemones, barnacles), provide food and shelter to a variety of fish and invertebrates (Wolfson and Glinski 1986). This artificial habitat covers an area of about 22 acres off Point Loma (assuming a 36-ft width of pipe and ballast rock). Catches of rockfish could be enhanced over this area, but would probably be too small to be discernible in recreational or commercial landings.

The pipeline and diffusers, however, represent a potential hazard to commercial fishermen using traps that can snag on the pipe and ballast rock. Lobster, crab, and fish traps are used throughout the area. Since the location of the pipeline and diffusers is well-marked on navigation charts and commercial vessels are equipped with accurate positioning systems, it is possible to place fishing gear a safe distance away. Nevertheless, commercial trap fishermen target the pipe area, apparently choosing to risk higher gear-loss for a better yield per trap next to the high-relief rocky habitat created by the pipe and ballast rock.

Biological Impacts

Long-term research carried out in the Point Loma kelp bed has not revealed any discharge-related effects (see publications by Dayton, Tegner, and associates in References). Nor is there any suggestion in the historical fisheries catch of outfall impacts (see Commercial Fishing Section). These studies and data sets were not designed to elucidate outfall effects. The Point Loma monitoring program was, however, intended to do precisely that. The following section briefly reviews monitoring program results related to the impact on commercial and recreational fisheries.

The discharge of treated wastewater at Point Loma could affect fisheries species by altering water or sediment quality. Water quality parameters are monitored at stations around the outfall, in the kelp bed, along the shoreline, and at control stations to the north and south (COSD (City of San Diego) 2002-2007). Strong local currents and high initial dilution (>200:1) facilitate rapid mixing and dispersion of the effluent. Except in the immediate vicinity of the outfall, where minor alterations in dissolved oxygen, pH, and light transmittance may occur, changes in physical and chemical parameters in surrounding ocean waters have reflected natural alterations in oceanographic processes (e.g., upwelling, plankton blooms) and long-term regime changes like El Niño.

Unlike dissolved components of the wastewater that are swept away by the currents, particles discharged from the outfall may settle to the ocean floor. This can change the grain size and organic content of the sediments which in turn affects the abundance and diversity of marine organisms living there. Contaminants can also be introduced since many of the potentially harmful chemicals in wastewater are bound to particles.

Alterations in sediment quality in the vicinity of the Point Loma Ocean Outfall are only apparent at the station 984 ft (300 m) from the wye diffusers, where coarser sediments and higher sulfide levels have been periodically detected (COSD 2002-2007). The change in grain size may be due to turbulence created as the current flows past the pipe on the bottom, wafting away the finer particles (Diener et al. 1997). Although higher sulfide levels that periodically occur adjacent to the outfall are consistent with the deposition of organic material from the discharge, other indicators of organic loading (biochemical oxygen, demand total organic carbon, total nitrogen, total volatile solids) are low relative to reference stations (see Appendix E – Benthic Communities and Organisms).

Concentrations of anthropogenic chemicals in sediments at Point Loma are generally near or below detection limits at all sampling stations, the notable exception being DDE, a breakdown product of the pesticide DDT. DDE, a legacy of historical discharge, is found in sediments throughout southern California (Mearns et al. 1991, Noblet et al. 2002). Levels of DDE at Point Loma are low relative to concentrations elsewhere in the southern California Bight (COSD 2002-2007).

There is no consistent pattern of metal concentrations in the sediments as a function of distance from the outfall - the highest levels of iron, aluminum, and copper are found at the northern reference stations. Trace metals are generally at or below detection levels.

Changes in sediment quality should also be reflected in the types of species living on and in the sediment. Two elements of the monitoring program provide this type of information: 1) benthic infauna, and 2) demersal (bottom-dwelling) fish and megabenthic invertebrates. Benthic infauna are collected by taking grab samples of the bottom. Demersal fish and invertebrates are gathered by trawling across the bottom. Living in close association with the sediments, these groups are classic indicators of altered conditions. Also, many important fisheries species live on the bottom and/or feed there.

The infaunal community around the outfall is dominated by an ophiuroid-polychaete assemblage typical of this depth and sediment type in southern California (Bergen et al. 2000, Ranasinghe et al. 2003). Changes that have occurred in the soft-bottom maroinvertebrate assemblage surrounding the outfall are mainly related to large-scale oceanographic events like El Niño (Zmarzly et al. 1994). However, there is some indication of discharge effect at the monitoring station closest to the outfall (COSD 2007). Abundance of the ophiuroid *Amphiodia* which is sensitive to organic enrichment has decreased, although this has not been the case for other pollution sensitive species. Other changes in community structure suggest that the impact may be due to the presence of the outfall structure itself, rather than the influence of discharged wastewater (Posey and Ambrose 1994, Diener et al. 1997). Whatever the reason, infaunal communities near the Point Loma outfall remain similar to those observed prior to discharge and are comparable to natural indigenous communities (see Appendix E – Benthic Communities and Organisms).

Trawl samples at Point Loma are dominated by small flatfish and sea urchins. Though inherently more variable than infaunal data, the trawl data also indicate that normal oceanographic processes control the abundance and diversity of demersal fish and megabenthic invertebrates living around the outfall (COSD 2002-2007). Patterns in abundance, biomass, and species composition have remained stable since monitoring began (see Appendix E – Benthic Communities and Organisms). The fish collected by trawling are healthy, with few parasites and a low level or absence of fin rot, tumors, and other physical abnormalities.

One of the most important elements of the Point Loma monitoring program from the fisheries perspective is the measurement of chemical contaminants in fish tissues. Fish can accumulate pollutants from: 1) absorption of dissolved chemicals in the water, 2) ingestion of contaminated suspended particles or sediment particles, and 3) ingestion of contaminated food (Allen 2006, Allen et al. 2007). Incorporation of contaminants into an organism's tissue is called bioaccumulation. Contaminants can also be concentrated as they are passed through the food web when higher trophic level organisms feed on contaminated prey. Bioaccumulation has potential ecological and human health implications (OEHHA (California Office of Environmental Health Hazard Assessment) 2007a,b).

The Point Loma Ocean Outfall monitoring program targets two types of fish for assessment of contaminant levels: flatfish and rockfish (see Bioaccumulation Assessment – Appendix F). Samples are taken at various distances from the outfall and at control stations to the north and south. Flatfish and rockfish at Point Loma have concentrations of metals in liver and muscle tissue characteristic of values detected throughout the Southern California Bight (Mearns et al. 1991, Allen et al. 1998, 2002b, 2007). There is no apparent relationship between higher metal levels and proximity to the outfall. Elevated levels of arsenic were found in fish species at both outfall and control stations. The source of this arsenic has assessed to be vents from natural hot springs off the coast of northern Baja California. A variety of man-made compounds including DDT (and its derivatives) and PCBs are routinely found in fish tissue throughout the area. These chlorinated hydrocarbons are ubiquitous in southern California, but their concentration in sediments and organisms is steadily decreasing in most areas (Mearns et al. 1991, Allen et al. 1998, 2002, 2007). Samples taken near the outfall do not have higher levels of DDT and PCBs than reference samples.

The United States Food and Drug Administration established limits for the concentration of mercury and DDT in seafood sold for human consumption (Mearns et al. 1991). Muscle tissue levels in flatfish and rockfish at Point Loma are consistently below these limits. There have been no warnings, advisories, harvest closures, or, restrictions on seafood taken from the Point Loma area (personal communication with the staff of the San Diego County Environmental Health Services Department; California State Department of Public Health; California State EPA Office of Environmental Health Hazard Assessment; and the U.S. Food and Drug Administration, San Diego Branch).

Cumulative Impacts

Cumulative impacts are defined in the National Environmental Protection Act (NEPA) (42 USC § 4321 *et seq*. and 32 CFR 775 respectively) as: the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future action regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR § 1508.7).

In general, the effects of a particular action or group of actions must meet all of the following criteria to be considered cumulative impacts:

- Effects of several actions occur in a common locale or region,
- Effects on a particular resource are similar in nature, such that the same specific element of a resource is affected in the same specific way, and
- Effects are long-term as short-term impacts dissipate over time and cease to contribute to cumulative impacts.

The discharge of wastewater from commercial activities, including municipal wastewater treatment plants, power generating stations, industrial plants (e.g., desalination plants), and storm water from drains into open ocean waters, bays, or estuaries can introduce chemical constituents potentially detrimental to estuarine and marine habitats. These constituents include pathogens, nutrients, sediments, heavy metals, oxygen demanding substances, hydrocarbons, and toxics. Historically, wastewater discharges have been one of the largest sources of contaminants into coastal waters. However, wastewater discharges have been regulated under increasingly stringent requirements over the last 25 years and mass emissions of most constituents have been significantly reduced (SCCWRP (Southern California Coastal Research Project) 2003, 2006). Nonpoint source/storm water runoff, on the other hand, has not been regulated to the same degree and continues to be a substantial remaining source of contamination to the coastal areas and ocean.

Human uses of the Point Loma area include swimming, surfing, snorkeling, SCUBA diving and other recreational sports, recreational and commercial fishing, mariculture, cruising, whale-watching, research and education, wastewater discharge, military activity, navigation, and shipping. Potential threats to EFH and Managed Species include degradation of water quality, habitat modification, pollution (chemicals, marine debris, etc.), introduction of exotic species, disease, natural events, and global climate change (Field et al. 2003, Jackson et al. 2001, IEF (In Ex Fishing) 2006).

In addition, fishing and non-fishing activities, individually or in combination, can adversely affect EFH and Managed Species (NOAA 1998, Dayton et al. 2003, Morgan and Chuenpagdee 2003, Hanson et al. 2003). Potential impacts of commercial fishing include over-fishing of targeted species and bycatch, both of which negatively affect fish stocks (Barnette 2001, NRC 2002, Dieter et al. 2003). Mobile fishing gears such as bottom trawls (now prohibited to deeper than 3,500 ft) disturb the seafloor and reduce structural complexity (Auster and Langton 1998, Johnson 2002). Indirect effects of trawls include increased turbidity; alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (continued catch by lost or discarded gear), and generation of marine debris (Hamilton 2000). Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats. Recreational fishing also poses a threat because of the large number of participants and the intense, concentrated use of specific habitats (Coleman et al. 2004).

Natural stresses include storms and climate-based environmental shifts, such as harmful algal blooms and hypoxia (Scholin et al. 2000, IEF 2006). Disturbance from ship traffic and exposure to biotoxins and anthropogenic contaminants may stress animals, weaken their immune systems, and make them vulnerable to parasites and diseases that would not normally compromise natural activities or be fatal (Pew Oceans Commissions 2003).

A number of factors influence water quality and biological conditions in the Point Loma area. Key potential influences on water quality include the Point Loma treated wastewater discharge, regional non-point source discharges, local river outflows, and other local non-point sources such as harbors, marinas, storm drains, and urban runoff.

The effects of the Point Loma discharge on water quality and biological conditions are evident only in deep waters (below the euphotic zone) within or near the Zone of Initial Dilution (ZID). Organic enrichment of the sediments due to the outfall discharge is not occurring beyond the ZID. Contaminant loading of sediments is not evident in the discharge vicinity. Sediment chemistry is comparable to reference areas along southern California's outer continental shelf. Biological conditions do not indicate any environmentally-significant changes associated with the discharge. A balanced indigenous population of shellfish, fish and wildlife exist immediately beyond the ZID.

While significant natural variations in fish populations are observed (in response to factors such as water temperature), the Point Loma wastewater discharge is not having any significant effect on demersal fish assemblages off Point Loma. Fish populations are healthy and lack physical abnormalities such as fin erosion or tumors. Levels of trace metals, chlorinated hydrocarbons, pesticides, and polyaromatic hydrocarbons are relatively low, with concentrations within the range found in fish throughout the Southern California Bight. Overall, no outfall-related effects are evident from bioaccumulation data. Contaminants in fish tissues in the Point Loma area are similar to those at reference sites beyond the influence of the discharge.

Thus, the incremental contribution by the proposed action on the marine environment is expected to be insignificant. The overall effect on fish stocks would be negligible compared to the impact of commercial and recreational fishing in the Point Loma area.

There would not be incremental or synergistic impacts on present or reasonably foreseeable future uses of the Point Loma area. The proposed action would not make a significant contribution to the regional cumulative impacts on EFH or Managed Species.

Commercial Fishing

California's commercial fisheries have declined over the last 25 years, with the largest dip in the most recent years. Between 1982 and 1999, California's fishing fleet decreased from approximately 6,700 to 2,700 vessels (NOEP 2005).

In 1976, California's commercial fleet landed a peak of 1.3 billion pounds of fish and invertebrates, compared to landings of 650 million pounds in 2000 (NOEP 2005). Changes in the economics of fisheries and restrictions imposed to manage fishery populations have dramatically altered the commercial take of marine resources (CDFG 2001a). Commercial fishing has been effected by seasonal area closures, quota reductions, and long-term stock-building plans. Salmon fishing quotas have diminished in response to public concerns following the listing of five California salmon population types under the federal Endangered Species Act (ESA). A decline in tuna landings has resulted from the shift of landing ports from California to less costly cannery operations in Samoa and Puerto Rico. Severe decreases in abalone stocks and concerns about the extinction of the white abalone lead to the total commercial fishing ban of abalone south of San Francisco in 1997.

Management regulations have also played a role in the development of new commercial fishing industries. For example, the 1994 California Constitutional Amendment (Prop. 132) prohibiting gillnet fishing in near-shore areas of central and southern California led to the development of a major hook and line fishery for rockfish and cabezon (Leet et al. 2001).

Increasing regulation will likely continue to reduce the variety of fisheries in the future. The 1998 California Marine Life Management Act (MLMA), resulted in additional suspension of permits in the near-shore fishery, and a squid management plan is in place that involves further access restrictions. The 1999 California Marine Life Protection Act authorized new protections for ocean habitats and wildlife. It also created a new network of marine protected (fishing-restricted) areas along the coast, setting aside zones in some cases, where preservation of targeted species will help revive some of the more depleted stocks (NOEP 2005). Outside the industry, competing uses of waterfront property for recreational boating, commercial cargo handling, and tourism and housing limits the availability of shore-side space for commercial fishing support facilities.

Despite the decline of landings of some species in California, fisheries for other species have been relatively resilient. For example, according to the California Department of Fish and Game, increased international demand for squid resulted in a dramatic increase in landings during non-El Niño years, which has attracted participation from former salmon fishermen in California. Growth of California fisheries also included the development of specialized fisheries for sea urchin, Pacific herring, and rockfish. However, restrictions on rockfish are now affecting these efforts (NOEP 2005).

All of these challenges have lead to a decline in the total weight and value of commercial fish landings in California since 2000. With the exception of the Central Coast, all regions have experienced loss of landings and value. Los Angeles County, accounting for more than 95% of the total landings and 90% of the total value, has experienced the greatest drop during the period. The only county experiencing slight steady landing growth is San Diego, although the total value declined (see: NMFS site and www.OceanEconomics.org for detailed fisheries information) (NOEP 2005).

The major commercial fisheries of the Southern California Bight, their seasons and harvest gear used during the 2000-2006 period are listed in Table 11 (trawl no longer includes bottom trawls, which were prohibited in all U.S. west coast waters between Mexico and Canada to a depth of 11,483 ft (3,500 m), approved on 7 March 2007).

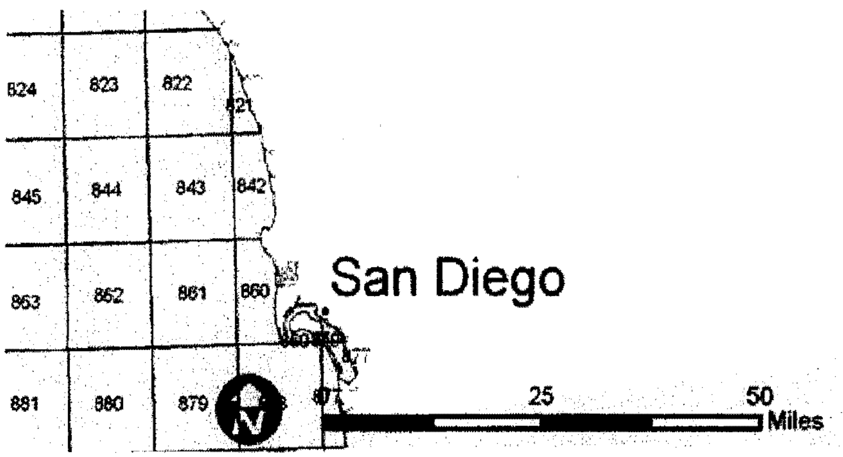
Table 11. Commercial Fisheries Groups Seasons and Harvest Methods.

Fishery	**Season**	**Harvest Methods**
Coastal Pelagic Species		
Anchovy, mackerels, sardine, squid	Year round, seasonal by species, some with harvest guidelines	Purse seine, drum seine, trawl, gillnet, dip net, some line gear (mackerel)
Highly Migratory Species		
Tunas, sharks, billfish, swordfish, dolphin	Year round, seasonal by species and region	Gillnet, purse seine, set net, drift net, troll, hook and line, harpoon (swordfish)
Groundfish Species		
Flatfish, rockfish, thorneyheads, roundfish, scorpionfish, skates, sharks, chimeras	Year round, seasonal by species and region	Trawl, trap, troll, gillnet, set net, hook and line
Other Finfish		
CA halibut, CA sheephead, white seabass	Year round, seasonal by species	Trawl, set gillnet, drift nets, trap, hook and line
Invertebrates		
Lobster, urchin, prawn, crab, shrimp	Year round, seasonal by species	Trap, trawl, diver
Marine Plants		

Table 11. Commercial Fisheries Groups Seasons and Harvest Methods.		
Fishery	**Season**	**Harvest Methods**
Kelp	Year round	Specialized cutting ship

Fishery catch statistics are reported for large fishery blocks providing ambiguity that protects commercial fishers' "secret spots". Fish blocks are 9- by 11-mile rectangles, or approximately 100 square miles of ocean area. Figure 8 depicts the distribution of CDFG fish blocks in the vicinity of Point Loma.

Figure 8. Southern California Fisheries Block Chart.



From catch data supplied by commercial fishermen, CDFG reports the total number of pounds of commercial fish landed by species in California. The fish block that includes the Point Loma Ocean Outfall is block 860. Fish catch for block 860 is presented in Table 12.

Table 12. Yearly Fish Catch Reported from Fish Block 860 (lbs).							
SPECIES	2000	2001	2002	2003	2004	2005	2006
Barracuda, CA	4,146	3,338	9,946	1,011	2,774	2,419	847
Bonito, Pacific	267	9	244	902	1,174	795	6,708
Cabezon	28	106	253	88	340	166	104
Crab, rock	125,149	108,621	40,954	76,883	71,938	42,179	25,510
Crab, spider	3,920	1,601	1,861	2,696	3,747	3,615	7,825
Croaker, white	26	0	316	0	0	0	0
Dolphinfish	306	139	0	666	188	21	201
Eel, moray	33	13	0	301	341	7	0
Halibut, CA	22,206	18,730	8,928	6,057	7,713	9,767	6,167

Table 12. Yearly Fish Catch Reported from Fish Block 860 (lbs).							
SPECIES	2000	2001	2002	2003	2004	2005	2006
Lingcod	13	41	319	1,118	1,182	471	615
Lobster, CA	160,743	119,734	107,925	125,873	171,029	152,095	215,840
Louvar	0	358	0	424	91	0	149
Octopus	0	0	162	61	215	80	19
Opah	4,234	1,739	257	4,141	932	76	460
Prawn, spot	884	90	218	24	262	4,4053	6,894
Queenfish	0	0	4,005	4,489	0	0	0
Rockfish, all	4,759	4,130	2,209	859	5,519	3,718	2,982
Sablefish	3,685	65	0	6,155	2,483	1,373	592
Sanddab	459	48	0	0	0	0	9
Sardine, Pacific	658	0	687	0	263	170	137
Scorpionfish,CA	2,871	3,232	3,265	14	140	178	244
Sea cucumber	6,408	1,110	17,347	8,440	9,357	10,505	0
Seabass, giant	0	221	80	10	166	326	135
Seabass, white	5,793	3,800	11,596	25,105	6,850	12,620	3,522
Shark, bigeye	522	94	0	457	152	233	0
Shark, leopard	533	313	442	181	613	49	0
Shark, shortfin mako	2,185	7,267	2,999	2,611	4,838	7,454	313
Shark, soupfin	1,121	1,350	133	15	10	213	105
Shark, thresher	7,062	4,014	4,081	1,472	3,915	1,884	1,062
Sheephead	11,346	7,236	10,926	14,694	14,994	29,368	15,333
Shrimp, ghost	319	263	94	354	185	19	0
Snail, sea	13	126	44	0	32	0	0
Snail, top	26,148	8,448	1,200	664	1,663	745	0
Sole	249	208	9	0	0	0	0
Squid, jumbo	586	0	734	0	0	133	0
Squid, market	794	473	0	0	34,371	0	954
Surfperch	542	1,175	0	30	0	214	0
Swordfish	19,685	20,839	2,749	23,810	6,070	1,577	7,397
Thornyheads	157	0	2	67	3	6	0
Tuna, albacore	3,585	12,370	54,389	18,219	13,243	109	0

Table 12. Yearly Fish Catch Reported from Fish Block 860 (lbs).							
SPECIES	2000	2001	2002	2003	2004	2005	2006
Tuna, bigeye	0	1,508	0	0	0	0	0
Tuna, bluefin	9,177	505	623	1,624	554	0	25
Tuna, skipjack	457	191	35	1,114	45	286	63
Tuna, yellowfin	1,063	2,542	0	1,091	399	35	277
Urchin, purple	0	25	300	521	654	1,936	596
Urchin, red	585,438	763,362	999,719	832,300	764,933	679,456	766,444
Whelk, Kellet	1,624	966	183	68	42	8,360	20,986
Whitefish, ocean	25	13	381	21	58	157	32
Yellowtail	8,305	4,536	1,194	1,825	8,886	3,682	1,481

Source data: CA Fish & Game.

Many commercially important species are found in block 860. The most commonly landed species during the years 2000-2006 were red urchin, California spiny lobster, rock crab, sheephead, California halibut, white seabass, and albacore tuna. The most commonly landed species from block 860 during 1994-1998 were red urchin, California lobster, sheephead, white croaker, sea cucumber, top snail, and rockfish (Wolfson and Glinski 2000). Urchin and lobster were by far the top two catches throughout the entire 1994-2006 period. The mean red urchin catch was 885,363 lbs/yr (1994-1998) and 770,236 lbs/yr (2000-2006). The mean CA lobster catch was 155,912 lbs/yr (1994-1998) and 150,463 lbs/yr (2000-2006).

Not all fish caught from Block 860 are landed in San Diego, so the proportion of the catch that contributes to San Diego's economy is unknown. Catch data specific to Point Loma are not available. However, landing data are collected at the two landing ports closest to Point Loma: San Diego Port Basin adjacent to Point Loma (Point Loma Harbor) and Mission Bay Harbor. These data provide a better estimate of the economic contribution of Point Loma's fisheries to the local economy. Landings for the top ten commercially important species (in terms of weight and value) at Point Loma and Mission Bay during 2006 are presented in Table 13.

Table 13. Commercial Fishery Landings at Point Loma and Mission Bay 2006.			
Species	**Poundage**	**Value**	**Harvest method & depth**
Lobster, CA spiny	189,742	$1,643,317	Kelp, traps 30 ft <120 ft
Urchin, red	788,395	$471,794	Kelp, hand, 30 ft- 80 ft
Prawn, spot	18,853	$208,522	Bottom traps 600-1,800 ft
Sablefish	27,949	$114,863	Trawl, net, traps, 900-4,200 ft
Sheephead, CA	21,385	$91,246	Kelp, rock, trap, hook,<280 ft

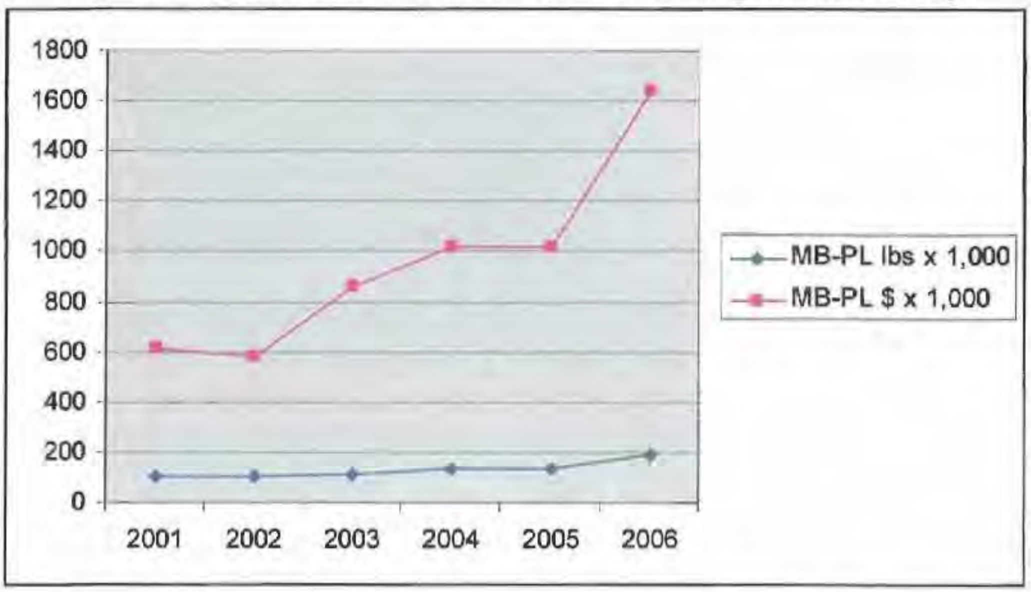
Table 13. Commercial Fishery Landings at Point Loma and Mission Bay 2006.			
Species	**Poundage**	**Value**	**Harvest method & depth**
Thornyhead, shortspine	20,774	$85,897	Trawl/net 1,200-4,200 ft
Seabass, white	6,725	$11,852	Surface < 400 ft, hook & line
Rockfish, blackgill	10,976	$11,286	Trap, hook, 150-900 ft
Crab, rock unspecified	14,599	$10,371	Bottom traps 90-300 ft
Rockfish, group shelf	5,129	$10,282	Trap, hook, 150-900 ft

Source data: CA Dept. of F&G 2006 Final. External Data (non-confidential)

The highest landing $ values at Point Loma and Mission Bay during 2006 were for the California spiny lobster and the red urchin (red urchin had the highest poundage). These top two commercial "fish" species are the same as in previous years (Wolfson and Glinski 1986, 1990, 1992, 1994, 1995, 2000).

Lobsters are nocturnally-active crustaceans that shelter under rocks and in crevices during the day and forage at night. The females migrate to shallow water during spring and summer to spawn; in fall they move to deeper water to mate. Lobster are caught in traps set along the inner, middle and outer edges of kelp beds, and over hard-bottom, mostly in depths of 30-120 ft. The season runs from the 1st Wednesday in October to the 1st Wednesday after March 15. Early in the season traps are set just outside the surf line to the inner edge of the kelp bed. As winter storms approach, traps are moved farther offshore into the kelp bed and along its outer edge. Lobster catch landings and dollar values at Point Loma and Mission Bay Harbors during the 2001-2005 seasons are shown in Figure 9.

Figure 9. Lobster Catch and Value for Point Loma plus Mission Bay.



The lobster catch was relatively stable with a slight increase in landed weight during the 2001-2006 period. The dollar value of the catch increased substantially during the period to over $1.6 million dollars in 2006.

Comparing the current period, 2001-2006, to the prior (1994-1999) as reported in Wolfson and Glinski (2000), sea urchin landings decreased in 1997-1998, reflecting the influence of an El Niño effect. This was not the case for lobster – 1994 had the lowest catch and 1997 the highest, with the lobster harvest at Point Loma averaging 150,000 pounds/year during the 1994 to 1998 seasons. The current period was not as productive, averaging 130,333 lbs/yr landed at Point Loma-Mission Bay (PL-MB). The 2006 lobster harvest landed at PL-MB was 189,742 lbs.

Sea urchin are harvested for their roe, which is known as "uni". Harvesting is done by divers in the Point Loma kelp bed, usually in depths of 30-70 ft using a hookah breathing system connected to a surface vessel or platform.

The overall California catch of the red sea urchin has varied considerably during the past 30 years (Figure 10). Variations are due to a number of factors including limited development of the fishery prior to the mid-1980s, a strong 1982-1983 El Niño, a rush into the unrestricted fishery precipitated by a rapidly developing Japanese market for "uni" during the late 1980s and early 1990s, subsequent limited access permitting in response to resource depletion combined with weak El Niños in 1987 and 1992, and additional catch restrictions. The continued diminished urchin harvests in 1997-1998 were a result of the loss of kelp, their primary food source, during the prevailing strong El Niño (Wolfson and Glinski 2000).

Figure 10. California Annual Red Urchin Landings.

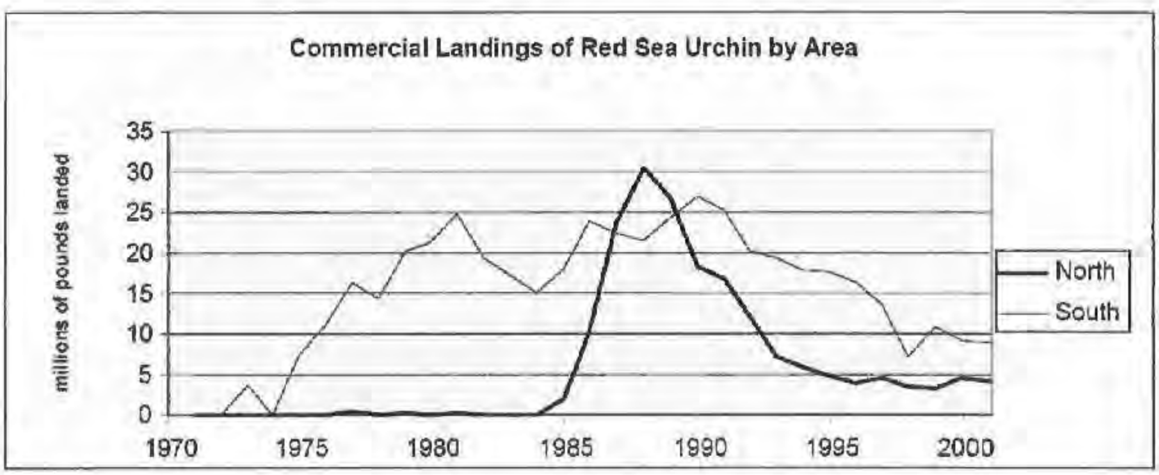


Figure from: CDFG 2002.

Since 1999, the entire southern California catch (minus San Diego county catch) has continued to decline while the San Diego county catch has remained relatively steady with some increase. Since 1999, the entire southern California catch (minus San Diego county catch) has continued to decline while the San Diego county catch has remained relatively steady with some increase. The Point Loma-Mission Bay (PL-MB) harvest averaged 812,962 lbs/yr through the period 2001-2006.

Both the lobster and urchin fisheries occur near or in the kelp beds, which are limited to maximum depths of about 90 ft over consolidated bottom (out to about 1 mile from shore). Thus, these fisheries take place at a distance of 3.5 miles or greater from the Point Loma Ocean Outfall.

Over the past twenty years there has been a steady increase in demand for "live" finfish. This began primarily to serve members of the Asian community and has since grown to include many markets and Asian restaurants. The "live" finfish industry has grown as an alternate off-season opportunity for many in the lobster fishery and increased in 1994 with the gillnet closure within 3 nm of shore. Traps will catch practically any species willing to enter a small space for food. The primary target species weigh generally 1 ½ - 2 ½ pounds and include CA sheephead, CA halibut, CA scorpionfish, cabezon, lingcod and several members of the genus *Sebastes* (rockfish). These fish, selected from live tank displays, bring several times the value of their previously filleted colleagues. From 1989 to 1995, live landings of CA sheephead increased more than 10-fold, more than 100-fold for CA halibut, and more than 1,000-fold for cabezon. These are the same species sought by private boat recreational anglers, and a "Nearshore Finfish Trap Endorsement" is now required to catch finfish in baited traps for the "live" market.

Sablefish are caught by trawls, nets, trap, and hook and line. Different regulations apply for each method. Sablefish are found in depths of 900-4,200 ft, with greatest densities in the 1,200-1,800 ft range. Sablefish can live 50 years and can weigh up to 126 lbs. They enter the fishery as early as 1 year of age and most are taken by the trawl fishery by years 4-6, at a weight of less than 25 lbs. Traps and long-line hook fisheries generally catch the older, larger fish. Most of the catch is exported to Japan where it is served as sushi. In the U.S., sablefish are often marketed as black cod, the smaller ones are often filleted and sold as butterfish.

Spot prawn are shrimp. They have four bright white spots, hence the name. As of 1 April 2003 the use of trawl nets to take spot prawn has been prohibited. The season for spot prawn south of Point Arguello, Santa Barbara is closed November 1 through January 31. Today, most spot prawn are caught in traps set on the sea floor at depths of 600-1,200 ft; with some taken incidentally in the ridgeback prawn fishery. Much of the spot prawn catch off Point Loma goes to supply restaurants featuring live display.

California sheephead are another profitable fishery in the Point Loma area. The California sheephead, *Semicossyphus pulcher*, is a large, colorful wrasse. Male sheephead reach a length of 3 feet, a weight of 36 pounds, and have a white chin, black head, and pinkish to red body. Females are smaller, with a brownish red to rose-colored body. Populations off southern California have declined because of fishing pressure. Large males are now rare because they are sought by recreational spear fishermen. Sheephead are taken commercially by traps and kept alive for display in restaurant aquaria where patrons select a specific fish for preparation. The red color and soft, delicate flesh are especially prized in Asian cuisine.

Rock crabs are cousins of the dungeness crab. Off Point Loma, they are mostly caught in traps to depths of 300 ft. The predominant species taken is the yellow rock crab, *Cancer anthonyi*. They range from Magdalena Bay, Baja California to Humbolt Bay, California, but are abundant only as far north as Point Conception. In southern California, rock crab are most common on rocky bottoms at depths of 30-145 feet, but are also found on open sandy bottoms where they partially bury themselves when inactive. Over sand, adults feed on live benthic prey and scavenge dead organisms that fall to the bottom.

Shortspine thornyheads are found off California in waters ranging from 100-5,000 ft deep. They migrate to deeper water as they grow and are closely associated with the bottom. They are usually fished from bottom waters 1,200-4,200 ft deep with peak abundance generally in the 1,800-3,000 ft range. Like rockfish, they are members of the family Scorpaenidae, and like sablefish, they are currently primarily exported to Japan for sushi.

California halibut, a regular component of the fisheries catch off Point Loma, are a prized, non-schooling flatfish. Known as the left-eyed-flounders, about 40% are actually right-eyed. They range from Baja California to British Columbia. Halibut feed almost exclusively on anchovies and other small fish. They spawn in shallow waters from April-July. In the San Diego area they are caught in depths to about 300 ft, by hook and line, directed longline, and set gill nets in federal waters (>3 nm). The best catches are usually in springtime over sandy bottom. The fishing season is mid-June to mid-March. California halibut range in size up to a maximum of about 70 lbs, although most are much smaller.

White seabass are the largest members of the croaker family (Sciaenidae) in California. They can grow to 90 lbs, although fish over 60 lbs are rare. Adults school over rocky areas or near and within kelp beds. They can be caught near the surface and to depths of nearly 400 ft. Other common names for white seabass are king croaker, weakfish and sea trout (juveniles).

Rockfish are non-migratory, and many species of rockfish are caught in the offshore area of Point Loma. Numerous rockfish stocks in both northern and southern California are considered depleted, and in an effort to better regulate the stocks, rockfish were divided into nearshore, shelf and slope groups in 2001. The shelf group (Table 7) is comprised of 32 fish of the genus *Sebastes*. They are most commonly caught by trap and hook and line over the continental shelf from depths of 120-900 ft (20- 150 fm). Live catches bring top prices and are often sold live to Asian restaurants.

Other important commercial species caught in the area (Table 7) are:

The *Groundfish Species* (GF) particularly the slope rockfish group and the nearshore rockfish group, scorpionfish, lingcod, longspine thornyhead and cabezon are caught off Point Loma. The invertebrates; octopus, sea cucumber and spider crab are also taken in small numbers on or near the bottom.

The *Highly Migratory Species* (HMS) are represented by catches of albacore, swordfish and thresher shark. Albacore are found worldwide in temperate waters; in the eastern Pacific they range from south of Guadalupe Island, Baja California to southeast Alaska (Eschmeyer et al. 1985). Their food varies but consists mostly of small fish, and sometimes squid and crustaceans. In southern California albacore are usually found 20-100 mi offshore. Normal catch size is 20-40 lbs.

Swordfish are found in tropical and temperate ocean waters. They migrate north from Baja California into California coastal waters in springtime then move south in the fall to spawn and over-winter. Swordfish grow to 1,200 lbs and 14 ft in length. Adult swordfish eat squid and pelagic fish. They are caught near the surface, mostly at night Swordfish are taken well off Point Loma every year. Prior to the early 1980s harpooning swordfish at the surface was the primary harvest method. Only a few boats still use harpoons. West coast longliners are prohibited from fishing in the Exclusive Economic Zone, or anywhere for swordfish using this method. There were 30,933 lbs (worth $142,245) of swordfish landed at Point Loma and Mission Bay Harbor during 2005.

Several stocks of *Coastal Pelagic Species* (CPS) support fisheries along the southern California coast: these are Pacific sardine, northern anchovy, jack mackerel, chub (Pacific) mackerel, and market squid. The CPS Fishery Management Plan distinguishes between "actively managed" and "monitored" species. Actively managed species (Pacific sardine and Pacific mackerel) are assessed annually by harvest guidelines and fishing seasons. The remaining CPS (northern anchovy, jack mackerel, and market squid) are monitored to ensure their stocks are stable, but annual stock assessments and federal fishery controls are not used (PFMC 2007a).

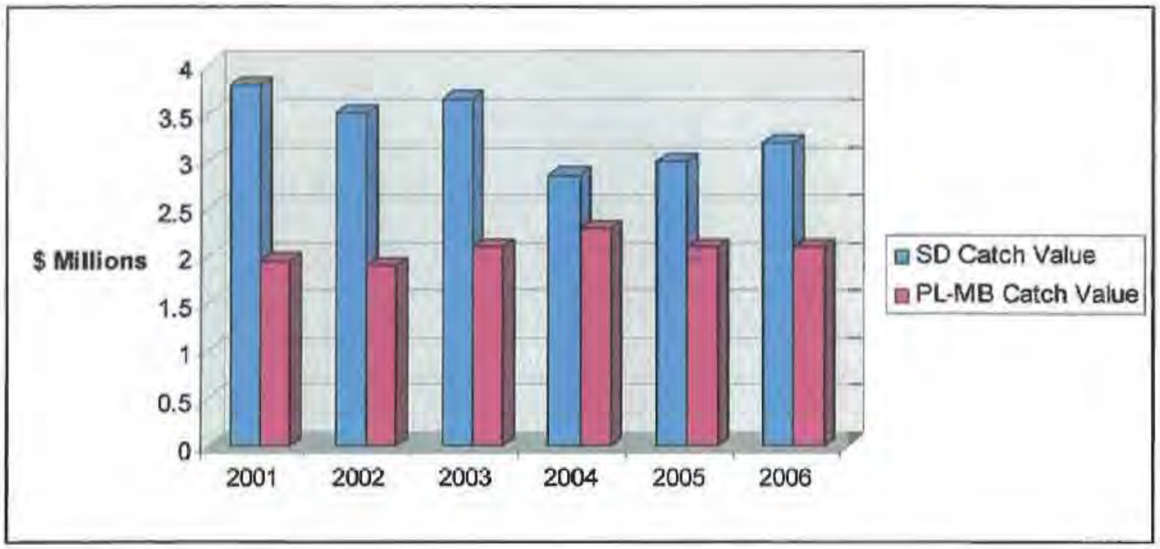
Pacific mackerel are a schooling seasonal species in the area. In the eastern Pacific they range from Chile to the Gulf of Alaska. They feed on larval, juvenile and small fish, and, occasionally on squid and crustaceans. Dense schools of Pacific mackerel are caught in surface waters by the purse seine fleet. Most Pacific mackerel caught off California weigh less than 3 pounds. This fish is known as a "wet fish" because it requires minimal processing prior to canning. The catch is mainly targeted for human consumption and for use as pet food. A small amount is sold at fresh seafood markets.

Sardines are small, pelagic, schooling fish that are members of the herring family. The California fishery peaked in 1936-1937 and vanished from southern California during the 1950s. Fishing pressure was first suspected as the cause, but it was subsequently determined that cooling ocean temperatures contributed to the decline. The late 1990s warm water cycle has brought the sardine back to southern California, where the purse seine fishing season for sardines now runs year-round.

The California market squid, *Loligo opalescens*, has been harvested since the 1860s and has become the largest fishery in California in terms of tonnage and dollars since 1993 (Zeidberg et al. 2004). Squid landings decreased substantially following the large El Niño events in 1982-1983 and 1997-1998, but not the smaller El Niño events of 1987 and 1992. Market squid are small (5 inch mantle length). They occupy the middle trophic level in California waters, and may be the state's most important marine forage species. They are short-lived (about 10 months). Market squid are primary prey for at least 19 species of fish, 13 species of birds, and six species of mammals (Morejohn et al. 1978). Since the decline of the anchovy fishery, market squid is possibly the largest biomass of any single marketable species in the coastal environment of California. The majority of squid landings occur around the California Channel Islands, from Point Dume to the Santa Monica Bay, and in the southern portion of the Monterey Bay (Rogers-Bennett 2000). The fishery has varied through the years due to El Niño events and rapid fluctuations in market value. El Niño events have traditionally depleted the market squid fishery and driven up the value due to poor landings (Leet et al. 2001). They are generally caught near the surface, but can be found to depths of 800 ft. During the 1990s, purse seines became the dominant gear used in the harvest of market squid. During the past several years purse seines have accounted for roughly three-quarters of the fleet, and roughly 25% of the fleet were drum seines. Currently, market squid are fished year-round with increased catch rates from September through February in southern California.

The total catch value of all species landed in Point Loma and Mission Bay (PL-MB), during the most recent 6 year period available, is compared to the remainder of San Diego County (SD) (Oceanside Harbor and San Diego Harbor including Imperial Beach) in Figure 11.

Figure 11. Six Year Commercial Catch Value ($ Millions).



The value of species landed at PL-MB was relatively stable compared to other ports in San Diego County during the period. In 2001, the value of the PL-MB catch alone was 50% of the value from the rest of San Diego County, and represented 33% of the total catch value for the entire county (PL-MB plus remainder of SD ports). By 2006, the PL-MB catch was 71% of the value from the rest of San Diego County, and represented 59% of the total catch value for the entire county.

San Diego coastal commercial catches have been relatively stable during the last few years, although fish catches and values have fluctuated historically. These fluctuations occur for particular species, for species catch composition, and for overall cumulative catch. Changes in the abundance of southern California marine fish populations during the past 30-years have raised concerns that these populations are at risk. The changes have been attributed to varying oceanic conditions, overfishing, pollution, and habitat alterations. The relative impacts from natural and anthropogenic contributions are poorly understood.

Allen et al. (2005) analyzed fish population trends from 20- to 30-year fish databases (e.g., power generating station fish impingement and trawl monitoring, recreational fishing, and publicly owned treatment work (POTW) trawl monitoring). Combined, these databases provided information on 298 species of fish. A number of long-term environmental databases (e.g., CalCOFI oceanographic data, shoreline temperature, coastal runoff, and POTW effluent contaminant mass emissions) were used to identify several important independent environmental variables (e.g., Pacific Decadal Oscillation (PDO); El Niño-Southern Oscillation (ENSO); offshore temperature; upwelling in the north, Southern California Bight, and south; coastal runoff; and contaminant mass emissions). Most southern California fish populations had population trends that followed changes in natural oceanic variables during this time-frame. The most important of these were PDO (positive and negative responses), upwelling in the Southern California Bight, offshore temperature, and ENSO. The PDO was the dominant influence for most species in these databases, with the presence or absence of upwelling during the warm regime having an important influence on others.

Removal of fish by fishing can have a profound influence on individual populations, their survival, and shifts in community composition. In a recent study of retrospective data, Jackson et al. (2001) analyzed paleoecological records from marine sediments from 125,000 years ago to present, archaeological records from 10,000 years before present, historical documents, and ecological records from scientific literature sources over the past century. Examining this longer term data and information, they concluded that ecological extinction caused by overfishing preceeds all other pervasive human disturbance to coastal ecosystems including pollution, degradation of water quality, and anthropogenic climatic change.

Plant species: Giant kelp (*Macrocystis pyrifera*) has been harvested from the Point Loma kelp bed by the same company since 1929. Kelp is the world's fastest growing marine plant, growing approximately 2 ft/day. It has been the single most valuable fishery in the vicinity of Point Loma because of the high value added products created from it. Kelp, gathered by specially designed, mechanized ships is used for the extraction of algin, a hydrocolloid. Algin is used as a binder, stabilizer, and, emulsifier in pharmaceutical products, in cosmetics and soaps, and, in a wide variety of food, drink, and industrial products (McPeak and Glantz 1984). Some of the statewide kelp harvest is also used to feed abalone in mariculture operations.

Since 1957, southern California kelp beds have undergone a two-thirds reduction in standing biomass (Steneck et al. 2002). El Niño events and increasing sea surface temperature have been linked with this decline (Dayton et al. 1992, Tegner et al. 1996). In the Southern California Bight, kelp habitats of concern include the Malibu coast, the Palos Verdes Peninsula, the coast between Newport and Laguna Beach, San Onofre, south Carlsbad, and Point Loma along the mainland coast, and, Santa Catalina and San Clemente Islands (Leet et al. 2001).

Between 1967 and 1980, kelp restoration was conducted along the Palos Verdes Peninsula (Leet et al. 2001); however, El Niño events severely decreased the size of those beds (Leet et al. 2001). Many restoration attempts have failed but there have been two major successful projects, one along the Palos Verdes Peninsula and the second at the entrance to Mission Bay (at the north end of Point Loma) (Leet et al. 2001).

The Point Loma kelp bed, the largest kelp bed in San Diego County, has had special commercial importance because of its proximity to the San Diego kelp processing plant (Wolfson and Glinski 2000). Kelp from this bed was used to produce high grade, enhanced value products (food agents and pharmaceuticals). Although the poundage and landed value is proprietary, Wolfson and Glinski (2000) conjectured that a commercial value of $5-$10 million/year for the Point Loma kelp bed would be a reasonable estimate.

After 76 years of operation, the International Specialty Products Company announced on 9 June 2005 they would be closing their San Diego kelp processing facility within a year and moving operations to an existing plant in Scotland. In recent years the company has been hampered by rising costs for fuel, labor, and raw materials. The closure affected 135 employees (San Diego Union Tribune 2005). The facility has since terminated its San Diego Operations, and structure demolitions are now complete (2007).

Mariculture

The California Department of Fish and Game is the principal authority issuing permits for marine aquaculture (mariculture) in California. The California State Lands Commission and various municipal entities may grant tideland leases, but if aquaculture is involved, the operation must be registered with the California Department of Fish and Game.

Most mariculture in San Diego is located in lagoons and bays. The Hubbs-Sea World Research Institute operates a white seabass hatchery at the Agua Hedionda Lagoon in Carlsbad (27 mi north of the outfall). Two additional mariculture projects are also located there: the Kent Seafarms Research Facility and Carlsbad Aqua Farms, which grows mussels and oysters. Sea World sponsors mariculture research at its Mission Bay facility and Dr. David Lapoda has conducted independent aquaculture studies at a site adjacent to Mission Bay (DON 2005).

Operation White Seabass, a partnership of the Hubbs-Sea World Research Institute, Southern California Edison and the San Diego Oceans Foundation, is working to re-introduce white seabass to San Diego coastal waters (DON 2005). The program begins at the hatchery in Carlsbad where the young bass are raised to a length of three inches. From there they are transferred to growout pens for a three to four month stay. Then, having reached a length of eight to ten inches, they are released. Growout pens are planned for San Diego Bay as well with the capacity for producing over 50,000 juvenile white seabass annually (DON 2005).

The only active mariculture in San Diego open ocean waters involves the dispersal of abalone larvae off Point Loma. Maritech, Inc. of San Diego has approval from the California Department of Fish and Game for "abalone ranching" along the Point Loma headlands. Abalone are induced to spawn in tanks on Maritechs' research vessel and cultured larvae are released in the vicinity of the Point Loma kelp bed at the age of 3-5 days (DON 2005). If their program results in the recovery of the abalone population at Point Loma, Maritech hopes to gain exclusive rights to commercial harvest of sub-legal sized abalone.

Recreational Fishing

Much of Point Loma is a military reservation with restricted shoreline access – thus shorefishing is limited and the vast majority of sportfishing is from boats. Typical species targeted by recreational anglers include rockfish, Pacific mackerel, kelp/sand bass, California barracuda, Pacific bonito, California sheephead, white seabass, California halibut, yellowtail, rockfish, and seasonally, HMS such as tunas.

Of all the California fisheries, the most profound changes in catch composition has occurred in the southern California private vessel and Commercial Passenger Fishing Vessel (CPFV) fisheries (Love 2006). Most significant is the sharp decline in the numbers of rockfish caught, particularly bocaccio, and olive and blue rockfish. Once mainstays of the fishery, bocaccio, olive and blue rockfish have practically disappeared from the recreational catch. It is likely this was caused both by overfishing (recreational and commercial) and 25 years of juvenile recruitment failure from adverse oceanographic conditions (Love et al. 1998a,b). During the same period, a number of warm-water species, such as yellowtail, Pacific barracuda, California scorpionfish, ocean whitefish, vermilion rockfish, and honeycomb rockfish became much more abundant. Perhaps the most fundamental, recent change in the California fishing industry is the emergence of the private recreational vessel fleet, which is now the single largest component of the recreational fishery (Love 2006).

Throughout California, the fishing effort by private vessel anglers was almost equal to all other fishing modes combined, and private vessel anglers caught almost 50% of the entire marine recreational catch. Overfishing and environmental changes have been followed by declines of rockfish, lingcod and other stocks, changing the face of fishing. Federally mandated stock rebuilding plans cut bag limits, created closed seasons, set minimum size limits and established marine reserves. In the face of these new realities, creative CPFV operators were offering sanddab specials during rockfish closures. In an effort to reduce pressure on some stocks, some members of the industry began encouraging catch and release, a virtually unthinkable idea to most anglers of the past. Other CPFVs were also diversifying into such areas of ecotourism as whale and bird watching. The number of anglers in the industry may have peaked in the late 1980s or early 1990s and private vessels are now the most lucrative element of the industry (Love 2006).

