ATTACHMENT 1

NPDES 1999 Receiving Water Monitoring Reports for El Segundo and Scattergood Generating Stations. Los Angeles County, California. Prepared by MBC Applied Environmental Sciences

99-EA-02

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM 1999 RECEIVING WATER MONITORING REPORT EL SEGUNDO AND SCATTERGOOD GENERATING STATIONS LOS ANGELES COUNTY, CALIFORNIA

1999 Survey

Prepared for:

Los Angeles Department of Water and Power
Southern California Edison Company
and El Segundo Power L.L.C.

Prepared by:

MBC *Applied Environmental Sciences*
3000 Redhill Avenue
Costa Mesa, California 92626

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EXECUTIVE SUMMARY

The 1999 National Pollutant Discharge Elimination System (NPDES) marine monitoring program for the El Segundo and Scattergood Generating Stations was conducted in accordance with specifications set forth by the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) in NPDES Permit Nos. CA0001147 and CA0000370, respectively. The 1999 sampling included physical and chemical monitoring of the receiving waters and sediments, and biological monitoring of infaunal assemblages and mussels. Fish and macroinvertebrate impingement studies were also conducted periodically throughout the year. Results of the 1999 sampling surveys were compared among stations and with previous studies to determine if the beneficial uses of the receiving waters continue to be protected.

The Scattergood Generating Station is owned and operated by the Los Angeles Department of Water and Power (LADWP). The El Segundo Generating Station, formerly owned by Southern California Edison Company (SCE), was purchased by El Segundo Power L.L.C. on 4 April 1998. SCE will continue to provide operational support under contract to El Segundo Power L.L.C.

WATER QUALITY MONITORING

The 1999 water quality measurements indicated that the cooling water discharged from the El Segundo and Scattergood Generating Stations did not have an adverse effect on receiving waters in the study area. During winter, only minor fluctuations of temperature, dissolved oxygen (DO), and pH were detected. During summer, surface temperatures were typically higher than in winter with seasonal stratification apparent throughout the study area, including a cold water mass, which usually indicates upwelling, detected at some stations. All temperature, DO, and pH values were within the normal ranges for the area and seasons.

SEDIMENT MONITORING

Sediment Grain Size

Sediments in 1999 consisted primarily of sand (average 93%) with a mean grain size of 2.33 phi (fine sand). Sediments were coarsest at offshore Station B5, upcoast of the Scattergood and El Segundo discharge structures, and finest at offshore Station B8, downcoast of the Scattergood and El Segundo discharge structures. At Station B5, mean grain size was five times coarser than mean grain size at the other offshore stations. Sediment composition and distribution in the study area was primarily affected by natural causes unrelated to the operation of the generating stations. No spatial patterns were apparent that would suggest effects from the Scattergood or El Segundo Generating Stations.

Sediment Chemistry

In 1999, sediment concentrations of all metals were highest at nearshore Station B2. Slightly higher concentrations of metals at Station B2 corresponded with higher amounts of fine sediments (silt and clay) at that station. Lowest concentrations of all metals were detected at offshore Station B5. Sediment metal concentrations in the study area were within the range found in sediments throughout the Southern California Bight and continue to be below levels determined to be potentially toxic to benthic organisms. No adverse effects from the operation of the El Segundo and Scattergood Generating Stations were detected from the 1999 sampling.

MUSSEL BIOACCUMULATION

Analysis of metal levels in mussels near the El Segundo and Scattergood Generating Station indicated bioaccumulation of metals was not appreciable. Tissue concentrations of copper in mussel tissue from the El Segundo Generating Station were higher than previously recorded in the study area, but still within ranges seen in comparable surveys in southern California. Zinc concentrations from mussels collected in the same area were similar to values previously recorded since 1990. Copper and zinc concentrations in mussel tissue from Scattergood Generating Station were also similar to previously recorded values. Chromium and nickel have not been detected since 1990. Metal levels were not elevated in comparison to those found at other locations in the Southern California Bight.

BIOLOGICAL MONITORING

Benthic Infauna

The core benthic infauna community sampled in 1999 was similar in composition to that of previous years. Species richness averaged 40 species per station, which is below the average from 1990 to 1998. Abundance averaged 155 individuals per station (3,875 individuals/m^2), which is the lowest of the surveys conducted in this decade. These differences were primarily influenced by the effects of an ongoing La Niña which is known to shift centers of population and temporarily favor recruitment of some species and reduce recruitment of others. In one such shift, the Malacostraca arthropods were more abundant than polychaete annelids (the usual dominants). These shifts are within the core group of species and only reflect the absence or addition of a few species. Bivalve mollusks were third most speciose followed by nemerteans which is usual for the infauna offshore of the generating stations. In general, species richness was greater nearshore than offshore, while abundance was greatest offshore. No pattern in species composition or abundance was attributed to the operation of the El Segundo or Scattergood Generating Stations.

Fish Impingement

There were noticeable differences between the El Segundo and Scattergood Generating Stations in the species of fish and macroinvertebrates impinged in 1999. Due to plant operations, El Segundo conducted fewer heat treatments than Scattergood during 1999, which would likely account for many of these differences. All of the species common to both El Segundo and Scattergood were typical in the offshore habitat. The occurrence of these species throughout the Southern California Bight, and their continued abundance and high species diversity at both generating stations, indicated that operation of the El Segundo and Scattergood Generating Stations is not having an appreciable adverse effect on the diverse fish and macroinvertebrate populations in the study area.

CONCLUSION

The overall results of the 1999 NPDES monitoring program indicated that operation of the El Segundo and Scattergood Generating Stations had no detectable adverse effects on the beneficial uses of the receiving waters.

INTRODUCTION

This report presents and discusses the results of the 1999 receiving water monitoring studies conducted for the El Segundo and Scattergood Generating Stations. The 1999 monitoring program was conducted in accordance with specifications set forth in National Pollutant Discharge Elimination System (NPDES) Monitoring and Reporting Program No. 4667 (Permit No. CA0001147) issued for the El Segundo Generating Station by the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) on 5 December 1994 and NPDES Monitoring and Reporting Program No. 1886 (Permit No. CA0000370) issued for the Scattergood Generating Station by the LARWQCB on 27 February 1995 (Appendix A). Results of the 1999 surveys were compared among stations and with past physical oceanographic and biological studies to determine what effects, if any, the generating station discharge is having on the marine environment, and if the beneficial uses of the receiving waters are being protected. Sampling included physical and chemical monitoring of the receiving waters and sediments, and biological monitoring of infaunal assemblages and mussels. Fish and macroinvertebrate impingement studies were also conducted periodically throughout the year.

The Scattergood Generating Station is owned and operated by the Los Angeles Department of Water and Power (LADWP). The El Segundo Generating Station, formerly owned by Southern California Edison Company (SCE), was purchased by El Segundo Power L.L.C. on 4 April 1998. SCE will continue to provide operational support under contract to El Segundo Power L.L.C.

DESCRIPTION OF GENERATING STATIONS

El Segundo Generating Station

The El Segundo Generating Station (ESGS) is located at the western boundary of the City of El Segundo. It consists of four fossil-fuel, steam-electric generating units. Units 1 & 2 are rated at 175 Megawatts (Mw) each and Units 3 & 4 at 335 Mw each. The total station rating is 1,020 Mw; however, the plant operated at only 11.9% of total capacity in 1999 (Harnsberger 1999, pers. comm.).

Seawater for cooling is supplied to Units 1 & 2 via a 10-ft (3.0-m) inside diameter (ID) concrete conduit which extends approximately 790 m offshore to a depth of -30 ft Mean Lower Low Water (MLLW). Approximately 144,000 gallons per minute (gpm) are supplied to the units through a screening structure at the plant end of the intake conduit. The screens remove trash, algae, and marine organisms which enter with the cooling water. After passing the screens, the cooling water is pumped to each of two steam condensers, one per turbine. The water temperature is increased 12.2°C when the units are operated at full capacity. The heated water is discharged through a 10-ft-ID conduit, which terminates approximately 1,900-ft (500-m) offshore at a water depth of -26 ft MLLW.

The cooling water system for Units 3 & 4 is separate from Units 1 & 2 but is essentially the same. Dimensional differences are: (1) 12-ft (3.6-m) ID intake and discharge conduits, extending 2,600-ft (800-m) and 2,100-ft (640-m) offshore at -30 ft MLLW respectively; (2) the cooling water flow is 295,000 gpm; and (3) temperature rise across the condensers at full load is 12.2°C.

During the winter sampling on 24 February 1999, no circulating pumps were operating during any part of the day at Units 1 & 2; however, 0.07of flow mgd was discharged by pumps used for cooling auxiliary systems and for lowering water in the retention basins. The ambient temperature was 15.6°C at the intake at Units 1 & 2 and 16.1°C at the discharge, 0.5°C above ambient. Two circulating pumps discharged 162.5 mgd at Units 3 & 4 with an intake temperature of 16.7°C and discharge temperature of 21.7°C, 5.0°C above ambient. During summer sampling on 13 August 1999, 103.7 mgd was discharged by two circulating pumps at Units 1 & 2 with 398.6 mgd discharged by four circulating pumps at Units 3 & 4. The discharge temperature was 30.0°C at Units

1 & 2, (10.6°C above ambient) and 28.3°C at Units 3 & 4, 8.3°C above ambient (Harnsberger 1999, pers. comm.).

Scattergood Generating Station

The Los Angeles Department of Water and Power's Scattergood Generating Station (SGS) is located in the City of Los Angeles at the western boundary of the City of El Segundo, approximately one-half mile north of the El Segundo Generating Station. It is comprised of three fossil-fueled, steam-electric generating units. Units 1 & 2 are rated at 185 Mw each and Unit 3 at 460 Mw. Units 1 & 2 have been on-line since 1958-1959 and Unit 3 since 1974. The total capacity of the plant is 830 Mw; however, the plant operated at only 15% of capacity in 1999 (Mofidi 1999, pers. comm.).

Cooling water is drawn from Santa Monica Bay, at a maximum rate of 344,000 gallons per minute (gpm), through a single 12-ft (3.6-m) ID conduit, which extends approximately 500 m offshore. Seawater enters the system through a 17.5-ft (5.3-m) ID vertical riser. The flow is directed horizontally to the inlet conduit through a 32.5-ft (9.9-m) diameter velocity cap which is suspended 5 ft (1.5-m) above the vertical riser. Seawater is drawn from near mid-depth at an elevation of -15 ft MLLW; the seafloor at this location is approximately -30 ft MLLW. Water enters the plant approximately 150 m inland via a walled forebay containing a screen array and pumping chamber. The design temperature increase for Units 1 & 2 is 10°C; Unit 3 operates at a temperature increase of 7.8°C.

Cooling water is discharged through a single 12-ft (3.6-m) ID conduit that runs parallel to the intake conduit. The discharge riser is also 17.5 ft (5.3-m) ID and has a lip at -15 ft MLLW. The discharge riser is located approximately 365 m offshore from the mean high tide line. Depth of the seafloor at this location is approximately -27 ft MLLW.

During the winter sampling on 24 February 1999, 256 million gallons daily (mgd) were discharged by five circulating pumps. The discharge temperature was 27.7°C, 13.3°C above ambient. On 13 August 1999, seven circulators pumped 390 mgd at a discharge temperature of 29.5°C, 13.9°C above the ambient intake temperature of 15.6°C (Mofidi 1999, pers. comm.).

DESCRIPTION OF STUDY AREA

Location

The study area is located in Santa Monica Bay between latitudes 33°56'N and 33°52'N; and longitudes 118°25'W and 118°28'W (Figure 1).The Standard Oil Company of California - El Segundo Refinery is located between the two generating stations. The Hyperion Treatment Plant, with its deep-water discharge, is approximately 450 m upcoast of the Scattergood Generating Station. Farther north is Marina del Rey Harbor and the mouth of Ballona Creek. Manhattan Beach Pier and the southernmost set of survey stations are downcoast of both generating stations.

Physiography

The general orientation of the coastline between Point Conception and the Mexican border is from northwest to southeast. The continental margin has been slowly emerging over geological time, resulting in a predominantly cliffed coastline which is broken by plains in the vicinity of Oxnard-Ventura, Los Angeles, and San Diego. Most of the coastal region drains via short streams which flow only during rain storms. However, only a small part of the storm drainage reaches the ocean directly; most is impounded by dams or diverted for other uses.

The eight islands offshore southern California influence water circulation and oceanographic characteristics along the mainland coast. The mainland shelf is narrow along the coast, ranging from

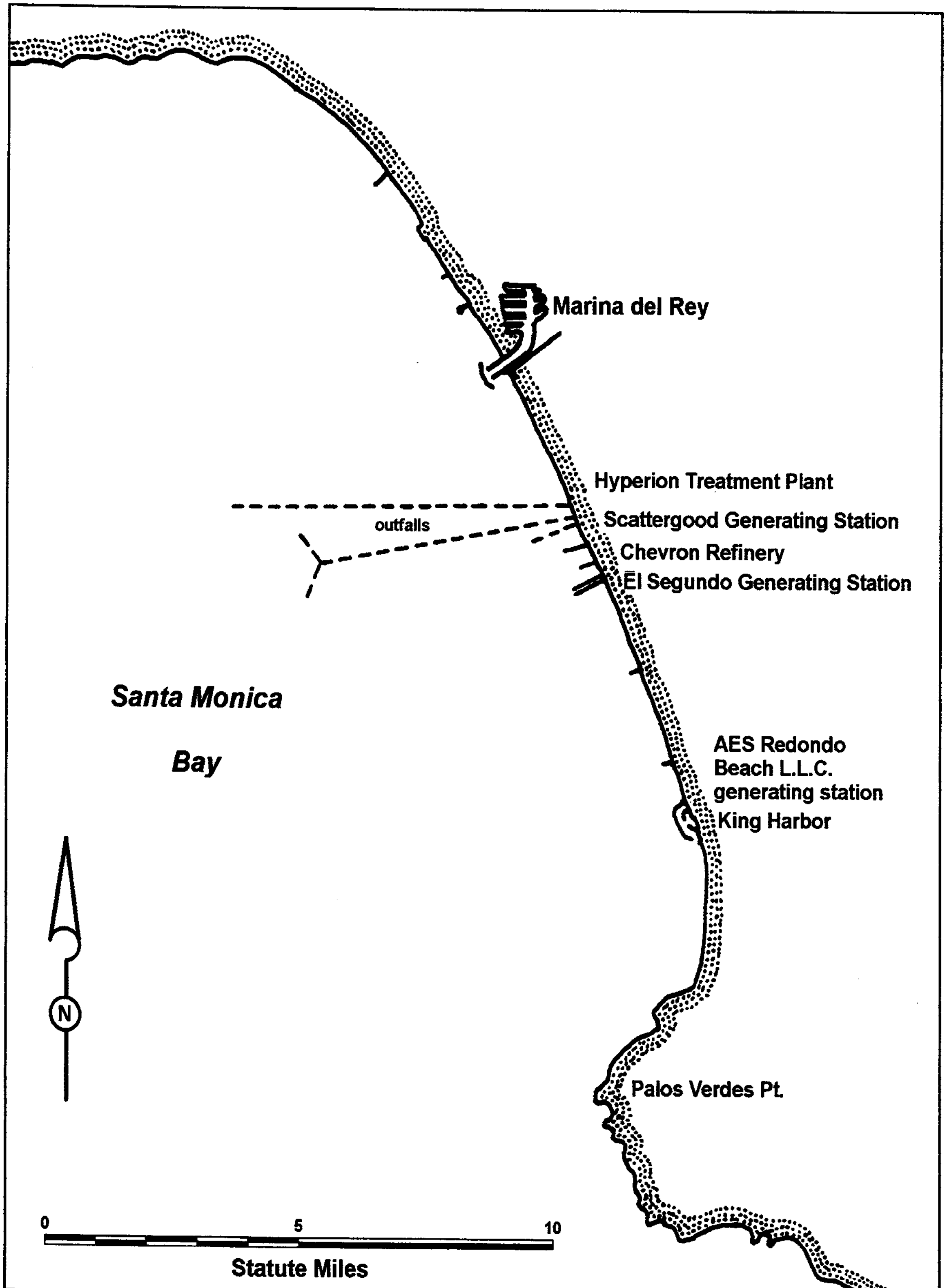


Figure 1. Location of the study area. El Segundo and Scattergood Generating Stations NPDES, 1999.

less than 1.6 to more than 15 km wide, and averaging approximately 7 km. Seaward of the shelf is an irregular, geologically complex region known as the continental borderland, comprising basins and ridges which extend from near the surface to depths in excess of 2,400 m.

Oceanographic conditions in the study area are largely a function of offshore water masses, but these are modified by local conditions, especially local submarine topography. Santa Monica Bay is characterized by a gently sloping (about 0.5°) continental shelf. At water depths of about 80 m the shelf steepens as it approaches Santa Monica Basin (Terry et al. 1956). Within the Bay the continental shelf ranges in width from a few hundred meters to about 19 km, forming a large central plateau which is dissected by submarine canyons.

Santa Monica Submarine Canyon comes to within 11 km of shore offshore at Ballona Creek and the head of Redondo Submarine Canyon comes to within a few hundred meters of King Harbor in Redondo Beach. The shelf is broadest in the vicinity of the study area where the El Segundo and Scattergood Generating Stations discharge. Submarine canyons often cause anomalies in current direction and velocity; they may also enhance the transport of bottom water and act as migratory corridors for fish and invertebrates. In 1969, the predominant flow in Redondo Submarine Canyon was up-canyon, at an average speed of about 2.5 cm/s (Shepard and Marshall 1973).

Prior to development, the coast between Santa Monica and the Palos Verdes Peninsula consisted primarily of sand dunes, although wetlands were present adjacent to Ballona Creek. At present, about 50% of the shore comprises sandy beaches. Offshore the seafloor is composed largely of unconsolidated sediments which are generally finer with increasing distance from shore. Most nearshore sediments are olive green sands which form an elongate bed off Manhattan Beach and a large patch on the central plateau (Terry et al. 1956). Silty sand is found at mid-depths over much of the central plateau. Clay was a minor sediment constituent in the 1950s, but was more common in the 1970s (Bascom 1978).

Reduced wave intensity in summer allows sand and finer materials to accumulate nearshore; in winter, storms move them offshore to deep water (Grant and Shepard 1939). Nearshore sands typically move parallel to shore by longshore drift and may be transported into the heads of submarine canyons. Sand from the study area is expected to move southward into Redondo Submarine Canyon. Dikes, groins, and jetties have been constructed to interfere with littoral drift to aid in sand retention. In addition, beach nourishment, whereby sand is transported to the beach, is practiced. Since the Ballona Creek drainage was channelized in the 1930s, there has been little sediment input from the coastal plain; the major source of sand is now via runoff from the Santa Monica Mountains and the Santa Clara River (MBC 1988). Sediment moves downcoast from the Santa Clara River, around Point Dume, and into the northern portion of Santa Monica Bay during years of high runoff.

Climate

Southern California lies in a climatic regime broadly defined as Mediterranean, which is characterized by short, mild winters and warm, dry summers. Long-term annual precipitation near the coast averages about 46 cm, of which 90% occurs between November and April. Sea breezes are caused by differential heating between land and sea. During the summer, these breezes combine with the prevailing winds that blow out of the northwest to produce strong onshore winds. They typically start around noon and may continue through late afternoon, with speeds reaching 40 km per hour. In late fall and winter, reverse pressure systems frequently develop, causing coastal offshore winds from the southeast from November through February, typically between 1300 and 2000 hrs. Monthly mean air temperatures along the coast range from 8.3°C in winter to 20.6°C in summer, with the minimum dropping slightly below freezing and the maximum rising above 37°C.

Currents

Water in the northern Pacific Ocean is driven eastward by prevailing westerly winds until it impinges on the western coast of North America, where it divides to flow both north and south. The southern component is the California Current, a diffuse and meandering water mass which generally flows to the southeast (Jones 1971). No fixed western boundary to this current is defined; more than 90% of the bulk water transport is within 725 km of the California coast.

South of Point Conception, the California Current diverges; one branch turns northward and flows inshore of the Channel Islands as the Southern California Countercurrent (Jones 1971). Surface speed in the countercurrent ranges from 5 to 10 cm/s. The general flow is complicated by small eddies around the Channel Islands and fluctuates seasonally, being well developed in summer and autumn, and weak or even absent in winter and spring. Generalized surface water circulation off southern California is shown in Figure 2. Currents near the coast are strongly influenced by a combination of wind, tide, and topography. When wind-driven currents are superimposed on the tidal motion, a strong diurnal component is usually apparent. Therefore, short-term observations of currents near the coast may often vary considerably in both direction and speed.

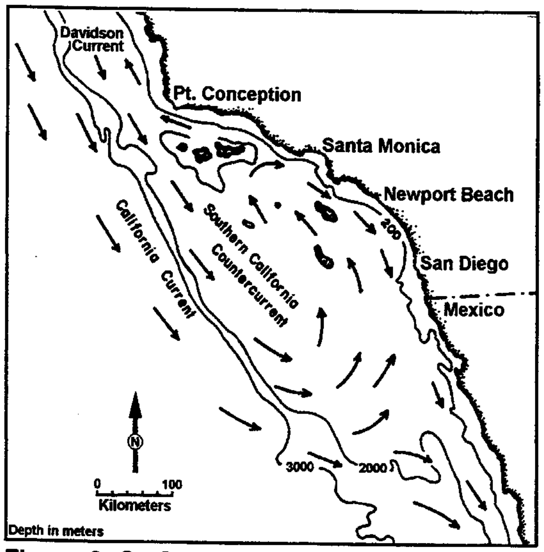


Figure 2. Surface circulation in the Southern California Bight (from Jones 1971). El Segundo and Scattergood Generating Stations NPDES, 1999.

Water generally enters Santa Monica Bay from the south and moves in a slow counterclockwise eddy. However, during winter a clockwise gyre may develop, with longshore flow of 2 cm/s (SCCWRP 1973, Hendricks 1980). Recent studies suggest that the clockwise gyre may be the dominant pattern on the shelf and that it reverses for a few days at a time due to tidal action. Tidal currents in Santa Monica Bay were slowest at the head of Redondo Submarine Canyon and greatest over the central parts of the broad shelf (Allan Hancock Foundation 1965).

Tides

Tides along the California coast are mixed semi-diurnal, with two unequal highs and two unequal lows during each 25-hr period. In the eastern North Pacific Ocean, the tide wave rotates in a counterclockwise direction. As a result, flood tide currents flow upcoast and ebb tide currents flow downcoast.

Upwelling

The predominantly northwesterly winds along the California coast are responsible for large-scale upwelling. From about February to October these winds induce offshore movement of surface water, which is replaced by the upwelling of deeper ocean waters near the coast. The upwelled water is colder, more saline, lower in oxygen, and higher in nutrient concentrations than surface waters. Thus, upwelling not only alters the physical properties of the surface waters, but also affects biological productivity by providing nutrients for the surface phytoplankton.

RECEIVING WATER CHARACTERISTICS

Water quality at El Segundo and Scattergood Generating Stations is affected by hydrology, currents, storm water runoff, industrial discharges, and ship traffic. In addition, climatological parameters such as solar radiation, humidity, and wind influence the condition of the receiving water.

The capacity of the marine environment to assimilate heated effluent depends on its ability to dilute and disperse the thermal discharge. The extent to which these functions are accomplished depends on the quantity and temperature of the thermal effluent relative to normal ocean temperature, ocean current patterns, and dispersion characteristics of the receiving waters. The following discussion focuses on natural ocean temperatures along the southern California coast and in Santa Monica Bay and addresses other physical and chemical oceanographic characteristics that influence the local marine biota.

Temperature

Natural water temperatures fluctuate throughout the year in response to seasonal and diurnal variations in currents, meteorological conditions such as wind, air temperature, relative humidity, and cloud cover, and other parameters such as ocean waves and turbulence. Natural temperature is defined by the California State Water Resources Control Board as "the temperature of the receiving water at locations, depths, and times which represent conditions unaffected by any elevated temperature waste discharge."

On the average natural surface water temperatures may be expected to vary diurnally 1°C to 2°C in summer and 0.3°C to 1°C in winter (EQA/MBC 1973). Factors which contribute to rapid daytime warming of the sea surface include weak winds, clear skies, and warm air temperatures. Conversely, overcast skies, moderate air temperatures, and the mixing of surface waters by winds and waves limit the daily warming. Natural surface water temperatures in Santa Monica Bay range from 11.7°C to 22.2°C annually (EQA/MBC 1973).

When there is a large difference between surface and bottom water temperatures, a steep temperature gradient between adjacent water layers of different temperatures (a thermocline) may develop. Natural thermoclines are formed when absorption of solar radiation elevates the temperature of surface water which then remains separated from the subsurface layer. Artificial thermoclines may result when warm water from a thermal discharge overlies cooler receiving waters. Off southern California, a reasonably sharp natural thermocline normally develops during the summer months; winter thermoclines are weakly defined.

Salinity

Salinity is a measure of the concentration of dissolved salts and is relatively constant in the open ocean. In coastal environments it fluctuates as a result of the introduction of freshwater runoff, direct rainfall, and evaporation. Salinities in Santa Monica Bay are relatively uniform, ranging from 33.0 to 34.0 parts per thousand (ppt) (Allan Hancock Foundation 1965).

Density

Seawater density varies inversely with temperature and directly with salinity. Water temperature is the major factor influencing density stratification in southern California since salinity is relatively uniform. As a result, density gradients are most pronounced in spring and summer. Thermoclines are often present during these parts of the year.

Dissolved Oxygen

Dissolved oxygen (DO) is utilized by aquatic plants and animals for respiration. It is replenished by gaseous exchange with the atmosphere and as a by-product of photosynthesis. Concentrations of DO in the surface waters of Santa Monica Bay range from approximately 5 to 12 mg/l (Allan Hancock Foundation 1965). High DO values can result from increased photosynthetic activity and low values result from the decomposition of organic matter and mixing of surface waters with oxygen-poor subsurface waters.

Hydrogen Ion Concentration

The hydrogen ion concentration (pH) in the Southern California Bight varies narrowly around a mean of approximately 8.0 and decreases slightly with depth. Normal pH values in Santa Monica Bay range between 8.0 and 8.6 (Allan Hancock Foundation 1965).

BENEFICIAL USES OF RECEIVING WATERS

The State Water Resources Control Board (1978) enumerated 10 beneficial uses of coastal and tidal waters in the nearshore zone of the Pacific Ocean. Of these, nine were specifically identified with the El Segundo-Scattergood area:

Industrial Service Supply

Uses which do not depend primarily on water quality such as mining, cooling water, hydraulic conveyance, gravel washing, fire protection, and oil well repressurization.

Water Contact Recreation

Includes all recreational uses involving body contact with water, such as swimming, wading, water skiing, skin diving, surfing, sportfishing, use in therapeutic spas, or other uses where ingestion of the water is reasonably possible.

Non-contact Water Recreation

Recreational uses which involve the presence of water, but do not necessarily require body contact, such as picnicking, sunbathing, hiking, beachcombing, camping, pleasure boating, tidepool and marine life study, hunting, and general aesthetic enjoyment.

Ocean Commercial and Sportfishing

Includes the commercial collection of fish and shellfish, including those collected for bait, plus sportfishing in the ocean, bays, estuaries, and similar non-freshwater areas.

Marine Habitat

Provides for the preservation of the marine ecosystem, including the propagation and sustenance of fish, shellfish, marine mammals, waterfowl, and marine vegetation.

Preservation of Rare and Endangered Species

Provides an aquatic habitat necessary, at least in part, for the survival of certain species established as being rare or endangered.

Navigation

Includes commercial and ocean shipping, and military (naval) operation.

Shellfish Harvesting

The collection of shellfish such as clams, oysters, abalone, shrimp, crab, and lobster for sport or commercial purposes.

Fish Spawning

Provides high quality aquatic habitat especially suitable for fish spawning.

MATERIALS AND METHODS

SCOPE OF THE MONITORING PROGRAM

The 1999 monitoring program for the El Segundo and Scattergood Generating Stations was conducted by MBC Applied Environmental Sciences (MBC) in accordance with specifications set forth in the NPDES Monitoring and Reporting Programs (Appendix A). The monitoring program included winter and summer water column profiling, summer sediment sampling for grain size and chemistry, summer biological sampling for benthic infauna and mussels, and periodic impingement sampling for fish and macroinvertebrates.

STATION LOCATIONS

The locations of the monitoring stations are described in Appendix A and shown on Figure 3. The 1999 monitoring program included 12 receiving water (RW) water quality stations, eight sediment stations and eight infaunal (B) stations.

WATER COLUMN MONITORING

Temperature (°C), dissolved oxygen (DO), and hydrogen ion concentration (pH) were continuously measured throughout the water column during the winter and summer surveys. Sampling was conducted on both flood and ebb tides at each of the 12 receiving water monitoring stations (Figure 3). Data were obtained *in situ* using an SBE 9/17 CTD water quality profiling system (Sea-Bird), and averaged at 1.0 m intervals. In the field, the data were transferred from the Sea-Bird to floppy disk for storage. In the laboratory, data were processed using Sea-Bird proprietary software (SeaSoft ver. 4.35). The resulting information was imported into MS Excel spreadsheets for further reduction and analysis. Water column profiles were plotted using SigmaPlot (ver. 5.0 software).

SEDIMENT MONITORING

Sediment samples for grain size and metal chemical analyses were collected during the summer survey at eight benthic stations (Stations B1 - B8) by biologist-divers. Grain size samples were collected using a 15-cm-long, 3.5-cm-diameter, plastic core tube. Sediment samples were collected at the same time infauna samples were taken, and were transferred to jars or plastic bags for later laboratory analysis.

Sediment Grain Size

The size distributions of sediment particles were determined using two techniques: laser light diffraction to measure the amount and patterns of light scattered by a particle's surface for the

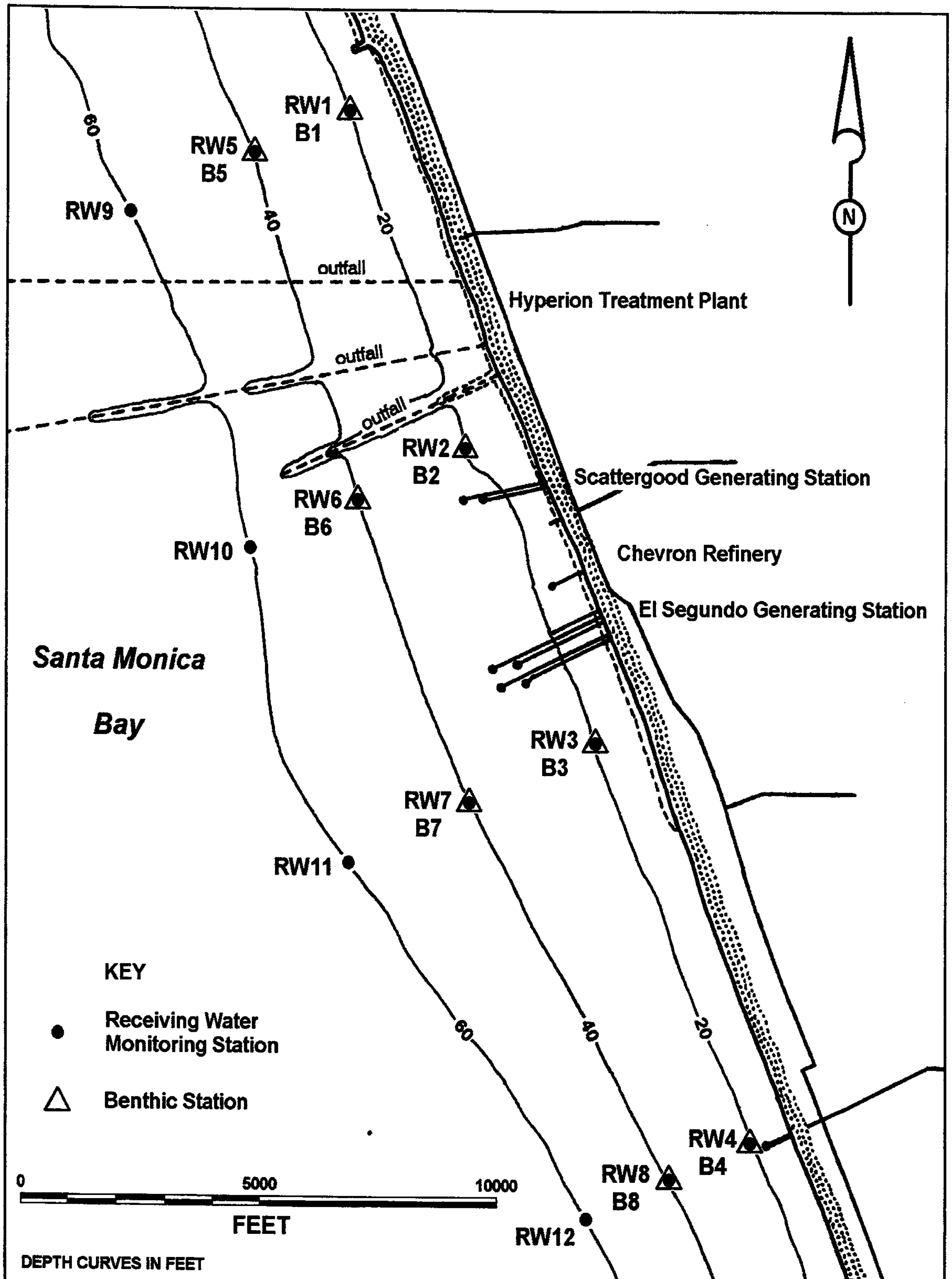


Figure 3. Location of the monitoring stations. El Segundo and Scattergood Generating Stations NPDES, 1999.

sand/silt/clay fraction, and standard sieving for the gravel fraction. Laboratory data from the two methods were combined and presented in tabular format. Resulting analyses include mean and median grain size, standard deviation of the grain size, sorting, skewness, and kurtosis. Data were plotted as size-distribution curves. Additional details are provided in Appendix B.

Sediment Chemistry

Sediment cores collected for chemical analyses were placed on ice in the field and maintained at approximately 4 °C until laboratory procedures began. Sediments were analyzed for total percent solids and four metals: chromium, copper, nickel, and zinc. EPA method 160.3 was used to determine percent solids and EPA method 6010 for metals.

MUSSEL BIOACCUMULATION

Bay mussels (*Mylitus edulis*) were collected near the discharges by biologist-divers during the summer survey for bioaccumulation monitoring. Two sets of 45 mussels with shell lengths averaging 65.5 mm at SGS and 54.2 mm at ESGS were processed according to methods used in the California Mussel Watch (Appendix A, SWRCB 1986). Soft tissue from the mussels was analyzed for copper, chromium, nickel, and zinc. Results were compared to levels found in other mussel watch programs, including resident bay mussels from pier reference sites which were collected and analyzed concurrently for another NPDES monitoring program.

BIOLOGICAL MONITORING

The biological monitoring program consisted of benthic infauna sampling by biologists using diver-operated box corers at eight stations (Stations B1 - B8) during the summer survey. Sampling fish and macroinvertebrate populations from heat treatment impingement operations were conducted at the screenwells of the El Segundo and Scattergood Generating Stations.

Benthic Infauna

Infaunal sampling was conducted at the eight benthic stations (Figure 3), using a hand-held, diver-operated box corer (Figure 4) which collects a bottom sample of 10 cm x 10 cm x 10 cm for a total sample volume of 1.0 liter. The box corer is pushed into the sediment and a closing blade is swung across the mouth of the box. The core is then withdrawn from the sediment and sealed by a neoprene lid for transport to the surface.

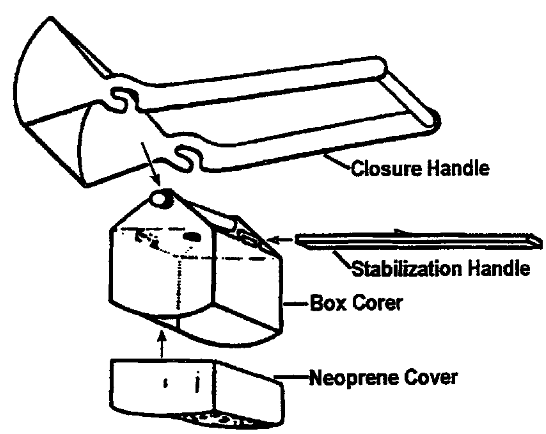


Figure 4. Diver-operated box corer used to collect infaunal samples. El Segundo and Scattergood Generating Stations NPDES, 1999.

Samples were washed in the field using a 0.5 mm stainless-steel mesh screen, labeled, and fixed in buffered 10% Formalin-seawater. In the laboratory, samples were re-screened through a 0.25 mm sieve, transferred to 70% isopropyl alcohol, sorted to major taxonomic groups, identified to the lowest practical taxonomic level, and counted. Representative specimens were added to MBC's reference collection.

Following identification, the weight of organisms in the major taxonomic groups in each replicate was obtained. Specimens were placed on small, pre-weighed mesh screens which had been submersed in 70% isopropyl alcohol, blotted on a paper towel, and air-dried for five minutes. Total wet weight minus screen tare weight provided the wet weight of the organisms. Large organisms were weighed separately.

Fish Impingement

Fish impingement sampling was conducted during representative periods of normal operation and during all heat treatment procedures to obtain an estimate of total impingement for the year. A normal operation survey is defined as a sample of all fish and macroinvertebrates entrained by water flow into the generating station intake and subsequently impinged onto traveling screens during a 24-hour period, with all circulating pumps operating, if possible. Normal operation abundance for the year is estimated by multiplying the number of normal operation samples by the total operational days during the year. The number of operational days is usually less than 365 because of plant maintenance downtime and seasonal fluctuations in the demand for electricity, which may result in decreased water flow into the power plant. Extrapolated normal operations abundance and biomass for 1999 were based on 12 sample days and 62.9% of the annual flow of water into the plant. Extrapolation exceptions were made where such extrapolations would result in exaggerated counts for species that typically occur in low abundance.

A heat treatment is an operational procedure designed to eliminate mussels, barnacles, and other fouling organisms, which grow in and occlude the generating station conduits. During a heat treatment, heated effluent water from the discharge conduit is re-entrained via cross-connecting tunnels to the intake conduit until the water temperature rises to approximately 40.5°C in the screenwells. This temperature is maintained for a period of at least one hour during which time all mussels, barnacles, and incidental fish and invertebrates living within the intake conduit and forebay succumb to the heated water. All material is subsequently impinged onto the traveling screens and removed from the forebay. The fish and macroinvertebrates are then separated from incidental debris, sorted by species, identified, and counted. Fish are measured (mm) to either standard length, total length, or disk width (as appropriate), and examined for external parasites, anatomical anomalies, and other abnormalities. Aggregate weights are taken by species for both fish and macroinvertebrates. Unusual specimens and those of uncertain identity are preserved in 10% Formalin-seawater and returned to the laboratory for positive species determination and, if warranted, retention in the MBC collection of voucher species. Data are collected for each heat treatment survey and combined with the estimated normal operation data to determine the total impingement loss for the year. Data was supplied and preliminary analyses performed by Kevin T. Herbinson, SCE.

STATISTICAL ANALYSES

Summary statistics developed from the biological data included the number of individuals (expressed as both number per grab and density), number of species and Shannon-Wiener (Shannon and Weaver 1962) species diversity (H') index.

The diversity equation is as follows:

Shannon-Wiener

$$H' = -\sum_{j=1}^{s} \frac{n_j}{N} \ln \frac{n_j}{N}$$

where:

n_j = number of individuals in the j^{th} species
S = total number of species
N = number of individuals

Data from infaunal coring collections were subjected to log transformations (when necessary) and classified (clustered) using the SYSTAT (SYSTAT ver. 5.0, Systat, Inc., Evanston, IL) clustering module (Wilkinson 1986). Cluster analysis provides a graphic representation of the relationship between species, their individual abundance, and spatial occurrence among the stations sampled. In theory, if physical conditions were identical at all stations, the biological community would be expected to be identical as well. In practice this is never the case, but it is expected that the characteristics of adjacent stations would be more similar than those distant from one another. The dendrogram shows graphically the degree of similarity (and dissimilarity) between observed characteristics and the expected average. The two-way analysis utilized in this study illustrates groupings of species and stations, as well as their relative abundance, expressed as a percent of the overall mean. Two classification analyses are performed on each set; in one (normal analysis) the sites are grouped on the basis of the species which occurred in each, and in the other (inverse analysis) the species are grouped according to their distribution among the sites. Each analysis involves three steps. The first is the calculation of an inter-entity distance (dissimilarity) matrix using Euclidean distance (Clifford and Stephenson 1975) as the measure of dissimilarity.

Clifford and Stephenson

$$D = \left[\sum_{1}^{n} (x_1 - x_2) \right]^{1/2}$$

D = Euclidean distance between two entities
x_1 = score for one entity
x_2 = score for other entity
n = number of attributes

The second procedure, referred to as sorting, clusters the entities into a dendrogram based on their dissimilarity. The group average sorting strategy is used in construction of the dendrogram (Boesch 1977). In step three, the dendrograms from both the site and species classifications are combined into a two-way coincidence table. The relative abundance values of each species are replaced by symbols (Smith 1976) and entered into the table. In the event of extreme high abundance of a single species, abundance data are transformed using a natural log transformation [ln(x)].

RESULTS

FIELD OPERATIONS

The 1999 NPDES surveys at El Segundo and Scattergood Generating Stations were conducted on 24 February, 15 July, and 13 August 1999. Latitude and longitude coordinates for water quality and benthic stations are given in Table1.

Table 1. Latitude/longitude coordinates of sampling stations. El Segundo and Scattergood Generating Stations NPDES, 1999.

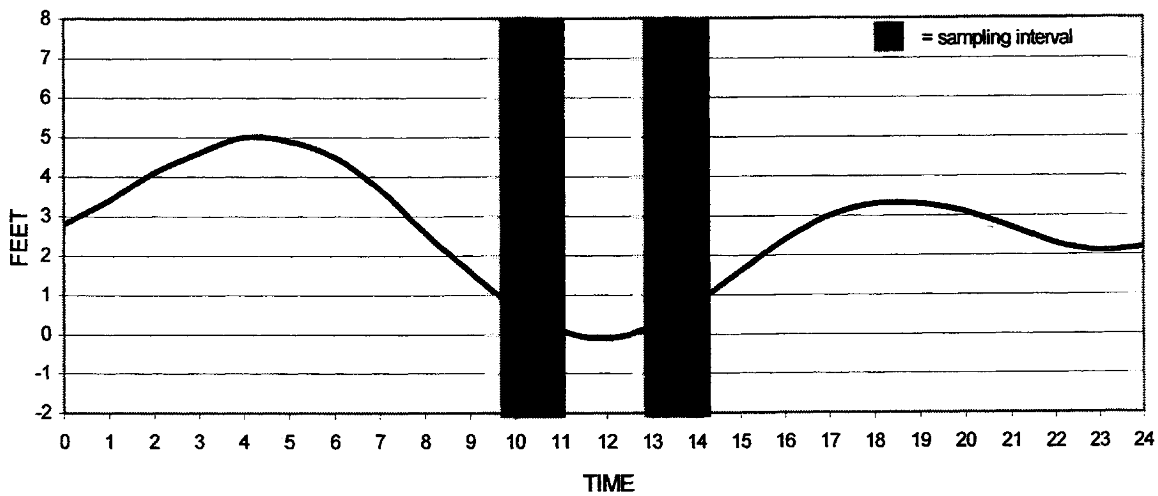
Stations			
Water Quality	Benthic	Latitude	Longitude
RW1	B1	33°56.23	118°26.63
RW2	B2	33°55.19	118°26.13
RW3	B3	33°54.27	118°25.57
RW4	B4	33°53.63	118°25.43
RW5	B5	33°56.20	118°27.05
RW6	B6	33°55.06	118°26.63
RW7	B7	33°54.07	118°26.10
RW8	B8	33°53.54	118°25.83
RW9		33°56.89	118°27.44
RW10		33°54.95	118°27.08
RW11		33°53.82	118°26.64
RW12		33°53.39	118°26.19

Water quality data were collected during ebb and flood tides in both winter and summer. Winter ebb tide was sampled on 24 February 1999 between 0931 and 1105 hr; flood tide, between 1252 and 1423 hr (Figure 5). Skies were clear all day with light winds that changed from east 2 kn to southwest 4 kn during sampling. Seas were southwest 3 to 4 ft throughout the day. Tides ranged from a high of +5.0 ft Mean Lower Low Water (MLLW) at 0422 hr to a low of –0.1 ft MLLW at 1153 hr, and back to a high of +3.4 ft MLLW at 1833 hr. Summer flood tide was sampled on 13 August 1999 between 1000 and 1131 hr; ebb tide between 1303 and 1433 hr (Figure 6). Seas were southwest 1 to 3 ft, with winds southwest 2 to 8 kn. Skies were clear to mostly cloudy during sampling. The tide ranged from a low of -0.4 ft MLLW at 0537 hr to a high of +4.7 ft MLLW at 1159 hr, and back to a low of +1.5 ft MLLW at 1730 hr.

Infauna, grain size and sediment chemistry samples were collected by biologist-divers between 0920 and 1600 hr on 15 July 1999. Seas were southwest at 2 to 3 ft, with southwest winds 2 to 8 kn. Skies were partly cloudy throughout the day.

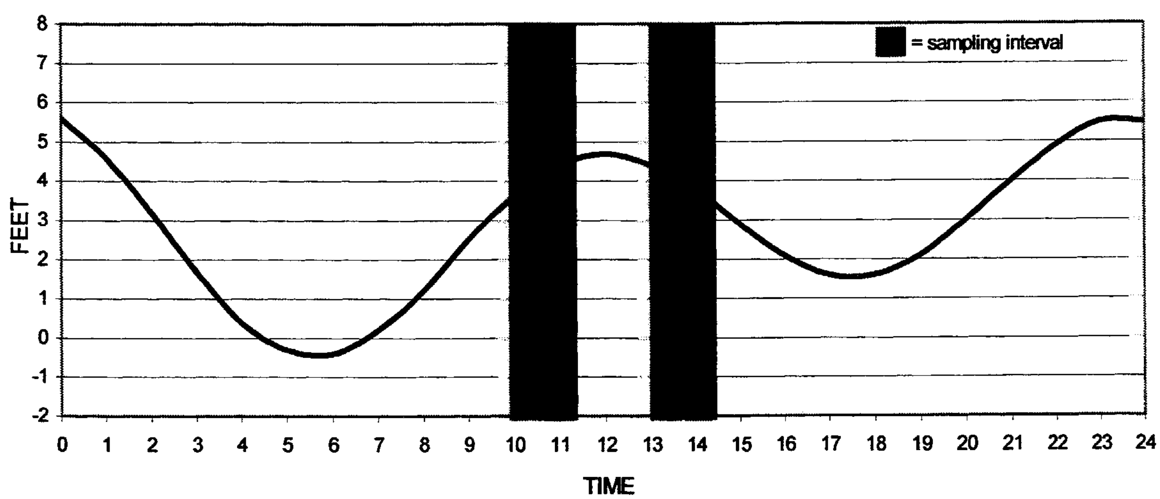
During the winter survey, no oil films, grease, or red tide was observed. The inshore waters were turbid from breaking waves at Stations RW2, RW3, and RW4 during ebb tide. Plastic trash was observed at Stations RW5, RW7, and RW12. Western gulls (*Larus occidentalis*) were observed at Stations RW2 and RW11, and Heermann's gulls (*Larus heermanni*) were seen at Station RW9. A surf scoter (*Melanitta perspicillata*) was seen at Station RW1; western grebes (*Aechmophorus occidentalis*) at Stations RW2; and a loon (*Gavia* sp.) at Station RW11. No California brown pelicans (*Pelecanus occidentalis californicus*) or California least terns (*Sterna antillarum browni*) were observed during any component of the winter survey.

