ATTACHMENT 3

NPDES 1997 Receiving Water Monitoring Reports for El Segundo and Scattergood Generating Stations. Los Angeles County, California. Prepared by MBC Applied Environmental Sciences

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97-EA-03

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
1997 RECEIVING WATER MONITORING REPORT
EL SEGUNDO AND SCATTERGOOD GENERATING STATIONS
LOS ANGELES COUNTY, CALIFORNIA

1997 Survey

Prepared for:

Southern California Edison Company
and Los Angeles Department of Water and Power

Prepared by:

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

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PROJECT STAFF

Department of Water and Power
City of Los Angeles

S. M. Damron
F. Mofidi

MBC *Applied Environmental Sciences*

Project Manager

M. D. Curtis

Marine Scientists

M. D. Curtis
R. H. Moore
A. K. Morris
C. L. Paquette
D. G. Vilas

Technicians

T. M. Bullard
S. E. Finck

Project Coordinator

K. L. Mitchell

Editor

C. L. Paquette
P. J. Amberg

Word Processing

R. A. Moore

Outside Consultants

Conshelf Services, Inc.

C. T. Mitchell

Entrix

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EXECUTIVE SUMMARY

WATER QUALITY MONITORING

Water quality parameters indicate that the cooling water discharged from the El Segundo and Scattergood Generating Stations did not have an adverse effect on waters in the study area. No abnormally high temperature values were recorded at any of the stations. Dissolved oxygen concentrations increased to a small degree with depth during the summer, while winter values were more erratic, but well within the normal range. Hydrogen ion concentrations (pH) were within the normal range, though winter measurements fluctuated slightly.

SEDIMENT MONITORING

Sediment Grain Size

Sediments in the study area were, on average, 91% sand, with a mean grain size of 3.30 phi (very fine sand). Generally, sediments were finer and better sorted offshore than nearshore. This pattern is attributable to the greater turbulence nearshore. No patterns were apparent relative to the discharges. Sediments were slightly finer than the average for past surveys, but were similar to those in 1991, 1993, and 1994.

Sediment Chemistry

Sediment levels of chromium, copper, nickel, and zinc were similar to those found in surveys since 1990. Higher metal levels found at upcoast Stations B1, B2, and B5 are probably due to the higher percentages of fine materials in the sediments. Since sediment metal concentrations have not been consistently highest near the generating station discharges, it does not appear that the discharges have an appreciable effect on the metal levels in the area.

BIOLOGICAL MONITORING

Infauna

The benthic infaunal community in the study area was similar to that of previous years. Species richness averaged 51 species per station, which was above the average from 1990 to 1994. Abundance averaged 189 individuals per station (4,725 individuals/m^2), which was slightly below the average. Polychaete annelids were the most abundant organisms. In general, abundance and species richness were greater offshore than nearshore, with highest values at Station B5, furthest upcoast, where sediments were finest. No pattern related to the generating station outfalls was noted.

Fish and Macroinvertebrates

In 1997, there were minor differences in species of fish and macroinvertebrates impinged between El Segundo Generating Station (ESGS) and Scattergood Generating Station (SGS), but abundances of both were higher at ESGS. All of the species common to both ESGS and SGS are typical in the habitat offshore; all of the species taken at only one generating station in 1997 have been found at both generating stations in past years. The occurrence of these species throughout the Southern California Bight and continued abundance and high species diversity at both generating stations indicate that ESGS and SGS are not having an unduly adverse impact on the diverse fish and macroinvertebrate populations surrounding the offshore discharge and intakes.

CONCLUSION

The results of the physical and biological monitoring in 1997 indicated that the El Segundo and Scattergood Generating Stations had no perceivable effects upon the beneficial uses of the receiving waters.

INTRODUCTION

This report presents and discusses the results of the winter and summer 1997 receiving water monitoring studies conducted at El Segundo and Scattergood Generating Stations (ESGS/SGS). Winter sampling consisted of water quality profiles only which were conducted by Entrix. Summer sampling consisted of water quality profiles conducted by Entrix and biological and sediment chemistry sampling conducted by MBC Applied Environmental Sciences (MBC). All data were analyzed, interpreted, and reported by MBC for the Southern California Edison Company's (SCE) El Segundo and the Los Angeles Department of Water and Power's (LADWP) Scattergood Generating Stations. Physical oceanographic and biological studies were conducted to determine if the beneficial uses of the receiving water in and around the El Segundo and Scattergood Generating Stations discharges are being protected.

The results of the present surveys are compared to those of thermal effect studies done for ESGS in 1971-1972 (Lockheed Aircraft Service Company 1973) and National Pollutant Discharge Elimination System (NPDES) surveys conducted for SGS and ESGS in 1978, 1980, 1986, 1988, and 1990 by Lockheed Center for Marine Research and Intersea Research Corporation (1979), Intersea Research Corporation (1981), and Occidental College, Vantuna Research Group (1987, 1989, 1990), and MBC (1991a - 1993a, 1994, 1995, and 1996).

Specifications for the studies are described by the California Regional Water Quality Control Board, Los Angeles Region, in the Monitoring and Reporting Program portion of NPDES Permit Nos. CA0001147 (ESGS) and CA0000370 (SGS), as adopted on 5 December 1994 for ESGS and 27 February 1995 for SGS. Relevant portions of the Permit are presented in Appendix A.

In letters to LADWP and SCE, dated 18 May 1995, the United States Environmental Protection Agency (USEPA) and the Los Angeles Regional Water Quality Control Board (LARWQCB) allowed LADWP and SCE to reduce their levels of normal receiving water monitoring in exchange for assisting the LARWQCB in establishing a regional database system (Appendix A-1, A-2). As no significant adverse impacts on the biota had been documented over the past several years, the LARWQCB determined that biological monitoring could be suspended. Water quality monitoring was continued because a consistent, but minor, effect on temperature of the receiving water had been documented. This agreement expired following the winter sampling of 1997; therefore, the summer sampling consisted of the normal monitoring program for summer as described in the NPDES permit, as adopted on 5 December 1994 for ESGS and 27 February 1995 for SGS.

DESCRIPTION OF GENERATING STATIONS

El Segundo Generating Station

Southern California Edison's 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) and Units 3 & 4 at 335 Mw. The total station rating is 1,020 Mw; however, the plant operated at 12.37% of total capacity in 1997 (R. Harnsberger 1997, 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 22°F (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 (-30 ft MLLW) and 2,100 ft (640 m) offshore, respectively; (2) the cooling water flow is 295,000 gpm; and (3) temperature rise across the condensers at full load is 22°F (12.2°C).

During the winter sampling on 28 April 1997, 51.8 million gallons daily (mgd) were discharged by one circulating pump operating part of the day at Units 1 & 2; 194.8 mgd were discharged by two circulating pumps at Units 3 & 4. The discharge temperature was 62° F (16.7°C), 5° F (2.8°C) above ambient at Units 1 & 2, and it was 74.5° F (23.6°C), 17.5° F (9.7°C) above ambient at Units 3 & 4. During summer sampling on 29 July 1997, 194.8 mgd were discharged by two circulating pumps at Units 1 & 2 and 398.6 mgd were discharged by four circulating pumps at Units 3 & 4. The discharge temperature was 63.1° F (17.3°C) at Units 1 & 2, 3.1° F (1.7°C) above ambient; it was 79.6° F (26.4°C) at Units 3 & 4, 19.6° F (10.9°C) above ambient (R. Harnsberger 1997, 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 megawatts (Mw); however, the plant operated at 15% of capacity in 1997 (F. Mofidi 1997, 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 18°F (10°C); Unit 3 operates at a temperature increase of 14°F (7.7°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 28 April 1997, 112 million gallons daily (mgd) were discharged by two circulating pumps. The discharge temperature was 68°F (20°C), 12°F (6.7°C) warmer than the intake temperature of 56°F (13.3°C). On 29 July 1997, five circulators pumped 304 mgd; the discharge temperature was 72°F (22.2°C), 15°F (8.3°C) above the ambient intake temperature of 57°F (13.9°C) (Mofidi 1997, pers. comm.).

DESCRIPTION OF STUDY AREA

Location

The study area is located in Santa Monica Bay and is between latitudes 33°56' and 33°52'; and longitudes 118°25'W and 118°28'W longitude (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 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 ft 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).

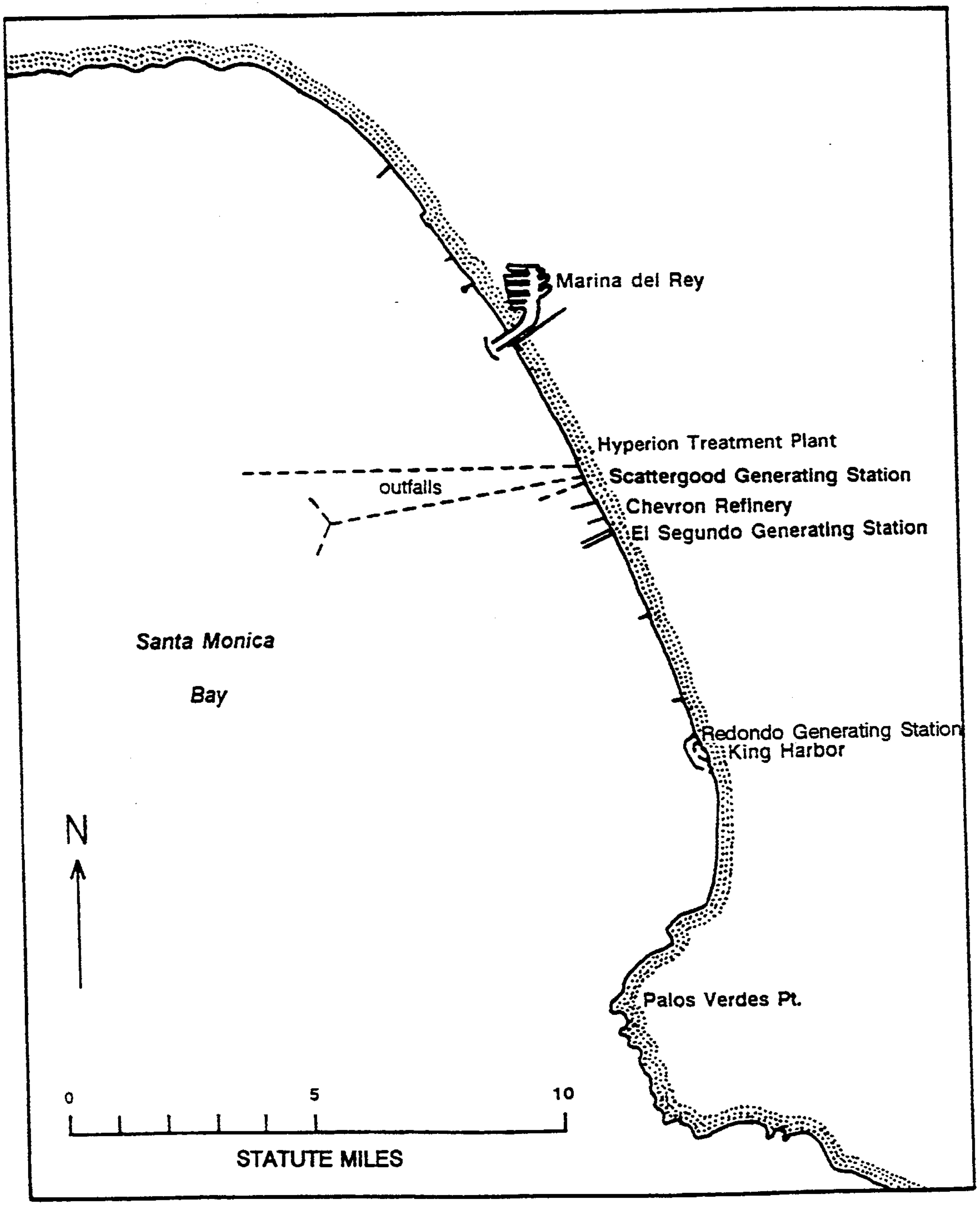

Figure 1. Locations of El Segundo and Scattergood Generating Stations within the Santa Monica Bay area. El Segundo and Scattergood Generating Stations NPDES, 1997

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.

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).

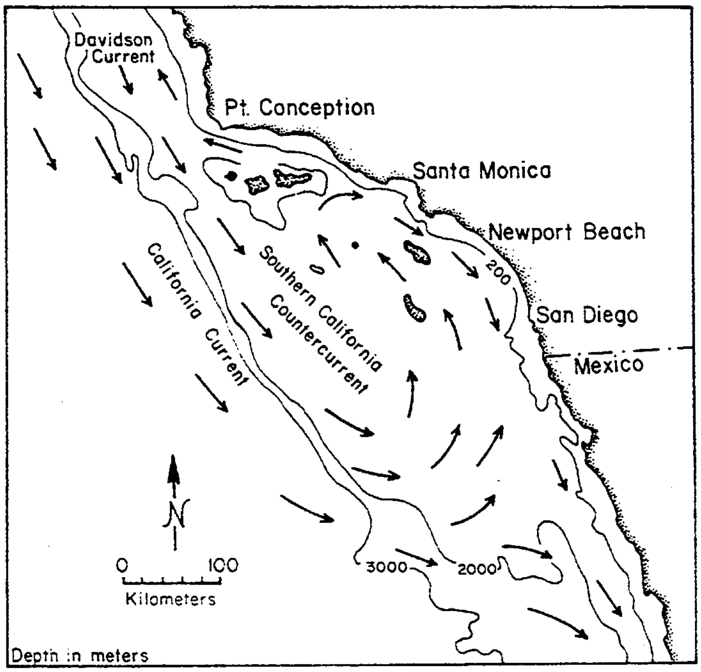

Figure 2. Surface circulation in the Southern California Bight (from Jones 1971). El Segundo and Scattergood Generating Stations NPDES, 1997

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

As specified by the California Regional Water Quality Control Board, Los Angeles Region, receiving water monitoring offshore of the El Segundo and the Scattergood Generating Stations included physical, biological, and water quality sampling programs during which measurements and observations were made to determine if the beneficial uses of the receiving waters described above are being protected.

STATION LOCATIONS

The 1997 monitoring program was conducted by both MBC Applied Environmental Sciences (MBC) and Entrix. Water quality sampling during both winter and summer was conducted by Entrix. Sampling of the physical and biological oceanographic environment was conducted during summer 1997 by MBC at the monitoring stations described in Appendix A and shown in Figure 3.

WATER COLUMN MONITORING

Temperature (°C), dissolved oxygen (DO), and hydrogen ion concentration (pH) were 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 a SeaBird water quality monitoring system, and averaged at 1.0 m intervals. In the field, the data were transferred from the SeaBird to floppy disk for storage. In the laboratory, data were processed using SeaBird proprietary software (SeaSoft ver. 4.35). The resulting information was imported into Lotus 1-2-3 spreadsheets for further reduction and analysis. Temperature and dissolved oxygen 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 each of the eight benthic stations (B1 through B8) by biologist-divers. Grain size samples were collected using a 15-cm plastic core tube 3.5 cm in diameter. Sediment samples were collected at the same time infauna samples were taken, and were transferred to jars or plastic bags for later laboratory analysis.

Grain Size

The size distributions of sediment particles were determined using two techniques: standard sieving for gravel and sand, and the hydrometer method for the silt-clay fraction. Laboratory data were entered into a computer program which automatically calculates mean grain size, sorting, skewness, and kurtosis, and plots size-distribution curves. Additional details are provided in Appendix B.

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

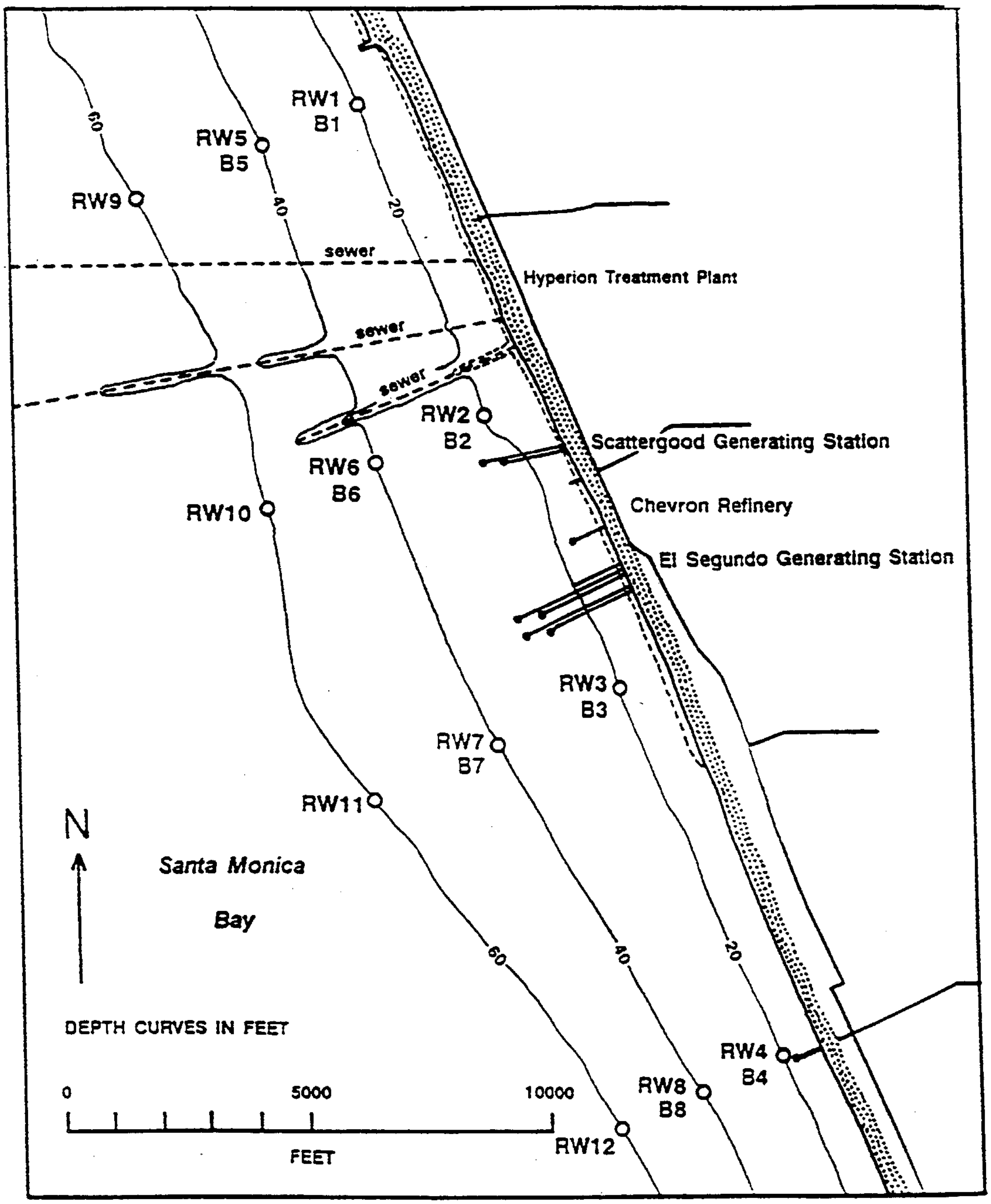

Figure 3. Locations of monitoring stations. El Segundo and Scattergood Generating Stations NPDES, 1997

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.

BIOLOGICAL MONITORING

The biological monitoring program consisted of benthic infauna sampling by biologists using diver-operated box corers at eight stations during the summer survey, and sampling of fish and macroinvertebrate populations from heat treatment impingement operations at the screenwells at the El Segundo Generating Station and at the Scattergood Generating Station.

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.

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.

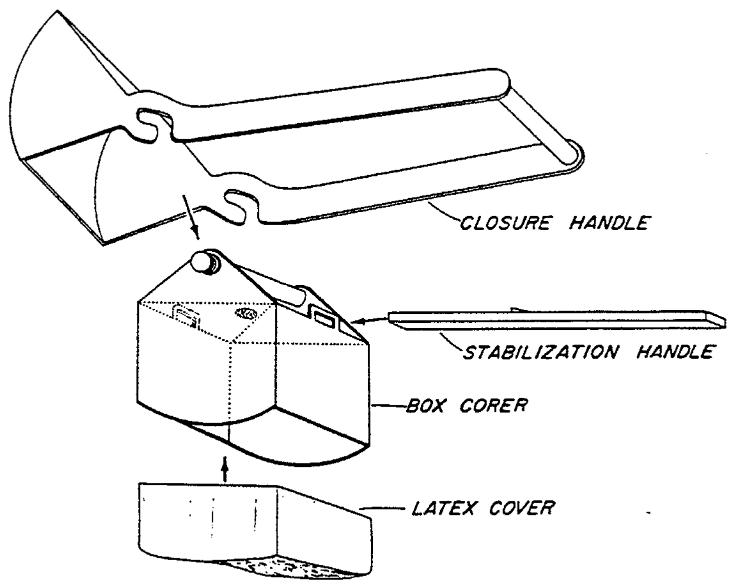

Figure 4. Diver-operated box corer used to collect infauna samples. El Segundo and Scattergood Generating Stations NPDES, 1997

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 and Macroinvertebrates

Fish impingement sampling was conducted by MBC biologists during heat treatment operations at ESGS and SGS. A heat treatment is a operational procedure conducted at the generating stations designed to eliminate mussels, barnacles, and other fouling organisms which grow in the intake conduits. Heated effluent water from the discharge conduit is re-entrained via cross-connecting tunnels to the intake conduit until the water temperature rises to slightly over 100°F (37° C). A temperature in excess of 100° F (37° C) is maintained for at least one hour, during which time all barnacles, mussels, other fouling organisms, and incidental fish and invertebrates living within the intake and forebay succumb to the heated water. These are subsequently impinged onto the traveling screens and removed from the forebay.

All fish and macroinvertebrates impinged during heat treatments were separated from incidental debris, sorted to species, identified, and counted. Fish were measured to standard length (mm), and total length (depending on species), and examined for external parasites, anatomical anomalies, and other abnormalities. Aggregate weights were taken by species for both fish and invertebrates.

Unusual specimens and those of uncertain identity were preserved in 10% Formalin-seawater and returned to the laboratory for positive species determination and, if warranted, retention in the MBC collection of voucher specimens.

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.

$$H' = -\sum_{j=1}^{S} \frac{n_j}{N} \ln \frac{n_j}{N} \qquad \text{Shannon-Wiener}$$

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

Infauna data were subjected to classification (clustering) analysis using the SYSTAT clustering module (SYSTAT ver. 5.0, Systat, Inc., Evanston, IL). Two classification analyses were performed on abundance and species data sets; 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:

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

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, infauna abundance data are transformed using a natural log transformation [ln(x)].

RESULTS

FIELD OPERATIONS

The 1997 NPDES surveys at El Segundo and Scattergood Generating Stations were conducted on 26 April and 17 and 29 July 1997. Loran C and latitude and longitude coordinates for water quality and benthic stations are given in Table 1.

Table 1. Loran C and latitude/longitude coordinates of sampling stations. El Segundo and Scattergood Generating Stations NPDES, 1997

Stations		Loran C Coordinates		Latitude	Longitude
RW1	B1	28176.0	41108.6	33°56.16	118°26.74
RW2	B2	28176.4	41102.2	33°55.08	118°26.15
RW3	B3	28176.5	41096.7	33°54.19	118°25.68
RW4	B4	28176.8	41093.3	33°53.56	118°25.39
RW5	B5	28174.7	41110.1	33°55.96	118°27.17
RW6	B6	28175.0	41104.4	33°55.02	118°26.65
RW7	B7	28175.0	41098.7	33°54.01	118°26.22
RW8	B8	28175.5	41095.0	33°53.45	118°25.83
RW9	-	28173.3	41111.8	33°55.81	118°27.64
RW10	-	28173.2	41106.3	33°54.82	118°27.18
RW11	-	28173.4	41100.9	33°53.81	118°26.79
RW12	-	28174.1	41097.4	33°53.38	118°26.36

Water quality data were collected during ebb and flood tides in both winter and summer. Winter ebb tide was sampled on 28 April 1997 between 0748 and 0840 hrs; flood tide, between 1228 and 1355 hrs. Skies changed from overcast to partly cloudy, with winds from 1 to 10 kn during sampling. Seas were west 2 to 3 ft throughout the day. Tides ranged from a high of +4.6 ft Mean Lower Low Water (MLLW) at 0112 hrs to a low of +0.1 ft at 0853 hrs, and back to a high of +3.2 ft at 1607 hrs. Summer ebb tide was sampled on 29 July 1997 between 0929 and 1148 hrs, and flood tide between 1328 and 1444 hrs. Seas were 0 to 2 ft, with winds 3 to 10 kn. Skies were overcast during sampling. The tide ranged from a high of +3.5 ft at 0748 hrs to a low of +2.1 ft at 1234 hrs, and back to a high of +5.7 ft at 1901 hrs.

Infaunal, grain size and sediment chemistry samples were collected by biologist-divers between 0913 and 1530 hrs on 17 July 1997. Seas were from the southwest at 1 to 3 ft, with southwest winds 3 to 10 kn. Skies were overcast in the morning and changed to partly cloudy by midday.

During the winter survey, no oil films, grease or floatables were observed. Water was turbid at Stations RW1 and RW5. Red tide (plankton bloom) was observed at all stations during ebb tide, and at all stations except RW1 during flood tide. Western gulls (*Larus occidentalis*) were observed at Stations RW7, RW8, and RW11. California sea lions (*Zalophus californianus*) were seen at Stations RW10 and RW11. California brown pelicans (*Pelecanus occidentalis californicus*) were seen at Stations RW2, RW6, and RW11. California least terns (*Sterna antillarum browni*) were observed at Station RW2.

During the summer surveys, no oil films or grease, turbidity, or red tide was observed. Floating tar clumps were seen at Station B4. Drift algae were seen at Station B1, and foam was noted at Station RW4. Western gulls were observed at Stations RW1, RW3, RW5, RW6, RW10, and RW11, and unidentified terns (*Sterna* spp.) at Station B5. California sea lions were seen at Stations RW1 and RW11, and bottlenose dolphins (*Tursiops truncatus*) at Station B4. California brown pelicans were seen at Stations RW1, RW2, B1, B5, and B6. California least terns were observed at Stations RW8, RW9, B5, and B6.

WATER COLUMN MONITORING

Receiving water monitoring stations are shown in Figure 3. Water quality data for ebb and flood tide are provided for each survey in Figures 5 through 10 and are summarized in Table 2. Raw data are presented in Appendix C.

Table 2. Summary of water quality parameters. El Segundo and Scattergood Generating Stations NPDES, 1997

	Temp. (°C)		D.O. (mg/l)		pH		Temp. (°C)		D.O. (mg/l)		pH	
Winter												
	Surface						Bottom					
	ebb	fld	ebb	fld	ebb	fld	ebb	fld	ebb	fld	ebb	fld
Average	15.24	15.88	9.82	9.60	8.28	8.47	13.25	14.05	7.65	7.95	8.09	8.18
Maximum	15.62	16.39	10.72	10.45	8.33	8.53	15.30	16.09	9.80	9.72	8.26	8.48
Minimum	14.71	15.44	8.87	9.12	8.20	8.31	11.53	12.21	5.29	5.71	7.95	7.98
Summer												
	Surface						Bottom					
	ebb	fld	ebb	fld	ebb	fld	ebb	fld	ebb	fld	ebb	fld
Average	20.49	20.46	7.24	7.37	8.43	8.43	17.06	17.54	7.31	7.46	8.37	8.39
Maximum	21.16	21.40	7.47	7.53	8.46	8.46	19.97	21.15	7.62	7.71	8.42	8.48
Minimum	19.39	19.45	6.88	7.20	8.40	8.42	14.24	14.41	7.05	7.26	8.32	8.32

Temperature

In winter, mean surface water temperature during ebb tide was 15.24°C; temperatures ranged from 14.71°C at Station RW1 to 15.62°C at Station RW4 (Table 2). Mild to strong temperature gradients were present at all stations on ebb tide except Station RW4. All gradients began below one to three meters (Figure 5). During flood tide, mean surface water temperature was 15.88°C; temperatures ranged from 15.44°C at Station RW10 to 16.39°C at Station RW2. Temperatures were near isothermal at Station RW3, while at all other stations, temperature gradually decreased with depth. At Stations RW6, RW7, RW10 and RW11 a thermocline was detected between 10 and 17 meters (Figure 5). The maximum surface-to-bottom difference recorded was at Station RW11 during ebb tide (3.97°C) and at Station RW9 during flood tide (3.53°C). The greatest average change per meter of depth occurred at station during ebb tide and at station during flood tide.

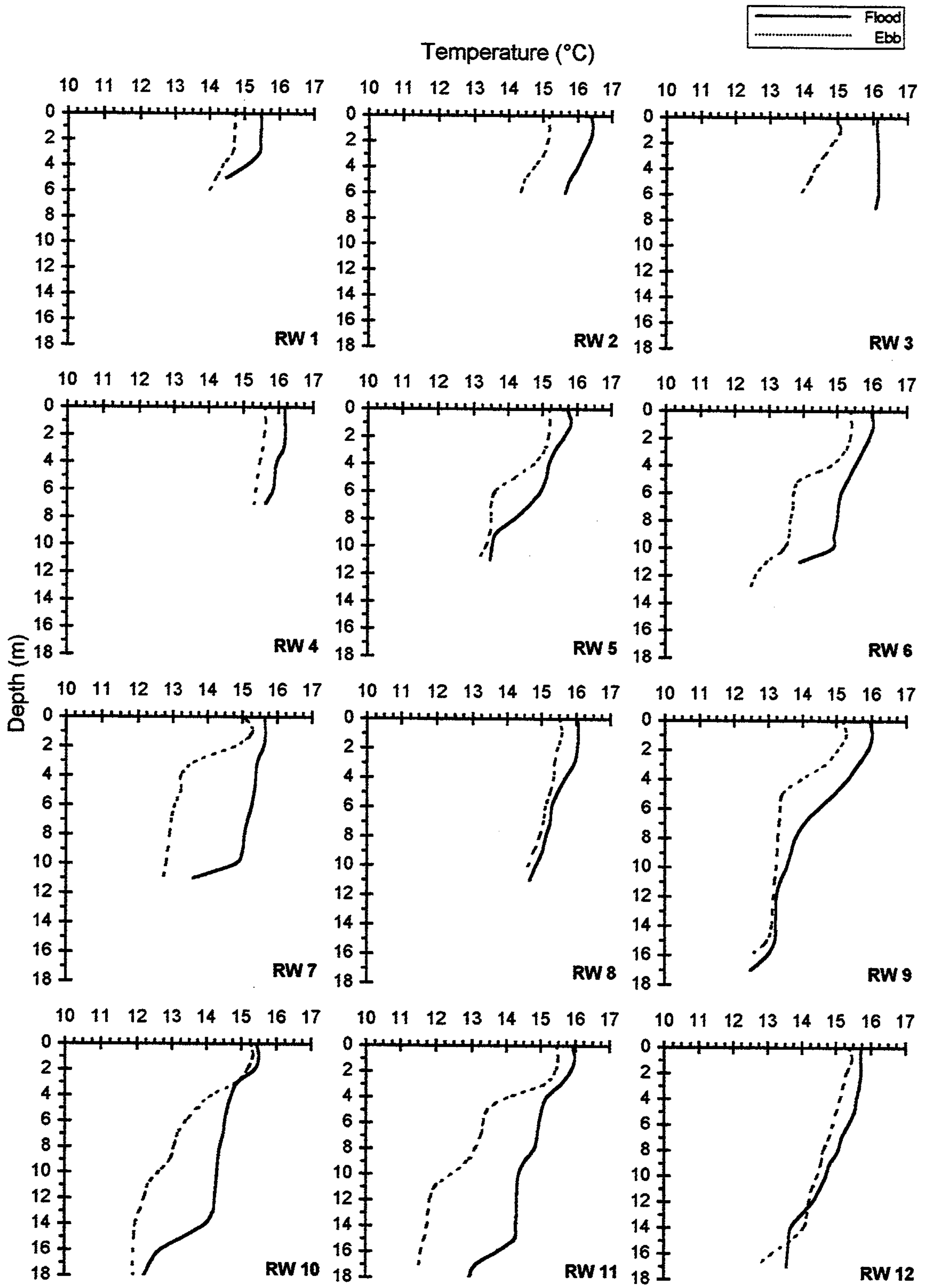

Figure 5. Temperature vertical profiles during the winter survey. El Segundo and Scattergood Generating Stations NPDES, 1997

In summer, mean surface water temperature during ebb tide was 20.49°C; temperatures ranged from 19.39°C at Station RW6 to 21.16°C at Station RW4 (Table 2). Mild to strong temperature gradients were present at all stations at ebb tide. All gradients began below one to three meters at the nearshore stations and between three to five meters at the offshore stations (Figure 6). During flood tide, mean surface water temperature was 20.46°C; temperatures ranged from 19.45°C at Station RW6 to 21.40°C at Station RW4. Temperature gradients were present at all stations during flood tide except Station RW4 which appeared isothermal. The minimum and maximum surface-to-bottom difference recorded was at Station RW12 (6.65°C during ebb tide and 5.57°C during flood tide). The greatest change in temperature per meter of depth occurred at Station RW8 during ebb tide 0.49 and at Station RW12 during flood tide (0.31).

Dissolved Oxygen

In winter, surface dissolved oxygen (DO) concentrations averaged 9.82 mg/l during ebb tide, ranging from 8.87 mg/l at Station RW1 to 10.72 mg/l at Station RW12 (Table 2). During flood tide, the mean surface DO concentration was 9.60 mg/l; DO ranged from 9.12 mg/l at Station RW3 to 10.45 mg/l at Station RW11. During ebb tide, DO concentrations at the nearshore stations decreased slightly with depth with the exception of Station RW2 where the DO concentration slightly increased with depth (Figure 7). Generally, at all other stations during ebb tide, there was a decrease in DO concentration with depth. During flood tide, DO concentrations fluctuated with depth at most stations. At Stations RW4 through RW12, DO concentration readings peaked multiple times and at various depths. The maximum surface-to-bottom difference was 5.15 mg/l at Station RW11 during ebb tide, and 4.09 mg/l at the same station during flood tide.

In summer, mean surface DO concentrations were 7.24 mg/l during ebb tide and 7.37 mg/l during flood tide. At ebb tide, surface DO values ranged from 6.88 mg/l at Station RW3 to 7.47 mg/l at Station RW10. During flood tide, surface DO ranged from 7.20 mg/l at Station RW3 to 7.53 mg/l at Station RW9 (Table 2). Flood tide DO values were generally higher than ebb tide measurements at the nearshore and intermediate stations (Figure 8). At the offshore stations, flood and ebb tide DO concentrations were very similar with Stations RW8, RW10, RW11, and RW12 all having overlapping values. The maximum flood tide surface-to-bottom difference was 0.53 mg/l at Station RW10. The maximum ebb tide surface-to-bottom difference was 0.57 mg/l at Station RW11.

Hydrogen Ion Concentration

In winter, hydrogen ion concentration (pH) at the surface averaged 8.28 during ebb tide, and ranged from 8.20 at Station RW1 to 8.33 at Station RW9 (Table 2). During flood tide, mean surface pH was 8.47, and values ranged from 8.31 at Station RW1 to 8.53 at Station RW9. Values were fairly uniform throughout the water column during both tidal stages, generally decreasing with depth (Figure 9). The maximum surface-to-bottom difference was 0.37 during ebb tide at Station RW11, and 0.56 during flood tide at Station RW9.

In summer, mean surface pH was 8.43 during both ebb and flood tides (Table 2). Values ranged from 8.40 to 8.46 at ebb tide and from 8.42 to 8.46 at flood tide. At all stations, pH levels were virtually identical with almost no change with depth (Figure 10). The maximum surface-to-bottom difference was 0.14 during ebb tide at Station RW8, and 0.11 during flood tide at Station RW12.

