NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM
2006 RECEIVING WATER MONITORING REPORT
RELIANT ENERGY ORMOND BEACH GENERATING STATION
VENTURA COUNTY, CALIFORNIA

2006 Survey

Prepared for:

Reliant Energy

Prepared by:

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

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EXECUTIVE SUMMARY

The 2006 National Pollutant Discharge Elimination System (NPDES) marine monitoring program for the Ormond Beach Generating Station owned and operated by Reliant Energy was conducted in accordance with specifications set forth by the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) in NPDES Permit No. CA0001198 dated 28 June 2001. The 2006 studies included physical monitoring of the receiving waters and underlying sediments and biological sampling of benthic infaunal assemblages and mussels. Fish and macroinvertebrate impingement studies were also conducted periodically throughout the year. Results of the 2006 surveys were compared among stations and with previous studies to determine if the beneficial uses of the receiving waters continue to be protected.

WATER COLUMN MONITORING

Operations of the Ormond Beach Generating Station were sporadic during winter 2006 and no circulating water pumps were in operation on the day of the sampling. As expected, no thermal influence from the discharge was noted during the winter sampling in 2006. During summer, a warm water surface lens was noted at the discharge during the morning flood tide, while on ebb tide, warm near-surface water temperatures were found in the vicinity of and downcoast of the discharge, consistent with operations on the day of sampling. Still, surface temperatures were typical of the area during previous surveys. Dissolved oxygen (DO) concentrations were typical of the study area with most DO concentrations higher later in the day as a result of increased photosynthetic activity. Some very high surface DO values found in winter during the afternoon tide were likely related to patchy red tide blooms observed in the area on the day of sampling. Unlike in 2005, DO values did not drop below the level considered to be a threshold of biological concern. Values of pH were somewhat more variable in winter than during summer, likely a result of winter red tide conditions. Still pH varied relatively narrowly and values were similar to levels found in previous sampling. Salinity was consistent during both seasons and appeared unaffected by the operation of the generating station.

With the exception of the warm water plume near the discharge during summer, variations in water quality parameters observed in 2006 can be attributed to natural physical and biological processes. Water quality measurements indicated that in 2006 the cooling water discharge from the Ormond Beach Generating Station did not have an adverse effect on receiving waters in the study area.

SEDIMENT CHARACTERISTICS

Sediment Grain Size

Sediments in the study area in 2006 were similar among stations, consisting primarily of sand with lesser amounts of silt and clay. While mean grain size in the study area in 2005 was the greatest on record, a result of the very coarse sediments found at one station, mean grain size in 2006 was consistent with most previous surveys, particularly between 1999 and 2004. Sediment characteristics were otherwise similar among stations. Similarity of sediment grain size and distribution in 2006 suggest that differences observed in 2005 were localized and transitory. While the degree of influence of the discharge on local sediments varies from year to year, the resemblance of sediment characteristics at and inshore of the discharge to those at the remaining stations suggests that in 2006 sediment composition and distribution in the study area appeared to be affected primarily by natural causes and not by the operations of the Ormond Beach Generating Station.

Sediment Chemistry

In 2006, metal concentrations were not strongly related to the percent of fine material in the sediments, likely a result of similarity in sediment characteristics and relatively low metal concentrations typically found in sediments off Ormond Beach. Lowest concentrations of chromium, zinc, and the lowest nickel concentration recorded in the area since 1990 were found inshore of the discharge, where the highest concentration of copper also occurred. As in previous surveys, sediment metal levels were lower than mean values found in regional monitoring of sediments in shallow coastal waters of southern California and well below concentrations determined to be potentially toxic to marine organisms. Concentrations of sediment metals did not appear to be influenced by the operation of the Ormond Beach Generating Station.

MUSSEL BIOACCUMULATION

In 2006, mussels were not found in the vicinity of the Ormond Beach Generating Station discharge. For that reason, donor mussels were purchased from a commercial supplier in Carlsbad, California and transplanted to a mooring near the Ormond Beach discharge where the mussels were allowed to acclimate for a period of 94 days. Tissues from the mussels at the discharge were analyzed for bioaccumulation of the metals chromium, copper, nickel, and zinc. Results were compared with those from mussels collected at the donor site at the time of the transplant and to mussels collected from the Hermosa Beach Pier in Santa Monica Bay, which served as the reference site.

Concentrations of chromium in mussel tissues transplanted into the vicinity of the discharge were elevated in 2006, but were lower than levels in source mussels at the time of the transplant and in mussels collected from the Santa Monica Bay reference site. Chromium levels were also elevated at other sites in southern California in 2006. Other than chromium, metal levels at the discharge in 2006 were lower than occurred in 2005, notably so in the case of nickel. Concentrations of copper, nickel and zinc at the discharge were similar to values found previously in the area and at the donor and reference sites. While elevated chromium was found at all sites in 2006, concentrations of copper, nickel and zinc did not exceed levels in mussels considered elevated for bay mussels by the SMWP. Similarity of tissue metal levels among sites and to previous studies, and to other areas in southern California, suggests that the operation of the Ormond Beach Generating Station is not elevating metal concentrations above background levels.

BENTHIC INFAUNA

The infauna community in the study area in 2006 was composed primarily of annelid worms, arthropods, nemertean worms, small Pacific sand dollars, and clams. A total of 107 species was collected, slightly few than in 2005. Mean species richness (47 species per station) was the same as in 2005, however, and was very similar to the long-term mean for summer surveys conducted in the study area since 1978. Mean species diversity (H') was slightly below that for 2005, but was above the long-term mean. Abundance, at a mean density for the area of 5,373 individuals/m^2, was greater than in 2005, but still was considerably below the long-term mean. The pattern of infaunal values in 2006 (similar among communities along the discharge isobath but slightly lower inshore of the discharge) has been observed in previous surveys. Composition of the infaunal communities was also similar to those in the past. The abundant species in 2006 were among the core group of species occurring in the study area since 1978. Most consistent have been the annelids *Apoprionospio pygmaea*, *Mediomastus acutus*, and *Spiophanes bombyx*, the cumacean *Diastylopsis tenuis*, Pacific sand dollar (*Dendraster excentricus*), the amphipod *Rhepoxynius menziesi*, the clam *Tellina modesta*, and the nemertean *Carinoma mutabilis*. Overall, the communities found in 2006 were typical of the shallow subtidal habitat throughout the Southern California Bight.

The infaunal communities were comparable among the five stations on the discharge isobath, with similar abundances, species richness, and diversity. They were dominated primarily by *Diastylopsis tenuis*, *Apoprionospio pygmaea*, and *Mediomastus acutus*. Inshore of the discharge, abundance was low, species richness and diversity were lower than at any of the other stations, and the community was dominated by a somewhat different suite of species, including Pacific sand dollar and *Carinoma mutabilis*, as well as *A. pygmaea*. Community parameters and composition appeared to be somewhat related to sediment characteristics, as species richness and diversity were greater where sediments were finer, indicating a more stable environment. However, abundance was highest where sediments were coarsest, immediately upcoast of the generating station discharge. Values for the Southern California Benthic Response Index, applied for the first time in 2006, suggested that all of the communities in the study area were undisturbed, or healthy. No pattern of infaunal parameters relating to the discharge was apparent.

IMPINGEMENT

Fish and macroinvertebrates species collected during impingement surveys at the Ormond Beach Generating Station in 2006 were similar to those of the last 16 years, indicating a healthy, stable community in the nearshore area. No heat treatments were conducted and normal operation sampling frequency increased to nearly twice monthly for the year. An estimated impingement total of 4,910 fish from 41 taxa weighing 702 kg were collected in 2006, with abundances generally lower than previous sample years. Estimated macroinvertebrate abundances impinged during normal operation in 2006 was 27,746 individuals, very similar to recent years, especially 2005 when 26,937 individuals were collected. Fluctuations in fish and macroinvertebrate abundance and biomass appear to be due in part to natural population variation, although recent declines in impingement catches are probably related to reductions in intake flow. There was no indication that the operation of the generating station adversely affected the core species populations.

CONCLUSIONS

The overall results of the 2006 NPDES monitoring program indicated that operation of the Ormond Beach Generating Station had no detectable adverse effects on the beneficial uses of the receiving waters.

INTRODUCTION

This report presents and discusses the results of the 2006 receiving water monitoring studies conducted for the Ormond Beach Generating Station, which is owned and operated by Reliant Energy. The 2006 monitoring program was conducted in accordance with specifications set forth in National Pollutant Discharge Elimination System (NPDES) Monitoring and Reporting Program No. 5619 (Permit No. CA0001198) issued by the California Regional Water Quality Control Board, Los Angeles Region (LARWQCB) on 28 June 2001 (Appendix A). Results of the 2006 surveys were compared among locations in the study area and with past physical oceanographic and biological studies to determine any effects the generating station discharge is having on the marine environment, and if the beneficial uses of the receiving waters are being protected. Sampling included physical and chemical monitoring of receiving waters, sediments, and mussel tissue, and biological monitoring of infaunal and fish and macroinvertebrate assemblages. Fish and macroinvertebrate impingement studies were also conducted at the generating station periodically throughout the year.

DESCRIPTION OF THE GENERATING STATION

The Ormond Beach Generating Station is located on the coast of California, approximately 3.7 kilometers (km) southeast of the entrance to Port Hueneme in Ventura County (Figure 1). The station consists of two steam-electric, gas-fueled generating units, rated at 750 megawatts (Mw) each. At full load, the boiler of each unit produces 2.6 million kilograms (kg) of steam per hour which is supplied to tandem compound turbines at a temperature of 555.6°C.

Cooling water is supplied to the station through a 4.0-meter (m) inside-diameter (ID) concrete conduit at a flow rate of about 475,000 gallons per minute (gpm). The intake structure is located 640 m offshore at a water depth of about 10 m Mean Low Lower Water (MLLW); the port is 2 m above the bottom and is covered by a raised velocity cap. Seawater enters the conduit at a velocity of about 82 centimeters per second (cm/s) and passes through a screening facility in the plant to remove marine life, trash, and other debris.

After passing through the screenwell, cooling water is pumped to two condensers (one per unit), where its temperature is elevated approximately 16.7°C when the plant is operating at full capacity. The heated effluent is returned to the ocean through a 4.3-m-ID conduit which terminates 457 m offshore at a bottom depth of 9 m (MLLW). The discharge water is directed vertically upward and exits the conduit at a depth of 6 m (MLLW) at a speed of about 87 cm/s.

Approximately 20,000 gpm of the main flow is diverted to three auxiliary heat exchangers that cool treated distilled water for other plant equipment. The temperature of this water is elevated approximately 5.6°C before it is returned to join the main stream in the discharge conduit.

During the 26 April 2006 winter survey, none of the four circulator pumps were operating. During the 23 August 2006 summer survey, the generating station operated two of four circulator pumps, discharging at the rate of 19.04 mgd. Intake temperature was 14.0°C, with an increase in water temperature across the condensers of 6.9°C, resulting in a discharge temperature of 20.9°C. During 2006, the Ormond Beach Generating Station operated at 3.77% of its total operating capacity (Melchor 2006, pers. comm.).

DESCRIPTION OF THE STUDY AREA

The Ormond Beach Generating Station is located on the coastal plain of the Ventura Basin which is defined by two coastal features: the barrier beaches at Point Mugu (11.3 km to the south) and the delta of the Ventura River (20.9 km to the north) (Figure 1). Prominent natural features of this portion of the Southern California Bight include the dunes along Mandalay Beach, the marshes

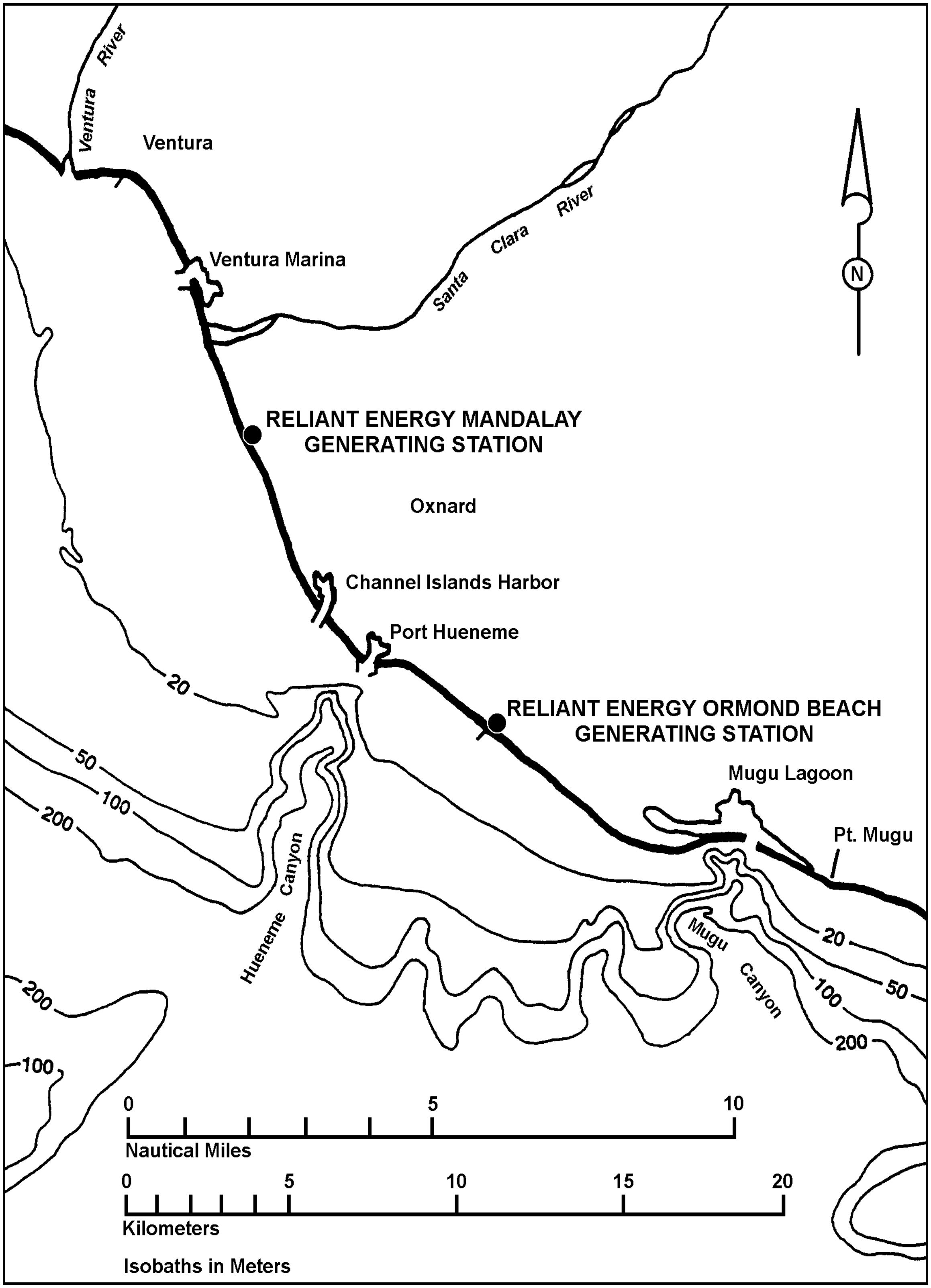


Figure 1. Location of the study area. Ormond Beach Generating Station NPDES, 2006.

and lagoon on the naval reservation near Point Mugu, and the straight, sandy beaches interrupted by the Ventura Marina, Channel Islands Harbor, and the harbor at Port Hueneme.

The physiography, climate, and general oceanography of the southern California coastal region all contribute to the general character of the study area. The fate of any thermal discharges into coastal waters is influenced by the complex interactions of the above factors. The plume in turn may alter the nature of the biota present in the area. All of these factors have long- and short-term cycles as well as non-periodic components. Winds, tides, and currents are particularly important since they determine to the greatest extent the actual fate of the thermal effluent.

Physiography

The general orientation of the coast from Point Conception to the Mexican border is northwest to southeast. The continental margin has been slowly emerging over geological time, resulting in a predominantly cliffed coastline, although it is broken by coastal plains in the vicinity of Oxnard-Ventura, Los Angeles, and San Diego.

The eight islands offshore from the southern California mainland strongly influence water circulation and oceanographic conditions throughout the Bight. The mainland shelf along the coast is narrow, ranging from less than two to almost 20 km in width, but averaging about 7 km. Seaward of the shelf is an irregular and geologically complex region known as the continental borderland. The bottom here comprises a series of basins and ridges which extend in depth from near-surface to depths in excess of 2,400 m.

Climate

Southern California is a climatic regime defined broadly as Mediterranean, which is characterized by short, mild winters and warm, dry summers. Monthly mean air temperatures along the coast range from 8°C in winter to 21°C in summer, with daily minima dropping slightly below freezing and maxima reaching above 37°C.

Annual precipitation near the coast averages about 46 cm, 90% of which occurs between November and April. Drainage of the coastal region is largely by way of many short streams which normally flow only during rainstorms. Only a small part of the storm runoff actually reaches the ocean, most being impounded by dams and used for other purposes.

Sea breezes, which develop from differences in heating between land and sea, combine with prevailing coastal winds (which blow out of the northwest in summer) to produce strong onshore winds. In summer the sea breezes usually begin at mid-day and may continue through the late afternoon, with speeds reaching 37 km/hour. In late fall and winter, reverse pressure systems frequently develop. Coastal winds tend to be from the southeast from November through February and typically blow from early afternoon to 2000 hours (hr).

Currents

Water in the northern Pacific Ocean is driven eastward by prevailing winds until it impinges on the western coast of North America where it divides and flows both north and south. The southern component is the California Current, a diffuse and meandering water mass which generally flows to the southeast. There is no fixed western boundary to this current, but more than 90% of its 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, forming the Southern California Countercurrent. Surface speed in the countercurrent ranges between 5 and 10 cm/s. The general flow pattern is complicated by eddies in the Channel Islands region and it fluctuates seasonally. It is more strongly developed in summer and autumn and weak or occasionally absent in winter and spring. Generalized surface water circulation off southern California is shown in Figure 2.

Nearshore, coastal currents are strongly influenced by a combination of wind, tides, and local topography. When wind-driven currents are superimposed on tidal motions, a strong diurnal pattern is usually apparent. Therefore, short-term observations of currents near the coast often vary in both direction and speed.

Tides

Tides along the California coast are mixed, with two unequal highs and two unequal lows during each 25 hr period. The tide is a long-period wave that is a combination of semidiurnal components (each having nearly 12 hr periods) and diurnal components with nearly 25 hr periods. In the eastern North Pacific Ocean, the tide wave rotates in a counterclockwise direction so that tidal extremes occur progressively later in the day northwards along the coast. As a result, flood tide currents flow upcoast and ebb tide currents flow downcoast.

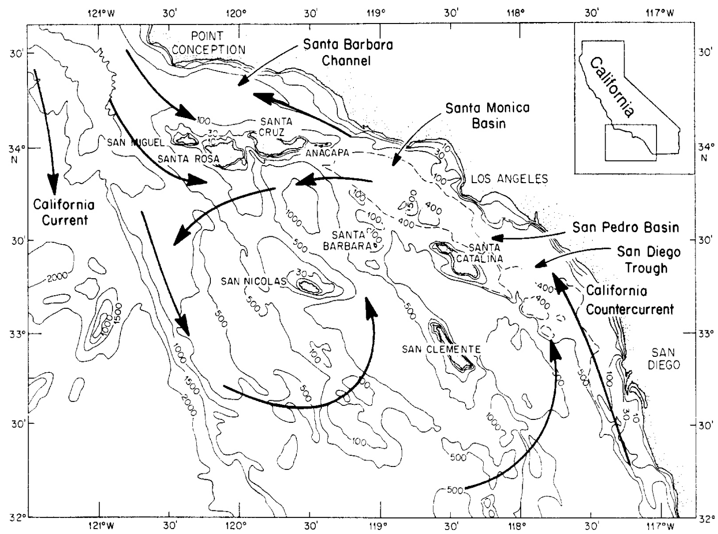


Figure 2. Surface circulation in the Southern California Bight (from Hickey 1992). Ormond Beach Generating Station NPDES, 2006.

Upwelling

The predominant northwesterly winds are responsible for large scale upwelling along the California coast. From about February to October, these winds induce offshore movement of surface water which is replaced by the upwelling of deeper ocean waters. 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.

RECEIVING WATER CHARACTERISTICS

The capacity of the marine environment to assimilate waste heat depends on its ability to dilute and disperse it. The assimilation capacity depends on the ambient water temperature as well as the amount and temperature of the thermal discharge. Dispersion is largely determined by local wind, wave, tide, and current patterns. The following summary concerns general patterns of natural ocean temperatures off southern California as well as other physical characteristics of the nearshore water mass.

Temperature

Natural seawater temperature fluctuates throughout the year as a result of seasonal and diurnal variations in meteorological conditions such as wind, air temperature, insolation, cloud cover, and relative humidity as well as oceanographic conditions such as currents, tides, turbulence, and vertical mixing. The California State Water Resource Control Board defines natural temperature as "the temperature of the receiving water at locations, depths, and times which represent conditions unaffected by any elevated temperature waste discharge" (SWRCB 1975).

Previous studies have shown that natural surface temperatures may vary several degrees in a single day, depending upon time of day, time of year, and prevailing oceanographic and meteorological conditions. Temperatures offshore Ormond Beach range from monthly means of 13.3°C in February and March to 16.7°C in August. Mean maximum natural surface temperatures are 14.4°C during the winter and 22.2°C in the summer (MBC 1975).

When there are large differences between surface and bottom temperatures, a thermocline may develop (a thermocline is an area of rapid temperature change between two layers of water). Natural thermoclines are formed when absorption of solar radiation at the surface produces a heated surface layer which is not mixed vertically. Artificial thermoclines may result from the discharge of warm water above cooler waters and the lack of vertical mixing. Off southern California, a reasonably sharp thermocline usually develops in summer at depths up to 30 m. Only very weak thermoclines appear in winter.

Salinity

Salinity is a measure of the concentration of salts in water which can be expressed as a weight of salts dissolved in a volume of water. Typically, the concentration of salts in the ocean is roughly 35 grams per kilogram of water and can be expressed as 35 parts per thousand (ppt). Although relatively constant in the open ocean, salinity varies in the nearshore as a result of freshwater runoff and evaporation. Mean surface salinities at the Ventura Marina between 1965 and 1971 ranged from 24.1 ppt during a period of high storm runoff to a high of 33.9 ppt (IRC 1973). Yearly averages were about 33.5 ppt.

Dissolved Oxygen

Dissolved oxygen (DO) is used by plants and animals in normal respiration and metabolic processes. It is replenished in seawater by gaseous exchange with the atmosphere and through photosynthesis by plants. Concentrations in surface waters off Ormond Beach between July 1970 and January 1973 ranged from 7.3 to 11.0 mg/l (IRC 1973). The high values were probably a result of active photosynthetic processes and the low values a result of mixing with oxygen-depleted subsurface water.

Hydrogen Ion Concentration

The hydrogen ion concentration (pH) in southern California surface waters varies narrowly around a mean of approximately 8.1 and decreases slightly as the water becomes more acidic with depth. However, values will naturally approach 8.6 during phytoplankton blooms, which rapidly metabolize carbonates in the surface waters. Values can also drop below 7.9, although this generally occurs in waters below 100 meters, or in confined water ways such as harbors, where organic decomposition and reduced circulation will lead to an accumulation of acidic byproducts. Maximum pH values recorded during four quarterly surveys offshore Ormond Beach between December 1973 and September 1974 were 8.0 to 8.6 (EQA/MBC 1975).

Hydrography

The ocean floor of the Ventura Basin is characterized by three distinct areas: a broad and gently sloping area directly in front of the Ormond Beach Generating Station, and two submarine canyons (Hueneme and Mugu) at either edge (Figure 1 and IRC 1973). At Ormond Beach, the 20 fathom contour is within 7 km of shore, while to the north at Mandalay it is no closer than 13 km.

General nearshore circulation in the area is affected by the two canyons, Port Hueneme, Channel Islands Harbor, the Ventura Marina, and the Santa Clara River. However, there is little evidence that these features significantly affect circulation in the immediate study area.

Littoral Drift

In response to longshore currents, sand typically moves parallel to shore, then into the heads of submarine canyons. In the Hueneme area, the net littoral sediment transport is downcoast in the range of 600,000 to 900,000 m^3 per year. The construction of the harbor entrance effectively trapped much of the normal supply to Ormond Beach; that which was not trapped was diverted into the head of Hueneme Canyon. Erosion downstream of the harbor-entrance jetties is about 900,000 m^3 per year. To offset these losses, slightly more than 1,500,000 m^3 are dredged biannually and deposited to intertidal and subtidal habitats at Ormond Beach. This deposition can have a detrimental impact on the nearshore biota. Erosion southeast of the jetties continues at the rate of 1,500,000 m^3 per year.

BENEFICIAL USES OF RECEIVING WATERS

The Water Quality Control Plan for the Santa Clara River Basin adopted by the California Regional Water Quality Control Board (1994) lists beneficial uses of waters in the nearshore and offshore zones of the Santa Clara-Calleguas Hydrographic Unit, which includes Ormond Beach and the study area. These uses are:

Industrial Service Supply (IND) - Uses of water for industrial activities that do not depend primarily on water quality including, but not limited to, mining, cooling water supply, hydraulic conveyance, gravel washing, fire protection, or oil well re-pressurization.

Navigation (NAV) - Uses of water for shipping, travel, or other transportation by private, military, or commercial vessels.

Water Contact Recreation (REC-1) - Uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs.

Non-contact Water Recreation (REC-2) - Uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities.

Commercial and Sport Fishing (COMM) - Uses of water for commercial or recreational collection of fish, shellfish, or other organisms including, but not limited to, uses involving organisms intended for human consumption or bait purposes.

Marine Habitat (MAR) - Uses of water that support marine ecosystems including, but not limited to, preservation or enhancement of marine habitats, vegetation such as kelp, fish, shellfish, or wildlife (e.g., marine mammals, shorebirds).

Wildlife Habitat (WILD) - Uses of water that support terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.

Preservation of Biological Habitats (BIOL) - Uses of water that support designated areas or habitats, such as Areas of Special Biological Significance (ASBS), established refuges, parks, sanctuaries, ecological reserves, or other areas where the preservation or enhancement of natural resources requires special protection.

Rare, Threatened, or Endangered Species (RARE) - Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.

Migration of Aquatic Organisms (MIGR) - Uses of water that support habitats necessary for migration, acclimatization between fresh and salt water, or other temporary activities by aquatic organisms, such as anadromous fish.

Spawning, Reproduction, and/or Early Development (SPWN) - Uses of water that support high quality aquatic habitats suitable for reproduction and early development of fish.

Shellfish Harvesting (SHELL) - Uses of water that support habitats suitable for the collection of filter-feeding shellfish (e.g., clams, oysters, and mussels) for human consumption, commercial, or sport purposes.

Although all of the above are not directly associated with the receiving waters of the Ormond Beach Generating Station at all times, they may be reasonably assumed to constitute occasional beneficial uses of the nearshore waters in the study area.

SCOPE OF THE MONITORING PROGRAM

The 2006 monitoring program for the Ormond Beach Generating Station was conducted by MBC Applied Environmental Sciences (MBC) in accordance with specifications set forth in the NPDES Monitoring and Reporting Program (Appendix A). The monitoring program included winter and summer water column profiling, summer sediment sampling for grain size and chemistry, mussel sampling for bioaccumulation, summer biological sampling for benthic infauna, and periodic impingement sampling of fish and macroinvertebrates.

STATION LOCATIONS

The locations of the monitoring stations are described in Appendix A and shown in Table 1 and Figure 3. The 2006 monitoring program included nine water quality (RW) stations, and six sediment and benthic infauna (B) stations.

Table 1. Latitude/longitude coordinates of sampling stations. Ormond Beach Generating Station NPDES, 2006.

Stations			
Water Quality	Benthic	Latitude	Longitude
RW1	B1	34°07.70'	119°10.98'
RW2	B2	34°07.51'	119°10.68'
RW3	B3	34°07.44'	119°10.46'
RW4	B4	34°07.33'	119°10.34'
RW5	B5	34°07.10'	119°10.06'
RW6	B6	34°07.50'	119°10.38'
RW7		34°07.17'	119°10.72'
RW8		34°06.52'	119°09.34'
RW9		34°08.16'	119°11.78'

FIELD OBSERVATIONS

The NPDES water quality monitoring surveys were conducted on 26 April and 23 August, and benthic sampling was conducted on 24 August 2006. Latitude and longitude coordinates for all receiving water (RW) and benthic (B) stations are listed in Table 1.

During the winter survey, no oil sheens, grease, or floatables were observed at any of the stations. A patchy red tide (plankton bloom) was observed throughout the receiving water stations and the water was slightly to moderately turbid. Western gulls (*Larus occidentalis*) were seen at Stations RW2 and RW7. A California sea lion (*Zalophus californianus*) was noted at Station RW3 and a California brown pelican (*Pelecanus occidentalis californicus*) at Station RW7. No California least terns (*Sterna antillarum browni*) were observed during the winter monitoring.

During the summer surveys, no oil sheens, grease, turbidity, or red tide (plankton bloom) were observed at any of the stations. Drift kelp (*Macrocystis pyrifera*) was noted at Station RW9. Western gulls were seen at most of the receiving water stations and at Station B3. Two unidentified terns (*Sterna* spp) were observed at Station RW5 and cormorants (*Phalacrocorax* spp) were seen at Stations RW1, RW2, and RW6. A harbor seal (*Phoca vitulina*) was noted at Station B1 and California brown pelicans were seen at Stations RW2, RW6, RW9, and B6. No California least terns (*Sterna antillarum browni*) were observed during the summer surveys.

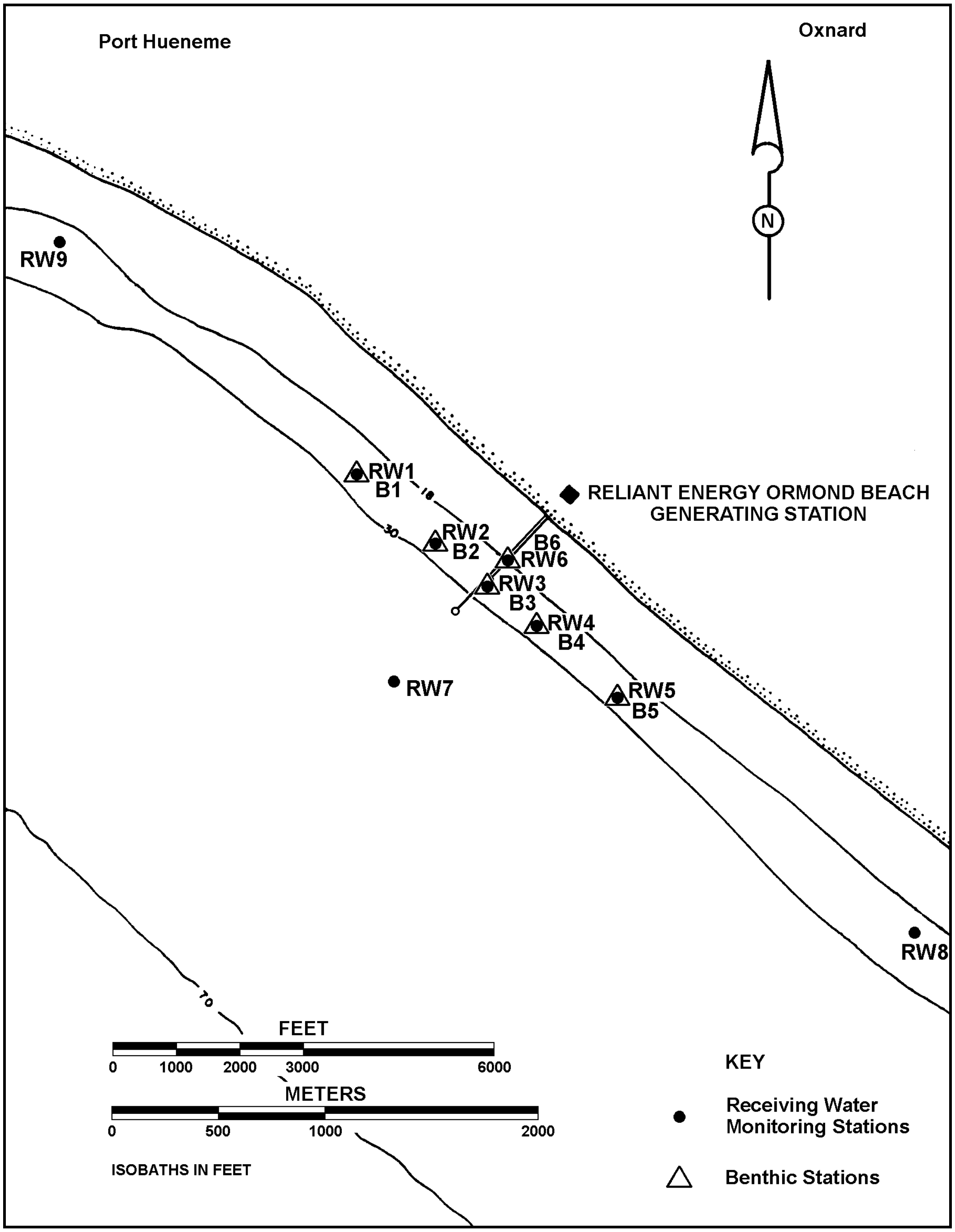


Figure 3. Location of the monitoring stations. Ormond Beach Generating Station NPDES, 2006.

STATISTICAL ANALYSES

Summary statistics developed from the biological data included the number of individuals (expressed as per standard area), number of species and Shannon-Wiener (Shannon and Weaver 1962) species diversity (H') index. The diversity equation is as follows:

Shannon-Wiener

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

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

The Southern California Benthic Response Index (BRI) is an abundance-weighted average pollution tolerance of species occurring in a sample, and is a measure of the condition of marine and estuarine benthic communities (Smith et al. 2003). It classifies benthic communities as "reference" (i.e. undisturbed) or one of four levels of response to increased disturbance. The index formula is:

Benthic Response

$$BRI_s = \frac{\sum_{i=1}^{n} \sqrt[3]{a_{si}}\; p_i}{\sum_{i=1}^{n} \sqrt[3]{a_{si}}}$$

where:
- BRI_s = BRI value for sampling unit s_i
- n = number of species with pollution tolerance scores in s_i
- p_i = pollution tolerance of species *i*
- a_{si} = abundance of species *i* in *s*

Species pollution tolerances p_i were determined during BRI development as the position of the abundance distribution of species *i* on a gradient between the most and least disturbed sites. Species without pollution tolerance values are not included in the calculation. Pollution tolerance values were not assigned to species if the data were insufficient to assign a value. The index was developed for benthic samples that were sieved through a 1-mm mesh screen. Pollution tolerance scores were derived for coastal shelf samples for shallow (10-30 m deep), mid-depth (>30-120 m deep), and deep (>120-324 m deep) habitats, and for bay and harbor habitat samples, northern (Point Conception to Newport Bay) and southern (Dana Point to the U.S.-Mexico border). The species names for which scores are available are based on Edition 4 of the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT) list of invertebrate species (SCAMIT 2001).

Evenness (J') is a measure of the degree to which a sampled community is dominated by one or a few species. Values of evenness range from 1.0 (all species with identical abundances) to 0 (Pielou 1977). The evenness equation is as follows:

$$J' = \frac{H'}{\ln S}$$

where:
- J' = Evenness
- H' = Shannon-Wiener Index
- S = number of species within the community

Infauna data were subjected to log transformations (when necessary) and classified (clustered) using NCSS 2000 Hierarchial Clustering (Hintze 1998). Cluster analysis provides a graphic representation of the relationship between species, their individual abundance, and spatial occurrence among the stations sampled. In theory, if physical conditions were identical at all stations, the biological community would be expected to be identical as well. In practice this is never the case, but it is expected that the characteristics of adjacent stations would be more similar than those distant from one another. The dendrogram shows graphically the degree of similarity (and dissimilarity) between observed characteristics and the expected average. The two-way analysis utilized in this study illustrates groupings of species and stations, as well as their relative abundance, expressed as a percent of the overall mean. Two classification analyses are performed on each set; in one (normal analysis) the sites are grouped on the basis of the species which occurred in each, and in the other (inverse analysis) the species are grouped according to their distribution among the sites. Each analysis involves three steps. The first is the calculation of an inter-entity distance (dissimilarity) matrix using Euclidean distance (Clifford and Stephenson 1975) as the measure of dissimilarity.

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

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

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

DETECTION / REPORTING LIMITS

Detection/reporting limits used in reporting chemistry results are interpreted as the smallest amount of a given analyte that can be measured above the random noise inherent in any analytical tool. Thus, any value below the detection/reporting limits cannot be considered a reliable estimate of analyte concentration. Therefore, where a test for a given analyte results in a level below the detection/reporting limit, a “none detected” (ND) value has been assigned. The complication of what numerical value to substitute for ND in statistical calculations is addressed by EPA (1989, Section 5.3.3). When values for a given analyte are ND for all stations, then means and standard deviations will also be considered ND. However, when an analyte is detected at some stations and not at others, statistical calculations can be made by substituting ND values with either (a) zero, (b) one-half the average detection limit, or (c) the average detection limit (EPA 1989). Determining which substitution to use is based on whether or not substantial information exists to support the historical presence or absence of a given analyte at the station location. Since chemistry analyses have repeatedly resulted in ND values at the same stations through past surveys, ND values have been replaced with zeros in performing statistical calculations. As the ability to detect chemicals in increasingly smaller concentrations has improved greatly with time, detection/reporting limits differ in virtually all past surveys; this would confound any yearly comparison if options (b) or (c) from above were used. Historical raw data are presented in the appendices for possible supplementary study.

WATER COLUMN MONITORING

Water column measurements of physical and chemical characteristics of seawater such as temperature, dissolved oxygen (DO), hydrogen ion concentration (pH), and salinity are important components of a discharge monitoring program. Because biological communities exist in equilibrium in the marine environment, changes in seawater characteristics can result in potentially adverse impacts to these communities. As the physical/chemical properties of the receiving waters can vary naturally on a relatively small scale, water quality sampling is designed to assess these parameters in a way that helps determine the scale of seasonal and tidally driven oceanographic influences with respect to the point of discharge. Long-term monitoring of these parameters can help determine whether deviations from expected patterns exist that may indicate impacts from the discharge on local biological communities and to determine whether the beneficial uses of the receiving water remain protected.

MATERIALS AND METHODS

Temperature, DO, pH, and salinity were measured throughout the water column at nine stations during the winter and summer surveys. Sampling was conducted on both flood and ebb tides at each of the receiving water monitoring stations (Figure 4). Data were obtained *in situ* using an SBE 9/17 water quality profiling system (Sea-Bird), and averaged at 1.0-m intervals. In the field, the data were transferred from the Sea-Bird to floppy disk for storage. In the laboratory, data were processed using Sea-Bird proprietary software (SeaSoft). The resulting information was imported into Microsoft Excel spreadsheets for reduction and analysis.

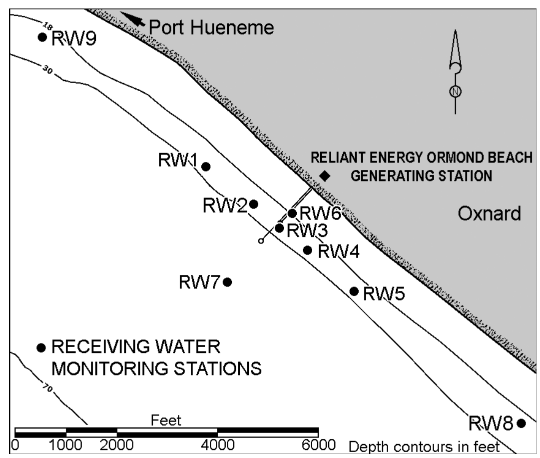


Figure 4. Location of the water column sampling stations. Ormond Beach Generating Station NPDES, 2006.

Winter water quality was monitored at Stations RW1 through RW9 on 26 April 2006 during flood and ebb tides. Flood tide was monitored between 0804 and 0850 hours (hr) and ebb tide was monitored between 1314 and 1356 hr (Figure 5). On the day of monitoring, the tide rose from a low of -0.6 ft Mean Lower Low Water (MLLW) at 0315 hr to a high of +4.6 ft MLLW at 0916 hr, then fell to a low of +0.5 ft MLLW at 1502 hr. Skies were mostly to partly cloudy with winds that changed from west at 3 to 5 kn to southeast at 5 to 7 kn by the afternoon. Seas were west at 2 to 3 ft.

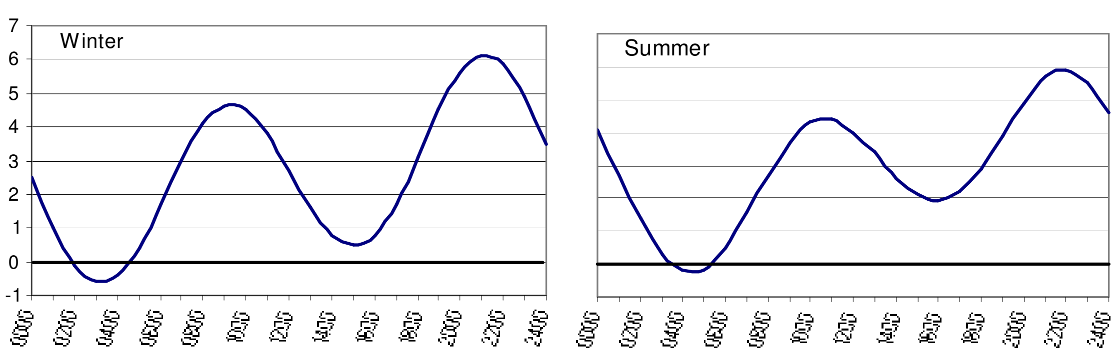


Figure 5. Tidal rhythms during water column sampling, winter and summer surveys. Ormond Beach Generating Station NPDES, 2006.

Summer water quality was monitored at Stations RW1 through RW9 on 23 August 2006 during flood and ebb tides. Flood tide was monitored between 0733 and 0818 hr and ebb tide was monitored between 1323 and 1409 hr (Figure 5). On the day of monitoring, the tide rose from a low of -0.3 ft MLLW at 0423 hr to a high of +4.4 ft MLLW at 1037 hr, then fell to a low of +1.9 ft MLLW at 1556 hr. Skies were overcast and foggy in the morning and clear by the afternoon. Winds were from the west at 3 to 10 kn. Seas were west at 1 to 3 ft.

RESULTS

Water quality monitoring was conducted during flood and ebb tide, in winter and summer, offshore of the Ormond Beach Generating Station to determine potential effects of the generating station discharge on receiving waters. Receiving water monitoring stations are shown in Figure 4. During both seasons, flood tide was sampled in the early morning, while ebb tide was sampled early afternoon. During the winter sampling no circulating pumps were operation (Melchor 2006, pers. comm.). Winter circulating pump operations were sporadic in 2006, with the water quality sampling occurring on the fifth of six consecutive days without operation. On the day of the summer sampling two of the four circulating pumps were in operation, with a relatively low flow of 19.3 mgd and a discharge temperature of 20.9°C. Seasonal water quality data for flood and ebb tides are presented in Figure 6 through 9 and summarized in Table 2. Raw data are presented in Appendix B.

Table 2. Summary of water quality parameters during flood and ebb tides. Ormond Beach Generating Station NPDES, 2006.

	Temp. (°C)		D.O. (mg/l)		pH		Salinity (psu)		Temp. (°C)		D.O. (mg/l)		pH		Salinity (psu)	
Winter																
	Surface								Bottom							
	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb
Mean	12.14	13.51	7.49	10.60	7.81	8.05	33.55	33.54	11.47	11.60	5.56	6.25	7.65	7.72	33.66	33.68
Minimum	11.95	13.21	7.00	8.91	7.78	7.93	33.54	33.49	10.95	11.34	5.00	5.57	7.62	7.68	33.62	33.61
Maximum	12.46	14.27	8.49	15.55	7.90	8.32	33.58	33.56	11.83	12.20	5.93	7.71	7.68	7.82	33.72	33.77
Summer																
	Surface								Bottom							
	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb	flood	ebb
Mean	15.15	17.55	8.18	8.30	8.17	8.23	33.42	33.47	13.95	15.66	7.89	8.36	8.14	8.22	33.47	33.48
Minimum	14.53	17.12	7.78	8.11	8.13	8.22	33.40	33.45	13.56	14.22	7.66	8.10	8.12	8.19	33.43	33.44
Maximum	16.10	18.19	8.44	8.48	8.19	8.25	33.44	33.50	14.25	17.36	8.14	8.85	8.16	8.24	33.56	33.53

Temperature

During the winter survey, surface water temperatures averaged 12.14°C during morning flood tide and 13.51°C during afternoon ebb tide (Table 2). Surface temperatures were similar among stations during each tide in winter, varying by about 1°C or less among stations during either tidal cycle. During flood tide, surface temperatures ranged from 11.95°C at Station RW9, 7,920 ft upcoast of the discharge to 12.46°C at Station RW8, 7,920 ft downcoast of the discharge. During ebb tide, surface temperatures ranged from 13.21°C at Station RW9 to 14.27°C at Station RW7, the deepest station, offshore of the discharge at a depth of 40 ft. Surface temperatures at each station increased by about 1.4°C between the morning and afternoon tides with the greatest difference found at Station RW7, where surface temperature was 2.17°C warmer on ebb tide (Appendix B-1). Temperatures on flood tide were relatively consistent throughout the water column, decreasing with depth with no strong thermal gradients (Figure 6). The greatest surface-to-bottom difference on flood

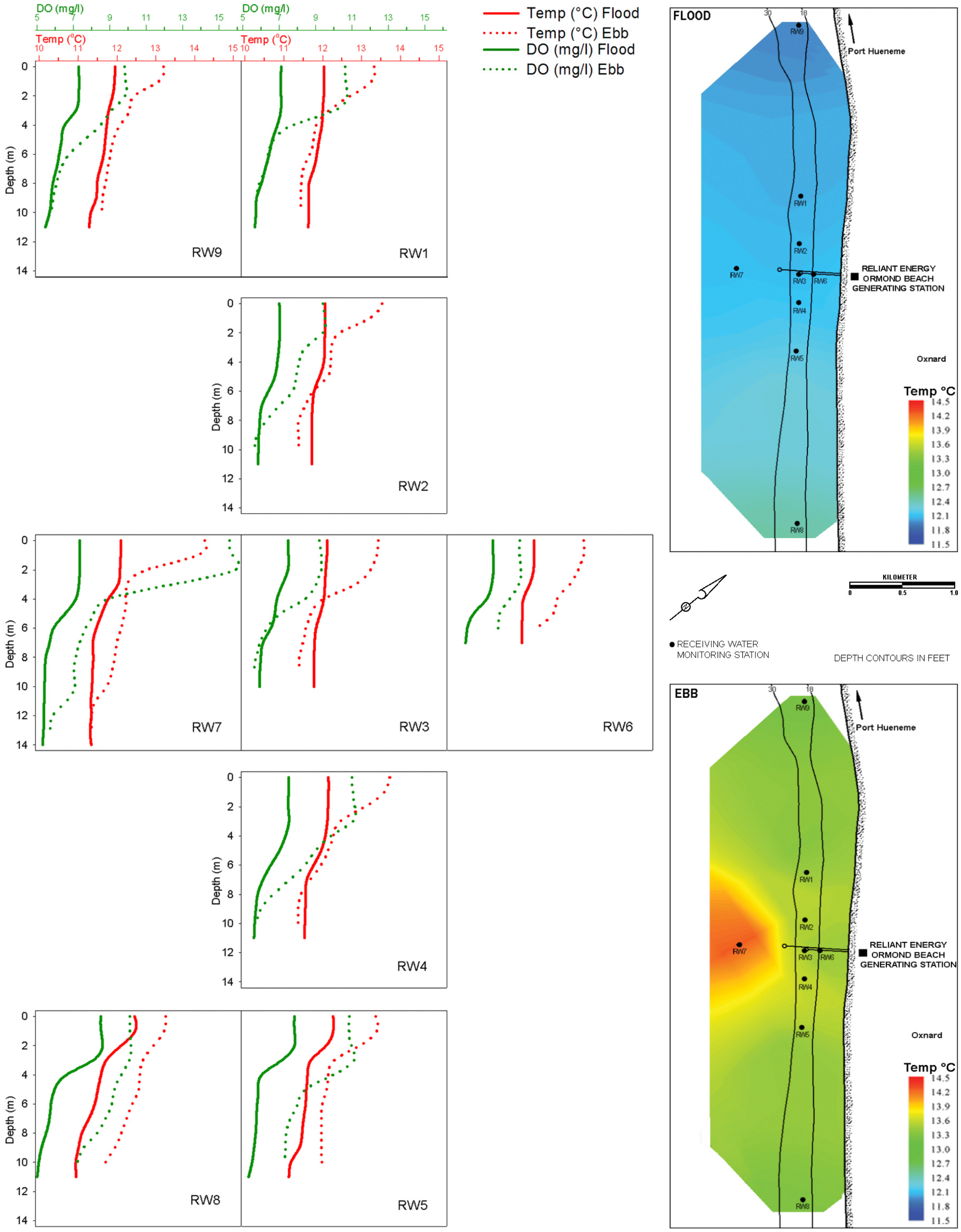


Figure 6. False color surface temperature contour plots and temperature and dissolved oxygen vertical profiles during flood and ebb tides, winter survey. Ormond Beach Generating Station NPDES, 2006.

tide occurred at Station RW8 (1.51 ℃) (Appendix B-1). Temperatures on ebb tide at most stations decreased rapidly in the upper water column with obvious thermal gradients between the surface and about 4-m depth (Figure 6). A thermocline exceeding 1.3°C was observed between 1- and 2-m depth at Station RW7, were the greatest surface-to-bottom difference of 2.93°C was found (Appendix B-1). Bottom water temperatures averaged 11.47°C during flood tide and 11.60°C during ebb tide (Table 2). Flood tide near-bottom temperatures ranged from 10.95°C at Station RW8 to 11.83°C at Station RW6, the shallowest station, inshore of the discharge at a depth of 20 ft. During ebb tide, near-bottom temperatures ranged from 11.34°C at Station RW7 to 12.20°C at Station RW6. No surface water warming associated with the discharge was noted in winter 2006.

During the summer survey, surface temperatures averaged 15.15°C during morning flood tide and 17.55°C during the afternoon ebb tide (Table 2). Surface temperatures were also relatively similar among stations during each tide in summer, varying by about 1.6°C on flood tide and 1.1°C during ebb tide. Flood tide surface temperatures ranged from 14.53°C at Station RW6 to 16.10°C at Station RW8. Surface temperatures during ebb tide ranged from 17.12°C at Station RW9 to 18.19°C at Station RW3, at the point of discharge. Surface temperatures generally varied by about 2.4°C between tides and were warmer during the afternoon, with the greatest difference found at Station RW6 where surface temperature was 3.36°C warmer on ebb tide (Appendix B-2). During flood tide temperatures were fairly consistent with depth throughout the water column with no notable thermal gradients, except at Station RW3 (Figure 7). The greatest surface-to-bottom difference during flood tide (2.02°C) was found at Station RW8 (Appendix B-2). During ebb tide, temperatures were fairly consistent with depth throughout the water column at the upcoast and shallow stations, while stronger thermal gradients occurred at the downcoast and deeper stations below a depth of about 6 m (Figure 7). The greatest surface-to-bottom temperature difference of 3.61°C occurred at Station RW8 on ebb tide (Appendix B-2). Bottom water temperatures in 2006 averaged 13.95°C during flood tide and 15.66°C during ebb tide. Flood tide water temperatures ranged from 13.56°C at Stations RW9 to 14.25°C at Station RW6 (Table 2). Ebb tide bottom water temperatures ranged from 14.22°C at Station RW7 to 17.36°C at Station RW6.

Dissolved Oxygen

In winter, surface dissolved oxygen (DO) concentrations during flood tide averaged 7.49 mg/l and ranged from 7.00 mg/l at Station RW2, 1,000 ft upcoast of the discharge to 8.49 mg/l at Station RW8 (Table 2). During ebb tide, surface DO concentrations averaged 10.60 mg/l and ranged from 8.91 mg/l at Station RW6 to 15.55 mg/l at Station RW7. Near-bottom DO values averaged 5.56 mg/l during flood tide, and 6.25 mg/l during ebb tide. During flood tide DO was relatively consistent with depth, with DO decreasing below subsurface maxima at 2 to 4 m with slightly greater reductions at those depths corresponding to the mild temperature gradients at most stations (Figure 6). During the afternoon ebb tide dissolved oxygen concentrations in the upper water column were generally 1.5 to 3.5 mg/l higher except at Station RW7 where surface concentrations were 8.21 mg/l higher on ebb tide. On ebb tide, subsurface DO maxima were found at all stations in the upper few meters of the water column, below which generally strong reductions in DO coincided with depths where stronger thermal gradients were found during ebb tide sampling. Below a depth of about 4 to 6 m, reductions in DO concentrations with depth slowed, with bottom DO concentrations similar to levels found on flood tide except at the two stations farthest downcoast and at the shallowest station. Maximum surface-to-bottom DO differentials occurred at Station RW8 (3.49 mg/l) during flood tide, and at Station RW7 (9.84 mg/l) during ebb tide (Appendix B-1).

In summer, surface dissolved oxygen concentrations during flood tide averaged 8.18 mg/l and ranged from 7.78 mg/l at Station RW3 to 8.44 mg/l at Station RW9 (Table 2). During ebb tide, surface DO concentrations averaged 8.30 mg/l and ranged from 8.11 mg/l at Station RW8 to 8.48 mg/l at Station RW9. Near-bottom DO values averaged 7.89 mg/l during flood tide, and 8.36 mg/l during ebb tide. Dissolved oxygen concentrations in the upper water column were generally higher during the later ebb tide sampling except at Station RW5, 3,000 ft downcoast of the discharge, and at Station RW8 where concentrations in the upper 4 to 8 m of the water column were slightly higher

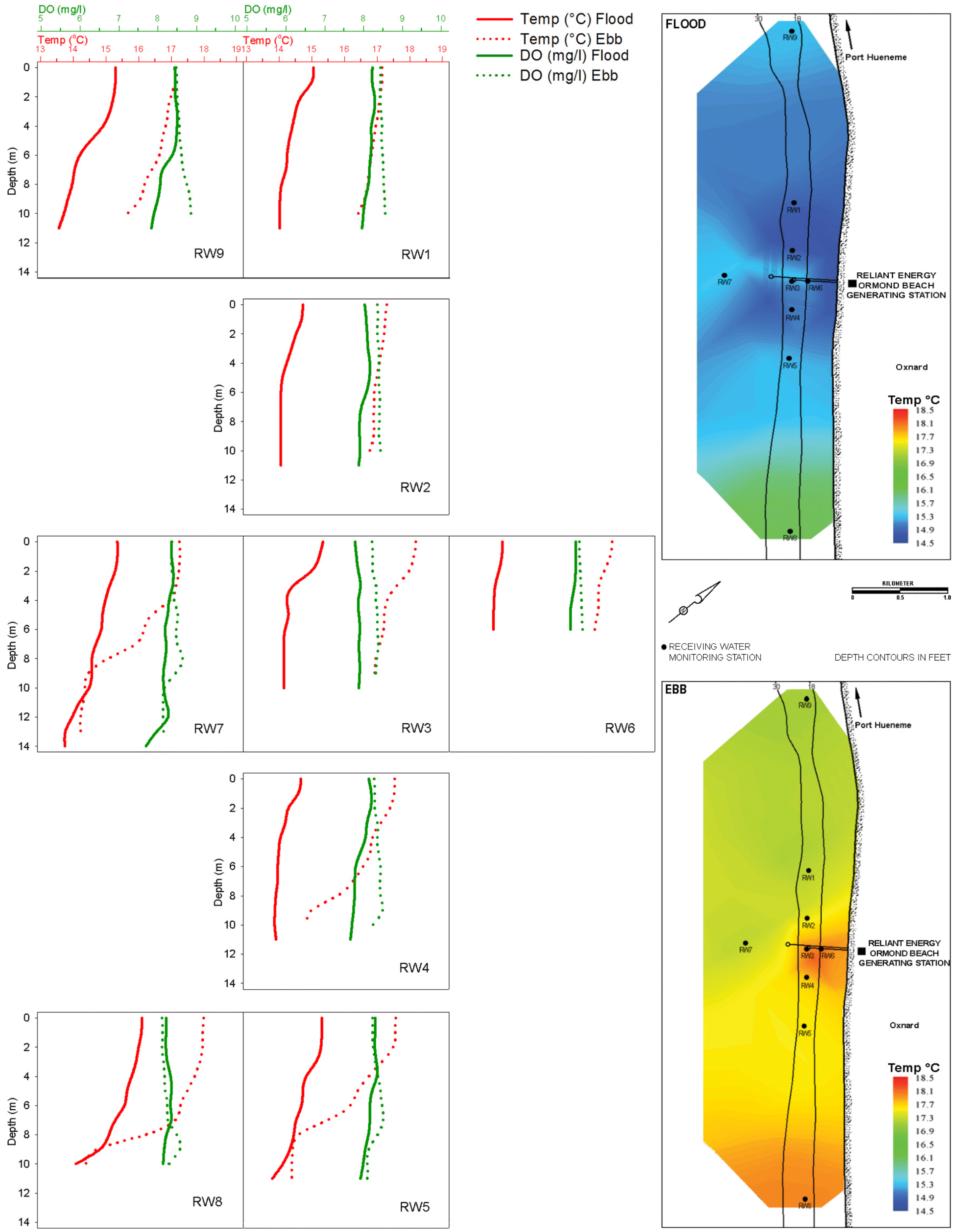


Figure 7. False color surface temperature contour plots and temperature and dissolved oxygen vertical profiles during flood and ebb tides, summer survey. Ormond Beach Generating Station NPDES, 2006.

during the morning flood tide (Figure 7). Dissolved oxygen concentrations were relatively consistent with depth, with slight subsurface maxima in the upper 4 to 8 meters at most stations on flood tide, and a general trend of moderately increasing DO with depth on ebb tide. Maximum surface-to-bottom DO differentials occurred at Station RW7 where DO concentration decreased by 0.66 mg/l during flood tide, and at Station RW9 where DO increased by 0.37 mg/l during ebb tide (Appendix B-2).