During the summer surveys, no oil films or grease, turbidity, or red tide was observed. Drift kelp was seen at Station B5. Heermann's gulls, western gulls, and Caspian terns (*Sterna caspia*) were observed throughout the study area. Forster's terns (*Sterna forsteri*) were seen at Station RW6, and royal terns (*Sterna maxima*) were seen at Station B1. Bottlenose dolphins (*Tursiops truncatus*) were seen at Station B1, and California sea lions (*Zalophus californianus*) were seen at Stations RW10 and RW11. California brown pelicans were seen at Stations RW5, RW6, RW9, RW11, and RW12. No California least terns were observed during any component of the summer survey.



Pacific Standard Time			Wednesday			February 24, 1999	
Time	Height	Time	Height	Time	Height	Time	Height
0:00	5.0'	1153	-0.1'	1833	3.4'	2311	2.1

Figure 5. Tidal rhythms during water column sampling, winter survey. El Segundo and Scattergood Generating Stations NPDES, 1999.



Pacific Daylight Time			Friday			August 13, 1999	
Time	Height	Time	Height	Time	Height	Time	Height
0:00	-0.4'	1159	4.7'	1730	1.5'	2331	5.6'

Figure 6. Tidal rhythms during water column sampling, summer survey. El Segundo and Scattergood Generating Stations NPDES, 1999.

Temperature

In winter, mean surface water temperature during ebb tide was 13.50°C; temperatures ranged from 13.13°C at Station RW9 to 13.88°C at Station RW2 (Table 2). Temperature gradients were mild, with all stations decreasing gradually with depth, except Station RW4, which maintained a similar temperature throughout the 7m deep water column (Figure 7). Temperatures at Stations RW 8 and RW 12 were similar in the upper water column, but decreased with greater depth. During flood tide, mean surface water temperature was 13.91°C; temperatures ranged from 13.41°C at Stations RW9 and RW10 to 14.77°C at Station RW2. Compared to ebb tide, temperatures during flood tide were generally warmer at the surface and, although temperatures also gradually decreased with depth, the differences in maximum and minimum temperatures were generally greater during flood tide. The mean bottom temperature during ebb tide was 12.27°C and during flood tide was 12.44°C. Bottom temperatures ranged from 11.29°C at Station RW11 to 13.51°C at Station RW2 during ebb tide, and from 11.89°C at Station RW9 to 13.43°C at Station RW2 during flood tide. The maximum surface-to-bottom difference recorded was at Stations RW7 and RW11during both ebb tide (2.07°C and 2.06°C) and at Station RW5 on flood tide (2.34°C).

Table 2. Summary of water quality parameters during ebb and flood tides. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Temp. (°C)		D.O. (mg/l)		pH		Temp. (°C)		D.O. (mg/l)		pH	
							Winter					
	Surface						Bottom					
	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood
Mean	13.50	13.91	8.11	8.03	7.83	7.82	12.27	12.44	6.96	7.15	7.76	7.75
Minimum	13.13	13.41	7.72	7.65	7.82	7.80	11.29	11.89	5.73	6.22	7.66	7.71
Maximum	13.88	14.77	8.44	8.53	7.86	7.83	13.51	13.43	8.32	8.37	7.82	7.80
							Summer					
	Surface						Bottom					
	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood
Mean	20.20	19.91	7.90	7.82	8.13	8.13	16.29	15.67	8.55	8.42	8.08	8.06
Minimum	19.27	19.15	7.50	7.68	8.12	8.12	13.42	13.66	8.06	7.92	8.00	7.98
Maximum	21.29	20.41	8.16	8.08	8.14	8.14	19.86	19.24	8.91	9.08	8.14	8.13

In summer, mean surface water temperature during ebb tide was 20.20°C; temperatures ranged from 19.27°C at Station RW11 to 21.29°C at Station RW4 (Table 2). Temperature gradients were present at all stations during ebb tide, with the gradients beginning below one to six meters (Figure 8). While temperature at most stations decreased gradually with depth, an obvious thermocline was present at Station RW4, which decreased by almost 4.5°C over 6 m depth. During flood tide, surface temperatures were generally lower than ebb tide. Mean surface water temperature was 19.91°C, with temperatures ranging from 19.15°C at Station RW12 to 20.41°C at Station RW5. Profiles from flood tide showed that temperature at all stations decreased with depth, with strong temperature gradients in the top 12 meters of all stations except RW4, RW10, RW11, and RW12. The mean bottom temperature during ebb tide was 16.29°C and during flood tide was 15.67°C. Bottom temperature ranged from 13.42°C at Station RW11 to 19.88°C at Station RW2 during ebb tide, and from 13.66°C at Station RW11 to 19.24°C at Station RW4 on flood tide. The maximum surface-to-bottom difference on both tides was recorded at Station RW9; 6.00°C during ebb tide and 5.94°C during flood tide.

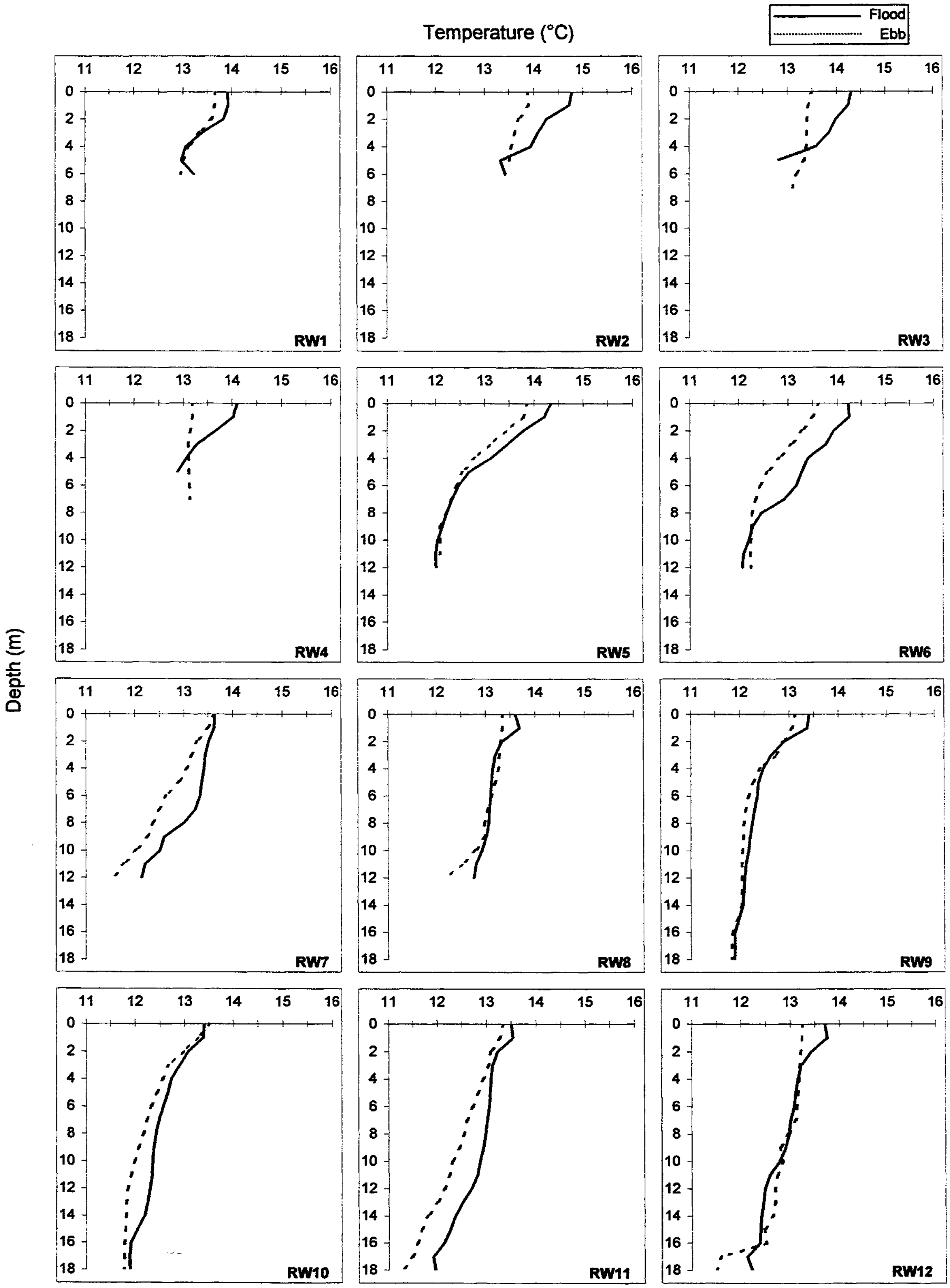


Figure 7. Temperature vertical profiles during flood and ebb tides, winter survey. El Segundo and Scattergood Generating Stations NPDES, 1999.

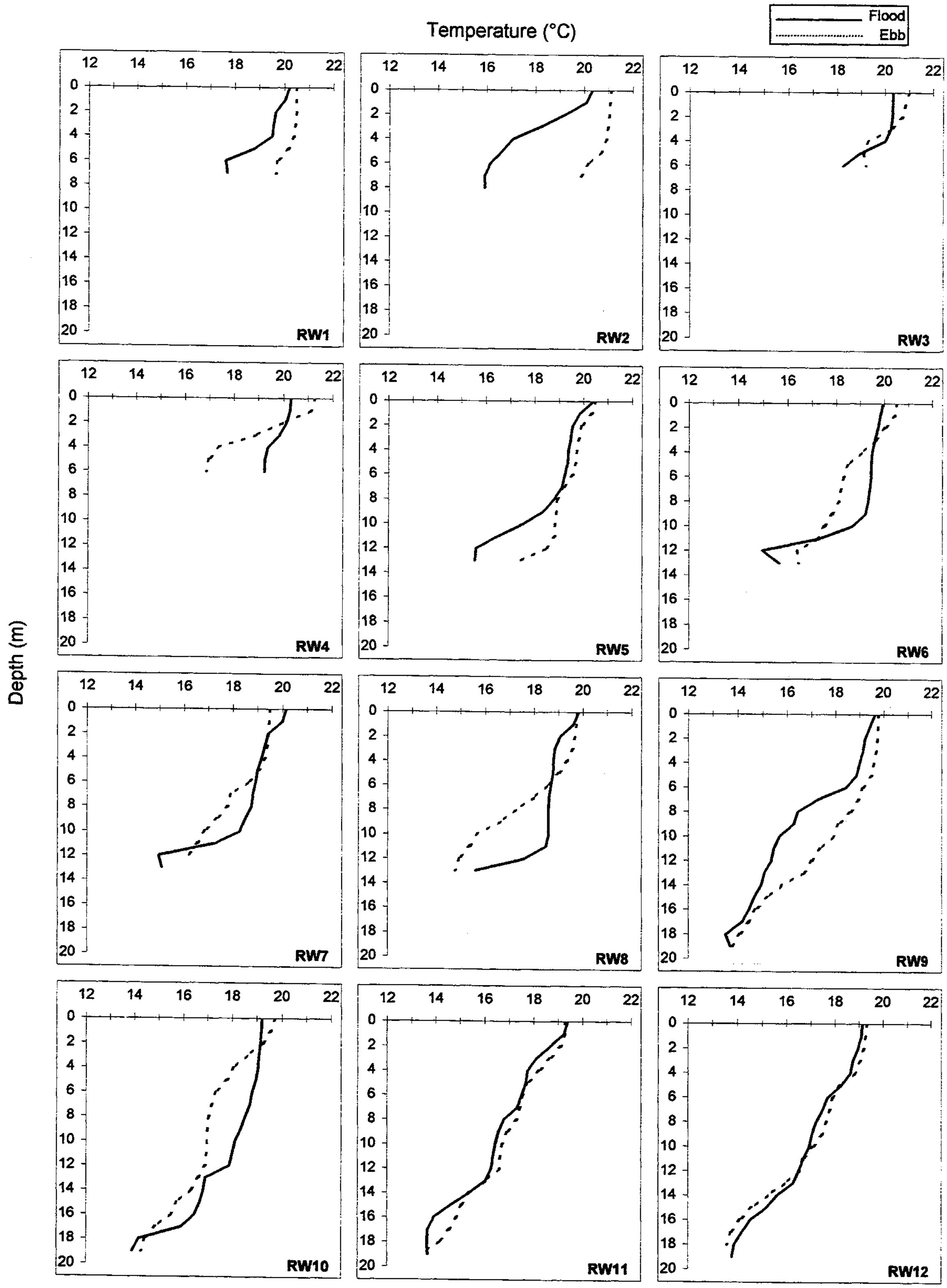


Figure 8. Temperature vertical profiles during flood and ebb tides, summer survey. El Segundo and Scattergood Generating Stations NPDES, 1999.

Dissolved Oxygen

In winter, surface dissolved oxygen (DO) concentrations averaged 8.11 mg/l during ebb tide, ranging from 7.72 mg/l at Station RW9 to 8.44 mg/l at Station RW4 (Table 2). During flood tide, the mean surface DO concentration was 8.03 mg/l; ranging from 7.65 mg/l at Station RW2 to 8.53 mg/l at Station RW1. During ebb tide, DO concentrations generally increased slightly with depth then decreased below a mid-water maximum found between 3 and 5 meters depth (Figure 9). Offshore Stations RW11 and RW12 were fairly consistent in the upper water column, with decrease and fluctuation in DO levels below 10 m depth. The mean bottom DO during ebb tide was 6.96 mg/l and during flood tide was 7.15 mg/l. The lowest bottom value on ebb tide occurred at Station RW11, with a DO of 5.73 mg/l and on flood at Station RW5, with a DO of 6.22 mg/l. The highest bottom values were 8.32 mg/l at Station RW2, and 8.37 mg/l at Station RW3, on ebb and flood tides, respectively. Mean surface DO was slightly higher during flood tide, while mean bottom DO was slightly higher during ebb tide. Surface DO levels were similar at each station between tides except at Station RW2, with ebb tide surface DO almost 0.6 mg/l higher than during flood tide. During flood tide, DO concentration tended to remain constant or increase slightly to mid-depth, as during ebb, then decrease below 4 to 10 meters. The maximum surface-to-bottom difference in DO concentration was 2.27 mg/l at Station RW7 during ebb tide, and 1.87 mg/l at Station RW5 during flood tide.

In summer, mean surface DO concentrations were 7.90 mg/l during ebb tide and 7.82 mg/l during flood tide (Table 2). During ebb tide, surface DO values ranged from 7.50 mg/l at Station RW3 to 8.16 mg/l at Station RW1. During flood tide, surface DO ranged from 7.68 mg/l at Station RW3 to 8.06 mg/l at Station RW1. Ebb tide surface DO values were similar to flood tide measurements (Figure 10). During both tides, DO values increased with depth in the water column, with the highest values mid-water. Maximum DO was found at 6 m depth or deeper (as deep as 18 m at Station RW10) at all stations during both tides. Below the mid-depth maximum, DO decreased to the bottom. DO concentrations were similar throughout the water column, with the greatest change only about 1.2 mg/l on either tide.

Hydrogen Ion Concentration

In winter, hydrogen ion concentration (pH) at the surface averaged 7.83 during ebb tide, fluctuating less than 0.2 units at all stations (Table 2). During flood tide, mean surface pH was 7.82, with values fluctuating 0.1units or less at all stations. Values were fairly uniform throughout the water column. Profiles of pH during flood tide were similar to those of ebb tide at each station, although pH at Station RW12 was about 0.05 units lower throughout the water column on flood tide (Figure 11). The maximum surface-to-bottom difference was 0.18 during ebb tide at Stations RW11 and RW12, and 0.10 during flood tide at Station RW5.

In summer, mean surface pH was 8.13 during both tides, with values fluctuating 0.16 or less on either tide (Table 2). At all stations, pH levels were nearly identical with very little change withdepth (Figure 12).

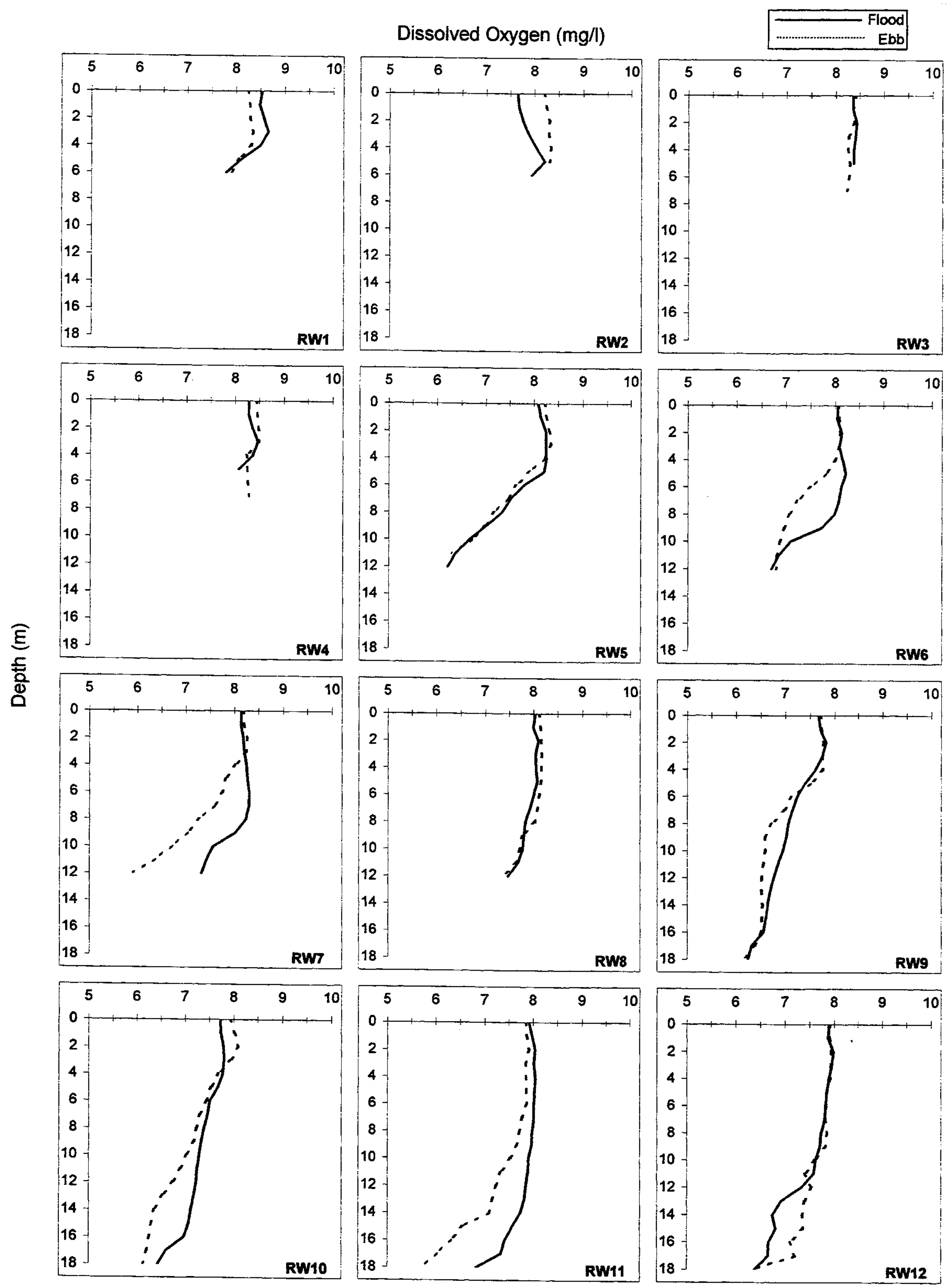


Figure 9. Dissolved oxygen vertical profiles during flood and ebb tides, winter survey. El Segundo and Scattergood Generating Stations NPDES, 1999.

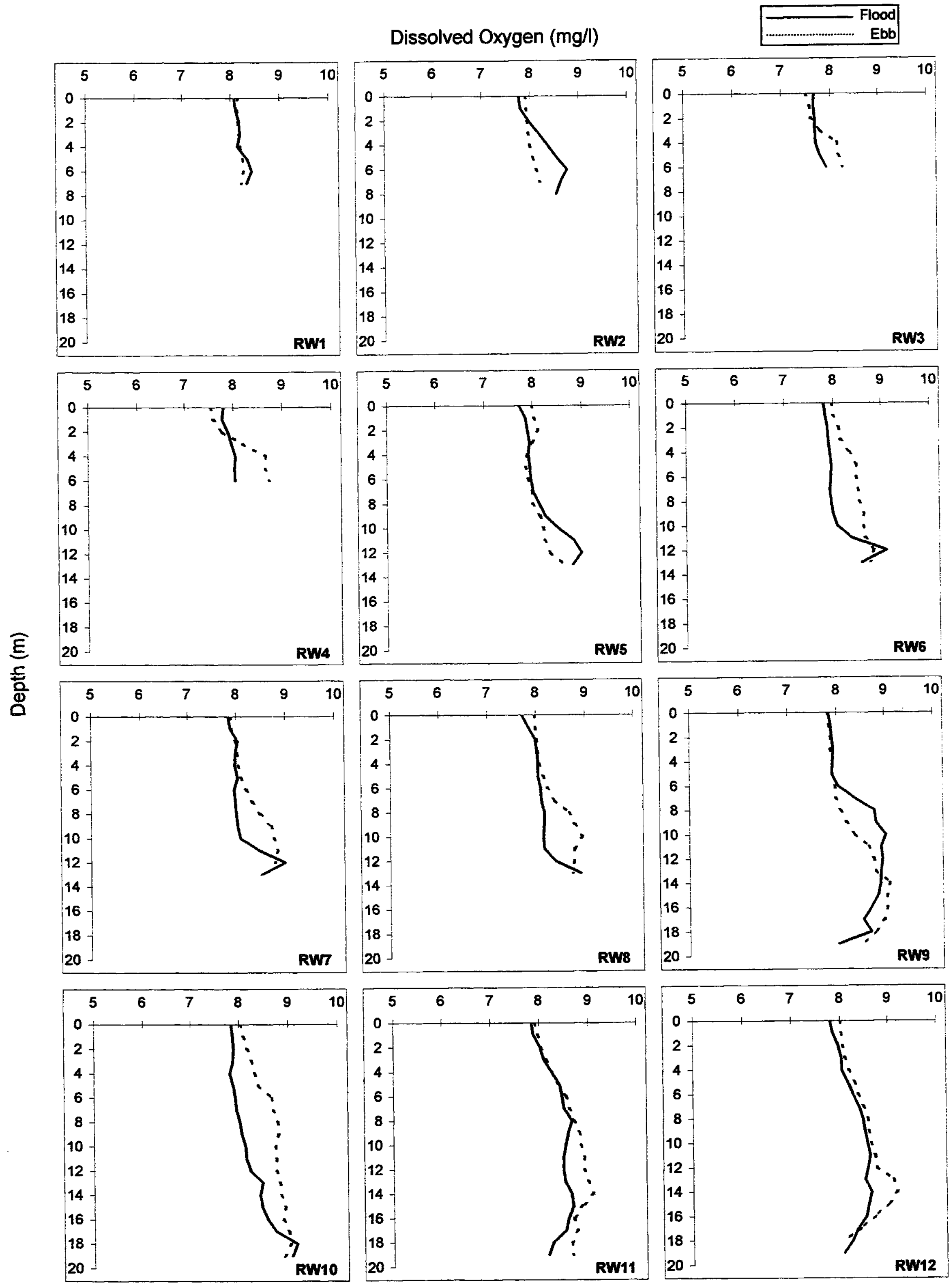


Figure 10. Dissolved oxygen vertical profiles during flood and ebb tides, summer survey. El Segundo and Scattergood Generating Stations NPDES, 1999.

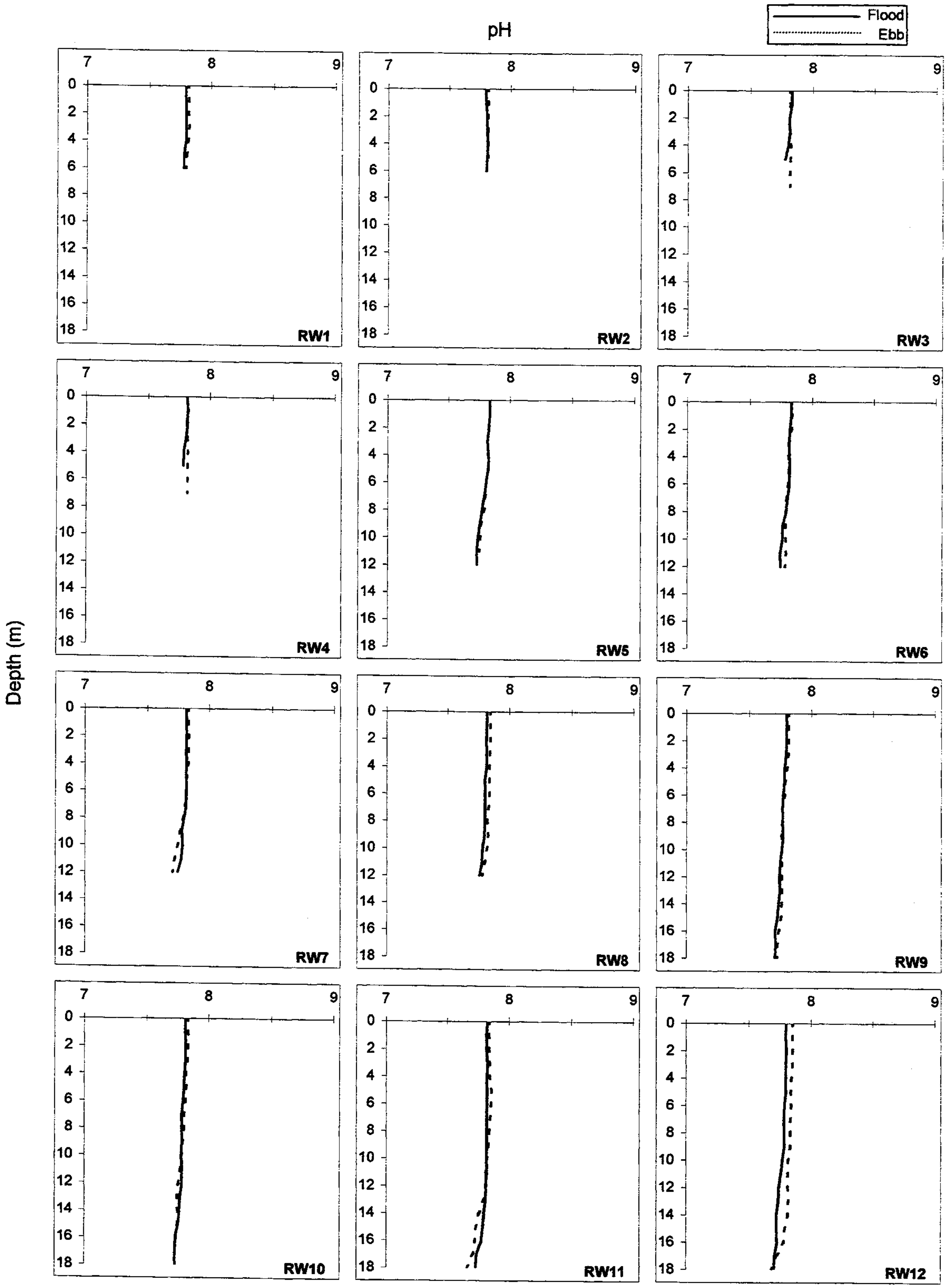


Figure 11. Hydrogen ion concentration (pH) vertical profiles during flood and ebb tides, winter survey. El Segundo and Scattergood Generating Stations NPDES, 1999.

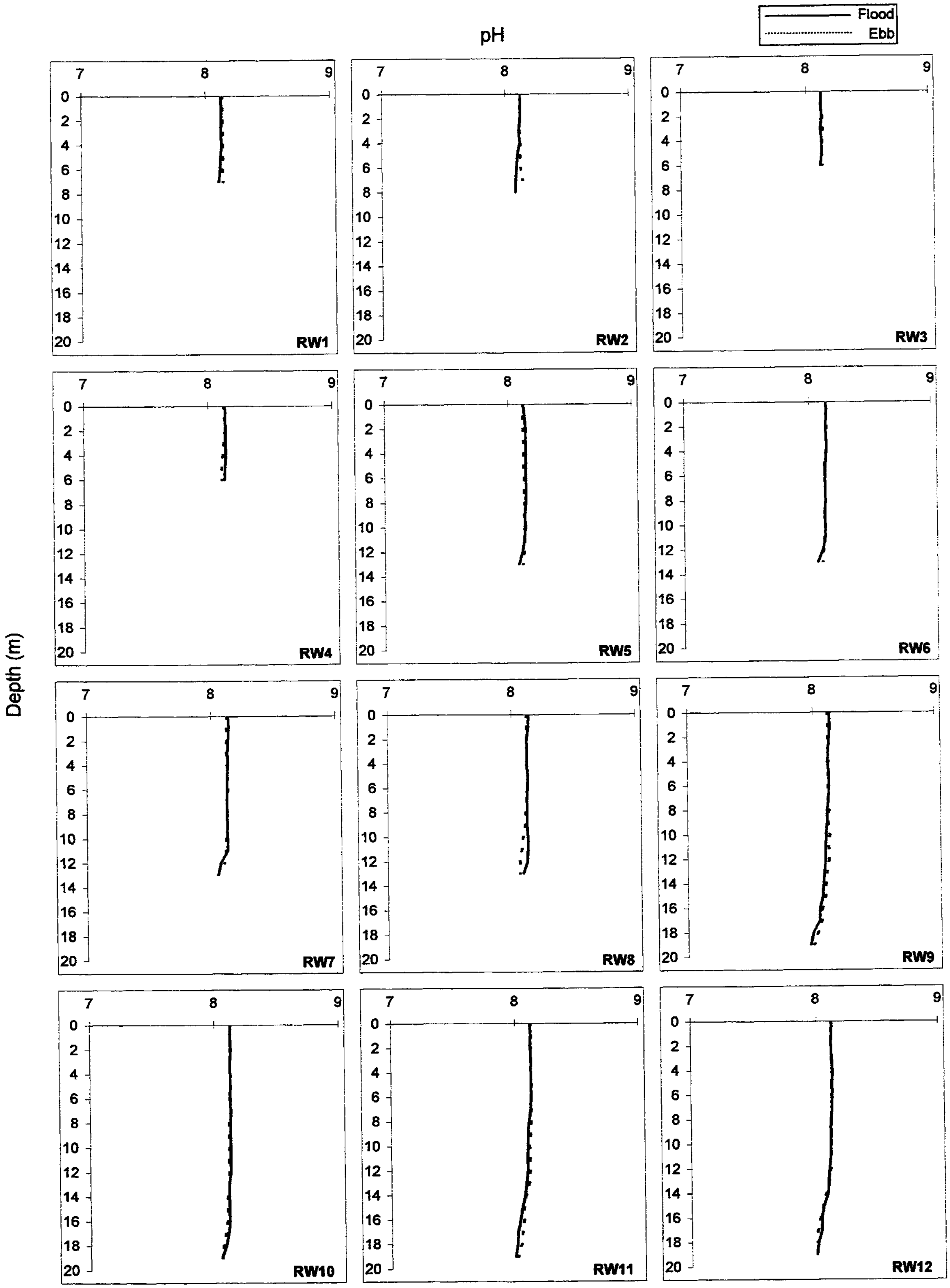


Figure 12. Hydrogen ion concentration (pH) vertical profiles during flood and ebb tides, summer survey. El Segundo and Scattergood Generating Stations NPDES, 1999.

SEDIMENT MONITORING

Sediment Grain Size

Particle size distribution curves for each station are presented in Appendix D and sediment grain size parameters are summarized in Table 3. Grain size is expressed in phi (Φ) units, which are inversely related to grain diameter in millimeters (mm).

Table 3. Sediment grain size parameters. El Segundo and Scattergood Generating Stations NPDES, 1999.

Parameter	Nearshore					Offshore					Overall	
	B1	B2	B3	B4	Mean	B5	B6	B7	B8	Mean	Mean	S.D.
% Gravel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Sand	88.78	84.37	97.82	95.72	91.67	99.30	92.76	93.90	94.20	95.04	93.36	4.84
% Silt	10.00	14.04	1.60	3.34	7.25	0.67	5.64	4.60	4.36	3.82	5.53	4.45
% Clay	1.22	1.59	0.58	0.94	1.08	0.03	1.60	1.50	1.44	1.14	1.11	0.56
Mean grain size												
phi	2.64	3.01	2.47	2.67	2.70	0.71	3.07	3.05	3.13	2.49		0.80
mm	161	124	181	158	156.0	612	119	121	114	241.5	198.8	168.8
Sorting (f)	1.23	1.07	0.59	0.99	0.97	0.86	0.63	0.53	0.50	0.63	0.80	0.28
Skewness	-0.14	0.06	-0.06	-0.33	-0.12	-0.11	0.08	0.12	0.08	0.04	-0.04	0.15
Kurtosis	1.06	1.47	1.08	1.73	1.34	1.07	1.48	1.28	1.24	1.26	1.30	0.24

In 1999, sediments at all stations were composed primarily of fine sand with smaller amounts of silt and clay (Table 3). Overall, samples from the four stations averaged 93% sand, 6% silt, and 1% clay, with an average mean grain size of 2.33 phi (199 µm, fine sand). Sediments were finest at offshore Station B8 (downcoast of the El Segundo discharge structures at a depth of 40 ft), where mean grain size was 3.13 phi (114 µm). Coarsest sediments were collected from offshore Station B5 (located upcoast of the Scattergood discharge), where mean grain size was 0.71 phi (612 µm). Sediments at the nearshore stations averaged 92% fine sand, with a mean grain size of 2.68 phi (156 µm) while sediments at the offshore stations averaged 95% medium-to-fine sand, with a mean grain size of 2.05 phi (242 µm).

Sorting, a measure of the spread of the particle distribution curve, averaged 0.80 phi overall, indicating moderately sorted sediments (Table 3). Sorting values ranged from 0.50 phi (well sorted) at offshore Station B8 to 1.23 phi (poorly sorted) at nearshore Station B1. Sediments at Stations B1 and B2, upcoast of the Scattergood discharge on the 20 ft isobath, were poorly sorted, indicating a broad range of size classes.

Sediments at all stations were slightly skewed; average skewness was -0.04 (Table 3). Lowest skewness was -0.33 at Station B4, indicating an excess of coarse material, while highest skewness was at Station B7 (0.12, indicating an excess of fine material).

Kurtosis is a measure of the peakedness of the particle distribution curve. A kurtosis value of 1.00 represents a normal particle distribution curve. Kurtosis values at all stations were greater than 1.00, indicating leptokurtic (excessively peaked) distributions, with dominance by a narrow range of particle sizes (Table 3). Lowest kurtosis values occurred at Stations B1, B3, and B5, while highest kurtosis values occurred at Station B4.

Sediment Chemistry

Concentrations of metals found in sediments at each station are presented in Appendix E and are summarized in Table 4. In 1999, concentrations of all metals were highest at nearshore Station B2 (Table 4). Lowest concentrations of all metals were detected at offshore Station B5.

Overall, chromium concentrations ranged from 6.8 to 22 mg/kg, copper from 1.8 to 7.0 mg/kg, nickel from 1.9 to 11 mg/kg, and zinc ranged from 15 to 43 mg/kg.

Table 4. Sediment metal concentrations (mg/dry kg). El Segundo and Scattergood Generating Stations NPDES, 1999.

Metal	Station B1	B2	B3	B4	B5	B6	B7	B8	Survey Mean	S.D.	Detection Level
Chromium	15	22	12	16	6.8	17	18	16	14.0	4.5	1
Copper	4.3	7	2.4	2.4	1.8	4.7	4.1	2.3	3.1	1.7	1
Nickel	8.2	11	5.3	6.5	1.9	7.3	7.5	7.2	5.7	2.6	1
Zinc	31	43	19	18	15	24	23	20	19.8	9.0	1

MUSSEL BIOACCUMULATION

In 1999, forty-five (45) bay mussels (*Mytilus edulis*) were collected from the Scattergood discharge structure and also from the El Segundo discharge structures. Shell lengths of mussels collected at the Scattergood discharge ranged from 50 to 74 mm and averaged 65.6 mm. Mean shell length of mussels collected from El Segundo averaged 54.2 mm and ranged from 50 to 62 mm.

Copper and zinc were detected in all three replicates of bay mussel tissue collected from the El Segundo discharge structure (Table 5, Appendix F). Mean concentration of copper was 24.3 mg/dry kg, and mean concentration of zinc was 120 mg/dry kg. Chromium and nickel were not detected in any of the replicates.

Table 5. Bay mussel tissue metal concentrations (mg/dry kg). El Segundo and Scattergood Generating Stations NPDES, 1999.

Metal	Replicate 1	2	3	Mean	S.D.
El Segundo Generating Station					
Chromium	N.D.	N.D.	N.D.	N.D.	N.D.
Copper	18	14	41	24.3	14.6
Nickel	N.D.	N.D.	N.D.	N.D.	N.D.
Zinc	100	120	140	120.0	20.0
Scattergood Generating Station					
Chromium	N.D.	N.D.	N.D.	N.D.	N.D.
Copper	8.5	N.D.	N.D.	2.8	
Nickel	N.D.	N.D.	N.D.	N.D.	N.D.
Zinc	130	110	100	113.3	15.3
N.D. = not detected					

Copper was detected in one replicate of bay mussel tissue collected from the Scattergood discharge structure at a concentration of 8.5 mg/dry kg. Zinc was detected in all three replicates of mussel tissue at a mean concentration of 113 mg/dry kg. Chromium and nickel were not detected in any of the replicates.

BIOLOGICAL MONITORING

Benthic Infauna

Results of infaunal analyses are presented by station and replicate in Appendix G and are summarized in Tables 6, 7, and 8.

Species Composition. A total of 1,237 infaunal organisms representing 143 species and nine phyla was collected during the summer survey (Table 6, Appendix G-1). Arthropoda was the most abundant and second most diverse phylum, accounting for 49% of the individuals and almost 32% of the species. The phylum Annelida was second most abundant, accounting for 30% of the individuals, but was first in species richness with 38% of the species. Mollusca was the third most abundant phylum comprising about 8% of individuals and 13% of the species. Echinoderms represented 6.5% of the abundance but was represented by only five species, while Nemerteans had 11 species but only 3.5% of the abundance. The four remaining phyla represented only 2.7% of the individuals and 5.6.% of the species. Two phyla, Sipuncula and Nematoda only had one representative species, while Chordata was represented by two species and Cnidaria by four species (Appendices G-1 and G-2). Echinoderms were generally more abundant at nearshore stations, while arthropods, mollusks, and chordates were found in greater numbers at the offshore stations. Annelids and Nermerteans were relatively evenly distributed between the offshore and nearshore stations. Of the remaining three phyla, two had greater numbers at offshore stations, and one was more numerous at the nearshore stations (Table 6).

Table 6. Number of infaunal species and individuals by phylum. El Segundo and Scattergood Generating Stations NPDES, 1999.

Parameter	Nearshore				Offshore				Total	Percent Total
	B1	B2	B3	B4	B5	B6	B7	B8		
Number of species										
Annelida	16	10	15	16	12	22	13	26	55	38.2
Arthropoda	13	11	13	11	5	18	10	20	46	31.9
Mollusca	4	3	7	6	3	1	3	6	19	13.2
Nemertea	2	-	2	4	4	2	5	5	11	7.6
Echinodermata	2	3	2	2	2	2	1	-	5	3.5
Cnidaria	-	-	4	1	-	1	-	2	4	2.8
Chordata	-	-	-	-	1	-	1	1	2	1.4
Nematoda	1	1	1	-	1	1	-	-	1	0.7
Sipuncula	-	-	-	-	-	1	-	-	1	0.7
Total	38	28	44	40	28	48	33	60	144	
Number of individuals										
Arthropoda	55	31	75	69	7	164	102	108	611	49.4
Annelida	73	22	45	44	44	67	21	60	376	30.4
Mollusca	7	3	14	7	27	1	13	23	95	7.7
Echinodermata	3	43	21	3	3	2	5	-	80	6.5
Nemertea	4	-	3	5	4	4	12	11	43	3.5
Cnidaria	-	-	5	5	-	1	-	2	13	1.1
Nematoda	1	1	1	-	8	1	-	-	12	1.0
Chordata	-	-	-	-	1	-	2	2	5	0.4
Sipuncula	-	-	-	-	-	2	-	-	2	0.2
Total	143	100	164	133	94	242	155	206	1237	

Number of Species. Species richness averaged 39.9 species per station and ranged from 28 species at both Station B2 and B5 to 60 species at Station B8 (Table 7). In general, species richness was slightly higher at offshore stations (an average of 42.3 species per station) than at nearshore stations (an average of 37.5 species).

Abundance and Density. Abundance averaged 154.6 individuals per station and ranged from 94 individuals at Station B5 to 242 individuals at Station B6 (Table 7). Density averaged 3,865 individuals/m^2, and ranged from 2,350 individuals/m^2 to 6,050 individuals/m^2. On average, abundance and density were greater offshore (an average of 174.3 individuals per station, or 4,356 individuals/m^2) than nearshore (an average of 135.0 individuals per station, or 3,375 individuals/m^2). The higher abundance at Station B6 was due to large numbers of the arthropods *Aoroides inermis* and *Photis* OCI, and the polychaete *Monticellina cryptica* which occurred in high numbers at that station.

Table 7. Infaunal community parameters. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Nearshore				Offshore					
Parameter	B1	B2	B3	B4	B5	B6	B7	B8	Total	Mean
Number of species										
Total	38	28	44	40	28	48	33	60	143	39.9
Rep. Mean	18.0	12.0	17.0	15.0	8.8	19.3	13.5	23.5		
Rep. S.D.	4.3	4.7	6.5	5.7	4.9	3.6	5.4	8.2		
Number of individuals										
Total	143	100	164	133	94	242	155	206	1237	154.6
Rep. Mean	35.8	25.0	41.0	33.3	23.5	60.5	38.8	51.5		
Rep. S.D.	10.0	4.5	21.1	15.6	18.6	35.7	28.4	25.1		
Diversity (H')										
Total	3.13	2.57	3.14	2.94	2.56	2.79	2.36	3.44	3.86	2.87
Rep. Mean	2.78	2.02	2.47	2.18	1.68	2.41	1.99	2.73		
Rep. S.D.	0.17	0.69	0.29	0.33	0.49	0.24	0.28	0.33		
Biomass (kg)										
Total	1.22	22.66	68.43	2.70	1.04	1.38	0.81	3.26	101.51	12.69
Rep. Mean	0.31	5.67	17.11	0.68	0.26	0.34	0.20	0.82		
Rep. S.D.	0.20	5.11	8.08	0.98	0.17	0.16	0.14	1.00		

Species Diversity. Shannon-Wiener species diversity index (H') values averaged 2.87 per station, and ranged from 2.36 at Station B7 to 3.44 at Station B8 (Table 7). Diversities were high due to the lack of clearly dominant forms at any of the stations. The offshore station average (2.79) was slightly lower than the nearshore station average (2.95).

Biomass. Biomass averaged 12.69 g per station, or 317.25 g/m^2. Biomass was highest at Station B3 (68.43 g, or 1,710.75 g/m^2) and next highest at Station B2 due to the collection of relatively large Pacific sand dollars (Table 7, Appendix G-3, G-4). The nearshore station average for biomass (23.75 g, or 593.81 g/m^2) was much greater than the offshore station average (1.62 g, or 40.56 g/m^2) due to the presence of the Pacific sand dollars in the nearshore samples.

The 28 most abundant species, those which each comprised 1% or more of the total abundance, accounted for 75% of all the organisms collected (Table 8). The four most abundant species, the arthropods *Aoroides inermis*, *Diastylopsis tenuis*, and *Rhepoxynius menziesi*, and the echinoderm *Dendraster excentricus*, along with the fifth and sixth most abundant species, the polychaete annelid *Apoprionospio pygmaea* and the arthropod *Photis* OCI, together, comprised 42% of the abundance. Both *Dendraster excentricus* and *Rhepoxynius menziesi* occurred primarily at the nearshore stations, while *Aoroides inermis* and *Diastylopsis tenuis* occurred mainly, and *Photis* OCI only, at offshore stations. Five species, *Photis* OCI, *Monticellina cryptica*, *Levinsenia gracilis*, *Solamen columbianum*, and *Photis bifurcata were* captured only from offshore stations while one other, the arthropod *Leptocuma forsmani* was obtained only from nearshore stations.

Cluster Analysis. Results of cluster analysis (classification) of the 28 most abundant infaunal species (Table 8) are presented in Figure 13.

Normal (site) analysis clustered the four stations into two groups. Group I consists of all of the nearshore stations and two offshore stations while Group II includes the other two offshore stations.

Inverse (species) analysis clustered the dominant species into three species groups. The arthropods *Aoroides inermis* and *Diastylopsis tenuis* and the annelid *Apoprionospio pygmaea* comprised (Group A), as they co-occurred at Stations B6 and B8 in relatively high numbers, did not occur at Station 5, and were resent in similar abundances at the remainder of the stations. The

Table 8. The 28 most abundant infaunal species. El Segundo and Scattergood Generating Stations NPDES, 1999.

		Nearshore				Offshore					Percent	Cum.
Phy	Species	B1	B2	B3	B4	B5	B6	B7	B8	Total	Total	Percent
AR	*Aoroides inermis*	-	-	25	34	-	70	-	23	152	12.3	12.3
AR	*Diastylopsis tenuis*	10	7	-	6	-	29	70	30	152	12.3	24.6
AR	*Rhepoxynius menziesi*	7	2	20	20	1	11	14	-	75	6.1	30.6
EC	*Dendraster excentricus*	-	37	20	-	2	1	5	-	65	5.3	35.9
AN	*Apoprionospio pygmaea*	18	2	2	1	-	12	4	7	46	3.7	39.6
AR	*Photis* OC1 (MEC) 1996	-	-	-	-	-	22	-	9	31	2.5	42.1
AN	*Owenia fusiformis*	18	1	3	5	-	1	1	1	30	2.4	44.5
AR	*Leptocuma forsmani*	17	6	2	1	-	-	-	-	26	2.1	46.6
MO	*Tellina modesta*	1	-	2	1	-	-	8	14	26	2.1	48.7
AN	*Monticellina cryptica*	-	-	-	-	-	17	-	7	24	1.9	50.7
AN	*Goniada littorea*	4	5	1	8	-	4	1	-	23	1.9	52.5
AN	*Levinsenia gracilis*	-	-	-	-	23	-	-	-	23	1.9	54.4
AN	*Spiophanes bombyx*	-	-	5	5	4	1	3	5	23	1.9	56.3
NE	*Carinoma mutabilis*	2	-	-	2	1	3	8	6	22	1.8	58.0
AR	*Photis brevipes*	-	-	1	1	-	10	-	10	22	1.8	59.8
MO	*Solamen columbianum*	-	-	-	-	21	-	-	-	21	1.7	61.5
AN	*Ampharete labrops*	-	-	4	-	2	11	-	3	20	1.6	63.1
AN	*Nephtys caecoides*	4	3	4	2	1	2	3	1	20	1.6	64.8
AN	*Chaetozone setosa Cmplx*	2	1	6	5	-	1	-	1	16	1.3	66.0
AR	*Campylaspis* sp. C Myers & Benedict 1974	3	3	8	-	-	-	1	-	15	1.2	67.3
AR	*Photis bifurcata*	-	-	-	-	-	6	-	8	14	1.1	68.4
MO	*Solen sicarius*	4	1	7	-	1	-	-	-	13	1.1	69.4
AR	*Synchelidium shoemakeri*	1	-	10	1	-	-	-	1	13	1.1	70.5
AN	*Cirriformia spirabrancha*	-	-	8	2	-	-	-	2	12	1.0	71.5
AR	*Ericthonius brasiliensis*	-	-	1	-	-	1	-	10	12	1.0	72.4
AR	*Gibberosus myersi*	-	-	2	-	-	1	7	2	12	1.0	73.4
AN	*Mediomastus acutus*	3	2	2	2	-	1	1	1	12	1.0	74.4
NT	Nematoda	1	1	1	-	8	1	-	-	12	1.0	75.3

AR = Arthropoda; EC = Echinodermata; AN = Annelida; NE = Nemertea; MO = Mollusca; NT = Nematoda

species in Groups B, differed from all other species in that they were found in lesser abundance at Stations B6 and B8, while they were fairly abundant at the other six stations. Group C contained species that were relatively abundant at Stations B6 and B8, but were generally occurring in low abundance at the remaining stations, or at few of the remaining stations.