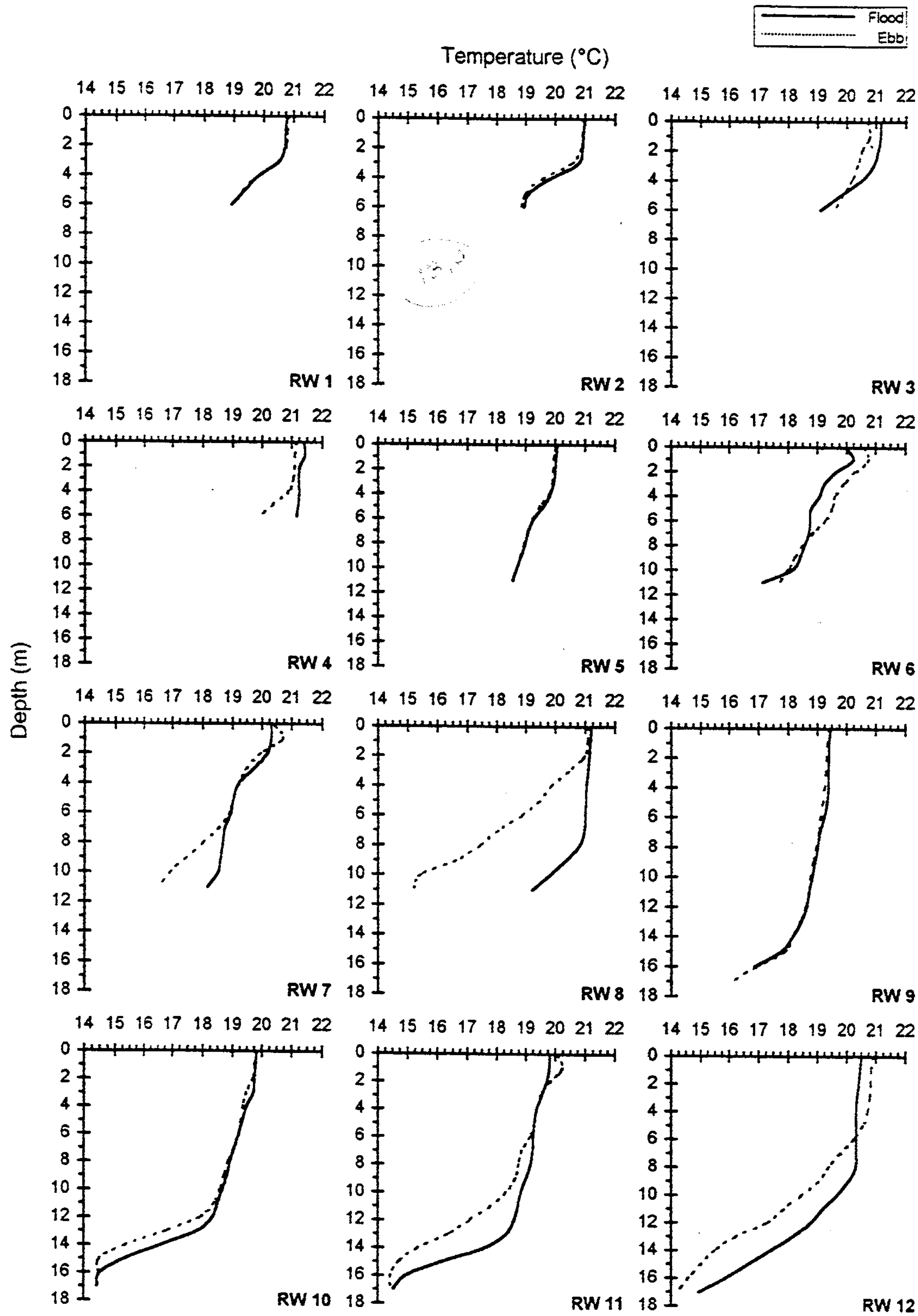

Figure 6. Temperature vertical profiles during the summer survey. El Segundo and Scattergood Generating Stations NPDES, 1997

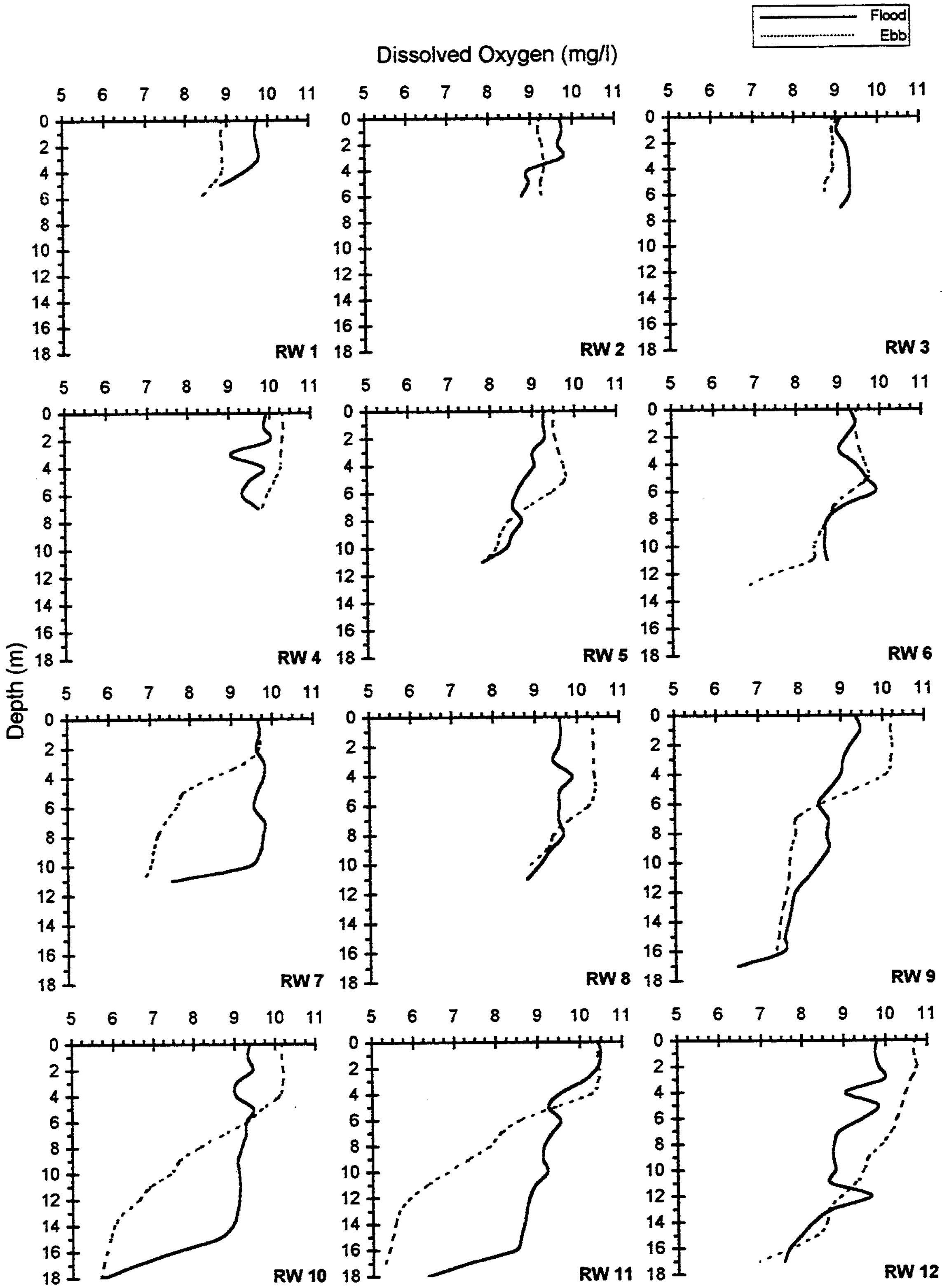

Figure 7. Dissolved oxygen vertical profiles during the winter survey. El Segundo and Scattergood Generating Stations NPDES, 1997

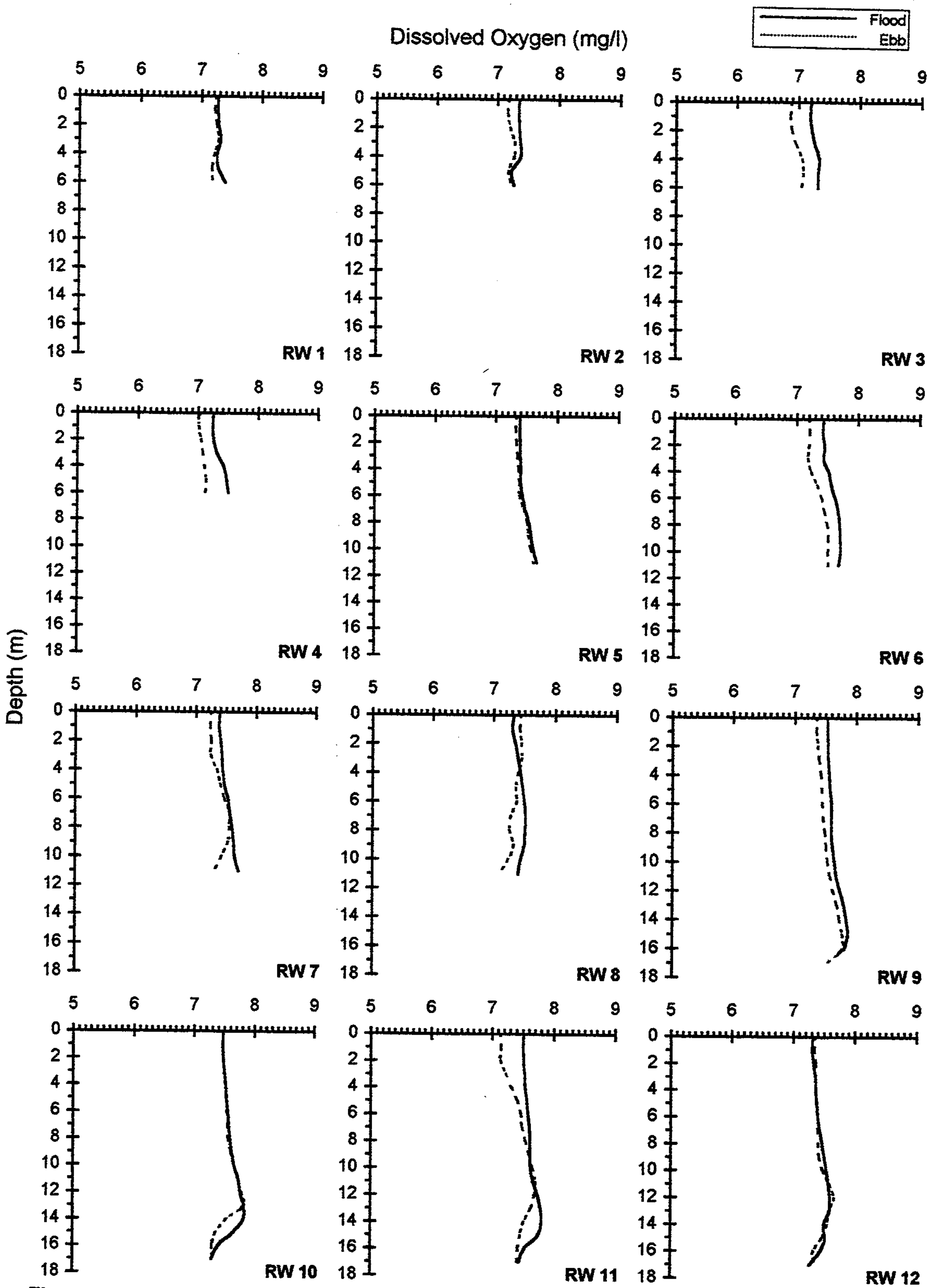

Figure 8. Dissolved oxygen vertical profiles during the summer survey. El Segundo and Scattergood Generating Stations NPDES, 1997

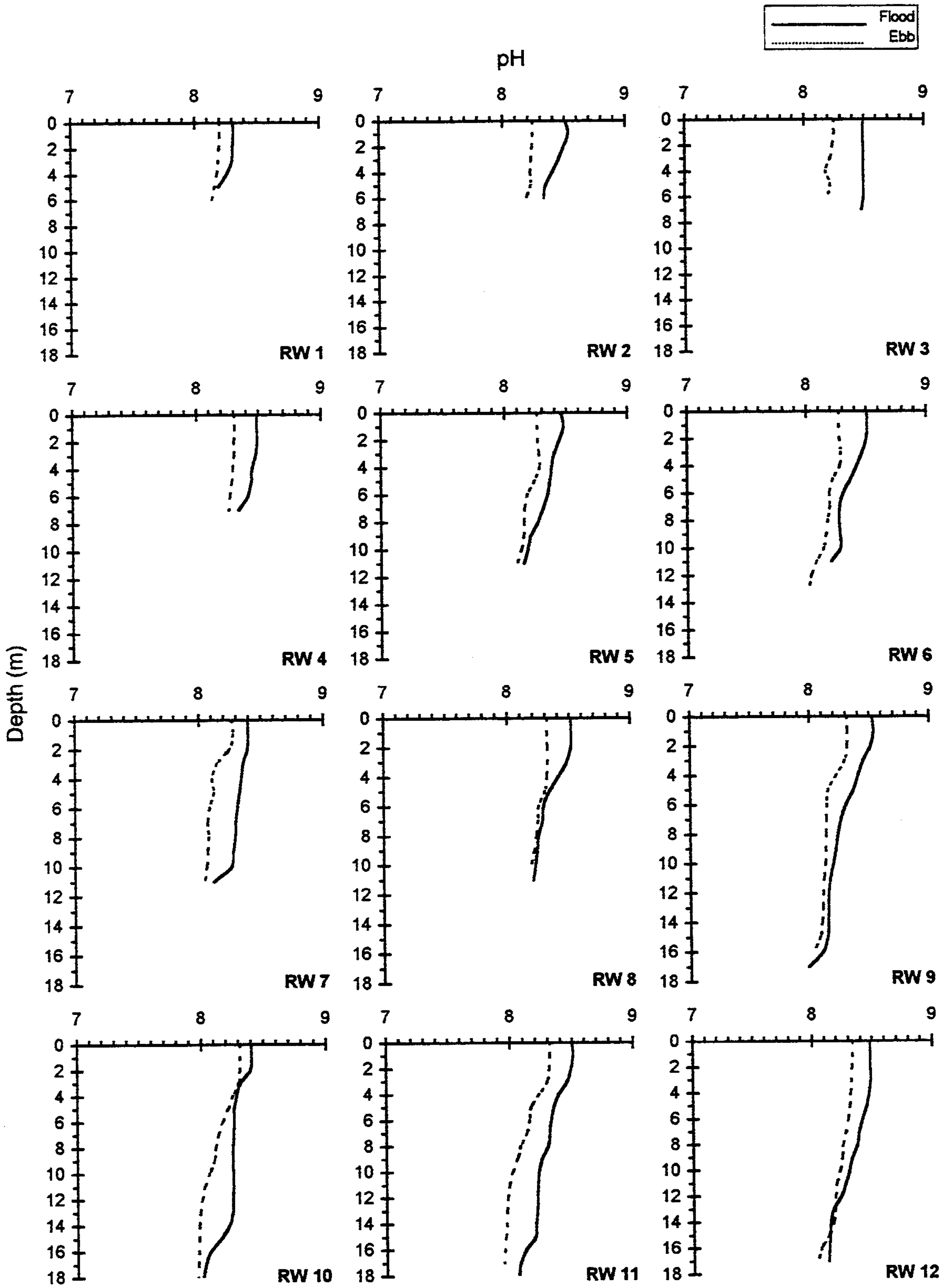

Figure 9. Hydrogen ion concentration (pH) vertical profiles during the winter survey. El Segundo and Scattergood Generating Stations NPDES, 1997

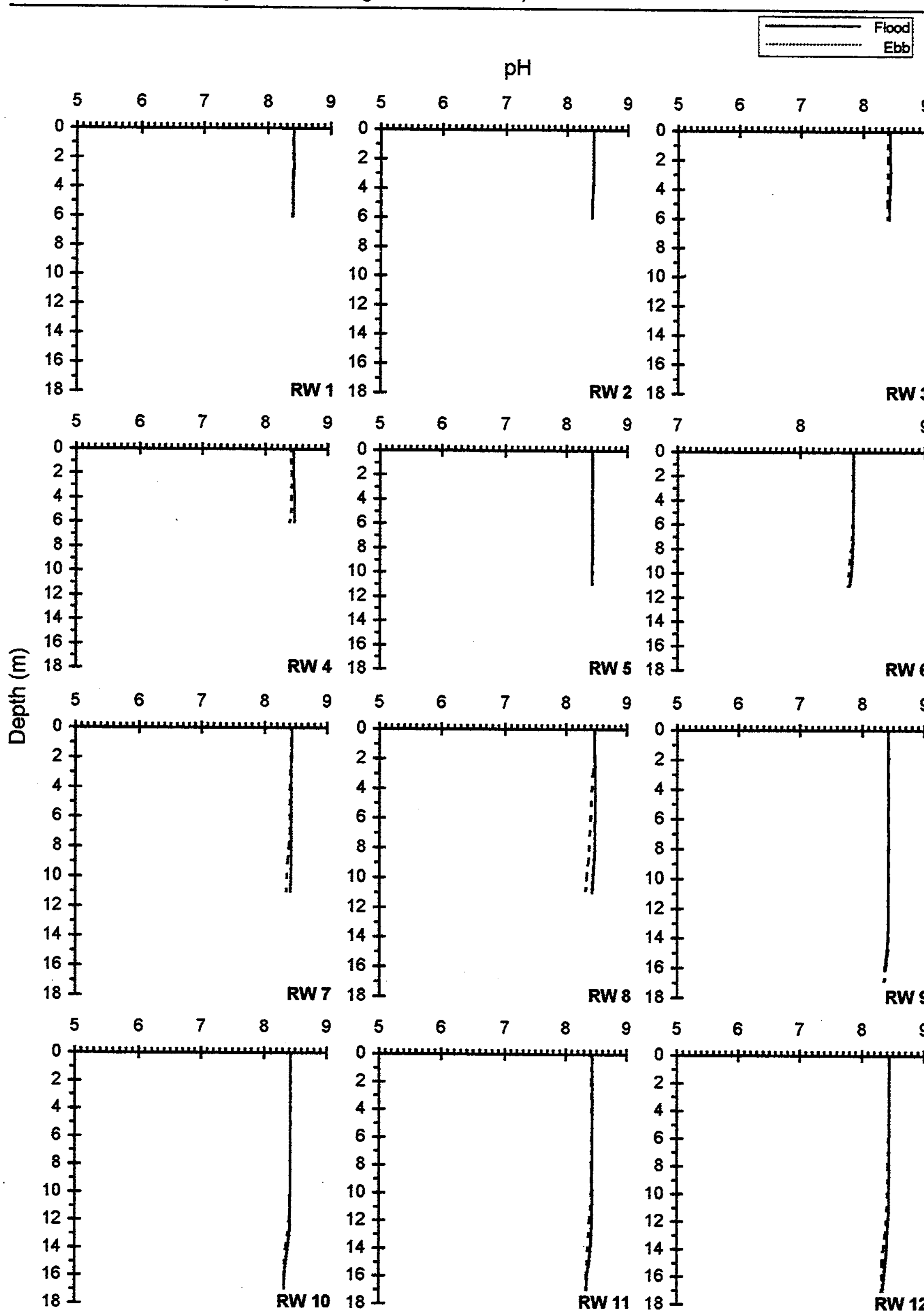

Figure 10. Hydrogen ion concentration (pH) vertical profiles during the summer survey. El Segundo and Scattergood Generating Stations NPDES, 1997

SEDIMENT MONITORING

Sediment Grain Size

Particle size distribution curves and parameters describing sediment grain size characteristics at each station are presented in Appendix D and 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, 1997

	Nearshore					Offshore					Overall	
Parameter	B1	B2	B3	B4	Mean	B5	B6	B7	B8	Mean	Mean	S.D.
% Gravel	0.02	0.00	0.07	0.07	0.04	0.05	0.00	0.00	0.00	0.01	0.03	0.03
% Sand	91.05	80.59	98.92	96.92	91.87	77.96	94.34	95.35	94.32	90.49	91.18	7.22
% Silt	7.95	18.06	0.69	3.01	7.43	18.33	3.94	3.05	4.91	7.56	7.49	6.47
% Clay	0.98	1.35	0.32	0.00	0.66	3.66	1.72	1.60	0.76	1.94	1.30	1.05
Mean Grain Size												
phi	3.19	3.57	2.63	3.04	3.11	3.80	3.37	3.38	3.38	3.48	3.30	0.33
µm	110	84	162	122	120	72	96	96	96	90	105	25.8
Sorting (%)*	61.33	62.79	66.05	68.86	64.8	62.16	72.19	74.91	78.26	71.9	68.3	5.9
Skewness	-0.18	0.36	-0.19	-0.15	-0.04	0.06	0.08	0.04	0.16	0.09	0.02	0.18
Kurtosis	1.44	1.41	1.16	1.14	1.29	2.56	1.40	1.30	1.46	1.68	1.48	0.42

* Sharp and Fan (1963), based on 25 intervals.

Sediments from the eight benthic stations were composed primarily of sand, with smaller amounts of silt and clay (Table 3). A very small amount of gravel occurred in samples from four of the stations. Overall, samples averaged 91% sand, 8% silt, and 1% clay, with an average mean grain size of 3.30 phi (105 μm, very fine sand). Sediments were coarsest at nearshore Station B3 (mean grain size of 2.63 phi [162 μm] and 99% sand) and finest at offshore Station B5 (3.80 phi [72 μm] and 78% sand). Nearshore stations averaged 91.9% sand, with a mean grain size of 3.11 phi (120 μm), while offshore stations were slightly finer on average, with 90.5% sand and a mean grain size of 3.48 phi (90 μm).

Sediments were generally well sorted, averaging 68% and ranging from 61% (moderately well sorted) at Station B1 to 78% (well sorted) at Station B8 (Table 3). Sediments were slightly better sorted at offshore stations, with an average of 72% compared with an average of 65% for the nearshore stations. In general, sediments were slightly skewed, averaging 0.02 and ranging from a positive skewness of 0.36 at Station B2, indicating an excess of fine material, to a negative value of -0.19 at Station B3, indicating excess coarse material. Kurtosis values averaged 1.48, and ranged from 1.14 at Station B4 to 2.56 at Station B5. A kurtosis value of 1.00 results from a normal distribution curve. Kurtosis values for all stations were greater than 1.00, indicating leptokurtic (excessively peaked) distributions, with dominance by a narrow range of particle sizes. Offshore sediments were both more positively skewed and more leptokurtic than those nearshore.

Chemistry

Concentrations of chromium, copper, nickel, and zinc in the sediments were highest at Station B5 (Table 4). Lowest concentrations for chromium, nickel and zinc were found at Station B3, while lowest concentrations of copper were found at Station B8. Chromium concentrations ranged from 12 to 20 mg/kg, copper from 3.9 to 7.1 mg/kg, nickel from 9.4 to 13 mg/kg, and zinc from 18 to 33 mg/kg. Sediment chemistry analytical results are presented in Appendix E.

Table 4. Concentrations of metals (mg/dry kg) in sediments. El Segundo and Scattergood Generating Stations NPDES, 1997

	Nearshore					Offshore					Overall		Detection
Metal	B1	B2	B3	B4	Mean	B5	B6	B7	B8	Mean	Mean	S.D.	Limit
Chromium	13.0	15.0	12.0	13.0	13.3	20.0	14.0	16.0	15.0	16.3	14.8	2.5	1.0
Copper	5.7	6.5	4.2	4.2	5.2	7.1	5.8	5.2	3.9	5.5	5.3	1.2	1.0
Nickel	10.0	11.0	9.4	9.6	10.0	13.0	9.5	10.0	10.0	10.6	10.3	1.2	1.0
Zinc	25.0	29.0	18.0	19.0	22.8	33.0	21.0	21.0	19.0	23.5	23.1	5.4	1.0

BIOLOGICAL MONITORING

Infauna

Results of infaunal analyses are presented by station and replicate in Appendix F and are summarized in Tables 5, 6, and 7.

Species Composition. A total of 1,512 infaunal organisms representing 155 species and 13 phyla was collected during the summer survey (Table 5, Appendix F-1). Annelida was the most abundant and diverse phylum, accounting for 52% of the individuals and 42% of the species. The phylum Arthropoda was second most abundant, accounting for 13% of the individuals and 21% of the species, and Mollusca was third in abundance, with 10% of the individuals and 19% of the species. The 10 remaining phyla represented only 24% of the individuals and 17% of the species. Six phyla contained only one species each, and one contained only one individual (Appendices F-1 and F-2). Annelids and sipunculids (one of the minor phyla) were generally more abundant at nearshore stations than at offshore stations, while all other groups were typically more abundant offshore (Table 5). All of the major phyla were more diverse offshore.

The 26 most abundant species, those which each comprised 1% or more of the total abundance, accounted for 73% of all the organisms collected (Table 6). The three most abundant species, the polychaete annelids *Mediomastus acutus*, *Apoprionospio pygmaea*, and *Owenia collaris*, together comprised more than 22% of the abundance. These three species occurred primarily at the nearshore stations, while the fourth and fifth most abundant species, Pacific sand dollar (*Dendraster excentricus*) and an unidentified Loxosomatidae (a minute entoproct, formerly in a group of bryozoans, or moss animals), occurred only at offshore stations. However, most of the abundant species occurred throughout the study area.

Number of Species. Species richness averaged 51 species per station and ranged from 33 species at Station B4 to 67 species at Station B5 (Table 7). In general, species richness was higher at offshore stations (an average of 58 species per station) than at nearshore stations (an average of 44 species).

Abundance and Density. Abundance averaged 189 individuals per station and ranged from 122 individuals at Station B4 to 258 individuals at Station B5 (Table 7). Density averaged 4,740 individuals/m^2, and ranged from 3,100 individuals/m^2 to 6,500 individuals/m^2. On average, abundance and density were greater offshore (an average of 204 individuals per station, or 5,100 individuals/m^2) than nearshore (an average of 174 individuals per station, or 4,380 individuals/m^2). The high abundance at Station B5 was due to large numbers of Loxosomatidae which occurred

Table 5. Abundance of infauna by major phylum. El Segundo and Scattergood Generating Stations NPDES, 1997

	Nearshore				Offshore					Percent
Parameter	B1	B2	B3	B4	B5	B6	B7	B8	Total	Total
Number of Individuals										
Annelida	154	144	78	67	105	82	69	89	788	52.1
Arthropoda	16	17	32	29	16	10	38	38	196	13.0
Mollusca	9	28	5	6	23	10	38	37	156	10.3
Echinodermata	3	-	4	2	6	10	31	30	86	5.7
All others	17	27	42	18	108	26	21	27	286	18.9
Total	199	216	161	122	258	138	197	221	1512	
Number of Species										
Annelida	21	22	19	16	34	22	19	25	63	40.6
Arthropoda	10	7	9	5	11	7	14	15	36	23.2
Mollusca	7	11	4	5	10	4	10	9	30	19.4
Echinodermata	1	-	1	1	2	2	2	2	5	3.2
All others	11	10	8	6	10	10	10	13	21	13.5
Total	50	50	41	33	67	45	55	64	155	

Table 6. The 26 most abundant infaunal species. El Segundo and Scattergood Generating Stations NPDES, 1997

		Nearshore				Offshore					Percent	Cum.
Phy	Species	B1	B2	B3	B4	B5	B6	B7	B8	Total	Total	Percent
AN	*Mediomastus acutus*	23	33	1	2	37	9	11	7	123	8.2	8.2
AN	*Apoprionospio pygmaea*	34	27	8	21	6	5	7	6	114	7.6	15.7
AN	*Owenia collaris*	29	33	16	18	-	3	-	4	103	6.8	22.5
EC	*Dendraster excentricus*	-	-	-	-	5	9	30	29	73	4.8	27.4
EN	Loxosomatidae	-	-	-	-	73	-	-	-	73	4.8	32.2
MO	*Tellina modesta*	1	10	-	-	11	7	22	18	69	4.6	36.8
AN	*Spiophanes bombyx*	4	2	8	2	-	5	12	15	48	3.2	40.0
AN	*Prionospio lighti*	28	1	7	7	2	-	-	-	45	3.0	42.9
CN	*Zaolutus actius*	2	8	16	10	-	-	-	1	37	2.5	45.4
AN	*Polydora cirrosa*	-	1	1	-	1	17	14	2	36	2.4	47.8
AN	*Spiochaetopterus costarum*	3	5	10	4	2	3	1	6	34	2.3	50.0
NE	*Carinoma mutabilis*	3	3	8	-	4	4	-	7	29	1.9	52.0
AN	*Exogone lourei*	-	-	-	-	-	-	4	25	29	1.9	53.9
AR	*Diastylopsis tenuis*	3	5	3	3	-	3	9	2	28	1.9	55.7
AR	*Monoculodes hartmanae*	1	5	4	15	-	-	1	1	27	1.8	57.5
AR	*Gibberosus myersi*	1	2	9	8	-	1	5	-	26	1.7	59.2
NT	Nematoda	-	-	-	-	18	3	2	1	24	1.6	60.8
NE	*Paranemertes californica*	1	2	8	2	1	4	4	2	24	1.6	62.4
MO	*Cooperella subdiaphana*	-	6	-	-	1	1	4	11	23	1.5	63.9
NE	*Tubulanus polymorphus*	1	4	4	-	4	2	3	4	22	1.5	65.4
AN	*Goniada littorea*	3	7	-	2	4	4	1	1	22	1.5	66.9
AN	*Glycera convoluta*	8	4	4	-	2	2	1	-	21	1.4	68.3
PR	Phoronida	1	-	2	3	2	5	3	2	18	1.2	69.4
AN	*Syllis (Typosyllis) sp.*	-	7	-	-	3	7	-	1	18	1.2	70.6
AR	*Argissa hamatipes*	1	-	-	-	4	1	6	4	16	1.1	71.7
AR	*Uromunna ubiquita*	-	1	3	-	1	-	2	9	16	1.1	72.8

Phylum Key: AN = Annelida; AR = Arthropoda; CN = Cnidaria; EC = Echinodermata; EN = Entoprocta; MO = Mollusca; NE = Nemertea; NT = Nematoda; PR = Phoronida

Table 7. Summary of infaunal community parameters. El Segundo and Scattergood Generating Stations NPDES, 1997

	Nearshore					Offshore					Overall
Parameter	B1	B2	B3	B4	Mean	B5	B6	B7	B8	Mean	Mean
Species											
Total	50	50	41	33	43.5	67	45	55	64	57.8	50.6
Rep. Mean	20.8	22.3	21.0	14.8	19.7	25.5	22.5	23.0	26.0	24.2	22.0
Rep. S.D.	5.4	4.9	3.2	1.9	3.9	2.9	6.4	2.1	5.6	4.3	4.1
Individuals											
Total	199	216	161	122	174.5	258	138	197	221	203.5	189.0
Rep. Mean	50.0	54.0	40.0	31.0	43.8	65.0	35.0	49.0	55.0	51.0	47.4
Rep. S.D.	9.3	14.7	9.4	6.2	9.9	30.9	10.3	8.5	8.8	14.6	12.3
Diversity											
Total	3.02	3.18	3.34	2.58	3.03	0.98	2.53	3.38	3.48	2.59	2.81
Rep. Mean	2.55	2.70	2.83	2.11	2.55	0.85	2.03	2.82	2.90	2.15	2.35
Rep. S.D.	0.29	0.17	0.16	0.17	0.20	0.28	0.27	0.10	0.27	0.23	0.21
Biomass											
Total	4.11	3.81	2.49	2.29	3.18	1.01	1.26	1.99	12.14 *	4.10	3.64
Rep. Mean	1.03	0.95	0.62	0.57	0.79	0.25	0.32	0.50	3.04	1.03	0.91
Rep. S.D.	0.62	1.01	0.38	0.24	0.56	0.15	0.11	0.27	4.61	1.28	0.92

* Includes one spiny sand star (*Astropecten armatus*) at 9.19g.

in only one replicate. Excluding this species, abundance at Station B5 was similar to the average abundance for the offshore stations, while the next highest abundance occurred at Station B8

Species Diversity. Shannon-Wiener species diversity index (H') values averaged 2.81 per station, and ranged from 0.98 at Station B5 to 3.48 at Station B8 (Table 7). The value at Station B5 was much lower than at any other station. On average, diversity was slightly greater nearshore (average of 3.03 per station) than offshore (average of 2.59 per station).

Biomass. Biomass averaged 3.64 g per station, or 91 g/m^2). Biomass was highest at Station B8 (12.14 g, or 304 g/m^2). However, 76% of the biomass at that station was contributed by a single large spiny sea star (*Astropecten armatus*) which weighed 9.19 g (Table 7, Appendix F-3). Biomass is commonly adjusted by excluding such large organisms which are a magnitude or more larger than the rest of the samples, as they are rarely collected and they bias the data. Adjusted biomass was therefore highest at Station B1 (4.11 g, or 103 g/m^2) and lowest at Station B5 (1.01 g, or 25 g/m^2). Adjusted biomass was generally greater nearshore (average of 3.18 g, or 79 g/m^2) than offshore (average of 1.80 g, or 45 g/m^2).

Cluster Analysis. Results of cluster analysis (classification) of the 26 most abundant infaunal species (Table 6) are presented in Figure 11.

Normal (site) analysis clustered the eight stations into three groups. Group I consists of the four nearshore stations; within this group, adjacent stations clustered most closely. Stations B3 and B4 were the most similar. Group II includes three of the four offshore stations, with Stations B6 and B7 being most similar. Station B5 alone forms Group III; this station was least similar to the other stations, although it was more similar to the other offshore stations than to nearshore stations.

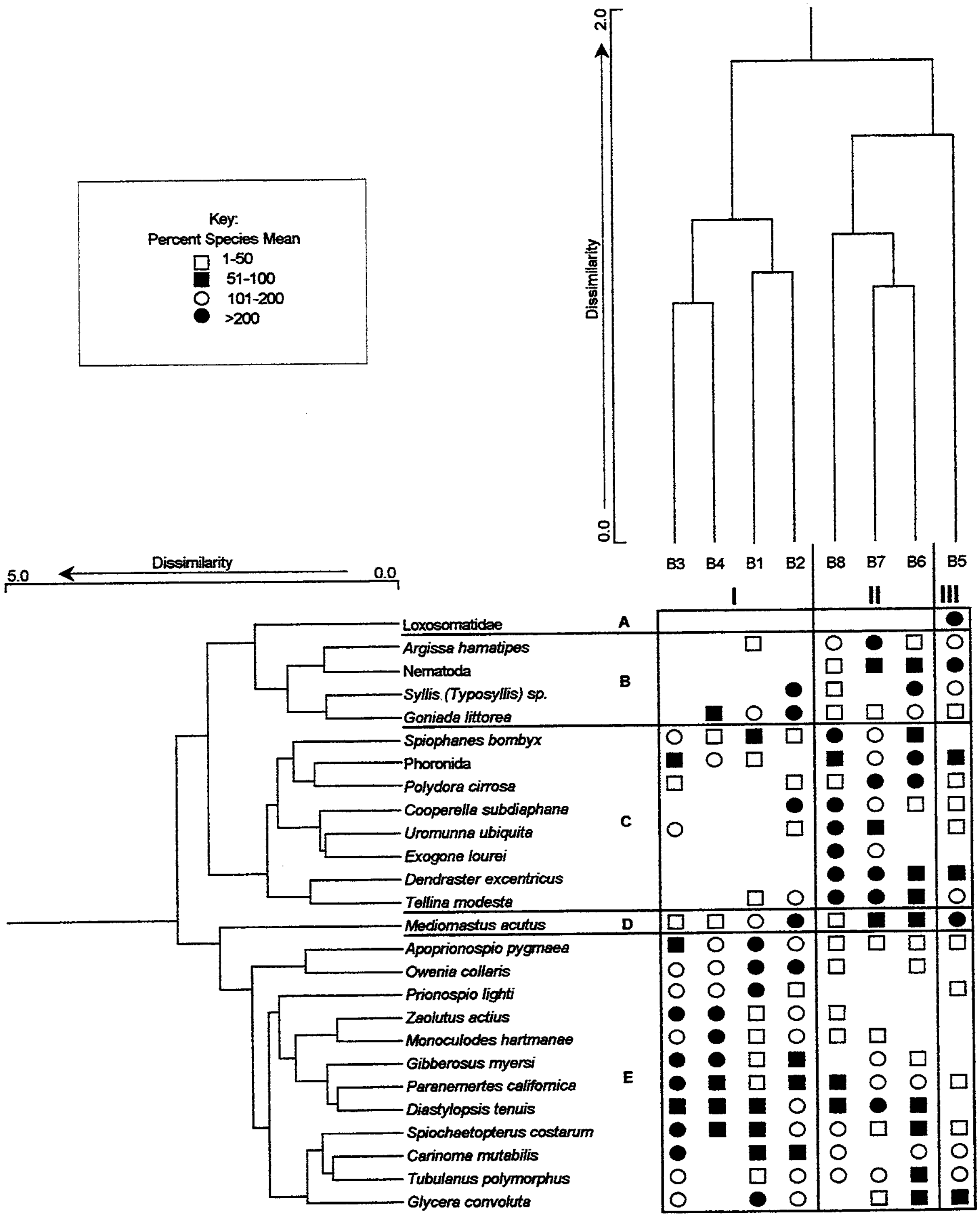

Figure 11. Two-way coincidence table resulting from normal (station) and inverse (species) classification dendrograms for the 26 most abundant infaunal species. El Segundo and Scattergood Generating Stations NPDES, 1997

Inverse (species) analysis clustered the dominant species into five species groups. The unidentified Loxosomatidae (Group A) was unique, as it occurred in high numbers and only at one station. *Mediomastus acutus* (Group D) also grouped alone; it was the most abundant species and was found at every station. The species in Groups B and C occurred primarily at the offshore stations, while the species in Group E occurred mostly at nearshore stations.

Fish and Macroinvertebrates

Results from heat treatment surveys of fish entrained and impinged at the El Segundo (ESGS) and the Scattergood Generating Stations (SGS) during the 1997 sampling year (1 October 1996 to 30 September 1997) are presented below. Data are summarized in Tables 8 through 12 and presented in their entirety in Appendix G. Fish and macroinvertebrate data are presented separately for each generating station.

Fish

Species Composition. In total, at least 53 species representing two classes and 27 families of fish were taken during 16 heat treatment operations at the generating stations (Appendix G-1). Total abundances are listed in Appendix G-2.

El Segundo. Heat treatment surveys at ESGS Units 1 & 2 and Units 3 & 4 yielded at least 45 species of fish representing two classes and 24 families (Appendix G-1). Five families of cartilaginous fish (Elasmobranchiomorphi = Chondrichthyes) and 19 families of bony fish (Osteichthyes) were dominated by six species of surfperch in the family Embiotocidae and six species of croakers in the family Sciaenidae. Three heat treatments at Units 1 & 2 yielded 23 species, whereas at least 44 species were taken from Units 3 & 4 during the five heat treatments occurring there.

Scattergood. Heat treatment surveys at SGS yielded 53 species of fish, representing two classes and 27 families (Appendix G-1). Five families of cartilaginous fish and 22 families of bony fish were dominated by six species of surfperch and six species of croakers.

Abundance. A total of 41,003 individual fish was taken at the two stations; 20,015 fish (49%) were taken from SGS and 20,988 (51%) from ESGS (Table 8, Appendix G-2). The 15 overall most abundant species occurred at both stations and were similarly abundant at both SGS and ESGS.

Queenfish (*Seriphus politus*) was the most abundant species overall, accounting for 32% (13,062) of the individuals; it was the most abundant species at SGS, but was second in abundance at ESGS with 23% (4,842) of the total (Table 8). The second most abundant fish overall (17% of the total) was jacksmelt (*Atherinopsis californiensis*), which ranked first at ESGS and eighth at SGS. The third, fourth, and fifth most abundant species overall, accounting for a combined total of 24.4%, were northern anchovy (*Engraulis mordax*), salema (*Xenistius californiensis*), and topsmelt (*Atherinops affinis*), respectively. While northern anchovy was ranked second in abundance at SGS, it was seventh at ESGS; salema was ranked sixth and third, respectively; and topsmelt was fourth at SGS, but tenth at ESGS. Yellowfin croaker (*Umbrina roncador*), walleye surfperch (*Hyperprosopon argenteum*), white croaker (*Genyonemus lineatus*), Pacific sardine (*Sardinops sagax*), and kelp bass (*Paralabrax clathratus*) were the sixth through tenth, respectively, most abundant fish overall. These five species accounted for 20.1% of the combined abundance, and were similarly abundant at SGS (20.5%) and ESGS (19.8%). Grunion (*Leuresthes tenuis*) also was abundant at ESGS.

