



**CHEMISTRY, TOXICITY AND BENTHIC
COMMUNITY CONDITIONS IN SEDIMENTS
OF THE SAN DIEGO BAY REGION**

PUBLIC SUMMARY

MARCH 1997

**STATE WATER RESOURCES CONTROL BOARD
CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY**

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IN SEDIMENTS OF THE SAN DIEGO BAY REGION

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As part of the Bay Protection and Toxic Cleanup Program (BPTCP), the State Water Resources Control Board (SWRCB), in cooperation with the National Oceanic and Atmospheric Administration (NOAA), sponsored a study of sediment conditions in the San Diego Bay Region. Information collected in this effort can be used by the San Diego Regional Water Quality Control Board to assist in identifying toxic hot spots.

The report contains descriptions and evaluations of chemical and biological data collected from San Diego Bay and its historical tributaries between October 1992 and May 1994. Monitoring and reporting efforts were conducted by the California Department of Fish and Game and its subcontractors.

The study objectives were to determine the:

1. Presence or absence of adverse biological effects in representative areas of the San Diego Bay Region;
2. Relative severity of adverse effects, and to distinguish more severely impacted sediments from those less severely impacted;

Measurements Completed
Toxicity tests
Organisms that live in sediments
3. Relative spatial extent of toxicant-associated effects in the San Diego Bay Region;

Chemicals present in the sediments

4. Relationships between toxicants and measures of effects in the San Diego Bay Region.

Three hundred and fifty stations were sampled in areas including San Diego Bay, Mission Bay, the San Diego River Estuary and the Tijuana River Estuary.

The research involved chemical analysis of sediments, benthic community analysis and toxicity testing of sediments and water surrounding the sediment particles (pore water). Chemical analyses and bioassays were performed on sediment samples collected at each station. Analysis of the community of organisms that live in the

sediments was made on a subset of the total number of stations sampled (benthic community index).

Methods for Analyzing the Data

Benthic Community -- Index

Toxicity -- Reference envelope and comparison to controls

Chemistry -- Available guidelines

Chemical pollution was observed using comparisons to established sediment quality guidelines. Two sets of guidelines were used: the Effects Range-Low (ERL)/Effects Range-Median (ERM) guidelines developed by NOAA and the Threshold Effects Level (TEL)/Probable Effects Level (PEL)

guidelines used in Florida. Copper, mercury, zinc, total chlordane, total PCBs and the PAHs were most often found to exceed critical ERM or PEL values and were considered the major chemicals or chemical groups of concern in the San Diego Bay Region.

Identification of degraded and undegraded habitat (as determined by large organisms that live in the sediments) was conducted using a cumulative, weight-of-evidence approach. Analyses were performed to identify relationships between the community of organisms within and between each station or site (*e.g.*, analyses of habitat and species composition, assessment of indicator species, and other measures).

Analyses of the 75 stations sampled for sediment community structure identified 23 undegraded stations, 43 degraded and 9 transitional stations.

The statistical significance of toxicity test results was determined using two approaches: the reference envelope approach and laboratory control comparison approach used by the United States Environmental Protection Agency-Environmental Monitoring and Assessment Program

Analysis of organisms that live in sediments

23 undegraded stations

43 degraded stations

9 transitional stations

(EMAP) and NOAA-National Status and Trends programs. The reference envelope approach showed that toxicity for the amphipod sediment test was significant when survival was less than 48 percent in samples tested.

The laboratory control comparison approach was used to compare test sediment samples against laboratory controls to determine statistically significant differences in test organism response.

Toxicity Results

Over half the area of the Bay was toxic to amphipods

Pore water was toxic to organisms even if diluted with sea water

Criteria for toxicity in this approach were
(1) survival of less than 80 percent of the control value; and
(2) significant difference between test samples and

controls. Using this approach, there was no absolute value below which all samples could be considered toxic, although survival below a range of 72-80 percent was generally considered toxic.

Using this definition of toxicity, 56 percent of the total area sampled was toxic to the amphipod. The pore water was also toxic to organisms even if it was diluted with clean sea water. (For the pore water sea urchin development test, 29 percent of the total area was toxic when the pore water was diluted to a quarter of its concentration. Fifty-four percent of the Bay was toxic when pore water was diluted by half, and 72 percent was toxic for undiluted pore water.)