Hydrogen Ion Concentration

In winter, surface hydrogen ion concentrations (pH) averaged 7.81 during flood tide and 8.05 during ebb tide (Table 2). Flood tide pH values ranged from 7.78 at Station RW1, 3,000 ft upcoast of the discharge, and Stations RW2 and RW9 to 7.90 at Station RW8. Ebb tide pH values ranged from 7.93 at Station RW6 to 8.32 at Station RW7. Bottom pH values averaged 7.65 during flood tide and 7.72 on ebb tide. Flood tide bottom values ranged from 7.62 at Station RW8 to 7.68 at Station RW6. Ebb tide bottom pH values ranged from 7.68 at Stations RW3 and RW4 1,000 ft downcoast of the discharge, to 7.82 at Station RW5. Hydrogen ion concentrations during flood tide decreased slightly with depth at all stations, but otherwise ranged narrowly, varying by about 0.23 units among stations and depths during the morning tide (Appendix B-1). Hydrogen ion values were more variable during the afternoon ebb tide, with higher pH values found at the surface at all stations and greater variability through the water column (Figure 8). On ebb tide pH decreased with depth to values similar to those found near the bottom on flood tide.

Surface pH values in the summer averaged 8.17 during flood tide and 8.23 during flood tide (Table 2). Flood tide pH values ranged from 8.13 at Station RW3 to 8.19 at Stations RW5, RW7 and RW8. Ebb tide pH values ranged from 8.22 at Station RW3 to 8.25 at Station RW8. Bottom pH values averaged 8.14 during flood tide and 8.22 on ebb tide. Flood tide bottom values ranged from 8.12 at Station RW9 to 8.16 at Station RW6. Ebb tide bottom pH values ranged from 8.19 at Station RW7 to 8.24 at Station RW2. Hydrogen ion values were relatively consistent throughout the water column, although generally slightly higher on ebb tide (Figure 9). In summer, pH varied by less than 0.15 units among stations, between tides and with depth.

Salinity

Winter surface salinities averaged 33.55 practical salinity units (psu) during flood tide and 33.54 psu during ebb tide (Table 2). Flood tide salinities ranged from 33.54 to 33.58 psu, while ebb tide salinities ranged from 33.49 to 33.56 psu. Bottom salinities averaged 33.66 psu during flood tide and 33.68 psu during ebb tide. Salinities remained relatively consistent during flood tide, increasing slightly with increasing depth, although generally more variable during the afternoon ebb tide (Figure 8). In winter, salinity varied by less than 0.3 psu among stations, between tides and with depth.

Summer surface salinity averaged 33.42 psu during flood tide and 33.47 on ebb tide (Table 2). Salinities ranged from 33.40 to 33.44 psu during flood tide and 33.45 to 33.50 psu during flood ebb. Near-bottom water salinities averaged 33.47 psu on flood tide and 33.48 psu on flood tide. Salinity values were relatively uniform on both tides and with depth at all stations, although slightly more variable at Stations RW5 and RW7 on both tides and Station RW8 on ebb tide (Figure 9). In summer the greatest variability was found at Station RW7 between tides, however, overall salinity varied by less than 0.5 psu among stations, between tides and with depth.

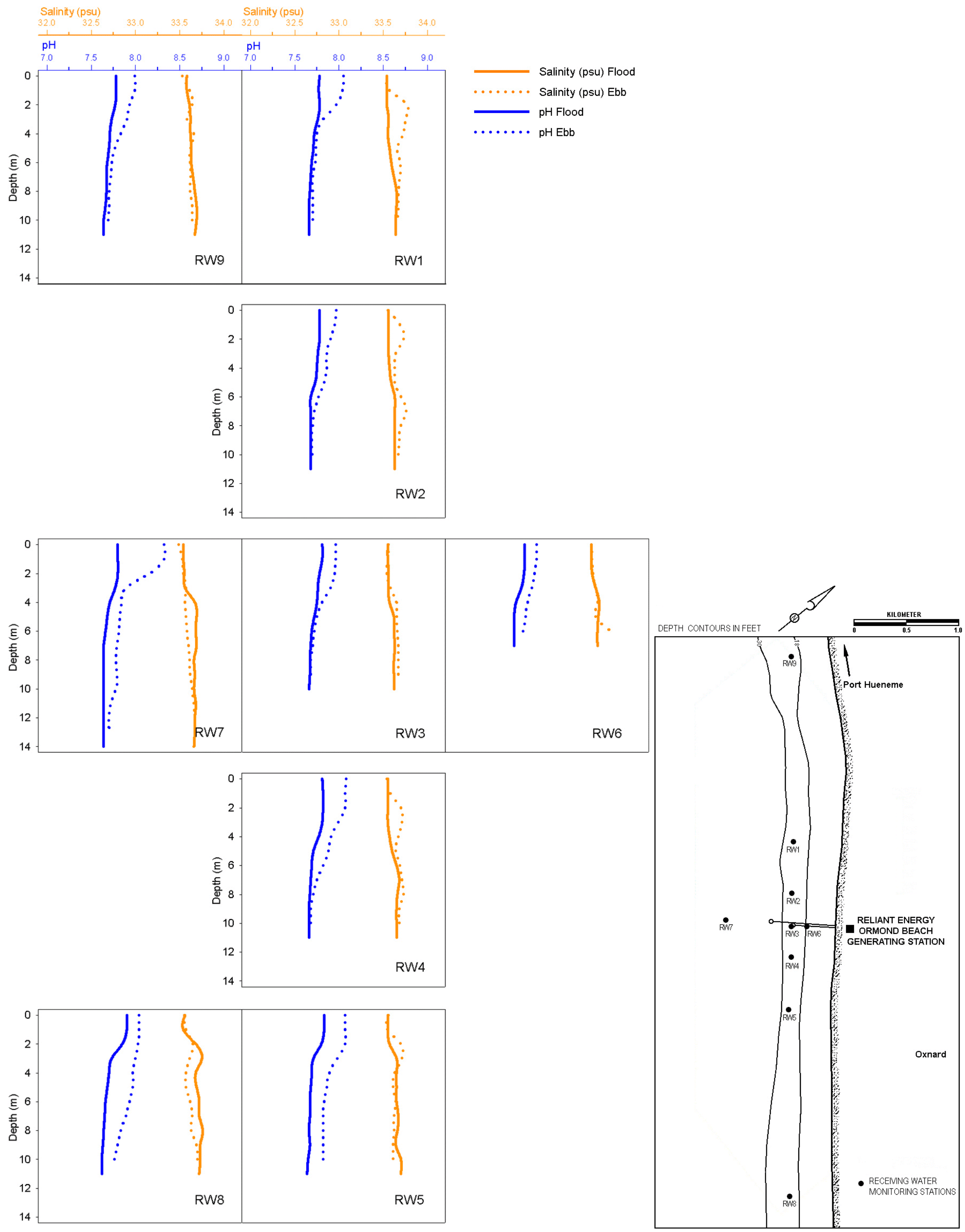


Figure 8. Hydrogen ion concentration (pH) and salinity vertical profiles during flood and ebb tides, winter survey. Ormond Beach Generating Station NPDES, 2006.

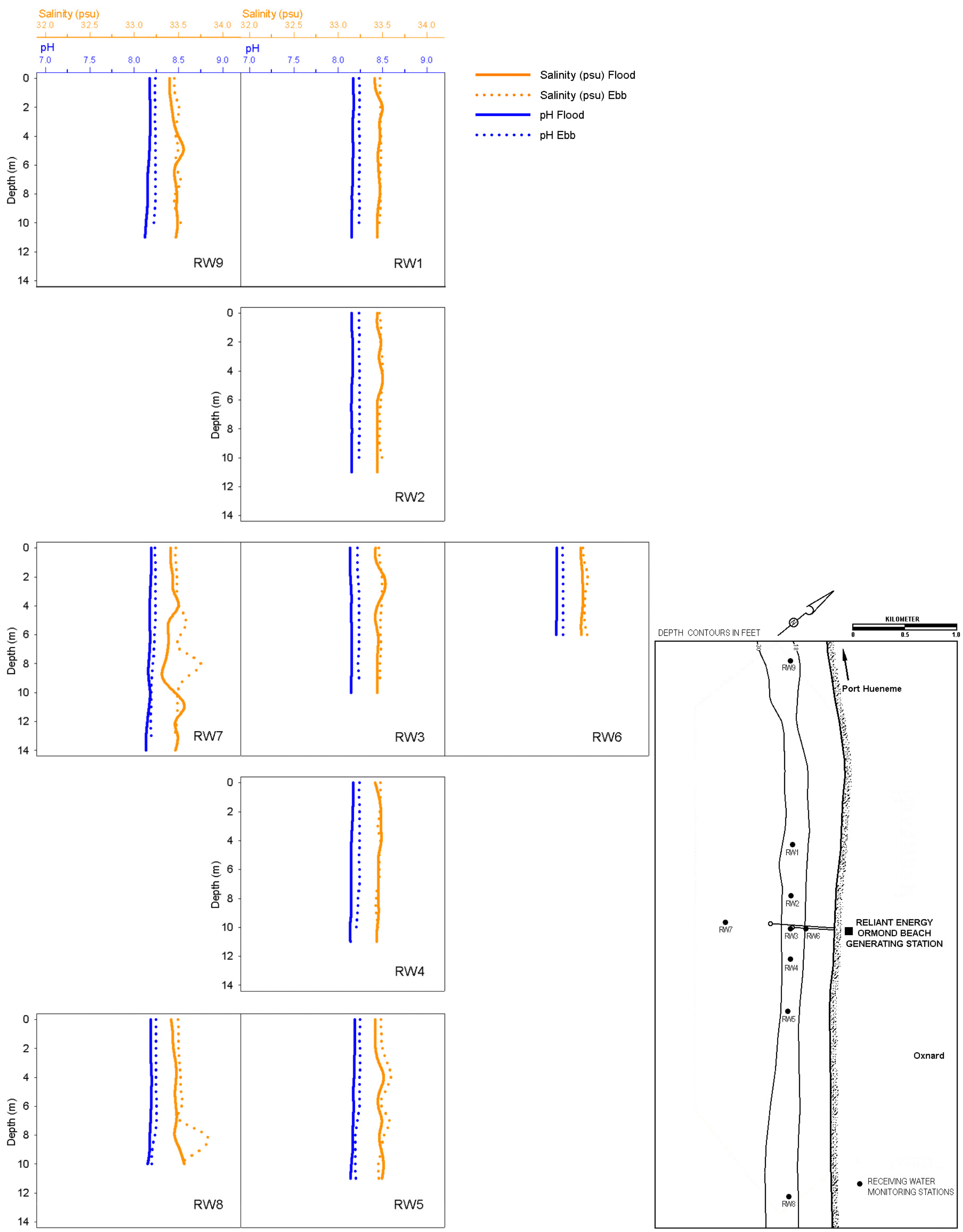


Figure 9. Hydrogen ion concentration (pH) and salinity vertical profiles during flood and ebb tides, summer survey. Ormond Beach Generating Station NPDES, 2006.

DISCUSSION

Water quality monitoring was conducted on two tides each during winter and summer to determine potential influence of the Ormond Beach Generating Station discharge on the receiving waters. During the winter sampling, no circulating pumps were in operation at the Ormond Beach Generating Station (Melchor 2006, pers. comm.). During flood tide, temperatures were relatively similar with depth at all stations, decreasing slightly from surface to bottom at all stations. Warmer surface water temperatures in the early afternoon, likely a result of solar insolation, resulted in stronger thermal gradients in the upper water column at all stations and a relatively strong thermocline at Station RW7 on the ebb tide. Surface temperatures were similar among stations during each tide in winter, varying by about 1°C or less among stations during either tidal cycle. Surface temperatures at each station increased by about 1.4°C between the morning and afternoon tides with the greatest difference found at Station RW7 where surface temperature was 2.17°C warmer on ebb tide. Surface temperatures in 2006 were more typical of winter sampling results than were found in the area in 2005 when mean temperatures were approximately 2-3°C cooler than commonly reported in winter surveys (MBC 1986, 1988, 1990, 1994-2001a, 2002-2004a, 2005; Ogden 1991-1993). As expected, water temperatures at Station RW3, nearest the discharge, were similar to those found throughout the sampling area and no thermal influence from the Ormond Beach Generating Station discharge was evident during the 2006 winter sampling (Figure 6).

During the summer water quality sampling two of the four circulating pumps were in operation with a relatively low flow of 19.3 mgd of cooling water with a discharge temperature of 20.9°C, or 6.9°C above intake water temperature (Melchor 2006, pers. comm.). As in winter, surface temperatures in 2006 were more typical of summer surveys than occurred in the area in 2005 (MBC 1986, 1988, 1990, 1994-2001a, 2002-2004a, 2005; Ogden 1991-1993). In summer, temperatures during morning flood tide were fairly consistent with depth throughout the water column with no notable thermal gradients, except at the discharge where warmer water was noted in the upper three meters. Surface temperatures generally varied by about 2.4°C between tides with warmer surface temperatures found during the afternoon ebb tide, likely due to solar insolation. The greatest difference between tides was found inshore of the discharge where surface temperature was 3.36°C warmer on ebb tide and the bottom temperature was higher than found at corresponding depths at other stations. Temperature profiles were similar between tides at the upcoast stations, while stations in the vicinity and downcoast of the discharge were more variable during ebb tide, with stronger thermal gradients below a depth of about 4 to 6 m (Figure 7). A warm water surface lens was noted at the discharge during the morning flood tide, while during ebb tide, warmer near-surface water temperatures were found in the vicinity of and downcoast of the discharge. This pattern reflects tidal influences on the thermal discharge from the generating station on the day of sampling. Even in areas influenced by the thermal field, surface temperatures were typical of the area during previous surveys. Other than at the shallowest station inshore of the discharge on ebb tide, the thermal field did not contact the seafloor.

The concentration of dissolved oxygen in seawater is affected by physical, chemical, and biological variables. High DO levels may be the result of cool water temperatures (solubility of oxygen in water inversely correlates with temperature), active photosynthesis, and/or mixing at the air-water interface (Sverdrup et al. 1942). Conversely, low concentrations may result from high water temperatures, high rates of organic decomposition, and/or extensive mixing of surface waters with oxygen-poor subsurface waters. Dissolved oxygen concentrations typically fluctuates in the nearshore temperate environment around 7.5 mg/l (Kennish 2001), with a threshold of biological concern of 5 mg/l.

During the winter survey, DO was relative consistent during flood tide, decreasing slightly with depth below subsuface maxima at about 2- to 4-m depth, with somewhat more pronounced reductions at depths that coincided with mild thermal gradients. Dissolved oxygen concentrations in the upper water column were generally 1.5 to 3.5 mg/l higher during the afternoon ebb tide sampling except at Station RW7 where surface concentrations were 8.21 mg/l higher on ebb tide. The very high DO near-surface values (up to 15.55 mg/l) along with a reduction in DO concentrations with depth below thermal gradients are consistent with patterns found associated with red tides, which were noted in patchy distributions in the area during winter sampling. On ebb tide, subsurface DO maxima were found at all stations in the upper few meters of the water column, below which generally strong reductions in DO with depth coincided with the stronger thermal gradients found during ebb tide sampling. Below a depth of about 4 to 6 m, reductions in DO concentrations with depth slowed, with bottom DO concentrations similar to levels found on flood tide except at the two stations farthest downcoast and at the shallowest station. Increased DO in the water column during the later ebb sampling is probably attributable to increased phytoplanktonic photosynthesis following the early morning sampling. The lowest DO found during the winter occurred near-bottom at the station farthest downcoast where a DO concentration of 5.00 mg/l was reported on flood tide. Values below the threshold of biological concern were also noted during 2005 sampling. These reduced values are undoubtedly related to natural conditions such as a high rate of organic decomposition of red tide organisms near bottom and not generating station operations. All DO values from the winter survey were within the range normally found in the area (MBC 1986, 1988, 1990, 1994-2001a, 2002-2004a, 2005; Ogden 1991-1993) and with one exception, above the level of biological concern.

In summer, DO values were more similar among stations and between tides than during the winter surveys, with concentrations that varied less throughout the water column and between tides than in winter. Dissolved oxygen concentrations in the upper water column in summer were generally higher during the later ebb tide sampling except at the stations farthest downcoast of the discharge, where concentrations in the upper 4 to 8 m were slightly higher during the morning flood tide (Figure 7). Dissolved oxygen concentrations were relatively consistent with depth during both tides, with slight subsurface maxima in the upper 4 to 8 meters at most stations on flood tide, and a general trend of moderately increased DO with depth to the bottom on ebb tide. Generally higher DO levels during the afternoon sampling are consistent with replenishment by photosynthetic activity at most stations. The similarity of DO levels with depth suggests that during the summer sampling the water column was fairly well mixed during both tides. Dissolved oxygen concentrations were in the range previously recorded offshore the generating station (MBC 1986, 1988, 1990, 1994-2001a, 2002-2004a, 2005; Ogden 1991-1993) and were well above the level of biological concern.

In the open ocean, pH remains fairly constant due to the buffering capacity of sea water (Sverdrup et al. 1942). However, in nearshore areas, pH may vary due to physical, chemical, and biological influences. For instance, in areas with a large organic influx, such as bays, estuaries, and near river mouths, microbial decomposition can alter pH levels. Along with a reduction in DO, decomposition also results in the production of humic acids, which reduces pH (Duxbury and Duxbury 1984). Decreased pH values may also occur in areas of fresh water influx, since fresh water generally has a lower pH than salt water. In contrast, phytoplankton blooms, which are often associated with nearshore upwelling, may initially cause an increase in pH. High photosynthetic rates increase the removal of carbon dioxide from water, thus reducing the bicarbonate concentration, resulting in an increase in pH. In winter, pH values were more variable between tides and with depth than during summer sampling (Figure 8 and 9). Hydrogen ion concentrations in the study area varied by 0.7 units between tides in winter, although values were more consistent within each tidal cycle. Increased pH values and higher variability through the water column during the afternoon was likely related to increased photosynthetic activity of the patchy red tide observed in the area in winter. In summer, pH was relatively consistent throughout the water column, although generally slightly higher on ebb tide. Still, hydrogen ion values were notably uniform, varying by less than 0.15 units among stations, between tides and with depth. In 2006 all pH values were consistent with concentrations previously recorded in the study area (MBC 1986, 1988, 1990, 1994-2001a, 2002-2004a, 2005; Ogden 1991-1993) and did not appear to be related to operation of the thermal discharge.

Salinity in the open ocean is generally 35 psu (ppt). However, in nearshore areas subjected to freshwater influx, salinity is usually slightly lower. Direct measurements of salinity are impractical, however, requiring the evaporation of one kilogram of seawater to obtain a final weight of salts. The most efficient measurement of salinity is determined by the electrical conductivity of seawater, which is precisely measured through the use of a CTD (conductivity-temperature-depth) instrument and is reported in “practical salinity units” (psu) which correlates one-to-one with parts per thousand (ppt). In southern California, salinity values of nearshore waters are generally between 33 and 34 ppt (Dailey et al. 1993). Reductions in nearshore salinity usually result from freshwater input, while slight increases are often associated with upwelling of colder, more saline waters.

In winter, salinities remained relatively consistent during flood tide, increasing slightly with depth, although generally more variable during the afternoon ebb tide (Figure 8). During summer, salinity values were relatively uniform on both tides and with depth at all stations, although slightly more variable at Stations RW5 and RW7 on both tides and Station RW8 on ebb tide (Figure 9). In winter, salinity varied by less than 0.3 psu, while in summer variability was slightly greater than in winter but still differed by less than 0.5 psu among stations, between tides and with depth. All values reported in 2006 were typical of the nearshore waters of southern California, and did not appear to be influenced by the operation of the generating station.

CONCLUSION

In winter 2006, the Ormond Beach Generating Station circulating water pumps were not in operation during sampling. Water temperatures were similar throughout the sampling area and no thermal influence from discharge was evident. In summer, a warm water surface lens was noted at the discharge during the morning flood tide, while during ebb tide, warm near-surface water temperatures were found in the vicinity of and downcoast of the discharge. This pattern reflects tidal influences on the thermal discharge from the generating station on the day of sampling. Even in areas influenced by the thermal field, surface temperatures were typical of the area during previous surveys. With the exception of the warm water plume near the discharge during summer, variations in water quality parameters observed in 2006 can be attributed to natural physical and biological processes. Water quality measurements indicated that in 2006 the cooling water discharge from the Ormond Beach Generating Station did not have an adverse effect on receiving waters in the study area.

SEDIMENT CHARACTERISTICS

Marine sediment characteristics are affected by both natural and anthropogenic influences. Tides, currents, and wave action all influence sediment grain size by suspending and transporting fine-grained material, resulting in coarser sediments in dynamic areas and finer sediments in areas of reduced currents and wave action. Coastal streams and rivers contribute sediments as well as contaminants to the marine environment, with variable influence from year-to-year depending on yearly rain amounts. In coastal environments, man-made structures such as jetties and breakwaters alter water movement and may result in changes in local sediment characteristics and deposition patterns, while sand replenishment projects can influence sediment characteristics over large intertidal and subtidal areas. In addition to influencing grain size, anthropogenic inputs may contribute contaminants, including metals, to the environment which can bind to sediments. Sediment grain size and sediment chemistry trends are useful in characterizing year-to-year differences that may be related to either natural or anthropogenic influences.

MATERIALS AND METHODS

Bottom samples for sediment grain size and sediment chemistry analyses were collected at Stations B1 through B6 during the summer of 2006 (Figure 10). All samples were collected *in situ* by biologist-divers in conjunction with infauna sampling.

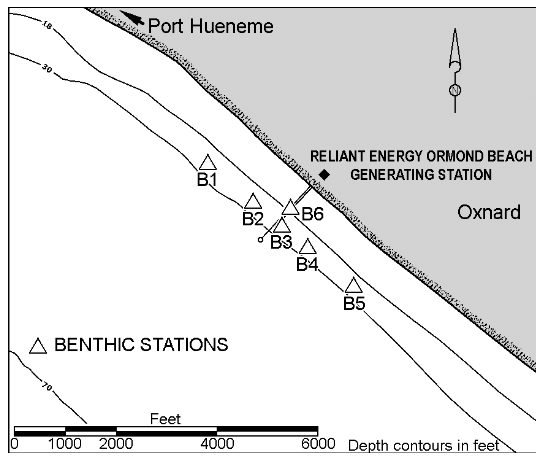


Figure 10. Location of the benthic sampling stations. Ormond Beach Generating Station NPDES, 2006.

Sediment Grain Size

A sample of sediments for grain size analysis was taken at each station using a 3.5-centimeter (cm)-diameter, 15-cm-long plastic core tube. The sample was transferred to a plastic bag for laboratory analysis.

The size distributions of sediment particles were determined using two techniques: laser light diffraction to measure the amount and patterns of light scattered by a particle's surface for the sand/silt/clay fraction, and standard sieving for the gravel fraction. Laboratory data from the two methods were combined and presented in tabular format. Resulting analyses include mean and median grain size, standard deviation of the grain size, sorting, skewness, and kurtosis. Data were plotted as size-distribution curves. Additional details are provided in Appendix C-1.

Sediment Chemistry

Samples for sediment chemistry analysis were taken from the upper 2 cm of the sediments at each station. Collection jars were filled with seawater and taken to the sea floor by biologist-divers where sediment samples were collected directly with the glass jars.

Sediments were kept on ice while in the field, and maintained at approximately 4°C until laboratory procedures began. Replicate sediment samples were composited by the analytical laboratory prior to analysis and reported as station results. Sediment was analyzed for total percent solids and four metals: chromium, copper, nickel, and zinc. Environmental Protection Agency (EPA) method 160.3 was used in determining percent solids and EPA method 6020 for metal analysis.

RESULTS

Sediment chemistry and grain size samples were collected by biologist-divers at Stations B1 through B6 on 24 August 2006 between 0732 and 0950 hours. Skies were overcast and winds were still. Seas were west at 2 to 3 ft.

Sediment Grain Size

Sediment distribution curves and parameters describing sediment grain size characteristics for each station are presented in Appendix C and are summarized in Table 3. Grain size is expressed in phi (Φ) units, which are inversely related to grain diameter (Appendix C-1).

Table 3. Sediment grain size parameters. Ormond Beach Generating Station NPDES, 2006.

	Station							
Parameter	B1	B2	B3	B4	B5	B6	Mean	S.D.
% Gravel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
% Sand	82.08	88.91	85.25	83.99	82.12	90.39	85.46	3.49
% Silt	14.02	8.66	10.88	12.48	14.20	6.70	11.16	3.01
% Clay	3.90	2.43	3.87	3.53	3.68	2.91	3.39	0.59
Mean grain size								
phi	3.32	2.62	3.04	2.96	3.29	3.08	3.03	0.25
µm	100	163	122	128	102	118	122	23
Sorting(ϕ)	1.132	1.319	1.206	1.328	1.117	0.819	1.154	0.187
Skewness	0.305	0.012	0.349	0.203	0.318	0.369	0.259	0.134
Kurtosis	2.091	1.156	1.957	1.576	1.955	2.045	1.797	0.363

Sediments at the six stations in 2006 were composed primarily of sand, with smaller amounts of silt and clay (Table 3). Gravel was not found at any of the stations in 2006. Overall, sediments from the six stations averaged about 85% sand, 11% silt, and 3% clay, with an average mean grain size of 3.03 (122 µm, very fine sand). Sediments were finest at Station B1, 3,000 ft upcoast of the discharge, where mean grain size was 3.32 phi (100 µm, very fine sand). Sediments were coarsest at Station B2, 1,000 ft upcoast of the discharge, where mean grain size was 2.62 phi (163 µm, fine sand).

Sorting, a measure of the spread of the particle distribution curve, averaged 1.15 phi overall, representing poorly sorted sediments (Table 3). Sorting values ranged from 0.82 phi (moderately well sorted) at Station B6, inshore of the discharge at a depth of 20 ft, to 1.33 phi (poorly sorted) at Station B2. Sorting at all stations ranged narrowly with sediments at all except Station B6 in the poorly sorted category. Poorly-sorted sediments are composed of a broad range of particle size classes, while well-sorted sediments contain fewer size classes. The sediment distribution curve for Station B2 was trimodal with a primary peak in the fine sand category, a secondary peak at fine-to-medium sand and a third small peak suggested in the silt-clay size category (Appendix C-2). Distribution curves at the remaining stations were slightly bimodal, with peaks in the fine sand category and small secondary peaks in the silt-clay size classes.

Skewness and kurtosis tell how closely the grain size distribution approaches the normal Gaussian probability curve. More extreme skewness and kurtosis values indicate non-normal distributions. Skewness is a measure of the symmetry of the particle distribution curve; a value of zero indicates a symmetrical distribution of fine and coarse materials around the median of the curve, while a value greater then zero (positive) indicates an excess of fine material, and a negative value indicates an excess of coarse material. Skewness ranged from 0.01 at Station B2 to 0.37 at Station B6 (Table 3). Distribution curves were skewed toward finer material at all stations.

Kurtosis is a measure of the peakedness of the particle distribution curve. A kurtosis value of 1.0 represents a normal particle distribution curve while a value greater than 1.0 indicates a leptokurtic (peaked) distribution with better sorting in the central portion of the curve than in the tails. A value less than 1.0 indicates a platykurtic (flattened) distribution and a lack of dominance by any one size category. Kurtosis values at all stations in 2006 stations were greater than 1.0, indicating leptokurtic (excessively peaked) distributions, with dominance by a narrow range of size classes (Table 3). Kurtosis ranged from 1.16 at Station B2 to 2.09 at Station B1 and averaged 1.80.

Sediment Chemistry

Sediment samples collected at the six benthic stations were analyzed for chromium, copper, nickel, and zinc. Values are reported as dry weight. Sediment metal concentrations are presented in Appendix D and summarized in Table 4. Metal concentrations were similar among stations, with highest values found at stations upcoast, at, and inshore of the generating station discharge.

Table 4. Sediment metal concentrations (mg/dry kg). Ormond Beach Generating Station NPDES, 2006.

	Station										Reporting
Metal	B1	B2	B3	B4	B5	B6	Mean	S.D.	ERL	ERM	Limits
Chromium	9.16	8.17	8.67	7.42	8.72	2.74	7.48	2.40	81	370	0.04 - 0.13
Copper	3.67	3.22	3.99	3.05	4.17	5.15	3.88	0.76	34	270	0.04 - 0.13
Nickel	7.04	6.40	7.59	6.58	7.52	2.50	6.27	1.91	21	51.6	0.04 - 0.13
Zinc	25.0	21.8	24.5	20.2	24.9	7.74	20.7	6.6	150	410	0.45 - 1.3

ERL = Effects Range Low
ERM = Effects Range Medium

Chromium. Sediment chromium concentrations averaged 7.48 mg/kg and ranged from 2.74 mg/kg at Station B6 to 9.16 mg/kg at Station B1 (Table 4).

Copper. Sediment copper concentrations averaged 3.88 mg/kg and ranged from 3.05 mg/kg at Station B4, 1,000 ft downcoast of the discharge to 5.15 mg/kg at Station B6 (Table 4).

Nickel. Sediment nickel concentrations averaged 6.27 mg/kg and ranged from 2.50 mg/kg at Station B6 to 7.59 mg/kg at the discharge (Station B3) (Table 4).

Zinc. Sediment zinc concentrations averaged 20.7 mg/kg and ranged from 7.74 mg/kg at Station B6 to 25.0 mg/kg at Station B1 (Table 4).

DISCUSSION

Sediment Grain Size

In 2006, sediments were analyzed from six stations offshore the Ormond Beach Generating Station. Sediments were similar among stations, consisting primarily of sand with lesser amounts of fine material (silt and clay) and mean grain sizes in the fine and very fine sand categories. Particle distribution curves at all stations were skewed toward finer material. Sediment grain sizes at and inshore of the discharge, Stations B3 and B6, respectively, were similar to those found at the other stations. Slightly coarser sediments were found upcoast of the discharge at Station B2. The percent contribution to the sediments by fine material was similar among all stations, with lowest percentage of fines found at Station B2 and along the 20-ft isobath at Station B6.

Mean grain size in the study area in 2005 was the greatest on record, a result of the coarse sediments found at Station B2 (Figure 11; Appendix C-3; MBC 1979, 1981, 1986, 1988, 1990, 1994, 1997-2001a, 2002-2004a, 2005; Ogden 1991-1993). In 2006, however, mean grain size was consistent with mean grain size recorded in most previous surveys, particularly between 1999 and 2004 (Figure 11). Despite the similarity in overall grain size, there has been year-to-year variability

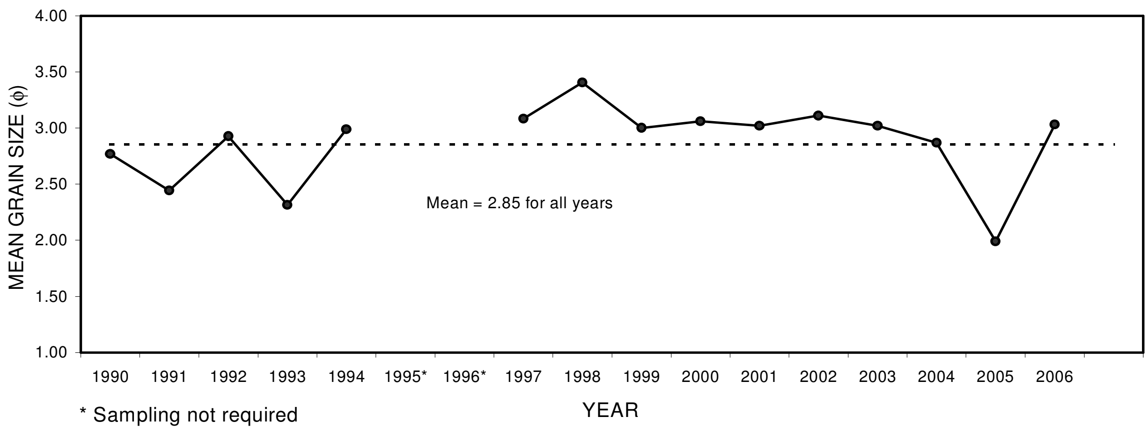


Figure 11. Comparison of sediment mean grain size, 1990 - 2006. Ormond Beach Generating Station NPDES, 2006.

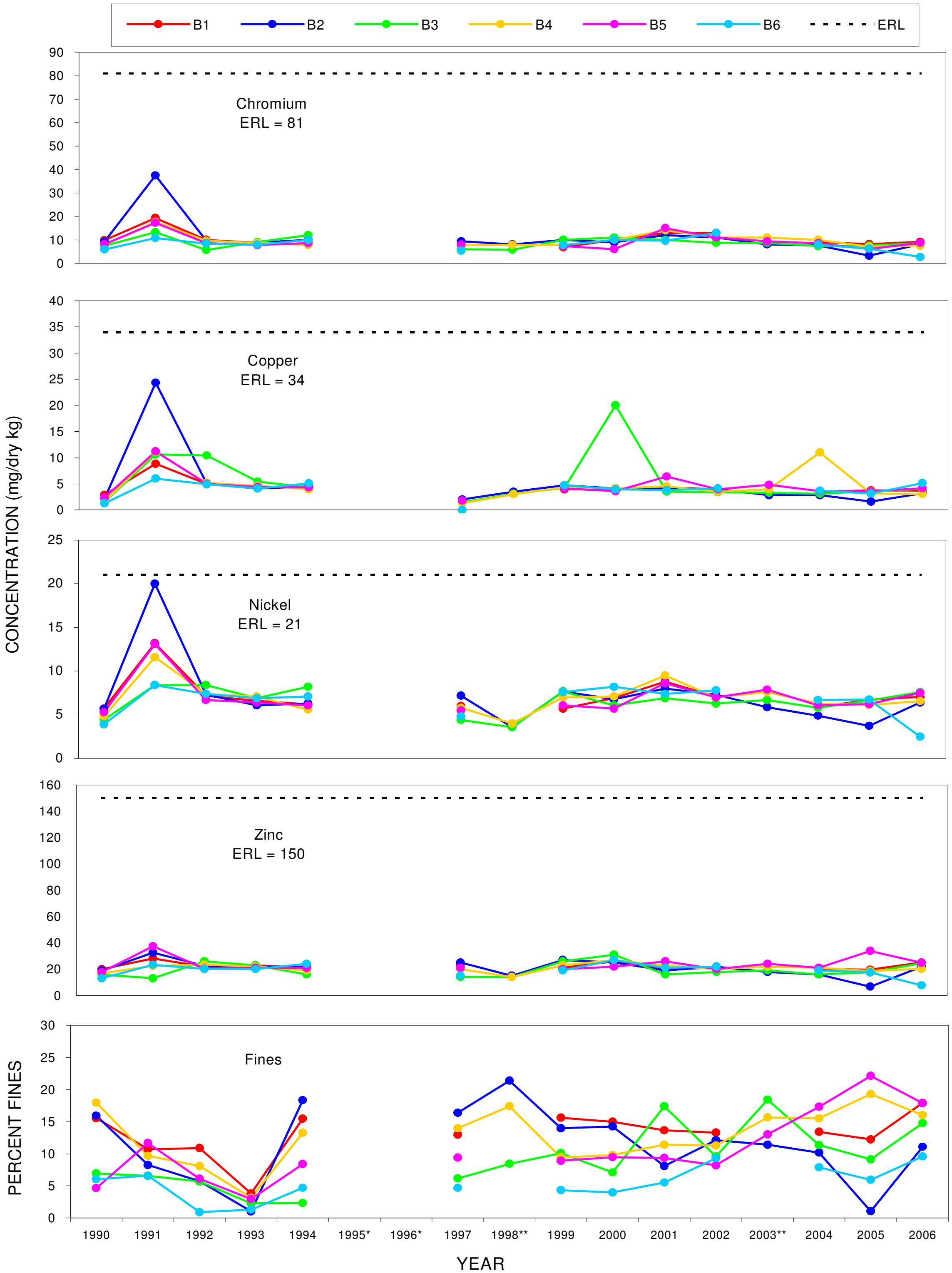
in grain size among stations off the generating station. In the 13 surveys since 1990 (excluding 1998 and 2003 when the sampling program was limited to three or four stations), sediments were finest at the discharge twice, inshore of the discharge once, downcoast of the discharge twice, and upcoast of the discharge eight times, including this year (Appendix C-3). Coarsest sediments occurred at the discharge six times, upcoast four times, and inshore three times.

Coarser sediments at Station B2 in 2006 are likely a remnant of the very coarse sediments found at the station in 2005. The sediments at this station in 2005 were consistent with relict sands found in isolated patches on the Santa Barbara Shelf (AHF 1959). Relict sands represent poorly-weathered sediments historically deposited as beaches or dunes during periods of lower sea level (Emory 1952, 1960; Terry et al. 1956). Occurrence of the coarse sands may also have been related to dredge and sand bypass operations that were conducted at Channel Islands Harbor in late 2004, with sand discharged just downcoast from Port Hueneme (Ryan 2006, pers. comm.), although disposal operations would likely also have affected sediments at Station B1. Similarity of sediment grain size and distribution in 2006 suggest that differences observed in 2005 were localized and transitory. The resemblance of sediment characteristics at and inshore of the discharge to the remaining stations suggests that in 2006 sediment composition and distribution in the study area appeared to be affected primarily by natural causes.

Sediment Chemistry

In 2006, sediments at six stations off the Ormond Beach Generating Station were analyzed for the presence and concentration of chromium, copper, nickel, and zinc. Metal levels were relatively similar among stations. Highest chromium and zinc were recorded 3,000 ft upcoast of the discharge, while highest nickel levels were recorded at the discharge, and highest copper inshore of the discharge on the 20-ft isobath. Lowest concentrations of chromium, nickel and zinc were recorded inshore of the discharge and lowest copper 1,000 ft downcoast of the discharge. Most metal concentrations were similar to values recorded in 2005 and in previous surveys (Figure 12). Nickel concentration at Station B6 in 2006 was the lowest detected in sediments from the study area since 1990.

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. 1982). Comparisons should take into account the relative amounts of fine and coarse sediments. Sediments in the study



*No sampling required; ** 1998 - only three stations required; *** 2003 - only four stations required.

Figure 12. Comparison of sediment metal concentrations and percent fines by station, 1990 - 2006. Ormond Beach Generating Station NPDES, 2006.

area have consistently been sandy. In previous years, the largest percentages of fines (silt and clay combined) were usually recorded at the upcoast stations or Station B4 downcoast from the discharge (Figure 12 and Appendix D-2). Continuing this trend somewhat, this year the greatest percentage of fine material was recorded at upcoast Station B1, with a similar percentage of fine material found at Station B5 farthest downcoast of the discharge. Highest concentrations of chromium and zinc were recorded at Station B1, but highest levels of copper and nickel occurred at Stations B6 and B3, respectively, the stations with the lowest percentages of fine material in 2006. Despite the survey high copper value at Station B6, chromium, nickel and zinc values at this station were about one-third the concentrations of these metals at the remaining stations. Still, because of an overall similarity in sediment characteristics at stations in the Ormond Beach area and relatively low metal concentrations typically found in sediments, metal levels in the area do not always appear to relate to the amount of fine material in the sediments (MBC 1990, 1994, 1997-2001a, 2002-2004a, 2005; Ogden 1991-1993).

Historically, metal levels in the area were highest in 1991 (Figure 12). In 1992, concentrations of most metals decreased substantially, and by 1993 metal concentrations were similar to levels detected in 1990. A similar pattern was recorded in sediment metal concentrations offshore the Mandalay Generating Station, located upcoast from Channel Islands Harbor (MBC 2004b). Since 1993, metal concentrations in the study area have been relatively consistent with the exception of an anomalously high copper concentration detected in 2000 at the discharge. In 2000, levels of chromium, copper, and zinc were all highest at the discharge, even though the amount of fine material there was low, suggesting the generating station as a possible source (MBC 2000). In 2001, no pattern of metal concentrations relative to the discharge was apparent (MBC 2001a). In 2002, metal concentrations were very similar among stations, but concentrations of metals were lowest at the discharge and highest inshore of the discharge (MBC 2002). In 2003 and 2004, lowest metal levels were found upcoast and at the discharge, and highest metal concentrations were found downcoast of the discharge, while in 2005 lowest metal concentrations were found upcoast of the discharge at the station along with the very coarse sediments.

Most metal values observed in 2006 were typical of the area and similar to the long-term means at all stations (Appendix D-2). Metal levels throughout the Ormond Beach study area 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). Mean concentrations of metals off the generating station in 2006 were 1.6 to 3.6 times less than the mean metal concentrations found in sediments at shallow (15–100 ft) coastal stations sampled in 2003 from throughout the Southern California Bight (Schiff et al. 2006).

Concentrations of metals in the study area have consistently been 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). Concentrations below the ERL represent a minimal effects range; a range intended to estimate conditions where effects would be rarely observed (Long et al. 1995). Metal concentrations have never exceeded their respective ERLs in the study area (Figure 12).

Pollutants come from a variety of sources of both industrial and domestic origin. Oil and gasoline combustion releases many substances, including cadmium, copper, chromium, lead, mercury, and zinc. These and other metals are also used in paints, pigments, batteries, manufacturing, and protective coatings. Aerial fallout is a diffuse and potentially large source of contaminants derived from other sources, and may include metals, chlorinated hydrocarbons, and

PAHs (SCCWRP 1973, 1986). As these contaminants accumulate on the ground, they are washed into rivers by rainfall, and are eventually deposited in the ocean.

Sediment metal concentrations have remained relatively consistent in the area since 1990, and in 2006 metal concentrations were similar among stations and to previous surveys. Metal concentrations in 2006 were not strongly related to the percent of fine material in the sediments. Metal levels in the area vary slightly from year to year and no long-term patterns of metal concentrations relative to the discharge were apparent. Concentrations of sediment metals in 2006 did not appear to be influenced by the operation of the Ormond Beach Generating Station.

CONCLUSION

Sediment Grain Size

In 2006, slightly coarser sediments found upcoast of the discharge were likely a remnant of the very coarse sediments found at that station in 2005. Sediment characteristics were otherwise similar among stations. Similarity of sediment grain size and distribution in 2006 suggest that differences observed in 2005 were localized and transitory. While the degree of influence of the discharge on local sediments varies from year to year, the resemblance of sediment characteristics at and inshore of the discharge to those at the remaining stations suggests that in 2006 sediment composition and distribution in the study area appeared to be affected primarily by natural causes and not by the operations of the Ormond Beach Generating Station.

Sediment Chemistry

In 2006, metal concentrations were not strongly related to the percent of fine material in the sediments, likely a result of similarity in sediment characteristics and relatively low metal concentrations typically found in sediments off Ormond Beach. Lowest concentrations of chromium, zinc, and the lowest nickel concentration recorded in the area since 1990 were found inshore of the discharge, where the highest concentration of copper also occurred. As in previous surveys, sediment metal levels were lower than mean values found in regional monitoring of sediments in shallow coastal waters of southern California and well below concentrations determined to be potentially toxic to marine organisms. Concentrations of sediment metals did not appear to be influenced by the operation of the Ormond Beach Generating Station.

MUSSEL BIOACCUMULATION

Concentrations of many toxic substances in water are often too low or transitory to be reliably detected through the analysis of water samples. Also, many toxic substances are not water-soluble, but are instead associated with sediments or organic tissues. Tissues from aquatic organisms are preferably sampled because they accumulate and concentrate toxic substances to levels which may be hundreds of times the levels found in water samples, thus facilitating the detection of pollutants. Mussels are excellent subjects for this purpose because they 1) are sessile, 2) are long-lived, 3) can be transplanted and maintained in areas were they do not occur, and 4) reliably concentrate toxic pollutants from the water (SWRCB 1995, 2000).

MATERIALS AND METHODS

Typically, mussels for tissue analysis have been collected off of the Ormond Beach Generating Station discharge buoy. Replacement of the buoy in early 2006, however, eliminated this site as a mussel source this year. As a result, live bay mussels (*Mytilus galloprovincialis*) were purchased from a commercial mussel distributor, Carlsbad Aquafarms, for transplant into the Ormond Beach area. Donor mussels were harvested from Agua Hedionda Lagoon in Carlsbad, California on 17 July 2006, cleaned and placed within protective enclosures that allowed unrestricted water flow to the mussels, and transplanted to a mooring established near the Ormond Beach discharge on 18 July 2006. Additional mussels from the donor site were frozen for later analysis and comparison with the transplanted mussels. On 20 October 2006, after 94 days the transplanted mussels were retrieved and returned to the laboratory for chemical analysis.

Forty-five (45) transplanted bay mussels with shell lengths averaging 63 mm were collected from the mooring and returned to the laboratory for chemical analysis. Three replicate samples, each a composite of the tissue from 15 mussels, were analyzed for concentrations of the metals chromium, copper, nickel, and zinc according to methods used in the California State Mussel Watch Program (SMWP; Appendix A and SWRCB 1986). The same methods were used with the bay mussels collected from the donor site and from another set of bay mussels collected on 22 June 2006 from the Hermosa Beach Pier in Santa Monica Bay, which served as a reference site.

During sample analysis, metals are detectable at very low concentrations. The level below which the analytical method will no longer detect the analyte is referred to as the method detection limit (MDL). However, concentrations are only reported when results can be confirmed by exceeding a confidence level, termed the reporting limit (RL). If metal concentrations are detected at a level below the RL the results cannot reliably be reported and sample results are reported as none detected (ND). Beginning in 2005, analytical reporting limits for bioaccumulated metals were lower than in previous years (MBC 1990, 1999-2001a, 2002-2004a, 2005; Ogden 1991-1993). As a result in 2005 and 2006, concentrations of some metals were reported at lower levels than possible during previous surveys. For QA/QC purposes, the analytical laboratory may randomly analyze one sample twice to confirm results and provide the results from both analyses. While both replicates are usually very similar, some differences in metal concentrations are typical, and the highest value determined during either analysis is presented in the results.

RESULTS

In 2006, chromium, copper, nickel, and zinc were detected in all mussel tissue replicates from the generating station area, the donor site and at a pier reference site (Table 5 and Appendix E).

Chromium concentrations in mussels from the generating station ranged from 6.07 to 6.97 mg/dry kg with a mean of 6.53 mg/dry kg (Table 5). Mean chromium concentration at the discharge was lower than at both the donor site (7.91mg/dry kg), and the reference site (10.05 mg/dry kg).

Table 5. Mussel tissue metal concentrations (dry weight and reporting limits, mg/dry kg; wet weight and EDL, mg/wet kg). Ormond Beach Generating Station NPDES, 2006.

	Dry Weight						Wet Weight						
	Replicate					Reporting	Replicate						
Metal	1	2	3	Mean	SD	Limits	1	2	3	Mean	SD	EDL 85	EDL 95
Discharge													
Chromium	6.97	6.07	6.55	6.53	0.45	0.05	**1.12**	**0.95**	**1.08**	**1.05**	0.09	0.73	1.60
Copper	5.806	5.665	6.238	5.903	0.299	0.05	0.93	0.88	1.03	0.95	0.07	2.28	4.28
Nickel	1.016	1.06	1.92	1.33	0.51	0.05	0.16	0.17	0.32	0.21	0.09	0.78	1.06
Zinc	82.294	74.184	78.074	78.184	4.056	0.05	13.17	11.57	12.88	12.54	0.85	42.92	52.60
% Solids	16	15.6	16.5	16	-	0.1	-	-	-	-	-	-	-
Donor Site													
Chromium	6.47	7.34	9.92	7.91	1.79	0.05	**1.27**	**1.38**	**1.73**	**1.46**	0.24	0.73	1.60
Copper	4.686	4.792	9.19	6.22	2.57	0.05	0.92	0.90	1.60	1.14	0.40	2.28	4.28
Nickel	0.479	0.503	0.861	0.614	0.214	0.05	0.09	0.09	0.15	0.11	0.03	0.78	1.06
Zinc	90.194	89.064	105.954	95.071	9.442	0.05	17.77	16.74	18.44	17.65	0.85	42.92	52.60
% Solids	19.7	18.8	17.4	18.6	-	0.1	-	-	-	-	-	-	-
Hermosa Beach Reference Site													
Chromium	9.17	9.89	11.1	10.05	0.98	0.05	**1.60**	**1.51**	**1.60**	**1.57**	0.05	0.73	1.60
Copper	5.09	6.7	5.73	5.84	0.81	0.05	0.89	1.03	0.83	0.91	0.10	2.28	4.28
Nickel	0.48	0.56	0.65	0.56	0.09	0.05	0.08	0.09	0.09	0.09	0.01	0.78	1.06
Zinc	70.6	73.8	87.3	77.2	8.9	0.05	12.4	11.3	12.6	12.07	0.69	42.92	52.60
% Solids	17.5	15.3	14.4	15.7	-	0.1	-	-	-	-	-	-	-

EDL = Elevated Data Levels **Blue** values exceed EDL 85 **Red** values exceed EDL 95

Copper concentrations from the discharge averaged 5.90 mg/dry kg with a range from 5.81 to 6.24 mg/dry kg (Table 5). Copper was highest in the donor mussels (6.22 mg/dry kg) and lowest at the reference site (5.84 mg/dry kg), but still relatively similar among the sites.

Nickel levels in mussels from the discharge ranged from 1.02 to 1.92 mg/dry kg with a mean of 1.33 mg/dry kg (Table 5). Nickel at the discharge was about twice the mean concentration at the donor site (0.61 mg/dry kg) and at the reference site (0.56 mg/dry kg).

Zinc concentrations at the discharge site ranged from 74.18 to 82.29 mg/dry kg, with a mean concentration of 78.18 mg/dry kg (Table 5). Zinc concentrations were highest in the donor mussels with a mean concentration 95.07 mg/dry kg and lowest at the reference site with a mean of 77.2 mg/dry kg.

DISCUSSION

SMWP monitors levels of metals and organic pollutants in both native California mussels (*Mytilus californianus*) and bay mussels. Bioaccumulation of pollutants by the two species was found to be comparable, although some differences were found between the mussels, likely related to habitat preference (SWRCB 1995, 2000). California mussels are preferentially used for analysis. However, a resident population of mussels is sometimes not available in an area, such as offshore of the Ormond Beach Generating Station. In that case, mussels are transplanted into the area for at least 90 days. All analytical results are reported on a dry weight basis; however, wet weight concentrations were calculated for comparison with evaluation criteria.

Water quality standards for evaluating bioaccumulation in mussel tissues are primarily based on human or animal health criteria, and several standards of comparison are currently available (SWRCB 1995, 2000). However, action levels for only a few organic chemicals have been determined. Because of this, the SMWP developed a method of comparison among samples based on elevated data levels (EDL). The EDL for any particular substance is based on a ranking of statewide tissue levels for that substance from the ongoing SMWP. Elevated data levels are determined for each species and may vary depending on whether the mussels are resident or transplanted. Elevated data levels are updated periodically based on recent data. In the EDL ranking system the 50th percentile corresponds to the median of all values rather than to a mean. The 85th percentile (EDL 85) indicates that a chemical is markedly elevated from the median. The 95th percentile (EDL 95) indicates values that are highly elevated above the median. While no studies have strictly compared these values, this information is useful in determining if a particular substance has been found in unusually high concentrations and in comparing local results to recent statewide results.

In 2006, mussels were not found in the vicinity of the Ormond Beach Generating Station discharge. For that reason, donor mussels were purchased from a commercial supplier in Carlsbad, California and transplanted to a mooring near of the Ormond Beach discharge where the mussels were allowed to acclimate for a period of 94 days. Results were compared with those from mussels collected at the donor site at the time of the transplant and to mussels collected from the Hermosa Beach Pier in Santa Monica Bay, which served as a reference site.

Chromium was reported in all replicates from the generating station discharge, in the donor mussels, and at the reference site. Tissue concentrations of chromium in mussels at the discharge in 2006 were detected at levels about twice those found in the area in 2005 (Table 5, Figure 13). Previous to 2005, chromium was reported in mussels from the discharge at very low levels in 2002, at an extremely high level in 1991 and at levels about one-third current levels in 1990 (Figure 13 and Appendix E; MBC 1990, 1999-2001a, 2002-2004a, 2005; Ogden 1991-1993). Chromium undoubtedly occurred in tissues during all years, but at levels which could not reliably be reported with previous analytical reporting limits. Still, most chromium concentrations at the discharge in 2005 were found at levels that exceeded previous reporting limits, suggesting that chromium in the area was higher than in preceding years. Levels were even higher in 2006, suggesting that the chromium levels in the area recently increased. In 2005, the mean concentration of chromium in mussel tissues from the reference site was about one-third the level found at the discharge; however, in 2006 levels from the reference site (where levels were more than seven times higher than in 2005) were about 50% higher than levels in mussels from the discharge, while chromium concentrations in the donor mussels were about 20% higher than at the discharge. Higher-than-normal chromium levels were noted in mussels at the discharge, from the Agua Hedionda donor site and the Santa Monica Bay reference site, as well as from other areas of southern California in 2006 (MBC 2006a-f, in prep.). Wet-weight chromium levels in mussels from the Ormond Beach discharge exceeded the EDL 85 for bay mussels indicating that chromium was elevated in the study area in 2006. Replicate chromium levels in mussel tissue from the donor site and the Hermosa Beach Pier reference site exceeded the EDL 85 or EDL 95 for bay mussels, indicating that chromium was elevated or highly elevated at these sites.

Copper was detected in all replicates in 2006. Copper concentrations in mussels from the discharge were one-half the levels found in the area in 2005, and generally lower than levels found in the area since 1999 (except 2003) (Figure 13; Appendix E-2). Copper levels were very similar among sites in 2006, with slightly higher values found in the donor mussels and the lowest at the Hermosa Beach reference site. Wet-weight copper levels at the discharge and at the donor and reference sites were below the EDL 85 value for bay mussels, indicating that in 2006 copper concentrations were below levels considered elevated by the SMWP.

In 2006, nickel was reported in all replicates from the discharge, the donor site and the reference site. Nickel concentrations in mussels from the discharge were about five and one-half times lower than the levels found in the area in 2005. Previous to 2005, nickel occurred in tissues from the area in 2002 and at very high levels in 1991 (Figure 13, Appendix E). In 2005 nickel was detected in mussels from the discharge at levels that were notably higher than occurred at the reference site, while levels at the reference site were similar between years. While nickel at the

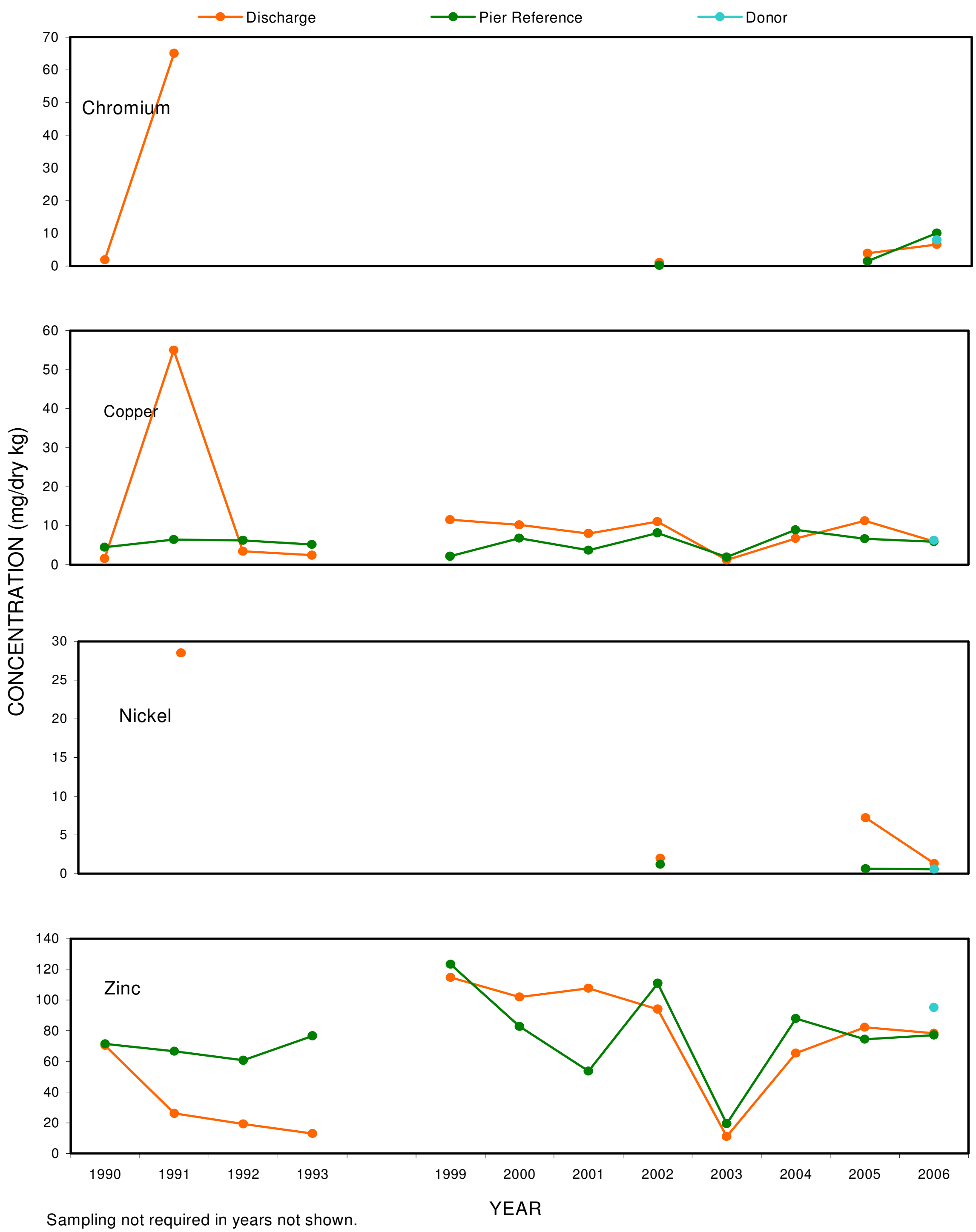


Figure 13. Comparison of mean chromium, copper, nickel, and zinc concentrations in mussel tissue at discharge and at reference sites, 1990 - 2006. Ormond Beach Generating Station NPDES, 2006.

discharge was about twice the mean concentration at either the donor site or at the reference site in 2006, concentrations in mussel tissues collected at all sites were below the EDL 85 values for resident populations of bay mussels, indicating that nickel levels were not found at levels considered elevated by the SMWP.