El Segundo. Only 147 individuals were taken in three heat treatments at Units 1 & 2, whereas 20,841 individuals were taken during the five heat treatments at Units 3 & 4 (Table 9, Appendix G-3). Catch per heat treatment at the Units 1 & 2 screenwell averaged 49 individuals

Table 8. Numbers and individuals and biomass (kg) of the 15 most abundant fish species impinged during heat treatments at El Segundo and Scattergood Generating Stations.

Species	Scattergood No.	Scattergood Wt. (kg)	El Segundo No.	El Segundo Wt. (kg)	Total Abundance	Percent Total	Cumulative Percent	Total Biomass
Seriphus politus	8225	138.640	4842	125.125	13067	31.87	31.87	263.765
Atherinopsis californiensis	375	41.165	6730	689.172	7105	17.33	49.20	730.337
Engraulis mordax	2871	15.446	959	13.760	3830	9.34	58.54	29.206
Xenistius californiensis	822	38.679	2836	151.400	3658	8.92	67.46	190.079
Atherinops affinis	2261	86.861	240	8.329	2501	6.10	73.56	95.190
Umbrina roncador	2403	334.594	88	11.895	2491	6.08	79.63	346.489
Hyperprosopon argenteum	874	32.686	1264	69.095	2138	5.21	84.85	101.781
Genyonemus lineatus	640	22.072	1174	64.760	1814	4.42	89.27	86.832
Sardinops sagax	78	2.992	1157	27.644	1235	3.01	92.28	30.636
Paralabrax clathratus	110	18.605	476	181.954	586	1.43	93.71	200.559
Leuresthes tenuis	23	0.523	484	7.800	507	1.24	94.95	8.323
Paralabrax nebulifer	301	85.320	60	20.239	361	0.88	95.83	105.559
Cheilotrema saturnum	220	17.997	129	20.567	349	0.85	96.68	38.564
Phanerodon furcatus	153	7.401	26	1.467	179	0.44	97.12	8.868
Anisotremus davidsonii	95	36.456	48	18.879	143	0.35	97.47	55.335
Survey Totals	20015	1005.581	20988	1710.462	41003			2716.043
Total Species	53		45		54			

and 10 species, and ranged from 12 individuals and four species (10 September 1997) to 113 individuals and 19 species (21 May 1997) (Appendix G-4). Catches at Units 3 & 4 averaged 4,168 individuals and 24 species per heat treatment and ranged from 12 species and 41 individuals (26 July 1997) to 35 species and 10,565 individuals (8 February 1997).

The 15 most abundant species at ESGS accounted for almost 93% of all individuals taken (Appendix G-3). As less than 1% of the fish were taken at Units 1 & 2, abundance at Units 3 & 4 controlled the overall abundance. Therefore, the top 15 species in abundance were present at Units 3 & 4 in very similar abundance as that for the station overall. Only three (white croaker, grunion, and top smelt) of these 15 species were not present at Units 1 & 2, and only one species, brown rockfish (*Sebastes auriculatus*) taken at Units 1 & 2 was not present at Units 3 & 4 (Table 10 and Appendix G-3).

Scattergood. Eight heat treatments were conducted at SGS, with the catch per heat treatment averaging 2,502 individuals and 25 species (Table 11). The catch ranged from 348 individuals and 11 species (29 April 1997) to 5,635 individuals (25 December 1996) and 41 species (8 November 1996) (Appendix G-5).

The five most abundant species at SGS, representing four families, accounted for over 83% of all the individuals taken at the station and included, in order of abundance, queenfish, northern anchovy, yellowfin croaker, topsmelt, and walleye surfperch (Table 8). The remaining 48 species totaled 3,381 individuals and accounted for only 17% of the abundance.

Biomass. Biomass totaled 2,716.04 kg for fish taken during heat treatments at both stations (Table 8, Appendix G-2). Biomass was unevenly distributed between the two stations with SGS accounting for 37% of the overall total and ESGS accounting for 63%. Jacksmelt accounted for 26.9% of the total biomass and, with yellowfin croaker (12.8%), queenfish (9.7%), kelp bass (7.4%), and salema (7.0%) accounted for 64% of the biomass and weighed 1,731.23 kg.

Table 9. Numbers of species and individuals and biomass (kg) of fish impinged during heat treatments at El Segundo Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997

Date			Number: Species	Number: Individuals	Biomass
Units 1 & 2					
21	May	1997	19	113	9.50
7	August	1997	8	22	3.61
10	September	1997	4	12	0.43
Total			23	147	13.54
Mean			10	49	4.51
Units 3 & 4					
30	October	1996	17	578	120.76
8	February	1997	11	10565	581.92
3	June	1997	17	3713	193.04
26	July	1997	30	41	81.20
11	September	1997	25	5944	720.00
Total			44	20841	1696.92
Mean			20	4168	339.38
Overall					
Total			44	20988	1710.46
Mean			16	2624	213.81

Table 10. Numbers of individuals and biomass (kg) of the 15 most abundant fish impinged during heat treatments at El Segundo Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997

Species	Units 1 & 2 Abund.	Units 1 & 2 Biomass	Units 3 & 4 Abund.	Units 3 & 4 Biomass	Total Abund.	Total Biomass	% Comp. Abund.	% Comp. Biomass
Atherinopsis californiensis	7	1.257	6723	687.915	6730	689.172	32.07	40.29
Seriphus politus	13	1.097	4829	124.028	4842	125.125	23.07	7.32
Xenistius californiensis	10	0.564	2826	150.836	2836	151.400	13.51	8.85
Hyperprosopon argenteum	2	0.144	1262	68.951	1264	69.095	6.02	4.04
Genyonemus lineatus	-	-	1174	64.760	1174	64.760	5.59	3.79
Sardinops sagax	8	0.578	1149	27.066	1157	27.644	5.51	1.62
Engraulis mordax	7	0.153	952	13.607	959	13.760	4.57	0.80
Leuresthes tenuis	-	-	484	7.800	484	7.800	2.31	0.46
Paralabrax clathratus	40	1.466	436	180.488	476	181.954	2.27	10.64
Atherinops affinis	-	-	240	8.329	240	8.329	1.14	0.49
Cheilotrema saturnum	1	0.108	128	20.459	129	20.567	0.61	1.20
Chromis punctipinnis	19	0.728	83	7.370	102	8.098	0.49	0.47
Umbrina roncador	1	0.420	87	11.475	88	11.895	0.42	0.70
Myliobatis californica	2	0.850	76	189.240	78	190.090	0.37	11.11
Paralabrax nebulifer	7	0.276	53	19.963	60	20.239	0.29	1.18
Survey Totals	147	13.539	20841	1696.923	20988	1710.462		
Total Species	22		44		45			

El Segundo. Fish biomass totaled 1,710.46 kg during the heat treatment surveys at ESGS in 1997 (Table 10). Four of the same five species ranked highest in biomass overall were ranked highly at ESGS. In addition to jacksmelt, kelp bass, salema, and queenfish (in order of abundance), walleye surfperch was also highly ranked (fifth) at ESGS. Collectively, these five species amassed a weight of 1,216.74 kg, 71% of the biomass at ESGS (Appendix G-3).

Units 1 & 2 biomass totaled 13.54 kg and ranged from 0.43 kg (10 September 1997) to 9.5 kg (21 May 1997) (Table 9, Appendix G-6). One cabezon (*Scorpaenichthys marmoratus*) accounted for almost 20% of the overall biomass, while 40 kelp bass accounted for 10.8%, with jacksmelt contributing 9.3%, queenfish 8.1%, and black surfperch (*Embiotoca jacksoni*) contributing an additional 6.8% (Table 10).

Table 11. Numbers of species and individuals and biomass (kg) of fish impinged during heat treatments at Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997

Date	Number: Species	Number: Individuals	Biomass
8 Nov 96	41	2431	133.83
25 Dec 96	28	5635	125.46
29 Jan 97	33	4576	148.41
13 Mar 97	17	954	33.55
29 Apr 97	11	348	9.64
29 May 97	17	1268	24.47
22 Jul 97	30	1748	137.33
22 Sep 97	25	3055	392.90
Total	53	20015	1005.58
Mean	25	2502	125.70

Biomass at Units 3 & 4 totaled 1,696.92 kg and ranged from 81.20 kg (26 July 1997) to 720.00 kg (11 September 1997) (Table 9). In addition to the sizeable contribution from jacksmelt (40.5%), kelp bass (10.6%), salema (8.9%), and queenfish (7.3%), bat ray (*Myliobatis californía*) contributed 11.2% of the biomass, in spite of contributing less than 1% of the abundance (Table 10). Together these five species accounted for 78.5% of the biomass (1,332.51 kg).

Scattergood. In 1997, fish biomass totaled 1,005.58 kg during the eight heat treatment surveys at SGS (Table 11). Biomass averaged 125.70 kg per survey and ranged from 9.64 kg (29 April 1997) to 392.90 kg (22 September 1997) (Appendix G-7). Yellowfin croaker accounted for one-third (33.3%) of the biomass and, together with the next four ranking species (queenfish, topsmelt, barred sand bass, and jacksmelt), accounted for 68.3% (686.58 kg) of the total biomass (Table 8).

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.

Population Structure. Length-frequency histograms (Figures 12 to 15, *Paralabrax nebulifer*, *P. clathratus*, *Seriphus politus*, and *Engraulis mordax*) were constructed of two of the more abundant forage species, northern anchovy and queenfish, and of two species of sport fishing importance, 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 most numerous fish taken for 1997 and was most frequently entrained at the 70 to 80 mm SL size range at SGS with a smaller mode at 120 to 130 mm SL, whereas the size distribution at ESGS indicated entrained and impinged fish were bimodally distributed at the 100 and 130 mm SL size range more frequently (Figure 12).

Northern anchovy was the third most abundant species for 1997. The northern anchovy population at SGS peaked at 80 mm SL, while at ESGS the population peaked at 100 to 110 mm SL (Figure 13).

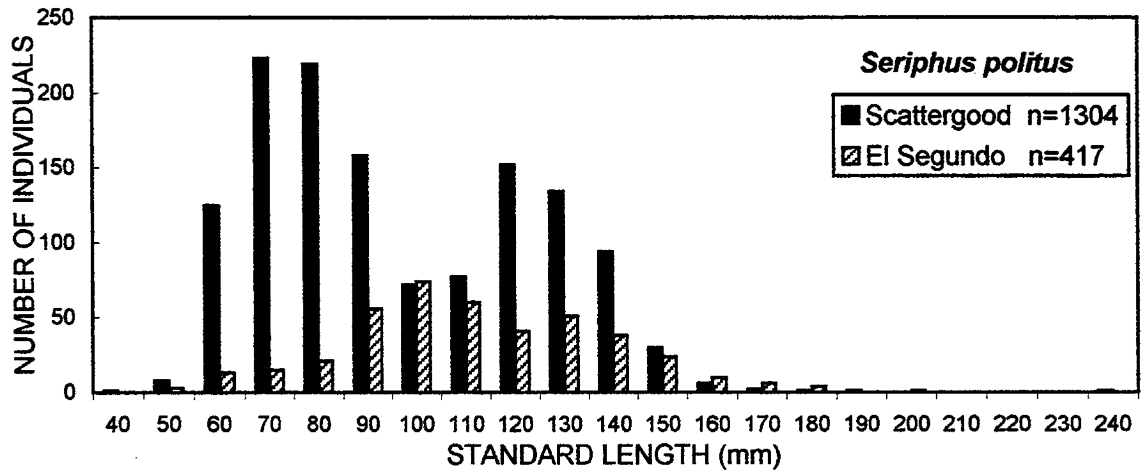

Figure 12. Length-frequency histogram for queenfish (*Seriphus politus*). El Segundo and Scattergood Generating Stations NPDES, 1997

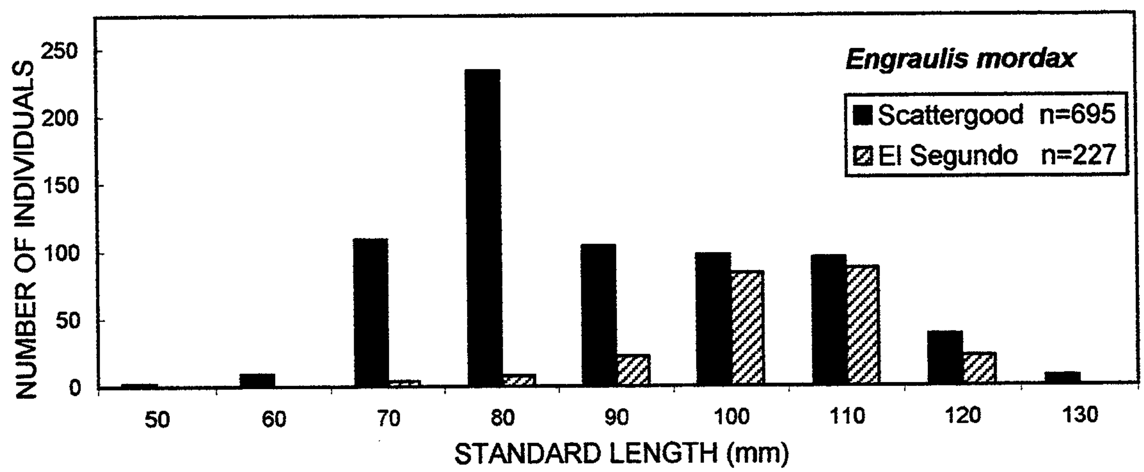

Figure 13. Length-frequency histogram for northern anchovy (*Engraulis mordax*). El Segundo and Scattergood Generating Stations NPDES, 1997

Kelp bass size distribution indicated a trimodal population at ESGS with peaks at 110, 210, and 240 mm SL; at SGS, the population was also trimodal with peaks noted at 50, 140, and 210 mm SL (Figure 14).

Size distribution of the barred sand bass population at SGS indicated the distribution of the majority of the entrained individuals was centered at 210 mm SL, with a small mode at 60 to 80 mm SL; at ESGS, the majority of the entrained barred sand bass were between 220 and 260 mm SL (Figure 15).

Diseases and Abnormalities. No diseases or abnormalities were noted on any fish caught during the impingement surveys at either generating station.

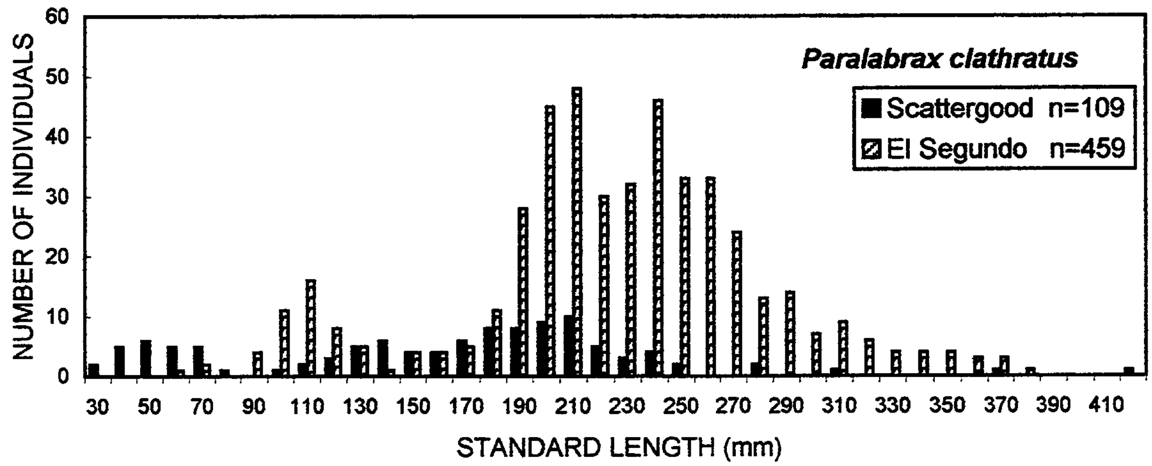

Figure 14. Length-frequency histogram for kelp bass (*Paralabrax clathratus*). El Segundo and Scattergood Generating Stations NPDES, 1997

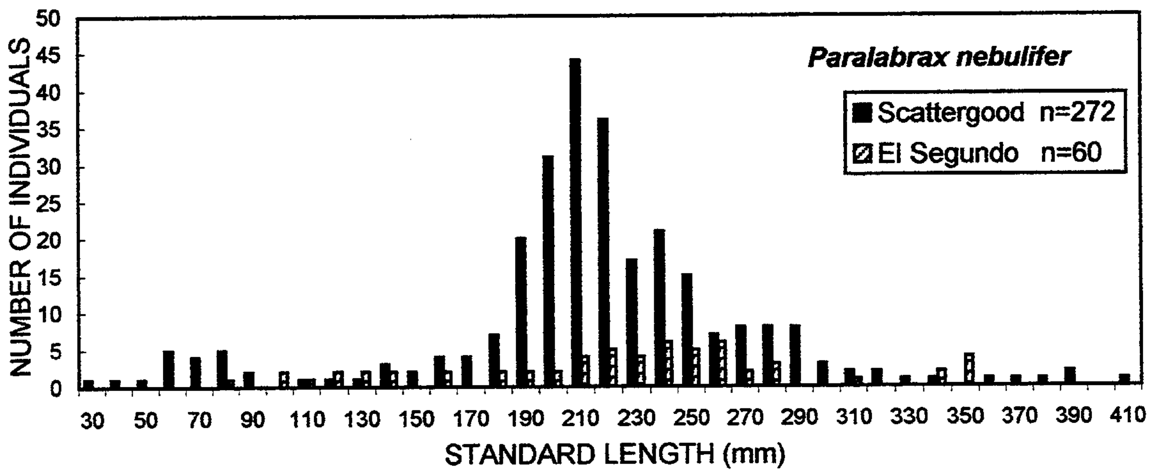

Figure 15. Length-frequency histogram for barred sandbass (*Paralabrax nebulifer*). El Segundo and Scattergood Generating Stations NPDES, 1997

Macroinvertebrates

A total of 26 motile invertebrate species with a total biomass of 217.8 kg were collected during heat treatment impingement surveys at SGS and ESGS (Table 12, Appendices G-8 through G-13). These species represented four phyla, and 14 families, and included 18 species of crustaceans, four echinoderms, three mollusks, and one cnidarian (Appendix G-1).

Members of the rock crab family Cancridae accounted for 25.8% of all invertebrates taken, and almost 40% of the biomass. Red rock shrimp (*Lysmata californica*) was the most abundant invertebrate accounting for 37.6% of the individuals, but only 7% of the biomass. The ocher seastar *(Pisaster ochraeus)* was the second most abundant species with 21.8% of the abundance and 11.7% of the biomass. Yellow rock crab (*Cancer anthonyi*) was the third most abundant overall, comprising 18.5% of the invertebrates taken, and it contributed 30% of the biomass (Appendix G-8). The tuberculate pear crab (*Pyromaia tuberculata*) was fourth in abundance (8%) and the red rock crab (*Cancer antennarius*) was fifth in abundance (6%); together, these five species accounted for 91.9% of the invertebrates taken. California spiny lobster (*Panulirus*

Table 12. Numbers of individuals and biomass (kg) of macroinvertebrates impinged during heat treatments at El Segundo and Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997

Species	Scattergood Abund.	Scattergood Biomass	El Segundo Abund.	El Segundo Biomass	Total Abundance	Percent Total	Cumulative Percent	Total Biomass
Lysmata californica	938	1.172	2881	14.763	3819	37.63	37.63	15.935
Pisaster ochraceus	2	0.194	2208	25.217	2210	21.78	59.40	25.411
Cancer anthonyi	528	3.047	1351	62.755	1879	18.51	77.92	65.802
Pyromaia tuberculata	108	0.247	704	1.750	812	8.00	85.92	1.997
Cancer antennarius	337	5.694	274	14.08	611	6.02	91.94	19.774
Pachygrapsus crassipes	20	2.969	206	1.574	226	2.23	94.17	4.543
Navanax inermis	112	0.364	5	0.041	117	1.15	95.32	0.405
Cancer gracilis	-	-	96	1.339	96	0.95	96.27	1.339
Octopus bimaculatus	54	12.697	35	14.484	89	0.88	97.14	27.181
Panulirus interruptus	37	29.695	28	17.214	65	0.64	97.78	46.909
Survey totals	1305	60.361	7904	156.073	10149			217.800
Total species	20		20		26			

interruptus) and two-spotted octopus (*Octopus bimaculatus/bimaculoides*) each contributed less than 1% of the abundance, but they accounted for 21.5 and 12.5% of the biomass, respectively.

Differences in species diversity in the catch data between ESGS and SGS heat treatment operations were not substantial. Both ESGS and SGS each had 20 of the 26 species, and 14 species were common to both stations (Appendix G-8). These species in common accounted for more than 98% of the abundance and biomass; most of the species that occurred uniquely at either station were represented by few individuals and collectively accounted for only slightly more than 1% of the abundance and biomass. There were, however, substantial differences in abundance and biomass between the two stations with ESGS accounting for almost 72% of the biomass and 78% 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 16). Abundance of entrained and impinged California spiny lobster was relatively similar between SGS and ESGS. There was a large mode from 70 to 100 mm CL in the overall population for the two stations with a single peak at 90 mm CL; while SGS had a bimodal distribution, with a large mode from 70 to 100 mm CL and a small peak at 120 mm CL, ESGS had a single peak at 90 mm CL.

DISCUSSION

WATER COLUMN MONITORING

Temperature

In winter, there was little thermal enhancement of the receiving waters due to the operation of the El Segundo and Scattergood Generating Stations. The two monitoring stations closest to the discharge sites (Station RW2 upcoast of the Scattergood Generating Station discharge and

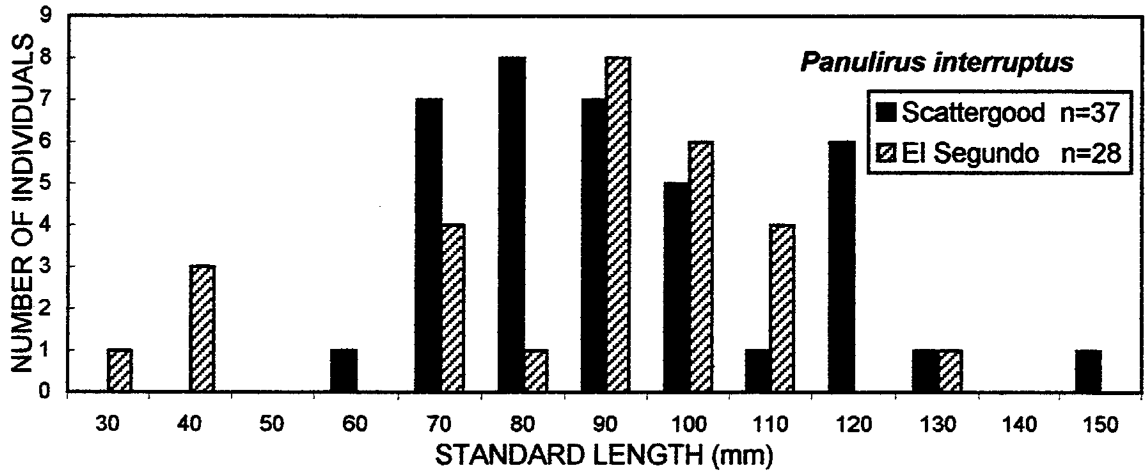

Figure 16. Length-frequency (carapace length) histogram for California spiny lobster (*Panulirus interruptus*). El Segundo and Scattergood Generating Stations NPDES, 1997

Station RW3 downcoast of the El Segundo Generating Station discharge) were well within the range of values recorded from all the stations. No strong pattern of thermal enhancement could be established.

During winter, surface temperatures varied only slightly more than 1° C during both ebb and flood tide. The water column at intermediate and offshore stations downcoast and upcoast of the discharge sites showed some stratification. The water column was slightly more stratified during ebb tide than during flood tide. At most intermediate and offshore stations, temperatures during flood tide decreased sharply at depth indicating a layer of cold water near the bottom. The only exception to this was Station RW8 where temperature decreased only slightly with depth. All temperatures fell within ranges found in previous surveys (MBC 1990a - 1993a, 1994, 1995, and 1996).

In summer, surface temperatures were typically higher than in winter. Ebb and flood tide profiles were similar with the exception of Station RW8 which showed distinctly different profiles (Figure 6). Profiles for offshore stations all indicated a layer of cold, dense water at depth. The highest surface temperatures at ebb and flood tides were observed at Station RW4, downcoast of the El Segundo Generating Station discharge.

Mean surface temperatures (ebb and flood tides) in 1997 were roughly within the range of those recorded in past years (MBC 1990a - 1993a, 1994, 1995 and 1996). Differences among surveys are most likely due to seasonal changes and do not necessarily reflect thermal enhancement directly related to the generating stations.

In winter, dissolved oxygen values during flood tide fluctuated widely when compared to ebb tide values. In summer, dissolved oxygen measurements were fairly uniform throughout the water column. In most cases, profiles correlated inversely with the corresponding temperature profiles. However, the winter dissolved oxygen profiles appeared to correspond directly with the temperature profiles. Summer dissolved oxygen concentrations were well within the range of previously reported values (MBC 1990a - 1993a, 1994, 1995, and 1996). There were no apparent effects on dissolved oxygen concentrations which 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 1990a - 1993a, 1994).

SEDIMENT MONITORING

Sediment Grain Size

Sediments in the study area were, on average, 91% sand, with a mean grain size of 3.30 phi, in the very fine sand category. Generally, sediments were finer and better sorted offshore than nearshore. Finest sediments were found at offshore Station B5 (furthest upcoast); the other three offshore stations (Stations B6 to B8) were very similar to each other in all parameters. Coarsest sediments were at the nearshore station immediately downcoast of the El Segundo Generating Station discharge. At both depths, sediments were increasingly better sorted downcoast. No patterns were apparent relative to the discharges.

Sediment parameters in 1997 were very similar to those in the previous surveys in 1991, 1993, and 1994, but differed from those in 1990 and 1992, when very coarse sediments occurred at some nearshore stations (Table 13) (MBC 1990a - 1993a, 1994). Sediments offshore were slightly finer and more poorly sorted than the average for the five previous surveys, while nearshore sediments were somewhat finer and were better sorted.

Table 13. Average sediment mean grain size and sorting, 1990 - 1997. Scattergood and El Segundo Generating Stations NPDES, 1997

	Year					
Parameter	1990	1991	1992	1993	1994	1997
Mean grain size (phi)						
All stations	2.53	3.26	2.61	3.38	3.32	3.30
Nearshore stations	1.78	3.13	2.02	3.24	3.19	3.11
Offshore stations	3.29	3.40	3.40	3.52	3.45	3.48
Sorting (%)						
All stations	67	67	65	71	70	68
Nearshore stations	58	63	60	68	65	65
Offshore stations	75	71	70	74	75	72

In all surveys, offshore sediments have been finer than those nearshore. This difference is typical for the southern California coastal shelf, and is attributable to the greater turbulence on the sea floor due to waves and currents at the shallower nearshore stations. Finer particles are more easily suspended, and are redeposited further offshore in calmer water.

Sediment Chemistry

Sediments at Station B5 had the highest concentrations of chromium, copper, nickel, and zinc (Figure 17). Levels of copper, nickel, and zinc were slightly elevated at Station B2, and zinc concentrations were also somewhat elevated at Station B1. Lowest concentrations for chromium, nickel, and zinc were found at Station B3, while lowest concentrations of copper were found at Station B8. In surveys from 1990 to 1993, the highest levels of metals have generally occurred at Station B5 (Figure 18). Since 1993, however, metal levels at Station B2 and Station B5 have been similarly elevated.

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). Comparisons should take into account the relative amounts of fine and coarse sediments.

From 1990 to 1993, percentages of fine sediments and metal levels were highest at Station B5 (Figure 18). In 1993, the percentage of fines at Station B2 increased, 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 has been following a similar pattern of increase since 1993. In 1997, the highest percentage of fines and the corresponding comparatively high level of metals occurred at Station B5.

Metal concentrations at the remainder of the stations have remained relatively constant since 1990. In 1997, little difference was seen between metal levels found at nearshore and offshore stations (Table 4, Figure 17). However, Stations B1, B2 and B5, where metal levels were generally higher, are all upcoast of the generating stations.

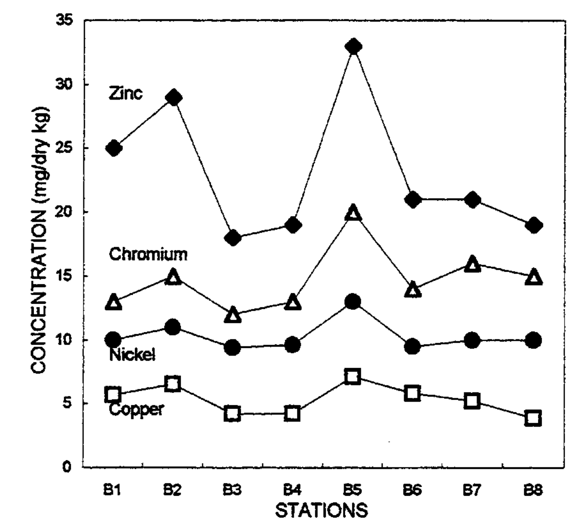

Figure 17. Concentration of metals (mg/dry kg) in sediments. Scattergood and El Segundo Generating Stations NPDES, 1997

All values observed in 1997 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). Concentrations of metals in the study area have also been consistently below levels determined to be potentially toxic to benthic organisms. Ranges of potential toxicity were developed by 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). Except at Station B5 in 1990, metal concentrations in the study area have been less than half the determined concentration 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.

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 discharges which are difficult to determine the origins. (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. No extremely high or low values were noted in sediments at stations nearest the discharges, nearshore or offshore, suggesting that the generating stations have not had a noticeable effect on metal concentrations in the sediments.

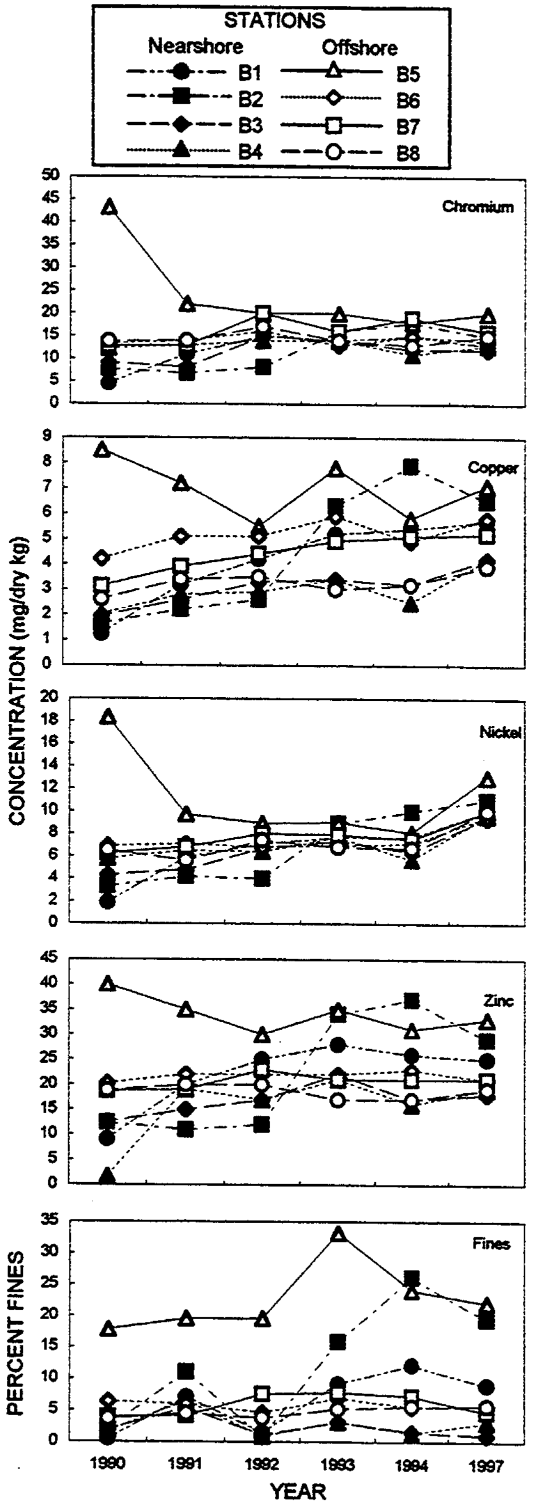

Figure 18. Sediment metals concentrations and percent fines at each station, 1990 to 1997. El Segundo and Scattergood Generating Stations NPDES, 1997

BIOLOGICAL MONITORING

Infauna

The benthic infauna was most abundant and species richness was greatest at Station B5, the offshore station furthest upcoast. Abundance and species richness were generally greater offshore than nearshore (204 individuals and 58 species per station vs. 174 individuals and 44 species per station). However, average species diversity offshore was lower than the nearshore average because of the low value at Station B5, which resulted from high numerical dominance of the community by one species. Polychaete annelids were the most abundant organisms, followed by Pacific sand dollars, arthropods (primarily amphipods and cumaceans) and bivalve mollusks (clams). The most abundant species overall, the polychaete *Mediomastus acutus*, was not dominant at any station, but was rather uniformly distributed. However, the second and third most abundant species, the polychaetes *Apoprionospio pygmaea* and *Owenia collaris* (a tube builder), were far more abundant nearshore than offshore. The unidentified Loxosomatidae, fourth most abundant, was found in great abundance in one replicate at offshore Station B5; this species typically attaches en masse to a larger host, such as an errant polychaete or crab (Cadien 1997, pers. comm). The fifth and sixth most abundant species, Pacific sand dollar and the plain tellin (*Tellina modesta*), were much more abundant offshore than nearshore.

The benthos at the offshore stations supports greater numbers of individuals and a more diverse community, probably due to lower turbulence and finer sediments, which contain more organic matter. Even among the offshore stations, the greatest number of species and individuals occurred at Station B5 where sediments were finest, consisting mostly of very fine sand. A few species (Pacific sand dollar, plain tellin, and the polychaetes *Polydora cirrosa* and *Exogone lourei* occurred almost exclusively in this habitat. However, a number of species occurred primarily nearshore where conditions are more rigorous. The amphipod arthropods *Monoculodes hartmanae* and *Gibberosus myersi* are fastswimming or burrowing, and are adapted to areas of high turbulence and coarse sand. Many polychaete worms, such as *Owenia collaris*, build tubes which provide protection and help to stabilize the sand. The small sea anemone *Zaolutus actius*, in turn, attaches to the worm tubes.

Results of the 1997 survey were similar to those of previous NPDES summer surveys from 1990 through 1994 (MBC 1990a - 1993a, 1994). Average species richness in 1997 (51 species per station) was slightly lower than in 1994, but was higher than from 1990 through 1993. However, abundance (189 individuals per station, or 4,725/m^2) was less than half that in 1994 and was also lower than in 1992 and 1993, resulting in higher species diversity than in the previous three surveys. The pattern of greater abundance and species richness at the offshore stations than at the nearshore stations was also consistent with results of previous summer surveys. However, unlike all previous surveys, average diversity offshore was lower than nearshore, due to the low value at Station B5.

Comparison of station community parameters for 1997 with the average values and ranges for the previous five years shows that nearshore species richness and diversity were slightly greater than the average, with values for Stations B2 and B3 being higher than previously recorded (Figure 19). However, offshore values did not show a consistent pattern, and most were near the average. Nearshore abundance values in 1997 were similar to the average, while offshore values were consistently lower, with abundance at Station B6 being lower than previously recorded.

The 1997 infaunal analysis demonstrated no pattern related to the Scattergood and El Segundo Generation Stations' discharges. This is consistent with previous results. Nearshore abundance has been greatest at Station B2, just north of the Scattergood outfall, and offshore abundance at Station B5, furthest upcoast. At both of these stations, sediments have been finer than the average. This is unlikely to be related to the generating station outfalls, as Station B5 is too far away to be influenced by the outfalls, and the stations immediately downcoast and offshore of the outfalls showed no consistent pattern in any infaunal community parameter.

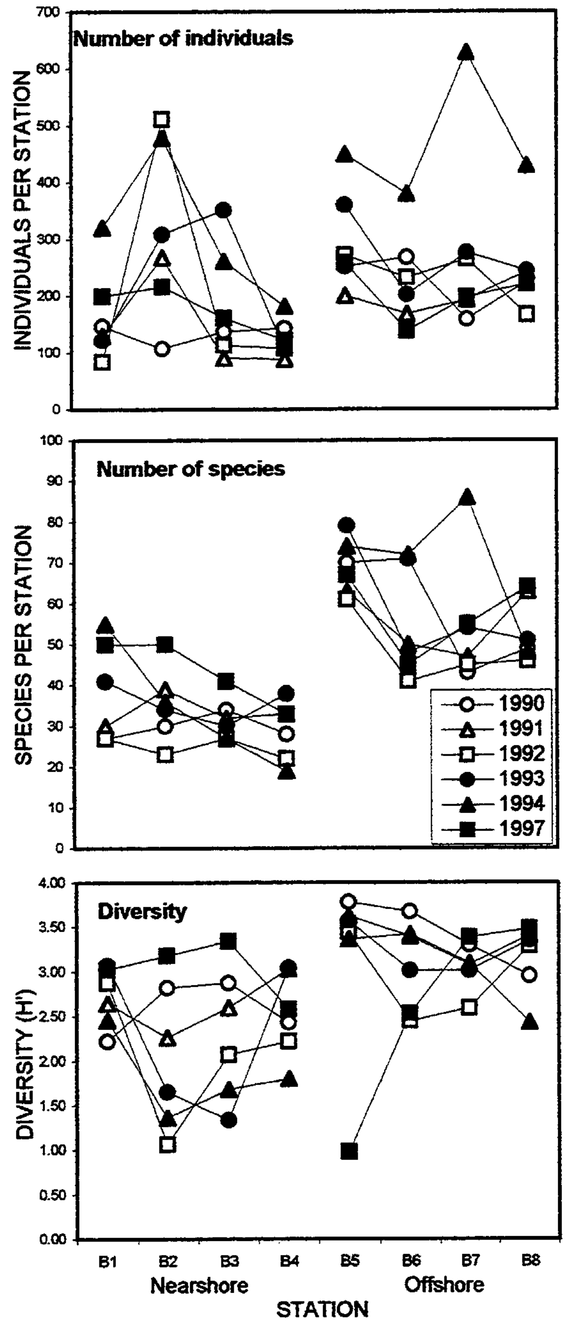

Figure 19. Numbers of infaunal individuals and species, and Shannon-Wiener species diversity (H') 1990 to 1997. El Segundo and Scattergood Generating Stations NPDES, 1997

Fish and Macroinvertebrates

Fish

Eight heat treatments were conducted at both SGS and ESGS from 1 October 1996 to 30 September 1997. Impingement abundance, and species richness were similar between the two stations; however, ESGS contributed almost 63% of the biomass. Biomass at ESGS was higher than the 19 year average, while biomass at SGS was lower than the 12 year average. Fifty-four species were taken overall: 53 at SGS, and 45 at ESGS. The 22 most abundant species in 1997 were present at both stations and accounted for over 99% of the combined abundance (Appendix G-2). None of the 10 species that occurred at only one station were unique; they are common species in impingement catches and have occurred at both stations in the past.