In the Point Loma area, the extensive kelp bed remains the primary focus of sportfishing activity. A still flourishing commercial passenger and private fishing vessel fleet, based in San Diego Bay and Mission Bay, operates in the vicinity of Point Loma. CPFVs (commonly called party boats) provide bait, gear rental, food service, fish cleaning, and transportation to fishing grounds for paying passengers on half-day and full day trips. CPFVs mainly fish the outside edge of the kelp bed, as do the majority of private sportfishing boats (Wolfson and Glinski 1986, 1990, 1992, 1995, 2000).

Catch data for the commercial passenger fishing vessel fleet in San Diego and Mission Bays during 2001-2006 appears below in Table 14.

Table 14. San Diego and Mission Bay CPFV Fleet Catch 2001-2006.

Common name	2001	2002	2003	2004	2005	2006
Barracuda, CA	44,206	53,861	28,082	44,015	17,387	24,707
Bass, barred sand	67,164	114,353	100,025	52,799	76,938	4,505

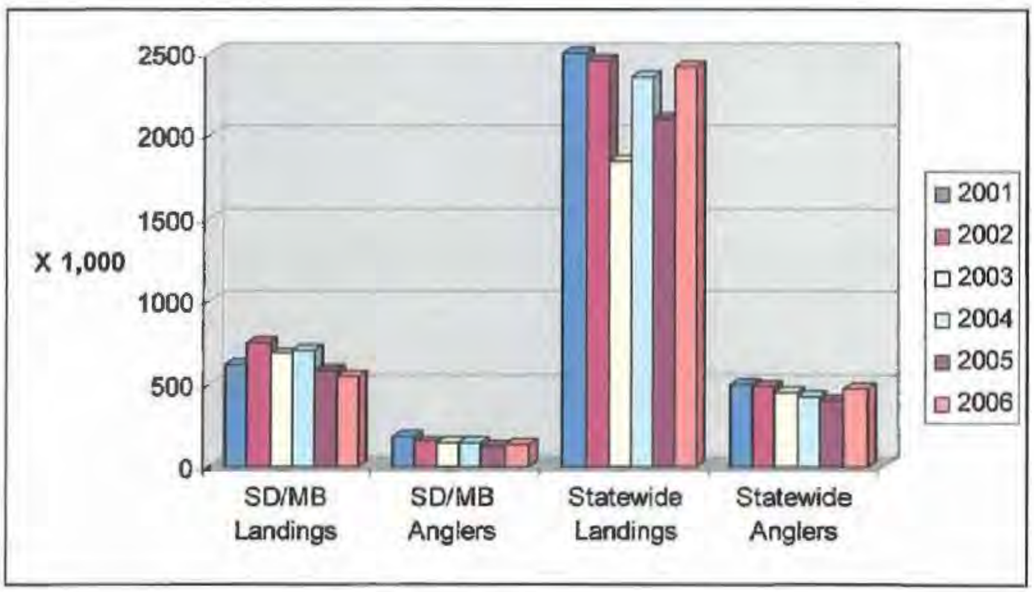
Table 14. San Diego and Mission Bay CPFV Fleet Catch 2001-2006.						
Common name	2001	2002	2003	2004	2005	2006
Bass, kelp	67,457	60,518	69,054	98,616	46,988	48,175
Bonito, Pacific	4,687	5,066	11,618	30,760	7,938	53,319
Cabezon	225	82	164	112	46	60
Croaker, white	1,071	391	166	88	353	300
Dolphinfish	3,440	0	0	0	0	0
Fishes, unspecific	4,197	3,540	5,674	5,764	4,210	5,420
Flatfishes, unspecific	152	34	35	6	12	25
Halfmoon	92	0	0	0	0	0
Halibut, CA	507	402	306	448	332	167
Inverts, unspecific	0	7,814	523	977	10,365	684
Lingcod	629	5,352	7,690	2,274	3,014	2,444
Mackerel, jack	1,319	200	155	24	82	7
Mackerel, Pacific	16,697	16,279	14,034	6,556	13,344	5,573
Other HMS	0	51,277	80,476	80,026	72,676	97,974
Rockfish, all	56,612	60,379	52,856	58,900	80,888	63,468
Sanddab	0	100	73	300	484	200
Scorpionfish, CA	32,542	18,927	20,006	25,647	30,287	18,936
Seabass, white	614	227	243	227	195	218
Shark, all	244	48	59	112	167	115
Sheephead, CA	2,235	1,545	1,893	1,517	1,473	2,720
Tuna, albacore	178,843	272,349	217,726	174,047	94,679	19,898
Tuna, bluefin	19,573	0	0	0	0	0
Tuna, skipjack	7,512	0	0	0	0	0
Tuna, yellowfin	30,194	0	0	0	0	0
Whitefish, ocean	23,551	15,626	12,538	11,339	15,413	9,733
Yellowtail	57,576	58,730	59,442	104,513	61,565	143,263
TOTAL LANDINGS	**621,339**	**747,101**	**682,838**	**699,067**	**538,836**	**545,663**
Number Anglers	182,428	152,848	147,700	149,383	126,783	133,677
Number CPFVs	81	80	105	98	98	89
Catch/Angler	3.41	4.89	4.62	4.68	4.25	4.08

The principal sportfish caught in the vicinity of Point Loma during the period were sand bass, kelp bass, rockfish, barracuda, scorpionfish, and 5-25 nm offshore, the seasonal migratory species albacore tuna and yellowtail (jack). Remarkably, with some minor yearly fluctuations in rank, these were the same top-rated sportfish caught in the area during 1983-1985, 1991-1993 and 1994-1998 (Wolfson and Glinski 1986, 1995, 2000, respectively).

The number of reporting CPFVs in the San Diego/Mission Bay area increased by about twenty-percent during the 2001-2006 period (from 81 to 89, although it peaked at 105 during 2003), whereas there was a decline in both the number of anglers and in fish landings. The catch/angler remained roughly the same with the overall 6 year average catch/angler being 4.32 fish per trip.

A comparison of San Diego/Mission Bay's CPFV fleet activity to the statewide CPFV fleet activity (omitting SD/MB) from 2001-2006 is made in Figure 12.

Figure 12. San Diego/Mission Bay vs. Statewide CPFV Activity.



The number of CPFV anglers declined somewhat during the 6 year period, both for San Diego/Mission Bay and the rest of the state. This probably reflects the overall state trend of increasing private boat ownership and participation in ocean recreational fishing previously described. CPFV landings show variation during the period, with a relatively steady downward trend for the state in general and a less clear fluctuation for the PL-MB CPFV fleet.

Although numerous factors contribute to the availability of sportfish, and therefore landings, the multi-year decline in landings generally reflects the decline in the number of CPFV anglers in both regions - since the catch per angler remained relatively steady throughout the period. Anglers aboard CPFVs statewide did slightly better in the overall average number of fish landed during the period. Statewide, anglers averaged 4.90 fish/angler/ trip compared to 4.32 fish for anglers in the San Diego/Mission Bay region.

The precise causes for this are unknown, but might include overall fishing pressure differences (commercial and recreational), and a seasonal shift (summer) of San Diego fishing effort from the nearshore and kelp bed areas to well offshore in search of highly prized albacore tuna when they are within 5-20 nm of the coast. There is also increased interest in multiple day trips when HMS are available. The offshore catch (and presumably the availability of HMS) has greater variability than catches of coastal pelagic species or groundfish species. Therefore, the overall number of fish landed may decline while the individual fish size increases. For example, albacore are highly prized large fish - anglers are often willing expend more effort and money to catch desirable HMS compared to numerous, smaller sand bass, kelp bass or rockfish. When HMS are within reach there is also an increase in and shift to private boats and fast sportfish charter boats known as 6-pacs (referring to the number of passengers Captains are licensed to carry). Quantitative records of catches from 6-pac boats and private vessels are not reflected in the CPFV catch above.

The California Recreational Fisheries Survey (CRFS) is a statewide sampling program designed to collect catch/effort data on all modes of marine recreational finfish fishing. It is a collaborative effort of the California Department of Fish and Game and the Pacific States Marine Fisheries Commission. This survey began in 2004, but includes data from previous programs dating back to 1999. Data are collected from 6 districts; the South District includes Los Angeles, Orange and San Diego counties. It includes data collected from CPFVs, harbors, marinas, piers, landings and from shore and other shore structures (CDFG 2006).

Table 15. Estimated Number and Mode of Fishing Trips in the South District 2005.

Fishing Mode					
District	**Man-made Structures**	**Beaches & Banks**	**CPFV**[1]	**Private & Rental Boats**	**District Total**
South	518,763	210,974	254,646	326,010	1,310,393

Because much of Point Loma is a restricted military instillation, the percentage of fishing from beaches and man-made structures is greatly reduced compared to that of the southern district in general shown above.

In previous recreational boat position studies off Point Loma, we found fishing from private boats concentrated on the kelp bed, and often mirrored CPFVs positions (Wolfson and Glinski 1985). This resulted in similar species being caught, with the exception of shellfish species (lobster, crab, rock scallops, and sea urchin) which are taken by sport divers in the nearshore zone.

Sportfishing by divers, both free-divers and SCUBA, at Point Loma also takes place in and around the Point Loma kelp bed. Abalone can no longer be collected, but lobster and scallops continue to be collected (by hand) and a variety of fish are taken by spear. The rip rap boulders covering the outfall pipeline form an artificial reef providing good recreational fishery catch (Wolfson and Glinski 1994).

Table 16 categorizes the typical catch zones of species caught by recreational fishers in the vicinity of Point Loma and offshore.

Table 16. Typical Catch Zones for Recreational Species.			
	SURFACE	**MID WATER**	**BOTTOM**
FISH			
Barracuda	X		
Bass, sand			X
Bass, kelp	X	X	X
Bonito	X	X	
Flatfish			X
Lingcod		X	X
Mackerels	X		
Rockfish			X
Scorpionfish			X
Sheephead			X
Tunas, all	X	X	
Whitefish			X
Yellowtail	X		
SHELLFISH			
Crab			X
Lobster			X
Sea snail			X
Sea Urchin			X

Recreational fishing varies seasonally and is weather related, especially when fishing from boats, as is the case off Point Loma. Summer months show an increase in fishing activity in both state and federal waters. Inshore recreational fishing gradual increases throughout the calendar year beginning in March and ending in February. Recreational fishing trips generally peak during the summer months (DON 2005).

RECREATIONAL ACTIVITIES

California is the number one travel destination in the United States (NOEP 2005). The California tourism industry generates more than $75 billion annually in direct travel spending and supports more than 1 million jobs, which makes it the 3rd largest employer and 5th largest contributor to the state's economy.

World famous sandy beaches and favorable weather in southern California make a substantial contribution to state tourism revenues and employment. Tourism and Recreation has been the fastest growing economic activity, both in volume and diversity, along the coastal zone (NOEP 2005).

All economic activities associated with coastal recreation are linked to good water quality. Protecting coastal beneficial uses such as swimming, surfing, boating, and fishing has a direct economic payoff. Burgeoning coastal recreation increases revenue flows to hotels, restaurants, and service industries.

California's beaches are among the most popular vacation destinations. More than 12 million people visited California beaches during the year 2000; Table 17 summarizes participation in various activities for these beach visitors.

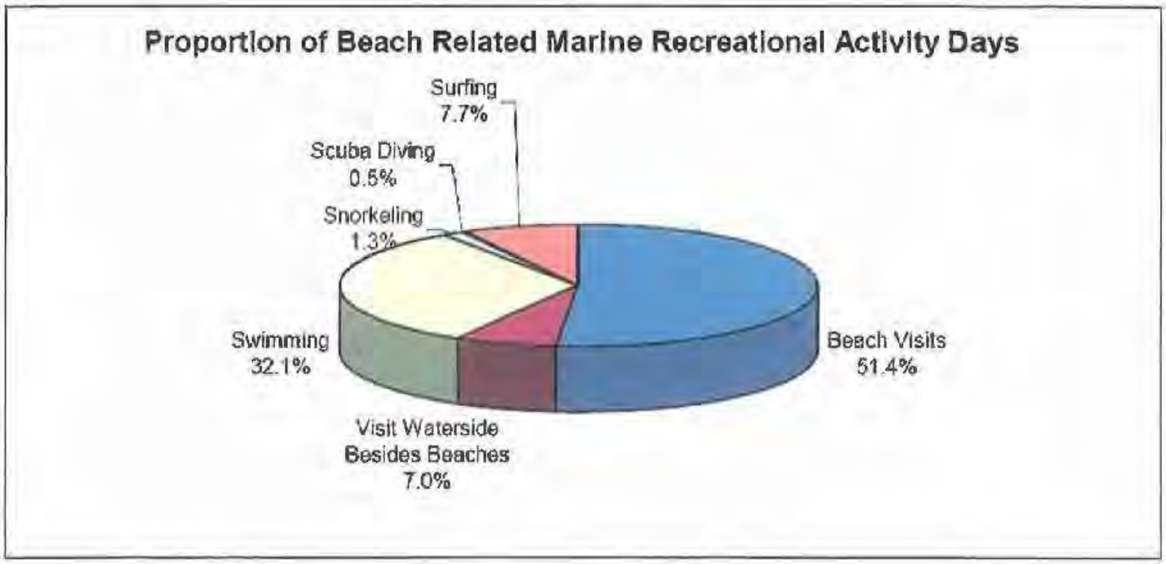
Table 17. Participation in CA Beach Activities in the Year 2000.

Recreational Activity	Number of Participants	Number of Days	Average Days Per Person
Visit Beaches	12,598,069	151,429,000	12.02
Swimming	8,398,997	94,573,000	11.26
Scuba Diving	288,023	1,383,000	4.80
Surfing	1,114,372	22,633,000	20.31
Wind Surfing	82,201	n/a	n/a
Snorkeling	706,998	3,818,000	5.40

Source: ORRRC 2000.

On average, each person made slightly more than 12 trips per year. The average number of activity days per participant (participation rate) gives a measure of intensity of participation. It varies from activity to activity, being as low as 4.8 days for scuba diving and as high as 20 days for surfing. Figure 13 depicts the proportionate contribution for each of the listed beach activities.

Figure 13. California Beach Related Activities.



In San Diego, the Mediterranean climate, beaches and bays, and temperate ocean waters provide abundant opportunities for marine recreation. These amenities draw visitors from around the world, making tourism San Diego's third-largest industry (after manufacturing $25B (2002); and defense, $12B (2006) (San Diego Chamber of Commerce 2007)). Visitor spending totaled over $6 billion in San Diego during 2006 (San Diego Convention and Visitor's Bureau 2007).

Ocean recreation at Point Loma includes aesthetic enjoyment, sightseeing, sunbathing, hiking, picnicking, tide-pooling, whale watching, boating, sailing, and sport fishing. These types of activities are designated as non-contact water recreation by the San Diego Regional Water Quality Control Board and are defined as "involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible" (SDRWQCB 2007a).

Ocean recreation off Point Loma also includes swimming and wading, skim boarding, water skiing and wake boarding, snorkeling, surfing, sailboarding, kite-sailing, kayaking, outrigger canoeing, paddleboarding, free diving, SCUBA diving, and personal watercraft (PWC) (jet ski) operation. These activities are designated by the San Diego Regional Water Quality Control Board as water contact recreation and are defined as "involving body contact with water, where ingestion of water is reasonably possible" (SDRWQCB 2007a).

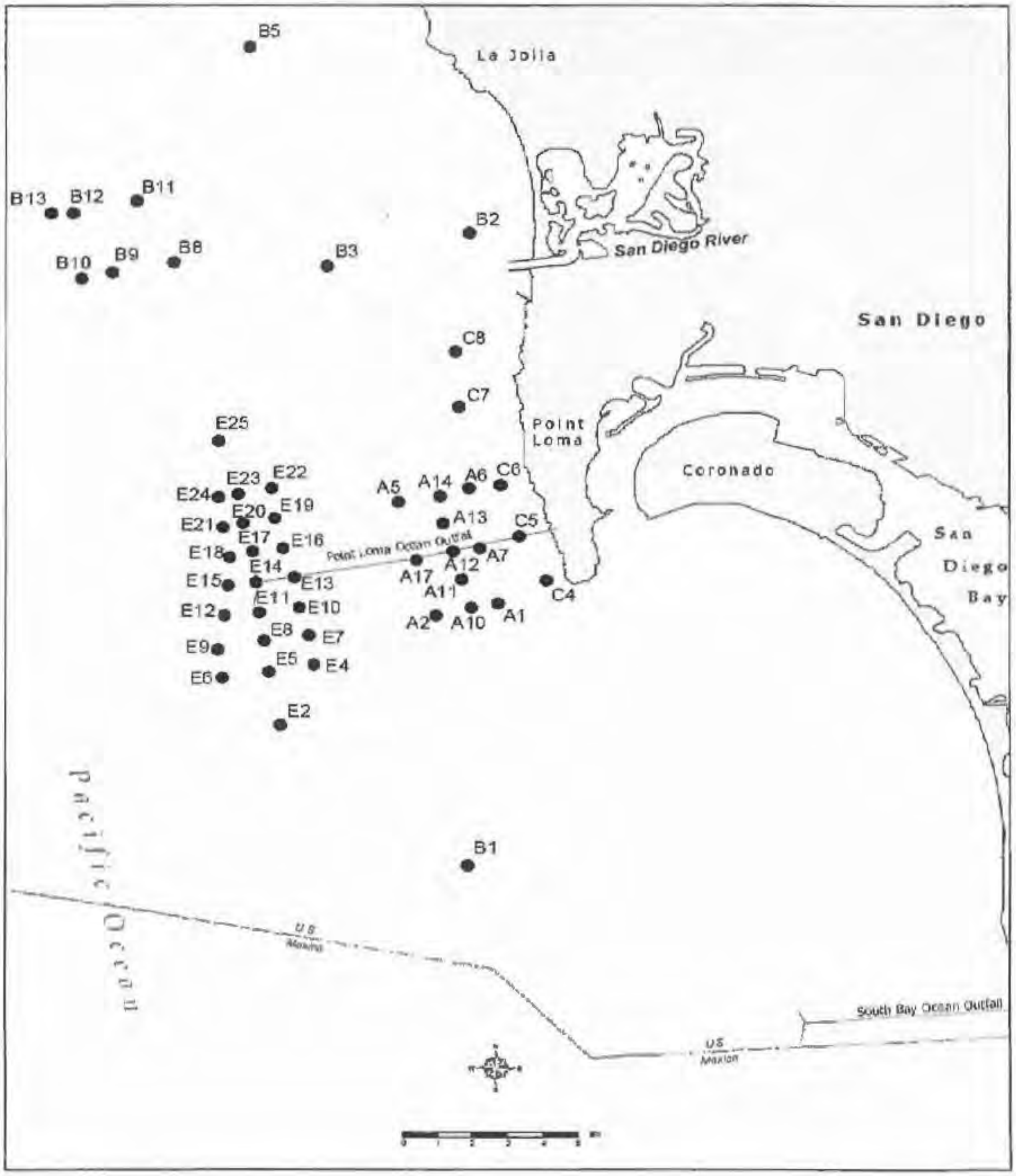
The only data on the specific distribution of recreational activity off Point Loma comes from field observations made in the mid 1980's by Wolfson and Glinski (1986). They identified and plotted the position of individual boats and water craft during the summer of 1986. Most ocean recreation in the vicinity of Point Loma was found to occur in the inshore and nearshore areas, with fishing and diving concentrated in the kelp bed area. Power boating and sailing were the only recreational activities observed with any regularity beyond the outer edge of the kelp bed (beyond 1 mile (mi) from shore). The intensity of these activities rapidly diminished at increasing distance offshore.

The territorial waters of the State of California extend to 3 nautical miles (nm) offshore. The United States Federal Government has exclusive jurisdiction from 3-12 nm offshore (DOALOS 2007). Although no specific investigations of recreational use of Federal waters off Point Loma have been conducted, information is available from monitoring logs and observations of the crew of the San Diego Metropolitan Wastewater Department's monitoring vessels.

The City of San Diego PLWTP ocean monitoring program conducts sampling at a grid of stations extending from 3 mi (4.6 km) south of the outfall to 8 mi (12.7 km) north of the outfall (Figures 14 and 15). The sampling stations in the grid range in depth from 30 ft (9 m) to 380 ft (116 m) and extend from .3 mi (.5 km) to 6.8 mi (11 km) offshore.

Figure 14. City of San Diego Water Quality Monitoring Stations (2003-2007) .

Figure 15. City of San Diego Water Quality Monitoring Stations (<2003).



The monitoring vessel captain keeps a log of sampling activity at each sampling station and notes prevailing conditions, including boats and ships in the area. From January 2001 to July 2007, monitoring logs indicate the presence of boats or ships during 17 of the 1,726 station sampling events in Federal waters (Table 18). The observations included Navy and Coast Guard vessels and fishing and sail boats, but no water contact recreation craft were observed in the vicinity of sampling stations in Federal waters.

Table 18. Vessels Observed at Monitoring Stations in Federal Waters.			
Station Type	Station Number	Sample Date	Comments
Water quality	F21	27-Mar-02	Boats
Water quality	E15	17-Jul-02	Light chop, Fishing boat
Water quality	E16	30-Aug-02	Calm, Sailboat
Water quality	E24	30-Aug-02	Calm, Coast Guard vessel
Water quality	E23	26-Sep-02	Calm, Coast Guard vessel
Water quality	E13	26-Sep-02	Navy dolphin boat
Water quality	B13	15-Oct-02	Calm, Fishing boat
Water quality	E8	15-Oct-02	Calm, Navy ships
Water quality	E10	22-Nov-02	Calm, Coast guard vessel
Water quality	E11	14-Apr-05	Calm, Fishing boats
Water quality	F16	12-Apr-06	Calm, Boats
Water quality	F19	5-Jul-06	Calm, Boats
Water quality	F34	7-Jul-06	Small fishing boat
Water quality	F15	5-Oct-06	Boats
Water quality	F30	9-Apr-07	Navy ship on station
Water quality	F35	9-Apr-07	Sportfishing boat
Water quality	F25	11-Apr-07	Sportfishing boat

From January 2001 to July 2007, the three City of San Diego monitoring vessels, Metro, Monitor III, and Oceanus, spent 1,354 days at sea. Interviews were conducted on November 14 and 15, 2007 with four members of the ocean monitoring crew who served a total of 2,262 days on these vessels during the period. Their observations of maritime and recreational activity are summarized below.

Large vessels, principally Navy ships and commercial carriers (cargo transports, oil tankers, barges), generally transit the Point Loma area beyond 5 miles offshore. Most ship traffic funnels into and out of San Diego Bay well to the south of the outfall area. Recreational vessels (fishing and pleasure boats) in Federal waters off Point Loma are heading to or returning from offshore fishing banks and islands. Power and sail boats traversing the Point Loma area generally cruise along the outer edge of the kelp bed and are rarely seen more than a mile and a half offshore.

Recreational fishing in Point Loma ocean waters takes place primarily in the nearshore zone and in the kelp bed area. The monitoring crews report occasionally seeing commercial passenger fishing vessels (Party Boats) and sport fishing craft as far out as the decommissioned outfall (2 miles offshore) but practically never further offshore.

Swimming, surfing, and snorkeling occur in the nearshore area, inside the kelp bed. The vast majority of PWC operators, water skiers, wake boarders, board sailors, kite boarders, kayakers, canoers, and paddleboarders are seen inshore of the kelp bed. The monitoring crews could not recall a single incident of these types of recreational activities occurring in Federal waters.

Recreational SCUBA diving off Point Loma is focused on the kelp bed, with dive boats rarely sighted beyond a mile and a quarter offshore. Recreational fishers venturing into deeper water may occasionally free dive below floating kelp patties to spear gamefish, but this activity has not been observed by the monitoring crew in Federal waters.

Table 19 shows where water contact recreation takes place off Point Loma, based on these monitoring observations and on the recreational use assessment in this appendix. Virtually all swimming, surfing, diving, paddling, fishing from paddle craft, board sailing, water skiing, and PWC operation is confined to waters less than 2 nm from shore. No known water contact recreational uses exist outside of State regulated waters.

Table 19. Water Contact Recreation in the Vicinity of Point Loma.

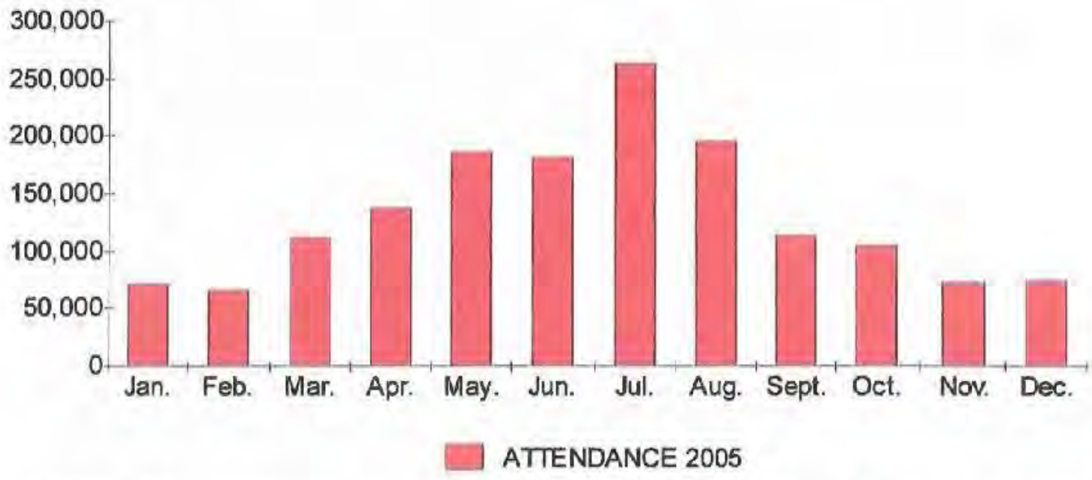
ACTIVITY	Inshore (depth 0 to 10ft)	Nearshore (depth 10 to 30ft)	Kelp Bed (to 100ft/1 mi offshore)	Offshore State Waters (1-2nm)	(2-3nm)	Federal Waters (3-12nm)
Swimming and wading	X					
Skim boarding	X					
Water skiing and wake boarding	X	X				
Snorkeling	X	X				
Surfing	X	X				
Sail/Kite board	X	X	X			
Kayak/canoeing	X	X	X			
Paddleboarding	X	X	X	X		
Free diving		X	X	X		
SCUBA diving			X	X		
PWC			X	X		

Swimming and Wading

The majority of swimming and wading (walking through the water) in the vicinity of Point Loma takes place at Ocean Beach, about 6 mi north of the Point Loma Ocean Outfall. Beach activities are very popular at Ocean Beach's (OB) public beach near the mouth of the San Diego River Channel and adjacent Mission Bay Harbor. Although some people swim at remote "pocket beaches" along Point Loma, OB has virtually all the amenities sought by beach-goers - proximity to major highways, an expansive, gently sloping sandy beach with easy access, a large parking lot, showers, restrooms, a pavilion, and lifeguards. The OB pier, near-by shops, and numerous restaurants also contribute to making OB one of the most popular (3^{rd} or 4^{th} out of 21 public beaches in the city) among visitors and tourists.

Beach attendance is weather dependent and varies seasonally. Figure 16 presents the OB monthly beach attendance from data records provided by the San Diego Lifeguard Service (Oceanfront Statistics Report Data).

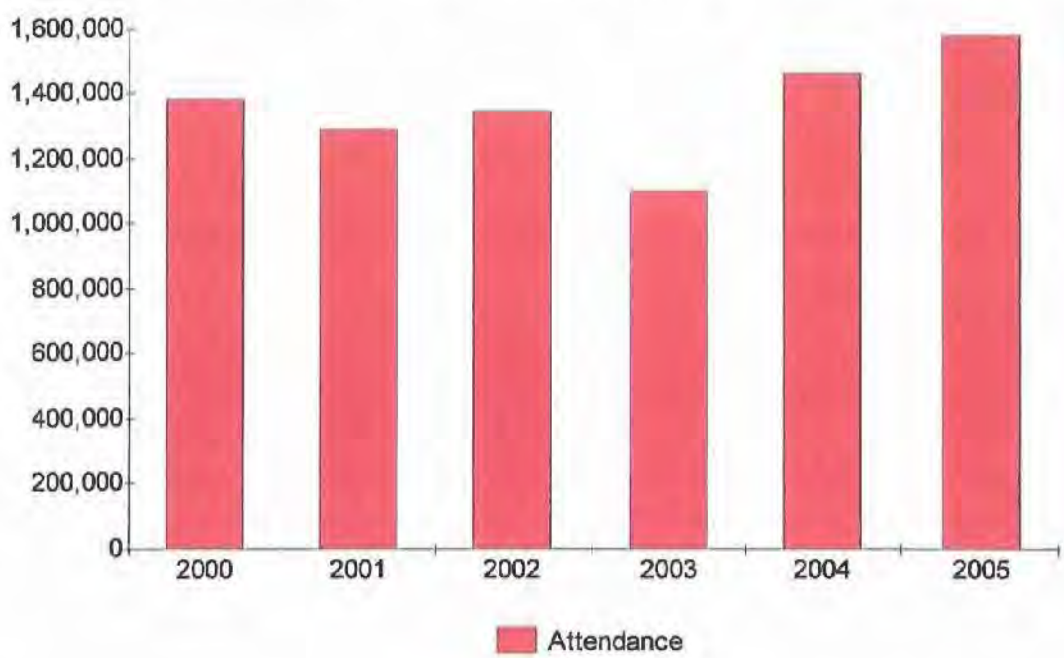
Figure 16. Monthly Beach Attendance at Ocean Beach, CA (2005).



Over 1,581,000 beach trips were made to OB, California during 2005. Summer months are most popular. July had the highest monthly attendance, the 4th of July Weekend (3 days) typically has the highest use of the year (1.43 million visits for all 21 S.D. beaches 2005), followed by Memorial Day Weekend (3 days) (926,000 all S.D. beaches 2005).

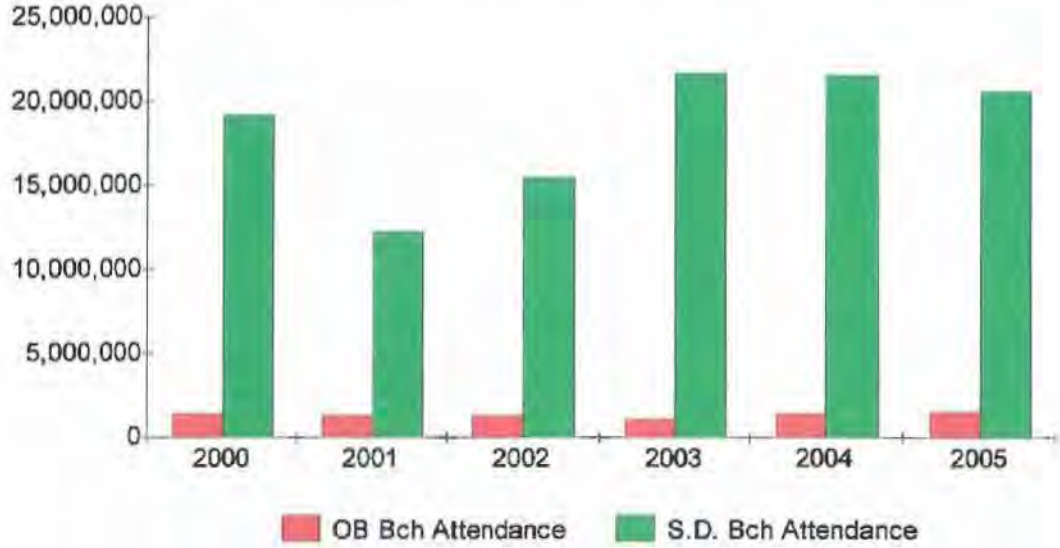
The trend in beach attendance at OB for the most recent five-year period appears in Figure 17.

Figure 17. Trends in Beach Attendance at Ocean Beach (2000-2005).



Variations in attendance at any particular beach depend on factors such as planned events, competing near-by recreational opportunities, wind and sea-state, and traffic and construction. In Figure 18, attendance data for OB are compared to the combined attendance data for the remaining 20 San Diego city beaches during 2000-2005.

Figure 18. Attendance at Ocean Beach versus Other San Diego Beaches.



Yearly beach attendance ranged between 1.10-1.58 million (mean=1.36m) for OB, and between 12.27-21.61 million (mean=18.44m) for the other 20 beaches in San Diego. There are unexplained variations in attendance over the period, however, the overall attendance at OB and the remaining 20 San Diego beaches combined show a slight increase in attendance since year 2000.

Skim-boarding

A popular activity among the young, skim boarding involves running along the water's edge and jumping onto a short flat board to skim atop a thin layer of wave-washed water over the sand. Newer boards and the growing populatity of new "tricks" have more enthusiasts skimming toward breaking waves to become airborne to do flips and lunges into water (up to a few feet deep) just beyond the beach. This activity is by design limited to gradually sloping sandy beaches, in this vicinity, those between Dog Beach and Ocean Beach Pier. The small pocket beaches along the remainder of Point Loma are of limited interest to skim boarders.

Surfing

California accounts for about 35% of U.S. surfing in terms of the number of participants and the number of surfing activity days (NOEP 2005). With its warmer climate and waters, San Diego is an especially popular surfing venue. Surfing is here defined as an activity that employs a surf board of some type to ride waves—boogie board, surfboard, belly board, knee board or standup paddle board. Sandy bottom beach breaks in the vicinity of Point Loma, Ocean Beach pier, and the San Diego River channel jetty attract surfers year-round. Farther south along Point Loma, the Sunset Cliffs offshore reefs and kelp bed provide good surfing opportunities for experienced surfers. Because waves break in water depths approximately equal to their height, the majority of surfing at Point Loma takes place over depths considerably less that 15-20 ft, and well inside of the shoreward boundary of the kelp bed (½ mi offshore). When low spring tides coincide with large swells, surfers do at times wait for waves at scattered peak breaks (over areas of bottom shallower than the general surroundings) just inside the inner edge of the Point Loma kelp bed.

A relatively new type of surfing, tow-in surfing, employs a PWC (discussed below) to pull surfers into larger waves peaking offshore well before they become steep and break. Once the surfer feels the push of the wave, the tow line is released, the PWC veers off, and the surfer rides the wave like a paddle-in surfer. This type of surfing is rarely observed in the vicinity of Point Loma.

Standup paddle board surfing brings yet another variation to surfing in California. This type of surfing was practiced historically. Participants use longer special boards, usually in the 9 ft- 12 ft range, and a specialized, extended paddle. Unlike regular surfing in which a surfer lies prone while paddling and jumps up to ride, standup boarders paddle out to the break while standing on their board. Waves are also caught standing and the paddle is used for balance and to assist in turning the board. This type of surfing is relatively uncommon off Point Loma.

Kite-boarding and Sailboarding

Kiteboarding is considered the world's fastest growing sport and gives new meaning to the old adage, "go fly a kite". Kiteboarders use a shute or kite on a long set of control lines rather than a sail to harness the wind. Like sailboarders, kiteboarders use a board, more like a ski-board or snowboard rather than a surf or sailboard, to carve and skim along the water's surface and get airborne launching off the face of waves. The sport was founded over two decades ago in France. Interest in the sport in the U.S. accelerated about 10 years ago with improvements in equipment and the advent of articles and magazines dedicated to the sport. Classes are offered at various San Diego locations including the Mission Bay Aquatic center. Kiteboarding can be enjoyed in bays and large enclosed bodies of water, but the real thrill comes with ocean kiteboarding and wave jumping. Like sailboarding, kiteboarding requires easy access to the shore. The steep stairs and cliffs along Point Loma are not conducive to the sport and participants generally prefer long sandy beaches and relatively kelp-free waters so high speeds can be attained. Sail and kite boards can be deployed from boats, but this is infrequent. Therefore, kiteboarding and sailboarding are not well represented in the immediate vicinity of Point Loma.

Kayaking, Surf Ski and Outrigger Canoeing

Ocean kayaking is rarely observed in the vicinity of the Point Loma. The steep bluffs eliminate the possibility of beach launching, so kayakers must reach the area by larger pleasure boats or by paddling from OB, San Diego Bay or Mission Bay harbor. Though uncommon, some sportfishing from kayaks does take place at the northern and southern ends of the Point Loma kelp bed, and the occasional surf kayaker is observed riding waves in the surf zone.

Kayakers participate in the Bay to Bay ocean race mentioned in the outrigger canoe section below. The route taken varies depending upon ocean swell conditions and the individual participant's race strategy; sometimes participants remain shoreward of the kelp bed while others take a route beyond the kelp bed.

Surf skis is similar in a way to kayaks, however, the vehicle used is a cross between a surfboard and a kayak; the rider sits in an indentation on the board rather than within its confines. Most surf skiers ride waves much like surfers, but many simply paddle for enjoyment and in competition. Competitions usually involve other classes of craft, such as canoes and kayaks. They do take place in offshore ocean waters over routes covering many miles.

With approximately 24 clubs in southern California, outrigger canoeing is a fast growing team sport in California. There are four outrigger canoe clubs in Mission Bay with several hundred male and female active members. One to 6 person Polynesian-style canoes are used with an "ama" or outrigger on the left side. Clubs have divisions for ages 12 and under all the way up through men and women's Senior Masters (45 and older). They practice several times a week and participate in local, regional and, international races. Most practice sessions and local races are within the confines of the bay, but some practices and races venture into the ocean from Mission Bay harbor, and may go out as much as 3 mi offshore.

In San Diego, the longest local ocean race is the annual Bay to Bay Race. Running from Mission Bay to San Diego Bay and held in mid-to-late summer, the Bay to Bay Race draws between 100 to 200 participants and every kind of paddling class including kayaks. The actual race route depends upon prevailing weather and swell conditions. When ocean swells are large, paddlers opt for the outside the kelp bed route, when calm conditions prevail most competitors take a more direct, inshore of the kelp bed, route. Other events exit Mission Bay, head to sea in the direction of Crystal pier in Pacific Beach, and then return to finish inside Mission Bay.

Outside of organized competitions, kayaking and canoeing are only infrequently observed off Point Loma.

In addition, some fishing from kayaks, surf skis and canoes is seen at times in and around the kelp bed during summer. However, this is relativey uncommon.

Paddleboarding

Paddleboards are specialized large surfboards (usually about 14 ft) used for paddle races. Some organized races are open water ocean courses of 16 miles or or more. Most popular in the waters off Hawaii, paddle races do occur in California waters, notably, the Catalina Island and the San Onofre races and some long distance races between various San Diego piers, and between San Diego and Mission Bays. Some practice paddling takes place in the vicinity of the Point Loma kelp bed. During summer, paddleboarders may fish near shore or in and around the kelp bed; but, this activity is infrequent.

Water skiing and Wake boarding

Although water skiing and wake boarding are popular activities in San Diego as a whole, they are not often seen in the vicinity of Point Loma. Both activities usually remain within the confines of either Mission Bay or San Diego Bay. The ocean waters only rarely offer the smooth surface preferred by skiers, and as the name implies, wake boarders perform their maneuvers on the wake of the towing vessel, or the wake caused by another vessel. In the past the tow vessel was always a boat. Today, with larger more powerful PWC (discussed below) wake boarders could conceivably venture into the ocean and perhaps make use of ocean swells in the surf zone in a manner somewhat similar to tow-in surfers.

SCUBA, Snorkeling, and Free-diving

The abundant and diverse marine life, a multitude of professional dive charter boats, and year-round temperate weather make southern California one of the world's great diving destinations. Recreational divers of all types frequent both natural habitats such as reefs, seamounts and kelp beds such as those off Point Loma, and artificial habitats.

Readily accessible by boat from San Diego Bay and Mission Bay, the Point Loma kelp bed and reef is one of the premier dive spots in southern California (Wolfson and Glinski 1986, Sheckler and Sheckler 1989, Krival 2001). Underwater photography of kelp and reef creatures is increasingly popular, and has far surpassed hunting for game species. Some divers spearfish for sheephead, rockfish, bass, flatfish, wrasses, bonitos, amberjacks, barracudas, and sculpins. Harvesting of lobsters, sea urchins, rock scallops and other invertebrates is popular in some areas, such as the Point Loma kelp forest, and prohibited in others, such as the La Jolla Cove Marine Preserve.

Artificial marine habitats off southern California are also popular, particularly among SCUBA and free divers. These habitats include shipwrecks, artificial reefs composed of concrete rubble, Navy towers, oil and gas platforms, and even airplane wrecks. These substrates quickly become encrusted with marine life and attract a full array of marine species including predatory migratory species.

Wreck Alley (described in the artificial reef section) is one of the most popular diving destinations off San Diego. Located just offshore of Mission Bay, Wreck Alley showcases the remains of several vessels that were scuttled in order to benefit divers and serve as artificial reefs, including the *Ruby E*, ex-HMCS *Yukon*, *Shooter's Fantasy*, and *El Rey*.

Also located offshore of Mission Bay is the Naval Ocean Systems Center Tower, a Naval research station that collapsed in a storm in 1988. At an average depth of 30 ft (9 m), this site is suitable for divers of all skill levels including snorkelers. Off San Diego Bay are two additional shipwrecks, the ex-USS *Hogan* (a destroyer) and *S-37* (a submarine), which were used as Naval bombing targets during WWII.

The popularity of SCUBA diving in San Diego is affected by economic and meteorological conditions. During good economic times and mild weather, the number of people learning to dive and the frequency of diving by certified divers increases. Naturally, when rough, low light or cold conditions prevail SCUBA activity subsides.

The usual maximum range of recreational SCUBA divers is about 100 ft, but most dives are made in 40-70 ft depths.

Snorkeling generally takes place much closer to shore in shallow waters, usually 8-15 ft deep, and perhaps out to 20-30 ft depths in the vicinity of Point Loma. Some limited snorkeling does occur within the Point Loma kelp bed, however, this activity has declined greatly since the ban on abalone harvesting from all waters south of San Francisco went into affect a decade ago.

Freediving, here defined as breath hold deep diving, is similar to snorkeling but generally involves greater depths and frequently, hunting for game. In San Diego a close knit group of skin divers just after WWII, known as the "Bottom Scratchers" began skin diving in the La Jolla-Point Loma area. They made their own gear and, initially, their primary goal was seeking game. Freediving has since evolved into a unique sport with specialized but minimal gear. Freedivers hunt game, particularly large fish, in deep and sometimes open blue water. It is a hardy pursuit for a small group of well-conditioned individuals. There are numerous freedive clubs around the nation, with one in San Diego. They have meets and competitions for their members and with other freedive clubs from outside the area. Experienced freedivers dive in excess of 40 ft to spear game. Some freediving takes place in and around the Point Loma kelp bed. Freediving also includes the extreme sport of competitive apnea diving where divers attain great depths without use of an underwater breathing apparatus. The "no limits" (wear any weight & weight drop permitted, sled use OK, balloons OK for ascent) free-diving world record currently stands at 492 ft.

Wolfson and Glinski (1986) estimated about 5,000 SCUBA occurred annually in and around the Point Loma kelp bed. Other types of diving in the area are limited.

Jet Skiing/Personal Watercraft

Jet skiing, or personal water craft boats (PWC) developed over the past two decades. Jet skiing is a generic term for all forms of personal, motorized watercraft including the traditional jet ski with a single rider, now replaced by larger more powerful PWC capable of carrying more than one rider. All PWC currently have gasoline-powered engines and use water jets for propulsion.

PWC are infrequently seen off Point Loma. Access limitations and use restrictions tend to confine personal watercraft activity to areas of San Diego and Mission Bay and their harbor entrances. PWC are prohibited in the nearshore zone off Cabrillo National Monument and anywhere near bathers, swimmers or surfers. Since beach access is not feasible, personal watercraft must come from San Diego or Mission Bay. Rarely, PWC are launched from large pleasure boats anchored offshore, therefore, PWC use is not common off Point Loma.

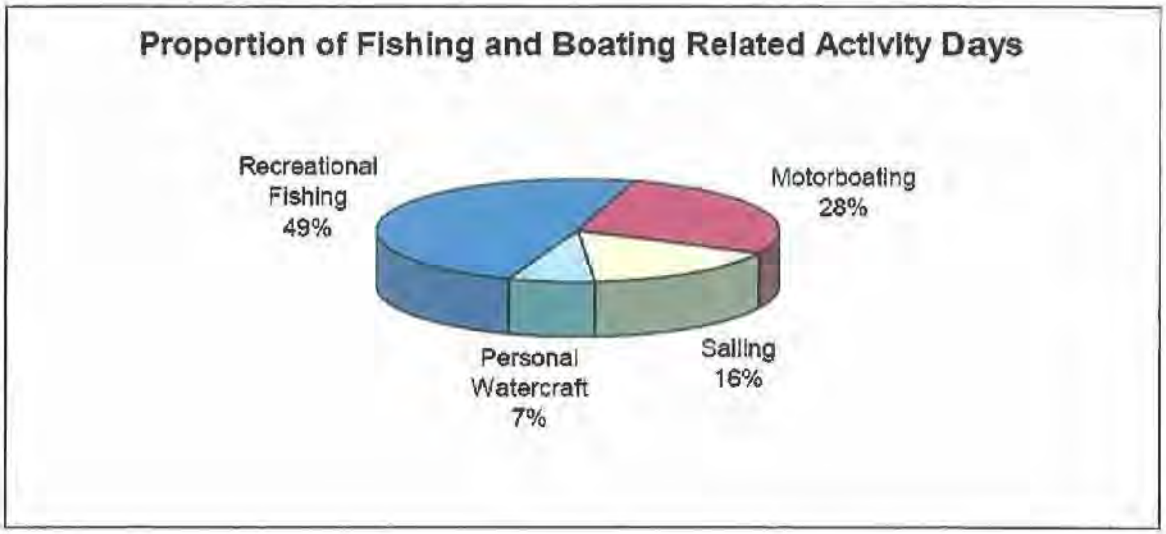
Tidepooling

Tidepooling is popular in the vicinity of Point Loma. The Mia J. Tegner Point Loma (State Marine Conservation Area) SMCA, at the southern tip of Point Loma at Cabrillo National Monument, is the focal point of tidepooling in the area. It is estimated that about one hundred thousand people per year visit the Cabrillo National Monuments' tide pools (Engle and Largier 2006). Another "easy access" point to the rocky shoreline is the stairs at the foot of Ladera Street and Sunset Cliffs Boulevard. Here the level of tidepooling activity diminishes rapidly both north and south with increasing distance from the stairs.

Boating and Sailing

Boating and sailing are popular throughout coastal California. In 2000, more than 2.7 million fishers participated in more than 20.3 million recreational fishing activity days along the California coast, while more than 4 million people participated in marine boating related activities. California had the largest number of marine fishers and sailors, while it was ranked second, behind Florida, in motor boating in the U.S. The proportions of different boating and fishing related activities are given in Figure 19 (NOEP 2005).

Figure 19. Boating Related Activity in California during 2000.



The waters in and around San Diego Bay are an internationally recognized venue for competitive yachting. In 1995, the America's Cup regatta was held in waters just offshore of San Diego Bay. Today, competitive sailors from a number of different countries frequently practice along the racing course. Inside the bay, a regatta course is located in open waters to the west of Naval Station San Diego. For the 18 public marinas, four private yacht clubs, four free boat launch ramps, 55 boatyards, restaurant docks, and anchorages in existence within San Diego Bay, a total of 8,281 boat slips are available, with over 80% occupancy. Recreational boat berthing areas are found mainly at Shelter Island, Harbor Island, The Embarcadero, Glorietta Bay, Coronado Cays, and Chula Vista. In addition, Mission Bay has 4 public launch ramps and numerous marinas supplying another 1,759 slips.

Most ocean boating near San Diego and Mission Bays takes place in and around the Point Loma kelp bed (fishing and diving), and sail and power boats traverse the area 1-1.5 mi offshore just beyond the outer edges of the kelp bed while traveling between San Diego and Mission Bays.

Whale Watching

Gray whales (*Eschrichtius robustus*) migrate through San Diego's coastal waters twice yearly on their way between summer feeding grounds off Alaska and calving areas in the coastal lagoons of Baja California. The major migration route through southern California is between the mainland and the offshore islands. The whales tend to swim closer to the shore during February and March on their northward migration when calves are present, than on the southward migration during December and January. At Point Loma they traverse the offshore waters from the outer edge of the kelp bed, about 1 nm offshore, out to the horizon.

Private boats and commercial passenger vessels venture out from San Diego Bay and Mission Bay to watch the whales. As of 1998, 31 charter companies ran whale watching tours (using a wide variety of sail and powerboats) (San Diego Convention and Visitors Bureau 1999). Charter vessels continue to operate, and whale watchers now (2007) also have the option of observing migrating whales from Navy Seal style go-fast RIB-inflatable boats out of San Diego Bay (San Diego Convention and Visitors Bureau 2007). Kayakers also venture out from shores to observe whales.

During warm, calm, winter and spring weekends, dozens of boats may be seen off Point Loma observing whales. The National Marine Fisheries Service, the agency responsible for protecting gray whales under the Marine Mammal Protection Act, has issued guidelines for safe, non-disruptive whale watching. Vessels are to go no faster than a whale or group of whales while paralleling them within 100 yards and do nothing to cause a whale to change direction. The guidelines also state that a whale's normal behavior should not be interrupted and that doing so constitutes illegal harassment. In season, whale watching vessels regularly ply the waters off Point Loma.

Cruising

Another increasingly popular form of ocean adventure is a voyage on a cruise ship. San Diego's cruise ship industry continues to boom. In 1998, seventy cruise ships made port calls in San Diego (with 86,777 passengers). In 2006, 255 cruises departed from San Diego carrying more than 500,000 passengers. This represents well over a 500% increase since 1998, and a 180% growth rate since year 2000. For 2007, the Cruise Lines International Association and the Port of San Diego estimate 665,000 passengers will leave for cruises from San Diego, and, Carnival Cruise Lines announced it will make San Diego its year-round home port for its ship, "*Elation*", which carries 2,053 passengers. This is the first cruise ship to be berthed in San Diego year-round. The Port of San Diego is planning a substantial expansion of the Cruise Ship Terminal and facilities in anticipation of continued increasing demand.