When combined, the results of the amphipod and urchin development toxicity tests showed 14 percent of the study area to be toxic when diluted to a quarter of its original concentration. Twenty-seven percent and 36 percent of the study area were toxic to both organisms in pore water (at half the original concentration and undiluted, respectively) and amphipods in sediment.

Statistical analyses failed to reveal strong correlations between amphipod survival and chemical concentration. It is suspected that most organisms are tolerant of pollutants until a threshold is exceeded. Comparisons to sediment quality guideline thresholds demonstrate an increased incidence of toxicity for San Diego Bay

Region samples with chemical concentrations exceeding the ERM or PEL values. It is further suspected that toxicity in urban bays is caused by exposure to complex mixtures of chemicals.

Stations requiring further investigation were ranked based on existing evidence. Each station receiving a high, moderate or low priority ranking meets one or more of the criteria under evaluation for determining hot spot status in the BPTCP. Stations meeting all criteria were given the highest priority for further action. A ranking scheme was developed to evaluate stations of lower priority.

The ranking of each site is presented in Figures 1 through 4.

Seven stations (representing four sites) were given a high priority ranking, 43 stations were given a moderate priority ranking, and 57 stations were given a low priority ranking.

The seven stations receiving the high priority ranking were

in the Seventh Street channel area, two naval shipyard areas near the Coronado Bridge, and the downtown Anchorage area west of the airport. The majority of stations given moderate rankings were associated with commercial areas and naval shipyard areas in the vicinity of the Coronado Bridge. Low priority stations were interspersed throughout the San Diego Bay Region.

A review of historical data supports the conclusions of the current research. Recommendations are made for complementary investigations which could provide additional evidence for further characterizing stations of concern.

Site and Station Ranks

**High priority -- 7 stations
(representing four sites)**

Moderate priority -- 43 stations

Low priority -- 57 stations

The report citation is:

Fairey, R., C. Bretz, S. Lamerdin, J. Hunt, B. Anderson, S. Tudor, C.J. Wilson, F. LaCaro, M. Stephenson, M. Puckett, and E.R. Long. 1996. Chemistry, toxicity, and benthic conditions in the San Diego Bay region. 169 pp. + 5 Appendices.

The report may be obtained by calling the SWRCB's Office of Legislative and Public Affairs at (916) 657-1247 or by writing to the following address:

Office of Legislative and Public Affairs
State Water Resources Control Board
P.O. Box 100
Sacramento, CA 95812-0100