Although, overall abundance patterns for both stations for most species were similar, some species were more abundant at one or the other of the generating stations. Jacksmelt, for instance, was very abundant at ESGS, accounting for more than 32% of the station's abundance, but it was less than 2% of the catch at SGS. Conversely, topsmelt accounted for 11.3% of the catch at SGS, but only 1% at ESGS. Yellowfin croaker, Pacific sardine, salema, grunion, barred sandbass, and kelp bass also exhibited similar mixed distribution patterns with substantially more of the species caught at one station over the other. The reason for the disparity in catch between SGS and ESGS is probably related to varying types of substrate typical in the area of the intakes.

Queenfish was the most abundant species in 1997 and was ranked first overall in impingement catches during six of the last eight years (Table 14). They are also a major portion of trawl catches in the nearshore Southern California Bight and they are similarly abundant in impingement and trawl catches throughout most of the bight (MBC unpubl. impingement and 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.

Jacksmelt and topsmelt, from the Family Atherinidae, were abundant, ranking second and fifth, respectively, in 1997. Their average rank was fourth and second, respectively, for the last eight years (Table 14). 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 an important part of 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).

Northern anchovy were third in abundance in 1997. This species forms large pelagic schools which by chance encounter the intake currents. They have not been particularly abundant at ESGS or SGS in the last eight years and their average rank fails to place them in the most abundant 20 species taken in that time period; they are not an important component of the fish fauna at either station (Table 14).

Pacific sardine was the ninth most abundant species in 1997. 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

Table 14. Ranks of the most abundant fish species impinged during heat treatments at El Segundo and Scattergood Generating Stations, 1990 to 1997. El Segundo and Scattergood Generating Stations NPDES, 1997

	Scattergood and El Segundo Heat Treatments								
Species	1990	1991	1992	1993	1994	1995	1996	1997	Average
Seriphus politus	1	1	5	1	4	1	1	1	1.9
Atherinops affinis	4	2	2	6	6	3	3	5	3.9
Xenistius californiensis	7	3	10	4	8	5	8	4	6.1
Atherinopsis californiensis	12	17	6	3	2	6	5	2	6.6
Hyperprosopon argenteum	9	10	3	9	12	7	9	7	8.3
Genyonemus lineatus	8	14	11	15	5	5	4	8	8.7
Sebastes paucispinis	-	18	-	-	-	-	55	-	9.1
Chromis punctipinnis	2	5	4	8	11	11	18	16	9.4
Paralabrax clathratus	3	9	7	10	14	12	15	10	10.0
Paralabrax nebulifer	6	8	9	14	9	14	11	12	10.4
Anisotremus davidsonii	5	7	8	5	10	21	20	15	11.4
Umbrina roncador	17	19	13	19	13	10	7	6	13.0
Phanerodon furcatus	16	11	15	13	20	20	12	14	15.1
Leuresthes tenuis	10	12	-	17	33	8	36	11	15.9
Cheilotrema saturnum	18	15	17	18	15	18	17	13	16.3
Peprilus simillimus	13	13	28	12	19	33	14	31	20.4
Medialuna californiensis	14	23	16	20	17	24	28	25	20.8
Rhacochilus toxotes	23	21	14	24	28	29	21	22	22.7
Damalichthys vacca	19	16	19	22	36	23	35	20	23.7
Porichthys notatus	11	6	22	32	30	36	27	29	24.1

plants as evidenced by their regular impingement at the power plants since 1990 (MBC 1990a - 1993a, 1994, 1995, and 1996). This parallels their recent rise in abundance in California waters as their population expands (Love 1991).

Barred sand bass and kelp bass are relatively important sport fish and are of concern to the resource agencies charged with their management. Each of these species was abundant among the fish impinged at both generating stations. About one-fourth as many kelp bass were entrained at SGS than at ESGS; conversely, barred sand bass entrainment was five fold greater at SGS than at ESGS (Appendix G-2). Although both species are attracted to high-relief areas such as intakes, they utilize the areas slightly differently.

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.

Four other species with a high average rank in the most abundant species were salema (*Xenistius californiensis*), walleye surfperch (*Hyperprosopon argenteum*), white croaker (*Genyonemus lineatus*), and blacksmith (*Chromis punctipinnis*) (Table 14). Blacksmith is a species that associates with reef structures, such as the intake, for foraging and shelter (Love 1991). Salema are mid-water schooling fishes found in shallow water (Love 1991). White croaker and walleye surfperch are nocturnal feeding species which form schools during the daylight hours (Love 1991). All four of these species occurred in similar abundances in the prior three years.

Length-frequency histograms of the queenfish, northern anchovy, and kelp and barred sand bass populations indicated similar populations impinged at both SGS and at ESGS. Most histograms were relatively smooth curves, indicating that the intake is impinging a cross section of the population found in the nearshore waters.

The queenfish population distribution histogram was bimodal at SGS and displayed a single mode at ESGS. Queenfish were most abundant in the impingement catch at 70 mm SL at SGS, corresponding to young-of-the-year (YOTY) indicating the presence of a spring spawn. A second mode at 120 mm SL corresponds to two-year-old fish (Love 1991). At ESGS, queenfish were most abundant at 100 mm SL or one-year-old fish (Love 1991). This is probably the same age cohorts as the YOTY entrained earlier in the year at SGS.

The majority of the northern anchovy population at SGS was centered at 80 mm SL, whereas, at ESGS the population centered near 110 mm SL. The population distribution at SGS indicated the presence of a new year class as the YOTY were turning age-one. The population at ESGS were composed of mostly age-two fish (Love 1991).

Entrained and impinged barred sand bass population ranged from two-year-old to five-year-old individuals (170 to 290 mm SL) (Love 1991). Most of the kelp bass population (190 to 290 mm SL) were three-year-old to five-year-old fish at ESGS (Hulbrock 1974). The distribution of barred sand bass at ESGS were relatively uniform across the population, whereas the population peaked at age-three fish at SGS. There was a small peak of six-year olds at 300 mm SL at SGS. The kelp bass population distribution indicated a majority of two-year-old fish at SGS and one, two, and three-year-old fish at ESGS. The population distributions for both species have been almost identical for the last seven years, indicating there have been no discernable effects on the populations offshore by the generating stations (MBC 1990a - 1993a, 1994, 1995, and 1996).

Abundant species were ranked for each of the last five years and ranks were then averaged to determine the most abundant species for the eight-year period (Table 14). Eighteen of the 20 most abundant species over the last eight years occurred among the 20 most abundant during each year; all 18 of those species were present in 1997. 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 1997 and from SGS from 1986 to 1997 (Table 15). Impingement biomass for 1997 at ESGS was about 120% of its long term mean; however, at SGS it was only 50% of its long-term mean. Impingement data from SGS indicate that fish biomass was lowest in 1993, continuing 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 (thus heavier) pelagic schooling species jack mackerel, jacksmelt, and Pacific sardine.

Although the biomass taken at ESGS in 1997 is larger than the mean biomass, it is only half of the biomass seen prior to 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 1,001 kg per year. The almost 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 Southern California Edison's 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.). The reasons for the increase in impingement in 1997 are unknown as demand for electricity was not much greater than during the past decade. It may be related, however, to the ongoing effects of a large El Niño Southern Oscillation Event (ENSO) which is bringing southern ocean currents with warmer-than-normal temperatures. These events have been known to cause marked changes in abundance of certain species.

Table 15. Biomass (kg) of fish impinged during heat treatments at El Segundo and Scattergood Generating Stations, 1979 to 1997. El Segundo and Scattergood Generating Stations NPDES, 1997

	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	1712.60	1726.14	1005.58
Mean	425.47568	1001.1103	1426.586	2112.38

NA = Data not available

Macroinvertebrates

Macroinvertebrate populations were similar at both stations. Rock crabs, red striped shrimp, and tuberculate pear crabs were the most abundant species at both generating stations. The ocher seastar was abundant at ESGS and was only rarely seen at SGS; however, it is likely that the unusual number of ocher seastars noted at ESGS are the result of a serendipitous spawning that took place within the intake conduits during an extended station outage during which period no heat treatments were conducted (R. Harnsberger 1997, pers. comm.). The relative abundances of two-spot octopus and California spiny lobster were also similar between the two generating stations. Although lobsters were slightly smaller at SGS, most of the population was greater than the legal size limit (approximately 83 mm carapace length); the population at ESGS was slightly larger overall and most were greater than legal size (CFD&G 1997). Overall species diversity, abundance, and biomass were relatively similar between power plants, and were similar to prior years (MBC 1990a - 1993a, 1994, 1995, and 1996).

CONCLUSIONS

Water quality measurements indicated that discharged effluent from the El Segundo and Scattergood Generating Stations had no adverse effects on receiving waters in the study area. Temperature, dissolved oxygen, and pH measurements were within ranges considered normal for Santa Monica Bay. Observed minor fluctuations in dissolved oxygen and pH values most likely reflect temporal and spatial variation, and do not imply any effect by the generating stations on the environment.

Sediments in the study area were mostly sand, with a mean grain size in the very fine sand category. Generally, sediments were finer and better sorted offshore than nearshore, a pattern attributable to the greater turbulence nearshore. No patterns were apparent relative to the discharges.

The distribution of metals in the sediments of the study area do not appear to be related to the generating station discharges. Highest concentrations were located upcoast of the discharges and were related to the amount of fine material in the sediments. Sediment metal levels were within the range of variability noted in past surveys.

The benthic infaunal community in the study area was similar to that of previous years. Species richness averaged 51 species per station, which was above the average from 1990 to 1994. Abundance averaged 189 individuals per station (4,725 individuals/m^2), which was slightly below the average. Polychaete annelids were the most abundant organisms. In general, abundance and species richness were greater offshore than nearshore, with highest values at Station B5, furthest upcoast, where sediments were finest. No pattern related to the generating station outfalls was noted.

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 eight years, indicate that the Scattergood and El Segundo Generating Stations are not unduly influencing the fish and macroinvertebrate communities offshore.

Overall, the results of the 1997 monitoring study suggest that the beneficial uses of the receiving water continue to be maintained and protected.

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APPENDIX A

Receiving water monitoring specifications
El Segundo and Scattergood Generating Stations NPDES, 1997

Appendix A-1. Letter of authorization. Los Angeles Department of Water and Power, NPDES 1997.

STATE OF CALIFORNIA—ENVIRONMENTAL PROTECTION AGENCY PETE WILSON, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION
101 CENTRE PLAZA DRIVE
MONTEREY PARK, CA 91754-2156
(213) 266-7500
FAX: (213) 266-7600

May 18, 1995

Mr. Norman N. Nichols, General Manager
Department of Water and Power
City of Los Angeles
P.O. Box 111
Los Angeles, California 90051

MONITORING AND REPORTING PROGRAM REQUIREMENTS:
SCATTERGOOD GENERATING STATION (CA0000370, M1886)
HAYNES GENERATING STATION (CA0000353, M2769)
HARBOR GENERATING STATION (CA0000361, M2020)

As you know, the Waste Discharge Requirements adopted on February 27, 1995, for your three generating stations identified the Regional Board's need for an information management system to store and analyze monitoring program data. Creation of a regional database will allow more effective use of monitoring data to make management decisions for the protection of beneficial uses and public resources. Creation of such a database is one component of the transition to the development of a comprehensive regional monitoring program for nearshore ocean waters.

The City of Los Angeles' Department of Water and Power and Southern California Edison Company have agreed to provide a combined total of up to $290,000 towards the creation of a regional database. To compensate for this contribution, United States Environmental Protection Agency and Los Angeles Regional Board staff have agreed to reduce the required Receiving Water Monitoring Program for 1995. We hope to implement a redesigned regional monitoring program during the summer of 1996, and anticipate substantial modifications to the Monitoring and Reporting Requirements for your six generating stations to allow your participation in this new comprehensive monitoring plan. You will be notified in advance of any such changes to your monitoring programs.

Mr. Norman E. Nichols
Page 2

For 1995, the receiving water monitoring program at each generating station shall consist of the following:

1. Receiving water monitoring stations shall be maintained at the normal locations for each generating station.

2. Temperature-depth profiles shall be taken semi-annually (May and November, if practicable) at all receiving water monitoring stations. These profiles shall be measured from surface to bottom at depth intervals sufficient to define the temperature gradient. Dissolved oxygen and pH shall be measured at the surface, mid-depth and bottom, at a minimum, each time that a temperature profile is taken.

3. The following general observations or measurements shall be reported for each sampling period:

   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 materials.
   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.

4. The fish trawling, benthic infaunal sampling, sediment chemistry sampling, and bioaccumulation sampling components may be discontinued until otherwise directed by the Executive Officer.

The above changes are effective immediately. We appreciate your interest in and support of regional monitoring and a regional database. If you have any questions, please telephone me at (213) 266-7510 or Michael Lyons at (213) 266-7616.

Catherine Tyrrell

for ROBERT P. GHIRELLI, D.Env.
Executive Officer

cc: Environmental Protection Agency, Region 9, Permits Section (W-5-1)
Dr. Mark Gold, Director, Heal the Bay
Ms. Susan Damron, City of Los Angeles, Dept. of Water and Power, Environmental and Governmental Affairs

Appendix A-2. Letter of authorization. Southern California Edison Company, NPDES 1997.

STATE OF CALIFORNIA—ENVIRONMENTAL PROTECTION AGENCY PETE WILSON, Governor

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LOS ANGELES REGION
101 CENTRE PLAZA DRIVE
MONTEREY PARK, CA 91754-2156
(213) 266-7500
FAX: (213) 266-7600

May 18, 1995

Mr. John Fielder, Vice President
Southern California Edison Company
2244 Walnut Grove Avenue
Rosemead, California 91770

MONITORING AND REPORTING PROGRAM REQUIREMENTS:
ALAMITOS GENERATING STATION (CA0001139, M6113)
EL SEGUNDO GENERATING STATION (CA0001147, M4667)
REDONDO GENERATING STATION (CA0001201, M0536)
LONG BEACH GENERATING STATION (CA0001171, M5764)
ORMOND BEACH GENERATING STATION (CA0001198, M5619)
MANDALAY GENERATING STATION (CA0001180, M2093)

As you know, the Waste Discharge Requirements adopted on December 5, 1994, for your six generating stations identified the need for an information management system to store and analyze monitoring program data. Creation of a regional database will allow more efective use of monitoring data to make management decisions for the protection of beneficial uses and public resources. Creation of such a database is one component of the transition to the development of a comprehensive regional monitoring program for nearshore ocean waters.

Southern California Edison Company and the City of Los Angeles' Department of Water and Power have agreed to provide a combined total of up to $290,000 towards the creation of a regional database. To compensate for this contribution, United States Environmental Protection Agency and Los Angeles Regional Board staff have agreed to reduce the required Receiving Water Monitoring Program for 1995. We hope to implement a redesigned regional monitoring program during the summer of 1996, and anticipate substantial modifications to the Monitoring and Reporting Requirements for your six generating stations to allow your participation in this new comprehensive monitoring plan. You will be notified in advance of any such changes to your monitoring programs.

For 1995, the receiving water monitoring program at each generating station shall consist of the following:

1. Receiving water monitoring stations shall be maintained at the normal locations for each generating station.

Mr. John Fielder
Page 2

2. Temperature-depth profiles shall be taken semi-annually (summer and winter) at all receiving water monitoring stations. These profiles shall be measured from surface to bottom at depth intervals sufficient to define the temperature gradient. Dissolved oxygen and pH shall be measured at the surface, mid-depth and bottom, at a minimum, each time that a temperature profile is taken.

3. The following general observations or measurements shall be reported for each sampling period:

   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 materials.
   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.

4. Fish trawling, benthic infaunal sampling, sediment chemistry, bioaccumulation sampling components may be discontinued until otherwise directed by the Executive Officer.

The above changes are effective immediately. We appreciate your interest in and support of regional monitoring and a regional database. If you have any questions, please telephone me at (213)266-7510 or Michael Lyons at (213)266-7616.

Catherine Tyrrell

ROBERT P. GHIRELLI, D.Env.
Executive Officer

cc: U.S. Environmental Protection Agency, Region 9, Permits Section (W-5-1)
Dr. Mark Gold, Director, Heal the Bay
Dr. David W. Kay, D.Env., Environmental Affairs, Southern California Edison Company

Appendix A-3. Receiving water monitoring specifications. El Segundo and Scattergood Generating Station NPDES, 1997.

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.

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. 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 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 (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.

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

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).

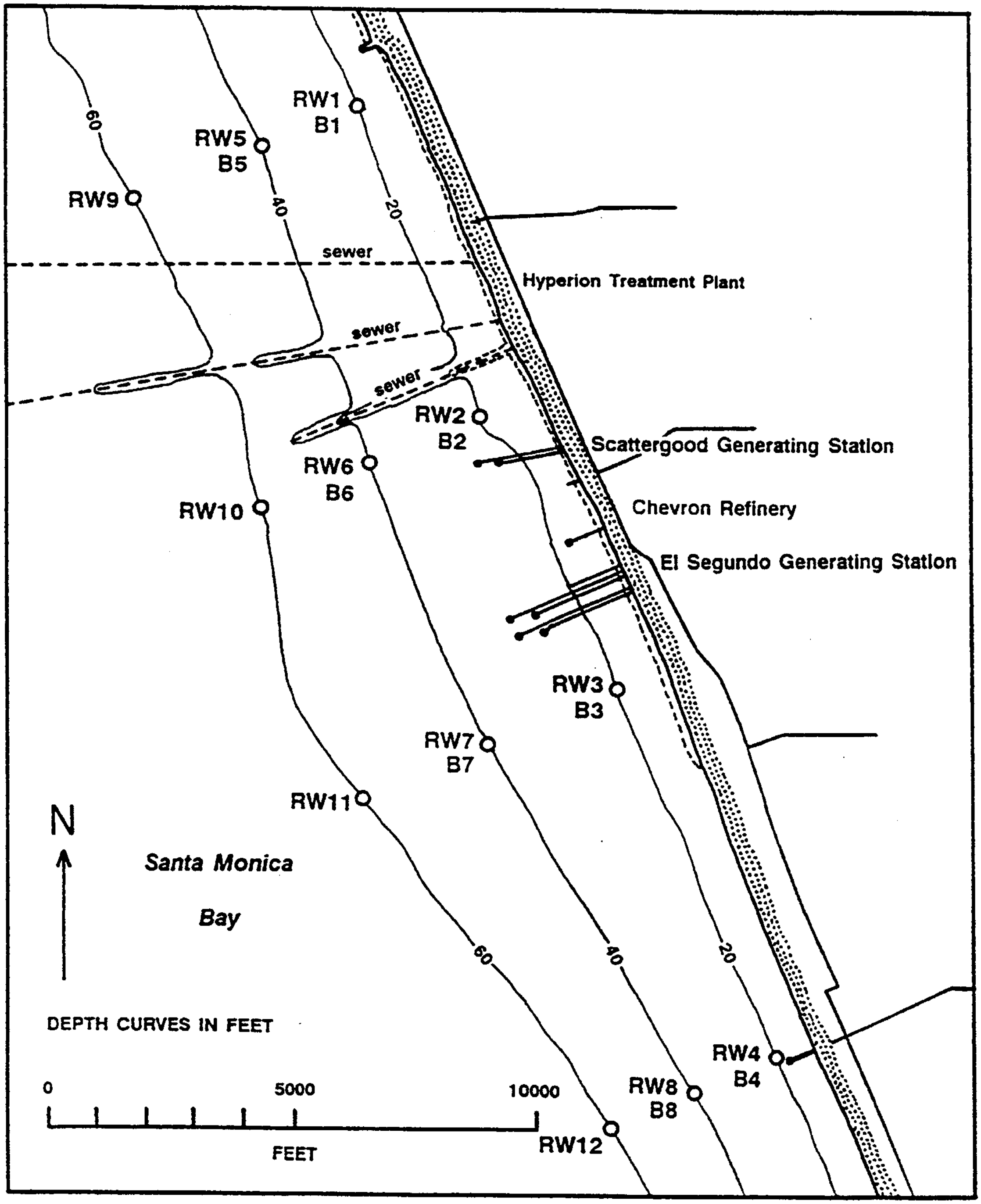
Ordered by: Robert P. Ghirelli
ROBERT P. GHIRELLI, D.Env.
Executive Officer

Date: February 27, 1995

CDS\

Appendix A-3. (Cont.).

Monitoring and Reporting Program No. 1886 CA0000370
City of Los Angeles, Dept. of Water and Power
Scattergood Generating Station



Scattergood Receiving Water Monitoring Stations.

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. <u>Receiving Water Monitoring</u>

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):

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.

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

CA0001147

SUMMARY OF RECEIVING WATER MONITORING

Constituents	Units	Station No.	Type of Sample	Minimum Frequency of Analysis
Temperature	^0C	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.

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

CA0001147

IV. STORM WATER MONITORING AND REPORTING

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

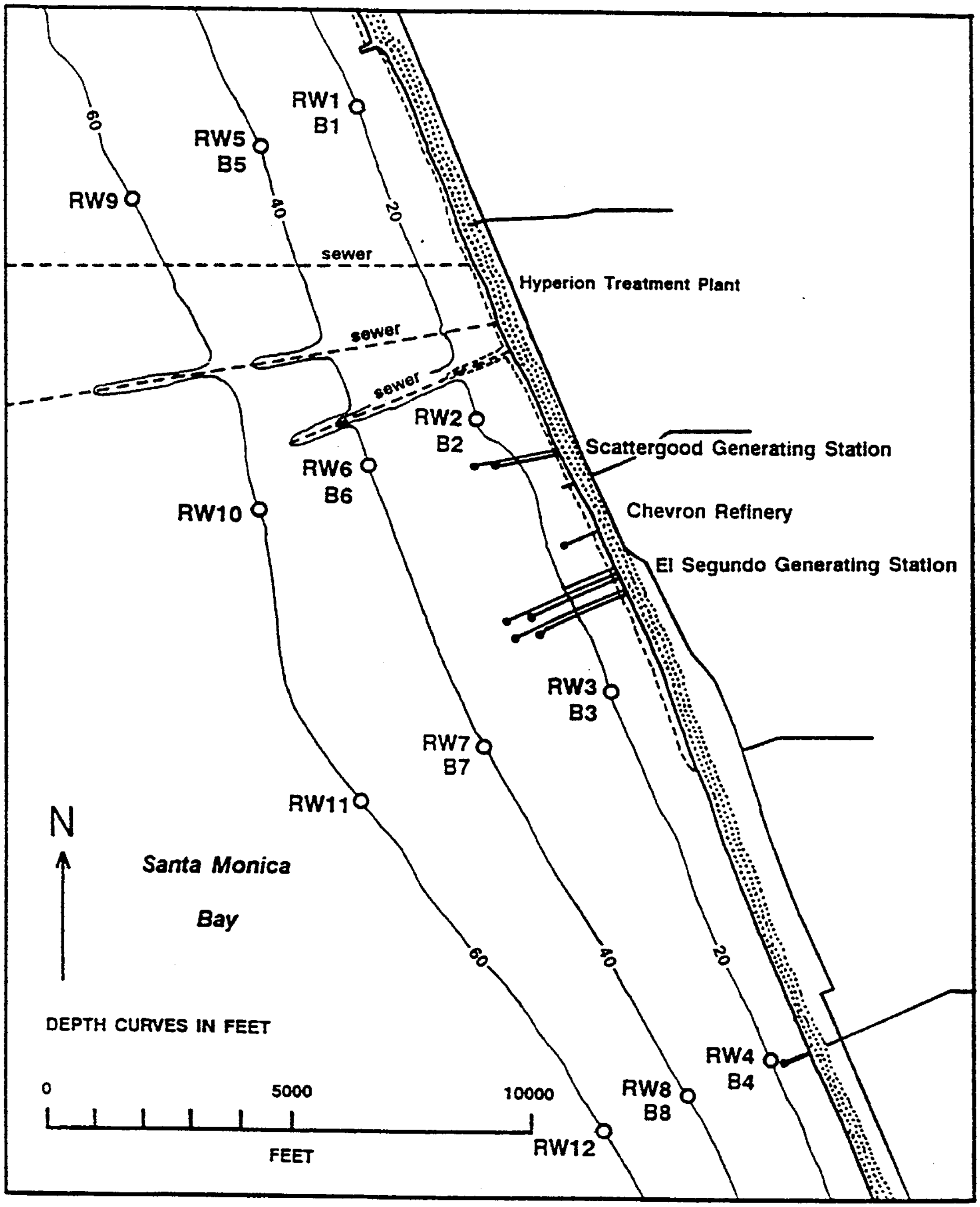
Ordered By: Robert P. Ghirelli
ROBERT P. GHIRELLI, D.Env.
Executive Officer

Date: December 5, 1994

/RNA

Appendix A-4. (Cont.).

Monitoring and Reporting Program No. 4667 CA0001147
Southern California Edison
El Segundo Generating Station



El Segundo 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 sand size range (2.0 mm through 0.063 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 silt-clay fraction of the sediments [4 phi through 8 phi (0.063 mm through >0.0039 mm) for silt, 8 phi and greater for clay (0.0039 mm and smaller)] is analyzed by the hydrometer method. The sample is suspended in a column of water and changes in density of the suspension (produced by the various settling rates of different size particles) is measured over time with a hydrometer.

The weight of sediment retained on each screen and density and time interval data from the hydrometer analysis are 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.

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

Sharp and Fan (1963) sorting is another measure of the evenness with which particles are apportioned among size classes. The index ranges from 0 to 100 (i.e., essentially a percentile measure), with 0 indicating that particles are distributed absolutely evenly among size classes and 100 being completely sorted (i.e., all particles falling within a single size class).

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 ($\beta_\phi < 1$). β_ϕ = 1.00 for a normal curve. Curve category interpretations are based on Folk (1974).

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

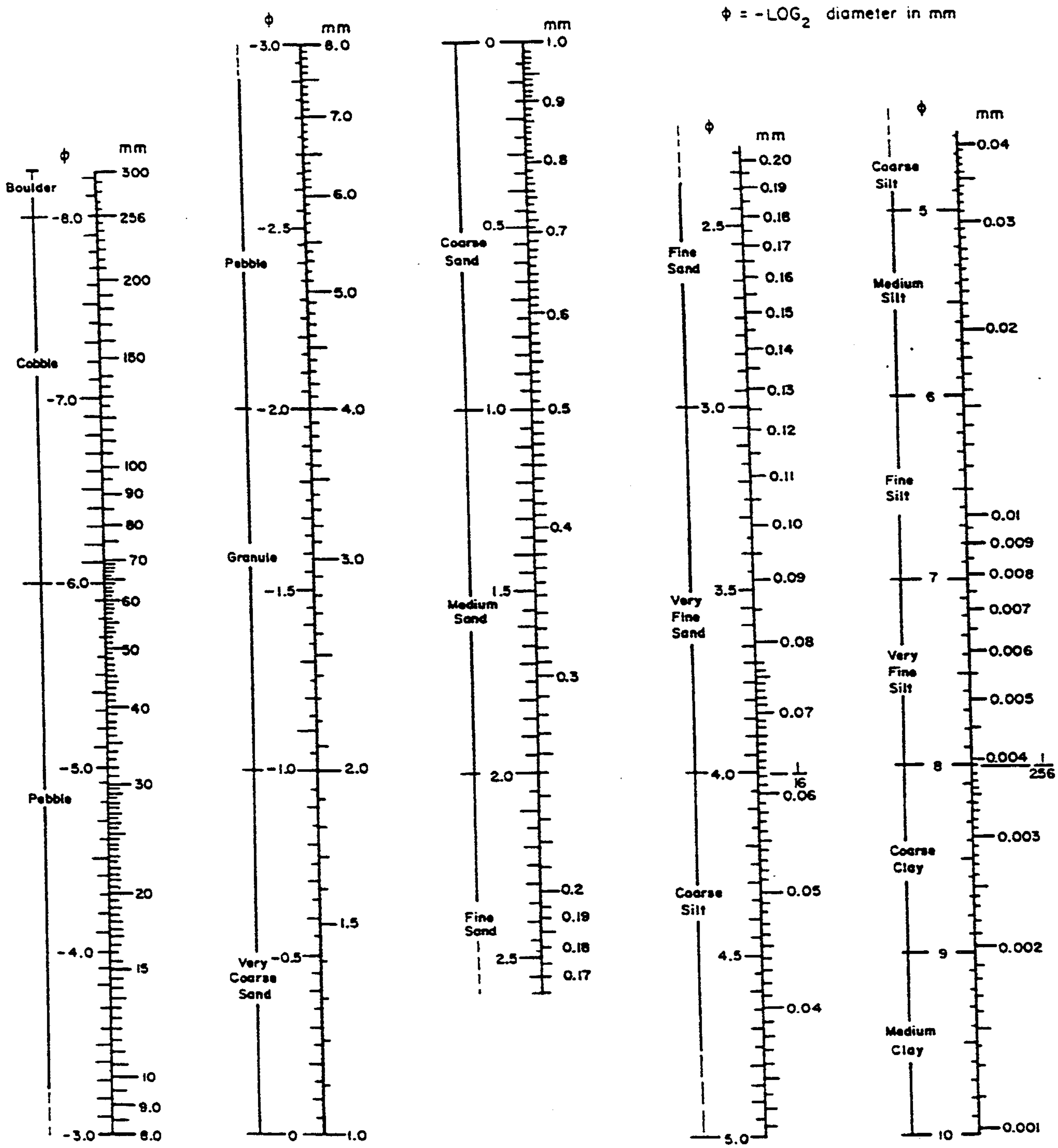
LITERATURE CITED

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.

Sharp, W. E., and P. F. Fan. 1963. A sorting index. J. Geology. 71(1):76-84.

Appendix B. (Cont.).



APPENDIX C

Water quality profiles at receiving water monitoring stations
El Segundo and Scattergood Generating Stations NPDES, 1997

Appendix C-1. Water quality parameters at receiving water monitoring stations during ebb and flood tides*. El Segundo and Scattergood Generating Stations NPDES, winter 1997.

Flood Tide

RW1

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.47	9.71	8.31
1	15.48	9.68	8.31
2	15.45	9.74	8.31
3	15.44	9.76	8.30
4	15.07	9.40	8.26
5	14.49	8.84	8.19

RW2

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	16.39	9.70	8.51
1	16.43	9.75	8.53
2	16.35	9.66	8.49
3	16.16	9.76	8.45
4	15.99	8.94	8.39
5	15.76	8.96	8.35
6	15.63	8.78	8.33

RW3

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	16.13	9.12	8.49
1	16.12	9.02	8.49
2	16.14	9.21	8.50
3	16.15	9.29	8.50
4	16.16	9.33	8.50
5	16.16	9.33	8.50
6	16.15	9.31	8.49
7	16.09	9.12	8.48

RW4

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	16.19	9.92	8.49
1	16.18	9.85	8.49
2	16.20	9.99	8.49
3	16.15	9.04	8.48
4	15.96	9.85	8.45
5	15.91	9.48	8.44
6	15.85	9.31	8.41
7	15.64	9.72	8.34

RW5

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.72	9.27	8.46
1	15.82	9.26	8.47
2	15.62	9.28	8.44
3	15.35	9.00	8.40
4	15.19	9.03	8.38
5	15.11	8.80	8.36
6	14.94	8.60	8.35
7	14.61	8.52	8.31
8	14.17	8.73	8.27
9	13.65	8.50	8.20
10	13.54	8.35	8.18
11	13.47	7.80	8.15

RW6

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.97	9.30	8.50
1	16.03	9.40	8.51
2	15.91	9.19	8.50
3	15.70	9.02	8.47
4	15.50	9.42	8.42
5	15.30	9.67	8.37
6	15.11	9.89	8.30
7	15.04	9.14	8.28
8	14.99	8.73	8.27
9	14.91	8.67	8.28
10	14.86	8.66	8.28
11	13.89	8.72	8.20

RW7

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.63	9.65	8.39
1	15.66	9.70	8.40
2	15.60	9.60	8.39
3	15.44	9.80	8.36
4	15.38	9.78	8.34
5	15.35	9.62	8.33
6	15.26	9.54	8.31
7	15.16	9.80	8.30
8	15.07	9.76	8.29
9	15.01	9.70	8.28
10	14.82	9.41	8.26
11	13.59	7.55	8.12

RW8

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	16.05	9.59	8.51
1	16.06	9.61	8.52
2	16.03	9.56	8.51
3	15.94	9.43	8.48
4	15.68	9.87	8.40
5	15.45	9.58	8.34
6	15.29	9.57	8.29
7	15.25	9.55	8.28
8	15.13	9.66	8.25
9	15.02	9.36	8.24
10	14.83	9.12	8.22
11	14.66	8.80	8.20

RW9

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.95	9.34	8.53
1	16.02	9.46	8.54
2	15.89	9.22	8.51
3	15.61	9.05	8.45
4	15.32	8.98	8.41
5	14.91	8.72	8.37
6	14.45	8.46	8.30
7	14.04	8.68	8.26
8	13.78	8.64	8.23
9	13.66	8.69	8.22
10	13.53	8.46	8.20
11	13.33	8.19	8.17
12	13.24	7.89	8.16
13	13.22	7.80	8.16
14	13.20	7.72	8.15
15	13.19	7.63	8.14
16	12.96	7.61	8.10
17	12.49	6.48	7.98

RW10

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.44	9.38	8.40
1	15.50	9.32	8.41
2	15.37	9.43	8.40
3	14.88	9.05	8.31
4	14.72	9.03	8.28
5	14.60	9.46	8.26
6	14.52	9.28	8.26
7	14.49	9.27	8.26
8	14.38	9.16	8.25
9	14.33	9.07	8.25
10	14.31	9.09	8.26
11	14.28	9.12	8.26
12	14.24	9.09	8.25
13	14.21	9.04	8.25
14	13.96	8.94	8.22
15	13.33	8.57	8.16
16	12.66	7.54	8.07
17	12.39	6.52	8.03
18	12.21	5.71	8.01

RW11

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.91	10.45	8.50
1	15.97	10.49	8.51
2	15.85	10.40	8.49
3	15.57	10.09	8.46
4	15.16	9.50	8.39
5	15.02	9.26	8.35
6	14.95	9.54	8.33
7	14.89	9.34	8.32
8	14.80	9.15	8.30
9	14.50	9.11	8.25
10	14.34	9.22	8.23
11	14.31	8.92	8.22
12	14.30	8.78	8.22
13	14.29	8.72	8.21
14	14.26	8.66	8.20
15	14.23	8.57	8.19
16	13.71	8.44	8.12
17	13.10	7.33	8.08
18	12.94	6.34	8.06

RW12

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.72	9.79	8.48
1	15.71	9.74	8.48
2	15.73	9.83	8.48
3	15.67	9.96	8.49
4	15.59	9.04	8.47
5	15.53	9.82	8.45
6	15.36	9.44	8.42
7	15.16	8.89	8.39
8	15.06	8.75	8.37
9	14.82	8.73	8.33
10	14.70	8.79	8.30
11	14.52	8.67	8.27
12	14.31	9.63	8.23
13	13.96	8.70	8.17
14	13.67	8.27	8.14
15	13.62	7.97	8.14
16	13.58	7.68	8.13
17	13.55	7.55	8.13

* Data provided by Entrix

Appendix C-1. (Cont.)