Fish Impingement

Results from heat treatment surveys of fish entrained and impinged at El Segundo (ESGS) and Scattergood Generating Stations (SGS) during the 1999 sampling year (1 October 1998 to 30 September 1999) are presented below. Data are summarized in Tables 9 through 11 and presented in their entirety in Appendix H. Fish and macroinvertebrate data are presented separately for each generating station.

Fish

Species Composition. In total, 56 species representing two classes and 28 families of fish were taken during 10 heat treatment operations at the generating stations (Appendix H-1). Abundances for each species are listed in Appendix H-2.

El Segundo. Heat treatment and normal operation surveys at Units 1 & 2 yielded 16 species of fish representing two classes and 10 families (Table 9, Appendix H-1). One family of cartilaginous (Elasmobranchiomorphi = Chondrichthyes) fish and nine families of bony fish (Osteichthyes) were dominated by four species of surfperch in the family Embiotocidae. Heat treatment and normal operation surveys at ESGS Units 3 & 4 yielded 24 species of fish representing two classes and 17 families (Table 9, Appendix H-1). Four families of cartilaginous fish and 13

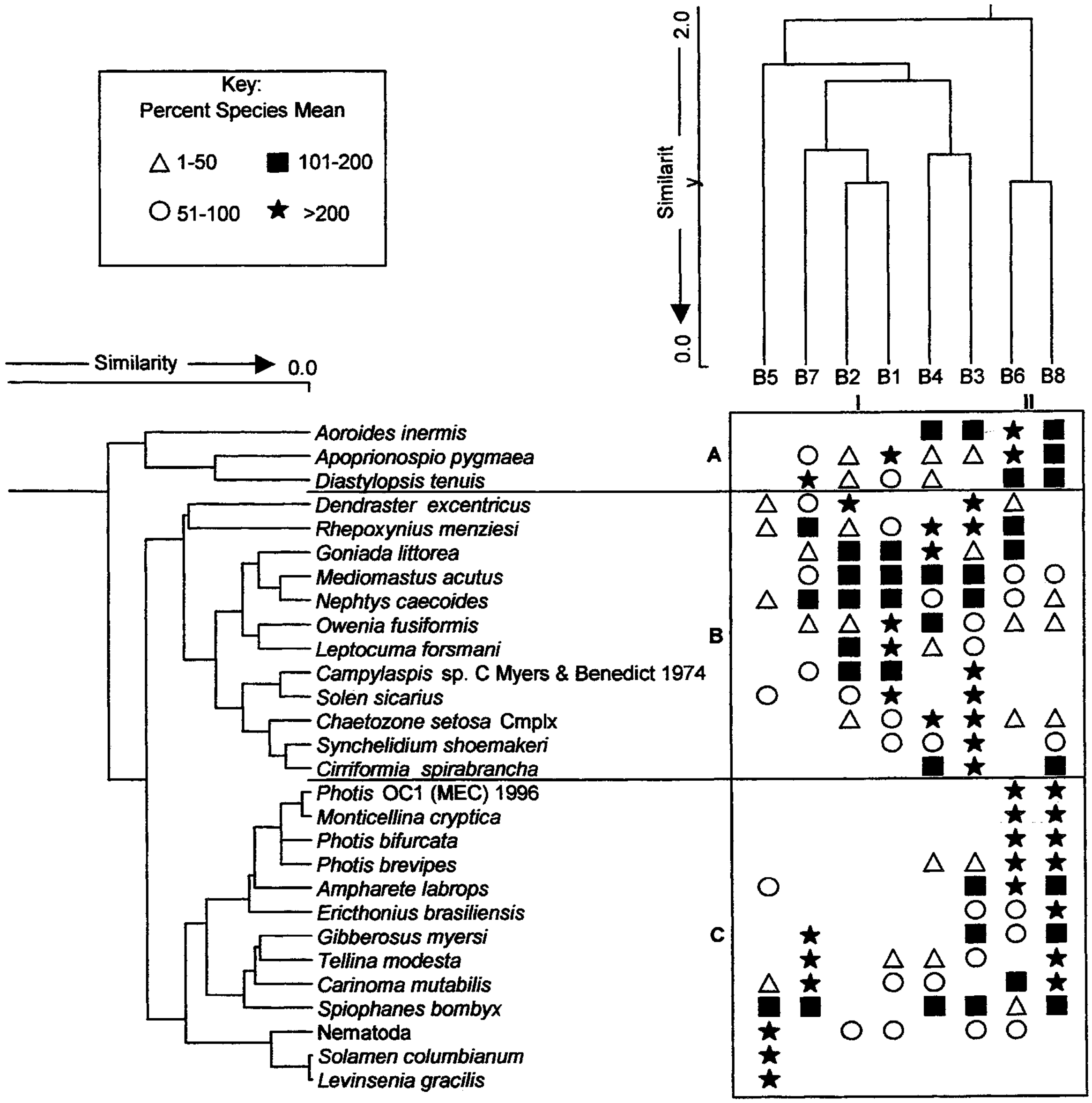


Figure 13. Two-way coincidence table resulting from normal (station) and inverse (species) classification dendrograms for the 28 most abundant infaunal species. El Segundo and Scattergood Generating Stations NPDES, 1999.

families of bony fish were dominated by four species of croakers in the family Sciaenidae and three species of surfperch.

Scattergood. Heat treatment surveys at SGS yielded 53 species of fish, representing two classes and 25 families (Table 9, Appendix H-1). Five families of cartilaginous fish and 20 families of bony fish were dominated by six species of croakers and six species of surfperch.

Abundance. A total of 42,134 individual fish was taken at the two generating stations; 40,804 fish (96.8%) were taken from SGS and 1,130 (3.2%) from ESGS (Table 9, Appendix H-2). All of the 15 overall most abundant species occurred at SGS, while only 11 occurred at ESGS; 1

Table 9. Number of individual sand biomass (kg) of the 15 most abundant fish species impinged during heat treatments. El Segundo and Scattergood Generating Stations NPDES, 1999.

Species	Scattergood		El Segundo		Total	Percent	Cumulative	Total
	No.	Wt. (kg)	No.	Wt. (kg)	Abundance	Total	Percent	Biomass
Atherinops affinis	24093	750.49	8	0.12	13067	31.01	31.01	750.61
Seriphus politus	4258	111.93	-	-	7105	16.86	47.88	111.93
Atherinopsis californiensis	3901	185.33	12	0.80	3830	9.09	58.54	186.13
Sardinops sagax	3261	119.01	250	11.18	3658	8.68	67.46	130.19
Umbrina roncador	2554	813.28	51	11.44	2501	5.94	73.56	824.72
Engraulis mordax	1661	7.27	-	-	2491	5.91	79.63	7.27
Xenistius californiensis	149	6.32	203	9.76	2138	5.07	84.85	16.08
Anisotremus davidsonii	35	18.17	311	179.15	1814	4.31	89.27	197.32
Paralabrax nebulifer	300	117.59	21	11.16	1235	2.93	92.28	128.75
Paralabrax clathratus	50	9.17	151	58.77	586	1.39	93.71	67.93
Cheilotrema saturnum	51	9.44	120	28.53	507	1.20	94.95	37.98
Sebastes paucispinis	126	1.29	-	-	361	0.86	95.83	1.29
Genyonemus lineatus	78	4.75	-	-	349	0.83	96.68	4.75
Porichthys notatus	8	0.91	58	3.31	179	0.42	97.12	4.22
Chromis punctipinnis	29	2.52	14	0.93	143	0.34	97.47	3.45
Survey Totals	40804	2317.85	1330	379.66	42134			2697.51
Total Species	53		29		56			

of those species were among the 15 most abundant species at SGS, and 10 were among the top 15 at ESGS.

Topsmelt (*Atherinops affinis*) was the most abundant species overall, accounting for 57.2% (24,101) of the individuals; it was the most abundant species at SGS with 59.0% of the abundance, but was eighteenth in abundance at ESGS with less than 1% of the total (Table 9). The second most abundant fish overall (10.1% of the total) was queenfish (*Seriphus politus*), which ranked second at SGS but did not occur at ESGS. The third, fourth, and fifth most abundant species overall, accounting for a combined total of 23.8%, were jacksmelt (*Atherinopsis californiensis*), Pacific sardine (*Sardinops sagax*), and yellowfin croaker (*Umbrina roncador*), respectively. While jacksmelt was ranked third in abundance at SGS, it was fifteenth at ESGS; Pacific sardine was ranked fourth and second, respectively; and yellowfin croaker was fifth at SGS, but seventh at ESGS. Northern anchovy (*Engraulis mordax*), salema (*Xenistius californiensis*), sargo (*Anisotremus davidsonii*), barred sand bass (*Paralabrax nebulifer*), and kelp bass (*Paralabrax clathratus*) were the sixth through tenth, respectively, most abundant fish overall. These five species accounted for 6.8% of the combined abundance. Together these top 10 ranked species accounted for almost 98% of the total catch at the two generating stations.

At SGS, boccacio (*Sebastes paucispinis*) and white croaker (*Genyonemus lineatus*) were among the ten most abundant species. At ESGS, black croaker (*Cheilotrema saturnum*), plainfin midshipman (*Porichthys notatus*), giant kelpfish (*Heterostichus rostratus*), and black surfperch (*Embiotoca jacksoni*) were among the ten most abundant species.

El Segundo. There were 135 individuals taken during the two heat treatments at Units 1 & 2, and 1,054 individuals taken at the single heat treatment at Units 3 & 4 (Table 10, Appendix H-4). Catch per heat treatment at the Units 1 & 2 screenwell averaged 68 individuals and nine species, and ranged from four individuals and three species (31 October 1998) to 131 individuals and 14 species (28 September 1999). Combined with the estimated 141 individuals and four species taken during normal operations (Appendices G8 and G9), a total of 1,330 individuals and 29 species were taken at ESGS. The 10 most abundant species at ESGS accounted for 91.0% of all individuals taken (Appendix H-3).

Scattergood. Seven heat treatments were conducted at SGS, with the catch per heat treatment averaging 5,829 individuals and 21 species (Table 11). The catch ranged from 12 individuals and three species (3 December 1998) to 21,028 (23 June 1999) individuals and 34 species (6 May 1999) (Appendix H-5).

The 10 most abundant species at SGS, representing seven families, accounted for 99.0% of all the individuals taken at the station (Table 9). The remaining 43 species totaled 423 individuals and accounted for only 1.0% of the abundance.

Table 10. Number of species, number of individuals, and biomass (kg) of fish impinged during heat treatments at the El Segundo Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1999.

Date			Number		Biomass
			Species	Individuals	
Units 1 & 2					
31.00	Oct	98	3.00	4.00	1.8
28.00	Sep	99	14.00	131.00	37.6
Total			15.00	135.00	39.4
Mean			8.50	67.50	19.7
Units 3 & 4					
29.00	Oct	98	21.00	1054.00	332.9
Overall					
Total			26.00	1189.00	372.3
Mean			12.67	396.33	124.1

Biomass. Biomass totaled 2,697.51 kg for fish impinged at both stations (Table 9, Appendix H-2). Biomass was unevenly distributed between the two stations, with SGS accounting for 85.9% of the overall total and ESGS accounting for 14.1%. Yellowfin croaker accounted for 30.6% of the total biomass; this species and six others, topsmelt (27.8%), sargo (7.3%), jacksmelt (6.9%), Pacific sardine (4.8%), barred sand bass (4.8%), and queenfish (4.1%) accounted for 86.4% of the biomass and weighed 2,329.65 kg.

El Segundo. Fish biomass totaled 39.41 kg during the heat treatment surveys at ESGS Units 1 & 2 in 1999, and 372.27 kg at the heat treatment at Units 3 & 4 (Table 10, Appendix H-4). Combined with normal operation surveys, fish biomass totaled 379.66 kg at ESGS in 1999 (Appendix H-3). The six species ranked highest in biomass at ESGS were sargo, kelp bass, black croaker, yellowfin croaker, Pacific sardine, and barred sand bass. Four of these species (sargo, yellowfin croaker, Pacific sardine, and barred sand bass) were also highly ranked overall. Collectively, these six species amassed a weight of 300.24 kg or 79.1% of the biomass at ESGS (Appendix H-3). Biomass at Units 1 & 2 heat treatments averaged 19.71 kg, and ranged from 1.81 kg (31 October 1998) to 37.60 kg (28 September 1999) (Table 10).

Scattergood. In 1999, fish biomass totaled 2,317.85 kg during the seven heat treatment surveys at SGS (Table 11). Biomass averaged 331.12 kg per survey and ranged from 0.09 kg (3 December 1998) to 1,127.98 kg (12 August 1999) (Appendix H-7). Yellowfin croaker accounted for 35.1% of the biomass; this and the next five ranking species (topsmelt, jacksmelt, Pacific sardine, barred sand bass, and queenfish) accounted for 90.5% (2,097.62 kg) of the total biomass (Table 9).

Size (Length). Standard length (SL), total length (TL), or disk width (DW), where appropriate, were measured in mm for the first 200 individuals of each species impinged during heat treatment surveys.

Table 11. Number of species, number of individuals, and biomass (kg) of fish impinged during heat treatments at the Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1999.

Date			Number		Biomass
			Species	Individuals	
29	Oct	98	16	413	47.0
3	Dec	98	3	12	0.1
21	Jan	99	8	1082	1.4
16	Mar	99	29	1165	94.0
6	May	99	34	7455	334.9
23	Jun	99	33	21028	712.5
12	Aug	99	24	9649	1128.0
Total			53	40804	2317.9
Mean			21	5829	331.1

Population Structure. Length-frequency histograms (Figures 14 to 17) were constructed of one of the more abundant forage species, queenfish, and three species of sport fishing importance, sargo, kelp bass, and barred sand bass. These species were sufficiently abundant at one or both of the stations to construct meaningful histograms, which were utilized to determine if the intake selectively entrained particular size classes. These histograms do not necessarily reflect the composition of the offshore population.

Queenfish was the second most numerous fish taken for 1999. It was most frequently entrained at the 60 to 130 mm SL size range at SGS, with modes at 70 and 110 mm SL (Figure 14). Queenfish were not taken at ESGS.

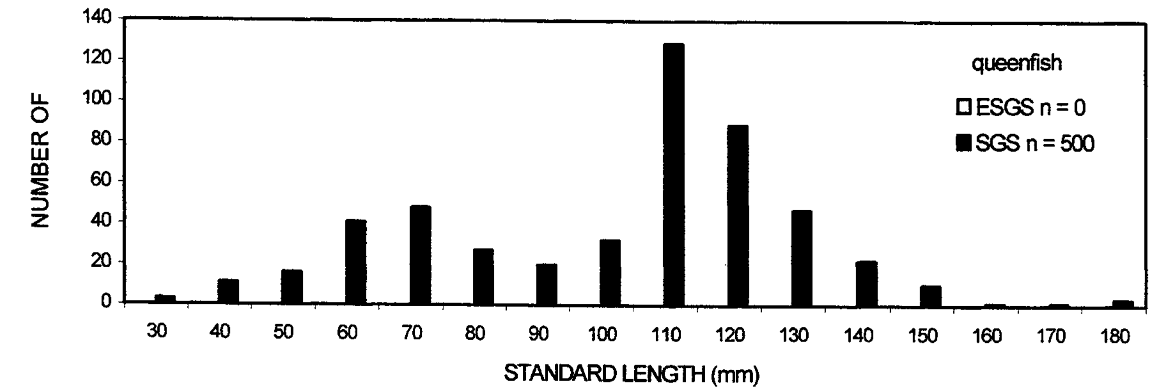


Figure 14. Length-frequency distribution of queenfish (*Seriphus politus*) taken during impingement surveys. El Segundo and Scattergood Generating Stations NPDES, 1999.

Sargo was the eighth most abundant species for 1999. The sargo population at SGS ranged from 130 to 370 mm SL with peaks at 170, and 250 mm SL; at ESGS the population ranged from 150 to 380 mm SL, and had peaks at 160 and 240 mm SL (Figure 15).

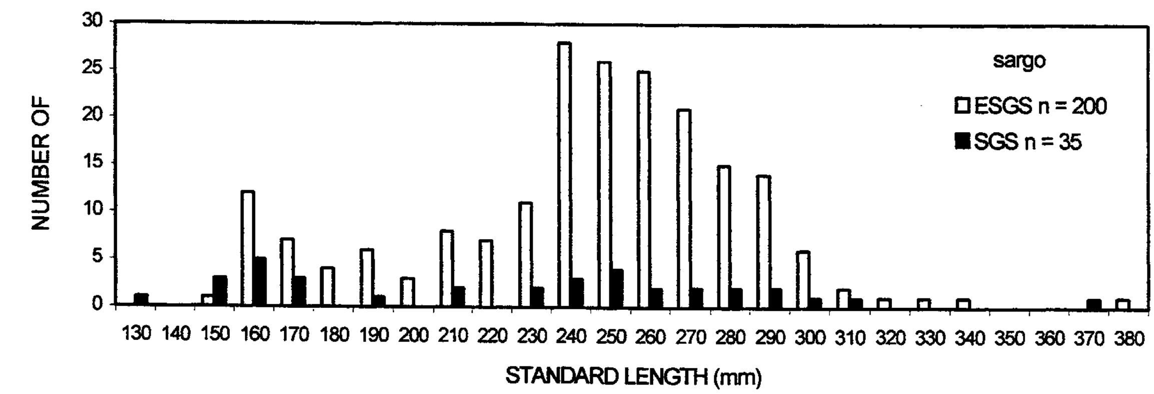


Figure 15. Length-frequency distribution of sargo (*Anisotremus davidsonii*) taken during impingement surveys. El Segundo and Scattergood Generating Stations NPDES, 1999.

Kelp bass size distribution indicated a trimodal population at SGS with peaks at 40, 180, and 250 mm SL; at ESGS, the population was also trimodal, with peaks noted at 170, 220, and 260 mm SL (Figure 16). At SGS most of the individuals were between 210 and 270 mm SL , and at ESGS most were between 170 and 270 mm SL.

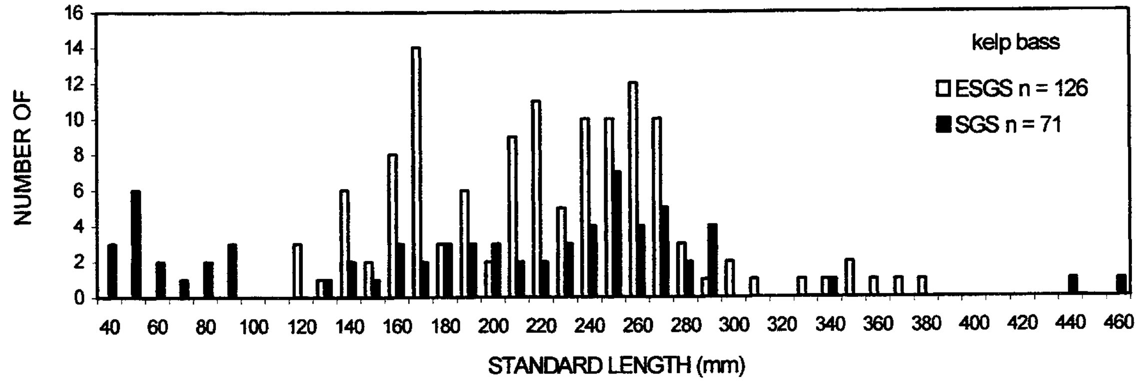


Figure 16. Length-frequency distribution of kelp bass (*Paralabrax clathratus*) taken during impingement surveys. El Segundo and Scattergood Generating Stations NPDES, 1999.

Size distribution of the Pacific sardine population at SGS showed a peak at 130 mm SL, with the majority of the entrained individuals between 120 and 140 mm SL. At ESGS, there was a peak at 150 mm SL, with most of the individuals between 140 and 160 mm SL (Figure 17).

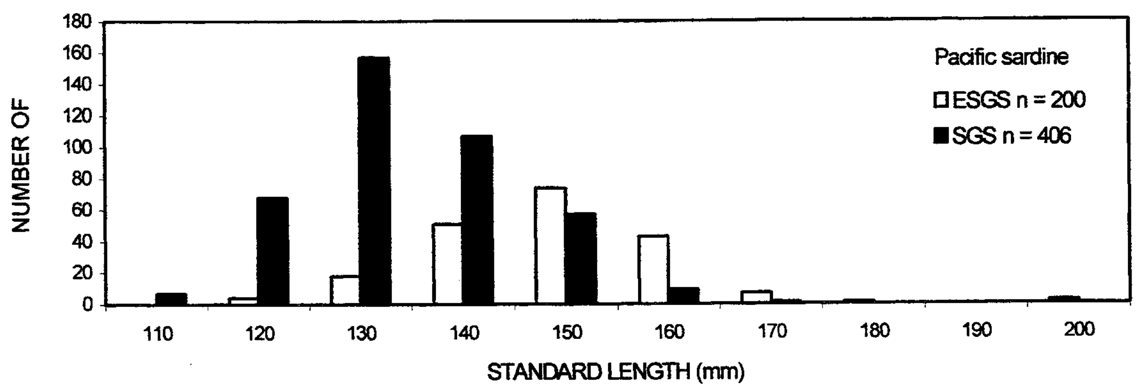


Figure 17. Length-frequency distribution of Pacific sardine (*Sardinops sagax*) taken during impingement surveys. El Segundo and Scattergood Generating Stations NPDES, 1999.

Diseases and Abnormalities. No diseases or abnormalities were noted on any fish caught during the impingement surveys. However, at SGS, one leopard shark (*Triakis semifasciata*) had a rubber gasket around its head and embedded in the skin at its gill slit, and a species of parasitic fish lice, *Lironeca vulgaris*, occurred on an individual queenfish.

Macroinvertebrates

A total of 21 motile macroinvertebrate species with a total biomass of 3,150.68 kg were collected during heat treatment impingement surveys at SGS, and heat treatment and normal operation surveys at ESGS (Table 12, Appendices H-10 through H-15). These species represented five phyla and 15 families, and included 13 species of crustaceans, three species each of cnidarians and mollusks, one echinoderm, and one urochordate (Appendix H-1).

Two of the top three most abundant invertebrate species, Pacific rock crab (*Cancer antennarius*) and yellow rock crab (*Cancer anthonyi*), were members of the rock crab family Cancridae, and accounted for 79.1% of all invertebrates taken and 84.8% of the biomass (Table 12, Appendix H-8). A salp, (*Thetys vagina*), was second in abundance (16.2%) and biomass (8.7%) and red rock shrimp (*Lysmata californica*) was the fourth most abundant invertebrate (1.8%), but

Table 12. Number of individuals and biomass (kg) of the 11 most abundant macroinvertebrates impinged during heat treatments. El Segundo and Scattergood Generating Stations NPDES, 1999.

Species	Scattergood Abund.	Scattergood Biomass	El Segundo Abund.	El Segundo Biomass	Total Abundance	Percent Total	Cumulative Percent	Total Biomass
Cancer antennarius	11	0.111	28492	2637.639	28503	75.65	75.65	2637.750
Thetys vagina	-	-	6096	274.500	6096	16.18	91.83	274.500
Cancer anthonyi	56	0.158	1236	33.434	1292	3.43	95.26	33.592
Lysmata californica	678	0.784	10	0.022	688	1.83	97.09	0.806
Pyromaia tuberculata	305	0.252	18	0.056	323	0.86	97.95	0.308
Panulirus interruptus	194	91.000	93	34.700	287	0.76	98.71	125.700
Octopus bimaculatus / bimaculoides	155	16.981	37	41.986	192	0.51	0.51	58.967
Heptacarpus palpator	81	0.046	10	0.015	91	0.24	0.24	0.061
Navanax inermis	13	0.042	58	0.206	71	0.19	0.43	0.248
Portunus xantusii	34	0.214	27	0.491	61	0.16	0.59	0.705
Polyorchis penicillata	14	0.091	31	15.270	45	0.12	0.71	15.361
Survey totals	1563	112.260	36113	3038.420	37676			3150.675
Total species	18		14		21			

contributed less than 1% of the biomass. Together, these four species accounted for more than 97% of the invertebrates taken. California spiny lobster (*Panulirus interruptus*) and two-spotted octopus (*Octopus bimaculatus/bimaculoides*) each contributed less than 1% of the abundance, but they accounted for 4.0% and 1.9% of the biomass, respectively.

The 11 species in common to the two generating stations comprised over 99% of the total abundance (Appendix H-8). A similar number of species occurred at SGS (18) as at ESGS (14), and nine of the ten species that occurred uniquely at either station were represented by few individuals and collectively accounted for less than 1% of the abundance and 1% of the biomass. The exception was the salp (*T. vagina*), which was high in both abundance and biomass, and which was only taken at ESGS. There was a substantial difference in abundance and biomass between the two stations, with ESGS accounting for almost 96% of the biomass and more than 96% of the abundance.

Because of the sport and commercial importance of California spiny lobster, carapace lengths (CL) were measured to determine the size frequency of entrained individuals. This species was sufficiently abundant to construct a length-frequency histogram of catches from both ESGS and SGS (Figure 18). Abundance of entrained and impinged California spiny lobster was greater at SGS than at ESGS. At both stations there was a large mode from 50 to 90 mm CL, each with a peak at 70 mm CL.

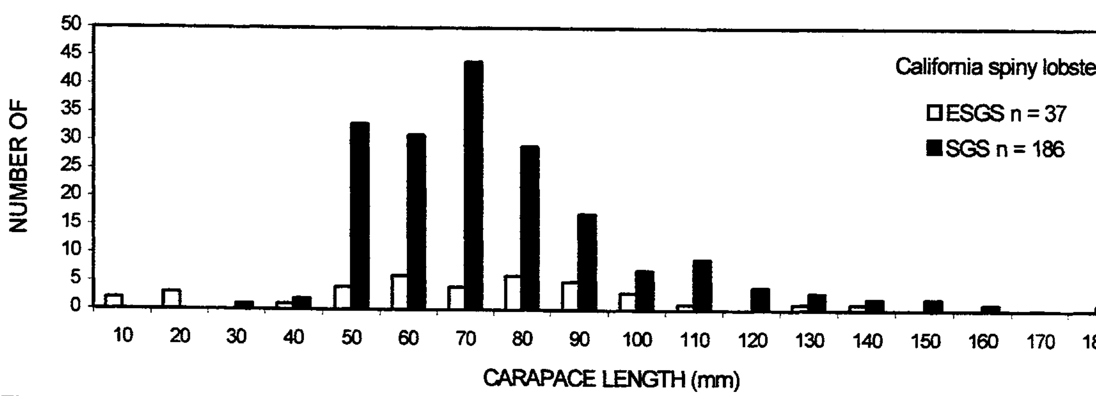


Figure 18. Length-frequency (carapace length) distribution of California spiny lobster (*Panulirus interruptus*) taken during impingement surveys. El Segundo and Scattergood Generating Stations NPDES, 1999.

DISCUSSION

WATER COLUMN MONITORING

There was no detected thermal field from the discharge of effluent to the receiving waters during either the winter or summer survey due to the operation of the El Segundo and Scattergood Generating Stations. The profiles of the two monitoring stations closest to the discharge sites (Station RW2 upcoast of the Scattergood Generating Station discharge and Station RW3 downcoast of the El Segundo Generating Station discharge) were similar to other stations, with temperatures well within the range of values recorded from all the stations.

During winter, surface temperatures varied by slightly less than 1 °C between ebb and flood tides. Intermediate and deep station temperature profiles were similar on both tides, but temperature profiles at the shallow, nearshore stations were notably different between tides. During ebb tide the water column at the nearshore stations appeared well mixed with little difference between the surface and bottom temperatures. During flood tide, however, the water columns of all of the nearshore stations appeared stratified, with bottom temperatures similar to ebb tide values, but surface temperatures higher than during ebb tide. This type of temperature difference is common in the afternoon, and is a result of solar insolation heating the surface water without mixing into the water column. All temperatures fell within ranges found in previous surveys (MBC 1990-1998).

In summer, surface temperatures were typically higher than in winter. Surface temperatures varied less than 1 °C between both tides. Afternoon ebb tide water was slightly warmer and there appeared to be better mixing throughout the water column than during flood tide, except at Station RW4, where a stronger temperature gradient was found during ebb tide. Profiles from flood tide showed that temperature at all stations decreased with depth, with strong temperature gradients in the top 12 meters of all stations except RW4, RW10, RW11, and RW12. The temperature profiles indicate that an upwelled mass of cold water was present upcoast and inshore during flood tide. An offshore deeper cold water mass has been seen in this area during previous surveys. Temperatures (ebb and flood tides) in 1999 were within the range of those recorded in past years (MBC 1990-1998). As no thermal field was noted at stations near the discharges, differences among surveys were most likely due to seasonal changes and were not related to the generating stations.

During both winter and summer surveys, dissolved oxygen profiles were similar among most stations and surface DO concentrations during both surveys were very similar among all stations for both tides. During the winter, DO concentrations generally corresponded to temperature, as would be expected, in the top few meters of the water column, then switched to a direct correspondence with further depth. This direct correspondence of DO to temperature has been noted during previous winter sampling in the area (MBC 1997), but is probably not significant since both DO and temperature vary little throughout the water column. During the summer, with more pronounced temperature gradients, DO concentrations showed a strong inverse correspondence to temperature at all stations and tides, with peak DO values corresponding to the lowest temperature values. All dissolved oxygen concentrations were well within the range of previously reported values (MBC 1990-1998). There were no apparent effects that could be attributed to the generating station discharges.

Hydrogen ion concentration (pH) varied only slightly with depth, especially during summer. Values were within ranges considered normal in previous reports (MBC 1990-1998).

SEDIMENT MONITORING

Sediment Grain Size

In 1999, sediments were finest at Station B8, located downcoast of the discharges on the 40-ft isobath, while coarsest sediments occurred at Station B5, upcoast of the discharges at a depth of 40 ft. Sediment grain size characteristics in 1999 were somewhat similar to those observed in previous surveys (Figure 19) (MBC 1990-1994, 1997-1998). In 1999, mean grain size at offshore station B5 was five times coarser than mean grain sizes at the other offshore stations. This explains the somewhat coarse mean grain size for the offshore stations. In 1999, mean grain size at the nearshore stations was coarsest since the 1992 survey. Sediments in the study area are typically coarsest nearshore; greater turbulence and currents nearshore suspend finer particles which are deposited further offshore in calmer water. However, fine sediments have also been found nearshore. Second finest sediments of the 1994 survey occurred at Station B1 in 1994 and at Station B2 in 1991, 1993, and 1997.

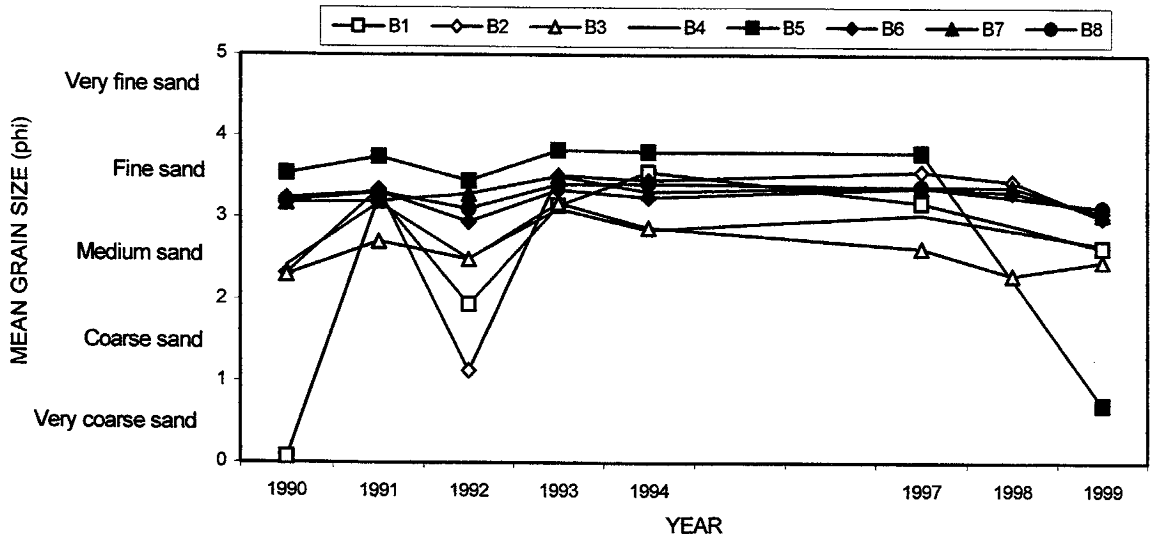


Figure 19. Comparison of sediment mean grain size, 1990 - 1999. El Segundo and Scattergood Generating Stations NPDES, 1999.

Sediment composition and distribution in the study area are likely primarily affected by natural causes, such as sediment transport, deposition from Ballona Creek, which enters Santa Monica Bay approximately two miles north of Station B1, and nearshore currents. Littoral currents in the study area move up to eight feet per second, and are capable of transporting beach sediments alongshore (Drake and Gorsline 1973). Dikes, groins, and jetties in the study area were constructed to facilitate sand accumulation; otherwise, beach sands tend to move toward Redondo Canyon and offshore (MBC 1988). Results from the 1999 survey indicate no apparent patterns in sediment grain size relative to the discharges for the El Segundo and Scattergood Generating Stations.

Sediment Chemistry

Highest concentrations of chromium, copper, nickel, and zinc occurred at Station B2 in 1999. Lowest concentrations of all metals were found at Station B5.

Differences in metal concentrations among sites are often directly related to the amount of fine-grained material in the sediment. Fine-grained sediments may contain higher amounts of metals due to the greater available surface area (Ackermann 1980, de Groot et al. 1980). Therefore, comparisons should take into account the relative amounts of fine and coarse sediments.

Since 1990, highest metal levels have generally occurred at Stations B2 and B5 (Figure 20). From 1990 to 1993, both percentages of fine sediments and metal levels were highest at Station B5, upcoast of Station B6 (Figure 19). In 1993, the percentage of "fines" (silt and clay combined) increased at Station B2, and consequently the metal levels at Station B2 increased from among the lowest to levels typical at Station B5. In 1994, the highest percentage of fine sediments and, in general, the highest levels of metals were found at Station B2. To a lesser degree, percent fines and metals at Station B1, upcoast of Station B2, followed a similar pattern of increase from 1993 to 1997. In 1997, the highest percentage of fines and the corresponding comparatively high level of metals occurred at Station B5, but in 1998 and 1999, highest metal concentrations occurred at Station B2, the station with the largest fines fraction. Metal concentrations in 1999 were similar to values recorded in 1998.

All values observed in 1999 were within the range found in sediments within the Southern California Bight and were lower than or comparable to levels found by the National Oceanographic and Atmospheric Administration (NOAA) at other sandy, offshore sites in southern California (NOAA 1991a). Elevated sediment metal levels may be toxic to some organisms. Ranges of toxicity have been developed by the National Oceanic and Atmospheric Administration (NOAA) (NOAA 1991b) and later updated (Long et al. 1995) using data from spiked sediment bioassays, sediment-water equilibrium partitioning, and the co-occurrence of adversely affected fauna and contaminant levels in the field. Chemical concentrations believed to be associated with adverse biological effects from the various independent studies were compared for each parameter and the lower 10 percentile was designated as the "Effects Range-Low" (ERL). The median of concentration levels was designated the "Effects Range-Median" (ERM). Since 1990, sediment metal concentrations in the study area have been well below the determined concentrations for low effects, which are 81 mg/kg for chromium, 34 mg/kg for copper, 20.9 mg/kg for nickel, and 150 mg/kg for zinc (Figure 20).

The wide distribution of metals in the study area does not appear to be related to the generating station discharges; more likely it is due to non-point source discharges (NOAA 1991c). There are several other sources of metals in the vicinity, such as boating-related activities in Marina del Rey, the nearby oil refineries and wastewater treatment plant, and storm drains which carry street runoff into Santa Monica Bay (MBC 1993b). Ballona Creek, to the north, could be a source of fine sediments and their associated metal contaminants. In 1998, little difference was seen between metal levels found at nearshore and offshore stations, and no extremely high or low values were noted in sediments at stations nearest the discharges. Highest metal concentrations occurred at Station B2, where the greatest amount of silt and clay occurred. As in past surveys, the distribution of metals in the study area appears to be related to localized sediment grain size. There is no indication that operation of the generating stations has had an appreciable effect on sediment metal concentrations in the study area.

MUSSEL BIOACCUMULATION

In 1999, bay mussels were collected from the study area for analysis of tissue metal concentrations.

Bay mussel tissue collected from the El Segundo discharge structures in 1999 had detectable levels of copper and zinc. Mean copper concentration in 1999 was highest of the six surveys performed since 1990 and three times higher than the mean concentration found in the 1994 study (MBC 1990-1994). In 1999, replicates 1 and 2 had copper concentrations of 18 and 14 mg/dry kg, respectively. Although these values are higher than concentrations recorded in 1994, they are similar to the copper concentration recorded in 1991 (14 mg/dry kg). Replicate 3, however, had a copper

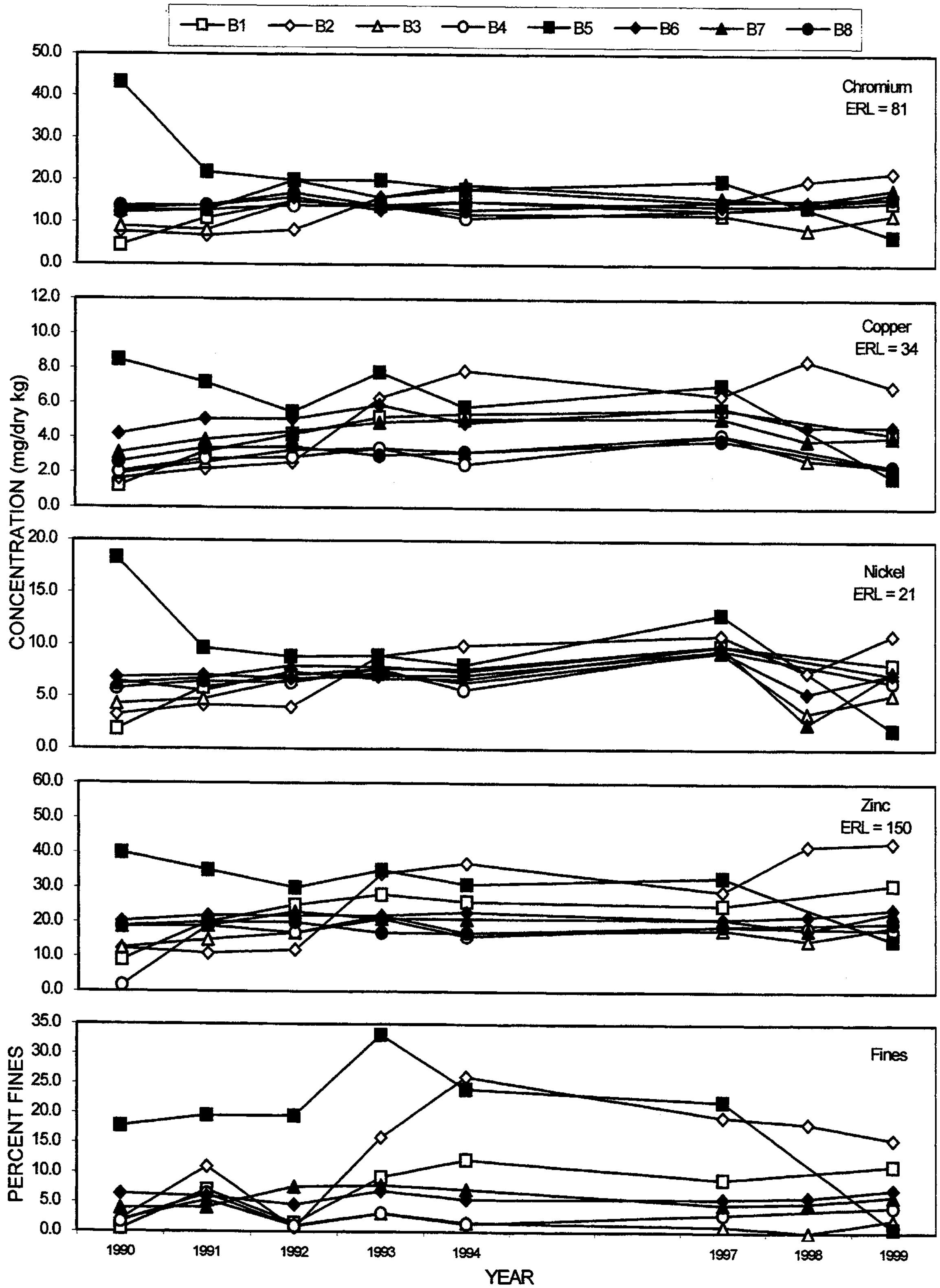


Figure 20. Comparison of sediment metal concentrations and percent fines by station,1990 - 1999. El Segundo and Scattergood Generating Stations NPDES, 1999.

concentration of 41 mg/dry kg, which is nearly three times the value recorded in 1991. Mean zinc concentration in 1999 was second highest since 1990.

Bay mussel tissue collected from the Scattergood discharge in 1999 also had detectable levels of copper and zinc. Mean copper concentration in 1999 was nearly nine times lower than mean copper concentration from El Segundo, and second lowest of the six surveys performed since 1990 (MBC 1990-1994). Mean zinc concentration in 1999 was comparable to zinc levels from El Segundo in 1999. Chromium and nickel have not been detected in mussel tissue in the study area since the 1990 NPDES surveys.

In 1988, California State Mussel Watch (CSMW) found levels of copper between 16 and 23 mg/dry kg in resident California mussels (*Mytilus californianus*) collected in Santa Monica Bay (SWRCB 1990). The same study also found levels of copper between 3 and 29 mg/wet kg in transplanted California mussels collected in nearby Marina Del Rey. Mussel tissue analyzed from Ormond Beach in 1991 had a copper concentration of 55 mg/wet kg (Ogden 1991). An overview of copper concentrations in whole bay mussels conducted by CSMW and the National Oceanic and Atmospheric Administration (NOAA) in the Southern California Bight from 1980 to 1986 found copper tissue levels ranging from 4.0 to 120 mg/dry kg (NOAA 1991c). One conclusion was that copper appeared to be a contaminant in mussels principally near major recreational and industrial harbors, and secondarily near other harbors. Reasons for the higher copper concentrations at El Segundo in 1999 are unknown, but are likely unrelated to the operation of the generating stations.

In the same CSMW and NOAA studies, zinc concentrations ranged from 80 to 560 mg/dry kg. In 1999, maximum replicate zinc concentration in the study area was 140 mg/dry kg. Highest mean zinc concentration of three replicates in the study area occurred in 1991 at 190 mg/dry kg, but levels have remained lower since then (Figure 21).

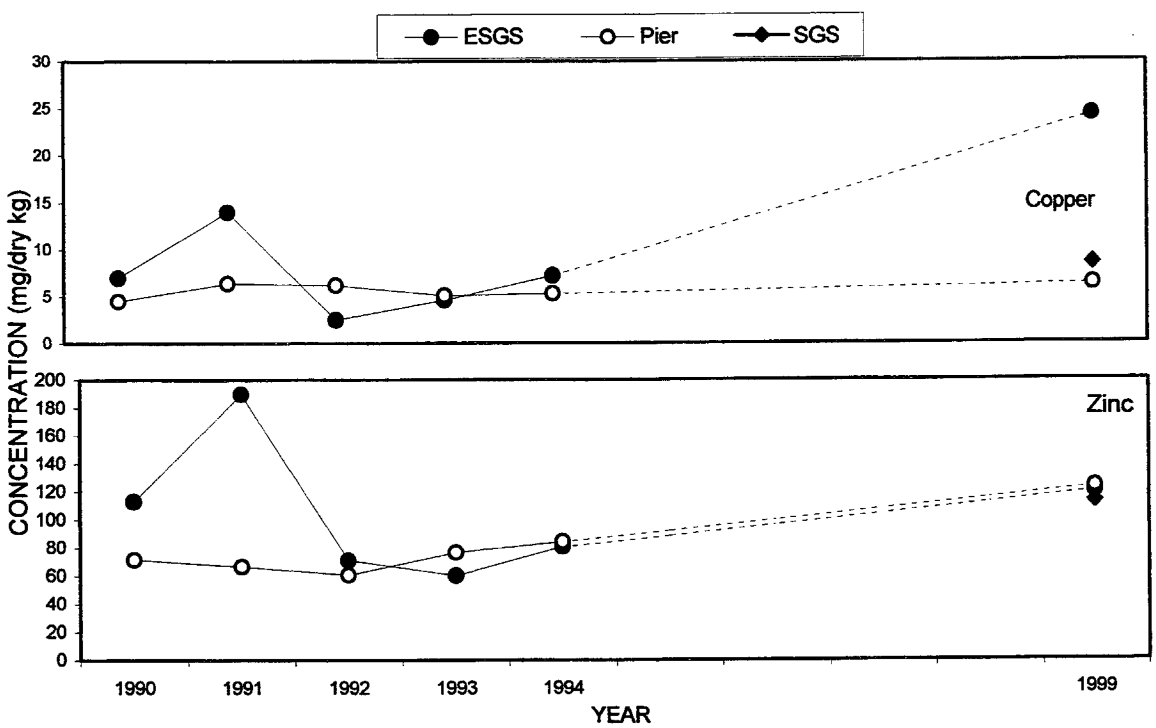


Figure 21. Comparison of copper and zinc concentrations in bay mussel tissue, El Segundo and pier reference site, 1990-1994 and 1999. El Segundo and Scattergood Generating Stations NPDES, 1999.

Mussel tissue metal levels within ranges of those found in other studies indicate that there is no major source of metals in the study area. Copper levels in mussel tissue from El Segundo were higher in 1999 than in previous surveys, but were similar to levels reported in other comparable surveys.

BIOLOGICAL MONITORING

Benthic Infauna

The benthic infaunal species were most abundant at station B6, offshore and upcoast of Scattergood and El Segundo Generating Stations. The arthropod *Aoroides inermis* was co-ranked for first in abundance and accounted for almost 29% of the abundance at Station B6. It was also relatively abundant at offshore Station B8, and it was captured in relatively high numbers at nearshore Stations B3 and B4. *Aoroides inermis* is typically found in the nearshore environment but in much reduced abundance. Slightly more *A. inermis* were found at the offshore stations than at the nearshore stations. The other first ranked most abundant species, the arthropod *Diastylopsis tenuis,* accounting for more than 12% of the total abundance is typically found in the nearshore environment in the Southern California Bight (Bernard and Given 1960). The third most common species, the arthropod *Rhepoxynius menziesi* was similar to the other two in that it was obtained from both nearshore and the offshore stations. The largest animal with the greatest individual biomass captured was the echinoderm *Dendraster excentricus* (Merrill and Hobson 1970). It is a filter feeder with patchy distribution preferring the more inshore turbulent waters. In keeping with its preferred habitat, it was especially abundant in the nearshore waters at Stations B2 and B3. The usually ubiquitous infaunal polychaete *Apoprionospio pygmaea* was only fifth in abundance in 1999. This species prefers sandy siltier areas. They are usually more abundant in the inshore area of the generating stations; however, in 1999 they were found in equal densities at the nearshore and offshore stations.