Zinc was detected in all mussel tissue replicates in 2006. Zinc concentrations from the discharge area were lower than occurred in 2005, and while higher than levels found in 2004 and 2003, still lower than levels found between 1999 and 2002 (Appendix E-2; MBC 1990, 1999-2001a, 2002-2004a, 2005; Ogden 1991-1993). In 2006, zinc levels at the discharge were similar to those found at the reference site and somewhat lower than levels found in the donor mussels (Figure 13). Wet-weight zinc concentrations from the discharge were notably lower than the EDL 85 values for bay mussels, indicating that zinc levels were not elevated near the Ormond Beach discharge. Wet-weight concentrations of zinc at both the donor site and the reference site were also below levels considered elevated.

CONCLUSION

Concentrations of chromium in mussel tissues transplanted into the vicinity of the discharge were elevated in 2006, but were lower than levels in source mussels at the time of the transplant and in mussels collected from a Santa Monica Bay reference site. Chromium levels were also elevated at other sites in southern California in 2006. Other than chromium, metal levels at the discharge in 2006 were lower than occurred in 2005, notably so in the case of nickel. Concentrations of copper, nickel and zinc at the discharge were similar to values found previously in the area and at the donor and reference sites. While elevated chromium was found at all sites in 2006, concentrations of copper, nickel and zinc did not exceed levels considered elevated for bay mussels by the SMWP. Similarity of tissue metal levels among sites, to previous studies, and to other areas in southern California suggests that the operation of the Ormond Beach Generating Station is not elevating metal concentrations above background levels.

BENTHIC INFAUNA

The benthic infauna, invertebrates that live in the bottom sediments, are an important part of the marine ecosystem. These animals are a major food source for fish and other larger invertebrates, and contribute to nutrient recycling. Some species are highly sensitive to effects of human activities, while others thrive under altered conditions. The assessment of the benthic community is, therefore, a major component of many marine monitoring programs, which document both existing conditions and trends over time.

The benthic infaunal community offshore of the Ormond Beach generating station has been sampled as part of the NPDES environmental monitoring program since 1978. Benthic samples were collected in both winter and summer from 1978 to 1988, and only in summer since 1990. Six stations were sampled in all surveys except 1998 (only three stations) and 2003 (four stations, two replicates each instead of four replicates as in all other surveys) (Figure 14). New for 2006 is presentation of the Southern California Benthic Response Index (BRI), which was developed to provide a scientifically valid criterion or threshold that can be used to distinguish "healthy" and "unhealthy" benthic communities (Smith et al. 2003).

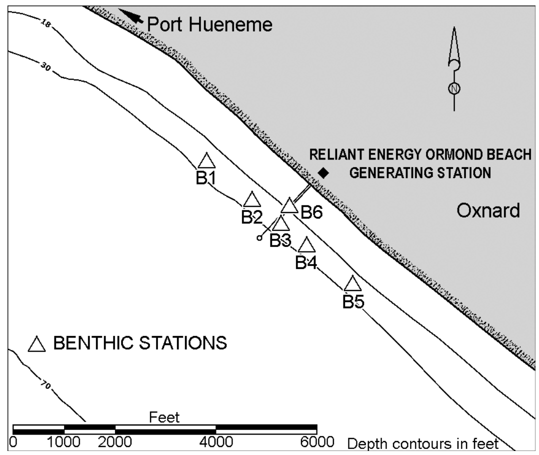


Figure 14. Location of the benthic sampling stations. Ormond Beach Generating Station NPDES, 2006.

MATERIALS AND METHODS

Biologist-divers collected sediment cores for analysis of infauna composition at Stations B1 through B6 on 24 August 2006 between 0732 and 0950 hr. Skies were overcast, winds were calm, and seas were west at 2 to 3 ft. Four replicate cores were collected at each station using a hand-held, diver-operated box corer (Figure 15). The box corer collects a uniform sample of 100.0 cm^2 surface area to a depth of 10.0 cm for a total sample volume of 1.0 liter. The box corer is pushed into the sediments and a closing blade is swung across the mouth of the box. Upon withdrawal from the sediments, the sample is sealed in the box by a neoprene lid for transport to the surface. Samples were washed in the field using a 0.5-mm U.S. Standard Sieve, labeled, and fixed in buffered 10% formalin-seawater.

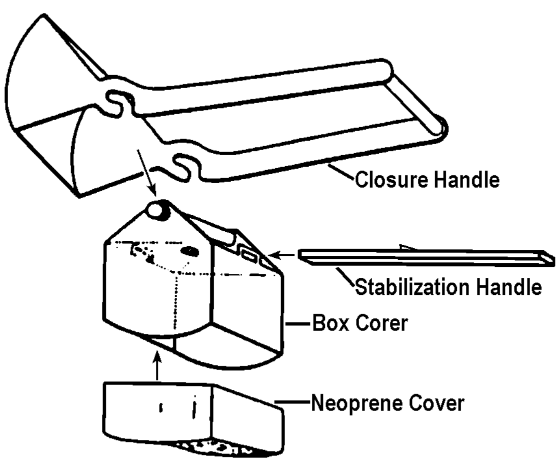


Figure 15. Diver-operated box corer used to collect infaunal samples. Ormond Beach Generating Station NPDES, 2006.

In the laboratory, samples were transferred to 70% isopropyl alcohol, sorted to major taxonomic groups, identified to the lowest practical taxonomic level, and counted. Identifications and nomenclature followed the usage accepted by the Southern California Association of Marine Invertebrate Taxonomists (SCAMIT 2001). Representative specimens were added to MBC's reference collection. Following identification, the weight of organisms for each major taxonomic group in each replicate was obtained. Specimens were placed on small, pre-weighed mesh screens that had been immersed in 70% isopropyl alcohol, blotted on a paper towel, and air-dried for five minutes. Large organisms, if any, were weighed separately. Data are presented by station and replicate in Appendix F.

RESULTS

Species Composition. A total of 1,289 individuals in 107 species (or taxa) and 12 phyla (major groups) were taken in the 2006 benthic infauna sampling offshore of the Ormond Beach generating station (Table 6 and Appendix F-1). Annelids (segmented worms) were the most diverse phylum, with 44 species (41% of the total), followed by arthropods with 32 species (30%), mollusks with 11 species (10%), and nemertean (ribbon) worms with eight species (8%). Each of the remaining eight phyla was represented by less than 4% of the species in the collection. Annelids were also the most abundant phylum, comprising about 46 % of the individuals in the samples. Arthropods were second most abundant, with 33% of the individuals, but nemerteans were third with 9%, while mollusks were fourth in abundance, with about 5% of the individuals. Echinoderms were only slightly less abundant than mollusks. Each of the seven remaining phyla comprised less than 1% of the abundance.

Species Richness. Species richness averaged 47 species per station, and ranged from 34 species at Station B6, inshore of the discharge, to 55 species at Station B1, farthest upcoast (Table 7).

Table 6. Number of infaunal species and individuals by phylum. Ormond Beach Generating Station NPDES, 2006.

	Station							Percent
Parameter	B1	B2	B3	B4	B5	B6	Total	Total
Number of species								
Annelida	24	19	18	20	25	13	44	41.1
Arthropoda	16	19	18	11	10	11	32	29.9
Mollusca	6	2	4	5	6	4	11	10.3
Nemertea	4	4	5	4	6	4	8	7.5
Echinodermata	2	2	3	3	1	2	4	3.7
Cnidaria	1	-	-	-	1	-	2	1.9
Chordata	-	-	1	-	-	-	1	0.9
Kinorhynca	1	-	-	-	-	-	1	0.9
Nematoda	1	1	-	1	1	-	1	0.9
Phorona	-	-	-	-	1	-	1	0.9
Platyhelminthes	-	-	-	1	1	-	1	0.9
Sipunculida	-	-	-	-	1	-	1	0.9
Total	55	47	49	45	53	34	107	
Number of individuals								
Annelida	112	92	80	78	170	63	595	46.2
Arthropoda	34	166	108	58	24	36	426	33.0
Nemertea	9	20	22	14	17	36	118	9.2
Mollusca	14	5	13	9	9	19	69	5.4
Echinodermata	2	11	4	9	3	34	63	4.9
Nematoda	2	3	-	1	2	-	8	0.6
Cnidaria	1	-	-	-	2	-	3	0.2
Platyhelminthes	-	-	-	2	1	-	3	0.2
Chordata	-	-	1	-	-	-	1	0.1
Kinorhynca	1	-	-	-	-	-	1	0.1
Phorona	-	-	-	-	1	-	1	0.1
Sipunculida	-	-	-	-	1	-	1	0.1
Total	175	297	228	171	230	188	1289	

Abundance. Abundance averaged 215 individuals per station (5,373 individuals/m^2) and ranged from 171 individuals at Station B4, immediately downcoast of the discharge, to 297 individuals at Station B2, immediately upcoast of the discharge (Table 7).

Species Diversity. Shannon-Wiener species diversity (H') averaged 3.10 per station and ranged from 2.73 at Station B6, where species richness was lowest, to 3.42 at Station B1, where species richness was highest (Table 7).

Benthic Response Index. The Southern California Benthic Response Index (BRI) is the abundance-weighted average pollution tolerance of species occurring in a sample. The pollution tolerance scores (p_i) for shallow coastal shelf habitat (10 to 30 m) were used in the computations, even though the station inshore of the discharge is shallower than the depth range recommended for application of the index. In addition, the screen mesh size used for sieving the samples from the study area (0.5 mm) was smaller than the mesh size used for the samples from which the BRI was developed. BRI values averaged 17.9 for the study area, and ranged from 9.6 at Station B6 to 23.1 at Station B1 (Table 7).

Table 7. Infaunal community parameters. Ormond Beach Generating Station NPDES, 2006.

	Station							
Parameter	B1	B2	B3	B4	B5	B6	Total	Mean
Number of species								
Total	55	47	49	45	53	34	107	47
Rep. Mean	23	23	24	21	25	17		22
Rep. S.D.	3	6	4	1	3	4		
Number of individuals								
Total	175	297	228	171	230	188	1289	215
Rep. Mean	44	74	57	43	58	47		54
Rep. S.D.	8	26	23	5	6	11		
Density (Number/m^2)								5373
Diversity (H')								
Total	3.42	2.86	3.02	3.30	3.24	2.73	3.54	3.10
Rep. Mean	2.85	2.44	2.68	2.77	2.82	2.43		
Rep. S.D.	0.22	0.53	0.51	0.14	0.14	0.14		
Benthic Response Index (BRI)								
Total	23.1	17.8	15.8	19.6	21.7	9.6	20.2	17.9
Biomass (g)								
Total	1.05	1.11	1.81	1.24	1.33	0.81	7.34	1.22
Rep. Mean	0.26	0.28	0.45	0.31	0.33	0.20		0.31
Rep. S.D.	0.09	0.12	0.33	0.26	0.12	0.12		
g/m^2								31

Biomass. Infauna biomass totaled 7.34 g for the survey and averaged 1.22 g per station (31 g/m^2) (Table 7, Appendix F-4). Values ranged from 0.81 g at Station B6 to 1.81 g at Station B3, at the discharge. Annelids contributed 45% of the biomass due to their abundance, while arthropods contributed only 18% of the biomass, considerably less than their proportion of the abundance. Echinoderms contributed 15% of the biomass, which was much more than their proportion of the abundance.

Community Composition. Twenty-three species each comprised 1% or more of all individuals collected; together they totaled just over 21% of the species but almost 81% of the individuals in the infauna collection (Table 8, Appendix F-2). They included 12 annelids, seven

Table 8. The 23 most abundant infaunal species. Ormond Beach Generating Station NPDES, 2006.

		Station							Percent	Cum.
Phylum	Species	B1	B2	B3	B4	B5	B6	Total	Total	Percent
AR	*Diastylopsis tenuis*	8	102	67	22	10	-	209	16.21	16.21
AN	*Apoprionospio pygmaea*	19	19	15	13	26	28	120	9.31	25.52
AN	*Mediomastus acutus*	30	13	5	19	34	5	106	8.22	33.75
NE	*Carinoma mutabilis*	4	11	6	10	7	31	69	5.35	39.10
EC	*Dendraster excentricus*	1	6	1	7	3	33	51	3.96	43.06
AR	*Rhepoxynius menziesi*	6	3	15	12	3	11	50	3.88	46.94
AN	*Onuphis* sp 1 Pt. Loma 1983	10	8	6	7	16	2	49	3.80	50.74
AN	*Chone* sp SD1 Pt. Loma 1997	2	4	13	3	9	10	41	3.18	53.92
MO	*Tellina modesta*	5	4	10	3	1	16	39	3.03	56.94
AN	*Exogone lourei*	6	1	-	-	30	-	37	2.87	59.81
AN	*Monticellina cryptica*	6	17	-	5	9	-	37	2.87	62.68
AN	*Syllis (Typosyllis) farallonensis*	7	5	-	5	4	7	28	2.17	64.86
AN	*Scoletoma tetraura Cmplx*	2	6	11	3	3	-	25	1.94	66.80
AR	*Zeugophilomedes oblonga*	5	12	1	7	-	-	25	1.94	68.74
NE	Lineidae	-	6	7	2	3	2	20	1.55	70.29
AR	*Gibberosus myersi*	-	7	1	5	1	5	19	1.47	71.76
AR	*Rhepoxynius abronius*	1	1	5	3	1	8	19	1.47	73.24
AN	*Glycera macrobranchia*	3	2	1	4	7	1	18	1.40	74.63
AN	*Scoletoma* sp	1	2	5	3	5	1	17	1.32	75.95
AR	*Cyclaspis* sp C SCAMIT 1986	1	14	-	-	2	-	17	1.32	77.27
AN	*Aricidea (Acmira) catherinae*	5	-	2	2	5	1	15	1.16	78.43
AN	*Goniada littorea*	2	3	5	2	3	-	15	1.16	79.60
AR	*Photis macinerneyi*	-	9	3	2	-	1	15	1.16	80.76

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

arthropods, two nemerteans, and one each of echinoderm and mollusk. The cumacean *Diastylopsis tenuis* was the most abundant species overall, comprising 16% of the individuals, but it was unevenly distributed: it was the top species only at Stations B2, B3, and B4, and it was not present at Station B6. The polychaete annelids *Apoprionospio pygmaea* and *Mediomastus acutus* were second and third most abundant, with 9% and 8%, of the collection, respectively; *M. acutus* was the most abundant species at Stations B1and B5. The nemertean *Carinoma mutabilis* and Pacific sand dollar (*Dendraster excentricus*) were the most abundant species at Station B6, but were only moderately abundant elsewhere. All of the sand dollars were very small (Appendix F-4). Species with uneven distributions besides *Diastylopsis* included the annelid *Exogone lourei*, which occurred primarily at Station B5, and the cumacean *Cyclaspis* sp C, which occurred primarily at Station B2. Otherwise, the top species were similarly abundant among the six stations. These included the amphipod *Rhepoxynius menziesi*, the annelids *Onuphis* sp 1 and *Chone* sp SD1, and the clam *Tellina modesta*.

Cluster Analyses. The 23 most abundant species were used for the normal (site-group) and inverse (species-group) cluster analyses (Figure 16). The six stations did not separate into distinct groups, but demonstrated a gradient of increasing dissimilarity. Stations B1 and B4 clustered most closely, indicating greatest similarity, with Station B5 next in similarity. The communities at these stations contained the same abundant species and were not strongly numerically dominated by a single species. With each successive link, the communities in Group I were increasingly less similar, ending with Station B3 (at the discharge). The community at Station B6 (inshore of the discharge) (Group II) was most dissimilar to those elsewhere, even though it included some of the same dominant species, such as *Apoprionospio pygmaea*.

The most abundant species clustered into four groups, based on their occurrences (Figure 16). The species in Group A were most abundant at Station B2, and those in Group B were most abundant primarily at Station B5. The majority of species in these two groups were absent from at least two stations, most frequently Station B6. Group C included the top species that were generally uniformly distributed among the six stations. These three station groups clustered fairly close together. Group D, which included the three most abundant species, was most dissimilar to the other groups. In this group, *Mediomastus acutus* and *Apoprionospio pygmaea*, which occurred at all of the stations, clustered most closely. *Diastylopsis tenuis*, which was very abundant at Station B2 and B3 and absent from Station B6, clustered somewhat distantly with the other two species.

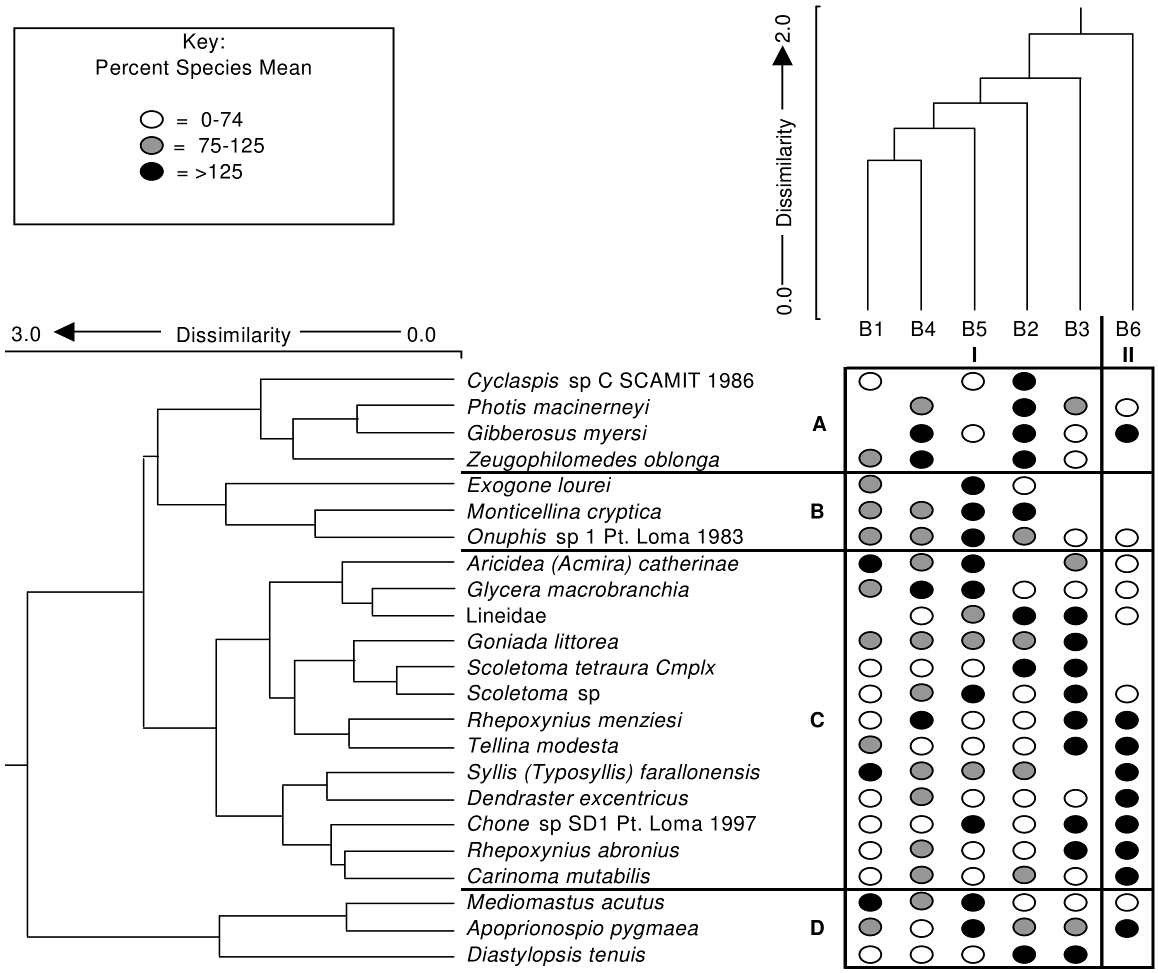


Figure 16. Two-way coincidence table resulting from normal (station) and inverse (species) classification dendrograms for the 23 most abundant infaunal species. Ormond Beach Generating Station NPDES, 2006.

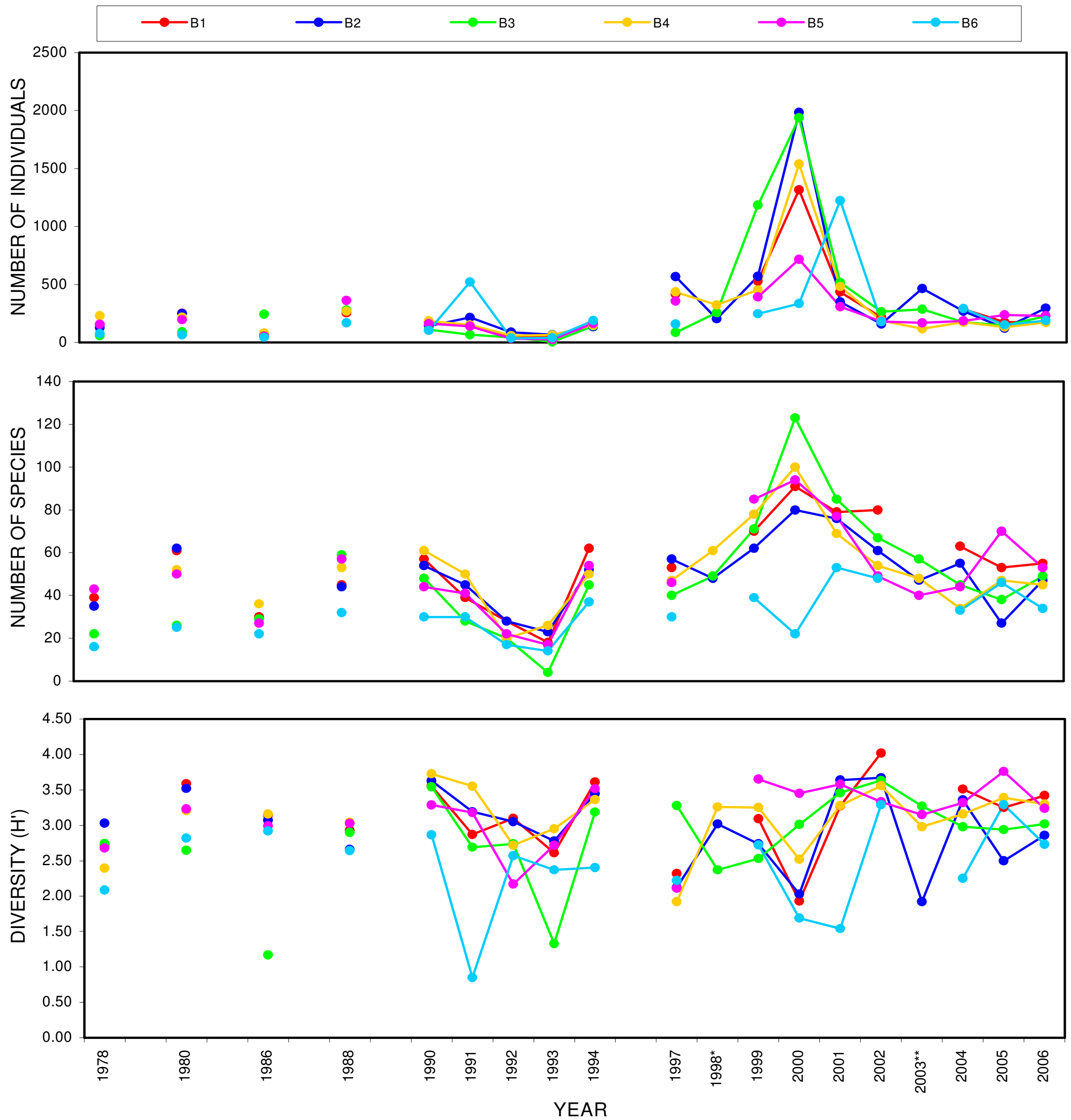
DISCUSSION

The infauna communities in the study area in 2006 were composed predominantly of annelid worms, arthropods, nemertean worms, small Pacific sand dollars, and clams. Communities were similar among the five stations on the same isobath as the generating station discharge. They were dominated primarily by *Diastylopsis tenuis*, *Apoprionospio pygmaea*, and *Mediomastus acutus*. The communities farthest upcoast and immediately downcoast of the discharge were most alike, with low abundances, high species diversities, and similar suites of species. Infaunal parameter values for the community at the discharge were near the means for the study area, but relative abundances of some of the dominant species were slightly different from those at the stations upcoast and downcoast. The community at the station inshore of the discharge was least similar to those elsewhere, with low species richness and diversity, and a somewhat different group of dominant species. Pacific sand dollar, *Carinoma mutabilis*, and *A. pygmaea* were most abundant there, and a few of the species abundant elsewhere were absent or scarce at that location. All of the abundant species found in the study area are typical of sandy habitats on the shallow coastal shelf. The Benthic Response Index values for all of the stations were low, within the range of 0 to 25 (Reference category), indicating that the communities were undisturbed, or healthy.

Composition of the infauna community reflects the substrate in which it lives (Gray 1974). Particle size and sorting affect sediment stability and cohesiveness, influencing the ability of infaunal animals to burrow. The coastline at the Ormond Beach generating station is exposed to swell from both the south and west, and the nearshore subtidal sediments are strongly affected by both storms and normal wave activity. Sediments are relatively coarse, due to the winnowing effect of moving water, and there is little organic matter. Generally, nearshore sand faunas tend to be impoverished when compared to siltier offshore sands (Barnard 1963). This pattern was not obvious in the study area, as abundance was higher and species richness was about average where sediments were coarsest. However, species richness was higher where sediments were finer. Species occupying the nearshore habitat are adapted to the relatively coarse sediments and to nearly constant disruption of the substrate (Oliver et al. 1980). Although small, these organisms are capable of reburying themselves quickly after the upper layers of sediment in which they live are disturbed by a passing wave or swell, or they tend to burrow deeper into the sediment and are therefore less affected by disturbance. Many of these species' life history strategies, including frequent and abundant production of young, also allow them to rapidly repopulate a habitat severely disrupted during winter storms. When conditions are calm, the environment is more stable and finer sediments accumulate, in which deposit-feeding species, such as annelids, can live in permanent tubes (Barnard 1963, Oliver et al. 1980).

The efficient burrowers occurring in the infauna communities in 2006 include the nemertean *Carinoma mutabilis*, the amphipods *Rhepoxynius menziesi and R. abronius*, and the ostracod *Zeugophilomedes oblonga*. The abundance of strong swimmers such as the cumaceans *Diastylopsis tenuis* and *Cyclaspis* sp C, and the amphipod *Gibberosus myersi* also indicates the influence of water movement in the nearshore environment. The species in this group were generally found throughout the study area, but the majority were most abundant just upcoast of the discharge where sediments were coarsest, and were least abundant where sediments were finer, farthest upcoast and farthest downcoast. Annelids, many of which live in tubes, were more abundant where sediments were finer, suggesting greater stability of the substrate.

The infauna communities in 2006 were similar to those found in previous summer surveys conducted in the study area since 1978 (MBC 1979, 1981, 1986, 1988, 1990, 1994, 1997-2001a, 2002-2004a, 2005; Ogden 1991-1993). Abundances everywhere except farthest downcoast were greater than in 2005, with a mean density for the area of 5,373 individuals/m^2, about 34% greater than in the previous year (although biomass was only slightly greater than in 2005). However, abundance was still considerably below the long-term mean of over 9,000 individuals/m^2. Abundance was particularly high in 1997 due to the extreme number of nematodes at the discharge, and in 2000, when the annelid *Owenia collaris* was very abundant everywhere except inshore of the discharge (Figure 17). (As a resource exchange with RWQCB's Bight-wide programs, not all stations were sampled in 1998 and 2003, and only two replicates were collected per station in 2003; in addition, the enormous number of nematodes found in 1997 were excluded from the values shown in Figure 17). A total of 107 species was collected in 2006, compared with 133 species in 2005. However, mean species richness was the same in both years (47 species per station), very similar to the long-term mean. As with abundance, species richness was particularly high in 2000 everywhere except inshore of the discharge. Mean species diversity in 2006 was slightly below that for 2005, but was above the long-term mean.



No sampling required in years not shown; * 1998 - only three stations required; * 2003 - only four stations required.

Figure 17. Comparison of infaunal community parameters 1978 - 2006, summer surveys. Ormond Beach Generating Station NPDES, 2006.

Since 1978, abundance has been greater, on average, immediately upcoast of the discharge (Station B2) than at the other stations and species richness has been greater immediately downcoast of the discharge (Station B4) (Figure 17; MBC 1979, 1981, 1986, 1988, 1990, 1994, 1997-2001a, 2002-2004a, 2005; Ogden 1991-1993). Highest mean species diversity has been for the community farthest downcoast (Station B5), due to relatively high species richness and low mean abundance (lowest for the study area). Overall, however, values have been relatively similar among stations along the discharge isobath. Relatively low abundance, and lowest species richness and diversity have generally been found inshore of the discharge. These results are consistent with the long-term sediment grain size data (Appendix C-3).

Composition of the infaunal community in the study area in 2006 was similar to those in prior surveys (MBC 1979, 1981, 1986, 1988, 1990, 1994, 1997-2001a, 2002-2004a, 2005; Ogden 1991-1993). The top five species in 2006 were among the 12 most abundant species occurring in the study area since 1978, and 11 of the abundant species in 2006 were among the 19 long-term community dominants (Appendix F-5). Most consistent have been *Apoprionospio pygmaea*, *Mediomastus acutus*, and another annelid, *Spiophanes bombyx*, *Diastylopsis tenuis*, Pacific sand dollar, *Rhepoxynius menziesi*, the clam *Tellina modesta*, and *Carinoma mutabilis*. Conversely, a few species have been quite variable in abundance from survey to survey. In addition to nematodes and *Owenia collaris*, mentioned above, the annelids *Pectinaria californiensis* and *Armandia brevis*, the clam *Siliqua lucida*, and the amphipods *Aoroides inermis*, *Photis brevipes*, *Jassa slatteryi*, *Ericthonius brasiliensis*, and *Caprella verrucosa*, the isopod *Uromunna ubiquita*, the ostracod *Euphilomedes longiseta*, and the southern moonsnail hermit crab, *Isocheles pilosus* have occurred only sporadically but occasionally have been very abundant. Only four of these species were present in 2006, and they were not abundant. Overall, however, the majority of the infauna species seen in 2006 comprise a core group that has persisted in the study area, resembling the dominant communities found in similar shallow-water habitats throughout the Southern California Bight (Barnard 1963, Dexter 1978, Oliver et al. 1980).

CONCLUSION

Abundance, diversity, and composition of the infauna communities in 2006 were influenced somewhat by sediment characteristics, as species richness and diversity were greater where sediments were finer, indicating a more stable environment. However, abundance was highest where sediments were coarsest, immediately upcoast of the generating station discharge. Overall, values for infaunal parameters were similar among the communities along the discharge isobath. The community at the station inshore of the discharge was least similar to those elsewhere, with low species richness and diversity, and a somewhat different group of dominant species. The Benthic Response Index values suggested that all of the communities were undisturbed, or healthy. The communities were similar to those found in the study area since 1978, and were typical of the shallow, nearshore environment. No adverse effects of the generating station discharge were apparent.

IMPINGEMENT

Ormond Beach Generating Station is located approximately 3.7 km southeast of the entrance to Port Hueneme in Ventura County, California. Seawater is supplied to the once through cooling system (OTC) through a submerged, velocity-capped intake structure. The intake structure is located 640 m offshore at a depth of -10 m Mean Low Lower Water (MLLW). The intake point is 2 m above the bottom. Seawater drawn into the cooling system and screened for debris, first by bar racks that remove large debris followed by mesh traveling screens that remove the remaining material. Impinged material caught on the screens, including fish and macroinvertebrates, is washed off the screens into collection baskets.

Fish impingement was monitored by Proteus Sea Farms International, Inc., Ojai, California during normal operation of the cooling water system. Normal operation refers to the daily operational mode of the cooling water system. This report summarizes these observations and subsequent analysis over the monitoring period to determine the interaction between the operation of the cooling water system and the general health and stability of the source water community.

MATERIALS AND METHODS

At Ormond Beach Generating Station, Proteus Sea Farms International, Inc. conducted all fish impingement monitoring and subsequent data entry. Data was later transmitted to MBC Applied Environmental Sciences for analysis. No heat treatments were monitored during the 2006 monitoring year (1 October 2005 to 30 September 2006). In order to assess the impingement of marine organisms at the generating station during normal operation, 24-hr surveys were conducted. A single 24-hr impingement survey was conducted in October and November 2005. From 1 March 2006 through 30 September 2006, each 24-hr survey was subdivided into shorter 6-hr (approximately) survey periods. The subdivision was incorporated to support a larger ongoing investigation of the cooling water system. During such surveys, the traveling screens and collection baskets were cleared of all accumulated debris at the beginning of the 24-hr period. Accumulated material was sorted to remove fish and macroinvertebrates and all organisms were identified to the lowest practical taxonomic level. Up to 50 individuals of each fish species were measured to the nearest millimeter (mm) standard length (SL) or other appropriate length (disc width [DW] or total length [TL]), aggregate biomass (gram [g]) recorded for measured and any additional unmeasured individuals. Length frequency distributions for those fishes examined were derived by rounding the recorded length to the nearest ten millimeters (1 to 4 = 0, 5 to 9 = 10). Abundance per size class was plotted using MS Excel 2000. Total abundance for fish species with greater than 50 individuals was estimated by dividing the total weight of the unmeasured individuals by the mean individual weight of the measured samples from within each species. Macroinvertebrates were also sorted, counted and an aggregate weight taken.

Due to variation in daily operating patterns, normal operation survey fish and macroinvertebrate data were standardized to circulated water flow rates to determine the rate of impingement by the following equation: Impingement Rate = Number (or weight) Impinged /Circulated Water Volume for Sampling Period in Million Gallons (MG), with the volume of water circulated determined based on the water flow rate during the period surveyed. For each month, the mean monthly impingement rate was multiplied by the total monthly cooling water flow to derive an estimated monthly impinged abundance and biomass (kilogram [kg]) The estimated annual impinged abundance represents the summation of each estimated monthly abundance. No surveys occurred between December 2005 through February 2006 due to infrequent operation of the circulating water pumps. Estimated data for these months was derived by multiplying the mean impingement rate of November 2005 and March 2006, to represent the most seasonally relevant conditions available, by the sporadic cooling water flow volumes during the period of infrequent operations.

RESULTS

Normal operation surveys at the Ormond Beach Generating Station were conducted over 31 operational days throughout the 2006 monitoring year. No heat treatments were conducted during this period. Complete survey data is available in Appendix G of this report.

Fish

All impinged abundance and biomass was attributed to normal operation of the cooling water system in the absence of heat treatments. During the normal operation surveys, 288 individual fish of 41 species were collected weighing 38.32 kg (Table 9). Based on these observations, and associated impingement rates, an estimated total of 4,910 individuals weighing 702 kg were impinged during the survey year.

Table 9. Estimated normal operation impinged abundance and biomass (kg) by fish species. Ormond Beach Generating Station NPDES, 2006.

	Observed		Estimated		% Total	
Species	Abu.	Biom. (kg)	Abu.	Biom. (kg)	Abu.	Biom. (kg)
speckled sanddab	49	0.390	921	7.506	18.8	1.1
shiner perch	50	0.414	725	7.251	14.8	1.0
northern anchovy	22	0.322	578	9.118	11.8	1.3
bay pipefish	23	0.059	301	0.737	6.1	0.1
plainfin midshipman	13	0.606	257	12.071	5.2	1.7
topsmelt	14	0.344	228	6.158	4.6	0.9
white seaperch	25	2.154	204	17.858	4.2	2.5
queenfish	10	0.237	202	5.643	4.1	0.8
California tonguefish	7	0.199	140	4.081	2.9	0.6
thornback	7	2.168	127	40.207	2.6	5.7
Pacific pompano	8	0.496	124	9.117	2.5	1.3
bat ray	5	3.429	103	68.188	2.1	9.7
hornyhead turbot	6	0.538	101	9.151	2.1	1.3
Pacific staghorn sculpin	5	0.245	98	4.802	2.0	0.7
specklefin midshipman	3	0.157	88	6.354	1.8	0.9
walleye surfperch	4	0.171	80	3.467	1.6	0.5
shovelnose guitarfish	3	11.138	45	201.737	0.9	28.7
Pacific chub mackerel	2	0.151	45	3.396	0.9	0.5
vermillion rockfish	3	1.264	45	19.442	0.9	2.8
basketweave cuskeel	2	0.107	42	2.271	0.9	0.3
English sole	2	0.383	40	8.098	0.8	1.2
yellow snake eel	2	0.378	39	7.164	0.8	1.0
Pacific electric ray	2	10.709	39	208.408	0.8	29.7
California lizardfish	2	0.498	37	8.865	0.8	1.3
Pacific sardine	2	0.052	28	0.857	0.6	0.1
rainbow seaperch	1	0.013	24	0.310	0.5	0.0
C-O sole	1	0.108	23	2.452	0.5	0.3
spiny dogfish	1	0.699	22	15.384	0.4	2.2
kelp greenling	1	0.023	21	0.488	0.4	0.1
curlfin sole	1	0.097	21	2.059	0.4	0.3
brown rockfish	1	0.119	21	2.526	0.4	0.4
silver surfperch	1	0.005	19	0.093	0.4	0.0
senorita	1	0.036	19	0.681	0.4	0.1
blacktip poacher	1	0.002	19	0.038	0.4	0.0
sharpnose surfperch	1	0.033	19	0.623	0.4	0.1
painted greenling	1	0.069	19	1.302	0.4	0.2
California skate	1	0.128	18	2.261	0.4	0.3
cabezon	1	0.023	16	0.376	0.3	0.1
California halibut	2	0.156	10	1.426	0.2	0.2
diamond turbot	1	0.046	1	0.054	0.0	0.0
bocaccio	1	0.155	1	0.183	0.0	0.0
Total	288	38.321	4,910	702.203		
Number of Species	41		41			

Speckled sanddab (*Citharichthys stigmaeus*) was the most abundant species impinged with an estimated 921 individuals, followed by shiner perch (*Cymatogaster aggregata*) with 725 individuals (Table 9). Six additional species had estimated abundances greater than 200 individuals: northern anchovy (*Engraulis mordax*) with 578 individuals, bay pipefish (*Syngnathus leptorhynchus*) with 301 individuals, plainfin midshipman (*Porichthys notatus*) with 257 individuals, topsmelt (*Atherinops affinis*) with 228 individuals, white seaperch (*Phanerodon furcatus*) with 204 individuals, and queenfish (*Seriphus politus*) with 202 individuals. The estimated abundances for the remaining 33 species were 150 individuals or less, each.

Pacific electric ray (*Torpedo californica*) contributed the most to impinged biomass with an estimated 208 kg, followed by shovelnose guitarfish (*Rhinobatos productus*) with 202 kg (Table 9). Estimated impinged biomass for five additional species exceeded 15 kg, including: bat ray (*Myliobatis californica*; 68 kg), thornback (*Platyrhinoidis triseriata*; 40 kg), vermillion rockfish (*Sebastes miniatus*; 19 kg), white seaperch (17 kg), and spiny dogfish (*Squalas acanthias*;15 kg). Estimated impinged biomass for the remaining 34 species was less than 15 kg each.

Length Frequency Analysis

Length frequency analysis was conducted on the two most abundant species, speckled sanddab and shiner perch. Collections of speckled sanddab exhibited a unimodal distribution with a peak at 70 mm SL (Figure 18). Standard lengths of measured shiner perch indicated a unimodal distribution, with a peak at 60 mm SL (Figure 19).

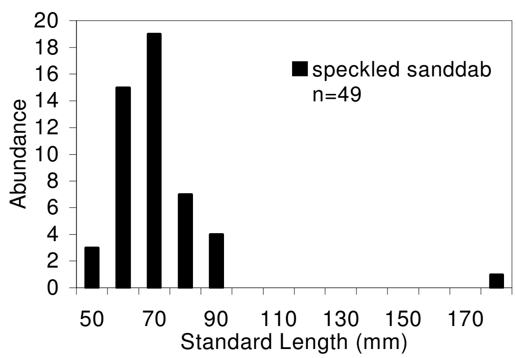


Figure 18. Length-frequency distribution of speckled sanddab (*Citharichthys stigmaeus*) taken during impingement surveys. Ormond Beach Generating Station NPDES, 2006.

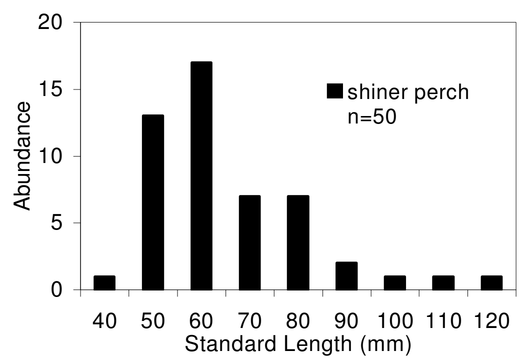


Figure 19. Length-frequency distribution of shiner perch (*Cymatogaster aggregata*) taken during impingement surveys. Ormond Beach Generating Station NPDES, 2006.

Macroinvertebrates

In 2006, a total of 1,345 individuals of 28 macroinvertebrate species weighing 36.09 kg were observed during impingement sampling at Ormond Beach Generating Station (Table 10). Based on these observations, and the associated impingement rate, an estimated 27,746 individuals weighing 711 kg were impinged over the year.

Red rock shrimp (*Lysmata californica*) was the most frequently impinged species with an estimated 7,265 individuals (Table 10). Red rock crab (*Cancer productus*) was the second most abundant species, with an estimated 4,364 individuals impinged. Five additional species each contributed greater than an estimated 1,000 individuals, including: common salp (*Thetys vagina*) with 3,621 individuals, Pacific rock crab (*Cancer antennarius*) with 3,566 individuals, graceful crab (*Cancer gracilis*) with 2,258 individuals, yellowleg shrimp (*Farfantepenaeus californiensis*) with 2,220

Table 10. Number of individuals and biomass (kg) of macroinvertebrate species impinged during heat treatment and estimated normal operation surveys. Ormond Beach Generating Station NPDES, 2006.

	Observed		Estimated		% Total	
Species	Abu.	Biom. (kg)	Abu.	Biom. (kg)	Abu.	Biom. (kg)
red rock shrimp	7	1.371	7,265	28.334	26.2	4.0
red rock crab	123	2.165	4,364	43.606	15.7	6.1
common salp	1	2.725	3,621	58.652	13.1	8.3
Pacific rock crab	180	14.975	3,566	340.290	12.9	47.9
graceful crab	170	4.197	2,258	74.872	8.1	10.5
yellowleg shrimp	28	0.545	2,220	9.933	8.0	1.4
yellow crab	149	3.360	1,591	53.740	5.7	7.6
giant green anemone	352	0.153	691	9.609	2.5	1.4
California market squid	3	0.871	445	13.829	1.6	1.9
blackspotted bay shrimp	11	0.245	348	1.238	1.3	0.2
striped shore crab	6	0.062	221	5.921	0.8	0.8
northern kelp crab	1	0.020	205	2.049	0.7	0.3
tuberculate pear crab	2	0.018	171	0.450	0.6	0.1
Xantus swimming crab	4	0.112	127	1.155	0.5	0.2
California two-spot octopus	10	0.699	118	13.515	0.4	1.9
hairy rock crab	120	0.176	112	2.284	0.4	0.3
sheep crab	2	0.970	100	21.253	0.4	3.0
Monterey jelly	3	0.072	64	1.164	0.2	0.2
intertidal coastal shrimp	1	0.005	62	0.106	0.2	0.0
redbanded clear shrimp	65	0.006	44	0.130	0.2	0.0
purple sea urchin	2	0.006	42	0.065	0.2	0.0
dwarf teardrop crab	4	0.001	28	0.028	0.1	0.0
giant-spined sea star	4	0.145	20	2.828	0.1	0.4
warty sea cucumber	8	0.208	19	1.975	0.1	0.3
red jellyfish	2	1.783	19	16.596	0.1	2.3
thin-shell littleneck	1	0.009	10	0.090	0.0	0.0
globose kelp crab	1	0.064	10	0.647	0.0	0.1
purple-striped jellyfish	85	1.125	5	6.232	0.0	0.9
Total	1,345	36.088	27,746	710.591		
Number of Taxa	28		28			

individuals, and yellow crab (*Cancer anthonyi*) with 1,591 individuals. Estimated abundances for each of the remaining 21 species was 1,000 individuals, or less.

Pacific rock crab contributed the most to estimated impinged biomass with 340 kg (Table 10). Graceful crab contributed the second highest biomass with an estimated 75 kg impinged. An additional five species contributed more than 20 kg to the estimated impinged biomass: common salp (59 kg), yellow crab (54 kg), red rock crab (44 kg), red rock shrimp (28 kg), and sheep crab (*Loxorhynchus grandis*; 21 kg). The remaining 21 species each accounted for less than 20 kg.

DISCUSSION

Fish species composition in 2006 was generally similar to results found previously in the area, and other shallow nearshore areas throughout the Southern California Bight (Allen 1985). A recurring group of fish species have been observed in impingement sampling since 1990 with six of the ten most abundant species in 2006 among the ten most abundant species long-term (Table 11). Total estimated impingement abundance in 2006 was lower than numbers found in 2005, primarily due to reductions in abundances of species very abundant in 2005, such as queenfish and shiner perch. The reduction in impingement abundances were likely a result of reduced operations during the monitoring year. In 2006, the volume of cooling water circulated (44,114 mg) was approximately one-half of that circulated in 2005 (88,503 mg) (MBC 2005).

Table 11. The 10 most abundant fish species impinged during heat treatment and normal operation surveys, 1990 - 2006. Ormond Beach Generating Station NPDES, 2006.

	Year																		%
Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	Total
queenfish	7,460	43,501	16,697	82,521	16,382	24,008	4,218	4,725	6,632	161	361	3,057	11,089	2,684	375	882	202	224,956	59.6
Pacific sardine	322	86	110	1,643	362	1,056	197	2,921	21,434	24	89	295	483	107	632	156	28	29,944	7.9
shiner perch	278	270	997	1,333	1,023	8,830	503	2,423	891	8	366	542	532	1,397	1,113	2,716	725	23,947	6.3
northern anchovy	301	365	891	631	2,022	1,600	2,169	4,329	73	177	564	1,144	2,095	4,076	1,395	426	578	22,837	6.0
walleye surfperch	1,506	1,521	3,942	550	126	616	10	1,353	431	-	2	611	432	266	11	143	80	11,599	3.1
white seaperch	1,606	987	1,054	1,019	1,169	2,454	395	926	158	-	35	36	75	86	55	229	204	10,489	2.8
plainfin midshipman	1,844	1,484	999	490	336	432	11	-	-	46	58	1	172	2	-	-	257	6,131	1.6
Pacific pompano	1	157	72	738	22	16	4	1	1	-	5	3,350	186	280	8	30	124	4,995	1.3
white croaker	14	707	149	2,506	58	679	50	4	433	-	-	101	65	5	-	-	-	4,771	1.3
speckled sanddab	-	390	230	504	60	240	-	-	-	-	461	1,330	102	454	40	19	921	4,751	1.3
Survey totals																			
Total individuals	14,680	51,860	28,796	94,602	23,403	41,996	8,664	19,266	31,545	761	3,078	15,382	16,209	11,132	4,987	6,216	4,910	377,487	
Total species	54	65	54	60	59	48	41	38	47	28	42	49	54	53	43	47	41	120	

Speckled sanddab with an estimated 921 individuals was the most abundant species impinged in 2006, the highest taken since 2001 and the second highest total reported for the species since 1990 (Table 11). A non-schooling species, speckled sanddab is found commonly associated with soft-bottom habitats throughout the shallow nearshore environment of southern California (Allen 1982, Allen 1985). They feed mainly during the day, and hunt primarily by sight on epifaunal invertebrates (Ford 1965, Allen 1982). Because of their small size, they are not an important part of the commercial catch, although they are present in some of the landings, and are frequently sought by recreational anglers (Allen and Leos 2001). Speckled sanddab is a non-schooling species that has exhibited variable abundances in impingement sampling since 1990 (Table 11).

Speckled sanddab spawning takes place from July through September, with a peak in August (Allen and Leos 2001). Speckled sanddab larvae are pelagic, and can be found near the surface, and out to many miles offshore. Attempts to age individuals are difficult, but at 120 mm SL they may be about two years old, maturing at one year old, with a life span of approximately four years (Fitch and Lavenberg 1975). With a peak abundance in measured fish at 70 mm SL most individuals collected in 2006 were approximately one year old.

Shiner perch was the second most abundant species in 2006 and is the third highest in overall abundance since 1990 (Table 11). Impingement in 2006 of shiner perch was approximately one-half that of the long-term mean of 1,409 individuals per year since 1990 (Appendix G-11). Shiner perch have been somewhat variable in the area since 1990, but have consistently been among the most abundant fish impinged since 2000 (Table 11). Shiner perch are abundant in southern California, and range from San Quintin, Baja California to Alaska in depths from the surface to 480 ft (Miller and Lea 1972, Love et al. 2005). Allen (1985) observed shiner perch distribution to encompass all soft substrates throughout its range, with notably low abundances in the vicinity of kelp bed and rocky reef habitats. There is no targeted commercial fishery for shiner perch due to their small size, although they do occur as incidental catches in many of the soft-bottom fisheries, such as California halibut (*Paralichthys californicus*) trawl fishery. Shiner perch are a common incidental catch in the California recreational fishery (Fritzsche and Collier 2001). Shiner perch abundances declined in some impingement and trawl catches in southern California after the 1970s (MBC 2001a, Stull and Tang 1996). This decline could be related to oceanic temperature regimes as there was a measurable shift from a cool water to a warmer water regime offshore of California in the 1980s and 1990s (MBC 2001b). In southern California, zooplankton (a food source for shiner perch [Allen 1982]) decreased in biomass by about 80% between 1951 and 1993, with most of the decline occurring after the 1970s (Roemmich and McGowan 1995).

Odenweller (1975) observed shiner perch in the Age-I class to average 56.8 mm SL, while Age-III class individuals averaged 100.6 mm SL in samples collected from Anaheim Bay, California.

These values suggest individuals impinged at Ormond Beach Generating Station during the 2006 survey year were predominantly near one year old. Shiner perch are primarily planktivores, especially during the summer and fall months (Odenweller 1975) when they are most abundant in impingement samples, possibly feeding on plankton that has been entrained and passed through the once through cooling water system at the generating station. Shiner perch populations were also examined in 1997, 1998, 2001, 2002, 2004, and 2005; all those years showed unimodal populations, with peaks at 60 mm, 70 mm, 80 mm (2001 and 2002), and 90-100 mm SL, respectively (MBC 1990, 1994, 1997-2001a, 2002-2004a, 2005a).

The pattern of fish impingement biomass losses during normal operation since 2000 has shown a steadily increasing trend, punctuated by two years (2001 and 2004) of inordinately high normal operation biomass (Table 12). Overall, however, impinged biomass has declined since 1987. Prior to 1988, Ormond Beach Generating Station was a base load station, running all circulating pumps between six and ten months per year (SCE unpubl. flow data). Between 1988 and 2000, the generating station operated between 8% and 36% of its rated capacity, running circulator pumps at full capacity only one to three months of the year. Since 1988, annual biomass of impinged fish has been about one-tenth of the mean for the nine years prior to 1988, ranging since between about 300 and 2,700 kg per year. Biomass in 2006 was strongly influenced by relatively high numbers of larger individual species, such as Pacific electric ray, shovelnose guitarfish, bat ray, and thornback impinged during normal operation monitoring. In addition to operational flow differences among years, other potential influences that may determine the impingement losses each year include: variation in fish abundances, oceanographic conditions, the random impingement of large numbers of schooling species and foraging behavior of common offshore species in the vicinity of the intake.

Table 12. Fish biomass (kg) collected during heat treatment and estimated normal operation surveys, 1979-2006. Ormond Beach Generating Station NPDES, 2006.

Year	Normal Operation	Heat Treatment	Total
1979	36,741.7	2,375.6	39,117.3
1980	20,437.2	655.9	21,093.1
1981	13,890.5	2,074.5	15,965.0
1982	5,860.0	2,221.8	8,081.8
1983	16,388.1	571.0	16,959.1
1984	6,333.4	374.6	6,708.0
1985	4,018.4	433.2	4,451.6
1986	6,037.9	1,629.0	7,666.9
1987	10,606.6	769.1	11,375.7
1988	1,108.0	793.0	1,901.0
1989	1,163.4	763.8	1,927.2
1990	1,026.7	322.4	1,349.1
1991	1,166.4	1,543.5	2,709.9
1992	346.7	1,312.4	1,659.1
1993	949.7	1,731.1	2,680.9
1994	457.5	646.2	1,103.7
1995	548.8	931.6	1,480.4
1996	395.7	324.9	720.6
1997	561.3	543.7	1,105.0
1998	226.2	715.0	941.2
1999	328.1	33.7	361.8
2000	170.1	141.4	311.5
2001	2,456.4	231.6	2,688.0
2002	255.4	192.3	447.7
2003	536.1	235.2	771.3
2004	1,052.2	110.0	1,162.2
2005	537.6	157.5	695.2
2006	702.2	0.0	702.2
Summary			
Total	134,302.4	21,834.1	156,136.5
Mean	4,948.2	808.7	5,756.8

As with the fish population, impingement monitoring suggests that a core group of recurring and abundant macroinvertebrate species continues in the area. Many of the macroinvertebrate species impinged at the station were crabs and shrimps that live in and on the pipes of the intake cooling structure. Strong current flows into the generating station intakes bring larvae that, once entrained, settle and grow in essentially ideal conditions. These fouling communities are typically composed primarily of mollusc and arthropod species and are common in coastal cooling water systems in southern California (Graham et al. 1977, IRC 1981). With an ample food supply, these individuals survive within the cooling water system until are removed during a heat treatment. Abundance attributed to normal operation was similar between 2005 and 2006, suggesting that it is unlikely that the generating station has had any appreciable effect on the nearshore macroinvertebrate population.

Contrary to recent years, when one of the rock crab species is the most frequently impinged macroinvertebrate species, red rock shrimp was the most abundant species impinged in 2006. Red rock shrimp is frequently encountered during impingement monitoring throughout the Southern California Bight in 2006 (MBC 2006 unpublished data). Red rock shrimp ranges from Tomales Bay, California to the Galapagos but is more common south of Point Conception, California, in depths ranging from the low intertidal zone to 60 m (Jensen 1995). Commonly known as a cleaning shrimp, red rock shrimp has been commonly observed cleaning picking parasites off the bodies of other animals, most often fishes (Morris et al. 1980).

Estimated normal operation macroinvertebrate impingement in 2006 was consistent with 2005, with 27,746 and 26,937 respectively (MBC 2005). The five most abundant species in 2006, red rock shrimp, red rock crab, common salp, Pacific rock crab and graceful crab are also the five most abundant species taken in impingement sampling long term (Appendix G-12) and are common throughout the Southern California Bight. The continued presence of these core species in the study area demonstrates the stability of the community and suggests that the nearshore macrofaunal marine communities in the vicinity of the intake are not stressed by the loss due to impingement.

CONCLUSION

Fish and macroinvertebrates species collected during impingement surveys at the Ormond Beach Generating Station in 2006 were similar to those of the last 16 years, indicating a healthy, stable community in the nearshore area. Fluctuations in fish and macroinvertebrate abundance and biomass appear to be due in part to natural population variation, although recent declines in impingement abundances are probably related to reductions in intake flow. There was no indication that the operation of the generating station adversely affected the core species populations.

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APPENDIX A

Receiving water monitoring specifications

Reliant Energy Incorporated
Ormond Generating Station
Monitoring and Reporting Program No. C1-5619

CA0001198
Order No. 01-092

V. RECEIVING WATER MONITORING

A. Receiving Water

1. Pursuant to the Code of Federal Regulations [40 CFR § 122.41(j) and §122.48(b)], the monitoring program for a discharger receiving a NPDES permit must determine compliance with NPDES permit 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., nonpoint source runoff, aerial fallout) nor to evaluate the current status of important ecological resources on a regional basis.

B. Regional Database

1. 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.

