Executive Summary

The monitoring and reporting requirements for the City of San Diego's (City) South Bay Water Reclamation Plant (SBWRP) and International Boundary and Water Commission's (IBWC) International Wastewater Treatment Plant (IWTP) are outlined in NPDES Permit Nos. CA0109045 and CA0108928, respectively. Since effluent from the SBWRP and IWTP commingle before discharge to the Pacific Ocean through the South Bay Ocean Outfall (SBOO), the receiving waters monitoring requirements are similar and a single ocean monitoring program is conducted to comply with both permits. The primary objectives of the South Bay ocean monitoring program are to a) measure compliance with NPDES permit requirements and California Ocean Plan (COP) standards, and b) assess the impact of wastewater discharged through the outfall 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 in San Diego, southward to Playa Blanca in northern Baja California (Mexico), while offshore monitoring occurs in an adjacent area overlying the coastal continental shelf at sites ranging from 9 to 55 m in depth.

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 USA/Mexico border in order to evaluate patterns and trends over a broader geographic area. However, no such regional study was conducted in 2008 due to a resource exchange agreement approved by the San Diego Regional Water Quality Control Board and the U.S. Environmental Protection Agency, which allowed the City and IBWC to devote these resources towards participation in the 2008 Southern California Bight Regional Monitoring Program (Bight'08). Data from Bight'08 are not yet available and are therefore not included herein. These data are scheduled to be reported separately in 2011.

The receiving waters monitoring effort for the South Bay region may be divided into several major components, with each comprising a separate chapter in this report entitled: Oceanographic Conditions, Microbiology, Sediment Characteristics, Macrobenthic Communities, Demersal Fishes and Megabenthic Invertebrates, and Bioaccumulation of Contaminants in Fish Tissues. Chapter 1 presents a general introduction and overview of the ocean monitoring program for the region. In Chapter 2 data regarding various physical and chemical oceanographic parameters are evaluated to characterize water mass transport potential in the region. Chapter 3 presents the results of water quality monitoring conducted along the shore and in offshore waters, which includes the measurement of fecal indicator bacteria (FIB) to assess potential effects of both natural and anthropogenic inputs, and to determine compliance with water contact standards specified in the 2001 COP. The results of benthic sampling and analyses of soft-bottom sediments and their associated macrofaunal communities are presented in Chapters 4 and 5, respectively. Chapter 6 presents the results of trawling activities to assess the status of bottom dwelling (demersal) fishes and megabenthic invertebrate communities. Bioaccumulation studies to determine whether contaminants are present in the tissues of local species supplement the monitoring of fish populations and are presented in Chapter 7. In addition to the above activities, the City and IBWC 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 the 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 2008. An overview and summary of the main findings for each of the major components of the monitoring program are included below.

Oceanographic Conditions

The South Bay outfall region was characterized by relatively normal oceanographic conditions in 2008, which included typical seasonal patterns such as localized upwelling and corresponding phytoplankton blooms in the spring, maximum stratification of the water column in mid-summer, and reduced stratification during the winter. Aerial imagery detected the signature of the wastewater plume in near-surface waters above the outfall discharge site on several occasions between January–April and November–December when the water column was generally well mixed. In contrast, the waste field appeared to remain deeply submerged between late April–October when the water column was stratified. There was no apparent relationship during the year between proximity to the outfall and values of ocean temperature, salinity, pH, transmissivity, chlorophyll *a*, and dissolved oxygen. Instead, conditions in 2008 remained notably consistent with changes in large scale patterns reported for the California Current System, indicating that other factors such as upwelling of deep waters and large-scale oceanographic events (e.g., El Niño, La Niña) continue to explain most of the temporal and spatial variability observed in water quality parameters for the South Bay region.

Microbiology

There was no evidence that contaminated waters associated with the SBOO waste field reached the shoreline or near-shore recreational waters off southern San Diego in 2008. Although elevated FIBs were occasionally detected along the shore and at some nearshore stations, these data do not appear to indicate the shoreward transport of wastewater. Instead, analysis of FIB distributions and remote sensing observations indicate that other sources such as outflows (e.g., turbidity plumes) originating from the Tijuana River and Los Buenos Creek in northern Baja California (Mexico), or associated with stormwater and terrestrial runoff following storm events, are more likely to impact water quality along and near the shore in the South Bay region. For example, the shore stations located near the Tijuana River and Los Buenos Creek have long had higher FIB concentrations than stations located further north. Further, historical analyses of various water quality parameters have demonstrated that the general relationship between rainfall and elevated levels of indicator bacteria has remained consistent since ocean monitoring began in 1995. During 2008, the majority of elevated FIB densities not associated with rainfall occurred at offshore monitoring sites located near (i.e., within 1000 m) the outfall diffuser legs and at depths of 18 m or below.

Sediment Characteristics

The composition of sediments at the various benthic sites sampled in the South Bay region during 2008 varied from fine silts to very coarse sands (or other coarse materials), which is similar to patterns seen in previous years. The large variation in sediment composition may be partially attributed to the multiple geological origins of red relict sands, shell hash, coarse sands, and other detrital sediments. In addition, the transport and deposition of sediments originating from the Tijuana River, and to a lesser extent from San Diego Bay, may contribute to higher silt content at some stations located near the outfall and to the north. There was no evident relationship between sediment composition and proximity to the SBOO discharge site.