As would be expected, species richness was slightly higher at the offshore stations. The shallower nearshore environment off Scattergood and El Segundo Generating Stations tends to be a high energy habitat with constant wave action. Also, the sediment type tends not to vary much. The Intermediate Disturbance Hypothesis predicts that areas with moderate amounts of physical disturbance will support a higher species richness than an area with a high amount of disturbance (Connell 1978). The findings of this survey are consistent with this hypothesis. Other factors that contribute to the higher species richness offshore are grain size and organic content of the sediment (Bernard 1963, Knox 1977). The benthos at the offshore stations supports a more diverse community, because it tends to have finer sediments, which often contain more organic matter. On average sediments were finer offshore than nearshore in this year's survey.

From a phyletic perspective, the polychaete annelids were the most species rich group with 55 species represented. Polychaetes are highly successful in virtually all marine habitats, including the type of environment found off Scattergood and El Segundo Generating Stations. An equally successful class of animals is the Malacostraca arthropods which were the second most species rich group in this survey with 46 species represented. The arthropods which dominate the survey site are, for the most part, burrowing deposit feeders though some have the ability to swim. With 19 species represented, the molluscan class Bivalvia was the third most species rich group. The bivalves are typically filter feeders that effectively utilize the inshore and offshore areas for habitat. Nermerteans (ribbon worms) had 11 species. These are deposit feeders that are ubiquitous in the nearshore environment. All other represented classes had five or fewer species accounted for in this year's survey.

Results of the 1999 survey indicate the same core group of species common to the inshore waters of the Southern California Bight continue to dominate the infauna offshore of El Segundo and Scattergood Generating Stations. Although, community dominants shift in response to oceanographic perturbations, the community remains very similar to those of previous NPDES summer surveys from 1990 through 1994 and 1997 and 1998 (MBC 1990–1994, 1997, 1998). This survey occurred during a powerful La Niña, an oceanographic phenomena known to change distribution patterns in the Southern California Bight. It is therefore not surprising that species have fewer numbers of animals than were obtained in 1998 and in other years.

Despite the survey differences, some general patterns can be seen when compared with previous years. For example, average values of species richness, abundance, and diversity per station can provide some comparisons between years. In past surveys, average abundance was highest in 1994 (390.9 animals per station) and the previous lowest was in 1991 (172.5 animals per station); the 1999 survey yielded an average of 154.6 animals per station, lower than in any other year (Figure 22). The greatest measure of species richness per station was in 1994 (52.1 species per station) and the lowest was in 1992 (36.6 species per station). The present survey yielded a mean of 39.9 species per station (low to intermediate in species richness). The highest measure of mean species diversity was in 1990 (3.01) and lowest in 1994 (2.45); mean diversity in 1999 was 2.87, about intermediate for the several surveys. The high diversity of this year's survey was due to relatively few species with very high numbers and quite a few species that were cosmopolitan in their distribution. These juxtapositions, where low abundance is accompanied by fairly high species richness and high diversity are not uncommon and have been observed in past surveys. At the stations surveyed in 1999, species richness was greater offshore, but diversity was not. Species richness and diversity has been consistently higher offshore in all previous surveys since 1990. The more even distribution of diversity patterns in 1999 indicate that other processes outside the normal oceanographic regime, probably the la Niña, have intervened to affect these patterns.

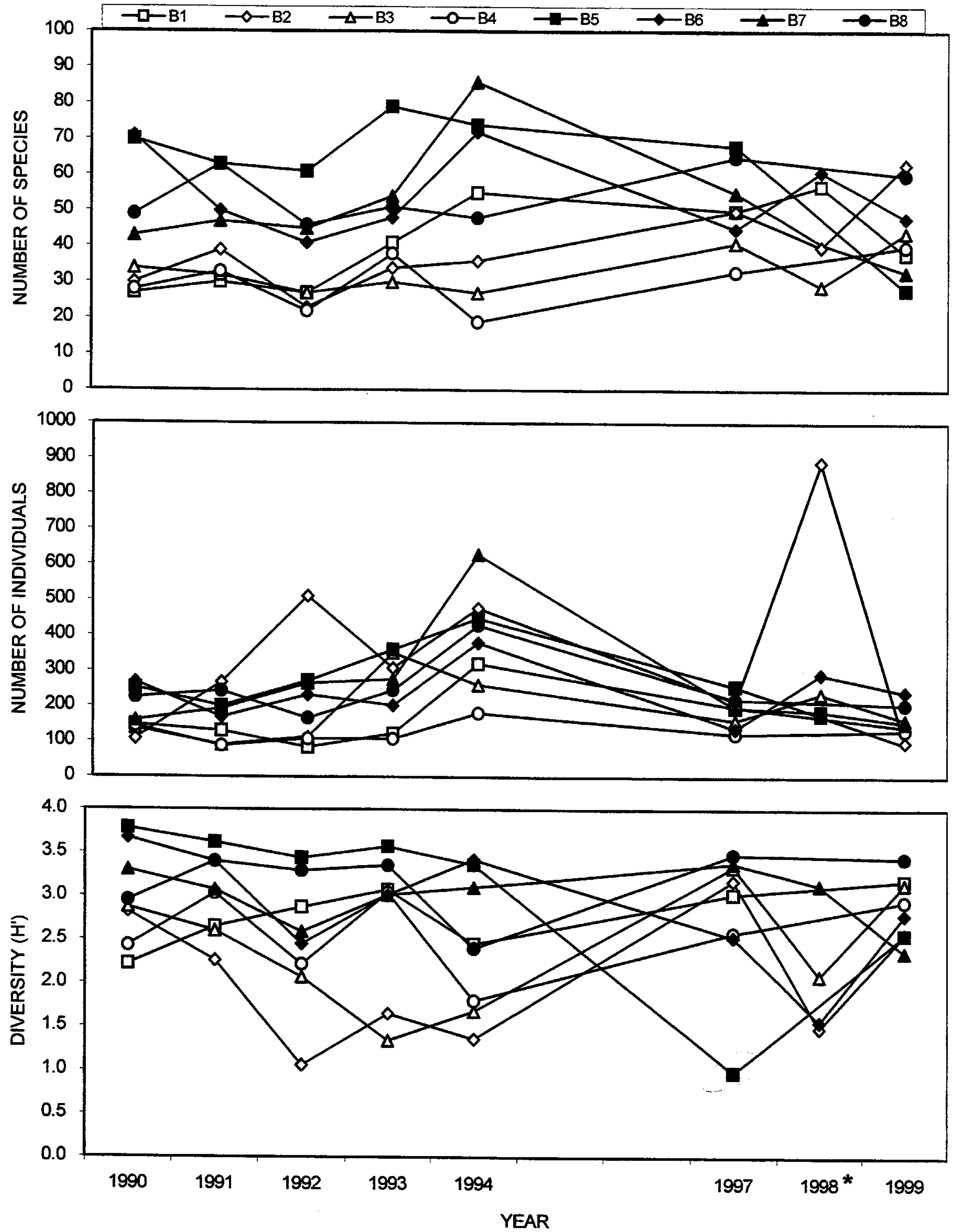
The pattern of species distribution, abundance, richness, and diversity for the 1999 infaunal analysis appears to be the result of natural processes. The Scattergood and El Segundo Generating Stations' discharges do not appear to have adversely impacted the nearshore or offshore infaunal communities.

Fish Impingement

Fish

Seven heat treatments were conducted at SGS and three at ESGS from 1 October 1998 to 30 September 1999. Almost 50% more species were impinged at Scattergood, with 30 times higher abundance and six times higher biomass, than at El Segundo. Biomass at both ESGS and SGS was lower than the 21-year average and the 14-year average, respectively. Compared to prior years, when there were typically eight heat treatments at ESGS, impingement was about 30% of the long-term average. Fifty-six species were taken overall: 53 at SGS, and 29 at ESGS. Of the 15 most abundant species present in 1999 at the two stations, all were present at SGS, and eleven occurred at ESGS. These 15 species accounted for almost 98% of the combined abundance (Appendix G-2). All of the 30 species that occurred at only one station are common species in impingement catches and have occurred at both generating stations in the past.

Abundance at SGS was much higher than that at ESGS. One species, topsmelt, constituted almost 60% of the overall abundance, with most of those individuals occurring in a single heat treatment. Approximately 70% of the total abundance at SGS was seen in the two late-spring heat treatments. Of the most abundant species, only one, salema, had a similar abundance at the two stations although it made up much different compositions of the catch. It comprised over 15% at ESGS, but was less than 1% at SGS. Conversely, queenfish accounted for over 10% of the catch at SGS, but was not present at ESGS (where many predatory kelp bass were present). These differences are likely the result of the fewer number of heat treatments at ESGS, but more importantly the vast difference in water flow volumes into the generating stations.



* = Only 4 stations were sampled in 1998

Figure 22. Comparison of infaunal community parameters, 1990 - 1999. El Segundo and Scattergood Generating Stations NPDES, 1999.

Topsmelt was the most abundant species in 1999, and another member of the Family Atherinidae, jacksmelt, was third most abundant. They were, on average, second and fourth in abundance, respectively, for the last ten years (Table 13). Both species occur in great abundance in the inshore waters of Santa Monica Bay and are especially attracted to the discharge structures because of foraging opportunities (Stephens 1977). These two species are active during the day and quiescent at night; they have been observed in the impingement catch in great numbers immediately following tunnel reversal operations occurring during heat treatments conducted during daylight (Curtis, MBC, pers. obs.). Both species are frequently caught in the sportfishery, and are important prey items for several marine birds, but are seldom targeted by the commercial fish industry (Leet et al. 1992). Jacksmelt form larger, denser schools than topsmelt, and range over much of the inshore area of California (Leet et al. 1992).

Table 13. Ranking of the most abundant fish species impinged during heat treatments,1990 - 1999. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Scattergood and El Segundo Heat Treatments										
Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
Seriphus politus	1	1	5	1	4	1	1	1	1	2	1.8
Atherinops affinis	4	2	2	6	6	3	3	5	4	1	3.6
Xenistius californiensis	7	3	10	4	8	4	8	4	5	7	6.0
Atherinopsis californiensis	12	17	6	3	2	6	5	2	6	3	6.2
Genyonemus lineatus	8	14	11	15	5	4	4	8	2	13	8.4
Paralabrax clathratus	3	9	7	10	14	12	15	10	12	10	10.2
Paralabrax nebulifer	6	8	9	14	9	14	11	12	11	9	10.3
Anisotremus davidsonii	5	7	8	5	10	21	20	15	7	8	10.6
Chromis punctipinnis	2	5	4	8	11	11	18	16	22	15	11.2
Umbrina roncador	17	19	13	19	13	10	7	6	8	5	11.7
Hyperprosopon argenteum	9	10	3	9	12	7	9	7	10	47	12.3
Sardinops sagax	36	49	23	2	3	2	2	9	3	4	13.3
Cheilotrema saturnum	18	15	17	18	15	17	17	13	9	11	15.0
Engraulis mordax	24	4	1	43	49	9	6	3	18	6	16.3
Leuresthes tenuis	10	12	-	17	33	8	36	11	17	28	19.1
Phanerodon furcatus	16	11	15	13	20	20	12	14	42	33	19.6
Embiotoca jacksoni	15	22	20	33	27	19	16	24	24	16	21.6
Sebastes miniatus	-	-	-	-	-	-	-	-	-	22	22.0
Medialuna californiensis	14	22	16	20	17	24	28	25	34	26	22.6
Rhacochilus toxotes	23	21	14	24	28	29	21	21	29	20	23.0

Queenfish was the second most abundant species in 1999, and was first in overall abundance for the last ten years (Table 13). They are also a major portion of trawl catches in the nearshore Southern California Bight (MBC unpubl. trawl data). Queenfish is a schooling species abundant over sandy bottoms, and is most common at depths of 10 m (Allen 1982), which coincides with the depth of the intake structures. They form quiescent schools near the bottom in daytime, and disperse and feed in the water column at night (Love 1991), when they become susceptible to the intake currents. Their absence from ESGS is probably due to predation within the quiet forebay waters of the generating station.

Pacific sardine was the fourth most abundant species in 1999. Pacific sardines have made a remarkable comeback after a disastrous decline in the fisheries in the early 1950s. Although impingement catches were sporadically monitored in the 1960s and broad scale monitoring commenced in the 1970s, it was not until 1993 that large numbers of sardines appeared in the impingement catches at ESGS and SGS. They have continued to be visitors near the power plants as evidenced by their regular impingement at the power plants since 1990 (MBC 1990-1994, 1997, 1998). They were twelfth in abundance overall since 1990, and have ranked among the top ten species since 1993 (Table 13). This parallels their recent rise in abundance in California waters as their population expands (Love 1991).

Yellowfin croaker was the fifth most abundant species in 1999. Yellowfin croaker occur in schools in nearshore habitats, generally from the surf zone out to about 15 m depth (Leet 1992). They occur most frequently along sandy beaches just outside the surf zone, and are a popular sportfish (Love 1991). They are abundant during the summer months, and are infrequently seen in the winter months, when they either move offshore to deeper water, or south to warmer waters (Love 1991).

Barred sand bass and kelp bass, the eighth and ninth most abundant species, are important sportfish and are of concern to the resource agencies charged with their management. Barred sand bass are found near and on the bottom near the margins of reefs to which they are attracted as focal points for feeding, mating, and living area (Helvey and Smith 1985). Although barred sand bass populations are probably equally abundant in the ESGS and SGS areas, the single intake and discharge structures at SGS are the only focal points for the population in the vicinity, and they, therefore, attract a greater portion of the available nearshore population. The preponderance of focal points surrounding the ESGS area, such as the beach erosion groins, the Chevron discharge structure, and the two intake and discharge structures at ESGS, reduces the population pressure on any single area by attracting only a portion of the available population. Therefore, fewer individuals are attracted to the more risky areas near the intakes.

Kelp bass, on the other hand, are attracted to high-relief patch reefs, not as a focal point, but because prey availability is maximized at high current areas surrounding reefs and also at the intakes. The higher density of structures near the ESGS area probably attracts more kelp bass than the area near SGS because of the greater abundance of fish and invertebrates (all potential prey) associated with the increase in available niches. This species also actively swims in the water column, maintaining positive rheotaxis to the current flow, a behavior which exposes a greater portion of the population to the intake flow.

The remaining three of the ten most abundant species in 1999 were northern anchovy, salema, and sargo (Table 9). Northern anchovy and salema are mid-water schooling fishes found in shallow water (Love 1991). Sargo are generally associated with reef structures, and forage for food near the sand margin (Love 1991). All three of these species have ranked among the top ten species at least six of the last ten years (Table 13).

Length-frequency histograms of the sargo, Pacific sardine, and kelp bass populations indicated similar populations impinged at both SGS and at ESGS, although in different abundances. Although queenfish was only impinged at SGS, they probably were entrained at ESGS but succumbed to predation in the forebay. Most histograms were relatively smooth curves, indicating that the intake is not selective but is impinging a cross section of the population found in the nearshore waters at ESGS and SGS.

The queenfish population distribution histogram was bimodal at SGS. Queenfish were most abundant in the impingement catch at 100 mm SL, corresponding to approximately one year old individuals (DeMartini and Fountain 1981). The second mode at 70 mm SL corresponds to young-of-the-year (YOTY) indicating the presence of a spring spawn. A higher percentage of this years fish were smaller, indicating a good recruitment into the population. A similar pattern was seen in 1997, with a greater percentage of older fish the following year (MBC 1997,1998).

The majority of the sargo population at both stations was centered around 240 to 250 mm SL, corresponding to four year old fish, with a second grouping at two years old (Love 1991). Similar distributions were seen in 1998 (except for a larger YOTY class), indicating a stable population in the offshore waters (MBC 1998).

The kelp bass population ranged from YOTY to six-year-old fish (40 to 300 mm SL) (Hulbrock 1974, Love 1991). At ESGS, most of the fish were age-two or older with very few YOTY, while at SGS, the kelp bass distribution indicated a strong recruitment of YOTY fish, with most of the

the remainder of the population age-two to age-four fish (170 to 270 mm). Other than the greater recruitment of YOTY, the kelp bass population distribution has been almost identical for the last eight years, indicating there have been no appreciable effects on the populations offshore by the generating stations (MBC 1990-1994, 1997, 1998).

Pacific sardine populations at the two generating stations were similar, with slightly larger individuals present at ESGS. This is most likely due to the timing of the entrainment and subsequent heat treatments, rather than a difference between the generating stations. Sardines mature about 170 mm (Love 1991), so most of these are young fish.

Abundant species were ranked for each of the last ten years and ranks were then averaged to determine the most abundant species for the ten-year period (Table 13). At least nine of these 20 most abundant species over the last ten years have occurred among the 20 most abundant during each year. All twenty were present in 1999, and 18 of those species occurred in every year since 1990. This recurring core group of species demonstrates the stability of the community and suggests that the populations present offshore are not unduly stressed by the relatively minor loss due to entrainment.

Heat treatment data from ESGS Units 1 & 2 and Units 3 & 4 are available from 1979 to 1999 and from SGS from 1986 to 1999 (Table 14). Impingement biomass for 1999 at ESGS was about 30% of its long-term mean, and at SGS it was 10% greater than its long-term mean. Impingement data from SGS indicate that fish biomass was lowest in 1993, which was part of a trend of declining catches from a high in 1986. The large increase noted in 1994 and again in 1996 appears to be related to the chance increase in impingement of the larger pelagic schooling species such as topsmelt, jack mackerel, jacksmelt, and Pacific sardine. As these and other species increase in abundance, the catches appear to be increasing slightly.

The decrease in fish biomass at ESGS continues a trend seen beginning in 1984. Fish biomass at ESGS during the period from 1979 to 1983 averaged 3,333 kg per year, but since 1984, it has remained relatively low, averaging only 723 kg per year. The more than three-fold decrease in impingement was due to the decreased demand for power from ESGS following completion of Units 2 & 3 at San Onofre Nuclear Generating Station (SONGS) in 1983-1984. During this same period, SGS continued operating at normal levels. With increased capacity at SONGS, many of the southern California generating stations (including ESGS) have operated at much lower capacity and, more importantly for fish impingement, with fewer circulators running, which has resulted in decreased flows at the intake and an exponential decline in impingement (Curtis, MBC, pers. obs.).

Table 14. Biomass (kg) of fish impinged during heat treatments, 1979 - 1999. El Segundo and Scattergood Generating Stations NPDES, 1999.

	El Segundo			Scattergood
Year	1 & 2	3 & 4	Total	
1979	1440.83	2248.46	3689.29	NA
1980	1353.74	2455.43	3809.17	NA
1981	1269.96	2612.56	3882.52	NA
1982	579.83	1980.86	2560.69	NA
1983	1357.23	1366.87	2724.1	NA
1984	239.93	515.91	755.84	NA
1985	351.89	465.38	817.27	NA
1986	99.65	1615.39	1715.04	3224.05
1987	215.97	328.76	544.73	1698.68
1988	210.71	55.15	265.86	1722.23
1989	274.86	9.12	283.98	1289.27
1990	109.33	614.87	724.2	1447.22
1991	380.48	20.26	400.74	2028.61
1992	48.53	358.85	407.38	931.23
1993	51.51	1022.71	1074.22	828.82
1994	0.53	760.45	760.98	5902.55
1995	70.41	667.99	738.40	1092.18
1996	15.11	209.48	224.59	4178.14
1997	13.54	1696.92	1710.46	1005.58
1998	0.00	406.84	406.84	1780.62
1999	41.00	338.66	379.66	2317.85
Mean	386.91	940.52	1327.43	2103.36

NA = Data not available

Macroinvertebrates

Macroinvertebrate catches were greater at ESGS than at SGS. Rock crabs and common salp were the most abundant species at ESGS, and red striped shrimp and tuberculate pear crab were the most abundant species at SGS. Two other species of sport or commercial interest, two-spot octopus and California spiny lobsters, were present in greater abundance at SGS. Almost 85% of the California spiny lobsters at ESGS, and 67% of those at SGS, were greater than the legal size limit (approximately 83 mm carapace length) (CFD&G 1997). Overall species diversity was similar to prior years, although abundance and biomass were higher this year than noted since 1992 (MBC 1990-1994, 1997). Most of the invertebrates seen in 1999 were taken at ESGS during normal operation monitoring. With the low frequency of heat treatments, individuals settling out of the plankton become resident in the seawater system and grow larger and heavier.

CONCLUSIONS

Water quality measurements indicated that the cooling water discharged from the El Segundo and Scattergood Generating Stations did not have an adverse effect on receiving waters in the study area. Only minor fluctuations of temperature, DO, and pH were detected, all most likely due to temporal and spatial variations in longshore currents and the degree of solar insolation input to the area.

Sediments in the study area were mostly sand, with a mean grain size in the fine sand category. Sediments were coarsest at offshore Station B5, upcoast of the Scattergood and El Segundo discharge structures, and finest at offshore Station B8, downcoast of the Scattergood and El Segundo discharge structures. No spatial patterns were apparent that would suggest effects from the Scattergood or El Segundo Generating Stations.

The distribution of metals in the sediments of the study area did not appear to be related to the generating station discharges. Highest concentrations of all metals were upcoast of the discharges and appear to be related to the amount of fine material in the sediments. Concentrations of all metals were within ranges found in sediments in the Southern California Bight and below levels determined to be potentially toxic to benthic organisms.

Mean copper concentration in bay mussel tissue collected offshore the El Segundo Generating Station was higher than in past surveys since 1990, while mean zinc concentration was second highest since 1990. Mean copper and zinc concentrations from mussel tissue collected near the Scattergood Generating Station were similar to values recorded in past surveys. All metal concentrations were within ranges found in other surveys in the Southern California Bight. Chromium and nickel were not detected in mussel tissues near the generating stations. These results indicate that the bioaccumulation of metals has not been appreciable near the El Segundo and Scattergood Generating Station discharges.

The benthic infaunal community in the study area in 1999 was similar to that of previous years. Species richness and abundance was below, while diversity was above, the average for the 1990 to 1998 surveys. However, this comparison is greatly influenced by the presence of an ongoing la Niña which is known to shift distribution of species. No pattern in species composition or abundance could be attributed to the Scattergood and El Segundo Generating Stations' discharges.

High diversity and abundance of the fish population entrained by the SGS and ESGS intakes suggest that a variety of niches are available near the discharge and intake structures. Continued high diversity and abundance of core species, as evidenced by impingement data from the last nine years, indicated that impingement at the Scattergood and El Segundo Generating Stations is not unduly influencing the fish and macroinvertebrate communities in the nearshore.

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APPENDIX A

Receiving water monitoring specifications

Southern California Edison
El Segundo Generating Station
Monitoring and Reporting Program No. 4667

CA0001147

III. RECEIVING WATER MONITORING

A. Regional Monitoring Program

1. Pursuant to the Code of Federal Regulation [40 CFR §122.41(j) and §122.48(b)], the monitoring program for a discharger receiving a National Pollutant Elimination System (NPDES) permit must determine compliance with NPDES permit terms and conditions, and demonstrate that State water quality standards are met.

2. Since compliance monitoring focuses on the effects of point source discharge, it is not designed to assess impacts from other sources of pollution (e.g., non-point source run-off, aerial fallout) nor to evaluate the current status of important ecological resources on a regional basis.

   Several efforts are underway to develop and implement a comprehensive regional monitoring program for the Southern California Bight. These efforts have the support and participation from regulatory agencies, dischargers, and environmental groups. The goal is to establish a regional program to address public health concerns, monitor trends in natural resources and nearshore habitats, and assess regional impacts from all contaminant sources.

3. A pilot regional monitoring program was conducted during the summer of 1994 to test an alternative sampling design that combines elements of compliance monitoring with a broader regional assessment approach. This pilot program was designed by USEPA, the State Water Resources Control Board, and three Regional Water Quality Control Boards (Los Angeles, Santa Ana, San Diego) in conjunction with the Southern California Coastal Water Research Project and participating discharger agencies.

4. The results of the pilot program will be evaluated and used to redesign the current monitoring program and to develop a comprehensive regional monitoring program for the Southern California Bight. At the same time, the monitoring programs conducted by other dischargers and agencies will be integrated into this regional program. If predictable relationships among the biological, water quality, and effluent monitoring variables can be demonstrated, it may be appropriate to decrease the sampling effort. Conversely, the monitoring program may be intensified if it appears that the objectives cannot be achieved through the existing monitoring program. In general, the goal is a more efficient monitoring program that can be used for both compliance and regional bight-wide assessments.

5. Substantial changes to the compliance monitoring program for this generating station may be required over the next few years to fulfill the goals of regional monitoring, while retaining the compliance monitoring component required to evaluate the potential impacts from the NPDES discharge. Revisions to the existing program will be made under the discretion of the USEPA and the Los Angeles Regional Board as necessary to accomplish this goal; and may include a reduction or increase in the number of parameters to be monitored, the frequency of monitoring, or the number, type, and location of samples collected.

B. Regional Database

1. Development and implementation of an information management system to support integrated analysis and transfer of monitoring program data is required so that management decisions for the protection of beneficial uses and public resources can be based on an evaluation of all available information. This represents one significant component of the action plan developed for the Santa Monica Bay Restoration Project. The Los Angeles Regional Board supports this goal and plans to move forward by establishing a Regional Database containing discharger monitoring data and other pertinent information submitted to or collected by the Regional Board and other agencies.

2. Southern California Edison (SCE) and the City of Los Angeles Department of Water and Power (DWP) have indicated a desire to assist the Regional Board in establishing this regional database system. This could be accomplished by diverting a portion of the resources normally dedicated to the power plant's annual receiving water monitoring programs into the creation of a database and associated analytical tools.

3. USEPA and the Los Angeles Regional Board believe that the existing monitoring programs for SCE's and DWP's generating stations will be substantially revised when these programs are integrated into a comprehensive regional monitoring program. These revisions are expected to be implemented within the next two years.

4. Although the monitoring conducted over the past several years has demonstrated an increase in temperature in the receiving waters around the discharge points of the generating stations, no adverse impacts to benthic infaunal or fish communities have been documented. Therefore, until the monitoring programs are revised for inclusion into a comprehensive regional program, USEPA and the Los Angeles Regional Board would have no objection to reducing the receiving monitoring required for compliance monitoring purposes, provided that SCE and DWP help fund the creation of a regional database. Upon approval by the Executive Officer, SCE and DWP may implement such a plan in lieu of the Receiving Water Monitoring specified below.

C. Receiving Water Monitoring

The receiving water monitoring program shall consist of periodic biological surveys of the area surrounding the discharge, and shall include studies of those physical - chemical characteristics of the receiving waters which may be impacted by the discharge.

This program may be performed as a joint effort with the City of Los Angeles' Department of Water and Power in connection with the receiving water monitoring program for the Scattergood Generating Station.

Location of Sampling Stations (see Attached Figure 3):

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1. Receiving water stations shall be located as follows:

   a. RW1 - 7,875 feet upcoast of the Scattergood discharge terminus, at a depth of 20 feet.

   b. RW2 - 1,000 feet upcoast of the El Segundo discharge terminus, at a depth of 20.

   c. RW3 - 1,750 feet downcoast of the El Segundo discharge terminus, at a depth of 20 feet.

   d. RW4 - 9,900 feet downcoast of the El Segundo discharge terminus, at a depth of 20 feet.

   e. RW5 - directly offshore of Station RW1, at a depth of 40 feet.

   f. RW6 - directly offshore of Station RW2, at a depth of 40 feet.

   g. RW7 - directly offshore of station RW3, at a depth of 40 feet.

   h. RW8 - directly offshore of Station RW4, at a depth of 40 feet.

   i. RW9 - directly offshore of Station RW1, at a depth of 60 feet.

   j. RW10 - directly offshore of Station RW2, at a depth of 60 feet.

   k. RW11 - directly offshore of Station RW3, at a depth of 60 feet.

   l. RW12 - directly offshore of Station RW4, at a depth of 60 feet.

2. Benthic stations shall be located as follows:

   Stations B1 through B8 shall be located directly beneath Stations RW1 through RW8, respectively.

D. Type and Frequency of Sampling:

1. Temperature profiles shall be measured semi.annually (summer and winter) each year at Stations RW1 through RW12 from surface to bottom at a minimum of on-meter intervals. Dissolved oxygen levels and pH shall be measured semi-annually at the surface, mid-depth and bottom at each station, at a minimum. All stations shall be sampled on both a flooding tide and an ebbing tide during each semi-annual survey.

2. Impingement sampling for fish and commercially important macroinvertebrates shall be conducted at least once every two months at Intake Nos. 001 and 002. Impingement sampling shall coincide with heat treatments.

   Fish and macroinvertebrates shall be identified to the lowest possible taxon. For each intake point, data reported shall include numerical abundance of each fish and macroinvertebrate species, wet weight of each species (when combined weight of individuals in each species exceeds 0.2 kg), number of individuals in each 1-centimeter size class (based on standard length) for each species and total number of species are collected. When large numbers of given species are collected, length/weight data need only be recorder for 50 individuals and total number and total weight may be estimated.

3. Native California mussels (Mytilus Calfornianus) shall be collected during the summer from the discharge conduit, as close to the point of discharge as possible, for bioaccumulation monitoring. The mussels shall be collected and analyzed as described in Appendix A of the "California State Mussel Watch Marine Water Quality Monitoring Program 1985-86" (Water Quality Monitoring Report No. 87-2WQ). Mussel tissue shall be analyzed for copper, chromium, nickel and zinc at a minimum.

4. Benthic sampling shall be conducted annually during the summer at Stations B1 through B8.

   a. One liter sediment core samples shall be collected by divers at each of the benthic stations for biological examination and determination of biomass and diversity, and for sediment analyses. Four replicates shall be obtained at each station for benthic analyses, and each shall be analyzed separately. A fifth sample shall be taken at each station for sediment analyses and general description.

b. Each benthic replicate sample shall be sieved through a 0.5 mm standard mesh screen. All organisms recovered shall be enumerated and identified to the lowest taxon possible. Infaunal organisms shall be reported as concentrations per liter for each replicate and each station. Total abundance, number of species and Shannon-Weiner diversity indices shall be calculated (using natural logs) for each replicate and each station.

   Biomass shall be determined as the wet weight in grams or milligrams retained on a 0.5 millimeter screen per unit volume (e.g., 1 liter) of sediment. Biomass shall be reported for each major taxonomic group (e.g., polychaetes, crustaceans, mollusks) for each replicate and each station.

c. Sediment grain size analyses shall be performed on each sediment sample (sufficiently detailed to calculate percent weight in relation to phi size). Sub samples (upper two centimeters) shall be taken from each sediment sample and analyzed for copper, chromium, nickel and zinc.

5. The following general observations or measurements at the receiving water and benthic stations shall be reported.

   a. Tidal stage and time of monitoring.

   b. General water conditions.

   c. Extent of visible turbidity or color patches.

   d. Appearance of oil films or grease, or floatable material.

   e. Depth at each station for each sampling period.

   f. Presence or absence of red tide.

g. Presence of marine life.

h. Presence and activity of the California least tern and the California brown pelican.

6. During periodic maintenance of the intake structures and discharge of calcareous material to the receiving waters, the following observations or measurements shall be recorded and reported in the next monitoring report:

a. Date and times of discharge(s).

b. Estimate of volume and weight of discharge(s).

c. Composition of discharge(s).

d. General water conditions and weather conditions.

e. Appearance and extent of any oil films or grease, floatable material or odors.

f. Appearance and extent of visible turbidity or color patches.

g. Presence of marine life.

h. Presence and activity of the California least tern and the California brown pelican.

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SUMMARY OF RECEIVING WATER MONITORING

Constituents	Units	Station No.	Type of Sample	Minimum Frequency of Analysis
Temperature	°C	RW1-RW12	vertical profile	semi-annually (flood, ebb)
Dissolved oxygen	mg/l	RW1-RW12	vertical profile	semi-annually (flood, ebb)
pH	pH units	RW1-RW12	vertical profile	semi-annually (flood, ebb)
Fish and macro invertebrates	---	Intakes No. 001 and 002	impingement	bi-monthly
Mussels	---	Discharge	tissue	annually
Benthic infauna	---	B1-B8	grab	annually
Sediments	---	B1-B8	grab	annually

E. Chlorine Residual Study

Pursuant to Section 301(g), the discharger has applied for a variance from the residual chlorine effluent limitation based on Ocean Plan objectives. If the USEPA approves the variance request, the discharger shall conduct a study to demonstrate that there is no significant adverse impact on the receiving water as a result of the discharge of higher levels of residual chlorine. Within 90 days following the USEPA's final approval of the variance request, the discharger shall submit a study plan for approval by Executive officer and the Discharger shall implement the approved study within 90 days of approval.

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IV. STORM WATER MONITORING AND REPORTING

The discharger shall implement the attached Storm Water Monitoring and Reporting Program (Attachment 1).

Ordered By: [signature]
ROBERT P. GHIRELLI, D.Env.
Executive Officer

Date: December 5, 1994

/RNA

Appendix A-1. (Cont.).

Monitoring and Reporting Program No. 4667 CA0001147
Southern California Edison
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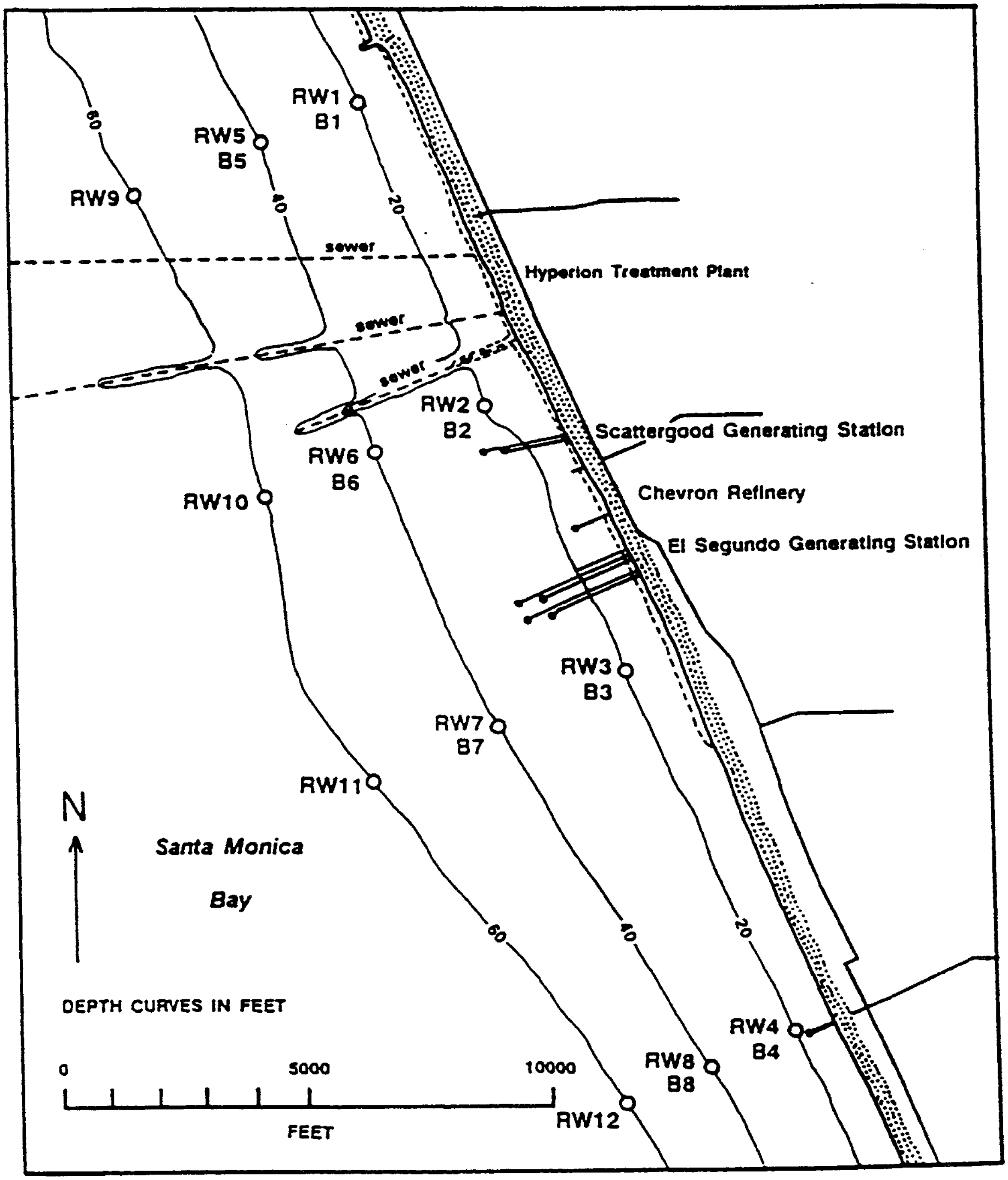

El Segundo Receiving Water Monitoring Stations.

Monitoring and Reporting Program No. 1886 CA0000370
Scattergood Generating Station

III. RECEIVING WATER MONITORING

A. Regional Monitoring Program

1. Pursuant to the Code of Federal Regulation [40 CFR §122.41(j) and §122.48(b)], the monitoring program for a discharger receiving a National Pollutant Elimination System (NPDES) permit must determine compliance with NPDES permit terms and conditions, and demonstrate that State water quality standards are met.

2. Since compliance monitoring focuses on the effects of point source discharge, it is not designed to assess impacts from other sources of pollution (e.g., non-point source run-off, aerial fallout) nor to evaluate the current status of important ecological resources on a regional basis.

Several efforts are underway to develop and implement a comprehensive regional monitoring program for the Southern California Bight. These efforts have the support and participation from regulatory agencies, dischargers, and environmental groups. The goal is to establish a regional program to address public health concerns, monitor trends in natural resources and nearshore habitats, and assess regional impacts from all contaminant sources.

3. A pilot regional monitoring program was conducted during the summer of 1994 to test an alternative sampling design that combines elements of compliance monitoring with a broader regional assessment approach. This pilot program was designed by USEPA, the State Water Resources Control Board, and three Regional Water Quality Control Boards (Los Angeles, Santa Ana, San Diego) in conjunction with the Southern California Coastal Water Research Project and participating discharger agencies.

4. The results of the pilot program will be evaluated and used to redesign the current monitoring program and to develop a comprehensive regional monitoring program for the Southern California Bight. At the same time, the monitoring programs conducted by other dischargers and agencies will be integrated into this regional program. If predictable relationships among the biological, water quality, and effluent monitoring variables can be demonstrated, it may be appropriate to decrease the sampling effort. Conversely, the monitoring program may be intensified if it appears that the objectives cannot be achieved through the existing monitoring program. In general, the goal is a more efficient monitoring program that can be used for both compliance and regional bight-wide assessments.

5. Substantial changes to the compliance monitoring program for this generating station may be required over the next few years to fulfill the goals of regional monitoring, while retaining the compliance monitoring component required to evaluate the potential impacts from the NPDES discharge. Revisions to the existing program will be made under the discretion of the USEPA and the Los Angeles Regional Board as necessary to accomplish this goal; and may include a reduction or increase in the number of parameters to be monitored, the frequency of monitoring, or the number, type, and location of samples collected.

B. Regional Database

1. Development and implementation of an information management system to support integrated analysis and transfer of monitoring program data is required so that management decisions for the protection of beneficial uses and public resources can be based on an evaluation of all available information. This represents one significant component of the action plan developed for the Santa Monica Bay Restoration Project. The Los Angeles Regional Board supports this goal and plans to move forward by establishing a Regional Database containing discharger monitoring data and other pertinent information submitted to or collected by the Regional Board and other agencies.

2. Southern California Edison (SCE) and the City of Los Angeles Department of Water and Power (DWP) have indicated a desire to assist the Regional Board in establishing this regional database system. This could be accomplished by diverting a portion of the resources normally dedicated to the power plant's annual receiving water monitoring programs into the creation of a database and associated analytical tools.

3. USEPA and the Los Angeles Regional Board believe that the existing monitoring programs for SCE's and DWP's generating stations will be substantially revised when these programs are integrated into a comprehensive regional monitoring program. These revisions are expected to be implemented within the next two years.

4. Although the monitoring conducted over the past several years has demonstrated an increase in temperature in the receiving waters around the discharge points of the generating stations, no adverse impacts to benthic infaunal or fish communities have been documented. Therefore, until the monitoring programs are revised for inclusion into a comprehensive regional program, USEPA and the Los Angeles Regional Board would have no objection to reducing the receiving water monitoring required for compliance monitoring purposes, provided that SCE and DWP help fund the creation of a regional database. Upon approval by the Executive Officer, SCE and DWP may implement such a plan in lieu of the Receiving Water Monitoring specified below.

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C. Receiving Water Sampling Stations.

The receiving water monitoring program shall consist of periodic biological surveys of the area surrounding the discharge, and shall include studies of those physical-chemical characteristics of the receiving waters which may be impacted by the discharge.

This program may be performed as a joint effort with the Southern California Edison Company in connection with the receiving water monitoring program for the El Segundo Generating Station.

Location of Sampling Stations (see Attached figure)

1. Receiving water stations shall be located as follows:

   a. Station RW1 - 7,875 feet upcoast of the Scattergood discharge terminus, at a depth of 20 feet.

   b. Station RW2 - 1,000 feet upcoast of the Scattergood discharge terminus, at a depth of 20 feet.

   c. Station RW3 - 1,750 feet downcoast of the El Segundo discharge terminus, at a depth of 20 feet.

   d. Station RW4 - 9,900 feet downcoast of the El Segundo discharge terminus, at a depth of 20 feet.

   e. Station RW5 - directly offshore of Station RW1, at a depth of 40 feet.

   f. Station RW6 - directly offshore of Station RW2, at a depth of 40 feet.

   g. Station RW7 - directly offshore of Station RW3, at a depth of 40 feet.

   h. Station RW8 - directly offshore of Station RW4, at a depth of 40 feet.

   i. Station RW9 - directly offshore of Station RW1, at a depth of 60 feet.

   j. Station RW10 - directly offshore of Station RW2, at a depth of 60 feet.

k. Station RW11 - directly offshore of Station RW3, at a depth of 60 feet.

l. Station RW12 - directly offshore of Station RW4, at a depth of 60 feet.

2. Benthic stations shall be located as follows:

   Stations B1 though B8 shall be located directly beneath Stations RW1 through RW8, respectively.

D. <u>Type and Frequency of Sampling:</u>

1. Temperature profiles shall be measured semi-annually (summer and winter) each year at Stations RW1 through RW12 from surface to bottom at a minimum of one-meter intervals. Dissolved oxygen levels and pH shall be measured semi-annually at the surface, mid-depth and bottom at each station, at a minimum. All stations shall be sampled on both a flooding tide and an ebbing tide during each semi-annual survey.

2. Impingement sampling for fish and commercially important macroinvertebrates shall be conducted at least once every two months at Intake No. 001. Impingement sampling shall coincide with heat treatments.

   Fish and macroinvertebrates shall be identified to the lowest possible taxon. For each intake point, data reported shall include numerical abundance of each fish and macro-invertebrate species, wet weight of each species (when combined weight of individuals of one species exceeds 0.2 kg), number of individuals in each 1-centimeter size class (based on standard length) for each species and total number of species and individuals collected. When large numbers of a given species are collected, length/weight data need only be recorded for 50 individuals and total number and total weight may be estimated.

3. During the first year of the permit, native California mussels (<u>Mytilus calfornianus</u>) shall be collected during the summer from the discharge conduit, as close to the point of discharge as possible, for bioaccumulation monitoring. The mussels shall be collected and analyzed as described in Appendix A of the "California State

Mussel Watch Marine Water Quality Monitoring Program 1985-86" (Water Quality Monitoring Report No. 87-2WQ). Mussel tissue shall be analyzed for copper, chromium, nickel and zinc, at a minimum.

The first year's data will be carefully evaluated and the Executive Officer shall decide whether to continue, modify or eliminate the mussel sampling component of the monitoring program.

4. Benthic sampling shall be conducted annually during the summer at Stations B1 through B8.

   a. One liter sediment core samples shall be collected by divers at each of the benthic stations for biological examination and determination of biomass and diversity, and for sediment analyses. Four replicates shall be obtained at each station for benthic analyses, and each shall be analyzed separately. A fifth sample shall be taken at each station for sediment analyses and general description.

   b. Each benthic replicate sample shall be sieved through a 0.5 mm standard mesh screen. All organisms recovered shall be enumerated and identified to the lowest taxon possible. Infaunal organisms shall be reported as concentrations per liter for each replicate and each station. Total abundance, number of species and Shannon-Weiner diversity indices shall be calculated (using natural logs) for each replicate and each station.

      Biomass shall be determined as the wet weight in grams or milligrams retained on a 0.5 millimeter screen per unit volume (e.g., 1 liter) of sediment. Biomass shall be reported for each major taxonomic group (e.g., polychaetes, crustaceans, mollusks) for each replicate and each station.

   c. Sediment grain size analyses shall be performed on each sediment sample (sufficiently detailed to calculate percent weight in relation to phi size). During the first year of the permit, sub-samples (upper two centimeters) shall be taken from each sediment sample and analyzed for copper, chromium, nickel and zinc.

The first year's data will be carefully evaluated and the Executive Officer shall decide whether to continue, modify or eliminate the mussel sampling component of the monitoring program.

5. The following general observations or measurements at receiving water and benthic stations shall be reported.

   a. Tidal stage and time of monitoring.

   b. General water conditions.

   c. Extent of visible turbidity or color patches.

   d. Appearance of oil films or grease, or floatable material.

   e. Depth at each station for each sampling period.

   f. Presence or absence of red tide.

   g. Presence of marine life.

   h. Presence and activity of the California least tern and the California brown pelican.

SUMMARY OF RECEIVING WATER MONITORING

Parameter	Units	Stations	Type of Sample	Minimum Frequency
Temperature	°C	RW1-RW12	vertical profile	semi-annually (flood, ebb)
Dissolved oxygen	mg/l	RW1-RW12	vertical profile	semi-annually (flood, ebb)
pH	pH	RW1-RW12 units	vertical profile	semi-annually (flood, ebb)
Fish and macro invertebrates	---	Intakes No. 001	impingement	bi-monthly
Mussels	___	Discharge	tissue	annually
Benthic infauna	---	B1-B8	grab	annually
Sediments	---	B1-B8	grab	annually

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E. Chlorine Residual Study

Pursuant to Section 301(g), the Discharger has applied for variance from the residual chlorine effluent limitation based on Ocean Plan objectives. If the USEPA approves the variance request, the Discharger shall conduct a study to demonstrate that there is no significant adverse impact on the receiving water as a result of the discharge of higher levels of residual chlorine. Within 90 days following the USEPA's final approval of the variance request, the Discharger shall submit a study plan to the Regional Board for approval by the Executive Officer and the Discharger shall implement the study plan within 90 days.

IV. Storm Water Pollution Prevention Plan (SWPP) Monitoring and Reporting

The discharger shall implement the attached Stormwater Monitoring and Reporting Program (Attachment 1).