OTHER BENEFICIAL USES

Marine Protected Areas

San Diego County has 17 protected marine areas (CDFG 2007h). Some are entirely aquatic (San Diego-La Jolla Ecological Preserve, San Diego Marine Life Refuge, San Diego-La Jolla Underwater Park, Scripps Coastal Reserve, Encinitas Marine Life Refuge, Cardiff-San Elijo Underwater Park) and some have only their western portion in the marine environment (Border Field State Park, Cabrillo National Monument, Torrey Pines State Reserve, and seven State Beaches).

Three of San Diego County's Marine Protected Areas (MPAs) are in the vicinity of Point Loma. The closest MPAs to the Point Loma Ocean Outfall are the 1) Mia J. Tegner Point Loma State Marine Conservation Area (SMCA), 2) the San Diego-La Jolla Ecological Reserve, 3) the San Diego Marine Life Refuge and Area of Special Biological Significance (SDMLR-ASBS) which includes Scripps Coast Reserve. Areas of Special Biological Significance (ASBSs) are designated by the California State Legislature and are defined as having biological communities of such extraordinary value that no risk of change in their environment can be entertained (SWRCB 2007a). The California Ocean Plan prohibits discharge of waste into an ASBS and requires that outfalls be located at a sufficient distance away from an ASBS to assure the maintenance of natural water quality conditions (SWRCB 2007a).

State Water Quality Protection Areas (SWQPAs) are designated to protect marine species or biological communities from an undesirable alteration in natural water quality. All Areas of Special Biological Significance (ASBS) that were previously designated by the State Water Board are now also classified as a subset of State Water Quality Protection Areas and require special protections afforded by the revised Ocean Plan 2005 adopted on February 14, 2006 (SWRCB 2005).

The Mia J. Tegner Point Loma SMCA at the southern end of Point Loma has 0.54 nm of shoreline and extends 0.01 nm (150 ft) seaward to include intertidal and subtidal habitat (0-6ft). The oceanic boundary extends 900 ft (275 m) offshore from mean low-low tide. It protects marine populations in the Cabrillo National Monument. The Cabrillo National Monument, a major attraction for both research scientists and the public, is one of the largest, readily accessible, best preserved tidal area in San Diego. The Mia J. Tegner Point Loma SMCA is approximately 4.4 nm east of the discharge.

San Diego-La Jolla Ecological Reserve (ER), just north of Point La Jolla, includes 1.62 mi (1.41 nm) of shoreline and extends seaward 0.67 mi (0.58 nm) to include an area of rocky reef habitat at depths out to 280 ft. It protects near-shore habitat that supports research activities of the Scripps Institution of Oceanography and encompasses the San Diego-La Jolla Ecological Reserve Area of Special Biological Significance. Approximately 13.8 mi (12 nm) north of the Point Loma Ocean Outfall, the San Diego-La Jolla Ecological Reserve is located in the 5,977 acre San Diego-La Jolla Underwater Park which was dedicated by the San Diego City Council in 1970 to protect the natural ecology and environment. The Park extends from Alligator Point in La Jolla north to Del Mar and out to a distance of 8,000 ft from shore. The underwater park is managed by the City of San Diego's Park and Recreation Department, Coastal Division, and is overseen by an Underwater Parks Management Committee.

San Diego Marine Life Refuge (SDMLR) is immediately north of the San Diego-La Jolla ER in La Jolla Bay, adjacent to Scripps Institution of Oceanography. In 1929, the California State Legislature granted the University of California "sole possession, occupation, and use" of the intertidal zone and subtidal zone to 1,000 ft offshore along the 2,600-ft oceanfront of the Scripps Institution of Oceanography (SIO). This area was designated as the San Diego Marine Life Refuge in 1957 and was included in the University of California's Natural Reserve System in 1965. It is part of the collective San Diego-La Jolla Underwater Park. The park has a total surface area of 5,977 acres while the surface area of the SDMLR-ASBS is approximately 92 acres. The SDMLR-ASBS includes three distinct habitats: a broad, sandy shelf; a concrete pier piling system; and an intertidal mudstone reef complex of dikes, boulders, and ledges with depths of 0-20 ft. Within this area, the Scripps Coast Reserve extends to depths of 745 ft.

Silver Strand State Beach in the City of Coronado is located 10 miles south of the Point Loma Ocean Outfall and Border Field State Park is 13 miles (11.3 nm) to the south.

Research and Education

Underwater research has been conducted in the Point Loma kelp bed since the mid 1950's when Wheeler North of the California Institute of Technology and his associates at Scripps Institution of Oceanography (SIO) began long-term investigations of kelp bed ecology (Neushul 1959, North 1964, North and Hubbs 1968). Professors Paul Dayton and Mia Tegner of SIO have done ecological surveys at fixed locations in the Point Loma kelp bed since 1971 (e.g., Dayton and Tegner 1984, 1990; Dayton et al. 1984, 1992, 1998, 1999; Graham 2004, Hewitt et al. 2007, Parnell et al. 2005, Tegner and Dayton 1977, 1981, 1987, 1991; Tegner et al. 1995, 1996, 1997: Steneck et al. 2002). Their descriptive and experimental studies have established a database unique in the world. Dayton and Tegner have demonstrated that large-scale, low-frequency episodic changes in oceanographic climate ultimately control kelp forest community structure. Local biological processes, like recruitment, growth, survivorship, and, reproduction, may be driven by small-scale ecological patterns. But decade-long shifts in climate (between cold water, nutrient-rich La Niñas and warm water, nutrient-stressed El Niños) and rare but catastrophic storms have been the principal forces governing the diversity and productivity of the kelp forest community at Point Loma.

The Point Loma kelp bed also serves as a site for SIO and San Diego State University graduate student research (e.g., Neushul 1959, Gerodette 1971, Deysher 1984, Graham 2000, Mai and Hovel 2007), and for ongoing unpublished research on CA spiny lobster movements in the Point Loma kelp bed by Hovel, Lowe, Loflen, and Palaoro 2007-2009).

Cabrillo National Monument's intertidal community has been studied since the 1970s and investigations continue today (Engle and Largier 2006). Diver surveys and gillnet fish collections were recently undertaken (Craig and Pondella 2005) in the Monument's 128 acre administrative waters which extend 900 ft from shore and encompass the Mia J. Tegner SMCA. Within the Monument's administrative waters are 100 species of macroalgae (Miller 2005), 247 species of marine invertebrates (NPS 2006), and 48 species of fish (Craig and Pondella 2005). The fish assemblage is typical of the southern California rocky mainland coast, and the overall richness is comparable to similar habitats in the San Diego region (NPS 2006). The Cabrillo Intertidal Monitoring Program began in 1990 and continues twice/year coinciding with extreme low tides during spring and fall. Thirteen key taxa are monitored near shore and in the kelp, and, birds and visitors are also counted. Students from schools throughout San Diego County make field trips to the Cabrillo National Monuments' tide pool area. An estimated one hundred thousand people visit the Cabrillo National Monuments' tide pools annually (NPS 2006).

The Point Loma Ocean Outfall Monitoring Program provides an extensive database on marine water quality and marine biology beginning with pre-design studies in 1958-59. The monitoring program at Point Loma was not designed as a research program, but, instead, was established to determine regulatory compliance. Even so, the monitoring program has generated data with considerable utility for scientific inquiry. For example, Conversi and McGowan (1992) analyzed 15 years of water transparency data at 7 monitoring stations to evaluate the influence of anthropogenic influences (sewage discharge) and natural oceanographic events. They concluded that anthropogenic activities had not affected transparency, while natural factors such as seasonality and distance from the coast had.

The La Jolla ocean area is a major focus of research and education in San Diego. The Scripps Institution of Oceanography, one of the nation's premier oceanographic training institutions, studies physical, chemical, and biological aspects of the marine environment; research aimed at understanding how two-thirds of the planet functions. The longest continuous measurements of oceanographic parameters (salinity, temperature, biomass, nutrients, etc.) anywhere in the world have been taken in this area. La Jolla waters are used to calibrate and test ocean instruments developed for deployment throughout the world.

The United States National Marine Fisheries Service has a major marine center in La Jolla. San Diego State University, the University of San Diego, and the Hubbs/Sea World Research Institute all have ocean studies programs in the area. The Environmental Science Division of the Naval Command, Control and Ocean Surveillance Center, San Diego, conducts ecological research in San Diego Bay and occasionally off Point Loma.

The Marine Mammal Systems Division of the U.S. Navy Space and Naval Warfare System Center on Point Loma conducts a wide variety of research on marine mammal biology, some involving training and field trials in San Diego ocean waters. Navy research has focused on dolphins because of their exceptional sonar for detecting objects in the water and on the bottom (superior to any sonar developed by man) and on sea lions because of their acute underwater hearing and low light level vision. Both are also capable, unlike human divers, of making repeated deep dives without experiencing "the bends" (decompression sickness). Working with dolphins and sea lions, Navy scientists have developed Marine Mammal Systems (MMS) for operational fleet deployment. Each "System" has 4 to 8 marine mammals, an Officer-in-Charge, and, several enlisted personnel. All MMSs can be deployed by aircraft, helicopter, and, land vehicles with all equipment necessary to sustain an operational deployment. Four types of MMSs are based at Navy facilities in San Diego Bay: Mk 4 – using dolphins to detect and mark mines moored off the bottom, Mk 5 – using sea lions to detect and recover mines (at depths up to 1,000 ft), Mk 6 - using dolphins to detect and intercept swimmers and divers, and, Mk 7 - using dolphins to detect and mark mines on the bottom. Training exercises for these systems and others currently under development are conducted in the open ocean off Point Loma.

The San Diego Coastkeepers have an ongoing kelp restoration and monitoring project in the southern portion of the Point Loma kelp bed (San Diego Coastkeeper 2007). This site serves as a reference area for comparison to their reforestation project at a small, former kelp bed in Del Mar.

Artificial Reefs

Designed to enhance sportfishing, 24 artificial reefs have been built along the southern California coast since 1958 (CDFG 2001b). Nine of these are in San Diego County. Five artificial reefs are within 20 mi of Point Loma (Table 20).

Table 20. Artificial Reefs in the Vicinity of Point Loma.

NAME	YEAR BUILT	DEPTH (feet)	MATERIAL	SIZE (tons or number)	Lat Deg N	Lat Min	Lat Sec	Long Deg W	Long Min	Long Sec
Torrey Pines 2	1975	44	quarry rock dock floats	3,000 tons 1 barge load	32	53	35	117	15	35
Torrey Pines 1	1964	67	quarry rock	1,000 tons	32	53	12	117	15	50
Pacific Beach 1A	1987	42-72	quarry rock	10,000 tons	32	47	20	117	16	42
Pacific Beach 2A					32	47	25	117	16	45
Pacific Beach 3A					32	47	35	117	16	50
Pacific Beach 4A					32	47	40	117	16	55
Pacific Beach 1B					32	47	24	117	16	30
Pacific Beach 2B					32	47	30	117	16	30
Pacific Beach 3B					32	47	38	117	16	34
Pacific Beach 4B					32	47	46	117	16	35
Pacific Beach 1C					32	47	30	117	16	12
Pacific Beach 2C					32	47	36	117	16	12
Pacific Beach 3C					32	47	44	117	16	14
Pacific Beach 4C					32	47	50	117	16	18
Pacific Beach Center					32	47	35	117	16	35
Mission Bay Park -El Rey	1987	80	wrecked ship		32	45	51	117	16	38
Mission Bay Park- Ruby E		90	wrecked ship		32	46	2	117	16	36
Mission Bay Park Kelp Reef	1991-93	60	concrete rubble		32	46	12	117	16	4
Mission Bay Park -NEL Tower		60	steel structure		32	46	22	117	16	3
Mission Bay Park -Concrete		80-90	concrete rubble		32	45	51	117	16	31
International Reef 1	1992	165	quarry rock	10,000 tons	32	32	40.3	117	14	53.1
International Reef 2					32	32	39.7	117	14	54
International Reef 3					32	32	37.5	117	14	50
International Reef 4					32	32	38.8	117	14	48.2
International Reef 5	2001		concrete rubble	300 tons	32	32	41	117	14	50.5
Missile Tower	1993		4 story missile platform	1 piece	32	32	29.7	117	14	47.4

last update: June 2001

Torrey Pines Artificial Reefs #1 and #2 are 16 miles to the north and the International Artificial Reef is 18 mi south of the Point Loma Treatment Facility. Mission Bay Artificial Reef and Pacific Beach Artificial Reef are about 9 mi north of the tip of Point Loma and therefore are the closest artificial reefs to the Point Loma Ocean Outfall.

The Mission Bay Artificial Reef, located at 32° 46′ 14″ N/ 117° 16′ 18″ W at depths of 80-90 ft is closest to the Point Loma Ocean Outfall. It was established in 1987 as a 173 acre site. The original reef consisted of three sunken vessels. Concrete rubble has been added periodically. Most notable was the 1991-1993 addition of 9,000 tons of concrete roadway rubble which was scattered over 11 acres at 60 ft depths. Shortly after the material was placed kelp began growing, and this artificial reef has supported the kelp since then. It became a focus of research prior to the construction of the Southern California Edison mitigation kelp reef off San Clemente, since the Mission Beach Kelp Reef represents the first time kelp has been sustained for more than a couple of years on an artificial reef in the United States. This artificial reef also includes a "Wreck Alley" of ships deliberately placed on the bottom to provide high-relief habitat for fish and invertebrates. "Wreck alley" is a popular dive spot only 1 nm from the entrance to Mission Bay (about 6.9 mi (6 nm) from the Point Loma Ocean Outfall) at a magnetic heading of 324°. The site includes the decommissioned 366-ft Canadian destroyer, HMCS *Yukon*, which was deliberately sink on 14 July 2000 and is a popular dive destination for experienced technical divers.

The Pacific Beach Artificial Reef is located 2.9 mi (2.5 nm) from the Mission Bay entrance channel, also on a heading of 324° magnetic. It encompasses about 109 seafloor acres with depths ranging from 42-72 ft (coordinates are 32° 47′ 35″N/ 117° 16′ 35″W). Composed of 10,000 tons of quarry rock, it quickly became a kelp habitat complete with kelp bass and sand bass, and is a seasonal destination for divers seeking lobster. Artificial reefs are increasingly popular destinations for fishing and sport diving.

Navigation and Shipping

San Diego Harbor is vital to the two largest segments of San Diego's economy; the $25 billion plus/year manufacturing industry and the $14 billion a year defense industry (San Diego Chamber of Commerce 2007). Coastal shipping lanes are over ten miles from shore, but commercial vessels come closer off Point Loma where they funnel into San Diego Bay. Arriving ships make landfall at Buoy-1, three miles due west of the harbor entrance, where they pick up a pilot to guide them in to their berth.

Last year (2006) was a record breaking year with cargo tonnage and revenues surpassing the previous year. Over 3.5 million metric tons of cargo passed through the port, with revenues from operations reaching $35 million (Port of San Diego 2007).

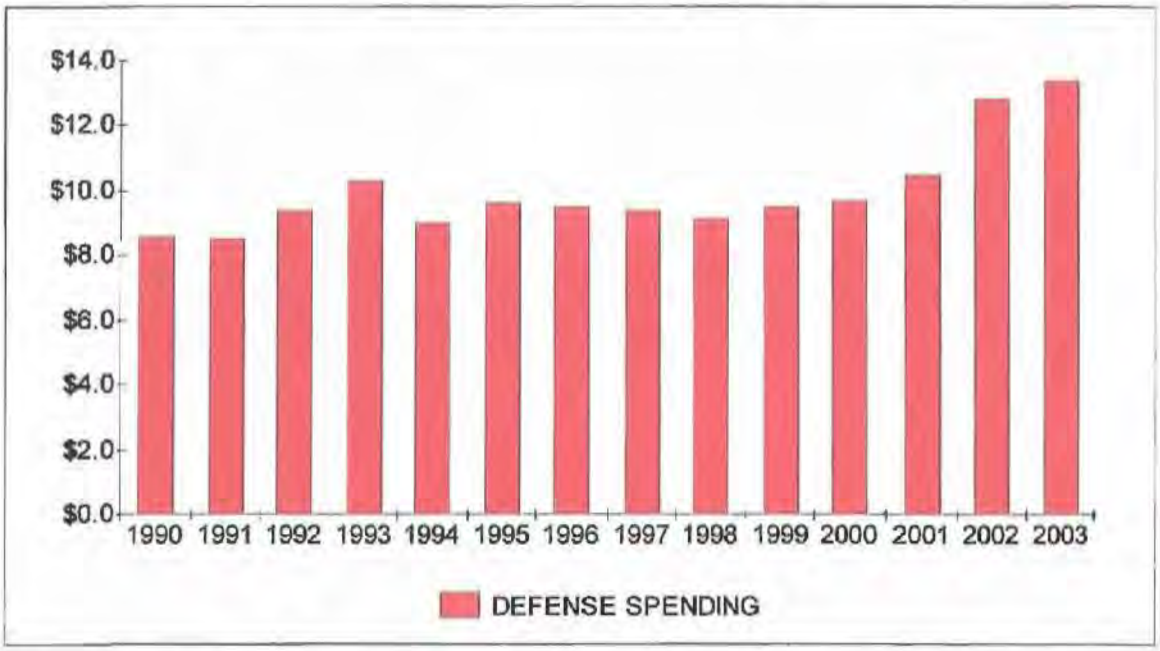
Military and Industrial Use

San Diego Bay is homeport to over 40 Navy ships (as of spring 2007), making San Diego one of the two largest concentrations of Naval forces in the world, the other at Hampton Roads, Virginia. San Diego's berthing of the Pacific Fleet includes 2 aircraft carriers, destroyers, cruisers, frigates, submarines, amphibious ships, and service (auxiliary) vessels. As many as 100 Navy ships may be in port at one time.

A 3rd aircraft carrier, the *Carl Vinson*, will be joining the carriers *Reagan* and *Nimitz* at North Island in 2009 or early 2010. This will again make San Diego home port to 3 carriers as it was during WWII and during 2001 to early 2005. The Navy plans an additional shift of forces from the Atlantic to the Pacific, and more ships, including 10 mine warfare vessels and 4 of the new Littoral Combat ships - the first of which should arrive by summer 2007. Three A-B class destroyers and two additional attack submarines will also arrive in a year or two.

The active duty military population based in San Diego is approximately 130,000 people, roughly 80,000 of which are Navy and Marine personnel. A San Diego Chamber of Commerce study released in January 2006 revealed Pentagon spending supports nearly 1 in every 5 jobs from San Ysidro to Oceanside. It estimated the military's annual expenditure in San Diego was $13.4 billion (2003) with an economic impact of $20 billion - at least 65% of it from the Navy. According to the Chamber of Commerce, an additional aircraft carrier alone is estimated to be worth $2 billion in economic benefits to San Diego (San Diego Union Tribune 2007). San Diego defense revenues between 1990-2003 are shown in Figure 20.

Figure 20. San Diego Defense Revenues in $ Billions.



Data Source: San Diego Regional Chamber of Commerce.

Navy ships enter and exit San Diego Bay virtually every day. The offshore area is used extensively for military operations including surface and submarine fleet maneuvers, and for antisubmarine warfare training. Most of this activity takes place well seaward of the discharge area.

Two industrial facilities in the area utilize large volumes of sea water: San Diego Gas and Electric's South Bay Power Plant in San Diego Bay and Sea World in Mission Bay (SCCWRP 2006). Two other facilities discharge small volumes of sea water: the Scripps Institution of Oceanography and the Western Salt Company at the southern end of San Diego Bay, which has been in operation for more than 100 years producing solar evaporated salt from ponds at the southern end of San Diego Bay. All operate under permits from the EPA and the San Diego Regional Water Quality Control Board (SCCWRP 2006).

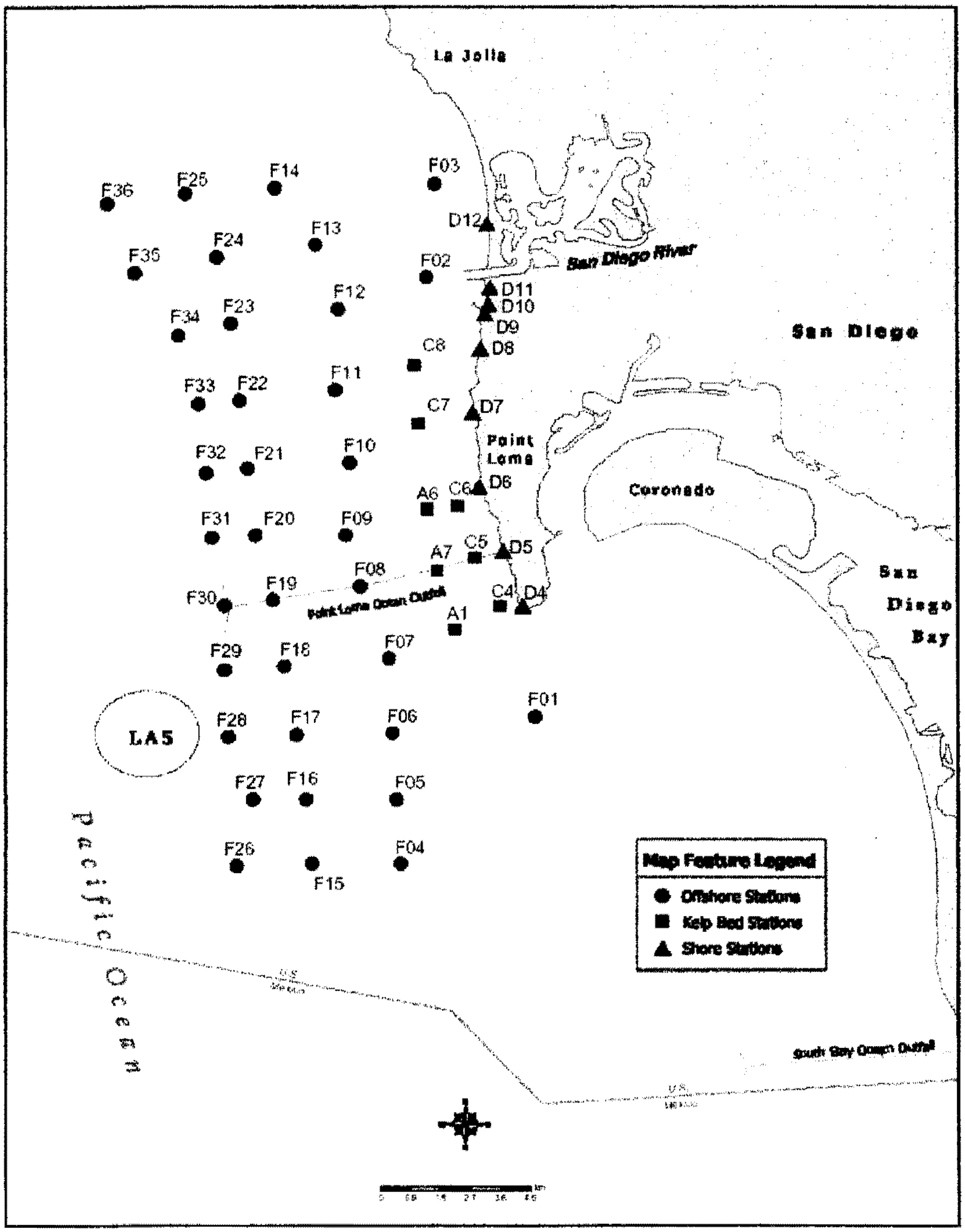
The ship building industry in California is heavily dependent on the federal government as its primary market. General Dynamics NASSCO has been designing and building ships since 1960, specializing in auxiliary and support ships for the U.S. Navy and oil tankers and dry cargo carriers for commercial markets. Located in San Diego Bay, NASSCO employs more than 4,500 people and is the only major ship construction yard on the West Coast of the United States. Over the last four decades, NASSCO has delivered over 112 ships to the world's fleets - 58 ships to commercial customers and 54 ships for the U.S. Navy - becoming America's leading commercial shipbuilder during this period. NASSCO currently has contracts to build nine T-AKE dry cargo/ammunition ships for the U.S. Navy and nine U.S. Jones Act product tankers for U.S. Shipping Partners. Because of its location, expertise and full-service capabilities, the Navy relies on NASSCO as a repair facility for its Pacific Fleet ships (General Dynamics NASSCO 2007).

General Dynamics NASSCO also performs maintenance and repairs for commercial operators. Since California has a large ship building capacity, changes in national policies that promote increased shipbuilding for the Navy could have a positive influence on California's economy (NOEP 2005).

Environmental Monitoring

The Environmental Monitoring and Technical Services Division of the City of San Diego's Metropolitan Wastewater Department monitors the ocean in the vicinity of the Point Loma Ocean Outfall. The monitoring area centers on the discharge site 5 mi (4.5 nm) off Point Loma at a depth of 320 ft (Figure 21).

Figure 21. Monitoring Stations for the Point Loma Ocean Outfall.



Shoreline monitoring extends north to Mission Beach and south to Imperial Beach. Offshore monitoring covers the coastal shelf from La Jolla to Imperial Beach between depths of 30 to 380 ft. There are benthic and infauna monitoring stations, trawl stations, and rig fishing stations. Together the monitoring stations encompass an area of 95 square miles.

Utilizing two monitoring vessels, the Monitor III and the Oceanus, more than 350 sampling days are logged annually. Marine biologists use specialized sampling gear and instruments, a remote operated vehicle (ROV), and dive surveys to collect the wide array of information necessary to define the ecological health of the ocean environment and to identify potential health concerns associated with the recreational use of San Diego's coastline (COSD 2007).

There are five components to the core monitoring program: a) general water quality monitoring, b) bacteriological monitoring of the offshore waters, kelp beds, and shoreline, c) monitoring of sediments for grain size, chemistry and benthic community structure, d) monitoring of demersal fish and megabenthic invertebrate communities, and contaminant body burdens in fish and, e) monitoring of kelp bed canopy cover (SDRWQCB 2003).

The City of San Diego also participates in regional monitoring activities coordinated by the Southern California Coastal Water Project (SCCWRP). Regional monitoring maximizes the efforts of all monitoring partners to best utilize the pooled scientific resources of the region (SDRWQCB 2003). During these coordinated sampling efforts, the discharger's sampling and analytical effort may be reallocated to provide a regional assessment of the impact of the discharge of municipal wastewater to the Southern California Bight as a whole.

In addition to the above activities, the City supports other projects relevant to assessing ocean quality in the region. One such project is a remote sensing study of the San Diego/Tijuana coastal region that is jointly funded by the City and the International Boundary and Water Commission (IBWC). A long-term study of the Point Loma kelp forest, funded by the City, is also being conducted by scientists at the Scripps Institution of Oceanography (see SIO 2004).

Finally, the current Monitoring and Reporting Program includes plans to perform adaptive or special Strategic Process Studies each year as determined by the City in conjunction with the SDRWQCB and the EPA. These Special Studies are an integral part of the permit monitoring program. They differ from other elements of the monitoring program being short-term and are designed to address specific research or management issues that are not addressed by the routine core monitoring elements. Such studies have included a comprehensive scientific review of the Point Loma ocean monitoring program and a sediment mapping study for both the Point Loma and South Bay coastal regions.

PUBLIC HEALTH

Microbiological Compliance

This section covers aspects of the Point Loma Ocean Outfall monitoring program that relate to public health. The City of San Diego performs shoreline and water column bacterial monitoring in the region surrounding the Point Loma Ocean Outfall. Bacteriological densities, together with oceanographic data, provide information about the movement and dispersion of wastewater discharged through the outfall. Monitoring of the San Diego and neighboring coastline also included satellite and aerial remote sensing (see Oceanographic Monitoring Summaries COSD 2005, 2006, 2007). These surveys assist in detecting the turbidity signature from the Point Loma Ocean Outfall plume and differentiating between the outfall plume and coastal discharges. Such data help distinguish between bacterial contamination events caused by the Point Loma Ocean Outfall discharge and those attributable to other point and non-point sources (e.g., river and bay discharges).

The Point Loma Ocean Outfall monitoring program is designed to assess general water quality and determine the level of compliance with regulatory standards in the current NPDES discharge permit (Table 21).

Table 21. Point Loma Ocean Outfall NPDES Permit Bacteriological Standards.

Bacteriological compliance standards for water contact areas. CFU = Colony Forming Units. (SDRWQCB 2003).

(1) *30-day coliform standard* – no more than 20% of the samples at a given station in any 30-day period may exceed a concentration of 1,000 CFU per 100 ml.

(2) *10,000 total coliform standard* – no single sample when verified by a repeat sample collected within 48 hrs, may exceed a concentration of 10,000 CFU per 100 ml.

(3) *60-day fecal coliform standard* – no more than 10% of the samples at a given station in any 60-day period may exceed a concentration of 400 CFU per 100 ml.

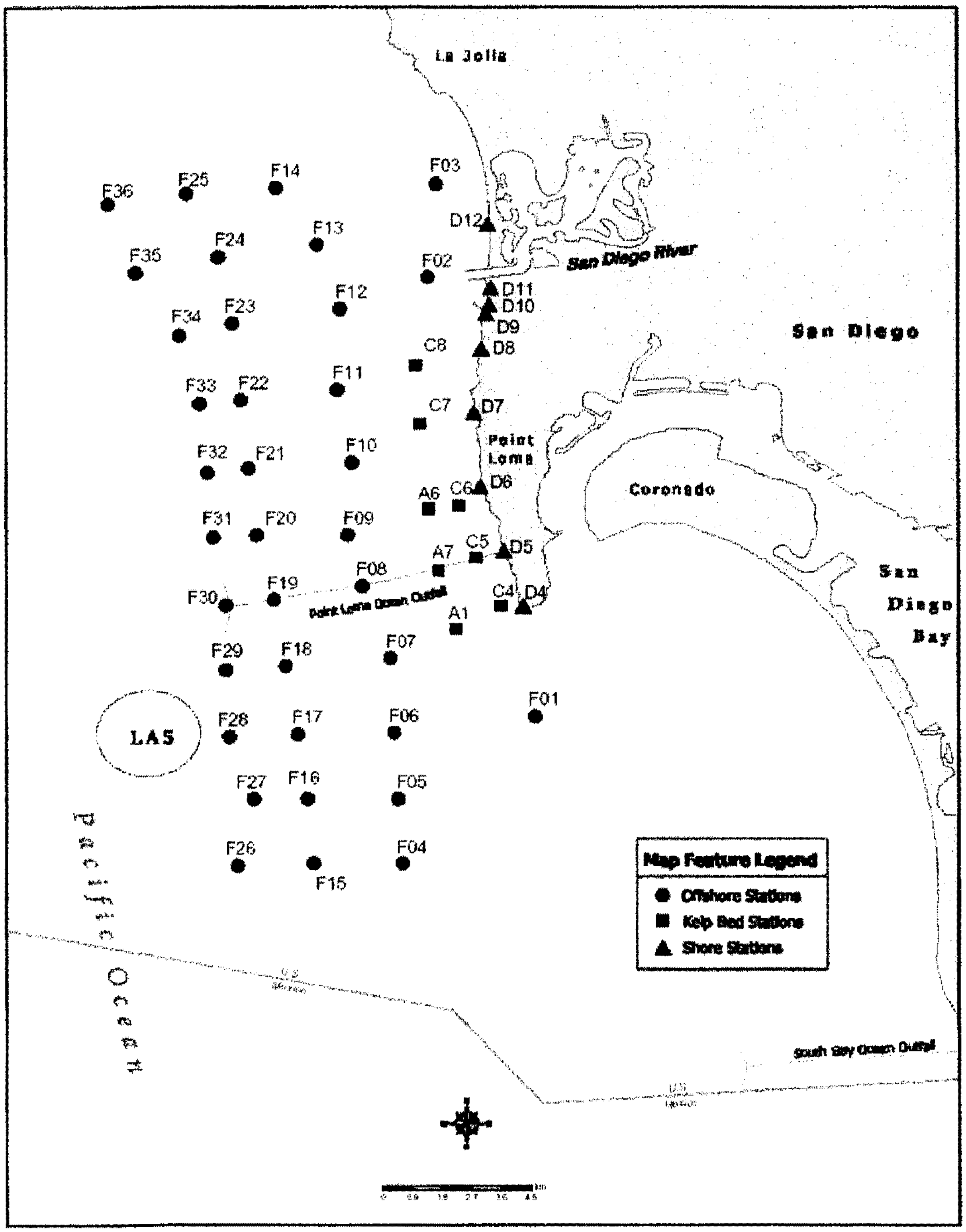
(4) *geometric mean* – the geometric mean of the fecal coliform concentration at any given station in any 30-day period may not exceed 200 CFU per 100 ml, based on no fewer than five samples.

In the following section, discussion of compliance with regulatory standards is based on the existing NPDES Permit (SDRWQCB 2003) which contains bacteriological standards incorporated from the 2001 California Ocean Plan (CSWRCB 2001). The California Ocean Plan was revised in 2005 (CSWRCB 2005). If this Application for Modification of Secondary Treatment Requirements is approved, the renewed NPDES permit would presumably include the new bacteriological standards contained in the 2005 California Ocean Plan. Appendix C discusses projected complance with the new regulatory standards in the current California Ocean Plan.

As a part of the Point Loma Ocean Outfall Microbiology Monitoring Program, water samples for bacteriological analyses are collected at fixed shore and offshore sampling sites. Since 2004, sampling has been conducted throughout the year – these data are reviewed in the following section.

Bacteriological sampling is performed at eight shore stations (D4, D5, and D7–D12; Figure 21) to monitor bacteria levels along public beaches. Seawater samples are collected from the surf zone at each shoreline station. Visual observations of water color and clarity, surf height, human or animal activity, and weather conditions are recorded at the time of sample collection. Eight stations located in the Point Loma kelp bed are also monitored to assess water quality conditions in areas used for water contact sports (e.g., SCUBA diving and kayaking). These stations include three sites (stations C4, C5, C6) located near the inshore edge of the kelp bed along the 9-m depth contour, and five sites (stations A1, A6, A7, C7, C8) located near the offshore edge of the kelp bed along the 18-m depth contour (Figure 22). Samples are taken at three depths for each station – at the surface, in midwater, and near the bottom. The shore and kelp stations are sampled on a weekly basis on a schedule such that each day of the week is represented over a two month period. The seawater samples are transported on ice to the City's Marine Microbiology Laboratory and analyzed to determine concentrations of total coliform, fecal coliform, and enterococcus bacteria.

Figure 22. Point Loma Ocean Outfall Shore and Near-shore Monitoring Stations.



Thirty-six offshore stations (F01–F36 – Figure 22) are also sampled quarterly (January, April, July, and October) to estimate the spatial extent of the wastewater plume at these times. The number of samples collected at each offshore station is depth-dependent, ranging from 3 to 5 fixed depths.

Monthly mean densities of total coliform, fecal coliform, and enterococcus bacteria are calculated for each station, depth (offshore stations), and transect (offshore stations). In order to detect spatial-temporal patterns in bacteriological contamination, these data are evaluated relative to monthly rainfall and climatological data collected at Lindbergh Field (San Diego, CA) and remote sensing data collected by Ocean Imaging Corporation. Shore and kelp bed station compliance are determined according to the number of days that each station was out of compliance with the 30-day total coliform, 10,000 total coliform, 60-day fecal coliform, and geometric mean standards.

Bacteriological data for the offshore stations are not subject to California Ocean Plan standards; but, these data are used to examine patterns in the dispersion of the waste field. Oceanographic conditions and other events (e.g., storm water flows, nearshore and surface water circulation patterns) identified through remote sensing data are evaluated relative to the bacterial data. California Ocean Plan (COP) bacteriological benchmarks are used as reference points to distinguish elevated bacteriological values in receiving water samples. These benchmarks are a) ≥1000 CFU/ 100 mL for total coliform, b) ≥400 CFU/100 mL for fecal coliforms, and c) ≥104 CFU/100 mL for enterococcus. "Contaminated" water samples are considered to have total coliform concentrations ≥1000 CFU/ 100 mL and a fecal:total (F:T) ratio ≥0.1. Samples from offshore monthly water quality stations that meet these criteria are used as indicators of the Point Loma Ocean Outfall waste field.

Shore and kelp bed station compliance with Point Loma Wastewater Treatment Plant NPDES Permit bacteriological standards for 2004 is summarized in Tables 22 and 23 according to the number of days that each station was out of compliance (from COSD 2005).

Table 22. 2004 Shoreline Station Compliance.

Summary of compliance with California Ocean Plan water contact standards for PLOO shore stations during 2004. The values reflect the number of days that each station exceeded the 30-day total and 60-day fecal coliform standards. Shore stations are listed left to right from south to north.

30-Day Total Coliform Standard

Month	**# days**	**D4**	**D5**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**
January	31	0	0	0	0	0	0	0	0
February	29	0	0	0	0	0	0	0	0
March	31	0	0	0	0	0	0	0	0
April	30	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0
June	30	0	0	0	0	0	0	0	0
July	31	0	0	0	0	0	0	0	0
August	31	0	0	0	0	0	0	0	0
September	30	0	0	0	0	0	0	0	0
October	31	0	0	0	15	0	0	3	0
November	30	0	0	0	26	0	0	21	0
December	31	0	0	1	0	0	0	0	0
Compliance (%)		100%	100%	<100%	89%	100%	100%	93%	100%

60-Day Fecal Coliform Standard

Month	**# days**	**D4**	**D5**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**
January	31	0	0	0	0	0	0	0	0
February	29	0	0	0	0	0	0	0	0
March	31	0	0	0	0	0	0	0	0
April	30	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0
June	30	0	0	0	0	0	0	0	0
July	31	0	0	0	0	0	0	0	0
August	31	0	0	0	0	0	0	0	0
September	30	0	0	0	0	0	0	0	0
October	31	0	0	0	15	0	0	0	0
November	30	0	0	0	30	0	0	0	0
December	31	0	0	0	19	0	0	0	0
Compliance (%)		100%	100%	100%	83%	100%	100%	100%	100%

Table 23. 2004 Kelp Bed Station Compliance.

Summary of compliance with California Ocean Plan water contact standards for PLOO kelp bed stations during 2004. The values reflect the number of days that each station exceeded the 30-day total and 60-day fecal coliform standards. Kelp stations are listed left to right from south to north by depth contour.

30-Day Total Coliform Standard

		9-m stations			18-m stations				
Month	**# days**	**C4**	**C5**	**C6**	**A1**	**A7**	**A6**	**C7**	**C8**
January	31	0	0	0	0	0	0	0	0
February	29	0	0	0	0	0	0	0	0
March	31	0	0	0	0	0	0	0	0
April	30	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0
June	30	0	0	0	0	0	0	0	0
July	31	0	0	0	0	0	0	0	0
August	31	0	0	0	0	0	0	0	0
September	30	0	0	0	0	0	0	0	0
October	31	0	0	0	0	0	0	0	0
November	30	1	0	0	1	12	0	0	0
December	31	1	1	1	1	1	0	0	1
Compliance (%)		99%	<100%	<100%	99%	96%	100%	100%	<100%

60-Day Fecal Coliform Standard

		9-m stations			18-m stations				
Month	**# days**	**C4**	**C5**	**C6**	**A1**	**A7**	**A6**	**C7**	**C8**
January	31	0	0	0	0	0	0	0	0
February	29	0	0	0	0	0	0	0	0
March	31	0	0	0	0	0	0	0	0
April	30	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0
June	30	0	0	0	0	0	0	0	0
July	31	0	0	0	0	0	0	0	0
August	31	0	0	0	0	0	0	0	0
September	30	0	0	0	0	0	0	0	0
October	31	0	0	0	0	0	0	0	0
November	30	0	0	0	0	0	0	0	0
December	31	1	0	0	0	0	0	0	0
Compliance (%)		<100%	100%	100%	100%	100%	100%	100%	100%

During 2004, compliance with bacteriological standards at the shore and kelp stations was generally high, despite heavy rainfall that periodically affected nearshore water quality (see Oceanographic Conditions Summary COSD 2005). Water quality samples from the shoreline stations in 2004 were over 80% compliant with the 30-day total and 60-day fecal coliform standards and 100% compliant with the 10,000 total coliform and geometric mean standards. Similarly, 2004 kelp bed samples were compliant with the 30-day total coliform standard over 95% of the time, and almost 100% of the time with the 60-day fecal coliform standard. The few exceptions occurred in October, November, or December. During this time, water quality samples exceeded the 30-day total coliform standard at stations D8 and D11 (October–November) and Station D7 (December). Samples collected at station D8 also exceeded the 60-day fecal coliform during all three months. In addition, a few samples collected at kelp stations A1, A7, and C4 during November and at most kelp stations in December caused these sites to exceed the 30-day total coliform standard. Stations C4 and C5 exceeded the 10,000 total coliform standard once each in December, and station C4 also exceeded the 60-day fecal coliform standard once in December (COSD 2005). Generally, these incidences of non-compliance followed periods of high rainfall. For example, exceedences of the 10,000 coliform standard at stations C4 and C5 occurred on December 30 following a 2-day storm that accumulated 2.9 inches of rain. Since these samples had relatively low fecal coliform values and F:T ratios ≤ 0.1, the origin of the contamination probably was not sewage related. Two samples collected at station D8 (on September 29 and October 17) had total and fecal coliform densities well above their respective benchmark values, but occurred when there was little or no rain. Visual observations recorded during both sampling events indicated large amounts of kelp, trash, and the presence of dogs, all of which are likely contributors to the source of the elevated coliform densities.

Of the 564 bacteriological samples collected at the offshore quarterly stations in 2004, 67 (12%) had total coliform densities ≥ 1000 CFU/mL and an F:T ratio ≥ 0.1. Total coliform concentrations in surface and subsurface waters (1–25 m) ranged from non-detectable levels to 400 CFU/100 mL throughout the year. Moreover, all surface and subsurface fecal coliform densities were <160 CFU/100 mL. In contrast, total coliform concentrations in relatively deep waters (60–98 m) ranged between 2 and 22,000 CFU/100 mL. Each of the 67 samples with total coliform densities ≥ 1000 CFU/mL and F:T ratios ≥ 0.1 came from this depth range suggesting that the stratified water column restricted the plume to mid- and deep-water depths throughout the year (see Microbiological Sampling Summary COSD 2005).

Similarly, there was little evidence that discharged wastewater impacted nearshore waters in 2004. Mean bacterial levels along the 80-m and 98-m depth transects stations were much higher than those closer to shore (i.e., 18-m and 60-m transects). Sixty-five of the sixty-seven samples with total coliform densities ≥ 1000 CFU/mL and F:T coliform ratios ≥ 0.1 came from the 80-m and 98-m depth transects. The other two samples occurred along the 60-m transect, both at station F08.

Kelp bed stations were 100% in compliance in 2004 with bacteriological standards expect during November-December following significant rainfall (Table 23). It is possible that persistent northward surface currents helped drive storm-related contamination from more southern sources in to the waters off Point Loma (see Oceanographic Summary COSD 2005).

Compliance with Point Loma Wastewater Treatment Plant NPDES Permit bacteriological standards for shore and kelp bed stations in 2005 is shown in Tables 24 and 25 (from COSD 2006).

Table 24. 2005 Shore Station Compliance.

Summary of compliance with California Ocean Plan water contact standards for PLOO shore stations during 2005. The values reflect the number of days that each station exceeded the 30-day total and 60-day fecal coliform standards. Shore stations are listed left to right from south to north.

30-Day total coliform standard

Month	**# days**	**D4**	**D5**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**
January	31	0	0	24	29	0	0	0	0
February	28	6	0	0	1	0	0	0	0
March	31	0	0	0	0	0	0	0	0
April	30	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0
June	30	0	0	0	0	0	0	0	0
July	31	0	0	0	0	0	0	0	0
August	31	0	0	0	0	0	0	0	0
September	30	0	0	0	0	0	0	0	0
October	31	0	0	0	0	0	0	0	0
November	30	0	0	0	0	0	0	0	0
December	31	0	0	0	0	0	0	0	0
Compliance (%)		98%	100%	93%	92%	100%	100%	100%	100%

60-Day fecal coliform standard

Month	**# days**	**D4**	**D5**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**
January	31	0	0	0	31	0	0	0	0
February	28	0	0	0	25	0	0	0	0
March	31	0	0	0	0	0	0	0	0
April	30	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0
June	30	0	0	0	0	0	0	0	0
July	31	0	0	0	0	0	0	0	0
August	31	0	0	0	0	0	0	0	0
September	30	0	0	0	0	0	0	0	0
October	31	0	0	0	0	0	0	0	0
November	30	0	0	0	0	0	0	0	0
December	31	0	0	0	0	0	0	0	0
Compliance (%)		100%	100%	100%	85%	100%	100%	100%	100%

Table 25. 2005 Kelp Bed Station Compliance.

Summary of compliance with California Ocean Plan water contact standards for PLOO kelp bed stations during 2005. The values reflect the number of days that each station exceeded the 30-day total and 60-day fecal coliform standards. Kelp stations are listed left to right from south to north and by depth contour.

30-Day total coliform standard

		9-m stations			18-m stations				
Month	**# days**	**C4**	**C5**	**C6**	**A1**	**A7**	**A6**	**C7**	**C8**
January	31	28	28	18	18	1	0	0	11
February	28	0	0	0	0	0	0	0	0
March	31	0	0	0	0	0	0	0	0
April	30	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0
June	30	0	0	0	0	0	0	0	0
July	31	0	0	0	0	0	0	0	0
August	31	0	0	0	0	0	0	0	0
September	30	0	0	0	0	0	0	0	0
October	31	0	0	0	0	0	0	0	0
November	30	0	0	0	0	0	0	0	0
December	31	0	0	0	0	0	0	0	0
Compliance (%)		92%	92%	95%	95%	100%	100%	100%	97%

60-Day Fecal Coliform Standard

		9-m stations			18-m stations				
Month	**# days**	**C4**	**C5**	**C6**	**A1**	**A7**	**A6**	**C7**	**C8**
January	31	31	15	0	0	0	0	0	0
February	28	27	17	0	0	0	0	0	0
March	31	0	0	0	0	0	0	0	0
April	30	0	0	0	0	0	0	0	0
May	31	0	0	0	0	0	0	0	0
June	30	0	0	0	0	0	0	0	0
July	31	0	0	0	0	0	0	0	0
August	31	0	0	0	0	0	0	0	0
September	30	0	0	0	0	0	0	0	0
October	31	0	0	0	0	0	0	0	0
November	30	0	0	0	0	0	0	0	0
December	31	0	0	0	0	0	0	0	0
Compliance (%)		84%	91%	100%	100%	100%	100%	100%	100%

During 2005, shore and kelp stations had a perfect record of compliance with bacteriological standards except during the heavy rainfall in January and February (Tables 24 and 25). Compliance with the 30-day total coliform standard at the shore stations ranged from 92 to 100% in 2005, with only 3 stations below 100% compliance. This is similar to 2004, another year of heavy rains, when compliance ranged from 89 to 100% and only 2 stations had less than 100% compliance. The few exceedances of the 30-day total coliform standard along the shoreline occurred at stations D4, D7, and D8 during the wettest months of January and February. Station D8 was the only shore station that exceeded the 60-day fecal coliform standard. Compliance with the 60-day fecal coliform standard at station D8 in 2005 (85%) was similar to compliance in 2004

(83%). All shore stations were 100% compliant with the 10,000 total coliform and 30-day fecal coliform geometric mean standards.

The highest mean total coliform and enterococcus densities occurred in January in samples collected along the shore on January 3 and 9, when 3.2 inches of rain accumulated over a 7-day period. However, only 6 out of 12 samples with total coliforms ≥ 1000 CFU/100 mL occurred in January and February during rain events. Only 1 of these 6 samples contained bacterial levels that exceeded the benchmark values for fecal coliforms and enterococcus (400 and 104 CFU/100 mL, respectively) and was indicative of wastewater. This sample, collected from station D8 on January 3, had an F:T ratio ≥ 0.1 and densities of fecal coliforms and enterococcus above their benchmark values (400 and 104 CFU/100 mL, respectively). In contrast, samples from stations D8 and D11 on June 26, and station D11 on December 29 had total and fecal coliform densities well above their respective benchmark values but occurred when there was no recorded rainfall. Potential sources of contamination that may have contributed to these elevated bacterial densities include dogs (contributing feces), which were present at station D11 on June 26, and kelp (a medium for bacterial growth) (Martin and Gruber 2005), that was present at station D8 on June 26 and station D11 on December 29. The beach around station D11 is unique in that it is a designated area for people to walk their dogs. In addition, contamination may have resulted from a population of transient people living upstream of station D11. High counts of indicator bacteria have also been present during dry periods at station D8 in previous years.

Levels of compliance for the kelp stations were slightly lower in 2005 compared to 2004. Compliance with the 30-day total coliform standard at these stations ranged from 92 to 100% in 2005 (Table 25) compared to 96 to 100% in 2004 (Table 23). The exceedances of the 30-day total coliform standard occurred only in January. Stations C4 and C5 were the only kelp stations out of compliance with the 60-day fecal coliform standard. Elevated total and fecal coliform levels from the end of December 2004 caused the initial exceedances in the beginning of 2005. All kelp stations were 100% compliant with the 10,000 total coliform and 30-day fecal coliform geometric mean standards.

Most of the bacteriological samples collected from the kelp bed and offshore stations in 2005 were not indicative of contaminated waters. Only 3% (n=65) of the samples had total coliform densities ≥ 1000 CFU/100 mL and an F:T ratio ≥ 0.1 (see Microbiological Summary COSD 2006). Total coliform densities in shallow waters (1–25 m) ranged from 0 to 2,600 CFU/100 mL throughout the year, while densities of fecal coliforms ranged from 0 to 500 CFU/100 mL. All but 2 of the samples indicative of contaminated water came from sample depths greater than 25 m. The highest mean indicator bacterial densities came from depths of 60 m and greater, suggesting that the stratified water column restricted the plume to mid- and deep-water depths throughout the year.

Compliance with bacteriological standards during 2006 for shore and kelp stations was very high (COSD 2007). Shore station D11 was the only station to fall below 100% compliance. The few exceedances of the 30-day total coliform standard occurred at station D11 during March, the wettest month of the year. All kelp stations were 100% compliant with bacteriological standards.

In 2006, a total of 2,496 samples were collected for bacteriological analyses, including 495 from the shoreline stations, 1,437 at the kelp stations, and 564 at the quarterly offshore stations. Of these, only 49 had total coliform concentrations greater than or equal to the 1000 CFU/100 mL benchmark. Five of these samples were collected at the shore stations and 44 at the offshore stations, while none were collected at the kelp stations. Forty of these 44 offshore samples also had F:T ratios ≥0.1 and were used as possible indicators of plume movement.