Figure 1: Priorities in North San Diego Bay

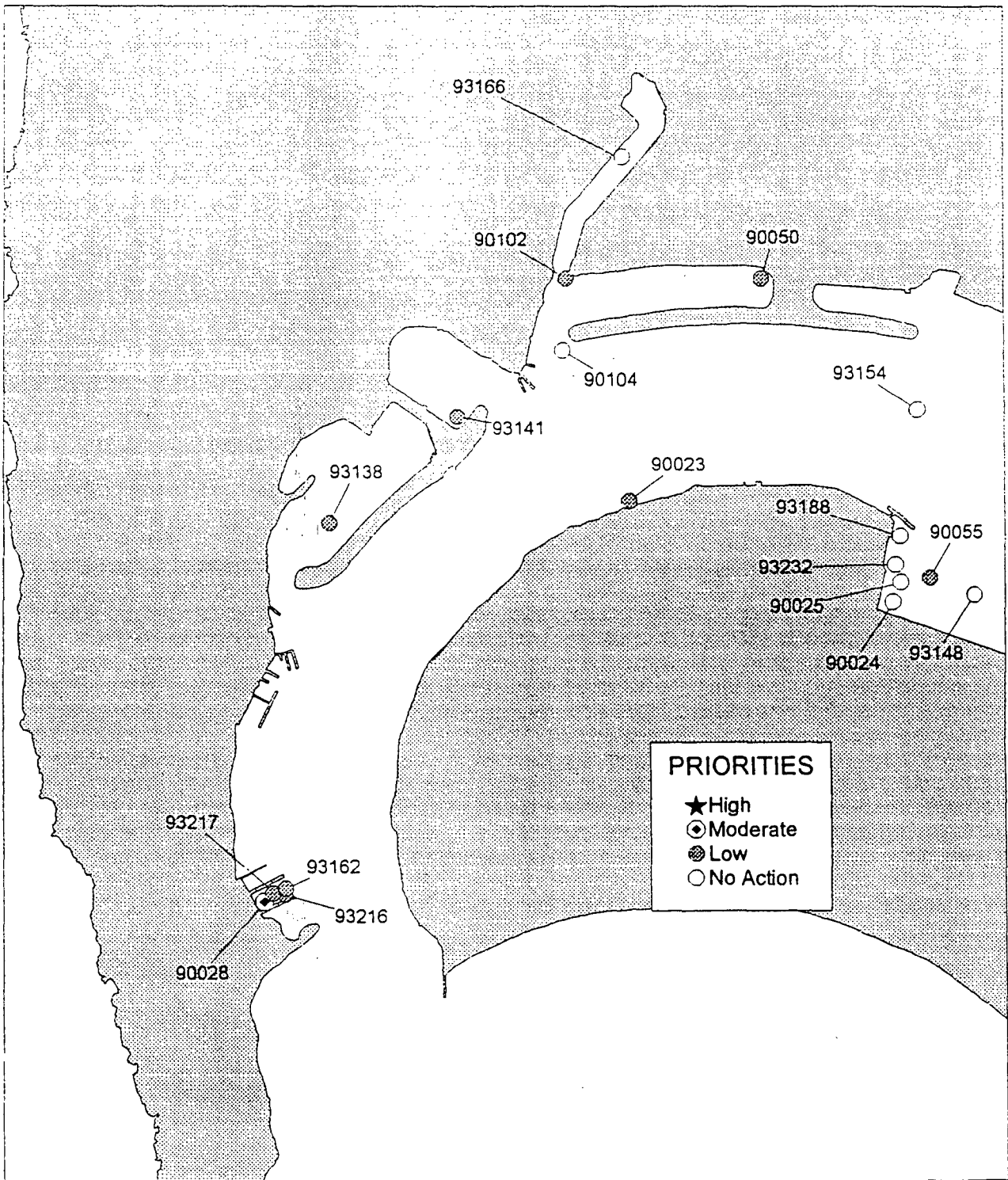


Figure 2: Priorities in Mid San Diego Bay