Ebb Tide

RW1

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	14.71	8.87	8.20
1	14.73	8.85	8.20
2	14.70	8.88	8.20
3	14.68	8.88	8.19
4	14.40	8.87	8.18
5	14.21	8.65	8.16
6	13.99	8.36	8.14

RW2

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.16	9.22	8.24
1	15.19	9.17	8.24
2	15.14	9.27	8.24
3	15.02	9.30	8.23
4	14.75	9.32	8.22
5	14.46	9.24	8.23
6	14.34	9.26	8.19

RW3

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	14.96	8.92	8.24
1	15.07	8.90	8.25
2	14.85	8.94	8.24
3	14.60	8.91	8.22
4	14.32	8.93	8.18
5	14.14	8.76	8.22
6	13.88	8.72	8.20

RW4

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.62	10.32	8.31
1	15.63	10.34	8.31
2	15.60	10.31	8.30
3	15.55	10.28	8.31
4	15.47	10.27	8.29
5	15.40	10.12	8.28
6	15.36	9.93	8.27
7	15.30	9.80	8.26

RW5

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.19	9.51	8.26
1	15.21	9.50	8.26
2	15.18	9.53	8.27
3	15.06	9.62	8.28
4	14.75	9.73	8.28
5	14.19	9.77	8.24
6	13.62	9.42	8.18
7	13.50	8.87	8.16
8	13.50	8.44	8.15
9	13.47	8.22	8.15
10	13.36	8.13	8.13
11	13.14	7.85	8.10

RW6

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.39	9.43	8.27
1	15.42	9.41	8.27
2	15.36	9.45	8.28
3	15.19	9.52	8.29
4	14.80	9.64	8.28
5	13.91	9.71	8.22
6	13.71	9.30	8.19
7	13.70	8.91	8.19
8	13.62	8.76	8.18
9	13.59	8.56	8.16
10	13.45	8.41	8.15
11	12.95	8.36	8.08
12	12.61	7.41	8.04
13	12.45	6.69	8.02

RW7

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.04	9.68	8.26
1	15.30	9.68	8.28
2	14.79	9.68	8.25
3	13.69	9.33	8.15
4	13.23	8.53	8.10
5	13.24	7.84	8.12
6	13.05	7.66	8.09
7	12.96	7.39	8.07
8	12.91	7.17	8.08
9	12.86	7.08	8.07
10	12.81	7.02	8.06
11	12.71	6.83	8.05

RW8

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.52	10.38	8.32
1	15.58	10.37	8.32
2	15.46	10.39	8.32
3	15.38	10.39	8.32
4	15.36	10.40	8.32
5	15.25	10.42	8.30
6	15.11	10.28	8.25
7	15.06	9.80	8.25
8	14.95	9.43	8.23
9	14.78	9.30	8.21
10	14.60	8.91	8.19

RW9

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.17	10.21	8.32
1	15.29	10.19	8.32
2	15.05	10.24	8.31
3	14.66	10.21	8.30
4	13.94	10.09	8.23
5	13.41	9.37	8.15
6	13.33	8.51	8.15
7	13.31	7.93	8.14
8	13.27	7.91	8.14
9	13.25	7.80	8.13
10	13.23	7.75	8.13
11	13.18	7.73	8.12
12	13.14	7.68	8.11
13	13.12	7.59	8.11
14	13.09	7.52	8.10
15	12.96	7.48	8.08
16	12.49	7.41	8.03

RW10

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.25	10.18	8.31
1	15.33	10.16	8.31
2	15.17	10.20	8.31
3	14.87	10.20	8.30
4	14.16	10.11	8.26
5	13.77	9.68	8.22
6	13.43	9.31	8.18
7	13.16	8.69	8.14
8	13.06	8.10	8.12
9	12.95	7.64	8.10
10	12.64	7.41	8.07
11	12.31	6.90	8.03
12	12.21	6.61	8.01
13	12.07	6.23	7.99
14	11.95	6.02	7.98
15	11.92	5.92	7.98
16	11.90	5.83	7.98
17	11.89	5.75	7.97
18	11.90	5.69	7.97

RW11

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.46	10.43	8.32
1	15.50	10.42	8.32
2	15.42	10.45	8.32
3	15.10	10.44	8.30
4	14.04	10.27	8.23
5	13.45	9.43	8.17
6	13.32	8.57	8.15
7	13.25	8.13	8.13
8	13.09	7.84	8.08
9	12.87	7.34	8.06
10	12.44	6.84	8.02
11	11.99	6.32	7.99
12	11.84	5.91	7.98
13	11.79	5.64	7.97
14	11.76	5.55	7.97
15	11.68	5.48	7.96
16	11.58	5.40	7.95
17	11.53	5.29	7.95

RW12

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	15.38	10.72	8.33
1	15.47	10.68	8.34
2	15.30	10.76	8.33
3	15.21	10.62	8.32
4	15.12	10.49	8.32
5	15.01	10.40	8.31
6	14.90	10.27	8.30
7	14.79	10.16	8.28
8	14.63	9.92	8.25
9	14.56	9.58	8.25
10	14.45	9.48	8.23
11	14.29	9.28	8.20
12	14.20	8.93	8.19
13	14.15	8.64	8.18
14	14.06	8.58	8.17
15	13.65	8.36	8.13
16	13.12	7.73	8.07
17	12.67	6.95	8.04

Appendix C-2. Water quality parameters at receiving water monitoring stations during ebb and flood tides*. El Segundo and Scattergood Generating Stations NPDES, summer 1997.

Flood Tide

RW1

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.78	7.27	8.42
1	20.73	7.26	8.42
2	20.71	7.28	8.42
3	20.53	7.32	8.41
4	19.84	7.25	8.41
5	19.37	7.27	8.41
6	18.92	7.39	8.41

RW2

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.99	7.35	8.43
1	20.94	7.34	8.43
2	20.91	7.35	8.43
3	20.76	7.37	8.43
4	19.84	7.37	8.42
5	19.11	7.23	8.41
6	18.94	7.26	8.41

RW3

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	21.17	7.20	8.43
1	21.15	7.18	8.43
2	21.07	7.22	8.44
3	20.91	7.26	8.44
4	20.49	7.34	8.43
5	19.79	7.31	8.42
6	19.09	7.32	8.42

RW4

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	21.40	7.24	8.46
1	21.43	7.23	8.46
2	21.26	7.25	8.46
3	21.23	7.31	8.47
4	21.24	7.42	8.47
5	21.21	7.47	8.48
6	21.15	7.50	8.48

RW5

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.08	7.39	8.42
1	20.03	7.38	8.42
2	20.01	7.39	8.42
3	19.96	7.40	8.42
4	19.84	7.41	8.42
5	19.60	7.40	8.42
6	19.27	7.44	8.42
7	19.09	7.48	8.42
8	18.98	7.54	8.42
9	18.84	7.58	8.42
10	18.68	7.62	8.42
11	18.55	7.67	8.42

RW6

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	19.99	7.44	8.43
1	20.24	7.42	8.43
2	19.62	7.45	8.43
3	19.23	7.44	8.43
4	19.06	7.52	8.43
5	18.79	7.56	8.43
6	18.75	7.63	8.43
7	18.70	7.68	8.42
8	18.54	7.70	8.42
9	18.41	7.71	8.42
10	18.13	7.72	8.41
11	17.14	7.69	8.40

RW7

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.31	7.39	8.44
1	20.31	7.37	8.44
2	20.18	7.40	8.44
3	19.75	7.42	8.43
4	19.20	7.44	8.43
5	19.03	7.47	8.43
6	18.95	7.53	8.43
7	18.74	7.56	8.43
8	18.67	7.59	8.43
9	18.60	7.62	8.43
10	18.51	7.64	8.43
11	18.15	7.71	8.42

RW8

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	21.21	7.32	8.46
1	21.17	7.30	8.46
2	21.13	7.35	8.47
3	21.10	7.39	8.47
4	21.04	7.43	8.47
5	21.02	7.46	8.47
6	21.00	7.50	8.47
7	20.97	7.51	8.47
8	20.80	7.51	8.47
9	20.33	7.50	8.45
10	19.80	7.43	8.44
11	19.20	7.39	8.43

RW9

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	19.45	7.53	8.42
1	19.40	7.53	8.42
2	19.39	7.54	8.42
3	19.37	7.55	8.42
4	19.37	7.56	8.42
5	19.34	7.57	8.42
6	19.24	7.59	8.42
7	19.08	7.59	8.42
8	19.01	7.59	8.42
9	18.92	7.62	8.42
10	18.82	7.64	8.42
11	18.72	7.67	8.42
12	18.63	7.74	8.42
13	18.45	7.80	8.42
14	18.15	7.84	8.41
15	17.75	7.87	8.40
16	16.84	7.80	8.37
17	15.51	7.60	8.34

RW10

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	19.83	7.48	8.42
1	19.79	7.47	8.42
2	19.76	7.48	8.43
3	19.71	7.50	8.43
4	19.48	7.52	8.43
5	19.35	7.53	8.43
6	19.21	7.55	8.43
7	19.06	7.57	8.42
8	18.92	7.59	8.42
9	18.81	7.62	8.42
10	18.66	7.66	8.42
11	18.50	7.74	8.42
12	18.31	7.77	8.41
13	17.83	7.83	8.41
14	16.60	7.82	8.38
15	15.34	7.64	8.35
16	14.51	7.40	8.33
17	14.41	7.29	8.32

RW11

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	19.81	7.50	8.43
1	19.79	7.50	8.43
2	19.71	7.51	8.43
3	19.54	7.53	8.43
4	19.37	7.54	8.43
5	19.28	7.56	8.43
6	19.24	7.59	8.43
7	19.22	7.61	8.43
8	19.16	7.62	8.43
9	18.99	7.62	8.43
10	18.81	7.63	8.43
11	18.70	7.67	8.43
12	18.57	7.74	8.43
13	18.31	7.80	8.42
14	17.54	7.81	8.41
15	16.11	7.74	8.38
16	14.91	7.52	8.35
17	14.50	7.44	8.34

RW12

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.50	7.31	8.44
1	20.46	7.30	8.44
2	20.42	7.33	8.44
3	20.35	7.35	8.44
4	20.33	7.36	8.44
5	20.32	7.38	8.44
6	20.32	7.40	8.44
7	20.32	7.43	8.44
8	20.30	7.47	8.44
9	20.05	7.50	8.44
10	19.66	7.54	8.43
11	19.18	7.58	8.43
12	18.75	7.60	8.42
13	18.14	7.60	8.41
14	17.38	7.50	8.39
15	16.64	7.52	8.38
16	15.84	7.45	8.35
17	14.93	7.26	8.33

* Data provided by Entrix

Appendix C-2. (Cont.)

Ebb Tide

RW1

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.84	7.23	8.41
1	20.79	7.22	8.41
2	20.76	7.25	8.41
3	20.53	7.28	8.41
4	19.87	7.22	8.40
5	19.33	7.17	8.40
6	19.05	7.18	8.40

RW2

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.95	7.19	8.43
1	20.91	7.17	8.43
2	20.86	7.21	8.43
3	20.55	7.28	8.43
4	19.59	7.27	8.42
5	19.03	7.18	8.41
6	18.83	7.22	8.41

RW3

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.72	6.88	8.40
1	20.79	6.86	8.40
2	20.53	6.89	8.39
3	20.38	6.96	8.40
4	20.18	7.06	8.40
5	19.87	7.07	8.39
6	19.60	7.05	8.39

RW4

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	21.16	7.02	8.42
1	21.10	7.00	8.42
2	21.10	7.04	8.43
3	21.05	7.07	8.43
4	20.89	7.10	8.43
5	20.38	7.13	8.42
6	19.97	7.11	8.40

RW5

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.01	7.33	8.42
1	19.96	7.32	8.42
2	19.94	7.33	8.43
3	19.91	7.35	8.42
4	19.81	7.37	8.43
5	19.48	7.39	8.43
6	19.22	7.39	8.42
7	19.07	7.46	8.42
8	18.95	7.52	8.43
9	18.81	7.54	8.42
10	18.68	7.58	8.42
11	18.56	7.62	8.42

RW6

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.60	7.20	8.42
1	20.77	7.21	8.42
2	20.31	7.20	8.42
3	19.92	7.18	8.42
4	19.59	7.23	8.42
5	19.50	7.33	8.42
6	19.27	7.41	8.42
7	18.87	7.45	8.42
8	18.51	7.50	8.41
9	18.22	7.52	8.40
10	18.00	7.51	8.39
11	17.71	7.51	8.39

RW7

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.40	7.23	8.43
1	20.71	7.23	8.43
2	19.97	7.24	8.42
3	19.50	7.24	8.42
4	19.24	7.34	8.41
5	19.03	7.39	8.41
6	18.90	7.47	8.41
7	18.57	7.55	8.41
8	18.01	7.55	8.40
9	17.46	7.53	8.38
10	16.97	7.42	8.36
11	16.54	7.30	8.35

RW8

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	21.09	7.43	8.46
1	21.08	7.41	8.46
2	20.99	7.45	8.46
3	20.44	7.45	8.44
4	19.87	7.40	8.43
5	19.46	7.36	8.41
6	18.86	7.37	8.40
7	18.05	7.28	8.39
8	17.43	7.25	8.38
9	16.62	7.32	8.36
10	15.44	7.24	8.33
11	15.20	7.10	8.32

RW9

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	19.39	7.36	8.42
1	19.35	7.34	8.42
2	19.32	7.37	8.42
3	19.29	7.39	8.42
4	19.25	7.42	8.42
5	19.19	7.44	8.42
6	19.12	7.44	8.42
7	19.06	7.46	8.42
8	18.97	7.48	8.43
9	18.85	7.51	8.42
10	18.77	7.53	8.42
11	18.70	7.57	8.42
12	18.61	7.62	8.42
13	18.42	7.68	8.42
14	18.17	7.72	8.42
15	17.88	7.77	8.41
16	16.93	7.78	8.38
17	16.12	7.51	8.36

RW10

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	19.79	7.47	8.43
1	19.76	7.47	8.43
2	19.70	7.48	8.43
3	19.47	7.49	8.43
4	19.37	7.51	8.43
5	19.30	7.53	8.43
6	19.25	7.54	8.43
7	19.05	7.55	8.43
8	18.86	7.56	8.43
9	18.71	7.61	8.43
10	18.57	7.66	8.42
11	18.39	7.73	8.42
12	17.91	7.78	8.41
13	16.79	7.83	8.39
14	15.38	7.55	8.35
15	14.51	7.36	8.33
16	14.45	7.30	8.33
17	14.43	7.32	8.33

RW11

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.09	7.14	8.42
1	20.23	7.14	8.42
2	19.83	7.13	8.42
3	19.52	7.22	8.43
4	19.38	7.31	8.43
5	19.29	7.41	8.43
6	19.16	7.46	8.43
7	18.85	7.49	8.42
8	18.73	7.54	8.42
9	18.64	7.61	8.42
10	18.33	7.65	8.42
11	17.79	7.70	8.41
12	17.07	7.69	8.39
13	16.35	7.63	8.37
14	15.34	7.51	8.36
15	14.72	7.46	8.34
16	14.42	7.42	8.33
17	14.42	7.41	8.33

RW12

Depth (m)	Temp. (°C)	D.O. (mg/L)	pH
0	20.89	7.35	8.44
1	20.83	7.34	8.44
2	20.82	7.36	8.44
3	20.78	7.37	8.44
4	20.71	7.37	8.44
5	20.55	7.37	8.43
6	20.24	7.40	8.43
7	19.80	7.40	8.43
8	19.39	7.41	8.42
9	19.04	7.42	8.42
10	18.44	7.49	8.41
11	17.84	7.59	8.40
12	17.27	7.66	8.39
13	16.21	7.59	8.37
14	15.47	7.56	8.35
15	15.03	7.47	8.33
16	14.60	7.33	8.33
17	14.24	7.35	8.32

APPENDIX D

Size frequency distribution and sediment statistical parameters
El Segundo and Scattergood Generating Stations NPDES, 1997

Appendix D. Sediment grain size distribution and statistical parameters by station. El Segundo and Scattergood Generating Stations NPDES, 1997.

Station B1.

FREQUENCY DISTRIBUTION TABLE

MEAN PHI INTERVAL	INTERVAL PERCENT	CUMULATIVE PERCENT
-1.25	0.02	0.02
-1.00	0.14	0.16
-0.25	0.21	0.37
0.25	0.52	0.89
0.75	0.95	1.84
1.25	2.92	4.75
1.75	6.12	10.88
2.25	7.33	18.21
2.75	12.82	31.03
3.25	38.91	69.94
3.75	21.13	91.07
4.15	3.10	94.17
4.54	2.85	97.02
5.02	0.95	97.97
5.73	0.63	98.61
6.45	0.06	98.67
7.20	0.35	99.02
8.20	0.30	99.32
9.20	0.24	99.57
10.20	0.19	99.76
11.20	0.14	99.89
12.20	0.08	99.97
13.20	0.03	100.00

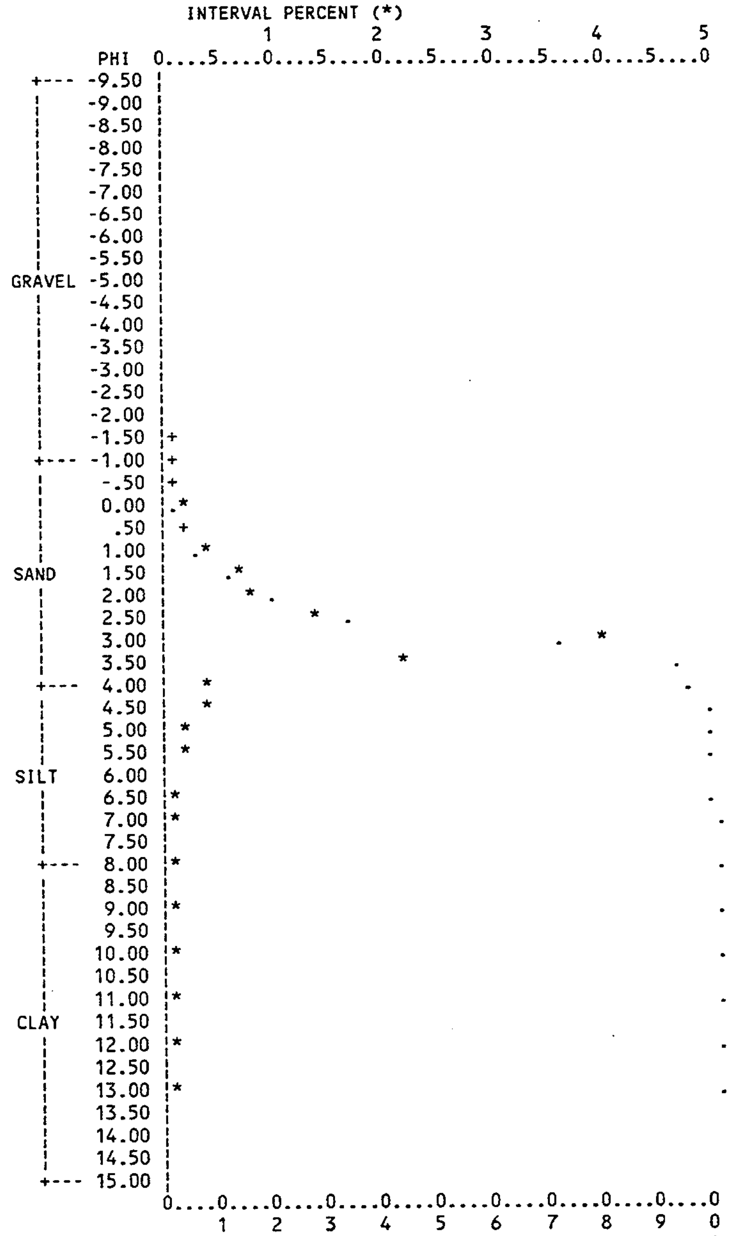
% GRAVEL = 0.02
% SAND = 91.05
% SILT = 7.95
% CLAY = 0.98

SEDIMENT DISTRIBUTION PARAMETERS (MOMENT)

MEAN	DISPERSION	SKEWNESS	KURTOSIS
3.19	0.74	-0.18	1.44

SHARP & FAN SORTING INDEX
BASED ON 15 INTERVALS = 54.03445
BASED ON 25 INTERVALS = 61.32906

FREQUENCY DISTRIBUTION PLOT
INTERVAL PERCENT (*)



CUMULATIVE PERCENT (.)

ONE PHI INTERVAL PERCENT TOTAL SEDIMENT WEIGHT DISTRIBUTION

-10 =< -9	0.00	-5 =< -4	0.00	0 =< 1	1.47	5 =< 6	0.51	10 =< 11	0.23
-9 =< -8	0.00	-4 =< -3	0.00	1 =< 2	9.04	6 =< 7	0.80	11 =< 12	0.10
-8 =< -7	0.00	-3 =< -2	0.00	2 =< 3	20.16	7 =< 8	0.25	12 =< 13	0.09
-7 =< -6	0.00	-2 =< -1	0.02	3 =< 4	60.04	8 =< 9	0.37	13 =< 14	0.00
-6 =< -5	0.00	-1 =< 0	0.35	4 =< 5	6.39	9 =< 10	0.17	14 =< 15	0.00

Appendix D. (Cont.).

Station B2.

FREQUENCY DISTRIBUTION TABLE

MEAN PHI INTERVAL	INTERVAL PERCENT	CUMULATIVE PERCENT
-0.25	0.02	0.02
0.25	0.01	0.03
0.75	0.03	0.05
1.25	0.20	0.25
1.75	0.58	0.83
2.25	1.57	2.40
2.75	17.85	20.26
3.25	43.31	63.56
3.75	17.02	80.59
4.17	7.84	88.43
4.57	3.51	91.94
5.07	3.51	95.44
5.54	1.75	97.20
5.99	0.44	97.63
6.46	0.53	98.16
7.20	0.49	98.65
8.20	0.41	99.06
9.20	0.34	99.40
10.20	0.26	99.66
11.20	0.19	99.85
12.20	0.11	99.96
13.20	0.04	100.00

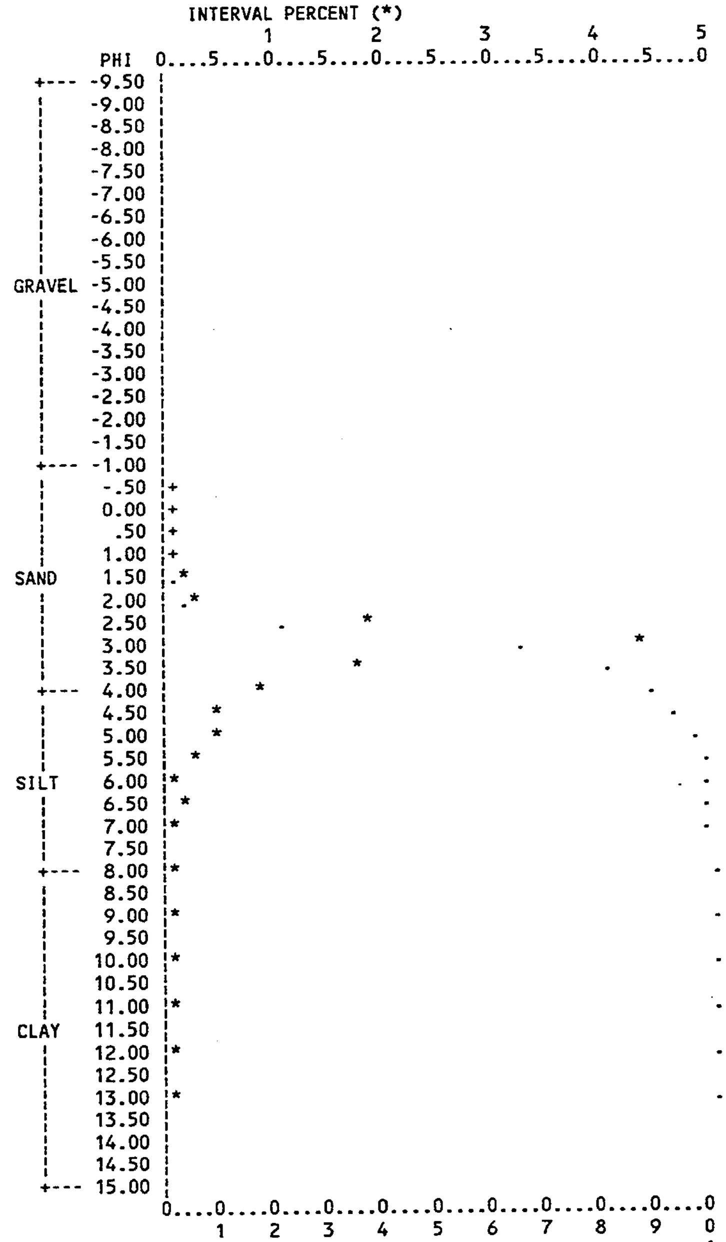
% GRAVEL = 0.00
% SAND = 80.59
% SILT = 18.06
% CLAY = 1.35

SEDIMENT DISTRIBUTION PARAMETERS (MOMENT)

MEAN	DISPERSION	SKEWNESS	KURTOSIS
3.57	0.65	0.36	1.41

SHARP & FAN SORTING INDEX
BASED ON 14 INTERVALS = 54.61801
BASED ON 25 INTERVALS = 62.79271

FREQUENCY DISTRIBUTION PLOT
INTERVAL PERCENT (*)



CUMULATIVE PERCENT (.)

ONE PHI INTERVAL PERCENT TOTAL SEDIMENT WEIGHT DISTRIBUTION

-10 =< -9	0.00	-5 =< -4	0.00	0 =< 1	0.04	5 =< 6	4.19	10 =< 11	0.32
-9 =< -8	0.00	-4 =< -3	0.00	1 =< 2	0.78	6 =< 7	0.88	11 =< 12	0.13
-8 =< -7	0.00	-3 =< -2	0.00	2 =< 3	19.42	7 =< 8	0.34	12 =< 13	0.12
-7 =< -6	0.00	-2 =< -1	0.00	3 =< 4	60.33	8 =< 9	0.51	13 =< 14	0.00
-6 =< -5	0.00	-1 =< 0	0.02	4 =< 5	12.65	9 =< 10	0.24	14 =< 15	0.00

Appendix D. (Cont.).

Station B3.

FREQUENCY DISTRIBUTION TABLE

MEAN PHI INTERVAL	INTERVAL PERCENT	CUMULATIVE PERCENT
-1.25	0.07	0.07
-1.00	0.16	0.23
-0.25	0.25	0.49
0.25	0.72	1.21
0.75	1.31	2.52
1.25	3.61	6.13
1.75	9.69	15.82
2.25	18.78	34.60
2.75	40.37	74.96
3.25	20.30	95.26
3.75	3.73	98.99
4.50	0.04	99.03
5.25	0.26	99.28
6.25	0.22	99.50
7.25	0.18	99.68
8.25	0.14	99.82
9.25	0.10	99.92
10.25	0.06	99.98
11.25	0.02	100.00

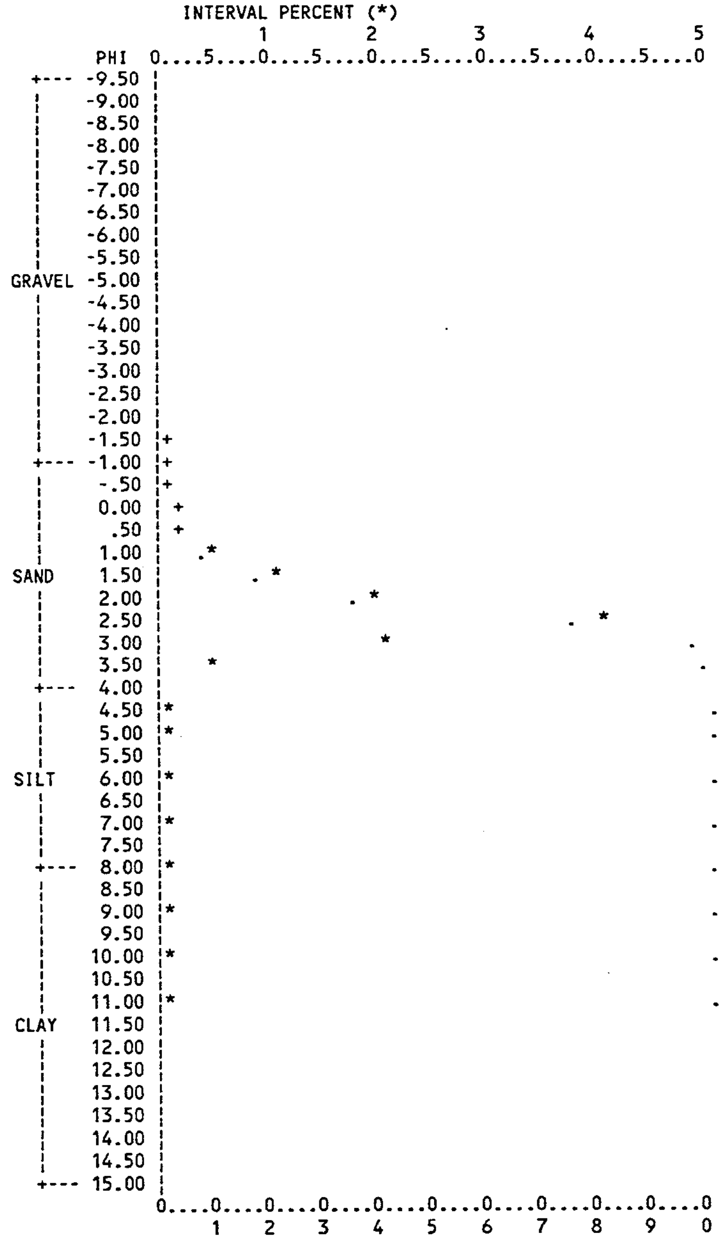
% GRAVEL = 0.07
% SAND = 98.92
% SILT = 0.69
% CLAY = 0.32

SEDIMENT DISTRIBUTION PARAMETERS (MOMENT)

MEAN	DISPERSION	SKEWNESS	KURTOSIS
2.63	0.61	-0.19	1.16

SHARP & FAN SORTING INDEX
BASED ON 13 INTERVALS = 57.39603
BASED ON 25 INTERVALS = 66.0512

FREQUENCY DISTRIBUTION PLOT
INTERVAL PERCENT (*)



ONE PHI INTERVAL PERCENT TOTAL SEDIMENT WEIGHT DISTRIBUTION

-10 =< -9	0.00	-5 =< -4	0.00	0 =< 1	2.03	5 =< 6	0.19	10 =< 11	0.06
-9 =< -8	0.00	-4 =< -3	0.00	1 =< 2	13.30	6 =< 7	0.26	11 =< 12	0.00
-8 =< -7	0.00	-3 =< -2	0.00	2 =< 3	59.15	7 =< 8	0.13	12 =< 13	0.00
-7 =< -6	0.00	-2 =< -1	0.07	3 =< 4	24.02	8 =< 9	0.16	13 =< 14	0.00
-6 =< -5	0.00	-1 =< 0	0.42	4 =< 5	0.10	9 =< 10	0.07	14 =< 15	0.00

Appendix D. (Cont.).

Station B4.

FREQUENCY DISTRIBUTION TABLE

MEAN PHI INTERVAL	INTERVAL PERCENT	CUMULATIVE PERCENT
-1.25	0.07	0.07
-1.00	0.12	0.19
-0.25	0.21	0.41
0.25	0.27	0.67
0.75	0.28	0.95
1.25	0.83	1.78
1.75	3.09	4.87
2.25	8.69	13.56
2.75	28.10	41.67
3.25	42.30	83.97
3.75	13.02	96.99
4.13	1.33	98.31
4.75	1.26	99.58
5.75	0.42	100.00

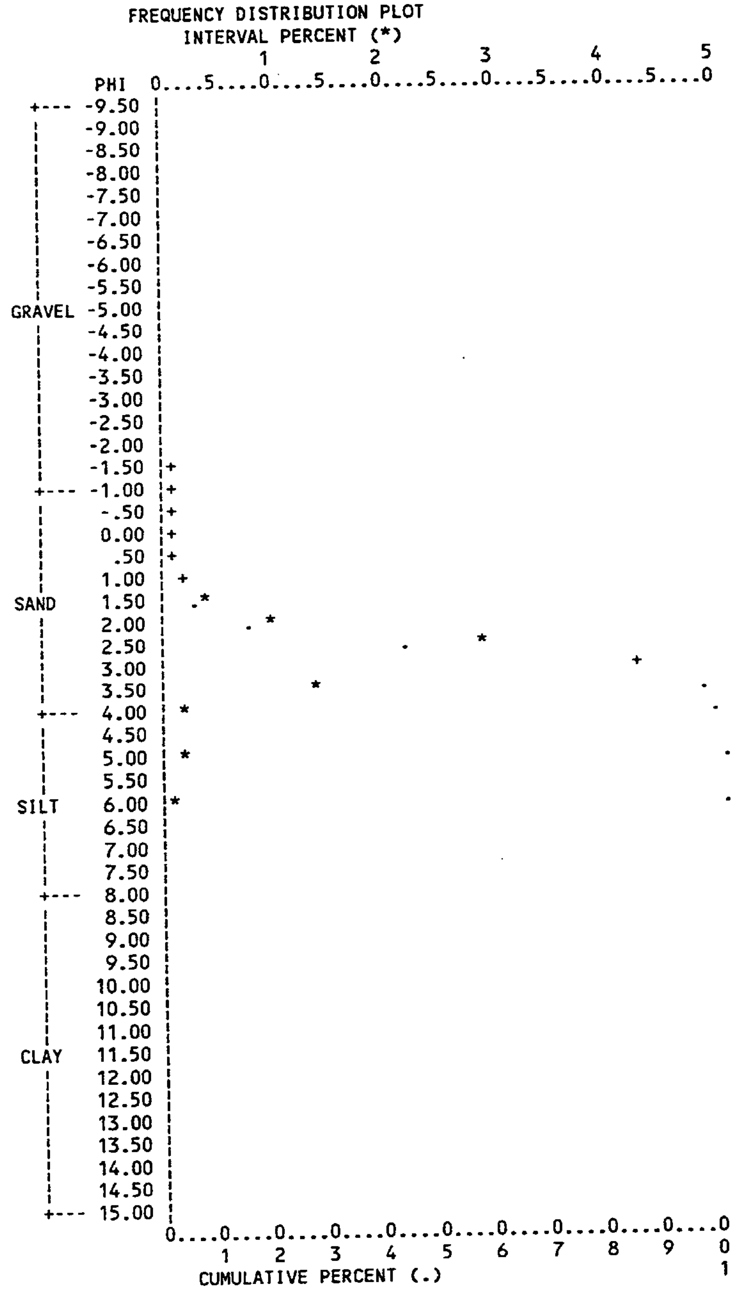
% GRAVEL = 0.07
% SAND = 96.92
% SILT = 3.01
% CLAY = 0.00

SEDIMENT DISTRIBUTION PARAMETERS (MOMENT)

MEAN	DISPERSION	SKEWNESS	KURTOSIS
3.04	0.48	-0.15	1.14

SHARP & FAN SORTING INDEX
BASED ON 9 INTERVALS = 54.38206
BASED ON 25 INTERVALS = 68.86093

FREQUENCY DISTRIBUTION PLOT



ONE PHI INTERVAL PERCENT TOTAL SEDIMENT WEIGHT DISTRIBUTION

-10 =< -9	0.00	-5 =< -4	0.00	0 =< 1	0.54	5 =< 6	0.32	10 =< 11	0.00
-9 =< -8	0.00	-4 =< -3	0.00	1 =< 2	3.92	6 =< 7	0.42	11 =< 12	0.00
-8 =< -7	0.00	-3 =< -2	0.00	2 =< 3	36.80	7 =< 8	0.00	12 =< 13	0.00
-7 =< -6	0.00	-2 =< -1	0.07	3 =< 4	55.32	8 =< 9	0.00	13 =< 14	0.00
-6 =< -5	0.00	-1 =< 0	0.34	4 =< 5	2.27	9 =< 10	0.00	14 =< 15	0.00

Appendix D. (Cont.).

Station B5.

FREQUENCY DISTRIBUTION TABLE

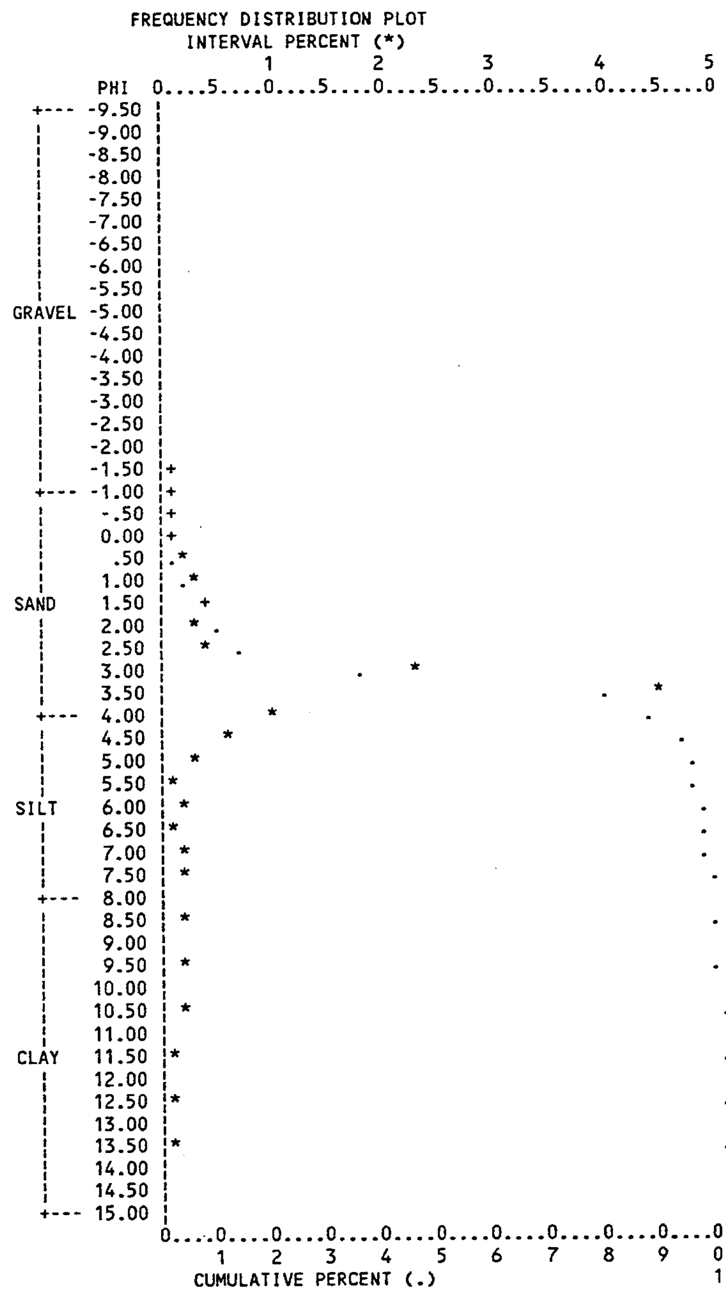
MEAN PHI INTERVAL	INTERVAL PERCENT	CUMULATIVE PERCENT
-1.25	0.05	0.05
-1.00	0.05	0.09
-0.25	0.08	0.17
0.25	0.23	0.40
0.75	0.50	0.91
1.25	1.82	2.73
1.75	3.20	5.93
2.25	2.30	8.22
2.75	3.03	11.26
3.25	22.30	33.56
3.75	44.45	78.01
4.17	8.99	86.99
4.57	5.50	92.49
5.04	1.83	94.32
5.53	0.46	94.78
6.00	0.55	95.33
6.47	0.46	95.79
6.97	0.55	96.34
7.72	0.97	97.31
8.72	0.82	98.13
9.72	0.67	98.80
10.72	0.52	99.33
11.72	0.37	99.70
12.72	0.22	99.93
13.72	0.07	100.00

% GRAVEL = 0.05
% SAND = 77.96
% SILT = 18.33
% CLAY = 3.66

SEDIMENT DISTRIBUTION PARAMETERS (MOMENT)

MEAN	DISPERSION	SKEWNESS	KURTOSIS
3.80	0.59	0.06	2.56

SHARP & FAN SORTING INDEX
BASED ON 17 INTERVALS = 57.01454
BASED ON 25 INTERVALS = 62.16476



ONE PHI INTERVAL PERCENT TOTAL SEDIMENT WEIGHT DISTRIBUTION

-10 =< -9	0.00	-5 =< -4	0.00	0 =< 1	0.73	5 =< 6	1.80	10 =< 11	1.08
-9 =< -8	0.00	-4 =< -3	0.00	1 =< 2	5.02	6 =< 7	1.05	11 =< 12	0.11
-8 =< -7	0.00	-3 =< -2	0.00	2 =< 3	5.33	7 =< 8	0.24	12 =< 13	0.55
-7 =< -6	0.00	-2 =< -1	0.05	3 =< 4	66.75	8 =< 9	1.62	13 =< 14	0.05
-6 =< -5	0.00	-1 =< 0	0.13	4 =< 5	15.24	9 =< 10	0.18	14 =< 15	0.07

Appendix D. (Cont.).