Ordered by: Robert P. Ghirelli
ROBERT P. GHIRELLI, D.Env.
Executive Officer

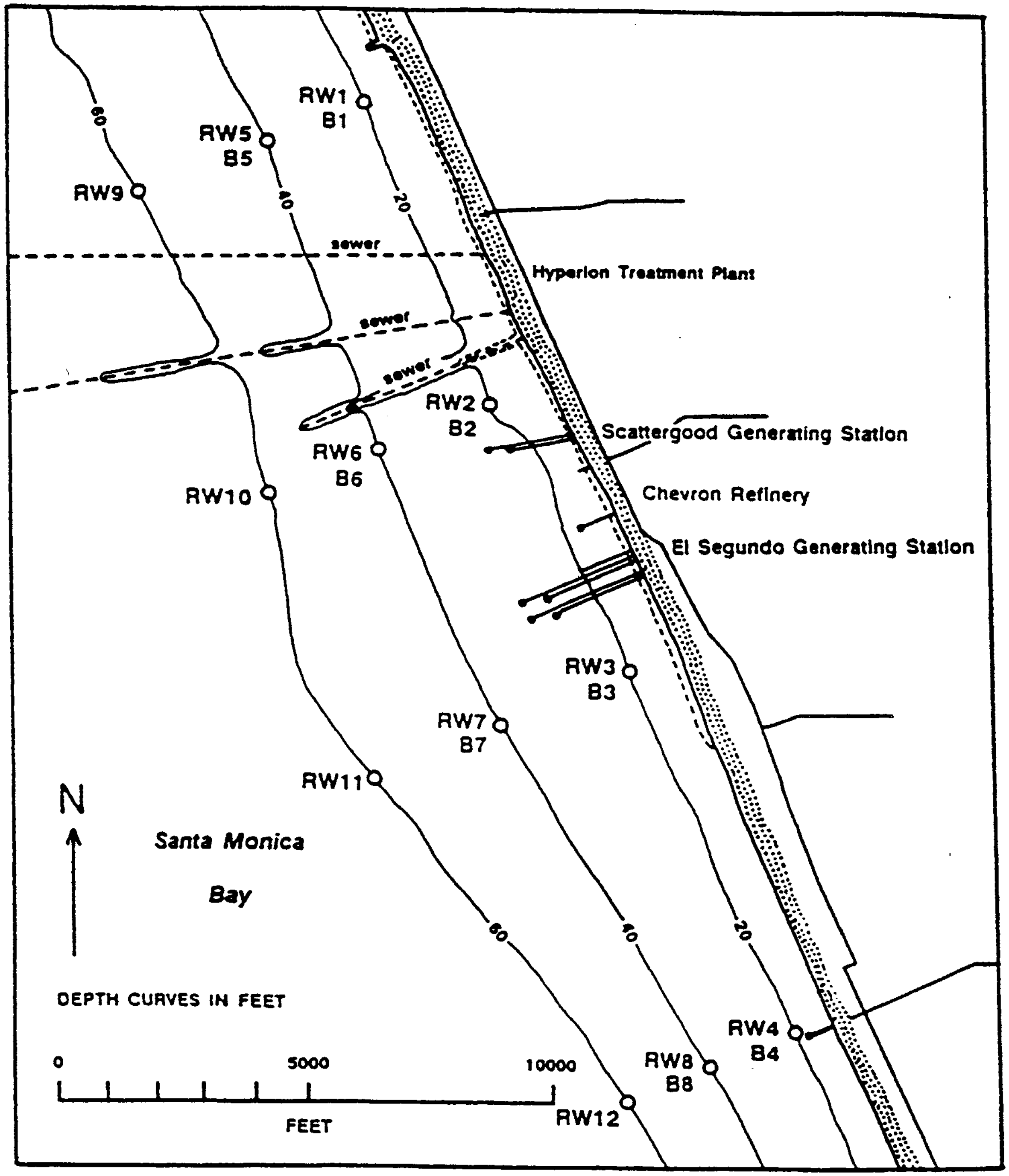
Date: February 27, 1995

CDS\

Appendix A-2. (Cont.).

Monitoring and Reporting Program No. 1886
City of Los Angeles, Dept. of Water and Power
Scattergood Generating Station

CA0000370



Scattergood Receiving Water Monitoring Stations.

APPENDIX B

Grain size techniques

Appendix B. Grain size techniques.

Sediment Grain Size Analysis

Analysis of sediment samples for size distribution characteristics are performed using two techniques. Sediments in the gravel size range (> 2.0 mm in diameter) are analyzed using a series of standard sieves having screen openings of 0.5 phi increments (diameter in phi units = $-\log_2$ diameter in mm, or = -ln diameter in mm ÷ ln 2). The sand-silt-clay fraction of sediments [-1 phi through 4 phi (2.0 mm through 0.0625 mm) for sand], [4 phi through 8 phi (0.0625 mm through 0.004 mm) for silt, 8 phi and greater for clay (0.0039 mm and smaller)] is analyzed by laser light diffraction. The sample is suspended in a suspension column and continuously circulated through the laser beam. The laser beam passes through the sample where the suspended particles scatter incident light. Fourier optics collect diffracted light and focus it on to three sets of detectors. A composite, time-averaged diffraction pattern is measured by 126 detectors. Sizes are computed and summed into normal distribution classifications.

Laboratory data from the two methods are mathematically combined and entered into a computer program which calculates and prints size-distribution characteristics and plots both interval and cumulative frequency distribution curves.

Analysis of the plotted cumulative size frequency curves is performed as described by Inman (1952). The median, 5th, 16th, 84th, and 95th percentiles (converted to phi notation) of the sediment distribution curve is used to calculate mean grain size diameter, sorting coefficient, and measures of skewness and kurtosis. Where sediment distribution coincides with a normal distribution curve, the 16th and 84th percentiles represent diameters one standard deviation on either side of the mean. The following formulas are used in the calculations:

1. Mean Diameter (M_ϕ) is the average particle size in the central 68% of the distribution.

$$M_\phi = (\phi_{16} + \phi_{50} + \phi_{84}) \;/\; 3$$

2. Sorting (σ_ϕ) measures the uniformity (or non-uniformity) of particle quantities in each size category of the sediment distribution. A σ_ϕ value under 0.35ϕ indicates that particles are very well sorted (i.e. sediments are primarily composed of a narrow range of size classes, or a single size class), while a value of over 4.0ϕ indicates that the sediments are extremely poorly sorted, or evenly distributed among size classes.

$$\sigma_\phi = \frac{\phi_{84} - \phi_{16}}{4} + \frac{\phi_{95} - \phi_5}{6.6}$$

3. Skewness (α_ϕ) is a measure of the direction and extent of departure of the mean from the median (in a normal or symmetrical curve they coincide). In symmetrical curves, α_ϕ=0.00 with limits of -1.00 and +1.00. Negative values indicate the particle distribution is skewed toward larger particle diameters, while positive values indicate the distribution is skewed toward smaller particle diameters.

$$\alpha_\phi = \frac{\phi_{16} + \phi_{84} - 2\phi_{50}}{2(\phi_{84} - \phi_{16})} + \frac{\phi_5 + \phi_{95} - 2\phi_{50}}{2(\phi_{95} - \phi_5)}$$

4. Kurtosis (β_ϕ) is a measure of how far the sediment distribution curve departs from a normal Gaussian shape at its peak. Curves with greater than normal amounts of sediment at their modes will be sharp or leptokurtic ($\beta_\phi > 1$). Those with fatter tails and lower peaks than expected are termed platykurtic ($\beta_\phi < 1$). $\beta_\phi = 1.00$ for a normal curve. Curve category interpretations are based on Folk (1974).

$$\beta_\phi = \frac{\phi_{95} - \phi_5}{2.44(\phi_{75} - \phi_{25})}$$

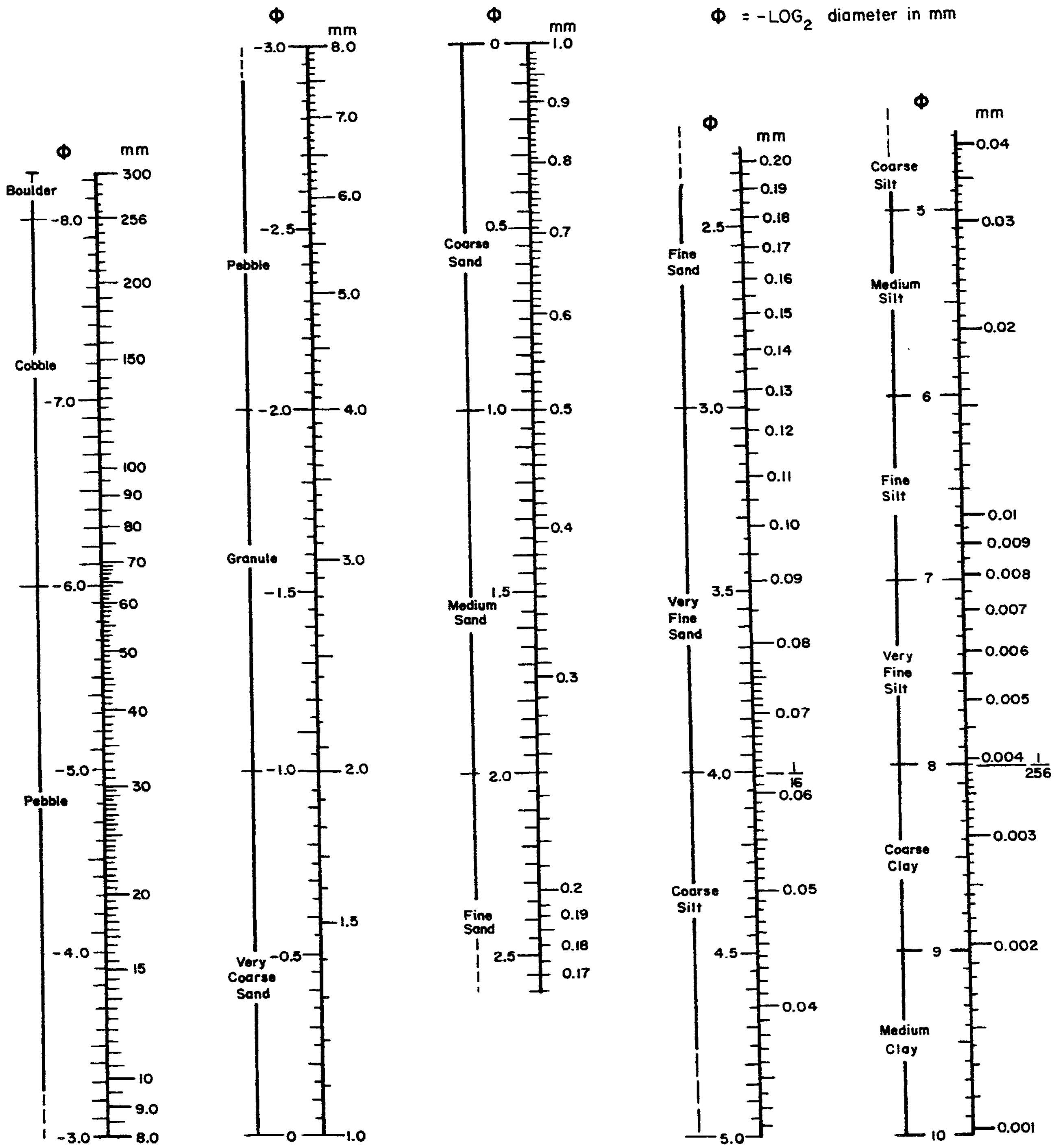
LITERATURE CITED

Folk, R. L. 1974. Petrology of sedimentary rocks. Hemphill Publishing Co., Austin, TX. 182 p.

Inman, D. L. 1952. Measures for describing the size distribution of sediments. J. Sed. Pet. 22:125-145.

Appendix B. (Cont.).

Phi - Millimeter Conversion Figure



Measurement sorting values for a large number of sediments has suggested the following verbal classification scale for sorting:

σ_I under	.35 ϕ,	very well sorted	1.0-2.0 ϕ,	poorly sorted
	.35-.50 ϕ,	well sorted	2.0-4.0 ϕ,	very poorly sorted
	.50-.71 ϕ,	moderately well sorted	over 4.0 ϕ,	extremely poorly sorted
	.71-1.0 ϕ	moderately sorted		

APPENDIX C

Water quality parameters at each receiving water monitoring station

Appendix C-1. Water quality parameters at each receiving water monitoring station during flood and ebb tides. El Segundo and Scattergood Generating Stations NPDES, winter 1999.

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB
RW1	0	13.91	13.66	8.53	8.24	7.80	7.82
	1	13.93	13.65	8.49	8.29	7.80	7.82
	2	13.82	13.59	8.58	8.29	7.80	7.82
	3	13.39	13.34	8.66	8.35	7.80	7.83
	4	13.06	13.13	8.50	8.32	7.80	7.82
	5	12.96	13.01	8.11	8.06	7.78	7.80
	6	13.22	12.95	7.79	7.90	7.78	7.80
RW2	0	14.77	13.88	7.65	8.21	7.80	7.82
	1	14.72	13.91	7.69	8.25	7.80	7.82
	2	14.25	13.70	7.76	8.31	7.80	7.82
	3	14.08	13.62	7.88	8.30	7.80	7.81
	4	13.94	13.55	8.04	8.34	7.81	7.82
	5	13.33	13.51	8.21	8.32	7.80	7.81
	6	13.43		7.94		7.80	
RW3	0	14.31	13.49	8.36	8.43	7.83	7.82
	1	14.25	13.43	8.36	8.36	7.83	7.82
	2	13.99	13.40	8.44	8.39	7.82	7.82
	3	13.85	13.39	8.41	8.27	7.82	7.82
	4	13.59	13.39	8.38	8.25	7.81	7.83
	5	12.82	13.34	8.37	8.30	7.78	7.82
	6		13.19		8.28		7.82
	7		13.10		8.23		7.82
RW4	0	14.10	13.19	8.28	8.44	7.82	7.82
	1	14.02	13.19	8.28	8.45	7.82	7.83
	2	13.66	13.15	8.36	8.48	7.82	7.82
	3	13.28	13.10	8.47	8.49	7.81	7.82
	4	13.06	13.11	8.36	8.24	7.79	7.82
	5	12.89	13.12	8.08	8.25	7.79	7.82
	6		13.13		8.26		7.82
	7		13.14		8.29		7.82
RW5	0	14.34	13.87	8.09	8.22	7.83	7.83
	1	14.20	13.78	8.13	8.25	7.83	7.84
	2	13.77	13.43	8.24	8.32	7.82	7.83
	3	13.46	13.11	8.24	8.35	7.81	7.81
	4	13.13	12.80	8.25	8.21	7.82	7.82
	5	12.68	12.55	8.21	7.91	7.82	7.82
	6	12.46	12.43	7.80	7.63	7.80	7.80
	7	12.33	12.32	7.52	7.46	7.79	7.79
	8	12.22	12.23	7.34	7.17	7.77	7.79
	9	12.14	12.09	7.00	6.99	7.76	7.76
	10	12.04	12.09	6.67	6.72	7.74	7.76
	11	12.00	12.09	6.37	6.32	7.73	7.75
	12	12.00		6.22		7.73	
RW6	0	14.23	13.63	8.06	8.07	7.83	7.84
	1	14.26	13.51	8.04	8.08	7.83	7.84
	2	13.93	13.28	8.14	8.10	7.82	7.84
	3	13.77	13.08	8.09	8.09	7.82	7.81
	4	13.40	12.82	8.16	8.01	7.82	7.82
	5	13.27	12.58	8.22	7.81	7.82	7.82
	6	13.16	12.43	8.13	7.50	7.82	7.81
	7	12.91	12.34	8.08	7.23	7.80	7.80
	8	12.45	12.27	7.99	7.07	7.79	7.79
	9	12.28	12.25	7.72	6.96	7.77	7.79
	10	12.20	12.24	7.09	6.88	7.76	7.79
	11	12.10	12.23	6.85	6.82	7.75	7.79
	12	12.07	12.24	6.70	6.80	7.75	7.78

Appendix C-1. (Cont.).

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB
RW7	0	13.63	13.63	8.14	8.18	7.82	7.84
	1	13.61	13.50	8.14	8.20	7.82	7.84
	2	13.51	13.27	8.19	8.27	7.82	7.84
	3	13.44	13.16	8.21	8.25	7.82	7.84
	4	13.41	13.07	8.25	8.02	7.82	7.83
	5	13.37	12.90	8.27	7.82	7.82	7.83
	6	13.33	12.63	8.31	7.76	7.82	7.82
	7	13.23	12.50	8.30	7.59	7.82	7.81
	8	13.01	12.38	8.23	7.28	7.80	7.79
	9	12.59	12.27	8.01	7.04	7.78	7.77
	10	12.51	12.04	7.56	6.72	7.79	7.75
	11	12.22	11.79	7.42	6.36	7.78	7.72
	12	12.14	11.56	7.33	5.91	7.75	7.71
RW8	0	13.60	13.35	8.03	8.12	7.82	7.84
	1	13.69	13.35	8.00	8.15	7.82	7.84
	2	13.33	13.32	8.11	8.16	7.81	7.84
	3	13.20	13.29	8.04	8.17	7.82	7.84
	4	13.15	13.27	8.05	8.16	7.81	7.84
	5	13.13	13.20	8.09	8.16	7.80	7.84
	6	13.11	13.12	8.00	8.12	7.80	7.84
	7	13.09	13.04	7.93	8.09	7.80	7.83
	8	13.08	12.98	7.83	8.03	7.80	7.82
	9	13.01	12.99	7.80	7.77	7.80	7.83
	10	12.93	12.79	7.78	7.72	7.78	7.82
	11	12.81	12.52	7.68	7.65	7.78	7.80
	12	12.76	12.19	7.48	7.37	7.76	7.78
RW9	0	13.41	13.13	7.67	7.72	7.80	7.82
	1	13.37	13.07	7.72	7.74	7.80	7.82
	2	12.90	12.89	7.83	7.78	7.80	7.82
	3	12.63	12.72	7.75	7.76	7.80	7.82
	4	12.47	12.41	7.61	7.77	7.79	7.81
	5	12.38	12.27	7.40	7.51	7.79	7.79
	6	12.35	12.18	7.23	7.12	7.78	7.79
	7	12.30	12.12	7.15	6.98	7.77	7.77
	8	12.26	12.09	7.06	6.72	7.77	7.77
	9	12.20	12.08	7.02	6.58	7.78	7.77
	10	12.18	12.05	6.94	6.58	7.77	7.77
	11	12.12	12.05	6.84	6.54	7.75	7.77
	12	12.10	12.05	6.76	6.51	7.75	7.77
	13	12.08	12.04	6.69	6.51	7.75	7.77
	14	12.06	12.03	6.63	6.53	7.74	7.77
	15	11.98	11.97	6.60	6.52	7.73	7.76
	16	11.90	11.86	6.55	6.50	7.71	7.74
	17	11.91	11.84	6.31	6.37	7.72	7.73
	18	11.89	11.83	6.23	6.14	7.71	7.73

Appendix C-1. (Cont.).

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB
RW10	0	13.41	13.54	7.73	7.93	7.81	7.84
	1	13.39	13.28	7.74	8.02	7.82	7.84
	2	13.09	12.99	7.79	8.10	7.82	7.84
	3	12.91	12.68	7.80	7.94	7.82	7.84
	4	12.73	12.56	7.78	7.69	7.81	7.82
	5	12.66	12.45	7.67	7.54	7.80	7.83
	6	12.57	12.32	7.51	7.44	7.80	7.82
	7	12.49	12.24	7.47	7.31	7.79	7.80
	8	12.42	12.17	7.39	7.23	7.79	7.81
	9	12.38	12.08	7.33	7.19	7.79	7.79
	10	12.36	11.99	7.30	7.03	7.78	7.79
	11	12.34	11.92	7.25	6.90	7.79	7.78
	12	12.30	11.85	7.23	6.75	7.79	7.76
	13	12.26	11.83	7.18	6.54	7.77	7.75
	14	12.19	11.82	7.12	6.36	7.77	7.75
	15	12.05	11.81	7.07	6.30	7.76	7.75
	16	11.92	11.79	6.97	6.26	7.73	7.74
	17	11.88	11.78	6.60	6.21	7.73	7.73
	18	11.90	11.78	6.43	6.13	7.73	7.73
RW11	0	13.51	13.35	7.92	7.85	7.82	7.84
	1	13.54	13.28	7.98	7.87	7.82	7.84
	2	13.23	13.09	8.04	7.92	7.82	7.84
	3	13.13	13.05	8.01	7.85	7.82	7.84
	4	13.10	12.95	8.05	7.86	7.82	7.84
	5	13.09	12.84	8.03	7.86	7.82	7.86
	6	13.06	12.73	8.02	7.87	7.82	7.85
	7	13.02	12.61	8.02	7.77	7.82	7.85
	8	12.99	12.55	7.99	7.73	7.82	7.84
	9	12.95	12.46	7.97	7.67	7.82	7.83
	10	12.88	12.32	7.91	7.54	7.82	7.82
	11	12.82	12.25	7.89	7.33	7.82	7.81
	12	12.70	12.16	7.84	7.23	7.81	7.82
	13	12.53	12.02	7.82	7.16	7.81	7.80
	14	12.37	11.81	7.74	7.09	7.79	7.76
	15	12.28	11.69	7.57	6.55	7.79	7.73
	16	12.15	11.61	7.41	6.31	7.78	7.73
	17	11.92	11.50	7.33	6.02	7.74	7.71
	18	11.97	11.29	6.83	5.73	7.73	7.66
RW12	0	13.71	13.25	7.90	7.93	7.80	7.86
	1	13.76	13.25	7.88	7.91	7.80	7.86
	2	13.42	13.22	7.98	7.95	7.80	7.86
	3	13.22	13.20	7.96	7.94	7.80	7.86
	4	13.16	13.18	7.90	7.93	7.80	7.85
	5	13.11	13.17	7.86	7.85	7.80	7.84
	6	13.08	13.14	7.83	7.84	7.79	7.85
	7	13.01	13.12	7.81	7.84	7.79	7.84
	8	12.98	12.97	7.74	7.86	7.79	7.84
	9	12.90	12.79	7.71	7.83	7.79	7.84
	10	12.78	12.86	7.63	7.61	7.77	7.82
	11	12.58	12.74	7.58	7.40	7.76	7.82
	12	12.49	12.69	7.33	7.55	7.75	7.82
	13	12.46	12.70	6.92	7.40	7.74	7.82
	14	12.41	12.65	6.74	7.36	7.73	7.82
	15	12.39	12.47	6.81	7.38	7.73	7.79
	16	12.38	12.52	6.67	7.10	7.73	7.78
	17	12.12	11.59	6.65	7.20	7.71	7.73
	18	12.23	11.51	6.38	6.34	7.71	7.68

Appendix C-2. Water quality parameters at each receiving water monitoring station during flood and ebb tides. El Segundo and Scattergood Generating Stations NPDES, summer 1999.

		Temp. (°C)		Oxygen (mg/l)		pH	
	Depth (m)	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW1	0	20.21	20.51	8.08	8.16	8.12	8.14
	1	20.03	20.51	8.11	8.14	8.13	8.14
	2	19.64	20.50	8.18	8.16	8.13	8.14
	3	19.58	20.47	8.19	8.18	8.12	8.14
	4	19.51	20.41	8.15	8.20	8.13	8.14
	5	18.81	20.19	8.35	8.25	8.12	8.14
	6	17.63	19.73	8.43	8.27	8.12	8.14
	7	17.68	19.67	8.33	8.22	8.11	8.14
RW2	0	20.34	21.12	7.78	7.92	8.12	8.12
	1	20.11	21.07	7.81	7.93	8.12	8.12
	2	19.19	21.04	7.98	7.95	8.12	8.12
	3	18.19	21.01	8.17	7.97	8.11	8.12
	4	17.06	20.93	8.37	8.00	8.11	8.12
	5	16.63	20.72	8.55	8.06	8.10	8.12
	6	16.16	20.20	8.76	8.14	8.09	8.12
	7	15.92	19.86	8.62	8.20	8.08	8.14
	8	15.93		8.54		8.08	
RW3	0	20.34	21.00	7.68	7.50	8.12	8.12
	1	20.33	20.84	7.66	7.57	8.12	8.12
	2	20.31	20.72	7.69	7.60	8.13	8.13
	3	20.24	20.23	7.69	7.80	8.12	8.14
	4	19.99	19.31	7.70	8.15	8.13	8.13
	5	18.94	19.10	7.79	8.16	8.13	8.13
	6	18.27	19.22	7.92	8.26	8.12	8.14
RW4	0	20.31	21.29	7.80	7.55	8.14	8.13
	1	20.27	21.12	7.78	7.59	8.14	8.13
	2	20.13	19.96	7.90	7.79	8.14	8.14
	3	19.84	18.89	7.97	8.20	8.14	8.13
	4	19.37	17.41	8.05	8.67	8.14	8.12
	5	19.26	16.97	8.03	8.66	8.14	8.11
	6	19.24	16.87	8.04	8.76	8.13	8.11
RW5	0	20.41	20.53	7.73	7.99	8.12	8.12
	1	19.85	20.35	7.86	8.03	8.13	8.12
	2	19.55	19.92	7.91	8.13	8.14	8.12
	3	19.48	19.82	7.94	8.00	8.14	8.12
	4	19.39	19.73	7.92	7.90	8.14	8.13
	5	19.36	19.69	7.95	7.86	8.14	8.12
	6	19.22	19.56	7.97	7.91	8.14	8.13
	7	19.11	19.18	8.01	8.00	8.14	8.13
	8	18.77	18.91	8.14	8.00	8.14	8.13
	9	18.33	18.89	8.26	8.15	8.13	8.13
	10	17.52	18.83	8.52	8.22	8.14	8.13
	11	16.50	18.81	8.83	8.24	8.13	8.13
	12	15.61	18.44	9.00	8.36	8.11	8.13
	13	15.55	17.39	8.81	8.63	8.08	8.11
RW6	0	19.95	20.51	7.81	7.98	8.14	8.14
	1	19.84	20.45	7.85	8.00	8.14	8.14
	2	19.75	20.02	7.90	8.13	8.14	8.14
	3	19.61	19.63	7.91	8.15	8.14	8.14
	4	19.51	19.06	7.94	8.35	8.14	8.14
	5	19.48	18.49	7.96	8.49	8.13	8.13
	6	19.47	18.32	7.96	8.49	8.13	8.13
	7	19.41	18.21	7.94	8.53	8.13	8.13
	8	19.34	18.13	7.96	8.55	8.13	8.13
	9	19.23	17.83	8.00	8.65	8.13	8.13
	10	18.68	17.50	8.09	8.64	8.13	8.13
	11	17.34	17.24	8.38	8.67	8.13	8.12
	12	14.97	16.40	9.12	8.86	8.11	8.12
	13	15.64	16.45	8.59	8.77	8.07	8.10

Appendix C-2. (Cont.).

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB
RW7	0	20.14	19.48	7.84	7.90	8.14	8.13
	1	19.99	19.46	7.90	7.91	8.14	8.12
	2	19.42	19.44	8.03	8.00	8.14	8.13
	3	19.29	19.38	7.99	8.03	8.13	8.12
	4	19.16	19.32	7.98	8.05	8.14	8.13
	5	18.99	19.06	8.03	8.11	8.13	8.13
	6	18.91	18.62	7.96	8.21	8.13	8.14
	7	18.80	17.90	7.99	8.34	8.13	8.13
	8	18.74	17.79	8.00	8.49	8.13	8.13
	9	18.50	17.35	8.04	8.73	8.13	8.13
	10	18.27	16.84	8.09	8.77	8.13	8.12
	11	17.30	16.56	8.47	8.85	8.13	8.12
	12	14.95	16.15	9.00	8.79	8.07	8.10
	13	15.09		8.52		8.05	
RW8	0	19.82	19.78	7.73	7.99	8.14	8.12
	1	19.61	19.75	7.86	8.00	8.14	8.12
	2	19.06	19.68	7.99	8.02	8.13	8.13
	3	18.84	19.58	8.03	8.05	8.13	8.12
	4	18.79	19.36	8.05	8.07	8.13	8.12
	5	18.76	19.00	8.05	8.16	8.13	8.13
	6	18.69	18.53	8.10	8.24	8.13	8.13
	7	18.61	17.99	8.12	8.38	8.13	8.13
	8	18.58	17.23	8.17	8.68	8.13	8.11
	9	18.59	16.61	8.17	8.79	8.13	8.11
	10	18.59	15.70	8.15	8.96	8.13	8.09
	11	18.47	15.39	8.17	8.79	8.13	8.08
	12	17.59	14.95	8.39	8.78	8.13	8.07
	13	15.62	14.79	8.91	8.75	8.09	8.07
RW9	0	19.64	19.79	7.84	7.83	8.14	8.12
	1	19.44	19.79	7.89	7.86	8.14	8.13
	2	19.23	19.77	7.91	7.89	8.14	8.13
	3	19.15	19.72	7.94	7.88	8.13	8.13
	4	19.02	19.62	7.92	7.92	8.13	8.13
	5	18.88	19.52	7.90	7.92	8.13	8.13
	6	18.44	19.13	8.03	7.97	8.14	8.13
	7	17.25	18.97	8.38	7.99	8.13	8.13
	8	16.44	18.62	8.79	8.09	8.12	8.14
	9	16.28	18.11	8.83	8.20	8.12	8.13
	10	15.67	17.91	9.03	8.39	8.11	8.14
	11	15.46	17.37	8.94	8.68	8.10	8.13
	12	15.36	17.00	8.97	8.78	8.10	8.13
	13	15.07	16.69	8.93	8.83	8.09	8.12
	14	14.95	15.78	8.92	9.12	8.09	8.11
	15	14.66	15.19	8.87	9.06	8.08	8.10
	16	14.45	14.70	8.73	9.06	8.06	8.07
	17	14.18	14.44	8.56	9.00	8.05	8.07
	18	13.51	14.08	8.72	8.82	8.00	8.04
	19	13.70	13.79	8.03	8.56	7.98	8.00

Appendix C-2. (Cont.).

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB
RW10	0	19.21	19.73	7.85	8.04	8.13	8.13
	1	19.19	19.57	7.88	8.10	8.13	8.13
	2	19.14	19.23	7.89	8.17	8.13	8.13
	3	19.09	18.61	7.88	8.26	8.13	8.13
	4	19.05	18.05	7.81	8.32	8.13	8.13
	5	18.97	17.80	7.88	8.40	8.13	8.13
	6	18.81	17.32	7.93	8.66	8.13	8.13
	7	18.71	17.17	7.95	8.70	8.13	8.13
	8	18.53	17.06	8.02	8.79	8.13	8.12
	9	18.33	16.99	8.06	8.81	8.13	8.12
	10	18.10	16.97	8.13	8.74	8.13	8.12
	11	17.99	16.96	8.15	8.76	8.13	8.12
	12	17.87	16.90	8.23	8.76	8.13	8.12
	13	16.91	16.62	8.48	8.83	8.12	8.12
	14	16.83	16.31	8.42	8.85	8.12	8.11
	15	16.68	15.73	8.47	8.94	8.12	8.10
	16	16.46	15.49	8.58	8.89	8.12	8.10
	17	15.90	14.86	8.74	9.01	8.11	8.09
	18	14.19	14.43	9.17	9.04	8.09	8.07
	19	13.90	14.27	9.08	8.91	8.06	8.06
RW11	0	19.40	19.27	7.85	7.92	8.12	8.13
	1	19.24	19.30	7.89	7.98	8.13	8.13
	2	18.67	19.10	8.03	8.04	8.13	8.13
	3	18.12	18.65	8.10	8.15	8.13	8.13
	4	17.75	18.21	8.25	8.25	8.13	8.13
	5	17.67	17.73	8.41	8.39	8.13	8.14
	6	17.51	17.55	8.46	8.55	8.13	8.13
	7	17.31	17.43	8.51	8.62	8.13	8.13
	8	16.77	17.30	8.67	8.71	8.11	8.13
	9	16.55	16.89	8.59	8.83	8.10	8.13
	10	16.42	16.70	8.54	8.84	8.10	8.12
	11	16.35	16.62	8.49	8.92	8.10	8.12
	12	16.27	16.59	8.49	8.91	8.10	8.12
	13	16.03	16.04	8.52	9.00	8.09	8.11
	14	15.39	15.38	8.65	9.10	8.08	8.08
	15	14.61	15.06	8.69	8.87	8.05	8.07
	16	13.93	14.86	8.58	8.69	8.04	8.07
	17	13.66	14.56	8.54	8.77	8.02	8.05
	18	13.65	14.15	8.27	8.65	8.01	8.05
	19	13.66	13.42	8.18	8.68	8.00	8.01
RW12	0	19.15	19.34	7.81	8.02	8.13	8.12
	1	19.11	19.29	7.87	8.04	8.13	8.13
	2	18.96	19.20	7.97	8.06	8.13	8.13
	3	18.75	19.07	8.03	8.11	8.13	8.13
	4	18.64	18.83	8.04	8.19	8.13	8.13
	5	18.28	18.21	8.16	8.32	8.13	8.13
	6	17.71	17.90	8.27	8.38	8.13	8.13
	7	17.48	17.80	8.40	8.51	8.13	8.13
	8	17.23	17.65	8.49	8.59	8.12	8.12
	9	17.05	17.46	8.53	8.61	8.12	8.12
	10	16.94	17.10	8.58	8.65	8.12	8.11
	11	16.70	16.68	8.63	8.74	8.12	8.12
	12	16.50	16.53	8.58	8.78	8.10	8.12
	13	16.28	15.92	8.53	9.12	8.10	8.10
	14	15.60	15.23	8.66	9.20	8.09	8.08
	15	15.17	14.58	8.60	9.02	8.06	8.05
	16	14.52	14.10	8.54	8.73	8.04	8.03
	17	14.18	13.74	8.37	8.42	8.04	8.01
	18	13.88	13.58	8.25	8.06	8.01	8.00
	19	13.78		8.07		8.00	

APPENDIX D

Sediment grain size distribution and statistical parameters by station

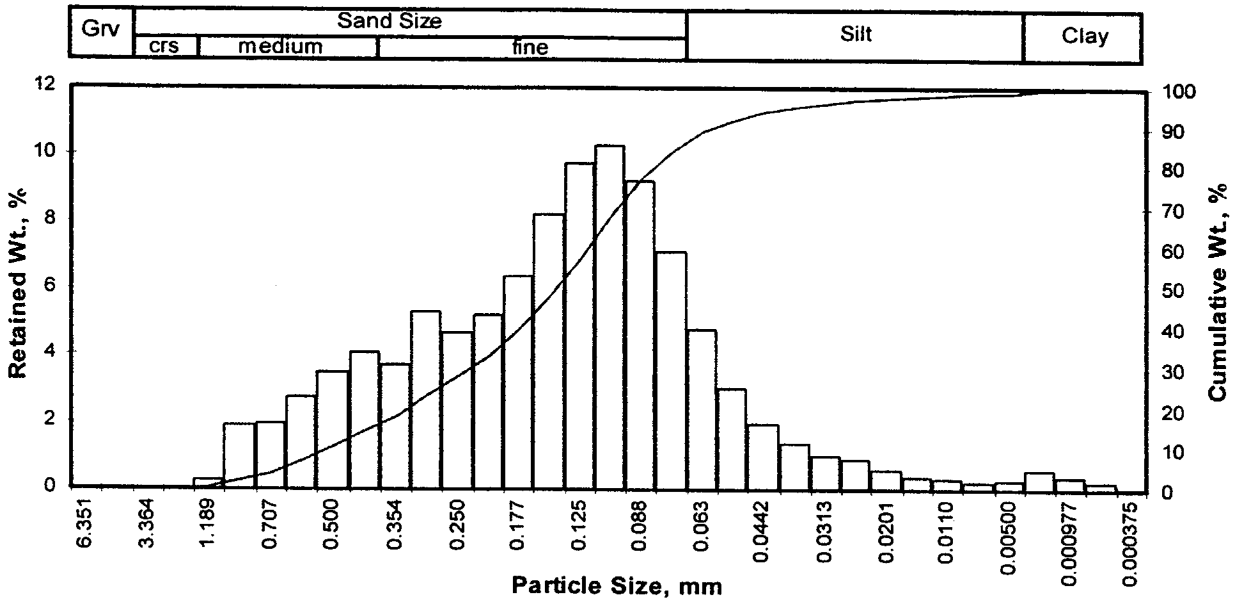
Appendix D. Sediment grain size distribution and statistical parameters by station. El Segundo and Scattergood Generating Stations NPDES, 1999.

Station B1

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Del Mar Analytical	**PTS File No:**	29471
Project:	n/a	**Sample ID:**	IJ00817
Project No:	IJ00799.MBC	**Depth, ft:**	na



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.27	0.27	0.27
0.0331	0.841	0.25	20	1.91	1.91	2.18
0.0278	0.707	0.50	25	1.97	1.97	4.15
0.0234	0.595	0.75	30	2.74	2.74	6.89
0.0197	0.500	1.00	35	3.48	3.48	10.37
0.0166	0.420	1.25	40	4.07	4.07	14.44
0.0139	0.354	1.50	45	3.69	3.69	18.12
0.0117	0.297	1.75	50	5.28	5.28	23.40
0.0098	0.250	2.00	60	4.66	4.66	28.06
0.0083	0.210	2.25	70	5.19	5.19	33.25
0.0070	0.177	2.50	80	6.32	6.32	39.57
0.0059	0.149	2.75	100	8.18	8.18	47.75
0.0049	0.125	3.00	120	9.74	9.74	57.49
0.0041	0.105	3.25	140	10.26	10.26	67.74
0.0035	0.088	3.50	170	9.20	9.20	76.94
0.0029	0.074	3.75	200	7.08	7.08	84.02
0.0025	0.063	4.00	230	4.76	4.76	88.78
0.0021	0.053	4.25	270	2.99	2.99	91.77
0.00174	0.0442	4.50	325	1.93	1.93	93.70
0.00146	0.0372	4.75	400	1.38	1.38	95.08
0.00123	0.0313	5.00	450	1.02	1.02	96.10
0.000986	0.0250	5.32	500	0.91	0.91	97.01
0.000790	0.0201	5.64	635	0.56	0.56	97.56
0.000615	0.0156	6.00		0.38	0.38	97.95
0.000435	0.0110	6.50		0.32	0.32	98.26
0.000308	0.00781	7.00		0.24	0.24	98.50
0.000197	0.00500	7.65		0.28	0.28	98.78
0.000077	0.00195	9.00		0.60	0.60	99.38
0.000038	0.000977	10.00		0.38	0.38	99.77
0.000019	0.000488	11.00		0.21	0.21	99.98
0.000015	0.000375	11.38		0.02	0.02	100.00
TOTALS				**100.02**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	0.58	0.0264	0.670
10	0.97	0.0200	0.509
16	1.36	0.0154	0.391
25	1.84	0.0110	0.280
40	2.51	0.0069	0.175
50	2.81	0.0056	0.143
60	3.06	0.0047	0.120
75	3.45	0.0036	0.092
84	3.75	0.0029	0.074
90	4.10	0.0023	0.058
95	4.74	0.0015	0.038

Measure	Trask	Inman	Folk-Ward
Median, phi	2.81	2.81	2.81
Median, in.	0.0056	0.0056	0.0056
Median, mm	0.143	0.143	0.143
Mean, phi	2.43	2.55	2.64
Mean, in.	0.0073	0.0067	0.0063
Mean, mm	0.186	0.170	0.161
Sorting	0.572	1.197	1.228
Skewness	1.122	-0.213	-0.143
Kurtosis	0.209	0.738	1.058

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	14.44
Fine Sand	200	69.58
Silt	>0.005 mm	14.76
Clay	<0.005 mm	1.22
	Total	**100**

Phone: (562) 907-3607 Fax: (562) 907-3610

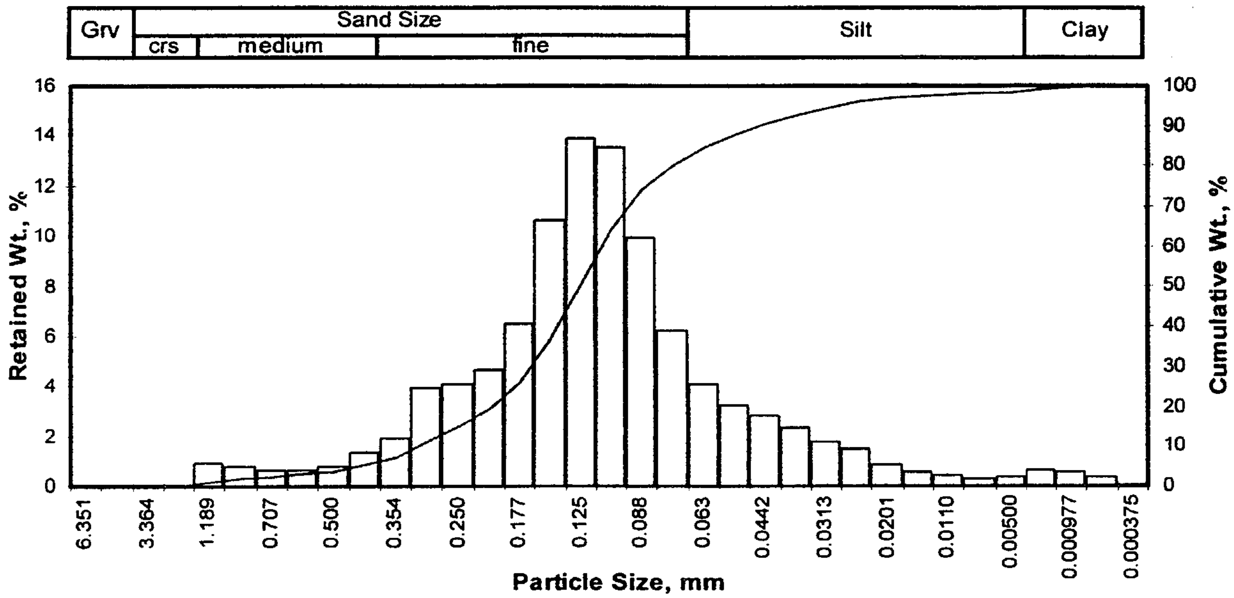
Appendix D. (Cont.).

Station B2

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Del Mar Analytical	**PTS File No:**	29471
Project:	n/a	**Sample ID:**	IJ00818
Project No:	IJ00799.MBC	**Depth, ft:**	na



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.93	0.93	0.93
0.0331	0.841	0.25	20	0.76	0.76	1.69
0.0278	0.707	0.50	25	0.67	0.67	2.35
0.0234	0.595	0.75	30	0.61	0.61	2.96
0.0197	0.500	1.00	35	0.75	0.75	3.71
0.0166	0.420	1.25	40	1.37	1.37	5.08
0.0139	0.354	1.50	45	1.88	1.88	6.96
0.0117	0.297	1.75	50	3.92	3.92	10.88
0.0098	0.250	2.00	60	4.08	4.08	14.96
0.0083	0.210	2.25	70	4.63	4.63	19.59
0.0070	0.177	2.50	80	6.50	6.50	26.09
0.0059	0.149	2.75	100	10.64	10.64	36.72
0.0049	0.125	3.00	120	13.88	13.88	50.60
0.0041	0.105	3.25	140	13.51	13.51	64.11
0.0035	0.088	3.50	170	9.93	9.93	74.04
0.0029	0.074	3.75	200	6.23	6.23	80.27
0.0025	0.063	4.00	230	4.10	4.10	84.37
0.0021	0.053	4.25	270	3.26	3.26	87.63
0.00174	0.0442	4.50	325	2.79	2.79	90.42
0.00146	0.0372	4.75	400	2.30	2.30	92.72
0.00123	0.0313	5.00	450	1.73	1.73	94.45
0.000986	0.0250	5.32	500	1.48	1.48	95.93
0.000790	0.0201	5.64	635	0.85	0.85	96.78
0.000615	0.0156	6.00		0.55	0.55	97.33
0.000435	0.0110	6.50		0.44	0.44	97.77
0.000308	0.00781	7.00		0.31	0.31	98.09
0.000197	0.00500	7.65		0.33	0.33	98.41
0.000077	0.00195	9.00		0.67	0.67	99.08
0.000038	0.000977	10.00		0.54	0.54	99.62
0.000019	0.000488	11.00		0.34	0.34	99.97
0.000015	0.000375	11.38		0.03	0.03	100.00
TOTALS				100.01	100.00	100.00

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	1.24	0.0167	0.425
10	1.69	0.0122	0.309
16	2.06	0.0095	0.240
25	2.46	0.0072	0.182
40	2.81	0.0056	0.143
50	2.99	0.0050	0.126
60	3.17	0.0044	0.111
75	3.54	0.0034	0.086
84	3.98	0.0025	0.063
90	4.46	0.0018	0.045
95	5.12	0.0011	0.029

Measure	Trask	Inman	Folk-Ward
Median, phi	2.99	2.99	2.99
Median, in.	0.0050	0.0050	0.0050
Median, mm	0.126	0.126	0.126
Mean, phi	2.90	3.02	3.01
Mean, in.	0.0053	0.0049	0.0049
Mean, mm	0.134	0.124	0.124
Sorting	0.688	0.960	1.069
Skewness	0.994	0.029	0.063
Kurtosis	0.182	1.021	1.473

Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	5.08
Fine Sand	200	75.20
Silt	>0.005 mm	18.14
Clay	<0.005 mm	1.59
	Total	100

Phone: (562) 907-3607 Fax: (562) 907-3610

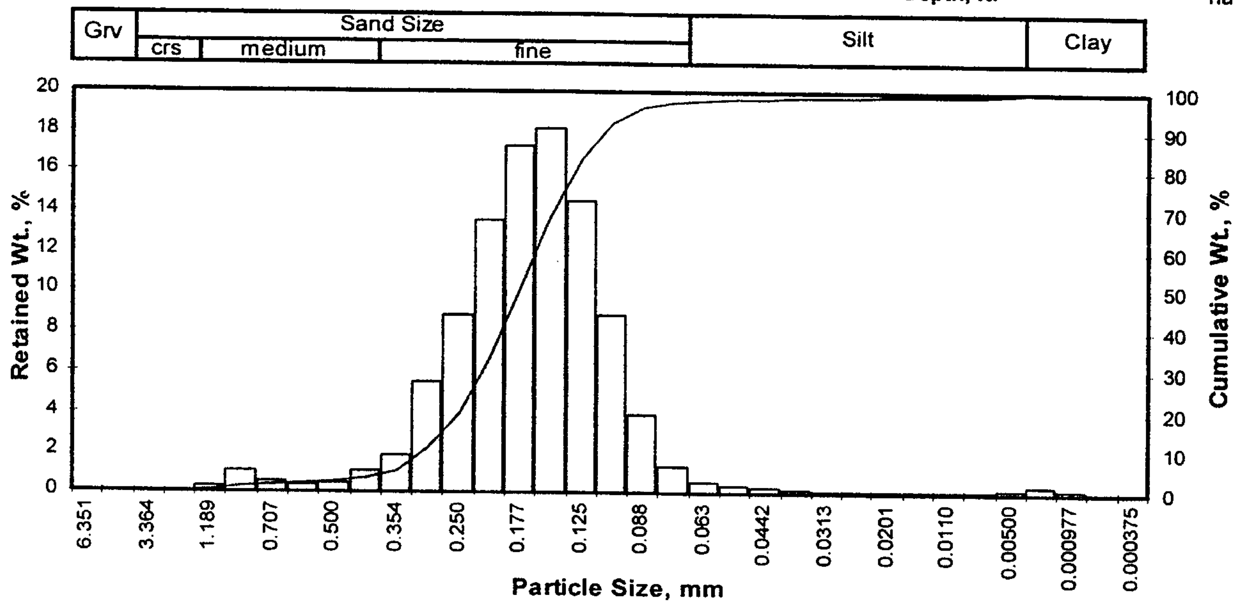
Appendix D. (Cont.).

