

**FINAL**

**TECHNICAL MEMORANDUM**  
**OAKLAND INNER HARBOR (IR SITE 20)**  
**AND TODD SHIPYARD (IR SITE 28)**  
**ALAMEDA POINT, CALIFORNIA**

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## EXECUTIVE SUMMARY

This Technical Memorandum presents the results of the supplementary sediment survey conducted at Oakland Inner Harbor (OIH) and Todd Shipyard (TS) in Alameda Point, California. This final report incorporates comments received from the regulatory agencies and stakeholders on the draft report, dated August 24, 2001. Specific responses are presented in Appendix A.

The purpose of this report was to provide a summary of the environmental conditions based on the overall ecology and sediment dynamics observed in the field. Previous investigations performed at Oakland Inner Harbor were found to be insufficient for evaluating potential risks associated with the site. In addition, data have not historically been collected at the area identified as Todd Shipyard by the Navy. This report only addresses the offshore areas associated with Todd Shipyard; the onshore portion is being evaluated separately. The areas were designated as Installation Restoration (IR) Sites 20 and 28 for Oakland Inner Harbor and Todd Shipyard, respectively, following the closure of the Naval Air Station (NAS) Alameda in 1997. The original Todd Shipyard located east of IR Site 28 was not owned or operated by the Navy, and the portion of area identified as Alameda Annex has been transferred to the City of Alameda as a separate facility. Both facilities are not addressed in this report.

The March 2001 Sediment Screening Study was designed to provide initial sediment screening data, for the purpose of refining the sampling design of a proposed field and laboratory study. Based on the field observations, the shoreline along Oakland Inner Harbor is characterized as rocky substrate (i.e., riprap) with limited intertidal areas (i.e., sand beaches and mudflats). In addition, the results of the survey indicate that the area of soft sediment is smaller than previously assumed, only averaging approximately 246 ft in width of undredged sediment. Beyond this shelf, within the dredged shipping channel, the sediment surface drops off precipitously. Water depth ranges up to approximately 50 ft in the center of the Oakland Inner Harbor channel, with water depths along the sediment shelf typically ranging from less than 10 ft to 40 ft.

The screening study found elevated concentrations above ambient levels of several compounds at discrete locations along the shoreline in close proximity to known outfall locations. Slightly elevated levels of PCBs, some metals, and PAHs were observed in the western portion of Oakland Inner Harbor at locations OIH57 and OIH30, and in the eastern portion of Todd Shipyard. These areas correspond roughly with one outfall at each site where distributions of the contaminants are due to tidal action over time. The contamination currently being measured at these outfalls are due to historical practices. Sediments from the upgradient storm sewer lines were removed during the 1997 removal action (Tetra Tech EMI, 1997). Effects range-median quotients (ERM-Qs) based on both the set of five screening constituents used in the screening analysis, and for a larger list of 18 constituents from the fixed laboratory results, mirrored this general pattern. In addition, slightly elevated levels of a number of pesticides were observed in a localized area near sample location OIH57. The majority of constituents detected in the Oakland Inner Harbor were found to be consistent with San Francisco ambient levels.

Although a few chemicals were detected near outfalls at concentrations elevated compared to ambient locations, the majority of the chemicals evaluated were found to be within ambient levels. The actual extent of contamination is isolated with restricted spatial distribution. In addition, the shelf itself offers limited foraging and nesting habitat based on the water depth and shelf dimension. Overall, there is a low potential for adverse impacts to ecological and human receptors from exposure to contaminated sediment at Oakland Inner Harbor and Todd Shipyard. Consequently, there does not appear to be an immediate need to evaluate these areas further.

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## APPENDIX

Appendix A: Response to Comments from BCT Members and Stakeholders

## ACRONYMS AND ABBREVIATIONS

BHC	benzene hexachloride
BPTCP	Bay Protection and Toxic Hotspot Cleanup Program
BRAC	Base Realignment and Closure Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPEC	chemical of potential ecological concern
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DSM	Data Summary Memorandum
ER-L	effects range-low
ER-M	effects range-median
ERM-Q	effects range-median quotient
HPAH	high molecular weight PAH
IR	Installation Restoration
LPAH	low molecular weight PAH
MLLW	mean lower low water
NAS	Naval Air Station
OIH	Oakland Inner Harbor
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PRC	PRC Environmental Management, Inc.
RI	Remedial Investigation
RMP	Regional Monitoring Program
RWQCB	Regional Water Quality Control Board (San Francisco Bay Region)
SFEI	San Francisco Estuary Institute
SPAWAR	(U.S. Navy) Space and Naval Warfare Systems Center
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRV	toxicity reference value
TS	Todd Shipyard
UTL	upper tolerance limit
XRF	x-ray fluorescence

## 1.0 INTRODUCTION

Alameda Point is a former U.S. Navy installation site located at the northern end of Alameda Island on the east side of San Francisco Bay, California (Figure 1). The installation, formerly known as Naval Air Station (NAS) Alameda, served as an aircraft maintenance, repair, and retrofit center and as a base of operations for Naval surface craft from before World War II until its closure in 1997 under the Defense Base Realignment and Closure Act (BRAC) of 1990. NAS Alameda was renamed Alameda Point in a reorientation of the facility toward civilian use.