2. Two pilot regional monitoring programs were conducted; one during the summer of 1994 and another in 1998. The purpose of the pilot programs were to test an alternative sampling design that combines elements of compliance monitoring with a broader regional assessment approach. The pilot program was designed by USEPA, the State Board, and three regional Boards (Los Angeles, Santa Ana, and San Diego) in conjunction with the Southern California Coastal Water Research Project and participating discharger agencies.

   The pilot regional monitoring programs included the following components: microbiology; water quality; sediment chemistry; sediment toxicity testing; benthic infauna; demersal fish; and bioaccumulation.

3. The two pilot regional monitoring programs were funded primarily by resource exchanges with the participating discharger agencies. During the year when the pilot regional monitoring was scheduled, USEPA and this Regional Board eliminated portions of the routine compliance monitoring programs for that year, while retaining certain critical compliance monitoring elements. A certain percentage of the traditional sampling sites were also retained to maintain continuity of the historical record and to allow comparison of different sampling designs. The exchanged resources were redirected to complete sampling within the regional monitoring program design. Thus, the Discharger's overall level of effort for the 1994 and 1998 pilot programs remained approximately the same as the compliance monitoring programs.

4. Given the apparent benefits realized by the first two regional monitoring programs, it is probable that similar comprehensive sampling efforts will be repeated for the California Bight at periodic intervals (perhaps every four or five years). At the present time, it appears likely that the next regional monitoring program will be attempted during the summer of 2002 - 2003.

5. We anticipate that future regional monitoring programs will be funded in a similar manner. Revisions to the routine compliance monitoring program will be made under the direction of the USEPA and this Regional Board as necessary to accomplish this goal; and may include resource exchanges in the number of parameters to be monitored, the frequency of monitoring, or the number, type, and location of samples collected.

6. The compliance monitoring programs for the Mandalay Generating Station, and other major ocean dischargers will serve as the framework for the regional monitoring program. However, substantial changes to these programs may be required to fulfill the goals of regional monitoring, while retaining the compliance monitoring component required to evaluate the potential impacts from NPDES discharges. Revisions to the existing program will be made under the direction of the USEPA and this 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.

C. Receiving Water Monitoring

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

Location of Sampling Stations (see Attached Figure 1):

1. Receiving water stations in the surf zone shall be located as follows:

   a. Station RW1 – 3000 feet upcoast of the discharge terminus, at a depth of 30 feet.

   b. Station RW2 - 1000 feet upcoast of the discharge terminus, at a depth of 30 feet.

   c. Station RW3 - At the point of discharge.

   d. Station RW4 - 1000 feet downcoast of the discharge terminus, at a depth of 30 feet.

   e. Station RW5 - 3000 feet downcoast of the discharge terminus, at a depth of 30 feet.

   f. Station RW6 – along the centerline of the discharge conduit, at a depth of 20 feet.

   g. Station RW7 – along the centerline of the discharge conduit, at a depth of 40 feet.

h. Station RW8 – 7,920 feet downcoast of the discharge terminus, at a depth of 30 feet.

i. Station RW9 – 7,920 feet upcoast of the discharge terminus, at a depth of 30 feet.

2. Benthic stations shall be located as follows:

Stations B1 through B6 shall be located directly beneath Stations RW1 through RW6, respectively.

D. Type and Frequency of Sampling:

1. Temperature profiles shall be measured semiannually (summer and winter) each year at Stations RW1 through RW9 from surface to bottom at a minimum of one-meter intervals. Dissolved oxygen levels and pH shall be measured semiannually at least at the surface, mid-depth and bottom at each station. All stations shall be sampled during both a flooding tide and an ebbing tide during each semiannual survey.

2. Impingement sampling for fish and commercially important macroinvertebrates shall be conducted at least once every two months at Intake Serial 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 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 collected. When large numbers of given species are collected, length/weight data need only be recorded for 50 individuals and total number and total weight may be estimated based on aliquots samples. Total fish impinged per heat treatment or sampling event shall be reported and data shall be expressed per unit volume water entrained.

3. Native California mussels (Mytilus Californianus) 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.

6. Benthic sampling shall be conducted annually during the summer at Stations B1 through B6.

   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 an 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 the size). Sub-samples (upper tow centimeters) shall be taken from each sediment sample and analyzed for copper, chromium, nickel and zinc.

7. The following general observations or measurement at receiving water, benthic and trawl stations shall be reported:

   a. Tidal stage, time, and date of monitoring.
   b. General water conditions.
   c. Color of the water.
   d. Appearance of oil films or greases, or floatable materials.
   e. Extent of visible turbidity or color patches.
   f. Direction of tidal flow.
   g. Description of odor, if any, of the receiving water.
   h. Depth at each station for each sampling period.

Appendix A. (Cont.).

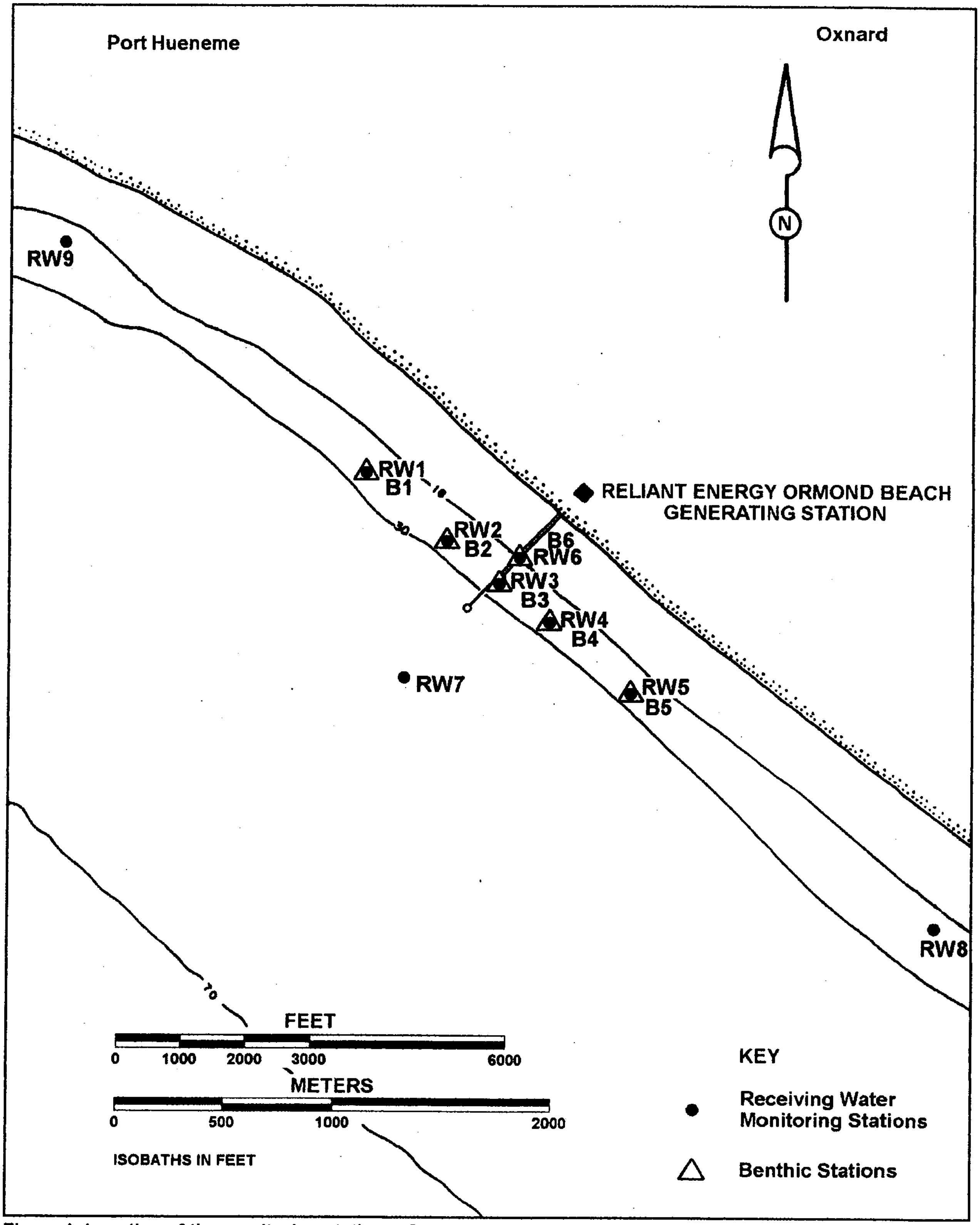


Figure 1. Location of the monitoring stations. Ormond Beach Generating Station.

APPENDIX B

Receiving water quality parameters by station

Appendix B-1. Water quality parameters at each receiving water monitoring station during flood and ebb tides. Ormond Beach Generating Station NPDES, winter 2006.

		Temp. (°C)		Oxygen (mg/l)		pH		Salinity (psu)	
	Depth (m)	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW1	0	12.03	13.33	7.10	10.61	7.78	8.05	33.54	33.54
	1	12.03	13.26	7.08	10.65	7.77	8.04	33.54	33.57
	2	12.03	12.72	7.09	10.74	7.78	7.97	33.54	33.77
	3	12.00	12.17	7.08	10.04	7.76	7.82	33.56	33.75
	4	11.98	11.84	6.89	7.76	7.72	7.75	33.55	33.73
	5	11.91	11.77	6.62	6.69	7.71	7.74	33.57	33.66
	6	11.85	11.67	6.44	6.38	7.69	7.73	33.59	33.69
	7	11.77	11.50	6.22	6.25	7.68	7.70	33.62	33.69
	8	11.65	11.45	6.01	5.90	7.67	7.70	33.65	33.67
	9	11.64	11.44	5.75	5.74	7.66	7.70	33.65	33.67
	10	11.64	11.43	5.71	5.69	7.66	7.70	33.64	33.66
	11	11.63		5.66		7.66		33.64	
RW2	0	12.06	13.53	7.00	9.41	7.78	7.97	33.56	33.55
	1	12.06	13.21	7.02	9.51	7.78	7.95	33.56	33.69
	2	12.06	12.44	7.02	9.38	7.78	7.90	33.56	33.73
	3	12.05	12.23	6.98	8.45	7.76	7.86	33.56	33.64
	4	12.03	12.20	6.89	8.10	7.75	7.86	33.57	33.63
	5	11.92	12.13	6.75	7.92	7.73	7.83	33.59	33.63
	6	11.78	11.75	6.40	7.73	7.68	7.77	33.63	33.70
	7	11.74	11.55	6.03	6.99	7.68	7.72	33.63	33.76
	8	11.72	11.38	5.93	6.31	7.68	7.70	33.63	33.70
	9	11.72	11.38	5.87	5.77	7.68	7.69	33.63	33.68
	10	11.72	11.38	5.85	5.63	7.68	7.70	33.63	33.67
	11	11.72		5.84		7.68		33.63	
RW3	0	12.11	13.43	7.47	9.20	7.81	7.96	33.55	33.56
	1	12.11	13.40	7.50	9.30	7.81	7.96	33.55	33.55
	2	12.08	13.23	7.47	9.29	7.78	7.95	33.56	33.54
	3	12.06	12.85	7.17	9.01	7.76	7.90	33.56	33.58
	4	12.03	12.03	6.87	8.41	7.75	7.81	33.57	33.65
	5	11.94	11.70	6.75	7.06	7.72	7.75	33.62	33.65
	6	11.83	11.57	6.53	6.32	7.69	7.72	33.62	33.66
	7	11.79	11.49	6.10	5.94	7.68	7.70	33.63	33.67
	8	11.78	11.40	5.98	5.73	7.67	7.68	33.62	33.67
	9	11.78	11.39	5.93	5.57	7.67	7.68	33.62	33.67
	10	11.78		5.91		7.66		33.62	
RW4	0	12.15	13.73	7.52	10.98	7.81	8.08	33.55	33.54
	1	12.15	13.58	7.51	11.04	7.82	8.07	33.55	33.58
	2	12.14	13.09	7.49	11.15	7.82	8.07	33.55	33.70
	3	12.12	12.45	7.53	11.03	7.81	7.99	33.55	33.71
	4	12.07	12.27	7.34	9.85	7.77	7.91	33.57	33.67
	5	11.96	12.14	7.01	8.99	7.71	7.88	33.60	33.64
	6	11.77	11.96	6.53	8.40	7.69	7.82	33.65	33.69
	7	11.59	11.68	6.10	7.57	7.68	7.75	33.68	33.71
	8	11.56	11.44	5.81	6.66	7.67	7.71	33.66	33.73
	9	11.55	11.37	5.71	5.98	7.66	7.68	33.65	33.68
	10	11.54	11.37	5.64	5.73	7.66	7.68	33.65	33.68
	11	11.53		5.61		7.66		33.65	

Appendix B-1. (Cont.).

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB	Salinity (psu) FLOOD	Salinity (psu) EBB
RW5	0	12.27	13.37	7.82	10.85	7.83	8.07	33.55	33.56
	1	12.27	13.39	7.83	10.83	7.83	8.07	33.55	33.55
	2	12.09	12.96	7.83	10.96	7.80	8.07	33.57	33.70
	3	11.70	12.30	7.14	11.09	7.71	7.98	33.65	33.71
	4	11.61	12.15	6.03	9.98	7.69	7.89	33.65	33.63
	5	11.58	12.10	5.84	8.44	7.68	7.86	33.65	33.61
	6	11.56	11.99	5.78	8.01	7.67	7.83	33.65	33.64
	7	11.51	11.96	5.74	7.61	7.67	7.82	33.67	33.62
	8	11.47	11.97	5.70	7.37	7.66	7.82	33.66	33.62
	9	11.40	11.97	5.61	7.33	7.67	7.82	33.64	33.61
	10	11.18	11.98	5.50	7.30	7.65	7.82	33.70	33.61
	11	11.13		5.31		7.64		33.70	
RW6	0	12.15	13.42	7.43	8.91	7.80	7.93	33.55	33.55
	1	12.15	13.42	7.44	8.89	7.80	7.93	33.55	33.56
	2	12.13	13.28	7.46	8.97	7.79	7.91	33.56	33.57
	3	12.03	13.06	7.36	8.84	7.76	7.88	33.60	33.60
	4	11.87	12.74	7.08	8.35	7.70	7.83	33.64	33.62
	5	11.84	12.64	6.37	7.81	7.68	7.81	33.63	33.60
	6	11.83	12.20	6.02	7.71	7.68	7.78	33.62	33.77
	7	11.83		5.93		7.68		33.62	
RW7	0	12.10	14.27	7.34	15.55	7.80	8.32	33.54	33.49
	1	12.10	14.09	7.34	15.74	7.80	8.32	33.54	33.53
	2	12.08	12.77	7.35	15.89	7.80	8.16	33.55	33.54
	3	12.03	12.26	7.29	12.46	7.77	7.89	33.56	33.57
	4	11.78	12.23	7.12	8.92	7.71	7.84	33.67	33.56
	5	11.61	12.20	6.54	8.10	7.68	7.82	33.69	33.57
	6	11.47	12.11	5.90	7.65	7.66	7.81	33.68	33.58
	7	11.38	12.00	5.68	7.33	7.64	7.79	33.69	33.60
	8	11.39	11.94	5.47	7.12	7.64	7.78	33.66	33.61
	9	11.37	11.87	5.43	7.01	7.64	7.79	33.67	33.62
	10	11.36	11.74	5.40	7.06	7.64	7.78	33.66	33.64
	11	11.33	11.45	5.38	6.61	7.64	7.72	33.68	33.66
	12	11.34	11.35	5.37	5.85	7.64	7.70	33.67	33.67
	13	11.31	11.34	5.35	5.71	7.64	7.70	33.67	33.67
	14	11.34		5.30		7.64		33.66	
RW8	0	12.46	13.26	8.49	10.09	7.90	8.04	33.56	33.55
	1	12.47	13.22	8.51	10.09	7.90	8.04	33.54	33.57
	2	12.11	12.94	8.59	10.15	7.85	8.03	33.68	33.65
	3	11.73	12.67	8.08	10.07	7.73	8.00	33.75	33.61
	4	11.59	12.59	6.61	9.62	7.70	7.97	33.68	33.57
	5	11.51	12.56	5.96	9.24	7.68	7.97	33.69	33.57
	6	11.43	12.40	5.75	9.11	7.66	7.93	33.72	33.62
	7	11.28	12.25	5.67	8.76	7.65	7.89	33.72	33.64
	8	11.10	12.11	5.49	8.29	7.64	7.83	33.76	33.63
	9	11.01	11.95	5.24	7.55	7.63	7.80	33.73	33.69
	10	10.94	11.70	5.09	7.20	7.62	7.76	33.73	33.70
	11	10.95		5.00		7.62		33.72	

Appendix B-1. (Cont.).

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB	Salinity (psu) FLOOD	Salinity (psu) EBB
RW9	0	11.95	13.21	7.27	9.79	7.78	7.99	33.58	33.53
	1	11.94	13.08	7.30	9.86	7.78	7.99	33.58	33.61
	2	11.89	12.44	7.28	9.84	7.77	7.93	33.61	33.64
	3	11.79	12.33	7.13	9.07	7.73	7.90	33.62	33.58
	4	11.74	12.08	6.51	8.49	7.71	7.83	33.62	33.66
	5	11.70	11.92	6.34	7.60	7.70	7.77	33.63	33.62
	6	11.66	11.83	6.21	6.76	7.68	7.73	33.63	33.62
	7	11.57	11.77	6.06	6.29	7.67	7.72	33.65	33.62
	8	11.49	11.70	5.86	6.06	7.67	7.70	33.67	33.62
	9	11.47	11.63	5.77	5.88	7.66	7.70	33.69	33.64
	10	11.33	11.62	5.68	5.76	7.64	7.69	33.69	33.64
	11	11.29		5.45		7.64		33.67	

Appendix B-2. Water quality parameters at each receiving water monitoring station during flood and ebb tides. Ormond Beach Generating Station NPDES, summer 2006.

		Temp. (°C)		Oxygen (mg/l)		pH		Salinity (psu)	
	Depth (m)	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB	FLOOD	EBB
RW1	0	15.05	17.15	8.23	8.44	8.17	8.23	33.41	33.47
	1	14.99	17.14	8.22	8.43	8.17	8.24	33.43	33.47
	2	14.67	17.09	8.28	8.43	8.17	8.24	33.50	33.48
	3	14.50	17.03	8.27	8.45	8.16	8.23	33.46	33.47
	4	14.41	16.96	8.20	8.47	8.16	8.24	33.47	33.48
	5	14.31	16.89	8.20	8.46	8.17	8.24	33.45	33.48
	6	14.25	16.83	8.18	8.49	8.16	8.24	33.45	33.48
	7	14.21	16.76	8.15	8.51	8.16	8.24	33.46	33.47
	8	14.07	16.71	8.12	8.52	8.15	8.24	33.47	33.48
	9	14.03	16.62	8.04	8.54	8.15	8.24	33.45	33.47
	10	14.02	16.42	8.00	8.55	8.15	8.23	33.44	33.46
	11	14.02		7.96		8.15		33.44	
RW2	0	14.72	17.29	8.03	8.36	8.15	8.23	33.44	33.46
	1	14.69	17.25	8.07	8.37	8.15	8.24	33.44	33.48
	2	14.52	17.21	8.09	8.35	8.16	8.24	33.48	33.47
	3	14.38	17.16	8.11	8.39	8.16	8.23	33.46	33.49
	4	14.23	17.06	8.16	8.40	8.16	8.24	33.49	33.50
	5	14.10	16.98	8.15	8.39	8.15	8.24	33.49	33.50
	6	14.06	16.91	8.07	8.41	8.15	8.24	33.44	33.48
	7	14.04	16.90	7.94	8.41	8.15	8.24	33.44	33.47
	8	14.04	16.90	7.90	8.41	8.15	8.24	33.44	33.47
	9	14.04	16.90	7.90	8.40	8.15	8.24	33.44	33.46
	10	14.05	16.78	7.91	8.44	8.15	8.24	33.44	33.50
	11	14.05		7.87		8.15		33.44	
RW3	0	15.34	18.19	7.78	8.22	8.13	8.22	33.42	33.46
	1	15.23	18.13	7.82	8.23	8.14	8.21	33.43	33.47
	2	14.99	17.98	7.87	8.24	8.14	8.22	33.52	33.49
	3	14.43	17.60	7.92	8.32	8.15	8.23	33.52	33.49
	4	14.24	17.31	7.87	8.32	8.15	8.23	33.44	33.49
	5	14.28	17.22	7.88	8.35	8.15	8.24	33.42	33.47
	6	14.18	17.20	7.90	8.35	8.15	8.23	33.45	33.48
	7	14.15	17.08	7.88	8.38	8.15	8.23	33.45	33.48
	8	14.15	16.96	7.89	8.34	8.15	8.22	33.44	33.47
	9	14.15	16.92	7.90	8.31	8.15	8.23	33.44	33.47
	10	14.15		7.88		8.15		33.44	
RW4	0	14.67	17.53	8.13	8.26	8.17	8.24	33.42	33.48
	1	14.58	17.52	8.20	8.29	8.17	8.23	33.46	33.48
	2	14.28	17.39	8.18	8.29	8.16	8.24	33.48	33.47
	3	14.19	17.11	8.09	8.35	8.16	8.24	33.48	33.45
	4	14.04	16.85	8.05	8.36	8.15	8.24	33.48	33.47
	5	13.99	16.80	7.92	8.38	8.14	8.24	33.46	33.46
	6	13.96	16.58	7.80	8.43	8.14	8.24	33.45	33.46
	7	13.95	16.26	7.77	8.42	8.15	8.24	33.45	33.45
	8	13.90	15.79	7.77	8.44	8.14	8.22	33.45	33.43
	9	13.87	14.99	7.74	8.49	8.15	8.22	33.45	33.43
	10	13.86	14.84	7.70	8.25	8.13	8.20	33.44	33.44
	11	13.90		7.66		8.14		33.43	

Appendix B-2. (Cont.).

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB	Salinity (psu) FLOOD	Salinity (psu) EBB
RW5	0	15.30	17.56	8.30	8.23	8.19	8.24	33.41	33.48
	1	15.30	17.56	8.30	8.23	8.19	8.24	33.42	33.48
	2	15.28	17.49	8.29	8.25	8.19	8.24	33.42	33.50
	3	15.13	17.14	8.33	8.30	8.18	8.25	33.46	33.55
	4	14.83	16.75	8.34	8.37	8.18	8.24	33.51	33.59
	5	14.72	16.40	8.22	8.44	8.17	8.24	33.47	33.53
	6	14.68	16.17	8.17	8.47	8.17	8.24	33.45	33.49
	7	14.52	15.48	8.16	8.50	8.17	8.21	33.49	33.58
	8	14.45	14.59	8.12	8.36	8.16	8.20	33.46	33.51
	9	14.33	14.42	8.04	8.13	8.16	8.19	33.48	33.49
	10	14.11	14.38	7.99	8.10	8.15	8.19	33.51	33.45
	11	13.79	14.39	7.92	8.10	8.14	8.20	33.49	33.46
RW6	0	14.53	17.89	8.17	8.26	8.16	8.23	33.43	33.46
	1	14.51	17.83	8.17	8.26	8.16	8.23	33.44	33.48
	2	14.42	17.65	8.16	8.28	8.16	8.23	33.45	33.51
	3	14.31	17.49	8.13	8.29	8.16	8.23	33.46	33.49
	4	14.28	17.48	8.06	8.31	8.16	8.23	33.46	33.48
	5	14.26	17.44	8.02	8.32	8.16	8.23	33.44	33.48
	6	14.25	17.36	8.03	8.34	8.16	8.23	33.44	33.51
RW7	0	15.35	17.25	8.35	8.37	8.19	8.23	33.41	33.47
	1	15.35	17.26	8.36	8.35	8.19	8.24	33.41	33.47
	2	15.28	17.23	8.40	8.36	8.19	8.24	33.43	33.48
	3	15.11	17.15	8.38	8.41	8.18	8.24	33.44	33.48
	4	14.98	16.96	8.29	8.42	8.18	8.24	33.50	33.50
	5	14.89	16.41	8.25	8.52	8.18	8.24	33.40	33.58
	6	14.86	16.17	8.19	8.48	8.18	8.23	33.39	33.52
	7	14.69	15.91	8.22	8.51	8.18	8.22	33.38	33.51
	8	14.57	15.06	8.19	8.64	8.16	8.21	33.34	33.75
	9	14.56	14.46	8.14	8.46	8.16	8.20	33.32	33.58
	10	14.48	14.35	8.15	8.18	8.18	8.19	33.46	33.49
	11	14.19	14.30	8.22	8.14	8.17	8.19	33.57	33.49
	12	13.97	14.23	8.27	8.13	8.15	8.19	33.46	33.48
	13	13.75	14.22	7.98	8.14	8.14	8.19	33.49	33.45
	14	13.74		7.69		8.13		33.47	
RW8	0	16.10	17.99	8.21	8.11	8.19	8.25	33.42	33.50
	1	16.08	17.96	8.21	8.12	8.19	8.25	33.43	33.50
	2	16.00	17.96	8.21	8.12	8.19	8.25	33.44	33.50
	3	15.92	17.87	8.25	8.14	8.19	8.25	33.47	33.51
	4	15.79	17.71	8.33	8.18	8.20	8.25	33.47	33.52
	5	15.65	17.49	8.35	8.19	8.19	8.25	33.46	33.53
	6	15.56	17.28	8.33	8.25	8.19	8.25	33.47	33.53
	7	15.29	17.12	8.35	8.27	8.18	8.25	33.48	33.52
	8	15.09	16.21	8.22	8.50	8.18	8.23	33.46	33.81
	9	14.81	14.72	8.17	8.57	8.18	8.20	33.51	33.75
	10	14.08	14.38	8.14	8.29	8.15	8.20	33.56	33.50

Appendix B-2. (Cont.).

	Depth (m)	Temp. (°C) FLOOD	Temp. (°C) EBB	Oxygen (mg/l) FLOOD	Oxygen (mg/l) EBB	pH FLOOD	pH EBB	Salinity (psu) FLOOD	Salinity (psu) EBB
RW9	0	15.29	17.12	8.44	8.48	8.18	8.24	33.40	33.45
	1	15.29	17.11	8.45	8.49	8.18	8.23	33.40	33.46
	2	15.23	16.98	8.45	8.50	8.18	8.24	33.42	33.50
	3	15.12	16.90	8.50	8.53	8.18	8.23	33.45	33.48
	4	14.91	16.83	8.50	8.55	8.18	8.24	33.50	33.47
	5	14.53	16.72	8.47	8.57	8.17	8.24	33.55	33.49
	6	14.20	16.64	8.37	8.62	8.16	8.24	33.47	33.46
	7	14.04	16.40	8.13	8.65	8.15	8.24	33.46	33.52
	8	13.97	16.17	8.06	8.75	8.15	8.24	33.48	33.47
	9	13.84	16.05	8.00	8.83	8.15	8.24	33.48	33.46
	10	13.71	15.65	7.90	8.85	8.13	8.22	33.49	33.53
	11	13.56		7.84		8.12		33.47	

APPENDIX C

Sediment grain size techniques and statistical parameters by station

Appendix C-1. Grain size techniques.

Sediment Grain Size Analysis

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

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

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

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

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

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

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

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

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

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 (β_ϕ > 1). Those with fatter tails and lower peaks than expected are termed platykurtic (β_ϕ < 1). β_ϕ = 1.00 for a normal curve. Curve category interpretations are based on Folk (1974).

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

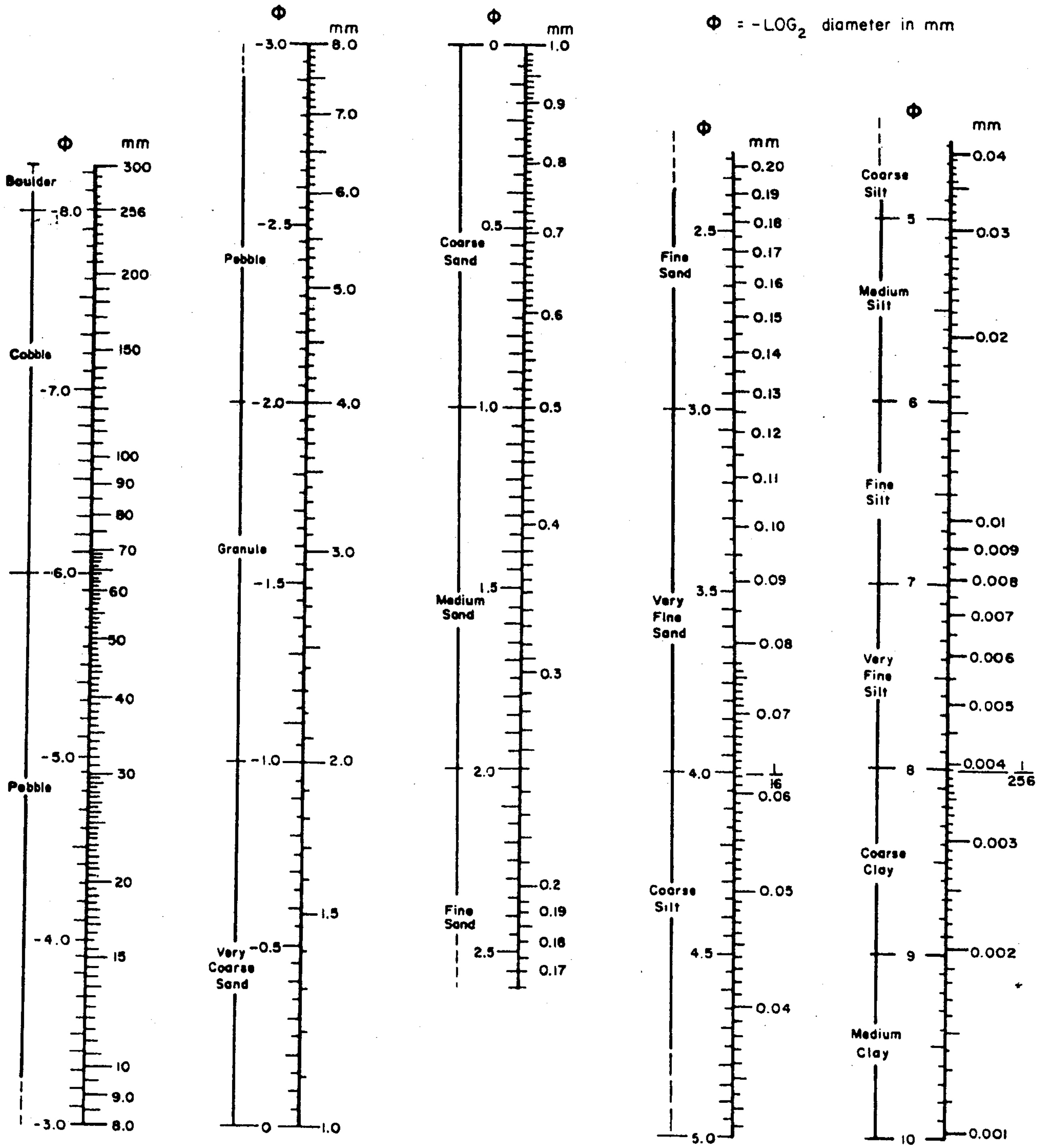
LITERATURE CITED

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

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

Appendix C-1. (Cont.).

Phi - Millimeter Conversion Figure



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

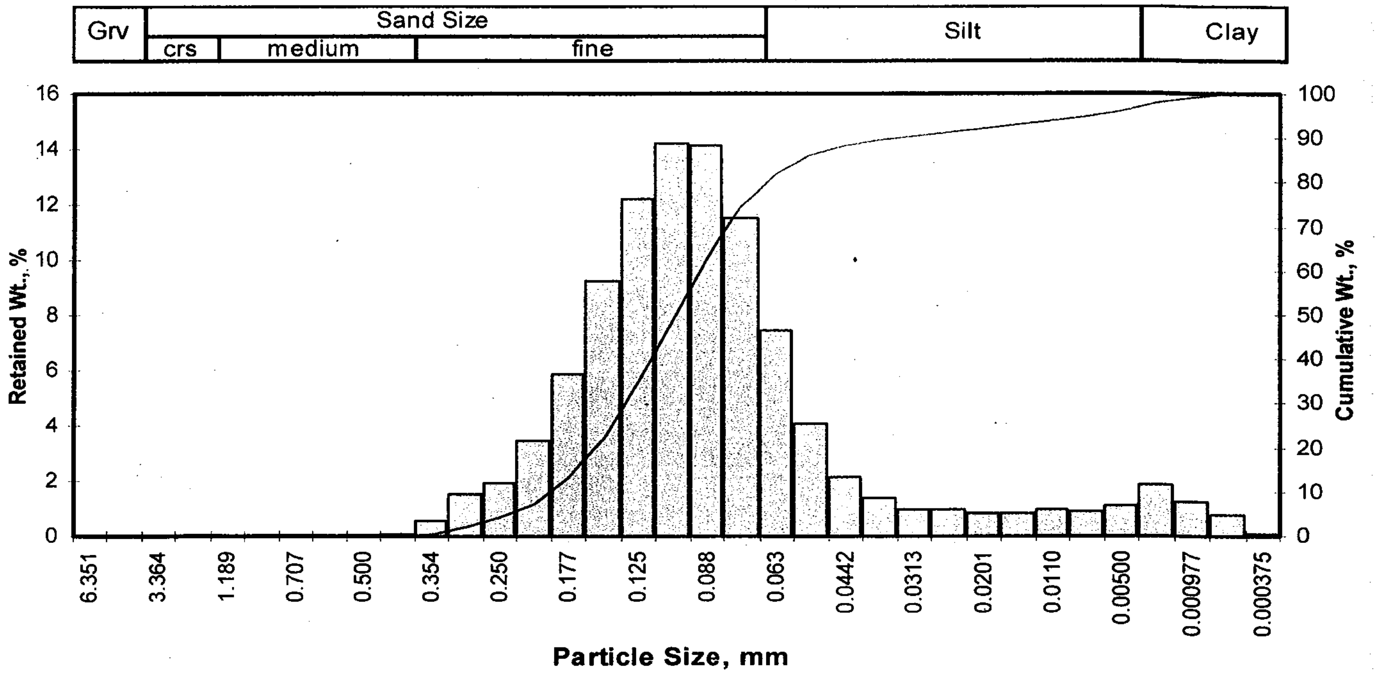
σ_I under	.35 ϕ,	very well sorted
	.35-.50 ϕ,	well sorted
	.50-.71 ϕ,	moderately well sorted
	.71-1.0 ϕ	moderately sorted
	1.0-2.0 ϕ,	poorly sorted
	2.0-4.0 ϕ,	very poorly sorted
	over 4.0 ϕ,	extremely poorly sorted

Appendix C-2. Sediment grain size distribution and statistical parameters by station. Ormond Beach Generating Station NPDES, 2006.

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	36828
Project:	N/A	**Sample ID:**	OBGS B1
Project No:	06-10-0032	**Depth, ft:**	N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.07	0.07	0.07
0.0139	0.354	1.50	45	0.53	0.53	0.60
0.0117	0.297	1.75	50	1.54	1.54	2.14
0.0098	0.250	2.00	60	1.96	1.96	4.11
0.0083	0.210	2.25	70	3.42	3.42	7.53
0.0070	0.177	2.50	80	5.84	5.84	13.37
0.0059	0.149	2.75	100	9.21	9.21	22.58
0.0049	0.125	3.00	120	12.20	12.21	34.79
0.0041	0.105	3.25	140	14.20	14.21	49.00
0.0035	0.088	3.50	170	14.10	14.11	63.11
0.0029	0.074	3.75	200	11.50	11.51	74.61
0.0025	0.063	4.00	230	7.47	7.47	82.08
0.0021	0.053	4.25	270	4.04	4.04	86.13
0.00174	0.0442	4.50	325	2.15	2.15	88.28
0.00146	0.0372	4.75	400	1.36	1.36	89.64
0.00123	0.0313	5.00	450	0.96	0.96	90.60
0.000986	0.0250	5.32	500	0.94	0.94	91.54
0.000790	0.0201	5.64	635	0.82	0.82	92.36
0.000615	0.0156	6.00		0.80	0.80	93.16
0.000435	0.0110	6.50		0.97	0.97	94.13
0.000308	0.00781	7.00		0.90	0.90	95.03
0.000197	0.00500	7.65		1.07	1.07	96.10
0.000077	0.00195	9.00		1.84	1.84	97.94
0.000038	0.000977	10.00		1.21	1.21	99.15
0.000019	0.000488	11.00		0.77	0.77	99.92
0.000015	0.000375	11.38		0.08	0.08	100.00
TOTALS				**99.90**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	2.07	0.0094	0.239
10	2.36	0.0077	0.195
16	2.57	0.0066	0.168
25	2.80	0.0057	0.144
40	3.09	0.0046	0.117
50	3.27	0.0041	0.104
60	3.44	0.0036	0.092
75	3.76	0.0029	0.074
84	4.12	0.0023	0.058
90	4.84	0.0014	0.035
95	6.98	0.0003	0.008

Measure	Trask	Inman	Folk-Ward
Median, phi	3.27	3.27	3.27
Median, in.	0.0041	0.0041	0.0041
Median, mm	0.104	0.104	0.104
Mean, phi	3.20	3.34	3.32
Mean, in.	0.0043	0.0039	0.0039
Mean, mm	0.109	0.098	0.100
Sorting	1.396	0.774	1.132
Skewness	0.991	0.100	0.305
Kurtosis	0.218	2.178	2.091

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

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.07
Fine Sand	200	74.54
Silt	>0.005 mm	21.49
Clay	<0.005 mm	3.90
	Total	100

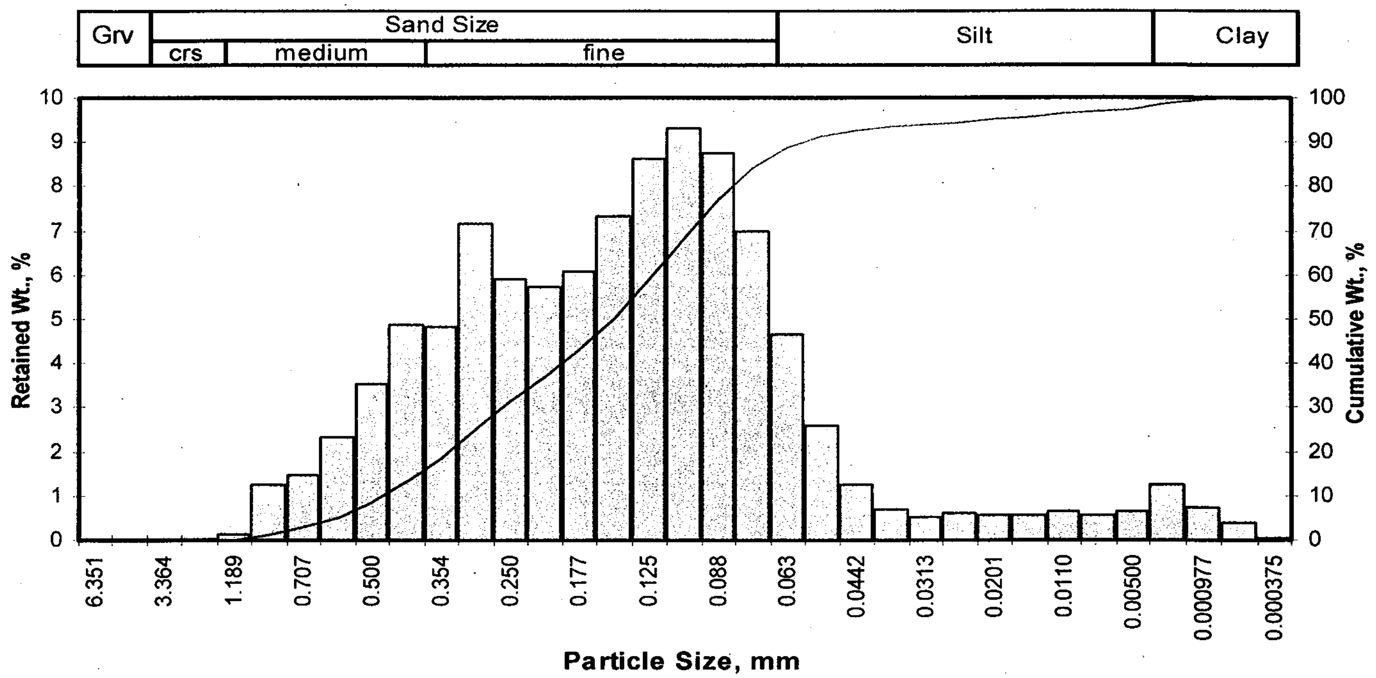
Phone: (562) 907-3607 Fax: (562) 907-3610

Appendix C-2. (Cont.).

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	36828
Project:	N/A	**Sample ID:**	OBGS B2
Project No:	06-10-0032	**Depth, ft:**	N/A



Opening: Inches	Opening: Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.14	0.14	0.14
0.0331	0.841	0.25	20	1.25	1.25	1.39
0.0278	0.707	0.50	25	1.45	1.45	2.84
0.0234	0.595	0.75	30	2.31	2.31	5.15
0.0197	0.500	1.00	35	3.55	3.55	8.70
0.0166	0.420	1.25	40	4.86	4.86	13.56
0.0139	0.354	1.50	45	4.83	4.83	18.39
0.0117	0.297	1.75	50	7.14	7.14	25.53
0.0098	0.250	2.00	60	5.90	5.90	31.43
0.0083	0.210	2.25	70	5.73	5.73	37.16
0.0070	0.177	2.50	80	6.07	6.07	43.23
0.0059	0.149	2.75	100	7.33	7.33	50.57
0.0049	0.125	3.00	120	8.63	8.63	59.20
0.0041	0.105	3.25	140	9.32	9.32	68.52
0.0035	0.088	3.50	170	8.74	8.74	77.26
0.0029	0.074	3.75	200	7.00	7.00	84.26
0.0025	0.063	4.00	230	4.65	4.65	88.91
0.0021	0.053	4.25	270	2.59	2.59	91.50
0.00174	0.0442	4.50	325	1.27	1.27	92.77
0.00146	0.0372	4.75	400	0.71	0.71	93.48
0.00123	0.0313	5.00	450	0.52	0.52	94.00
0.000986	0.0250	5.32	500	0.61	0.61	94.61
0.000790	0.0201	5.64	635	0.57	0.57	95.18
0.000615	0.0156	6.00		0.55	0.55	95.73
0.000435	0.0110	6.50		0.64	0.64	96.37
0.000308	0.00781	7.00		0.55	0.55	96.92
0.000197	0.00500	7.65		0.65	0.65	97.57
0.000077	0.00195	9.00		1.25	1.25	98.82
0.000038	0.000977	10.00		0.74	0.74	99.56
0.000019	0.000488	11.00		0.40	0.40	99.96
0.000015	0.000375	11.38		0.04	0.04	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than: Weight percent	Phi Value	Particle Size: Inches	Particle Size: Millimeters
5	0.73	0.0237	0.601
10	1.07	0.0188	0.477
16	1.38	0.0152	0.385
25	1.73	0.0119	0.301
40	2.37	0.0076	0.194
50	2.73	0.0059	0.151
60	3.02	0.0048	0.123
75	3.44	0.0036	0.092
84	3.74	0.0029	0.075
90	4.11	0.0023	0.058
95	5.54	0.0008	0.022

Measure	Trask	Inman	Folk-Ward
Median, phi	2.73	2.73	2.73
Median, in.	0.0059	0.0059	0.0059
Median, mm	0.151	0.151	0.151
Mean, phi	2.35	2.56	2.62
Mean, in.	0.0077	0.0067	0.0064
Mean, mm	0.197	0.170	0.163
Sorting	1.805	1.182	1.319
Skewness	1.108	-0.146	0.012
Kurtosis	0.249	1.032	1.156

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

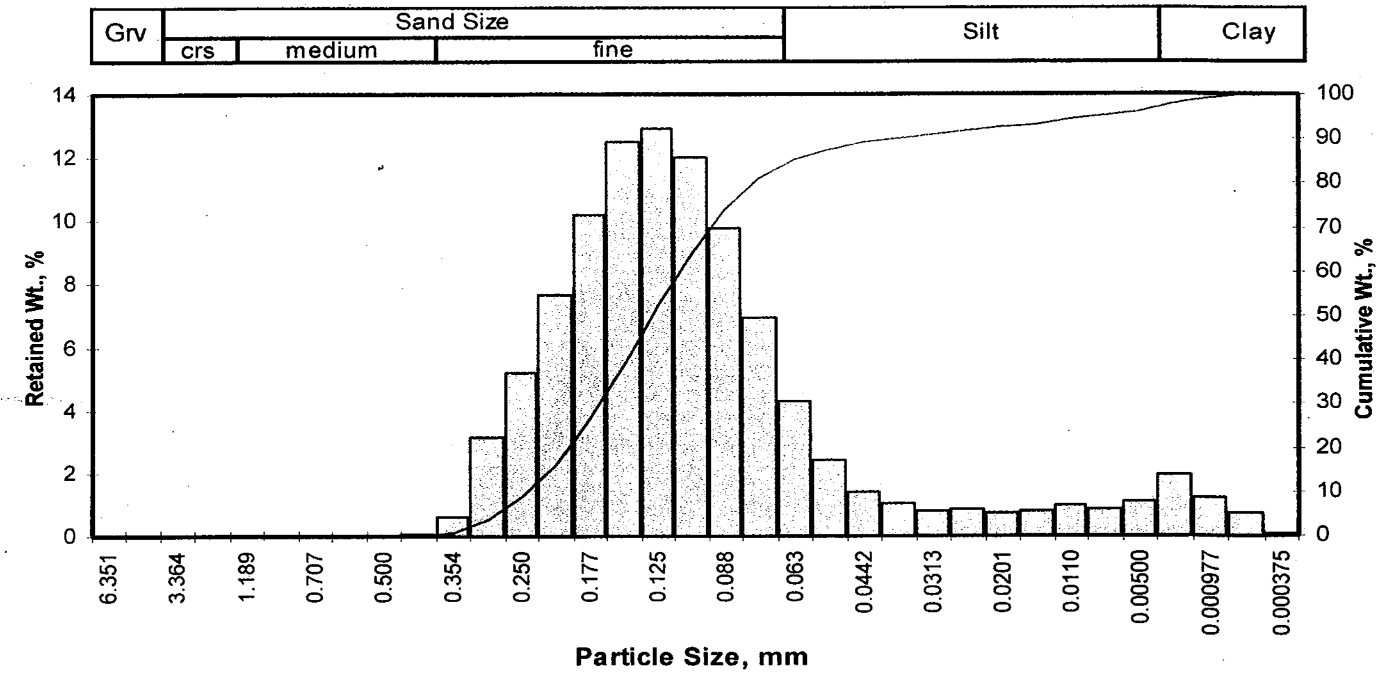
Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	13.56
Fine Sand	200	70.70
Silt	>0.005 mm	13.31
Clay	<0.005 mm	2.43
	Total	**100**

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

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	36828
Project:	N/A	**Sample ID:**	OBGS B3
Project No:	06-10-0032	**Depth, ft:**	N/A



Opening		Phi of	U.S.	Sample Weight,	Increment Weight,	Cumulative Weight,
Inches	Millimeters	Screen	No.	grams	percent	percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.05	0.05	0.05
0.0139	0.354	1.50	45	0.62	0.62	0.67
0.0117	0.297	1.75	50	3.11	3.11	3.79
0.0098	0.250	2.00	60	5.16	5.16	8.95
0.0083	0.210	2.25	70	7.63	7.63	16.58
0.0070	0.177	2.50	80	10.20	10.21	26.79
0.0059	0.149	2.75	100	12.50	12.51	39.30
0.0049	0.125	3.00	120	12.90	12.91	52.20
0.0041	0.105	3.25	140	12.00	12.01	64.21
0.0035	0.088	3.50	170	9.77	9.78	73.98
0.0029	0.074	3.75	200	6.95	6.95	80.94
0.0025	0.063	4.00	230	4.31	4.31	85.25
0.0021	0.053	4.25	270	2.41	2.41	87.66
0.00174	0.0442	4.50	325	1.41	1.41	89.07
0.00146	0.0372	4.75	400	1.02	1.02	90.09
0.00123	0.0313	5.00	450	0.80	0.80	90.89
0.000986	0.0250	5.32	500	0.83	0.83	91.72
0.000790	0.0201	5.64	635	0.75	0.75	92.47
0.000615	0.0156	6.00		0.77	0.77	93.25
0.000435	0.0110	6.50		0.94	0.94	94.19
0.000308	0.00781	7.00		0.87	0.87	95.06
0.000197	0.00500	7.65		1.07	1.07	96.13
0.000077	0.00195	9.00		1.90	1.90	98.03
0.000038	0.000977	10.00		1.18	1.18	99.21
0.000019	0.000488	11.00		0.72	0.72	99.93
0.000015	0.000375	11.38		0.07	0.07	100.00
TOTALS				**99.90**	**100.00**	**100.00**

Cumulative Weight Percent greater than			
Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	1.81	0.0112	0.285
10	2.03	0.0096	0.244
16	2.23	0.0084	0.213
25	2.46	0.0072	0.182
40	2.76	0.0058	0.147
50	2.96	0.0051	0.129
60	3.16	0.0044	0.112
75	3.54	0.0034	0.086
84	3.93	0.0026	0.066
90	4.73	0.0015	0.038
95	6.97	0.0003	0.008

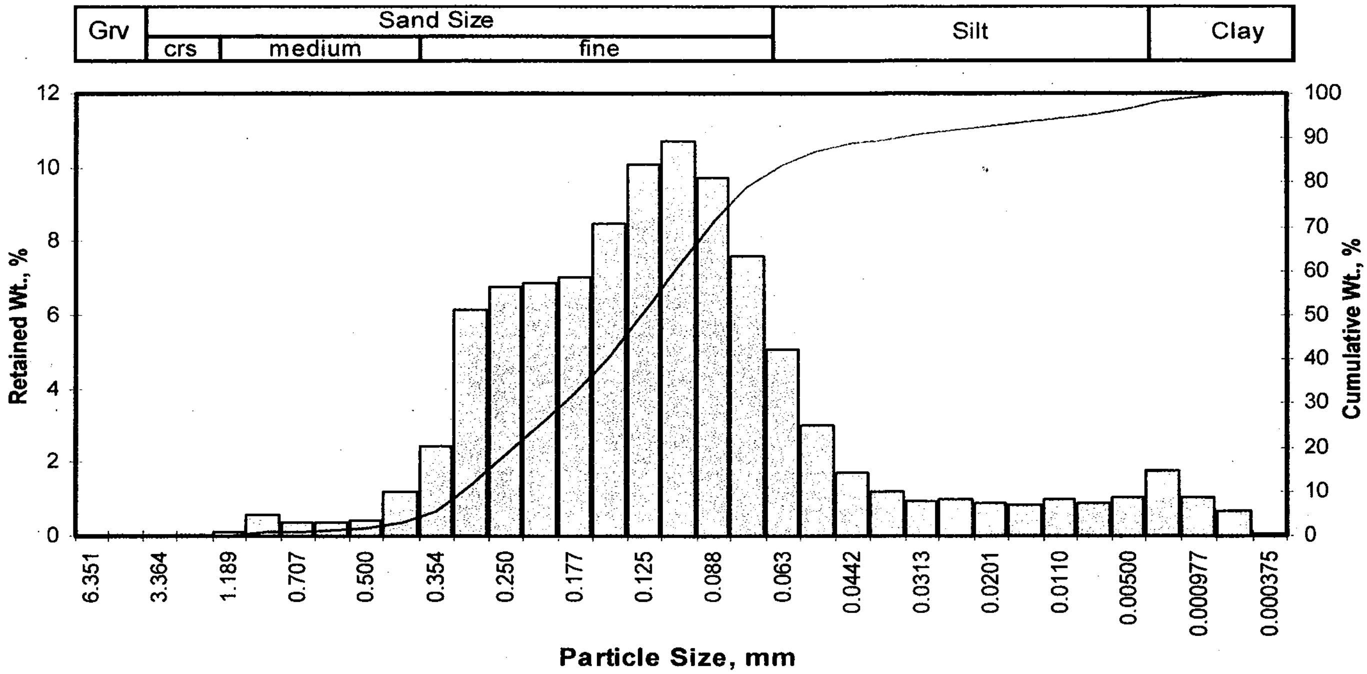
Measure	Trask	Inman	Folk-Ward
Median, phi	2.96	2.96	2.96
Median, in.	0.0051	0.0051	0.0051
Median, mm	0.129	0.129	0.129
Mean, phi	2.90	3.08	3.04
Mean, in.	0.0053	0.0047	0.0048
Mean, mm	0.134	0.118	0.122
Sorting	1.454	0.848	1.206
Skewness	0.973	0.144	0.349
Kurtosis	0.233	2.041	1.957
Grain Size Description (ASTM-USCS Scale)	Fine sand (based on Mean from Trask)		

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.05
Fine Sand	200	80.88
Silt	>0.005 mm	15.19
Clay	<0.005 mm	3.87
	Total	100

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	36828
Project:	N/A	**Sample ID:**	OBGS B4
Project No:	06-10-0032	**Depth, ft:**	N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.10	0.10	0.10
0.0331	0.841	0.25	20	0.59	0.59	0.69
0.0278	0.707	0.50	25	0.37	0.37	1.06
0.0234	0.595	0.75	30	0.36	0.36	1.42
0.0197	0.500	1.00	35	0.42	0.42	1.84
0.0166	0.420	1.25	40	1.20	1.20	3.04
0.0139	0.354	1.50	45	2.44	2.44	5.48
0.0117	0.297	1.75	50	6.16	6.16	11.64
0.0098	0.250	2.00	60	6.76	6.76	18.40
0.0083	0.210	2.25	70	6.89	6.89	25.29
0.0070	0.177	2.50	80	7.05	7.05	32.34
0.0059	0.149	2.75	100	8.48	8.48	40.81
0.0049	0.125	3.00	120	10.10	10.10	50.91
0.0041	0.105	3.25	140	10.70	10.70	61.61
0.0035	0.088	3.50	170	9.70	9.70	71.31
0.0029	0.074	3.75	200	7.59	7.59	78.90
0.0025	0.063	4.00	230	5.09	5.09	83.99
0.0021	0.053	4.25	270	2.99	2.99	86.98
0.00174	0.0442	4.50	325	1.71	1.71	88.69
0.00146	0.0372	4.75	400	1.18	1.18	89.87
0.00123	0.0313	5.00	450	0.94	0.94	90.81
0.000986	0.0250	5.32	500	1.00	1.00	91.81
0.000790	0.0201	5.64	635	0.87	0.87	92.68
0.000615	0.0156	6.00		0.85	0.85	93.53
0.000435	0.0110	6.50		1.00	1.00	94.53
0.000308	0.00781	7.00		0.89	0.89	95.42
0.000197	0.00500	7.65		1.05	1.05	96.47
0.000077	0.00195	9.00		1.76	1.76	98.23
0.000038	0.000977	10.00		1.06	1.06	99.29
0.000019	0.000488	11.00		0.65	0.65	99.94
0.000015	0.000375	11.38		0.06	0.06	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	1.45	0.0144	0.366
10	1.68	0.0123	0.311
16	1.91	0.0105	0.266
25	2.24	0.0083	0.212
40	2.73	0.0060	0.151
50	2.98	0.0050	0.127
60	3.21	0.0042	0.108
75	3.62	0.0032	0.081
84	4.00	0.0025	0.062
90	4.79	0.0014	0.036
95	6.77	0.0004	0.009

Measure	Trask	Inman	Folk-Ward
Median, phi	2.98	2.98	2.98
Median, in.	0.0050	0.0050	0.0050
Median, mm	0.127	0.127	0.127
Mean, phi	2.77	2.96	2.96
Mean, in.	0.0058	0.0051	0.0050
Mean, mm	0.146	0.129	0.128
Sorting	1.614	1.045	1.328
Skewness	1.033	-0.020	0.203
Kurtosis	0.237	1.543	1.576

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

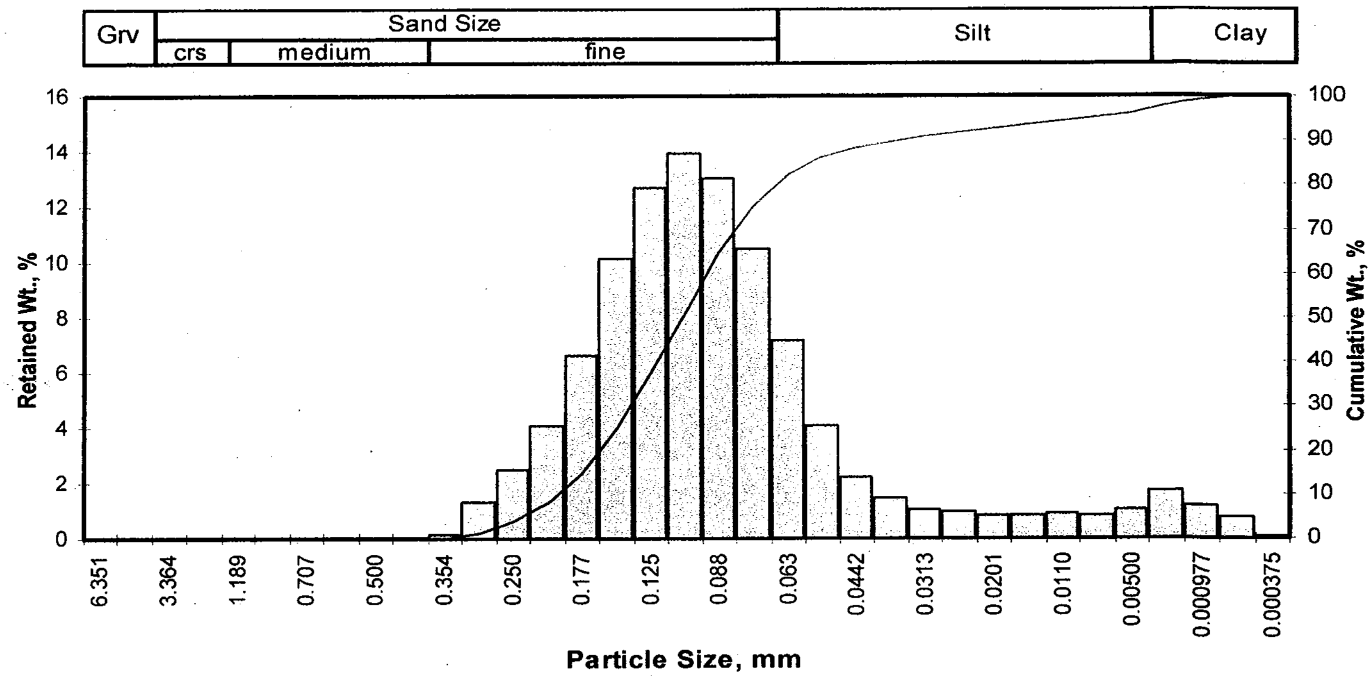
Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	3.04
Fine Sand	200	75.86
Silt	>0.005 mm	17.57
Clay	<0.005 mm	3.53
	Total	**100**

Appendix C-2. (Cont.).