Station B3

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Del Mar Analytical	**PTS File No:**	29471
Project:	n/a	**Sample ID:**	IJ00819
Project No:	IJ00799.MBC	**Depth, ft:**	na



Opening: Inches	Opening: Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.25	0.25	0.25
0.0331	0.841	0.25	20	1.06	1.06	1.31
0.0278	0.707	0.50	25	0.52	0.52	1.83
0.0234	0.595	0.75	30	0.34	0.34	2.17
0.0197	0.500	1.00	35	0.43	0.43	2.60
0.0166	0.420	1.25	40	1.04	1.04	3.64
0.0139	0.354	1.50	45	1.83	1.83	5.47
0.0117	0.297	1.75	50	5.42	5.42	10.89
0.0098	0.250	2.00	60	8.85	8.85	19.74
0.0083	0.210	2.25	70	13.58	13.58	33.32
0.0070	0.177	2.50	80	17.28	17.28	50.60
0.0059	0.149	2.75	100	18.11	18.11	68.71
0.0049	0.125	3.00	120	14.55	14.55	83.26
0.0041	0.105	3.25	140	8.83	8.83	92.09
0.0035	0.088	3.50	170	3.88	3.88	95.97
0.0029	0.074	3.75	200	1.32	1.32	97.29
0.0025	0.063	4.00	230	0.53	0.53	97.82
0.0021	0.053	4.25	270	0.37	0.37	98.19
0.00174	0.0442	4.50	325	0.26	0.26	98.45
0.00146	0.0372	4.75	400	0.16	0.16	98.62
0.00123	0.0313	5.00	450	0.11	0.11	98.73
0.000986	0.0250	5.32	500	0.12	0.12	98.85
0.000790	0.0201	5.64	635	0.11	0.11	98.96
0.000615	0.0156	6.00		0.10	0.10	99.07
0.000435	0.0110	6.50		0.11	0.11	99.17
0.000308	0.00781	7.00		0.10	0.10	99.27
0.000197	0.00500	7.65		0.15	0.15	99.42
0.000077	0.00195	9.00		0.39	0.39	99.81
0.000038	0.000977	10.00		0.18	0.18	99.99
0.000019	0.000488	11.00		0.01	0.01	100.00
0.000015	0.000375	11.38		0.00	0.00	100.00
TOTALS				99.99	100.00	100.00

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size: Inches	Particle Size: Millimeters
5	1.44	0.0145	0.369
10	1.71	0.0120	0.306
16	1.89	0.0106	0.269
25	2.10	0.0092	0.234
40	2.35	0.0077	0.197
50	2.49	0.0070	0.178
60	2.63	0.0064	0.162
75	2.86	0.0054	0.138
84	3.02	0.0049	0.123
90	3.19	0.0043	0.110
95	3.44	0.0036	0.092

Measure	Trask	Inman	Folk-Ward
Median, phi	2.49	2.49	2.49
Median, in.	0.0070	0.0070	0.0070
Median, mm	0.178	0.178	0.178
Mean, phi	2.43	2.46	2.47
Mean, in.	0.0073	0.0072	0.0071
Mean, mm	0.186	0.182	0.181
Sorting	0.768	0.563	0.585
Skewness	1.010	-0.060	-0.057
Kurtosis	0.244	0.776	1.077
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)		

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	3.64
Fine Sand	200	93.66
Silt	>0.005 mm	2.13
Clay	<0.005 mm	0.58
	Total	100

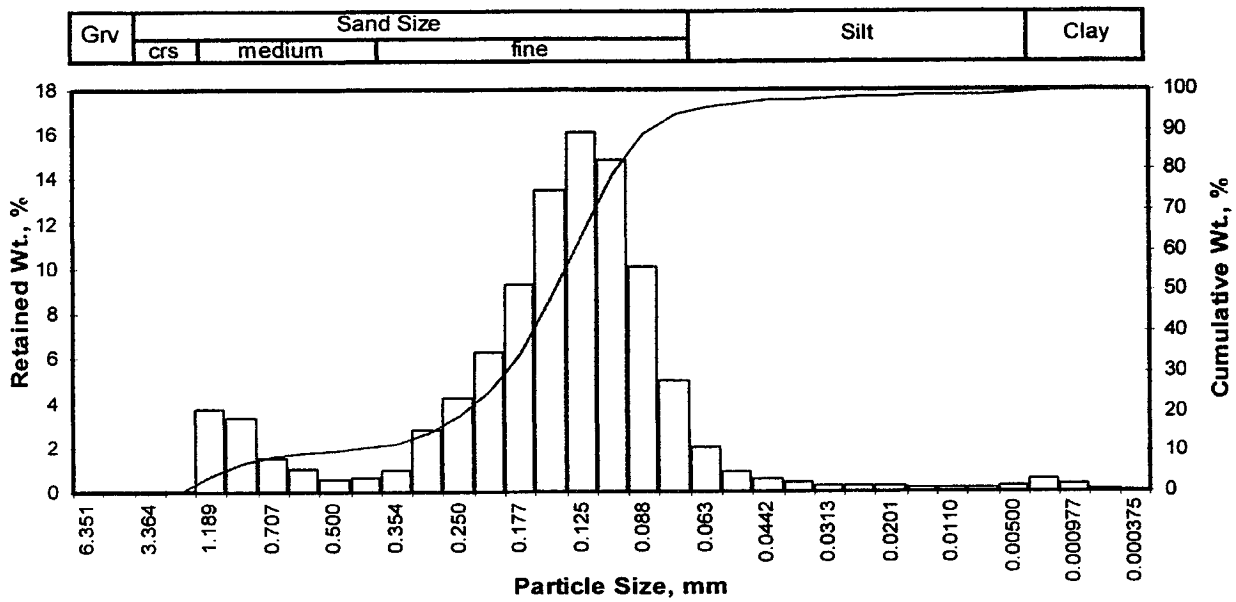
Appendix D. (Cont.).

Station B4

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Del Mar Analytical	**PTS File No:**	29471
Project:	n/a	**Sample ID:**	IJ00820
Project No:	IJ00799.MBC	**Depth, ft:**	na



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	3.75	3.75	3.75
0.0331	0.841	0.25	20	3.35	3.35	7.10
0.0278	0.707	0.50	25	1.51	1.51	8.61
0.0234	0.595	0.75	30	1.01	1.01	9.62
0.0197	0.500	1.00	35	0.58	0.58	10.20
0.0166	0.420	1.25	40	0.63	0.63	10.82
0.0139	0.354	1.50	45	0.97	0.97	11.80
0.0117	0.297	1.75	50	2.80	2.80	14.60
0.0098	0.250	2.00	60	4.17	4.17	18.77
0.0083	0.210	2.25	70	6.28	6.28	25.05
0.0070	0.177	2.50	80	9.28	9.28	34.33
0.0059	0.149	2.75	100	13.51	13.51	47.84
0.0049	0.125	3.00	120	16.09	16.09	63.93
0.0041	0.105	3.25	140	14.83	14.83	78.77
0.0035	0.088	3.50	170	10.03	10.03	88.80
0.0029	0.074	3.75	200	4.97	4.97	93.77
0.0025	0.063	4.00	230	1.95	1.95	95.72
0.0021	0.053	4.25	270	0.88	0.88	96.60
0.00174	0.0442	4.50	325	0.57	0.57	97.17
0.00146	0.0372	4.75	400	0.40	0.40	97.58
0.00123	0.0313	5.00	450	0.27	0.27	97.85
0.000986	0.0250	5.32	500	0.25	0.25	98.09
0.000790	0.0201	5.64	635	0.20	0.20	98.30
0.000615	0.0156	6.00		0.19	0.19	98.48
0.000435	0.0110	6.50		0.20	0.20	98.68
0.000308	0.00781	7.00		0.17	0.17	98.84
0.000197	0.00500	7.65		0.22	0.22	99.06
0.000077	0.00195	9.00		0.52	0.52	99.58
0.000038	0.000977	10.00		0.32	0.32	99.90
0.000019	0.000488	11.00		0.10	0.10	100.00
0.000015	0.000375	11.38		0.00	0.00	100.00
TOTALS				**99.98**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	-0.06	0.0411	1.045
10	0.91	0.0209	0.531
16	1.83	0.0110	0.280
25	2.25	0.0083	0.211
40	2.60	0.0065	0.164
50	2.78	0.0057	0.145
60	2.94	0.0051	0.130
75	3.19	0.0043	0.110
84	3.38	0.0038	0.096
90	3.56	0.0033	0.085
95	3.91	0.0026	0.067

Measure	Trask	Inman	Folk-Ward
Median, phi	2.78	2.78	2.78
Median, in.	0.0057	0.0057	0.0057
Median, mm	0.145	0.145	0.145
Mean, phi	2.64	2.61	2.67
Mean, in.	0.0063	0.0065	0.0062
Mean, mm	0.160	0.164	0.158
Sorting	0.722	0.773	0.988
Skewness	1.047	-0.228	-0.331
Kurtosis	0.113	1.568	1.734
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)		

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	10.82
Fine Sand	200	82.95
Silt	>0.005 mm	5.29
Clay	<0.005 mm	0.94
	Total	100

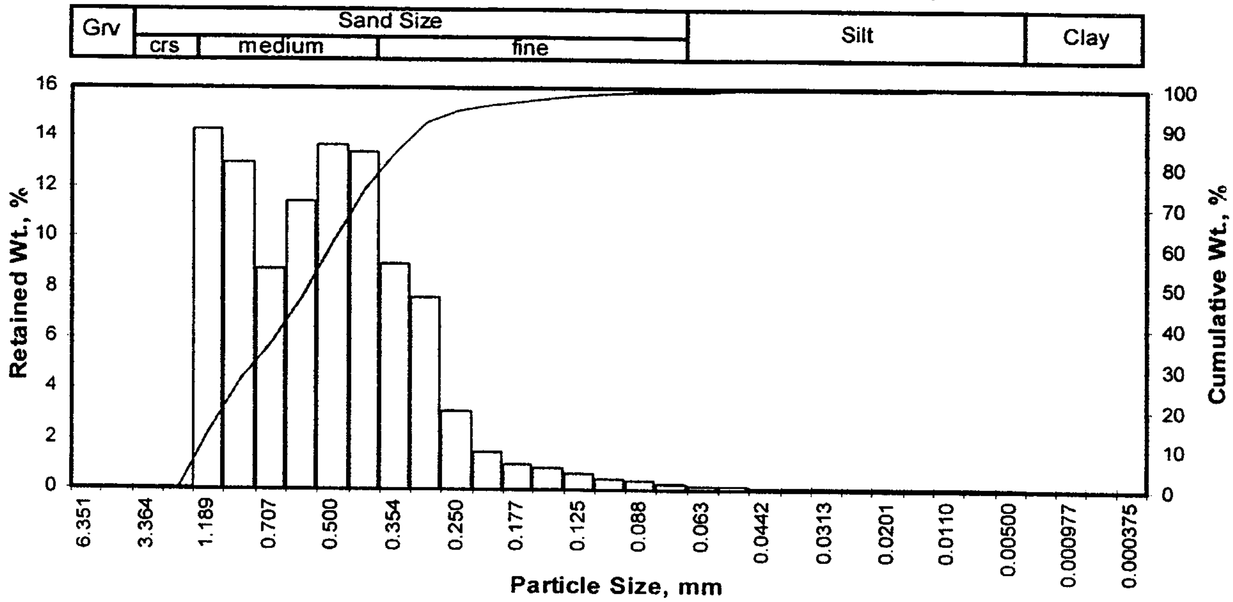
Appendix D. (Cont.).

Station B5

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Del Mar Analytical	**PTS File No:**	29471
Project:	n/a	**Sample ID:**	IJ00845
Project No:	IJ00799.MBC	**Depth, ft:**	na



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	14.31	14.31	14.31
0.0331	0.841	0.25	20	13.00	13.00	27.31
0.0278	0.707	0.50	25	8.73	8.73	36.04
0.0234	0.595	0.75	30	11.40	11.40	47.44
0.0197	0.500	1.00	35	13.70	13.70	61.14
0.0166	0.420	1.25	40	13.41	13.41	74.56
0.0139	0.354	1.50	45	8.95	8.95	83.51
0.0117	0.297	1.75	50	7.63	7.63	91.14
0.0098	0.250	2.00	60	3.08	3.08	94.22
0.0083	0.210	2.25	70	1.50	1.50	95.72
0.0070	0.177	2.50	80	0.97	0.97	96.69
0.0059	0.149	2.75	100	0.81	0.81	97.50
0.0049	0.125	3.00	120	0.64	0.64	98.13
0.0041	0.105	3.25	140	0.46	0.46	98.59
0.0035	0.088	3.50	170	0.32	0.32	98.91
0.0029	0.074	3.75	200	0.22	0.22	99.13
0.0025	0.063	4.00	230	0.16	0.16	99.30
0.0021	0.053	4.25	270	0.12	0.12	99.42
0.00174	0.0442	4.50	325	0.08	0.08	99.50
0.00146	0.0372	4.75	400	0.05	0.05	99.55
0.00123	0.0313	5.00	450	0.04	0.04	99.59
0.000986	0.0250	5.32	500	0.05	0.05	99.65
0.000790	0.0201	5.64	635	0.06	0.06	99.70
0.000615	0.0156	6.00		0.07	0.07	99.77
0.000435	0.0110	6.50		0.08	0.08	99.85
0.000308	0.00781	7.00		0.06	0.06	99.91
0.000197	0.00500	7.65		0.06	0.06	99.97
0.000077	0.00195	9.00		0.03	0.03	100.00
0.000038	0.000977	10.00		0.00	0.00	100.00
0.000019	0.000488	11.00		0.00	0.00	100.00
0.000015	0.000375	11.38		0.00	0.00	100.00
TOTALS				99.99	100.00	100.00

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	-0.74	0.0657	1.668
10	-0.48	0.0548	1.391
16	-0.19	0.0448	1.137
25	0.16	0.0352	0.894
40	0.59	0.0262	0.666
50	0.80	0.0227	0.576
60	0.98	0.0200	0.507
75	1.26	0.0164	0.417
84	1.52	0.0138	0.350
90	1.71	0.0120	0.305
95	2.13	0.0090	0.228

Measure	Trask	Inman	Folk-Ward
Median, phi	0.80	0.80	0.80
Median, in.	0.0227	0.0227	0.0227
Median, mm	0.576	0.576	0.576
Mean, phi	0.61	0.67	0.71
Mean, in.	0.0258	0.0248	0.0241
Mean, mm	0.656	0.630	0.612
Sorting	0.683	0.851	0.860
Skewness	1.061	-0.154	-0.112
Kurtosis	0.220	0.686	1.067
Grain Size Description (ASTM-USCS Scale)	Medium sand (based on Mean from Trask)		

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	74.56
Fine Sand	200	24.58
Silt	>0.005 mm	0.83
Clay	<0.005 mm	0.03
	Total	100

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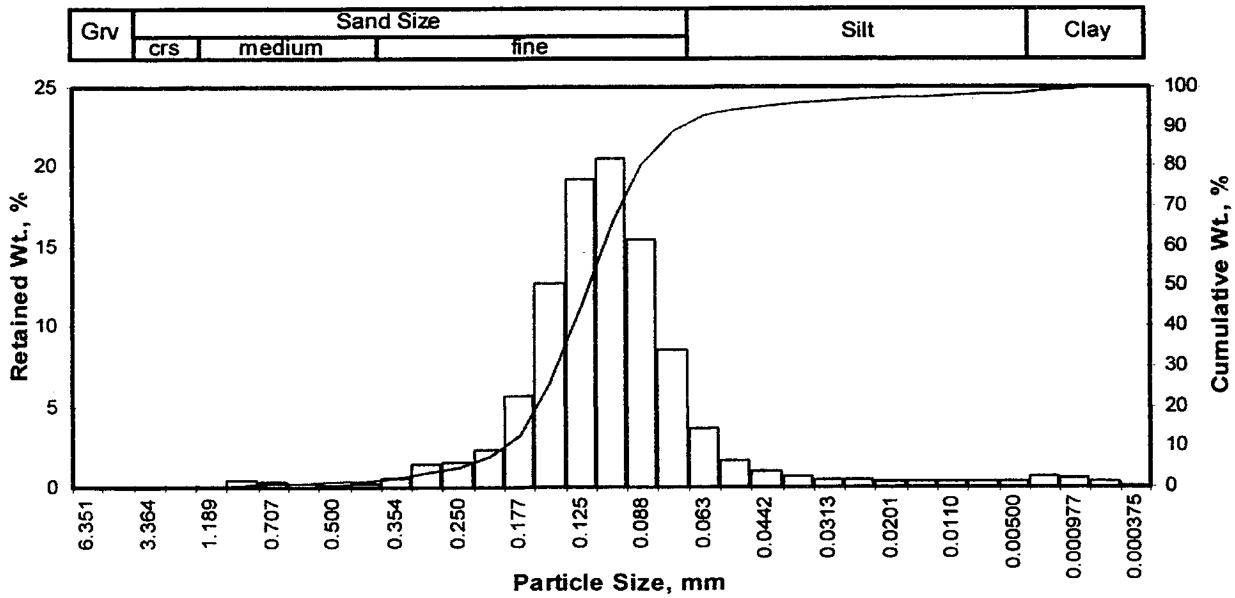
Station B6

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Del Mar Analytical	PTS File No:	29471
Project:	n/a	Sample ID:	IJ00846
Project No:	IJ00799.MBC	Depth, ft:	na



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.44	0.44	0.44
0.0278	0.707	0.50	25	0.38	0.38	0.82
0.0234	0.595	0.75	30	0.23	0.23	1.05
0.0197	0.500	1.00	35	0.15	0.15	1.20
0.0166	0.420	1.25	40	0.25	0.25	1.45
0.0139	0.354	1.50	45	0.55	0.55	2.00
0.0117	0.297	1.75	50	1.43	1.43	3.43
0.0098	0.250	2.00	60	1.50	1.50	4.93
0.0083	0.210	2.25	70	2.36	2.36	7.29
0.0070	0.177	2.50	80	5.66	5.66	12.95
0.0059	0.149	2.75	100	12.68	12.68	25.63
0.0049	0.125	3.00	120	19.20	19.20	44.83
0.0041	0.105	3.25	140	20.46	20.46	65.29
0.0035	0.088	3.50	170	15.42	15.42	80.71
0.0029	0.074	3.75	200	8.44	8.44	89.15
0.0025	0.063	4.00	230	3.61	3.61	92.76
0.0021	0.053	4.25	270	1.60	1.60	94.36
0.00174	0.0442	4.50	325	0.95	0.95	95.30
0.00146	0.0372	4.75	400	0.64	0.64	95.94
0.00123	0.0313	5.00	450	0.44	0.44	96.39
0.000986	0.0250	5.32	500	0.42	0.42	96.81
0.000790	0.0201	5.64	635	0.35	0.35	97.15
0.000615	0.0156	6.00		0.31	0.31	97.47
0.000435	0.0110	6.50		0.33	0.33	97.79
0.000308	0.00781	7.00		0.28	0.28	98.07
0.000197	0.00500	7.65		0.33	0.33	98.40
0.000077	0.00195	9.00		0.69	0.69	99.09
0.000038	0.000977	10.00		0.54	0.54	99.63
0.000019	0.000488	11.00		0.34	0.34	99.97
0.000015	0.000375	11.38		0.03	0.03	100.00
TOTALS				100.00	100.00	100.00

Cumulative Weight Percent greater than: Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	2.01	0.0098	0.249
10	2.37	0.0076	0.193
16	2.56	0.0067	0.170
25	2.74	0.0059	0.150
40	2.94	0.0051	0.131
50	3.06	0.0047	0.120
60	3.19	0.0043	0.110
75	3.41	0.0037	0.094
84	3.60	0.0033	0.083
90	3.81	0.0028	0.071
95	4.42	0.0018	0.047

Measure	Trask	Inman	Folk-Ward
Median, phi	3.06	3.06	3.06
Median, in.	0.0047	0.0047	0.0047
Median, mm	0.120	0.120	0.120
Mean, phi	3.03	3.08	3.07
Mean, in.	0.0048	0.0047	0.0047
Mean, mm	0.122	0.118	0.119
Sorting	0.793	0.519	0.625
Skewness	0.994	0.030	0.078
Kurtosis	0.228	1.325	1.476
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)		

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	1.45
Fine Sand	200	87.70
Silt	>0.005 mm	9.26
Clay	<0.005 mm	1.60
	Total	100

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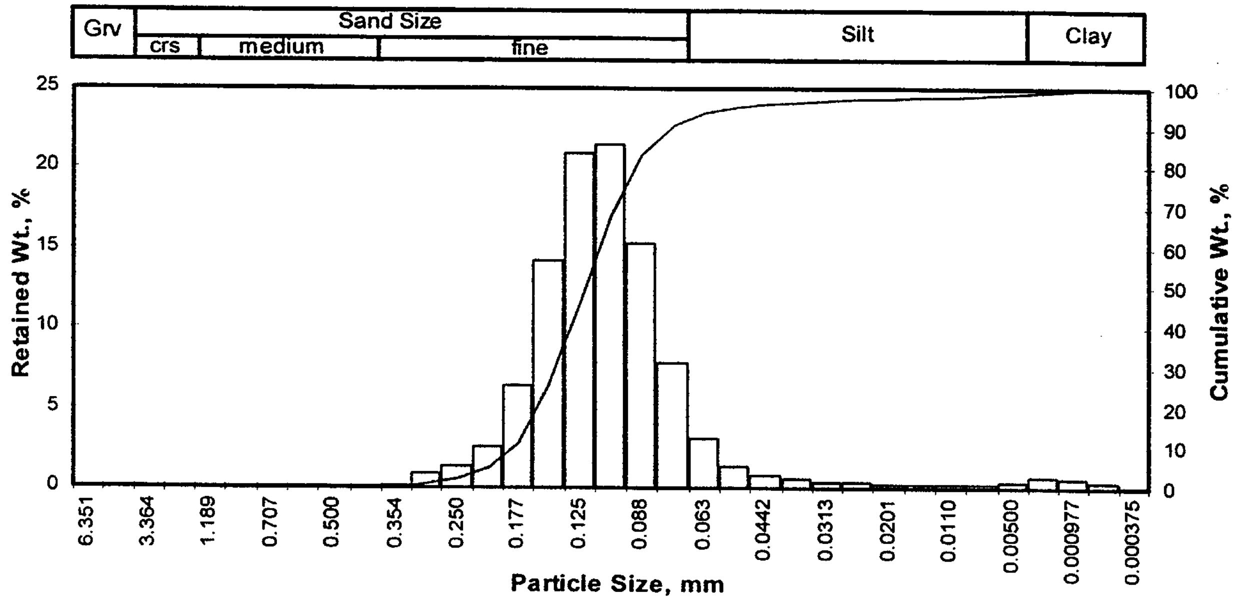
Appendix D. (Cont.).

Station B7

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Del Mar Analytical	**PTS File No:**	29471
Project:	n/a	**Sample ID:**	IJ00847
Project No:	IJ00799.MBC	**Depth, ft:**	na



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.00	0.00	0.00
0.0139	0.354	1.50	45	0.11	0.11	0.12
0.0117	0.297	1.75	50	0.85	0.85	0.97
0.0098	0.250	2.00	60	1.27	1.27	2.24
0.0083	0.210	2.25	70	2.49	2.49	4.73
0.0070	0.177	2.50	80	6.43	6.43	11.16
0.0059	0.149	2.75	100	14.25	14.25	25.41
0.0049	0.125	3.00	120	20.93	20.93	46.34
0.0041	0.105	3.25	140	21.43	21.43	67.77
0.0035	0.088	3.50	170	15.30	15.30	83.07
0.0029	0.074	3.75	200	7.78	7.78	90.85
0.0025	0.063	4.00	230	3.05	3.05	93.90
0.0021	0.053	4.25	270	1.30	1.30	95.20
0.00174	0.0442	4.50	325	0.77	0.77	95.97
0.00146	0.0372	4.75	400	0.51	0.51	96.48
0.00123	0.0313	5.00	450	0.34	0.34	96.83
0.000986	0.0250	5.32	500	0.33	0.33	97.16
0.000790	0.0201	5.64	635	0.27	0.27	97.43
0.000615	0.0156	6.00		0.25	0.25	97.68
0.000435	0.0110	6.50		0.28	0.28	97.95
0.000308	0.00781	7.00		0.25	0.25	98.20
0.000197	0.00500	7.65		0.30	0.30	98.50
0.000077	0.00195	9.00		0.64	0.64	99.14
0.000038	0.000977	10.00		0.51	0.51	99.65
0.000019	0.000488	11.00		0.32	0.32	99.97
0.000015	0.000375	11.38		0.03	0.03	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight	Phi	Particle Size	
percent	Value	Inches	Millimeters
5	2.26	0.0082	0.209
10	2.45	0.0072	0.182
16	2.58	0.0066	0.167
25	2.74	0.0059	0.149
40	2.92	0.0052	0.132
50	3.04	0.0048	0.121
60	3.16	0.0044	0.112
75	3.37	0.0038	0.097
84	3.53	0.0034	0.087
90	3.72	0.0030	0.076
95	4.21	0.0021	0.054

Measure	Trask	Inman	Folk-Ward
Median, phi	3.04	3.04	3.04
Median, in.	0.0048	0.0048	0.0048
Median, mm	0.121	0.121	0.121
Mean, phi	3.02	3.06	3.05
Mean, in.	0.0048	0.0047	0.0047
Mean, mm	0.123	0.120	0.121
Sorting	0.805	0.472	0.532
Skewness	0.991	0.031	0.115
Kurtosis	0.246	1.065	1.279
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)		

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.00
Fine Sand	200	90.85
Silt	>0.005 mm	7.65
Clay	<0.005 mm	1.50
	Total	100

Phone: (562) 907-3607 Fax: (562) 907-3610

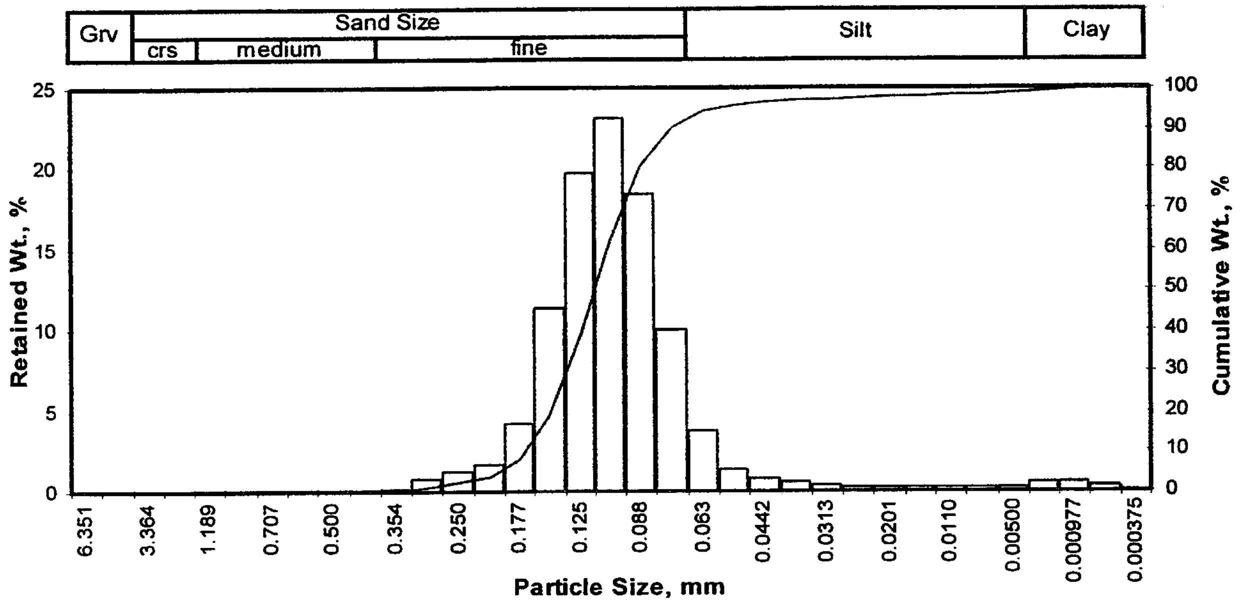
Appendix D. (Cont.).

Station B8

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Del Mar Analytical	**PTS File No:**	29471
Project:	n/a	**Sample ID:**	IJ00848
Project No:	IJ00799.MBC	**Depth, ft:**	na



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.00	0.00	0.00
0.0139	0.354	1.50	45	0.06	0.06	0.06
0.0117	0.297	1.75	50	0.82	0.82	0.88
0.0098	0.250	2.00	60	1.16	1.16	2.04
0.0083	0.210	2.25	70	1.60	1.60	3.64
0.0070	0.177	2.50	80	4.18	4.18	7.82
0.0059	0.149	2.75	100	11.32	11.32	19.14
0.0049	0.125	3.00	120	19.69	19.68	38.82
0.0041	0.105	3.25	140	23.14	23.13	61.95
0.0035	0.088	3.50	170	18.45	18.45	80.40
0.0029	0.074	3.75	200	10.03	10.03	90.43
0.0025	0.063	4.00	230	3.77	3.77	94.20
0.0021	0.053	4.25	270	1.34	1.34	95.54
0.00174	0.0442	4.50	325	0.76	0.76	96.29
0.00146	0.0372	4.75	400	0.51	0.51	96.80
0.00123	0.0313	5.00	450	0.31	0.31	97.12
0.000986	0.0250	5.32	500	0.28	0.27	97.39
0.000790	0.0201	5.64	635	0.24	0.24	97.63
0.000615	0.0156	6.00		0.22	0.22	97.85
0.000435	0.0110	6.50		0.23	0.23	98.09
0.000308	0.00781	7.00		0.21	0.21	98.30
0.000197	0.00500	7.65		0.26	0.26	98.56
0.000077	0.00195	9.00		0.59	0.59	99.15
0.000038	0.000977	10.00		0.50	0.50	99.65
0.000019	0.000488	11.00		0.32	0.32	99.97
0.000015	0.000375	11.38		0.03	0.03	100.00
TOTALS				**100.03**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight percent	**Phi Value**	**Particle Size Inches**	**Particle Size Millimeters**
5	2.33	0.0078	0.199
10	2.55	0.0067	0.171
16	2.68	0.0061	0.156
25	2.82	0.0056	0.141
40	3.01	0.0049	0.124
50	3.12	0.0045	0.115
60	3.23	0.0042	0.107
75	3.43	0.0037	0.093
84	3.59	0.0033	0.083
90	3.74	0.0029	0.075
95	4.15	0.0022	0.056

Measure	Trask	Inman	Folk-Ward
Median, phi	3.12	3.12	3.12
Median, in.	0.0045	0.0045	0.0045
Median, mm	0.115	0.115	0.115
Mean, phi	3.09	3.14	3.13
Mean, in.	0.0046	0.0045	0.0045
Mean, mm	0.117	0.114	0.114
Sorting	0.812	0.455	0.503
Skewness	0.997	0.032	0.082
Kurtosis	0.251	1.001	1.237
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)		

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.00
Fine Sand	200	90.43
Silt	>0.005 mm	8.13
Clay	<0.005 mm	1.44
	Total	100

 Phone: (562) 907-3607 Fax: (562) 907-3610

APPENDIX E

Sediment chemistry by station

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
1014 E Cooley Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046
16525 Sherman Way, Suite C-11, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843
9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (619) 505-9596 FAX (619) 505-9689
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785 0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99201 E/99300C ESGS/SGS
Sample Descript: Composite Solid
First Sample #: IG01528

Sampled: 7/15/99
Received: 7/16/99
Extracted: 7/20/99
Reported: 7/29/99

PERCENT SOLIDS (EPA 160.3)

Laboratory Number	Sample Description	Reporting Limit %	Sample Result %	Date Analyzed	Dilution Factor	QC Batch
IG01528	B1 (I,II,III)	N.A.	74%	7/20/99	1.0	IG20S01S
IG01529	B2 (I,II,III)	N.A.	71%	7/20/99	1.0	IG20S01S
IG01530	B3 (I,II,III)	N.A.	76%	7/20/99	1.0	IG20S01S
IG01531	B4 (I,II,III)	N.A.	76%	7/20/99	1.0	IG20S01S
IG01532	B5 (I,II,III)	N.A.	80%	7/20/99	1.0	IG20S01S
IG01533	B6 (I,II,III)	N.A.	71%	7/20/99	1.0	IG20S01S
IG01534	B7 (I,II,III)	N.A.	71%	7/20/99	1.0	IG20S01S
IG01535	B8 (I,II,III)	N.A.	69%	7/20/99	1.0	IG20S01S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99201 E/99300C
ESGS/SGS
Sample Descript: Composite Solid
First Sample #: IG01528

Sampled: 7/15/99
Received: 7/16/99
Extracted: 7/24/99
Reported: 7/29/99

CHROMIUM (EPA 6010B)

Laboratory Number	Sample Description	Reporting Limit mg/Kg (ppm)	Sample Result mg/Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
IG01528	B1 (I,II,III)	1.4	15	7/25/99	1.0	IG24ME1S
IG01529	B2 (I,II,III)	1.4	22	7/25/99	1.0	IG24ME1S
IG01530	B3 (I,II,III)	1.3	12	7/25/99	1.0	IG24ME1S
IG01531	B4 (I,II,III)	1.3	16	7/25/99	1.0	IG24ME1S
IG01532	B5 (I,II,III)	1.3	6.8	7/25/99	1.0	IG24ME1S
IG01533	B6 (I,II,III)	1.4	17	7/25/99	1.0	IG24ME1S
IG01534	B7 (I,II,III)	1.4	18	7/25/99	1.0	IG24ME1S
IG01535	B8 (I,II,III)	1.4	16	7/25/99	1.0	IG24ME1S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99201 E/99300C
ESGS/SGS
Sample Descript: Composite Solid
First Sample #: IG01528

Sampled: 7/15/99
Received: 7/16/99
Extracted: 7/24/99
Reported: 7/29/99

COPPER (EPA 6010B)

Laboratory Number	Sample Description	Reporting Limit mg/Kg (ppm)	Sample Result mg/Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
IG01528	B1 (I,II,III)	1.4	4.3	7/25/99	1.0	IG24ME1S
IG01529	B2 (I,II,III)	1.4	7.0	7/25/99	1.0	IG24ME1S
IG01530	B3 (I,II,III)	1.3	2.4	7/25/99	1.0	IG24ME1S
IG01531	B4 (I,II,III)	1.3	2.4	7/25/99	1.0	IG24ME1S
IG01532	B5 (I,II,III)	1.3	1.8	7/25/99	1.0	IG24ME1S
IG01533	B6 (I,II,III)	1.4	4.7	7/25/99	1.0	IG24ME1S
IG01534	B7 (I,II,III)	1.4	4.1	7/25/99	1.0	IG24ME1S
IG01535	B8 (I,II,III)	1.4	2.3	7/25/99	1.0	IG24ME1S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

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9830 South 51st St., Suite B 120, Phoenix, AZ 85044 (480) 785 0043 FAX (480) 785 0851

Del Mar Analytical

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99201 E/99300C ESGS/SGS
Sample Descript: Composite Solid
First Sample #: IG01528

Sampled: 7/15/99
Received: 7/16/99
Extracted: 7/24/99
Reported: 7/29/99

NICKEL (EPA 6010B)

Laboratory Number	Sample Description	Reporting Limit mg/Kg (ppm)	Sample Result mg/Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
IG01528	B1 (I,II,III)	1.4	8.2	7/25/99	1.0	IG24ME1S
IG01529	B2 (I,II,III)	1.4	11	7/25/99	1.0	IG24ME1S
IG01530	B3 (I,II,III)	1.3	5.3	7/25/99	1.0	IG24ME1S
IG01531	B4 (I,II,III)	1.3	6.5	7/25/99	1.0	IG24ME1S
IG01532	B5 (I,II,III)	1.3	1.9	7/25/99	1.0	IG24ME1S
IG01533	B6 (I,II,III)	1.4	7.3	7/25/99	1.0	IG24ME1S
IG01534	B7 (I,II,III)	1.4	7.5	7/25/99	1.0	IG24ME1S
IG01535	B8 (I,II,III)	1.4	7.2	7/25/99	1.0	IG24ME1S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
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9830 South 51st St., Suite B 120, Phoenix, AZ 85044 (480) 785 0043 FAX (480) 785 0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99201 E/99300C
ESGS/SGS
Sample Descript: Composite Solid
First Sample #: IG01528

Sampled: 7/15/99
Received: 7/16/99
Extracted: 7/24/99
Reported: 7/29/99

ZINC (EPA 6010B)

Laboratory Number	Sample Description	Reporting Limit mg/Kg (ppm)	Sample Result mg/Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
IG01528	B1 (I,II,III)	6.8	31	7/25/99	1.0	IG24ME1S
IG01529	B2 (I,II,III)	7.0	43	7/25/99	1.0	IG24ME1S
IG01530	B3 (I,II,III)	6.6	19	7/25/99	1.0	IG24ME1S
IG01531	B4 (I,II,III)	6.6	18	7/25/99	1.0	IG24ME1S
IG01532	B5 (I,II,III)	6.3	15	7/25/99	1.0	IG24ME1S
IG01533	B6 (I,II,III)	7.0	24	7/25/99	1.0	IG24ME1S
IG01534	B7 (I,II,III)	7.0	23	7/25/99	1.0	IG24ME1S
IG01535	B8 (I,II,III)	7.2	20	7/25/99	1.0	IG24ME1S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Method Blank

Extracted: 7/24/99
Reported: 7/29/99

CHROMIUM (EPA 6010B)

Laboratory Description	Reporting Limit mg/L (ppm)	Sample Result mg/L (ppm)	Date Analyzed	QC Batch
Method Blank	1.0	N.D.	7/25/99	IG24ME1S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
1014 E Cooley Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046
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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Method Blank

Extracted: 7/24/99
Reported: 7/29/99

COPPER (EPA 6010B)

Laboratory Description	Reporting Limit mg/L (ppm)	Sample Result mg/L (ppm)	Date Analyzed	QC Batch
Method Blank	1.0	N.D.	7/25/99	IG24ME1S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Method Blank

Extracted: 7/24/99
Reported: 7/29/99

NICKEL (EPA 6010B)

Laboratory Description	Reporting Limit mg/L (ppm)	Sample Result mg/L (ppm)	Date Analyzed	QC Batch
Method Blank	1.0	N.D.	7/25/99	IG24ME1S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
1014 E Cooley Dr., Suite A, Colton, CA 92324 (909) 370-4667 FAX (909) 370-1046
16525 Sherman Way, Suite C-11, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843
9484 Chesapeake Dr., Suite 805, San Diego, CA 92123 (619) 505-9596 FAX (619) 505-9689
9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Method Blank

Extracted: 7/24/99
Reported: 7/29/99

ZINC (EPA 6010B)

Laboratory Description	Reporting Limit mg/L (ppm)	Sample Result mg/L (ppm)	Date Analyzed	QC Batch
Method Blank	5.0	N.D.	7/25/99	IG24ME1S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (949) 261-1022 FAX (949) 261-1228
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9830 South 51st St, Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MS/MSD DATA REPORT

METHOD: EPA 6010B
Instrument: ICP
Matrix: Soil

Date Analyzed: 7/25/99

Sample: IG01336

Batch: IG24ME1S

Analyte	R1	Sp	MS	MSD	PR1	PR2	RPD	MEAN PR	Acceptance Limits	
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	%	%	%	%	RPD	MPR
Chromium	9.27	50	53.6	53.0	89%	87%	1.1%	88%	20	80-120
Copper	10.7	50	53.5	48.2	86%	75%	10%	80%	20	80-120
Nickel	6.37	50	48.3	46.8	84%	81%	3.2%	82%	20	80-120
Zinc	20.3	50	63.9	60.2	87%	80%	6.0%	84%	20	80-120

Definition of Terms:

R1.................... Result of Sample Analysis
Sp.................... Spike Concentration Added to Sample
MS.................... Matrix Spike Result
MSD.................. Matrix Spike Duplicate Result
PR1.................. Percent Recovery of MS; ((MS-R1) / SP) X 100
PR2.................. Percent Recovery of MSD; ((MSD-R1) / SP) X 100
RPD.................. Relative Percent Difference; ((MS-MSD)/(MS+MSD)/2) X 100
Acceptance Limits..... Statistically determined on an annual basis.

DEL MAR ANALYTICAL

APPENDIX F

Mussel tissue chemistry by station

Del Mar Analytical

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MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99201 E
ESGS NPDES
Sample Descript: Mussel tissue, ESGS-I
Lab Number: II01261

Sampled: 7/15/99
Received: 9/15/99
Extracted: 9/20/99-9/22/99
Reported: 9/24/99

LABORATORY ANALYSIS

Analyte	EPA Method	Reporting Limit mg/dry Kg (ppm)	Sample Result mg/dry Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
Chromium	6010B	5.3	N.D.	9/21/99	1.0	II20ME2S
Copper	6010B	5.3	18	9/21/99	1.0	II20ME2S
Nickel	6010B	5.3	N.D.	9/21/99	1.0	II20ME2S
Percent Solids (%)	160.3	N.A.	19	9/22/99	1.0	II22SO1S
Zinc	6010B	26	100	9/21/99	1.0	II20ME2S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99201 E
ESGS NPDES
Sample Descript: Mussel tissue, ESGS-II
Lab Number: II01262

Sampled: 7/15/99
Received: 9/15/99
Extracted: 9/20/99-9/22/99
Reported: 9/24/99

LABORATORY ANALYSIS

Analyte	EPA Method	Reporting Limit mg/dry Kg (ppm)	Sample Result mg/dry Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
Chromium	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Copper	6010B	6.3	14	9/21/99	1.0	II20ME2S
Nickel	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Percent Solids (%)	160.3	N.A.	16	9/22/99	1.0	II22SO1S
Zinc	6010B	31	120	9/21/99	1.0	II20ME2S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

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MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99201 E
ESGS NPDES
Sample Descript: Mussel tissue, ESGS-III
Lab Number: I101263

Sampled: 7/15/99
Received: 9/15/99
Extracted: 9/20/99-9/22/99
Reported: 9/24/99

LABORATORY ANALYSIS

Analyte	EPA Method	Reporting Limit mg/dry Kg (ppm)	Sample Result mg/dry Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
Chromium	6010B	5.6	N.D.	9/21/99	1.0	II20ME2S
Copper	6010B	5.6	41	9/21/99	1.0	II20ME2S
Nickel	6010B	5.6	N.D.	9/21/99	1.0	II20ME2S
Percent Solids (%)	160.3	N.A.	18	9/22/99	1.0	II22SO1S
Zinc	6010B	28	140	9/21/99	1.0	II20ME2S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

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MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Method Blank

Extracted: 9/20/99
Reported: 9/24/99

LABORATORY ANALYSIS

Analyte	EPA Method	Reporting Limit mg/Kg (ppm)	Sample Result mg/Kg (ppm)	Date Analyzed	QC Batch
Chromium....................................	6010B	1.0	N.D.	9/21/99	II20ME2S
Copper..	6010B	1.0	N.D.	9/21/99	II20ME2S
Nickel..	6010B	1.0	N.D.	9/21/99	II20ME2S
Zinc...	6010B	5.0	N.D.	9/21/99	II20ME2S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MS/MSD DATA REPORT

METHOD: EPA 6010B
Instrument: ICP
Matrix: Soil

Date Analyzed: 9/21/99

Sample: II01252

Batch: II20ME2S

Analyte	R1	Sp	MS	MSD	PR1	PR2	RPD	MEAN PR	Acceptance Limits RPD	Acceptance Limits MPR
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	%	%	%	%	RPD	MPR
Arsenic	3.65	50	48.0	46.5	89%	86%	3.2%	87%	20	80-120
Cadmium	0	50	46.0	44.8	92%	90%	2.6%	91%	20	80-120
Chromium	0	50	44.7	43.4	89%	87%	3.0%	88%	20	80-120
Copper	0	50	49.3	48.2	99%	96%	2.3%	98%	20	80-120
Lead	0	50	45.4	44.2	91%	88%	2.7%	90%	20	80-120
Molybdenum	0	50	44.9	43.4	90%	87%	3.4%	88%	20	80-120
Nickel	0	50	46.1	44.6	92%	89%	3.3%	91%	20	80-120
Selenium	0	50	42.8	42.3	86%	85%	1.2%	85%	20	80-120
Zinc	20.0	50	62.1	65.6	84%	91%	5.5%	88%	20	80-120

Definition of Terms:

R1.................... Result of Sample Analysis
Sp.................... Spike Concentration Added to Sample
MS.................... Matrix Spike Result
MSD.................. Matrix Spike Duplicate Result
PR1.................. Percent Recovery of MS; ((MS-R1) / SP) X 100
PR2.................. Percent Recovery of MSD; ((MSD-R1) / SP) X 100
RPD.................. Relative Percent Difference; ((MS-MSD)/(MS+MSD)/2) X 100
Acceptance Limits..... Statistically determined on an annual basis.

DEL MAR ANALYTICAL

Del Mar Analytical

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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99300 C
SGS NPDES
Sample Descript: Mussel tissue, SGS-I
Lab Number: II01252

Sampled: 7/15/99
Received: 9/15/99
Extracted: 9/20/99-9/22/99
Reported: 9/24/99

LABORATORY ANALYSIS

Analyte	EPA Method	Reporting Limit mg/dry Kg (ppm)	Sample Result mg/dry Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
Chromium....................................	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Copper..	6010B	6.3	8.5	9/21/99	1.0	II20ME2S
Nickel..	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Percent Solids (%).....................	160.3	N.A.	16	9/22/99	1.0	II22SO1S
Zinc...	6010B	31	130	9/21/99	1.0	II20ME2S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

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MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99300 C
SGS NPDES
Sample Descript: Mussel tissue, SGS-II
Lab Number: II01253

Sampled: 7/15/99
Received: 9/15/99
Extracted: 9/20/99-9/22/99
Reported: 9/24/99

LABORATORY ANALYSIS

Analyte	EPA Method	Reporting Limit mg/dry Kg (ppm)	Sample Result mg/dry Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
Chromium	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Copper	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Nickel	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Percent Solids (%)	160.3	N.A.	16	9/22/99	1.0	II22SO1S
Zinc	6010B	31	110	9/21/99	1.0	II20ME2S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

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9830 South 51st St., Suite B 120, Phoenix, AZ 85044 (480) 785 0043 FAX (480) 785 0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Client Project ID: 99300 C
SGS NPDES
Sample Descript: Mussel tissue, SGS-III
Lab Number: II01254

Sampled: 7/15/99
Received: 9/15/99
Extracted: 9/20/99-9/22/99
Reported: 9/24/99

LABORATORY ANALYSIS

Analyte	EPA Method	Reporting Limit mg/dry Kg (ppm)	Sample Result mg/dry Kg (ppm)	Date Analyzed	Dilution Factor	QC Batch
Chromium	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Copper	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Nickel	6010B	6.3	N.D.	9/21/99	1.0	II20ME2S
Percent Solids (%)	160.3	N.A.	16	9/22/99	1.0	II22SO1S
Zinc	6010B	31	100	9/21/99	1.0	II20ME2S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

Del Mar Analytical

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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MBC Applied Env. Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524
Attention: Mike Curtis

Method Blank

Extracted: 9/20/99
Reported: 9/24/99

LABORATORY ANALYSIS

Analyte	EPA Method	Reporting Limit mg/Kg (ppm)	Sample Result mg/Kg (ppm)	Date Analyzed	QC Batch
Chromium	6010B	1.0	N.D.	9/21/99	II20ME2S
Copper	6010B	1.0	N.D.	9/21/99	II20ME2S
Nickel	6010B	1.0	N.D.	9/21/99	II20ME2S
Zinc	6010B	5.0	N.D.	9/21/99	II20ME2S

Analytes reported as N.D. were not present at or above the reporting limit.

