

EXECUTIVE SUMMARY

The Santa Monica Bay receiving water monitoring program is promulgated under NPDES Permit No. CA0109991 issued to the Hyperion Treatment Plant (HTP), City of Los Angeles. The plant operated under Waste Discharge Requirements, Order No. 94-021 from May 11, 1994 until May 14, 2005 when the new Waste Discharge Requirements, Order No. R4-2005-0020, became effective. The NPDES Permit and associated Waste Discharge Requirements Orders were issued jointly by the Los Angeles Regional Water Quality Control Board (Regional Board) and the United States Environmental Protection Agency, Region IX (USEPA). Under this permit, extensive monitoring of effluent quality, microbiology, ambient water quality, benthic sediments and macrofauna, demersal fish and invertebrates, and priority pollutant tissue concentrations of trawled organisms and sportfish is required to determine impacts, if any, from HTP treated effluent discharged into Santa Monica Bay (SMB). This biennial assessment report contains Santa Monica Bay monitoring data collected during the period from January 2005 through December 2006. The annual summary of effluent and receiving water data is reported separately to the Regional Board and USEPA.

On November 23, 1998, full-secondary treatment process was implemented at HTP thereby significantly improving the quality of the treated wastewater being discharged into the marine

environment. The full-secondary process was augmented in calendar years 1998–1999 with additional pure oxygen activated sludge modules, secondary clarifiers, and egg-shaped digesters to achieve a very high quality effluent. During the period from January 2005 through December 2006, HTP discharged an average of 324 MGD of treated wastewater into Santa Monica Bay through Serial Discharge Port No. 002 (5-Mile Outfall).

A modified benthic sampling program was submitted and accepted by the RWQCB in December 1998 and implemented in January 1999. This sampling program modified the former sampling grid to create a combination fixed-station and random-station array in order to more effectively assess any effects from HTP's secondary-treated discharge on Santa Monica Bay. This modified program continued to be employed during the period reported here.

Bacterial concentrations within the Bay, including the shallow waters along its beaches, also were examined to assess the impact of the HTP discharge. Past studies have indicated water quality along the Santa Monica Bay shoreline is not impacted by the Hyperion discharge; it appears to be impacted primarily by nonpoint urban runoff sources. As a result, the shoreline stations were re-positioned nearer to storm drains in 1995, so as to monitor the stormwater runoff. In December 2001, the shoreline monitoring program was placed

in the Los Angeles County Municipal Stormwater Separate Sewer System (MS4) Permit. Both a dry- and a wet-weather TMDL (Total Maximum Daily Load), addressing impairment of Santa Monica Bay Beaches due to bacteria, became effective July 15, 2003. These TMDLs required development of a Coordinated Shoreline Monitoring Plan for Santa Monica Bay Beaches. This was developed and submitted to the Regional Board in April 2004. This plan required sampling points to be located at point zero, which is the point where the flow from the storm drain reaches the surf. Several stations reported herein were relocated to point zero on November 1, 2004. The current HTP NPDES Permit, which became effective May 14, 2005, does not require this shoreline monitoring for SMB Beaches; consequently, shoreline bacteria monitoring data discussed in this report extends only from January through May 2005. Additional shoreline bacteria monitoring data can be found in the annual MS4 report.

EFFLUENT QUALITY

Completion of HTP's secondary treatment expansion and subsequent discharge of fully secondary-treated effluent beginning in November 1998 resulted in a marked and immediate effect on the quality of effluent discharged into Santa Monica Bay; this "high quality treatment" continued through this reporting period. The efficient removal of solids from wastewater has resulted in fewer solids and associated pollutants being discharged. During 2005–2006, removal efficiencies were still high with little change from the previous reporting period (2003–2004). In 2005, there were three effluent permit exceedances; two were due to unchlorinated waste water and rain water discharges through the 1-Mile outfall on consecutive days of a storm, and the third was due to a settleable solids exceedance. In 2006, Hyperion had a historical planned diversion of plant effluent from the normally-used 5-Mile outfall pipe to the emergency-use 1-Mile outfall pipe. This was to enable inspection of the aging 5-Mile outfall. During this event, there was an exceedance of the limitations for ammonia set for

the 1-Mile outfall. Also during 2006, chronic toxicity exceedances prompted an initial Toxicity Reduction Evaluation. Other than those mentioned above, all permit requirements were met or surpassed during this reporting period of January 2005 to December 2006.