Bacterial densities were generally low at the shore stations in 2006 (Table 26). Monthly total coliform densities during the year averaged from 2 to 1,264 CFU/100 mL. Although rainfall was below average for the year, the highest mean densities occurred during the wet months (see Chapter 2 COSD 2007). For example, total coliform densities were highest in February as a result of one sample collected from station D11 on February 21 following a rain event. Of the 5 shore samples with total coliforms ≥1000 CFU/100 mL, 2 were collected in February and May during rain events, and one occurred in March when trace amounts of rain fell prior to sampling. Two samples from station D8 were not associated with rain events but did contain bacterial levels that exceeded the benchmark values for total and fecal coliforms and were indicative of contaminated water (F:T ratio ≥0.1). However, high counts of indicator bacteria have also been present during dry periods at station D8 in previous years (COSD 2005, 2006) and the relationship between rainfall and monthly mean fecal coliform concentrations was not significant (Spearman correlation; n=12, p=0.32).

Table 26. 2006 Shoreline Station Compliance.

Shore station bacterial densities and rainfall data for the PLOO region during 2006. Mean total coliform, fecal coliform, and enterococcus bacteria densities are expressed as CFU/100 mL. Rain is measured at Lindbergh Field, San Diego, CA (see NOAA/NWS 2007). Sample size (n) for each station is given in parentheses.

Month	Rain (in.)		D4 (61)	D5 (62)	D7 (62)	D8 (62)	D9 (62)	D10 (62)	D11 (62)	D12 (61)	All stations
Jan	0.36	*Total*	5	4	5	274	96	132	141	22	85
		Fecal	6	2	3	140	6	15	14	3	24
		Entero	3	2	3	24	10	11	16	5	9
Feb	1.11	*Total*	57	6	59	61	8	77	1264	5	195
		Fecal	6	3	70	21	2	16	37	4	20
		Entero	3	5	7	8	2	6	17	2	6
Mar	1.36	*Total*	2	3	6	54	16	256	668	90	137
		Fecal	2	2	4	20	3	20	25	4	10
		Entero	3	2	2	16	4	12	10	6	7
Apr	0.88	*Total*	2	57	3	58	10	72	230	10	55
		Fecal	2	17	3	23	4	6	17	4	9
		Entero	2	6	2	6	2	3	4	3	4
May	0.77	*Total*	85	43	23	176	10	286	319	6	119
		Fecal	4	12	6	46	3	24	42	2	17
		Entero	3	9	7	94	2	29	54	3	25
Jun	0.00	*Total*	49	56	24	76	24	40	76	115	56
		Fecal	2	6	4	9	3	11	18	10	8
		Entero	2	2	5	4	2	7	7	38	8
Jul	0.04	*Total*	13	20	128	32	13	53	116	21	49
		Fecal	2	2	7	14	2	49	28	8	14
		Entero	2	2	4	2	2	9	31	2	7
Aug	0.01	*Total*	52	16	92	28	13	180	96	52	66
		Fecal	3	4	5	4	2	19	17	9	8
		Entero	2	2	2	2	2	12	29	7	8
Sep	0.00	*Total*	6	15	124	80	10	48	32	7	40
		Fecal	2	4	4	28	3	12	14	10	10
		Entero	2	6	8	9	2	3	4	2	5
Oct	0.76	*Total*	17	24	57	137	21	61	29	16	45
		Fecal	2	3	10	53	4	24	11	5	14
		Entero	4	2	18	22	2	15	6	7	10
Nov	0.15	*Total*	11	32	136	360	16	81	49	61	93
		Fecal	6	6	29	113	4	22	30	33	30
		Entero	9	6	10	84	8	7	7	39	21
Dec	0.71	*Total*	7	10	13	164	52	66	64	22	50
		Fecal	4	6	6	92	20	30	40	7	26
		Entero	2	30	2	287	18	38	142	14	67
Annual means		**Total**	**24**	**24**	**55**	**128**	**25**	**112**	**251**	**34**	
		Fecal	**3**	**5**	**12**	**48**	**5**	**21**	**24**	**8**	
		Entero	**3**	**6**	**6**	**46**	**5**	**13**	**27**	**11**	

Other potential sources of contamination that may have contributed to elevated bacterial densities at shore stations D8 and D11 include kelp and seagrass beach wrack (see Martin and Gruber 2005) and shorebirds, all of which were present during the collection of many of the samples. There is also a tidally influenced storm drain at station D8, which may accumulate organic debris (kelp and surfgrass) and amplify bacterial densities (Martin heavy recreational use or decaying kelp and surfgrass wrack material. Despite a below average amount of rainfall in 2006, most of these elevated bacterial densities came during the wettest months of February through May. All of the kelp bed stations had low densities of all indicator bacteria. Furthermore, all 7 kelp bed stations and all but one shore station were 100% compliant with the 4 COP standards. Shore station D11, located near the mouth of the San Diego River, was 95% compliant with the 30-day total coliform standard and 100% compliant with the other 3 COP standards. All of the exceedances at station D11 occurred during March when rains were heaviest; however, an analysis of rainfall and shore station bacterial densities showed that there was no significant correlation between rain and fecal coliforms.

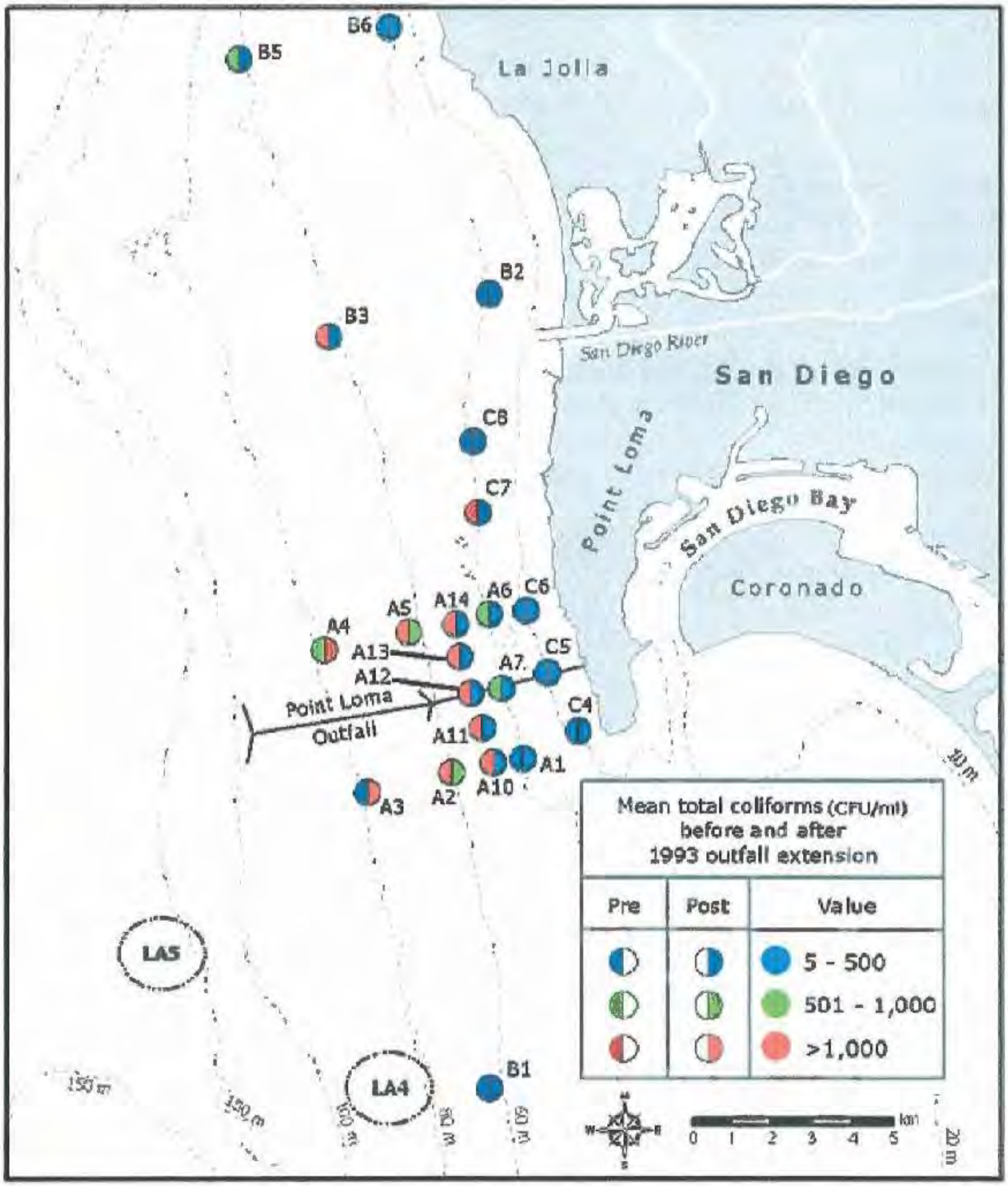
It is also unlikely that the Point Loma Ocean Outfall wastewater reached surface waters in 2006. Bacteriological evidence of contaminated water at the offshore stations was predominantly limited to samples collected from depths of 60 m and deeper. The only shallow water sample indicative of contaminated water was taken from station F01 (12 m depth) in April, and may have been due to sewage discharge from Naval Base San Diego into the San Diego Bay.

The discharge depth (~98 m) may be the dominant factor that keeps the plume from reaching the surface. Wastewater is released into cold, dense seawater that does not appear to mix with the top 25 m of the water column. Physical parameters suggest that the water column was strongly stratified during the spring through fall months. However, the absence of evidence for bacteriological contamination in the surface waters in January, when the water column was well mixed, suggests that stratification may not be the only factor limiting the depth of the plume to 60 m and deeper.

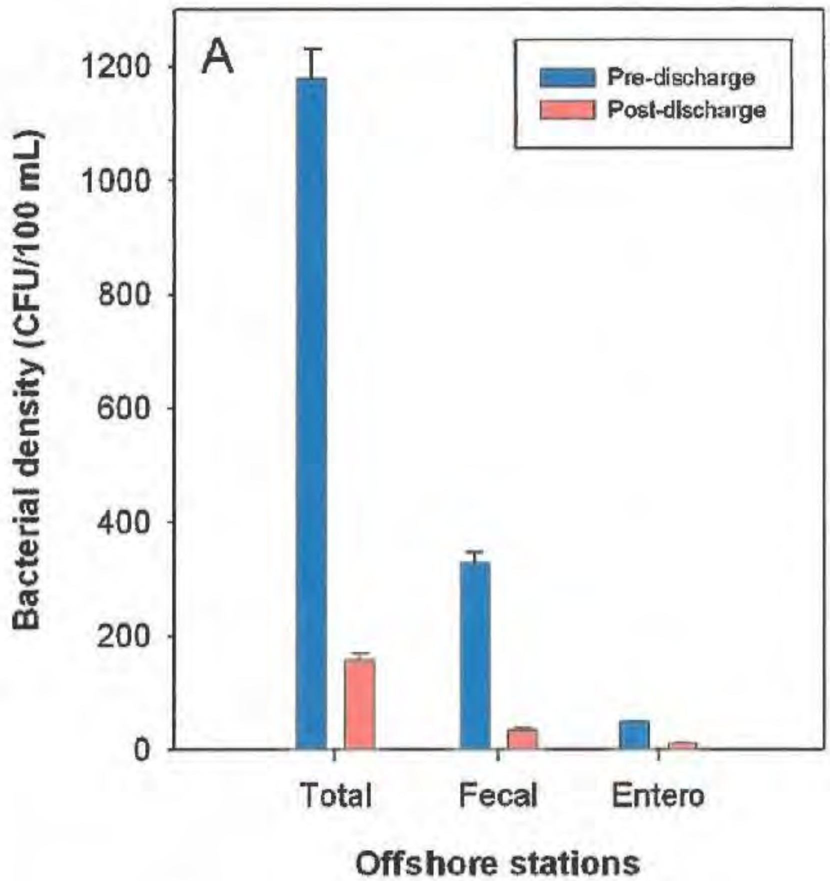
The dominant direction of the Point Loma Ocean Outfall waste field flow appeared to be northward in 2006. High bacterial densities were detected at the northern limits of the quarterly sampling grid during most quarters, and were detected at the southern limits only in April. There was also evidence that the plume moved inshore to the 60-m depth contour in April. It also appears that the plume may have dispersed farther offshore than most of the sampling stations in January, when contaminated water was only detected well north of the Point Loma Ocean Outfall in the 60 m sample from station F33. There did not appear to be one consistent pattern for the distribution of the wastefield.

Analyses of historical data indicated that since the extension of the Point Loma Ocean Outfall, the wastefield is no longer reaching the shoreline. Mean coliform densities at shore stations significantly decreased during the post-discharge period. Similarly, all kelp bed station indicator bacterial densities decreased significantly during the post-discharge period. The largest decreases were detected in the 12 and 18-m depth samples. There is no bacteriological evidence that the Point Loma Ocean Outfall wastefield has reached the Point Loma kelp bed since the outfall extension went into operation. Similarly, all indicator bacterial densities from the monthly offshore stations significantly decreased during the post-discharge period. The highest mean fecal coliform densities shifted from 24–43 m depth samples during the pre-discharge period to 80 m samples during the post-discharge period. These results, combined with recent results from quarterly station samples, indicate that the wastewater plume is remaining below the thermocline and offshore of the Point Loma kelp bed.

Figure 28. Offshore Coliform Densities Before and After Outfall Extension. (Comparison of pre- and post-discharge mean total coliform densities (CFU/100 mL) for Point Loma Ocean Outfall water quality monitoring stations where monthly bacteriological samples were collected from 1991–2003.)



There was no evidence that the Point Loma Ocean Outfall wastewater plume reached the shoreline or recreational waters in 2006. Elevated bacterial densities along the shore were limited to stations D8 and D11 where the source of contamination may have been


A
Pre-discharge
Post-discharge
Bacterial density (CFU/100 mL)
1200
1000
800
600
400
200
0
Total
Fecal
Entero
Offshore stations

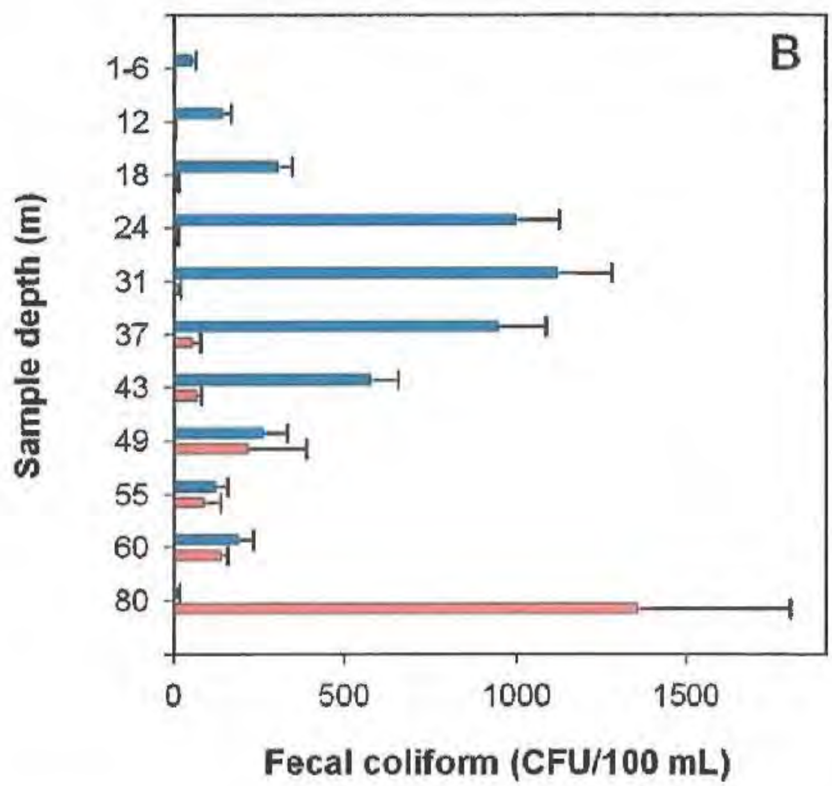
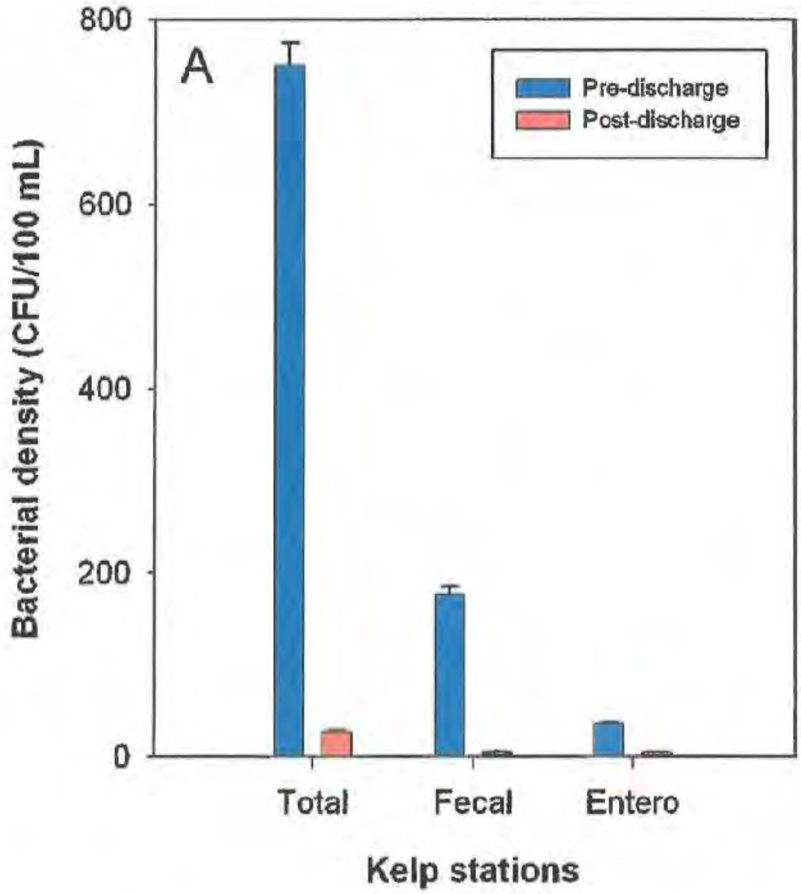

B
Sample depth (m)
1-6
12
18
24
31
37
43
49
55
60
80
0
500
1000
1500
Fecal coliform (CFU/100 mL)

Table 28. Significance of Difference in Bacterial Densities After Outfall Extension. (Independent sample t-test results for pre-extension discharge versus post-extension discharge periods from Point Loma Ocean Outfall shore, kelp, and monthly offshore stations. Data are log(x+1) transformed. The pre-extension discharge period is from January 1991 to November 1993, while post-extension data used in this analysis is from November 1993 to December 2006 (Shore and Kelp) and November 1993 to July 2003 (Offshore).)

	Variable	t	df	P
Shore	Total coliform	-2.243	1319	0.025
	Fecal coliform	-3.967	1294	<0.001
	Enterococcus	-1.698	5786	0.089
Kelp	Total coliform	-68.360	13,356	<0.001
	Fecal coliform	-59.411	11,668	<0.001
	Enterococcus	-55.091	12,281	<0.001
Offshore	Total coliform	-28.937	6735	<0.001
	Fecal coliform	-27.340	6131	<0.001
	Enterococcus	-25.688	6430	<0.001

Mean densities of indicator bacteria at the offshore samples were also significantly lower and samples indicative of contaminated water have been restricted to deeper waters since discharge began through the extended outfall (Figure 27, Table 28). For example, the highest fecal coliform densities occurred in samples taken from 24 to 43 m during the pre-discharge period, but occurred in samples from 80 m during the post-discharge period (Figure 25). Similarly, fecal densities greater than 400 CFU/100 mL have not been found shallower than 12 m during the post-discharge period. Finally, total coliforms densities during the post-discharge period have fallen below 1000 CFU/100 mL at stations along the 60 m contour near the old outfall as well as those stations farther inshore, with densities >1000 CFU/100 mL limited to stations along the 80 m contour (Figure 28). Overall these results suggest that the extension of the outfall pipe has suppressed the surfacing potential and significantly reduced the onshore movement of the Point Loma Ocean Outfall wastefield.

Figure 27. Offshore Bacterial Densities Before and After Outfall Extension. (Point Loma Ocean Outfall monthly offshore station mean bacterial densities (mean±SE) collected by (A) parameter and (B) depth from 1991–2006. The pre-discharge period is from January 1991 to November 1993 while post-discharge is from November 1993 to July 2003. Sample size indicated as Pre/Post. Total=total coliform (n=4,444/6,977), Fecal=fecal coliform (n=4,477/6,980), Entero=enterococcus (n=4,476/6,980).)


A
Pre-discharge
Post-discharge
Bacterial density (CFU/100 mL)
800
600
400
200
0
Total
Fecal
Entero
Kelp stations

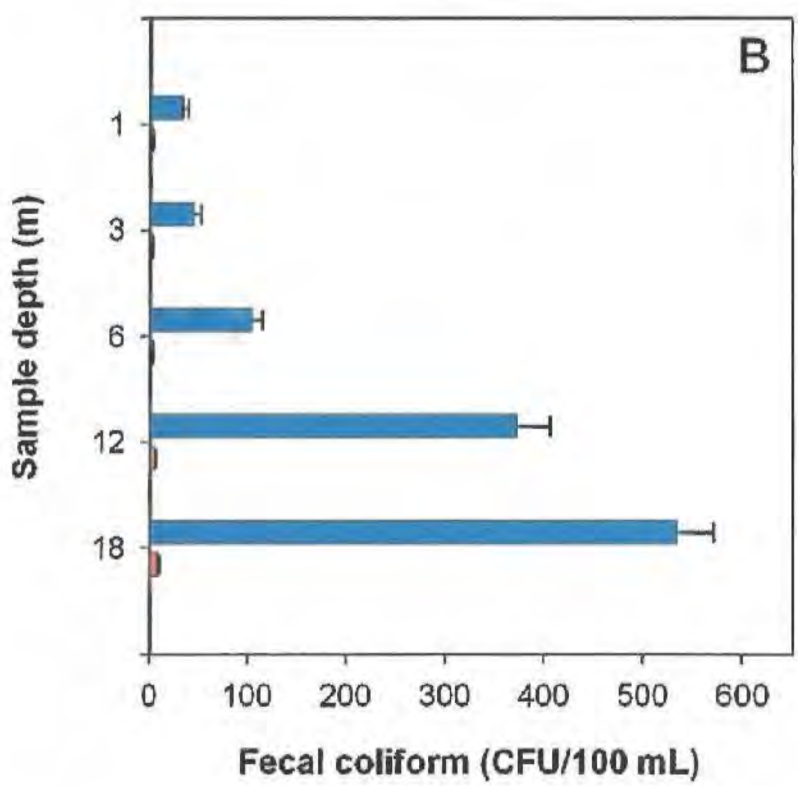
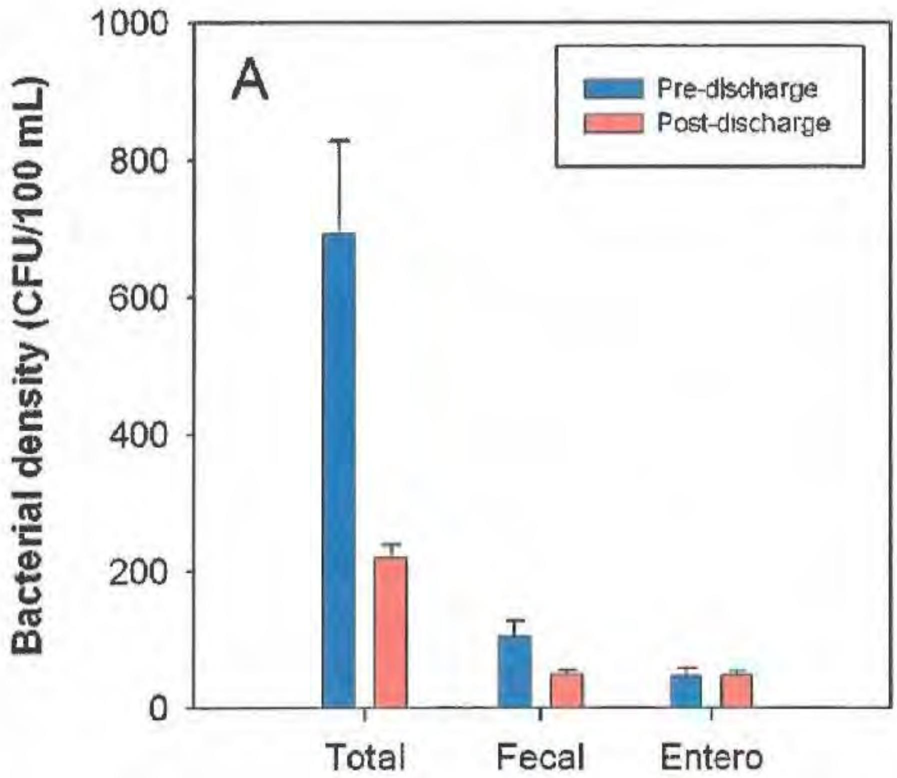
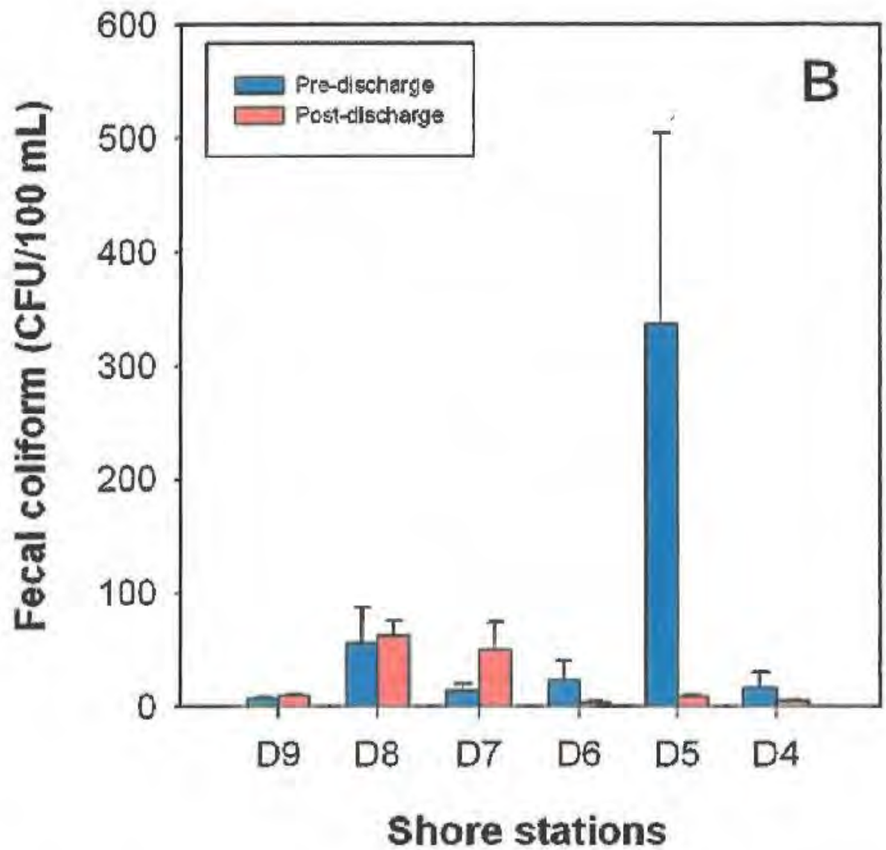

B
Sample depth (m)
1
3
6
12
18
0
100
200
300
400
500
600
Fecal coliform (CFU/100 mL)

Figure 26. Bacterial Densities at Kelp Stations Before and After Outfall Extension. (Point Loma Ocean Outfall kelp station mean bacterial densities (mean±SE) collected by (A) parameter and (B) depth from 1991–2006. The pre-discharge period is from January 1991 to November 1993 while post-discharge is from November 1993 to December 2006. Sample size indicated as Pre/Post. Total=total coliform (n=10,550/17,883), Fecal=fecal coliform (n=10,540/17,925), Entero=enterococcus (n=10,531/17,924).)


A
Pre-discharge
Post-discharge
Bacterial density (CFU/100 mL)
1000
800
600
400
200
0
Total
Fecal
Entero


B
Pre-discharge
Post-discharge
Fecal coliform (CFU/100 mL)
600
500
400
300
200
100
0
D9
D8
D7
D6
D5
D4
Shore stations

the kelp bed stations. MODIS imagery indicated that surface waters were flowing north in early April, but had switched back to a southward flow right before the April quarterly sampling (Ocean Imaging 2007). Elevated bacterial densities were found up to 4.7 mi (7.5 km) south of the Point Loma Ocean Outfall along the 60 m contour in April and may have been due to discharge from the San Diego Bay and Tijuana River following several rain events. MODIS imagery revealed turbidity plumes from the San Diego Bay and Tijuana River in the sampling area before the April sampling (Ocean Imaging 2007).

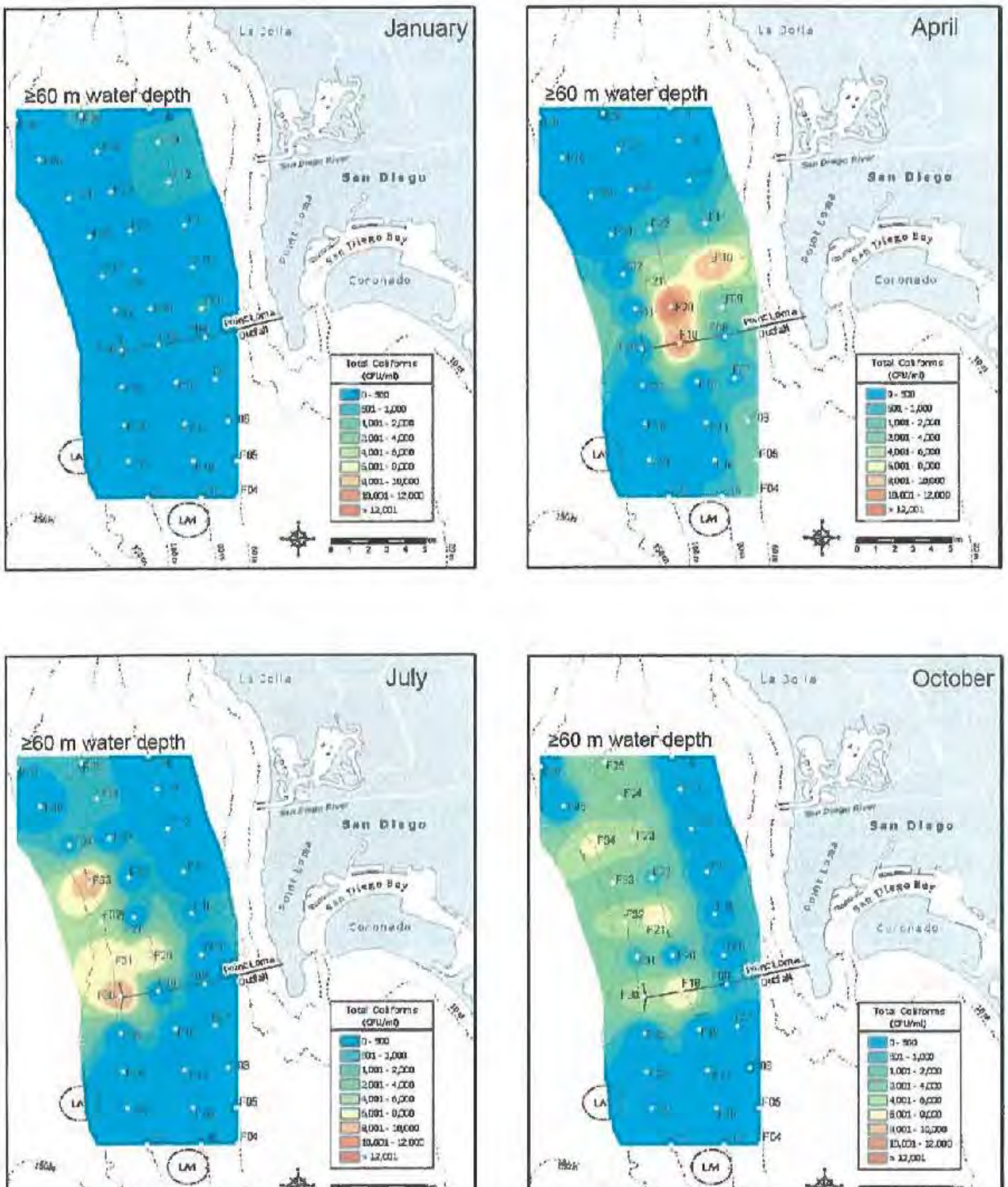
In July and October of 2006, contaminated water was detected up to 7.8 mi (12.5 km) north of the Point Loma Ocean Outfall (stations F36 and F25) along the 80 m and 98 m contours. Data from an acoustic doppler current profiler (ADCP) also indicated that the dominant direction of current flow for bottom waters (42–98 m depths) around the Point Loma Ocean Outfall diffusers in October was north with some movement east and west (City of San Diego, unpublished data).

Historical Analyses

The extension of the Point Loma Ocean Outfall was designed to eliminate bacterial contamination in the Point Loma kelp bed and nearshore waters. To evaluate the effectiveness of the outfall extension, mean bacterial densities for pre-discharge (1/1/1991–11/23/1993) and postdischarge (11/24/1993–12/31/2006) periods were compared for shore, kelp, and offshore station surveys (see Materials and Methods COSD 2007). The results indicate that the Point Loma Ocean Outfall extension has greatly reduced the flow of the wastewater plume into the Point Loma kelp bed such that it is rarely, if ever, detected along the shoreline or the kelp beds (see Figures 25 and 26). Mean total and fecal coliform densities from samples collected at the shore stations, and all 3 indicator bacteria at the kelp stations, were significantly lower once discharge through the extended outfall began (Table 28). Station D5, located along the shoreline where the outfall pipe meets the shore, had the largest decline in fecal coliform densities during the post-discharge period. The largest overall decrease at the kelp stations occurred in total coliform densities, while fecal coliform densities declined at all depths in the post-discharge period.

Figure 25. Bacterial Densities at Shore Stations Before and After Outfall Extension. (Mean bacterial densities (mean±SE) for Point Loma Ocean Outfall shore stations from 1991–2006. The pre-extension period is from January 1991 to November 1993 while post-extension is from November 1993 to December 2006. Sample size indicated as Pre/Post. (A) Mean densities by parameter. Total=total coliform (n=1,007/4,768), Fecal=fecal coliform (n=1007/4781), Entero=enterococcus (n=1,008/4,780). (B) Mean fecal coliform densities by station (n=212–556). Stations are arranged from north to south on the x-axis.)

Figure 24. Mean Total Coliform Concentrations from Depths of 60m or More. (Distribution of mean total coliform counts from depths of 60 m and below collected during quarterly offshore surveys in 2006. Contaminated water (see text) was generally not detected in samples shallower than 60 m depth.)



In April 2006, the wastefield was detected along the 80 and 60 m contours, mostly to the north and inshore of the outfall. Although the wastefield appeared to have moved eastward in April, it was not detected at special study stations A11 and A13 or at any of

There was little evidence that the wastewater plume reached nearshore waters in 2006. For example, none of the bacteriological samples collected from the kelp bed stations had elevated bacterial densities. Mean bacterial densities were highest at stations along the 80 and 98-m transects of quarterly offshore stations (Figure 23B). Thirty-five of the 40 samples indicative of contaminated water were collected from sites along these transects. The other 5 samples came from station F01 (18-m depth contour) and stations F05, F06, F09, and F10 (60-m depth contour). The relatively high bacterial densities in samples collected at station F01 may be related to the release of over 10 million gallons of sewage during 2005–2006 from Naval Base San Diego into San Diego Bay (U.S. Navy 2006).

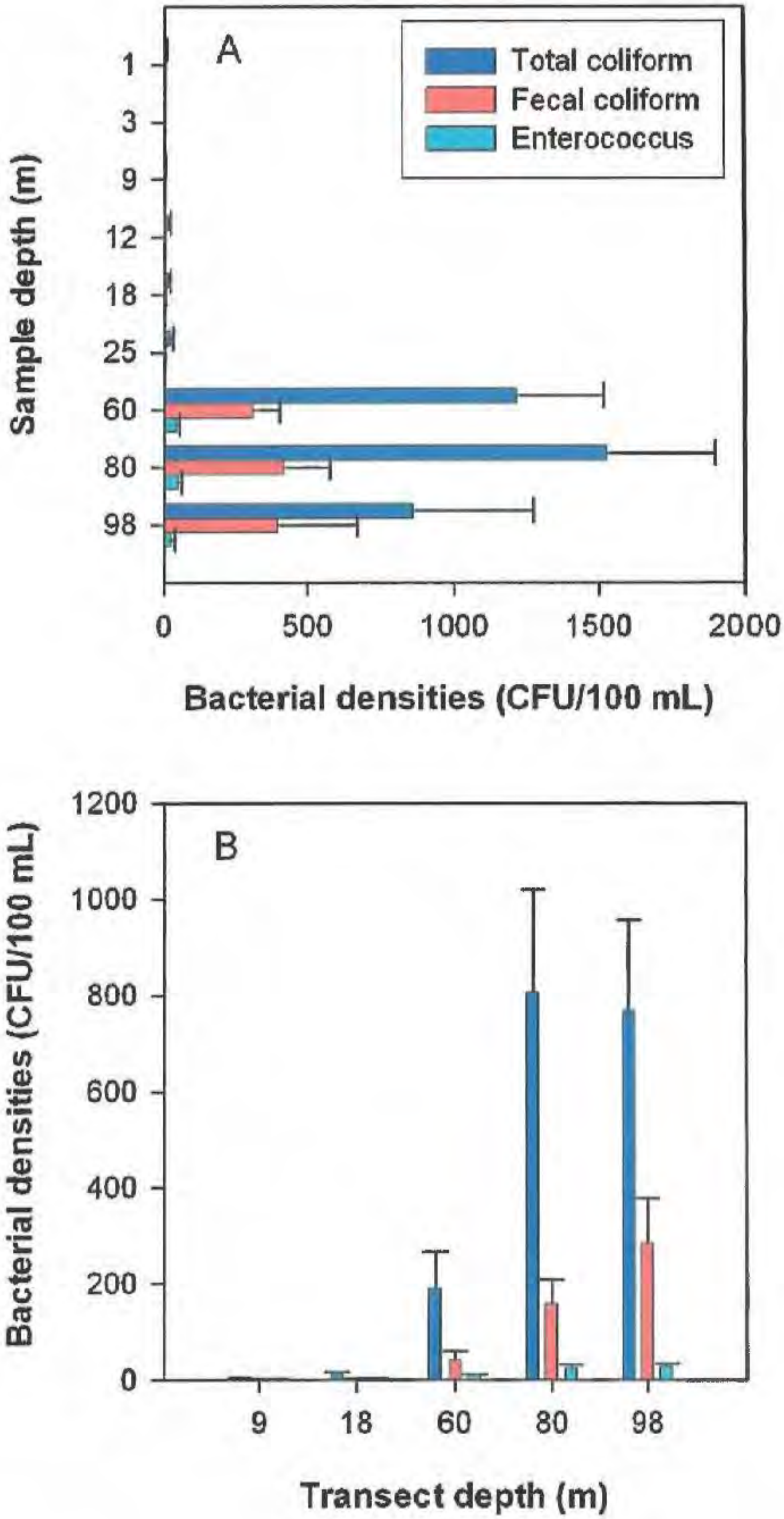
Mean bacterial densities were generally highest at the 80 m stations in April 2006, the 98 m stations in July 2006, and the 80 m and 98 m stations in October 2006 (Table 27). The lowest densities were in January 2006 with elevated samples in only one sample.

Table 27. 2006 Kelp Bed and Offshore Station Compliance.

Mean bacterial densities (CFU/100 mL) for quarterly sampling events in 2006 at PLOO kelp bed and offshore stations. n=number of samples collected quarterly. Sample size for 9-m kelp bed stations in January=42.

Assay	Contour	n	January	April	July	October
Total	9-m kelp bed	45	3	2	3	4
	18-m kelp bed	75	10	13	3	11
	18-m offshore	9	8	184	109	2
	60-m offshore	33	109	584	34	37
	80-m offshore	44	123	1362	451	1284
	98-m offshore	55	150	6	1809	1110
Fecal	9-m kelp bed	45	2	2	2	2
	18-m kelp bed	75	3	3	2	2
	18-m offshore	9	3	27	28	3
	60-m offshore	33	20	127	9	4
	80-m offshore	44	23	331	91	193
	98-m offshore	55	35	3	754	345
Entero	9-m kelp bed	45	2	2	2	2
	18-m kelp bed	75	2	2	2	2
	18-m offshore	9	2	2	24	2
	60-m offshore	33	9	23	4	2
	80-m offshore	44	11	61	10	18
	98-m offshore	55	14	2	60	33

The spatial distribution of the wastefield varied by quarter in 2006 (Figure 24). Interpolation of the bacteriological data from 60 m and below indicates that there was a possible offshore movement in January, as evidenced by the lack of elevated bacterial densities around and inshore of the Point Loma Ocean Outfall diffusers. The only January sample containing bacterial densities indicative of contaminated water occurred 3.5 mi (5.6 km) north of the Point Loma Ocean Outfall at station F33 (60 m depth sample). MODIS imagery showed offshore flows of surface waters that occurred up to 1 week before the January quarterly sampling (Ocean Imaging 2007).


A
Total coliform
Fecal coliform
Enterococcus
Sample depth (m)
1
3
9
12
18
25
60
80
98
0
500
1000
1500
2000
Bacterial densities (CFU/100 mL)
B
Bacterial densities (CFU/100 mL)
1200
1000
800
600
400
200
0
9
18
60
80
98
Transect depth (m)

and Gruber 2005). In contrast, the beach around station D11 is a designated dog recreation area and has a population of transient people living along the San Diego River upstream of the sampling site. Contamination from both sources is suspected in the elevated bacterial counts at this station.

Only 2% of the 2006 offshore station samples (n=40) collected were indicative of contaminated waters (total coliform density ≥1000 CFU/100 mL and an F:T ratio ≥0.1 (COSD 2006). Total coliform densities in shallow depths (1–25 m) ranged from <2 to 1400 CFU/100 mL throughout the year, while densities of fecal coliforms ranged from <2 to 160 CFU/100 mL. Only one shallow water sample, station F01 in April, was indicative of contaminated water. The highest mean densities of indicator bacteria came from depths of 60 m and greater (Figure 23A), suggesting that the stratified water column restricted the plume to mid- and deepwater depths throughout the year.

Figure 23. 2006 Kelp and Offshore Bacterial Densities at Point Loma.

Beach Water Quality

Heal the Bay is a non-profit environmental group that has prepared California beach water quality reports for 17 years (Heal the Bay 2007a). The same beach water quality information is included in the annual report of the National Resouces Defense Council – Testing the Waters covering U. S. vacation beaches (NRDC 2007).

Heal the Bay's Beach Report Cards™ provide beachgoers with water quality information by grading monitoring locations from Humboldt County to San Diego County (Heal the Bay 2007a). The grades are based on dry weather water quality data provided by over 20 different entities throughout California. The Beach Report Cards are based on the routine monitoring of beaches conducted by local health agencies and dischargers. The better the grade a beach receives (A is best, F is worst), the lower the presumed risk of illness to ocean users.

In the most recent Heal the Bay's Beach Report Card, Heal the Bay's 2007 California Summer Beach Report Card (Heal the Bay 2007b), water quality at beaches in San Diego County received nearly 100% A or B grades. Of the 93 locations monitored frequently enough to be included in the report, 92 sites (99%) received either an A or B grade. The drought played a major role in the excellent water quality as few storm drains and creeks discharged to beaches. The only location with data exceeding acceptable levels frequently enough to drop the grade to a D was at Pacific Beach (P.B.) Point.

In 2006, the City of San Diego completed a study to identify the source(s) of bacterial contamination in ocean waters at the inside cove of P.B. Point (City of San Diego and Weston Solutions 2006). A total of 40 surveys (with sampling at 10 shoreline sites within the cove during each survey) were conducted between June 1, 2005 and March 31, 2006 to determine the spatial and temporal extent of bacterial densities in the waters of P.B. Point. In addition to analysis of ocean and storm drain water by traditional test methods, PCR (polymerase chain reaction) and ribotyping genetic methods were employed as DNA finger printing techniques to track the source (human, bird, etc.) of bacteria measured in water quality samples. The major findings of the study were:

- Poor water circulation and the accumulation of decaying kelp in the inside cove during summer months are important factors for the high bacterial densities in adjacent ocean waters. Dry weather runoff from one of three storm drains and bird fecal matter can act as bacterial "seed" in the piles of decaying kelp on the beach.

- The kelp on the beach acts as a reservoir for bacteria. Bacterial re-growth also occurs in the kelp, and brine flies can transfer bacteria from contaminated kelp to uncontaminated kelp.

- Fecal coliform and enterococci bacterial levels are highest along the shoreline of P.B. Point cove during spring tides in summer and early fall (Spring tides occur during new and full moons). Bacteria are pulled into ocean waters during spring high tides when waves wash over the kelp and ponded storm drain water.

- There were no enterococci or fecal coliform exceedances measured in offshore waters (~100 – 200 yards from the beach) during any of the surveys.

- Results for PCR analysis of 182 samples (108 ocean water and 74 storm drain) indicated fecal bacteria from warm-blooded animals in 78% of the samples. However, only 2 samples (1%) from storm drains were positive for bacteria of human origin.

- Analysis by ribotyping for the three most frequently contaminated shoreline sites indicated 71% of the bacterial contamination comes from birds, 18% from dog, raccoon and rodents, 9% unknown, and 2% from sewage.

- Analysis by ribotyping for the most problematic storm drain in the cove indicated 48% of the bacterial contamination comes from birds, 43% from dog, raccoon and rodents, 4% unknown, and 5% from human and sewage.

Two sewage spills during the summer 2007 led to San Diego County beach closures (Heal the Bay 2007b). The first was a 20-gallon spill from a line underneath Imperial Beach Pier. The beach at the pier was closed for two days in May. Also, the beach adjacent to Lawrence and Kellogg streets in San Diego Bay was closed Aug. 28-31 due to a 600-gallon sewage spill at the US Navy Sub base. These beach closures were not related to the operation of the Point Loma Ocean Outfall facility.

With the exception of short-term sewage spills and the chronic contamination emanating from the Tijuana River, elevated bacteriological levels at beaches in San Diego County (Mission Bay, San Diego Bay, P.B. Point) appear to come from non-sewage sources. Water quality standards to protect human health in recreational waters have traditionally been assessed by measuring the concentration of "indicator bacteria" to infer the presence of fecal matter and associated fecal pathogens. Fecal matter originates from the intestines of warm-blooded animals, and the presence of fecal bacteria in surface waters is used as an indicator of human pathogens that can cause illness in recreational water users (EPA 2007b). Indicator bacteria may not cause illness themselves, but have been linked to the presence of harmful pathogens (EPA 2007c). Indicator bacteria are used as a surrogate for human pathogens because they are easier and less costly to measure than the pathogens themselves.

Beaches in San Diego with "compromised" water quality are located downstream of watersheds. Bacteria entering estuaries, bays, and the ocean originate from a wide variety of sources including natural sources such as feces from aquatic and terrestrial wildlife, and anthropogenic sources such as sewer line breaks, leaking septic systems, pets, trash, and homeless encampments. Once in the environment, bacteria also re-grow and multiply (City of San Diego and Weston Solutions 2004, Martin and Gruber 2005). As summarized above, the City of San Diego and Weston Solutions study of bacterial contamination at Pacific Beach Point (City of San Diego and Weston Solutions 2006) found that the elevated bacteriological levels stemmed mainly from bacteria regrowth in the kelp wrackline on the beach, and from birds and flies, not from sewage sources.

During wet weather, wash-off of bacteria from land is the primary mechanism for transport of bacteria from land into the ocean. During dry conditions, streams in urban areas have a sustained flow even if no rainfall has occurred. These flows result from land use practices that generate urban runoff, which enters storm drains and creeks and carries bacteria into the receiving water.

The San Diego Regional Water Quality Control Board in conjunction with other regulatory agencies and local research organizations investigated bacteriological water quality at "reference beaches" with upstream watershed consisting of at least 95 percent undeveloped lands. Because the reference beach drainage area consists almost entirely of undeveloped land, bacteria washed down to the beach come from natural, non-anthropogenic sources. Measurements during the 2004-2005 winter season showed that at four reference beaches (two in Los Angeles County, one in Orange County, and one in San Diego County) 27 percent of all samples collected within 24 hours of rainfall exceeded water quality standards for at least one indicator bacteria (i.e., a single sample bacteriological threshold was exceeded 27 percent of the time) (Schiff et al. 2005). Thus, lack of compliance with bacteriological standards at beaches downstream of watersheds is likely related to natural sources as well as anthropogenic ones.

The only shoreline sampling stations along Point Loma that have continuing episodes of non-compliance with water contact bacteriological standards (D 8-D11 - Figure 21) are located over seven miles from the Point Loma Ocean Outfall in the vicinity of the San Diego River (COSD 2005, 2006). Results of the long-term, comprehensive City of San Diego bacteriological monitoring program indicate that the Point Loma Ocean Outfall wastewater plume rarely, if ever, contacts the shoreline. Indicator bacteria detected at Ocean Beach adjacent to the San Diego River are derived from natural and urban sources washed off the land and transported to the area by freshwater flows. Thus, any public health risk along the Ocean Beach shoreline would be associated with exposure to pathogens transported from land, not from the ocean discharge of wastewater over seven miles away.

A recent Draft Technical Report by the San Diego Regional Water Quality Control Board acknowledges significant areas of uncertainty regarding the actual health risk associated with water contact in areas that fail to comply with bacteriological standards as a result of runoff from land (p. 137-139, SDRWQCB 2007b):

> "The San Diego Water Board recognizes that there are potential problems associated with using bacteriological standards to indicate the presence of human pathogens in receiving waters free of sewage discharges. The indicator bacteria standards were developed, in part, based on epidemiological studies in waters with sewage inputs. The risk of contracting a water-born illness from contact with urban runoff devoid of sewage, or human-source bacteria is not known. Some pathogens, such as *giardia* and *cryptosporidium* can be contracted from animal hosts. Likewise, domestic animals can pass on human pathogens through their feces. These and other uncertainties need to be addressed through special studies and, as a result, revisions to the Total Mass Daily Limits (TMDLs) established in this project may be appropriate.

