Appendix F

Executive Summary of El Niño Study
by Southern California Coastal Waters Research Project

Introduction

Urban stormwater runoff constitutes one of the largest inputs of chemical constituents to southern California's coastal waters. Substantial resources are spent monitoring the constituents in stormwater runoff, yet little is known about the effects of these inputs once they enter the ocean. Understanding the effects of stormwater on the marine environment is essential, because it provides the information needed to justify management action and to identify the most effective actions to improve environmental quality.

In 1996, a three-year research project sponsored by the Los Angeles County Department of Public Works, USC Sea Grant and the Southern California Coastal Water Research Project (SCCWRP) was initiated to examine the impacts of urban stormwater runoff on the beneficial uses of Santa Monica Bay. This study, the first integrated assessment of the impacts of stormwater discharges on coastal receiving water, investigated the effects of stormwater discharge from the two largest watersheds draining into Santa Monica Bay: Ballona Creek and Malibu Creek. The results of this investigation have shown that stormwater discharges produce particle-laden plumes that are concentrated in the upper 5-10 m of the water column and extend up to 10 km offshore. The plume from the discharge of stormwater from the highly urbanized Ballona Creek watershed was found to contain dissolved constituents that were toxic to marine life. Toxicity identification studies indicated that the toxicity was due to trace metals, with zinc the element of greatest concern. Studies of the sediments offshore of Ballona Creek also detected alterations in physical and chemical characteristics. Although elevated concentrations of some contaminants (lead, DDTs, PCBs, PAHs) were measured, biological impairment of sediment-dwelling animals was not detected.

While the types of impacts associated with stormwater discharge from Ballona Creek, have been identified, relatively few storm events have been studied. Early in 1997, forecasters began predicting that an El Niño condition in the Southern Hemisphere would bring increased rainfall to southern California in the 1997-98 wet season. In anticipation of an extreme winter season, studies were conducted to determine the effect of El Niño on urban stormwater. The objective of this research was to determine whether the unusual oceanographic conditions and storm events produced by El Niño conditions had an influence on the toxicity of Ballona Creek stormwater or the characteristics of the stormwater discharge plume in Santa Monica Bay.

The physical and optical characteristics of the Ballona Creek stormwater discharge plume and its toxicity were measured for three storm events occurring in February and March. Selected samples of the runoff plume were also analyzed for chemical constituents. All samples of stormwater from the Ballona Creek channel and surface water from the discharge plume were tested for toxicity using the sea urchin fertilization test. Selected surface water samples were further evaluated using toxicity identification evaluation (TIE) methods in order to characterize the toxicants present. The sampling and measurement methods were similar to those used in previous years so that the data could be compared. The results were examined to evaluate the effect of El Niño storms on three aspects of toxicity: magnitude of stormwater toxicity, spatial extent of the toxic portion of the plume, and the characteristics of the toxicants.

Southern California received record or near record rainfall during the 1997-1998 storm season. All of the anomalous rainfall occurred after the beginning of February. The Los Angeles civic center recorded over 20 in. of rain between February and the end of May; the annual average rainfall for this area is 14.8 in.

Magnitude of stormwater toxicity

The 1998 El Niño event did not have an unusual influence on the magnitude of Ballona Creek stormwater toxicity. The toxicity of the three stormwater samples measured in this study were typical of previous Ballona Creek samples analyzed. The results indicated that storm size and cumulative amount of prior rainfall had little influence on stormwater toxicity. The magnitude of toxicity was found to be affected by the number of antecedent dry days, however. Stormwater from rainfall preceded by more than 20 days of dry weather was found to have the highest toxicity. This relationship produced a seasonal pattern of greater toxicity in the first storm of the year that appeared to be independent of El Niño weather patterns.

Spatial extent of receiving water toxicity

The 1998 El Niño produced changes water temperature and salinity throughout Santa Monica Bay as a result of the presence of a large warm water mass from the south. The increased rainfall that occurred in 1998 altered the typical wet weather salinity structure of Santa Monica Bay. Reductions in salinity associated with freshwater inputs, normally confined to the upper few meters of the water column, were observed to extend 10-30 m below the surface following February's heavy rainfall. Coastal freshwater inputs to the surface layer were also detected much further offshore of Ballona Creek.

In contrast to these changes in water column characteristics, the spatial extent of receiving water toxicity within stormwater discharge plumes was similar to that observed during non El Niño storms. Surface water toxicity associated with runoff plumes in 1998 was limited to an area within 2 km of Ballona Creek, with most of the toxic samples located within 1 km of the creek mouth. The similarity in spatial distribution of the toxic portion of the plume is not surprising, considering that the characteristics of El Niño storms (rainfall volume and intensity) were similar to previous storms.

Evaluation of the toxicity data collected over the past three years indicates that two factors, storm size and time after the storm, are important determinants of the spatial extent of receiving water toxicity. The toxic portion of the stormwater plume extends further offshore following larger storms. The strong winds and large swells encountered during the El Niño study period rapidly dispersed the stormwater plumes to nontoxic concentrations within 24 hours.

Toxicant characteristics

The results of the surface water toxicity characterization studies (using phase I TIE procedures) were similar to data from samples analyzed before the El Niño. In all cases, addition of the metal chelating agent EDTA eliminated most or all of the toxicity. Filtration of the sample was also highly effective in reducing toxicity. The TIE results over three years of study are consistent with a conclusion that trace metals, especially zinc, are responsible for the toxicity measured with the sea urchin test. Other stormwater constituents may also be present in toxic amounts in Ballona Creek stormwater, as there is some uncertainty associated with biological variability, chemical methods, and species-specific differences in toxicant sensitivity.

Chemical composition of the plume

This study has produced the first measurements of chemical concentrations in both the dissolved and particulate fractions of the Ballona Creek stormwater plume. The results indicate that stormwater produced increased concentrations of trace metals and organics in the receiving water near Ballona Creek. More data are needed before the variability in composition can be examined in relation to weather conditions.