DEL MAR ANALYTICAL (ELAP #1197)
Michele Harper
Project Manager

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9830 South 51st St., Suite B-120, Phoenix, AZ 85044 (480) 785-0043 FAX (480) 785-0851

MS/MSD DATA REPORT

METHOD: EPA 6010B
Instrument: ICP
Matrix: Soil

Date Analyzed: 9/21/99

Sample: II01252

Batch: II20ME2S

Analyte	R1	Sp	MS	MSD	PR1	PR2	RPD	MEAN PR	Acceptance Limits	
	mg/Kg	mg/Kg	mg/Kg	mg/Kg	%	%	%	%	RPD	MPR
Arsenic	3.65	50	48.0	46.5	89%	86%	3.2%	87%	20	80-120
Cadmium	0	50	46.0	44.8	92%	90%	2.6%	91%	20	80-120
Chromium	0	50	44.7	43.4	89%	87%	3.0%	88%	20	80-120
Copper	0	50	49.3	48.2	99%	96%	2.3%	98%	20	80-120
Lead	0	50	45.4	44.2	91%	88%	2.7%	90%	20	80-120
Molybdenum	0	50	44.9	43.4	90%	87%	3.4%	88%	20	80-120
Nickel	0	50	46.1	44.6	92%	89%	3.3%	91%	20	80-120
Selenium	0	50	42.8	42.3	86%	85%	1.2%	85%	20	80-120
Zinc	20.0	50	62.1	65.6	84%	91%	5.5%	88%	20	80-120

Definition of Terms:

R1.................... Result of Sample Analysis
Sp.................... Spike Concentration Added to Sample
MS.................. Matrix Spike Result
MSD................. Matrix Spike Duplicate Result
PR1................. Percent Recovery of MS; ((MS-R1) / SP) X 100
PR2................. Percent Recovery of MSD; ((MSD-R1) / SP) X 100
RPD................. Relative Percent Difference; ((MS-MSD)/(MS+MSD)/2) X 100
Acceptance Limits..... Statistically determined on an annual basis.

DEL MAR ANALYTICAL

APPENDIX G

Infauna data by station

Appendix G-1. Infaunal master species list. El Segundo and Scattergood Generating Stations NPDES, 1999.

PHYLUM
Subphylum or Class
Species

CNIDARIA
- Anthozoa
  - *Zaolutus actius*
- Hydrozoa
  - *Plumularia corrugata*
  - *Rhizocaulus verticillatus*
  - *Tubularia* sp.

NEMERTEA
- Anopla
  - *Carinoma mutabilis*
  - *Cerebratulus californiensis*
  - *Lineus bilineatus*
  - *Micrura* sp.
  - *Tubulanus polymorphus* [1]
- Enopla
  - Enopla sp. A SCAMIT 1995
  - Hoplonemertea sp. A Paquette 1988
  - *Paranemertes californica* [2]
  - *Tetrastemma* sp.
  - *Tetrastemma* sp. A SCAMIT 1995
- Uncertain
  - Nemertea

NEMATODA
- Nematoda

MOLLUSCA
- Bivalvia
  - *Cooperella subdiaphana*
  - *Cumingia californica*
  - *Leptopecten latiauratus*
  - *Macoma indentata*
  - *Macoma* sp.
  - Mactridae
  - *Modiolus* sp.
  - *Mytilus galloprovincialis*
  - *Siliqua lucida*
  - *Solamen columbianum* [3]
  - *Solen sicarius*
  - *Tellina modesta*
- Gastropoda
  - *Caecum crebricinctum*
  - *Crepidula naticarum* [4]
  - *Crepidula norrisiarum*
  - *Neverita reclusiana*
  - *Rictaxis punctocaelatus*
  - *Turbonilla santarosana* [5]

SIPUNCULA
- Sipuncula

ANNELIDA
- Polychaeta
  - *Ampharete labrops*
  - *Amphitrite robusta*
  - *Aphelochaeta glandaria* [6]
  - *Apoprionospio pygmaea* [7]
  - *Arabella endonata*
  - *Aricidea (Acmira) catherinae* [8]
  - *Aricidea (Acmira) horikoshii* [9]
  - *Brania californiensis*
  - *Chaetozone corona*
  - *Chaetozone setosa* Cmplx [10]
  - *Chaetozone* sp.
  - *Chloeia pinnata*

PHYLUM
Subphylum or Class
Species

ANNELIDA (Cont.).
- Polychaeta
  - *Chone albocincta*
  - *Chone* sp.SD1 Pt. Loma 1997
  - *Cirriformia spirabrancha*
  - *Diopatra ornata*
  - *Dispio uncinata*
  - *Eudistylia vancouveri*
  - *Eulalia quadrioculata*
  - *Eumida longicornuta* [11]
  - *Glycera convoluta*
  - *Glycinde armigera*
  - *Goniada littorea*
  - *Goniada maculata*
  - *Hesionura coineaui difficilis*
  - *Leitoscoloplos pugettensis* [12]
  - *Levinsenia gracilis*
  - *Loimia medusa*
  - *Lumbrineris californiensis*
  - *Mediomastus acutus*
  - *Mediomastus* spp. [13]
  - *Micropodarke dubia*
  - *Monticellina cryptica* [14]
  - *Nephtys caecoides*
  - *Nephtys cornuta* [15]
  - *Nereis latescens*
  - *Onuphis* sp. 1 Pt. Loma 1983 [16]
  - *Owenia fusiformis* [17]
  - *Pectinaria californiensis* [18]
  - *Platynereis bicanaliculata*
  - *Polycirrus californicus*
  - *Polydora cirrosa*
  - *Prionospio (Minuspio) lighti* [19]
  - *Protodorvillea gracilis*
  - *Sabellaria gracilis*
  - *Saccocirrus* sp.
  - *Scoletoma tetraura* Cmplx [20]
  - *Scoloplos armiger* Cmplx [21]
  - *Sigalion spinosus* [22]
  - *Spiophanes bombyx*
  - *Spiophanes duplex* [23]
  - *Sthenelais tertiaglabra*
  - *Sthenelais verruculosa*
  - Syllidae
  - *Syllis (Typosyllis) farallonensis*

ARTHROPODA
- Malacostraca
  - *Ampelisca agassizi*
  - *Anchicolurus occidentalis*
  - *Ancinus granulatus*
  - *Aoroides exilis*
  - *Aoroides inermis*
  - Brachyura
  - *Campylaspis* sp. C Myers & Benedict 1974 [24]
  - *Cancer* sp.
  - *Caprella mendax*
  - *Caprella verrucosa*
  - *Diastylopsis tenuis*
  - *Edotia sublittoralis* [25]
  - *Ericthonius brasiliensis*
  - *Foxiphalus obtusidens*
  - *Gibberosus myersi* [26]
  - *Hartmanodes hartmanae* [27]
  - *Hemilamprops californica*
  - *Incisocalliope bairdi*

Appendix G-1. (Cont.).

PHYLUM Subphylum or Class Species	PHYLUM Subphylum or Class Species
ARTHROPODA (Cont.).	ARTHROPODA (Cont.).
Malacostraca	Ostracoda
Ischyrocerus pelagops	*Eusarsiella thominx*
Jassa slatteryi[28]	*Leuroleberis sharpei*
Lamprops quadriplicatus	*Parasterope hulingsi*
Laticorophium baconi[29]	Pycnogonida
Leptocuma forsmani	*Anoropallene palpida*
Listriella melanica	*Tanystylum intermedium*
Metamysidopsis elongata	
Neotrypaea californiensis[30]	ECHINODERMATA
Paramicrodeutopus schmitti	Asteroidea
Photis bifurcata	*Astropecten verrilli*
Photis brevipes	Echinoidea
Photis OCI (MEC) 1996	*Dendraster excentricus*
Pinnixa forficulimanus[31]	Ophiuroidea
Pontogeneia rostrata	*Amphiodia psara*
Pyromaia tuberculata	*Amphiodia* sp.
Rhepoxynius abronius	Amphiuridae
Rhepoxynius menziesi[32]	
Rudilemboides stenopropodus[33]	CHORDATA
Stenothoe estacola	Hemichordata
Stenothoides bicoma	Enteropneusta[35]
Synchelidium shoemakeri	Cephalochordata
Uromunna ubiquita[34]	*Branchiostoma californiense*

SCAMIT = Southern California Association of Marine Invertebrate Taxonomists

The following footnotes indicate names used in previous surveys:

1 *Tubulanus* sp. or *T. pellucidus/polymorphus*
2 *Paranemertes* sp. A SCAMIT
3 *Megacrenella columbiana*
4 *Crepidula excavata*
5 *Turbonilla* sp. C MBC
6 *Aphelochaeta* sp. C Dorsey, *Tharyx* sp. C SCAMIT, or *Tharyx* spp. (in part)
7 *Apoprionospio pygmaeus* or *Prionospio pygmaeus*
8 *Acmira catherinae* or *Acesta catherinae*
9 *Acmira horikoshii* or *Acesta horikoshii*
10 *Chaetozone "setosa"*, *C. cf. Setosa*, or *C. setosa*
11 *Eumida* sp. 2 Hamilton or *Eumida* sp. B SCAMIT
12 *Haploscoloplos elongata*
13 *Mediomastus ambiseta, M. acutus,* or *M. californiensis*
14 *Monticellina dorsobranchialis, Tharyx* sp. A SCAMIT, or *Tharyx* spp. (in part)
15 *Nephtys cornuta franciscana*
16 *Onuphis* sp. A SCAMIT
17 *Owenia collaris*
18 *Pectinaria californiensis newportensis*
19 *Minuspio cirrifera, Prionospio cirrifera,* or *P. lighti*
20 *Lumbrineris "tetraura", L. tetraura,* or *Scoletoma tetraura*
21 *Scoloplos armiger* or *Scoloplos "armiger"*
22 *Thalanessa spinosa* or *Eusigalion spinosa*
23 *Spiophanes missionensis*
24 *Campylaspis* sp. C MBC
25 *Edotea sublittoralis*
26 *Megaluropus longimerus*
27 *Monoculodes hartmanae*
28 *Jassa falcata*
29 *Corophium baconi*
30 *Callianasa* sp. or *Callianasa californiensis*
31 *Pinnixa* sp. A MBC
32 *Paraphoxus epistomus* or *Rhepoxynius epistomus*
33 *Acuminodeutopus stenopropodus*
34 *Munna* sp.
35 Hemichordata or Hemichordata, unid.

Appendix G-2. Infauna results by station. El Segundo and Scattergood Generating Stations NPDES, 1999.

Phylum	Species	Station								Total	Percent Total
		B1	B2	B3	B4	B5	B6	B7	B8		
AR	*Aoroides inermis*	-	-	25	34	-	70	-	23	152	12.29
AR	*Diastylopsis tenuis*	10	7	-	6	-	29	70	30	152	12.29
AR	*Rhepoxynius menziesi*	7	2	20	20	1	11	14	-	75	6.06
EC	*Dendraster excentricus*	-	37	20	-	2	1	5	-	65	5.25
AN	*Apoprionospio pygmaea*	18	2	2	1	-	12	4	7	46	3.72
AR	*Photis* OC1 (MEC) 1996	-	-	-	-	-	22	-	9	31	2.51
AN	*Owenia fusiformis*	18	1	3	5	-	1	1	1	30	2.43
AR	*Leptocuma forsmani*	17	6	2	1	-	-	-	-	26	2.10
MO	*Tellina modesta*	1	-	2	1	-	-	8	14	26	2.10
AN	*Monticellina cryptica*	-	-	-	-	-	17	-	7	24	1.94
AN	*Goniada littorea*	4	5	1	8	-	4	1	-	23	1.86
AN	*Levinsenia gracilis*	-	-	-	-	23	-	-	-	23	1.86
AN	*Spiophanes bombyx*	-	-	5	5	4	1	3	5	23	1.86
NE	*Carinoma mutabilis*	2	-	-	2	1	3	8	6	22	1.78
AR	*Photis brevipes*	-	-	1	1	-	10	-	10	22	1.78
MO	*Solamen columbianum*	-	-	-	-	21	-	-	-	21	1.70
AN	*Ampharete labrops*	-	-	4	-	2	11	-	3	20	1.62
AN	*Nephtys caecoides*	4	3	4	2	1	2	3	1	20	1.62
AN	*Chaetozone setosa* Cmplx	2	1	6	5	-	1	-	1	16	1.29
AR	*Campylaspis* sp. C Myers & Benedict 1974	3	3	8	-	-	-	1	-	15	1.21
AR	*Photis bifurcata*	-	-	-	-	-	6	-	8	14	1.13
MO	*Solen sicarius*	4	1	7	-	1	-	-	-	13	1.05
AR	*Synchelidium shoemakeri*	1	-	10	1	-	-	-	1	13	1.05
AN	*Cirriformia spirabrancha*	-	-	8	2	-	-	-	2	12	0.97
AR	*Ericthonius brasiliensis*	-	-	1	-	-	1	-	10	12	0.97
AR	*Gibberosus myersi*	-	-	2	-	-	1	7	2	12	0.97
AN	*Mediomastus acutus*	3	2	2	2	-	1	1	1	12	0.97
NT	Nematoda	1	1	1	-	8	1	-	-	12	0.97
AN	*Sigalion spinosus*	2	-	-	1	-	1	2	4	10	0.81
EC	Amphiuridae	2	5	-	2	-	-	-	-	9	0.73
AN	*Diopatra ornata*	-	-	-	2	-	3	1	3	9	0.73
AR	*Hemilamprops californica*	-	-	-	-	3	4	-	2	9	0.73
AN	*Leitoscoloplos pugettensis*	4	4	-	1	-	-	-	-	9	0.73
AN	*Nereis latescens*	-	-	4	2	-	1	-	2	9	0.73
AN	*Spiophanes duplex*	8	-	-	-	-	-	1	-	9	0.73
CN	*Zaolutus actius*	-	-	2	5	-	1	-	1	9	0.73
NE	*Micrura* sp.	2	-	2	1	1	1	1	-	8	0.65
AN	*Sabellaria gracilis*	-	-	-	-	-	1	-	7	8	0.65
AR	*Uromunna ubiquita*	-	-	-	1	-	2	3	2	8	0.65
AN	*Hesionura coineaui difficilis*	-	-	-	-	7	-	-	-	7	0.57
AR	*Jassa slatteryi*	-	5	2	-	-	-	-	-	7	0.57
AN	*Polydora cirrosa*	-	-	-	5	-	1	-	1	7	0.57
AR	*Caprella mendax*	6	-	-	-	-	-	-	-	6	0.49
MO	*Siliqua lucida*	-	1	-	-	-	-	4	1	6	0.49
AN	*Aphelochaeta glandaria*	-	-	-	-	-	1	-	4	5	0.40
MO	*Caecum crebricinctum*	-	-	-	-	5	-	-	-	5	0.40
AR	*Hartmanodes hartmanae*	-	-	1	1	-	1	2	-	5	0.40
AR	*Edotia sublittoralis*	2	1	-	1	-	-	-	-	4	0.32
CO	Enteropneusta	-	-	-	-	-	-	2	2	4	0.32
AR	*Foxiphalus obtusidens*	-	-	-	-	1	-	2	1	4	0.32
AN	*Pectinaria californiensis*	3	-	-	1	-	-	-	-	4	0.32
MO	*Rictaxis punctocaelatus*	-	-	-	1	-	-	-	3	4	0.32
AN	*Scoloplos armiger* Cmplx	-	2	1	-	-	-	1	-	4	0.32
AR	*Stenothoe estacola*	-	3	1	-	-	-	-	-	4	0.32
AN	*Sthenelais verruculosa*	2	-	1	1	-	-	-	-	4	0.32
AN	*Syllis (Typosyllis) farallonensis*	1	-	-	-	-	2	-	1	4	0.32
AR	*Anchicolurus occidentalis*	1	-	-	2	-	-	-	-	3	0.24
AN	*Chone* sp.SD1 Pt. Loma 1997	-	-	-	-	-	1	1	1	3	0.24
MO	*Crepidula naticarum*	-	-	1	1	-	1	-	-	3	0.24
AR	*Metamysidopsis elongata*	3	-	-	-	-	-	-	-	3	0.24
AR	*Pyromaia tuberculata*	-	-	-	-	-	1	-	2	3	0.24
EC	*Amphiodia psara*	-	-	1	1	-	-	-	-	2	0.16
EC	*Amphiodia* sp.	1	1	-	-	-	-	-	-	2	0.16
AR	*Ancinus granulatus*	2	-	-	-	-	-	-	-	2	0.16
AR	*Aoroides exilis*	-	-	-	-	-	1	-	1	2	0.16
AN	*Aricidea (Acmira) catherinae*	-	1	-	-	-	1	-	-	2	0.16
EC	*Astropecten verrilli*	-	-	-	-	1	1	-	-	2	0.16
AR	*Caprella verrucosa*	-	1	-	1	-	-	-	-	2	0.16
MO	*Cooperella subdiaphana*	-	-	-	-	-	-	-	2	2	0.16
MO	*Cumingia californica*	-	-	-	2	-	-	-	-	2	0.16
AN	*Dispio uncinata*	-	-	-	1	1	-	-	-	2	0.16
AN	*Goniada maculata*	-	-	-	-	-	1	-	1	2	0.16
NE	Hoplonemertea sp. A Paquette 1988	-	-	-	-	-	-	-	2	2	0.16
AR	*Incisocalliope bairdi*	-	-	1	-	-	1	-	-	2	0.16
AR	*Ischyrocerus pelagops*	-	-	-	-	-	1	1	-	2	0.16

Appendix G-2. (Cont.).

Phylum	Species	Station B1	B2	B3	B4	B5	B6	B7	B8	Total	Percent Total
AR	*Lamprops quadriplicatus*	-	-	-	-	-	-	1	1	2	0.16
AR	*Laticorophium baconi*	-	1	-	-	1	-	-	-	2	0.16
MO	*Leptopecten latiauratus*	-	-	1	1	-	-	-	-	2	0.16
MO	*Macoma* sp.	-	-	-	-	-	-	-	2	2	0.16
AN	*Mediomastus* spp.	-	-	-	-	-	2	-	-	2	0.16
MO	*Modiolus* sp.	-	-	1	1	-	-	-	-	2	0.16
NE	Nemertea	-	-	-	-	-	-	1	1	2	0.16
NE	*Paranemertes californica*	-	-	-	-	-	-	1	1	2	0.16
AR	*Rhepoxynius abronius*	-	-	-	-	-	1	-	1	2	0.16
AN	*Scoletoma tetraura* Cmplx	-	-	2	-	-	-	-	-	2	0.16
SI	Sipuncula	-	-	-	-	-	2	-	-	2	0.16
NE	*Tetrastemma* sp.	-	-	-	-	1	-	1	-	2	0.16
CN	*Tubularia* sp.	-	-	1	-	-	-	-	1	2	0.16
AR	*Ampelisca agassizi*	-	-	-	-	-	-	-	1	1	0.08
AN	*Amphitrite robusta*	-	1	-	-	-	-	-	-	1	0.08
AR	*Anoropallene palpida*	1	-	-	-	-	-	-	-	1	0.08
AN	*Arabella endonata*	-	-	-	-	-	-	-	1	1	0.08
AN	*Aricidea (Acmira) horikoshii*	-	-	-	-	-	-	1	-	1	0.08
MO	Bivalvia	-	1	-	-	-	-	-	-	1	0.08
AR	Brachyura	-	-	-	-	-	1	-	-	1	0.08
CO	*Branchiostoma californiense*	-	-	-	-	1	-	-	-	1	0.08
AN	*Brania californiensis*	-	-	1	-	-	-	-	-	1	0.08
AR	*Cancer* sp.	-	-	-	-	-	1	-	-	1	0.08
NE	*Cerebratulus californiensis*	-	-	-	-	1	-	-	-	1	0.08
AN	*Chaetozone corona*	-	-	-	-	-	1	-	-	1	0.08
AN	*Chaetozone* sp.	1	-	-	-	-	-	-	-	1	0.08
AN	*Chloeia pinnata*	-	-	-	-	1	-	-	-	1	0.08
AN	*Chone albocincta*	1	-	-	-	-	-	-	-	1	0.08
MO	*Crepidula norrisiarum*	-	-	-	-	-	-	-	1	1	0.08
NE	Enopla sp. A SCAMIT 1995	-	-	-	1	-	-	-	-	1	0.08
AN	*Eudistylia vancouveri*	-	-	-	-	-	-	-	1	1	0.08
AN	*Eulalia quadrioculata*	-	-	-	-	-	-	-	1	1	0.08
AN	*Eumida longicornuta*	-	-	-	-	-	-	-	1	1	0.08
AR	*Eusarsiella thominx*	-	1	-	-	-	-	-	-	1	0.08
AN	*Glycera convoluta*	1	-	-	-	-	-	-	-	1	0.08
AN	*Glycinde armigera*	-	-	-	-	-	1	-	-	1	0.08
AR	*Leuroleberis sharpei*	-	-	-	-	-	-	-	1	1	0.08
NE	*Lineus bilineatus*	-	-	-	-	-	-	-	1	1	0.08
AR	*Listriella melanica*	-	-	-	-	-	-	-	1	1	0.08
AN	*Loimia medusa*	-	-	-	-	-	-	-	1	1	0.08
AN	*Lumbrineris californiensis*	-	-	-	-	-	-	-	1	1	0.08
MO	*Macoma indentata*	-	-	1	-	-	-	-	-	1	0.08
MO	Mactridae	1	-	-	-	-	-	-	-	1	0.08
AN	*Micropodarke dubia*	-	-	-	-	1	-	-	-	1	0.08
MO	*Mytilus galloprovincialis*	-	-	-	-	-	-	1	-	1	0.08
AR	*Neotrypaea californiensis*	1	-	-	-	-	-	-	-	1	0.08
AN	*Nephtys cornuta*	-	-	-	-	1	-	-	-	1	0.08
MO	*Neverita reclusiana*	-	-	1	-	-	-	-	-	1	0.08
AN	*Onuphis* sp. 1 Pt. Loma 1983	-	-	-	-	-	-	-	1	1	0.08
AR	*Paramicrodeutopus schmitti*	-	-	-	-	1	-	-	-	1	0.08
AR	*Parasterope hulingsi*	-	-	-	-	-	-	1	-	1	0.08
AR	*Pinnixa forficulimanus*	-	-	-	-	-	-	-	1	1	0.08
AN	*Platynereis bicanaliculata*	-	-	-	-	-	-	-	1	1	0.08
CN	*Plumularia corrugata*	-	-	1	-	-	-	-	-	1	0.08
AN	*Polycirrus californicus*	-	-	-	-	1	-	-	-	1	0.08
AR	*Pontogeneia rostrata*	-	-	1	-	-	-	-	-	1	0.08
AN	*Prionospio (Minuspio) lighti*	1	-	-	-	-	-	-	-	1	0.08
AN	*Protodorvillea gracilis*	-	-	-	-	1	-	-	-	1	0.08
CN	*Rhizocaulus verticillatus*	-	-	1	-	-	-	-	-	1	0.08
AR	*Rudilemboides stenopropodus*	1	-	-	-	-	-	-	-	1	0.08
AN	*Saccocirrus* sp.	-	-	-	-	1	-	-	-	1	0.08
AR	*Stenothoides bicoma*	-	-	-	-	-	-	-	1	1	0.08
AN	*Sthenelais tertiaglabra*	-	-	1	-	-	-	-	-	1	0.08
AN	Syllidae	-	-	-	-	-	-	1	-	1	0.08
AR	*Tanystylum intermedium*	-	1	-	-	-	-	-	-	1	0.08
NE	*Tetrastemma* sp. A SCAMIT 1995	-	-	1	-	-	-	-	-	1	0.08
NE	*Tubulanus polymorphus*	-	-	-	1	-	-	-	-	1	0.08
MO	*Turbonilla santarosana*	1	-	-	-	-	-	-	-	1	0.08
	Number of individuals	143	100	164	133	94	242	155	206	1237	
	Number of species	38	28	44	40	28	48	33	60	143	
	Diversity (H')	3.13	2.57	3.14	2.94	2.56	2.79	2.36	3.44	3.86	

Appendix G-3. Infauna data by station and replicate. El Segundo and Scattergood Generating Stations NPDES, 1999.

Station B1

Phylum	Species	Replicate B1-I	B1-II	B1-III	B1-IV	Total	Percent Composition	Density No./m²
AN	*Apoprionospio pygmaea*	4	1	9	4	18	12.59	45.0
AN	*Owenia fusiformis*	2	7	7	2	18	12.59	45.0
AR	*Leptocuma forsmani*	3	3	4	7	17	11.89	42.5
AR	*Diastylopsis tenuis*	4	2	1	3	10	6.99	25.0
AN	*Spiophanes bombyx*	3	5	-	-	8	5.59	20.0
AR	*Rhepoxynius menziesi*	1	1	3	2	7	4.90	17.5
AR	*Caprella mendax*	1	-	-	5	6	4.20	15.0
AN	*Goniada littorea*	-	-	1	3	4	2.80	10.0
AN	*Leitoscoloplos pugettensis*	2	-	1	1	4	2.80	10.0
AN	*Nephtys caecoides*	1	-	2	1	4	2.80	10.0
MO	*Solen sicarius*	1	-	1	2	4	2.80	10.0
AR	*Campylaspis* sp. C Myers & Benedict 1974	-	-	-	3	3	2.10	7.5
AN	*Mediomastus acutus*	-	-	1	2	3	2.10	7.5
AR	*Metamysidopsis elongata*	1	-	-	2	3	2.10	7.5
AN	*Pectinaria californiensis*	1	-	2	-	3	2.10	7.5
EC	Amphiuridae	1	-	1	-	2	1.40	5.0
AR	*Ancinus granulatus*	-	-	1	1	2	1.40	5.0
NE	*Carinoma mutabilis*	-	-	-	2	2	1.40	5.0
AN	*Chaetozone setosa Cmplx*	-	1	1	-	2	1.40	5.0
AR	*Edotia sublittoralis*	-	-	1	1	2	1.40	5.0
NE	*Micrura* sp.	-	1	-	1	2	1.40	5.0
AN	*Sigalion spinosus*	-	1	1	-	2	1.40	5.0
AN	*Sthenelais verruculosa*	1	-	1	-	2	1.40	5.0
EC	*Amphiodia* sp.	-	-	1	-	1	0.70	2.5
AR	*Anchicolurus occidentalis*	-	-	-	1	1	0.70	2.5
AR	*Anoropallene palpida*	-	1	-	-	1	0.70	2.5
AN	*Chaetozone sp.*	1	-	-	-	1	0.70	2.5
AN	*Chone albocincta*	1	-	-	-	1	0.70	2.5
AN	*Glycera convoluta*	-	1	-	-	1	0.70	2.5
MO	Mactridae	1	-	-	-	1	0.70	2.5
NT	Nematoda	-	-	1	-	1	0.70	2.5
AR	*Neotrypaea californiensis*	-	-	-	1	1	0.70	2.5
AN	*Prionospio (Minuspio) lighti*	-	-	-	1	1	0.70	2.5
AR	*Rudilemboides stenopropodus*	-	-	-	1	1	0.70	2.5
AN	*Syllis (Typosyllis) farallonensis*	-	-	1	-	1	0.70	2.5
AR	*Synchelidium shoemakeri*	-	-	-	1	1	0.70	2.5
MO	*Tellina modesta*	1	-	-	-	1	0.70	2.5
MO	*Turbonilla santarosana*	-	1	-	-	1	0.70	2.5

Summary

Parameter	Replicate B1-I	B1-II	B1-III	B1-IV	Station Total	Replicate Mean	S.D.
Number of individuals	30	25	41	47	143	35.8	10.0
Number of species	18	12	20	22	38	18.0	4.3
Diversity (H')	2.87	2.86	2.53	2.88	3.13	2.78	0.17

Appendix G-3. (Cont.).

Station B2

Phylum	Species	Replicate B2-I	B2-II	B2-III	B2-IV	Total	Percent Composition	Density No./m²
EC	*Dendraster excentricus*	9	4	21	3	37	37.00	92.5
AR	*Diastylopsis tenuis*	1	4	1	1	7	7.00	17.5
AR	*Leptocuma forsmani*	-	2	1	3	6	6.00	15.0
EC	Amphiuridae	-	3	-	2	5	5.00	12.5
AN	*Goniada littorea*	-	3	2	-	5	5.00	12.5
AR	*Jassa slatteryi*	1	-	1	3	5	5.00	12.5
AN	*Leitoscoloplos pugettensis*	2	1	-	1	4	4.00	10.0
AR	*Campylaspis* sp. C Myers & Benedict 1974	1	-	-	2	3	3.00	7.5
AN	*Nephtys caecoides*	-	-	1	2	3	3.00	7.5
AR	*Stenothoe estacola*	1	-	-	2	3	3.00	7.5
AN	*Apoprionospio pygmaea*	1	-	-	1	2	2.00	5.0
AN	*Mediomastus acutus*	1	1	-	-	2	2.00	5.0
AR	*Rhepoxynius menziesi*	-	-	-	2	2	2.00	5.0
AN	*Scoloplos armiger* Cmplx	1	-	-	1	2	2.00	5.0
EC	*Amphiodia* sp.	1	-	-	-	1	1.00	2.5
AN	*Amphitrite robusta*	1	-	-	-	1	1.00	2.5
AN	*Aricidea (Acmira) catherinae*	-	1	-	-	1	1.00	2.5
MO	Bivalvia	-	-	-	1	1	1.00	2.5
AR	*Caprella verrucosa*	1	-	-	-	1	1.00	2.5
AN	*Chaetozone setosa Cmplx*	1	-	-	-	1	1.00	2.5
AR	*Edotia sublittoralis*	-	-	1	-	1	1.00	2.5
AR	*Eusarsiella thominx*	-	-	-	1	1	1.00	2.5
AR	*Laticorophium baconi*	-	-	-	1	1	1.00	2.5
NT	Nematoda	1	-	-	-	1	1.00	2.5
AN	*Owenia fusiformis*	-	-	-	1	1	1.00	2.5
MO	*Siliqua lucida*	-	-	1	-	1	1.00	2.5
MO	*Solen sicarius*	-	-	-	1	1	1.00	2.5
AR	*Tanystylum intermedium*	1	-	-	-	1	1.00	2.5

Summary

Parameter	Replicate B2-I	B2-II	B2-III	B2-IV	Station Total	Replicate Mean	S.D.
Number of individuals	24	19	29	28	100	25.0	4.5
Number of species	15	8	8	17	28	12.0	4.7
Diversity (H')	2.30	1.94	1.11	2.73	2.57	2.02	0.69

Appendix G-3. (Cont.).

Station B3

Phylum	Species	Replicate B3-I	B3-II	B3-III	B3-IV	Total	Percent Composition	Density No./m²
AR	*Aoroides inermis*	7	18	-	-	25	15.24	62.5
EC	*Dendraster excentricus*	10	3	3	4	20	12.20	50.0
AR	*Rhepoxynius menziesi*	5	3	8	4	20	12.20	50.0
AR	*Synchelidium shoemakeri*	2	4	4	-	10	6.10	25.0
AR	*Campylaspis* sp. C Myers & Benedict 1974	4	2	2	-	8	4.88	20.0
AN	*Cirriformia spirabrancha*	1	6	-	1	8	4.88	20.0
MO	*Solen sicarius*	4	3	-	-	7	4.27	17.5
AN	*Chaetozone setosa Cmplx*	-	4	-	2	6	3.66	15.0
AN	*Spiophanes bombyx*	-	1	3	1	5	3.05	12.5
AN	*Ampharete labrops*	-	4	-	-	4	2.44	10.0
AN	*Nephtys caecoides*	1	-	2	1	4	2.44	10.0
AN	*Nereis latescens*	-	4	-	-	4	2.44	10.0
AN	*Owenia fusiformis*	1	-	2	-	3	1.83	7.5
AN	*Apoprionospio pygmaea*	-	1	-	1	2	1.22	5.0
AR	*Gibberosus myersi*	1	-	1	-	2	1.22	5.0
AR	*Jassa slatteryi*	-	1	1	-	2	1.22	5.0
AR	*Leptocuma forsmani*	1	-	1	-	2	1.22	5.0
AN	*Mediomastus acutus*	-	-	2	-	2	1.22	5.0
NE	*Micrura* sp.	-	-	2	-	2	1.22	5.0
AN	*Scoletoma tetraura* Cmplx	-	2	-	-	2	1.22	5.0
MO	*Tellina modesta*	-	-	2	-	2	1.22	5.0
CN	*Zaolutus actius*	-	2	-	-	2	1.22	5.0
EC	*Amphiodia psara*	-	-	1	-	1	0.61	2.5
AN	*Brania californiensis*	-	1	-	-	1	0.61	2.5
MO	*Crepidula naticarum*	-	-	-	1	1	0.61	2.5
AR	*Ericthonius brasiliensis*	-	1	-	-	1	0.61	2.5
AN	*Goniada littorea*	-	-	-	1	1	0.61	2.5
AR	*Hartmanodes hartmanae*	-	-	1	-	1	0.61	2.5
AR	*Incisocalliope bairdi*	1	-	-	-	1	0.61	2.5
MO	*Leptopecten latiauratus*	-	1	-	-	1	0.61	2.5
MO	*Macoma indentata*	1	-	-	-	1	0.61	2.5
MO	*Modiolus* sp.	-	1	-	-	1	0.61	2.5
NT	Nematoda	-	-	1	-	1	0.61	2.5
MO	*Neverita reclusiana*	-	-	-	1	1	0.61	2.5
AR	*Photis brevipes*	-	1	-	-	1	0.61	2.5
CN	*Plumularia corrugata*	-	1	-	-	1	0.61	2.5
AR	*Pontogeneia rostrata*	-	1	-	-	1	0.61	2.5
CN	*Rhizocaulus verticillatus*	-	1	-	-	1	0.61	2.5
AN	*Scoloplos armiger* Cmplx	-	1	-	-	1	0.61	2.5
AR	*Stenothoe estacola*	-	1	-	-	1	0.61	2.5
AN	*Sthenelais tertiaglabra*	1	-	-	-	1	0.61	2.5
AN	*Sthenelais verruculosa*	-	-	-	1	1	0.61	2.5
NE	*Tetrastemma* sp. A SCAMIT 1995	-	-	1	-	1	0.61	2.5
CN	*Tubularia* sp.	-	1	-	-	1	0.61	2.5

Summary

Parameter	Replicate B3-I	B3-II	B3-III	B3-IV	Station Total	Replicate Mean	S.D.
Number of individuals	40	69	37	18	164	41.0	21.1
Number of species	14	26	17	11	44	17.0	6.5
Diversity (H')	2.26	2.80	2.61	2.20	3.14	2.47	0.29

Appendix G-3. (Cont.).

Station B4

Phylum	Species	Replicate B4-I	B4-II	B4-III	B4-IV	Total	Percent Composition	Density No./m²
AR	*Aoroides inermis*	20	-	14	-	34	25.56	85.0
AR	*Rhepoxynius menziesi*	3	6	1	10	20	15.04	50.0
AN	*Goniada littorea*	3	1	1	3	8	6.02	20.0
AR	*Diastylopsis tenuis*	2	-	-	4	6	4.51	15.0
AN	*Chaetozone setosa Cmplx*	-	-	4	1	5	3.76	12.5
AN	*Owenia fusiformis*	-	1	2	2	5	3.76	12.5
AN	*Polydora cirrosa*	5	-	-	-	5	3.76	12.5
AN	*Spiophanes bombyx*	1	1	2	1	5	3.76	12.5
CN	*Zaolutus actius*	2	-	-	3	5	3.76	12.5
EC	Amphiuridae	-	-	2	-	2	1.50	5.0
AR	*Anchicolurus occidentalis*	1	1	-	-	2	1.50	5.0
NE	*Carinoma mutabilis*	1	-	1	-	2	1.50	5.0
AN	*Cirriformia spirabrancha*	2	-	-	-	2	1.50	5.0
MO	*Cumingia californica*	-	-	2	-	2	1.50	5.0
AN	*Diopatra ornata*	1	-	1	-	2	1.50	5.0
AN	*Mediomastus acutus*	2	-	-	-	2	1.50	5.0
AN	*Nephtys caecoides*	-	-	1	1	2	1.50	5.0
AN	*Nereis latescens*	1	-	1	-	2	1.50	5.0
EC	*Amphiodia psara*	-	-	1	-	1	0.75	2.5
AN	*Apoprionospio pygmaea*	-	-	-	1	1	0.75	2.5
AR	*Caprella verrucosa*	-	1	-	-	1	0.75	2.5
MO	*Crepidula naticarum*	-	-	1	-	1	0.75	2.5
AN	*Dispio uncinata*	-	1	-	-	1	0.75	2.5
AR	*Edotia sublittoralis*	-	-	-	1	1	0.75	2.5
NE	Enopla sp. A SCAMIT 1995	1	-	-	-	1	0.75	2.5
AR	*Hartmanodes hartmanae*	-	-	-	1	1	0.75	2.5
AN	*Leitoscoloplos pugettensis*	1	-	-	-	1	0.75	2.5
AR	*Leptocuma forsmani*	-	-	1	-	1	0.75	2.5
MO	*Leptopecten latiauratus*	-	-	1	-	1	0.75	2.5
NE	*Micrura* sp.	-	-	1	-	1	0.75	2.5
MO	*Modiolus* sp.	-	-	1	-	1	0.75	2.5
AN	*Pectinaria californiensis*	-	-	1	-	1	0.75	2.5
AR	*Photis brevipes*	-	-	1	-	1	0.75	2.5
MO	*Rictaxis punctocaelatus*	1	-	-	-	1	0.75	2.5
AN	*Sigalion spinosus*	-	1	-	-	1	0.75	2.5
AN	*Sthenelais verruculosa*	1	-	-	-	1	0.75	2.5
AR	*Synchelidium shoemakeri*	-	-	-	1	1	0.75	2.5
MO	*Tellina modesta*	-	-	-	1	1	0.75	2.5
NE	*Tubulanus polymorphus*	1	-	-	-	1	0.75	2.5
AR	*Uromunna ubiquita*	-	-	1	-	1	0.75	2.5

Summary

Parameter	Replicate B4-I	B4-II	B4-III	B4-IV	Station Total	Replicate Mean	S.D.
Number of individuals	49	13	41	30	133	33.3	15.6
Number of species	18	8	21	13	40	15.0	5.7
Diversity (H')	2.26	1.74	2.54	2.18	2.94	2.18	0.33

Appendix G-3. (Cont.).

Station B5

Phylum	Species	Replicate B5-I	B5-II	B5-III	B5-IV	Total	Percent Composition	Density No./m²
AN	*Levinsenia gracilis*	-	10	8	5	23	24.47	57.5
MO	*Solamen columbianum*	4	5	1	11	21	22.34	52.5
NT	Nematoda	-	8	-	-	8	8.51	20.0
AN	*Hesionura coineaui difficilis*	-	7	-	-	7	7.45	17.5
MO	*Caecum crebricinctum*	-	5	-	-	5	5.32	12.5
AN	*Spiophanes bombyx*	-	2	-	2	4	4.26	10.0
AR	*Hemilamprops californica*	-	3	-	-	3	3.19	7.5
AN	*Ampharete labrops*	-	2	-	-	2	2.13	5.0
EC	*Dendraster excentricus*	1	-	-	1	2	2.13	5.0
EC	*Astropecten verrilli*	-	-	-	1	1	1.06	2.5
CO	*Branchiostoma californiense*	-	-	1	-	1	1.06	2.5
NE	*Carinoma mutabilis*	-	-	1	-	1	1.06	2.5
NE	*Cerebratulus californiensis*	-	1	-	-	1	1.06	2.5
AN	*Chloeia pinnata*	-	-	-	1	1	1.06	2.5
AN	*Dispio uncinata*	-	-	1	-	1	1.06	2.5
AR	*Foxiphalus obtusidens*	1	-	-	-	1	1.06	2.5
AR	*Laticorophium baconi*	-	1	-	-	1	1.06	2.5
AN	*Micropodarke dubia*	-	1	-	-	1	1.06	2.5
NE	*Micrura* sp.	-	1	-	-	1	1.06	2.5
AN	*Nephtys caecoides*	1	-	-	-	1	1.06	2.5
AN	*Nephtys cornuta*	-	-	1	-	1	1.06	2.5
AR	*Paramicrodeutopus schmitti*	-	1	-	-	1	1.06	2.5
AN	*Polycirrus californicus*	-	1	-	-	1	1.06	2.5
AN	*Protodorvillea gracilis*	-	1	-	-	1	1.06	2.5
AR	*Rhepoxynius menziesi*	-	-	-	1	1	1.06	2.5
AN	*Saccocirrus* sp.	-	1	-	-	1	1.06	2.5
MO	*Solen sicarius*	1	-	-	-	1	1.06	2.5
NE	*Tetrastemma* sp.	-	-	1	-	1	1.06	2.5

Summary

	Replicate B5-I	B5-II	B5-III	B5-IV	Station Total	Replicate Mean	S.D.
Number of individuals	8	50	14	22	94	23.5	18.6
Number of species	5	16	7	7	28	8.8	4.9
Diversity (H')	1.39	2.40	1.45	1.46	2.56	1.68	0.49

Appendix G-3. (Cont.).

Station B6

Phylum	Species	Replicate B6-I	B6-II	B6-III	B6-IV	Total	Percent Composition	Density No./m²
AR	*Aoroides inermis*	-	21	46	3	70	28.93	175.0
AR	*Diastylopsis tenuis*	5	11	7	6	29	11.98	72.5
AR	*Photis* OC1 (MEC) 1996	-	5	15	2	22	9.09	55.0
AN	*Monticellina cryptica*	4	4	2	7	17	7.02	42.5
AN	*Apoprionospio pygmaea*	6	3	3	-	12	4.96	30.0
AN	*Ampharete labrops*	1	3	3	4	11	4.55	27.5
AR	*Rhepoxynius menziesi*	3	1	6	1	11	4.55	27.5
AR	*Photis brevipes*	-	1	8	1	10	4.13	25.0
AR	*Photis bifurcatus*	-	-	5	1	6	2.48	15.0
AN	*Goniada littorea*	-	2	1	1	4	1.65	10.0
AR	*Hemilamprops californica*	2	1	1	-	4	1.65	10.0
NE	*Carinoma mutabilis*	-	3	-	-	3	1.24	7.5
AN	*Diopatra ornata*	-	2	-	1	3	1.24	7.5
AN	*Mediomastus* spp.	-	-	-	2	2	0.83	5.0
AN	*Nephtys caecoides*	1	-	-	1	2	0.83	5.0
SI	Sipuncula	-	1	1	-	2	0.83	5.0
AN	*Syllis (Typosyllis) farallonensis*	1	1	-	-	2	0.83	5.0
AR	*Uromunna ubiquita*	-	-	2	-	2	0.83	5.0
AR	*Aoroides exilis*	-	-	1	-	1	0.41	2.5
AN	*Aphelochaeta glandaria*	-	-	1	-	1	0.41	2.5
AN	*Aricidea (Acmira) catherinae*	-	-	-	1	1	0.41	2.5
EC	*Astropecten verrilli*	1	-	-	-	1	0.41	2.5
AR	Brachyura	-	1	-	-	1	0.41	2.5
AR	*Cancer* sp.	-	-	-	1	1	0.41	2.5
AN	*Chaetozone corona*	-	-	-	1	1	0.41	2.5
AN	*Chaetozone setosa Cmplx*	-	-	-	1	1	0.41	2.5
AN	*Chone* sp.SD1 Pt. Loma 1997	-	-	1	-	1	0.41	2.5
MO	*Crepidula naticarum*	-	-	1	-	1	0.41	2.5
EC	*Dendraster excentricus*	1	-	-	-	1	0.41	2.5
AR	*Ericthonius brasiliensis*	-	1	-	-	1	0.41	2.5
AR	*Gibberosus myersi*	-	-	1	-	1	0.41	2.5
AN	*Glycinde armigera*	-	1	-	-	1	0.41	2.5
AN	*Goniada maculata*	-	-	1	-	1	0.41	2.5
AR	*Hartmanodes hartmanae*	-	-	1	-	1	0.41	2.5
AR	*Incisocalliope bairdi*	-	-	1	-	1	0.41	2.5
AR	*Ischyrocerus pelagops*	-	1	-	-	1	0.41	2.5
AN	*Mediomastus acutus*	1	-	-	-	1	0.41	2.5
NE	*Micrura* sp.	-	-	-	1	1	0.41	2.5
NT	Nematoda	1	-	-	-	1	0.41	2.5
AN	*Nereis latescens*	-	-	-	1	1	0.41	2.5
AN	*Owenia fusiformis*	1	-	-	-	1	0.41	2.5
AN	*Polydora cirrosa*	-	1	-	-	1	0.41	2.5
AR	*Pyromaia tuberculata*	-	-	-	1	1	0.41	2.5
AR	*Rhepoxynius abronius*	-	1	-	-	1	0.41	2.5
AN	*Sabellaria gracilis*	-	-	-	1	1	0.41	2.5
AN	*Sigalion spinosus*	-	-	-	1	1	0.41	2.5
AN	*Spiophanes bombyx*	1	-	-	-	1	0.41	2.5
CN	*Zaolutus actius*	-	-	1	-	1	0.41	2.5

Summary

Parameter	Replicate B6-I	B6-II	B6-III	B6-IV	Station Total	Replicate Mean	S.D.
Number of individuals	29	65	109	39	242	60.5	35.7
Number of species	14	20	22	21	48	19.3	3.6
Diversity (H')	2.37	2.38	2.17	2.74	2.79	2.41	0.24

Appendix G-3. (Cont.).

Station B7

Phylum	Species	Replicate B7-I	B7-II	B7-III	B7-IV	Total	Percent Composition	Density No./m²
AR	*Diastylopsis tenuis*	11	41	3	15	70	45.16	175.0
AR	*Rhepoxynius menziesi*	1	10	2	1	14	9.03	35.0
NE	*Carinoma mutabilis*	1	3	1	3	8	5.16	20.0
MO	*Tellina modesta*	1	3	3	1	8	5.16	20.0
AR	*Gibberosus myersi*	5	2	-	-	7	4.52	17.5
EC	*Dendraster excentricus*	-	5	-	-	5	3.23	12.5
AN	*Apoprionospio pygmaea*	3	-	-	1	4	2.58	10.0
MO	*Siliqua lucida*	-	1	-	3	4	2.58	10.0
AN	*Nephtys caecoides*	-	-	1	2	3	1.94	7.5
AN	*Spiophanes bombyx*	1	1	1	-	3	1.94	7.5
AR	*Uromunna ubiquita*	-	2	-	1	3	1.94	7.5
CO	Enteropneusta	2	-	-	-	2	1.29	5.0
AR	*Foxiphalus obtusidens*	1	1	-	-	2	1.29	5.0
AR	*Hartmanodes hartmanae*	1	1	-	-	2	1.29	5.0
AN	*Sigalion spinosus*	2	-	-	-	2	1.29	5.0
AN	*Aricidea (Acmira) horikoshii*	-	-	1	-	1	0.65	2.5
AR	*Campylaspis* sp. C Myers & Benedict 1974	-	1	-	-	1	0.65	2.5
AN	*Chone* sp.SD1 Pt. Loma 1997	-	1	-	-	1	0.65	2.5
AN	*Diopatra ornata*	-	-	1	-	1	0.65	2.5
AN	*Goniada littorea*	-	1	-	-	1	0.65	2.5
AR	*Ischyrocerus pelagops*	1	-	-	-	1	0.65	2.5
AR	*Lamprops quadriplicatus*	-	1	-	-	1	0.65	2.5
AN	*Mediomastus acutus*	-	1	-	-	1	0.65	2.5
NE	*Micrura* sp.	-	-	1	-	1	0.65	2.5
MO	*Mytilus galloprovincialis*	-	-	1	-	1	0.65	2.5
NE	Nemertea	-	1	-	-	1	0.65	2.5
AN	*Owenia fusiformis*	-	1	-	-	1	0.65	2.5
NE	*Paranemertes californica*	1	-	-	-	1	0.65	2.5
AR	*Parasterope hulingsi*	-	1	-	-	1	0.65	2.5
AN	*Scoloplos armiger* Cmplx	1	-	-	-	1	0.65	2.5
AN	*Spiophanes duplex*	-	1	-	-	1	0.65	2.5
AN	Syllidae	-	-	-	1	1	0.65	2.5
NE	*Tetrastemma* sp.	-	1	-	-	1	0.65	2.5

Summary

Parameter	Replicate B7-I	B7-II	B7-III	B7-IV	Station Total	Replicate Mean	S.D.
Number of individuals	32	80	15	28	155	38.8	28.4
Number of species	14	21	10	9	33	13.5	5.4
Diversity (H')	2.20	1.97	2.18	1.60	2.36	1.99	0.28

Appendix G-3. (Cont.).