Indicator bacteria are used to measure the risk of swimmer illness because they have been shown to indicate the presence of human pathogens, such as viruses, when human bacteria sources are present. Bacterial indicators have been historically used because they are easier and less costly to measure than the pathogens themselves. In recent years, however, questions have been raised regarding the validity of using indicator bacteria to ascertain risk to swimmers in recreational waters, since they appear to be less correlated to viruses when sources are from urban runoff (Jiang et al. 2001). In fact, most epidemiology studies conducted to measure the risk of swimmer illness in the presence of indicator bacteria have taken place in receiving waters containing known sewage impacts.

To date, only two epidemiology studies have been conducted where the bacteria source was primarily urban runoff. The Santa Monica Bay epidemiology study (Haile et al, 1999) reported that there was a direct correlation between swimming related illnesses and densities of indicator bacteria. The sites included in this study were known to contain human sources of fecal contamination. Most recently, the Mission Bay epidemiological study (Colford et al. 2007) showed that there was no correlation between swimmer illness and concentrations of indicator bacteria. Unlike Santa Monica Bay, bacteria sources in Mission Bay were shown to be primarily of nonhuman origin (City of San Diego and Weston Solutions 2004). The studies caution against extrapolating the results from the Mission Bay study to other locations, since there have been extensive cleanup activities on this waterbody and subsequently bacteria source analyses have shown that human fecal sources are only a minor contributor. The link between bacteria loads from urban runoff containing mostly nonhuman sources, and risk of illness needs to be better understood.

Recent studies have also shown that bacteria regrowth is a significant phenomenon (City of San Diego and Weston Solutions 2004, City of Laguna Niguel and Kennedy Jenks 2003). Such regrowth can cause elevations in bacteria levels that do not correspond to an increase in human pathogens and risk of illness. For example, the Mission Bay Source Identification Study found that bacteria multiply in the wrack line on the beach (eel grass and other debris) during low tide, causing exceedances of the water quality objectives during high tide when the wrack is inundated. This same phenomenon likely occurs inside storm drains, where tidal cycles and freshwater input can cause bacteria to multiply. In both these cases, an increase in bacteria densities does not necessarily correlate to an increase in the presence of human pathogens. The regrowth phenomenon is problematic since dischargers must expend significant resources to reduce the current bacteria loads to receiving waters to meet the required waste load reductions.

As information is gathered, initiating special studies to understand the uncertainties between bacteria levels and bacteria sources within the watersheds may be useful. Specifically, continuing research may be helpful to answer the following questions: • What is the risk of illness from swimming in water contaminated with urban/stormwater runoff devoid of sewage? • Do exceedances of the bacteria water quality objectives from animal sources (wildlife and domestic) increase the risk of illness? • Are there other, more appropriate surrogates for measuring the risk of illness than the indicator bacteria standards currently used? Addressing these uncertainties is needed to maximize effectiveness of strategies to reduce the risk of illness, which is currently measured by indicator bacteria densities. Dischargers may work with the San Diego Water Board to determine if such special studies are appropriate."

Fish Tissue Compliance

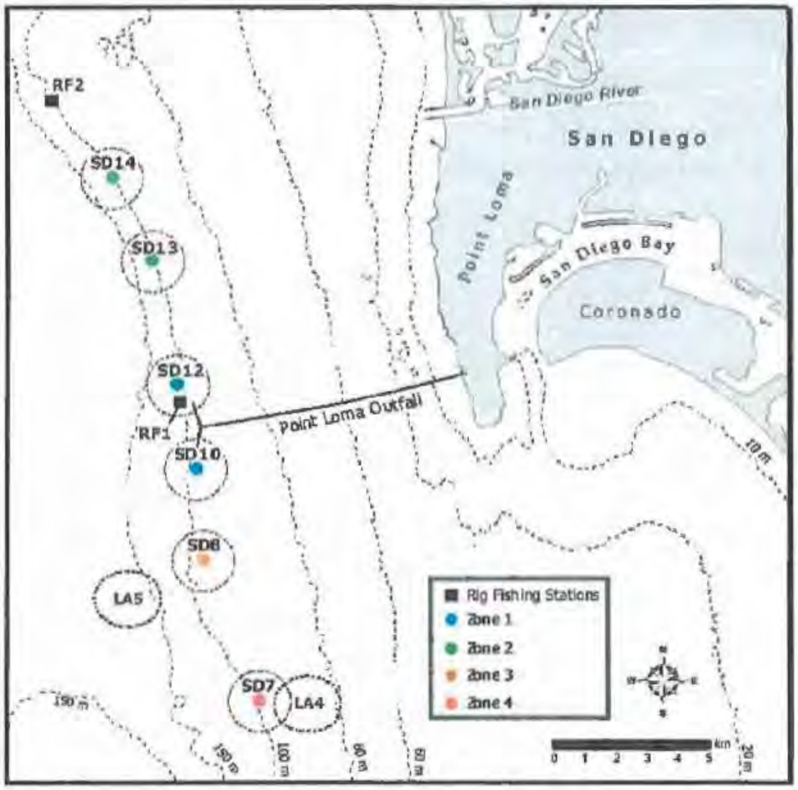
Contaminants enter the ocean environment through various sources including rivers and streams, storm drains, industrial discharges, municipal wastewater discharges, dredge and disposal activities, aerial fallout, vessel activities and spills, mineral mining, oil exploration and extraction, and through natural sources such as hydrothermal vents, hydrocarbon and elemental seeps. All of these sources have the potential to impact fish populations and possibly public health, if contaminated fish are consumed.

Some of the contaminants entering the ocean remain dissolved and are distributed by ocean currents and eddies. Many contaminants are physically or chemically bound to particulate matter and settle to the bottom. Contaminants may bioaccumulate – that is, be retained in the tissues of marine organisms and concentrated through food-webs. The degree to which bioaccumulation occurs depends on the solubility, particle affinity, oxidation state, volatility, and degradability of the specific chemical. These differences determine how contaminants are distributed within biological communities and along the California coast (Allen 2006).

Fish exposure may include absorption of dissolved chemicals from seawater (by the gills or epidermis), contact with sediment contaminants, ingestion of sediment particles or suspended particulate matter, and ingestion and assimilation of contaminants from food organisms. Demersal (bottom dwelling) fish are useful in biomonitoring programs because of their potential exposure and proximity to bottom sediments, and because most contaminants found in marine organisms are hydrophobic, and accumulate in lipid (fatty) reservoirs of the organism. For these reasons, levels of contaminants in tissues of demersal fish are often related to those found in the environment (Schiff and Allen 1997).

The City of San Diego's Metropolitan Wastewater Department Ocean Monitoring Program collects fish off Point Loma to check for accumulation of contaminants by (1) deploying Otter trawls along the 100 m depth contour to capture demersal fish for liver tissues analysis, and (2) by rig-fishing to capture fish for muscle tissues analysis (Figure 29).

Figure 29. Otter Trawl and Rig Fishing Stations and Zones.



Pacific sanddabs (*Citharichthys sordidus*) are collected by trawl in 4 zones and various rockfish (*Sebastes* spp) are collected at 2 rig fishing stations (RF1 and RF2).

Chemical analyses are performed on the fish livers because this organ is where contaminants typically concentrate (COSD 2006). The following discussion, tables and figures are taken from the two most recent Point Loma Ocean Outfall annual monitoring reports: COSD 2006 and COSD 2007.

Results of the liver tissue analysis from trawl caught Pacific sanddabs in 2005 are shown in Table 29.

Table 29. Liver Tissue Analysis for Trawl Caught Fish in 2005.
Concentrations of metals, total PCB, and pesticides detected in liver tissues from trawl-caught Pacific sanddabs during October 2005. n=number of detected values out of 12 samples.

Parameter	n	Min	Max	Mean
Metals (ppm)				
Aluminum	11	1.12	11.70	6.98
Antimony	6	0.57	1.25	0.91
Arsenic	12	4.27	6.07	5.39
Barium	12	0.01	0.25	0.10
Cadmium	12	1.37	8.75	4.41
Chromium	10	0.21	3.10	0.70
Copper	12	2.33	7.37	4.16
Iron	12	33.30	124.00	63.44
Lead	12	0.47	1.42	0.86
Manganese	12	0.56	1.18	0.84
Mercury	8	0.03	0.09	0.05
Nickel	8	0.10	1.25	0.32
Selenium	12	0.44	0.88	0.62
Thallium	12	4.60	6.35	5.76
Tin	1	0.25	0.25	0.25
Zinc	12	15.70	22.10	19.16
Pesticides (ppb)				
Total DDT	12	147.30	534.50	322.73
Lindane				
BHC (beta isomer)	1	5.70	5.70	5.70
BHC (delta isomer)	1	3.40	3.40	3.40
HCB, Hexachlorobenzene	12	2.40	4.70	3.32
Chlordane				
alpha (*cis*) Chlordane	12	4.10	8.70	5.63
gamma (*trans*) Chlordane	1	1.90	1.90	1.90
cis-Nonachlor	10	2.50	4.80	3.21
trans-Nonachlor	12	4.50	11.00	6.45
Total PCB (ppb)	12	76.70	321.20	189.76
Lipids (%wt)	12	43.5	60.90	48.55

Twelve metals, including aluminum, arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, selenium, thallium, and zinc occurred in over 80% of the liver samples from Pacific sanddabs collected by trawl in 2005. Antimony, mercury, nickel, and tin were also detected, but less frequently. Although silver and tin were detected in almost all of the Pacific sanddabs collected in 2004, tin was detected in less than 10% of the samples in 2005 and silver was not detected at all (COSD 2006). Concentrations of most metals were < 7 ppm. Exceptions were iron and zinc, which had concentrations above 20 ppm in at least one sample.

Comparisons of frequently detected metals from samples collected closest to the discharge (Zone 1) and those located farther away (Zones 2-4) indicate no relationship between contaminant loads and proximity to the outfall (COSD 2006). The highest mean values of chromium, lead, manganese, mercury, nickel, and zinc occurred in Zone 3, the zone closest to the LA-5 dredge material site.

Several chlorinated pesticides were detected in liver tissues during 2005. Total DDT was found in all samples at concentrations ranging from about 147 to 535 ppb. Other pesticides that were detected frequently included hexachlorobenzene (HCB), alpha (cis) Chlordane, cis- Nonachlor, and trans-Nonachlor. In contrast, BHC (Lindane) and gamma (trans) Chlordane were rarely detected (COSD 2006). The maximum concentration for any one of these pesticides was 11 ppb (trans-Nonachlor), which was very low relative to total DDT. PCBs occurred in all samples. Total PCB concentrations (i.e., the sum of all congeners detected in a sample, tPCB) were variable, ranging from about 77 to 321 ppb, with a mean of approximately 190 ppb (COSD 2006). As with metals, there was no clear relationship between concentrations of the frequently occurring pesticides or PCBs and proximity to the outfall. Generally, higher values of tPCB, tDDT, alpha (*cis*) Chlordane, *cis*-and *trans*-Nonachlor occurred in Zones 1, 3 or 4, but these values were not substantially different from those that occurred in Zone 2.

Results of the liver tissue analysis from trawl caught fish in 2006 are shown in Table 30.

Table 30. Liver Tissue Analysis for Trawl Caught Fish in 2006.

Concentrations of metals, total PCB, and pesticides detected in liver tissues from trawl-caught fishes during October 2006. The number of samples per species is indicated parenthetically; n=number of detected values; nd=not detected.

	English sole (1)				Pacific sanddab (11)				Overall	
Parameter	n	Min	Max	Mean	n	Min	Max	Mean	% Detected	Max
Metals (ppm)										
Aluminum	1	1.5	1.5	1.5	9	0.6	18.6	6.3	83	18.6
Antimony	nd	—	—	—	3	1.14	2.31	1.72	25	2.31
Arsenic	1	13.3	13.3	13.3	11	0.5	2.7	1.6	100	13.3
Barium	1	0.185	0.185	0.185	11	0.055	0.112	0.080	100	0.185
Beryllium	nd	—	—	—	1	0.004	0.004	0.004	8	0.004
Cadmium	1	1.07	1.07	1.07	11	2.11	6.57	4.48	100	6.57
Chromium	1	0.374	0.374	0.374	11	0.175	0.975	0.515	100	0.975
Copper	1	15.8	15.8	15.8	11	2.7	4.9	3.6	100	15.8
Iron	1	170	170	170	11	57	146	104	100	170
Lead	1	1.76	1.76	1.76	1	1.55	1.55	1.55	17	1.76
Manganese	1	1.34	1.34	1.34	11	0.49	2.02	1.11	100	2.02
Mercury	1	0.037	0.037	0.037	11	0.043	0.153	0.084	100	0.153
Nickel	nd	—	—	—	2	0.247	0.333	0.290	17	0.333
Selenium	1	1.65	1.65	1.65	11	0.59	1.03	0.75	100	1.65
Silver	1	0.493	0.493	0.493	6	0.085	0.275	0.193	58	0.493
Thallium	nd	—	—	—	1	1.87	1.87	1.87	8	1.87
Tin	1	1.77	1.77	1.77	11	1.85	4.18	2.65	100	4.18
Zinc	1	80.8	80.8	80.8	11	16.5	32.6	22.0	100	80.8
Pesticides (ppb)										
HCB	1	0.9	0.9	0.9	11	2.1	4.0	3.1	100	4.0
Total Chlordane	1	3.3	3.3	3.3	11	9.6	24.4	18.3	100	24.4
Total DDT	1	912.7	912.7	912.7	11	235.2	457.1	364.6	100	912.7
Total PCB (ppb)	1	219.8	219.8	219.8	11	153.9	479.1	298.6	100	479.1
Lipids (%wt)	1	17.8	17.8	17.8	11	30.8	56.4	42.3	100	56.4

Twelve metals, including aluminum, arsenic, barium, cadmium, chromium, copper, iron, manganese, mercury, selenium, tin, and zinc, occurred in over 80% of the liver samples analyzed from Pacific sanddabs and English sole collected by trawl in 2006 (Table 30). Antimony, beryllium, lead, nickel, silver, and thallium were also detected, but less frequently. Tissue concentrations of most metals were < 20 ppm. The only exceptions were iron and zinc, which had concentrations up to about 170 and 81 ppm, respectively. Comparisons of the frequently detected metals from Pacific sanddab samples collected in 2006 closest to the discharge (Zone 1) to those located farther away (Zones 2–4) suggest that there was no clear relationship between contaminant loads and proximity to the outfall (COSD 2007).

Three chlorinated pesticides (hexachlorobenzene (HCB), chlordane, DDT) were detected in all samples collected during 2006 (Table 30). Total concentrations ranged from about 3 to 24 ppb for chlordane, 235 to 913 ppb for DDT, and 0.9 to 4 ppb for HCB (COSD 2007). Total chlordane consisted primarily of trans nonachlor, alpha (cis) Chlordane, and cis nonachlor, which were present in 10 or more of the samples. In contrast, gamma (trans) Chlordane was present in just 5 of the samples (see Appendix D.3 COSD 2007).

PCBs were also detected in all samples. Total PCB concentrations (i.e., the sum of all congeners detected in a sample, tPCB) were variable, ranging from about 154 to 479 ppb. As with metals, there was no relationship between concentrations of the frequently occurring pesticides or PCBs and proximity to the outfall (COSD 2007). The highest concentration of chlordane occurred in a sample of Pacific sanddabs collected in Zone 1, but the other 2 samples from this zone contained chlordane concentrations similar to those collected at other sites. Mean values of DDT and HCB appeared to be higher in samples from Zones 1 and 3 (nearest the outfall and LA-5, respectively), but these differences are only slight. On the other hand, total PCB was clearly highest for all 3 sanddab samples from Zone 3, located relatively near the LA-5 disposal site. Elevated levels of PCBs in various fish species have been demonstrated at this location before (e.g., COSD 2003). The area contains materials dredged from San Diego Bay, which is known to have elevated levels of PCBs. Since there are no detectable concentrations of PCBs in the Point Loma Outfall discharge or elevated concentrations in nearby sediments (see Appendix E), it is likely that the deposited San Diego Bay sediments contribute to the elevated levels of PCBs present in Zone 3 fish.

The two rig-fishing stations in the Point Loma Ocean Outfall Ocean Monitoring Program are positioned along the 100 m depth contour (Figure 29). Station RF1 is just north of the terminus of the northern outfall diffuser and station RF2 is located about 10 mi farther north. The fish targeted for collection by rig-fishing represent typical sport fishing species, and are therefore of recreational and commercial importance. Muscle tissue is analyzed from these fish because it is the tissue most often consumed by humans, and therefore the results have human health implications.

Aluminum, arsenic, barium, copper, iron, manganese, mercury, selenium, thallium, and zinc occurred in at least two-thirds of the muscle tissue samples from various rockfish collected at rig fishing stations in 2005 (Table 31). Chromium, lead, and silver were also detected, but only in one half or fewer of the samples. The metals with the highest mean concentrations included aluminum, arsenic, iron, thallium, and zinc. Each exceeded 2 ppm for at least one species of fish sampled; however there was little difference between species relative to the mean concentration for these metals. Other contaminants, such as DDT and PCB, were detected in 100% of the muscle samples, while the pesticides BHC (Lindane), HCB, and Chlordane were found much less frequently (Table 32).

Table 31. Metals in Fish Muscle Tissue in 2005 (ppm).

Metals detected in muscle tissues from fishes collected at PLOO rig fishing stations during October 2005. Data are compared to U.S. FDA action limits and median international standards when possible. Bold values exceed these standards; n=number of detected values; nd=not detected.

	Al	As	Ba	Cr	Cu	Fe	Pb	Mn	Hg	Se	Ag	Th	Zn
Mixed rockfish													
N (out of 2)	1	2	2	1	2	2	nd	2	2	2	nd	2	2
Min	3.28	**2.60**	0.011	0.048	0.73	1.7	—	0.05	0.05	**0.347**	—	2.6	3.1
Max	3.28	**2.87**	0.064	0.048	1.01	2.9	—	0.07	0.11	**0.478**	—	2.9	3.1
Mean	3.28	**2.74**	0.037	0.048	0.87	2.3	—	0.06	0.08	**0.412**	—	2.8	3.1
Rosethorn rockfish													
N (out of 1)	1	1	1	nd	1	1	nd	1	1	1	nd	1	1
Value	1.09	**2.49**	0.013	—	0.76	2.0	—	0.08	0.11	**0.367**	—	2.6	2.9
Speckled rockfish													
N (out of 1)	1	1	nd	nd	1	1	1	1	1	1	1	1	1
Value	1.87	**1.71**	—	—	0.27	2.2	0.34	0.05	0.07	**0.352**	0.5	2.62	3.0
Squarespot rockfish													
N (out of 2)	1	2	1	1	2	2	2	2	2	2	nd	2	2
Min	2.47	**2.16**	0.008	0.087	0.25	3.7	0.32	0.03	0.21	0.275	—	2.8	3.2
Max	2.47	**2.54**	0.008	0.087	0.46	5.0	0.42	0.06	0.26	**0.364**	—	2.9	3.4
Mean	2.47	**2.35**	0.008	0.087	0.36	4.3	0.37	0.04	0.24	**0.320**	—	2.9	3.3
ALL SPECIES													
% Detected	67	100	67	33	100	100	50	100	100	100	17	100	100
US FDA Action Limit*									1				
Median International Standard*		1.40		1.0	20		2		0.5	0.3			70

*From Mearns et al. 1991. US FDA mercury action limits and all international standards are for shellfish, but are often applied to fish. All limits apply to the sale of seafood for human consumption.

Table 32. Non-Metals in Fish Muscle Tissue in 2005.

Concentrations of chlorinated pesticides, PCBs, and lipids detected in muscle tissues from rockfish collected at rig fishing stations during October 2005. Data are compared to U.S. FDA action limits and median international standards when possible. BHC(B)=BHC, beta isomer; BHC(D)=BHC, delta isomer; HCB=hexachlorobenzene; A(c)C=alpha (*cis*) Chlordane; G(t)C= gamma (*trans*) Chlordane; CN=*cis*-Nonachlor; TN=*trans*-Nonachlor. Values are expressed in parts per billion (ppb) for all parameters except lipids, which are presented as percent weight (% wt). n=number of detected values, nd=not detected.

	Total	Lindane			Chlordane				Total	
	DDT	BHC(B)	BHC(D)	HCB	A(c)C	G(t)C	CN	TN	PCB	Lipids
Mixed rockfish										
N (out of 2)	2	nd	nd	2	2	1	1	2	2	2
Min	11	—	—	0.1	0.3	0.3	0.5	0.4	6	2.31
Max	63.6	—	—	0.3	0.7	0.3	0.5	1.2	34.4	3.13
Mean	37.3	—	—	0.2	0.5	0.3	0.5	0.8	20.2	2.72
Rosethorn rockfish										
N (out of 1)	1	nd	nd	nd	nd	nd	nd	nd	1	1
Value	2.3	—	—	—	—	—	—	—	0.8	0.3
Speckled rockfish										
N (out of 1)	1	nd	nd	1	nd	nd	nd	nd	1	1
Value	5.7	—	—	0.1	—	—	—	—	1.3	1.4
Squarespot rockfish										
N (out of 2)	2	1	1	2	1	1	nd	1	2	2
Min	12.4	5.8	7.6	0.1	0.9	1.0	—	0.4	3.2	2.09
Max	15.1	5.8	7.6	0.2	0.9	1.0	—	0.4	3.8	2.76
Mean	13.75	5.8	7.6	0.15	0.9	1.0	—	0.4	3.5	2.425
ALL SPECIES										
% Detected	100	17	17	83	50	33	17	50	100	
US FDA Action Limit*	5000									
Median International Standard*	5000									

*From Table 2.3 in Mearns et al. 1991. USFDA action limit for total DDT is for fish muscle tissue, US FDA mercury action limits and all international standards are for shellfish, but are often applied to fish. All limits apply to the sale of seafood for human consumption.

To address human health concerns, concentrations of constituents found in muscle tissue samples were compared to both national and international limits and standards (Tables 31 and 32). The United States Food and Drug Administration (FDA) has set limits on the amount of mercury, total DDT, and Chlordane in seafood that is to be sold for human consumption and there are also international standards for acceptable concentrations of various metals (see Mearns et al. 1991). While many compounds were detected in the muscle tissues of fish collected as part of the Point Loma Ocean Outfall monitoring program, only arsenic and selenium had concentrations that were higher than international standards. The source of this arsenic is assessed to be vents from natural hot springs off the coast of northern Baja California. Fish throughout the Southern California Bight have relatively high levels of selenium (Mearns et al. 1991).

In addition to addressing health concerns, spatial patterns were assessed for total DDT and total PCB, as well as all metals that occurred frequently in muscle tissue samples

(COSD 2006, 2007). A single sample in 2005 of mixed rockfish at RF1 had concentrations of tPCB, tDDT, and barium that were well above other samples. These parameters were detected in a sample that included tissue from a rockfish that was 7 cm larger than all other fish collected (39 cm SL vs < 32 cm SL), indicating that this fish was likely much older than the other fish and therefore had a longer exposure to the sediments. Overall, concentrations of metals, HCB, DDT, and PCB were somewhat variable in the muscle tissues from fish at both rig fishing stations, and there was no evident relationship with proximity to the outfall.

Comparison of contaminant loads between RF1 and RF2 should be considered with caution however, because different species of fish were collected at the two sites. All specimens belong to the same family, Scorpaenidae, and have similar life histories (e.g., bottom dwelling tertiary carnivores), so they have similar mechanisms of exposure (e.g., exposure from direct contact with the sediments and through possibly similar food sources). These species are therefore comparable to a certain degree. However, since they are not the same species, differences in physiology and food choices may exist that could affect the accumulation of contaminants.

In 2005, twelve trace metals, 3 pesticides, and a combination of PCBs were each detected in over 80% of the liver samples from Pacific sanddabs collected around the Point Loma Ocean Outfall. Contaminant loads were within the range of those reported previously for other Southern California Bight fish assemblages (see Mearns et al. 1991, Allen et al. 1998, 2002b, 2007). In addition, concentrations of these contaminants were generally similar to those reported previously by the City of San Diego (COSD 1996–2005). Concentrations of most parameters were similar across zones/stations, and no clear relationship with proximity to the outfall was evident.

The occurrence of metals and chlorinated hydrocarbons in Point Loma Ocean Outfall fish tissues may be due to many factors. Mearns et al. (1991) described the distribution of several contaminants, including arsenic, mercury, DDT, and PCBs as being ubiquitous in the Southern California Bight. In fact, many metals (e.g., aluminum and iron) occur naturally in the environment, although little information is available on their background levels in fish tissues. Brown et al. (1986) determined that no areas of the Southern California Bight are sufficiently free of chemical contaminants to be considered reference sites. This has been supported by more recent work regarding PCBs and DDTs (e.g., Allen et al. 1998, 2002b, 2007).

Other factors that affect the accumulation and distribution of contaminants include the physiology and life history of different fish species. For example, exposure to contaminants can vary greatly between species and also among individuals of the same species depending on migration habits (Otway 1991). Fish may be exposed to contaminants in a contaminated area and then move into an area that is less contaminated. This may explain why many of the pesticides and PCBs detected in fish collected off Point Loma in 2005 and 2006 were found in low concentrations or were not detected at all in sediments surrounding the outfall. In addition, differences in feeding habits, age, reproductive status, and gender can affect the amount of contaminants a fish will retain in its tissues (e.g., Connell 1987, Evans et al. 1993). These factors make comparisons of contaminants among species and between stations difficult.

Overall, there was no evidence that fish collected in 2005 were contaminated by the discharge of waste water from the Point Loma Ocean Outfall. Concentrations of mercury and DDT in muscle tissues from sport fish collected in the area were below FDA human consumption limits. Finally, there was no other indication of poor fish health in the region, such as the presence of fin rot or other physical anomalies (see Chapter 6 COSD 2006).

In 2006, fourteen of 18 heavy metals analyzed were found in almost all of the samples from the 3 rockfish species collected at rig fishing stations (Table 33). These metals were aluminum, arsenic, barium, cadmium, chromium, copper, iron, mercury, manganese, nickel, antimony, selenium, tin, and zinc. Beryllium, lead, silver, and thallium were not detected. The metals present in the highest concentrations were aluminum, iron, and zinc. Concentrations of each of these metals exceeded 2 ppm for at least one species of fish; however, there was little difference between species relative to mean concentrations. Other contaminants, including the pesticides HCB, chlordane, and DDT, as well as PCBs, were detected in more than 65% of the muscle samples (Table 34). The highest concentration of all 4 contaminants occurred in a single sample of starry rockfish.

Table 33. Metals in Fish Muscle Tissue in 2006 (ppm).

Metals detected in muscle tissues from fishes collected at PLOO rig fishing stations during October 2006. Data are compared to USFDA action limits and median international standards (IS) when possible. Bold values exceed these standards; n=number of detected values; nd=not detected.

	Al	As	Ba	Cd	Cr	Cu	Fe	Hg	Mn	Ni	Sb	Se	Sn	Zn
Copper rockfish														
n (out of 3)	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Min	1.24	1.05	0.030	0.147	0.38	0.321	1.43	0.079	0.087	0.145	1.01	**0.35**	1.63	4.87
Max	4.75	**1.69**	0.035	0.178	0.53	0.534	2.22	0.100	0.144	0.378	1.11	**0.54**	1.77	5.73
Mean	2.84	1.28	0.034	0.158	0.44	0.431	1.93	0.088	0.107	0.234	1.05	**0.46**	1.71	5.24
Starry rockfish														
n (out of 1)	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Min	3.74	1.32	0.032	0.162	0.33	0.326	3.11	0.206	0.131	0.143	0.92	**0.37**	1.55	4.35
Max	3.74	1.32	0.032	0.162	0.33	0.326	3.11	0.206	0.131	0.143	0.92	**0.37**	1.55	4.35
Mean	3.74	1.32	0.032	0.162	0.33	0.326	3.11	0.206	0.131	0.143	0.92	**0.37**	1.55	4.35
Yellowtail rockfish														
n (out of 2)	2	1	2	2	2	2	2	2	2	2	2	2	2	2
Min	0.69	0.46	0.029	0.141	0.36	0.385	3.11	0.072	0.130	0.151	0.79	**0.30**	1.69	3.77
Max	8.19	0.46	0.037	0.156	0.47	0.447	4.58	0.079	0.132	0.161	0.83	**0.35**	1.71	4.28
Mean	4.44	0.46	0.033	0.149	0.42	0.416	3.85	0.076	0.131	0.156	0.81	**0.33**	1.70	4.03
% Detected	100	83	100	100	100	100	100	100	100	100	100	100	100	100
Max	8.19	**1.69**	0.037	0.178	0.53	0.534	4.58	0.206	0.144	0.378	1.11	**0.54**	1.77	5.73
USFDA Act. Limit*								1.00						
Median IS*		1.4		1.0	1.0	20		0.5				0.3	175	70

*From Mearns et al. 1991. USFDA mercury action limits and all international standards (IS) are for shellfish, but are often applied to fish. All limits apply to the sale of seafood for human consumption.

Table 34. Non-Metals in Fish Muscle Tissue in 2006.

Concentrations of chlorinated pesticides, PCBs, and lipids detected in muscle tissues from rockfish collected at rig fishing stations during October 2006. Data are compared to USFDA action limits (AL) and median international standards (IS) when possible. HCB=hexachlorobenzene; tChlor=chlordane. Values are expressed in ppb for all parameters except lipids, which are presented as percent weight (% wt). n=number of detected values.

	HCB	tChlor	tDDT	tPCB	Lipids
Copper rockfish					
n (out of 3)	3	2	3	3	3
Min	0.1	0.1	4.7	1.3	1.0
Max	0.1	0.2	5.3	1.7	3.4
Mean	0.1	0.2	5.0	1.5	2.3
Starry rockfish					
n (out of 1)	1	1	1	1	1
Min	0.2	0.6	19.3	7.3	1.5
Max	0.2	0.6	19.3	7.3	1.5
Mean	0.2	0.6	19.3	7.3	1.5
Yellowtail rockfish					
n (out of 2)	2	1	2	2	2
Min	0.1	0.1	3.6	0.5	0.5
Max	0.1	0.1	6.3	1.2	0.7
Mean	0.1	0.1	5.0	0.9	0.6
% Detected	100	67	100	100	100
Max	0.2	0.6	19.3	7.3	3.4
FDA -AL*		300	5000		
Median IS*		100	5000		

*From Table 2.3 in Mearns et al. 1991. The USFDA action limit for total DDT is for fish muscle tissue; the chlordane action limit and all international standards (IS) are for shellfish, but are often applied to fish. All limits apply to the sale of seafood for human consumption.

As in 2005, the only metals with concentrations in fish muscle tissue that exceeded international standards in 2006 were arsenic and selenium (Table 33). Overall 2006 concentrations of HCB, DDT, and PCB were somewhat variable in the muscle tissues from fish at both rig fishing stations, and there was no evident relationship with proximity to the outfall (COSD 2007). The highest values for several parameters were from the starry rockfish collected at station RF2 as discussed above. Starry rockfish are not commonly collected in this area, so it is possible that these fish recently migrated into the region.

In 2006, fourteen trace metals, 3 pesticides, and a combination of PCBs were detected in over 80% of the liver samples from Pacific sanddabs and English sole collected around the Point Loma outfall region (COSD 2007). Again, contaminant loads were within the range of those reported previously for other Southern California Bight fish assemblages (see Mearns et al. 1991, Allen et al. 1998, 2002b, 2007). In addition, concentrations of these contaminants were generally similar to those reported previously by the City of San Diego for this survey area (e.g., COSD 2006). Concentrations of most parameters were similar across zones/stations, and no clear relationship with proximity to the outfall was evident.

As in 2005, there was no evidence that fish collected in 2006 were contaminated by the discharge of wastewater from the Point Loma Ocean Outfall. Concentrations of mercury and DDT in muscle tissues from sport fish collected in the area were below USFDA human consumption limits. Again, there was no other indication of poor fish health in the region, such as the presence of fin rot or other physical anomalies (see Chapter 6 COSD 2007).

Health concerns regarding the consumption of fish are based on toxic or carcinogenic effects of the contaminant. The EPA (http://www.USEPA.gov/waterscience/fish/) has promulgated risk based consumption limit tables through their National Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories (EPA 2000). Contaminants of toxic concern (as of June 2007 (EPA 2007d)) are: dicofol, cadmium, methylmercury, selenium, TBT (tri-butyl tin), endosulfan, endrin, heptachlor epoxide, mirex, chlorpyrifes, diazion, disulfton, ethion, and terbufos. Contaminants of carcinogenic concern are: dieldrin, DDT, chlordane, arsenic, hexachlorobenzene, lindane, toxaphene, oxyfluorfen, PHAs, PCBs, and dioxins/furans.

The state of California Office of Environmental Health Hazard Assessment (OEHHA) Fish and Water Quality Evaluation Unit and the California Department of Public Health (CDPH 2007) provide information on fish contaminants, publish tissue limits for contaminants, and issue fish consumption advisories. OEHHA is the responsible agency for evaluating chemical contaminant health risk of California marine fish consumed by anglers. Neither OEHHA (OEHHA 2007a,b) nor the California Department of Public Health have issued any restrictions on fish consumption or advisories for marine coastal waters in San Diego County.

RESTRICTIONS

There are no Federal, State, or, local restrictions on recreational activities or other Beneficial Uses in the vicinity of the Point Loma discharge.

BENEFICIAL USE IMPACTS

Beneficial uses in the vicinity of Point Loma include aesthetic enjoyment, tide-pooling, wading and swimming, surfing, snorkeling, diving, sailing and boating, recreational and commercial fishing, whale watching, research and education, navigation and shipping, military and industrial use, and conservation of marine habitats and species.

A variety of factors influence water quality and biological conditions that protect and maintain these uses, including the Point Loma Ocean Outfall wastewater discharge, industrial discharges, local river outflows, urban runoff, and regional non-point sources such as harbors and marinas.

The Point Loma Ocean Outfall Monitoring Program focuses on key water quality and biological conditions (Table 35) using the types of data indicated in Table 36.

Table 35. Water Quality and Biological Conditions Monitored at Point Loma.

Water Quality Conditions:	**Biological Conditions:**
Dissolved Oxygen Depression	Diversity
Acute Toxicity	Survival of Biota
Chronic Toxicity	Impairment of Reproduction, Growth or Development
Water Clarity/Light Penetration	Migratory Patterns
Nutrient Levels	Habitat Enhancement
Presence of Pathogens	Rare and Endangered Species Habitat
Conductivity/Salinity Temperature	Incidence of Disease
pH	Nuisance Species

Table 36. Data Used to Assess Water Quality and Biological Conditions.

General Issue	**Specific Area of Concern**	**Available Monitoring Data**
Water Quality Conditions	DO Depression	Dissolved Oxygen
	Acute Toxicity	DO, Un-ionized-NH_3, Effluent Toxics, Bioassay
	Chronic Toxicity	Un-ionized-NH_3, Effluent Toxics, Bioassay
	Toxics Accumulation in Sediments	Effluent Toxics, Benthic organisms bioaccumulation
	Toxics Accumulation in Organisms	Effluent Toxics, Fish tissue bioaccumulation
	Nutrient Levels	Ammonia

Table 36. Data Used to Assess Water Quality and Biological Conditions.		
General Issue	**Specific Area of Concern**	**Available Monitoring Data**
	Water Clarity & Light Penetration	Observation, Turbidity, Transmissivity
	Pathogens	Total coliform, fecal coliform, enterococcus
	Salinity, temperature, pH	Salinity, temperature, pH
Biological Condition	Diversity	Benthic Infauna, Fish and Macroinvertebrates
	Survival of Biota	Observation
	Impairment of Reproduction, Growth, or Development	DO, Fish observations
	Migratory Patterns	Observation
	Habitat Enhancement	Observation
	Rare and Endangered Species Habitat	Observation
	Incidence of Disease and Parasitism	Observation
	Nuisance Species	Observation, Benthic Infauna, Fish

Monitoring data show effects of the Point Loma discharge only in deep waters (below the euphotic zone) within or near the Zone of Initial Dilution (ZID). While minor changes in some water quality parameters (e.g., dissolved oxygen and pH) have been observed in these areas, they are within the range of natural conditions.

Benthic conditions off Point Loma have shown some changes that may be expected near large ocean outfalls, although these were restricted to a relatively small, localized region near the discharge site. For example, sediment quality data have indicated slight increases over time in terms of sulfide and BOD concentrations at sites nearest the ZID, an area where relatively coarse sediment particles have also tended to accumulate. However, other measures of environmental impact such as concentrations of sediment contaminants (e.g., trace metals, pesticides) exhibit no patterns related to wastewater discharge.

Some descriptors of benthic community structure (e.g., abundance, species diversity) or indicators of environmental disturbance (Appendix E) have revealed temporal differences between reference areas and sites nearest the ZID. However, results from environmental disturbance indices such as the Benthic Response Index used to evaluate the condition of benthic assemblages show that macrobenthic invertebrate communities in the Point Loma region retain a balanced indigenous population.

Analyses of bottom dwelling (demersal) fish and trawl-caught megabenthic invertebrate communities also indicate no spatial or temporal patterns that can be attributed to effects

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Appendix H

Endangered Species

APPENDIX H

ENDANGERED SPECIES

For

CITY OF SAN DIEGO

APPLICATION FOR MODIFICATION OF SECONDARY TREATMENT REQUIREMENTS AT THE POINT LOMA TREATMENT FACILITY

To

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Table of Contents

Introduction

The endangered species assessment responds to the following questions in the Application for Modification of Secondary Treatment Requirements:

- Are endangered species present in the vicinity of the discharge?
- Have endangered species been effected by the discharge?

Regulatory Framework

The Endangered Species Act

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§ 1531 et seq.) establishes protection over and conservation of threatened and endangered species and the ecosystems on which they depend (USFWS 2007a). An endangered species is a species that is in danger of extinction throughout all or a significant portion of its range, while a threatened species is one that is likely to become endangered within the foreseeable future. The ESA establishes procedures for nominating species for protection and prohibits actions that would jeopardize their continued existence. All federal agencies are required to implement protection programs for threatened and endangered species and to use their authority to further the purposes of the ESA.

The Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 (16 U.S.C. §§ 1361 et seq.) established a moratorium on the "taking" of marine mammals in waters or on lands under U.S. jurisdiction (NMFS 2007a). It defines federal responsibility for conserving marine mammals (whales, dolphins, porpoises, seals, sea lions, and sea otters). The MMPA prohibits harassing, capturing, disturbing, or, killing marine mammals except under special permit. It creates a Marine Mammal Commission, Regional offices, and Fisheries Science Centers to implement research and protection.

California Endangered Species Act

California Endangered Species Act (CESA) of 1970, re-amended in 1984, is part of the California Fish and Game Code and is administered by the California Department of Fish and Game (CDFG 2007a). It establishes measures to conserve, protect, restore, and enhance threatened and endangered species and their habitats. Certain species that are not recognized as threatened or endangered under the federal Endangered Species Act may be listed as threatened or endangered under the California Endangered Species Act. The provisions included in the CESA generally parallel those in the federal ESA although, unlike its federal counterpart, the CESA also applies take prohibitions to species petitioned for listing (i.e., state candidates).

Existing Conditions

Twenty-four endangered species covered under the federal Endangered Species Act, the Marine Mammal Protection Act, and/or the California Endangered Species Act may occur in the vicinity of Point Loma (Table 1): eight marine mammals, seven birds, five sea turtles, two fish, and two invertebrates. Their population biology, status, and distribution are discussed in the following paragraphs.

Table 1. Endangered Species.

California Department of Fish and Game 2007b.
U.S. Fish and Wildlife Service 2007b.
National Marine Fisheries Service 2007b.

Marine Mammals		
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Meaptera novaeangliae*	Endangered
Right Whale	*Eubalaena japonica*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Guadalupe Fur Seal	*Arctocephalus townsendi*	Threatened
Steller Sea Lion	*Eumetopias jubatus*	Threatened
Birds		
California Brown Pelican	*Pelicanus occidentalis californicus*	Endangered
California Least Tern	*Sterna antillarum browni*	Endangered
Light-footed Clapper Rail	*Rallus longirostris levipes*	Endangered
Western Snowy Plover	*Charadrius alexandrinus nivosus*	Threatened
Short-tailed Albatross	*Phoebastria albatrus*	Endangered
Marbled Murrelet	*Brachyramphus marmaoratus*	Threatened
Xantus Murrelet	*Synthliboramphus hypoleucus*	Candidate
Sea Turtles		
East Pacific Green Turtle	*Celonia mydas*	Endangered
Loggerhead Turtle	*Caretta caretta*	Endangered
Leatherback Turtle	*Dermochelys coriacea*	Endangered
Olive Ridley Turtle	*Lepidochelys olivacea*	Endangered
Hawkbill Turtle	*Eretmochelys imbricata*	Endangered

Table 1. Endangered Species.		
Fish		
Chinook Salmon	*Oncorhynchus tshawytscha*	Endangered
Steelhead	*Oncorhynchus mykiss*	Endangered
Mollusk		
White Abalone	*Haliotis sorenseni*	Endangered
Black Abalone	*Haliotis cracherodii*	Candidate

Whales

Of the eight species of great whales that pass through San Diego coastal waters six are endangered: the blue whale, the fin whale, the humpback whale, the right whale, the sei whale, and the sperm whale (Table 1). The other two great whales, the gray whale and the minke whale, were previously endangered but have now recovered.

The gray whale, *Eschrichtius robustus*, is the most common whale observed along the San Diego coast and the most easily seen from shore (Barlow 2003). Gray whales are found only in the north Pacific Ocean – an Atlantic form is extinct (Bonnell and Dailey 1993). Each year, the gray whale undertakes the longest migration of any mammal, travelling 12,000 miles from its summer feeding grounds in the Bering and Chukchi Seas to breeding and calving lagoons of Baja California and back again to the Arctic Ocean. The journey south, lead by pregnant females, begins in late autumn with most whales passing Point Loma during January and February. The northern migration occurs during springtime with whales (especially mother-calf pairs) passing closer to shore than on the way south. Gray whales feed on benthic fauna (primarily amphipods) by scooping up the seabed and filtering the sediment and water through their coarse bristles of baleen (plates of chitinous fiber). Most feeding occurs during the summer in Alaskan waters, but opportunistic feeding has been observed along the migration route and in the Baja lagoons.

Hunted practically to extinction, the gray whale has staged a remarkable comeback since it was listed as endangered throughout its range under the Endangered Species Act in 1973. The species appears to have fully recovered and is thought to be close to or at its initial unexploited stock size. The gray whale population is increasing at a rate of 2-3% per year and the species was delisted on June 16, 1994 (NMFS 1994). Its current population size is estimated at between 19,000 and 23,000 (ACS 2007).

Minke whales, *Balaenoptera acutorostrata*, the smallest of the baleen whales, can occur year-round off California (Carretta et al. 2007). They feed on schooling fish and krill (small pelagic crustaceans). There appear to be resident populations of these sleek, baleen whales in central and southern California that do not migrate. They frequent shallower water more often than any other whales except gray whales. Although rare in California (estimated minimum population size of 585 (Carretta et al. 2007)), they are relatively abundant elsewhere and are not listed as "endangered" under the Endangered Species Act and are not considered "depleted" under the Marine Mammal Protection Act.

The other whales that periodically traverse the area off Point Loma are deeper water species. The most spectacular of these is the blue whale, *Balaenoptera musculus*. Blue whales, the largest animal that has ever lived, can reach over 100 feet in length and weigh as much as 160 tons (NMFS 2007c). They feed on small, pelagic crustaceans and can consume up to eight tons a day. Blue whales migrate from Mexico into California waters where they are present from June to November (Barlow 2003). The estimated minimum population size of blue whales in California is approximately 1,384 (Carretta et al. 2007).

Fin whales, *Balaenoptera physalus*, like blue whales, occur mainly in offshore waters. Recent observations show aggregations of this, second largest of the baleen whales, year-round off southern California (Barlow 2003). They eat krill, a variety of small schooling fishes, squid and copepods. Historical whaling drastically reduced fin whale and other whale stocks. Populations began to recover with implementation of the International Whaling Commission, Endangered Species Act, and the Marine Mammal Protection Act. Fin whales and blue whales are still at less than a third of their historic north Pacific carrying capacity (Carretta et al. 2007) and are considered "depleted" stocks under the Marine Mammal Protection Act.

Humpback whales, *Meaptera novaeangliae*, are distinguished by their long pectoral fins (flippers) and complex, repetitive vocalizations. They feed on schools of fish and krill (small pelagic crustaceans) and reach a length of 60 feet. The migratory population of humbacks present in California offshore waters during summer and fall ranges from Costa Rica to southern British Columbia (Barlow 2003). Humpback whales are formally listed as endangered under the ESA, and consequently the California/Mexico stock is automatically considered as a "depleted" and "strategic" stock under the MMPA (Carretta et al. 2007).

Prior to being hunted by man, the right whale, *Eubalena japonica*, occurred from the Bering Sea to central Baja California (NMFS 2007d). It was targeted early for exploitation because it is slow moving, easy to approach, provides large quantities of meat, oil, and bone, and floats after being killed – thus the common name – the <u>right</u> whale to kill. They consume zooplankton, krill and copepods. The NMFS has recently (December 2006) proposed listing the north Pacific population of right whales as a separate endangered species from the north Atlantic population (NMFS 2006a). The current population size of right whales in the north Pacific is likely fewer than 1,000 animals (NMFS 2005a). It is rarely sighted in southern California waters.

The sei whale, *Balaenoptera borealis*, is the fastest great whale and can reach speeds well over 20 miles per hour. Their diet consists of copepods, krill, amphipods, and, small schooling fish and squid. In the north Pacific, they are distributed far out to sea and are rarely encountered in continental waters (Barlow 2003). Although confirmed sightings have been made off California, sei whales would be very uncommon visitors to the Point Loma region. The estimated minimum population size for the eastern north Pacific stock of sei whales is 35 (Carretta et al. 2007).

The only great whale with teeth instead of baleen, the sperm whale, *Physeter macrocephalus*, is by far the most abundant worldwide. Its current population is estimated at roughly one million – four times the combined total population of the other five endangered large whale species (NMFS 2007e). Sperm whales attain lengths of 60 feet and are distinguished by an extremely large head. Feeding primarily on squid, sperm whales can make dives of over ten thousand feet deep lasting an hour and a half. Broadly distributed in the north Pacific, sperm whales are found year-round off California, with peak abundance in summer (Barlow 2003). They are still formally listed as endangered even though the eastern north Pacific population is estimated to be at 88% of the historic carrying capacity (Carretta et al. 2007).

Seals and Sea Lions

The other endangered marine mammals, the Guadalupe fur seal, *Arctocephalus townsendi*, the Steller sea lion, *Eumetopias jubatus*, are occasional but uncommon visitors to San Diego offshore waters. The Guadalupe fur seal breeds only on Guadalupe Island about 100 miles off the Baja California coast. Severely reduced by hunting in the 1800s, the species was considered extinct by the turn of the century. A small, remnant breeding colony was discovered by Carl Hubbs of the Scripps Institution of Oceanography on Guadalupe Island in 1954 and the population has grown since then (Bonnell and Daily 1993). Guadalupe fur seals feed on squid and lantern fish. The Guadalupe fur seal is now increasing exponentially at an average annual growth rate of 13.7% (Gallo 1994). It has been recently observed off the shore and on beaches of the Santa Barbara Channel Islands and San Clemente Island (Barlow 2003).

The Steller sea lion ranges from Baja California to Alaska, but is seldom seen in southern California except near the Channel Islands. Stellar sea lions are opportunistic marine predators, feeding on a variety of fish including mackerel, sculpin, rockfish, salmon, squid and octopus. Among pinnipeds, they are only surpassed in size by the walrus and elephant seal. The population has declined during the last two decades for unknown reasons. It was listed as a threatened species in 1990 (NMFS 1990). The status of the population west of 144° W longitude was upgraded to endangered in 1997 (NMFS 2007f) and a recovery plan was issued in 2006 (NMFS 2006b).

Birds

Of the seven species of endangered birds in Table 1, only the California brown pelican and the California least tern would be regularly encountered in marine waters off Point Loma. The California brown pelican, *Pelicanus occidentalis californicus*, is a large, long-lived bird weighing up to 10 pounds and reaching 30 years of age (USFWS 2007c). It has a prominent, unfeathered throat pouch and a wingspan of as much as 7 feet. The breeding range of the California brown pelican is from the southern California Channel Islands to Isla Ixtapa off the mainland coast of Mexico. Brown pelicans are social and gregarious, congregating in large flocks much of the year. They feed mainly on fish, captured by plunging into the water from heights of 30 to 60 ft. Brown pelicans rarely venture more than 20 miles from shore except when foraging around offshore island nesting sites.

California brown pelicans were placed on the endangered species list in 1970 after severe reproductive failure resulting from pesticide contamination (CDFG 2005). Elevated levels of DDT and other organochlorine compounds, accumulated from their prey, caused pelicans to lay eggs with shells so thin they broke during incubation (USFWS 1983, Gress 1994)). Nesting success increased after the subsequent banning of DDT and reduction of coastal discharge through source control. Populations of California brown pelicans are now primarily controlled by the availability of food and have recovered to the extent that USFWS is considering delisting the species (Arnold et al. 2007, USFWS 2006).

A 1993 survey of waterbirds in San Diego Bay (U.S. Navy 1995) found the greatest concentration of brown pelicans at Zuniga Point near the floating bait barges, docks, buoy, and piers where they are relatively undisturbed by humans. The rocky cliffs along the outer coast of Point Loma are an important roosting site for brown pelicans and they are frequently seen foraging over nearby coastal waters.

The California least tern, *Sterna antillarum browni*, the smallest north American tern, has a white body with a black cap, long narrow wings, and a broad, forked tail. It hovers above the water then plunges down to capture its prey - small fish (USFWS 2007d). Least terns migrate to California from central and south America in April, breed once or twice during the summer, then head south in September. The typical least tern nesting locations are sandy beaches, however, recreational activity and residential development have greatly diminished their local suitability. Many of the currently occupied nesting sites are man-made. In northern San Diego County, Batiquitos Lagoon has five specifically-designed least tern nesting areas that are fenced to keep out predators. Non-beach areas are also utilized in San Diego Bay at Lindberg Field, North Island Naval Air Station, and the Naval Training Center. Most foraging takes place within a few miles of nesting colonies, although some least terns venture much farther seeking food. Least terns are occasionally observed feeding in nearshore waters along the coast of Point Loma and in the kelp bed.