Station B6.

FREQUENCY DISTRIBUTION TABLE

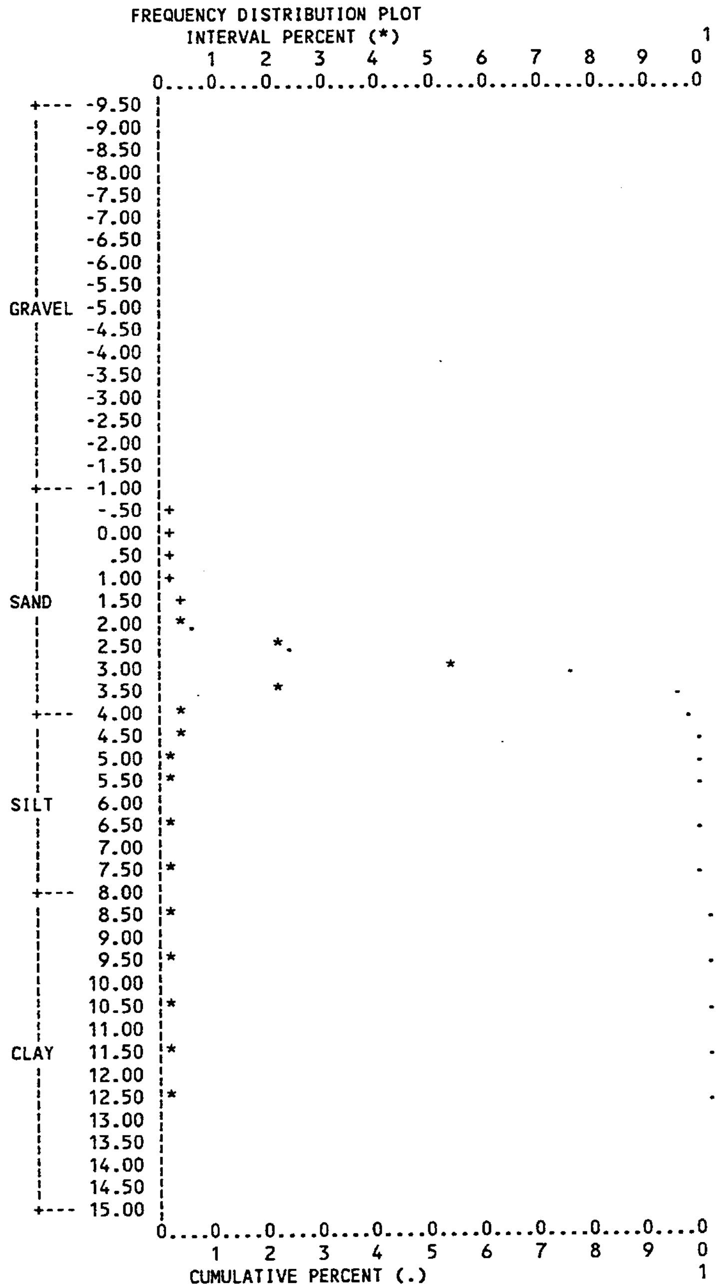
MEAN PHI INTERVAL	INTERVAL PERCENT	CUMULATIVE PERCENT
-0.25	0.01	0.01
0.25	0.01	0.02
0.75	0.05	0.07
1.25	0.54	0.61
1.75	1.37	1.98
2.25	1.54	3.53
2.75	19.25	22.77
3.25	52.11	74.88
3.75	19.46	94.34
4.14	1.43	95.76
4.52	1.35	97.11
5.01	0.45	97.56
5.73	0.09	97.65
6.71	0.62	98.28
7.71	0.53	98.80
8.71	0.43	99.23
9.71	0.34	99.57
10.71	0.24	99.81
11.71	0.14	99.95
12.71	0.05	100.00

% GRAVEL = 0.00
% SAND = 94.34
% SILT = 3.94
% CLAY = 1.72

SEDIMENT DISTRIBUTION PARAMETERS (MOMENT)

MEAN	DISPERSION	SKEWNESS	KURTOSIS
3.37	0.46	0.08	1.40

SHARP & FAN SORTING INDEX
BASED ON 14 INTERVALS = 66.07935
BASED ON 25 INTERVALS = 72.18951



ONE PHI INTERVAL PERCENT TOTAL SEDIMENT WEIGHT DISTRIBUTION

-10 =< -9	0.00	-5 =< -4	0.00	0 =< 1	0.06	5 =< 6	0.23	10 =< 11	0.53
-9 =< -8	0.00	-4 =< -3	0.00	1 =< 2	1.91	6 =< 7	0.58	11 =< 12	0.05
-8 =< -7	0.00	-3 =< -2	0.00	2 =< 3	20.79	7 =< 8	0.13	12 =< 13	0.18
-7 =< -6	0.00	-2 =< -1	0.00	3 =< 4	71.56	8 =< 9	0.87	13 =< 14	0.00
-6 =< -5	0.00	-1 =< 0	0.01	4 =< 5	3.00	9 =< 10	0.09	14 =< 15	0.00

Appendix D. (Cont.).

Station B7.

FREQUENCY DISTRIBUTION TABLE

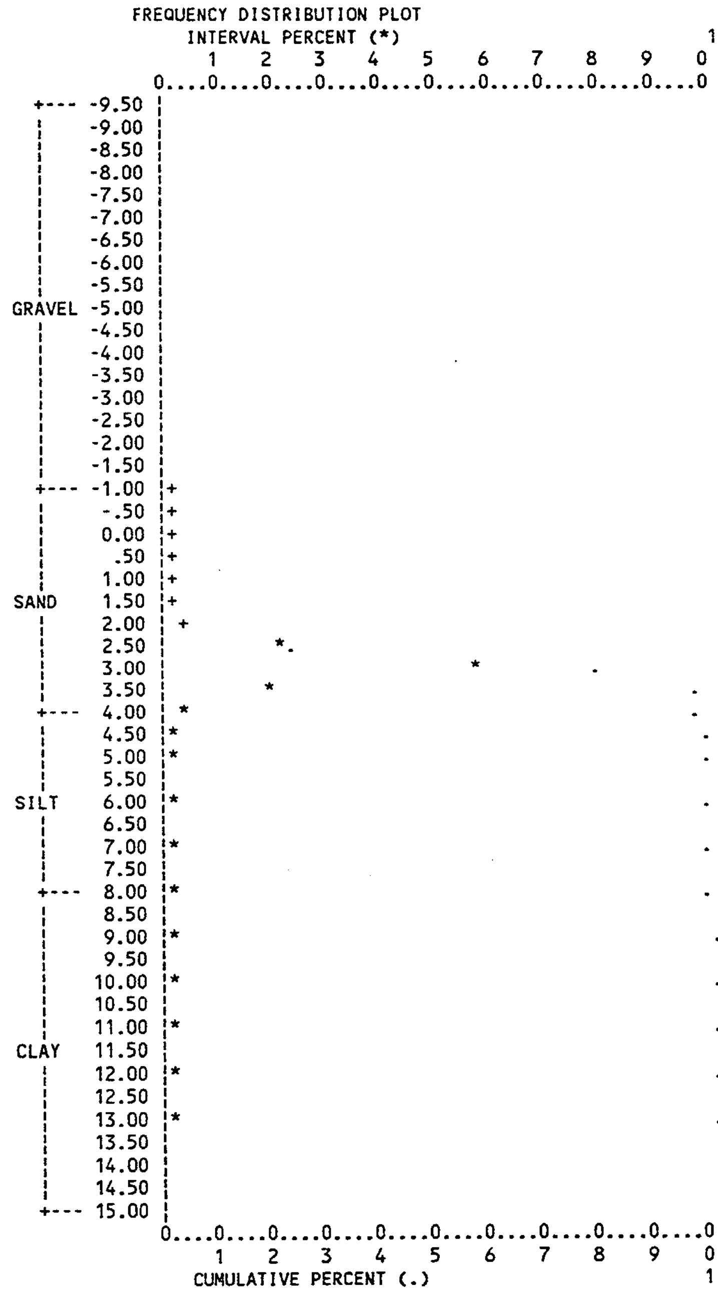
MEAN PHI INTERVAL	INTERVAL PERCENT	CUMULATIVE PERCENT
-0.75	0.02	0.02
-0.25	0.02	0.04
0.25	0.02	0.06
0.75	0.01	0.07
1.25	0.09	0.16
1.75	0.44	0.60
2.25	1.41	2.01
2.75	19.36	21.37
3.25	56.33	77.69
3.75	17.66	95.35
4.14	1.27	96.62
4.52	0.60	97.22
5.02	0.30	97.52
5.99	0.30	97.82
7.21	0.58	98.40
8.21	0.49	98.89
9.21	0.40	99.29
10.21	0.31	99.60
11.21	0.22	99.82
12.21	0.13	99.96
13.21	0.04	100.00

% GRAVEL = 0.00
% SAND = 95.35
% SILT = 3.05
% CLAY = 1.60

SEDIMENT DISTRIBUTION PARAMETERS (MOMENT)

MEAN	DISPERSION	SKEWNESS	KURTOSIS
3.38	0.41	0.04	1.30

SHARP & FAN SORTING INDEX
BASED ON 14 INTERVALS = 69.3983
BASED ON 25 INTERVALS = 74.91061



ONE PHI INTERVAL PERCENT TOTAL SEDIMENT WEIGHT DISTRIBUTION

-10 =< -9	0.00	-5 =< -4	0.00	0 =< 1	0.03	5 =< 6	0.16	10 =< 11	0.37
-9 =< -8	0.00	-4 =< -3	0.00	1 =< 2	0.53	6 =< 7	0.47	11 =< 12	0.16
-8 =< -7	0.00	-3 =< -2	0.00	2 =< 3	20.77	7 =< 8	0.41	12 =< 13	0.15
-7 =< -6	0.00	-2 =< -1	0.00	3 =< 4	73.98	8 =< 9	0.60	13 =< 14	0.00
-6 =< -5	0.00	-1 =< 0	0.04	4 =< 5	2.01	9 =< 10	0.29	14 =< 15	0.00

Appendix D. (Cont.).

Station B8.

FREQUENCY DISTRIBUTION TABLE

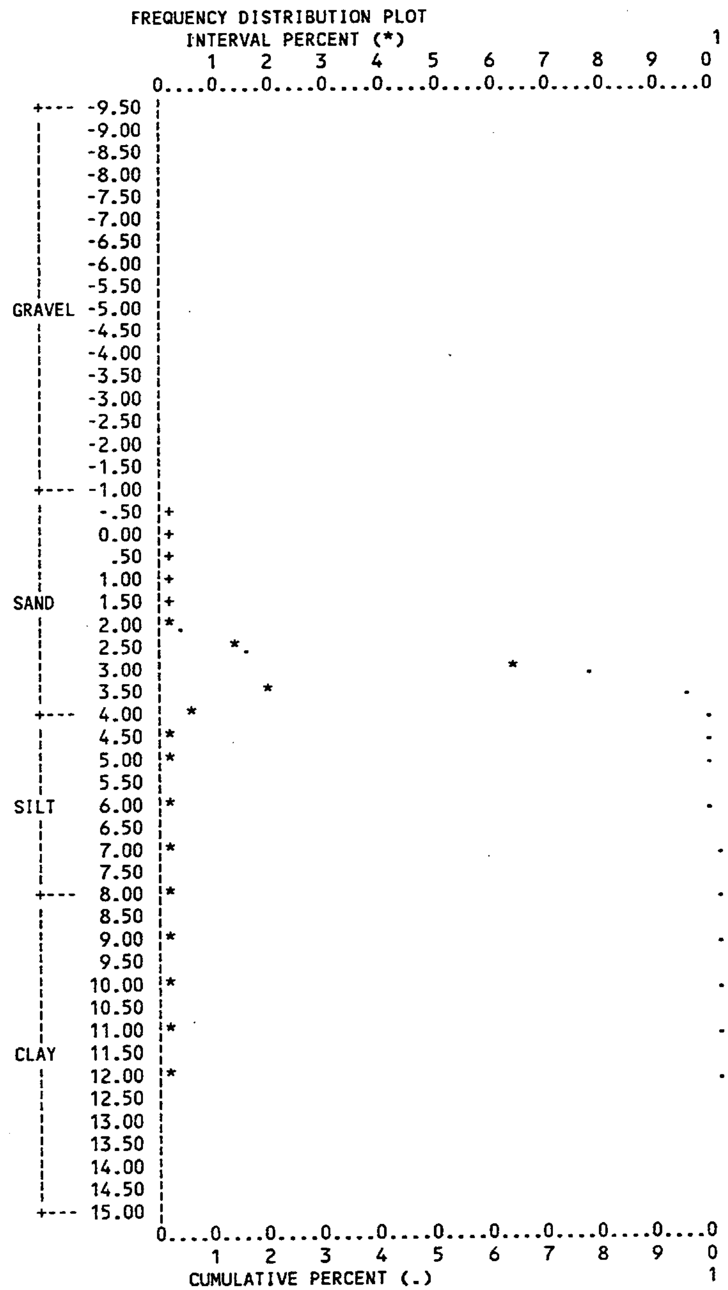
MEAN PHI INTERVAL	INTERVAL PERCENT	CUMULATIVE PERCENT
-0.25	0.02	0.02
0.25	0.02	0.04
0.75	0.02	0.06
1.25	0.15	0.21
1.75	0.40	0.61
2.25	0.86	1.47
2.75	11.99	13.46
3.25	62.25	75.71
3.75	18.62	94.32
4.13	3.12	97.44
4.51	0.71	98.15
5.25	0.36	98.51
6.25	0.40	98.90
7.25	0.33	99.24
8.25	0.27	99.51
9.25	0.21	99.73
10.25	0.15	99.88
11.25	0.09	99.97
12.25	0.03	100.00

% GRAVEL = 0.00
% SAND = 94.32
% SILT = 4.91
% CLAY = 0.76

SEDIMENT DISTRIBUTION PARAMETERS (MOMENT)

MEAN	DISPERSION	SKEWNESS	KURTOSIS
3.38	0.35	0.16	1.46

SHARP & FAN SORTING INDEX
BASED ON 14 INTERVALS = 73.47757
BASED ON 25 INTERVALS = 78.25508



ONE PHI INTERVAL PERCENT TOTAL SEDIMENT WEIGHT DISTRIBUTION

-10 =< -9	0.00	-5 =< -4	0.00	0 =< 1	0.04	5 =< 6	0.27	10 =< 11	0.18
-9 =< -8	0.00	-4 =< -3	0.00	1 =< 2	0.55	6 =< 7	0.48	11 =< 12	0.07
-8 =< -7	0.00	-3 =< -2	0.00	2 =< 3	12.85	7 =< 8	0.25	12 =< 13	0.03
-7 =< -6	0.00	-2 =< -1	0.00	3 =< 4	80.86	8 =< 9	0.33	13 =< 14	0.00
-6 =< -5	0.00	-1 =< 0	0.02	4 =< 5	3.92	9 =< 10	0.16	14 =< 15	0.00

APPENDIX E

Sediment chemistry by station
El Segundo and Scattergood Generating Stations NPDES, 1997

Del Mar Analytical

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
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MBC
3040 Redhill Ave.
Costa Mesa, CA 92626
Attention: Mike Curtis

Client Project ID: 97318
LADWP SGS/ESGS
Sample Descript: Composite Soil
First Sample #: GG03589

Sampled: Jul 17, 1997
Received: Jul 21, 1997
Extracted: Jul 29, 1997
Analyzed: Aug 1, 1997
Reported: Aug 1, 1997

CHROMIUM (EPA 6010)

Laboratory Number	Sample Description	Reporting Limit mg/ dry Kg (ppm)	Sample Result mg/ dry Kg (ppm)
GG03589	B1	1.0	13
GG03590	B2	1.0	15
GG03591	B3	1.0	12
GG03592	B4	1.0	13
GG03593	B5	1.0	20
GG03594	B6	1.0	14
GG03595	B7	1.0	16
GG03596	B8	1.0	15

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper

Michele Harper
Project Manager

Celebrating 10 years of service 1987-1997

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (714) 261-1022 FAX (714) 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
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968 8272 FAX (602) 968-1338

MBC
3040 Redhill Ave.
Costa Mesa, CA 92626
Attention: Mike Curtis

Client Project ID: 97318
LADWP SGS/ESGS
Sample Descript: Composite Soil
First Sample #: GG03589

Sampled: Jul 17, 1997
Received: Jul 21, 1997
Extracted: Jul 29, 1997
Analyzed: Aug 1, 1997
Reported: Aug 1, 1997

COPPER (EPA 6010)

Laboratory Number	Sample Description	Reporting Limit mg/ dry Kg (ppm)	Sample Result mg/ dry Kg (ppm)
GG03589	B1	1.0	5.7
GG03590	B2	1.0	6.5
GG03591	B3	1.0	4.2
GG03592	B4	1.0	4.2
GG03593	B5	1.0	7.1
GG03594	B6	1.0	5.8
GG03595	B7	1.0	5.2
GG03596	B8	1.0	3.9

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper
Michele Harper
Project Manager

Celebrating 10 years of service 1987-1997

Del Mar Analytical

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
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MBC	Client Project ID: 97318	Sampled:	Jul 17, 1997
3040 Redhill Ave.	LADWP SGS/ESGS	Received:	Jul 21, 1997
Costa Mesa, CA 92626	Sample Descript: Composite Soil	Extracted:	Jul 29, 1997
Attention: Mike Curtis	First Sample #: GG03589	Analyzed:	Aug 1, 1997
		Reported:	Aug 1, 1997

NICKEL (EPA 6010)

Laboratory Number	Sample Description	Reporting Limit mg/ dry Kg (ppm)	Sample Result mg/ dry Kg (ppm)
GG03589	B1	1.0	10
GG03590	B2	1.0	11
GG03591	B3	1.0	9.4
GG03592	B4	1.0	9.6
GG03593	B5	1.0	13
GG03594	B6	1.0	9.5
GG03595	B7	1.0	10
GG03596	B8	1.0	10

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper
Michele Harper
Project Manager

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (714) 261-1022 FAX (714) 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
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MBC
3040 Redhill Ave.
Costa Mesa, CA 92626
Attention: Mike Curtis

Client Project ID: 97318
LADWP SGS/ESGS
Sample Descript: Composite Soil
First Sample #: GG03589

Sampled: Jul 17, 1997
Received: Jul 21, 1997
Extracted: Jul 29, 1997
Analyzed: Aug 1, 1997
Reported: Aug 1, 1997

ZINC (EPA 6010)

Laboratory Number	Sample Description	Reporting Limit mg/ dry Kg (ppm)	Sample Result mg/ dry Kg (ppm)
GG03589	B1	1.0	25
GG03590	B2	1.0	29
GG03591	B3	1.0	18
GG03592	B4	1.0	19
GG03593	B5	1.0	33
GG03594	B6	1.0	21
GG03595	B7	1.0	21
GG03596	B8	1.0	19

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper

Michele Harper
Project Manager

Del Mar Analytical

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
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MBC 3040 Redhill Ave. Costa Mesa, CA 92626 Attention: Mike Curtis	Client Project ID: 97318 LADWP SGS/ESGS Sample Descript: Composite Soil First Sample #: GG03589	Sampled: Jul 17, 1997 Received: Jul 21, 1997 Extracted: Jul 24, 1997 Analyzed: Jul 24, 1997 Reported: Aug 1, 1997

PERCENT SOLIDS (EPA 160.3)

Laboratory Number	Sample Description	Sample Result %
GG03589	B1	63
GG03590	B2	60
GG03591	B3	63
GG03592	B4	62
GG03593	B5	52
GG03594	B6	59
GG03595	B7	64
GG03596	B8	58

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper
Michele Harper
Project Manager

Appendix E. (Cont.).

Del Mar Analytical

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
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MBC
3040 Redhill Ave.
Costa Mesa, CA 92626
Attention: Mike Curtis

Method Blank

Extracted: Jul 29, 1997
Analyzed: Aug 1, 1997
Reported: Aug 1, 1997
Matrix: Soil

CHROMIUM (EPA 6010)

Laboratory Description	Reporting Limit mg/ dry Kg (ppm)	Sample Result mg/ dry Kg (ppm)
Method Blank	1.0	N.D.

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper

Michele Harper
Project Manager

Appendix E. (Cont.).

Del Mar Analytical

2852 Alton Ave., Irvine, CA 92606 (714) 261-1022 FAX (714) 261-1228
1014 E. Cooley Dr., Suite A, Colton, CA 92524 (909) 370-4667 FAX (909) 370-1046
16525 Sherman Way, Suite C-11, Van Nuys, CA 91406 (818) 779-1844 FAX (818) 779-1843
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MBC
3040 Redhill Ave.
Costa Mesa, CA 92626
Attention: Mike Curtis

Method Blank

Extracted: Jul 29, 1997
Analyzed: Aug 1, 1997
Reported: Aug 1, 1997
Matrix: Soil

COPPER (EPA 6010)

Laboratory Description	Reporting Limit mg/ dry Kg (ppm)	Sample Result mg/ dry Kg (ppm)
Method Blank	1.0	N.D.

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper

Michele Harper
Project Manager

Del Mar Analytical

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
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MBC
3040 Redhill Ave.
Costa Mesa, CA 92626
Attention: Mike Curtis

Method Blank

Extracted: Jul 29, 1997
Analyzed: Aug 1, 1997
Reported: Aug 1, 1997
Matrix: Soil

NICKEL (EPA 6010)

Laboratory Description	Reporting Limit mg/ dry Kg (ppm)	Sample Result mg/ dry Kg (ppm)
Method Blank	1.0	N.D.

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper
Michele Harper
Project Manager

Del Mar Analytical

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
2465 W. 12th St., Suite 1, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MBC
3040 Redhill Ave.
Costa Mesa, CA 92626
Attention: Mike Curtis

Method Blank

Extracted:	Jul 29, 1997
Analyzed:	Aug 1, 1997
Reported:	Aug 1, 1997
Matrix:	Soil

ZINC (EPA 6010)

Laboratory Description	Reporting Limit mg/ dry Kg (ppm)	Sample Result mg/ dry Kg (ppm)
Method Blank	1.0	N.D.

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

DEL MAR ANALYTICAL (ELAP #1197)

Michele Harper
Michele Harper
Project Manager

Celebrating 10 years of service 1987-1997

Appendix E. (Cont.).

Del Mar Analytical

[illegible]
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
2465 W. 12th St., Suite I, Tempe, AZ 85281 (602) 968-8272 FAX (602) 968-1338

MS/MSD DATA REPORT

METHOD: **Metals**
Instrument: ICP
Matrix: SOIL

Date: 8/1/97

Sample #: GG04798

Analyte	**R1**	**SP**	**MS**	**MSD**	**PR1**	**PR2**	**RPD**	**MEAN PR**
	ppb	ppb	ppb	ppb	%	%	%	%
Arsenic	0	1000	1034	1035	103%	104%	0.10%	103%
Chromium	65	1000	1019	1034	95%	97%	1.46%	96%
Copper	66	1000	1023	1045	96%	98%	2.1%	97%
Iron	63790	1000	63390	64170	0%	38%	1.2%	19%
Nickel	67	1000	990	1005	92%	94%	1.50%	93%
Zinc	167	1000	1073	1091	91%	92%	1.66%	92%

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

APPENDIX F

Infauna data and biomass by station and replicate
El Segundo and Scattergood Generating Stations NPDES, 1997

Appendix F-1. Infaunal master species list. El Segundo and Scattergood Generating Stations NPDES, 1997.

PHYLUM
  Class
    Species

CNIDARIA
- Anthozoa
  - Edwardsiidae
  - Limnactiniidae sp. A SCAMIT 1989
  - Pennatulacea
  - *Zaolutus actius*
- Hydrozoa
  - *Clytia universitatis*

PLATYHELMINTHES
- Turbellaria
  - *Stylochus exiguus* [1]

NEMERTEA
- Anopla
  - *Carinoma mutabilis*
  - *Cerebratulus californiensis*
  - Lineidae
  - *Tubulanus cingulatus*
  - *Tubulanus polymorphus*
- Enopla
  - *Paranemertes californica* [2]
  - *Tetrastemma* sp.
- Uncertain
  - Nemertea

NEMATODA
  - Nematoda

ENTOPROCTA
  - Loxosomatidae

MOLLUSCA
- Bivalvia
  - *Cooperella subdiaphana*
  - *Macoma indentata*
  - *Macoma* sp.
  - *Modiolus* sp.
  - *Mysella* sp. C SCAMIT 1988
  - *Mysella tumida*
  - *Parvilucina tenuisculpta*
  - *Saxidomus nuttalli*
  - *Semele* sp.
  - *Solen sicarius*
  - *Tellina modesta*
- Gastropoda
  - *Acteocina culcitella* [3]
  - *Acteocina harpa* [4]
  - *Armina californica*
  - *Crepidula coei*
  - *Cyclostremella dalli*
  - *Doto amyra*
  - *Kurtziella plumbea*
  - *Nassarius perpinguis*
  - *Nitidiscala sawinae*
  - *Odostomia* sp.
  - *Olivella baetica*
  - *Philine bakeri*
  - *Rictaxis punctocaelatus*
  - *Turbonilla almo*
  - *Turbonilla pedroana*
  - *Turbonilla raymondi*

PHYLUM
  Class
    Species

MOLLUSCA
- Gastropoda
  - *Turbonilla santarosana*
  - *Turbonilla* sp.

SIPUNCULIDA
- Sipunculidea
  - *Thysanocardia nigra*

ANNELIDA
- Polychaeta
  - *Acmira catherinae* [5]
  - *Ampharete labrops*
  - *Ancistrosyllis hamata*
  - Aphelochaeta sp. C Dorsey 1984 [6]
  - *Apoprionospio pygmaea* [7]
  - *Arabella endonata*
  - *Aricidea wassi*
  - *Armandia brevis*
  - *Brania californiensis*
  - *Chaetopterus variopedatus*
  - *Chaetozone "setosa"* [8]
  - *Chone albocincta*
  - *Chone* sp. C Harris 1984
  - *Cirriformia tentaculata*
  - *Cirrophorus furcatus*
  - *Cossura* sp. A. Phillips 1987 [9]
  - *Drilonereis longa*
  - *Euchone incolor*
  - *Eumida longicornuta*
  - *Exogone lourei*
  - *Glycera convoluta*
  - *Glycinde armigera*
  - *Goniada littorea*
  - *Goniada maculata*
  - *Hesionella mccullochae*
  - *Leitoscoloplos pugettensis* [10]
  - Lumbrineridae
  - *Lumbrineris californiensis*
  - *Magelona pitelkai*
  - Maldanidae
  - *Mediomastus acutus*
  - *Metasychis disparidentatus*
  - *Monticellina cryptica* [11]
  - *Nephtys caecoides*
  - *Nephtys cornuta* [12]
  - *Nereis procera*
  - Onuphidae
  - *Onuphis eremita parva*
  - *Onuphis* sp. 1 Pt. Loma 1983 [13]
  - *Owenia collaris*
  - *Paleanotus bellis*
  - *Parandalia fauveli*
  - *Paraprionospio pinnata*
  - *Pectinaria californiensis* [14]
  - *Phyllodoce hartmanae*
  - *Phyllodoce pettiboneae*
  - *Phyllodoce* sp.
  - Phyllodocidae
  - *Podarkeopsis glabrus* [15]
  - *Poecilochaetus johnsoni*
  - *Polydora cirrosa*

Appendix F-1. (Cont.).

PHYLUM
- Class
  - Species

ANNELIDA
- Polychaeta
  - *Polydora limicola*
  - *Prionospio lighti*[16]
  - *Scoletoma tetraura*[17]
  - *Scoloplos "armiger"*[18]
  - *Sigalion spinosa*[19]
  - *Spiochaetopterus costarum*
  - *Spiophanes bombyx*
  - *Spiophanes duplex*[20]
  - *Subadyte mexicana*
  - *Syllis (Ehlersia) heterochaeta*
  - *Syllis (Typosyllis)* sp.
  - *Tenonia priops*

ARTHROPODA
- Cirripedia
  - *Balanus pacificus*
- Malacostraca
  - *Acuminodeutopus heteruropus*
  - *Amphideutopus oculatus*
  - *Ancinus granulatus*
  - *Aoroides* sp.[21]
  - *Argissa hamatipes*
  - *Campylaspis* sp. C Myers & Benedict 1974[22]
  - *Cerapus "tubularis"*
  - *Cyclaspis* sp. C SCAMIT 1986[23]
  - *Diastylopsis tenuis*
  - *Edotia sublittoralis*[24]
  - *Gibberosus devaneyi*[25]
  - *Gibberosus myersi*[26]
  - *Hemilamprops californica*
  - *Leptochelia dubia*[27]
  - *Leptocuma forsmani*
  - *Monoculodes hartmanae*
  - *Mysidopsis intii*
  - *Neotrypaea californiensis*[28]
  - *Pachynus barnardi*
  - Paguridea
  - *Photis bifurcata*
  - *Photis californica*

PHYLUM
- Class
  - Species

ARTHROPODA
- Malacostraca
  - *Photis macinerneyi*
  - *Pinnixa forficulimanus*[29]
  - *Pinnixa longipes*
  - *Pyromaia tuberculata*
  - *Rhepoxynius abronius*
  - *Rhepoxynius menziesi*[30]
  - *Rhepoxynius* sp. A SCAMIT 1987
  - *Synchelidium shoemakeri*
  - *Uromunna ubiquita*[31]
- Ostracoda
  - *Leuroleberis sharpei*
  - *Parasterope barnesi*
- Pycnogonida
  - *Anoropallene palpida*
  - Pycnogonida

ECHINODERMATA
- Asteroidea
  - Asteroidea
  - *Astropecten armatus*
- Echinoidea
  - *Dendraster excentricus*
  - *Lovenia cordiformis*
- Ophiuroidea
  - *Amphiodia* sp.

PHORONA
- Uncertain
  - Phoronida

BRACHIOPODA
- Inarticulata
  - *Glottidia albida*

CHORDATA
- Enteropneusta
  - Enteropneusta[32]
- Cephalochordata
  - *Branchiostoma californiense*

The following footnote numbers indicate names used in previous surveys:

1 *Tubulanus* spp. or *T. pellucidus/polymorphus*
2 *Paranemertes* sp. A SCAMIT
3 *Cylichnella culcitella*
4 *Cylichnella harpa*
5 *Acesta catherinae*
6 *Tharyx* spp. (in part)
7 *Apoprionospio pygmaeus* or *Prionospio pygmaeus*
8 *Chaetozone setosa?* or *C. cf. Setosa*
9 *Cossura candida*
10 *Haploscoloplos elongatus*
11 *Tharyx* sp. A SCAMIT or *Monticellina dorsobranchialis*
12 *Nephtys cornuta franciscana*
13 *Onuphis* sp. A SCAMIT
14 *Pectinaria californiensis newportensis*
15 *Gyptis brevipalpa*
16 *Prionospio cirrifera*
17 *Lumbrineris "tetraura"* or *L. tetraura*
18 *Scoloplos armiger*
19 *Thalanessa spinosa* or *Eusigalion spinosa*
20 *Spiophanes missionensis*
21 *Aora* sp.
22 *Campylaspis* sp. C MBC
23 *Cyclaspis* sp. C MBC
24 *Edotia sublittoralis*
25 *Gibberosus myersi* in 1990 (Sta B2 reps 2,3 & 4; Sta B3 all reps; Sta B4 rep 3 (12 of 18 sample))
26 *Megaluropus longimerus*
27 *Leptochelia* spp.
28 *Callianassa californiensis*
29 *Pinnixia* sp. A MBC
30 *Paraphoxus epistomus* or *Rhepoxynius epistomus*
31 *Munna* sp.
32 Hemichordata, unid.

Appendix F-2. Infaunal data by station. El Segundo and Scattergood Generating Stations NPDES, 1997.

Station B1

Phylum	Species	Replicate B1-I	B1-II	B1-III	B1-IV	Total	Percent Comp.	Number/ m²
AN	*Apoprionospio pygmaea*	3	7	13	11	34	17.1	850
AN	*Owenia collaris*	9	7	8	5	29	14.6	725
AN	*Prionospio lighti*	15	1	3	9	28	14.1	700
AN	*Mediomastus acutus*	11	2	4	6	23	11.6	575
AN	*Glycera convoluta*	3	3	1	1	8	4.0	200
AN	*Chone albocincta*	-	-	2	2	4	2.0	100
AR	*Neotrypaea californiensis*	1	1	1	1	4	2.0	100
AN	*Spiophanes bombyx*	1	3	-	-	4	2.0	100
EC	*Amphiodia* sp.	1	-	-	2	3	1.5	75
NE	*Carinoma mutabilis*	-	2	1	-	3	1.5	75
AR	*Diastylopsis tenuis*	2	-	1	-	3	1.5	75
AN	*Goniada littorea*	-	-	3	-	3	1.5	75
AN	*Leitoscoloplos pugettensis*	-	1	2	-	3	1.5	75
NE	Nemertea	-	1	1	1	3	1.5	75
MO	*Solen sicarius*	-	-	3	-	3	1.5	75
AN	*Spiochaetopterus costarum*	-	-	2	1	3	1.5	75
AN	*Ancistrosyllis hamata*	1	-	1	-	2	1.0	50
AR	*Cerapus "tubularis"*	-	-	2	-	2	1.0	50
AN	*Chone* sp. C Harris 1984	-	1	1	-	2	1.0	50
NE	Lineidae	-	1	1	-	2	1.0	50
AN	*Magelona pitelkai*	-	1	-	1	2	1.0	50
AN	*Pectinaria californiensis*	1	-	-	1	2	1.0	50
CN	*Zaolutus actius*	1	-	1	-	2	1.0	50
AN	*Acmira catherinae*	-	-	-	1	1	0.5	25
AN	*Arabella endonata*	-	1	-	-	1	0.5	25
AR	*Argissa hamatipes*	-	1	-	-	1	0.5	25
NE	*Cerebratulus californiensis*	1	-	-	-	1	0.5	25
AN	*Chaetozone "setosa"*	-	1	-	-	1	0.5	25
CO	Enteropneusta	-	-	1	-	1	0.5	25
AR	*Gibberosus myersi*	-	-	-	1	1	0.5	25
MO	*Kurtziella plumbea*	-	-	1	-	1	0.5	25
AN	Lumbrineridae	-	-	1	-	1	0.5	25
AN	Maldanidae	-	1	-	-	1	0.5	25
AR	*Monoculodes hartmanae*	-	-	-	1	1	0.5	25
AN	*Monticellina cryptica*	-	-	1	-	1	0.5	25
MO	*Nassarius perpinguis*	-	-	-	1	1	0.5	25
MO	*Nitidiscala sawinae*	1	-	-	-	1	0.5	25
MO	*Olivella baetica*	-	-	1	-	1	0.5	25
AR	Paguridea	-	-	-	1	1	0.5	25
NE	*Paranemertes californica*	-	-	1	-	1	0.5	25
AR	*Parasterope barnesi*	-	-	1	-	1	0.5	25
PR	Phoronida	1	-	-	-	1	0.5	25
AN	*Phyllodoce hartmanae*	-	1	-	-	1	0.5	25
AR	*Pinnixa longipes*	-	-	1	-	1	0.5	25
AR	*Rhepoxynius* sp. A SCAMIT 1987	-	-	1	-	1	0.5	25
MO	*Tellina modesta*	-	-	1	-	1	0.5	25
NE	*Tetrastemma* sp.	1	-	-	-	1	0.5	25
SI	*Thysanocardia nigra*	1	-	-	-	1	0.5	25
NE	*Tubulanus polymorphus*	-	1	-	-	1	0.5	25
MO	*Turbonilla* sp.	-	-	1	-	1	0.5	25

Summary

Parameter	Replicate B1-I	B1-II	B1-III	B1-IV	Station Total	Replicate Mean
Number of individuals	54	37	62	46	199	50
Number of species	17	19	30	17	50	20.8
Diversity (H')	2.23	2.62	2.98	2.36	3.02	2.55

Appendix F-2. (Cont.).

Station B2

Phylum	Species	Replicate B2-I	B2-II	B2-III	B2-IV	Total	Percent Comp.	Number/ m2
AN	*Mediomastus acutus*	8	6	12	7	33	15.3	825
AN	*Owenia collaris*	1	4	20	8	33	15.3	825
AN	*Apoprionospio pygmaea*	7	5	2	13	27	12.5	675
MO	*Tellina modesta*	3	1	3	3	10	4.6	250
CN	*Zaolutus actius*	-	2	6	-	8	3.7	200
AN	*Goniada littorea*	2	2	-	3	7	3.2	175
AN	*Syllis (Typosyllis)* sp.	-	1	4	2	7	3.2	175
MO	*Cooperella subdiaphana*	1	3	1	1	6	2.8	150
AN	*Leitoscoloplos pugettensis*	-	3	2	1	6	2.8	150
AR	*Diastylopsis tenuis*	2	1	1	1	5	2.3	125
AR	*Monoculodes hartmanae*	4	-	-	1	5	2.3	125
AN	*Pectinaria californiensis*	-	1	3	1	5	2.3	125
AN	*Spiochaetopterus costarum*	1	1	2	1	5	2.3	125
AN	*Glycera convoluta*	-	-	4	-	4	1.9	100
NE	*Tubulanus polymorphus*	-	2	1	1	4	1.9	100
NE	*Carinoma mutabilis*	1	-	-	2	3	1.4	75
NE	Nemertea	3	-	-	-	3	1.4	75
MO	Bivalvia	-	-	1	1	2	0.9	50
AR	*Campylaspis* sp. C Myers & Benedict 1974	-	2	-	-	2	0.9	50
AN	*Chone albocincta*	-	-	-	2	2	0.9	50
AN	*Cirriformia tentaculata*	-	-	-	2	2	0.9	50
CO	Enteropneusta	1	-	1	-	2	0.9	50
AR	*Gibberosus myersi*	2	-	-	-	2	0.9	50
NE	*Paranemertes californica*	-	-	1	1	2	0.9	50
CN	Pennatulacea	1	-	-	1	2	0.9	50
AN	*Scoletoma tetraura*	-	-	1	1	2	0.9	50
MO	*Semele* sp.	1	-	-	1	2	0.9	50
AN	*Spiophanes bombyx*	-	-	2	-	2	0.9	50
MO	*Turbonilla raymondi*	-	-	-	2	2	0.9	50
MO	*Acteocina harpa*	-	-	-	1	1	0.5	25
CO	*Branchiostoma californiense*	-	1	-	-	1	0.5	25
AN	*Chone* sp. C Harris 1984	-	-	-	1	1	0.5	25
MO	*Cyclostremella dalli*	-	-	1	-	1	0.5	25
NE	Lineidae	-	-	-	1	1	0.5	25
AN	Lumbrineridae	-	1	-	-	1	0.5	25
AN	*Lumbrineris californiensis*	1	-	-	-	1	0.5	25
MO	*Mysella tumida*	-	1	-	-	1	0.5	25
AR	*Mysidopsis intii*	1	-	-	-	1	0.5	25
MO	*Nitidiscala sawinae*	-	-	-	1	1	0.5	25
MO	*Odostomia* sp.	-	-	-	1	1	0.5	25
MO	*Olivella baetica*	-	-	-	1	1	0.5	25
AN	*Parandalia fauveli*	-	1	-	-	1	0.5	25
AN	*Podarkeopsis glabus*	1	-	-	-	1	0.5	25
AN	*Polydora cirrosa*	-	-	1	-	1	0.5	25
AN	*Prionospio lighti*	-	-	1	-	1	0.5	25
AR	Pycnogonida	-	-	-	1	1	0.5	25
AN	*Spiophanes duplex*	-	-	1	-	1	0.5	25
AN	*Subadyte mexicana*	-	-	1	-	1	0.5	25
SI	*Thysanocardia nigra*	-	-	-	1	1	0.5	25
AR	*Uromunna ubiquita*	-	-	-	1	1	0.5	25

Summary

Parameter	Replicate B2-I	B2-II	B2-III	B2-IV	Station Total	Replicate Mean
Number of individuals	41	38	72	65	216	54
Number of species	18	18	23	30	50	22.3
Diversity (H')	2.58	2.68	2.56	2.99	3.18	2.70

Appendix F-2. (Cont.).