WATER QUALITY AND MICROBIOLOGY

From January 1, 2005 until May 13, 2005 water samples from 18 Santa Monica Bay shoreline locations were collected under the Hyperion NPDES permit six days per week, Monday through Saturday, at point zero (point at which storm drain discharge meets, or would meet, the surf) and tested for total coliforms, *E. coli*, and enterococcus. Recognizing that plant effluent discharged from the 5-mile Outfall has no detectable impact on the SMB shoreline, the microbiology component for monitoring both the plant effluent and the SMB shoreline is not included under the current Hyperion NPDES Permit, which became effective May 14, 2005. Instead SMB shoreline bacteriological monitoring has been transferred to the MS4 permit, acknowledging that bacterial contamination of the shoreline is predominantly the result of storm drain flows and other non-point sources. Consequently, this report only includes shoreline bacteriological data collected through May 2005; additional shoreline bacteriological data can be found in the annual MS4 reports.

Bacterial densities among sampling sites during January through May 2005 showed that, overall, S04 (Santa Monica Canyon storm drain) generally had the highest geometric means for all three indicator bacteria during both dry- and wet-weather periods. Additional sites with overall high counts for all indicators were stations S01 (Surfrider Beach), S02 (Topanga Canyon), S03 (Pulga Canyon), S05 (Santa Monica Pier), S06 (Pico-Kenter Storm Drain), and S10 (Ballona Creek). These sites are predominately in the northern half of the Bay, indicating that geometric means for most north SMB sites were greater than those from sites located in the southern Bay. The

sampling locations with the lowest bacterial densities overall were stations S13 (40th Street, Manhattan Beach) and S14 (Manhattan Beach Pier) for wet- and dry-weather periods. Other sites with low geometric means were S15 (Hermosa Pier), S17 (Avenue I, Redondo Beach), and S18 (Malaga Cove).

Water quality monitoring via indicator bacteria for SMB inshore waters was performed five times per month at ten offshore sites and one land-based site from January 1 to May 13, 2005, and then reduced to annually under the new NPDES permit. Noticeably higher bacterial concentrations were detected at two inshore stations, IS08 and IS11 (off Ballona Creek and in King Harbor, respectively). These elevated concentrations appear to be related to local influences rather than to the Hyperion Treatment Plant discharge.

Following conversion to full-secondary treatment in November 1998, the HTP effluent has shown a substantial improvement and reduction in its bacterial levels. Additionally, the number of floatable materials such as plastic and rubber goods, which often originate from HTP, has declined from previous years as a result of the revamp in the treatment process. This pattern continued during this reporting period.

There were no NPDES Permit violations for the physical-chemical water quality standards as a result of HTP's wastewater discharge into Santa Monica Bay during 2005-2006. Examination of *x-y* linear graphics and color or black and white plots depicting pH, DO, light transmittance, CDOM (Color Dissolved Organic Material), and other profiles did not indicate that compliance limits for these parameters were exceeded. However, there were MOSO (Material of Sewage Origin) observations made on the water surface immediately above and adjacent to the 5-Mile Outfall while conducting surveys other than water quality; they were on January 25, June 6-8, June 13, and June 14, 2006. Microbiological results indicated that AB411 standards were not exceeded during these MOSO events. The wastewater field was detectable in every survey during the reporting period, primarily

by CDOM, salinity, and salinity anomaly. General descriptions of oceanic conditions and direction of the wastewater field movement are provided. All data were previously included in the HTP's Monthly Monitoring Reports and submitted to the Regional Board and USEPA.

SEDIMENT CHEMISTRY

Sediments in Santa Monica Bay are heterogeneous; comprised of varying levels of mainly sand and silt. Silt is predominant in the northwestern part of the Bay, sandy silt in the central and southern portions, and sand and gravel inshore and around Short Bank. Sulfide was detected at one of three stations for which it was sampled in 2005 and at all four 2006 stations.

All nine metal pollutants were detected across all surveyed stations during 2005 and 2006. Their maximum concentrations were measured at station E6 (in the vicinity of the 7-Mile Outfall). Two DDT derivatives and eighteen PCB congeners were detected during 2005 and 2006, and their detected levels were higher in 2006.