Once common along the southern California coast, the least tern population diminished to a low of about 600 pairs in the early 1970s as a result of loss of wetland habitat and increasing human disturbance. The implementation of mitigation measures following their classification as an endangered species helped the species slowly recover. The population has increased from 600 in 1973 to about 7,100 pairs in 2005. Recently, a 5-year review has recommended downlisting the species from endangered to threatened (USFWS 2007e).

The light-footed clapper rail, *Rallus longirostris levipes*, is a hen-sized bird with long legs and toes. It has a tawny breast, gray-brown back, and gray and white striped flanks (CDFG 2007c). They are year round inhabitants of coastal estuaries, and historically ranged from Santa Barbara County to San Quintin, Baja California, Mexico. Loss and degradation of southern California wetlands resulted in the species being listed as endangered. The light-footed clapper rail population fell to its lowest level in 1989 when only 163 pairs were recorded in eight southern California marshes. The population then slowly increased to 325 and 307 pairs censused in 1996 and 1997, respectively in 15 of 16 California coastal wetlands (Zembel et al. 1997). The statewide population is now considered stable with 286 pairs and 350 pairs censused in 2003 and 2004 (CDFG 2005). In the vicinity of Point Loma, light-footed clapper rails currently inhabit the Tijuana River Valley, the Sweetwater Marsh National Wildlife Refuge, and the San Diego River Flood Control Channel. They feed primarily on invertebrates such as snails, crab, insects and worms.

The western snowy plover, *Charadrius alexandrinus nivosus*, is a small, pale-colored shorebird with dark patches on its upper breast. It feeds by probing the sand at the beach-surf interface for small crustaceans and marine worms. It breeds on coastal beaches from southern Washington to southern Baja California, Mexico (USFWS 2007f). The western snowy plover is threatened by habitat loss, human disturbance, and nest/egg destruction by native and introduced predators and domesticated pets. Western snowy plovers nest in San Diego Bay along the Silver Strand and at the south San Diego Bay Saltworks. They are occasional visitors to the Point Loma shoreline.

The last three bird species in Table 1 – the short-tailed albatross, the marbled murrelet and Xantus murrelet are strictly sea birds, usually found well offshore in southern California waters (DON 2005). These endangered birds would rarely be seen in the Point Loma area.

Sea Turtles

Five species of sea turtles occasionally visit San Diego ocean waters: green, loggerhead, leatherback, olive Ridley, and hawksbill – all are protected under the Endangered Species Act (Table 1). Sea turtles are saltwater reptiles with streamlined bodies built for trans-oceanic navigation (Bjorndal 1995). Although they live most of their life in the ocean, females return to land to lay their eggs on nesting beaches. Recovery plans for the U.S. Pacific populations of sea turtles provide a wealth of information on their distribution, diet, growth, reproduction, behavior, and health (NMFS and USFWS 1998a,b,c,d,e). These plans also discuss threats to the continued existence of sea turtles and define procedures and goals for their recovery.

All five species of sea turtles forage along the California coast in the summer and early fall when sea temperatures are warmest (Eckert 1993). There are no known sea turtle nesting sites in the San Diego area or anywhere on the west coast of the United States (USN 2005).

Most commonly seen in San Diego marine waters, the east Pacific green sea turtle, *Chelonia mydas*, nests on beaches of the Pacific coast of Mexico and ranges throughout the north Pacific Ocean (NMFS 2007g). Adults have three-foot-wide shells with a radiating pattern of brown, black, and cream colored markings and weigh about 100 pounds. The biting edge of the lower jaw is serrated. They eat algae and sea grasses. Green sea turtles are often found from July through September off the coast of California.

Green sea turtles aggregate at the southern end of San Diego Bay, attracted to the warm water effluent from the San Diego Gas and Electric (SDG&E) power plant (Dutton and McDonald 1990, McDonald et al. 1995). The southern portion of San Diego Bay supports a year-round population of approximately 60 turtles, which can often be seen foraging in eelgrass beds throughout South Bay (Port of San Diego 2007). Local researchers have used genetics and satellite telemetry to determine that the turtles are part of the Eastern Pacific nesting populations, and migrate thousands of miles to lay their eggs on beaches off the coast of Mexico. Within San Diego Bay, the turtles can most often be seen surfacing within the South San Diego Bay National Wildlife Refuge, which provides a protected foraging and rest area, as well as a prime study site for turtle biologists. The turtles' greatest threat in San Diego Bay is being hit by boats traveling over the 5-mile/hour speed limit posted throughout the southern portion of the bay (Port of San Diego 2007).

The loggerhead turtle, *Caretta caretta*, is a reddish-brown sea turtle with a large head. Adult loggerheads average about 200-300 pounds with shells about three-feet wide (NMFS 2007h). They take over two decades to mature and in the northern Pacific are only known to nest in southern Japan. Their diet consists of crabs, shrimp, mollusks and jellyfish. Most recorded sightings in California are juveniles (personal communication, Scott Eckert, Hubbs/Sea World Research Institute).

The leatherback turtle, *Dermochelys coriacea*, is the largest sea turtle in the world reaching over six-feet in diameter and weighing as much as 1,400 pounds (NMFS 2007i). Unlike other species which have solid shells covered with scales, the leatherbacks' shell is a bony matrix covered with a firm, rubbery skin with seven longitudinal ridges or keels. These large sea turtles feed mostly on jellyfish, nest in the tropics and subtropics, and range far into the north Pacific.

The olive Ridley turtle, *Lepodochelys olivacea*, is the smallest sea turtle in Pacific waters. Their shell is heart-shaped to round and may be colored grey-brown, black, or, olive. Olive Ridleys' eat a wide variety of food including crab, shrimp, lobster, jellyfish, and tunicates (NMFS 2007j). In San Diego waters, loggerheads, leatherbacks, and olive Ridleys are most often seen well offshore, unlike green sea turtles which tend to hug the shoreline (personal communication, Peter Dutton, National Marine Fisheries Service).

Like other Pacific sea turtles, the hawksbill turtle, *Eretmochelys imbricata*, makes vast oceanic excursions and could wind up off the U.S. west coast. Hawksbills have been classified as omnivores, however, recent research reveals they are primarily specialist sponge carnivores, preferring only a few species of sponge (Meylan 1988, Vicente 1994). However, there have been few hawksbill sightings north of Baja California Sur and its appearance in San Diego waters would be extremely unlikely (USN 2005, NMFS 2007k).

Fish

In 1997, National Marine Fisheries Service (NMFS) listed the southern California Evolutionary Significant Unit of West Coast steelhead (*Oncorhynchus mykiss*) as endangered (Federal Register: 18 August 1997 [Volume 62, Number 159, Pages 43937-43954]) (NMFS 1997). In March of 1999, the NMFS added nine species of salmon and steelhead to the Endangered Species list and designated critical habitat for them in 2005 (NMFS 2005b). Though most of these are Pacific northwest species, the chinook salmon and steelhead range south to California. Chinook salmon are mostly encountered north of Point Conception.

Steelhead, known as rainbow trout when they inhabit fresh water, typically migrate to marine waters after spending 2 years in streams and rivers. Steelhead are distributed from the Kamchatka Peninsula in the north Pacific to San Mateo Creek in northern San Diego County (USN 2005). Both species are occasionally caught in ocean waters off San Diego but do not enter streams in the San Diego Metropolitan area.

Invertebrates

The white abalone, *Haliotis sorenseni*, historically found from Punta Abreojos, Baja California, Mexico, to Point Conception, California lives on rocky reefs in depths of 80 to 200 feet (NMFS 2007l). They reproduce by broadcast spawning and reach sexual maturity at age 4 to 6 years at a size of 3 to 5 inches. Newly settled individuals feed on benthic diatoms, bacterial films, and single-celled algae found on coralline algal substrates. As they grow larger, white abalone feed on drift and attached algae. Adult white abalone can reach a shell length of up to 9 inches.

Inhabiting deeper water initially provided white abalone a refuge from divers, but a commercial fishery began in the early 1970s and together with increasing recreational take, over-harvesting lead to the collapse of the fishery in the 1980s. The white abalone was federally listed as an endangered species on 29 May 2001 (NMFS 2001).

The black abalone, *Haliotis cracherodii*, inhabits the intertidal and shallow subtidal zones where it has been easily targeted for exploitation. It has also experienced population declines throughout its range due to overfishing and is now thought to be extinct south of Point Conception (NMFS 2007m). In 2005, the black abalone was proposed by NMFS as a candidate for listing as an endangered species (NMFS 2005c). There is concern that the low remaining densities of both black and white abalone may be insufficient for continued reproductive success.

Environmental Consequences

Six of the eight endangered marine mammals in Table 1 are whales. In southern California, their principal threat is from gill nets and ship traffic (NMFS 2007n).

Entanglement in gill nets is a continuing problem, even after their prohibition within three miles from shore. Evidently, only the largest whales escape damage (Carretta et al. 2005). The estimated gill net mortality of blue and fin whales is virtually zero - fishermen report that they swim through nets without entangling and with little damage to the nets. For the other endangered whales, death or injury from entanglement is also relatively low, though not insignificant (Carretta et al 2007).

Ship strikes are another, continuing source of whale mortality and injury (NOAA 2007). Although the endangered Guadalupe fur seal and Steller sea lion are able to avoid being hit by ships, they too are subject to entanglement in fishing gear (Carretta et al. 2005).

Operation of the Point Loma ocean outfall could affect endangered species by altering physical, chemical or biological conditions including: habitat suitability, water quality, biological integrity (e.g., species abundance and diversity), food web dynamics (e.g., availability of prey), and the health of organisms (e.g., bioaccumulation of toxic substances, disease, and parasitism). Analysis of the receiving waters monitoring data off San Diego indicates that the PLOO has had a limited effect on the local marine environment. There has been no indication of change in any physical or chemical water quality parameter (e.g., dissolved oxygen, pH) that can be attributed to wastewater discharge off Point Loma (COSD 1996 - 2007). Instead, changes in these parameters have historically been associated primarily with natural events such as storm activity and the presence of plankton blooms.

Benthic conditions off Point Loma show some changes that may be expected near large ocean outfalls, although these were restricted to a relatively small, localized region near the discharge site (COSD 2007). For example, sediment quality data have indicated slight increases over time in sulfide and BOD concentrations at sites nearest the Zone of Initial Dilution (ZID), an area where relatively coarse sediment particles have also tended to accumulate. However, other measures of environmental impact such as concentrations of sediment contaminants (e.g., trace metals, pesticides) showed no patterns related to wastewater discharge. Some descriptors of benthic community structure (e.g., abundance, species diversity) or indicators of environmental disturbance (e.g., brittle star populations) have shown temporal differences between reference areas and sites nearest the ZID. However, results from environmental disturbance indices such as the Benthic Response Index that are used to evaluate the condition of benthic assemblages indicate that macrobenthic invertebrate communities in the Point Loma region remain characteristic of natural conditions. Analyses of bottom dwelling demersal fish and trawl-caught megabenthic invertebrate communities also reveal no spatial or temporal patterns that can be attributed to effects of wastewater discharge. Instead, a review of historical data (1991–2006) indicates that patterns of change in fish assemblages appear related to large-scale oceanographic events (e.g., El Niño conditions in 1998) or specific site locations (e.g., near dredge material disposal sites) (see Benthic Sediments and Organisms – Appendix E). The paucity of pathological evidence from local fish and the results of bioaccumulation studies also suggest that local fish assemblages remain healthy and are not adversely affected by wastewater discharge or other anthropogenic inputs. Consequently, there is currently no evidence of significant long-term negative impacts on water quality, sediment quality, or biotic communities in the coastal waters off Point Loma.

Operation of the Point Loma outfall could also potentially impact marine mammals through bioaccumulation of discharged constitutents. However, a review by O'Shea and Brownell (1994) suggests that bioaccumulation is not a significant issue for baleen whales. Concentrations of organochlorine and metal contaminants measured in over a thousand individuals of 10 species of baleen whales are low, relative to other marine mammal species. This is attributed to the fact that baleen whales typically inhabit deep water (away from nearshore sources of contamination) and feed at a low level in the food web. The blue whale, fin whale, humpback whale, sei whale, and right whale are baleen whales. The other endangered whale that may cross the Point Loma marine area, the sperm whale, also feeds at a relatively low level in the food chain (on squid).

The Guadualupe fur seal and the Steller sea lion are, however, top-level predators feeding primarily on fish. In the 1970s, high levels of DDT in California sea lions were thought to have been responsible for reproductive impairment and population decline (Delong et al. 1973), but other factors were probably involved (O'Shea and Brownell 1998). Concentrations of DDT in California sea lion blubber have greatly diminished since then and populations are now increasing exponentially (O'Hara and O'Shea 2005, Woshner 2006, Carretta et al. 2007). Present concern about the effects of tissue contaminants on marine mammals centers on sublethal effects of toxic contaminants, especially suppression of immune response and increased susceptibility to infection and disease (O'Shea et al. 1999, Le Boeuf et al. 2002, O'Shea and Tanabe 2003). The relatively low contaminant loads in Point Loma outfall-area fish (see Bioaccumulation Assessment – Appendix F) should not pose a significant threat of bioaccumulation to transient Guadalupe fur seals or Steller sea lions.

All the birds in Table 1 except the California brown pelican became endangered because of wetland habitat loss and disturbance (Duffy and Nettleship 1992). These bay and estuarine species - California least tern, light-footed clapper rail, and western snowy plover - occasionally forage over San Diego coastal water. The primary threat to their well-being would be bioaccumulation of toxic compounds from prey captured in the area (Arnold et al. 2007). This is also the case for the California brown pelican whose endangered status was brought about by DDT-induced reproductive failure (Gress 1994).

Regional evaluations have shown that virtually all bottom-dwelling fish populations in southern California have detectable levels of DDT and PCBs as a result of past discharge practices, now discontinued (SCCWRP 2003, 2006). The highest concentrations are on or near the Palos Verdes shelf off Whites Point in Los Angeles, an area with highly contaminated sediments, the result of historical discharge. Fish tissue burdens of DDT and PCBs decline to the north and south across the southern California bight. Concentrations of chlorinated hydrocarbons in fish from reference areas are now less than 5% of levels measured two decades ago (Allen et al. 2007). Contaminant burdens in fish tissues at Point Loma are comparable to those at reference sites beyond the influence of the discharge (Allen 2006, Allen et al. 2007). Endangered birds feeding in the area should not be exposed to a higher risk of bioaccumulation.

Of the five species of endangered sea turtles that may pass through the San Diego marine environment (Table 1), the green sea turtle would be most common and the one found closest to shore. Green turtles are subject to entrainment in coastal power plants, perhaps attracted to the lush growth of algae on the cooling water intake structures (most are released unharmed) (NMFS 2007g) . Green turtles have also been struck by boats in southern California. Although capable of deep dives, most sea turtles passing San Diego would be in surface waters. They should be unaffected by the discharge which is normally trapped below the thermocline, especially during the summer when turtles would be most prevalent.

The other two endangered species possibly occurring at Point Loma, the two salmon species and the two abalone species, should not be threatened by the discharge. The salmon would be transitory, and the abalone, if present, would be well inshore of the outfall, beyond potential adverse influence.

Long-term monitoring shows no evidence of significant impacts from operation of the PLOO on environmental conditions or biological communities that could affect the health and well-being of endangered species. Thus, maintaining the existing discharge through the Point Loma outfall should not have an adverse impact on endangered species or threaten their critical habitats.

Summary

Twenty-four species covered under the federal Endangered Species Act or the California Endangered Species Act may occur in the vicinity of the Point Loma ocean outfall: eight marine mammals, seven birds, five sea turtles, two fish, and two invertebrates. This endangered species assessment describes their population biology, status, distribution, and the potential impact of the Point Loma ocean outfall on them.

Six of the eight species of great whales that pass through Point Loma coastal waters are endangered: the blue whale, the fin whale, the humpback whale, the right whale, the sei whale, and the sperm whale. These endangered whales primarily occur in deep water well offshore. The other two great whales, the gray whale and the minke whale, frequent shallower water. They were previously listed as endangered but have now recovered and have been delisted. Two other endangered marine mammals, the Guadalupe fur seal and the Steller sea lion, are occasional but uncommon visitors to San Diego offshore waters.

Of the seven species of endangered birds, only the California brown pelican and the California least tern would be regularly encountered in marine waters off Point Loma. Five species of endangered sea turtles occasionally visit Point Loma ocean waters: green, loggerhead, leatherback, olive Ridley, and hawksbill. They forage along the California coast in the summer and early fall but do not nest on west coast beaches of the United States. The two endangered salmon species are uncommon in southern California. The remaining populations of white and black abalone are well beyond the influence of the Point Loma outfall.

Operation of the Point outfall could potentially impact endangered species through changes in environmental conditions that affect the species themselves and/or their prey. Monitoring data show effects of the Point Loma discharge only in deep water within or near the Zone of Initial Dilution (ZID) where minor water and sediment quality changes have been observed. Benthic communities in the Point Loma region remain characteristic of natural conditions with no suggestion of environmentally-significant changes associated with the discharge. A balanced indigenous population of shellfish, fish and wildlife exists immediately beyond the ZID.

While significant variations in fish populations are observed (in response to large-scale oceanographic events like El Niño), the Point Loma wastewater discharge is not having any descernible effect on demersal fish assemblages. Fish populations are healthy and lack physical abnormalities such as fin erosion or tumors. No outfall-related effects are evident from bioaccumulation data. Levels of trace metals, chlorinated hydrocarbons, pesticides, and polyaromatic hydrocarbons are relatively low, with concentrations in the range found in fish throughout the Southern California Bight.

Long-term monitoring shows no evidence of significant impacts from operation of the PLOO on environmental conditions or biological communities that could affect the health and well-being of endangered species. Thus, maintaining the existing discharge through the Point Loma outfall should not have an adverse impact on endangered species or threaten their critical habitats. Consultation with the U.S. National Marine Fisheries Service and the U.S. Fish and Wildlife Service supports these findings (see Correspondence & Attachments - Appendix T).

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Appendix I

Proposed Monitoring Program

APPENDIX I

PROPOSED MONITORING PROGRAM

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APPENDIX I

PROPOSED MONITORING PROGRAM

ABSTRACT

Monitoring and Reporting Program No. R9-2002-0025 and Addendum No. 1 thereto establish influent, effluent, receiving water, sediment chemistry, benthic, and fish tissue monitoring requirements for the Point Loma Ocean Outfall (PLOO) discharge. No changes are proposed in this existing core comprehensive monitoring program. The City proposes to continue participation in regional surveys of the Southern California Bight. Additionally, the City will continue to pursue special monitoring projects that address receiving water quality or discharge-related issues.

I.1 INTRODUCTION

Monitoring and Reporting Program No. R9-2002-0025 (NPDES CA0107409) was modified in June 2003 when the California Regional Water Quality Control Board, San Diego Region (Regional Board) adopted Addendum No.1 to Order No. R9-2002-0025. Addendum No. 1 modified the PLOO monitoring program to incorporate the recommendations of the Southern California Coastal Water Research Project (SCCWRP) *Model Monitoring Program for Large Ocean Dischargers in Southern California.*

The PLOO monitoring program is now in full alignment with the SCCWRP Model Monitoring Program. The City is committed to maintaining a comprehensive monitoring and reporting program, and does not propose any significant changes to the existing monitoring program.

I.2 BASIS OF THE EXISTING MONITORING AND REPORTING PROGRAM

The City of San Diego was a full participant with SCCWRP during the development of the *Model Monitoring Program for Large Ocean Dischargers in Southern California.* The SCCWRP Model Monitoring Program was developed with the support of:

- the local environmental community (e.g. Bay Council),
- the United States Environmental Protection Agency (EPA), and
- the Regional Board.

In addition to modifying the PLOO monitoring program, the Regional Board has implemented the Model Monitoring Program in NPDES permits issued to large wastewater dischargers within the San Diego Region.

The Model Monitoring Program involves three elements:

1) a core monitoring program that focuses on assessing effluent and receiving water compliance with applicable state and federal regulations,
2) participation in regional surveys involving multiple agencies and/or academic organizations that develop information about the Southern California Bight as well as its bays and estuaries, and
3) special projects designed to address and answer specific questions about some aspect of the ocean environment.

A key aspect of this new approach to monitoring is the adaptive nature of the program. The core program element retains much of the historically-imposed ocean outfall monitoring requirements and provides for specific sampling locations where specific constituents are measured. This core program is directed toward assessing compliance with federal standards established by EPA and state-wide standards established within the California Ocean Plan.

Whereas the core program remains somewhat static, the regional surveys and special projects are dynamic in their ability to adapt and change to address relevant questions and concerns. In this way, the monitoring is flexible to insure the best uses of resources and to adapt when new information becomes available. A special project may result in a one-time final report with additional actions necessary or it may generate the need to add an element to the core program to insure the issue is fully addressed. At the same time a special project may result in the reduction in a part of the core program if regulatory agencies conclude that the special monitoring information is more valuable (or replaces the need for) core monitoring elements. Any such changes to the core monitoring program, however, would only occur only upon approval by EPA or the Regional Board.

I.3 STATUS OF THE EXISTING MONITORING AND REPORTING PROGRAM

Core Monitoring Program. The core PLOO monitoring program remains as established in Monitoring and Reporting Program No. R9-2002-0025, as modified by Addendum No. 1 dated June 11, 2003. A copy of this program is attached to this appendix as Attachment I1.

Regional Surveys. The City of San Diego is a full participant in the comprehensive surveys of the Southern California Bight that are coordinated by SCCWRP every five years. The Bight '03 survey has just been completed and the final reports have been prepared. Planning is now underway for the next survey (Bight '08). Bight '08 field work is scheduled to begin in 2008. Survey information, past reports and plans for future surveys are available from the City of San Diego or SCCWRP.

Special Projects. The City of San Diego has been actively pursuing a large number of special projects. Specific projects have been identified as a result of reviews of the monitoring program and in consultation with the Bay Council, scientists at Scripps Institution of Oceanography (SIO), EPA staff, the Regional Board, and SCCWRP. Recent special projects of note include:

- work to assess the condition of deep ocean canyons offshore from Point Loma,
- sediment mapping studies to identify the most efficient locations for benthic monitoring stations including reference sites,
- a collaborative study with other dischargers, SCCWRP and academic institutions to assess the presence and impact of endocrine disrupting compounds in Southern California,
- moored observation studies where current meters and thermister arrays have been place off Point Loma to begin studies designed to provide definitive information about the outfall plume,
- collaborative work with SCCWRP on the development of rapid testing techniques for bacterial analysis,
- funding to SCCWRP for participation in DNA fingerprinting studies and virus analytical techniques, and
- assistance to Scripps Institution of Oceanography with placing a radar antenna at Point Loma to facilitate inclusion of that area in their Coastal Ocean Observing System.

Table I-1 presents a more complete summary listing of projects currently underway as part of the "special projects" provision of the monitoring and reporting program.

Table I-1
Special Projects Summary

Special Project	Status	Notes
Participate in 2008 regional monitoring survey of Southern California Bight (Bight'08)	In progress (kickoff occurred in 9/07)	Multi-year (2007-2013), multi-agency project; planning beginning summer 2007 and corresponding to wrap-up of Bight'03 project
Participate in 2003 regional monitoring survey of Southern California Bight (Bight'03)	Complete	Multi-year (2002-2007), multi-agency project; analysis and interpretation underway
Conduct San Diego regional (random array) benthic surveys from U.S./Mexico border to Del Mar	In progress	Annual surveys conducted by City (SBWRP and IWTP permits): July 07 survey in progress
Participate in San Diego Coastal Remote Sensing Project (conducted by Ocean Imaging, Inc)	In progress	FY08 = Year 5 of project, presently funded by City & IBWC; seeking County participation
Conduct San Diego Sediment Mapping Study	In progress (P-I report expected 12/07)	Multi-year (2004-2009), 2-phase collaborative project; City, SCCWRP, and Colorado State University; Phase-I data analysis and interpretation underway with P-I report expect ~12/31/07; P-II planning planned for ~Winter-Spring '08 and possible P-II sampling in Summer 2009
Participate in San Diego Regional Aerial Kelp Survey Project	In progress	Ongoing long-term, multi-agency project; Region 9 Kelp Consortium (2007-08 survey underway); project conducted by MBC Applied Environmental Sciences
Make field data available for use in SDCOOS work; assist in locating antennas at the Point Loma WTP to cover that area.	In progress	Data submitted monthly; working on getting approval for an antenna at Pt Loma.
Post annual ocean monitoring reports and associated data to City web site	In progress	Ongoing – completed on annual basis (i.e., posted by July 1)
Investigate expedited posting of data to web (e.g., monthly, quarterly)	Completed	Data posted to web on regular basis
Provide water quality data to County DHS for web posting	In progress	Ongoing
Make remote sensing data available to public	In progress	Ongoing – data available via Ocean Imaging Corp web site
Make aerial kelp survey data available	In progress	Ongoing – available as annual reports via Regional Board
Work with SIO to implement and expand SDCOOS throughout region	Partial/Pending	Helping install antennas at the Point Loma WTP, providing monitoring data. Region wide issue beyond just MWWD.
Moored Observation System Pilot Study (MOSPS): deploy thermistor strings off Point Loma for study of thermocline and current patterns	In progress	Part of MOSPS, which was approved by the Regional Board in Nov 2005; implemented August 2006 [~2-yr collaborative project with SIO]

Special Project	Status	Notes
Moored Observation System Pilot Study (MOSPS): deploy current meters (ADCPs) off Point Loma for study of thermocline and current patterns	In progress	Part of MOSPS (see above); implemented August 2006 [~2-yr collaborative project with SIO]
Point Loma Outfall Circulation Study (PLOCS), Phase I : expansion of MOSPS	In progress	PLOCS, Phase I : a) determine most common circulation patterns and trajectory of wastewater plume; and b) compare above to tides, currents, and winds to determine forcing of major circulation patterns; planning underway July 2007 (collaborative project with SIO, E. Parnell, principal investigator)
Point Loma Outfall Circulation Study (PLOCS), Phase II: plume tracking studies	In progress/pending	PLOCS, Phase II: design and implementation of wastewater plume tracking studies (e.g., AUVs, tow-yos, drifters); initial planning underway July 2007 with detailed planning awaiting outcome of MOSPS and PLOCS Phase I (collaborative project with SIO, E. Parnell, principal investigator)
Design "permanent" or long-term moored observation system	Pending	Dependent upon results of MOSPS
Ocean outfall bacteria survival/dispersion study	Pending (scheduled)	Study focused on South Bay outfall, but relevant to other discharges; originally approved by the Regional Board for Winter 2005, but deferred to later due to unacceptable weather conditions (City and Ocean Imaging)
Resume benthic sampling at stations near original inshore outfall to recapture long-term time series data	In progress	Ongoing: began July 2004 as subset of Sediment Mapping Study and continued 2005-2007 as ongoing annual Original Outfall Benthic Surveys (approved by the Regional Board 11/05); July 07 survey work in progress
Conduct pilot study of deep ocean benthic habitats	In progress (report expected in 12/07)	Deep Benthic Pilot Study (DBPS) implemented Fall 2005 (approved by the Regional Board 11/05); final data analysis and interpretation underway with final report expected 12/31/07
San Diego Sediment Mapping Study	In progress	See status under "Regional Issues"
Long-term regional assessment of benthic conditions off San Diego (1994–2003)	In progress	Assessment of annual regional benthic surveys conducted from the border region to Del Mar; report/paper expected 2008
Long-term assessment of changes and recovery in sediment quality and macrobenthic communities near the original Point Loma Ocean Outfall (~1985-2006)	In progress	Assessment of benthic conditions at original Pt Loma outfall sites (60 m); report/paper expected 2008-09 (collaborative project with SIO, E. Parnell)
Long-term assessment of changes in sediment quality and macrobenthic communities near the extended deepwater Point Loma Ocean Outfall (~1991-2006)	In progress	Long-term assessment of benthic conditions around extended Pt Loma outfall sites (~100 m); report/paper expected 2008-09 (collaborative project with SIO, E. Parnell)
Long-term assessment of changes in sediment quality and macrobenthic communities near the South Bay Ocean Outfall (~1995-2006)	In progress	Long-term assessment of benthic conditions near the South Bay outfall (~27 m); report/paper expected 2008-09 (collaborative project with SIO, E. Parnell)

Special Project	Status	Notes
Evaluate and participate in research on sensitive indicators; implement when practicable	In progress	Underway and ongoing; remain active and engaged in WERF and with SCCWRP
Evaluate and participate in research on endocrine disruptor compounds (EDCs); implement monitoring when practicable	In progress	Underway and ongoing; remain active and engaged in WERF and with SCCWRP
Endocrine disruption in Southern California coastal flatfish	In progress	Collaborative project (5 studies) with other discharge agencies (LACSD, OCSD, City of LA), academic institutions (e.g., UCR, UCSD, CSULB), and SCCWRP; project began May-June 2006 and is currently underway
Assist in development of microbial source tracking techniques	In progress	Underway and ongoing; working with SCCWRP and academic institutions
Assist in development of rapid test methods for bacteriological monitoring; implement when appropriate	In progress	Underway and ongoing; working with SCCWRP and academic institutions
Follow research on virus testing techniques and standards development; implement monitoring when appropriate	In progress	Underway and ongoing
Design and implement microbial source tracking special study	In progress	Pacific Beach Point study - first phase

I.4 SUMMARY OF PROPOSED MONITORING PROGRAM CHANGES

No changes are proposed to the existing requirements established in Monitoring and Reporting Program No. R9-2002-0025 and Addendum No. 1 thereto. As noted, the adaptive nature of the present program accommodates regional surveys and special projects without the need for modification of the core program.

Special projects can be initiated and completed within the scope of the existing program, and no formal monitoring program changes are required to identify and begin a special project. If a project concludes that modification if the core program is required or warranted, regulators (EPA and the Regional Board) can consider such modifications on a case-by-case basis.

One special project the City will consider in the immediate near term is an assessment of Point Loma Wastewater Treatment Plant (Point Loma WTP) effluent disinfection. As documented in Appendices A, C, and D, the City has installed prototype effluent disinfection facilities at the Point Loma WTP and has requested Regional Board approval (see Appendix U) to initiate effluent disinfections operations.

In conjunction with the effluent disinfection program, the City may develop and implement a study to assess the efficiency and cost-effectiveness of disinfection facilities and operations. Special ocean bacteriological monitoring would be performed as part of the project to confirm the degree of pathogen indicator organisms in receiving waters. Such special monitoring, along with data developed as part of the moored observation special project, may provide information about the adequacy of present water quality monitoring station locations and monitoring frequencies. Until and unless such studies are completed, however, no changes in the existing water quality monitoring grid or frequencies are proposed.

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Attachment I1

Monitoring and Reporting Program R9-2002-0025

April 10, 2002

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
AND
U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION IX

MONITORING AND REPORTING PROGRAM NO. R9-2002-0025
NPDES PERMIT NO. CA0107409

FOR THE CITY OF SAN DIEGO
E. W. BLOM POINT LOMA METROPOLITAN WASTEWATER TREATMENT PLANT

DISCHARGE TO THE PACIFIC OCEAN
THROUGH THE POINT LOMA OCEAN OUTFALL
SAN DIEGO COUNTY

Monitoring and Reporting Program (MRP) No. R9-2002-0025 supersedes and entirely replaces the monitoring and reporting requirements previously established by MRP No. 95-106. MRP No. R9-2002-0025 shall take effect upon the date of adoption by the California Regional Water Quality Control Board, San Diego Region (hereinafter Regional Board).

A. GENERAL MONITORING AND REPORTING PROVISIONS

1. Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored waste stream. All samples shall be taken at the monitoring points specified in this MRP and, unless otherwise specified, before the waste stream joins or is diluted by any other waste stream, body of water, or substance. Monitoring points shall be subject to the approval of the Regional Board Executive Officer (hereinafter Executive Officer) and the U. S. Environmental Protection Agency, Region IX (hereinafter EPA), Water Division Director (hereinafter Director) and shall not be changed without notification to and the approval of the Executive Officer and the Director. Samples shall be collected at times representative of "worst case" conditions with respect to compliance with the requirements of Order No. R9-2002-0025.

2. Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to ensure that the accuracy of the measurements are consistent

with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ±5 percent from true discharge rates throughout the range of expected discharge volumes.

3. Monitoring must be conducted according to United States Environmental Protection Agency (USEPA) test procedures approved under Title 40 of the Code of Federal Regulations Part 136 (40CFR 136), Guidelines Establishing Test Procedures for the Analysis of Pollutants, as amended, unless otherwise specified for sludge in 40CFR 503, or unless other test procedures have been specified in Order No. R9-2002-0025 and/or in this monitoring and reporting program.

4. All analyses shall be performed in a laboratory certified to perform such analyses by the California Department of Health Services in accordance with the provision of Section 13176 CWC or a laboratory approved by the Executive Officer.

5. Monitoring results must be reported on discharge monitoring report (DMR) forms approved by the Executive Officer.

6. If the discharger monitors any pollutant more frequently than required by this MRP, using test procedures approved under 40 CFR 136, or as specified in this MRP, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. The increased frequency of monitoring shall also be reported.

7. The discharger shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this MRP, Order No. R9-2002-0025 and any enforcement order issued by the Regional Board, and records of all data used to complete the application for Order No. R9-2002-0025. Records shall be maintained for a minimum of five years from the date of the sample, measurement, report, or application. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the Executive Officer or Director. It is recommended that the discharger maintain the results of all analyses indefinitely.

8. Records of monitoring information shall include:

   a. The date, exact location, and time of sampling or measurements;

   b. The individual(s) who performed the sampling or measurements;

   c. The date(s) analyses were performed;

   d. The laboratory and individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of all such analyses.

9. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in Order No. R9-2002-0025 or in this MRP. The discharger shall report the analysis results, calculation results, data, and equations used in calculations.

10. All monitoring instruments and devices used by the discharger to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy. All flow measurement devices shall be calibrated at least once per year, or more frequently, to ensure continued accuracy of the devices. Annually, the discharger shall submit to the Executive Officer a written statement signed by a registered professional engineer certifying that all flow measurement devices have been calibrated and will reliably achieve the accuracy required by General Monitoring and Reporting Provision A.2.

11. The discharger shall have, and implement, an acceptable written quality assurance (QA) plan for laboratory analyses. An annual report shall be submitted by March 30 of each year which summarizes the QA activities for the previous year. Duplicate chemical analyses must be conducted on a minimum of ten percent of the samples or at least one sample per month, whichever is greater. The discharger must have a success rate equal to or greater than 80 percent. A similar frequency shall be maintained for analyzing spiked samples. When requested by EPA, the discharger will participate in the National Pollutant Discharge Elimination System (NPDES) discharger monitoring report quality assurance (QA) performance study.

12. The discharger shall report all instances of noncompliance not reported under 40 CFR 122.44 at the time monitoring reports are submitted. The reports shall contain the information listed in 40 CFR 122.44.

13. The monitoring reports shall be signed by an authorized person as required by 40 CFR 122.44.

14. A composite sample is generally defined as a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period. For volatile pollutants, aliquots must be combined in the laboratory immediately before analysis. The composite must be flow proportional; either the time interval between each aliquot or the volume of each aliquot must be proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot. Aliquots may be collected manually or automatically.

The 100-milliliter minimum volume of an aliquot does not apply to automatic self-purging samplers.

15. A grab sample is an individual sample of at least 100 milliliters collected at a randomly selected time over a period not exceeding 15 minutes.

16. For all bacterial analyses, sample dilutions shall be performed so the range of values extends from 2 to 16,000. The detection method used for each analysis shall be reported with the results of the analysis.

17. Detection methods used for coliforms (total and fecal) shall be those presented in the most recent edition of Standard Methods for the Examination of Water and Wastewater or any improved method determined by the Regional Board (and approved by EPA) to be appropriate. Detection methods used for enterococcus shall be those presented in Test Methods for Escherichia coli and Enterococci in Water by Membrane Filter Procedure (EPA 600/4-85/076) or any improved method determined by the Executive Officer to be appropriate.

18. MRP No. R9-2002-0025 may be modified by the Regional Board and EPA to enable the discharger to participate in comprehensive regional monitoring activities conducted in the Southern California Bight during the term of this permit. The intent of regional monitoring activities is to maximize the efforts of all monitoring partners using a more cost-effective monitoring design and to best utilize the pooled scientific resources of the region. During these coordinated sampling efforts, the discharger's sampling and analytical effort may be reallocated to provide a regional assessment of the impact of the discharge of municipal wastewater to the Southern California Bight. Anticipated modifications to the monitoring program will be coordinated so as to provide a more comprehensive picture of the ecological and statistical significance of monitoring results and to determine cumulative impacts of various pollution sources. If predictable relationships among the biological, water quality and effluent monitoring variables can be demonstrated, it may be appropriate to decrease the discharger's sampling effort. Conversely, the monitoring program may be intensified if it appears that the objectives cannot be achieved through the discharger's existing monitoring program. These changes will improve the overall effectiveness of monitoring in the Southern California Bight. Minor changes may be made without further public notice.

19. By July 1 of each year, the discharger shall submit an annual report to the Regional Board and EPA which contains tabular and graphical summaries of the monitoring data obtained during the previous year. The discharger shall discuss the compliance record and corrective actions taken, or which may be needed, to bring the discharge into full compliance with the requirements of Order No. R9-2002-0025 and this MRP. The report shall address operator certification and provide a list of current operating personnel and

their grade of certification. The report shall include the date of the facilities' Operations and Maintenance Manual, the date the manual was last reviewed, and a statement as to whether the manual is complete and valid for the current facilities. The report shall restate, for the record, the laboratories used by the discharger to monitor compliance with Order No. R9-2002-0025 and this MRP, and provide a summary of performance relative to the requirements in this MRP.

20. The discharger shall submit an annual report containing the following information:

    a. The number of equivalent unit connections to the sewerage system at the beginning of the year.

    b. The number of new equivalent unit connections added to the sewerage system during the year.

    c. The increase in influent flow volume resulting from the unit connections described in (b) above.

    d. The number of equivalent unit connections which have been authorized but not yet connected.

    e. The anticipated increase in influent flow volume resulting from connecting the units described in (d) above.

21. The sampling frequency of "daily" means that samples shall be collected seven days per week. "Weekly" samples shall be collected such that each day of the week is represented during a seven week period.

22. Monitoring results shall be reported at intervals and in a manner specified in this MRP and Order No. R9-2002-0025. Monitoring reports shall be submitted to the Regional Board and to EPA according to the following schedule:

REPORTS	**Report Period**	**Report Due**
MONTHLY REPORTS Influent and Effluent Solids Removal/Disposal Receiving Water Quality Report Tijuana Cross-Border Emergency Connection (when flowing)	Monthly	By the 1st day of 2nd following month (e.g., March 1 for January)

REPORTS	Report Period	Report Due
QUARTERLY REPORTS Sludge Analysis	 January-March April-June July-September October-December	 June 1 September 1 December 1 March 1
SEMI-ANNUAL REPORTS Pretreatment Report	 January-June	 September 1
ANNUAL REPORTS Pretreatment Report (Provision A.19) Sludge analysis QA Report Flow measurement Outfall inspection Receiving waters monitoring report Kelp report	 January-December	 April 1 April 1 April 1 July 1 July 1 July 1 October 1

23. All influent, effluent, and receiving water data shall be submitted annually to EPA for inclusion in the STORET database. The data shall be submitted in an electronic format specified by EPA.

B. INFLUENT AND EFFLUENT MONITORING

Influent monitoring is required to determine the effectiveness of pretreatment and nonindustrial source control programs, to assess the performance of treatment facilities, and to evaluate compliance with effluent limitations. As such, influent monitoring results must accurately characterize raw wastewater from the entire service area of the treatment facilities, unaffected by in-plant or return or recycle flows or the addition of treatment chemicals.

Effluent monitoring is required to determine compliance with the permit conditions and to identify operational problems and improve plant performance. Effluent monitoring also provides information on wastewater characteristics and flows for use in interpreting water quality and biological data. The effluent sampling station shall be located where representative samples of the effluent can be obtained. The sampling station shall be located downstream from any in-plant return flows and from the last connection through which wastes can be admitted to the outfall.

Influent and effluent monitoring shall be conducted as shown in the following table. In addition monitoring of the waste flow in the standby emergency connection from the City of Tijuana, Mexico, shall be conducted as shown in the following table, whenever there is flow from Mexico and/or the SBIWTP through the connection.

INFLUENT AND EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS

CONSTITUENT	Unit	Sample type	Sampling frequency		
			Influent stream	**Effluent stream**	**Emergency connection**
flowrate	MGD	recorder/totalizer	Continuous	Continuous	Continuous
BOD_5@20^0C	mg/l	24 hr. composite	Daily	Daily	Weekly
volatile suspended solids	mg/l	24 hr. composite	Daily	Daily	Weekly
total dissolved solids	mg/l	24 hr. composite	Daily	Daily	Weekly
temperature	^0C	grab	Daily	Daily	Weekly
floating particulates	mg/l	24 hr. composite	Daily	Daily	Weekly
TABLE A parameters					
grease & oil	mg/l	grab	Daily	Daily	Weekly
total suspended solids	mg/l	24 hr. composite	Daily	Daily	Weekly
settleable solids	ml/l	grab	Daily	Daily	Weekly
turbidity	NTU	grab	Daily	Daily	Weekly
pH	units	grab	Daily	Daily	Weekly
Table B parameters for protection of marine aquatic life					
arsenic	µg/l	24 hr. composite	Weekly	Weekly	Weekly
cadmium	µg/l	24 hr. composite	Weekly	Weekly	Weekly
chromium (VI)[1]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
copper	µg/l	24 hr. composite	Weekly	Weekly	Weekly
lead	µg/l	24 hr. composite	Weekly	Weekly	Weekly
mercury	µg/l	24 hr. composite	Weekly	Weekly	Weekly
nickel	µg/l	24 hr. composite	Weekly	Weekly	Weekly
selenium	µg/l	24 hr. composite	Weekly	Weekly	Weekly
silver	µg/l	24 hr. composite	Weekly	Weekly	Weekly
zinc	µg/l	24 hr. composite	Weekly	Weekly	Weekly
cyanide	µg/l	24 hr. composite	Weekly	Weekly	Weekly

CONSTITUENT	Unit	Sample type	Sampling frequency		
			Influent stream	Effluent stream	Emergency connection
ammonia (as N)	mg/l	24 hr. composite	Weekly	Weekly	Weekly
acute toxicity	TUa	24 hr. composite	-	Semi-annually	-
chronic toxicity	TUc	24 hr. composite	-	Monthly	-
phenolic compounds (nonchlorinated)	μg/l	24 hr. composite	Weekly	Weekly	Weekly
phenolic compounds (chlorinated)	μg/l	24 hr. composite	Weekly	Weekly	Weekly
endosulfan	μg/l	24 hr. composite	Weekly	Weekly	Weekly
endrin	μg/l	24 hr. composite	Weekly	Weekly	Weekly
HCH[2]	μg/l	24 hr. composite	Weekly	Weekly	Weekly
radioactivity	pci/l	24 hr. composite	Monthly	Monthly	Monthly
Table B parameters for protection of human health - non carcinogens					
acrolein	μg/l	grab	Monthly	Monthly	Monthly
antimony	μg/l	24 hr. composite	Monthly	Monthly	Monthly
bis(2-chloroethoxy) methane	μg/l	24 hr. composite	Monthly	Monthly	Monthly
bis(2-chloroisopropyl) ether	μg/l	24 hr. composite	Monthly	Monthly	Monthly
chlorobenzene	μg/l	grab	Monthly	Monthly	Monthly
chromium (III)[1]	μg/l	24 hr. composite	Monthly	Monthly	Monthly
di-n-butyl phthalate	μg/l	24 hr. composite	Monthly	Monthly	Monthly
dichlorobenzenes[3]	μg/l	24 hr composite	Monthly	Monthly	Monthly
diethyl phthalate	μg/l	24 hr. composite	Monthly	Monthly	Monthly
dimethyl phthalate	μg/l	24 hr. composite	Monthly	Monthly	Monthly
4,6-dinitro-2-methylphenol	μg/l	24 hr. composite	Monthly	Monthly	Monthly
2,4-dinitrophenol	μg/l	24 hr. composite	Monthly	Monthly	Monthly
ethylbenzene	μg/l	grab	Monthly	Monthly	Monthly
fluoranthene	μg/l	24 hr. composite	Monthly	Monthly	Monthly

CONSTITUENT	Unit	Sample type	Sampling frequency		
			Influent stream	**Effluent stream**	**Emergency connection**
hexachlorocyclopentadiene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
nitrobenzene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
thallium	µg/l	24 hr. composite	Monthly	Monthly	Monthly
toluene	µg/l	grab	Monthly	Monthly	Monthly
tributyltin	µg/l	24 hr. composite	Monthly	Monthly	Monthly
1,1,1-trichloroethane	µg/l	grab	Monthly	Monthly	Monthly
Table B parameters for protection of human health - carcinogens					
acrylonitrile	µg/l	grab	Monthly	Monthly	Monthly
aldrin	µg/l	24 hr. composite	Weekly	Weekly	Weekly
benzene	µg/l	grab	Monthly	Monthly	Monthly
benzidine	µg/l	24 hr composite	Monthly	Monthly	Monthly
beryllium	µg/l	24 hr. composite	Monthly	Monthly	Monthly
bis(2-chloroethyl) ether	µg/l	24 hr. composite	Monthly	Monthly	Monthly
bis(2-ethylhexyl) phthalate	µg/l	24 hr. composite	Monthly	Monthly	Monthly
carbon tetrachloride	µg/l	grab	Monthly	Monthly	Monthly
chlordane[5]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
chlorodibromomethane	µg/l	24 hr. composite	Monthly	Monthly	Monthly
chloroform	µg/l	grab	Monthly	Monthly	Monthly
DDT[6]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
1,4-dichlorobenzene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
3,3'-dichlorobenzidine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
1,2-dichloroethane	µg/l	grab	Monthly	Monthly	Monthly
1,1-dichloroethylene	µg/l	grab	Monthly	Monthly	Monthly
dichlorobromomethane	µg/l	24 hr. composite	Monthly	Monthly	Monthly
dichloromethane	µg/l	grab	Monthly	Monthly	Monthly

CONSTITUENT	Unit	Sample type	Sampling frequency		
			Influent stream	Effluent stream	Emergency connection
1,3-dichloropropene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
dieldrin	µg/l	24 hr. composite	Weekly	Weekly	Weekly
2,4-dinitrotoluene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
1,2-diphenylhydrazine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
halomethanes[7]	µg/l	24 hr. composite	Monthly	Monthly	Monthly
heptachlor	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hepthachlor epoxide	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hexachlorobenzene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hexachlorobutadiene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hexachloroethane	µg/l	24 hr. composite	Monthly	Monthly	Monthly
isophorone	µg/l	24 hr. composite	Monthly	Monthly	Monthly
N-nitrosodimethylamine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
N-nitroso-di-N-propylamine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
N-nitrosdiphenylamine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
PAHs[8]	µg/l	24 hr. composite	Monthly	Monthly	Monthly
PCBs[9]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
1,1,2,2-tetrachloroethane	µg/l	grab	Monthly	Monthly	Monthly
TCDD equivalents[10]	µg/l	24 hr. composite	Monthly	Monthly	Monthly
tetrachloroethylene	µg/l	grab	Monthly	Monthly	Monthly
toxaphene	µg/l	24 hr. composite	Weekly	Weekly	Weekly
trichloroethylene	µg/l	grab	Monthly	Monthly	Monthly
1,1,2-trichloroethane	µg/l	grab	Monthly	Monthly	Monthly
2,4,6-trichlorophenol	µg/l	24 hr. composite	Monthly	Monthly	Monthly
vinyl chloride	µg/l	grab	Monthly	Monthly	Monthly
remaining "priority pollutants"	µg/l	24 hr. composite	Monthly	Monthly	Monthly

SAMPLING OF RETURN STREAMS

Parameter	Units	Sample type	Sampling frequency
flowrate	MGD	recorder/totalizer	continuous
total suspended solids	mg/l	24 hr. composite	daily
BOD_5@20^0C	mg/l	24 hr. composite	daily

The discharger shall report the Mass Emission Rate (MER) in lb/day or mt/yr for all constituents that have MER effluent limitations or MER benchmarks established by Discharge Specifications B.1 and/or B.11 of Order No. R9-2002-0025. The discharger shall also report the concentration and flowrate used to calculate the MER for each constituent.

The system-wide percent removals of TSS and BOD_5 shall be calculated using the following formula (mass emissions in metric tons):

$$\text{\% Removal (TSS or BOD}_5\text{)} = \frac{\text{(System Influents – Return Streams) – Outfall Discharge}}{\text{System Influents – Return Streams}} \times 100$$

Where,

System Influents = PLMWTP Influent, NCWRP [make sure this term has previously been defined] Influent Pump Station, and NCWRP Influent from Penasquitos Pump Station.

Return Streams = NCWRP Filter Backwash, NCWRP Plant Drain, NCWRP Secondary and Un-disinfected Filtered Effluent Bypass, NCWRP Final Effluent, and MBC Centrate

The TSS and BOD_5 concentration, together with flow rate, of each stream shall be measured daily and a system-wide removal rate calculated according to the above formula. In the event that a flow rate measurement, TSS concentration, or BOD_5 concentration is not obtained from a stream, the median value for the previous calendar year for that stream shall be used as a surrogate number to allow completion of the calculation. The discharger shall be required to flag values where surrogate numbers are used in their self-monitoring reports submitted to the Regional Board. The failure to obtain a value may still be considered a violation of the permit that could result in enforcement action depending on the frequency of failures and efforts by the discharger to prevent such failures.

C. SLUDGE MONITORING REQUIREMENTS

General sludge monitoring and reporting requirements are contained in Sludge Requirements, Section I, of Order No. R9-2002-0025.

D. RECEIVING ENVIRONMENT MONITORING

Receiving environment monitoring shall be conducted as specified below. Station location, sample type, sample preservation, and analyses, when not specified, shall be by methods approved by the Executive Officer and Director.

Reports of marine monitoring surveys conducted to meet receiving water monitoring requirements of this MRP shall include, as a minimum, the following information:

- A description of climatic and receiving water characteristics at the time of sampling (weather observations, floating debris, discoloration, wind speed and direction, swell or wave action, time of sampling, tide height, etc.).
- A description of sampling stations, including differences unique to each station (e.g., station location, sediment grain size, distribution of bottom sediments, rocks, shell litter, calcareous worm tubes, etc.).
- A description of the sample collection and preservation procedures used in the survey.
- A description of the specific method used for laboratory analysis.
- An in-depth discussion of the results of the survey. All tabulations and computations shall be explained.

