EXECUTIVE SUMMARY

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The Orange County Sanitation District (District) conducted extensive ocean monitoring to evaluate potential environmental and public health effects from the discharge of treated wastewater off of Huntington Beach and Newport Beach, California. The data collected were used to determine compliance with receiving water conditions as specified in the District's National Pollution Discharge Elimination System (NPDES) permit, which was jointly issued in 2004 by the U.S. Environmental Protection Agency, Region IX (EPA) and the Regional Water Quality Control Board, Region 8 (RWQCB). The monitoring program was designed to determine compliance with permit criteria and to maintain the District's long-term data collection used for trend analyses. This report focuses on monitoring results and conclusions from July 2011 through June 2012.

Results of the monitoring program continued to show that ocean depth is the primary determinant of the distribution of organisms within the monitoring area. A trend of decreasing diversity and abundances for the infaunal (small invertebrates) communities within the zone of initial dilution (ZID) began in 2005 and eventually extended to the closest stations beyond the ZID (<1 km). This trend and included changes to the demersal fish community near the effluent discharge reflecting the altered infaunal communities (fish prey species) near the outfall. While changes in receiving water and sediment chemical and physical characteristics were identified near the outfall, these changes were typically small and not suggestive of causing adverse effects on biota. Biological communities more than 1 km beyond the ZID were generally healthy, diverse, and comparable to those occurring under similar environmental conditions throughout the Southern California Bight. Results from the current year found improving benthic community health evidenced by a return to near normal invertebrate communities at all sites outside of the ZID.

WATER QUALITY

Natural water quality conditions during 2011-12 were typical of previous years with only minor changes in measured water quality parameters, primarily characterized by temperature stratification (layering) of the water column throughout most of the year. Currents and stratification were primary factors in determining the location of the discharged wastewater plume. Predominant alongshore current flows and strong temperature stratification in spring and summer kept the plume below the ocean surface and away from shore. Even when strong stratification was not present, as was the case for the winter quarter, water quality monitoring data indicated that the wastewater plume remained at depth.

Plume-related changes in temperature, salinity, dissolved oxygen (DO), pH, and light transmissivity were measurable beyond the initial mixing zone during some surveys, but none of these changes were determined to be environmentally significant since they fell within natural ranges to which marine organisms are exposed and compliance with

California Ocean Plan (COP) criteria was high (97–99%). Values and patterns in DO and pH were driven more by natural rather than outfall processes. One exception was an apparent reduction in DO that occurred periodically due to secondary entrainment of deeper, lower oxygen water caused by the rising effluent plume.

During 2011-12, strong decreases in light transmittance (upwards to 30%) were associated with the Newport Canyon, while much smaller changes (less than 10%) were associated with the discharge plume. Light transmittance was most strongly affected by phytoplankton. In all surveys, chlorophyll-*a* and, putatively, the resuspension of bottom sediments within the Newport Canyon had the greatest impacts on water clarity. Both Secchi depth and the 1% photosynthetically active radiation (PAR) value showed similar spatial patterns of reduced water clarity in nearshore compared to offshore waters. However, the 10% PAR showed a better relationship with the subsurface chlorophyll-*a* maxima.

Maximum ammonia (NH3-N) concentrations were, respectively, 20 and 30 times less than the COP receiving water objectives for chronic (4 mg/L) and acute (6 mg/L) toxicity to marine organisms. Average values at all depths and for all seasons were several hundred times lower than these objectives. Only 16% of the NH3-N samples collected were above the detection limit of 0.02 mg/L and the vast majority of these (72%) were found below 15 m, typically below the 10% PAR and maximum chlorophyll-a depths. This subsurface distribution was limited primarily to within 2 km of the outfall. The low levels and limited distribution of ammonium along with the lack of association with chlorophyll-*a* suggests that the concentrations seen were not environmentally significant.

Since effluent disinfection began in August 2002, offshore bacterial concentrations have remained low and predominately below detection. This was the case for 2011-12 where 73–89% of the samples fell below the lower method detection limit of 10 MPN/100 mL and none of the measured bacteria exceeded their respective single sample maximum value; after the change all three had values that exceeded these limits by an order of magnitude.

Overall, the measured environmental and public health effects to the receiving water continue to be relatively small, with values that remain within the ranges of natural variability for the study area. Seasonal and yearly changes are dominated by large-scale regional influences. Plume effects that were observed, occurred primarily at depth, even in the winter when temperature differences between the surface and subsurface were reduced. In summary, results from the 2011-12 water quality program support the conclusion that the discharge is not greatly affecting the receiving water environment and that beneficial uses were maintained.

SEDIMENT QUALITY

Sediment quality (chemistry and physical characteristics) measurements in 2011-12 were consistent with results from previous years suggesting that the wastewater

discharge has minimal potential for adverse impact on biota outside the ZID for those measured constituents. Organic loading was minimal and did not create anaerobic sediment conditions or exceed thresholds that would promote a shift towards declining conditions beyond the ZID. There were only minor changes to sediment grain size, which were localized near the outfall. Sediment sulfide concentrations were generally low, but higher within the ZID, the Newport Canyon, and at deeper slope stations than at other mid-shelf stations. Stations near the discharge site, but outside the ZID, were comparable to farfield sites.