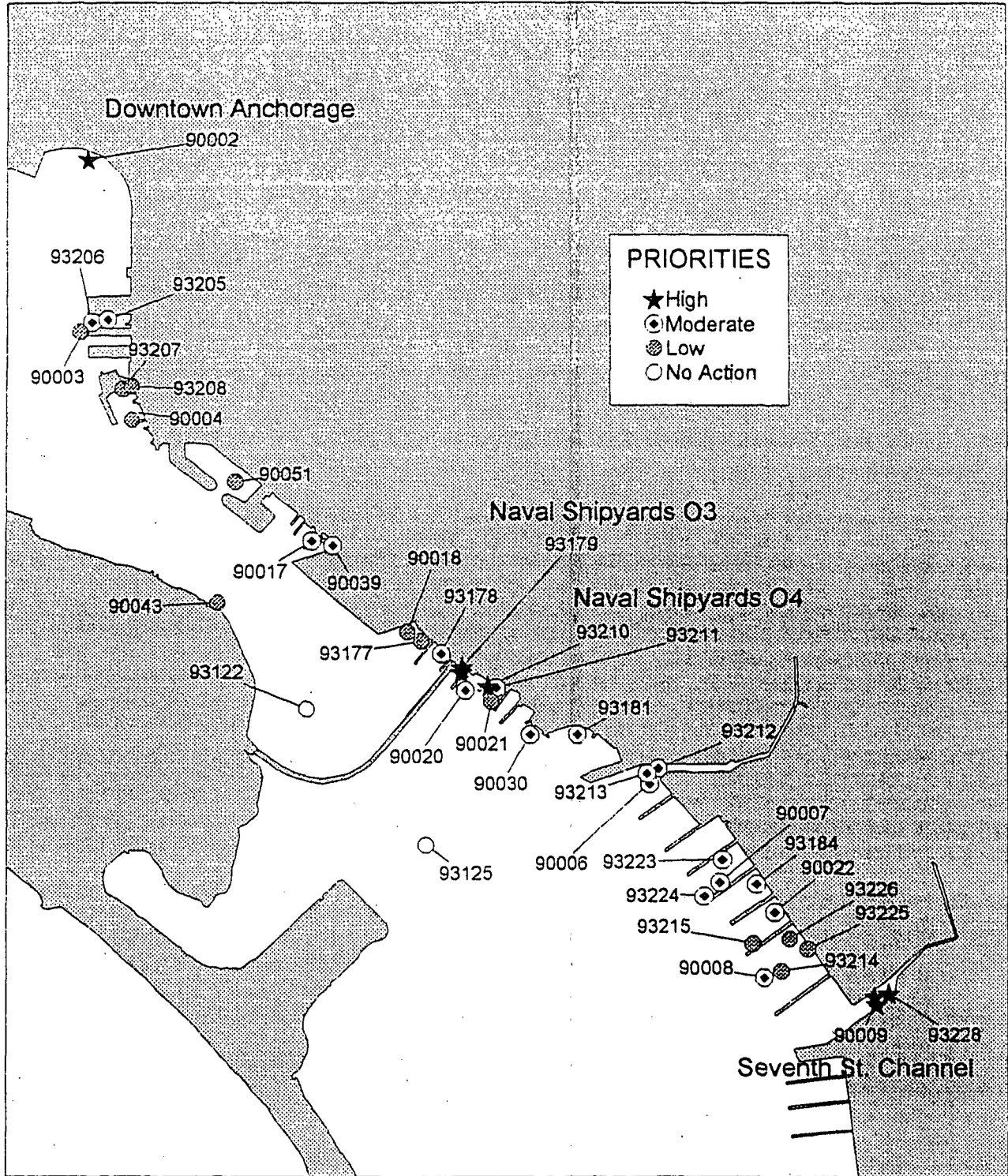


Figure 3: Priorities in South San Diego Bay

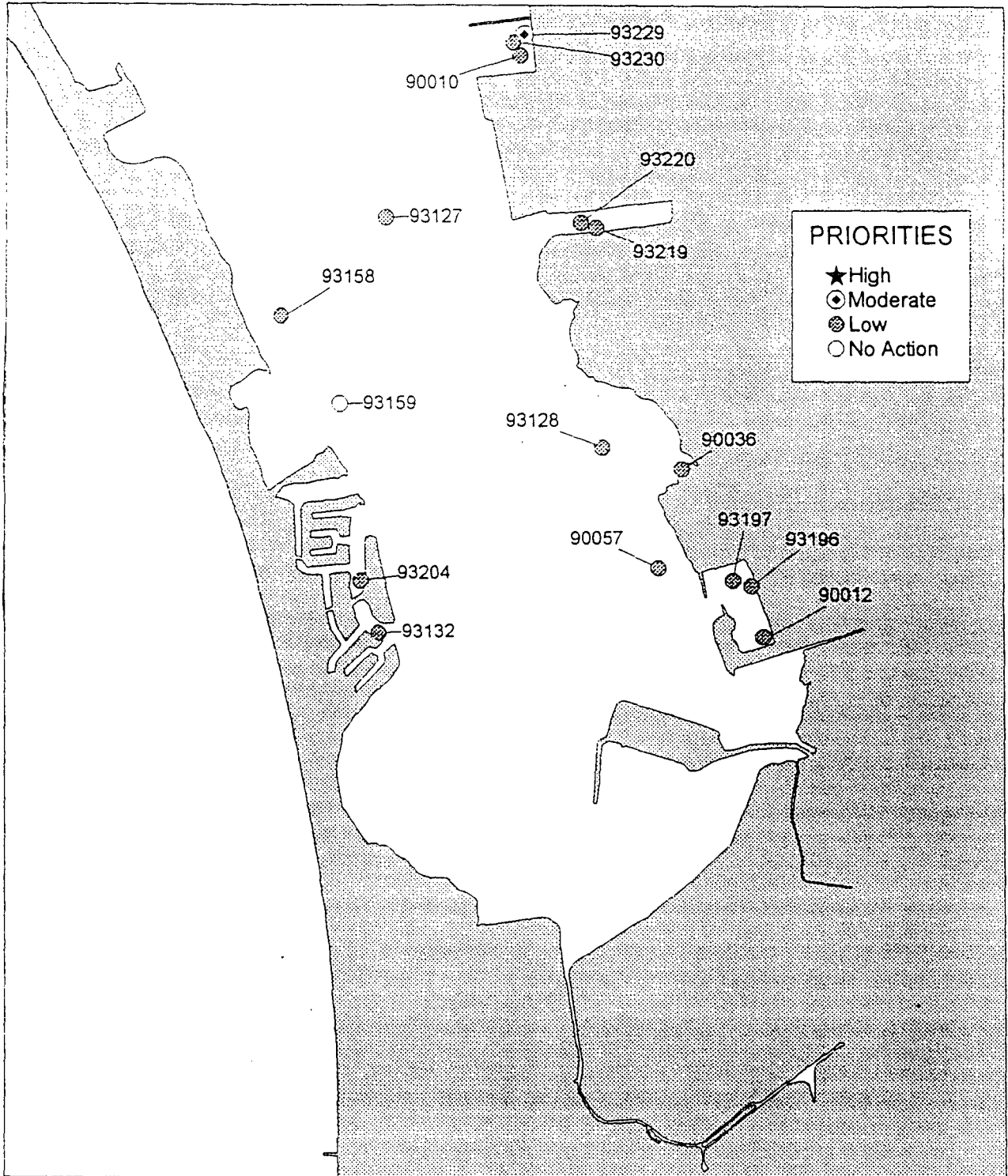