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	36828
Project:	N/A	**Sample ID:**	OBGS B5
Project No:	06-10-0032	**Depth, ft:**	N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.00	0.00	0.00
0.0139	0.354	1.50	45	0.16	0.16	0.16
0.0117	0.297	1.75	50	1.34	1.34	1.50
0.0098	0.250	2.00	60	2.49	2.49	4.00
0.0083	0.210	2.25	70	4.10	4.10	8.10
0.0070	0.177	2.50	80	6.62	6.62	14.72
0.0059	0.149	2.75	100	10.10	10.11	24.83
0.0049	0.125	3.00	120	12.70	12.71	37.54
0.0041	0.105	3.25	140	13.90	13.91	51.45
0.0035	0.088	3.50	170	13.00	13.01	64.46
0.0029	0.074	3.75	200	10.50	10.51	74.97
0.0025	0.063	4.00	230	7.15	7.16	82.12
0.0021	0.053	4.25	270	4.10	4.10	86.23
0.00174	0.0442	4.50	325	2.21	2.21	88.44
0.00146	0.0372	4.75	400	1.42	1.42	89.86
0.00123	0.0313	5.00	450	1.02	1.02	90.88
0.000986	0.0250	5.32	500	0.99	0.99	91.87
0.000790	0.0201	5.64	635	0.84	0.84	92.71
0.000615	0.0156	6.00		0.81	0.81	93.52
0.000435	0.0110	6.50		0.93	0.93	94.45
0.000308	0.00781	7.00		0.85	0.85	95.30
0.000197	0.00500	7.65		1.01	1.01	96.32
0.000077	0.00195	9.00		1.74	1.74	98.06
0.000038	0.000977	10.00		1.14	1.14	99.20
0.000019	0.000488	11.00		0.73	0.73	99.93
0.000015	0.000375	11.38		0.07	0.07	100.00
TOTALS				**99.90**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	2.06	0.0094	0.240
10	2.32	0.0079	0.200
16	2.53	0.0068	0.173
25	2.75	0.0058	0.148
40	3.04	0.0048	0.121
50	3.22	0.0042	0.107
60	3.41	0.0037	0.094
75	3.75	0.0029	0.074
84	4.11	0.0023	0.058
90	4.78	0.0014	0.036
95	6.82	0.0003	0.009

Measure	Trask	Inman	Folk-Ward
Median, phi	3.22	3.22	3.22
Median, in.	0.0042	0.0042	0.0042
Median, mm	0.107	0.107	0.107
Mean, phi	3.17	3.32	3.29
Mean, in.	0.0044	0.0039	0.0040
Mean, mm	0.111	0.100	0.102
Sorting	1.413	0.791	1.117
Skewness	0.981	0.125	0.318
Kurtosis	0.226	2.007	1.955

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

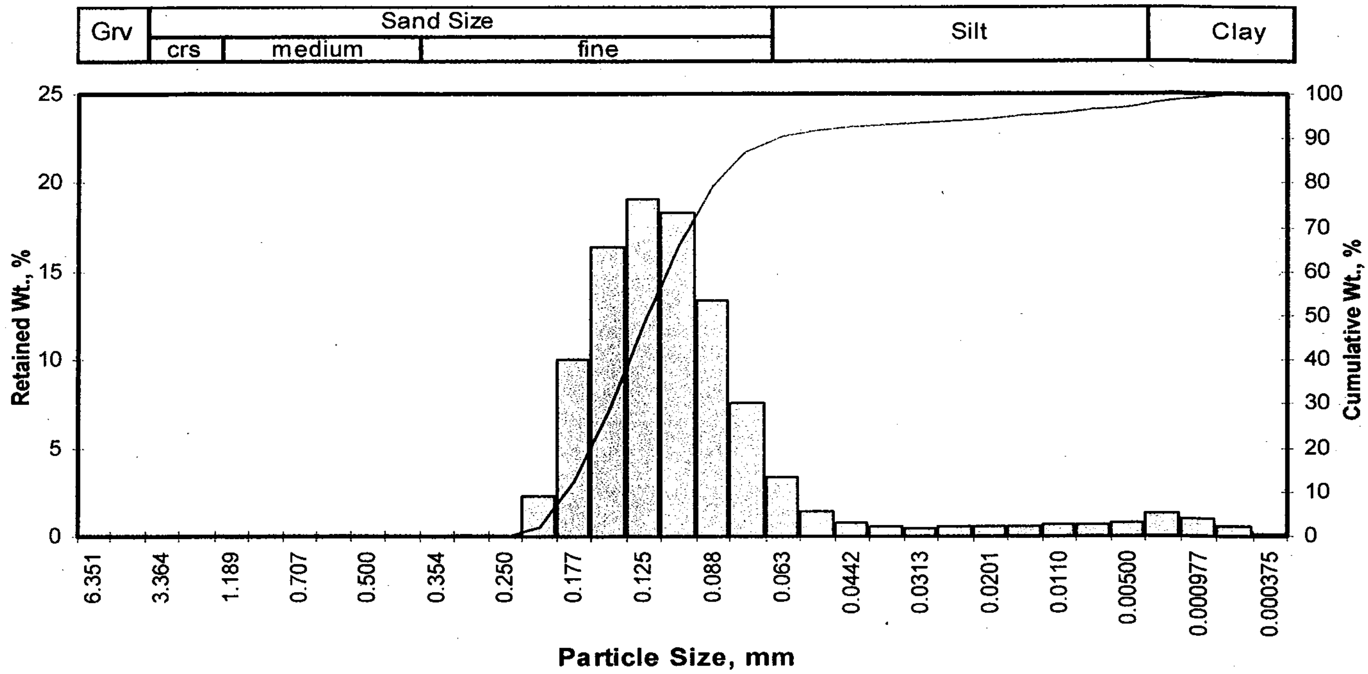
Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.00
Fine Sand	200	74.97
Silt	>0.005 mm	21.35
Clay	<0.005 mm	3.68
	Total	**100**

Appendix C-2. (Cont.).

PTS Laboratories, Inc.

Particle Size Analysis - ASTM D4464M

Client:	Calscience	**PTS File No:**	36828
Project:	N/A	**Sample ID:**	OBGS B6
Project No:	06-10-0032	**Depth, ft:**	N/A



Opening Inches	Opening Millimeters	Phi of Screen	U.S. No.	Sample Weight, grams	Increment Weight, percent	Cumulative Weight, percent
0.2500	6.351	-2.67	1/4	0.00	0.00	0.00
0.1873	4.757	-2.25	4	0.00	0.00	0.00
0.1324	3.364	-1.75	6	0.00	0.00	0.00
0.0787	2.000	-1.00	10	0.00	0.00	0.00
0.0468	1.189	-0.25	16	0.00	0.00	0.00
0.0331	0.841	0.25	20	0.00	0.00	0.00
0.0278	0.707	0.50	25	0.00	0.00	0.00
0.0234	0.595	0.75	30	0.00	0.00	0.00
0.0197	0.500	1.00	35	0.00	0.00	0.00
0.0166	0.420	1.25	40	0.00	0.00	0.00
0.0139	0.354	1.50	45	0.00	0.00	0.00
0.0117	0.297	1.75	50	0.00	0.00	0.00
0.0098	0.250	2.00	60	0.04	0.03	0.03
0.0083	0.210	2.25	70	2.25	2.25	2.28
0.0070	0.177	2.50	80	10.00	10.00	12.28
0.0059	0.149	2.75	100	16.40	16.40	28.68
0.0049	0.125	3.00	120	19.10	19.10	47.78
0.0041	0.105	3.25	140	18.30	18.30	66.08
0.0035	0.088	3.50	170	13.40	13.40	79.48
0.0029	0.074	3.75	200	7.55	7.55	87.03
0.0025	0.063	4.00	230	3.36	3.36	90.39
0.0021	0.053	4.25	270	1.39	1.39	91.78
0.00174	0.0442	4.50	325	0.73	0.73	92.51
0.00146	0.0372	4.75	400	0.55	0.55	93.06
0.00123	0.0313	5.00	450	0.48	0.48	93.54
0.000986	0.0250	5.32	500	0.54	0.54	94.08
0.000790	0.0201	5.64	635	0.51	0.51	94.59
0.000615	0.0156	6.00		0.52	0.52	95.11
0.000435	0.0110	6.50		0.64	0.64	95.75
0.000308	0.00781	7.00		0.60	0.60	96.35
0.000197	0.00500	7.65		0.74	0.74	97.09
0.000077	0.00195	9.00		1.34	1.34	98.43
0.000038	0.000977	10.00		0.92	0.92	99.35
0.000019	0.000488	11.00		0.59	0.59	99.94
0.000015	0.000375	11.38		0.06	0.06	100.00
TOTALS				**100.00**	**100.00**	**100.00**

Cumulative Weight Percent greater than

Weight percent	Phi Value	Particle Size Inches	Particle Size Millimeters
5	2.32	0.0079	0.201
10	2.44	0.0072	0.184
16	2.56	0.0067	0.170
25	2.69	0.0061	0.155
40	2.90	0.0053	0.134
50	3.03	0.0048	0.122
60	3.17	0.0044	0.111
75	3.42	0.0037	0.094
84	3.65	0.0031	0.080
90	3.97	0.0025	0.064
95	5.92	0.0006	0.016

Measure	Trask	Inman	Folk-Ward
Median, phi	3.03	3.03	3.03
Median, in.	0.0048	0.0048	0.0048
Median, mm	0.122	0.122	0.122
Mean, phi	3.01	3.10	3.08
Mean, in.	0.0049	0.0046	0.0047
Mean, mm	0.124	0.116	0.118
Sorting	1.285	0.546	0.819
Skewness	0.983	0.133	0.369
Kurtosis	0.253	2.298	2.045

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

Description	Retained on Sieve #	Weight Percent
Gravel	4	0.00
Coarse Sand	10	0.00
Medium Sand	40	0.00
Fine Sand	200	87.03
Silt	>0.005 mm	10.06
Clay	<0.005 mm	2.91
	Total	**100**

Appendix C-3. Yearly grain size values, 1990 - 2006. Ormond Beach Generating Station NPDES, 2006.

Year	Station	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Mean grain size phi	Mean grain size µm	Sorting*	Skewness	Kurtosis
2006	B1	0	82.08	14.02	3.9	3.32	100	1.132	0.305	2.091
	B2	0	88.91	8.66	2.43	2.62	163	1.319	0.012	1.156
	B3	0	85.25	10.88	3.87	3.04	122	1.206	0.349	1.957
	B4	0	83.99	12.48	3.53	2.96	128	1.328	0.203	1.576
	B5	0	82.12	14.2	3.68	3.29	102	1.117	0.318	1.955
	B6	0	90.39	6.7	2.91	3.08	118	0.819	0.369	2.045
2005	B1	0.00	87.78	10.57	1.65	3.25	105	0.704	0.021	1.220
	B2	28.38	70.57	1.05	0.00	0.06	962	2.104	-0.546	0.814
	B3	6.28	84.61	9.11	0.00	2.88	136	1.339	-0.431	2.001
	B4	0.00	80.69	15.12	4.19	3.31	101	1.248	0.292	2.116
	B5	0.00	77.86	17.85	4.29	3.47	90	1.203	0.370	2.036
	B6	0.00	94.03	4.70	1.27	3.06	120	0.583	0.027	1.233
2004	B1	0.73	85.86	10.87	2.54	3.24	106	0.84	0.14	1.57
	B2	0.38	89.42	8.08	2.12	2.55	170	1.21	0.12	1.02
	B3	7.47	81.15	8.30	3.08	2.49	178	1.76	0.08	2.72
	B4	0.67	83.83	12.00	3.50	3.07	119	1.25	0.15	1.89
	B5	2.88	79.81	13.43	3.88	3.11	116	1.28	0.30	1.80
	B6	0.00	92.12	5.83	2.05	2.93	131	0.78	0.14	1.67
2003	B1	-	-	-	-	-	-	-	-	-
	B2	0.00	88.59	9.40	2.01	2.88	136	1.10	-0.18	1.07
	B3	0.00	81.58	15.15	3.27	3.04	121	1.29	0.27	1.48
	B4	0.00	84.32	12.66	3.02	3.10	117	1.18	0.03	1.65
	B5	0.00	86.99	10.30	2.71	3.09	118	1.00	0.19	1.62
	B6	-	-	-	-	-	-	-	-	-
2002	B1	0.00	86.67	11.57	1.76	3.28	103	0.73	0.11	1.36
	B2	0.00	87.86	10.65	1.49	3.17	111	0.94	-0.24	1.64
	B3	0.00	90.43	7.74	1.83	2.93	131	0.81	0.23	1.33
	B4	0.00	88.70	9.77	1.53	3.21	108	0.74	0.01	1.34
	B5	0.00	91.79	6.96	1.25	2.93	131	0.79	-0.01	1.06
	B6	0.00	90.73	7.92	1.35	3.20	109	0.61	0.09	1.32
2001	B1	0.00	86.36	10.98	2.66	3.06	120	1.25	-0.04	1.97
	B2	0.00	91.91	6.71	1.38	2.60	165	1.24	-0.34	0.97
	B3	0.00	82.61	14.79	2.60	3.39	95	0.94	0.14	1.94
	B4	0.00	88.59	9.53	1.88	3.30	102	0.66	0.03	1.35
	B5	0.00	90.64	7.75	1.61	2.91	133	0.87	-0.01	1.12
	B6	0.00	94.47	4.53	1.00	3.01	124	0.59	0.01	1.15
2000	B1	0.00	84.99	13.01	2.00	3.31	101	0.81	0.09	1.50
	B2	0.00	85.76	12.58	1.66	3.44	92	0.60	0.03	1.30
	B3	0.00	92.90	5.73	1.37	2.87	137	0.79	-0.03	1.10
	B4	0.00	90.23	8.39	1.38	3.21	108	0.67	-0.03	1.21
	B5	0.00	90.54	7.84	1.62	2.95	129	0.81	0.10	1.14
	B6	0.00	96.03	3.04	0.93	2.72	152	0.59	0.01	1.15
1999	B1	0.00	84.36	13.08	2.56	3.14	113	1.08	0.07	1.63
	B2	0.00	86.01	11.82	2.17	3.10	117	1.16	-0.13	1.82
	B3	0.00	89.90	7.87	2.23	3.24	106	0.61	0.17	1.23
	B4	0.00	90.55	7.83	1.62	2.90	134	0.92	-0.11	1.16
	B5	0.00	91.09	7.27	1.64	2.88	136	0.85	0.06	1.23
	B6	0.00	95.66	3.34	1.00	2.80	144	0.71	-0.12	1.11
1998	B1	-	-	-	-	-	-	-	-	-
	B2	0.27	78.33	19.63	1.76	3.66	79	62.10	0.02	1.45
	B3	0.41	91.15	7.08	1.36	3.13	114	60.81	0.07	1.30
	B4	0.67	81.94	15.28	2.11	3.47	90	59.27	-0.09	1.39
	B5	-	-	-	-	-	-	-	-	-
	B6	-	-	-	-	-	-	-	-	-
1997	B1	0.44	86.56	11.41	1.58	3.37	97	61.85	-0.01	1.26
	B2	0.00	83.63	14.79	1.58	3.57	84	63.73	-0.10	1.46
	B3	0.39	93.45	4.30	1.86	2.34	198	48.90	0.12	0.88
	B4	0.02	85.99	11.84	2.15	3.47	90	63.41	-0.06	1.33
	B5	0.29	90.33	7.75	1.63	3.09	118	58.55	0.16	1.20
	B6	0.30	95.00	3.47	1.23	3.02	124	61.02	-0.12	1.03

Appendix C-3. (Cont.).

Year	Station	Gravel (%)	Sand (%)	Silt (%)	Clay (%)	Mean grain size phi	Mean grain size μm	Sorting*	Skewness	Kurtosis
1994	B1	0.33	84.21	15.46	0.00	3.35	98	64.36	-0.17	1.00
	B2	0.00	81.66	18.34	0.00	3.57	84	72.11	-0.11	1.12
	B3	0.06	97.55	2.31	0.07	2.05	241	63.01	0.04	1.15
	B4	0.00	86.52	13.28	0.20	3.30	102	65.07	-0.18	1.06
	B5	3.17	88.41	7.87	0.54	2.95	129	59.27	-0.11	1.12
	B6	0.33	94.86	4.71	0.10	3.30	102	76.01	-0.06	0.92
1993	B1	0.89	95.27	3.20	0.64	2.60	165	NA	NA	NA
	B2	0.00	98.96	0.52	0.52	2.21	216	NA	NA	NA
	B3	11.45	86.26	1.64	0.65	1.93	262	NA	NA	NA
	B4	3.96	92.91	2.69	0.45	2.48	179	NA	NA	NA
	B5	0.99	96.05	2.22	0.74	2.20	217	NA	NA	NA
	B6	0.28	98.41	0.44	0.87	2.57	168	NA	NA	NA
1992	B1	0.58	88.55	10.23	0.64	3.18	110	NA	NA	NA
	B2	0.04	94.23	4.59	1.15	3.00	125	NA	NA	NA
	B3	0.73	93.57	5.13	0.57	2.98	127	NA	NA	NA
	B4	1.44	90.47	7.28	0.81	3.10	117	NA	NA	NA
	B5	2.18	91.68	5.41	0.72	2.78	146	NA	NA	NA
	B6	6.81	92.28	0.69	0.23	2.62	163	NA	NA	NA
1991	B1	1.15	88.18	9.07	1.60	2.70	154	NA	NA	NA
	B2	0.01	91.72	7.17	1.10	2.70	154	NA	NA	NA
	B3	4.97	82.31	5.53	1.01	1.38	380	NA	NA	NA
	B4	0.83	89.46	8.00	1.71	2.80	144	NA	NA	NA
	B5	0.09	88.21	9.94	1.75	2.88	136	NA	NA	NA
	B6	0.57	92.83	5.50	1.10	2.90	134	NA	NA	NA
1990	B1	1.31	82.68	15.57	0.43	3.13	114	58.38	0.09	1.25
	B2	13.65	69.89	15.93	0.53	1.95	258	35.96	-0.60	1.67
	B3	0.00	93.06	6.25	0.69	2.93	131	66.26	0.11	1.41
	B4	0.00	82.05	17.81	0.14	3.55	86	71.74	0.26	0.98
	B5	0.00	95.32	4.00	0.68	2.74	150	70.61	0.12	1.39
	B6	0.22	93.36	6.02	0.40	2.82	142	60.83	-0.14	0.99
1988	B1	0.00	71.56	28.24	0.20	3.54	87	61.67	0.28	0.87
	B2	0.00	74.34	24.86	0.80	3.48	89	57.90	0.09	1.16
	B3	0.50	94.76	3.90	0.84	2.50	177	61.77	0.17	1.42
	B4	1.14	82.27	16.59	0.00	3.36	97	66.03	0.31	1.31
	B5	0.08	83.61	15.09	1.30	3.08	118	55.51	-0.01	1.05
	B6	2.17	93.98	3.02	0.82	2.76	148	72.40	0.16	1.59
1986	B1	0.00	84.19	15.68	0.00	3.24	105	30.60	-0.42	1.04
	B2	0.00	81.71	17.78	0.00	2.97	128	12.85	-0.04	0.72
	B3	0.00	87.38	12.34	0.28	3.03	123	43.02	0.23	1.11
	B4	0.00	79.96	19.78	0.25	3.54	87	49.24	0.12	1.04
	B5	0.58	92.14	6.47	0.81	2.48	179	50.81	0.35	1.01
	B6	0.74	91.32	7.50	0.44	3.07	119	55.67	-0.21	1.17
1980	B1	0.00	96.91	2.98	0.00	2.19	218	0.93	1.62	1.03
	B2	0.00	64.87	31.14	3.92	3.64	80	0.71	0.08	2.35
	B3	0.00	95.88	2.63	1.49	2.28	205	0.45	0.07	1.40
	B4	0.00	84.08	13.59	2.25	3.39	95	0.61	0.36	1.81
	B5	0.00	83.03	14.71	2.26	3.16	111	0.87	0.34	0.67
	B6	0.00	93.05	4.89	2.06	2.93	131	0.71	-0.08	1.19
1978[1]	B1	0.00	53.4	46.6		3.92	66	1.19	0.26	NA
	B2	0.00	58.6	41.4		3.88	68	0.69	0.08	NA
	B3	0.00	94.5	5.5		2.40	190	0.69	0.09	NA
	B4	0.00	68.9	30.9		3.69	78	0.74	0.01	NA
	B5	0.50	77.0	22.5		3.23	106	1.21	0.03	NA
	B6	0.20	84.6	15.2		2.87	137	0.99	0.10	NA

NA = Not Available
- = Not Required
*Sorting values: % 1986 - 1998
ϕ 1978 & 1980, 1999 - present
1 = Silt and Clay combined

APPENDIX D

Sediment chemistry by station

Calscience Environmental Laboratories, Inc.

Analytical Report

MBC Applied Environmental Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524

Date Received:	08/31/06
Work Order No:	06-08-1815
Preparation:	EPA 3050B
Method:	EPA 6020
Units:	mg/kg

Project: OBGS NPDES 05203A

Page 1 of 1

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B1 (I,II,III)	**06-08-1815-19**	**08/24/06**	**Solid**	**08/31/06**	**09/13/06**	**060831L03A**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Chromium	9.16	0.13	1.33		Nickel	7.04	0.13	1.33	
Copper	3.67	0.13	1.33		Zinc	25.0	1.3	1.33	

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B2 (I,II,III)	**06-08-1815-20**	**08/24/06**	**Solid**	**08/31/06**	**09/13/06**	**060831L03A**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Chromium	8.17	0.13	1.30		Nickel	6.40	0.13	1.30	
Copper	3.22	0.13	1.30		Zinc	21.8	1.3	1.30	

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B3 (I,II,III)	**06-08-1815-21**	**08/24/06**	**Solid**	**08/31/06**	**09/13/06**	**060831L03A**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Chromium	8.67	0.13	1.33		Nickel	7.59	0.13	1.33	
Copper	3.99	0.13	1.33		Zinc	24.5	1.3	1.33	

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B4 (I,II,III)	**06-08-1815-22**	**08/24/06**	**Solid**	**08/31/06**	**09/13/06**	**060831L03A**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Chromium	7.42	0.13	1.32		Nickel	6.58	0.13	1.32	
Copper	3.05	0.13	1.32		Zinc	20.2	1.3	1.32	

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B5 (I,II,III)	**06-08-1815-23**	**08/24/06**	**Solid**	**08/31/06**	**09/13/06**	**060831L03A**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Chromium	8.72	0.13	1.33		Nickel	7.52	0.13	1.33	
Copper	4.17	0.13	1.33		Zinc	24.9	1.3	1.33	

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B6 (I,II,III)	**06-08-1815-24**	**08/24/06**	**Solid**	**08/31/06**	**09/13/06**	**060831L03A**

Comment(s): -Results are reported on a dry weight basis.

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Chromium	2.74	0.04	0.446		Nickel	2.50	0.04	0.446	
Copper	5.15	0.04	0.446		Zinc	7.74	0.45	0.446	

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
Method Blank	**096-10-002-735**	**N/A**	**Solid**	**08/31/06**	**08/31/06**	**060831L03A**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Chromium	ND	0.100	1		Nickel	ND	0.100	1	
Copper	ND	0.100	1		Zinc	ND	1.00	1	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

MBC Applied Environmental Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524

Date Received:	08/31/06
Work Order No:	06-08-1815
Preparation:	N/A
Method:	EPA 160.3

Project: OBGS NPDES 05203A

Page 1 of 1

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B1 (I,II,III)	**06-08-1815-19**	**08/24/06**	**Solid**	**N/A**	**08/31/06**	**60831TSD1**

Parameter	Result	RL	DF	Qual	Units
Solids, Total	75.0	0.1	1		%

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B2 (I,II,III)	**06-08-1815-20**	**08/24/06**	**Solid**	**N/A**	**08/31/06**	**60831TSD1**

Parameter	Result	RL	DF	Qual	Units
Solids, Total	76.7	0.1	1		%

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B3 (I,II,III)	**06-08-1815-21**	**08/24/06**	**Solid**	**N/A**	**08/31/06**	**60831TSD1**

Parameter	Result	RL	DF	Qual	Units
Solids, Total	74.5	0.1	1		%

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B4 (I,II,III)	**06-08-1815-22**	**08/24/06**	**Solid**	**N/A**	**08/31/06**	**60831TSD1**

Parameter	Result	RL	DF	Qual	Units
Solids, Total	75.9	0.1	1		%

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B5 (I,II,III)	**06-08-1815-23**	**08/24/06**	**Solid**	**N/A**	**08/31/06**	**60831TSD1**

Parameter	Result	RL	DF	Qual	Units
Solids, Total	74.7	0.1	1		%

Client Sample Number	Lab Sample Number	Date Collected	Matrix	Date Prepared	Date Analyzed	QC Batch ID
OBGS B6 (I,II,III)	**06-08-1815-24**	**08/24/06**	**Solid**	**N/A**	**08/31/06**	**60831TSD1**

Parameter	Result	RL	DF	Qual	Units
Solids, Total	74.8	0.1	1		%

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

MBC Applied Environmental Sciences		Date Received:	08/31/06
3000 Redhill Avenue		Work Order No:	06-08-1815
Costa Mesa, CA 92626-4524		Preparation:	EPA 3050B
		Method:	EPA 6020

Project OBGS NPDES 05203A

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
06-08-1746-1	**Solid**	**ICP/MS A**	**08/31/06**	**08/31/06**	**060831S03**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Chromium	119	113	80-120	3	0-20	
Copper	111	106	80-120	2	0-20	
Nickel	115	114	80-120	1	0-20	
Zinc	116	121	80-120	1	0-20	3

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Duplicate

MBC Applied Environmental Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524

Date Received:	08/31/06
Work Order No:	06-08-1815
Preparation:	N/A
Method:	EPA 160.3

Project: OBGS NPDES 05203A

Quality Control Sample ID	Matrix	Instrument	Date Prepared:	Date Analyzed:	Duplicate Batch Number
06-08-1816-16	**Solid**	**N/A**	**N/A**	**08/31/06**	**60831TSD1**

Parameter	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
Solids, Total	77.3	77.1	0	0-25	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

MBC Applied Environmental Sciences
3000 Redhill Avenue
Costa Mesa, CA 92626-4524

Date Received:	N/A
Work Order No:	06-08-1815
Preparation:	EPA 3050B
Method:	EPA 6020

Project: OBGS NPDES 05203A

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
096-10-002-735	**Solid**	**ICP/MS A**	**08/31/06**	**08/31/06**	**060831L03A**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Chromium	106	109	80-120	2	0-20	
Copper	102	101	80-120	2	0-20	
Nickel	103	102	80-120	1	0-20	
Zinc	107	106	80-120	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order Number: 06-08-1815

Qualifier	Definition
*	See applicable analysis comment.
1	Surrogate compound recovery was out of control due to a required sample dilution, therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike or Matrix Spike Duplicate compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported with no further corrective action required.
A	Result is the average of all dilutions, as defined by the method.
B	Analyte was present in the associated method blank.
C	Analyte presence was not confirmed on primary column.
E	Concentration exceeds the calibration range.
H	Sample received and/or analyzed past the recommended holding time.
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
N	Nontarget Analyte.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
U	Undetected at the laboratory method detection limit.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Appendix D-2. Yearly sediment metal concentrations, 1990 - 2006. Ormond Beach Generating Station NPDES, 2006.

		Year															
Metal	Station	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Mean
Chromium	B1	9.9	19.3	10.0	8.8	10.0	8.6	-	6.9	10.0	13	13	-	9.1	8.22	9.16	10
ERL = 81	B2	9.3	37.5	9.6	8.9	10.0	9.4	8.1	9.9	9.0	12	11	8.1	7.6	3.29	8.17	11
	B3	7.4	13.3	5.7	9.1	12.0	6.1	5.8	10.0	11.0	9.9	8.7	8.7	7.4	7.60	8.67	8.8
	B4	8.0	17.7	9.6	8.8	7.9	7.9	7.9	7.8	10.0	14	11	11	10	7.17	7.42	10
	B5	8.2	17.3	8.6	7.8	8.6	8.0	-	7.4	6.1	15	11	9.4	8.5	6.17	8.72	9
	B6	5.9	10.8	8.4	8.0	9.9	5.4	-	7.8	10.0	9.6	13	-	8.0	6.27	2.74	8
Copper	B1	2.9	8.8	5.0	4.2	4.3	1.6	-	3.9	3.9	4.3	3.9	-	3.5	3.72	3.67	4.1
ERL = 34	B2	2.2	24.3	5.0	4.1	4.5	2.0	3.5	4.7	4.1	4.0	3.9	2.8	2.8	1.61	3.22	4.8
	B3	1.6	10.6	10.4	5.4	4.3	1.5	3.1	4.2	20.0	3.5	3.4	3.3	3.1	3.57	3.99	5.5
	B4	1.7	11.1	5.2	4.6	3.9	1.3	3.0	4.3	4.1	4.5	3.5	3.9	11	3.15	3.05	4.6
	B5	2.4	11.2	5.0	4.4	4.3	1.8	-	4.1	3.6	6.4	3.9	4.8	3.6	3.52	4.17	4.5
	B6	1.3	6.0	4.9	4.1	5.1	0.0	-	4.7	3.9	3.8	4.1	-	3.7	3.13	5.15	3.8
Nickel	B1	5.7	13.2	7.2	6.6	6.2	6.0	-	5.7	6.9	8.8	7.1	-	5.9	6.73	7.04	7.2
ERL = 20.9	B2	5.7	20.0	7.3	6.1	6.3	7.2	3.6	7.7	6.8	8.0	7.3	5.9	4.9	3.73	6.40	7.1
	B3	4.4	8.4	8.4	6.9	8.2	4.4	3.6	7.7	6.1	6.9	6.3	6.7	5.8	6.64	7.59	6.5
	B4	4.8	11.6	7.4	7.1	5.6	5.8	4.0	7.0	7.1	9.5	7.0	7.6	6.3	6.12	6.58	6.9
	B5	5.3	13.1	6.7	6.4	6.1	5.5	-	6.1	5.7	8.6	7.0	7.9	6.1	6.23	7.52	7.0
	B6	3.9	8.4	7.4	6.9	7.1	4.8	-	7.6	8.2	7.4	7.8	-	6.7	6.76	2.50	6.6
Zinc	B1	20.0	28.1	21.8	23	21	23	-	21	26	20	21	-	20	19.7	25.0	22
ERL = 150	B2	18.9	32.5	22.5	22	22	25	15	27	25	19	22	18	16	6.82	21.8	21
	B3	15.7	13.0	25.9	23	16	14	14	26	31	16	18	19	16	17.6	24.5	19
	B4	16.7	22.6	23.4	22	19	20	14	23	27	23	20	22	21	18.6	20.2	21
	B5	17.6	37.3	20.5	21	21	21	-	20	22	26	20	24	21	33.9	24.9	24
	B6	13.0	23.3	20.3	20	24	15	-	19	27	21	22	-	19	17.6	7.74	19
Fines	B1	15.6	10.7	10.9	3.8	15.5	13.0	-	15.6	15.0	13.6	13.3	-	13.4	12.22	17.92	13.1
	B2	15.9	8.3	5.7	1.0	18.3	16.4	21.4	14.0	14.2	8.1	12.1	11.4	10.2	1.05	11.09	11.3
	B3	6.9	6.6	5.7	2.3	2.3	6.2	8.4	10.1	7.1	17.4	9.6	18.4	11.4	9.11	14.75	9.1
	B4	18.0	9.7	8.1	3.1	13.3	14.0	17.4	9.5	9.8	11.4	11.3	15.7	15.5	19.31	16.01	12.8
	B5	4.7	11.7	6.1	3.0	8.4	9.4	-	8.9	9.5	9.4	8.2	13.0	17.3	22.14	17.88	10.7
	B6	6.0	6.6	0.9	1.3	4.7	4.7	-	4.3	4.0	5.5	9.3	-	7.9	5.97	9.61	5.4

ERL = Effects Range Low
- = not required

APPENDIX E

Mussel tissue chemistry by station

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169f*

CRG ID#:	*46671*	**Sample Description:**	OBGS MT-I 06-11-0211	**Date Sampled:**	20-Oct-06
Replicate #:	R1			**Date Received:**	02-Nov-06
DILUTION FACTOR:	1	**Matrix:**	Tissue		

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	6.97	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Copper (Cu)	NA	EPA 6020m	5.806	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Nickel (Ni)	NA	EPA 6020m	1.016	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Zinc (Zn)	NA	EPA 6020m	80.624	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46671 R1

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID: *26169f***

CRG ID#: *46671*
Replicate #: R2
DILUTION FACTOR: 1

Sample Description: OBGS MT-I 06-11-0211
Matrix: Tissue

Date Sampled: 20-Oct-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	6.57	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Copper (Cu)	NA	EPA 6020m	5.802	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Nickel (Ni)	NA	EPA 6020m	0.981	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Zinc (Zn)	NA	EPA 6020m	82.294	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46671 R2

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: ***Calscience Environmental Laboratories, Inc.*** **CRG Project ID:** ***26169f***

CRG ID#: ***46672***
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: OBGS MT-II 06-11-0211
Matrix: Tissue

Date Sampled: 20-Oct-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	6.07	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Copper (Cu)	NA	EPA 6020m	5.665	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Nickel (Ni)	NA	EPA 6020m	1.06	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Zinc (Zn)	NA	EPA 6020m	74.184	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46672 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169f*

CRG ID#: *46673*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: OBGS MT-III 06-11-0211
Matrix: Tissue

Date Sampled: 20-Oct-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	6.55	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Copper (Cu)	NA	EPA 6020m	6.238	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Nickel (Ni)	NA	EPA 6020m	1.92	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Zinc (Zn)	NA	EPA 6020m	78.074	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46673 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169f*

CRG ID#: *46671*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: OBGS MT-I 06-11-0211
Matrix: Tissue

Date Sampled: 20-Oct-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	16	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169f-112807

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46671 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

General Chemistry

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169f*

CRG ID#:	*46672*	**Sample Description:**	OBGS MT-II 06-11-0211	**Date Sampled:**	20-Oct-06
Replicate #:	R1			**Date Received:**	02-Nov-06
DILUTION FACTOR:	1	**Matrix:**	Tissue		

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	15.6	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169f-112808

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46672 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* — **CRG Project ID:** *26169f*

CRG ID#: 46673
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: OBGS MT-III 06-11-0211
Matrix: Tissue

Date Sampled: 20-Oct-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	16.5	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169f-112809

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46673 R1

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169f*

CRG ID#: *46670*
Replicate #: B1
DILUTION FACTOR: 1

Sample Description: QAQC 06-11-0211 Procedural Blank
Matrix: DI Water

Date Sampled:
Date Received:

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Copper (Cu)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Nickel (Ni)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056
Zinc (Zn)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169f-15056

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46670 B1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

General Chemistry

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169f*

CRG ID#: *46670*
Replicate #: B1
DILUTION FACTOR: 1

Sample Description: QAQC 06-11-0211 Procedural Blank
Matrix: DI Water

Date Sampled:
Date Received:

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	ND	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169f-112806

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46670 B1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: ***Calscience Environmental Laboratories, Inc.*** **CRG Project ID:** ***26169f***

CRG ID#:	***48253***	**Sample Description:**	QAQC 06-11-0211	CRM (NRC DORM-2)		**Date Sampled:**	
Replicate #:	CRM1					**Date Received:**	
Batch ID:	26169f-15056	**Matrix:**	Tissue			**Date Processed:**	28-Nov-06
Instrument:	ICPMS #1 HP 4500	**Analyst:**	P. Hershelman			**Date Analyzed:**	30-Nov-06

CONSTITUENT	METHOD	RESULT	UNITS	TRUE VALUE	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	EPA 6020m	34.53	µg/dry g	34.7	26.0 - 43.4	PASS
Copper (Cu)	EPA 6020m	2.208	µg/dry g	2.34	1.75 - 2.92	PASS
Nickel (Ni)	EPA 6020m	18.37	µg/dry g	19.4	14.5 - 24.2	PASS
Zinc (Zn)	EPA 6020m	22.694	µg/dry g	25.6	19.2 - 32.0	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Level; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
48253 CRM1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: Calscience Environmental Laboratories, Inc. **CRG Project ID: 26169f**

CRG ID#:	*48253*	**Sample Description:**	QAQC 06-11-0211	CRM (NRC DORM-2)	**Date Sampled:**	
Replicate #:	CRM2				**Date Received:**	
Batch ID:	26169f-15056	**Matrix:**	Tissue		**Date Processed:**	28-Nov-06
Instrument:	ICPMS #1 HP 4500	**Analyst:**	P. Hershelman		**Date Analyzed:**	30-Nov-06

CONSTITUENT	METHOD	RESULT	UNITS	TRUE VALUE	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	EPA 6020m	35.67	µg/dry g	34.7	26.0 - 43.4	PASS
Copper (Cu)	EPA 6020m	2.361	µg/dry g	2.34	1.75 - 2.92	PASS
Nickel (Ni)	EPA 6020m	18.55	µg/dry g	19.4	14.5 - 24.2	PASS
Zinc (Zn)	EPA 6020m	24.894	µg/dry g	25.6	19.2 - 32.0	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Level; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
48253 CRM2

Appendix E-1. (Cont.).

Sample ID: **46671-MS1/MS2** **OBGS MT-I** *Date Sampled:* **10/20/2006**

Parameter	*Non-Spiked Sample Concentration*			*Matrix Spike Results*					*Matrix Spike Duplicate Results*					*Acceptance Range*
	Rep-1	*Rep-2*	*Mean*	*Gross Conc.*	*Net Conc.*	*Spike Conc.*	*Percent Recovery*	*Comment*	*Gross Conc.*	*Net Conc.*	*Spike Conc.*	*Percent Recovery*	*Comment*	
Trace Metals				*Batch ID:***26169d-15055**										
Chromium (Cr)	0.18	0.18	0.18	2.1	1.92	2	**96**	PASS	2.07	1.89	2	**94**	PASS	55 - 135%
Copper (Cu)	0.136	0.136	0.136	2.113	1.977	2	**99**	PASS	2.073	1.937	2	**97**	PASS	65 - 125%
Nickel (Ni)	0.024	0.024	0.024	2.066	2.042	2	**102**	PASS	2.025	2.001	2	**100**	PASS	70 - 130%
Zinc (Zn)	1.886	1.886	1.886	3.797	1.911	2	**96**	PASS	3.744	1.858	2	**93**	PASS	60 - 120%

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: ***Calscience Environmental Laboratories, Inc.*** **CRG Project ID:** ***26169f***

CRG ID#:	***48253***	**Sample Description:**	QAQC 06-11-0211	CRM (NRC DORM-2)	**Date Sampled:**	
Batch ID:	26169f-15056	**Matrix:**	Tissue		**Date Received:**	
					Date Processed:	28-Nov-06
					Date Analyzed:	30-Nov-06

CONSTITUENT	FRACTION	METHOD	CRM1 µg/dry g	CRM2 µg/dry g	% RPD	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	NA	EPA 6020m	34.53	35.67	3	0 - 30%	PASS
Copper (Cu)	NA	EPA 6020m	2.208	2.361	7	0 - 30%	PASS
Nickel (Ni)	NA	EPA 6020m	18.37	18.55	1	0 - 30%	PASS
Zinc (Zn)	NA	EPA 6020m	22.694	24.894	9	0 - 30%	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
48253

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169f*

CRG ID#: *46671*
Batch ID: 26169d-15055

Sample Description: OBGS MT-I 06-11-0211
Matrix: Tissue

Date Sampled: 20-Oct-06
Date Received: 02-Nov-06
Date Processed: 28-Nov-06
Date Analyzed: 30-Nov-06

CONSTITUENT	FRACTION	METHOD	MS1 µg	MS2 µg	% RPD	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	NA	EPA 6020m	2.1	2.07	1	0 - 30%	PASS
Copper (Cu)	NA	EPA 6020m	2.113	2.073	2	0 - 30%	PASS
Nickel (Ni)	NA	EPA 6020m	2.066	2.025	2	0 - 30%	PASS
Zinc (Zn)	NA	EPA 6020m	3.797	3.744	1	0 - 30%	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
46671

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169f*

CRG ID#: *46671*

Batch ID: 26169f-15056

Sample Description: OBGS MT-I 06-11-0211

Matrix: Tissue

Date Sampled: 20-Oct-06
Date Received: 02-Nov-06
Date Processed: 28-Nov-06
Date Analyzed: 30-Nov-06

CONSTITUENT	FRACTION	METHOD	R1 µg/dry g	R2 µg/dry g	% RPD	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	NA	EPA 6020m	6.97	6.57	6	0 - 30%	PASS
Copper (Cu)	NA	EPA 6020m	5.806	5.802	0	0 - 30%	PASS
Nickel (Ni)	NA	EPA 6020m	1.016	0.981	4	0 - 30%	PASS
Zinc (Zn)	NA	EPA 6020m	80.624	82.294	2	0 - 30%	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
46671

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#: *46653*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: Control MT-I 06-11-0208
Matrix: Tissue

Date Sampled: 18-Jul-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	5.31	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Copper (Cu)	NA	EPA 6020m	4.686	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Nickel (Ni)	NA	EPA 6020m	0.467	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Zinc (Zn)	NA	EPA 6020m	89.134	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46653 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#: *46653*
Replicate #: R2
DILUTION FACTOR: 1

Sample Description: Control MT-I 06-11-0208
Matrix: Tissue

Date Sampled: 18-Jul-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	6.47	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Copper (Cu)	NA	EPA 6020m	4.374	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Nickel (Ni)	NA	EPA 6020m	0.479	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Zinc (Zn)	NA	EPA 6020m	90.194	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46653 R2

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: ***Calscience Environmental Laboratories, Inc.*** **CRG Project ID:** ***26169c***

CRG ID#: ***46654***
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: Control MT-II 06-11-0208
Matrix: Tissue

Date Sampled: 18-Jul-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	7.34	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Copper (Cu)	NA	EPA 6020m	4.792	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Nickel (Ni)	NA	EPA 6020m	0.503	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Zinc (Zn)	NA	EPA 6020m	89.064	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46654 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#: *46655*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: Control MT-III 06-11-0208
Matrix: Tissue

Date Sampled: 18-Jul-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	9.92	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Copper (Cu)	NA	EPA 6020m	9.19	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Nickel (Ni)	NA	EPA 6020m	0.861	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Zinc (Zn)	NA	EPA 6020m	105.954	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46655 R1

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: ***Calscience Environmental Laboratories, Inc.*** **CRG Project ID:** ***26169c***

CRG ID#: *46653*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: Control MT-I 06-11-0208
Matrix: Tissue

Date Sampled: 18-Jul-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	19.6	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169c-112806

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46653 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

General Chemistry

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#: *46653*
Replicate #: R2
DILUTION FACTOR: 1

Sample Description: Control MT-I 06-11-0208
Matrix: Tissue

Date Sampled: 18-Jul-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	19.7	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169c-112806

CONTROL SITE

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46653 R2

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#: *46654*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: Control MT-II 06-11-0208
Matrix: Tissue

Date Sampled: 18-Jul-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	18.8	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169c-112806

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46654 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

General Chemistry

Client: ***Calscience Environmental Laboratories, Inc.*** **CRG Project ID:** ***26169c***

CRG ID#: ***46655***
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: Control MT-III 06-11-0208
Matrix: Tissue

Date Sampled: 18-Jul-06
Date Received: 02-Nov-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	17.4	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169c-112806

CONTROL SITE

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46655 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#: *46652*
Replicate #: B1
DILUTION FACTOR: 1

Sample Description: QAQC 06-11-0208 Procedural Blank
Matrix: DI Water

Date Sampled:
Date Received:

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Copper (Cu)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Nickel (Ni)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055
Zinc (Zn)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	28-Nov-06	30-Nov-06	26169c-15055

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46652 B1

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

General Chemistry

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#: *46652*
Replicate #: B1
DILUTION FACTOR: 1

Sample Description: QAQC 06-11-0208 Procedural Blank
Matrix: DI Water

Date Sampled:
Date Received:

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	ND	Percent	0.1	0.1	28-Nov-06	28-Nov-06	26169c-112806

CONTROL SITE

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
46652 B1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#:	*48250*	**Sample Description:**	QAQC 06-11-0208	CRM (NRC DORM-2)	**Date Sampled:**	
Replicate #:	CRM1				**Date Received:**	
Batch ID:	26169c-15055	**Matrix:**	Tissue		**Date Processed:**	28-Nov-06
Instrument:	ICPMS #1 HP 4500	**Analyst:**	P. Hershelman		**Date Analyzed:**	30-Nov-06

CONSTITUENT	METHOD	RESULT	UNITS	TRUE VALUE	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	EPA 6020m	34.53	µg/dry g	34.7	26.0 - 43.4	PASS
Copper (Cu)	EPA 6020m	2.208	µg/dry g	2.34	1.75 - 2.92	PASS
Nickel (Ni)	EPA 6020m	18.37	µg/dry g	19.4	14.5 - 24.2	PASS
Zinc (Zn)	EPA 6020m	22.694	µg/dry g	25.6	19.2 - 32.0	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Level; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
48250 CRM1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#: *48250*
Replicate #: CRM2
Batch ID: 26169c-15055
Instrument: ICPMS #1 HP 4500

Sample Description: QAQC 06-11-0208 CRM (NRC DORM-2)
Matrix: Tissue
Analyst: P. Hershelman

Date Sampled:
Date Received:
Date Processed: 28-Nov-06
Date Analyzed: 30-Nov-06

CONSTITUENT	METHOD	RESULT	UNITS	TRUE VALUE	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	EPA 6020m	35.67	µg/dry g	34.7	26.0 - 43.4	PASS
Copper (Cu)	EPA 6020m	2.361	µg/dry g	2.34	1.75 - 2.92	PASS
Nickel (Ni)	EPA 6020m	18.55	µg/dry g	19.4	14.5 - 24.2	PASS
Zinc (Zn)	EPA 6020m	24.894	µg/dry g	25.6	19.2 - 32.0	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Level; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
48250 CRM2

CRG Marine Laboratories, Inc.
MATRIX SPIKE QAQC REPORT
Project ID: 26169c

Sample ID: 46653-MS1/MS2 Control MT-I

Date Sampled: 7/18/2006

Parameter	*Non-Spiked Sample Concentration*			*Matrix Spike Results*					*Matrix Spike Duplicate Results*					*Acceptance Range*
	Rep-1	*Rep-2*	*Mean*	*Gross Conc.*	*Net Conc.*	*Spike Conc.*	*Percent Recovery*	*Comment*	*Gross Conc.*	*Net Conc.*	*Spike Conc.*	*Percent Recovery*	*Comment*	
Trace Metals				*Batch ID:*26169c-15055										
Chromium (Cr)	0.17	0.17	0.17	1.98	1.81	2	**91**	PASS	2.03	1.86	2	**93**	PASS	55 - 135%
Copper (Cu)	0.124	0.124	0.124	2	1.876	2	**94**	PASS	2.056	1.932	2	**97**	PASS	65 - 125%
Nickel (Ni)	0.014	0.014	0.014	1.954	1.94	2	**97**	PASS	2.006	1.992	2	**100**	PASS	70 - 130%
Zinc (Zn)	2.445	2.445	2.445	4.289	1.844	2	**92**	PASS	4.299	1.854	2	**93**	PASS	60 - 120%

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#:	*48250*	**Sample Description:**	QAQC 06-11-0208	CRM (NRC DORM-2)		**Date Sampled:**	
						Date Received:	
Batch ID:	26169c-15055	**Matrix:**	Tissue			**Date Processed:**	28-Nov-06
						Date Analyzed:	30-Nov-06

CONSTITUENT	FRACTION	METHOD	CRM1 µg/dry g	CRM2 µg/dry g	% RPD	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	NA	EPA 6020m	34.53	35.67	3	0 - 30%	PASS
Copper (Cu)	NA	EPA 6020m	2.208	2.361	7	0 - 30%	PASS
Nickel (Ni)	NA	EPA 6020m	18.37	18.55	1	0 - 30%	PASS
Zinc (Zn)	NA	EPA 6020m	22.694	24.894	9	0 - 30%	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
48250

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Trace Metals

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID: *26169c***

CRG ID#:	*46653*	**Sample Description:**	Control MT-I 06-11-0208	**Date Sampled:**	18-Jul-06
				Date Received:	02-Nov-06
Batch ID:	26169c-15055	**Matrix:**	Tissue	**Date Processed:**	28-Nov-06
				Date Analyzed:	30-Nov-06

CONSTITUENT	FRACTION	METHOD	MS1 µg	MS2 µg	% RPD	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	NA	EPA 6020m	1.98	2.03	2	0 - 30%	PASS
Copper (Cu)	NA	EPA 6020m	2	2.056	3	0 - 30%	PASS
Nickel (Ni)	NA	EPA 6020m	1.954	2.006	3	0 - 30%	PASS
Zinc (Zn)	NA	EPA 6020m	4.289	4.299	0	0 - 30%	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261

46653

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.
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Trace Metals

Client: ***Calscience Environmental Laboratories, Inc.*** **CRG Project ID:** ***26169c***

CRG ID#:	***46653***	**Sample Description:**	Control MT-I 06-11-0208	**Date Sampled:**	18-Jul-06
				Date Received:	02-Nov-06
Batch ID:	26169c-15055	**Matrix:**	Tissue	**Date Processed:**	28-Nov-06
				Date Analyzed:	30-Nov-06

CONSTITUENT	FRACTION	METHOD	R1 µg/dry g	R2 µg/dry g	% RPD	ACCEPTANCE RANGE	COMMENT
Chromium (Cr)	NA	EPA 6020m	5.31	6.47	20	0 - 30%	PASS
Copper (Cu)	NA	EPA 6020m	4.686	4.374	7	0 - 30%	PASS
Nickel (Ni)	NA	EPA 6020m	0.467	0.479	3	0 - 30%	PASS
Zinc (Zn)	NA	EPA 6020m	89.134	90.194	1	0 - 30%	PASS

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

California ELAP Certificate # 2261
46653

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General Chemistry

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26169c*

CRG ID#:	*46653*	**Sample Description:**	Control MT-I 06-11-0208	**Date Sampled:**	18-Jul-06
				Date Received:	02-Nov-06
Batch ID:	26169c-112806	**Matrix:**	Tissue	**Date Processed:**	28-Nov-06
				Date Analyzed:	28-Nov-06

CONSTITUENT	FRACTION	METHOD	R1 Percent	R2 Percent	% RPD	ACCEPTANCE RANGE	COMMENT
Percent Solids	NA	EPA 160.3	19.6	19.7	1	0 - 30%	PASS

CONTROL SITE

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; E= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable.

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Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26170*

CRG ID#: *42296*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: RGS HBP-I mussel 06-08-0125
Matrix: Tissue

Date Sampled: 22-Jun-06 09:36
Date Received: 04-Aug-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	9.17	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Copper (Cu)	NA	EPA 6020m	5.09	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Nickel (Ni)	NA	EPA 6020m	0.48	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Zinc (Zn)	NA	EPA 6020m	70.6	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
42296 R1

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Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26170*

CRG ID#: *42296*
Replicate #: R2
DILUTION FACTOR: 1

Sample Description: RGS HBP-I 06-08-0125 mussel
Matrix: Tissue

Date Sampled: 22-Jun-06 09:36
Date Received: 04-Aug-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	8.43	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Copper (Cu)	NA	EPA 6020m	4.9	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Nickel (Ni)	NA	EPA 6020m	0.47	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Zinc (Zn)	NA	EPA 6020m	70.1	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
42296 R2

Appendix E-1. (Cont.).

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Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26170*

CRG ID#: *42297*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: RGS HBP-II 06-08-0125 mussel
Matrix: Tissue

Date Sampled: 22-Jun-06 09:36
Date Received: 04-Aug-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	9.89	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Copper (Cu)	NA	EPA 6020m	6.7	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Nickel (Ni)	NA	EPA 6020m	0.56	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Zinc (Zn)	NA	EPA 6020m	73.8	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
42297 R1

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26170*

CRG ID#: *42298*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: RGS HBP-III 06-08-0125 mussel
Matrix: Tissue

Date Sampled: 22-Jun-06 09:36
Date Received: 04-Aug-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	11.1	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Copper (Cu)	NA	EPA 6020m	5.73	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Nickel (Ni)	NA	EPA 6020m	0.65	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Zinc (Zn)	NA	EPA 6020m	87.3	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
42298 R1

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26170*

CRG ID#: *42296*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: RGS HBP-I 06-08-0125 mussel
Matrix: Tissue

Date Sampled: 22-Jun-06 09:36
Date Received: 04-Aug-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	17.5	Percent	0.1	0.1	15-Aug-06	15-Aug-06	26170-14054

REFERENCE SITE

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
42296 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26170*

CRG ID#: *42297* **Sample Description:** RGS HBP-II 06-08-0125 mussel **Date Sampled:** 22-Jun-06 09:36
Replicate #: R1 **Date Received:** 04-Aug-06
DILUTION FACTOR: 1 **Matrix:** Tissue

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	15.3	Percent	0.1	0.1	15-Aug-06	15-Aug-06	26170-14054

REFERENCE SITE

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

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42297 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.

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Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26170*

CRG ID#: *42298*
Replicate #: R1
DILUTION FACTOR: 1

Sample Description: RGS HBP-III mussel 06-08-0125
Matrix: Tissue

Date Sampled: 22-Jun-06 09:36
Date Received: 04-Aug-06

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	14.4	Percent	0.1	0.1	15-Aug-06	15-Aug-06	26170-14054

REFERENCE SITE

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
42298 R1

Appendix E-1. (Cont.).

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID: *26170***

CRG ID#: *42295*
Replicate #: B1
DILUTION FACTOR: 1

Sample Description: QAQC 06-08-0125 Procedural Blank
Matrix: DI Water

Date Sampled:
Date Received:

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Chromium (Cr)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Copper (Cu)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Nickel (Ni)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054
Zinc (Zn)	NA	EPA 6020m	ND	µg/dry g	0.025	0.05	14-Aug-06	15-Aug-06	26170-14054

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
42295 B1

CRG Marine Laboratories, Inc.
2020 Del Amo Blvd., Suite 200, Torrance, CA 90501-1206 (310) 533-5190 FAX (310) 533-5003 crglabs@sbcglobal.net

Client: *Calscience Environmental Laboratories, Inc.* **CRG Project ID:** *26170*

CRG ID#: *42295*
Replicate #: B1
DILUTION FACTOR: 1

Sample Description: QAQC 06-08-0125 Procedural Blank
Matrix: DI Water

Date Sampled:
Date Received:

CONSTITUENT	FRACTION	METHOD	RESULT	UNITS	MDL	RL	DATE PROCESSED	DATE ANALYZED	BATCH ID
Percent Solids	NA	EPA 160.3	ND	Percent	0.1	0.1	15-Aug-06	15-Aug-06	26170-14054

REFERENCE SITE

MDL= Method Detection Limit (CFR 40 Part 136); RL= Reporting Limit; J= Estimated Value below the RL and above the MDL; ND= Not Detected; NA= Not Applicable; MI = Matrix Interferance

California ELAP Certificate # 2261
42295 B1

Appendix E-2. Yearly mussel tissue metal concentrations (mg/dry kg), 1990 - 2006. Ormond Beach Generating Station NPDES, 2006.