Sediment quality guidelines, effects-range low (ERL) and effects-range median (ERM), were used as benchmarks in evaluating the potential for degradation by chemical contaminants. Most sediment metal concentrations throughout the monitoring area were below both benchmarks, including within the ZID. Only copper and nickel exceeded their ERLs, predominately at slope and basin stations

Concentrations of polychlorinated biphenyls (PCBs) were higher in sediments near the outfall as compared to other 60-m stations; however, no concentration outside the ZID exceeded the ERL. Sediment dichloro-diphenyl-trichloroethane (DDT) concentrations exceeded the ERL at most 60-m sites, but did not exhibit any patterns related to the outfall. DDT is a legacy contaminant that is wide spread throughout the Southern California Bight (SCB). Polycyclic aromatic hydrocarbons (PAH) were higher at the outfall compared to farfield sites, but at concentrations well below the ERL.

Mean Effects-Range Median Quotient (mERMq) analysis indicated a very low probability of sediment toxicity at both within-ZID and non-ZID sites based on sediment contaminant levels. Whole-sediment toxicity testing at 10 stations in summer 2011 and 8 stations in winter 2012 encompassing both within-ZID and non-ZID mid-shelf stations showed no significant sediment toxicity at any station. This indicates a low likelihood of effluent impacts on biota.

BIOLOGICAL COMMUNITIES

Infaunal Invertebrate Communities

Similar to previous years, the 2011-12 results showed that natural features of the study region, including bottom depth, sediment grain size, and complex bathymetry (e.g., submarine canyon habitats), accounted for the larger-scale spatial patterns of infaunal communities within the monitoring area. Station proximity to the outfall diffuser was also a factor, but only affected those stations closest to the outfall.

Since 2005, invertebrate communities within the ZID had been declining to the point of being considered degraded by the Infaunal Trophic Index (ITI) and as having a loss of biodiversity by the Benthic Response Index (BRI). The summer 2011 sampling showed several mid-shelf stations near the outfall were characterized as changed or showed marginal deviation from reference per the ITI and BRI. By the winter 2012 sampling, all

mid-shelf stations classified as normal or reference by the ITI and BRI, with the exception of Station C2, which is located within the Newport Canyon and supports a much different community. Several stations within the submarine canyons, slope, and basin areas are also classified as impacted (i.e., other than normal or reference), but it is not clear if these were related to the effluent discharge.

The causes of the recent decline in the infauna and the expansion of impacts away from the outfall were studied by District scientists. A summary of the studies are presented in Chapter 7 of this report. Since 2002, major changes in District treatment processes and operations include the initiation of effluent disinfection, the construction of additional secondary treatment facilities, and the Ground Water Replenishment System (GWRS). The conclusion drawn from the three-year ZID investigation was that residual chlorine and chlorination by-product chemicals were the primary cause of the change to invertebrate communities. These effects were possibly exacerbated by reduced final effluent flows resulting from the GWRS effluent diversions and the discharge of reverse osmosis reject flows generated by GWRS.

Demersal Fishes and Macroinvertebrates

Results for demersal fish and macroinvertebrates were generally consistent with past findings. Bottom depth, regional influences (e.g., El Niño, La Niña), and normal oceanographic cycles were more important than the effluent discharge in affecting the distribution and abundance of fish in the study area. Demersal fish and macroinvertebrate communities near the outfall were comparable to local and regional reference stations with results within the range of values for non-POTW (Publically Owned Treatment Works) sites throughout the SCB. The results indicated that the outfall area was not degraded and that it supported normal fish and macroinvertebrate populations.

Tissue Contaminants in Fish

The accumulation of contaminants by fish can occur due to both direct exposure to contaminated water and sediments, and the ingestion of contaminated prey. Contaminants were examined in fish muscle and liver tissues. Findings for 2011-12 were representative of previous years. Concentrations of mercury, DDT, and other chlorinated pesticides in all edible fish tissues collected at near-outfall and farfield locations were below federal and state action levels and/or health advisory limits. PCB concentrations in edible fish tissue were generally higher in fish collected at the outfall or comparable to those in fish collected at the farfield station, but were well below the state and federal action levels. PCBs are legacy contaminants that are still found in sediments due to their long degradation times. The detection of PCBs in fish tissues is the result of this prolonged exposure, and not current discharge practices.

Fish Health

The types and frequencies of external health problems for fish can be important indicators of environmental health. Examinations of fish for ectoparasites, tumors, fin erosion, and skin lesions showed that fish in the monitoring area were generally healthy. External parasites and other external abnormalities occurred in less than 1% of the fish collected, with no evident outfall influence. These results were consistent with previous years and indicate that the outfall is not an epicenter of disease.

CONCLUSION

The findings and conclusions for the 2011-12 monitoring effort were consistent with long-term reported findings that showed limited impacts to the receiving water, sediment, and trawl fish and macroinvertebrate communities. Plume-related changes to receiving water temperature, salinity, dissolved oxygen, pH, and transmissivity observed beyond the ZID were well within the range of natural variability. Low concentrations of bacteria in water contact zones, in concert with the limited distributions of ammonia and absence of associations of the wastewater plume with phytoplankton blooms, suggest that the discharge had no discernible impact on environmental or human health. The low levels of contaminants in fish tissues and the low incidents of external abnormalities and diseases in fish demonstrated that the outfall was not an epicenter of disease.

Consistent with previous years, invertebrate communities outside the ZID generally were normal and similar to reference areas in the Southern California. Minor impacts were found at stations outside the ZID in the summer 2011 survey, but the winter 2012 survey found all mid-shelf non-ZID stations supported normal communities. Continued monitoring will determine of this trend continues.