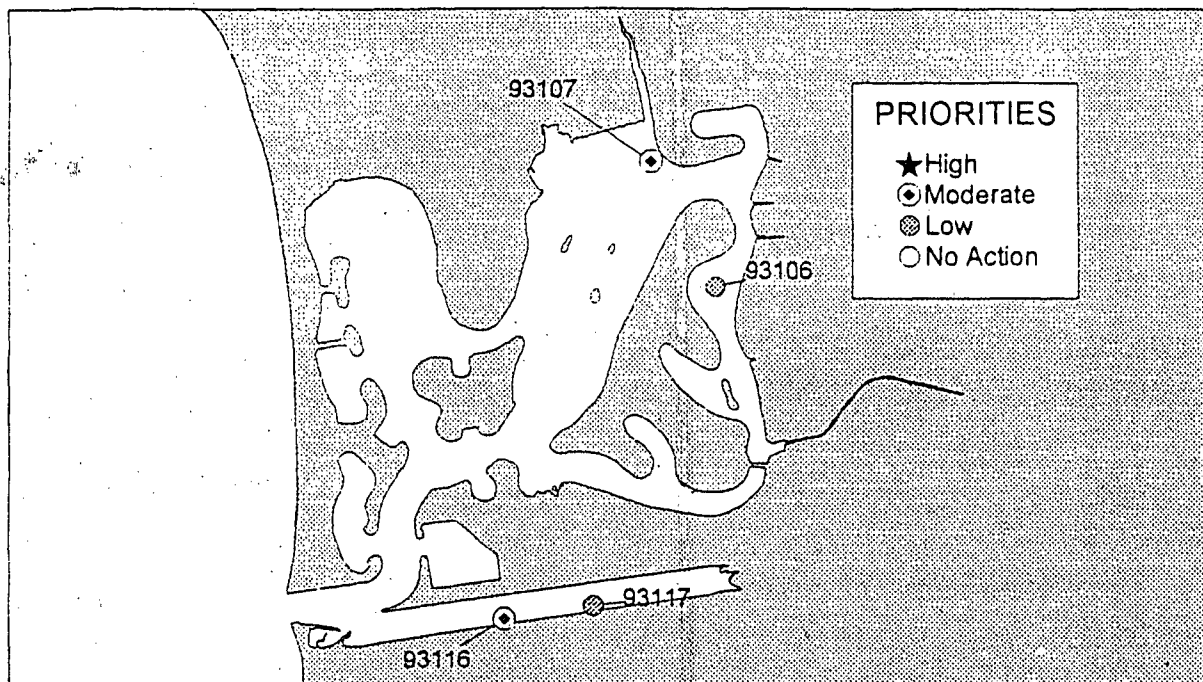


Figure 4: Priorities in Mission Bay and San Diego River Estuary



Tijuana River Estuary