Metal pollutants were most concentrated near the 7-Mile and 5-Mile Outfalls. Derivatives of DDT and PCBs, conversely, were more concentrated in the southern region of the Bay near the Palos Verdes Shelf.

To assess the biological impact of bulk sediment contamination in Santa Monica Bay, the concentrations of metal and organic pollutants were compared with their Effective Range-Low (ER-L) and Effective Range-Median (ER-M) values. In 2005 and 2006, most metal pollutants at all Santa Monica Bay stations were below their ER-M values, but exceeded their ER-L values. The average concentration of total DDT in the Bay exceeded its ER-M. The average concentration of total PCB was below ER-M in 2005 but exceeded ER-M values in 2006.

MACROFAUNAL ASSEMBLAGES

Several analytical techniques were employed to assess the benthic macrofaunal data, each contributing to the understanding of macrofaunal community structure in SMB. Community indices form the starting point from which gross community characteristics are identified and/or graphed, whereas cladistic or parsimony analyses with subsequent multivariate ordinations provide a means to discern station relationships and community characteristics within the various areas of the Bay and over time and possible impacts from the effluent discharge of HTP.

The vast array of community indices generally showed similar patterns when mapped back on the cladograms or onto the ordinations. Total phylogenetic diversity appeared to have the best fit. Other community measures (such as the BRI, H', d) also showed close concordance with the cladograms. Quantitative taxonomic diversity, which is not sample-size dependent, reached similar values very early in the historic trending of the outfall samples suggesting saturation with higher taxa in the community can occur very rapidly.

Species numbers continue to increase since Hyperion Treatment Plant went to full secondary treatment, with the highest number of taxa (171) in our sampling array now being found at the 5-Mile Outfall station, Z1. The parsimony analysis from 2005 and 2006 indicate the spatial extent of impact (outfall footprint) continues to decline with improved treatment, as the 5-Mile Outfall stations, Z1 and Z2, grouped in two different locations in the cladogram. This lack of station grouping fidelity suggests an increasing loss of "outfall signal" that is undoubtedly due to the continued improvement in effluent quality.

The cladistic analysis of the subset of nine stations that are measured for selected priority pollutants grouped by depth, location in the Santa Monica Bay, granulometry, and sediment chemistry. Mapping the abiotic parameters and pollutants on the 3-D plot-

trees revealed that the highest metal concentrations still reside at the 7-Mile Outfall (E6), with much lower concentrations near the 5-Mile Outfall, followed by the remaining stations farther away from the 5-Mile Outfall. Total DDT when mapped was shown to be highest at Station E6 followed by C9a. High concentrations at C9a in the southern portion of Santa Monica Bay are consistent with the northward movement of these organic compounds from the Palos Verdes Shelf; high concentrations on the Palos Verdes Shelf result from past discharge from the Los Angeles County Sanitation's sewer system by Montrose Chemical Corporation.

An historical analysis of the 7-Mile Outfall Station E6 was performed for the first time using PAE (Parsimony Analysis of Endemicity). The macrofauna samples (1983-1987) from the sludge-pumping era group together along with the samples from 1988. These communities were extremely species depauperate. The cladogram posits a large 1989-1995 clade and another large 1996-2006 clade. Both clades have similar species richness with the 1989-2006 clade possessing higher abundance values. Only a few different species characterize the different clades. Regarding sediment granulometry, higher percentages of sand characterize the last ten years, while higher percentages of clay were present in the first ten years after the cessation of sludge discharge. Pollutant concentrations remain elevated and highly variable with no apparent temporal trend or pattern. This is undoubtedly due to the nature of the substrate, which consists of a very thin layer of deposited sediment, resting on top of a bed of physically unstable, inert non-compactable sludge material.

Historical trending of the 5-Mile Outfall stations Z1 and Z2 from the parsimony analyses continues to show a stunning change in community structure over time associated with improved treatment process. Independent mapping of mass-emission data from 1983 through 2006, community indices, pollution-tolerant, and pollution-sensitive species, all produced near perfect maps or distribution patterns explaining macrofaunal community patterns. The pattern was similar, with pollution-sensitive species

now recolonizing the area after full-secondary treatment went into affect. The majority of the single occurrences from the macrofauna data set were restricted to the 1999-2006 clade, underscoring the lack of randomness in the distribution of rare species, and their value in bio-monitoring.