Station B3

Phylum	Species	Replicate B3-I	B3-II	B3-III	B3-IV	Total	Percent Comp.	Number/ m^2
AN	*Owenia collaris*	7	1	3	5	16	9.9	400
CN	*Zaolutus actius*	6	-	5	5	16	9.9	400
AN	*Spiochaetopterus costarum*	4	1	2	3	10	6.2	250
AN	*Gibberosus myersi*	3	5	1	-	9	5.6	225
AN	*Apoprionospio pygmaea*	1	2	1	4	8	5.0	200
NE	*Carinoma mutabilis*	-	2	3	3	8	5.0	200
NE	*Paranemertes californica*	5	-	3	-	8	5.0	200
AN	*Spiophanes bombyx*	4	1	1	2	8	5.0	200
AN	*Prionospio lighti*	-	5	2	-	7	4.3	175
AR	*Neotrypaea californiensis*	3	1	1	-	5	3.1	125
AN	*Onuphis eremita parva*	3	1	1	-	5	3.1	125
EC	*Amphiodia* sp.	1	1	2	-	4	2.5	100
AR	*Gibberosus devaneyi*	2	1	1	-	4	2.5	100
AN	*Glycera convoluta*	1	-	1	2	4	2.5	100
AR	*Monoculodes hartmanae*	-	3	1	-	4	2.5	100
NE	*Tubulanus polymorphus*	2	-	-	2	4	2.5	100
AR	*Diastylopsis tenuis*	2	-	1	-	3	1.9	75
AN	*Hesionella mccullochae*	3	-	-	-	3	1.9	75
AN	*Scoloplos "armiger"*	1	1	-	1	3	1.9	75
AR	*Uromunna ubiquita*	-	-	1	2	3	1.9	75
AN	*Acmira catherinae*	-	-	1	1	2	1.2	50
AR	*Leptocuma forsmani*	-	1	1	-	2	1.2	50
AN	*Magelona pitelkai*	-	1	-	1	2	1.2	50
AN	*Phyllodoce pettiboneae*	-	1	-	1	2	1.2	50
PR	Phoronida	1	-	-	1	2	1.2	50
AN	Phyllodocidae	2	-	-	-	2	1.2	50
MO	*Solen sicarius*	-	-	1	1	2	1.2	50
NE	*Tetrastemma* sp.	1	-	-	1	2	1.2	50
AR	*Ancinus granulatus*	-	-	1	-	1	0.6	25
AN	*Armandia brevis*	-	-	1	-	1	0.6	25
CO	*Branchiostoma californiense*	1	-	-	-	1	0.6	25
AN	*Cirriformia tentaculata*	-	1	-	-	1	0.6	25
MO	*Cyclostremella dalli*	1	-	-	-	1	0.6	25
AN	*Eumida longicornuta*	-	-	1	-	1	0.6	25
MO	*Kurtziella plumbea*	-	1	-	-	1	0.6	25
NE	Lineidae	-	-	-	1	1	0.6	25
AN	Lumbrineridae	-	-	1	-	1	0.6	25
AN	*Mediomastus acutus*	1	-	-	-	1	0.6	25
MO	*Nitidiscala sawinae*	1	-	-	-	1	0.6	25
AN	*Polydora cirrosa*	-	-	1	-	1	0.6	25
AR	*Rhepoxynius menziesi*	-	1	-	-	1	0.6	25

Summary

Parameter	Replicate B3-I	B3-II	B3-III	B3-IV	Station Total	Replicate Mean
Number of individuals	56	31	38	36	161	40
Number of species	23	19	25	17	41	21.0
Diversity (H')	2.91	2.72	3.06	2.65	3.34	2.83

Appendix F-2. (Cont.).

Station B4

Phylum	Species	Replicate B4-I	B4-II	B4-III	B4-IV	Total	Percent Comp.	Number/ m^2
AN	*Apoprionospio pygmaea*	6	4	2	9	21	17.2	525
AN	*Owenia collaris*	9	3	2	4	18	14.8	450
AN	*Monoculodes hartmanae*	3	1	5	6	15	12.3	375
CN	*Zaolutus actius*	4	4	1	1	10	8.2	250
AR	*Gibberosus myersi*	-	2	5	1	8	6.6	200
AN	*Prionospio lighti*	1	4	-	2	7	5.7	175
AN	*Spiochaetopterus costarum*	3	-	-	1	4	3.3	100
AR	*Diastylopsis tenuis*	-	-	2	1	3	2.5	75
PR	Phoronida	1	1	1	-	3	2.5	75
EC	*Amphiodia* sp.	2	-	-	-	2	1.6	50
AN	*Goniada littorea*	1	-	1	-	2	1.6	50
AN	*Mediomastus acutus*	1	1	-	-	2	1.6	50
AR	*Neotrypaea californiensis*	2	-	-	-	2	1.6	50
MO	*Olivella baetica*	-	1	1	-	2	1.6	50
NE	*Paranemertes californica*	1	-	1	-	2	1.6	50
AN	*Pectinaria californiensis*	-	1	-	1	2	1.6	50
AN	*Spiophanes bombyx*	-	1	-	1	2	1.6	50
AN	*Spiophanes duplex*	2	-	-	-	2	1.6	50
CO	*Branchiostoma californiense*	1	-	-	-	1	0.8	25
AN	*Cirriformia tentaculata*	-	1	-	-	1	0.8	25
AR	*Leuroleberis sharpei*	-	-	-	1	1	0.8	25
CN	Limnactiniidae sp. A SCAMIT 1989	1	-	-	-	1	0.8	25
NE	Lineidae	-	-	1	-	1	0.8	25
MO	*Modiolus* sp.	1	-	-	-	1	0.8	25
AN	*Magelona pitelkai*	-	1	-	-	1	0.8	25
MO	*Nitidiscala sawinae*	-	1	-	-	1	0.8	25
AN	*Onuphis eremita parva*	-	1	-	-	1	0.8	25
MO	*Rictaxis punctocaelatus*	-	1	-	-	1	0.8	25
MO	*Saxidomus nuttalli*	-	-	-	1	1	0.8	25
AN	*Scoletoma tetraura*	-	-	1	-	1	0.8	25
AN	*Scoloplos "armiger"*	-	-	-	1	1	0.8	25
AN	*Sigalion spinosa*	1	-	-	-	1	0.8	25
AN	*Syllis (Ehlersia) heterochaeta*	-	-	-	1	1	0.8	25

Summary

Parameter	Replicate B4-I	B4-II	B4-III	B4-IV	Station Total	Replicate Mean
Number of individuals	40	28	23	31	122	31
Number of species	17	16	12	14	33	14.8
Diversity (H')	2.23	2.29	2.04	1.87	2.58	2.11

Appendix F-2. (Cont.).

Station B5

Phylum	Species	Replicate B5-I	B5-II	B5-III	B5-IV	Total	Percent Comp.	Number/ m^2
EN	Loxosomatidae	-	73	-	-	73	28.3	1825
AN	*Mediomastus acutus*	10	16	10	1	37	14.3	925
NT	Nematoda	-	5	10	3	18	7.0	450
MO	*Tellina modesta*	4	1	1	5	11	4.3	275
AN	*Monticellina cryptica*	2	2	1	2	7	2.7	175
AN	*Apoprionospio pygmaea*	1	-	4	1	6	2.3	150
AN	*Chaetozone "setosa"*	1	1	2	1	5	1.9	125
EC	*Dendraster excentricus*	4	-	1	-	5	1.9	125
AN	*Scoletoma tetraura*	-	1	2	2	5	1.9	125
AR	*Argissa hamatipes*	2	1	1	-	4	1.6	100
NE	*Carinoma mutabilis*	2	1	1	-	4	1.6	100
AN	*Goniada littorea*	2	-	-	2	4	1.6	100
MO	*Philine bakeri*	4	-	-	-	4	1.6	100
NE	*Tubulanus polymorphus*	-	-	4	-	4	1.6	100
AN	*Hesionella mccullochae*	3	-	-	-	3	1.2	75
AN	*Syllis (Typosyllis)* sp.	-	2	1	-	3	1.2	75
AN	*Aphelochaeta* sp. C Dorsey 1984	1	1	-	-	2	0.8	50
AR	*Edotia sublittoralis*	-	-	2	-	2	0.8	50
CO	Enteropneusta	1	-	1	-	2	0.8	50
AN	*Glycera convoluta*	-	-	1	1	2	0.8	50
AR	*Hemilamprops californica*	2	-	-	-	2	0.8	50
AN	*Nephtys cornuta*	1	-	1	-	2	0.8	50
AN	*Nereis procera*	-	-	-	2	2	0.8	50
PR	Phoronida	1	-	-	1	2	0.8	50
AN	*Phyllodoce* sp.	1	-	-	1	2	0.8	50
AN	*Podarkeopsis glabrus*	-	1	1	-	2	0.8	50
AN	*Prionospio lighti*	1	-	1	-	2	0.8	50
AN	*Spiophanes duplex*	-	-	2	-	2	0.8	50
AN	*Spiochaetopterus costarum*	1	-	-	1	2	0.8	50
PL	*Stylochus exiguus*	1	-	1	-	2	0.8	50
MO	*Acteocina culcitella*	-	-	-	1	1	0.4	25
MO	*Acteocina harpa*	-	-	1	-	1	0.4	25
AR	*Amphideutopus oculatus*	-	-	1	-	1	0.4	25
EC	*Amphiodia* sp.	-	1	-	-	1	0.4	25
AR	*Anoropallene palpida*	-	-	-	1	1	0.4	25
AN	*Aricidea wassi*	-	-	1	-	1	0.4	25
AR	*Balanus pacificus*	-	-	-	1	1	0.4	25
MO	Bivalvia	-	-	-	1	1	0.4	25
AN	*Cirrophorus furcatus*	-	-	-	1	1	0.4	25
MO	*Cooperella subdiaphana*	-	-	-	1	1	0.4	25
AN	*Cossura* sp. A. Phillips 1987	-	-	1	-	1	0.4	25
AR	*Cyclaspis* sp. C SCAMIT 1986	-	-	1	-	1	0.4	25
AN	*Drilonereis longa*	-	-	1	-	1	0.4	25
AN	*Euchone incolor*	-	1	-	-	1	0.4	25
AN	*Glycinde armigera*	1	-	-	-	1	0.4	25
AN	*Goniada maculata*	1	-	-	-	1	0.4	25
AN	*Leitoscoloplos pugettensis*	-	1	-	-	1	0.4	25
NE	Lineidae	1	-	-	-	1	0.4	25
AN	Lumbrineridae	1	-	-	-	1	0.4	25
MO	*Macoma* sp.	-	1	-	-	1	0.4	25
AN	*Metasychis disparidentatus*	-	-	-	1	1	0.4	25
AR	*Mysidopsis intii*	-	1	-	-	1	0.4	25
NE	Nemertea	-	1	-	-	1	0.4	25
AN	*Onuphis* sp. 1 Pt. Loma 1983	-	-	-	1	1	0.4	25
AR	*Pachynus barnardi*	-	1	-	-	1	0.4	25
NE	*Paranemertes californica*	-	-	1	-	1	0.4	25
AN	*Paraprionospio pinnata*	1	-	-	-	1	0.4	25
AN	*Pectinaria californiensis*	-	1	-	-	1	0.4	25
AN	*Phyllodoce pettiboneae*	-	1	-	-	1	0.4	25
AN	*Poecilochaetus johnsoni*	-	-	-	1	1	0.4	25
AN	*Polydora cirrosa*	-	-	-	1	1	0.4	25

Appendix H-2. (Cont.).

Station B5

Phylum	Species	Replicate B5-I	B5-II	B5-III	B5-IV	Total	Percent Comp.	Number/ m^2
AR	*Synchelidium shoemakeri*	-	-	1	-	1	0.4	25
AN	*Tenonia priops*	-	-	1	-	1	0.4	25
MO	*Turbonilla pedroana*	-	1	-	-	1	0.4	25
MO	*Turbonilla santarosana*	-	1	-	-	1	0.4	25
MO	*Turbonilla* sp.	1	-	-	-	1	0.4	25
AR	*Uromunna ubiquita*	-	-	-	1	1	0.4	25

Summary

Parameter	Replicate B5-I	B5-II	B5-III	B5-IV	Station Total	Replicate Mean
Number of individuals	51	116	57	34	258	65
Number of species	26	23	30	23	68	25.5
Diversity (H')	0.69	0.49	0.97	1.24	0.98	0.85

Appendix F-2. (Cont.).

Station B6

Phylum	Species	Replicate B6-I	B6-II	B6-III	B6-IV	Total	Percent Comp.	Number/ m^2
AN	*Polydora cirrosa*	1	1	14	1	17	12.3	425
EC	*Dendraster excentricus*	1	1	1	6	9	6.5	225
AN	*Mediomastus acutus*	1	2	2	4	9	6.5	225
AN	*Chaetozone "setosa"*	3	2	1	1	7	5.1	175
AN	*Syllis (Typosyllis)* sp.	1	4	1	1	7	5.1	175
MO	*Tellina modesta*	-	3	1	3	7	5.1	175
AN	*Apoprionospio pygmaea*	1	3	1	-	5	3.6	125
PR	Phoronida	-	3	1	1	5	3.6	125
AN	*Spiophanes bombyx*	3	-	-	2	5	3.6	125
NE	*Carinoma mutabilis*	-	2	1	1	4	2.9	100
AN	*Goniada littorea*	1	-	2	1	4	2.9	100
NE	*Paranemertes californica*	-	2	1	1	4	2.9	100
AN	*Spiophanes duplex*	-	1	1	2	4	2.9	100
AR	*Diastylopsis tenuis*	1	1	1	-	3	2.2	75
NT	Nematoda	1	-	-	2	3	2.2	75
AN	*Onuphis eremita parva*	2	-	1	-	3	2.2	75
AN	*Owenia collaris*	-	1	1	1	3	2.2	75
AN	*Spiochaetopterus costarum*	-	1	-	2	3	2.2	75
AN	*Aphelochaeta* sp. C Dorsey 1984	1	1	-	-	2	1.4	50
CO	Enteropneusta	-	1	1	-	2	1.4	50
AN	*Glycera convoluta*	-	-	1	1	2	1.4	50
NE	Lineidae	1	1	-	-	2	1.4	50
AN	Maldanidae	-	-	1	1	2	1.4	50
AN	*Paraprionospio pinnata*	-	-	1	1	2	1.4	50
AR	*Photis californica*	-	1	1	-	2	1.4	50
PL	*Stylochus exiguus*	-	-	2	-	2	1.4	50
NE	*Tubulanus polymorphus*	1	-	1	-	2	1.4	50
AR	*Argissa hamatipes*	-	1	-	-	1	0.7	25
EC	Asteroidea	-	1	-	-	1	0.7	25
AN	*Brania californiensis*	-	-	1	-	1	0.7	25
AN	*Chaetopterus variopedatus*	-	-	1	-	1	0.7	25
CN	*Clytia universitatis*	-	-	1	-	1	0.7	25
MO	*Cooperella subdiaphana*	-	-	1	-	1	0.7	25
AR	*Cyclaspis* sp. C SCAMIT 1986	-	-	1	-	1	0.7	25
MO	*Cyclostremella dalli*	-	1	-	-	1	0.7	25
MO	*Doto amyra*	-	-	1	-	1	0.7	25
AN	*Euchone incolor*	-	-	-	1	1	0.7	25
AR	*Gibberosus myersi*	-	1	-	-	1	0.7	25
AR	*Hemilamprops californica*	-	1	-	-	1	0.7	25
AN	*Hesionella mccullochae*	-	-	-	1	1	0.7	25
AN	*Monticellina cryptica*	-	-	-	1	1	0.7	25
AN	*Onuphis* sp. 1 Pt. Loma 1983	-	-	1	-	1	0.7	25
AN	*Phyllodoce pettiboneae*	-	-	1	-	1	0.7	25
AR	*Pyromaia tuberculata*	-	-	1	-	1	0.7	25
NE	*Tubulanus cingulatus*	-	-	1	-	1	0.7	25

Summary

Parameter	Replicate B6-I	B6-II	B6-III	B6-IV	Station Total	Replicate Mean
Number of individuals	19	36	48	35	138	35
Number of species	14	23	32	21	45	22.5
Diversity (H')	1.61	2.24	2.28	1.98	2.53	2.03

Appendix F-2. (Cont.).

Station B7

Phylum	Species	Replicate B7-I	B7-II	B7-III	B7-IV	Total	Percent Comp.	Number/ m^2
EC	*Dendraster excentricus*	6	6	5	13	30	15.2	750
MO	*Tellina modesta*	7	6	5	4	22	11.2	550
AN	*Polydora cirrosa*	-	12	-	2	14	7.1	350
AN	*Spiophanes bombyx*	3	2	5	2	12	6.1	300
AN	*Mediomastus acutus*	4	2	1	4	11	5.6	275
AR	*Diastylopsis tenuis*	5	-	1	3	9	4.6	225
AN	*Apoprionospio pygmaea*	4	1	-	2	7	3.6	175
AR	*Argissa hamatipes*	3	1	2	-	6	3.0	150
AR	*Gibberosus myersi*	3	-	-	2	5	2.5	125
AN	*Brania californiensis*	-	4	-	-	4	2.0	100
MO	*Cooperella subdiaphana*	1	-	1	2	4	2.0	100
MO	*Crepidula coei*	-	4	-	-	4	2.0	100
CO	Enteropneusta	3	-	1	-	4	2.0	100
AN	*Exogone lourei*	2	1	1	-	4	2.0	100
NE	*Paranemertes californica*	-	2	2	-	4	2.0	100
AN	*Paraprionospio pinnata*	1	1	-	1	3	1.5	75
PR	Phoronida	-	-	1	2	3	1.5	75
AR	*Photis bifurcata*	-	2	1	-	3	1.5	75
AR	*Rhepoxynius abronius*	1	-	-	2	3	1.5	75
NE	*Tubulanus polymorphus*	1	1	1	-	3	1.5	75
AR	*Aoroides* sp.	-	2	-	-	2	1.0	50
AR	*Leptochelia dubia*	-	1	1	-	2	1.0	50
MO	*Macoma* sp.	1	-	-	1	2	1.0	50
NT	Nematoda	-	1	-	1	2	1.0	50
AN	*Sigalion spinosa*	-	-	1	1	2	1.0	50
AN	*Tenonia priops*	-	-	2	-	2	1.0	50
AR	*Uromunna ubiquita*	1	1	-	-	2	1.0	50
AN	*Acmira catherinae*	-	-	-	1	1	0.5	25
AN	*Ampharete labrops*	-	1	-	-	1	0.5	25
AR	*Balanus pacificus*	-	1	-	-	1	0.5	25
AR	*Campylaspis* sp. C Myers & Benedict 1974	1	-	-	-	1	0.5	25
CN	*Clytia universitatis*	-	1	-	-	1	0.5	25
MO	*Doto amyra*	-	1	-	-	1	0.5	25
BC	*Glottidia albida*	-	-	-	1	1	0.5	25
AN	*Glycera convoluta*	-	-	1	-	1	0.5	25
AN	*Goniada littorea*	1	-	-	-	1	0.5	25
AN	*Hesionella mccullochae*	1	-	-	-	1	0.5	25
MO	*Kurtziella plumbea*	-	1	-	-	1	0.5	25
NE	Lineidae	-	-	1	-	1	0.5	25
EC	*Lovenia cordiformis*	1	-	-	-	1	0.5	25
MO	*Macoma indentata*	-	-	1	-	1	0.5	25
AR	*Monoculodes hartmanae*	-	-	-	1	1	0.5	25
MO	*Mysella* sp. D SCAMIT 1988	-	1	-	-	1	0.5	25
AR	*Mysidopsis intii*	-	-	1	-	1	0.5	25
NE	Nemertea	-	1	-	-	1	0.5	25
MO	*Nitidiscala sawinae*	1	-	-	-	1	0.5	25
MO	*Olivella baetica*	1	-	-	-	1	0.5	25
AN	*Onuphis eremita parva*	-	-	-	1	1	0.5	25
AN	*Pectinaria californiensis*	1	-	-	-	1	0.5	25
CN	Pennatulacea	-	-	-	1	1	0.5	25
AR	*Pinnixa forficulimanus*	1	-	-	-	1	0.5	25
AN	*Scoletoma tetraura*	-	-	-	1	1	0.5	25
AN	*Spiochaetopterus costarum*	-	1	-	-	1	0.5	25
AN	*Spiophanes duplex*	1	-	-	-	1	0.5	25
AR	*Synchelidium shoemakeri*	-	-	1	-	1	0.5	25

Appendix H-2. (Cont.).

Summary

Parameter	Replicate B7-I	B7-II	B7-III	B7-IV	Station Total	Replicate Mean
Number of individuals	55	58	36	48	197	49
Number of species	24	26	21	21	55	23.0
Diversity (H')	2.95	2.86	2.80	2.67	3.38	2.82

Appendix F-2. (Cont.).

Station B8

Phylum	Species	Replicate B8-I	B8-II	B8-III	B8-IV	Total	Percent Comp.	Number/ m^2
EC	*Dendraster excentricus*	5	8	11	5	29	13.1	725
AN	*Exogone lourei*	6	1	2	16	25	11.3	625
MO	*Tellina modesta*	7	2	5	4	18	8.1	450
AN	*Spiophanes bombyx*	3	5	4	3	15	6.8	375
MO	*Cooperella subdiaphana*	1	3	6	1	11	5.0	275
AR	*Uromunna ubiquita*	-	1	3	5	9	4.1	225
NE	*Carinoma mutabilis*	2	3	-	2	7	3.2	175
AN	*Mediomastus acutus*	2	1	1	3	7	3.2	175
AN	*Apoprionospio pygmaea*	2	4	-	-	6	2.7	150
AR	*Cyclaspis* sp. C SCAMIT 1986	1	2	-	3	6	2.7	150
AN	*Spiochaetopterus costarum*	-	4	2	-	6	2.7	150
AR	*Argissa hamatipes*	1	1	1	1	4	1.8	100
AN	*Owenia collaris*	2	1	-	1	4	1.8	100
AN	*Spiophanes duplex*	-	-	-	4	4	1.8	100
NE	*Tubulanus polymorphus*	1	2	1	-	4	1.8	100
AR	*Balanus pacificus*	-	3	-	-	3	1.4	75
AR	*Photis bifurcata*	-	2	-	1	3	1.4	75
PL	*Stylochus exiguus*	3	-	-	-	3	1.4	75
AR	*Acuminodeutopus heteruropus*	-	2	-	-	2	0.9	50
AN	*Aphelochaeta* sp. C Dorsey 1984	1	-	1	-	2	0.9	50
AR	*Diastylopsis tenuis*	-	-	2	-	2	0.9	50
CO	Enteropneusta	2	-	-	-	2	0.9	50
AN	*Nephtys caecoides*	-	1	1	-	2	0.9	50
AN	*Onuphis eremita parva*	-	-	1	1	2	0.9	50
NE	*Paranemertes californica*	-	1	-	1	2	0.9	50
MO	*Parvilucina tenuisculpta*	-	2	-	-	2	0.9	50
PR	Phoronida	1	-	-	1	2	0.9	50
AR	*Photis californica*	-	1	-	1	2	0.9	50
AN	*Polydora cirrosa*	-	2	-	-	2	0.9	50
AR	*Aoroides* sp.	-	-	-	1	1	0.5	25
MO	*Armina californica*	-	1	-	-	1	0.5	25
EC	*Astropecten armatus*	1	-	-	-	1	0.5	25
AR	*Campylaspis* sp. C Myers & Benedict 1974	-	-	-	1	1	0.5	25
NE	*Cerebratulus californiensis*	1	-	-	-	1	0.5	25
AN	*Chaetozone "setosa"*	-	1	-	-	1	0.5	25
AN	*Chone albocincta*	-	-	-	1	1	0.5	25
CN	Edwardsiidae	1	-	-	-	1	0.5	25
AN	*Goniada littorea*	1	-	-	-	1	0.5	25
AN	*Goniada maculata*	-	-	-	1	1	0.5	25
AR	*Hemilamprops californica*	-	-	-	1	1	0.5	25
AN	*Hesionella mccullochae*	-	-	-	1	1	0.5	25
AN	*Leitoscoloplos pugettensis*	-	-	-	1	1	0.5	25
NE	Lineidae	-	-	-	1	1	0.5	25
AN	Maldanidae	-	1	-	-	1	0.5	25
MO	*Modiolus* sp.	-	1	-	-	1	0.5	25
AR	*Monoculodes hartmanae*	-	1	-	-	1	0.5	25
MO	*Mysella* sp. C SCAMIT 1988	1	-	-	-	1	0.5	25
MO	*Mysella tumida*	-	-	1	-	1	0.5	25
NT	Nematoda	-	-	1	-	1	0.5	25
NE	Nemertea	-	-	-	1	1	0.5	25
AN	*Nereis procera*	-	-	-	1	1	0.5	25
MO	*Odostomia* sp.	-	-	-	1	1	0.5	25
AN	Onuphidae	-	1	-	-	1	0.5	25
AN	*Paleanotus bellis*	-	1	-	-	1	0.5	25
AR	*Parasterope barnesi*	1	-	-	-	1	0.5	25
AR	*Photis macinerneyi*	-	-	-	1	1	0.5	25
AN	*Poecilochaetus johnsoni*	-	1	-	-	1	0.5	25
AN	*Polydora limicola*	-	1	-	-	1	0.5	25
AR	*Rhepoxynius abronius*	1	-	-	-	1	0.5	25
AN	*Scoletoma tetraura*	1	-	-	-	1	0.5	25
AN	*Syllis (Typosyllis)* sp.	-	-	1	-	1	0.5	25
NE	*Tubulanus cingulatus*	-	1	-	-	1	0.5	25

Appendix H-2. (Cont.).

Station B8

Phylum	Species	Replicate B8-I	B8-II	B8-III	B8-IV	Total	Percent Comp.	Number/ m^2
MO	*Turbonilla almo*	-	1	-	-	1	0.5	25
CN	*Zaolutus actius*	-	-	1	-	1	0.5	25

Summary

Parameter	Replicate B8-I	B8-II	B8-III	B8-IV	Station Total	Replicate Mean
Number of individuals	48	63	45	65	221	55
Number of species	24	33	18	29	65	26.0
Diversity (H')	2.91	3.26	2.51	2.90	3.48	2.90

Appendix F-3. Infaunal wet weight biomass data (g). Scattergood and El Segundo Generating Stations NPDES, 1997.

Sta-Rep	Annelida	Arthropoda	Mollusca	Echinodermata	Other	Total
B1-I	1.152	0.014	0.026	0.058	0.641	1.890
B1-II	0.450	<0.001	-	-	0.005	0.455
B1-III	0.799	0.172	0.004	-	0.038	1.014
B1-IV	0.530	<0.001	0.082	0.038	0.105	0.754
TOTAL	2.931	0.187	0.111	0.096	0.788	4.112
B2-I	0.183	0.039	0.009	-	0.164	0.395
B2-II	0.035	<0.001	<0.001	-	0.024	0.058
B2-III	2.065	<0.001	0.017	-	0.254	2.336
B2-IV	0.772	0.158	0.065	-	0.027	1.021
TOTAL	3.054	0.198	0.091	-	0.468	3.810
B3-I	0.736	0.053	0.010	0.006	0.207	1.012
B3-II	0.113	0.034	<0.001	<0.001	<0.001	0.147
B3-III	0.262	0.216	0.001	<0.001	0.044	0.524
B3-IV	0.597	<0.001	0.039	-	0.175	0.811
TOTAL	1.709	0.304	0.049	0.006	0.427	2.494
B4-I	0.613	0.041	0.010	0.013	0.184	0.861
B4-II	0.429	0.045	0.002	-	0.158	0.635
B4-III	0.178	0.213	0.055	-	0.055	0.500
B4-IV	0.290	<0.001	<0.001	-	<0.001	0.290
TOTAL	1.510	0.299	0.066	0.013	0.397	2.285
B5-I	0.103	0.008	<0.001	<0.001	0.039	0.151
B5-II	0.270	0.202	0.002	<0.001	0.001	0.475
B5-III	0.184	0.005	<0.001	<0.001	0.008	0.197
B5-IV	0.129	0.046	<0.001	-	0.009	0.184
TOTAL	0.687	0.261	0.002	-	0.058	1.007
B6-I	0.164	<0.001	-	<0.001	<0.001	0.164
B6-II	0.113	0.204	<0.001	<0.001	0.058	0.375
B6-III	0.126	0.088	0.081	<0.001	0.017	0.313
B6-IV	0.215	-	0.151	0.042	<0.001	0.408
TOTAL	0.617	0.292	0.232	0.042	0.076	1.259
B7-I	0.197	0.015	<0.001	0.055	0.627	0.895
B7-II	0.146	0.193	0.065	0.005	0.001	0.410
B7-III	0.038	0.006	0.001	0.095	0.196	0.335
B7-IV	0.257	0.002	<0.001	0.063	0.025	0.348
TOTAL	0.638	0.216	0.066	0.218	0.851	1.988
B8-I	0.085	0.214	0.035	9.193	0.369	9.896
B8-II	0.326	1.255	0.006	0.001	<0.001	1.587
B8-III	0.117	0.011	0.040	0.138	<0.001	0.305
B8-IV	0.115	0.196	0.003	<0.001	0.040	0.354
TOTAL	0.643	1.675	0.083	9.332	0.409	12.143
GRAND TOTAL	11.788	3.432	0.701	9.706	3.471	29.099

* B8-I: Includes one large *Astropecten armatus* at 9.191g

APPENDIX G

Fish and invertebrate heat treatment data
El Segundo and Scattergood Generating Stations NPDES, 1997

Appendix G-1. Fish and invertebrate heat treatment master species list. El Segundo and Scattergood Generating Stations NPDES, 1997.

PHYLUM / Class / Family / Species	Common Name
CNIDARIA	
Scyphozoa	
Pelagiidae	
Pelagia colorata (=noctiluca, = panopyra)	purple jellyfish
MOLLUSCA	
Gastropoda	
Aglajidae	
Navanax inermis	Navanax
Cephalopoda	
Loliginiidae	
Loligo opalescens	California market squid
Octopodidae	
Octopus bimaculatus/bimaculoides	California two-spot octopus
CRUSTACEA	
Malacostraca	
Alpheidae	
Alpheus sp.	snapping shrimps
Betaeus longidactylus	visored shrimp
Hippolytidae	
Heptacarpus palpator	tiger shrimp
Lysmata californica	red striped shrimp
Palinuridae	
Panulirus interruptus	California spiny lobster
Majidae	
Loxorhynchus grandis	sheep crab
Pugettia producta	northern kelp crab (=shieldbacked kelp crab)
Pyromaia tuberculata	tuberculate pear crab
Cancridae	
Cancer amphioetus	bigtooth rock crab
Cancer antennarius	Pacific rock crab
Cancer anthonyi	yellow rock crab
Cancer gracilis	graceful rock crab
Cancer jordani	hairy cancer crab
Cancer productus	rock crab
Portunidae	
Portunus xantusii	Xantus swimming crab
Pilumnidae	
Lophopanopeus sp.	crestleg crabs
Pilumnus spinohirsutus	retiring hairy crab
Grapsidae	
Pachygrapsus crassipes	striped shore crab
ECHINODERMATA	
Asteroidea	
Asteriidae	
Pisaster giganteus	giant-spined sea star
Pisaster ochraceus	ochre star
Holothuroidea	
Stichopodidae	
Parastichopus californicus	California sea cucumber
Parastichopus parvimensis	warty sea cucumber
VERTEBRATA	
Elasmobranchiomorphi (= Chondrichthyes, Elasmobranchii)	
Heterodontidae	
Heterodontus francisci	horn shark
Carcharinidae	
Mustelus californicus	gray 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 G-1. (Cont.).

PHYLUM Class Family Species	Common Name
VERTEBRATA cont.	
Engraulidae	
Anchoa compressa	deepbody anchovy
Engraulis mordax	northern anchovy
Ophidiidae	
Chilara taylori	spotted cusk-eel
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 rastrelliger	grass rockfish
Cottidae	
Scorpaenichthys marmoratus	cabezon
Serranidae	
Paralabrax clathratus	kelp bass
Paralabrax maculatofasciatus	spotted sand bass
Paralabrax nebulifer	barred sand bass
Stereolepis gigas	giant sea bass
Carangidae	
Trachurus symmetricus	jack mackerel
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
Medialuna californiensis	halfmoon
Embiotocidae	
Cymatogaster aggregata	shiner perch
Damalichthys vacca	pile perch
Embiotoca jacksoni	black perch
Hyperprosopon argenteum	walleye surfperch
Phanerodon furcatus	white seaperch
Rhacochilus toxotes	rubberlip seaperch
Pomacentridae	
Chromis punctipinnis	blacksmith
Sphyraenidae	
Sphyraena argentea	California barracuda
Labridae	
Halichoeres semicinctus	rock wrasse
Oxyjulis californica	senorita
Clinidae	
Heterostichus rostratus	giant kelpfish
Blenniidae	
Hypsoblennius gentilis	mussel blenny
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	
Pleuronichthys ritteri	spotted turbot

Appendix G-2. Abundance, biomass (kg), and percent occurrence of fish impinged during heat treatments at El Segundo and Scattergood Generating Stations. El Segundo and Scattergood Generating Stations NPDES, 1997.

