Executive Summary

The monitoring and reporting requirements for the City of San Diego (City) South Bay Water Reclamation Plant (SBWRP) and International Boundary and Water Commission (IBWC) International Wastewater Treatment Plant (IWTP) are outlined in NPDES Permits Nos. CA0109045 and CA0108928, respectively. Since effluent from the SBWRP and IWTP commingles as it is discharged through the South Bay Ocean Outfall (SBOO), the receiving water monitoring requirements are similar and a single ocean monitoring program is conducted by the City to comply with both permits. The main objective of the South Bay ocean monitoring program is to assess the impact of wastewater discharged through the SBOO on the marine environment off southern San Diego, including effects on water quality, sediment conditions, and marine organisms. The study area centers around the SBOO discharge site, which is located approximately 5.6 km offshore at a depth of 27 m. Monitoring at sites along the shore extends from Coronado southward to Playa Blanca, northern Baja California, while offshore monitoring occurs in an adjacent area overlying the coastal continental shelf at sites ranging in depth from 9 to 55 m.

Prior to the initiation of wastewater discharge in 1999, the City of San Diego conducted a 3½-year baseline study designed to characterize background environmental conditions in the South Bay region in order to provide information against which post-discharge data could be compared. Additionally, a region-wide survey of benthic conditions is typically conducted each year at randomly selected sites from Del Mar to the US/Mexico border. Such studies are useful for evaluating patterns and trends over a broader geographic area, thus providing additional information to help distinguish reference areas from sites impacted by anthropogenic influences. The results of the 2006 annual survey of randomly selected stations are presented herein.

The receiving waters monitoring effort for the South Bay region may be divided into several major components, each comprising a separate chapter in this report: Oceanographic Conditions, Microbiology, Sediment Characteristics, Macrobenthic Communities, Demersal fishes and Megabenthic Invertebrates, and Bioaccumulation of Contaminants in Fish Tissues. Data regarding various physical and chemical oceanographic parameters are evaluated to characterize water mass transport potential in the region. Water quality monitoring along the shore and in offshore waters includes the measurement of bacteriological indicators to assess the potential effects of both natural and anthropogenic inputs, and determine compliance with 2001 California Ocean Plan (COP) bacteriological standards for water contact areas. Benthic monitoring includes sampling and analyses of soft-bottom macrofaunal communities and their associated sediments, while communities of demersal fish and megabenthic invertebrates are the focus of trawling activities. Bioaccumulation studies to determine whether contaminants are present in the tissues of local species supplement the monitoring of fish populations. In addition to the above activities, the City and the International Boundary and Water Commission support other projects relevant to assessing ocean quality in the region. One such project is a remote sensing study of the San Diego/Tijuana coastal region. These results are incorporated herein into the interpretations of oceanographic and microbiological data (see Chapters 2 and 3).

The present report focuses on the results of all ocean monitoring activities conducted in the South Bay region during 2006. An overview and summary of the main findings for each of the major components of the monitoring program are included below.

OCEANOGRAPHIC CONDITIONS

Although the seasonal transition for water temperatures occurred relatively early in the year (June–July rather than August–September), oceanographic conditions in the South Bay region

were generally similar to previous patterns. Thermal stratification of the water column followed the typical cycle with maximum stratification in mid-summer and reduced stratification during winter. Relatively low annual rainfall generated less stormwater runoff in 2006 than in the previous year. Aerial imagery from the remote sensing study indicated that the outfall plume was present in shallow sub-surface waters from January through April and in December when the water column was well-mixed, and was deeply submerged during May–November when the water column was stratified. In general, data from both oceanographic measurements and aerial imagery provide no evidence that any water quality parameter (e.g., dissolved oxygen, pH) changed significantly due to wastewater discharge via the SBOO. In addition, a historical review of oceanographic data did not reveal any changes in water parameters related to the beginning of discharge in January 1999. Instead, these data indicate that natural events such as stormwater runoff and large scale oceanographic events explain most of the observed temporal and spatial variability in water quality parameters in the South Bay region.

MICROBIOLOGY

The greatest effects on nearshore water quality conditions in the South Bay region in 2006 appeared to be associated with river discharge and runoff during storm events. For example, despite a lower annual rainfall, annual mean concentrations of fecal coliform bacteria along the shoreline near the Tijuana River in 2006 were similar to levels seen during 2005, a year with much heavier rain. However, bacterial densities at individual shore and kelp stations were lower overall, resulting in rates of compliance with 2001 COP standards that were much higher. Data from the offshore sites suggested that the wastewater plume was confined to sub-surface waters from March through November when the water column was stratified. In contrast, bacterial counts indicative of wastewater were evident in surface waters near the SBOO only during January when the water column was well-mixed. Overall, various water quality data suggest that elevated bacterial counts detected along the shore in 2006 were not caused by the shoreward transport of wastewater from the outfall. Instead, bacterial levels in nearshore waters correspond more to inputs and the transport of materials from the Tijuana River and Los Buenos Creek.