A novel approach correlating various phylodiversity indices and the biointegrity index BRI with mass emission variables over 23 years at the 5-mile Outfall stations Z1 and Z2 was conducted, in order to determine the best performing candidate to infer community response in an environmental monitoring context. Both the BRI and quantitative taxonomic diversity (Δ) performed relatively well in this context. The remaining phylodiversity indices did not correlate well with the various mass emission values. Quantitative taxonomic diversity performed slightly better (11 higher *r*-values all highly significant calculated via independent contrasts in the PDAP: TREE module in Mesquite) than the biointegrity index BRI with regard to the 16 mass emission variables.

These data and analyses strongly suggest the 5-Mile outfall area continues to improve in response to the continual improvement in effluent quality.

TRAWLED ORGANISMS

Due to the high degree of variability associated with many aspects of trawl-caught macrofauna, coupled with the relatively high effluent quality and the progression of positive response of the macrofauna community to it, discrimination among fine spatiotemporal sampling events (seasons, years, biennia) is difficult to accomplish. However, the higher abundances of pollution-tolerant species and the decrease or absence of pollution-sensitive species revealed by character or species mapping on the cladograms suggest continuing, albeit minimal, impact on these organisms and thus on the outfall community. These responses are being witnessed in a much smaller area than that seen in the past, decreasing the spatial footprint of impact.

The cladogram and within group PCA (principal coordinates analysis) ordination reveal distinct species assemblages that existed before the Hyperion Treatment Plant implemented full-secondary treatment and improved effluent quality and a change in these assemblages after this operational improvement. The trawl response index, although highly variable over time, does not show any trawl sample event to be perturbed after 1989. The elongate branches at the top of the cladogram from the analysis of 5-Mile Outfall station Z2 over time, represent higher diversity of the trawl-caught community after Hyperion Treatment Plant implemented full-secondary treatment. Many species show increased abundances and occurrences after full-secondary treatment, with 27% of the species found exclusively from 1999-2006. These analyses suggest the trawl-caught fish and invertebrate community continues to ameliorate in response to the continued improvements in effluent quality.

TISSUE CHEMISTRY

Analyses of chemical contaminants in the tissues of selected trawled fish and rig-caught sportfish is required under HTP's NPDES Permit. The trawled organisms are closely associated with the sea bottom throughout much of their lives. Thus, they are more likely to bioaccumulate pollutants from contaminated sediments and potential bottom-dwelling prey compared to organisms living higher in the water column. Analyses of pollutants in rig-caught fish are of considerable interest to the public, as fishermen also seek these species.

Ten samples of hornyhead turbot were analysed in 2005 and three in 2006. Analyses were conducted on both muscle and liver tissues. As, Hg, and Se were detected in all muscle and liver samples collected in both 2005 and 2006. Of the six DDT and forty-five PCB derivatives analyzed for in hornyhead turbot tissues during the 2005 and 2006 surveys, two DDT derivatives and twenty-eight PCB congeners were detected in either muscle or liver in 2005, and three DDT derivatives and thirty PCB congeners were detected in 2006. Although mercury, DDTs,

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and PCBs were detected in some hornyhead turbot samples in 2005-2006, none of them exceeded the values of 0.080, 0.560, and 0.020 mg/kg, respectively, set by US EPA and OEHHA.

Three sportfish species were collected in March 2005, and seven sportfish species were collected in August and October of 2005. No sportfish tissue analyses were required for 2006 by the new permit. White croaker was the numerically dominant sportfish collected. Cyanide was not detected in any of the muscle samples of sportfish species, but As, Se, and Hg were detected in all. The most frequently detected pesticides were p,p'-DDE and p,p'-DDD. P,p'-DDE was detected in seven out of eight sportfish species caught, and its highest average concentration was found in the muscle of California scorpionfish. The average concentration

of p,p'-DDD found in muscle of the five species of fish were relatively low.

Sixteen different PCB congeners were found in the muscle of California scorpionfish and white croaker. The highest average concentration of all PCB congeners was for PCB 153/168 in the muscle of white croaker.

Although mercury was detected in all sportfish tissue sampled in 2005, five out of eight species exceeded the 0.08 mg/kg limit set by US EPA and OEHHA. They are cabezon, white croaker, California scorpionfish, black croaker, and barred sand bass. Two sportfish species, white croaker and California scorpionfish, exceeded the PCB level of 0.02 mg/kg set by US EPA and OEHHA.