Concentrations of contaminants such as sulfides, total nitrogen (TN), total organic carbon (TOC), various trace metals, pesticides, PCBs, and PAHs were

generally low in South Bay sediments compared to other areas of the southern California continental shelf. Levels of the organic loading indicator TN, as well as several metals, tended to increase as sediments became finer. Further, levels of all of the organic loading indicators have not shown changes around the outfall or elsewhere coincident with the start of wastewater discharge in early 1999. Concentrations for only two metals exceeded Effects Range Low (ERL) environmental threshold values during the year: (1) the ERL for arsenic was exceeded in sediments from a single site located offshore of the SBOO; (2) the ERL for silver was exceeded in sediments from multiple stations located throughout the monitoring area. Other contaminants were detected either infrequently (i.e., PCBs and pesticides) or in only low concentrations (i.e., PAHs) in sediments during the year. Overall, there was no pattern in sediment contaminant concentrations relative to the SBOO discharge site.

Macrobenthic Communities

Benthic macrofaunal assemblages surrounding the SBOO were similar in 2008 to those that occurred during previous years, including the period prior to wastewater discharge, and varied along gradients of sediment structure, depth, and to a lesser degree, TOC content. These assemblages were typical of those occurring in other sandy, shallow- and mid-water habitats throughout the Southern California Bight (SCB). For example, most of the sandier, shallower sites contained high abundances of the spionid polychaete *Spiophanes bombyx*, a species characteristic of similar habitats and assemblages in the SCB. In contrast, slightly different assemblages occurred at mid-depth stations that had finer sediments characteristic of much of the SCB mainland shelf. Finally, sites with sediments composed of significant quantities of relict red sands, other coarse sands or shell hash were inhabited by unique assemblages characterized by several species of polychaetes (i.e., *Polycirrus* sp, *Protodorvillea gracilis*, *Hesionura coineaui difficilis*, *Micropodarke dubia*, *Typosyllis* sp SD1, and *Pisione* sp).

Benthic community structure parameters such as species richness and total abundance also varied with depth and sediment type, with no clear patterns relative to the outfall. Instead, patterns of region-wide abundance fluctuations appear to mirror historical patterns for *S. bombyx*. The range of values for most parameters was similar in 2008 to that seen in previous years, and results for the benthic response index (BRI) were characteristic of undisturbed sediments. In addition, changes that did occur in macrofaunal community structure 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, macrofaunal 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 wastewater discharge has caused degradation of the marine benthos in the SBOO monitoring region.

Demersal Fishes and Megabenthic Invertebrate Communities

Speckled sanddabs continued to dominate fish assemblages surrounding the SBOO during 2008 as they have in previous years. This species occurred at all stations and accounted for 59% of the total catch. Other characteristic, but less abundant species included the roughback sculpin, yellowchin sculpin, California lizardfish, longfin sanddab, hornyhead turbot, longspine combfish, English sole, and California tonguefish. Most of these common fishes were relatively small, averaging less than 20 cm in length. Although the composition and structure of fish assemblages varied among stations, these differences mostly reflected variation in speckled sanddab populations.

Assemblages of relatively large (megabenthic) trawl-caught invertebrates in the region were similarly dominated by one prominent species, the sea star *Astropectin verrilli*. Variations in megabenthic invertebrate community structure generally reflected changes in the abundance of this species, as well as other characteristic species

including the sea urchin *Lytechinus pictus*, the sand dollar *Dendraster terminalis*, and the shrimp *Crangon nigromaculata*.

Overall, results from the 2008 trawl surveys provide no evidence that wastewater discharge has affected either demersal fish or megabenthic invertebrate communities in the region. The relatively low species richness and small populations that occurred in the region are consistent with the depth and sandy habitat in which the trawl stations are located. Further, patterns in the abundance and distribution of species were similar at stations located near the outfall and farther away, suggesting a lack of significant anthropogenic influence. Changes in these communities instead appear to be more likely due to natural factors such as fluctuating water temperatures associated with large-scale oceanographic events (e.g., El Niño) and the mobile nature of many species. Finally, the absence of any indicators of disease or other physical abnormalities in local fishes suggests that populations in the region remain healthy.

Contaminants in Fish Tissues

There was no clear evidence to suggest that tissue contaminant loads in fish captured at the SBOO monitoring sites were affected by the discharge of wastewater in 2008. Although several tissue samples contained metals that exceeded pre-discharge maximum values, concentrations of most contaminants were not substantially different from pre-discharge data. In addition, the samples that did exceed pre-discharge values were distributed widely among the stations and showed no pattern relative to wastewater discharge. Further, all contaminant values were within the range of those reported previously for SCB fishes.

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 bioaccumulation and distribution of contaminants in local fishes include the different physiologies and life history traits of various species. Exposure to contaminants can vary greatly between species and even among individuals of the same species depending on migration habits. For example, 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 in the region that may contribute to contamination.