	Chromium					Copper					Nickel					Zinc				
	Rep 1	Rep 2	Rep 3	Mean	SD	Rep 1	Rep 2	Rep 3	Mean	SD	Rep 1	Rep 2	Rep 3	Mean	SD	Rep 1	Rep 2	Rep 3	Mean	SD
2006	6.97	6.07	6.55	6.53	0.45	5.806	5.665	6.238	5.903	0.299	1.016	1.06	1.92	1.33	0.51	82.294	74.184	78.074	78.184	4.056
2005	3.23	3.23	5.06	3.84	1.06	8.54	12.8	12.4	11.25	2.35	7.55	3.49	10.6	7.21	3.57	65	95.6	86.1	82	15.7
2004	ND	ND	ND	-	-	6.1	8.7	5.3	6.70	1.78	ND	ND	ND	-	-	64	62	70	65	4.2
2003	ND	ND	ND	-	-	1.3	1.2	1.1	1.2	0.1	ND	ND	ND	-	-	11	11	10	11	0.6
2002	**0.99**	ND	ND	**0.99**	-	12	10	10	11	1.2	**2.6**	**1.7**	**1.8**	**2.0**	0.5	99	82	100	94	10.12
2001	ND	ND	ND	-	-	8.7	7.0	8.3	8.0	0.9	ND	ND	ND	-	-	77	96	150	108	37.9
2000	ND	ND	ND	-	-	8.8	12	9.8	10.2	1.6	ND	ND	ND	-	-	90	120	96	102	15.9
1999	ND	ND	ND	-	-	5.5	12	17	11.5	5.8	ND	ND	ND	-	-	150	94	100	115	30.7
1993	ND	NS	NS	-	-	2.4	NS	NS	2.4	-	ND	NS	NS	-	-	13	NS	NS	13	-
1992	ND	NS	NS	-	-	3.4	NS	NS	3.4	-	ND	NS	NS	-	-	19	NS	NS	19	-
1991	65.0	NS	NS	65.0	-	55.0	NS	NS	55.0	-	28.5	NS	NS	28.5	-	26	NS	NS	26	-
1990	2.24	1.73	1.57	1.85	0.35	2.2	0.9	1.5	1.5	0.7	ND	ND	ND	-	-	81	73	57	70	12.2
Donor Site																				
2006[1]	6.47	7.34	9.92	7.91	1.79	4.69	4.79	9.19	6.22	2.57	0.48	0.50	0.86	0.61	0.21	90.19	89.06	105.95	95.07	9.44

ND = Below the detection limit (for calculations ND = 0)
NS = Not Required
Bold = Values below reporting limit as estimated by the analytical laboratory
1 = Transplanated mussels

APPENDIX F

Infauna data by station

Appendix F-1. Infaunal master species list. Ormond Beach Generating Station NPDES, 2006.

PHYLUM (Phy)
Subphylum or Class
Species

CNIDARIA (CN)
- Anthozoa
  - Actiniaria
  - Actiniaria sp A Paquette 2005 [1]

PLATYHELMINTHES (PL)
- Turbellaria
  - *Stylochoplana* sp [2]

NEMERTEA (NE)
- Anopla
  - *Carinoma mutabilis*
  - *Cerebratulus* sp
  - Lineidae
  - *Micrura* sp
  - *Tubulanus nothus*
  - *Tubulanus polymorphus* [3]
- Enopla
  - *Paranemertes californica* [4]
- Uncertain
  - Nemertea

KINORHYNCHA (KI)
  - Kinorhyncha

NEMATODA (NT)
  - Nematoda

MOLLUSCA (MO)
- Gastropoda
  - *Odostomia* sp D MBC 1980
- Bivalvia
  - Bivalvia
  - *Cooperella subdiaphana*
  - Mytilidae
  - *Petricola carditoides*
  - *Periploma planiusculum*
  - *Protothaca staminea*
  - *Rochefortia tumida* [5]
  - *Siliqua lucida*
  - *Tellina modesta*
- Scaphopoda
  - *Cadulus aberrans* [6]

SIPUNCULA (SI)
- Phascolospomatidea
  - *Apionsoma misakianum* [7]

ANNELIDA (AN)
- Polychaeta
  - *Aphelochaeta glandaria* [8]
  - *Apoprionospio pygmaea*
  - *Arabella endonata*
  - *Aricidea (Acmira) catherinae* [9]
  - *Armandia brevis* [10]

PHYLUM
Subphylum or Class
Species

ANNELIDA (cont.)
- Polychaeta(Cont.).
  - *Chaetozone setosa* Cmplx [11]
  - *Chone* sp SD1 Pt. Loma 1997
  - *Eteone californica*
  - *Exogone lourei*
  - *Glycera macrobranchia* [12]
  - *Glycera nana*
  - *Glycinde armigera*
  - *Goniada littorea*
  - *Goniada maculata*
  - *Hesionella mccullochae*
  - *Mediomastus acutus* [13]
  - *Mediomastus ambiseta* [13]
  - *Monticellina cryptica* [14]
  - *Nephtys caecoides*
  - *Notomastus hemipodus*
  - *Onuphis* sp
  - *Onuphis* sp 1 Pt. Loma 1983
  - *Ophiodromus pugettensis*
  - *Owenia collaris* [15]
  - *Paraprionospio pinnata*
  - *Phyllodoce hartmanae*
  - *Podarkeopsis glabrus*
  - *Polycirrus* sp A SCAMIT 1995
  - *Polydora cirrosa*
  - *Polydora cornuta*
  - *Polyophthalmus pictus*
  - *Praxillella pacifica*
  - *Prionospio (Minuspio) lighti* [16]
  - *Scoletoma* sp
  - *Scoletoma tetraura* Cmplx [17]
  - *Sigalion spinosus* [18]
  - *Sphaerephesia similisetis*
  - *Sphaerosyllis californiensis*
  - *Spiochaetopterus costarum*
  - *Spiophanes berkeleyorum*
  - *Spiophanes bombyx*
  - *Spiophanes duplex* [19]
  - *Syllis (Ehlersia) heterochaeta*
  - *Syllis (Typosyllis) farallonensis* [20]

ARTHROPODA (AR)
- Pycnogonida
  - *Anoropallene palpida*
- Ostracoda
  - *Asteropella slatteryi*
  - *Euphilomedes carcharodonta*
  - *Euphilomedes longiseta*
  - *Leuroleberis sharpei*
  - *Parasterope hulingsi*
  - *Rutiderma rostratum*
  - *Zeugophilomedes oblongata* [21]

Appendix F-1. (Cont.).

PHYLUM Subphylum or Class Species	PHYLUM Subphylum or Class Species
ARTHROPODA (Cont.)	ARTHROPODA (Cont.)
Malacostraca	Malacostraca (Cont.)
Americhelidium shoemakeri [22]	*Rhepoxynius menziesi* [28]
Ampelisca agassizi [23]	*Rhepoxynius* sp A SCAMIT 1987
Anchicolurus occidentalis	*Tiron biocellata*
Blepharipoda occidentalis	
Campylaspis sp C Myers & Benedict 1974	ECHINODERMATA (EC)
Cumella californica [24]	Asteroidea
Cyclaspis nublia	*Astropecten* sp
Cyclaspis sp B SCAMIT 1989	Echinoidea
Cyclaspis sp C SCAMIT 1986	*Dendraster excentricus*
Diastylopsis tenuis	Ophiuroidea
Elasmopus bampo	*Amphiodia digitata*
Foxiphalus obtusidens [25]	*Amphiodia* sp
Gibberosus myersi [26]	
Hartmanodes hartmanae [27]	PHORONA (PR)
Ischyrocerus pelagops	Phoronida
Lamprops carinatus	Phoronidae
Lamprops quadriplicatus	
Metamysidopsis elongata	CHORDATA (CO)
Photis brevipes	Cephalochordata
Photis macinerneyi	*Branchiostoma californiensis*
Rhepoxynius abronius	

SCAMIT = Southern California Association of Marine Invertebrate Taxonomists

The following footnotes indicate names used in previous surveys:

1 Limnactiniidae sp A SCAMIT 1989
2 Platyhelminthes sp D MBC
3 *Tubulanus pellucidus/polymorphus, T.* sp or *T.* spp
4 *Paranemertes* sp A of SCAMIT
5 *Mysella tumida, M. cf. aleutica*
6 *Gadila aberrans*
7 *Golfingia misakiana*
8 *Aphelochaeta* sp C Dorsey
9 *Acmira catherinae*
10 *Armandia bioculata*
11 *Chaetozone "setosa", C.* cf. *setosa*
12 *Glycera convoluta*
13 *Mediomastus* spp (in part)
14 *Monticellina dorsobranchialis, Tharyx* sp A SCAMIT
15 *Owenia fusiformis*
16 *Minuspio cirrifera, Prionospio cirrifera*
17 *Lumbrineris "tetraura"* or *L. tetraura*
18 *Thalenessa spinosum*
19 *Spiophanes missionenesis*
20 *Typosyllis farallonensis*
21 *Zeugophilomedes oblongatus*
22 *Synchelidium shoemakeri*
23 *Ampelisca compressa*
24 *Cumella* sp A Myers & Benedict or *C.* sp A MBC
25 *Paraphoxus obtusidens*
26 *Megaluropus longimerus*
27 *Manoculodes hartmanae*
28 *Paraphoxus epistomus, Rhepoxynius epistomus*

Appendix F-2. Infauna results by station. Ormond Beach Generating Station NPDES, 2006.

Phylum	Species	Station B1	B2	B3	B4	B5	B6	Total	Percent Total
AR	*Diastylopsis tenuis*	8	102	67	22	10	-	209	16.21
AN	*Apoprionospio pygmaea*	19	19	15	13	26	28	120	9.31
AN	*Mediomastus acutus*	30	13	5	19	34	5	106	8.22
NE	*Carinoma mutabilis*	4	11	6	10	7	31	69	5.35
EC	*Dendraster excentricus*	1	6	1	7	3	33	51	3.96
AR	*Rhepoxynius menziesi*	6	3	15	12	3	11	50	3.88
AN	*Onuphis* sp 1 Pt. Loma 1983	10	8	6	7	16	2	49	3.80
AN	*Chone* sp SD1 Pt. Loma 1997	2	4	13	3	9	10	41	3.18
MO	*Tellina modesta*	5	4	10	3	1	16	39	3.03
AN	*Exogone lourei*	6	1	-	-	30	-	37	2.87
AN	*Monticellina cryptica*	6	17	-	5	9	-	37	2.87
AN	*Syllis (Typosyllis) farallonensis*	7	5	-	5	4	7	28	2.17
AN	*Scoletoma tetraura* Cmplx	2	6	11	3	3	-	25	1.94
AR	*Zeugophilomedes oblonga*	5	12	1	7	-	-	25	1.94
NE	Lineidae	-	6	7	2	3	2	20	1.55
AR	*Gibberosus myersi*	-	7	1	5	1	5	19	1.47
AR	*Rhepoxynius abronius*	1	1	5	3	1	8	19	1.47
AN	*Glycera macrobranchia*	3	2	1	4	7	1	18	1.40
AN	*Scoletoma* sp	1	2	5	3	5	1	17	1.32
AR	*Cyclaspis* sp C SCAMIT 1986	1	14	-	-	2	-	17	1.32
AN	*Aricidea (Acmira) catherinae*	5	-	2	2	5	1	15	1.16
AN	*Goniada littorea*	2	3	5	2	3	-	15	1.16
AR	*Photis macinerneyi*	-	9	3	2	-	1	15	1.16
AN	*Chaetozone setosa* Cmplx	2	1	-	4	4	-	11	0.85
NE	*Paranemertes californica*	-	2	6	1	1	1	11	0.85
AN	*Spiophanes bombyx*	4	3	-	1	-	2	10	0.78
EC	*Amphiodia* sp	1	5	2	1	-	1	10	0.78
NE	*Tubulanus polymorphus*	2	1	2	-	4	-	9	0.70
NT	Nematoda	2	3	-	1	2	-	8	0.62
AN	*Glycinde armigera*	2	1	2	-	2	-	7	0.54
AN	*Syllis (Ehlersia) heterochaeta*	1	2	2	-	-	2	7	0.54
MO	*Siliqua lucida*	2	1	-	-	3	1	7	0.54
AR	*Americhelidium shoemakeri*	-	-	-	-	2	4	6	0.47
AR	*Campylaspis* sp C Myers & Benedict 1974	3	1	1	-	-	1	6	0.47
AR	*Cumella californica*	1	1	3	1	-	-	6	0.47
AR	*Foxiphalus obtusidens*	-	3	1	2	-	-	6	0.47
MO	*Cadulus aberrans*	3	-	-	2	1	-	6	0.47
AN	*Armandia brevis*	2	2	-	1	-	-	5	0.39
AN	*Spiochaetopterus costarum*	-	-	2	-	1	2	5	0.39
AR	*Hartmanodes hartmanae*	-	2	-	-	2	1	5	0.39
AR	*Lamprops quadriplicatus*	-	3	1	1	-	-	5	0.39
MO	*Cooperella subdiaphana*	2	-	1	2	-	-	5	0.39
AN	*Notomastus hemipodus*	-	-	4	-	-	-	4	0.31
AR	*Anchicolurus occidentalis*	1	1	1	-	-	1	4	0.31
AR	*Euphilomedes carcharodonta*	-	2	2	-	-	-	4	0.31
AR	*Parasterope hulingsi*	1	1	1	-	-	1	4	0.31
AN	*Hesionella mccullochae*	-	-	2	1	-	-	3	0.23
AN	*Nephtys caecoides*	-	-	2	-	-	1	3	0.23
AN	*Onuphis* sp	-	1	-	1	-	1	3	0.23
AR	*Photis brevipes*	-	1	-	2	-	-	3	0.23
AR	*Rhepoxynius* sp A SCAMIT 1987	-	-	1	-	-	2	3	0.23
AR	*Rutiderma rostratum*	1	1	-	1	-	-	3	0.23
MO	Mytilidae	1	-	1	1	-	-	3	0.23
MO	*Rochefortia tumida*	-	-	-	1	1	1	3	0.23
NE	*Micrura* sp	1	-	1	1	-	-	3	0.23
NE	Nemertea	-	-	-	-	1	2	3	0.23
PL	*Stylochoplana* sp	-	-	-	2	1	-	3	0.23
AN	*Goniada maculata*	1	1	-	-	-	-	2	0.16
AN	*Mediomastus ambiseta*	-	-	-	-	2	-	2	0.16
AN	*Ophiodromus pugettensis*	-	-	-	-	2	-	2	0.16
AN	*Owenia collaris*	1	-	-	-	1	-	2	0.16
AN	*Paraprionospio pinnata*	2	-	-	-	-	-	2	0.16
AN	*Polyophthalmus pictus*	1	-	-	-	1	-	2	0.16
AN	*Spiophanes duplex*	-	-	-	1	1	-	2	0.16
AR	*Ampelisca agassizi*	1	-	-	-	1	-	2	0.16
AR	*Cyclaspis nubila*	-	-	1	-	1	-	2	0.16
AR	*Lamprops carinatus*	1	1	-	-	-	-	2	0.16
AR	*Metamysidopsis elongata*	-	-	2	-	-	-	2	0.16
CN	Actiniaria	-	-	-	-	2	-	2	0.16
MO	Bivalvia	-	-	-	-	2	-	2	0.16

Appendix F-2. (Cont.).

Phylum	Species	B1	B2	B3	B4	B5	B6	Total	Percent Total
		Station							
NE	*Tubulanus nothus*	2	-	-	-	-	-	2	0.16
AN	*Aphelochaeta glandaria*	-	-	1	-	-	-	1	0.08
AN	*Arabella endonata*	-	-	1	-	-	-	1	0.08
AN	*Eteone californica*	-	-	-	-	1	-	1	0.08
AN	*Glycera nana*	-	1	-	-	-	-	1	0.08
AN	*Phyllodoce hartmanae*	-	-	-	-	1	-	1	0.08
AN	*Podarkeopsis glabrus*	-	-	-	1	-	-	1	0.08
AN	*Polycirrus* sp A SCAMIT 1995	1	-	-	-	-	-	1	0.08
AN	*Polydora cirrosa*	-	-	-	1	-	-	1	0.08
AN	*Polydora cornuta*	1	-	-	-	-	-	1	0.08
AN	*Praxillella pacifica*	-	-	-	-	1	-	1	0.08
AN	*Prionospio (Minuspio) lighti*	-	-	1	-	-	-	1	0.08
AN	*Sigalion spinosus*	-	-	-	-	1	-	1	0.08
AN	*Sphaerephesia similisetis*	1	-	-	-	-	-	1	0.08
AN	*Sphaerosyllis californiensis*	-	-	-	1	-	-	1	0.08
AN	*Spiophanes berkeleyorum*	-	-	-	-	1	-	1	0.08
AR	*Anoropallene palpida*	-	-	-	-	1	-	1	0.08
AR	*Asteropella slatteryi*	1	-	-	-	-	-	1	0.08
AR	*Blepharipoda occidentalis*	-	-	-	-	-	1	1	0.08
AR	*Cyclaspis* sp B SCAMIT 1989	1	-	-	-	-	-	1	0.08
AR	*Elasmopus bampo*	1	-	-	-	-	-	1	0.08
AR	*Euphilomedes longiseta*	1	-	-	-	-	-	1	0.08
AR	*Ischyrocerus pelagops*	-	1	-	-	-	-	1	0.08
AR	*Leuroleberis sharpei*	-	-	1	-	-	-	1	0.08
AR	*Tiron biocellata*	-	-	1	-	-	-	1	0.08
CN	Actiniaria sp A Paquette 2005	1	-	-	-	-	-	1	0.08
CO	*Branchiostoma californiensis*	-	-	1	-	-	-	1	0.08
EC	*Amphiodia digitata*	-	-	1	-	-	-	1	0.08
EC	*Astropecten* sp	-	-	-	1	-	-	1	0.08
KI	Kinorhyncha	1	-	-	-	-	-	1	0.08
MO	*Odostomia* sp D MBC 1980	-	-	-	-	1	-	1	0.08
MO	*Periploma planiusculum*	-	-	-	-	-	1	1	0.08
MO	*Petricola carditoides*	-	-	1	-	-	-	1	0.08
MO	*Protothaca staminea*	1	-	-	-	-	-	1	0.08
NE	*Cerebratulus* sp	-	-	-	-	1	-	1	0.08
PR	Phoronidae	-	-	-	-	1	-	1	0.08
SI	*Apionsoma misakianum*	-	-	-	-	1	-	1	0.08
	Number of individuals	175	297	228	171	230	188	1289	
	Number of species	55	47	49	45	53	34	107	
	Diversity (H')	3.42	2.86	3.02	3.30	3.24	2.73	3.54	

Appendix F-3. Infauna data by station and replicate. Ormond Beach Generating Station NPDES, 2006.

Station B1

Phylum	Species	Replicate B1-I	B1-II	B1-III	B1-IV	Total	Percent Composition	Density No./m²
AN	*Mediomastus acutus*	2	15	6	7	30	17.14	750.0
AN	*Apoprionospio pygmaea*	7	6	1	5	19	10.86	475.0
AN	*Onuphis* sp 1 Pt. Loma 1983	1	5	3	1	10	5.71	250.0
AR	*Diastylopsis tenuis*	2	2	3	1	8	4.57	200.0
AN	*Syllis (Typosyllis) farallonensis*	1	5	1	-	7	4.00	175.0
AN	*Exogone lourei*	-	-	3	3	6	3.43	150.0
AN	*Monticillina cryptica*	1	1	2	2	6	3.43	150.0
AR	*Rhepoxynius menziesi*	3	3	-	-	6	3.43	150.0
AN	*Aricidea (Acmira) catherinae*	-	-	1	4	5	2.86	125.0
AR	*Zeugophilomedes oblonga*	1	-	4	-	5	2.86	125.0
MO	*Tellina modesta*	1	2	1	1	5	2.86	125.0
AN	*Spiophanes bombyx*	1	-	-	3	4	2.29	100.0
NE	*Carinoma mutabilis*	2	-	2	-	4	2.29	100.0
AN	*Glycera macrobranchia*	2	-	-	1	3	1.71	75.0
AR	*Campylaspis* sp C Myers&Benedict 1974	-	2	1	-	3	1.71	75.0
MO	*Cadulus aberrans*	1	-	1	1	3	1.71	75.0
AN	*Armandia brevis*	-		2	-	2	1.14	50.0
AN	*Chaetozone setosa* Cmplx	1	1	-	-	2	1.14	50.0
AN	*Chone* sp SD1 Pt. Loma 1997	1	1	-	-	2	1.14	50.0
AN	*Glycinde armigera*	1	-	-	1	2	1.14	50.0
AN	*Goniada littorea*	1	-	1	-	2	1.14	50.0
AN	*Paraprionospio pinnata*	-	2	-	-	2	1.14	50.0
AN	*Scoletoma tetraura* Cmplx	-	2	-	-	2	1.14	50.0
MO	*Cooperella subdiaphana*	1	-	1	-	2	1.14	50.0
MO	*Siliqua lucida*	-	-	-	2	2	1.14	50.0
NE	*Tubulanus nothus*	-	-	1	1	2	1.14	50.0
NE	*Tubulanus polymorphus*	-	1	-	1	2	1.14	50.0
NT	Nematoda	-	-	2	-	2	1.14	50.0
AN	*Goniada maculata*	1	-	-	-	1	0.57	25.0
AN	*Owenia collaris*	-	-	-	1	1	0.57	25.0
AN	*Polycirrus* sp A SCAMIT 1995	-	-	-	1	1	0.57	25.0
AN	*Polydora cornuta*	-	-	-	1	1	0.57	25.0
AN	*Polyophthalmus pictus*	-	-	1	-	1	0.57	25.0
AN	*Scoletoma* sp	-	-	1	-	1	0.57	25.0
AN	*Sphaerephesia similisetis*	1	-	-	-	1	0.57	25.0
AN	*Syllis (Ehlersia) heterochaeta*	-	1	-	-	1	0.57	25.0
AR	*Ampelisca agassizi*	-	1	-	-	1	0.57	25.0
AR	*Anchicolurus occidentalis*	-	1	-	-	1	0.57	25.0
AR	*Asteropella slatteryi*	1	-	-	-	1	0.57	25.0
AR	*Cumella californica*	-	-	1	-	1	0.57	25.0
AR	*Cyclaspis* sp B SCAMIT 1989	-	1	-	-	1	0.57	25.0
AR	*Cyclaspis* sp C SCAMIT 1986	1	-	-	-	1	0.57	25.0
AR	*Elasmopus bampo*	-	1	-	-	1	0.57	25.0
AR	*Euphilomedes carcharodonta*	-	-	1	-	1	0.57	25.0
AR	*Lamprops carinatus*	-	-	1	-	1	0.57	25.0
AR	*Parasterope hulingsi*	1	-	-	-	1	0.57	25.0
AR	*Rhepoxynius abronius*	1	-	-	-	1	0.57	25.0
AR	*Rutiderma rostratum*	-	-	1	-	1	0.57	25.0
CN	Actiniaria sp A Paquette 2005	-	1	-	-	1	0.57	25.0
EC	*Amphiodia* sp	-	1	-	-	1	0.57	25.0
EC	*Dendraster excentricus*	1	-	-	-	1	0.57	25.0
KI	Kinorhyncha	-	-	-	1	1	0.57	25.0
MO	Mytilidae	-	-	-	1	1	0.57	25.0
MO	*Protothaca staminea*	-	-	1	-	1	0.57	25.0
NE	*Micrura* sp	-	-	1	-	1	0.57	25.0

Summary

Parameter	Replicate B1-I	B1-II	B1-III	B1-IV	Station Total	Overall Mean	S.D.
Number of individuals	37	55	44	39	175	43.8	8.1
Number of species	25	21	26	20	55	23.0	2.9
Diversity (H')	3.00	2.59	3.06	2.73	3.42	2.85	0.22

Appendix F-3. (Cont.).

Station B2

Phylum	Species	Replicate B2-I	B2-II	B2-III	B2-IV	Total	Percent Composition	Density No./m²
AR	*Diastylopsis tenuis*	55	16	6	25	102	34.34	2550.0
AN	*Apoprionospio pygmaea*	3	5	8	3	19	6.40	475.0
AN	*Monticellina cryptica*	6	1	8	2	17	5.72	425.0
AR	*Cyclaspis* sp C SCAMIT 1986	1	7	5	1	14	4.71	350.0
AN	*Mediomastus acutus*	-	5	4	4	13	4.38	325.0
AR	*Zeugophilomedes oblonga*	3	8	1	-	12	4.04	300.0
NE	*Carinoma mutabilis*	1	1	4	5	11	3.70	275.0
AR	*Photis macinerneyi*	7	1	-	1	9	3.03	225.0
AN	*Onuphis* sp 1 Pt. Loma 1983	2	5	1	-	8	2.69	200.0
AR	*Gibberosus myersi*	2	4	1	-	7	2.36	175.0
AN	*Scoletoma tetraura* Cmplx	4	-	2	-	6	2.02	150.0
EC	*Dendraster excentricus*	1	3	1	1	6	2.02	150.0
NE	Lineidae	2	4	-	-	6	2.02	150.0
AN	*Syllis (Typosyllis) farallonensis*	-	3	1	1	5	1.68	125.0
EC	*Amphiodia* sp	1	3	-	1	5	1.68	125.0
AN	*Chone* sp SD1 Pt. Loma 1997	2	1	-	1	4	1.35	100.0
MO	*Tellina modesta*	-	2	1	1	4	1.35	100.0
AN	*Goniada littorea*	1	1	-	1	3	1.01	75.0
AN	*Spiophanes bombyx*	-	-	3	-	3	1.01	75.0
AR	*Foxiphalus obtusidens*	-	3	-	-	3	1.01	75.0
AR	*Lamprops quadriplicatus*	-	3	-	-	3	1.01	75.0
AR	*Rhepoxynius menziesi*	1	1	1	-	3	1.01	75.0
NT	Nematoda	2	1	-	-	3	1.01	75.0
AN	*Armandia brevis*	-	1	-	1	2	0.67	50.0
AN	*Glycera macrobranchia*	-	2	-	-	2	0.67	50.0
AN	*Scoletoma* sp	-	-	1	1	2	0.67	50.0
AN	*Syllis (Ehlersia) heterochaeta*	-	2	-	-	2	0.67	50.0
AR	*Euphilomedes carcharodonta*	-	1	-	1	2	0.67	50.0
AR	*Hartmanodes hartmanae*	-	2	-	-	2	0.67	50.0
NE	*Paranemertes californica*	-	-	2	-	2	0.67	50.0
AN	*Chaetozone setosa* Cmplx	-	-	1	-	1	0.34	25.0
AN	*Exogone lourei*	-	1	-	-	1	0.34	25.0
AN	*Glycera nana*	1	-	-	-	1	0.34	25.0
AN	*Glycinde armigera*	1	-	-	-	1	0.34	25.0
AN	*Goniada maculata*	-	-	-	1	1	0.34	25.0
AN	*Onuphis* sp	1	-	-	-	1	0.34	25.0
AR	*Anchicolurus occidentalis*	-	-	1	-	1	0.34	25.0
AR	*Campylaspis* spC Myers & Benedict 1974	-	1	-	-	1	0.34	25.0
AR	*Cumella californica*	1	-	-	-	1	0.34	25.0
AR	*Ischyrocerus pelagops*	-	1	-	-	1	0.34	25.0
AR	*Lamprops carinatus*	1	-	-	-	1	0.34	25.0
AR	*Parasterope hulingsi*	-	-	1	-	1	0.34	25.0
AR	*Photis brevipes*	-	1	-	-	1	0.34	25.0
AR	*Rhepoxynius abronius*	1	-	-	-	1	0.34	25.0
AR	*Rutiderma rostratum*	-	1	-	-	1	0.34	25.0
MO	*Siliqua lucida*	1	-	-	-	1	0.34	25.0
NE	*Tubulanus polymorphus*	-	-	1	-	1	0.34	25.0

Summary

Parameter	Replicate B2-I	B2-II	B2-III	B2-IV	Station Total	Overall Mean	S.D.
Number of individuals	101	91	54	51	297	74.3	25.5
Number of species	24	31	21	17	47	23.3	5.9
Diversity (H')	2.00	3.06	2.71	2.00	2.86	2.44	0.53

Appendix F-3. (Cont.).

Station B3

Phylum	Species	Replicate B3-I	B3-II	B3-III	B3-IV	Total	Percent Composition	Density No./m²
AR	*Diastylopsis tenuis*	1	3	42	21	67	29.39	1675.0
AN	*Apoprionospio pygmaea*	3	1	7	4	15	6.58	375.0
AR	*Rhepoxynius menziesi*	4	2	3	6	15	6.58	375.0
AN	*Chone* sp SD1 Pt. Loma 1997	3	1	3	6	13	5.70	325.0
AN	*Scoletoma tetraura* Cmplx	2	3	1	5	11	4.82	275.0
MO	*Tellina modesta*	4	1	3	2	10	4.39	250.0
NE	Lineidae	3	-	-	4	7	3.07	175.0
AN	*Onuphis* sp 1 Pt. Loma 1983	2	2	1	1	6	2.63	150.0
NE	*Carinoma mutabilis*	1	2	2	1	6	2.63	150.0
NE	*Paranemertes californica*	3	-	-	3	6	2.63	150.0
AN	*Goniada littorea*	1	1	3	-	5	2.19	125.0
AN	*Mediomastus acutus*	2	1	-	2	5	2.19	125.0
AN	*Scoletoma* sp	4	-	-	1	5	2.19	125.0
AR	*Rhepoxynius abronius*	3	1	-	1	5	2.19	125.0
AN	*Notomastus hemipodus*	1	2	-	1	4	1.75	100.0
AR	*Cumella californica*	-	1	1	1	3	1.32	75.0
AR	*Photis macinerneyi*	-	1	2	-	3	1.32	75.0
AN	*Aricidea (Acmira) catherinae*	1	-	1	-	2	0.88	50.0
AN	*Glycinde armigera*	-	-	1	1	2	0.88	50.0
AN	*Hesionella mccullochae*	1	-	-	1	2	0.88	50.0
AN	*Nephtys caecoides*	-	1	-	1	2	0.88	50.0
AN	*Spiochaetopterus costarum*	1	-	-	1	2	0.88	50.0
AN	*Syllis (Ehlersia) heterochaeta*	1	-	-	1	2	0.88	50.0
AR	*Euphilomedes carcharodonta*	-	-	-	2	2	0.88	50.0
AR	*Metamysidopsis elongata*	-	-	-	2	2	0.88	50.0
EC	*Amphiodia* sp	-	2	-	-	2	0.88	50.0
NE	*Tubulanus polymorphus*	1	-	-	1	2	0.88	50.0
AN	*Aphelochaeta glandaria*	1	-	-	-	1	0.44	25.0
AN	*Arabella endonata*	-	-	-	1	1	0.44	25.0
AN	*Glycera macrobranchia*	-	1	-	-	1	0.44	25.0
AN	*Prionospio (Minuspio) lighti*	-	1	-	-	1	0.44	25.0
AR	*Anchicolurus occidentalis*	-	1	-	-	1	0.44	25.0
AR	*Campylaspis* spC Myers & Benedict 1974	-	-	1	-	1	0.44	25.0
AR	*Cyclaspis nubila*	-	1	-	-	1	0.44	25.0
AR	*Foxiphalus obtusidens*	-	-	1	-	1	0.44	25.0
AR	*Gibberosus myersi*	-	-	-	1	1	0.44	25.0
AR	*Lamprops quadriplicatus*	-	-	1	-	1	0.44	25.0
AR	*Leuroleberis sharpei*	-	-	-	1	1	0.44	25.0
AR	*Parasterope hulingsi*	-	-	-	1	1	0.44	25.0
AR	*Rhepoxynius* sp A SCAMIT 1987	-	-	1	-	1	0.44	25.0
AR	*Tiron biocelata*	-	-	-	1	1	0.44	25.0
AR	*Zeugophilomedes oblonga*	1	-	-	-	1	0.44	25.0
CO	*Branchiostoma californiense*	-	-	1	-	1	0.44	25.0
EC	*Amphiodia digitata*	-	1	-	-	1	0.44	25.0
EC	*Dendraster excentricus*	-	-	1	-	1	0.44	25.0
MO	*Cooperella subdiaphana*	-	-	1	-	1	0.44	25.0
MO	Mytilidae	1	-	-	-	1	0.44	25.0
MO	*Petricola carditoides*	-	1	-	-	1	0.44	25.0
NE	*Micrura* sp	-	-	-	1	1	0.44	25.0

Summary

Parameter	Replicate B3-I	B3-II	B3-III	B3-IV	Station Total	Overall Mean	S.D.
Number of individuals	45	31	77	75	228	57.0	22.7
Number of species	23	22	20	29	49	23.5	3.9
Diversity (H')	2.98	3.00	1.92	2.81	3.02	2.68	0.51

Appendix F-3. (Cont.).

Station B4

Phylum	Species	Replicate B4-I	B4-II	B4-III	B4-IV	Total	Percent Composition	Density No./m²
AR	*Diastylopsis tenuis*	4	3	2	13	22	12.87	550.0
AN	*Mediomastus acutus*	2	4	9	4	19	11.11	475.0
AN	*Apoprionospio pygmaea*	1	8	2	2	13	7.60	325.0
AR	*Rhepoxynius menziesi*	-	3	5	4	12	7.02	300.0
NE	*Carinoma mutabilis*	3	1	4	2	10	5.85	250.0
AN	*Onuphis* sp 1 Pt. Loma 1983	1	3	-	3	7	4.09	175.0
AR	*Zeugophilomedes oblonga*	3	-	-	4	7	4.09	175.0
EC	*Dendraster excentricus*	-	3	2	2	7	4.09	175.0
AN	*Monticellina cryptica*	-	2	1	2	5	2.92	125.0
AN	*Syllis (Typosyllis) farallonensis*	2	1	2	-	5	2.92	125.0
AR	*Gibberosus myersi*	-	1	3	1	5	2.92	125.0
AN	*Chaetozone setosa* Cmplx	-	-	3	1	4	2.34	100.0
AN	*Glycera macrobranchia*	3	-	-	1	4	2.34	100.0
AN	*Chone* sp SD1 Pt. Loma 1997	-	-	2	1	3	1.75	75.0
AN	*Scoletoma* sp	-	1	-	2	3	1.75	75.0
AN	*Scoletoma tetraura* Cmplx	3	-	-	-	3	1.75	75.0
AR	*Rhepoxynius abronius*	-	1	-	2	3	1.75	75.0
MO	*Tellina modesta*	1	-	1	1	3	1.75	75.0
AN	*Aricidea (Acmira) catherinae*	1	1	-	-	2	1.17	50.0
AN	*Goniada littorea*	1	1	-	-	2	1.17	50.0
AR	*Foxiphalus obtusidens*	-	2	-	-	2	1.17	50.0
AR	*Photis brevipes*	-	2	-	-	2	1.17	50.0
AR	*Photis macinerneyi*	-	-	-	2	2	1.17	50.0
MO	*Cadulus aberrans*	1	-	1	-	2	1.17	50.0
MO	*Cooperella subdiaphana*	2	-	-	-	2	1.17	50.0
NE	Lineidae	1	-	1	-	2	1.17	50.0
PL	*Stylochoplana* sp	1	-	1	-	2	1.17	50.0
AN	*Armandia brevis*	-	1	-	-	1	0.58	25.0
AN	*Hesionella mccullochae*	-	-	1	-	1	0.58	25.0
AN	*Onuphis* sp	-	-	1	-	1	0.58	25.0
AN	*Podarkeopsis glabrus*	1	-	-	-	1	0.58	25.0
AN	*Polydora cirrosa*	-	1	-	-	1	0.58	25.0
AN	*Sphaerosyllis californiensis*	-	1	-	-	1	0.58	25.0
AN	*Spiophanes bombyx*	-	-	1	-	1	0.58	25.0
AN	*Spiophanes duplex*	1	-	-	-	1	0.58	25.0
AR	*Cumella californica*	-	-	-	1	1	0.58	25.0
AR	*Lamprops quadriplicatus*	1	-	-	-	1	0.58	25.0
AR	*Rutiderma rostratum*	-	-	-	1	1	0.58	25.0
EC	*Amphiodia* sp	1	-	-	-	1	0.58	25.0
EC	*Astropecten* sp	-	-	1	-	1	0.58	25.0
MO	Mytilidae	-	1	-	-	1	0.58	25.0
MO	*Rochefortia tumida*	1	-	-	-	1	0.58	25.0
NE	*Micrura* sp	-	-	1	-	1	0.58	25.0
NE	*Paranemertes californica*	-	1	-	-	1	0.58	25.0
NT	Nematoda	1	-	-	-	1	0.58	25.0

Summary

Parameter	Replicate B4-I	B4-II	B4-III	B4-IV	Station Total	Overall Mean	S.D.
Number of individuals	36	42	44	49	171	42.8	5.4
Number of species	22	21	20	19	45	20.5	1.3
Diversity (H')	2.95	2.80	2.72	2.61	3.30	2.77	0.14

Appendix F-3. (Cont.).

Station B5

Phylum	Species	Replicate B5-I	B5-II	B5-III	B5-IV	Total	Percent Composition	Density No./m²
AN	*Mediomastus acutus*	11	7	3	13	34	14.78	850.0
AN	*Exogone lourei*	9	6	6	9	30	13.04	750.0
AN	*Apoprionospio pygmaea*	2	7	10	7	26	11.30	650.0
AN	*Onuphis* sp 1 Pt. Loma 1983	2	8	3	3	16	6.96	400.0
AR	*Diastylopsis tenuis*	4	5	1	-	10	4.35	250.0
AN	*Chone* sp SD1 Pt. Loma 1997	4	-	4	1	9	3.91	225.0
AN	*Monticellina cryptica*	3	3	2	1	9	3.91	225.0
AN	*Glycera macrobranchia*	2	1	3	1	7	3.04	175.0
NE	*Carinoma mutabilis*	3	2	-	2	7	3.04	175.0
AN	*Aricidea (Acmira) catherinae*	3	1	1	-	5	2.17	125.0
AN	*Scoletoma* sp	-	3	2	-	5	2.17	125.0
AN	*Chaetozone setosa* Cmplx	-	3	-	1	4	1.74	100.0
AN	*Syllis (Typosyllis) farallonensis*	2	1	1	-	4	1.74	100.0
NE	*Tubulanus polymorphus*	-	1	3	-	4	1.74	100.0
AN	*Goniada littorea*	1	1	1	-	3	1.30	75.0
AN	*Scoletoma tetraura* Cmplx	2	-	-	1	3	1.30	75.0
AR	*Rhepoxynius menziesi*	1	-	1	1	3	1.30	75.0
EC	*Dendraster excentricus*	-	2	1	-	3	1.30	75.0
MO	*Siliqua lucida*	1	-	-	2	3	1.30	75.0
NE	Lineidae	1	-	-	2	3	1.30	75.0
AN	*Glycinde armigera*	-	1	1	-	2	0.87	50.0
AN	*Mediomastus ambiseta*	-	-	-	2	2	0.87	50.0
AN	*Ophiodromus pugettensis*	1	-	-	1	2	0.87	50.0
AR	*Americhelidium shoemakeri*	1	-	-	1	2	0.87	50.0
AR	*Cyclaspis* sp C SCAMIT 1986	1	-	1	-	2	0.87	50.0
AR	*Hartmanodes hartmanae*	2	-	-	-	2	0.87	50.0
CN	Actiniaria	1	-	-	1	2	0.87	50.0
MO	Bivalvia	1	1	-	-	2	0.87	50.0
NT	Nematoda	1	1	-	-	2	0.87	50.0
AN	*Eteone californica*	-	-	1	-	1	0.43	25.0
AN	*Owenia collaris*	-	-	-	1	1	0.43	25.0
AN	*Phyllodoce hartmanae*	-	-	1	-	1	0.43	25.0
AN	*Polyophthalmus pictus*	-	-	1	-	1	0.43	25.0
AN	*Praxillella pacifica*	-	-	-	1	1	0.43	25.0
AN	*Sigalion spinosus*	-	1	-	-	1	0.43	25.0
AN	*Spiochaetopterus costarum*	-	-	1	-	1	0.43	25.0
AN	*Spiophanes berkeleyorum*	-	1	-	-	1	0.43	25.0
AN	*Spiophanes duplex*	-	-	-	1	1	0.43	25.0
AR	*Ampelisca agassizi*	1	-	-	-	1	0.43	25.0
AR	*Anoropallene palpida*	-	1	-	-	1	0.43	25.0
AR	*Cyclaspis nubila*	1	-	-	-	1	0.43	25.0
AR	*Gibberosus myersi*	-	1	-	-	1	0.43	25.0
AR	*Rhepoxynius abronius*	1	-	-	-	1	0.43	25.0
MO	*Cadulus aberrans*	-	-	1	-	1	0.43	25.0
MO	*Odostomia* sp D MBC 1980	-	-	1	-	1	0.43	25.0
MO	*Rochefortia tumida*	-	-	-	1	1	0.43	25.0
MO	*Tellina modesta*	-	-	-	1	1	0.43	25.0
NE	*Cerebratulus* sp	-	-	-	1	1	0.43	25.0
NE	Nemertea	-	-	-	1	1	0.43	25.0
NE	*Paranemertes californica*	-	-	1	-	1	0.43	25.0
PL	*Stylochoplana* sp	1	-	-	-	1	0.43	25.0
PR	Phoronida	1	-	-	-	1	0.43	25.0
SI	*Apionsoma misakianum*	1	-	-	-	1	0.43	25.0

Summary

Parameter	Replicate B5-I	B5-II	B5-III	B5-IV	Station Total	Overall Mean	S.D.
Number of individuals	65	58	51	56	230	57.5	5.8
Number of species	29	22	24	24	53	24.8	3.0
Diversity (H')	3.01	2.76	2.85	2.68	3.24	2.82	0.14

Appendix F-3. (Cont.).

Station B6

Phylum	Species	Replicate B6-I	B6-II	B6-III	B6-IV	Total	Percent Composition	Density No./m²
EC	*Dendraster excentricus*	9	6	11	7	33	17.55	825.0
NE	*Carinoma mutabilis*	5	7	12	7	31	16.49	775.0
AN	*Apoprionospio pygmaea*	8	5	5	10	28	14.89	700.0
MO	*Tellina modesta*	3	5	3	5	16	8.51	400.0
AR	*Rhepoxynius menziesi*	1	-	8	2	11	5.85	275.0
AN	*Chone* sp SD1 Pt. Loma 1997	1	4	4	1	10	5.32	250.0
AR	*Rhepoxynius abronius*	1	1	3	3	8	4.26	200.0
AN	*Syllis (Typosyllis) farallonensis*	1	3	-	3	7	3.72	175.0
AN	*Mediomastus acutus*	1	2	-	2	5	2.66	125.0
AR	*Gibberosus myersi*	2	-	2	1	5	2.66	125.0
AR	*Americhelidium shoemakeri*	-	2	2	-	4	2.13	100.0
AN	*Onuphis* sp 1 Pt. Loma 1983	1	-	1	-	2	1.06	50.0
AN	*Spiochaetopterus costarum*	1	1	-	-	2	1.06	50.0
AN	*Spiophanes bombyx*	1	-	1	-	2	1.06	50.0
AN	*Syllis (Ehlersia) heterochaeta*	-	-	1	1	2	1.06	50.0
AR	*Rhepoxynius* sp A SCAMIT 1987	-	2	-	-	2	1.06	50.0
NE	Lineidae	1	-	1	-	2	1.06	50.0
NE	Nemertea	-	1	1	-	2	1.06	50.0
AN	*Aricidea (Acmira) catherinae*	-	1	-	-	1	0.53	25.0
AN	*Glycera macrobranchia*	-	-	1	-	1	0.53	25.0
AN	*Nephtys caecoides*	-	-	-	1	1	0.53	25.0
AN	*Onuphis* sp	-	-	1	-	1	0.53	25.0
AN	*Scoletoma* sp	1	-	-	-	1	0.53	25.0
AR	*Anchicolurus occidentalis*	-	-	1	-	1	0.53	25.0
AR	*Blepharipoda occidentalis*	1	-	-	-	1	0.53	25.0
AR	*Campylaspis* sp C Myers & Benedict 1974	-	-	1	-	1	0.53	25.0
AR	*Hartmanodes hartmanae*	-	-	1	-	1	0.53	25.0
AR	*Parasterope hulingsi*	-	-	-	1	1	0.53	25.0
AR	*Photis macinerneyi*	-	-	1	-	1	0.53	25.0
EC	Amphiodia sp	-	-	1	-	1	0.53	25.0
MO	*Periploma planiusculum*	1	-	-	-	1	0.53	25.0
MO	*Rochefortia tumdia*	1	-	-	-	1	0.53	25.0
MO	*Siliqua lucida*	-	-	1	-	1	0.53	25.0
NE	*Paranemertes californica*	-	-	-	1	1	0.53	25.0

Summary

Parameter	Replicate B6-I	B6-II	B6-III	B6-IV	Station Total	Overall Mean	S.D.
Number of individuals	40	40	63	45	188	47.0	10.9
Number of species	18	13	22	14	34	16.8	4.1
Diversity (H')	2.46	2.35	2.62	2.30	2.73	2.43	0.14

Appendix F-4. Infaunal wet weight biomass data (g). Ormond Beach Generating Station NPDES, 2006.

Sta-Rep	Annelida	Arthropoda	Mollusca	Echinodermata	Misc.	Total
B1-I	0.222	0.140	<0.0001	<0.0001	<0.0001	0.362
B1-II	0.256	<0.0001	<0.0001	0.018	0.005	0.278
B1-III	0.082	<0.0001	0.019	-	0.042	0.143
B1-IV	0.148	<0.0001	0.117	-	<0.0001	0.266
Total	0.708	0.140	0.136	0.018	0.047	1.048
B2-I	0.164	0.023	<0.0001	<0.0001	0.081	0.269
B2-II	0.204	0.190	<0.0001	0.040	<0.0001	0.434
B2-III	0.084	0.005	0.015	0.031	0.004	0.139
B2-IV	<0.0001	0.054	0.068	0.089	0.056	0.267
Total	0.452	0.272	0.083	0.160	0.141	1.108
B3-I	0.033	0.003	0.030	-	0.042	0.108
B3-II	0.309	0.120	0.060	0.351	0.055	0.895
B3-III	0.108	0.244	<0.0001	<0.0001	0.042	0.394
B3-IV	0.219	0.116	<0.0001	-	0.077	0.412
Total	0.669	0.482	0.090	0.351	0.217	1.809
B4-I	0.045	0.032	0.014	<0.0001	0.013	0.104
B4-II	0.179	<0.0001	<0.0001	<0.0001	<0.0001	0.179
B4-III	0.085	0.017	<0.0001	0.406	0.169	0.677
B4-IV	0.053	0.090	0.058	0.017	0.065	0.282
Total	0.362	0.138	0.073	0.423	0.246	1.242
B5-I	0.206	0.019	<0.0001	-	0.238	0.463
B5-II	0.322	0.064	<0.0001	<0.0001	0.006	0.392
B5-III	0.208	<0.0001	0.001	<0.0001	<0.0001	0.209
B5-IV	0.140	<0.0001	0.009	-	0.119	0.268
Total	0.877	0.083	0.010	<0.0001	0.363	1.333
B6-I	0.112	0.096	0.083	0.074	0.005	0.370
B6-II	0.049	<0.0001	0.015	0.039	0.003	0.106
B6-III	0.086	0.062	0.002	0.043	0.009	0.202
B6-IV	0.022	0.067	<0.0001	0.039	<0.0001	0.128
Total	0.270	0.224	0.100	0.195	0.017	0.805
Grand Total	3.338	1.340	0.491	1.146	1.031	7.345

Note: - = no animals

Appendix F-5. Yearly infaunal abundance. Ormond Beach Generating Station NPDES, 2006.

Phy	Species	Year 1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	% Total	Cum. %	FO
NT	Nematoda	7	5	-	2	6	2	-	-	5	8375	-	5	24	6	15	61	17	10	8	8548	21.50	21.50	15
AN	*Owenia collaris*	3	2	-	6	4	82	-	-	2	5	10	59	3275	111	2	1	1	1	2	3566	8.97	30.47	16
AN	*Apoprionospio pygmaea*	29	108	9	464	42	509	17	12	156	43	41	94	53	948	73	44	256	128	120	3146	7.91	38.38	19
AR	*Diastylopsis tenuis*	306	110	28	80	59	23	1	19	62	67	1	391	728	136	108	10	54	32	209	2424	6.10	44.48	19
EC	*Dendraster excentricus*	8	11	7	9	9	-	4	5	33	1075	31	32	118	360	62	333	88	42	51	2278	5.73	50.21	18
AN	*Mediomastus acutus*	28	30	-	-	-	-	-	2	27	66	282	86	124	94	43	44	72	81	106	1085	2.73	52.94	14
AR	*Rhepoxynius menziesi*	32	57	27	45	44	26	14	11	50	16	24	137	256	48	31	4	31	21	50	924	2.32	55.26	19
MO	*Tellina modesta*	8	48	23	13	29	5	3	1	32	22	13	105	316	106	37	9	87	6	39	902	2.27	57.53	19
AN	*Pectinaria californiensis*	3	-	1	123	2	-	-	1	-	15	1	465	46	19	4	1	-	2	-	683	1.72	59.25	13
MO	*Siliqua lucida*	1	17	17	10	-	7	-	22	29	31	15	473	11	14	12	2	3	8	7	679	1.71	60.95	17
AN	*Spiophanes bombyx*	9	39	22	53	22	17	28	24	33	19	13	32	63	33	33	16	40	19	10	525	1.32	62.27	19
NE	*Carinoma mutabilis*	-	4	9	12	13	13	32	10	20	43	22	16	19	54	43	25	58	29	69	491	1.23	63.51	18
AN	*Armandia brevis*	1	2	-	1	-	3	-	-	3	-	1	23	3	324	9	61	18	26	5	480	1.21	64.72	14
AR	*Photis macinerneyi*	-	-	4	66	12	1	-	-	5	43	2	72	166	29	14	2	10	4	15	445	1.12	65.84	15
AN	*Magelona sacculata*	7	100	37	127	27	66	12	3	-	-	-	-	5	8	8	-	-	2	-	402	1.01	66.85	12
AR	*Gibberosus myersi*	7	3	4	9	5	18	-	-	11	11	2	31	140	37	30	3	39	6	19	375	0.94	67.79	17
AR	*Anchicolurus occidentalis*	5	6	7	15	10	12	3	1	15	17	1	98	123	13	13	2	2	14	4	361	0.91	68.70	19
AN	*Aricidea (Acmira) catherinae*	26	70	6	18	10	12	21	5	12	8	2	11	9	39	19	5	20	33	15	341	0.86	69.55	19
AR	*Rhepoxynius abronius*	9	24	1	8	8	28	8	-	5	6	5	14	108	65	16	-	3	7	19	334	0.84	70.39	17
AR	*Aoroides inermis*	-	-	-	-	-	-	-	-	-	-	-	188	43	60	22	3	-	5	-	321	0.81	71.20	6
AR	*Photis brevipes*	6	-	-	-	3	2	-	-	5	1	15	106	122	14	11	15	-	-	3	303	0.76	71.96	12
AN	*Exogone lourei*	3	1	-	-	24	2	1	-	6	52	6	18	21	8	5	57	38	9	37	288	0.72	72.69	16
AN	*Goniada littorea*	42	18	9	10	24	20	4	6	15	14	12	27	17	10	15	3	6	2	15	269	0.68	73.37	19
AN	*Scoloplos armiger* Cmplx	7	6	21	25	28	43	19	5	18	43	11	5	1	3	8	-	11	1	-	255	0.64	74.01	17
AR	*Euphilomedes longiseta*	-	10	-	-	1	-	-	-	-	-	-	63	163	-	5	-	3	2	1	248	0.62	74.63	8
AN	*Chaetozone setosa* Cmplx	10	14	2	6	55	16	13	2	5	8	12	-	-	5	22	8	33	6	11	228	0.57	75.20	17
AN	*Capitella capitata* Cmplx	-	1	191	-	-	14	-	-	-	-	-	-	1	4	-	-	-	-	-	211	0.53	75.73	5
AN	*Onuphis* sp 1 Pt. Loma 1983	-	-	-	-	-	-	-	-	-	35	13	7	17	24	10	8	11	35	49	209	0.53	76.26	10
AR	*Jassa slatteryi*	-	-	-	-	9	-	-	-	-	-	-	93	86	4	-	-	5	6	-	203	0.51	76.77	6
AR	*Isocheles pilosus*	1	4	3	9	3	-	-	-	-	-	-	1	176	-	-	-	-	-	-	197	0.50	77.27	7
AN	*Mediomastus* spp	2	20	-	37	34	6	3	-	-	13	46	12	6	-	-	-	-	-	-	179	0.45	77.72	10
AR	*Ampelisca agassizi*	-	1	1	16	64	10	2	-	4	3	-	1	5	4	45	1	7	3	2	169	0.43	78.14	16
MO	*Cooperella subdiaphana*	-	-	2	7	3	-	-	-	-	5	4	18	90	10	9	6	1	-	5	160	0.40	78.54	12
AR	*Americhelidium shoemakeri*	25	-	2	5	-	-	-	-	1	-	-	11	77	13	5	2	1	4	6	152	0.38	78.93	12
AN	*Syllis (Typosyllis) farallonensis*	-	-	1	-	-	-	-	-	14	14	5	3	-	2	7	10	44	22	28	150	0.38	79.30	11
AN	*Nephtys caecoides*	8	7	4	10	13	8	5	2	12	4	3	18	16	6	7	7	4	12	3	149	0.37	79.68	19
MO	*Rochefortia tumida*	4	6	2	1	1	-	-	-	1	1	-	4	45	45	20	5	3	2	3	143	0.36	80.04	15
AR	*Ericthonius brasiliensis*	-	-	-	-	-	-	-	-	-	-	-	130	3	6	2	1	-	-	-	142	0.36	80.39	5
AN	*Magelona pitelkai*	1	68	-	3	9	23	4	1	3	2	-	-	3	11	3	-	-	7	-	138	0.35	80.74	13
NE	Nemertea	18	10	7	18	13	3	8	2	6	6	3	7	15	6	2	2	3	6	3	138	0.35	81.09	19
AR	*Lamprops carinatus*	1	1	-	-	1	1	-	-	-	2	-	11	63	39	9	5	-	1	2	136	0.34	81.43	12
NE	Lineidae	-	-	-	4	-	-	-	-	5	9	1	3	10	12	6	8	44	12	20	134	0.34	81.77	12
AR	*Jassa marmorata*	-	-	-	-	-	-	-	-	-	-	-	25	11	-	-	70	22	5	-	133	0.33	82.10	5
MO	*Modiolus* sp	-	-	-	-	1	-	-	-	1	-	8	16	92	6	2	7	-	-	-	133	0.33	82.44	8
AR	*Uromunna ubiquita*	5	5	-	1	-	-	-	-	2	1	-	1	102	10	4	-	1	-	-	132	0.33	82.77	10
AN	*Spiophanes duplex*	-	31	-	52	3	4	-	7	2	1	8	-	3	5	1	1	2	3	2	125	0.31	83.08	15
AN	*Scoletoma tetraura* Cmplx	1	8	4	4	2	-	-	11	8	8	-	4	9	-	-	1	34	5	25	124	0.31	83.40	14
AN	*Spiochaetopterus costarum*	15	6	-	32	-	-	-	-	6	3	1	3	11	24	-	1	9	1	5	117	0.29	83.69	13
AN	*Glycera macrobranchia*	3	4	1	5	4	4	5	3	6	12	4	2	5	10	6	3	8	6	18	109	0.27	83.96	19
AR	*Lamprops quadriplicatus*	1	1	-	1	2	3	-	-	20	8	-	19	11	5	22	-	5	4	5	107	0.27	84.23	14
AR	*Cumella californica*	-	1	-	-	-	-	-	-	3	17	-	6	39	9	5	2	14	3	6	105	0.26	84.50	11
AR	*Edotia sublittoralis*	3	1	3	1	2	6	-	1	10	12	1	10	35	8	1	-	6	2	-	102	0.26	84.75	16
NE	*Paranemertes californica*	-	3	-	4	5	-	-	-	4	6	8	5	21	18	2	-	14	1	11	102	0.26	85.01	13
MO	*Mysella* sp H SCAMIT 2001	2	11	11	75	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	100	0.25	85.26	5
NE	*Tubulanus polymorphus*	-	-	1	2	3	11	-	-	4	5	1	1	21	23	2	8	1	5	9	97	0.24	85.51	15
AR	*Caprella verrucosa*	-	-	-	-	-	-	-	-	-	-	-	-	96	-	-	-	-	-	-	96	0.24	85.75	1
AR	*Foxiphalus obtusidens*	1	-	-	-	1	-	-	-	4	2	-	33	20	7	5	6	4	6	6	95	0.24	85.99	12
AN	*Sigalion spinosus*	5	14	4	11	4	1	5	1	10	2	3	4	4	11	9	1	-	4	1	94	0.24	86.22	18
PR	*Phoronis* sp	14	8	-	17	-	-	-	-	-	-	-	6	11	21	3	6	2	6	-	94	0.24	86.46	10
AN	*Glycinde armigera*	-	-	1	11	2	-	-	-	5	19	12	1	5	3	3	3	3	16	7	91	0.23	86.69	14
AN	*Syllis* sp	-	2	-	22	35	12	13	3	-	-	-	-	3	-	-	-	-	-	-	90	0.23	86.91	7
AN	*Syllis (Ehlersia) heterochaeta*	-	-	-	-	-	-	-	-	-	-	12	7	8	4	2	22	9	16	7	87	0.22	87.13	9
AR	*Rhepoxynius* sp A SCAMIT 1987	12	7	3	5	-	3	2	1	5	-	-	4	5	14	11	-	10	-	3	85	0.21	87.35	14
AN	*Chone* sp SD1 Pt. Loma 1997	-	-	-	-	-	-	-	-	-	-	3	1	6	3	17	2	6	2	41	81	0.20	87.55	9
AR	*Zeugophilomedes oblonga*	-	-	-	1	2	-	-	-	-	-	-	-	8	3	6	10	23	3	25	81	0.20	87.75	9
CO	Enteropneusta	10	2	-	-	8	-	-	-	-	4	2	5	23	20	2	2	2	1	-	81	0.20	87.96	12
AR	*Photis* sp	52	18	-	-	1	9	-	-	-	-	-	-	-	-	-	-	-	-	-	80	0.20	88.16	4
MO	*Macoma* sp	-	9	-	1	3	-	-	-	9	11	-	-	27	10	2	5	-	2	-	79	0.20	88.36	10
AN	*Monticellina cryptica*	-	-	-	-	-	-	-	-	-	2	3	6	3	4	3	1	-	15	37	74	0.19	88.54	9
AR	*Cyclaspis* sp C SCAMIT 1986	-	1	-	2	-	2	-	-	-	9	-	8	4	3	1	2	21	4	17	74	0.19	88.73	12

Appendix F-5. (Cont.).