Historical analyses of various water quality parameters support the above results. Overall mean densities of total and fecal coliforms were lower at shore stations during the post-discharge period (1999–present) relative to the pre-discharge period (1995–1998). However, differences between these periods varied widely by station, with station S5, located nearest to the Tijuana River, demonstrating the greatest decline during the post-discharge period. At the kelp stations, mean total coliform density also declined during the post-discharge period while fecal coliform and enterococcus densities increased slightly. In contrast, post-discharge mean bacteriological densities at the offshore stations increased and were highest nearest the SBOO discharge site.

SEDIMENT QUALITY

The composition and quality of ocean sediments in the South Bay area were similar in 2006 to those observed during previous years. Sediments at most sites were dominated by fine sands with grain size tending to increase with depth. Stations located offshore and southward of the SBOO discharge area consisted of very coarse sediments, while sites located in shallower water and north of the outfall towards San Diego Bay had finer sediments.

Mean concentrations of total organic carbon (TOC) in South Bay sediments were higher in 2006 than in previous surveys, whereas total nitrogen (TN) values declined slightly. The increase in TOC was due mostly to an unusually high value at one station in July, along with increases of ~25% relative to 2005 values at several other shallow water sites. Trace metal concentrations decreased relative to 2005 with most values below pre-discharge levels. However, arsenic was present in concentrations above the Effects-Range-Low

(ERL) sediment quality threshold at one site north of the outfall while copper concentrations were above the ERL at one location south of the SBOO. Other contaminants (e.g., pesticides, PCB, PAH) were detected infrequently or at low levels during the year. Overall analyses of particle size and sediment chemistry data collected in 2006 provide no indication of contamination attributable to wastewater discharge.

MACROBENTHIC INVERTEBRATE COMMUNITIES

Benthic communities in the SBOO region included macrofaunal assemblages that varied along gradients of sediment structure and depth. Assemblages surrounding the SBOO in 2006 were similar to those that occurred during previous years. Most sites contained high abundances of the spionid polychaete *Spiophanes bombyx*, a species characteristic of other shallow-water assemblages in the Southern California Bight (SCB). This shallow water group was represented by several distinct sub-assemblages according to differences in sediment structure (i.e., either more fines or more coarse materials). Another type of assemblage occurred at sites from slightly deeper water where the sediments contained finer particles, and probably represents a transition between assemblages occurring in shallow sandy habitats and those occurring in finer mid-depth sediments off southern California. This assemblage also contained relatively high numbers of *S. bombyx*, but was distinguished from the shallow-water assemblages by denser populations of the polychaetes *S. duplex* and *Prionospio jubata*, the amphipod *Ampelisca agassizi*, and the tanaid *Leptochelia dubia*. Finally, sites with sediments composed of relict red sands or varied amounts of other coarse sand or shell hash were characterized by unique assemblages.

Species richness and abundance also varied with depth and sediment type in the region, although there were no clear patterns with respect to distance from the outfall. The range of values for most community parameters was similar in 2006 to that seen in previous years, and most environmental disturbance indices such as the BRI and ITI were characteristic of undisturbed sediments. In addition, changes in benthic community structure in the South Bay region that occurred during the year were similar in magnitude to those that have occurred previously and elsewhere off southern California. Such changes often correspond to large-scale oceanographic processes or other natural events. Overall, benthic assemblages in the region remain similar to those observed prior to wastewater discharge and to natural indigenous communities characteristic of similar habitats on the southern California continental shelf. There was no evidence that the SBOO wastewater discharge has caused degradation of the benthos in the area.

DEMERSAL FISH AND MEGABENTHIC INVERTEBRATE COMMUNITIES

As in previous years, speckled sanddabs continued to dominate South Bay fish assemblages in 2006. Although the numbers of speckled sanddabs have declined markedly from their peak in 2004, this species occurred at all stations and accounted for 49% of the total catch in 2006. Other characteristic, but less abundant, species included the California lizardfish, yellowchin sculpin, longfin sanddab, hornyhead turbot, California tonguefish, roughback sculpin, and English sole. Although fish assemblages varied among stations, these differences were mostly due to variations in speckled sanddab and California lizardfish populations.

The sea star *Astropecten verrilli,* dominated the large (megabenthic) trawl-caught invertebrate assemblages. Although community structure of these organisms also varied between sites, low species richness, abundance, biomass, and diversity generally characterized these assemblages.

Overall, results of the 2006 trawl surveys provide no evidence that the discharge of wastewater has affected either fish or megabenthic invertebrate communities in the region. Although highly variable, patterns in the abundance and distribution

of species were similar at stations located near the outfall and further away. Finally, the absence of physical abnormalities or evidence of disease on local fishes suggests that populations remain healthy in the region.

CONTAMINANTS IN FISH TISSUES

There was no clear evidence to suggest that tissue contaminant loads in fish tissues were affected by the discharge of wastewater in 2006. Although various contaminants were detected in both liver and muscle tissues, concentrations of most contaminants were not substantially different from those reported prior to discharge.