Station B8

Phylum	Species	Replicate B8-I	B8-II	B8-III	B8-IV	Total	Percent Composition	Density No./m²
AR	*Diastylopsis tenuis*	5	10	6	9	30	14.56	75.0
AR	*Aoroides inermis*	8	1	12	2	23	11.17	57.5
MO	*Tellina modesta*	11	-	2	1	14	6.80	35.0
AR	*Ericthonius brasiliensis*	1	-	9	-	10	4.85	25.0
AR	*Photis brevipes*	5	-	5	-	10	4.85	25.0
AR	*Photis* OC1 (MEC) 1996	3	1	5	-	9	4.37	22.5
AR	*Photis bifurcata*	5	-	3	-	8	3.88	20.0
AN	*Apoprionospio pygmaea*	2	2	2	1	7	3.40	17.5
AN	*Monticellina cryptica*	4	2	-	1	7	3.40	17.5
AN	*Sabellaria gracilis*	7	-	-	-	7	3.40	17.5
NE	*Carinoma mutabilis*	-	3	-	3	6	2.91	15.0
AN	*Spiophanes bombyx*	2	2	-	1	5	2.43	12.5
AN	*Aphelochaeta glandaria*	-	1	2	1	4	1.94	10.0
AN	*Sigalion spinosus*	2	2	-	-	4	1.94	10.0
AN	*Ampharete labrops*	2	-	-	1	3	1.46	7.5
AN	*Diopatra ornata*	-	-	3	-	3	1.46	7.5
MO	*Rictaxis punctocaelatus*	-	-	3	-	3	1.46	7.5
AN	*Cirriformia spirabrancha*	1	-	1	-	2	0.97	5.0
MO	*Cooperella subdiaphana*	1	-	1	-	2	0.97	5.0
CO	Enteropneusta	-	1	1	-	2	0.97	5.0
AR	*Gibberosus myersi*	1	-	1	-	2	0.97	5.0
AR	*Hemilamprops californica*	-	-	1	1	2	0.97	5.0
NE	Hoplonemertea sp. A Paquette 1988	-	-	1	1	2	0.97	5.0
MO	*Macoma* sp.	1	-	1	-	2	0.97	5.0
AN	*Nereis latescens*	1	-	1	-	2	0.97	5.0
AR	*Pyromaia tuberculata*	-	-	2	-	2	0.97	5.0
AR	*Uromunna ubiquita*	1	-	-	1	2	0.97	5.0
AR	*Ampelisca agassizi*	-	-	-	1	1	0.49	2.5
AR	*Aoroides exilis*	-	-	1	-	1	0.49	2.5
AN	*Arabella endonata*	-	-	1	-	1	0.49	2.5
AN	*Chaetozone setosa Cmplx*	-	-	-	1	1	0.49	2.5
AN	*Chone* sp.SD1 Pt. Loma 1997	-	1	-	-	1	0.49	2.5
MO	*Crepidula norrisiarum*	-	-	1	-	1	0.49	2.5
AN	*Eudistylia vancouveri*	1	-	-	-	1	0.49	2.5
AN	*Eulalia quadrioculata*	1	-	-	-	1	0.49	2.5
AN	*Eumida longicornuta*	-	-	1	-	1	0.49	2.5
AR	*Foxiphalus obtusidens*	-	-	1	-	1	0.49	2.5
AN	*Goniada maculata*	1	-	-	-	1	0.49	2.5
AR	*Lamprops quadriplicatus*	-	1	-	-	1	0.49	2.5
AR	*Leuroleberis sharpei*	-	1	-	-	1	0.49	2.5
NE	*Lineus bilineatus*	-	1	-	-	1	0.49	2.5
AR	*Listriella melanica*	-	1	-	-	1	0.49	2.5
AN	*Loimia medusa*	-	-	1	-	1	0.49	2.5
AN	*Lumbrineris californiensis*	-	-	1	-	1	0.49	2.5
AN	*Mediomastus acutus*	-	-	-	1	1	0.49	2.5
NE	Nemertea	-	-	-	1	1	0.49	2.5
AN	*Nephtys caecoides*	-	1	-	-	1	0.49	2.5
AN	*Onuphis* sp. 1 Pt. Loma 1983	-	-	1	-	1	0.49	2.5
AN	*Owenia fusiformis*	1	-	-	-	1	0.49	2.5
NE	*Paranemertes californica*	1	-	-	-	1	0.49	2.5
AR	*Pinnixa forficulimanus*	-	-	1	-	1	0.49	2.5
AN	*Platynereis bicanaliculata*	1	-	-	-	1	0.49	2.5
AN	*Polydora cirrosa*	-	1	-	-	1	0.49	2.5
AR	*Rhepoxynius abronius*	-	-	1	-	1	0.49	2.5
MO	*Siliqua lucida*	-	-	1	-	1	0.49	2.5
AR	*Stenothoides bicoma*	-	-	1	-	1	0.49	2.5
AN	*Syllis (Typosyllis) farallonensis*	-	1	-	-	1	0.49	2.5
AR	*Synchelidium shoemakeri*	-	-	1	-	1	0.49	2.5
CN	*Tubularia* sp.	-	-	1	-	1	0.49	2.5
CN	*Zaolutus actius*	1	-	-	-	1	0.49	2.5

Appendix G-3. (Cont.).

Station B8

Summary

	Replicate				Station	Replicate	
	B8-I	B8-II	B8-III	B8-IV	Total	Mean	S.D.
Number of individuals	70	33	76	27	206	51.5	25.1
Number of species	26	18	34	16	60	23.5	8.2
Diversity (H')	2.89	2.53	3.12	2.39	3.44	2.73	0.33

Appendix G-4. Infaunal wet weight biomass data (g). Scattergood/ El Segundo generating stations NPDES, 1999.

Sta-Rep	Annelida	Arthropoda	Mollusca	Echinodermata	Misc.	Total
B1-I	0.1224	0.0862	0.0205	0.0010	-	0.230
B1-II	0.5471	0.0136	0.0047	-	0.0147	0.580
B1-III	0.2405	0.0330	0.0002	0.0220	>0.0001	0.296
B1-IV	0.0758	0.0068	0.0158	-	0.0193	0.118
Total	0.9858	0.1396	0.0412	0.0230	0.0340	1.224
B2-I	0.3006	>0.0001	-	3.8108	>0.0001	4.111
B2-II	0.0229	>0.0001	-	3.1699	-	3.193
B2-III	0.0390	0.0002	>0.0001	13.1977	-	13.237
B2-IV	0.0547	>0.0001	0.0289	2.0390	-	2.123
Total	0.4172	0.0002	0.0289	22.2174	-	22.664
B3-I	0.0619	0.0428	0.0843	25.1692	-	25.3582
B3-II	0.4620	>0.0001	1.9973	8.2563		10.7156
B3-III	0.1876	0.0117	0.0035	9.4133	0.0319	9.6480
B3-IV	0.0699	0.0143	8.4768	14.1429	-	22.7039
Total	0.7814	0.0688	10.5619	56.9817	0.0319	68.4257
B4-I	1.9513	0.0235	0.0007	-	0.1538	2.1293
B4-II	0.0806	0.0306	-	-	-	0.1112
B4-III	0.2101	0.0075	0.0220	0.1103	<0.0001	0.3499
B4-IV	0.0776	0.0050	0.0194	-	0.0082	0.1102
Total	2.3196	0.0666	0.0421	0.1103	0.1620	2.7006
B5-I	0.0456	>0.0001	0.0038	0.0578	-	0.1072
B5-II	0.0380	0.0396	0.0150	-	0.0326	0.1252
B5-III	0.1593	-	0.0029	-	0.2061	0.3683
B5-IV	0.0026	0.0166	0.0627	0.3606	-	0.443
Total	0.2455	0.0562	0.0844	0.4184	0.2387	1.0432
B6-I	0.3128	0.0148	-	0.2044	0.0092	0.5412
B6-II	0.1261	0.0297	-	-	0.0080	0.1638
B6-III	0.1181	0.0445	<0.0001	-	0.1369	0.2995
B6-IV	0.3270	0.0133	-	-	0.0308	0.3711
Total	0.8840	0.1023	-	0.2044	0.1849	1.3756
B7-I	0.2547	0.0626	0.0398	-	0.0044	0.3615
B7-II	0.0314	0.0535	0.0207	<0.0001	0.0134	0.1190
B7-III	0.1550	0.0156	0.0468	-	0.0487	0.2661
B7-IV	0.0380	0.0154	>0.0001	-	0.0089	0.0623
Total	0.4791	0.1471	0.1073	-	0.0754	0.8089
B8-I	0.3988	0.0929	0.0186	-	0.0962	0.6065
B8-II	0.0497	0.0287	-	-	0.2734	0.3518
B8-III	1.7960	0.0974	0.0766	-	0.3090	2.2790
B8-IV	0.0240	0.0024	>0.0001	-	>0.0001	0.0264
Total	2.2685	0.2214	0.0952	-	0.6786	3.2637
Grand Total	8.381	0.802	10.961	79.955	1.406	101.505

Note: - = no animals

APPENDIX H

Fish and macroinvertebrate heat treatment and normal operation data

Appendix H-1. Fish and macroinvertebrate heat treatment master species list. El Segundo and Scattergood Generating Stations NPDES, 1999.

PHYLUM Class Family Species	Common Name
CNIDARIA	
Hydrozoa	
Polyorchidae	
Polyorchis penicillatus	penicillate jellyfish (= bell medusa)
Scyphozoa	
Pelagiidae	
Pelagia colorata	purple jellyfish
Pelagiidae, unid	brown jellyfish, unidentified
MOLLUSCA	
Gastropoda	
Aplysiidae	
Aplysia californica	California seahare
Aglajidae	
Navanax inermis	California aglaja (=striped sea hare)
Cephalopoda	
Octopodidae	
Octopus bimaculatus/bimaculoides	California two-spot octopus
CRUSTACEA	
Malacostraca	
Penaeidae	
Farfantepenaeus (=Penaeus) californiensis	California prawn
Hippolytidae	
Heptacarpus palpator	tiger shrimp
Lysmata californica	red striped shrimp
Palinuridae	
Panulirus interruptus	Calfornia spiny lobster
Majidae	
Loxorhynchus grandis	sheep crab
Pugettia producta	northern kelp crab (=shieldbacked kelp crab)
Pyromaia tuberculata	tuberculate pear crab
Cancridae	
Cancer antennarius	Pacific rock crab
Cancer anthonyi	yellow rock crab
Portunidae	
Portunus xantusii	Xantus swimming crab
Gecarcinidae	
Cardisoma crassum	mouthless grab
Grapsidae	
Hemigrapsus nudis	purple shore crab
Pachygrapsus crassipes	striped shore crab
ECHINODERMATA	
Holothuroidea	
Stichopodidae	
Parastichopus sp.	sea cucumber, unid.
UROCHORDATA	
Thaliacea	
Salpidae	
Thetys vagina	common salp
VERTEBRATA	
Elasmobranchiomorphi (= Chondrichthyes, Elasmobranchii)	
Heterodontidae	
Heterodontus francisci	horn shark
Scyliorhinidae	
Cephaloscyllium ventriosum	swell shark
Carcharinidae	
Mustelus henlei	brown smoothhound
Triakis semifasciata	leopard shark
Rhinobatidae	
Platyrhinoidis triseriata	thornback
Rhinobatos productus	shovelnose guitarfish
Myliobatidae	
Myliobatis californica	bat ray
Urolophidae (Dasyatidae, in part)	
Urolophus halleri	round stingray
Osteichthyes (=Actinopterygii)	
Clupeidae	
Sardinops sagax	Pacific sardine

Appendix H-1. (Cont.).

PHYLUM Class Family Species	Common Name
VERTEBRATA cont'd.	
Engraulidae	
Engraulis mordax	northern anchovy
Ophidiidae	
Ophidion scrippsae	basketweave cusk-eel
Batrachoididae	
Porichthys myriaster	specklefin midshipman
Porichthys notatus	plainfin midshipman
Atherinidae	
Atherinops affinis	topsmelt
Atherinopsis californiensis	jacksmelt
Leuresthes tenuis	California grunion
Scorpaenidae	
Scorpaena guttata	California scorpionfish
Sebastes auriculatus	brown rockfish
Sebastes miniatus	vermilion rockfish
Sebastes paucispinis	bocaccio
Hexagrammidae	
Oxylebius pictus	painted greenling
Cottidae	
Scorpaenichthys marmoratus	cabezon
Serranidae	
Paralabrax clathratus	kelp bass
Paralabrax nebulifer	barred sand bass
Haemulidae (=Pomadasyidae)	
Anisotremus davidsonii	sargo
Xenistius californiensis	salema
Sciaenidae	
Atractoscion nobilis	white seabass
Cheilotrema saturnum	black croaker
Genyonemus lineatus	white croaker
Menticirrhus undulatus	California corbina
Seriphus politus	queenfish
Umbrina roncador	yellowfin croaker
Kyphosidae (includes Girellidae and Scorpididae)	
Girella nigricans	opaleye
Hermosilla azurea	zebra perch
Medialuna californiensis	halfmoon
Embiotocidae	
Cymatogaster aggregata	shiner perch
Embiotoca jacksoni	black perch
Hyperprosopon argenteum	walleye surfperch
Phanerodon furcatus	white seaperch
Rhacochilus toxotes	rubberlip seaperch
Rhacochilus (=Damalichthys) vacca	pile perch
Pomacentridae	
Chromis punctipinnis	blacksmith
Hypsypops rubicundus	garibaldi
Labridae	
Halichoeres semicinctus	rock wrasse
Oxyjulis californica	senorita
Clinidae	
Gibbonsia elegans	spotted kelpfish
Heterostichus rostratus	giant kelpfish
Blenniidae	
Hypsoblennius gilberti	rockpool blenny
Scombridae	
Scomber japonicus	chub mackerel
Stromateidae	
Peprilus simillimus	Pacific butterfish
Bothidae (=Paralichthyidae)	
Citharichthys stigmaeus	speckled sanddab
Paralichthys californicus	California halibut
Pleuronectidae	
Hypsopsetta guttulata	diamond turbot
Pleuronichthys ritteri	spotted turbot
Pleuronichthys verticalis	hornyhead turbot
Balistidae	
Balistes polylepis	finescale triggerfish

Appendix H-2. Abundance, biomass (kg), and percent occurence of fish impinged at El Segundo and Scattergood Generating Stations. El Segundo and Scattergood Generating Stations NPDES, 1999.

Species	Scattergood		El Segundo		Total
	No.	Wt. (kg)	No.	Wt. (kg)	Abundance
Atherinops affinis	24093	750.490	8	0.120	24101
Seriphus politus	4258	111.928	-	-	4258
Atherinopsis californiensis	3901	185.330	12	0.800	3913
Sardinops sagax	3261	119.007	250	11.180	3511
Umbrina roncador	2554	813.275	51	11.444	2605
Engraulis mordax	1661	7.271	-	-	1661
Xenistius californiensis	149	6.320	203	9.756	352
Anisotremus davidsonii	35	18.165	311	179.154	346
Paralabrax nebulifer	300	117.590	21	11.162	321
Paralabrax clathratus	50	9.166	151	58.767	201
Cheilotrema saturnum	51	9.443	120	28.534	171
Sebastes paucispinis	126	1.294	-	-	126
Genyonemus lineatus	78	4.745	-	-	78
Porichthys notatus	8	0.909	58	3.307	66
Chromis punctipinnis	29	2.518	14	0.932	43
Embiotoca jacksoni	17	3.020	18	8.287	35
Menticirrhus undulatus	33	7.432	2	1.333	35
Heterostichus rostratus	6	0.121	27	0.764	33
Urolophus halleri	25	16.220	-	-	25
Rhacochilus toxotes	9	4.846	14	7.216	23
Rhacochilus vacca	3	1.421	15	7.633	18
Sebastes miniatus	17	0.049	-	-	17
Myliobatis californica	15	34.730	1	7.000	16
Scomber japonicus	-	-	15	1.006	15
Scorpaenichthys marmoratus	14	0.342	-	-	14
Hypsoblennius gilberti	3	0.006	10	0.040	13
Medialuna californiensis	1	0.129	12	5.050	13
Atractoscion nobilis	9	5.376	1	0.799	10
Leuresthes tenuis	10	0.134	-	-	10
Paralichthys californicus	10	9.693	-	-	10
Scorpaena guttata	7	0.260	3	0.678	10
Cymatogaster aggregata	9	0.441	-	-	9
Halichoeres semicinctus	8	1.264	-	-	8
Phanerodon furcatus	1	0.100	7	1.698	8
Pleuronichthys ritteri	8	0.632	-	-	8
Triakis semifasciata	6	41.300	1	8.000	7
Oxyjulis californica	6	0.464	-	-	6
Citharichthys stigmaeus	4	0.017	-	-	4
Girella nigricans	4	3.658	-	-	4
Oxylebius pictus	4	0.025	-	-	4
Rhinobatos productus	3	20.990	1	4.500	4
Hypsopsetta guttulata	3	0.482	-	-	3
Porichthys myriaster	3	0.865	-	-	3
Gibbonsia elegans	2	0.029	-	-	2
Hermosilla azurea	1	0.538	1	0.478	2
Heterodontus francisci	1	3.000	1	5.520	2
Balistes polylepis	-	-	1	2.000	1
Cephaloscyllium ventriosum	-	-	1	2.500	1
Hyperprosopon argenteum	1	0.079	-	-	1
Hypsypops rubicundus	1	0.098	-	-	1
Mustelus henlei	1	1.850	-	-	1
Ophidion scrippsae	1	0.007	-	-	1
Peprillus simillimus	1	0.058	-	-	1
Platyrhinoidis triseriata	1	0.233	-	-	1
Pleuronichthys verticalis	1	0.071	-	-	1
Sebastes auriculatus	1	0.421	-	-	1
Survey totals	40804	2317.852	1330	379.658	42133.66543
Number of species	53		29		56

Note: 0.00 < 0.005

Appendix H-3. Abundance, biomass (kg), and percent occurence of fish impinged at El Segundo Generating Station Units 1 & 2 and 3 & 4. El Segundo and Scattergood Generating Stations NPDES,

Species	Units 1 & 2		Units 3 & 4		Total		% Comp.	
	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass
Anisotremus davidsonii	1	0.134	310	179.020	311	179.154	23.4	47.2
Sardinops sagax	-	-	250	11.180	250	11.180	18.8	2.9
Xenistius californiensis	24	1.678	179	8.078	203	9.756	15.2	2.6
Paralabrax clathratus	25	8.357	126	50.410	151	58.767	11.4	15.5
Cheilotrema saturnum	33	6.774	87	21.760	120	28.534	9.0	7.5
Porichthys notatus	31	1.588	27	1.719	58	3.307	4.3	0.9
Umbrina roncador	21	3.588	30	7.856	51	11.444	3.8	3.0
Heterostichus rostratus	-	-	27	0.764	27	0.764	2.1	0.2
Paralabrax nebulifer	5	4.070	16	7.092	21	11.162	1.6	2.9
Embiotoca jacksoni	4	1.969	14	6.318	18	8.287	1.4	2.2
Rhacochilus vacca	1	0.843	14	6.790	15	7.633	1.1	2.0
Scomber japonicus	-	-	15	1.006	15	1.006	1.1	0.3
Chromis punctipinnis	1	0.104	13	0.828	14	0.932	1.1	0.2
Rhacochilus toxotes	2	0.596	12	6.620	14	7.216	1.1	1.9
Atherinopsis californiensis	-	-	12	0.800	12	0.800	0.9	0.2
Medialuna californiensis	-	-	12	5.050	12	5.050	0.9	1.3
Hypsoblennius gilberti	-	-	10	0.040	10	0.040	0.8	0.0
Atherinops affinis	8	0.120	-	-	8	0.120	0.6	0.0
Phanerodon furcatus	7	1.698	-	-	7	1.698	0.5	0.4
Scorpaena guttata	-	-	3	0.678	3	0.678	0.2	0.2
Menticirrhus undulatus	-	-	2	1.333	2	1.333	0.2	0.4
Atractoscion nobilis	-	-	1	0.799	1	0.799	0.1	0.2
Balistes polylepis	1	2.000	-	-	1	2.000	0.1	0.5
Cephaloscyllium ventriosum	-	-	1	2.500	1	2.500	0.1	0.7
Hermosilla azurea	1	0.478	-	-	1	0.478	0.1	0.1
Heterodontus francisci	-	-	1	5.520	1	5.520	0.1	1.5
Myliobatis californica	1	7.000	-	-	1	7.000	0.1	1.8
Rhinobatos productus	-	-	1	4.500	1	4.500	0.1	1.2
Triakis semifasciata	-	-	1	8.000	1	8.000	0.1	2.1
Survey totals	166	40.997	1164	338.661	1330	379.658		
Number of species	16		24		29			

Units 1 & 2 extrapolation based on flow data, using a multiplier (30.54) based on the number of sample days and monthly flow information.

Units 3 & 4 extrapolation based on flow data, using a multiplier (27.28) based on the number of sample days and monthly flow information.

Appendix H-4. Abundance of fish impinged during heat treatments by date at El Segundo Generating Station, Units 1 & 2 and 3 & 4. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Units 1 & 2			Units 3 & 4	Total
	31 Oct 98	28 Sep 99	Total	29 Oct 98	Abundance
Anisotremus davidsonii	-	1	1	310	311
Sardinops sagax	-	-	-	250	250
Paralabrax clathratus	-	25	25	126	151
Xenistius californiensis	-	24	24	124	148
Cheilotrema saturnum	-	33	33	87	120
Umbrina roncador	-	21	21	30	51
Paralabrax nebulifer	-	5	5	16	21
Embiotoca jacksoni	2	2	4	14	18
Rhacochilus vacca	1	1	2	14	16
Scomber japonicus	-	-	-	15	15
Chromis punctipinnis	-	1	1	13	14
Rhacochilus toxotes	1	-	1	12	13
Atherinopsis californiensis	-	-	-	12	12
Medialuna californiensis	-	-	-	12	12
Hypsoblennius gilberti	-	-	-	10	10
Atherinops affinis	-	8	8	-	8
Phanerodon furcatus	-	7	7	-	7
Scorpaena guttata	-	-	-	3	3
Menticirrhus undulatus	-	-	-	2	2
Atractoscion nobilis	-	-	-	1	1
Balistes polylepis	-	1	1	-	1
Hermosilla azurea	-	1	1	-	1
Heterodontus francisci	-	-	-	1	1
Myliobatis californica	-	1	1	-	1
Rhinobatos productus	-	-	-	1	1
Triakis semifasciata	-	-	-	1	1
Number of individuals	4	131	135	1054	1189
Number of species	3	14	15	21	26

Appendix H-5. Abundance of fish impinged during heat treatments by date at Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1999.

	1998		1999					Total
Species	29 Oct	3 Dec	21 Jan	16 Mar	6 May	23 Jun	12 Aug	Abundance
Atherinops affinis	27	-	-	275	-	19895	3896	24093
Seriphus politus	2	8	167	609	3243	222	7	4258
Atherinopsis californiensis	11	-	-	71	3789	30	-	3901
Sardinops sagax	221	-	1	9	1	2	3027	3261
Umbrina roncador	-	-	-	-	-	7	2547	2554
Engraulis mordax	2	-	906	22	105	626	-	1661
Paralabrax nebulifer	35	-	-	93	62	63	47	300
Xenistius californiensis	42	3	-	3	10	58	33	149
Sebastes paucispinis	-	-	-	11	95	20	-	126
Genyonemus lineatus	-	-	2	25	51	-	-	78
Cheilotrema saturnum	16	-	1	2	3	11	18	51
Paralabrax clathratus	24	-	-	1	4	13	8	50
Anisotremus davidsonii	18	-	-	-	-	1	16	35
Menticirrhus undulatus	-	-	-	5	15	-	13	33
Chromis punctipinnis	8	-	-	3	2	13	3	29
Urolophus halleri	-	-	-	1	3	15	6	25
Embiotoca jacksoni	-	-	-	2	1	14	-	17
Sebastes miniatus	-	-	-	-	17	-	-	17
Myliobatis californica	-	-	-	-	7	2	6	15
Scorpaenichthys marmoratus	-	-	-	5	2	7	-	14
Leuresthes tenuis	-	-	-	10	-	-	-	10
Paralichthys californicus	-	-	-	2	5	2	1	10
Atractoscion nobilis	-	-	-	4	1	-	4	9
Cymatogaster aggregata	-	-	-	-	9	-	-	9
Rhacochilus toxotes	2	-	-	1	1	4	1	9
Halichoeres semicinctus	-	-	-	-	1	4	3	8
Pleuronichthys ritteri	-	-	-	1	7	-	-	8
Porichthys notatus	-	-	-	-	5	3	-	8
Scorpaena guttata	-	-	1	3	-	1	2	7
Heterostichus rostratus	-	-	1	1	3	1	-	6
Oxyjulis californica	-	-	-	-	1	1	4	6
Triakis semifasciata	1	-	-	1	1	2	1	6
Citharichthys stigmaeus	-	1	3	-	-	-	-	4
Girella nigricans	-	-	-	1	-	-	3	4
Oxylebius pictus	-	-	-	1	3	-	-	4
Damalichthys vacca	-	-	-	-	-	2	1	3
Hypsoblennius gilberti	2	-	-	1	-	-	-	3
Hypsopsetta guttulata	-	-	-	-	3	-	-	3
Porichthys myriaster	-	-	-	-	1	2	-	3
Rhinobatos productus	-	-	-	1	1	-	1	3
Gibbonsia elegans	-	-	-	-	-	2	-	2
Hermosilla azurea	-	-	-	-	-	-	1	1
Heterodontus francisci	-	-	-	-	-	1	-	1
Hyperprosopon argenteum	-	-	-	-	-	1	-	1
Hypsypops rubicundus	1	-	-	-	-	-	-	1
Medialuna californiensis	-	-	-	-	-	1	-	1
Mustelus henlei	-	-	-	-	-	1	-	1
Ophidion scrippsae	-	-	-	-	1	-	-	1
Peprilus semillimus	-	-	-	-	1	-	-	1
Phanerodon furcatus	-	-	-	-	-	1	-	1
Platyrhinoidis triseriata	-	-	-	1	-	-	-	1
Pleuronichthys verticalis	-	-	-	-	1	-	-	1
Sebastes auriculatus	1	-	-	-	-	-	-	1
Number of individuals	413	12	1082	1165	7455	21028	9649	40804
Number of species	16	3	8	29	34	33	24	53

Appendix H-6. Biomass of fish impinged during heat treatments by date at El Segundo Generating Station, Units 1 & 2 and 3 & 4. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Units 1 & 2			Units 3 & 4	Total
	31 Oct 98	28 Sep 99	Total	29 Oct 98	Biomass
Anisotremus davidsonii	-	0.134	0.134	179.020	179.154
Paralabrax clathratus	-	8.357	8.357	50.410	58.767
Cheilotrema saturnum	-	6.774	6.774	21.760	28.534
Umbrina roncador	-	3.588	3.588	7.856	11.444
Sardinops sagax	-	-	-	11.180	11.180
Paralabrax nebulifer	-	4.070	4.070	7.092	11.162
Xenistius californiensis	-	1.678	1.678	7.260	8.938
Triakis semifasciata	-	-	-	8.000	8.000
Rhacochilus vacca	0.515	0.328	0.843	6.790	7.633
Embiotoca jacksoni	-	1.274	1.274	6.318	7.592
Rhacochilus toxotes	0.596	-	0.596	6.620	7.216
Myliobatis californica	-	7.000	7.000	-	7.000
Heterodontus francisci	-		-	5.520	5.520
Medialuna californiensis	-	-	-	5.050	5.050
Rhinobatos productus	-	-	-	4.500	4.500
Balistes polylepis	-	2.000	2.000	-	2.000
Phanerodon furcatus	-	1.698	1.698	-	1.698
Menticirrhus undulatus	-	-	-	1.333	1.333
Hermosilla azurea	0.695	0.478	1.173	-	1.173
Scomber japonicus	-		-	1.006	1.006
Chromis punctipinnis	-	0.104	0.104	0.828	0.932
Atherinopsis californiensis	-	-	-	0.800	0.800
Atractoscion nobilis	-	-	-	0.799	0.799
Scorpaena guttata	-	-	-	0.678	0.678
Atherinops affinis	-	0.120	0.120	-	0.120
Hypsoblennius gilberti	-	-	-	0.040	0.040
Biomass	1.806	37.603	39.409	332.860	372.269
Number of species	3	14	15	21	26

Appendix H-7. Biomass (kg) of fish impinged during heat treatments by date at Scattergood Generating Statio El Segundo and Scattergood Generating Stations NPDES, 1999.

	1998		1999					Total
Species	29 Oct	3 Dec	21 Jan	16 Mar	6 May	23 Jun	12 Aug	Biomass
Umbrina roncador	-	-	-	-	-	1.035	812.240	813.275
Atherinops affinis	1.440	-	-	9.860	-	617.450	121.740	750.490
Atherinopsis californiensis	1.470	-	-	6.950	175.650	1.260	-	185.330
Sardinops sagax	7.610	-	0.013	0.171	0.031	0.082	111.100	119.007
Paralabrax nebulifer	15.200	-	-	42.170	27.570	18.650	14.000	117.590
Seriphus politus	0.009	0.031	0.355	15.530	87.540	8.210	0.253	111.928
Triakis semifasciata	8.000	-	-	6.000	10.000	10.300	7.000	41.300
Myliobatis californica	-	-	-	-	13.430	10.600	10.700	34.730
Rhinobatos productus	-	-	-	6.000	5.000	-	9.990	20.990
Anisotremus davidsonii	5.680	-	-	-	-	0.175	12.310	18.165
Urolophus halleri	-	-	-	0.630	2.720	9.520	3.350	16.220
Paralichthys californicus	-	-	-	0.372	0.171	3.650	5.500	9.693
Cheilotrema saturnum	2.660	-	0.146	0.600	0.587	3.050	2.400	9.443
Paralabrax clathratus	2.060	-	-	0.007	0.649	5.350	1.100	9.166
Menticirrhus undulatus	-	-	-	0.961	2.161	-	4.310	7.432
Engraulis mordax	0.006	-	0.766	0.119	1.020	5.360	-	7.271
Xenistius californiensis	0.920	0.050	-	0.015	0.235	3.100	2.000	6.320
Atractoscion nobilis	-	-	-	0.540	0.336	-	4.500	5.376
Rhacochilus toxotes	1.390	-	-	0.150	0.242	2.780	0.284	4.846
Genyonemus lineatus	-	-	0.113	1.790	2.842	-	-	4.745
Girella nigricans	-	-	-	0.758	-	-	2.900	3.658
Embiotoca jacksoni	-	-	-	0.557	0.563	1.900	-	3.020
Heterodontus francisci	-	-	-	-	-	3.000	-	3.000
Chromis punctipinnis	0.014	-	-	0.310	0.109	1.850	0.235	2.518
Mustelus henlei	-	-	-	-	-	1.850	-	1.850
Damalichthys vacca	-	-	-	-	-	0.950	0.471	1.421
Sebastes paucispinis	-	-	-	0.029	1.120	0.145	-	1.294
Halichoeres semicinctus	-	-	-	-	0.160	0.556	0.548	1.264
Porichthys notatus	-	-	-	-	0.609	0.3	-	0.909
Porichthys myriaster	-	-	-	-	0.265	0.600	-	0.865
Pleuronichthys ritteri	-	-	-	0.089	0.543	-	-	0.632
Hermosilla azurea	-	-	-	-	-	-	0.538	0.538
Hypsopsetta guttulata	-	-	-	-	0.482	-	-	0.482
Oxyjulis californica	-	-	-	-	0.108	0.040	0.316	0.464
Cymatogaster aggregata	-	-	-	-	0.441	-	-	0.441
Sebastes auriculatus	0.421	-	-	-	-	-	-	0.421
Scorpaenichthys marmoratus	-	-	-	0.019	0.021	0.302	-	0.342
Scorpaena guttata	-	-	0.002	0.009	-	0.050	0.199	0.260
Platyrhinoidis triseriata	-	-	-	0.233	-	-	-	0.233
Leuresthes tenuis	-	-	-	0.134	-	-	-	0.134
Medialuna californiensis	-	-	-	-	-	0.129	-	0.129
Heterostichus rostratus	-	-	0.001	0.008	0.080	0.032	-	0.121
Phanerodon furcatus	-	-	-	-	-	0.100	-	0.100
Hypsypops rubicundus	0.098	-	-	-	-	-	-	0.098
Hyperprosopon argenteum	-	-	-	-	-	0.079	-	0.079
Pleuronichthys verticalis	-	-	-	-	0.071	-	-	0.071
Peprilus semillimus	-	-	-	-	0.058	-	-	0.058
Sebastes miniatus	-	-	-	-	0.049	-	-	0.049
Gibbonsia elegans	-	-	-	-	-	0.029	-	0.029
Oxylebius pictus	-	-	-	0.003	0.022	-	-	0.025
Citharichthys stigmaeus	-	0.009	0.008	-	-	-	-	0.017
Ophidion scrippsae	-	-	-	-	0.007	-	-	0.007
Hypsoblennius gilberti	0.002	-	-	0.004	-	-	-	0.006
Biomass	46.980	0.090	1.404	94.018	334.892	712.484	1127.984	2317.852

Appendix H-8. Abundance of fish impinged during heat treatments and normal operations at El Segundo Generating Station, Units 1 & 2. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Units 1 & 2 Heat Treatment		Units 1 & 2 Monitored NO		Units 1 & 2 Extrapolated NO		Units 1 & 2 Combined NO and HT	
	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass
Cheilotrema saturnum	33	6.774	-	-	-	-	33	6.774
Porichthys notatus	-	-	1	0.052	31	1.588	31	1.588
Paralabrax clathratus	25	8.357	-	-	-	-	25	8.357
Xenistius californiensis	24	1.678	-	-	-	-	24	1.678
Umbrina roncador	21	3.588	-	-	-	-	21	3.588
Atherinops affinis	8	0.120	-	-	-	-	8	0.120
Phanerodon furcatus	7	1.698	-	-	-	-	7	1.698
Paralabrax nebulifer	5	4.070	-	-	-	-	5	4.070
Embiotoca jacksoni	4	1.969	-	-	-	-	4	1.969
Rhacochilus vacca	2	0.843	-	-	-	-	2	0.843
Anisotremus davidsonii	1	0.134	-	-	-	-	1	0.134
Balistes polylepis	1	2.000	-	-	-	-	1	2.000
Chromis punctipinnis	1	0.104	-	-	-	-	1	0.104
Hermosilla azurea	1	0.478	-	-	-	-	1	0.478
Myliobatis californica	1	7.000	-	-	-	-	1	7.000
Rhacochilus toxotes	1	0.596	-	-	-	-	1	0.596
Survey totals	135	39.409	1	0.052	31	1.588	166	40.997
Number of species	15		1		1		16	

Extrapolation based on flow data, using a multiplier (30.54) based on 11 sample days and monthly flow information.

Appendix H-9. Abundance of fish impinged during heat treatments and normal operations at El Segundo Generating Station, Units 3 & 4. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Units 3 & 4 Heat Treatment		Units 3 & 4 Monitored NO		Units 3 & 4 Extrapolated NO		Units 3 & 4 Combined NO and HT	
	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass
Anisotremus davidsonii	310	179.020	-	-	-	-	310	179.020
Sardinops sagax	250	11.180	-	-	-	-	250	11.180
Xenistius californiensis	124	7.260	2	0.030	55	0.818	179	8.078
Paralabrax clathratus	126	50.410	-	-	-	-	126	50.410
Cheilotrema saturnum	87	21.760	-	-	-	-	87	21.760
Umbrina roncador	30	7.856	-	-	-	-	30	7.856
Heterostichus rostratus	-	-	1	0.028	27	0.764	27	0.764
Porichthys notatus	-	-	1	0.063	27	1.719	27	1.719
Paralabrax nebulifer	16	7.092	-	-	-	-	16	7.092
Scomber japonicus	15	1.006	-	-	-	-	15	1.006
Embiotoca jacksoni	14	6.318	-	-	-	-	14	6.318
Rhacochilus vacca	14	6.790	-	-	-	-	14	6.790
Chromis punctipinnis	13	0.828	-	-	-	-	13	0.828
Atherinopsis californiensis	12	0.800	-	-	-	-	12	0.800
Medialuna californiensis	12	5.050	-	-	-	-	12	5.050
Rhacochilus toxotes	12	6.620	-	-	-	-	12	6.620
Hypsoblennius gilberti	10	0.040	-	-	-	-	10	0.040
Scorpaena guttata	3	0.678	-	-	-	-	3	0.678
Menticirrhus undulatus	2	1.333	-	-	-	-	2	1.333
Atractoscion nobilis	1	0.799	-	-	-	-	1	0.799
Cephaloscyllium ventriosum	-	-	1	2.500	1	2.500	1	2.500
Heterodontus francisci	1	5.520	-	-	-	-	1	5.520
Rhinobatos productus	1	4.500	-	-	-	-	1	4.500
Triakis semifasciata	1	8.000	-	-	-	-	1	8.000
Survey totals	1054	332.860	5	2.621	110	5.801	1164	338.661
Number of species	21		4		4		24	

Extrapolation based on flow data, using a multiplier (27.28) based on 11 sample days and monthly flow information.

Appendix H-10. Abundance, biomass (kg), and percent occurence of macroinvertebrates impinged at El Segundo and Scattergood Generating Stations. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Scattergood		El Segundo		Total	Percent	Cumulative	Total
Species	Abund.	Biomass	Abund.	Biomass	Abundance	Total	Percent	Biomass
Cancer antennarius	11	0.111	28492	2637.639	28503	75.65	75.65	2637.750
Thetys vagina	-	-	6096	274.500	6096	16.18	16.18	274.500
Cancer anthonyi	56	0.158	1236	33.434	1292	3.43	3.43	33.592
Lysmata californica	678	0.784	10	0.022	688	1.83	1.83	0.806
Pyromaia tuberculata	305	0.252	18	0.056	323	0.86	0.86	0.308
Panulirus interruptus	194	91.000	93	34.700	287	0.76	0.76	125.700
Octopus bimaculatus/bimaculoides	155	16.981	37	41.986	192	0.51	0.51	58.967
Heptacarpus palpator	81	0.046	10	0.015	91	0.24	0.24	0.061
Navanax inermis	13	0.042	58	0.206	71	0.19	0.19	0.248
Portunus xantusii	34	0.214	27	0.491	61	0.16	0.16	0.705
Polyorchis penicillata	14	0.091	31	15.270	45	0.12	0.12	15.361
Pachygrapsus crassipes	4	0.038	4	0.010	8	0.02	0.02	0.048
Hemigrapsus nudis	7	0.006	-	-	7	0.02	0.02	0.006
Pugettia producta	4	0.052	-	-	4	0.01	0.01	0.052
Aplysia californica	2	0.003	-	-	2	0.01	0.01	0.003
Loxorhynchus grandis	2	1.083	-	-	2	0.01	0.01	1.083
Cardisoma crassum	1	0.035	-	-	1	0.00	0.00	0.035
Parastichopus sp.	-	-	1	0.068	1	0.00	0.00	0.068
Pelagia colorata	1	0.559	-	-	1	0.00	0.00	0.559
Pelagiidae	1	0.800	-	-	1	0.00	0.00	0.800
Penaeus californiensis	-	-	1	0.023	1	0.00	0.00	0.023
Survey totals	1563	112.255	36113	3038.420	37676			3150.675
Number of species	18		14		21			

Note: 0.00 < 0.005

Appendix H-11. Abundance, biomass (kg), and percent occurence of macroinvertebrates impinged at El Segundo Generating Station, Units 1 & 2 and 3 & 4. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Units 1 & 2		Units 3 & 4		Total		% Comp.	
Species	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass
Cancer antennarius	338	50.094	28154	2587.545	28492	2637.639	78.90	86.81
Thetys vagina	-	-	6096	274.500	6096	274.500	16.88	9.03
Cancer anthonyi	-	-	1236	33.434	1236	33.434	3.42	1.10
Panulirus interruptus	10	5.420	83	29.280	93	34.700	0.26	1.14
Navanax inermis	-	-	58	0.206	58	0.206	0.16	0.01
Octopus bimaculatus/bimaculoides	-	-	37	41.986	37	41.986	0.10	1.38
Polyorchis penicillata	31	15.270	-	-	31	15.270	0.08	0.50
Portunus xantusii	-	-	27	0.491	27	0.491	0.08	0.02
Pyromaia tuberculata	-	-	18	0.056	18	0.056	0.05	0.00
Heptacarpus palpator	-	-	10	0.015	10	0.015	0.03	0.00
Lysmata californica	10	0.022	-	-	10	0.022	0.03	0.00
Pachygrapsus crassipes	4	0.010	-	-	4	0.010	0.01	0.00
Parastichopus sp.	1	0.068	-	-	1	0.068	0.00	0.00
Penaeus californiensis	-	-	1	0.023	1	0.023	0.00	0.00
Survey totals	393	70.884	35720	2967.536	36113	3038.420		
Number of species	6		10		14			

Note: 0.00 < 0.005

Appendix H-12. Abundance and biomass (kg) of macroinvertebrates impinged in heat treatments (HT) and normal operations (NO) at El Segundo Generating Station, Units 1 & 2. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Units 1 & 2 Heat Treatment		Units 1 & 2 Monitored NO		Units 1 & 2 Extrapolated NO		Units 1 & 2 Combined NO and HT	
Species	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass
Cancer antennarius	2	0.008	11	1.640	336	50.086	338	50.094
Polyorchis penicillata	-	-	1	0.500	31	15.270	31	15.270
Lysmata californica	10	0.022	-	-	-	-	10	0.022
Panulirus interruptus	10	5.420	-	-	-	-	10	5.420
Pachygrapsus crassipes	4	0.010	-	-	-	-	4	0.010
Parastichopus sp.	1	0.068	-	-	-	-	1	0.068
Survey totals	27	5.528	12	2.140	366	65.356	393	70.884
Number of species	5		2				6	

Extrapolation based on flow data, using a multiplier (30.54) based on the number of sample days and monthly flow information.

Appendix H-13. Abundance and biomass (kg) of macroinvertebrates impinged in heat treatments (HT) and normal operations (NO) at El Segundo Generating Station, Units 3 & 4. El Segundo and Scattergood Generating Stations NPDES, 1999.

	Units 3 & 4 Heat Treatment		Units 3 & 4 Monitored NO		Units 3 & 4 Extrapolated NO		Units 3 & 4 Combined NO and HT	
Species	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass	Abundance	Biomass
Cancer antennarius	1	0.037	1032	94.850	28153	2587.508	28154	2587.545
Thetys vagina	-	-	2032	91.500	6096	274.500	6096	274.500
Cancer anthonyi	1127	25.250	4	0.300	109	8.184	1236	33.434
Panulirus interruptus	28	15.640	2	0.500	55	13.640	83	29.280
Navanax inermis	3	0.015	2	0.007	55	0.191	58	0.206
Octopus bimaculatus/bimaculoides	10	9.250	1	1.200	27	32.736	37	41.986
Portunus xantusii	-	-	1	0.018	27	0.491	27	0.491
Pyromaia tuberculata	18	0.056	-	-	-	-	18	0.056
Heptacarpus palpator	10	0.015	-	-	-	-	10	0.015
Penaeus californiensis	1	0.023	-	-	-	-	1	0.023
Survey totals	1198	50.286	3074	188.375	34522	2917.250	35720	2967.536
Number of species	8		7				10	

Extrapolation based on flow data, using a multiplier (27.28) based on the number of sample days and monthly flow information.

Appendix H-14. Abundance of macroinvertebrates impinged during heat treatments by date at Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1999.

Species	1998		1999					Total
	29 Oct	3 Dec	21 Jan	16 Mar	6 May	23 Jun	12 Aug	Abundance
Lysmata californica	21	-	-	6	60	150	441	678
Pyromaia tuberculata	5	-	-	-	-	-	300	305
Panulirus interruptus	15	-	-	33	34	57	55	194
Octopus bimaculatus/bimaculoides	4	1	1	38	47	57	7	155
Heptacarpus palpator	8	-	4	51	12	-	6	81
Cancer anthonyi	1	-	1	1	2	1	50	56
Portunus xantusii	3	-	4	2	14	1	10	34
Polyorchis penicillatus	-	-	8	2	4	-	-	14
Navanax inermis	11	-	-	1	1	-	-	13
Cancer antennarius	-	-	-	8	-	-	3	11
Hemigrapsus nudis	-	-	-	7	-	-	-	7
Pachygrapsus crassipes	2	1	-	-	-	-	1	4
Pugettia producta	-	-	-	2	1	1	-	4
Aplysia californica	2	-	-	-	-	-	-	2
Loxorhynchus grandis	-	-	-	-	1	1	-	2
Cardisoma crassum	-	-	-	-	-	1	-	1
Pelagia colorata	-	-	-	-	1	-	-	1
Pelagiidae	-	-	-	-	-	-	1	1
Number of individuals	72	2	18	151	177	269	874	1563
Number of species	10	2	5	11	11	8	10	18

Appendix H-15. Biomass of macroinvertebrates impinged during heat treatments by date at Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1999.

Species	1998		1999					Total
	29 Oct	3 Dec	21 Jan	16 Mar	6 May	23 Jun	12 Aug	Biomass
Panulirus interruptus	9.110	-	-	13.900	15.320	23.370	29.300	91.000
Octopus bimaculatus/bimaculoides	2.650	0.461	0.347	8.300	1.790	3.200	0.233	16.981
Loxorhynchus grandis	-	-	-	-	0.623	0.460	-	1.083
Scyphozoa	-	-	-	-	-	-	0.800	0.800
Lysmata californica	0.012	-	-	0.004	0.037	0.440	0.291	0.784
Pelagia colorata	-	-	-	-	0.559	-	-	0.559
Pyromaia tuberculata	0.002	-	-	-	-	-	0.250	0.252
Portunus xantusii	0.004	-	0.009	0.005	0.101	0.005	0.090	0.214
Cancer anthonyi	0.003	-	0.003	0.004	0.021	0.005	0.122	0.158
Cancer antennarius	-	-	-	0.023	-	-	0.088	0.111
Polyorchis penicillatus	-	-	0.050	0.009	0.032	-	-	0.091
Pugettia producta	-	-	-	0.022	0.015	0.015	-	0.052
Heptacarpus palpator	0.001	-	0.001	0.033	0.007	-	0.004	0.046
Navanax inermis	0.037	-	-	0.001	0.004	-	-	0.042
Pachygrapsus crassipes	0.021	0.010	-	-	-	-	0.007	0.038
Cardisoma crassum	-	-	-	-	-	0.035	-	0.035
Hemigrapsus nudis	-	-	-	0.006	-	-	-	0.006
Aplysia californica	0.003	-	-	-	-	-	-	0.003
Total biomass	11.843	0.471	0.410	22.307	18.509	27.530	31.185	112.255