1. Sampling Stations

a. <u>Offshore Water Quality Stations</u>. Offshore stations shall be located and numbered as follows:

Station	Depth (m)	N. Latitude	W. Longitude	Descriptor
A1	18	32° 39.56'	117° 15.72'	
A2	59	32° 39.37'	117° 16.68'	
A5	62	32° 41.32'	117° 17.27'	
A6	18	32° 41.56'	117° 16.18'	

Station	Depth (m)	N. Latitude	W. Longitude	Descriptor
A7	18	32° 40.53'	117° 16.01'	
A8	63	32° 39.84'	117° 16.84'	
A9	63	32° 40.83'	117° 17.12'	
A10	47	32° 39.50'	117° 16.13'	
A12	47	32° 40.47'	117° 16.42'	
A14	47	32° 41.43'	117° 16.63'	
A15	61	32° 40.10'	117° 16.90'	
A16	61	32° 40.58'	117° 17.05'	
B1	62	32° 35.00'	117° 16.18'	
B2	18	32° 46.00'	117° 16.18'	
B3	59	32° 45.42'	117° 18.38'	
B5	60	32° 49.25'	117° 19.60'	
B8	88	32° 45.50'	117° 20.77'	
B9	98	32° 45.33'	117° 21.70'	10.5 Km north of diffuser "Y"
B10	116	32° 45.22'	117° 22.16'	
B11	88	32° 46.57'	117° 21.35'	
B12	98	32° 46.36'	117° 22.30'	12.7 Km north of diffuser "Y"
B13	116	32° 46.38'	117° 22.64'	
C4	9	32° 39.95'	117° 14.98'	Approx. 660 m (2200 ft) west of the Point Loma Lighthouse and 1600 m south of the treatment plant outfall pipe
C5	9	32° 40.75'	117° 15.40'	Approx. 800 m (2600 ft) seaward of the Point Loma treatment plant immediately south of the outfall pipe
C6	9	32° 41.62'	117° 15.68'	Approx. 890 m (2900 ft) seaward and perpendicular to a point 1260 m north of the outfall pipe
C7	18	32° 42.98'	117° 16.33'	1.5 Km seaward of Station D7
C8	18	32° 43.96'	117° 16.40'	1.5 Km seaward of Station D8

Station	Depth (m)	N. Latitude	W. Longitude	Descriptor
E1	88	32° 37.53'	117° 18.35'	
E2	98	32° 37.45'	117° 19.09'	4.6 Km south of diffuser "Y"
E3	116	32° 37.29'	117° 20.09'	
E4	88	32° 38.50'	117° 18.57'	
E5	98	32° 38.38'	117° 19.28'	3.1 Km south of diffuser "Y"
E6	116	32° 38.28'	117° 20.00'	
E7	88	32° 39.00'	117° 18.65'	
E8	98	32° 38.91'	117° 19.34'	2.1 Km south of diffuser "Y"
E9	116	32° 38.75'	117° 20.06'	
E10	88	32° 39.50'	117° 18.81'	
E11	98	32° 39.40'	117° 19.42'	1.2 Km south of diffuser "Y"
E12	116	32° 39.37'	117° 19.96'	
E13	88	32° 40.01'	117° 18.89'	
E14	98	32° 39.94'	117° 19.49'	0.3 Km west of diffuser "Y"
E15	116	32° 39.88'	117° 19.91'	
E16	88	32° 40.52'	117° 19.07'	
E17	98	32° 40.48'	117° 19.54'	0.9 Km north of diffuser "Y"
E18	116	32° 40.38'	117° 19.88'	
E19	88	32° 41.04'	117° 19.18'	
E20	98	32° 40.96'	117° 19.67'	1.8 Km north of diffuser "Y"
E21	116	32° 40.89'	117° 20.00'	
E22	88	32° 41.58'	117° 19.25'	
E23	98	32° 41.47'	117° 19.77'	2.7 Km north of diffuser "Y"
E24	116	32° 41.40'	117° 20.06'	
E25	98	32° 42.38'	117° 20.07'	4.5 Km north of diffuser "Y"
E26	98	32° 43.82'	117° 20.57'	7.3 Km north of diffuser "Y"

b. **Shore Stations**. Shore stations shall be located and numbered as follows:

Station	N. Latitude	W. Longitude	Description
D1	32° 35.08'	117° 07.96'	Approx. 480 m (1600 ft) north of the pier at the end of Palm Ave in Imperial Beach
D2	32° 38.22'	117° 08.65'	Silver Strand State Beach, Area 4, just west of the Coronado Cays
D3	32° 40.58'	117° 10.74'	At the foot of Avenida del Sol seaward of the Hotel del Coronado
D4	32° 39.94'	117° 14.62'	Located at the southernmost tip of Point Loma just north of the lighthouse
D5	32° 40.85'	117° 14.94'	Directly in front of the Point Loma Wastewater Treatment plant where the outfall pipe enters the ocean
D6	32° 41.92'	117° 15.33'	Approx. 1260 m (4150 ft) north of the outfall pipe at NOSC seawater pump station
D7	32° 43.16'	117°15.44'	Sunset Cliffs at the foot of the stairs seaward of Ladera Street
D8	32° 44.22'	117°15.32'	Ocean Beach at the foot of the stairs seaward of Bermuda Street
D9	32° 44.80'	117°15.24'	Just south of the Ocean pier at the foot of the stairs seaward of Narragansett Street

c. **Fish trawl and rig fish stations**. Trawl stations shall be located and numbered as follows:

Station	Depth (m)	N. Latitude	W. Longitude
SD1	60	32° 46.40'	117° 18.60'
SD3	60	32° 41.76'	117° 17.30'
SD6	60	32° 39.47'	117° 16.85'
SD7	100	32° 35.06'	117° 18.39'
SD8	100	32° 37.54'	117° 19.37'
SD9	90	32° 39.24'	117° 18.84'
SD10	100	32° 39.16'	117° 19.50'
SD11	90	32° 40.73'	117° 19.96'
SD12	100	32° 40.65'	117° 19.81'

Station	Depth (m)	N. Latitude	W. Longitude
SD13	100	32° 42.83'	117° 20.25'
SD14	100	32° 44.30'	117° 20.96'
Rig fish stations shall be located in an area centered around the following sites			
RF1	107	32° 40.32'	117° 19.78'
RF2	96	32° 45.67'	117° 22.02'

2. Receiving Water Sampling and Analyses Requirements .

Receiving water monitoring shall be conducted as shown in the following table:

Parameter	Units	Stations	Sample Type	Sampling Frequency	Reporting Frequency
visual observations	---	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B8-B13, C4-C8, D1-D9, E2, E4-E25	visual	monthly	monthly
temperature	°C	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B8-B13, C4-C8, E2, E4-E25	profile	monthly	monthly
salinity	ppt	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B8-B13, C4-C8, E2, E4-E25	profile	monthly	monthly
dissolved oxygen	mg/l	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B8-B13, C4-C8, E2, E4-E25	profile	monthly	monthly
light transmittance	%	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B8-B13, C4-C8, E2, E4-E25	profile	monthly	monthly
secchi disk	m	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B8-B13, C4-C8, E2, E4-E25	visual	monthly	monthly
total suspended solids	mg/l	A1, A2, A5-A7, A10, A12, A14, B1, B3, B5, B9, B12, C4-C8, E2, E5, E8, E10, E12, E14, E16, E18	grab	monthly	monthly

Parameter	Units	Stations	Sample Type	Sampling Frequency	Reporting Frequency
pH	units	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B8-B13, C4-C8, E2, E4-E25	profile	monthly	monthly
total and fecal coliforms	CFU/ 100 ml	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B9, B12, C4-C8, D1-D9, E2, E5, E8, E10, E12, E14, E16, E18	grab	weekly-monthly	monthly
enterococcus	CFU/ 100 ml	A1, A2, A5-A7, A10, A12, A14, B1-B3, B5, B9, B12, C4-C8, D1-D9, E2, E5, E8, E10, E12, E14, E16, E18	grab	weekly-monthly	monthly
kelp	---	---	aerial photos	annually	annually

Visual observations of the surface water conditions at the designated receiving water stations shall be conducted in such a manner to enable the observer to describe and to report the presence, if any, of floatables of sewage origin. Observations of wind (direction and speed), weather (e.g., cloudy, sunny, or rainy), current (e.g., direction), and tidal conditions (e.g., high or low tide) shall be recorded. Observations of water color, discoloration, oil and grease, turbidity, odor, materials of sewage origin in the water or on the beach shall be recorded. These observations shall be taken whenever a sample is collected (generally monthly). Observations at shoreline stations D1 through D9, shall occur on a more frequent basis (weekly or every two weeks) corresponding with the increased frequency of shoreline bacterial monitoring during certain times of the year (see below).

Total suspended solids shall be measured monthly at three depths (1 meter below the surface, mid-depth and bottom). Oil and grease shall be measured monthly in surface waters (top 1 meter). Temperature, salinity, dissolved oxygen, light transmittance and pH shall be measured monthly throughout the entire water column using probes (e.g., XBTs, CTDs) or meters (e.g., DO, pH). Suspended solids, secchi disc and light transmittance measurements shall be taken on the same day and as close together in time as possible.

Total coliforms, fecal coliforms and enterococcus shall be sampled at nine shore stations (D1-D9) according to the following schedule. Weekly from May 1 through October 31 and every two weeks from November 1 through April 30.

Total coliforms, fecal coliforms and enterococcus shall be sampled at eight kelp bed stations (A1, A6, A7, C4, C5, C6, C7, C8) at least five times per month, such that each day of the week is represented over a two month period. Samples shall be collected from three depths (1 m below the surface, mid-depth and bottom).

Total coliforms, fecal coliforms and enterococcus shall be measured at least monthly at the remaining offshore stations at the following depth increments. Station B2, shall be sampled at three depths (1 m, 12 m and 18 m). Stations along the 45-meter contour (A10, A12, A14) shall be sampled at two depths (1 m and 40 m). Stations along the 60-meter contour (A2, A5, B1, B3, B5) shall be sampled at three depths (1 m, 40 m and 60 m) Stations along the 88-meter contour (E10 and E16) shall be sampled at five depths (1 m, 40 m, 60 m, 80 m and 88 m). Stations along the 98-meter contour (E2, E5, E8, E14, B9, B12) shall be sampled at five depths (1 m, 40 m, 60 m, 80 m and 98 m). Stations along the 116-m contour (E12, E18) shall be sampled at six depths (1 m, 40 m, 60 m, 80 m, 98 m , and 116 m).

3. Benthic Monitoring Requirements

a. Sediment Sampling and Analyses Requirements. Sediment samples shall be collected on a quarterly basis from twenty-three stations (B8-B13, E1-3, E5, E7-9, E11, E14, E15, E17, E19-21, E23, E25, E26) using a 0.1-m^2 modified Van Veen grab sampler. Sediment samples for chemical analyses shall be taken from the top 2 cm of the grab. These samples shall be analyzed for the set of constituents as listed below. For sediment chemistry ambient monitoring may be conducted using EPA approved or methods developed by NOAA's National Status and Trends Program for Marine Environmental Quality or methods developed in conjunction with the Southern California Bight Regional Monitoring Program. For chemical analysis of sediment, samples shall be reported on a dry weight basis.

Parameter	Units	Sample type	Frequency
Sediment grain size	μm	grab	quarterly
Total Organic Carbon	%	grab	quarterly
Total Nitrogen	%	grab	quarterly
Acid soluble sulfides	mg/kg	grab	quarterly
Metals			
Aluminum	mg/kg	grab	quarterly
Antimony	mg/kg	grab	quarterly
Arsenic	mg/kg	grab	quarterly
Cadmium	mg/kg	grab	quarterly
Chromium	mg/kg	grab	quarterly

Parameter	Units	Sample type	Frequency
Copper	mg/kg	grab	quarterly
Iron	mg/kg	grab	quarterly
Lead	mg/kg	grab	quarterly
Manganese	mg/kg	grab	quarterly
Mercury	mg/kg	grab	quarterly
Nickel	mg/kg	grab	quarterly
Selenium	mg/kg	grab	quarterly
Silver	mg/kg	grab	quarterly
Tin	mg/kg	grab	quarterly
Zinc	mg/kg	grab	quarterly
PCBs and Chlorinated Pesticides			
PCBs[11]	ng/kg	grab	quarterly
2,4'-DDD	ng/kg	grab	quarterly
4,4'-DDD	ng/kg	grab	quarterly
2,4'-DDE	ng/kg	grab	quarterly
4,4'-DDE	ng/kg	grab	quarterly
2,4'-DDT	ng/kg	grab	quarterly
4,4'-DDT	ng/kg	grab	quarterly
Aldrin	ng/kg	grab	quarterly
alpha-Chlordane	ng/kg	grab	quarterly
Dieldrin	ng/kg	grab	quarterly
Endosulfan	ng/kg	grab	quarterly
Endrin	ng/kg	grab	quarterly
gamma-BHC	ng/kg	grab	quarterly
Heptachlor	ng/kg	grab	quarterly
Heptachlor epoxide	ng/kg	grab	quarterly

Parameter	Units	Sample type	Frequency
Hexachlorobenzene	ng/kg	grab	quarterly
Mirex	ng/kg	grab	quarterly
Trans-nonachlor	ng/kg	grab	quarterly
Polycyclic Aromatic Hydrocarbons			
Acenapthene	µg/kg	grab	quarterly
Acenaphthylene	µg/kg	grab	quarterly
Anthracene	µg/kg	grab	quarterly
Benz(a)anthracene	µg/kg	grab	quarterly
Benzo(b)fluoranthene	µg/kg	grab	quarterly
Benzo(k)fluoranthene	µg/kg	grab	quarterly
Benzo(ghi)pyrelene	µg/kg	grab	quarterly
Benzo(a)pyrene	µg/kg	grab	quarterly
Benzo(e)pyrene	µg/kg	grab	quarterly
Biphenyl	µg/kg	grab	quarterly
Chrysene	µg/kg	grab	quarterly
Dibenz(ah)anthracene	µg/kg	grab	quarterly
Fluoranthene	µg/kg	grab	quarterly
Fluorene	µg/kg	grab	quarterly
Indeno(123cd)pyrene	µg/kg	grab	quarterly
Naphthalene	µg/kg	grab	quarterly
1-Methylnaphthalene	µg/kg	grab	quarterly
2-Methylnaphthalene	µg/kg	grab	quarterly
2,6-Dimethylnaphthalene	µg/kg	grab	quarterly
2,3,5-Trimethylnaphthalene	µg/kg	grab	quarterly
Perylene	µg/kg	grab	quarterly
Phenanthrene	µg/kg	grab	quarterly

Parameter	Units	Sample type	Frequency
1-Methylphenanthrene	μg/kg	grab	quarterly
Pyrene	μg/kg	grab	quarterly

b. <u>Infauna Monitoring</u>. For analyses of benthic infauna, two replicate samples of bottom sediments shall be collected and analyzed quarterly from the following 21 stations: B8-B13, E2, E5, E7-E9, E11, E14, E15, E17, E19-E21, E23, E25, and E26.

The benthic infaunal samples shall be collected using a 0.1-m^2 modified Van Veen grab. These sample grabs shall be separate from those collected for sediment analyses. The samples shall be sieved using a 1.0-mm mesh screen. The benthic organisms retained on the sieve shall be fixed in fifteen percent buffered formalin, and transferred to 70 percent ethanol within two to seven days for storage. All organisms, including infauna organisms, obtained during benthic monitoring shall be counted and identified to as low a taxon as possible. This enumeration and identification of organisms continues the historical data base developed by the discharger. This information shall be submitted quarterly. Biomass shall be estimated from wet weight measurements for each of the following taxa: molluscs, echinoderms, polychaetes, crustaceans and other taxa.

Community analyses shall consist of number of species, number of individuals per species and total numerical abundance, and biomass. Quarterly reports shall consist of the raw data (number of individuals per species) along with analysis of community parameters. Community parameters shall be summarized per station as:

Number of species per 0.1 m^2
Total number of species per station
Total numerical abundance
Biomass
Infaunal trophic index
Swartz' 75% dominance index
Shannon-Weiner's diversity index (H')
Pielou evenness (J')

Annual reports will include community parameters along with more detailed statistical comparisons including community, temporal, and spatial analyses. Methods may include, but are not limited to, various multivariate analyses such as cluster analysis, ordination, and regression. The discharger should also conduct additional analyses, as appropriate, to elucidate temporal and spatial trends in the data.

c. **Fish Monitoring**. Fish trawls shall be conducted to assess the community structure of demersal fish and macro-invertebrates and the presence of priority pollutants in fish. Single trawls for demersal fish and macro-invertebrates shall be conducted semiannually at three trawl stations (SD1, SD3, and SD6) and quarterly at each of eight trawl stations (SD7-SD14). Trawls shall be conducted using a Marinovich 7.62 m (25 ft) head rope otter trawl, using the guidance specified in the field manual developed for the Southern California Bight Pilot Project. Captured organisms shall be identified at all stations (SD1-SD14).

Fish collected by trawls should be identified to species. At all stations, community structure analysis should be conducted. Community structure analysis consists of the wet weight of each species, number of individuals per species, total numerical abundance, species richness, species diversity (i.e., Shannon-Wiener), multivariate pattern analyses (e.g., ordination and classification analyses). Abnormalities and disease symptoms shall be recorded and itemized (e.g., fin erosion, internal and external lesions, tumors).

Chemical analyses of fish tissue shall be performed semiannually on selected target species from SD7-SD14. The list of constituents shall be the same as for sediments with the exception that total lipids will be measured instead of organic carbon, nitrogen and sulfides. The species targeted for analysis will be selected for their ecological or commercial importance and abundance at each sampling location. Three replicate composite samples shall be prepared from each trawl station for both liver and muscle tissue. Each composite sample shall consist of tissues taken from at least three fish of the same species.

The species targeted for analysis at the trawl stations shall be primarily flatfish. The targeted species include but are not limited to the following: Pacific sanddab (Citharichthys sordidus), longfin sanddab (Citharichthys xanthostigma), speckled sanddab (Citharichthys stigmaeus), bigmouth sole (Hippoglossina stomata), or hornyhead turbot (Pleuronichthys verticalis). The California scorpionfish (Scorpaena guttata) and the halfbanded rockfish (Sebastes semicinctus) shall be targeted at sites that do not contain sufficient number of flatfish.

Rig fishing shall be performed semiannually to monitor the uptake of pollutants in fish which are consumed by man in order to determine the impact on public health, and to assess the impacts on local fish populations. Twice each year, fish shall be collected by hook and line or by setting baited lines from within the zone of initial dilution (ZID) and at some point removed from the ZID. The fish shall be representative of those caught by recreational and commercial fishermen in the area. Fish samples shall be identified as to species, number of individuals per species, standard length and wet weight. Physical abnormalities and disease symptoms shall be recorded and itemized (e.g., fin rot, internal and external lesions, and tumors).

Three replicate composite samples of the target species shall be obtained from each station. Each composite shall consist of a minimum of three individuals. Tissue shall be chemically analyzed for the same set of constituents as trawl-caught fish. The species targeted for analysis at the rig fishing stations shall be primarily rockfish. The selected species will be representative of a typical sport fisherman's catch. These include but are not limited to: greenbotched rockfish (Sebastes rosenblatti); canary rockfish (Sebastes pinniger), squarespot rockfish (Sebastes hopkinsi), and additional species of the genus Sebastes.

4. Remote Sensing.

The discharger shall participate and coordinate with state and local agencies and other dischargers in the San Diego Region in the development and implementation of a remote sensing monitoring program for the trans border ocean region. This remote sensing monitoring program is intended to identify and track (in near real time) the fate and transport of the effluent from the Point Loma Ocean Outfall, the South Bay Ocean Outfall, wet weather discharge from the Tijuana River, and other sources of coastal sewage and stormwater plumes in the area. This program will focus on obtaining satellite and aircraft imagery in an area extending up to 100 Km North and 100 Km south of the US-Mexico Border and up to 15 Km offshore. The discharger shall provide both technical and financial assistance with the implementation of this program.

5. Kelp Bed Monitoring.

Kelp bed monitoring is intended to assess the extent to which the discharge of wastes may affect the areal extent and health of coastal kelp beds. The discharger shall participate with other ocean dischargers in the San Diego Region in an annual regional kelp bed photographic survey. Kelp beds shall be monitored annually by means of vertical aerial infrared photography to determine the maximum areal extent of the region's coastal kelp beds within the calender year. Surveys shall be conducted as close as possible to the time when kelp bed canopies cover the greatest area. The entire San Diego Region coastline, from the international boundary to the San Diego Region/Santa Ana Region boundary shall be photographed on the same day. The images produced by the surveys shall be presented in the form of a 1:24,000 scale phot-mosaic of the entire San Diego Region coastline. Onshore reference points, locations of all ocean outfalls and diffusers, and the 30-foot (MLLW) and 60-foot (MLLW) depth contours shall be shown. The areal extent of the various kelp beds photographed in each survey shall be compared to that noted in surveys of previous years. Any significant losses which persist for more than one year shall be investigated by divers to determine the probable reason for the loss.

Table Footnotes

1. The discharger may, at its option, meet the effluent limitation and effluent mass emission benchmark for chromium (VI) or chromium (III) as a total chromium limitation and benchmark.

2. Endosulfan shall mean the sum of endosulfan-alpha and -beta and endosulfan sulfate.

3. HCH shall mean the sum of the alpha, beta, gamma (lindane) and delta isomers of hexachlorocyclohexane.

4. Dichlorobenzenes shall mean the sum of 1,2- and 1,3-dichlorobenzene.

5. Chlordane shall mean the sum of chlordane-alpha, chlordane-gamma, chlordene-alpha, chlordene-gamma, nonachlor-alpha, nonachlor-gamma, and oxychlordane.

6. DDT shall mean the sum of 4,4'DDT, 2,4'DDT, 4,4'DDE, 2,4'DDE, 4,4'DDD, and 2,4'DDD.

7. Halomethanes shall mean the sum of bromoform, bromomethane (methyl bromide), chloromethane (methyl chloride).

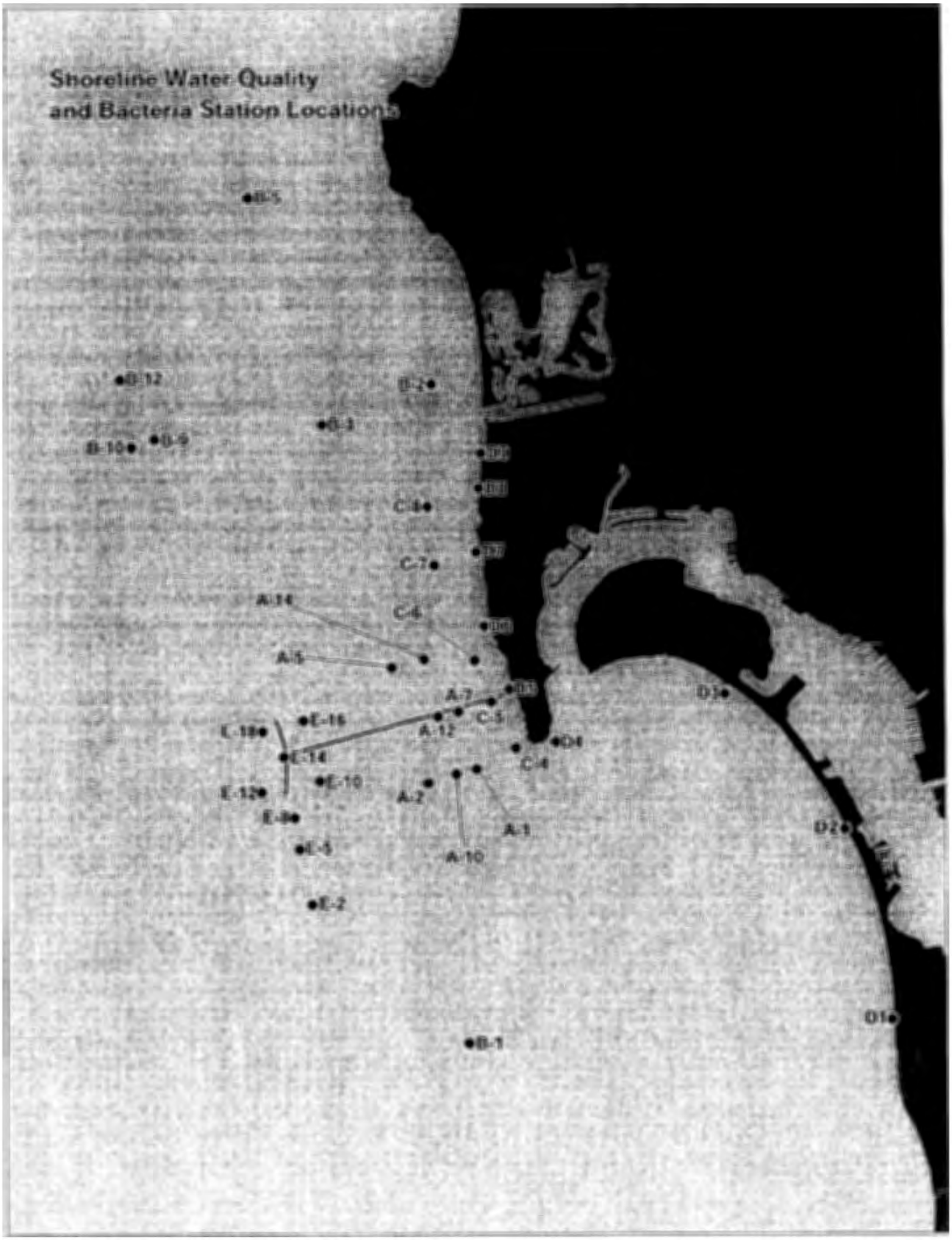
8. PAHs (polynuclear aromatic hydrocarbons) shall mean the sum of acenaphthylene, anthracene, 1,2-benzanthracene, 3,4-benzofluoranthene, benzo[k]fluoranthene, 1,12-benzoperylene, benzo[a]pyrene, chrysene, dibenzo[ah]anthracene, fluorene, indeno[1,2,3-cd]pyrene, phenanthrene and pyrene.

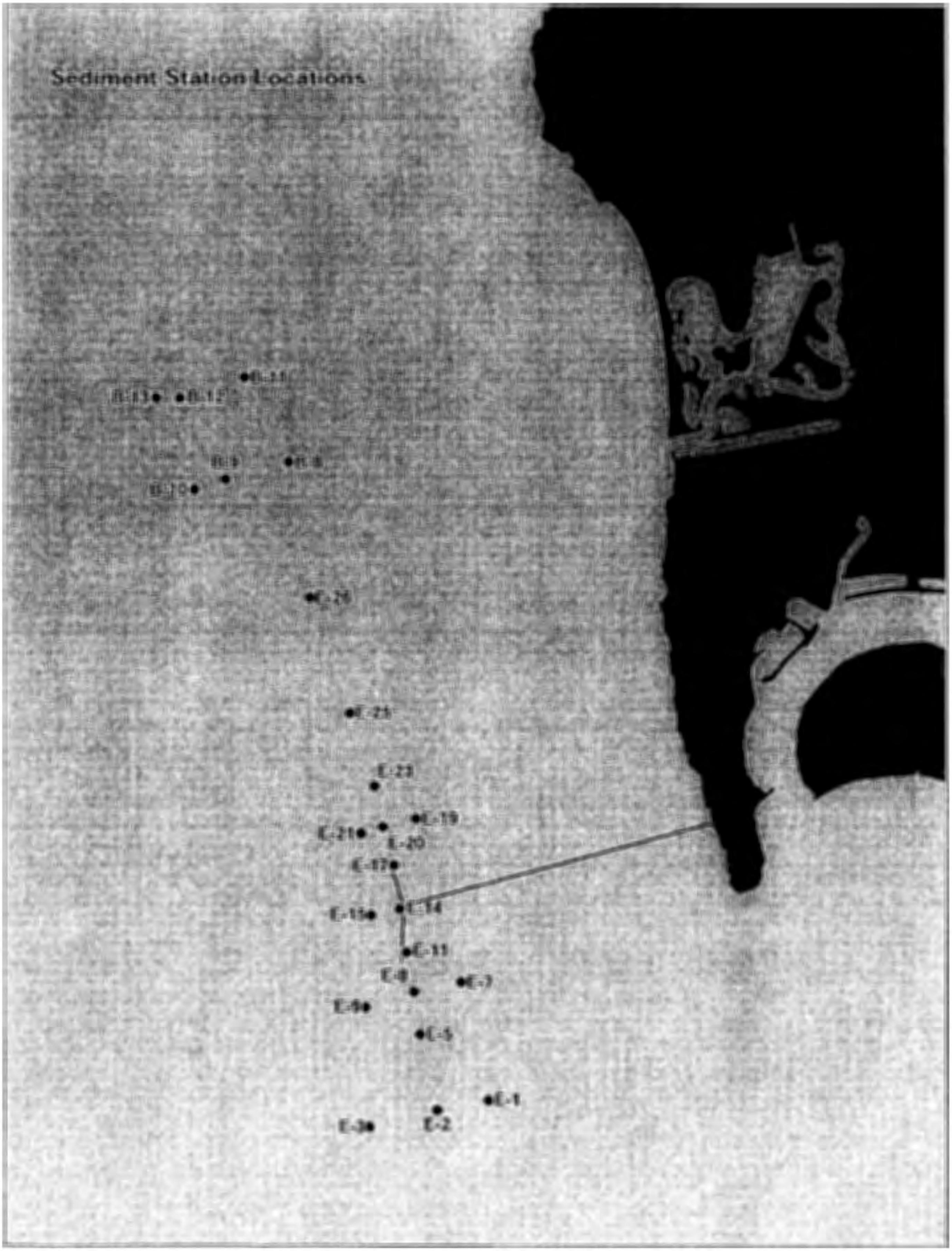
9. PCBs (polychlorinated biphenyls) shall mean the sum of chlorinated biphenyls whose analytical characteristics resemble those of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254 and Aroclor-1260.

10. TCDD equivalents shall mean the sum of the concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors, as shown in the table below.

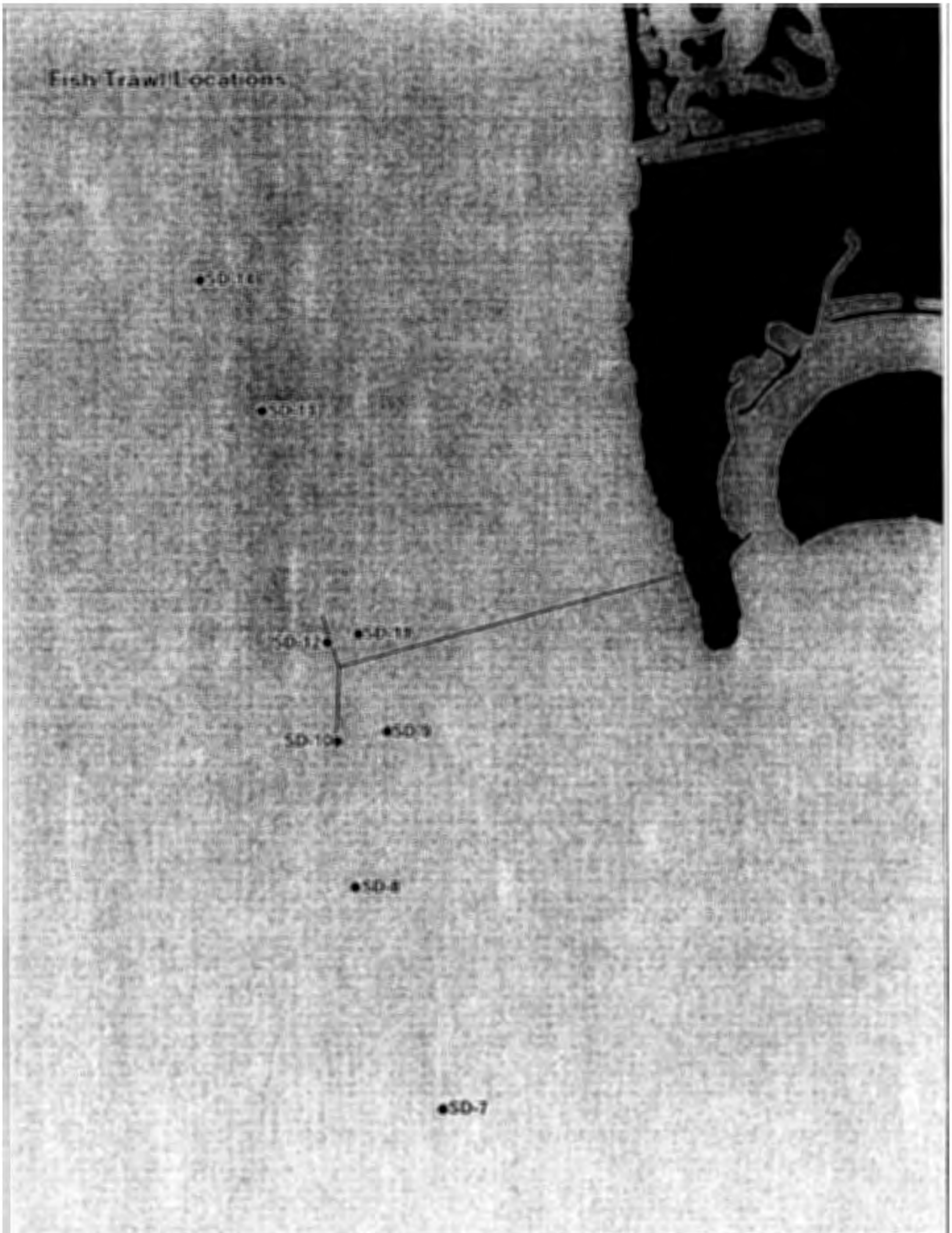
Isomer Group	Toxicity Equivalence Factor
2,3,7,8-tetra CDD	1.0
2,3,7,8-penta CDD	0.5
2,3,7,8-hexa CDDs	0.1
2,3,7,8-hepta CDD	0.01
octa CDD	0.001
2,3,7,8 tetra CDF	0.1
1,2,3,7,8 penta CDF	0.05
2,3,4,7,8 penta CDF	0.5
2,3,7,8 hexa CDFs	0.1
2,3,7,8 hepta CDFs	0.01
octa CDF	0.001

11. For sediment and fish tissue PCBs shall mean the sum of the following congeners: 18, 28, 37, 44, 49, 52, 66, 70, 74, 77, 81, 87, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 138, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 177, 180, 183, 187, 189, 194, 201, 206. These represent concensus based numbers developed by agencies participating in offshore regional monitoring programs in Southern California. These 41 congeners are thought to represent the most-important PCB congeners in terms of mass and toxicity.


Shoreline Water Quality
and Bacteria Station Locations
B-5
B-12
B-2
B-3
B-10
B-9
C-8
C-7
A-14
C-6
A-5
A-7
C-5
A-12
E-16
E-18
E-14
E-10
E-12
E-8
E-5
E-2
A-2
A-1
A-10
C-4
D4
D3
D2
D1
B-1



Sediment Station Locations
B-11
B-13
B-12
B-8
B-10
E-26
E-25
E-23
E-19
E-21
E-20
E-17
E-15
E-14
E-11
E-8
E-7
E-9
E-5
E-1
E-2
E-3


Fish Trawl Locations
SD-12
SD-10
SD-8
SD-7

June 11, 2003

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION
AND
U. S. ENVIRONMENTAL PROTECTION AGENCY
REGION IX

ADDENDUM NO. 1 TO ORDER NO. R9-2002-0025, NPDES PERMIT NO. CA0107409
MODIFYING THE
MONITORING AND REPORTING PROGRAM
FOR
THE CITY OF SAN DIEGO
E. W. BLOM POINT LOMA METROPOLITAN WASTEWATER TREATMENT PLANT

DISCHARGE TO THE PACIFIC OCEAN
THROUGH THE POINT LOMA OCEAN OUTFALL
SAN DIEGO COUNTY

The California Regional Water Quality Control Board, San Diego Region (Regional Board) and the United States Environmental Protection Agency, Region IX (USEPA) find that:

1. On April 10, 2002, this Regional Board adopted Order No. R9-2002-0025, *Waste Discharge Requirements and National Pollutant Discharge Elimination System Permit No. CA0107409 for the City of San Diego E.W. Blom Point Loma Metropolitan Wastewater Treatment Plant Discharge to the Pacific Ocean through the Point Loma Ocean Outfall, San Diego County.* The USEPA issued its final approval of the joint permit, as amended by State Water Resources Control Board (State Board) Order No. WQO 2002-0013, on September 12, 2002. During the public hearing on April 10, 2002, this Regional Board indicated that the monitoring and reporting program associated with the order would be modified at a later date to incorporate recommendations of the Southern California Coastal Water Research Project's (SCCWRP) *Model Monitoring Program for Large Ocean Discharges in Southern California.* The modifications to the monitoring and reporting program in this addendum are based on those recommendations.

2. According to Section 13383(e) of the California Water Code, the Regional Board may, upon application by any affected person, or on its own motion, review and revise waste discharge requirements.

3. The issuance of waste discharge requirements for this discharge is exempt from the requirement of preparation of environmental documents under the California Environmental Quality Act [Public Resources Code, Division 13, Chapter 3, Section 21000 *et seq.*] in

accordance with Section 13389 of the California Water Code.

4. The Regional Board has notified all interested parties of its intent to modify Order No. R9-2002-0025, NPDES Permit No. CA0107409.

5. The Regional Board in a public hearing on June 11, 2003 heard and considered all comments pertaining to the modification of Order No. R9-2002-0025, NPDES Permit No. CA0107409.

IT IS HEREBY ORDERED that, effective August 1, 2003, the following supersedes and entirely replaces the monitoring and reporting requirements previously established by Order No. R9-2002-0025, NPDES Permit No. CA0107409.

A. GENERAL MONITORING AND REPORTING PROVISIONS

1. Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored waste stream. All samples shall be taken at the monitoring points specified in this MRP and, unless otherwise specified, before the waste stream joins or is diluted by any other waste stream, body of water, or substance. Monitoring points shall be subject to the approval of the Regional Board Executive Officer (hereinafter Executive Officer) and the U. S. Environmental Protection Agency, Region IX (hereinafter USEPA), Water Division Director (hereinafter Director) and shall not be changed without notification to and the approval of the Executive Officer and the Director. Samples shall be collected at times representative of "worst case" conditions with respect to compliance with the requirements of Order No. R9-2002-0025.

2. Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to ensure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 5 percent from true discharge rates throughout the range of expected discharge volumes.

3. Monitoring must be conducted according to United States Environmental Protection Agency (USEPA) test procedures approved under Title 40 of the Code of Federal Regulations Part 136 (40CFR 136), Guidelines Establishing Test Procedures for the Analysis of Pollutants, USEPA SW-846, as amended, unless otherwise specified for sludge in 40CFR 503, or unless other test procedures have been specified in Order No. R9-2002-0025 and/or in this monitoring and reporting program.

4. All analyses shall be performed in a laboratory certified to perform such analyses by the California Department of Health Services in accordance with the provision of Section 13176 CWC or a laboratory approved by the Executive Officer.

5. Monitoring results must be reported on discharge monitoring report (DMR) forms approved by the Executive Officer.

6. If the discharger monitors any pollutant more frequently than required by this MRP, using test procedures approved under 40 CFR 136, or as specified in this MRP, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. The increased frequency of monitoring shall also be reported.

7. The discharger shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this MRP, Order No. R9-2002-0025 and any enforcement order issued by the Regional Board, and records of all data used to complete the application for Order No. R9-2002-0025. Records shall be maintained for a minimum of five years from the date of the sample, measurement, report, or application. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the Executive Officer or Director. It is recommended that the discharger maintain the results of all analyses indefinitely.

8. Records of monitoring information shall include:

    a. The date, exact location, and time of sampling or measurements;

    b. The individual(s) who performed the sampling or measurements;

    c. The date(s) analyses were performed;

    d. The laboratory and individual(s) who performed the analyses;

    e. The analytical techniques or methods used; and

    f. The results of all such analyses.

9. Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified in Order No. R9-2002-0025 or in this MRP. The discharger shall report the analysis results, calculation results, data, and equations used in calculations.

10. All monitoring instruments and devices used by the discharger to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy. All flow measurement devices shall be calibrated at least once per year, or more frequently, to ensure continued accuracy of the devices. Annually, the discharger shall submit to the Executive Officer a written statement signed by a registered professional engineer certifying that all flow measurement devices have been calibrated and will reliably achieve the accuracy required by General Monitoring and Reporting Provision A.2.

11. The discharger shall have, and implement, an acceptable written quality assurance (QA) plan for laboratory analyses. An annual report shall be submitted by April 1 of each year which summarizes the QA activities for the previous year. Duplicate chemical analyses must be conducted on a minimum of ten percent of the samples or at least one sample per month, whichever is greater. The discharger must have a success rate equal to or greater than 80 percent. A similar frequency shall be maintained for analyzing spiked samples. When requested by USEPA, the discharger will participate in the National Pollutant Discharge Elimination System (NPDES) discharger monitoring report quality assurance (QA) performance study.

12. The discharger shall report all instances of noncompliance not reported under 40 CFR 122.44 at the time monitoring reports are submitted. The reports shall contain the information listed in 40 CFR 122.44.

13. The monitoring reports shall be signed by an authorized person as required by 40 CFR 122.44.

14. A composite sample is generally defined as a combination of at least 8 sample aliquots of at least 100 milliliters, collected at periodic intervals during the operating hours of a facility over a 24-hour period. For volatile pollutants, aliquots must be combined in the laboratory immediately before analysis. The composite must be flow proportional; either the time interval between each aliquot or the volume of each aliquot must be proportional to either the stream flow at the time of sampling or the total stream flow since the collection of the previous aliquot. Aliquots may be collected manually or automatically. The 100-milliliter minimum volume of an aliquot does not apply to automatic self-purging samplers.

15. A grab sample is an individual sample of at least 100 milliliters collected at a randomly selected time over a period not exceeding 15 minutes.

16. For all bacterial analyses, sample dilutions shall be performed so the range of values extends from 2 to 16,000. The detection method used for each analysis shall be reported

with the results of the analysis.

17. Detection methods used for coliforms (total and fecal) shall be those presented in the most recent edition of Standard Methods for the Examination of Water and Wastewater or any improved method determined by the Executive Officer (and approved by USEPA) to be appropriate. Detection methods used for enterococcus shall be those presented in Test Methods for Escherichia coli and Enterococci in Water by Membrane Filter Procedure (EPA 600/4-85/076) or any improved method determined by the Executive Officer (and approved by USEPA) to be appropriate.

18. MRP No. R9-2002-0025 may be modified by the Executive Officer and USEPA to enable the discharger to participate in comprehensive regional monitoring activities conducted in the Southern California Bight during the term of this permit. The intent of regional monitoring activities is to maximize the efforts of all monitoring partners using a more cost-effective monitoring design and to best utilize the pooled scientific resources of the region. During these coordinated sampling efforts, the discharger's sampling and analytical effort may be reallocated to provide a regional assessment of the impact of the discharge of municipal wastewater to the Southern California Bight. Anticipated modifications to the monitoring program will be coordinated so as to provide a more comprehensive picture of the ecological and statistical significance of monitoring results and to determine cumulative impacts of various pollution sources.

19. By July 1 of each year, the discharger shall submit an annual report of the treatment plant and outfall operations to the Executive Officer and USEPA which contains tabular and graphical summaries of the monitoring data obtained during the previous year. The discharger shall discuss the compliance record and corrective actions taken, or which may be needed, to bring the discharge into full compliance with the requirements of Order No. R9-2002-0025 and this MRP. The report shall address operator certification and provide a list of current operating personnel and their grade of certification. The report shall include the date of the facilities' Operations and Maintenance Manual, the date the manual was last reviewed, and a statement as to whether the manual is complete and valid for the current facilities. The report shall restate, for the record, the laboratories used by the discharger to monitor compliance with Order No. R9-2002-0025 and this MRP, and provide a summary of performance relative to the requirements in this MRP.

20. The sampling frequency of "daily" means that samples shall be collected seven days per week. "Weekly" samples shall be collected such that each day of the week is represented during a seven week period.

21. Monitoring results shall be reported at intervals and in a manner specified in this MRP and Order No. R9-2002-0025. Monitoring reports shall be submitted to the Executive Officer and to USEPA according to the following schedule:

REPORTS	**Report Period**	**Report Due**
MONTHLY REPORTS Influent and Effluent Solids Removal/Disposal Receiving Water Quality Report Tijuana Cross-Border Emergency Connection (when flowing)	Monthly	By the 1st day of 2nd following month (e.g., March 1 for January)
QUARTERLY REPORTS Sludge Analysis	January-March April-June July-September October-December	June 1 September 1 December 1 March 1
SEMI-ANNUAL REPORTS Pretreatment Report	January-June	September 1
ANNUAL REPORTS Pretreatment Report (Provision A.19) Sludge analysis QA Report Treatment plant and outfall operations Outfall inspection Receiving waters monitoring report Kelp report	January-December	April 1 April 1 April 1 July 1 July 1 July 1 October 1

22. All influent, effluent, and receiving water data shall be submitted annually to USEPA for inclusion in the STORET database. The data shall be submitted in an electronic format specified by USEPA.

B. INFLUENT AND EFFLUENT MONITORING

Influent monitoring is required to determine the effectiveness of pretreatment and nonindustrial source control programs, to assess the performance of treatment facilities, and to evaluate compliance with effluent limitations. As such, influent monitoring results must accurately characterize raw wastewater from the entire service area of the treatment facilities, unaffected by in-plant or return or recycle flows or the addition of treatment chemicals.

Effluent monitoring is required to determine compliance with the permit conditions and to identify operational problems and improve plant performance. Effluent monitoring also provides information on wastewater characteristics and flows for use in interpreting water quality and biological data. The effluent sampling station shall be located where representative samples of the effluent can be obtained. The sampling station shall be located downstream from any in-plant return flows and from the last connection through which wastes can be admitted to the outfall.

Influent and effluent monitoring shall be conducted as shown in Table 1. In addition monitoring of the waste flow in the standby emergency connection from the City of Tijuana, Mexico, shall be conducted as shown in Table 1, whenever there is flow from Mexico and/or the SBIWTP through the connection.
The discharger shall report the Mass Emission Rate (MER) in lb/day or mt/yr for all constituents that have MER effluent limitations or MER benchmarks established by Discharge Specifications section B.1 and/or B.11 of Order No. R9-2002-0025. The discharger shall also report the concentration and flowrate used to calculate the MER for each constituent.

The system-wide percent removals of TSS and BOD_5 shall be calculated using the following formula (mass emissions in metric tons):

$$\%\ \text{Removal (TSS or } BOD_5) = \frac{\text{(System Influents} - \text{Return Streams)} - \text{Outfall Discharge}}{\text{System Influents} - \text{Return Streams}} \times 100$$

Where,

System Influents	=	PLMWTP Influent, North City Water Reclamation Plant (NCWRP) Influent Pump Station, and NCWRP Influent from Penasquitos Pump Station.
Return Streams	=	NCWRP Filter Backwash, NCWRP Plant Drain, NCWRP Secondary and Un-disinfected Filtered Effluent Bypass, NCWRP Final Effluent, and MBC Centrate

The TSS and BOD_5 concentration, together with flow rate, of each stream shall be measured daily (Table 2) and a system-wide removal rate calculated according to the above formula. In the event that a flow rate measurement, TSS concentration, or BOD_5 concentration is not obtained from a stream, the median value for the previous calendar year for that stream shall be used as a surrogate number to allow completion of the calculation. The discharger shall be required to flag values where surrogate numbers are used in their self-monitoring reports submitted to the Executive Officer. The failure to obtain a value may still be considered a violation of the permit that could result in enforcement action depending on the frequency of failures and efforts by the discharger to prevent such failures.

C. SLUDGE MONITORING REQUIREMENTS

General sludge monitoring and reporting requirements are contained in Sludge Requirements, Section I, of Order No. R9-2002-0025.

D. RECEIVING ENVIRONMENT MONITORING

Receiving environment monitoring shall be conducted as specified below. Station location, sample type, sample preservation, and analyses, when not specified, shall be by methods approved by the Executive Officer and Director.

The monitoring program around the current discharge site off Point Loma has been in existence since 1991 and has focused on physical, chemical, and biological patterns in the region. This program is being revised to reallocate existing effort to address crucial processes not addressed by earlier monitoring programs, and provide a regional framework for interpreting discharge-related effects. The monitoring program has been modified to reflect the principles expressed in the "Model Monitoring Program for Large Ocean Dischargers in Southern California" (SCCWRP, 2002). The following three components constitute the new receiving water monitoring program: 1) Core Monitoring, 2) Strategic Process Studies, and 3) Regional Monitoring. These three components are needed to evaluate compliance with the permit, federal 301(h) decision criteria, and State water quality standards, and to assess the effects of the discharge on the marine environment.

1. Core Monitoring.

There are five components to the core monitoring program: a) general water quality monitoring, b) bacteriological monitoring of the offshore waters, kelp beds, and shoreline, c) monitoring of sediments for grain size, chemistry and benthic community structure, d) monitoring of demersal fish and megabenthic invertebrate communities, and contaminant body burdens in fishes and e) monitoring of kelp bed canopy cover.

a. <u>General water quality</u>. The offshore water quality sampling program is designed to help evaluate the fate of the wastewater plume under various conditions and to determine if California Ocean Plan standards are being met. A 36 station grid shall be sampled on a quarterly basis for salinity, temperature, density, pH, transmissivity, dissolved oxygen (DO), chlorophyll *a* and enterococcus (Table 3, Figure 1). The grid shall be oriented along depth contours specified in Table 4. Salinity, temperature, density, pH, dissolved oxygen, light transmittance and chlorophyll *a* shall be measured throughout the entire water column. These may be measured using a CTD equipped with probes for pH and DO, a transmissometer (for light transmittance), and a fluorometer (for chlorophyll *a* measurements).

General water quality sampling at an additional eight stations located in the kelp beds is conducted at least five times per month (Tables 3 and 4, Figure 1). Sampling at these stations also includes the collection of water samples for bacteriological analysis (see "Microbiological sampling" below).

Visual observations of the surface water conditions at the designated receiving water stations shall be conducted in such a manner to enable the observer to describe and to report the presence, if any, of floatable materials of sewage origin. Observations of wind (direction and speed), weather (e.g., cloudy, sunny, or rainy), and tidal conditions (e.g., high or low tide) shall be recorded. Observations of water color, discoloration, oil and grease, turbidity, odor, materials of sewage origin in the water or on the beach shall be recorded. These observations shall be taken whenever a sample is collected.

b. Microbiological sampling. The purpose of bacterial sampling is to provide data to help track the wastewater plume in the offshore waters, to evaluate compliance with recreational water standards in the kelp beds, and to address issues of beach water quality at the shoreline stations.