The occurrence of both metals and chlorinated hydrocarbons in the tissues of South Bay fishes may be due to many factors, including the ubiquitous distribution of many contaminants in coastal sediments off southern California. Other factors that affect the accumulation and distribution of contaminants include the physiology and life history of different fish species. Exposure to contaminants can vary greatly between species and even among individuals of the same species depending on migration habits. Fish may be exposed to pollutants in a highly contaminated area and then move into a region that is less contaminated. This is of particular concern for fishes collected in the vicinity of the SBOO, as there are many other point and non-point sources that may contribute to contamination in the region.

SAN DIEGO REGIONAL SURVEY

In the summer of 2006, the City revisited 40 randomly chosen sites initially selected for 1996 survey in order to compare conditions 10 years later. Thirty-four sites ranging in depth from 12–197 m were successfully sampled during the 2006 survey. In addition, 7 repeat sites were sampled in 1995, 1996, 1997, 2005, and 2006.

Overall, the sediments reflect the diverse and patchy habitats common to the SCB. Stations between 31 and 120 m in depth were composed primarily of 63% sands and 36% fine particles and represent most of the mid-shelf region off San Diego. By comparison, sites occurring at shallow depths contained 81% sands and 19% fines, while sediments at deeper sites contained 57% sands and 41% fines. Stations with the most coarse sediments occurred in shallow waters offshore of the SBOO, and along the Coronado Bank, a southern rocky ridge located offshore of Point Loma. Relict sediments typical of the area offshore of the Tijuana River were found west of the SBOO. Sediment composition at shallow water sites from this survey and those included in the regular semi-annual sampling grid surrounding the SBOO were generally similar. In contrast, stations from the deeper semi-annual transects were composed of more sand and less fine materials than comparable mid-shelf samples.

Higher values for TOC and TN occurred in sediments from the deep and mid-shelf stations. For example, mean TOC values increased from the shallow-shelf to the deep water sites following the progression of increased percent fines. In contrast, the highest average concentrations of sulfides occurred among the shallow-shelf stations. In general, average concentrations of TOC and TN from the 2006 survey were slightly higher than 1996 values, and were indicative of a trend towards increased organics through time. Concentrations of several metals correlated with increasing percentage of fines or appeared to be associated with nearby sources of anthropogenic inputs such as ocean outfalls and dredge spoils disposal sites. Average concentrations for most metals were higher in deep shelf sediments where fine particles were more prevalent. Concentrations of trace metals in sediments were relatively similar between the 1996 and 2006 surveys. Concentrations of other contaminants (e.g., pesticides, PAHs, PCBs) were also greater in the sediments containing more fine particles. Contaminant levels at the shallow stations included in the SBOO semi-annual sampling grid contained higher TOC and lower sulfide concentrations, but similar metals concentrations relative to the shallow water samples from the

regional survey. In contrast, sediments at the deeper stations had lower levels of organics and trace metals than comparable mid-shelf samples. Overall, the 2006 regional survey data did not show any pattern of impact relative to wastewater discharge from the SBOO, although patterns associated with other anthropogenic sources (e.g., dredge spoils disposal) were evident.

The SCB benthos has long been considered a heterogeneous habitat, with the distribution of species and communities varying in space and time. The SCB shelf consists largely of an *Amphiodia* mega-community with other sub-communities representing simple variations determined by differences in substrate type and microhabitat. Results of the 2006 and previous regional surveys off San Diego generally support this characterization. The 2006 benthic assemblages were very similar to those sampled at the same sites 10 years previously (1996) and segregated mostly due to differences in habitat type (e.g., depth and sediment grain size). There was little evidence of anthropogenic impact. One assemblage characterized over 60% of the benthos off San Diego, with the ophiuroid *Amphiodia urtica* representing the dominant species. Co-dominant species within this assemblage included other taxa common to the region, such as the polychaetes *Prionospio jubata* and *Spiophanes duplex*, and the bivalve mollusc *Axinopsida serricata*. This group occurred along the mainland shelf at depths from 44 to 94 m, and in sediments containing a relatively high percentage of fine particles (e.g., 43% fines).

In contrast, the dominant species of other assemblages occurring in the region varied according to the sediment type or depth. Shallow water assemblages (<30 m) were generally composed of more coarse sediments and highly variable depending upon their sediment composition. At many of the stations comprising these assemblages, polychaete species such as *Monticellina siblina, Spiophanes bombyx*, and *Scoletoma* sp were numerically dominant. These assemblages were largely similar to other shallow, sandy sediment communities in the SCB. A deep-water assemblage located at depths >180 m was dominated by the polychaetes *S. kimballi* and *Paradiopatra parva,* and the mollusc *Compressidens stearnsi*. These sites had the highest percentage of fine particles and the second highest concentration of organic carbon were low in species richness.

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