Species	Scattergood No.	Scattergood Wt. (kg)	El Segundo No.	El Segundo Wt. (kg)	Total Abundance	Percent Total	Cumulative Percent	Total Biomass
Seriphus politus	8225	138.640	4842	125.125	13067	31.87	31.87	263.765
Atherinopsis californiensis	375	41.165	6730	689.172	7105	17.33	49.20	730.337
Engraulis mordax	2871	15.446	959	13.760	3830	9.34	58.54	29.206
Xenistius californiensis	822	38.679	2836	151.400	3658	8.92	67.46	190.079
Atherinops affinis	2261	86.861	240	8.329	2501	6.10	73.56	95.190
Umbrina roncador	2403	334.594	88	11.895	2491	6.08	79.63	346.489
Hyperprosopon argenteum	874	32.686	1264	69.095	2138	5.21	84.85	101.781
Genyonemus lineatus	640	22.072	1174	64.760	1814	4.42	89.27	86.832
Sardinops sagax	78	2.992	1157	27.644	1235	3.01	92.28	30.636
Paralabrax clathratus	110	18.605	476	181.954	586	1.43	93.71	200.559
Leuresthes tenuis	23	0.523	484	7.800	507	1.24	94.95	8.323
Paralabrax nebulifer	301	85.320	60	20.239	361	0.88	95.83	105.559
Cheilotrema saturnum	220	17.997	129	20.567	349	0.85	96.68	38.564
Phanerodon furcatus	153	7.401	26	1.467	179	0.44	97.12	8.868
Anisotremus davidsonii	95	36.456	48	18.879	143	0.35	97.47	55.335
Chromis punctipinnis	24	3.217	102	8.098	126	0.31	97.77	11.315
Atractoscion nobilis	105	25.085	17	3.995	122	0.30	98.07	29.080
Cymatogaster aggregata	86	1.344	30	0.607	116	0.28	98.35	1.951
Myliobatis californica	8	6.814	78	190.090	86	0.21	98.56	196.904
Damalichthys vacca	18	1.616	58	16.052	76	0.19	98.75	17.668
Rhacochilus toxotes	41	5.015	27	12.096	68	0.17	98.91	17.111
Scorpaena guttata	29	7.401	39	13.259	68	0.17	99.08	20.660
Anchoa compressa	55	0.753	-	-	55	0.13	99.21	0.753
Embiotoca jacksoni	21	2.115	21	6.599	42	0.10	99.32	8.714
Medialuna californiensis	19	5.838	15	5.263	34	0.08	99.40	11.101
Scomber japonicus	24	3.262	5	0.612	29	0.07	99.47	3.874
Menticirrhus undulatus	18	5.217	7	2.374	25	0.06	99.53	7.591
Pleuronichthys ritteri	18	2.066	5	0.386	23	0.06	99.59	2.452
Porichthys notatus	19	1.272	-	-	19	0.05	99.63	1.272
Platyrhinoidis triseriata	17	9.370	1	0.841	18	0.04	99.68	10.211
Peprillus simillimus	3	0.059	14	0.488	17	0.04	99.72	0.547
Halichoeres semicinctus	8	1.765	6	2.139	14	0.03	99.75	3.904
Paralichthys californicus	7	6.849	6	5.630	13	0.03	99.79	12.479
Oxyjulis californica	2	0.165	9	0.434	11	0.03	99.81	0.599
Rhinobatos productus	3	5.180	8	7.844	11	0.03	99.84	13.024
Urolophus halleri	4	2.738	6	3.221	10	0.02	99.86	5.959
Girella nigricans	1	0.847	5	3.960	6	0.01	99.88	4.807
Hypsoblennius gilberti	3	0.008	3	0.027	6	0.01	99.89	0.035
Trachurus symmetricus	3	0.079	3	0.581	6	0.01	99.91	0.660
Mustelus californicus	4	9.800	1	1.200	5	0.01	99.92	11.000
Sphyraena argentea	4	1.133	1	0.046	5	0.01	99.93	1.179
Heterodontus francisci	3	7.344	1	2.690	4	0.01	99.94	10.034
Heterostichus rostratus	3	0.086	-	-	3	0.01	99.95	0.086
Scorpaenichthys marmoratus	1	0.758	2	3.146	3	0.01	99.96	3.904
Triakis semifasciata	3	6.100	-	-	3	0.01	99.96	6.100
Chilara taylori	2	0.053	-	-	2	0.00	99.97	0.053
Citharichthys stigmaeus	2	0.015	-	-	2	0.00	99.97	0.015
Paralabrax maculatofasciatus	1	0.675	1	0.020	2	0.00	99.98	0.695
Sebastes auriculatus	-	-	2	0.205	2	0.00	99.98	0.205
Sebastes rastrelliger	1	0.657	1	0.373	2	0.00	99.99	1.030
Stereolepis gigas	1	0.750	1	6.100	2	0.00	99.99	6.850
Hypsoblennius gentilis	1	0.008	-	-	1	0.00	100.00	0.008
Ophidion scrippsae	1	0.046	-	-	1	0.00	100.00	0.046
Porichthys myriaster	1	0.644	-	-	1	0.00	100.00	0.644
Survey Totals	20015	1005.581	20988	1710.462	41003			2716.043
Total Species	53		45		54			

Note: 0.00 < 0.005

Appendix G-3. Abundance, biomass (kg), and percent occurrence of fish impinged during heat treatments at El Segundo Generating Station Units 1 & 2 and 3 & 4. El Segundo and Scattergood

Species	Units 1 & 2		Units 3 & 4		Total		% Comp.	
	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass
Atherinopsis californiensis	7	1.257	6723	687.915	6730	689.172	32.07	40.29
Seriphus politus	13	1.097	4829	124.028	4842	125.125	23.07	7.32
Xenistius californiensis	10	0.564	2826	150.836	2836	151.400	13.51	8.85
Hyperprosopon argenteum	2	0.144	1262	68.951	1264	69.095	6.02	4.04
Genyonemus lineatus	-	-	1174	64.760	1174	64.760	5.59	3.79
Sardinops sagax	8	0.578	1149	27.066	1157	27.644	5.51	1.62
Engraulis mordax	7	0.153	952	13.607	959	13.760	4.57	0.80
Leuresthes tenuis	-	-	484	7.800	484	7.800	2.31	0.46
Paralabrax clathratus	40	1.466	436	180.488	476	181.954	2.27	10.64
Atherinops affinis	-	-	240	8.329	240	8.329	1.14	0.49
Cheilotrema saturnum	1	0.108	128	20.459	129	20.567	0.61	1.20
Chromis punctipinnis	19	0.728	83	7.370	102	8.098	0.49	0.47
Umbrina roncador	1	0.420	87	11.475	88	11.895	0.42	0.70
Myliobatis californica	2	0.850	76	189.240	78	190.090	0.37	11.11
Paralabrax nebulifer	7	0.276	53	19.963	60	20.239	0.29	1.18
Damalichthys vacca	2	0.459	56	15.593	58	16.052	0.28	0.94
Anisotremus davidsonii	-	-	48	18.879	48	18.879	0.23	1.10
Scorpaena guttata	1	0.599	38	12.660	39	13.259	0.19	0.78
Cymatogaster aggregata	-	-	30	0.607	30	0.607	0.14	0.04
Rhacochilus toxotes	-	-	27	12.096	27	12.096	0.13	0.71
Phanerodon furcatus	9	0.410	17	1.057	26	1.467	0.12	0.09
Embiotoca jacksoni	5	0.925	16	5.674	21	6.599	0.10	0.39
Atractoscion nobilis	-	-	17	3.995	17	3.995	0.08	0.23
Medialuna californiensis	-	-	15	5.263	15	5.263	0.07	0.31
Peprillus simillimus	-	-	14	0.488	14	0.488	0.07	0.03
Oxyjulis californica	6	0.181	3	0.253	9	0.434	0.04	0.03
Rhinobatos productus	-	-	8	7.844	8	7.844	0.04	0.46
Menticirrhus undulatus	-	-	7	2.374	7	2.374	0.03	0.14
Halichoeres semicinctus	1	0.375	5	1.764	6	2.139	0.03	0.13
Paralichthys californicus	-	-	6	5.630	6	5.630	0.03	0.33
Urolophus halleri	-	-	6	3.221	6	3.221	0.03	0.19
Girella nigricans	-	-	5	3.960	5	3.960	0.02	0.23
Pleuronichthys ritteri	1	0.088	4	0.298	5	0.386	0.02	0.02
Scomber japonicus	-	-	5	0.612	5	0.612	0.02	0.04
Hypsoblennius gilberti	2	0.020	1	0.007	3	0.027	0.01	0.00
Trachurus symmetricus	-	-	3	0.581	3	0.581	0.01	0.03
Scorpaenichthys marmoratus	1	2.636	1	0.510	2	3.146	0.01	0.18
Sebastes auriculatus	2	0.205	-	-	2	0.205	0.01	0.01
Heterodontus francisci	-	-	1	2.690	1	2.690	0.00	0.16
Mustelus californicus	-	-	1	1.200	1	1.200	0.00	0.07
Paralabrax maculatofasciatus	-	-	1	0.020	1	0.020	0.00	0.00
Platyrhinoidis triseriata	-	-	1	0.841	1	0.841	0.00	0.05
Sebastes rastrelliger	-	-	1	0.373	1	0.373	0.00	0.02
Sphyraena argentea	-	-	1	0.046	1	0.046	0.00	0.00
Stereolepis gigas	-	-	1	6.100	1	6.100	0.00	0.36
Survey Totals	147	13.539	20841	1696.923	20988	1710.462		
Total Species	22		44		45			

Note: 0.00 < 0.005

Appendix G-4. Abundance of fish impinged in heat treatments by date at El Segundo Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997.

	Units 1 & 2				Units 3 & 4						Total
	21 May	7 Aug	10 Sep	Total	30 Oct	8 Feb	3 Jun	26 Jul	11 Sep	Total	Abundance
Atherinopsis californiensis	7	-	-	7	14	3520	19	11	3159	6723	6730
Seriphus politus	13	-	-	13	-	2598	2229	2	-	4829	4842
Xenistius californiensis	3	1	6	10	253	59	107	5	2402	2826	2836
Hyperprosopon argenteum	1	1	-	2	-	1232	26	4	-	1262	1264
Genyonemus lineatus	-	-	-	-	-	1155	19	-	-	1174	1174
Sardinops sagax	-	8	-	8	-	1024	124	-	1	1149	1157
Engraulis mordax	2	5	-	7	-	22	930	-	-	952	959
Leuresthes tenuis	-	-	-	-	-	484	-	-	-	484	484
Paralabrax clathratus	39	1	-	40	217	8	102	3	106	436	476
Atherinops affinis	-	-	-	-	-	236	-	-	4	240	240
Cheilotrema saturnum	-	1	-	1	25	14	32	3	54	128	129
Chromis punctipinnis	11	4	4	19	37	23	12	2	9	83	102
Umbrina roncador	1	-	-	1	2	44	-	-	41	87	88
Myliobatis californica	2	-	-	2	1	46	5	3	21	76	78
Paralabrax nebulifer	7	-	-	7	12	1	9	-	31	53	60
Damalichthys vacca	1	-	1	2	2	15	38	-	1	56	58
Anisotremus davidsonii	-	-	-	-	1	3	3	-	41	48	48
Scorpaena guttata	1	-	-	1	2	3	15	-	18	38	39
Cymatogaster aggregata	-	-	-	-	-	14	12	4	-	30	30
Rhacochilus toxotes	-	-	-	-	1	2	6	2	16	27	27
Phanerodon furcatus	9	-	-	9	-	8	8	-	1	17	26
Embiotoca jacksoni	5	-	-	5	-	3	5	-	8	16	21
Atractoscion nobilis	-	-	-	-	-	15	-	-	2	17	17
Medialuna californiensis	-	-	-	-	5	1	1	1	7	15	15
Peprillus simillimus	-	-	-	-	-	14	-	-	-	14	14
Oxyjulis californica	5	-	1	6	-	-	2	-	1	3	9
Rhinobatos productus	-	-	-	-	-	-	-	-	8	8	8
Menticirrhus undulatus	-	-	-	-	1	5	-	-	1	7	7
Halichoeres semicinctus	1	-	-	1	1	1	-	-	3	5	6
Paralichthys californicus	-	-	-	-	2	2	1	-	1	6	6
Urolophus halleri	-	-	-	-	-	1	3	-	2	6	6
Girella nigricans	-	-	-	-	-	-	-	-	5	5	5
Pleuronichthys ritteri	1	-	-	1	-	4	-	-	-	4	5
Scomber japonicus	-	-	-	-	-	4	1	-	-	5	5
Hypsoblennius gilberti	2	-	-	2	-	-	-	1	-	1	3
Trachurus symmetricus	-	-	-	-	2	1	-	-	-	3	3
Scorpaenichthys marmoratus	-	1	-	1	-	-	1	-	-	1	2
Sebastes auriculatus	2	-	-	2	-	-	-	-	-	-	2
Heterodontus francisci	-	-	-	-	-	-	1	-	-	1	1
Mustelus californicus	-	-	-	-	-	-	1	-	-	1	1
Paralabrax maculatofasciatus	-	-	-	-	-	-	1	-	-	1	1
Platyrhinoidis triseriata	-	-	-	-	-	1	-	-	-	1	1
Sebastes rastrelliger	-	-	-	-	-	1	-	-	-	1	1
Sphyraena argentea	-	-	-	-	-	1	-	-	-	1	1
Stereolepis gigas	-	-	-	-	-	-	-	-	1	1	1
Total Abundance:	113	22	12	147	578	10565	3713	41	5944	20841	20988
Species	19	8	4	23	17	35	28	12	26	44	45

Appendix G-5. Abundance of fish impinged during heat treatments by date at Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997.

	1996		1997						Total
	8 Nov	11 Dec	29 Jan	13 Mar	29 Apr	29 May	22 Jul	22 Sep	Abundance
Seriphus politus	1215	1945	3512	688	265	496	104	-	8225
Engraulis mordax	318	2176	55	2	3	282	35	-	2871
Umbrina roncador	24	5	14	-	-	2	150	2208	2403
Atherinops affinis	110	385	15	91	14	22	1160	464	2261
Hyperprosopon argenteum	79	576	160	10	1	28	20	-	874
Xenistius californiensis	130	197	65	7	44	192	81	106	822
Genyonemus lineatus	9	11	432	25	6	156	1	-	640
Atherinopsis californiensis	62	106	79	111	2	6	8	1	375
Paralabrax nebulifer	139	47	27	-	1	-	33	54	301
Cheilotrema saturnum	67	11	13	1	-	1	50	77	220
Phanerodon furcatus	41	55	34	-	1	15	7	-	153
Paralabrax clathratus	54	10	2	1	-	-	22	21	110
Atractoscion nobilis	43	16	42	-	-	-	1	3	105
Anisotremus davidsonii	3	2	-	-	-	-	26	64	95
Cymatogaster aggregata	9	17	4	1	10	43	2	-	86
Sardinops sagax	13	47	3	8	-	2	-	5	78
Anchoa compressa	7	-	48	-	-	-	-	-	55
Rhacochilus toxotes	17	9	15	-	-	-	-	-	41
Scorpaena guttata	8	1	-	-	-	-	4	16	29
Chromis punctipinnis	5	1	2	-	-	-	13	3	24
Scomber japonicus	20	4	-	-	-	-	-	-	24
Leuresthes tenuis	-	-	15	3	-	1	1	3	23
Embiotoca jacksoni	12	1	1	-	1	2	3	1	21
Medialuna californiensis	3	1	-	-	-	-	5	10	19
Porichthys notatus	-	-	-	1	-	18	-	-	19
Damalichthys vacca	12	4	1	-	-	-	1	-	18
Menticirrhus undulatus	2	-	7	-	-	-	8	1	18
Pleuronichthys ritteri	1	-	14	1	-	2	-	-	18
Platyrhinoidis triseriata	10	1	4	2	-	-	-	-	17
Halichoeres semicinctus	1	-	-	1	-	-	1	5	8
Myliobatis californica	1	3	1	-	-	-	2	1	8
Paralichthys californicus	1	-	-	-	-	-	4	2	7
Mustelus californicus	2	-	-	-	-	-	-	2	4
Sphyraena argentea	2	-	-	-	-	-	-	2	4
Urolophus halleri	1	1	-	-	-	-	2	-	4
Heterodontus francisci	-	1	1	-	-	-	1	-	3
Heterostichus rostratus	1	2	-	-	-	-	-	-	3
Hypsoblennius gilberti	-	-	-	-	-	-	1	2	3
Peprilus simillimus	-	-	3	-	-	-	-	-	3
Rhinobatos productus	1	-	1	-	-	-	-	1	3
Trachurus symmetricus	3	-	-	-	-	-	-	-	3
Triakis semifasciata	1	-	-	-	-	-	-	2	3
Chilara taylori	-	-	2	-	-	-	-	-	2
Citharichthys stigmaeus	1	-	1	-	-	-	-	-	2
Oxyjulis californica	1	-	1	-	-	-	-	-	2
Girella nigricans	-	-	-	-	-	-	1	-	1
Hypsoblennius gentilis	-	-	1	-	-	-	-	-	1
Ophidion scrippsae	-	-	-	1	-	-	-	-	1
Paralabrax maculatofasciatus	1	-	-	-	-	-	-	-	1
Porichthys myriaster	-	-	-	-	-	-	1	-	1
Scorpaenichthys marmoratus	-	-	-	-	-	-	-	1	1
Sebastes rastrelliger	-	-	1	-	-	-	-	-	1
Stereolepis gigas	1	-	-	-	-	-	-	-	1
Total Abundance:	2431	5635	4576	954	348	1268	1748	3055	20015
Total Species	41	28	33	17	11	17	30	25	53

Appendix G-6. Biomass (kg) of fish impinged in heat treatments by date at El Segundo Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997.

	Units 1 & 2				Units 3 & 4						Total
	21 Ma	7 Aug	10 Sep	Total	30 Oct	8 Feb	3 Jun	26 Jul	11 Sep	Total	Biomass
Atherinopsis californiensis	1.257	-	-	1.257	3.610	235.880	3.750	3.235	441.440	687.915	689.172
Myliobatis californica	0.850	-	-	0.850	1.140	79.170	5.380	75.000	28.550	189.240	190.090
Paralabrax clathratus	1.372	0.094	-	1.466	81.100	1.350	57.640	0.698	39.700	180.488	181.954
Xenistius californiensis	0.496	0.053	0.015	0.564	16.100	1.850	6.850	0.516	125.520	150.836	151.400
Seriphus politus	1.097	-	-	1.097	-	68.480	55.500	0.048	-	124.028	125.125
Hyperprosopon argenteum	0.127	0.017	-	0.144	-	67.800	1.050	0.101	-	68.951	69.095
Genyonemus lineatus	-	-	-	-	-	63.560	1.200	-	-	64.760	64.760
Sardinops sagax	-	0.578	-	0.578	-	20.960	6.080	-	0.026	27.066	27.644
Cheilotrema saturnum	-	0.108	-	0.108	3.580	2.130	7.500	0.399	6.850	20.459	20.567
Paralabrax nebulifer	0.276	-	-	0.276	2.750	0.013	3.700	-	13.500	19.963	20.239
Anisotremus davidsonii	-	-	-	-	0.301	1.178	2.050	-	15.350	18.879	18.879
Damalichthys vacca	0.089	-	0.370	0.459	0.672	4.910	9.840	-	0.171	15.593	16.052
Engraulis mordax	0.060	0.093	-	0.153	-	0.137	13.470	-	-	13.607	13.760
Scorpaena guttata	0.599	-	-	0.599	0.500	1.320	5.510	-	5.330	12.660	13.259
Rhacochilus toxotes	-	-	-	-	0.792	1.150	2.750	0.854	6.550	12.096	12.096
Umbrina roncador	0.420	-	-	0.420	0.555	4.270	-	-	6.650	11.475	11.895
Atherinops affinis	-	-	-	-	-	8.160	-	-	0.169	8.329	8.329
Chromis punctipinnis	0.661	0.027	0.040	0.728	3.130	2.400	0.950	0.149	0.741	7.370	8.098
Rhinobatos productus	-	-	-	-	-	-	-	-	7.844	7.844	7.844
Leuresthes tenuis	-	-	-	-	-	7.800	-	-	-	7.800	7.800
Embiotoca jacksoni	0.925	-	-	0.925	-	0.424	1.400	-	3.850	5.674	6.599
Stereolepis gigas	-	-	-	-	-	-	-	-	6.100	6.100	6.100
Paralichthys californicus	-	-	-	-	2.660	0.343	0.600	-	2.027	5.630	5.630
Medialuna californiensis	-	-	-	-	2.270	0.473	0.500	0.151	1.869	5.263	5.263
Atractoscion nobilis	-	-	-	-	-	2.610	-	-	1.385	3.995	3.995
Girella nigricans	-	-	-	-	-	-	-	-	3.960	3.960	3.960
Urolophus halleri	-	-	-	-	-	0.496	1.800	-	0.925	3.221	3.221
Scorpaenichthys marmoratus	-	2.636	-	2.636	-	-	0.510	-	-	0.510	3.146
Heterodontus francisci	-	-	-	-	-	-	2.690	-	-	2.690	2.690
Menticirrhus undulatus	-	-	-	-	0.605	1.450	-	-	0.319	2.374	2.374
Halichoeres semicinctus	0.375	-	-	0.375	0.447	0.278	-	-	1.039	1.764	2.139
Phanerodon furcatus	0.410	-	-	0.410	-	0.388	0.610	-	0.059	1.057	1.467
Mustelus californicus	-	-	-	-	-	-	1.200	-	-	1.200	1.200
Platyrhinoidis triseriata	-	-	-	-	-	0.841	-	-	-	0.841	0.841
Scomber japonicus	-	-	-	-	-	0.492	0.120	-	-	0.612	0.612
Cymatogaster aggregata	-	-	-	-	-	0.367	0.195	0.045	-	0.607	0.607
Trachurus symmetricus	-	-	-	-	0.550	0.031	-	-	-	0.581	0.581
Peprillus simillimus	-	-	-	-	-	0.488	-	-	-	0.488	0.488
Oxyjulis californica	0.177	-	0.004	0.181	-	-	0.176	-	0.077	0.253	0.434
Pleuronichthys ritteri	0.088	-	-	0.088	-	0.298	-	-	-	0.298	0.386
Sebastes rastrelliger	-	-	-	-	-	0.373	-	-	-	0.373	0.373
Sebastes auriculatus	0.205	-	-	0.205	-	-	-	-	-	-	0.205
Sphyraena argentea	-	-	-	-	-	0.046	-	-	-	0.046	0.046
Hypsoblennius gilberti	0.020	-	-	0.020	-	-	-	0.007	-	0.007	0.027
Paralabrax maculatofasciatus	-	-	-	-	-	-	0.020	-	-	0.020	0.020
Total Biomass	9.504	3.606	0.429	13.539	120.762	581.916	193.041	81.203	720.001	1696.92	1710.462

Appendix G-7. Biomass (kg) of fish impinged during heat treatments by date at Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997.

	1996		1997						Total
	8 Nov	11 Dec	29 Jan	13 Mar	29 Apr	29 May	22 Jul	22 Sep	Biomass
Umbrina roncador	3.599	0.153	0.208	-	-	0.604	29.780	300.250	334.594
Seriphus politus	19.450	24.900	67.620	13.070	4.500	6.200	2.900	-	138.640
Atherinops affinis	5.200	19.190	0.804	4.200	0.667	1.170	42.630	13.000	86.861
Paralabrax nebulifer	35.400	13.100	9.700	-	1.530	-	10.790	14.800	85.320
Atherinopsis californiensis	7.630	10.940	9.400	10.550	0.223	0.804	1.448	0.170	41.165
Xenistius californiensis	5.900	7.690	2.195	0.194	2.130	8.830	5.420	6.320	38.679
Anisotremus davidsonii	1.297	0.329	-	-	-	-	12.830	22.000	36.456
Hyperprosopon argenteum	3.250	20.450	7.740	0.411	0.001	0.347	0.487	-	32.686
Atractoscion nobilis	6.110	3.799	13.790	-	-	-	0.398	0.988	25.085
Genyonemus lineatus	0.468	0.795	17.300	1.900	0.280	1.308	0.021	-	22.072
Paralabrax clathratus	7.286	0.362	0.288	0.719	-	-	5.400	4.550	18.605
Cheilotrema saturnum	5.300	0.282	0.950	0.079	-	0.090	4.796	6.500	17.997
Engraulis mordax	1.700	9.900	0.334	0.004	0.028	3.030	0.450	-	15.446
Mustelus californicus	7.000	-	-	-	-	-	-	2.800	9.800
Platyrhinoidis triseriata	5.520	0.269	2.850	0.731	-	-	-	-	9.370
Phanerodon furcatus	1.965	2.910	1.648	-	0.024	0.474	0.380	-	7.401
Scorpaena guttata	2.360	0.412	-	-	-	-	1.069	3.560	7.401
Heterodontus francisci	-	1.684	3.010	-	-	-	2.650	-	7.344
Paralichthys californicus	0.059	-	-	-	-	-	4.340	2.450	6.849
Myliobatis californica	0.719	3.082	0.465	-	-	-	2.250	0.298	6.814
Triakis semifasciata	0.700	-	-	-	-	-	-	5.400	6.100
Medialuna californiensis	0.646	0.367	-	-	-	-	0.885	3.940	5.838
Menticirrhus undulatus	0.564	-	1.258	-	-	-	3.250	0.145	5.217
Rhinobatos productus	1.000	-	1.880	-	-	-	-	2.300	5.180
Rhacochilus toxotes	1.580	1.035	2.400	-	-	-	-	-	5.015
Scomber japonicus	2.580	0.682	-	-	-	-	-	-	3.262
Chromis punctipinnis	0.639	0.135	0.403	-	-	-	1.718	0.322	3.217
Sardinops sagax	0.473	1.394	0.185	0.712	-	0.061	-	0.167	2.992
Urolophus halleri	0.880	0.845	-	-	-	-	1.013	-	2.738
Embiotoca jacksoni	1.252	0.104	0.125	-	0.006	0.018	0.409	0.201	2.115
Pleuronichthys ritteri	0.072	-	1.793	0.040	-	0.161	-	-	2.066
Halichoeres semicinctus	0.265	-	-	0.437	-	-	0.189	0.874	1.765
Damalichthys vacca	1.015	0.218	0.138	-	-	-	0.245	-	1.616
Cymatogaster aggregata	0.142	0.355	0.059	0.054	0.250	0.432	0.052	-	1.344
Porichthys notatus	-	-	-	0.350	-	0.922	-	-	1.272
Sphyraena argentea	0.083	-	-	-	-	-	-	1.050	1.133
Girella nigricans	-	-	-	-	-	-	0.847	-	0.847
Scorpaenichthys marmoratus	-	-	-	-	-	-	-	0.758	0.758
Anchoa compressa	0.077	-	0.676	-	-	-	-	-	0.753
Stereolepis gigas	0.750	-	-	-	-	-	-	-	0.750
Paralabrax maculatofasciatus	0.675	-	-	-	-	-	-	-	0.675
Sebastes rastrelliger	-	-	0.657	-	-	-	-	-	0.657
Porichthys myriaster	-	-	-	-	-	-	0.644	-	0.644
Leuresthes tenuis	-	-	0.375	0.051	-	0.017	0.030	0.050	0.523
Oxyjulis californica	0.130	-	0.035	-	-	-	-	-	0.165
Heterostichus rostratus	0.012	0.074	-	-	-	-	-	-	0.086
Trachurus symmetricus	0.079	-	-	-	-	-	-	-	0.079
Peprilus simillimus	-	-	0.059	-	-	-	-	-	0.059
Chilara taylori	-	-	0.053	-	-	-	-	-	0.053
Ophidion scrippsae	-	-	-	0.046	-	-	-	-	0.046
Citharichthys stigmaeus	0.007	-	0.008	-	-	-	-	-	0.015
Hypsoblennius gentilis	-	-	0.008	-	-	-	-	-	0.008
Hypsoblennius gilberti	-	-	-	-	-	-	0.006	0.002	0.008
Total Biomass:	133.834	125.456	148.414	33.548	9.639	24.468	137.327	392.895	1005.58

Appendix G-8. Abundance, biomass (kg), and percent occurrence of invertebrates impinged during heat treatments at El Segundo and Scattergood Generating Stations. El Segundo and Scattergood Generating Stations NPDES, 1997.

	Scattergood		El Segundo		Total	Percent	Cumulative	Total
Species	Abund.	Biomass	Abund.	Biomass	Abundance	Total	Percent	Biomass
Lysmata californica	938	1.172	2881	14.763	3819	37.63	37.63	15.935
Pisaster ochraceus	2	0.194	2208	25.217	2210	21.78	59.40	25.411
Cancer anthonyi	528	3.047	1351	62.755	1879	18.51	77.92	65.802
Pyromaia tuberculata	108	0.247	704	1.750	812	8.00	85.92	1.997
Cancer antennarius	337	5.694	274	14.080	611	6.02	91.94	19.774
Pachygrapsus crassipes	20	2.969	206	1.574	226	2.23	94.17	4.543
Navanax inermis	112	0.364	5	0.041	117	1.15	95.32	0.405
Cancer gracilis	-	-	96	1.339	96	0.95	96.27	1.339
Octopus bimaculatus/bimaculoides	54	12.697	35	14.484	89	0.88	97.14	27.181
Panulirus interruptus	37	29.695	28	17.214	65	0.64	97.78	46.909
Heptacarpus palpator	47	0.063	15	0.086	62	0.61	98.39	0.149
Betaeus longidactylus	-	-	56	0.096	56	0.55	98.95	0.096
Cancer amphioetus	20	0.040	12	0.060	32	0.32	99.26	0.100
Pisaster giganteus	21	0.338	-	-	21	0.21	99.47	0.338
Portunus xantusii	5	0.051	10	0.083	15	0.15	99.62	0.134
Loxorhynchus grandis	7	4.207	6	2.034	13	0.13	99.74	6.241
Parastichopus californicus	-	-	6	0.270	6	0.06	99.80	0.270
Parastichopus parvimensis	1	0.009	4	0.124	5	0.05	99.85	0.133
Alpheus sp.	-	-	4	0.004	4	0.04	99.89	0.004
Loligo opalescens	3	0.046	-	-	3	0.03	99.92	0.046
Cancer productus	-	-	2	0.095	2	0.02	99.94	0.095
Pelagia colorata	2	0.890	-	-	2	0.02	99.96	0.890
Cancer jordani	-	-	1	0.004	1	0.01	99.97	0.004
Lophopanopeus sp.	1	0.001	-	-	1	0.01	99.98	0.001
Pilumnus spinohirsutus	1	0.001	-	-	1	0.01	99.99	0.001
Pugettia producta	1	0.002	-	-	1	0.01	100.00	0.002
Survey totals	1305	60.361	7904	156.073	10149			217.800
Total species	20		20		26			

Appendix G-9. Abundance, biomass (kg), and percent occurrence of invertebrates impinged during heat treatments at El Segundo Generating Station Units 1 & 2 and 3 & 4. El Segundo and Scattergood Generating Stations NPDES, 1997.

	Units 1 & 2		Units 3 & 4		Total		% Comp.	
Species	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass	Abund.	Biomass
Lysmata californica	2704	14.400	177	0.363	2881	14.763	36.45	9.46
Pisaster ochraceus	76	3.757	2132	21.460	2208	25.217	27.94	16.16
Cancer anthonyi	223	37.370	1128	25.385	1351	62.755	17.09	40.21
Pyromaia tuberculata	-	-	704	1.750	704	1.750	8.91	1.12
Cancer antennarius	53	10.550	221	3.530	274	14.080	3.47	9.02
Pachygrapsus crassipes	13	0.178	193	1.396	206	1.574	2.61	1.01
Cancer gracilis	6	0.307	90	1.032	96	1.339	1.21	0.86
Betaeus longidactylus	56	0.096	-	-	56	0.096	0.71	0.06
Octopus bimaculatus/bimaculoides	16	2.334	19	12.150	35	14.484	0.44	9.28
Panulirus interruptus	4	0.194	24	17.020	28	17.214	0.35	11.03
Heptacarpus palpator	4	0.004	11	0.082	15	0.086	0.19	0.06
Cancer amphioetus	-	-	12	0.060	12	0.060	0.15	0.04
Portunus xantusii	-	-	10	0.083	10	0.083	0.13	0.05
Loxorhynchus grandis	-	-	6	2.034	6	2.034	0.08	1.30
Parastichopus californicus	5	0.239	1	0.031	6	0.270	0.08	0.17
Navanax inermis	-	-	5	0.041	5	0.041	0.06	0.03
Alpheus sp.	4	0.004	-	-	4	0.004	0.05	0.00
Parastichopus parvimensis	-	-	4	0.124	4	0.124	0.05	0.08
Cancer productus	-	-	2	0.095	2	0.095	0.03	0.06
Cancer jordani	-	-	1	0.004	1	0.004	0.01	0.00
Survey totals	3164	69.433	4740	86.640	7904	156.073		
Total species	12		18		20			

Note: 0.00 < 0.005

Appendix G-10. Abundance of invertebrates impinged in heat treatments by date at El Segundo Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997.

	Units 1 & 2				Units 3 & 4						Total
	21 May	7 Aug	10 Sep	Total	30 Oct	8 Feb	3 Jun	26 Jul	11 Sep	Total	Abundance
Lysmata californica	2704	-	-	2704	90	24	40	11	3159	3324	6028
Pisaster ochraceus	76	-	-	76	2120	12	-	2	-	2134	2210
Cancer anthonyi	175	48	-	223	22	484	490	5	2402	3403	3626
Pyromaia tuberculata	-	-	-	-	7	12	90	4	-	113	113
Cancer antennarius	53	-	-	53	15	68	12	-	-	95	148
Pachygrapsus crassipes	8	5	-	13	32	-	30	-	1	63	76
Cancer gracilis	4	2	-	6	-	36	30	-	-	66	72
Betaeus longidactylus	56	-	-	56	-	-	-	-	-	-	56
Octopus bimaculatus/bimaculoides	13	2	1	16	3	2	7	3	106	121	137
Panulirus interruptus	4	-	-	4	12	5	2	-	4	23	27
Heptacarpus palpator	4	-	-	4	1	-	10	3	54	68	72
Cancer amphioetus	-	-	-	-	-	-	-	2	9	11	11
Portunus xantusii	-	-	-	-	-	4	-	-	41	45	45
Loxorhynchus grandis	-	-	-	-	4	-	2	3	21	30	30
Parastichopus californicus	5	-	-	5	-	-	1	-	31	32	37
Navanax inermis	-	-	-	-	-	1	1	-	1	3	3
Alpheus sp.	4	-	-	4	-	-	-	-	41	41	45
Parastichopus parvimensis	-	-	-	-	1	-	-	-	18	19	19
Cancer productus	-	-	-	-	2	-	-	4	-	6	6
Cancer jordani	-	-	-	-	1	-	-	2	16	19	19
Total Abundance:	3106	57	1	3164	2310	648	715	39	5904	9616	12780
Species	12	4	1	12	13	10	12	10	14	18	20

Appendix G-11. Abundance of invertebrates impinged in heat treatments by date at Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997.

Species	1996		1997						Total
	8 Nov	11 Dec	29 Jan	13 Mar	29 Apr	29 May	22 Jul	22 Sep	Abundance
Lysmata californica	60	1	2	-	-	-	400	475	938
Cancer anthonyi	120	3	1	1	1	2	400	-	528
Cancer antennarius	-	3	-	-	-	-	320	14	337
Navanax inermis	110	-	1	-	-	-	1	-	112
Pyromaia tuberculata	15	2	-	-	-	1	80	10	108
Octopus bimaculatus/bimaculoides	-	10	14	-	5	3	13	9	54
Heptacarpus palpator	40	2	5	-	-	-	-	-	47
Panulirus interruptus	14	-	2	-	-	-	9	12	37
Pisaster giganteus	13	2	6	-	-	-	-	-	21
Cancer amphioetus	-	-	-	-	-	-	20	-	20
Pachygrapsus crassipes	14	3	1	-	-	2	-	-	20
Loxorhynchus grandis	-	-	-	-	1	-	5	1	7
Portunus xantusii	-	-	3	-	1	-	-	1	5
Loligo opalescens	2	1	-	-	-	-	-	-	3
Pelagia colorata	-	-	-	1	1	-	-	-	2
Pisaster ochraceus	-	-	-	1	-	-	1	-	2
Lophopanopeus sp.	-	-	-	-	-	-	-	1	1
Parastichopus parvimensis	-	-	1	-	-	-	-	-	1
Pilumnus spinohirsutus	-	-	-	-	-	-	-	1	1
Pugettia producta	-	-	-	-	1	-	-	-	1
Total Abundance:	388	27	36	3	10	8	1249	524	2245
Species	9	9	10	3	6	4	10	9	20

Appendix G-12. Biomass of invertebrates impinged in heat treatments by date at El Segundo Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997.

	Units 1 & 2				Units 3 & 4						Total
	21 May	7 Aug	10 Sep	Total	30 Oct	8 Feb	3 Jun	26 Jul	11 Sep	Total	Biomass
Cancer anthonyi	35.950	1.420	-	37.370	0.577	10.000	14.100	0.708	-	25.385	62.755
Pisaster ochraceus	3.757	-	-	3.757	21.200	0.260	-	-	-	21.460	25.217
Panulirus interruptus	0.194	-	-	0.194	8.970	3.300	1.600	-	3.150	17.020	17.214
Lysmata californica	14.400	-	-	14.400	0.217	0.056	0.080	0.006	0.004	0.363	14.763
Octopus bimaculatus/bimaculoides	1.254	1.030	0.050	2.334	2.900	1.250	3.600	-	4.400	12.150	14.484
Cancer antennarius	10.550	-	-	10.550	0.566	0.824	1.420	0.720	-	3.530	14.080
Loxorhynchus grandis	-	-	-	-	0.024	-	2.010	-	-	2.034	2.034
Pyromaia tuberculata	-	-	-	-	0.013	0.032	0.260	1.440	0.005	1.750	1.750
Pachygrapsus crassipes	0.107	0.071	-	0.178	0.250	-	0.360	0.771	0.015	1.396	1.574
Cancer gracilis	0.289	0.018	-	0.307	-	0.660	0.240	0.132	-	1.032	1.339
Parastichopus californicus	0.239	-	-	0.239	-	-	0.031	-	-	0.031	0.270
Parastichopus parvimensis	-	-	-	-	0.013	-	-	0.111	-	0.124	0.124
Betaeus longidactylus	0.096	-	-	0.096	-	-	-	-	-	-	0.096
Cancer productus	-	-	-	-	0.095	-	-	-	-	0.095	0.095
Heptacarpus palpator	0.004	-	-	0.004	0.002	-	0.080	-	-	0.082	0.086
Portunus xantusii	-	-	-	-	-	0.044	-	0.039	-	0.083	0.083
Cancer amphioetus	-	-	-	-	-	-	-	0.060	-	0.060	0.060
Navanax inermis	-	-	-	-	-	0.025	0.013	0.003	-	0.041	0.041
Alpheus sp.	0.004	-	-	0.004	-	-	-	-	-	-	0.004
Cancer jordani	-	-	-	-	0.004	-	-	-	-	0.004	0.004
Total Biomass	66.844	2.539	0.050	69.433	34.831	16.451	23.794	3.990	7.574	86.64	######

Appendix G-13. Biomass of invertebrates impinged in heat treatments by date at Scattergood Generating Station. El Segundo and Scattergood Generating Stations NPDES, 1997.

	1996		1997						Total
	8 Nov	11 Dec	29 Jan	13 Mar	29 Apr	29 May	22 Jul	22 Sep	Biomass
Panulirus interruptus	10.200	-	0.945	-	-	-	10.300	8.250	29.695
Octopus bimaculatus/bimaculoides	-	1.820	6.030	-	2.400	0.138	1.484	0.825	12.697
Cancer antennarius	-	0.005	-	-	-	-	5.640	0.049	5.694
Loxorhynchus grandis	-	-	-	-	1.800	-	2.350	0.057	4.207
Cancer anthonyi	0.540	0.005	0.001	0.003	0.015	0.003	2.480	-	3.047
Pachygrapsus crassipes	2.944	0.005	0.006	-	-	0.014	-	-	2.969
Lysmata californica	0.075	0.001	0.001	-	-	-	0.600	0.495	1.172
Pelagia colorata	-	-	-	0.340	0.550	-	-	-	0.890
Navanax inermis	0.350	-	0.004	-	-	-	0.010	-	0.364
Pisaster giganteus	0.100	0.025	0.213	-	-	-	-	-	0.338
Pyromaia tuberculata	0.032	0.002	-	-	-	0.003	0.200	0.010	0.247
Pisaster ochraceus	-	-	-	0.075	-	-	0.119	-	0.194
Heptacarpus palpator	0.060	0.001	0.002	-	-	-	-	-	0.063
Portunus xantusii	-	-	0.036	-	0.010	-	-	0.005	0.051
Loligo opalescens	0.028	0.018	-	-	-	-	-	-	0.046
Cancer amphioetus	-	-	-	-	-	-	0.040	-	0.040
Parastichopus parvimensis	-	-	0.009	-	-	-	-	-	0.009
Pugettia producta	-	-	-	-	0.002	-	-	-	0.002
Lophopanopeus sp.	-	-	-	-	-	-	-	0.001	0.001
Pilumnus spinohirsutus	-	-	-	-	-	-	-	0.001	0.001
Total Biomass:	14.329	1.882	7.247	0.418	4.777	0.158	23.223	9.693	61.727