Phy	Species	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	% Total	Cum. %	FO
		Year																						
AN	*Dispio uncinata*	7	25	7	10	1	1	-	-	-	1	-	1	5	7	-	1	1	6	-	73	0.18	88.91	13
AR	*Stenothoe estacola*	-	-	-	-	1	-	-	-	-	-	-	-	3	-	-	2	35	25	-	66	0.17	89.08	5
AN	*Syllis (Typosyllis) aciculata*	35	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	0.16	89.24	2
CN	Actiniaria	-	1	-	-	6	6	-	-	-	-	-	-	41	5	1	-	-	-	2	62	0.16	89.40	7
AN	*Ampharete labrops*	5	1	-	1	-	-	-	3	5	-	10	2	4	3	8	7	-	11	-	60	0.15	89.55	12
PR	Phoronidae	-	3	7	-	9	3	-	-	7	19	4	-	-	-	4	-	1	-	1	58	0.15	89.69	10
AR	Phoxocephalidae	-	-	-	6	1	40	10	-	-	-	-	-	-	-	-	-	-	-	-	57	0.14	89.84	4
AR	*Campylaspis* sp C Myers&Benedict 1974	-	1	-	6	1	2	-	-	12	2	1	9	6	4	-	-	5	1	6	56	0.14	89.98	13
AR	*Leuroleberis sharpei*	-	1	1	5	10	3	-	-	1	-	3	7	7	3	5	4	2	2	1	55	0.14	90.12	15
AR	*Anoropallene palpida*	-	-	-	2	-	-	-	-	-	20	-	1	24	5	-	-	-	-	1	53	0.13	90.25	6
AR	*Balanus pacificus*	-	-	3	2	-	-	-	-	-	-	-	-	17	31	-	-	-	-	-	53	0.13	90.38	4
AR	*Monocorophium acherusicum*	-	-	-	5	2	-	-	-	-	-	-	-	27	-	12	6	-	-	-	52	0.13	90.51	5
AN	*Pista disjuncta*	5	1	1	2	18	1	2	-	-	-	10	4	2	-	3	-	1	-	-	50	0.13	90.64	12
AN	*Phyllodoce hartmanae*	-	-	-	14	3	7	2	-	-	-	1	-	11	6	-	2	1	1	1	49	0.12	90.76	11
AN	*Tharyx* spp Cmplx	33	13	-	-	1	1	-	1	-	-	-	-	-	-	-	-	-	-	-	49	0.12	90.89	5
AN	*Lumbrineris* spp	4	4	-	3	4	15	11	1	-	2	2	-	-	1	-	-	-	-	-	47	0.12	91.00	10
AR	*Euphilomedes carcharodonta*	1	8	1	4	2	1	-	-	5	10	-	1	3	3	3	-	1	-	4	47	0.12	91.12	14
AN	*Brania californiensis*	-	-	-	-	2	-	-	-	-	-	-	6	32	4	-	-	2	-	-	46	0.12	91.24	5
CN	*Zaolutus actius*	-	2	-	4	-	-	-	-	-	-	-	13	26	1	-	-	-	-	-	46	0.12	91.35	5
AN	*Polydora cirrosa*	-	-	-	-	-	-	-	-	-	-	-	17	23	3	1	-	-	-	1	45	0.11	91.47	5
AR	*Cyclaspis nubila*	-	-	-	3	1	-	-	-	8	5	-	16	5	1	1	-	-	1	2	43	0.11	91.57	10
AN	*Diopatra ornata*	-	-	-	-	-	1	-	-	-	2	-	10	8	1	7	13	-	-	-	42	0.11	91.68	7
AN	*Notomastus hemipodus*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2	16	1	16	4	40	0.10	91.78	6
AN	*Onuphis iridescens*	2	4	3	12	7	12	-	-	-	-	-	-	-	-	-	-	-	-	-	40	0.10	91.88	6
MO	*Protothaca staminea*	-	-	-	-	-	-	-	-	-	1	-	2	24	3	5	3	1	-	1	40	0.10	91.98	8
AR	*Podocerus brasiliensis*	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-	-	10	7	-	39	0.10	92.08	3
AN	Maldanidae	2	-	-	-	-	-	1	1	-	-	-	-	1	3	4	-	-	26	-	38	0.10	92.18	7
AN	*Neosabellaria cementarium*	-	-	-	-	-	-	-	-	-	1	4	21	5	2	-	-	-	4	-	37	0.09	92.27	6
AN	*Scoletoma* sp	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	2	-	14	17	37	0.09	92.36	5
AR	*Cerapus tubularis* Cmplx	-	2	-	-	4	-	-	4	4	-	1	5	10	3	3	1	-	-	-	37	0.09	92.45	10
AR	*Ischyrocerus pelagops*	-	-	-	-	-	-	-	-	-	-	-	7	29	-	-	-	-	-	1	37	0.09	92.55	3
MO	*Mactromeris catilliformis*	-	-	-	-	-	-	-	-	-	-	-	-	-	35	1	-	-	-	-	36	0.09	92.64	2
MO	*Nassarius perpinguis*	-	2	4	-	4	-	-	-	2	9	-	1	8	6	-	-	-	-	-	36	0.09	92.73	8
AN	*Syllides* sp	15	13	-	1	-	-	-	-	-	-	1	4	1	-	-	-	-	-	-	35	0.09	92.82	6
AR	*Gammaropsis thompsoni*	-	-	-	-	-	-	-	-	1	-	-	1	-	3	26	3	1	-	-	35	0.09	92.90	6
AR	*Hartmanodes hartmanae*	1	1	2	2	3	1	1	-	2	-	-	1	6	1	6	-	3	-	5	35	0.09	92.99	14
AN	*Onuphis eremita*	4	-	-	-	3	1	1	15	2	2	1	1	-	-	2	-	2	-	-	34	0.09	93.08	11
AR	*Photis bifurcata*	-	-	-	-	-	-	-	-	-	-	-	2	1	-	24	6	-	-	-	33	0.08	93.16	4
AR	*Rhepoxynius* sp	13	-	-	1	16	-	3	-	-	-	-	-	-	-	-	-	-	-	-	33	0.08	93.24	4
AR	*Rutiderma rostratum*	2	-	-	3	1	-	-	-	-	3	1	2	5	4	1	1	4	3	3	33	0.08	93.33	13
AR	*Tiron biocellata*	-	-	-	1	-	4	-	-	2	-	-	13	5	3	-	1	-	2	1	32	0.08	93.41	9
BC	*Glottidia albida*	4	1	3	3	5	-	-	1	3	5	1	1	3	2	-	-	-	-	-	32	0.08	93.49	12
MO	*Olivella baetica*	-	7	1	3	3	1	-	-	1	12	-	-	2	2	-	-	-	-	-	32	0.08	93.57	9
MO	*Rochefortia grippi*	-	7	-	-	1	-	-	-	-	-	-	-	13	-	-	8	-	3	-	32	0.08	93.65	5
AN	*Dorvillea (Schistomeringos) longicornis*	-	-	-	-	-	-	-	-	30	1	-	-	-	-	-	-	-	-	-	31	0.08	93.73	2
MO	*Cyclostremella dalli*	-	-	-	2	-	-	-	-	-	-	1	-	27	-	-	-	-	-	-	30	0.08	93.80	3
AN	Onuphidae	1	-	-	1	2	-	-	1	6	5	-	-	5	-	3	-	5	-	-	29	0.07	93.88	9
AR	*Hemilamprops californicus*	2	1	-	7	-	-	-	-	4	-	-	3	2	-	6	-	3	1	-	29	0.07	93.95	9
AN	*Sthenelais verruculosa*	6	2	3	1	1	2	-	5	1	-	-	3	2	-	2	-	-	-	-	28	0.07	94.02	11
CN	Limnactiniidae sp A SCAMIT 1989	-	-	-	-	1	-	-	-	3	3	3	-	3	8	3	1	3	-	-	28	0.07	94.09	9
EC	*Amphiodia urtica*	4	2	2	2	2	5	4	6	-	-	-	-	-	-	1	-	-	-	-	28	0.07	94.16	9
AN	*Podarkeopsis glabrus*	-	4	-	1	6	3	2	-	1	-	1	-	2	-	2	2	1	1	1	27	0.07	94.23	13
AN	*Phyllodoce* sp	1	19	-	1	-	1	-	-	2	-	-	1	-	1	-	-	-	-	-	26	0.07	94.29	7
AN	*Nereis latescens*	-	-	-	-	-	-	-	-	1	-	-	1	2	5	5	9	2	-	-	25	0.06	94.36	7
AR	*Rhepoxynius variatus*	-	-	-	1	7	1	1	2	-	-	-	2	-	1	8	-	-	1	-	24	0.06	94.42	9
EC	*Amphiodia* sp	-	-	-	-	-	1	-	-	4	1	1	3	2	-	1	-	-	1	10	24	0.06	94.48	9
MO	*Yoldia cooperi*	-	-	-	-	-	-	-	-	-	-	-	-	11	-	12	-	-	1	-	24	0.06	94.54	3
AN	*Leitoscoloplos pugettensis*	1	2	4	-	4	-	-	-	2	-	6	-	-	2	-	-	1	1	-	23	0.06	94.60	9
AN	*Nephtys cornuta*	-	4	-	2	2	-	-	-	1	3	-	-	-	4	2	-	4	1	-	23	0.06	94.65	9
AR	*Americhelidium rectipalmum*	-	-	-	3	-	-	-	-	-	-	-	2	8	3	5	-	2	-	-	23	0.06	94.71	6
AR	*Metharpinia jonesi*	5	6	-	-	-	-	-	-	3	8	-	-	-	-	-	1	-	-	-	23	0.06	94.77	5
AR	*Rhepoxynius stenodes*	-	1	-	-	1	-	-	-	-	2	3	16	-	-	-	-	-	-	-	23	0.06	94.83	5
AN	*Carazziella* sp A SCAMIT 1995	-	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-	-	-	-	22	0.06	94.88	1
AN	*Paraprionospio pinnata*	1	1	1	1	1	1	-	-	4	3	-	-	2	4	1	-	-	-	2	22	0.06	94.94	12
AN	*Polyophthalmus pictus*	-	-	-	-	-	17	-	-	-	2	-	-	-	-	-	-	1	-	2	22	0.06	94.99	4
AN	*Prionospio (Minuspio) lighti*	-	3	-	1	1	4	-	-	-	-	-	1	-	9	1	-	-	1	1	22	0.06	95.05	9
AR	*Asteropella slatteryi*	-	-	-	-	-	-	-	-	1	-	1	10	4	2	-	-	2	1	1	22	0.06	95.10	8
AR	*Photis macrotica*	17	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	0.06	95.16	2
AN	*Hesionella mccullochae*	-	-	-	-	-	-	-	-	-	2	1	1	7	-	-	-	4	3	3	21	0.05	95.21	7
AN	*Goniada maculata*	-	-	1	2	2	-	6	-	1	-	-	1	2	-	-	-	3	-	2	20	0.05	95.26	9

Appendix F-5. (Cont.).

		Year																				%	Cum.	
Phy	Species	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	Total	%	FO
AN	*Eumida longicornuta*	-	-	-	-	-	-	-	-	-	-	-	11	1	2	-	4	-	1	-	19	0.05	95.31	5
AR	*Monocorophium* sp	-	-	-	-	-	-	-	-	-	-	-	17	-	1	-	-	1	-	-	19	0.05	95.36	3
AR	*Anoplodactylus erectus*	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	-	-	-	-	18	0.05	95.40	1
AR	*Eohaustorius barnardi*	13	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	0.05	95.45	2
CN	*Edwardsia californica*	-	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	0.05	95.49	1
EC	Amphiuridae	-	-	-	-	-	-	-	-	7	-	-	-	-	1	1	2	2	5	-	18	0.05	95.54	6
AN	*Amaeana occidentalis*	3	1	-	-	-	-	6	-	-	1	5	-	-	-	-	-	-	1	-	17	0.04	95.58	6
AN	*Chone mollis*	1	-	-	-	-	-	1	2	-	-	-	-	1	-	7	2	-	3	-	17	0.04	95.62	7
AN	*Metasychis disparidentatus*	1	-	-	1	-	2	-	2	4	5	1	-	1	-	-	-	-	-	-	17	0.04	95.67	8
AR	*Eobrolgus spinosus*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	13	-	-	3	-	17	0.04	95.71	3
MO	*Rictaxis punctocaelatus*	1	1	-	1	-	-	-	-	-	3	2	-	3	2	1	-	3	-	-	17	0.04	95.75	9
AN	*Eupolymnia heterobranchia*	-	-	-	-	-	-	-	-	-	-	-	3	5	3	2	3	-	-	-	16	0.04	95.79	5
AN	*Sphaerephesia similisetis*	-	-	-	-	-	-	-	-	1	1	-	2	2	3	2	-	1	3	1	16	0.04	95.83	9
CO	*Branchiostoma californiensis*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	14	1	16	0.04	95.87	3
EC	*Amphiodia digitata*	-	2	-	-	-	-	-	-	-	-	-	2	1	-	6	1	-	3	1	16	0.04	95.91	7
AN	*Heteropodarke heteromorpha*	-	6	1	3	-	-	-	-	3	-	-	-	-	-	-	-	1	1	-	15	0.04	95.95	6
AN	*Lumbrineris californiensis*	-	-	1	1	-	-	-	-	3	4	-	-	-	1	1	-	1	3	-	15	0.04	95.99	8
AR	*Aoroides* sp	-	-	-	-	-	-	-	-	3	-	10	-	1	-	-	-	1	-	-	15	0.04	96.03	4
MO	Mytilidae	-	-	-	5	-	-	-	-	-	1	-	-	-	-	2	-	4	-	3	15	0.04	96.06	5
MO	*Neverita reclusiana*	-	-	-	2	1	-	-	-	-	-	-	-	10	2	-	-	-	-	-	15	0.04	96.10	4
NE	*Zygonemertes virescens*	-	-	-	-	-	-	-	-	-	-	-	-	-	12	2	1	-	-	-	15	0.04	96.14	3
AN	*Diopatra splendidissima*	-	-	2	-	-	-	-	1	-	-	3	-	5	2	-	-	-	1	-	14	0.04	96.17	6
AN	Euclymeninae sp A SCAMIT 1987	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	10	2	-	14	0.04	96.21	3
NE	*Carinomella lactea*	-	11	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	14	0.04	96.24	2
NE	*Cerebratulus californiensis*	-	-	-	8	-	2	2	-	-	-	-	2	-	-	-	-	-	-	-	14	0.04	96.28	4
PL	*Stylochoplana* sp	-	3	-	-	-	-	-	-	1	1	2	2	-	1	-	-	-	1	3	14	0.04	96.32	8
SI	*Siphonosoma ingens*	-	-	-	-	-	-	-	-	3	-	-	-	4	4	-	-	-	3	-	14	0.04	96.35	4
AN	*Malmgreniella macginitiei*	1	1	1	1	-	-	-	2	-	-	-	1	-	5	1	-	-	-	-	13	0.03	96.38	8
AN	*Phyllodoce longipes*	-	-	-	-	-	-	-	-	1	-	-	-	5	5	-	2	-	-	-	13	0.03	96.42	4
AN	*Platynereis bicanalicalata*	-	-	-	-	-	-	-	-	-	-	-	-	1	1	1	10	-	-	-	13	0.03	96.45	4
AN	*Rhynchospio glutaea*	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	10	-	-	-	13	0.03	96.48	3
AR	*Metatiron tropakis*	4	1	2	-	2	-	-	-	2	1	-	1	-	-	-	-	-	-	-	13	0.03	96.51	7
AR	*Nymphon* sp	-	-	3	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	13	0.03	96.55	2
AR	*Rhepoxynius homocuspidatus*	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13	0.03	96.58	1
EC	Echinoidea	2	3	-	-	-	1	-	7	-	-	-	-	-	-	-	-	-	-	-	13	0.03	96.61	4
EC	*Leptosynapta* sp	2	-	-	-	-	-	1	2	2	-	-	1	1	4	-	-	-	-	-	13	0.03	96.64	7
NE	*Tubulanus nothus*	-	-	-	-	-	-	-	-	-	1	-	2	1	-	5	-	-	2	2	13	0.03	96.68	6
PR	*Phoronopsis* sp	-	-	-	-	-	-	-	-	-	-	-	-	9	4	-	-	-	-	-	13	0.03	96.71	2
AN	*Aphelochaeta glandaria*	-	-	-	-	-	-	-	-	-	2	1	3	-	-	1	-	3	1	1	12	0.03	96.74	7
AN	*Nereis procera*	1	-	-	-	1	-	-	-	1	-	3	-	-	-	1	4	-	1	-	12	0.03	96.77	7
AN	*Polydora cornuta*	-	-	-	-	-	-	-	1	-	-	-	-	-	9	-	-	1	-	1	12	0.03	96.80	4
AR	*Americhelidium* sp	3	9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	0.03	96.83	2
EC	*Amphiodia psara*	1	1	1	-	1	-	-	-	1	-	1	1	1	2	2	-	-	-	-	12	0.03	96.86	10
MO	*Crepidula naticarum*	-	-	1	2	-	-	-	-	2	-	2	-	5	-	-	-	-	-	-	12	0.03	96.89	5
NE	*Micrura* sp	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	3	5	3	12	0.03	96.92	4
SI	*Apionsoma misakianum*	-	1	1	-	6	-	-	-	-	-	-	3	-	-	-	-	-	-	1	12	0.03	96.95	5
AN	*Axiothella rubrocincta*	-	-	1	-	-	-	1	-	-	-	-	-	-	-	5	4	-	-	-	11	0.03	96.98	4
AN	*Boccardia* sp	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	0.03	97.01	1
AN	*Glycera nana*	-	-	1	2	-	-	-	-	-	2	-	1	-	-	-	-	-	4	1	11	0.03	97.03	6
AN	*Glycera* sp	2	2	-	3	-	2	-	1	-	-	-	-	-	1	-	-	-	-	-	11	0.03	97.06	6
AN	*Magelona* sp	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	0.03	97.09	1
AN	*Nephtys* sp	-	2	-	2	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	11	0.03	97.12	3
AN	*Polydora* sp	-	-	-	10	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	11	0.03	97.15	2
AR	*Metamysidopsis elongata*	-	-	-	2	-	-	-	-	-	1	-	-	1	3	-	1	-	1	2	11	0.03	97.17	7
AR	*Parasterope hulingsi*	-	-	-	-	-	-	-	-	-	-	-	-	2	1	1	-	2	1	4	11	0.03	97.20	6
AR	*Tritella pilimana*	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	1	-	-	-	11	0.03	97.23	2
MO	*Leptopecten latiauratus*	-	-	-	-	1	-	-	-	-	-	5	2	2	1	-	-	-	-	-	11	0.03	97.26	5
MO	*Mactrotoma californica*	-	-	-	-	-	-	-	-	-	-	-	3	8	-	-	-	-	-	-	11	0.03	97.28	2
MO	*Nassarius* sp	-	-	-	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	0.03	97.31	1
NE	*Tetrastemma* sp A SCAMIT 1995	-	-	-	-	-	-	-	-	-	-	1	7	3	-	-	-	-	-	-	11	0.03	97.34	3
AN	*Magelona californica*	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-	-	-	-	10	0.03	97.36	1
AR	*Exosphaeroma rhomburum*	-	-	-	-	-	-	-	-	3	-	-	-	1	-	5	1	-	-	-	10	0.03	97.39	4
AR	Gammaridea	1	1	-	-	1	6	-	-	1	-	-	-	-	-	-	-	-	-	-	10	0.03	97.41	5
AR	*Ischyrocerus anguipes*	-	1	-	-	-	-	-	-	-	-	-	-	-	2	7	-	-	-	-	10	0.03	97.44	3
AR	*Rudilemboides stenopropodus*	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	0.03	97.46	1
MO	Bivalvia	-	2	-	-	1	1	-	1	2	-	-	-	-	-	1	-	-	-	2	10	0.03	97.49	7
MO	*Cadulus aberrans*	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	-	-	1	6	10	0.03	97.52	5
MO	*Macoma secta*	-	-	-	2	-	-	1	-	-	1	-	3	-	-	2	-	1	-	-	10	0.03	97.54	6
AN	Euclymeninae	-	-	-	-	1	6	1	1	-	-	-	-	-	-	-	-	-	-	-	9	0.02	97.56	4
AN	*Mediomastus ambiseta*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	5	2	9	0.02	97.59	3

Appendix F-5. (Cont.).

Phy	Species	Year 1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	% Total	Cum. %	FO
AN	*Mediomastus californiensis*	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	3	-	-	-	9	0.02	97.61	2
AN	*Onuphis* sp	-	-	-	3	-	-	-	1	-	-	-	-	-	-	-	-	-	2	3	9	0.02	97.63	4
AN	*Spiophanes berkeleyorum*	-	1	-	-	-	-	-	-	1	-	-	-	1	1	-	1	-	3	1	9	0.02	97.65	7
AR	*Atylus tridens*	1	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	9	0.02	97.68	3
AR	*Photis californica*	-	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	5	-	9	0.02	97.70	3
EC	Ophiuroidea	1	1	1	-	-	2	-	-	4	-	-	-	-	-	-	-	-	-	-	9	0.02	97.72	5
MO	*Chione* sp	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	9	0.02	97.74	2
MO	*Pandora bilirata*	-	-	-	-	-	-	-	-	-	1	-	-	3	3	1	1	-	-	-	9	0.02	97.77	5
MO	*Periploma planiusculum*	1	-	-	2	-	-	-	-	-	-	-	-	1	3	-	-	-	1	1	9	0.02	97.79	6
NE	*Tetrastemma candidum*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	6	-	-	9	0.02	97.81	2
AN	*Chone albocincta*	-	-	-	-	1	-	-	-	4	3	-	-	-	-	-	-	-	-	-	8	0.02	97.83	3
AN	*Glycera americana*	-	-	-	-	1	2	-	-	-	2	-	-	-	-	-	3	-	-	-	8	0.02	97.85	4
AN	*Sphaerosyllis californiensis*	-	-	-	-	-	-	-	-	-	-	1	-	4	-	-	2	-	-	1	8	0.02	97.87	4
AN	*Sthenelais tertiaglabra*	-	-	-	-	-	-	-	-	-	1	4	-	-	-	-	1	-	2	-	8	0.02	97.89	4
AN	*Tenonia priops*	-	-	-	3	-	-	-	-	2	-	-	1	1	-	1	-	-	-	-	8	0.02	97.91	5
AR	*Cancer* sp	-	-	-	-	-	-	-	-	1	-	-	4	2	1	-	-	-	-	-	8	0.02	97.93	4
AR	*Joeropsis lobata*	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	8	0.02	97.95	1
CN	Hydrozoa	1	2	3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	0.02	97.97	4
MO	*Balcis oldroydae*	2	3	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	1	-	8	0.02	97.99	5
MO	*Periploma discus*	-	5	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	8	0.02	98.01	3
AN	*Pista elongata*	-	-	-	-	-	-	-	-	-	-	-	1	-	3	3	-	-	-	-	7	0.02	98.03	3
AR	*Argissa hamatipes*	2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	-	1	-	-	7	0.02	98.05	4
CN	Anthozoa	-	2	1	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	0.02	98.07	4
MO	*Caecum crebricinctum*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	6	-	7	0.02	98.08	2
MO	*Macoma yoldiformis*	-	1	1	2	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	7	0.02	98.10	6
AN	*Arabella endonata*	-	-	-	-	1	-	-	-	2	-	-	-	1	-	-	-	1	-	1	6	0.02	98.12	5
AN	*Brania brevipharyngea*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	6	0.02	98.13	1
AN	*Halosydna johnsoni*	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	3	-	-	-	6	0.02	98.15	3
AN	*Heteromastus* sp	-	-	1	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	6	0.02	98.16	2
AN	*Nereiphylla castanea*	-	-	-	-	-	-	-	-	1	-	-	4	-	-	-	-	-	1	-	6	0.02	98.18	3
AR	*Callipallene californiensis*	4	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0.02	98.19	2
AR	*Cancer antennarius*	-	-	-	-	-	-	-	-	-	1	-	-	1	2	-	1	-	1	-	6	0.02	98.21	5
AR	*Lepidepecreum serraculum*	-	-	-	-	1	-	-	-	1	-	-	-	3	1	-	-	-	-	-	6	0.02	98.22	4
AR	*Leptocuma forsmani*	-	-	-	-	2	-	-	-	1	-	-	3	-	-	-	-	-	-	-	6	0.02	98.24	3
AR	*Stenothoe valida*	-	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	0.02	98.25	1
MO	*Acteocina culcitella*	-	-	1	-	-	-	1	-	1	-	-	-	-	3	-	-	-	-	-	6	0.02	98.27	4
MO	*Ennucula tenuis*	-	-	-	-	-	-	-	-	-	2	1	-	-	3	-	-	-	-	-	6	0.02	98.28	3
MO	*Mytilus* sp	-	-	-	5	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	6	0.02	98.30	2
MO	*Solen sicarius*	-	-	-	-	-	1	-	1	-	-	2	-	-		1	-	-	1	-	6	0.02	98.31	5
NE	*Tetrastemma nigrifrons*	-	-	-	-	-	-	-	-	-	2	-	-	-	2	2	-	-	-	-	6	0.02	98.33	3
PL	Platyhelminthes	4	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	6	0.02	98.34	2
SI	Sipuncula	1	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	6	0.02	98.36	4
AN	*Dipolydora bidentata*	-	-	-	-	1	-	-	-	3	-	-	-	1	-	-	-	-	-	-	5	0.01	98.37	3
AN	*Dipolydora socialis*	-	-	-	1	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	5	0.01	98.38	2
AN	*Eteone balboensis*	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0.01	98.40	3
AN	*Eteone* sp	-	-	-	2	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0.01	98.41	2
AN	*Lumbrineris japonica*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	3	-	-	5	0.01	98.42	3
AN	*Protodorvillea gracilis*	-	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	5	0.01	98.43	3
AN	Syllidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	4	-	5	0.01	98.45	2
AR	Calanoida	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0.01	98.46	1
AR	*Caprella californica*	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	5	0.01	98.47	1
AR	*Eochelidium* sp A SCAMIT 1996	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0.01	98.48	1
AR	*Eohaustorius sawyeri*	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	5	0.01	98.50	1
AR	*Laticorophium baconi*	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	2	1	-	5	0.01	98.51	4
AR	*Lepidopa californica*	-	1	2	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	5	0.01	98.52	4
AR	*Listriella melanica*	-	-	-	1	-	-	-	-	-	-	-	1	-	1	-	-	1	1	-	5	0.01	98.53	5
AR	*Mandibulophoxus gilesi*	1	-	-	-	-	1	1	1	-	-	-	-	-	-	-	-	1	-	-	5	0.01	98.55	5
AR	*Paracerceis* sp	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	5	0.01	98.56	1
AR	*Pinnixa* sp	2	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	5	0.01	98.57	4
AR	*Randallia ornata*	-	-	1	-	3	-	-	-	-	-	-	1	-	-	-	-	-	-	-	5	0.01	98.58	3
AR	*Rhepoxynius* sp H	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-	-	5	0.01	98.60	1
MO	*Crepidula norrisiarum*	-	-	-	-	-	-	-	-	-	-	-	3	-	1	1	-	-	-	-	5	0.01	98.61	3
MO	*Crepidula* sp	-	-	-	-	1	-	-	-	-	-	-	-	-	4	-	-	-	-	-	5	0.01	98.62	2
MO	*Macoma nasuta*	-	-	-	3	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	5	0.01	98.63	2
MO	*Odostomia* sp D MBC 1980	-	-	-	-	-	-	-	-	-	-	-	-	3	1	-	-	-	-	1	5	0.01	98.65	3
MO	*Tellina bodegensis*	1	-	-	-	-	-	-	-	1	-	-	1	1	1	-	-	-	-	-	5	0.01	98.66	5
PL	*Imogine exiguus*	-	-	-	-	-	-	-	-	3	1	1	-	-	-	-	-	-	-	-	5	0.01	98.67	3
PL	*Stylochoplana longipenis*	-	-	-	-	-	-	-	-	1	-	-	-	2	-	2	-	-	-	-	5	0.01	98.68	3
SI	*Thysanocardia nigra*	-	-	-	-	-	-	-	-	2	-	-	1	2	-	-	-	-	-	-	5	0.01	98.70	3
AN	*Cirriformia spirabrancha*	-	-	1	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	4	0.01	98.71	4

Appendix F-5. (Cont.).

		Year																				%	Cum.	
Phy	Species	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	Total	%	FO
AN	*Exogone uniformis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	4	0.01	98.72	1
AN	Polychaeta	-	-	-	-	-	-	-	1	1	-	-	-	-	2	-	-	-	-	-	4	0.01	98.73	3
AN	*Polycirrus* sp	-	-	1	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	4	0.01	98.74	3
AN	*Sabellaria gracilis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	1	-	-	4	0.01	98.75	2
AR	*Balanus* sp	-	-	1	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	4	0.01	98.76	3
AR	*Blepharipoda occidentalis*	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	1	4	0.01	98.77	4
AR	*Caprella mendax*	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	4	0.01	98.78	1
AR	*Euphilomedes* sp	-	-	-	-	1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0.01	98.79	2
AR	*Gnathopleustes serratus*	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	4	0.01	98.80	2
AR	*Joeropsis dubia*	-	-	-	-	-	-	-	-	1	-	-	-	1	1	1	-	-	-	-	4	0.01	98.81	4
AR	*Munnogonium tillerae*	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0.01	98.82	1
AR	*Neomysis kadiakensis*	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-	-	1	-	4	0.01	98.83	3
AR	*Neotrypaea californiensis*	-	-	1	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	4	0.01	98.84	3
AR	*Pinnixa longipes*	-	-	-	-	-	1	-	-	-	-	-	1	-	-	2	-	-	-	-	4	0.01	98.85	3
AR	*Pyromaia tuberculata*	-	-	-	-	-	-	-	-	-	-	-	1	3	-	-	-	-	-	-	4	0.01	98.86	2
CN	*Edwardsia* sp G MEC 1992	-	1	-	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	4	0.01	98.87	4
CN	Edwardsiidae	-	1	1	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	4	0.01	98.88	4
EC	*Lovenia cordiformis*	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0.01	98.89	1
MO	*Epitonium sawinae*	-	-	-	-	-	-	-	-	1	1	-	-	2	-	-	-	-	-	-	4	0.01	98.90	3
MO	*Kellia suborbicularis*	1	-	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	4	0.01	98.91	3
MO	*Kurtziella plumbea*	-	-	-	1	1	-	-	-	1	-	-	-	1	-	-	-	-	-	-	4	0.01	98.92	4
MO	*Mytilus galloprovincialis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	4	0.01	98.93	1
MO	*Rhamphidonta retifera*	-	-	-	-	-	-	-	-	-	-	-	2	1	1	-	-	-	-	-	4	0.01	98.94	3
NE	*Micrura alaskensis*	-	1	2	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0.01	98.95	3
PL	*Cryptocelis occidentalis*	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	0.01	98.96	1
AN	*Ancistrosyllis hamata*	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	1	-	3	0.01	98.97	3
AN	*Aphelochaeta monilaris*	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	3	0.01	98.97	2
AN	*Arabella iricolor*	-	-	-	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	0.01	98.98	2
AN	*Chaetozone armata*	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	3	0.01	98.99	2
AN	*Chaetozone corona*	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	1	-	-	3	0.01	99.00	3
AN	*Eteone fauchaldi*	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	3	0.01	99.00	3
AN	*Harmothoe* sp	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3	0.01	99.01	2
AN	*Hesionura coineaui difficilis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3	0.01	99.02	1
AN	*Heterospio catalinensis*	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	3	0.01	99.03	2
AN	*Mooreonuphis stigmatis*	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3	0.01	99.03	1
AN	*Ophiodromus pugettensis*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	3	0.01	99.04	2
AN	*Paleanotus bellis*	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	3	0.01	99.05	2
AN	*Polydora limicola*	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	3	0.01	99.06	1
AN	*Praxillella pacifica*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	3	0.01	99.06	2
AN	*Prionospio (Prionospio) heterobranchia*	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	1	-	-	-	3	0.01	99.07	3
AN	*Prionospio (Prionospio) jubata*	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	1	-	-	3	0.01	99.08	3
AN	*Scolelepis squamata*	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.01	99.09	1
AN	*Scoloplos* sp	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.01	99.09	2
AR	*Acuminodeutopus heteruropus*	-	-	-	-	-	-	-	-	1	1	-	-	-	-	1	-	-	-	-	3	0.01	99.10	3
AR	Mysidacea	2	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	3	0.01	99.11	2
AR	*Nebalia daytoni*	-	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	3	0.01	99.12	2
AR	*Nebalia pugettensis* Cmplx	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.01	99.12	2
AR	*Ogyrides* sp A Roney 1978	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	3	0.01	99.13	2
AR	*Pachygapsus crassipes*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	3	0.01	99.14	1
AR	*Pinnixa franciscana*	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	3	0.01	99.15	2
AR	*Postasterope barnesi*	-	-	-	-	1	-	-	-	-	2	-	-	-	-	-	-	-	-	-	3	0.01	99.15	2
AR	Pycnogonida	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.01	99.16	2
AR	*Xenoleberis californica*	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.01	99.17	2
CN	*Renilla kollikeri*	-	-	-	-	1	-	-	-	-	-	-	-	-	2	-	-	-	-	-	3	0.01	99.18	2
EC	*Amphipholus squamata*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	3	0.01	99.19	2
EC	Holothuroidea	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3	0.01	99.19	1
MO	*Donax gouldii*	-	1	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	3	0.01	99.20	2
MO	*Doto amyra*	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	3	0.01	99.21	1
MO	*Hiatella arctica*	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	3	0.01	99.22	3
MO	*Lyonsia californica*	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	3	0.01	99.22	2
MO	Mactridae	-	1	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.01	99.23	2
MO	*Modiolus rectus*	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3	0.01	99.24	1
MO	*Odostomia* sp	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	-	-	-	-	3	0.01	99.25	2
MO	*Saxidomus nuttalli*	-	-	-	1	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	3	0.01	99.25	3
MO	*Turbonilla* sp	-	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	0.01	99.26	1
NE	*Anopla* sp D SCAMIT 1995	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	3	0.01	99.27	1
NE	*Cerebratulus* sp	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	3	0.01	99.28	3
PL	*Notoplana* sp	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	1	-	-	3	0.01	99.28	3
AN	*Amastigos acutus*	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.29	1
AN	*Aricidea (Aedicira) pacifica*	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.29	1

Appendix F-5. (Cont.).

Phy	Species	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	% Total	Cum. %	FO
AN	*Carazziella* sp	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.30	1
AN	*Chone minuta*	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	2	0.01	99.30	2
AN	*Chone* sp	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.31	1
AN	*Decamastus gracilis*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	0.01	99.31	2
AN	*Diopatra* sp	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	2	0.01	99.32	2
AN	*Dipolydora* sp	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	2	0.01	99.32	2
AN	*Eranno lagunae*	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	0.01	99.33	1
AN	*Eteone californica*	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	2	0.01	99.33	2
AN	*Eulalia quadrioculata*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	2	0.01	99.34	2
AN	*Eusyllis blomstrandi*	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	0.01	99.34	1
AN	*Glycinde polygnatha*	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.35	1
AN	*Glycinde* sp	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.35	1
AN	*Goniada brunnea*	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2	0.01	99.36	2
AN	*Hydroides uncinatus*	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	0.01	99.36	1
AN	*Laonice cirrata*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	2	0.01	99.37	2
AN	*Loimia* sp A SCAMIT 2001	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	2	0.01	99.37	2
AN	*Micropodarke dubia*	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	0.01	99.38	1
AN	*Nephtys californiensis*	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	2	0.01	99.38	2
AN	Nereididae	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	2	0.01	99.39	2
AN	*Nereis* sp	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	2	0.01	99.39	2
AN	*Notomastus latescens*	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	0.01	99.40	1
AN	*Onuphis eremita parva*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	0.01	99.40	1
AN	*Ophelia assimilis*	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.41	1
AN	*Poecilochaetus johnsoni*	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	0.01	99.41	2
AN	*Polycirrus* sp A SCAMIT 1995	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	2	0.01	99.42	2
AN	*Polydora nuchalis*	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	0.01	99.42	1
AN	*Sphaerodoropsis sphaerulifer*	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	0.01	99.43	1
AR	*Ammothea hilgendorfi*	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.43	1
AR	*Aoroides exilis*	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	0.01	99.44	1
AR	Brachyura (Megalopa)	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	2	0.01	99.44	2
AR	*Cancer gracilis*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	2	0.01	99.45	2
AR	Cumacea	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	2	0.01	99.45	2
AR	*Cyclaspis* sp B SCAMIT 1989	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	2	0.01	99.46	2
AR	*Haliophasma geminatum*	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	2	0.01	99.46	2
AR	*Heterocrypta occidentalis*	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	0.01	99.47	1
AR	*Lepidepecreum gurjanovae*	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.47	2
AR	*Mysidopsis intii*	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	2	0.01	99.48	2
AR	Oedicerotidae	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.48	1
AR	*Pachynus barnardi*	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	0.01	99.49	1
AR	Peltidiidae	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	2	0.01	99.49	2
AR	Pinnotheridae	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.50	2
AR	*Zeuxo normani*	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	0.01	99.50	1
CN	*Actiniaria* sp A Paquette 2005	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	2	0.01	99.51	2
EC	*Amphiura arcystata*	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	0.01	99.51	1
EC	*Astropecten verrilli*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	2	0.01	99.52	2
EC	*Ophiothrix spiculata*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	2	0.01	99.52	2
EH	*Arynchite californica*	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.53	1
MO	*Alia carinata*	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	0.01	99.53	1
MO	*Emarcusia morroensis*	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.54	1
MO	*Epitonium* sp	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	0.01	99.54	1
MO	Facelinidae	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	2	0.01	99.55	1
MO	Gastropoda	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	2	0.01	99.55	2
MO	*Nuculana taphria*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	2	0.01	99.56	2
MO	*Odostomia farella*	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.56	1
MO	*Parvilucina tenuisculpta*	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	0.01	99.57	2
MO	*Petricola* sp	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2	0.01	99.57	1
MO	*Philine bakeri*	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	0.01	99.58	1
MO	*Tellina nuculoides*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	2	0.01	99.59	2
MO	*Tellina* sp B SCAMIT 1995	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	2	0.01	99.59	1
MO	*Vitrinella oldroydi*	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	0.01	99.60	2
MO	*Volvulella cylindrica*	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.60	2
NE	*Hoplonemertea* sp A Paquette 1988	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	2	0.01	99.61	2
NE	*Tubulanus frenatus*	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	0.01	99.61	1
NE	*Tubulanus* sp	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	2	0.01	99.62	1
PL	*Kaburakia excelsa*	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.01	99.62	1
PL	*Pseudoceros* sp	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	2	0.01	99.63	2
AN	Amphinomidae	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.63	1
AN	*Ancistrosyllis groenlandica*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.63	1
AN	Annelida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	0.00	99.63	1
AN	*Aricidea (Allia)* sp A SCAMIT 1996	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.64	1

Appendix F-5. (Cont.).

Phy	Species	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	% Total	Cum. %	FO
AN	*Aricidea (Aricidea) wassi*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	0.00	99.64	1
AN	*Bispira volutacornis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.64	1
AN	*Caulleriella alata*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.64	1
AN	*Caulleriella bioculata*	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.65	1
AN	*Caulleriella* sp	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.65	1
AN	*Chaetozone hartmanae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.65	1
AN	*Cossura* sp A Phillips 1987	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	0.00	99.65	1
AN	*Demonax* sp 1 Fitzhugh	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.66	1
AN	*Dorvillea (Schistomeringos) annulata*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.66	1
AN	Dorvilleidae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.66	1
AN	*Drilonereis nuda*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.66	1
AN	*Drilonereis* sp	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.67	1
AN	*Ephesiella brevicapitis*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.67	1
AN	*Eteone brigitteae*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.67	1
AN	*Eteone dilatae*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.67	1
AN	*Eteone lighti*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.68	1
AN	*Eusyllis* sp	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.68	1
AN	*Exogone dwisula*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.68	1
AN	Flabelligeridae	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.68	1
AN	*Goniada* sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.69	1
AN	*Gyptis* sp	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.69	1
AN	*Halosydna brevisetosa*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.69	1
AN	*Levinsenia gracilis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	0.00	99.69	1
AN	Lumbrineridae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.70	1
AN	*Lumbrineris cruzensis*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.70	1
AN	*Magelona hartmanae*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.70	1
AN	*Malmgreniella scriptoria*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.70	1
AN	*Megalomma pigmentum*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.71	1
AN	*Monticellina serratiseta*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.71	1
AN	*Naineris dendritica*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.71	1
AN	*Nicomache* sp	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.71	1
AN	*Notocirrus californiensis*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.72	1
AN	*Notomastus* sp A SCAMIT 2001	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0.00	99.72	1
AN	Oenonidae	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.72	1
AN	Oligochaeta	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0.00	99.72	1
AN	*Ophryotrocha* sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	0.00	99.73	1
AN	*Paranaitis polynoides*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.73	1
AN	*Parandalia ocularis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.73	1
AN	*Pareurythoe californica*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.73	1
AN	*Pherusa neopapillata*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.74	1
AN	*Phyllochaetopterus prolifica*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.74	1
AN	*Phyllodoce groenlandica*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.74	1
AN	*Phyllodoce pettiboneae*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.74	1
AN	*Polycirrus californicus*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.75	1
AN	*Polycirrus* sp 1 Banse 1980	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.75	1
AN	Polynoidae	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.75	1
AN	*Schistocomus* sp A SCAMIT 1987	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.75	1
AN	*Scolelepis tridentata*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0.00	99.76	1
AN	*Scoletoma* sp A (Harris 1985)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.76	1
AN	*Scoloplos acmeceps*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.76	1
AN	Sigalionidae	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.76	1
AN	Sphaerodoridae	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.77	1
AN	*Sphaerosyllis brandhorsti*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.77	1
AN	Spionidae	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.77	1
AN	*Spiophanes* sp	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.77	1
AN	*Sthenelais* sp	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.78	1
AN	*Syllis (Syllis) gracilis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.78	1
AN	*Syllis (Typosyllis) pulchra*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.78	1
AN	*Syllis (Typosyllis)* sp	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.78	1
AN	Terebellidae	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.79	1
AN	*Travisia gigas*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.79	1
AN	*Ysideria hastata*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.79	1
AR	*Acetabulastoma californica*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.79	1
AR	*Alpheus clamator*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.80	1
AR	*Ampelisca cristata cristata*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.80	1
AR	Ampeliscidae	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.80	1
AR	*Araphura cuspirostris*	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.80	1
AR	Arthropoda	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.81	1
AR	*Balanus nubilus*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.81	1
AR	*Cancer jordani*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.81	1

Appendix F-5. (Cont.).

Phy	Species	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	% Total	Cum. %	FO
AR	*Cancer productus*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.81	1
AR	*Cumella* sp	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.82	1
AR	*Cumella* sp K MBC 1993	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	0.00	99.82	1
AR	*Cyprideis stewarti*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0.00	99.82	1
AR	*Diastylis* sp	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.82	1
AR	*Elasmopus bampo*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0.00	99.83	1
AR	*Emerita analoga*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.83	1
AR	*Eohaustorius* sp	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.83	1
AR	Eusiridae	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.83	1
AR	*Exacanthomysis davisi*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.84	1
AR	Flabellifera	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.84	1
AR	*Gnathia crenulatifrons*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.84	1
AR	Harpacticoida	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.84	1
AR	*Heteroserolis carinata*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.85	1
AR	*Incisocalliope bairdi*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.85	1
AR	*Listriella diffusa*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.85	1
AR	*Listriella eriopisa*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.85	1
AR	Lysianassidae	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.86	1
AR	Natantia	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.86	1
AR	*Opisthopus transversus*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.86	1
AR	Ostracoda	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.86	1
AR	Paguridae	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.87	1
AR	*Photis* sp A MBC 1972	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.87	1
AR	*Photis* sp OC1 Diener 1992	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.87	1
AR	*Pinnixa tubicola*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.87	1
AR	*Portunus xantusii*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.88	1
AR	*Rhepoxynius heterocuspidatus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	0.00	99.88	1
CN	Pennatulacea	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	0.00	99.88	1
CN	*Stylatula elongata*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	0.00	99.88	1
EC	*Astropecten* sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0.00	99.89	1
EC	*Cucumaria piperata*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.89	1
EC	*Pentamera populifera*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.89	1
EN	Loxosomatidae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	0.00	99.89	1
EP	*Antropora tincta*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0.00	99.90	1
EP	*Bowerbankia gracilis*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	0.00	99.90	1
EP	*Caulibugula ciliata*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.90	1
EP	*Celleporella hyalina*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0.00	99.90	1
EP	*Cryptoarachnidium argilla*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.91	1
EP	*Farrella elongata*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.91	1
KI	Kinorhyncha	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0.00	99.91	1
MO	*Acteocina harpa*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.91	1
MO	*Acteocina inculta*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.92	1
MO	*Aglaja ocelligera*	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.92	1
MO	*Amiantis callosa*	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.92	1
MO	Chamidae	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.92	1
MO	*Chione undatella*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.93	1
MO	*Diplodonta sericata*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	0.00	99.93	1
MO	*Ensis myrae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.93	1
MO	*Halistylis pupoideus*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.93	1
MO	*Hermissenda crassicornis*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.94	1
MO	*Leporimetis obesa*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	99.94	1
MO	*Lithophaga plumula*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.94	1
MO	*Lucinoma annulata*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.94	1
MO	*Macoma carlottensis*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.95	1
MO	*Macoma indentata*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	0.00	99.95	1
MO	*Modiolus neglectus*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.95	1
MO	*Odostomia columbiana*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.95	1
MO	*Odostomia tenuisculpta*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.96	1
MO	*Ophiodermella cancellata*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.96	1
MO	*Petricola carditoides*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0.00	99.96	1
MO	*Polinices* sp	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.96	1
MO	*Polygireulima rutila*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.97	1
MO	Pseudodoridoidae	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.97	1
MO	*Rochefortia compressa*	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.97	1
MO	*Simomactra planulata*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.97	1
MO	*Sphenia fragilis*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	0.00	99.98	1
MO	*Sphenia luticola*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.98	1
MO	*Tellina idae*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.98	1
MO	*Turbonilla santarosana*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	0.00	99.98	1
MO	*Turbonilla* sp L MBC 1975	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.96	1

Appendix F-5. (Cont.).

Phy	Species	1978	1980	1986	1988	1990	1991	1992	1993	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	% Total	Cum. %	FO
MO	*Yoldia seminuda*	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	99.97	1
NE	*Monostylifera* sp SD 1 Pt. Loma 1995	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	99.97	1
NE	*Tetrastemma signifer*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	99.97	1
NE	*Tetrastemma* sp	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	0.00	99.97	1
SI	*Sipunculus nudus*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	0.00	99.97	1
Number of individuals		993	1267	576	1717	878	1238	312	244	933	10393	781	3373	7829	3311	1187	1095	1381	963	1289	39760			
Number of species		109	144	92	140	129	100	61	60	149	124	91	162	206	174	152	114	119	133	107	565			
Diversity (H')		3.37	3.92	3.17	3.41	4.00	2.91	3.51	3.52	3.97	0.99	3.11	3.45	2.94	3.28	4.19	3.28	3.60	3.60	3.54	3.80			
Number of stations/reps		7/4	7/4	7/4*	7/4	6/4	6/4	6/4	6/4	6/4	6/4	3/4	6/4	6/4	6/4	6/4	4/2	6/4	6/4	6/4				
Total biomass		NR	NR	28.0	1.43	75.3	2.71	21.4	16.1	12.7	7.96	6.02	78.9	437	16.6	28.9	6.3	6.2	6.8	7.3				

NR = Not Reported
F.O. = Frequency of Occurrence
Note: 0.00 = <0.005
* = Samples screened on 1.0mm screen, all other years on 0.5mm screen.

APPENDIX G

Fish and macroinvertebrate heat treatment and normal operation data

Appendix G-1. Species list of impinged fish and macroinvertebrate species. Ormond Beach Generating Station NPDES, 2006.

Phylum	Class	Family	Species	Common name
Arthropoda				
	Malacostraca			
		Cancridae		
			Cancer antennarius	Pacific rock crab
			Cancer anthonyi	yellow crab
			Cancer gracilis	graceful crab
			Cancer jordani	hairy rock crab
			Cancer productus	red rock crab
		Crangonidae		
			Crangon nigromaculata	blackspotted bay shrimp
		Epialtidae		
			Pugettia producta	northern kelp crab
			Taliepus nuttallii	globose kelp crab
		Grapsidae		
			Pachygrapsus crassipes	striped shore crab
		Hippolytidae		
			Heptacarpus pictus	redbanded clear shrimp
			Lysmata californica	red rock shrimp
		Majidae		
			Loxorhynchus grandis	sheep crab
			Pyromaia tuberculata	tuberculate pear crab
		Penaeidae		
			Farfantepenaeus californiensis	yellowleg shrimp
		Pisidae		
			Pelia tumida	dwarf teardrop crab
		Portunidae		
			Portunus xantusii	Xantus swimming crab
Cnidaria				
	Anthozoa			
		Actiniidae		
			Anthopleura xanthogrammica	giant green anemone
	Hydrozoa			
		Polyorchidae		
			Polyorchis montereyensis	Monterey jelly
			Polyorchis penicillatus	red jellyfish
	Scyphozoa			
		Pelagiidae		
			Chrysaora colorata	purple-striped jellyfish
Echinodermata				
	Asteroidea			
		Asterinidae		
			Pisaster giganteus	giant-spined sea star
	Echinoidea			
		Strongylocentrotidae		
			Strongylocentrotus purpuratus	purple sea urchin
	Holothuroidea			
		Stichipodidae		
			Parastichopus parvimensis	warty sea cucumber
Mollusca				
	Bivalvia			
		Veneridae		
			Protothaca tenerrima	thin-shell littleneck
	Cephalopoda			
		Loliginidae		
			Loligo opalescens	California market squid
		Octopodidae		
			Octopus bimaculatus/bimaculoides	California two-spot octopus
Chordata				
	Thaliacea			
		Salpidae		
			Thetys vagina	common salp
	Actinopterygii			
			unidentified species	unk fish
		Agonidae		
			Xeneretmus latifrons	blacktip poacher
Chordata (Cont.).				
		Atherinopsidae		
			Atherinops affinis	topsmelt
		Batrachoididae		
			Porichthys myriaster	specklefin midshipman
			Porichthys notatus	plainfin midshipman
		Clupeidae		
			Sardinops sagax	Pacific sardine
		Cottidae		
			Leptocottus armatus	Pacific staghorn sculpin
			Scorpaenichthys marmoratus	cabezon
		Cynoglossidae		
			Symphurus atricaudus	California tonguefish
		Embiotocidae		
			Cymatogaster aggregata	shiner perch
			Embiotocidae unid	unk surfperch
			Hyperprosopon argenteum	walleye surfperch
			Hyperprosopon ellipticum	silver surfperch
			Hypsurus caryi	rainbow seaperch
			Phanerodon furcatus	white seaperch
		Engraulidae		
			Engraulis mordax	northern anchovy
		Hexagrammidae		
			Hexagrammos decagrammus	kelp greenling
		Labridae		
			Oxyjulis californica	senorita
		Ophichthidae		
			Ophichthus zophochir	yellow snake eel
		Paralichthyidae		
			Citharichthys sordidus	Pacific sanddab
			Citharichthys stigmaeus	speckled sanddab
			Paralichthys californicus	California halibut
		Pleuronectidae		
			Eopsetta jordani	petrale sole
			Parophrys vetulus	English sole
			Pleuronichthys coenosus	C-O sole
			Pleuronichthys decurrens	curlfin sole
			Pleuronichthys guttulatus	diamond turbot
			Pleuronichthys verticalis	hornyhead turbot
		Sciaenidae		
			Seriphus politus	queenfish
		Scombridae		
			Scomber japonicus	Pacific chub mackerel
		Scorpaenidae		
			Sebastes miniatus	vermillion rockfish
			Sebastes paucispinis	bocaccio
			Sebastes auriculatus	brown rockfish
		Stromateidae		
			Peprilus simillimus	Pacific pompano
		Syngnathidae		
			Syngnathus leptorhynchus	bay pipefish
		Synodontidae		
			Synodus lucioceps	California lizardfish
		Ophididae		
			Ophidium scrippsae	basketweave cuskeel
	Chondrichthyes			
		Myliobatidae		
			Myliobatis californica	bat ray
		Platyrhinidae		
			Platyrhinoidis triseriata	thornback
		Rajidae		
			Raja inornata	California skate
		Rhinobatidae		
			Rhinobatos productus	shovelnose guitarfish
		Squalidae		
			Squalus acanthias	spiny dogfish
		Torpedinidae		
			Torpedo californica	Pacific electric ray

Appendix G-2. Abundance of fish impinged during normal operations by survey date at Ormond Beach Generating Station. Ormond Beach Generating Station NPDES, 2006.

	2005		2006																													
	Oct	Nov	Mar			Apr			May			Jun				Jul				Aug					Sep							Total
Taxa	7	17	6	7	8	5	6	7	2	3	17	5	6	7	8	3	4	20	21	19	20	21	23	24	6	7	21	22	28	29	30	Abundance
Cymatogaster aggregata	-	-	6	-	-	-	-	-	-	-	-	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	2	15	18	4	50
Citharichthys stigmaeus	1	-	-	-	2	-	41	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	49
Phanerodon furcatus	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24	-	25
Syngnathus leptorhynchus	7	2	-	-	-	1	2	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	1	5	1	1	23
Engraulis mordax	1	-	9	2	-	-	4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	4	-	22
Atherinops affinis	-	-	-	-	-	-	6	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	1	14
Porichthys notatus	-	-	-	-	-	-	8	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Seriphus politus	-	-	-	-	-	-	4	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	2	10
Peprilus simillimus	-	-	2	-	-	-	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	8
Platyrhinoidis triseriata	1	-	-	-	-	-	5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
Symphurus atricaudus	-	-	-	-	-	-	5	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
Pleuronichthys verticalis	-	-	-	-	1	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	6
Leptocottus armatus	-	-	-	-	-	-	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	5
Myliobatis californica	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	5
Hyperprosopon argenteum	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Porichthys myriaster	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Rhinobatos productus	1	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Sebastes miniatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	1	-	3
Ophichthus zophochir	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Paralichthys californicus	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	2
Parophrys vetulus	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Sardinops sagax	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Scomber japonicus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Synodus lucioceps	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Torpedo californica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	2
Ophidion scrippsae	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Hexagrammos decagrammus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Hyperprosopon ellipticum	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Hypsurus caryi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Oxyjulis californica	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pleuronichthys coenosus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pleuronichthys decurrens	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pleuronichthys guttulatus	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Raja inornata	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Scorpaenichthys marmoratus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1
Sebastes paucispinis	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Squalus acanthias	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Xeneretmus latifrons	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Sebastes auriculatus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Phanerodon atripes	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Oxylebius pictus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Total Abundance	11	3	19	2	5	3	103	24	3	-	-	-	1	3	7	1	1	1	-	-	2	1	-	-	2	1	1	6	21	58	9	288
Number of Taxa	5	2	5	1	4	3	27	15	3	-	-	-	1	3	4	1	1	1	-	-	2	1	-	-	2	1	1	5	3	9	5	41

Appendix G-3. Biomass (kg) of fish impinged during normal operations by survey date at Ormond Beach Generating Station. Ormond Beach Generating Station NPDES, 2006.