Enterococcus shall be measured at the 36 offshore stations at discrete sampling depths on a quarterly basis (Tables 3 and 4, Figure 1). The bottom sample depths listed in Table 4 correspond to the nominal depth contour for these stations; these "bottom" samples should be taken as near to the bottom as possible (e.g., around 1-2 m off the bottom), although the actual depth of sampling may vary slightly due to sea conditions and tidal cycle. The purpose of this offshore sampling is to assist in tracking the wastewater plume and not for compliance purposes, since the recreational bacterial standards do not apply beyond the 3-mile limit.

Total coliforms, fecal coliforms and enterococcus shall be sampled at the eight kelp bed stations at least five times per month, such that each day of the week is represented over a two month period. Samples shall be collected from three discrete depths (Tables 3 and 4, Figure 1); see above paragraph for description of bottom depths. For stations located along the 9-m depth contour, samples shall be collected at 1 m below the surface, at 3 m below the surface, and near the bottom (~9 m). For stations located along the 18-m depth contour, samples shall be collected at depths of 1 m below the surface, 12 m below the surface, and near the bottom (~18 m).

Total coliforms, fecal coliforms and enterococcus shall be sampled on a weekly basis at eight shoreline stations such that each day of the week is represented over a two month period. (Table 5, Figure 1).

The results of the microbiological sampling at the kelp bed and shoreline stations will be compared to California Ocean Plan Recreational Water standards.

c. **Sediment monitoring.** The physical and chemical properties of sediments and the biological communities that live in or on these sediments shall be monitored to evaluate potential effects of the outfall. The sediment monitoring program consists of a core program to assess spatial and temporal trends, a special mapping study to further delineate the spatial extent or footprint of any potential effect, and a regional monitoring component.

A core set of 12 to 22 stations shall be sampled twice a year (January and July) to assess spatial and temporal trends (Table 6, Figure 2). These consist of 12 primary core stations located along the 98-m depth contour, and an additional 10 secondary core stations located along the 88-m and 116-m depth contours.

A special study shall be conducted early on in the permit period to determine the optimum sampling design for mapping outfall effects (see Strategic Process Studies). A follow-up mapping effort shall also be conducted within the permit cycle. To accommodate these studies, the requirements for sampling the secondary cores stations shall be relaxed during the years when these mapping efforts occur. The requirements for sampling the secondary core stations shall also be relaxed to allow participation in bight-wide regional monitoring efforts (e.g., Bight'03).

Sediment samples for chemical analyses shall be taken from the top 2 cm of the grab. These samples shall be analyzed for the set of constituents as listed in Table 7. For sediment chemistry, ambient monitoring may be conducted using USEPA approved or methods developed by NOAA's National Status and Trends Program for Marine Environmental Quality or methods developed in conjunction with the Southern California Bight Regional Monitoring Program. For chemical analysis of sediment, samples shall be reported on a dry weight basis.

Benthic community sampling shall consist of two replicate samples collected at each station using a 0.1-m^2 modified Van Veen grab. These sample grabs shall be separate from those collected for chemistry analyses. The samples shall be sieved using a 1.0-mm mesh screen. The benthic organisms retained on the sieve shall be fixed in 15 percent buffered formalin, and transferred to 70 percent ethanol within two to seven days for storage. All benthic infaunal organisms obtained during benthic monitoring shall be counted and identified to as low a taxon as possible. This enumeration and identification of organisms continues the historical data base developed by the discharger.

Analysis of benthic community structure shall include determination of the number of species, number of individuals per species, and total numerical abundance present. The following parameters shall be summarized for each station:

Number of species per 0.1 m^2
Total number of species per station
Total numerical abundance
Infaunal trophic index (ITI)
Benthic response index (BRI)
Swartz' 75% dominance index
Shannon-Weiner's diversity index (H')
Pielou evenness (J')

d. Fish and invertebrate monitoring. Epibenthic trawls shall be conducted to assess the structure of demersal fish and megabenthic invertebrate communities, while the presence of priority pollutants in fish will be analyzed from species captured using both trawling and rig fishing techniques. Single community trawls for fish and invertebrates shall be conducted semi-annually at six trawl stations (Table 8, Figure 3). These stations represent an area near the outfall (stations SD10 and SD12), an area upcoast of the outfall (stations SD13 and SD14), and an area downcoast of the outfall (stations SD7 and SD8). Trawls shall be conducted using a Marinovich 7.62 m (25 ft) head rope otter trawl, using the guidance specified in the field manual developed for the Southern California Bight regional monitoring surveys. Captured organisms shall be identified at all stations.

All fish and megabenthic invertebrates collected by trawls should be identified to species if possible. Community structure analysis should be conducted at all stations for both fish and invertebrates. For fish, community structure analysis shall consist of determining the total wet weight and total number of individuals per species, the total numerical abundance of all fish, species richness, species diversity (H'), and multivariate pattern analyses (e.g., ordination and classification analyses). The presence of any physical abnormalities or disease symptoms (e.g., fin erosion, external lesions, tumors) or parasites shall also be recorded. For invertebrates, community structure shall be summarized as the total number of individuals per species, the total numerical abundance of all invertebrates, species richness, and species diversity (H').

Chemical analyses of fish tissues shall be performed annually on target species collected at or near the trawl and rig fishing stations (see Figure 3). The various stations are classified into zones for the purpose of collecting sufficient numbers of fish for tissue analyses (see Table 8). Trawl zone 1 represents the nearfield zone, defined as the area within a 1-km radius of stations SD10 and/or SD12; trawl zone 2 is considered the northern farfield zone, defined as the area within a 1-km radius of stations SD13 and/or SD14; trawl zone 3 represents the LA-5 disposal site zone, and is defined as the area centered within 1-km radius of station SD8; trawl zone 4 is considered the southern farfield zone, and is defined as the area centered within a 1-km radius of station SD7. The two rig fishing stations also represent two distinct zones. Rig fishing zone 1 is the nearfield area centered within a 1-km radius of station RF1; rig fishing zone 2 is considered the farfield area centered within a 1-km radius of station RF2.

Liver tissues shall be analyzed annually from fish collected in each of the above four trawl zones. Each trawl station may be trawled up to a maximum of five times in order to acquire sufficient numbers of fish for composite samples within a zone; trawls subsequent to the initial community trawl discussed above (i.e., trawls 2-5/site) may occur anywhere within a defined zone. Three replicate composites samples shall be prepared from each trawl zone, with each composite consisting of tissues from at least three fish of the same species collected within a zone. These liver tissues shall be analyzed for the presence of lipids, PCB congeners, chlorinated pesticides, and the metals mercury, arsenic and selenium (Table 9). The species targeted for analysis at the trawl sites shall be selected based upon their ecological or commercial importance (see Table 9). These species shall be primarily flatfish, and include the longfin sanddab (*Citharichthys xanthostigma*) and the Pacific sanddab (*Citharichthys sordidus*). If sufficient numbers of these primary target species are not present in a zone, secondary candidate species such as other flatfish or rockfish may be collected as necessary (see Table 9).

Rig fishing shall be performed annually to monitor the uptake of pollutants in fish species which are consumed by humans. Theses fish shall be representative of those caught by recreational and commercial fishery activities in the region. All fish shall be collected by hook and line or by setting baited lines or traps within the two zones described above. The species targeted for analysis at the rig fishing sites shall be primarily rockfish (see Table 9), and include the vermilion rockfish (*Sebastes miniatus*) and the copper rockfish (*Sebastes caurinus*). If sufficient numbers of these primary fish species are not present, other species (e.g., rockfish, scorpionfish) may be collected as necessary. Three replicate composite samples of the target species shall be obtained from each zone, with each composite consisting of a minimum of three individual fish. Muscle tissues shall be removed from the composites and chemically analyzed for the presence of lipids, PCB congeners, chlorinated pesticides, and the metals arsenic, cadmium, chromium, copper, lead, mercury, selenium, tin and zinc.

e. Monitoring of the kelp bed canopy. Kelp bed monitoring is intended to assess the extent to which the discharge of wastes may affect the aerial extent and health of coastal kelp beds. The discharger shall participate with other ocean dischargers in the San Diego Region in an annual regional kelp bed photographic survey. Kelp beds shall be monitored annually by means of vertical aerial infrared photography to determine the maximum aerial extent of the region's coastal kelp beds within the calendar year. Surveys shall be conducted as close as possible to the time when kelp bed canopies cover the greatest area. The entire San Diego Region coastline, from the international boundary to the San Diego Region/Santa Ana Region boundary shall be photographed on the same day. The images produced by the surveys shall be presented in the form of a 1:24,000 scale photo-mosaic of the entire San Diego Region coastline. Onshore reference points, locations of all ocean outfalls and diffusers, and the 30-foot (MLLW) and 60-foot (MLLW) depth contours shall be shown. The aerial extent of the various kelp beds photographed in each survey shall be compared to that noted in surveys of previous years. Any significant losses which persist for more than one year shall be investigated by divers to determine the probable reason for the loss.

2. Strategic Process Studies.

Special studies are an integral part of the permit monitoring program. They differ from other elements of the monitoring program in that they are intended to be short-term and are designed to address specific research or management issues that are not addressed by the routine core monitoring elements.

The scope of the special studies shall be determined by the discharger in coordination with the Executive Officer and the USEPA. The discharger may include input from whatever sources they deem appropriate. Each year, the discharger shall submit proposals for strategic process studies to the Executive Officer and the USEPA by September 30, for the following year's monitoring effort (July through June). The following calendar year, detailed scopes of work for the proposals, including reporting schedules, shall, if requested by the Executive Officer, be presented by the discharger at a spring Regional Board meeting. Upon approval by the Executive Officer and the USEPA, the discharger shall implement the special study. Reporting requirements and deadlines for the results of the special project studies will be determined and set at the time of project approval. Strategic process studies conducted during the period of this permit shall be at a level of effort equal to that of Year 1, unless the Executive Officer, USEPA, and discharger agree otherwise.

The special studies for Year 1 of the permit include the following:

a. Evaluation of the current monitoring program. The discharger shall fund an independent scientific review of the existing ocean monitoring program. At a minimum this study will address the extent to which the program addresses the principles and elements outlined in the Model Monitoring Program for Large Ocean Discharges in Southern California. Additionally, the scientists conducting the study shall consider the concerns of the discharger, regulators, and non-government organizations (NGOs) with regard to program adequacy and its ability to assess impacts to the environment and or public health. The study will provide input for future monitoring program modifications and will identify potential key research needs that may form the framework for planning special project studies in future years.

b. Sediment mapping study. During Year 1 the discharger shall develop the scope for a study to identify the optimal sampling design to determine the spatial extent of any outfall effect on sediments or benthic communities. The study is scheduled for the summer of 2004.

*c. **Remote Sensing***. The discharger shall participate and coordinate with state and local agencies and other dischargers in the San Diego Region in the development and implementation of a remote sensing monitoring program for the trans-border ocean region. This remote sensing monitoring program is intended to identify and track (in near real time) the fate and transport of wastewater discharged through the Point Loma and South Bay ocean outfalls, wet weather runoff from the Tijuana River, and other sources of coastal sewage and stormwater plumes in the area. This program will focus on obtaining satellite and aircraft imagery in an area extending up to 100 Km North and 100 Km south of the US-Mexico Border and up to 15 Km offshore. The discharger shall provide both technical and financial assistance with this program. It is anticipated that this program will continue in future years.

3. Regional Monitoring.

The discharger shall participate in regional monitoring activities coordinated by the Southern California Coastal Water Project (SCCWRP). The procedures for Executive Officer and USEPA approval shall be the same as detailed above for the strategic process studies. The intent of regional monitoring activities is to maximize the efforts of all monitoring partners using a more cost-effective monitoring design and to best utilize the pooled scientific resources of the region. During these coordinated sampling efforts, the discharger's sampling and analytical effort may be reallocated to provide a regional assessment of the impact of the discharge of municipal wastewater to the Southern California Bight. Anticipated modifications to the monitoring program will be coordinated so as to provide a more comprehensive picture of the ecological and statistical significance of monitoring results and to determine cumulative impacts of various pollution sources. The discharger has participated in regional monitoring efforts in 1994, 1998 and will be participating in the regional monitoring effort scheduled to begin in the summer of 2003 (Bight'03). The level of effort will provided to the Executive Officer and USEPA for approval.

During the 2003 regional survey, the discharger shall provide in-kind services in participating in all three components of the proposed regional monitoring activities as defined by the Bight'03 Steering Committee:

- Coastal Ecology (e.g., assessment of benthic sediment chemistry and macrofaunal communities, trawl-caught fish and invertebrate communities, tissue burden analyses of target pelagic and benthic species, sediment toxicity)
- Water Quality (e.g., offshore plume tracking associated with stormwater and riverine runoff from storm events, involving integration of remote sensing and collection of water

samples at sea; sampling events coordinated with Microbiology component)
- Microbiology (e.g., shoreline and surf zone microbiology tracking associated with storm events; sampling events coordinated with Water Quality component)

The discharger will be responsible for submitting the data collected during their portion of the regional monitoring program according to the prescribed schedule set by the Bight'03 Steering Committee. Detailed analysis of these data will not be required separately by the discharger since they will participate in the analysis and write-up of the complete results from the regional monitoring efforts. The final results, conclusions and recommendations of the project will be published as part of a comprehensive monitoring report for the Bight'03 regional monitoring survey.

It is anticipated that subsequent regional monitoring efforts will occur at 5-year intervals.

4. Reporting.

Reports of marine monitoring surveys conducted to meet receiving water monitoring requirements of this MRP shall include, as a minimum, the following information:

- A description of climatic and receiving water characteristics at the time of sampling (weather observations, floating debris, discoloration, wind speed and direction, swell or wave action, time of sampling, tide height, etc.).

- A description of sampling stations, including differences unique to each station (e.g., station location, sediment grain size, distribution of bottom sediments, rocks, shell litter, calcareous worm tubes, etc.).

- A description of the sample collection and preservation procedures used in the survey.

- A description of the specific method used for laboratory analysis.

- An in-depth discussion of the results of the survey. All tabulations and computations shall be explained.

Annual reports will be due July 1st and will include detailed statistical analyses of all data. Methods may include, but are not limited to, various multivariate analyses such as cluster analysis, ordination, and regression. The discharger should also conduct additional analyses, as appropriate, to elucidate temporal and spatial trends in the data.

TABLE 1. INFLUENT AND EFFLUENT SAMPLING AND ANALYSIS REQUIREMENTS

CONSTITUENT	Unit	Sample type	Sampling frequency		
			Influent stream	Effluent stream	Emergency connection
flowrate	MGD	recorder/totalizer	Continuous	Continuous	Continuous
BOD_5@20°C	mg/l	24 hr. composite	Daily	Daily	Weekly
volatile suspended solids	mg/l	24 hr. composite	Daily	Daily	Weekly
total dissolved solids	mg/l	24 hr. composite	Daily	Daily	Weekly
temperature	°C	grab	Daily	Daily	Weekly
floating particulates	mg/l	24 hr. composite	Daily	Daily	Weekly
TABLE A parameters					
grease & oil	mg/l	grab	Daily	Daily	Weekly
total suspended solids	mg/l	24 hr. composite	Daily	Daily	Weekly
settleable solids	ml/l	grab	Daily	Daily	Weekly
turbidity	NTU	grab	Daily	Daily	Weekly
pH	units	grab	Daily	Daily	Weekly
Table B parameters for protection of marine aquatic life					
arsenic	µg/l	24 hr. composite	Weekly	Weekly	Weekly
cadmium	µg/l	24 hr. composite	Weekly	Weekly	Weekly
chromium (VI)[1]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
copper	µg/l	24 hr. composite	Weekly	Weekly	Weekly
lead	µg/l	24 hr. composite	Weekly	Weekly	Weekly
mercury	µg/l	24 hr. composite	Weekly	Weekly	Weekly
nickel	µg/l	24 hr. composite	Weekly	Weekly	Weekly
selenium	µg/l	24 hr. composite	Weekly	Weekly	Weekly
silver	µg/l	24 hr. composite	Weekly	Weekly	Weekly
zinc	µg/l	24 hr. composite	Weekly	Weekly	Weekly
cyanide	µg/l	24 hr. composite	Weekly	Weekly	Weekly
ammonia (as N)	mg/l	24 hr. composite	Weekly	Weekly	Weekly
acute toxicity	TUa	24 hr. composite	-	Semi-annually	-
chronic toxicity	TUc	24 hr. composite	-	Monthly	-
phenolic compounds (nonchlorinated)	µg/l	24 hr. composite	Weekly	Weekly	Weekly
phenolic compounds (chlorinated)	µg/l	24 hr. composite	Weekly	Weekly	Weekly
endosulfan	µg/l	24 hr. composite	Weekly	Weekly	Weekly
endrin	µg/l	24 hr. composite	Weekly	Weekly	Weekly

CONSTITUENT	Unit	Sample type	Sampling frequency		
			Influent stream	Effluent stream	Emergency connection
HCH[2]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
radioactivity	pci/l	24 hr. composite	Monthly	Monthly	Monthly
Table B parameters for protection of human health - non carcinogens					
acrolein	µg/l	grab	Monthly	Monthly	Monthly
antimony	µg/l	24 hr. composite	Monthly	Monthly	Monthly
bis(2-chloroethoxy) methane	µg/l	24 hr. composite	Monthly	Monthly	Monthly
bis(2-chloroisopropyl) ether	µg/l	24 hr. composite	Monthly	Monthly	Monthly
chlorobenzene	µg/l	grab	Monthly	Monthly	Monthly
chromium (III)[1]	µg/l	24 hr. composite	Monthly	Monthly	Monthly
di-n-butyl phthalate	µg/l	24 hr. composite	Monthly	Monthly	Monthly
dichlorobenzenes[3]	µg/l	24 hr composite	Monthly	Monthly	Monthly
diethyl phthalate	µg/l	24 hr. composite	Monthly	Monthly	Monthly
dimethyl phthalate	µg/l	24 hr. composite	Monthly	Monthly	Monthly
4,6-dinitro-2-methylphenol	µg/l	24 hr. composite	Monthly	Monthly	Monthly
2,4-dinitrophenol	µg/l	24 hr. composite	Monthly	Monthly	Monthly
ethylbenzene	µg/l	grab	Monthly	Monthly	Monthly
fluoranthene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hexachlorocyclopentadiene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
nitrobenzene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
thallium	µg/l	24 hr. composite	Monthly	Monthly	Monthly
toluene	µg/l	grab	Monthly	Monthly	Monthly
tributyltin	µg/l	24 hr. composite	Monthly	Monthly	Monthly
1,1,1-trichloroethane	µg/l	grab	Monthly	Monthly	Monthly
Table B parameters for protection of human health – carcinogens					
acrylonitrile	µg/l	grab	Monthly	Monthly	Monthly
aldrin	µg/l	24 hr. composite	Weekly	Weekly	Weekly
benzene	µg/l	grab	Monthly	Monthly	Monthly
benzidine	µg/l	24 hr composite	Monthly	Monthly	Monthly
beryllium	µg/l	24 hr. composite	Monthly	Monthly	Monthly
bis(2-chloroethyl) ether	µg/l	24 hr. composite	Monthly	Monthly	Monthly
bis(2-ethylhexyl) phthalate	µg/l	24 hr. composite	Monthly	Monthly	Monthly
carbon tetrachloride	µg/l	grab	Monthly	Monthly	Monthly
chlordane[5]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
chlorodibromomethane	µg/l	24 hr. composite	Monthly	Monthly	Monthly

CONSTITUENT	Unit	Sample type	Sampling frequency		
			Influent stream	Effluent stream	Emergency connection
chloroform	µg/l	grab	Monthly	Monthly	Monthly
DDT[6]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
1,4-dichlorobenzene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
3,3'-dichlorobenzidine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
1,2-dichloroethane	µg/l	grab	Monthly	Monthly	Monthly
1,1-dichloroethylene	µg/l	grab	Monthly	Monthly	Monthly
dichlorobromomethane	µg/l	24 hr. composite	Monthly	Monthly	Monthly
dichloromethane	µg/l	grab	Monthly	Monthly	Monthly
1,3-dichloropropene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
dieldrin	µg/l	24 hr. composite	Weekly	Weekly	Weekly
2,4-dinitrotoluene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
1,2-diphenylhydrazine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
halomethanes[7]	µg/l	24 hr. composite	Monthly	Monthly	Monthly
heptachlor	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hepthachlor epoxide	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hexachlorobenzene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hexachlorobutadiene	µg/l	24 hr. composite	Monthly	Monthly	Monthly
hexachloroethane	µg/l	24 hr. composite	Monthly	Monthly	Monthly
isophorone	µg/l	24 hr. composite	Monthly	Monthly	Monthly
N-nitrosodimethylamine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
N-nitroso-di-N-propylamine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
N-nitrosdiphenylamine	µg/l	24 hr. composite	Monthly	Monthly	Monthly
PAHs[8]	µg/l	24 hr. composite	Monthly	Monthly	Monthly
PCBs[9]	µg/l	24 hr. composite	Weekly	Weekly	Weekly
1,1,2,2-tetrachloroethane	µg/l	grab	Monthly	Monthly	Monthly
TCDD equivalents[10]	ρg/l	24 hr. composite	Monthly	Monthly	Monthly
tetrachloroethylene	µg/l	grab	Monthly	Monthly	Monthly
toxaphene	µg/l	24 hr. composite	Weekly	Weekly	Weekly
trichloroethylene	µg/l	grab	Monthly	Monthly	Monthly
1,1,2-trichloroethane	µg/l	grab	Monthly	Monthly	Monthly
2,4,6-trichlorophenol	µg/l	24 hr. composite	Monthly	Monthly	Monthly
vinyl chloride	µg/l	grab	Monthly	Monthly	Monthly
remaining "priority pollutants"	µg/l	24 hr. composite	Monthly	Monthly	Monthly

Table 1. Footnotes

1. The discharger may, at its option, meet the effluent limitation and effluent mass emission benchmark for chromium (VI) or chromium (III) as a total chromium limitation and benchmark.

2. Endosulfan shall mean the sum of endosulfan-alpha and -beta and endosulfan sulfate.

3. HCH shall mean the sum of the alpha, beta, gamma (lindane) and delta isomers of hexachlorocyclohexane.

4. Dichlorobenzenes shall mean the sum of 1,2- and 1,3-dichlorobenzene.

5. Chlordane shall mean the sum of chlordane-alpha, chlordane-gamma, chlordene-alpha, chlordene-gamma, nonachlor-alpha, nonachlor-gamma, and oxychlordane.

6. DDT shall mean the sum of 4,4'DDT, 2,4'DDT, 4,4'DDE, 2,4'DDE, 4,4'DDD, and 2,4'DDD.

7. Halomethanes shall mean the sum of bromoform, bromomethane (methyl bromide), chloromethane (methyl chloride).

8. PAHs (polynuclear aromatic hydrocarbons) shall mean the sum of acenaphthylene, anthracene, 1,2-benzanthracene, 3,4-benzofluoranthene, benzo[k]fluoranthene, 1,12-benzoperylene, benzo[a]pyrene, chrysene, dibenzo[ah]anthracene, fluorene, indeno[1,2,3-cd]pyrene, phenanthrene and pyrene.

9. PCBs (polychlorinated biphenyls) shall mean the sum of chlorinated biphenyls whose analytical characteristics resemble those of Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254 and Aroclor-1260.

10. TCDD equivalents shall mean the sum of the concentrations of chlorinated dibenzodioxins (2,3,7,8-CDDs) and chlorinated dibenzofurans (2,3,7,8-CDFs) multiplied by their respective toxicity factors, as shown in the table below. USEPA method 8280 may be used to analyze TCDD equivalence.

Isomer Group	Toxicity Equivalence Factor
2,3,7,8-tetra CDD	1.0
2,3,7,8-penta CDD	0.5
2,3,7,8-hexa CDDs	0.1
2,3,7,8-hepta CDD	0.01
octa CDD	0.001
2,3,7,8 tetra CDF	0.1
1,2,3,7,8 penta CDF	0.05
2,3,4,7,8 penta CDF	0.5
2,3,7,8 hexa CDFs	0.1
2,3,7,8 hepta CDFs	0.01
octa CDF	0.001

11. For sediment and fish tissue PCBs shall mean the sum of the following congeners: 18, 28, 37, 44, 49, 52, 66, 70, 74, 77, 81, 87, 99, 101, 105, 110, 114, 118, 119, 123, 126, 128, 138, 149, 151, 153, 156, 157, 158, 167, 168, 169, 170, 177, 180, 183, 187, 189, 194, 201, 206. These represent concensus based numbers developed by agencies participating in offshore regional monitoring programs in Southern California. These 41 congeners are thought to represent the most-important PCB congeners in terms of mass and toxicity.

TABLE 2. SAMPLING OF RETURN STREAMS

Parameter	Units	Sample type	Sampling frequency
flowrate	MGD	recorder/totalizer	Continuous
total suspended solids	mg/l	24 hr. composite	Daily
BOD_5@20^{0}C	mg/l	24 hr. composite	Daily

TABLE 3. RECEIVING WATER MONITORING REQUIREMENTS

Parameter	Units	Sampl e Type	Sampling Frequency	
			Offshore stations	Kelp stations
visual observations	---	visual	quarterly	5x/month
temperature	°C	profile	quarterly	5x/month
Salinity	ppt	profile	quarterly	5x/month
dissolved oxygen	mg/l	profile	quarterly	5x/month
light transmittance	%	profile	quarterly	5x/month
Chlorophyll *a*	m	profile	quarterly	5x/month
pH	units	profile	quarterly	5x/month
total and fecal coliforms	CFU/100 ml	grab	—	5x/month
enterococcus	CFU/100 ml	grab	quarterly	5x/month

TABLE 4. OFFSHORE AND KELP BED WATER QUALITY STATIONS (SEE FIGURE 1)

Offshore Stations	Depth (m)	N. Latitude	W. Longitude	Discrete depths for bacteria samples
F01	18	32° 38.10'	117° 14.41'	1 m, 12 m, 18 m
F02	18	32° 45.41'	117° 16.19'	1 m, 12 m, 18 m
F03	18	32° 46.96'	117° 16.06'	1 m, 12 m, 18 m
F04	60	32° 35.64'	117° 16.60'	1 m, 25 m, 60 m
F05	60	32° 36.72'	117° 16.67'	1 m, 25 m, 60 m
F06	60	32° 37.82'	117° 16.73'	1 m, 25 m, 60 m
F07	60	32° 39.07'	117° 16.80'	1 m, 25 m, 60 m
F08	60	32° 40.26'	117° 17.27'	1 m, 25 m, 60 m
F09	60	32° 41.12'	117° 17.51'	1 m, 25 m, 60 m
F10	60	32° 42.33'	117° 17.44'	1 m, 25 m, 60 m
F11	60	32° 43.53'	117° 17.68'	1 m, 25 m, 60 m
F12	60	32° 44.88'	117° 17.64'	1 m, 25 m, 60 m
F13	60	32° 45.95'	117° 18.02'	1 m, 25 m, 60 m
F14	60	32° 46.89'	117° 18.69'	1 m, 25 m, 60 m
F15	80	32° 35.65'	117° 18.04'	1 m, 25 m, 60 m, 80 m
F16	80	32° 36.72'	117° 18.14'	1 m, 25 m, 60 m 80 m
F17	80	32° 37.79'	117° 18.31'	1 m, 25 m, 60 m, 80 m
F18	80	32° 38.93'	117° 18.52'	1 m, 25 m, 60 m, 80 m
F19	80	32° 39.98'	117° 18.90'	1 m, 25 m, 60 m, 80 m
F20	80	32° 41.12'	117° 18.99'	1 m, 25 m, 60 m, 80 m
F21	80	32° 42.23'	117° 19.12'	1 m, 25 m, 60 m, 80 m
F22	80	32° 43.36'	117° 19.25'	1 m, 25 m, 60 m, 80 m
F23	80	32° 44.64'	117° 19.40'	1 m, 25 m, 60 m, 80 m
F24	80	32° 45.74'	117° 19.63'	1 m, 25 m, 60 m, 80 m
F25	80	32° 46.80'	117° 20.16'	1 m, 25 m, 60 m, 80 m
F26	98	32° 35.61'	117° 19.29'	1 m, 25 m, 60 m, 80 m, 98 m
F27	98	32° 36.72'	117° 19.02'	1 m, 25 m, 60 m, 80 m, 98 m
F28	98	32° 37.76'	117° 19.42'	1 m, 25 m, 60 m, 80 m, 98 m
F29	98	32° 38.87'	117° 19.50'	1 m, 25 m, 60 m, 80 m, 98 m
F30	98	32° 39.94'	117° 19.49'	1 m, 25 m, 60 m, 80 m, 98 m
F31	98	32° 41.08'	117° 19.70'	1 m, 25 m, 60 m, 80 m, 98 m
F32	98	32° 42.16'	117° 19.80'	1 m, 25 m, 60 m, 80 m, 98 m
F33	98	32° 43.30'	117° 19.93'	1 m, 25 m, 60 m, 80 m, 98 m
F34	98	32° 44.44'	117° 20.27'	1 m, 25 m, 60 m, 80 m, 98 m
F35	98	32° 45.48'	117° 20.97'	1 m, 25 m, 60 m, 80 m, 98 m
F36	98	32° 46.63'	117° 21.40'	1 m, 25 m, 60 m, 80 m, 98 m
Kelp Stations	**Depth (m)**	**N. Latitude**	**W. Longitude**	**Discrete depths for bacteria samples**
A1	18	32° 39.56'	117° 15.72'	1 m, 12 m, 18 m
A6	18	32° 41.56'	117° 16.18'	1 m, 12 m, 18 m
A7	18	32° 40.53'	117° 16.01'	1 m, 12 m, 18 m
C4	9	32° 39.95'	117° 14.98'	1 m, 3 m, 9 m
C5	9	32° 40.75'	117° 15.40'	1 m, 3 m, 9 m
C6	9	32° 41.62'	117° 15.68'	1 m, 3 m, 9 m
C7	18	32° 42.98'	117° 16.33'	1 m, 12 m, 18 m
C8	18	32° 43.96'	117° 16.40'	1 m, 12 m, 18 m

TABLE 5. LOCATION OF SHORELINE BACTERIA STATIONS (SEE FIGURE 1)

Station	N. Latitude	W. Longitude	Description
D4	32° 39.94'	117° 14.62'	Located at the southernmost tip of Point Loma just north of the lighthouse
D5	32° 40.85'	117° 14.94'	Directly in front of the Point Loma Wastewater Treatment plant where the outfall pipe enters the ocean
D7	32° 43.16'	117° 15.44'	Sunset Cliffs at the foot of the stairs seaward of Ladera Street
D8	32° 44.22'	117° 15.32'	Ocean Beach at the foot of the stairs seaward of Bermuda Street
D9	32° 44.80'	117° 15.24'	Just south of the Ocean Beach pier at the foot of the stairs seaward of Narragansett Street
D10	32° 44.95'	117° 15.18'	Ocean Beach just north of west end of Newport Avenue, directly west of main lifeguard station
D11	32° 45.24'	117° 15.16'	North Ocean Beach (Dog Beach), directly west of south end of Dog Beach parking area at Voltaire St terminus, south side of stub jetty
D12	32° 46.28'	117° 15.21'	Mission Beach, directly west of main lifeguard station in Belmont Park located at the west end of Mission Bay Drive

TABLE 6. LOCATION OF OFFSHORE SEDIMENT STATIONS (SEE FIGURE 2)

Primary Core Stations	Depth (m)	N. Latitude	W. Longitude	Descriptor
B9	98	32° 45.33'	117° 21.70'	10.5 Km north of diffuser "Y"
B12	98	32° 46.36'	117° 22.30'	12.7 Km north of diffuser "Y"
E2	98	32° 37.45'	117° 19.09'	4.6 Km south of diffuser "Y"
E5	98	32° 38.38'	117° 19.28'	3.1 Km south of diffuser "Y"
E8	98	32° 38.91'	117° 19.34'	2.1 Km south of diffuser "Y"
E11	98	32° 39.40'	117° 19.42'	1.2 Km south of diffuser "Y"
E14	98	32° 39.94'	117° 19.49'	0.3 Km west of diffuser "Y"
E17	98	32° 40.48'	117° 19.54'	0.9 Km north of diffuser "Y"
E20	98	32° 40.96'	117° 19.67'	1.8 Km north of diffuser "Y"
E23	98	32° 41.47'	117° 19.77'	2.7 Km north of diffuser "Y"
E25	98	32° 42.38'	117° 20.07'	4.5 Km north of diffuser "Y"
E26	98	32° 43.82'	117° 20.57'	7.3 Km north of diffuser "Y"
Secondary Core Stations	**Depth (m)**	**N. Latitude**	**W. Longitude**	**Descriptor**
B8	88	32° 45.50'	117° 20.77'	
B11	88	32° 46.57'	117° 21.35'	
E1	88	32° 37.53'	117° 18.35'	
E7	88	32° 39.00'	117° 18.65'	
E19	88	32° 41.04'	117° 19.18'	
B10	116	32° 45.22'	117° 22.16'	
E3	116	32° 37.29'	117° 20.09'	
E9	116	32° 38.75'	117° 20.06'	
E15	116	32° 39.88'	117° 19.91'	
E21	116	32° 40.89'	117° 20.00'	

TABLE 7. OFFSHORE SEDIMENT MONITORING REQUIREMENTS

Parameter	Units	Sample type	Frequency
Sediment grain size	µm	grab	semiannual
Total Organic Carbon	%	grab	semiannual
Total Nitrogen	%	grab	semiannual
Acid soluble sulfides	mg/kg	grab	semiannual
Metals			
Aluminum	mg/kg	grab	semiannual
Antimony	mg/kg	grab	semiannual
Arsenic	mg/kg	grab	semiannual
Cadmium	mg/kg	grab	semiannual
Chromium	mg/kg	grab	semiannual
Copper	mg/kg	grab	semiannual
Iron	mg/kg	grab	semiannual
Lead	mg/kg	grab	semiannual
Manganese	mg/kg	grab	semiannual
Mercury	mg/kg	grab	semiannual
Nickel	mg/kg	grab	semiannual
Selenium	mg/kg	grab	semiannual
Silver	mg/kg	grab	semiannual
Tin	mg/kg	grab	semiannual
Zinc	mg/kg	grab	semiannual
PCBs and Chlorinated Pesticides			
PCBs[11]	ng/kg	grab	semiannual
2,4'-DDD	ng/kg	grab	semiannual
4,4'-DDD	ng/kg	grab	semiannual
2,4'-DDE	ng/kg	grab	semiannual
4,4'-DDE	ng/kg	grab	semiannual
2,4'-DDT	ng/kg	grab	semiannual
4,4'-DDT	ng/kg	grab	semiannual
Aldrin	ng/kg	grab	semiannual
alpha-Chlordane	ng/kg	grab	semiannual
Dieldrin	ng/kg	grab	semiannual
Endosulfan	ng/kg	grab	semiannual
Endrin	ng/kg	grab	semiannual
gamma-BHC	ng/kg	grab	semiannual
Heptachlor	ng/kg	grab	semiannual
Heptachlor epoxide	ng/kg	grab	semiannual
Hexachlorobenzene	ng/kg	grab	semiannual
Mirex	ng/kg	grab	semiannual
Trans-nonachlor	ng/kg	grab	semiannual

Polycyclic Aromatic Hydrocarbons			
Acenapthene	μg/kg	grab	semiannual
Acenaphthylene	μg/kg	grab	semiannual
Anthracene	μg/kg	grab	semiannual
Benz(a)anthracene	μg/kg	grab	semiannual
Benzo(b)fluoranthene	μg/kg	grab	semiannual
Benzo(k)fluoranthene	μg/kg	grab	semiannual
Benzo(ghi)pyrelene	μg/kg	grab	semiannual
Benzo(a)pyrene	μg/kg	grab	semiannual
Benzo(e)pyrene	μg/kg	grab	semiannual
Biphenyl	μg/kg	grab	semiannual
Chrysene	μg/kg	grab	semiannual
Dibenz(ah)anthracene	μg/kg	grab	semiannual
Fluoranthene	μg/kg	grab	semiannual
Fluorene	μg/kg	grab	semiannual
Indeno(123cd)pyrene	μg/kg	grab	semiannual
Naphthalene	μg/kg	grab	semiannual
1-Methylnaphthalene	μg/kg	grab	semiannual
2-Methylnaphthalene	μg/kg	grab	semiannual
2,6-Dimethylnaphthalene	μg/kg	grab	semiannual
2,3,5-Trimethylnaphthalene	μg/kg	grab	semiannual
Perylene	μg/kg	grab	semiannual
Phenanthrene	μg/kg	grab	semiannual
1-Methylphenanthrene	μg/kg	grab	semiannual
Pyrene	μg/kg	grab	semiannual

TABLE 8. LOCATION OF TRAWL AND RIG FISH STATIONS (SEE FIGURE 3)

Station	Depth (m)	N. Latitude	W. Longitude
SD7 (Zone 4)	100	32° 35.06'	117° 18.39'
SD8 (Zone 3)	100	32° 37.54'	117° 19.37'
SD10 (Zone 1)	100	32° 39.16'	117° 19.50'
SD12 (Zone 1)	100	32° 40.65'	117° 19.81'
SD13 (Zone 2)	100	32° 42.83'	117° 20.25'
SD14 (Zone 2)	100	32° 44.30'	117° 20.96'
Rig fish stations shall be located in an area centered around the following sites			
RF1 (Zone 1)	107	32° 40.32'	117° 19.78'
RF2 (Zone 2)	96	32° 45.67'	117° 22.02'

TABLE 9. FISH TISSUE ANALSYES

Station type	Tissue type	Analyte	Candidate species
trawl stations	liver	Lipids PCB congeners Chlorinated pesticides Trace metals (arsenic, mercury, selenium)	<u>Primary target species</u> Longfin sanddab Pacific sanddab <u>Secondary target species</u> Other flatfish (e.g., bigmouth sole, hornyhead turbot, Dover sole, English sole) Rockfish (e.g., *Sebastes* spp)
rig stations	muscle	Lipids PCB congeners Chlorinated pesticides Trace metals (arsenic, cadmium, chromium, copper, lead, mercury, selenium, tin, zinc)	<u>Primary target species</u> Vermilion rockfish Copper rockfish <u>Secondary target species</u> Other rockfish (e.g., *Sebastes* spp)

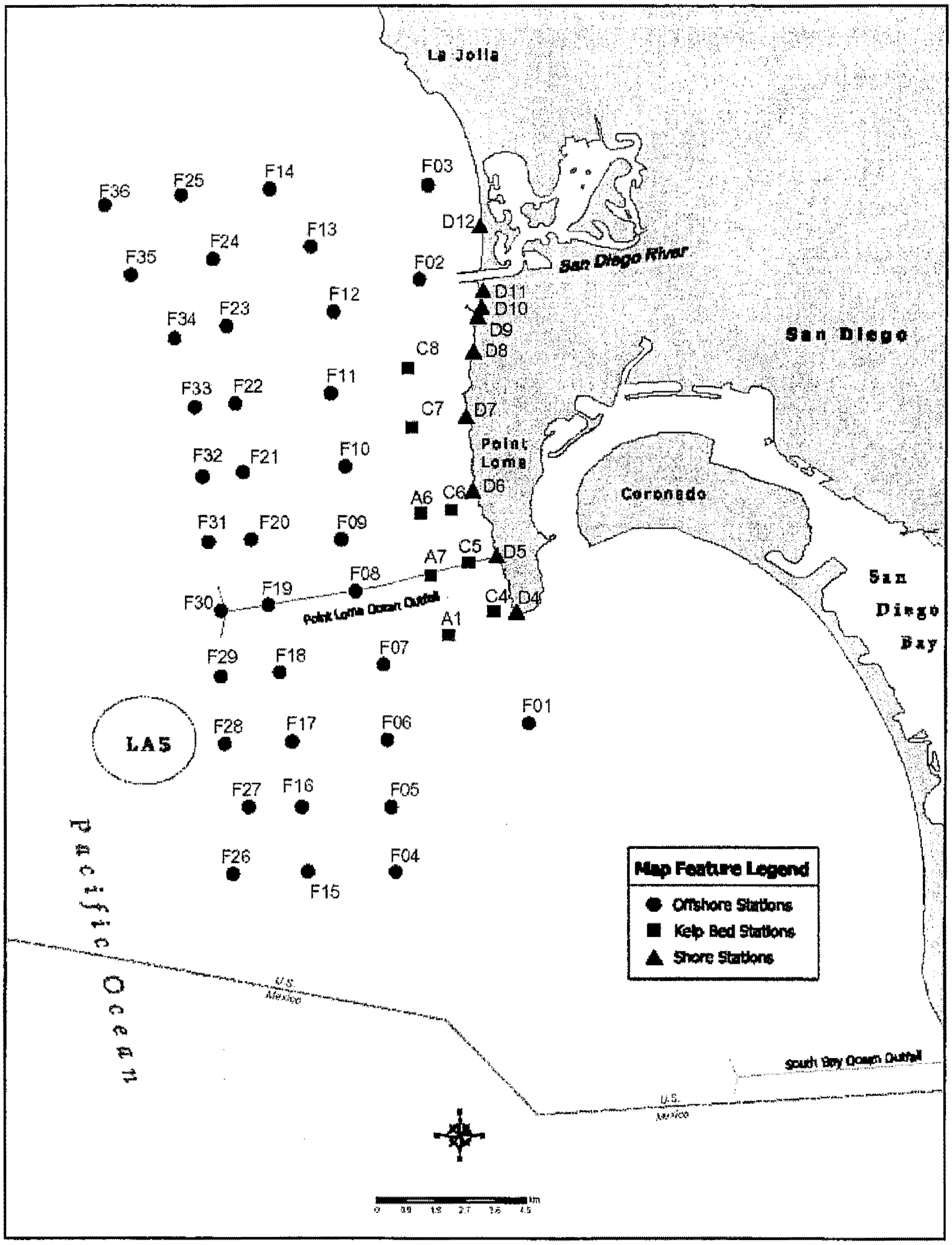


FIGURE 1.
Locations of shore, kelp bed, and offshore water quality monitoring stations surrounding the City of San Diego Point Loma Ocean Outfall

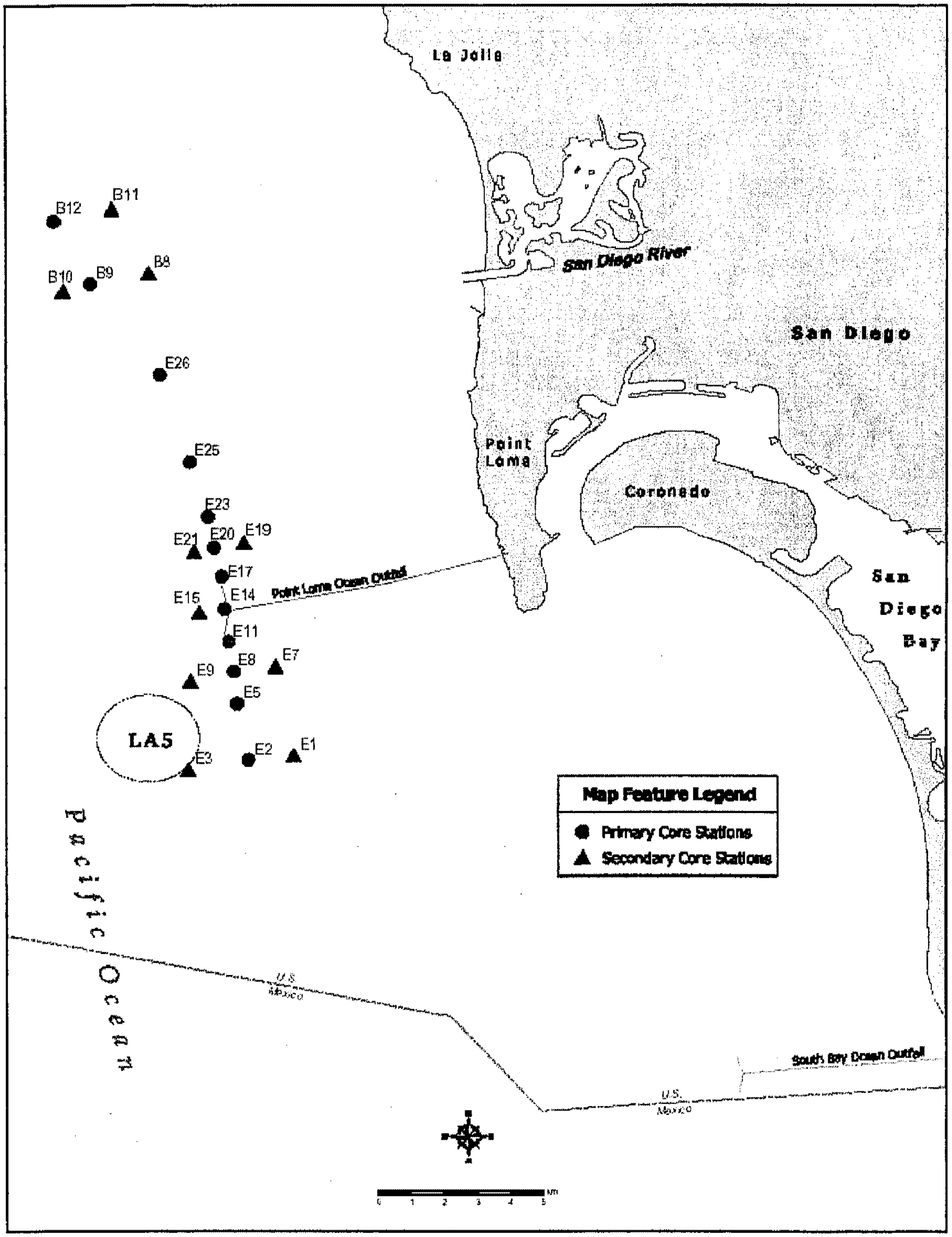


FIGURE 2.
Locations of benthic sediment and infauna monitoring stations surrounding the City of San Diego Point Loma Ocean Outfall

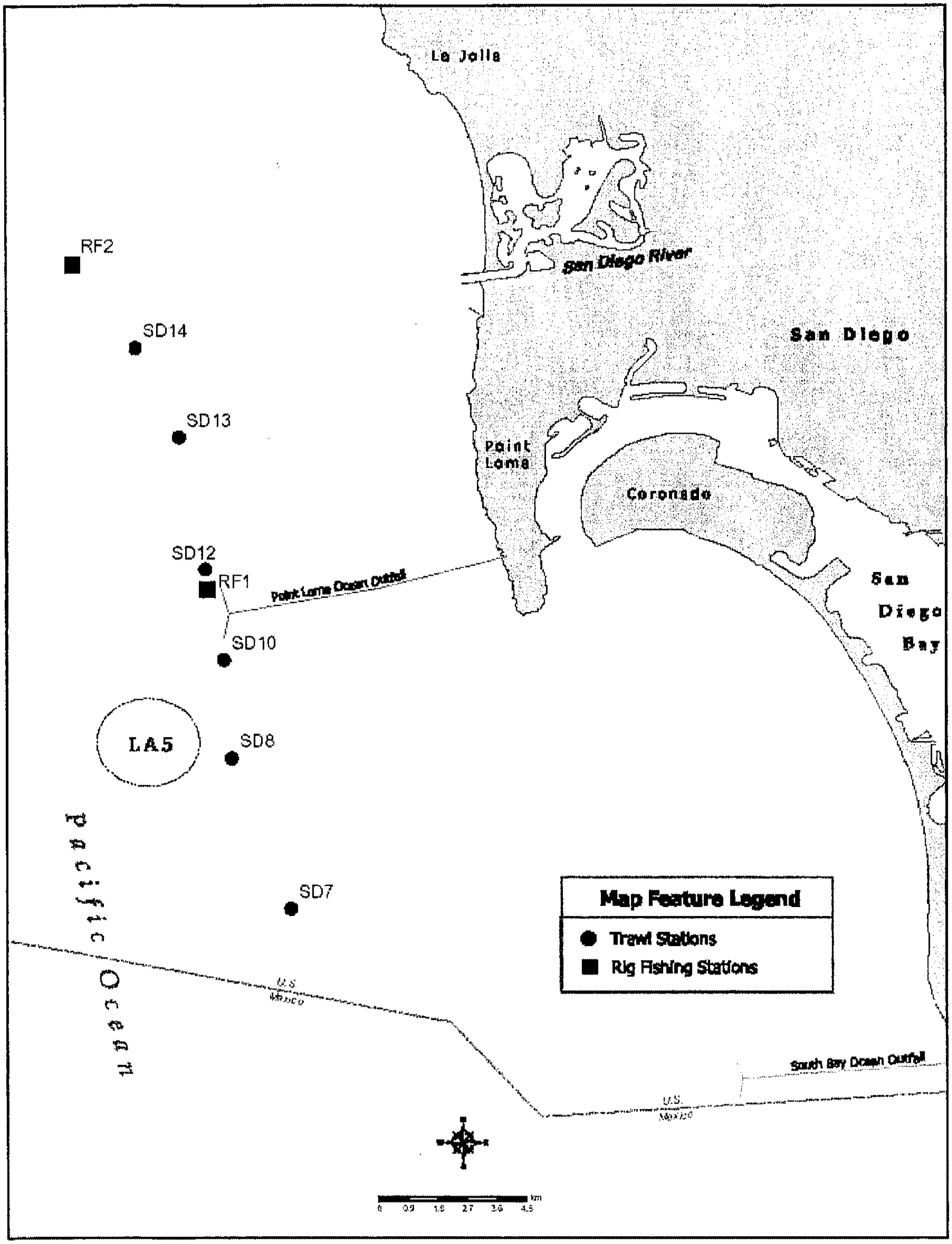


FIGURE 3.
Locations of trawl and rig fishing stations surrounding the City of San Diego Point Loma Ocean Outfall

This certifies that the foregoing is a full, true, and correct copy of Addendum No. 1 to Order No. R9-2002-0025, NPDES Permit No. CA0107409 adopted by the California Regional Water Quality Control Board, San Diego Region, on June 11, 2003 and issued by the United States Environmental Protection Agency, Region IX, on June 25, 2003.

JOHN H. ROBERTUS
Executive Officer
California Regional Water Quality Control Board
San Diego Region

CATHERINE KUHLMAN
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Region IX

For the Regional Administrator