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Impacts of stormwater runoff in the Southern California Bight: Relationships among plume constituents

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ABSTRACT

The effects from two winter rain storms on the coastal ocean of the Southern California Bight were examined as part of the Bight '03 program during February 2004 and February–March 2005. The impacts of stormwater from fecal indicator bacteria, water column toxicity, and nutrients were evaluated for five major river discharges: the Santa Clara River, Ballona Creek, the San Pedro Shelf (including the Los Angeles, San Gabriel, and Santa Ana Rivers), the San Diego River, and the Tijuana River. Exceedances of bacterial standards were observed in most of the systems. However, the areas of impact were generally spatially limited, and contaminant concentrations decreased below California Ocean Plan standards typically within 2–3 days. The largest bacterial concentrations occurred in the Tijuana River system where exceedances of fecal indicator bacteria were noted well away from the river mouth. Maximum nitrate concentrations (~40 μM) occurred in the San Pedro Shelf region near the mouth of the Los Angeles River. Based on the results of general linear models, individual sources of stormwater differ in both nutrient concentrations and the concentration and composition of fecal indicator bacteria. While nutrients appeared to decrease in plume waters due to simple mixing and dilution, the concentration of fecal indicator bacteria in plumes depends on more than loading and dilution rates. The relationships between contaminants (nutrients and fecal indicator bacteria) and plume indicators (salinity and total suspended solids) were not strong indicating the presence of other potentially important sources and/or sinks of both nutrients and fecal indicator bacteria. California Ocean Plan standards were often exceeded in waters containing greater than 10% stormwater (<28–30 salinity range). The median concentration dropped below the standard in the 32–33 salinity range (1–4% stormwater) for total coliforms and Enterococcus spp. and in the 28–30 salinity range (10–16% stormwater) for fecal coliforms. Nutrients showed a similar pattern with the highest median concentrations in water with greater than 10% stormwater. Relationships between colored dissolved organic matter (CDOM) and salinity and between total suspended solids and beam attenuation indicate that readily measurable, optically active variables can be used as proxies to provide at least a qualitative, if not quantitative, evaluation of the distribution of the dissolved, as well as the particulate, components of stormwater plumes. In this context, both CDOM absorption and the beam attenuation coefficient can be derived from satellite ocean color measurements of inherent optical properties suggesting that remote sensing of ocean color should be useful in mapping the spatial areas and durations of impacts from these contaminants.