	2005		2006																
	Oct	Nov		Mar			Apr			May				Jun				Jul	
Taxa	7	17	6	7	8	5	6	7	2	3	17	5	6	7	8	3	4	20	21
Rhinobatos productus	0.138	-	-	-	-	-	6.400	4.600	-	-	-	-	-	-	-	-	-	-	-
Torpedo californica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Myliobatis californica	-	-	-	-	-	-	1.798	0.373	0.634	-	-	-	-	-	-	-	-	-	-
Platyrhinoidis triseriata	0.473	-	-	-	-	-	1.438	0.257	-	-	-	-	-	-	-	-	-	-	-
Phanerodon furcatus	-	-	0.050	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sebastes miniatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Squalus acanthias	-	-	-	-	-	-	-	0.699	-	-	-	-	-	-	-	-	-	-	-
Porichthys notatus	-	-	-	-	-	-	0.452	0.154	-	-	-	-	-	-	-	-	-	-	-
Pleuronichthys verticalis	-	-	-	-	0.080	0.037	0.222	0.050	-	-	-	-	-	-	-	-	-	-	-
Synodus lucioceps	-	-	-	-	-	-	0.058	0.440	-	-	-	-	-	-	-	-	-	-	-
Peprilus simillimus	-	-	0.054	-	-	-	0.164	0.072	-	-	-	-	-	-	-	-	-	-	-
Cymatogaster aggregata	-	-	0.098	-	-	-	-	-	-	-	-	-	-	0.012	0.109	-	-	-	-
Citharichthys stigmaeus	0.005	-	-	-	0.015	-	0.239	0.120	-	-	-	-	-	-	-	-	-	-	-
Parophrys vetulus	-	-	-	-	-	-	0.383	-	-	-	-	-	-	-	-	-	-	-	-
Ophichthus zophochir	-	-	-	-	-	-	0.137	0.241	-	-	-	-	-	-	-	-	-	-	-
Atherinops affinis	-	-	-	-	-	-	0.175	0.056	-	-	-	-	-	-	-	-	-	-	-
Engraulis mordax	0.002	-	0.100	0.030	-	-	0.065	-	-	-	-	-	-	-	-	0.022	-	-	-
Leptocottus armatus	-	-	-	-	-	-	0.112	0.091	0.028	-	-	-	-	-	-	-	-	-	-
Seriphus politus	-	-	-	-	-	-	0.107	-	-	-	-	-	0.011	-	0.020	-	-	-	-
Symphurus atricaudus	-	-	-	-	-	-	0.104	0.041	0.054	-	-	-	-	-	-	-	-	-	-
Hyperprosopon argenteum	-	-	-	-	-	-	0.171	-	-	-	-	-	-	-	-	-	-	-	-
Porichthys myriaster	-	-	-	-	-	-	0.042	-	-	-	-	-	-	-	-	-	-	0.115	-
Paralichthys californicus	-	-	-	-	0.002	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sebastes paucispinis	-	-	0.155	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Scomber japonicus	-	-	-	-	-	-	0.078	-	-	-	-	-	-	-	0.073	-	-	-	-
Raja inornata	-	-	-	-	-	-	-	0.128	-	-	-	-	-	-	-	-	-	-	-
Sebastes auriculatus	-	-	-	-	-	-	0.119	-	-	-	-	-	-	-	-	-	-	-	-
Pleuronichthys coenosus	-	-	-	-	-	-	0.108	-	-	-	-	-	-	-	-	-	-	-	-
Ophidion scrippsae	-	-	-	-	-	-	0.107	-	-	-	-	-	-	-	-	-	-	-	-
Pleuronichthys decurrens	-	-	-	-	-	-	0.097	-	-	-	-	-	-	-	-	-	-	-	-
Oxylebius pictus	-	-	-	-	-	-	0.069	-	-	-	-	-	-	-	-	-	-	-	-
Syngnathus leptorhynchus	0.019	0.008	-	-	-	0.003	0.006	0.001	-	-	-	-	-	0.001	-	-	-	-	-
Sardinops sagax	-	0.019	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.033	-	-
Pleuronichthys guttulatus	-	-	-	-	0.046	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oxyjulis californica	-	-	-	-	-	0.036	-	-	-	-	-	-	-	-	-	-	-	-	-
Phanerodon atripes	-	-	-	-	-	-	0.033	-	-	-	-	-	-	-	-	-	-	-	-
Hexagrammos decagrammus	-	-	-	-	-	-	0.023	-	-	-	-	-	-	-	-	-	-	-	-
Scorpaenichthys marmoratus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hypsurus caryi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.013	-	-	-	-
Hyperprosopon ellipticum	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005	-	-	-	-	-
Xeneretmus latifrons	-	-	-	-	-	-	0.002	-	-	-	-	-	-	-	-	-	-	-	-
Total Biomass (kg)	0.637	0.027	0.457	0.030	0.143	0.076	12.709	7.323	0.716	-	-	-	0.011	0.018	0.215	0.022	0.033	0.115	-
Number of Taxa	5	2	5	1	4	3	27	15	3	-	-	-	1	3	4	1	1	1	-

Appendix G-3. (Cont.).

	2006												
	Aug					Sep							Total
Taxa	19	20	21	23	24	6	7	21	22	28	29	30	Biomass (kg)
Rhinobatos productus	-	-	-	-	-	-	-	-	-	-	-	-	11.138
Torpedo californica	-	5.845	-	-	-	-	-	-	4.864	-	-	-	10.709
Myliobatis californica	-	-	-	-	-	0.624	-	-	-	-	-	-	3.429
Platyrhinoidis triseriata	-	-	-	-	-	-	-	-	-	-	-	-	2.168
Phanerodon furcatus	-	-	-	-	-	-	-	-	-	-	2.104	-	2.154
Sebastes miniatus	-	0.288	0.744	-	-	-	-	-	-	-	0.232	-	1.264
Squalus acanthias	-	-	-	-	-	-	-	-	-	-	-	-	0.699
Porichthys notatus	-	-	-	-	-	-	-	-	-	-	-	-	0.606
Pleuronichthys verticalis	-	-	-	-	-	-	-	-	0.149	-	-	-	0.538
Synodus lucioceps	-	-	-	-	-	-	-	-	-	-	-	-	0.498
Peprilus simillimus	-	-	-	-	-	-	-	-	-	-	0.096	0.110	0.496
Cymatogaster aggregata	-	-	-	-	-	-	-	-	0.007	0.072	0.089	0.027	0.414
Citharichthys stigmaeus	-	-	-	-	-	-	0.011	-	-	-	-	-	0.390
Parophrys vetulus	-	-	-	-	-	-	-	-	-	-	-	-	0.383
Ophichthus zophochir	-	-	-	-	-	-	-	-	-	-	-	-	0.378
Atherinops affinis	-	-	-	-	-	-	-	-	-	-	0.094	0.019	0.344
Engraulis mordax	-	-	-	-	-	-	-	-	-	0.020	0.083	-	0.322
Leptocottus armatus	-	-	-	-	-	0.014	-	-	-	-	-	-	0.245
Seriphus politus	-	-	-	-	-	-	-	-	-	-	0.011	0.088	0.237
Symphurus atricaudus	-	-	-	-	-	-	-	-	-	-	-	-	0.199
Hyperprosopon argenteum	-	-	-	-	-	-	-	-	-	-	-	-	0.171
Porichthys myriaster	-	-	-	-	-	-	-	-	-	-	-	-	0.157
Paralichthys californicus	-	-	-	-	-	-	-	-	-	-	0.154	-	0.156
Sebastes paucispinis	-	-	-	-	-	-	-	-	-	-	-	-	0.155
Scomber japonicus	-	-	-	-	-	-	-	-	-	-	-	-	0.151
Raja inornata	-	-	-	-	-	-	-	-	-	-	-	-	0.128
Sebastes auriculatus	-	-	-	-	-	-	-	-	-	-	-	-	0.119
Pleuronichthys coenosus	-	-	-	-	-	-	-	-	-	-	-	-	0.108
Ophidion scrippsae	-	-	-	-	-	-	-	-	-	-	-	-	0.107
Pleuronichthys decurrens	-	-	-	-	-	-	-	-	-	-	-	-	0.097
Oxylebius pictus	-	-	-	-	-	-	-	-	-	-	-	-	0.069
Syngnathus leptorhynchus	-	-	-	-	-	-	-	0.003	0.004	0.010	0.002	0.002	0.059
Sardinops sagax	-	-	-	-	-	-	-	-	-	-	-	-	0.052
Pleuronichthys guttulatus	-	-	-	-	-	-	-	-	-	-	-	-	0.046
Oxyjulis californica	-	-	-	-	-	-	-	-	-	-	-	-	0.036
Phanerodon atripes	-	-	-	-	-	-	-	-	-	-	-	-	0.033
Hexagrammos decagrammus	-	-	-	-	-	-	-	-	-	-	-	-	0.023
Scorpaenichthys marmoratus	-	-	-	-	-	-	-	-	0.023	-	-	-	0.023
Hypsurus caryi	-	-	-	-	-	-	-	-	-	-	-	-	0.013
Hyperprosopon ellipticum	-	-	-	-	-	-	-	-	-	-	-	-	0.005
Xeneretmus latifrons	-	-	-	-	-	-	-	-	-	-	-	-	0.002
Total Biomass (kg)	-	6.133	0.744	-	-	0.638	0.011	0.003	5.047	0.102	2.865	0.246	38.321
Number of Taxa	-	2	1	-	-	2	1	1	5	3	9	5	41

Appendix G-4. Estimated monthly abundance of fish impinged during normal operations at Ormond Beach Generating Station. Ormond Beach Generating Station NPDES, 2006.

	2005			2006									Total
Taxa	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Abundance
Citharichthys stigmaeus	9	-	-	-	-	1	894	-	-	-	-	17	921
Cymatogaster aggregata	-	-	1	1	1	4	-	-	277	-	-	441	725
Engraulis mordax	9	-	70	57	46	253	75	-	-	26	-	42	578
Syngnathus leptorhynchus	65	10	-	-	-	-	78	-	32	-	-	116	301
Porichthys notatus	-	-	-	-	-	-	257	-	-	-	-	-	257
Atherinops affinis	-	-	-	-	-	-	144	-	-	-	-	84	228
Phanerodon furcatus	-	-	-	-	-	1	-	-	-	-	-	203	204
Seriphus politus	-	-	-	-	-	-	77	-	43	-	-	82	202
Symphurus atricaudus	-	-	-	-	-	-	116	24	-	-	-	-	140
Platyrhinoidis triseriata	9	-	-	-	-	-	118	-	-	-	-	-	127
Peprilus simillimus	-	-	-	-	-	1	81	-	-	-	-	42	124
Myliobatis californica	-	-	-	-	-	-	63	24	-	-	-	16	103
Pleuronichthys verticalis	-	-	-	-	-	1	83	-	-	-	-	17	101
Leptocottus armatus	-	-	-	-	-	-	59	23	-	-	-	16	98
Porichthys myriaster	-	-	-	-	-	-	40	-	-	48	-	-	88
Hyperprosopon argenteum	-	-	-	-	-	-	80	-	-	-	-	-	80
Rhinobatos productus	9	-	-	-	-	-	36	-	-	-	-	-	45
Scomber japonicus	-	-	-	-	-	-	21	-	24	-	-	-	45
Sebastes miniatus	-	-	-	-	-	-	-	-	-	-	37	8	45
Ophidion scrippsae	-	-	-	-	-	-	42	-	-	-	-	-	42
Parophrys vetulus	-	-	-	-	-	-	40	-	-	-	-	-	40
Ophichthus zophochir	-	-	-	-	-	-	39	-	-	-	-	-	39
Torpedo californica	-	-	-	-	-	-	-	-	-	-	22	17	39
Synodus lucioceps	-	-	-	-	-	-	37	-	-	-	-	-	37
Sardinops sagax	-	5	-	-	-	-	-	-	-	23	-	-	28
Hypsurus caryi	-	-	-	-	-	-	-	-	24	-	-	-	24
Pleuronichthys coenosus	-	-	-	-	-	-	23	-	-	-	-	-	23
Squalus acanthias	-	-	-	-	-	-	22	-	-	-	-	-	22
Hexagrammos decagrammus	-	-	-	-	-	-	21	-	-	-	-	-	21
Pleuronichthys decurrens	-	-	-	-	-	-	21	-	-	-	-	-	21
Sebastes auriculatus	-	-	-	-	-	-	21	-	-	-	-	-	21
Hyperprosopon ellipticum	-	-	-	-	-	-	-	-	19	-	-	-	19
Oxyjulis californica	-	-	-	-	-	-	19	-	-	-	-	-	19
Xeneretmus latifrons	-	-	-	-	-	-	19	-	-	-	-	-	19
Phanerodon atripes	-	-	-	-	-	-	19	-	-	-	-	-	19
Oxylebius pictus	-	-	-	-	-	-	19	-	-	-	-	-	19
Raja inornata	-	-	-	-	-	-	18	-	-	-	-	-	18
Scorpaenichthys marmoratus	-	-	-	-	-	-	-	-	-	-	-	16	16
Paralichthys californicus	-	-	-	-	-	1	-	-	-	-	-	9	10
Pleuronichthys guttulatus	-	-	-	-	-	1	-	-	-	-	-	-	1
Sebastes paucispinis	-	-	-	-	-	1	-	-	-	-	-	-	1
Total Abundance	101	15	71	58	47	264	2,582	71	419	97	59	1,126	4,910
Number of Taxa	5	2	2	2	2	9	30	3	6	3	2	15	41
Total Monthly Flow (mg)	3190	1735	133	107	86	240	3407	4036	5043	13113	4437	8588	

Note: Dec 2005 through Feb 2006 values based on average impingement rate of Nov 2005 and Feb 2006 multiplyed by the total monthly flow.

Appendix G-5. Estimated monthly biomass (kg) of fish impinged during normal operations at Ormond Beach Generating Station. Ormond Beach Generating Station NPDES, 2006.

	2005			2006									Total
Taxa	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Biomass (kg)
Torpedo californica	-	-	-	-	-	-	-	-	-	-	127.603	80.805	208.408
Rhinobatos productus	1.284	-	-	-	-	-	200.453	-	-	-	-	-	201.737
Myliobatis californica	-	-	-	-	-	-	42.548	15.359	-	-	-	10.281	68.188
Platyrhinoidis triseriata	4.403	-	-	-	-	-	35.804	-	-	-	-	-	40.207
Sebastes miniatus	-	-	-	-	-	-	-	-	-	-	17.488	1.954	19.442
Phanerodon furcatus	-	-	0.010	0.008	0.006	0.035	-	-	-	-	-	17.799	17.858
Squalus acanthias	-	-	-	-	-	-	15.384	-	-	-	-	-	15.384
Porichthys notatus	-	-	-	-	-	-	12.071	-	-	-	-	-	12.071
Pleuronichthys verticalis	-	-	0.016	0.012	0.010	0.056	6.482	-	-	-	-	2.575	9.151
Engraulis mordax	0.019	-	1.061	0.854	0.688	3.831	1.224	-	-	0.566	-	0.875	9.118
Peprilus simillimus	-	-	0.010	0.008	0.007	0.038	4.616	-	-	-	-	4.438	9.117
Synodus lucioceps	-	-	-	-	-	-	8.865	-	-	-	-	-	8.865
Parophrys vetulus	-	-	-	-	-	-	8.098	-	-	-	-	-	8.098
Citharichthys stigmaeus	0.047	-	0.003	0.002	0.002	0.011	7.250	-	-	-	-	0.191	7.506
Cymatogaster aggregata	-	-	0.019	0.015	0.012	0.069	-	-	4.782	-	-	2.354	7.251
Ophichthus zophochir	-	-	-	-	-	-	7.164	-	-	-	-	-	7.164
Porichthys myriaster	-	-	-	-	-	-	0.868	-	-	5.486	-	-	6.354
Atherinops affinis	-	-	-	-	-	-	4.735	-	-	-	-	1.423	6.158
Seriphus politus	-	-	-	-	-	-	2.019	-	0.688	-	-	2.936	5.643
Leptocottus armatus	-	-	-	-	-	-	3.925	0.649	-	-	-	0.228	4.802
Symphurus atricaudus	-	-	-	-	-	-	2.788	1.293	-	-	-	-	4.081
Hyperprosopon argenteum	-	-	-	-	-	-	3.467	-	-	-	-	-	3.467
Scomber japonicus	-	-	-	-	-	-	1.656	-	1.740	-	-	-	3.396
Sebastes auriculatus	-	-	-	-	-	-	2.526	-	-	-	-	-	2.526
Pleuronichthys coenosus	-	-	-	-	-	-	2.452	-	-	-	-	-	2.452
Ophidion scrippsae	-	-	-	-	-	-	2.271	-	-	-	-	-	2.271
Raja inornata	-	-	-	-	-	-	2.261	-	-	-	-	-	2.261
Pleuronichthys decurrens	-	-	-	-	-	-	2.059	-	-	-	-	-	2.059
Paralichthys californicus	-	-	-	-	-	0.001	-	-	-	-	-	1.425	1.426
Oxylebius pictus	-	-	-	-	-	-	1.302	-	-	-	-	-	1.302
Sardinops sagax	-	0.096	0.004	0.003	0.002	-	-	-	-	0.752	-	-	0.857
Syngnathus leptorhynchus	0.177	0.041	0.002	0.001	0.001	-	0.202	-	0.032	-	-	0.281	0.737
Oxyjulis californica	-	-	-	-	-	-	0.681	-	-	-	-	-	0.681
Phanerodon atripes	-	-	-	-	-	-	0:623	-	-	-	-	-	0.623
Hexagrammos decagrammus	-	-	-	-	-	-	0.488	-	-	-	-	-	0.488
Scorpaenichthys marmoratus	-	-	-	-	-	-	-	-	-	-	-	0.376	0.376
Hypsurus caryi	-	-	-	-	-	-	-	-	0.310	-	-	-	0.310
Sebastes paucispinis	-	-	0.030	0.024	0.020	0.109	-	-	-	-	-	-	0.183
Hyperprosopon ellipticum	-	-	-	-	-	-	-	-	0.093	-	-	-	0.093
Pleuronichthys guttulatus	-	-	0.009	0.007	0.006	0.032	-	-	-	-	-	-	0.054
Xeneretmus latifrons	-	-	-	-	-	-	0.038	-	-	-	-	-	0.038
Total Biomass (kg)	5.930	0.137	1.164	0.934	0.754	4.182	384.320	17.301	7.645	6.804	145.091	127.941	702.203
Number of Taxa	5	2	10	10	10	9	30	3	6	3	2	15	41
Total Monthly Flow (mg)	3190	1735	133	107	86	240	3407	4036	5043	13113	4437	8588	

Note: Dec 2005 through Feb 2006 values based on average impingement rate of Nov 2005 and Feb 2006 multiplyed by the total monthly flow.

Appendix G-12. Total abundance of macroinvertebrates impinged during heat treatments and extrapolated normal operations, 1994 - 2006. Ormond Beach Generating Station NPDES, 2006.

	YEAR													Percent	Cum.
Species	1994	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	Mean	Total	Percent
Cancer antennarius	138	4434	571	377	5184	5687	79	255	8590	23931	3566	52812	4801.1	34.33	34.33
Thetys vagina	14	-	-	11488	145	387	9599	29	40	-	3621	25323	2302.1	16.46	50.80
Cancer anthonyi	15636	55	-	-	-	-	-	29	-	-	1591	17311	1573.7	11.25	62.05
Cancer productus	42	-	-	-	11	-	4559	28	4767	1662	4364	15433	1403.0	10.03	72.09
Lysmata californica	353	510	90	22	64	4	371	14	17	457	7265	9167	833.4	5.96	78.05
Crangon nigromaculata	35	-	-	417	144	3060	916	58	1236	129	348	6343	576.6	4.12	82.17
Cancer gracilis	708	-	-	-	-	1201	1	14	1587	487	2258	6256	568.7	4.07	86.24
Portunus xantusii	2352	99	560	730	235	194	355	43	20	12	127	4727	429.7	3.07	89.31
Pelagia colorata	304	77	-	-	1823	-	489	-	-	-	-	2693	244.9	1.75	91.06
Farfantepenaeus californiensis	-	-	-	-	-	39	-	-	-	-	2220	2259	205.4	1.47	92.53
Pachygrapsus crassipes	1447	-	88	9	5	5	6	2	351	47	221	2181	198.3	1.42	93.95
Pisaster giganteus	1	1233	-	-	9	-	-	-	-	-	20	1263	114.8	0.82	94.77
Loligo opalescens	80	26	-	-	203	232	59	101	44	23	445	1213	110.3	0.79	95.56
Polyorchis penicillata	35	-	-	23	-	1	-	29	433	254	19	794	72.2	0.52	96.07
Cancer jordani	-	-	-	75	316	-	-	-	2	195	112	700	63.6	0.45	96.53
Anthopleura xanthogrammica	-	-	-	-	-	-	-	-	-	-	691	691	62.8	0.45	96.98
Pyromaia tuberculata	483	-	12	1	-	-	1	-	-	-	171	668	60.7	0.43	97.41
Pisaster sp	35	-	3	15	-	15	391	45	49	111	-	664	60.4	0.43	97.84
Octopus bimaculatus/bimaculoides	14	39	7	73	27	27	28	209	55	57	118	654	59.5	0.43	98.27
Loxorhynchus crispatus	2	-	-	-	269	208	1	31	61	37	-	609	55.4	0.40	98.66
Loxorhynchus grandis	33	31	5	-	-	1	2	9	90	117	100	388	35.3	0.25	98.92
Pugettia producta	21	-	-	30	-	-	-	-	2	2	205	260	23.6	0.17	99.09
Panulirus interruptus	3	1	6	3	69	82	2	61	-	-	-	227	20.6	0.15	99.23
Chrysaora colorata	-	-	-	-	-	-	-	202	-	12	5	219	19.9	0.14	99.38
Caudina arenicola	-	-	-	-	202	1	-	-	-	12	-	215	19.5	0.14	99.51
Strongylocentrotus purpuratus	14	-	-	-	5	1	34	30	-	-	42	126	11.5	0.08	99.60
Parastichopus sp	-	1	1	24	-	39	-	-	-	-	-	65	5.9	0.04	99.64
Polyorchis montereyensis	-	-	-	-	-	-	-	-	-	-	64	64	5.8	0.04	99.68
Salpa maxima	-	-	-	-	-	-	63	-	-	-	-	63	5.7	0.04	99.72
Heptacarpus palpator	-	-	-	-	-	-	-	-	-	-	62	62	5.6	0.04	99.76
Megathura crenulata	-	-	-	-	-	41	2	1	1	2	-	47	4.3	0.03	99.79
Heptacarpus pictus	-	-	-	-	-	-	-	-	-	-	44	44	4.0	0.03	99.82
Urechis caupo	-	-	-	-	-	-	-	-	20	23	-	43	3.9	0.03	99.85
Penaeus californiensis	7	-	1	-	29	-	-	-	-	-	-	37	3.4	0.02	99.87
Pelia tumida	-	-	-	-	-	-	-	-	-	-	28	28	2.5	0.02	99.89
Pelagia sp	-	-	24	2	-	-	-	-	-	-	-	26	2.4	0.02	99.91
Pisaster ochraceus	-	18	-	-	6	-	-	-	-	-	-	24	2.2	0.02	99.92
Loligo sp	-	-	-	23	-	-	-	-	-	-	-	23	2.1	0.02	99.94
Parastichopus parvimensis	-	-	-	-	-	-	-	-	-	-	19	19	1.7	0.01	99.95
Cancer sp	-	-	-	-	18	-	-	-	-	-	-	18	1.6	0.01	99.96
Navanax inermis	12	-	-	-	-	-	-	-	-	-	-	12	1.1	0.01	99.97
Protothaca tenerrima	-	-	-	-	-	-	-	-	-	-	10	10	0.9	0.01	99.98
Taliepus nuttallii	-	-	-	-	-	-	-	-	-	-	10	10	0.9	0.01	99.98
Holothuroidea unid.	7	-	-	-	-	-	-	-	-	-	-	7	0.6	0.00	99.99
Pleuroncodes planipes	7	-	-	-	-	-	-	-	-	-	-	7	0.6	0.00	99.99
Heimigrapsus nudus	-	-	-	-	-	-	-	6	-	-	-	6	0.5	0.00	100.00
Chorilia longipes	-	-	-	-	-	-	-	-	3	-	-	3	0.3	0.00	100.00
Pisaster brevispinus	2	-	-	-	-	-	-	-	-	-	-	2	0.2	0.00	100.00
Anthopleura elegantissima	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Anthopleura sp	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Dendraster excentricus	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Haliotis rufescens	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Loligo opalescens	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Loxorhynchus crispatus	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Loxrhynchus grandis	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Pachygrapsus sp	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Pollicipes polymerus	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Scyra acutifrons	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Thaliacea unid.	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Tresus nuttalli	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00	100.00
Number of individuals	21785	6524	1368	13312	8764	11225	16958	1196	17368	27570	27746	153816	12607.0		
Number of species	26	12	12	16	19	19	19	20	19	19	28	48	18.1		

Note: 0.00 = <0.005.

Total abundance based on heat treatment and extrapolated normal operations.

1994 extrapolations based on 50 sample days and 345 days of circulator operation.

1995-1996 no macroinvertebrate data available.

1997 extrapolations based on nine sample days and 4.06% of the total annual flow through the generating station.

1998 extrapolations based on eight sample days and 8.60% of the total annual flow through the generating station (except for *Pleuronectes vetulus, Psettichthys melanostictus,* and *Triakis semifasciata*).

1999 extrapolations based on flow data, using a multiplier (23.09) based on eight sample days and monthly flow information.

2000 extrapolations based on flow data, using a multiplier (28.76) based on nine sample days and monthly flow information (except for *Agonopsis sterletus*).

2001 extrapolations based on flow data. Multiplier based on monthly flow divided by flow on date sampled that month. Average multiplier = 31.86, based on twelve sample dates and 3.23% of the total annual flow through the generating station.

2002 extrapolations based on flow data. Multiplier based on monthly flow divided by flow on date sampled that month. Average multiplier = 34.09, based on twelve sample dates and 3.38% of the total annual flow through the generating station.

2003 extrapolations based on flow data. Multiplier based on monthly flow divided by flow on date sampled that month. Average multiplier = 26.10, based on twelve sample dates and 3.71% of the total annual flow through the generating station.

*2004 estimations based on flow data. Estimations derived by multiplying mean daily CPUE by total reported flow (152,367.48mg) for monitoring year 2004.

Appendix G-11. (Cont.).

Species	Year																	Total	Percent	
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006		Total	Mean
Hypsoblennius spp	1	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	8	0.00	0.5
Ophiodon elongatus	1	-	-	-	-	-	-	-	-	-	-	1	1	5	-	-	-	8	0.00	0.5
Platichthys stellatus	-	7	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	8	0.00	0.5
Eopsetta jordani	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	7	0.00	0.4
Icichthys lockingtoni	-	-	-	-	7	-	-	-	-	-	-	-	-	-	-	-	-	7	0.00	0.4
Sebastes caurinus	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	7	0.00	0.4
Hypsoblennius gentilis	-	-	-	1	-	-	-	-	-	2	-	-	-	-	-	3	-	6	0.00	0.4
Embiotoca lateralis	-	-	-	-	-	-	-	-	-	-	-	3	-	-	2	-	-	5	0.00	0.3
Gibbonsia elegans	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	4	0.00	0.2
Psettichthys melanostictus	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	4	0.00	0.2
Cottidae unidentified	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	3	0.00	0.2
Sebastes flavidus	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	3	0.00	0.2
Semicossyphus pulcher	-	-	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	3	0.00	0.2
Amphistichus koelzi	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	0.00	0.1
Sebastes melanops	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	2	0.00	0.1
Sebastes serriceps	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	2	0.00	0.1
Zalembius rosaceus	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	2	0.00	0.1
Sebastes sp	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	0.1
Agonopsis sp	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	0.1
Agonopsis sterletus	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	0.1
Artedius corallinus	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	0.1
Aulorhynchus flavidus	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	0.00	0.1
Balistes polylepis	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	0.1
Clinocottus sp	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	0.1
Gibbonsia montereyensis	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	0.1
Neoclinus blanchardi	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	0.1
Ophichthus triserialis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	0.00	0.1
Pholidae unidentified	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	0.00	0.1
Raja binoculata	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.00	0.1
Sebastes goodei	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	0.00	0.1
Syngnathus exilis	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	1	0.00	0.1
Number of individuals	14680	51860	28796	94602	23403	41996	8664	19266	31545	761	3078	15382	16209	11132	4987	6216	4768	377345		23286.0
Number of species	54	65	54	60	59	48	41	38	47	28	42	49	54	53	41	47	41	120		48.8

Note: 0.00 = <0.005.

Appendix G-11. (Cont.).

Species	Year 1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	Percent Total	Mean
Rhinobatos productus	27	2	-	17	8	1	4	32	30	-	1	-	4	6	-	-	45	177		10.4
Pleuronichthys coenosus	1	6	1	19	57	15	1	-	-	-	-	-	-	53	-	-	23	176	0.05	10.4
Sebastes paucispinis	29	46	22	8	-	-	-	-	-	-	29	-	1	2	-	31	2	170	0.05	10.0
Pleuronichthys decurrens	-	-	-	-	-	-	-	-	-	-	-	-	-	128	-	-	21	149	0.04	8.8
Paralabrax maculatofasciatus	-	-	8	-	-	-	47	-	87	-	3	-	-	-	-	-	-	145	0.04	8.5
Hypsurus caryi	-	9	12	4	4	11	1	1	-	-	-	-	1	4	-	35	24	106	0.03	6.2
Urobatis halleri	-	2	2	3	1	1	-	1	1	23	-	36	17	-	3	1	-	91	0.02	5.4
Cheilotrema saturnum	1	4	1	4	17	42	-	-	4	1	1	4	-	-	-	11	-	90	0.02	5.3
Raja inornata	-	-	-	1	-	-	-	-	-	-	-	-	67	-	-	-	18	86	0.02	5.1
Menticirrhus undulatus	-	10	-	-	1	-	-	-	2	-	-	71	-	-	1	-	-	85	0.02	5.0
Triakis semifasciata	-	-	1	-	-	-	-	-	4	-	-	66	-	-	-	12	-	83	0.02	4.9
Mustelus californicus	-	15	-	7	-	14	34	-	-	-	-	-	-	-	-	12	-	82	0.02	4.8
Squalus acanthias	-	7	8	29	-	-	1	-	12	-	-	-	-	-	-	-	22	79	0.02	4.6
Umbrina roncador	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	76	-	76	0.02	4.5
Sebastes miniatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66	66	0.02	3.9
Oxylebius pictus	4	-	21	-	4	2	-	-	-	-	1	1	-	5	8	-	19	65	0.02	3.8
Heterodontus francisci	-	-	-	-	-	-	-	-	1	-	-	-	1	1	-	59	-	62	0.02	3.6
Medialuna californiensis	3	6	6	2	31	10	-	-	-	-	-	-	-	-	2	-	-	60	0.02	3.5
Chilara taylori	9	22	-	1	-	-	-	-	-	-	-	-	-	-	-	23	-	55	0.01	3.2
Hexagrammos decagrammus	-	3	2	-	-	-	-	-	-	-	-	-	4	11	1	10	21	52	0.01	3.1
Citharichthys xanthostigma	-	22	-	7	-	-	-	-	-	-	-	-	-	-	20	-	-	49	0.01	2.9
Pleuronichthys guttulatus	-	8	-	-	14	-	-	-	-	23	-	-	-	-	-	-	2	47	0.01	2.8
Syngnathus californiensis	-	-	-	-	-	-	-	-	-	-	-	-	11	35	-	-	-	46	0.01	2.7
Sebastes serranoides	12	-	9	1	5	-	-	-	-	-	4	-	1	10	1	-	-	43	0.01	2.5
Atractoscion nobilis	-	6	-	15	3	3	3	2	7	-	1	-	-	-	-	-	-	40	0.01	2.4
Ophichthus zophochir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	39	0.01	2.3
Sebastes rastrelliger	4	6	3	10	1	6	-	-	2	-	-	-	3	4	-	-	-	39	0.01	2.3
Citharichthys sordidus	-	-	-	-	-	-	-	-	-	-	-	-	34	-	-	-	-	34	0.01	2.0
Cephaloscyllium ventriosum	-	7	1	23	-	-	-	-	-	-	-	-	3	-	-	-	-	34	0.01	2.0
Sebastes atrovirens	-	1	-	1	-	8	1	-	-	-	-	-	13	-	1	-	-	25	0.01	1.5
Mustelus sp	-	-	-	-	-	-	-	-	-	23	-	1	-	-	-	-	-	24	0.01	1.4
Merluccius productus	-	22	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	0.01	1.3
Mola mola	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	20	0.01	1.2
Phanerodon atripes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	19	0.01	1.1
Hyperprosopon ellipticum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	19	0.01	1.1
Xeneretmus latifrons	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	19	0.01	1.1
Anisotremus davidsonii	1	-	-	2	4	-	-	-	12	-	-	-	-	-	-	-	-	19	0.01	1.1
Girella nigricans	11	7	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	19	0.01	1.1
Xystreurys liolepis	10	-	1	-	7	-	-	-	-	-	-	-	-	-	-	-	-	18	0.00	1.1
Hypsoblennius gilberti	-	1	1	4	4	-	-	-	-	-	-	-	-	1	3	-	-	14	0.00	0.8
Hydrolagus colliei	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	12	-	12	0.00	0.7
Hermosilla azurea	-	7	-	-	-	-	-	1	-	-	-	-	3	-	-	-	-	11	0.00	0.6
Halichoeres semicinctus	2	-	2	-	-	-	-	-	-	-	-	2	2	2	-	-	-	10	0.00	0.6
Sphyraena argentea	-	-	-	8	-	1	-	-	1	-	-	-	-	-	-	-	-	10	0.00	0.6
Anchoa compressa	-	-	-	7	1	-	-	-	-	-	-	-	-	-	-	-	-	8	0.00	0.5

Appendix G-11. Total abundance of fish impinged during heat treatments and extrapolated normal operations, 1990 - 2006. Ormond Beach Generating Station NPDES, 2006

	Year																		Percent	
Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total	Total	Mean
Seriphus politus	7460	43501	16697	82521	16382	24008	4218	4725	6632	161	361	3057	11089	2684	375	882	219	224972	59.62	13233.7
Sardinops sagax	322	86	110	1643	362	1056	197	2921	21434	24	89	295	483	107	632	156	28	29945	7.94	1761.5
Cymatogaster aggregata	278	270	997	1333	1023	8830	503	2423	891	8	366	542	532	1397	1113	2716	822	24044	6.37	1414.4
Engraulis mordax	301	365	891	631	2022	1600	2169	4329	73	177	564	1144	2095	4076	1395	426	189	22447	5.95	1320.4
Hyperprosopon argenteum	1506	1521	3942	550	126	616	10	1353	431	-	2	611	432	266	11	143	80	11600	3.07	682.4
Phanerodon furcatus	1606	987	1054	1019	1169	2454	395	926	158	-	35	36	75	86	55	229	246	10530	2.79	619.4
Porichthys notatus	1844	1484	999	490	336	432	11	-	-	46	58	1	172	2	-	-	257	6132	1.63	360.7
Peprilus simillimus	1	157	72	738	22	16	4	1	1	-	5	3350	186	280	8	30	135	5006	1.33	294.5
Genyonemus lineatus	14	707	149	2506	58	679	50	4	433	-	-	101	65	5	-	-	-	4771	1.26	280.6
Citharichthys stigmaeus	-	390	230	504	60	240	-	-	-	-	461	1330	102	454	40	19	928	4758	1.26	279.9
Atherinops affinis	9	105	30	49	-	44	310	1620	204	-	-	974	37	-	-	-	245	3627	0.96	213.4
Scomber japonicus	10	11	1848	400	451	262	5	1	54	-	-	4	1	-	-	3	45	3095	0.82	182.1
Platyrhinoidis triseriata	46	322	33	200	76	60	2	50	72	-	29	565	21	205	61	37	127	1906	0.51	112.1
Paralabrax nebulifer	159	154	435	142	102	164	47	63	9	13	159	244	59	70	35	22	-	1877	0.50	110.4
Pleuronichthys verticalis	64	118	126	268	104	99	-	99	70	-	202	219	-	74	61	13	106	1623	0.43	95.4
Leuresthes tenuis	1	593	364	83	11	-	-	-	-	-	-	127	2	347	-	-	-	1528	0.40	89.9
Leptocottus armatus	73	16	27	85	23	1	7	30	98	92	175	463	16	67	121	68	94	1456	0.39	85.7
Trachurus symmetricus	194	15	8	266	275	499	-	2	11	-	-	1	-	1	64	60	-	1396	0.37	82.1
Myliobatis californica	-	53	78	154	85	2	1	8	15	2	-	740	14	66	-	24	99	1341	0.36	78.9
Torpedo californica	38	97	18	62	60	63	105	51	1	48	29	178	-	37	204	83	53	1127	0.30	66.3
Porichthys myriaster	1	69	-	-	1	-	72	199	25	-	115	212	39	121	22	119	88	1083	0.29	63.7
Syngnathus leptorhynchus	-	-	-	-	-	-	-	-	-	-	-	-	13	22	416	299	324	1074	0.28	63.2
Sebastes auriculatus	56	69	126	82	66	66	14	30	20	18	41	33	45	120	44	72	21	923	0.24	54.3
Paralabrax clathratus	89	63	92	72	57	221	65	52	14	9	20	8	12	25	19	11	-	829	0.22	48.8
Ophidion scrippsae	101	106	57	76	48	58	1	-	-	-	29	207	-	24	-	12	42	761	0.20	44.8
Rhacochilus toxotes	14	33	4	43	31	15	50	173	30	4	15	17	2	105	59	38	-	633	0.17	37.2
Symphurus atricaudus	10	7	16	15	28	42	200	49	-	23	-	36	-	-	24	47	132	629	0.17	37.0
Synodus lucioceps	9	7	-	-	7	-	-	-	-	-	-	143	303	-	-	106	37	612	0.16	36.0
Scorpaenichthys marmoratus	67	39	26	19	15	43	14	32	6	1	16	24	31	39	77	82	20	551	0.15	32.4
Amphistichus argenteus	-	4	-	2	-	-	-	-	190	-	29	118	1	2	-	118	-	464	0.12	27.3
Paralichthys californicus	65	17	29	92	14	16	3	1	39	-	-	62	-	31	20	-	13	402	0.11	23.7
Pleuronichthys ritteri	-	1	2	-	-	1	-	-	-	-	-	213	87	-	-	47	-	351	0.09	20.6
Rhacochilus vacca	67	94	32	27	25	19	1	-	2	4	1	2	50	17	1	5	-	347	0.09	20.4
Syngnathus sp	-	15	-	58	1	-	-	-	-	23	175	73	-	-	-	-	-	345	0.09	20.3
Embiotoca jacksoni	81	56	28	20	30	30	7	10	7	2	8	11	2	11	8	20	-	331	0.09	19.5
Xenistius californiensis	2	26	-	38	12	111	57	11	37	-	1	1	-	-	-	-	-	296	0.08	17.4
Chromis punctipinnis	16	22	100	32	16	9	13	8	29	2	2	3	1	7	1	4	-	265	0.07	15.6
Parophrys vetulus	9	-	-	-	8	-	-	49	155	-	-	-	-	-	-	-	40	261	0.07	15.4
Brachyistius frenatus	18	3	6	36	20	50	17	-	28	-	-	1	1	68	-	-	-	248	0.07	14.6
Atherinopsis californiensis	1	28	37	118	7	15	-	-	-	-	1	-	6	19	7	8	-	247	0.07	14.5
Heterostichus rostratus	21	14	13	12	44	33	3	2	-	-	1	4	28	1	62	-	-	238	0.06	14.0
Acanthogobius flavimanus	-	-	-	-	-	-	-	-	190	23	-	-	-	-	-	-	-	213	0.06	12.5
Scorpaena guttata	7	4	2	21	33	17	3	-	5	1	1	33	30	5	4	23	-	189	0.05	11.1
Oxyjulis californica	2	4	16	21	8	11	17	3	7	3	43	14	4	1	1	7	19	181	0.05	10.6

Appendix G-10. Estimated monthly biomass (kg) of macroinvertebrate impinged during normal operations at Ormond Beach Generating Station. Ormond Beach Generating Station NPDES, 2006.

	2005			2006									Total
Taxa	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Biomass (kg)
Cancer antennarius	0.242	0.162	0.048	0.038	0.031	0.150	45.442	22.621	170.064	61.100	2.225	38.167	340.290
Cancer gracilis	-	-	0.037	0.030	0.024	0.132	7.629	0.741	29.185	7.254	2.924	26.916	74.872
Thetys vagina	-	-	0.008	0.006	0.005	0.028	39.324	-	-	19.281	-	-	58.652
Cancer anthonyi	-	-	0.090	0.073	0.059	0.326	2.059	8.430	33.263	3.328	0.049	6.063	53.740
Cancer productus	-	-	-	-	-	-	-	-	-	26.610	4.854	12.142	43.606
Lysmata californica	-	-	0.009	0.007	0.006	0.034	22.307	0.572	1.058	3.809	0.105	0.427	28.334
Loxorhynchus grandis	-	-	-	-	-	-	-	8.974	11.700	0.579	-	-	21.253
Polyorchis penicillatus	16.596	-	-	-	-	-	-	-	-	-	-	-	16.596
Loligo opalescens	0.289	0.091	0.003	0.003	0.002	-	1.897	11.544	-	-	-	-	13.829
Octopus bimaculatus/bimaculoides	-	-	-	-	-	-	-	-	-	2.461	-	11.054	13.515
Farfantepenaeus californiensis	-	-	-	-	-	-	8.743	0.283	0.800	0.107	-	-	9.933
Anthopleura xanthogrammica	-	-	0.004	0.004	0.003	0.016	-	-	7.968	0.257	-	1.357	9.609
Chrysaora colorata	-	5.696	0.218	0.176	0.142	-	-	-	-	-	-	-	6.232
Pachygrapsus crassipes	-	-	-	-	-	-	-	0.240	5.681	-	-	-	5.921
Pisaster giganteus	-	-	-	-	-	-	-	-	-	-	-	2.828	2.828
Cancer jordani	-	-	-	-	-	-	-	-	-	0.339	0.478	1.467	2.284
Pugettia producta	-	-	-	-	-	-	-	-	2.049	-	-	-	2.049
Parastichopus parvimensis	-	-	-	-	-	-	-	-	-	-	-	1.975	1.975
Crangon nigromaculata	-	-	0.035	0.028	0.023	0.126	0.298	0.671	-	-	-	0.057	1.238
Polyorchis montereyensis	-	-	-	-	-	-	-	0.691	0.473	-	-	-	1.164
Portunus xantusii	0.065	-	0.010	0.008	0.006	0.036	0.304	-	-	-	0.726	-	1.155
Taliepus nuttallii	-	-	-	-	-	-	-	-	-	-	-	0.647	0.647
Pyromaia tuberculata	-	-	-	-	-	-	-	0.016	0.058	0.376	-	-	0.450
Heptacarpus pictus	-	-	-	-	-	-	-	-	-	0.068	-	0.062	0.130
Heptacarpus palpator	-	-	-	-	-	-	0.106	-	-	-	-	-	0.106
Protothaca tenerrima	-	-	-	-	-	-	-	-	-	-	-	0.090	0.090
Strongylocentrotus purpuratus	-	-	-	-	-	-	-	-	-	-	-	0.065	0.065
Pelia tumida	-	-	-	-	-	-	-	-	-	0.028	-	-	0.028
Total Biomass (kg)	17.192	5.949	0.462	0.373	0.301	0.848	128.109	54.783	262.299	125.597	11.361	103.317	710.591
Number of Taxa	4	3	10	10	10	8	10	11	11	14	7	15	28
Total Monthly Flow (mg)	3,190	1,735	133	107	86	240	3,407	4,036	5,043	13,113	4,437	8,588	

Note: Dec 2005 through Feb 2006 values based on average impingement rate of Nov 2005 and Feb 2006 multiplyed by the total monthly flow.

Appendix G-9. Estimated monthly abundance of macroinvertebrate impinged during normal operations at Ormond Beach Generating Station. Ormond Beach Generating Station NPDES, 2006.

		2005						2006					Total
Taxa	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Abundance
Lysmata californica	-	-	3	2	2	9	5,763	143	253	956	15	119	7,265
Cancer productus	-	-	-	-	-	-	-	-	-	3,864	141	359	4,364
Thetys vagina	-	-	-	-	-	1	1,238	-	-	2,382	-	-	3,621
Cancer antennarius	28	5	1	-	-	1	377	162	1,381	441	20	1,150	3,566
Cancer gracilis	-	-	1	1	1	4	83	15	294	1,028	77	754	2,258
Farfantepenaeus californiensis	-	-	-	-	-	-	1,973	16	204	27	-	-	2,220
Cancer anthonyi	-	-	1	1	1	3	21	46	232	986	25	275	1,591
Anthopleura xanthogrammica	-	-	-	-	-	1	-	-	543	26	-	121	691
Loligo opalescens	9	5	-	-	-	-	84	347	-	-	-	-	445
Crangon nigromaculata	-	-	9	7	6	33	112	172	-	-	-	9	348
Pachygrapsus crassipes	-	-	-	-	-	-	-	16	205	-	-	-	221
Pugettia producta	-	-	-	-	-	-	-	-	205	-	-	-	205
Pyromaia tuberculata	-	-	-	-	-	-	-	16	19	136	-	-	171
Portunus xantusii	9	-	1	-	-	2	77	-	-	-	38	-	127
Octopus bimaculatus/bimaculoides	-	-	-	-	-	-	-	-	-	23	-	95	118
Cancer jordani	-	-	-	-	-	-	-	-	-	28	23	61	112
Loxorhynchus grandis	-	-	-	-	-	-	-	16	30	54	-	-	100
Polyorchis montereyensis	-	-	-	-	-	-	-	48	16	-	-	-	64
Heptacarpus palpator	-	-	-	-	-	-	62	-	-	-	-	-	62
Heptacarpus pictus	-	-	-	-	-	-	-	-	-	23	-	21	44
Strongylocentrotus purpuratus	-	-	-	-	-	-	-	-	-	-	-	42	42
Pelia tumida	-	-	-	-	-	-	-	-	-	28	-	-	28
Pisaster giganteus	-	-	-	-	-	-	-	-	-	-	-	20	20
Parastichopus parvimensis	-	-	-	-	-	-	-	-	-	-	-	19	19
Polyorchis penicillatus	19	-	-	-	-	-	-	-	-	-	-	-	19
Protothaca tenerrima	-	-	-	-	-	-	-	-	-	-	-	10	10
Taliepus nuttallii	-	-	-	-	-	-	-	-	-	-	-	10	10
Chrysaora colorata	-	5	-	-	-	-	-	-	-	-	-	-	5
Total Abundance	65	15	16	11	10	54	9,790	997	3,382	10,002	339	3,065	27,746
Number of Taxa	4	3	6	4	4	8	10	11	11	14	7	15	28
Total Monthly Flow (mg)	3,190	1,735	133	107	86	240	3,407	4,036	5,043	13,113	4,437	8,588	

Note: Dec 2005 through Feb 2006 values based on average impingement rate of Nov 2005 and Feb 2006 multiplyed by the total monthly flow.

Appendix G-8. (Cont.).

	2006												
			Aug						Sep				Total
Taxa	19	20	21	23	24	6	7	21	22	28	29	30	Biomass (kg)
Cancer antennarius	-	-	0.111	-	-	0.074	-	0.037	0.032	0.888	0.399	0.564	14.975
Cancer gracilis	-	0.031	-	0.141	-	0.006	0.075	0.061	0.512	0.101	1.119	-	4.197
Cancer anthonyi	-	-	-	-	0.002	0.038	-	0.025	-	0.487	-	-	3.360
Thetys vagina	-	-	-	-	-	-	-	-	-	-	-	-	2.725
Cancer productus	0.063	0.112	0.014	-	-	-	-	0.047	-	0.702	0.082	0.099	2.165
Polyorchis penicillatus	-	-	-	-	-	-	-	-	-	-	-	-	1.783
Lysmata californica	-	-	0.007	-	-	-	-	-	0.001	0.024	0.005	0.003	1.371
Chrysaora colorata	-	-	-	-	-	-	-	-	-	-	-	-	1.125
Loxorhynchus grandis	-	-	-	-	-	-	-	-	-	-	-	-	0.970
Loligo opalescens	-	-	-	-	-	-	-	-	-	-	-	-	0.871
Octopus bimaculatus/bimaculoides	-	-	-	-	-	0.031	-	0.302	0.258	-	-	-	0.699
Farfantepenaeus californiensis	-	-	-	-	-	-	-	-	-	-	-	-	0.545
Crangon nigromaculata	-	-	-	-	-	-	-	-	-	0.006	-	-	0.245
Parastichopus parvimensis	-	-	-	-	-	-	-	-	-	0.208	-	-	0.208
Cancer jordani	-	0.021	-	-	-	-	-	-	-	0.143	-	-	0.176
Anthopleura xanthogrammica	-	-	-	-	-	-	-	-	-	-	0.057	0.019	0.153
Pisaster giganteus	-	-	-	-	-	0.145	-	-	-	-	-	-	0.145
Portunus xantusii	-	0.021	-	0.017	-	-	-	-	-	-	-	-	0.112
Polyorchis montereyensis	-	-	-	-	-	-	-	-	-	-	-	-	0.072
Taliepus nuttallii	-	-	-	-	-	-	-	-	-	-	0.064	-	0.064
Pachygrapsus crassipes	-	-	-	-	-	-	-	-	-	-	-	-	0.062
Pugettia producta	-	-	-	-	-	-	-	-	-	-	-	-	0.020
Pyromaia tuberculata	-	-	-	-	-	-	-	-	-	-	-	-	0.018
Protothaca tenerrima	-	-	-	-	-	-	-	-	-	-	0.009	-	0.009
Heptacarpus pictus	-	-	-	-	-	-	0.003	-	-	-	-	-	0.006
Strongylocentrotus purpuratus	-	-	-	-	-	-	-	-	-	-	0.006	-	0.006
Heptacarpus palpator	-	-	-	-	-	-	-	-	-	-	-	-	0.005
Pelia tumida	-	-	-	-	-	-	-	-	-	-	-	-	0.001
Total Biomass (kg)	0.063	0.185	0.132	0.158	0.002	0.294	0.078	0.472	0.803	2.559	1.741	0.685	36.088
Number of Taxa	1	4	3	2	1	5	2	5	4	8	8	4	28

Appendix G-8. Biomass (kg) of macroinvertebrates impinged during normal operations by survey date at Ormond Beach Generating Station. Ormond Beach Generating Station NPDES, 2006.

	2005		2006																
	Oct	Nov		Mar			Apr			May			Jun				Jul		
Taxa	7	17	6	7	8	5	6	7	2	3	17	5	6	7	8	3	4	20	21
Cancer antennarius	0.026	0.032	0.092	-	0.122	0.573	1.354	0.482	0.336	1.051	-	0.095	0.491	0.348	5.376	0.923	1.569	-	-
Cancer gracilis	-	-	0.026	-	0.163	-	0.363	-	0.048	-	-	0.147	0.397	-	0.774	0.069	0.110	-	0.054
Cancer anthonyi	-	-	-	0.342	0.123	-	0.097	-	0.457	0.079	-	-	0.428	0.696	0.449	-	0.129	0.008	-
Thetys vagina	-	-	-	-	0.040	-	1.240	0.736	-	-	-	-	-	-	-	0.234	0.475	-	-
Cancer productus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.420	0.626	-	-
Polyorchis penicillatus	1.783	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Lysmata californica	-	-	-	-	0.048	-	0.806	0.277	0.023	0.013	-	-	-	0.004	0.014	-	0.146	-	-
Chrysaora colorata	-	1.125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Loxorhynchus grandis	-	-	-	-	-	-	-	-	0.562	-	-	-	-	0.386	-	0.017	0.005	-	-
Loligo opalescens	0.031	0.018	-	-	-	-	0.024	0.067	0.244	0.487	-	-	-	-	-	-	-	-	-
Octopus bimaculatus/bimaculoides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.108	-	-
Farfantepenaeus californiensis	-	-	-	-	-	0.051	0.038	0.395	-	-	0.018	-	0.009	0.017	0.013	-	0.004	-	-
Crangon nigromaculata	-	-	-	0.007	0.173	-	0.016	-	0.036	0.007	-	-	-	-	-	-	-	-	-
Parastichopus parvimensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cancer jordani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.012	-	-
Anthopleura xanthogrammica	-	-	-	0.023	-	-	-	-	-	-	-	-	-	0.044	-	0.010	-	-	-
Pisaster giganteus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Portunus xantusii	0.007	-	-	-	0.051	0.003	0.007	0.006	-	-	-	-	-	-	-	-	-	-	-
Polyorchis montereyensis	-	-	-	-	-	-	-	-	0.043	-	-	-	-	0.029	-	-	-	-	-
Taliepus nuttallii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pachygrapsus crassipes	-	-	-	-	-	-	-	-	0.015	-	-	-	-	0.029	0.018	-	-	-	-
Pugettia producta	-	-	-	-	-	-	-	-	-	-	-	-	-	0.010	0.010	-	-	-	-
Pyromaia tuberculata	-	-	-	-	-	-	-	-	-	0.001	-	-	0.003	-	-	0.004	0.010	-	-
Protothaca tenerrima	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptacarpus pictus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.003	-	-
Strongylocentrotus purpuratus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heptacarpus palpator	-	-	-	-	-	-	0.003	0.002	-	-	-	-	-	-	-	-	-	-	-
Pelia tumida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.001	-	-
Total Biomass (kg)	1.847	1.175	0.118	0.372	0.720	0.627	3.948	1.965	1.764	1.638	0.018	0.242	1.328	1.563	6.654	1.677	3.198	0.008	0.054
Number of Taxa	4	3	2	3	7	3	10	7	9	6	1	2	5	9	7	7	13	1	1

Appendix G-7. Abundance of macroinvertebrates impinged during normal operations by survey date at Ormond Beach Generating Station. Ormond Beach Generating Station NPDES, 2006.

	2005		2006																													
	Oct	Nov	Mar			Apr			May			Jun				Jul				Aug					Sep							Total
Taxa	7	17	6	7	8	5	6	7	2	3	17	5	6	7	8	3	4	20	21	19	20	21	23	24	6	7	21	22	28	29	30	Abundance
Lysmata californica	-	-	-	-	13	-	207	73	6	3	-	-	-	1	3	-	37	-	-	-	-	1	-	-	-	-	-	1	5	1	1	352
Cancer productus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	62	83	-	-	3	1	1	-	-	-	-	2	-	23	3	2	180
Cancer antennarius	3	1	1	-	1	6	11	3	3	7	-	1	3	5	36	5	13	-	-	-	-	1	-	-	4	-	3	1	37	13	12	170
Thetys vagina	-	-	-	-	1	-	18	42	-	-	-	-	-	-	-	33	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	149
Farfantepenaeus californiensis	-	-	-	-	-	2	3	106	-	-	1	-	3	4	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	123
Cancer gracilis	-	-	1	-	4	-	4	-	1	-	-	1	3	-	9	11	27	-	1	-	2	-	2	-	1	3	2	11	1	36	-	120
Cancer anthonyi	-	-	-	3	1	-	1	-	2	1	-	-	3	5	3	-	39	2	-	-	-	-	-	1	3	-	1	-	20	-	-	85
Crangon nigromaculata	-	-	-	2	45	-	6	-	9	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	65
Loligo opalescens	1	1	-	-	-	-	1	3	7	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28
Anthopleura xanthogrammica	-	-	-	1	-	-	-	-	-	-	-	-	-	3	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	4	2	11
Portunus xantusii	1	-	-	-	3	1	2	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	-	10
Cancer jordani	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	6	-	-	8
Pyromaia tuberculata	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	1	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
Octopus bimaculatus/bimaculoides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	2	2	-	-	-	6
Loxorhynchus grandis	-	-	-	-	-	-	-	-	1	-	-	-	-	1	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Polyorchis montereyensis	-	-	-	-	-	-	-	-	3	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Strongylocentrotus purpuratus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	4
Pachygrapsus crassipes	-	-	-	-	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Heptacarpus palpator	-	-	-	-	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Heptacarpus pictus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2
Parastichopus parvimensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	2
Polyorchis penicillatus	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Pugettia producta	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Chrysaora colorata	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pelia tumida	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pisaster giganteus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1
Protothaca tenerrima	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Taliepus nuttallii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1
Total Abundance	7	3	2	6	68	9	255	229	33	29	1	2	13	22	56	114	264	2	1	3	5	3	3	1	10	4	10	15	95	63	17	1,345
Number of Taxa	4	3	2	3	7	3	10	7	9	6	1	2	5	9	7	7	13	1	1	1	4	3	2	1	5	2	5	4	8	8	4	28

Appendix G-6. Length frequency of impinged fish measured during normal operation surveys at Ormond Beach Generating Station. Ormond Beeach Generating Station NPDES, 2006.

	Size Class (cm)																																						Total
Taxa	2	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	26	28	29	30	31	34	35	36	38	39	43	45	55	59	60	109	115	Measured
Atherinops affinis	-	-	-	-	-	1	-	-	3	3	2	2	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14
Citharichthys stigmaeus	-	-	3	15	19	7	4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40
Cymatogaster aggregata	-	1	13	17	7	7	2	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50
Engraulis mordax	1	-	-	-	-	-	-	4	6	10	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
Hexagrammos decagrammus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Hyperprosopon argenteum	-	-	-	-	-	-	-	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4
Hyperprosopon ellipticum	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Hypsurus caryi	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Leptocottus armatus	-	-	-	-	-	-	1	-	1	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Myliobatis californica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	1	1	-	-	-	1	-	-	-	-	-	5
Ophichthus zophochir	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	2
Ophidion scrippsae	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Oxyjulis californica	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Oxylebius pictus	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Paralichthys californicus	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Parophrys vetulus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
Peprilus simillimus	-	-	-	-	-	-	1	-	3	1	-	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8
Phanerodon atripes	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Phanerodon furcatus	-	-	-	-	2	-	1	-	-	1	-	6	4	7	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25
Platyrhinoidis triseriata	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	1	-	-	1	-	1	1	-	-	-	-	-	7
Pleuronichthys coenosus	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pleuronichthys decurrens	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pleuronichthys guttulatus	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Pleuronichthys verticalis	-	-	-	-	-	-	-	-	1	1	-	-	2	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
Porichthys myriaster	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Porichthys notatus	-	-	-	-	-	-	-	-	-	-	4	2	4	-	2	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13
Raja inornata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Rhinobatos productus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	1	3
Sardinops sagax	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Scomber japonicus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Scorpaenichthys marmoratus	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Sebastes miniatus	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Sebastes paucispinis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Sebastes auriculatus	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Seriphus politus	-	-	-	1	-	2	-	1	1	1	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
Squalus acanthias	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1
Symphurus atricaudus	-	-	-	-	-	-	-	1	1	1	1	1	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7
Syngnathus leptorhynchus	-	-	-	1	-	-	-	-	-	-	-	-	1	1	1	1	3	3	4	3	2	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23
Synodus lucioceps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Torpedo californica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-	2
Xeneretmus latifrons	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1