To facilitate the transfer and reuse of property at Alameda Point, the Navy is assessing the environmental conditions of their Installation Restoration (IR) sites in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. The Sediment Screening Study was conducted in March 2001 at the Oakland Inner Harbor (IR Site 20) and Todd Shipyard (IR Site 28) areas to characterize the nature and extent of contamination of the offshore sediment from historical operations. The original Todd Shipyard located east of the footprint identified as IR Site 28 was not owned or operated by the Navy, and the portion of area designated as Alameda Annex was transferred to the City of Alameda as a separate facility. Both facilities are not addressed in this report.

This report only addresses the offshore areas associated with Todd Shipyard and Oakland Inner Harbor as shown on Figure 2; the onshore portion of Todd Shipyard is being evaluated separately. This Technical Memorandum presents the results of the supplementary sediment screening study and provides a summary of the environmental conditions based on the overall ecology and sediment dynamics observed in the field. Comments received from the BCT members and Stakeholders are incorporated into this report and specific responses are presented in Appendix A.

### 1.1 Objectives

The objective of this Technical Memorandum is to summarize current sediment conditions at Oakland Inner Harbor (OIH) and Todd Shipyard (TS) based on the results of the Sediment Screening Study conducted by Battelle in March 2001 (Battelle, 2001). That investigation was designed to provide initial sediment screening data, for the purpose of refining the sampling design of a proposed field and laboratory study. The results of the March investigation will be used to identify potential data gaps to be addressed prior to initiating the Remedial Investigation (RI) for IR Sites 20 and 28. The Data Gap Work Plan is proposed in April 2003 and will include evaluation of the full suite of analytes identified as chemicals of potential concern for these IR Sites.

### 1.2 Organization of Technical Memorandum

This Technical Memorandum is organized as follows:

**Section 1.0: Introduction.**

**Section 2.0: Oakland Inner Harbor/Todd Shipyard Background.** This section describes the history, the previous investigations, and environmental setting of the sites.

**Section 3.0: Rapid Sediment Screening Study.** This section discusses the sampling design and specific methods used for the Sediment Screening Study conducted by Battelle in March 2001.

**Section 4.0: Sediment Chemistry Data Evaluation.** A summary of the results of the Sediment Screening Study is presented.

**Section 5.0: Summary and Conclusions.**

**Section 6.0: References.**

## 2.0 OAKLAND INNER HARBOR/TODD SHIPYARD BACKGROUND

The following sections present a description of IR Sites 20 and 28, an overview of the previous investigations, and the current environmental settings.

### 2.1 Site Description

Oakland Inner Harbor is defined as the 2,760-m (3,000-yd) portion of the Oakland Estuary adjacent to the northern boundary of former NAS Alameda. The Oakland Inner Harbor Channel is a major industrial waterway serving marine terminals and repair facilities in the cities of Oakland and Alameda. The shipping channel has been dredged to a depth of 42 ft below mean lower low water (MLLW) and is authorized for deepening to 50 ft below MLLW in the future. IR Site 20 (OIH) and IR Site 28 (TS) are located on the southern side of the Oakland Inner Harbor Channel, adjacent to the northern shoreline of Alameda Point, and are managed under the Navy's IR program (Figure 2). Todd Shipyard is located on the eastern boundary of the channel and is approximately five acres in size. The original Todd Shipyard located east of IR Sites 20 and 28 past the Alameda/Oakland Ferry Terminal was not owned or operated by the Navy. The location is used as a turning basin for ships docking in Oakland and Alameda, and has been dredged numerous times to accommodate transport of deep draft ships.

The eastern portion of Oakland Inner Harbor and Todd Shipyard may have been potentially impacted from Navy's historical operations through wastewater and stormwater discharge, ship wastewater discharge, fuel transfers, and dissolution/fragmentation of ship bottom paints and creosote pilings. The shoreline of the area is almost entirely modified by human activity, and a variety of industries are located along its entire length including port facilities, ship-building and repair facilities, sand and gravel off-loading areas, and marinas. The Navy has been actively involved in removing the potential contamination found in the outfalls. Sediments from the upgradient storm sewer lines leading to outfalls along IR Sites 20 and 28 were removed during the 1997 removal action (Tetra Tech EMI, 1997). In Phase I of the removal action, sediments and debris were vacuumed from the storm sewer catch basins. Phase II of the removal action included cleaning the lines, which was verified using a video survey.

### 2.2 General Discussion of Previous Investigations

Environmental data were collected at IR Site 20 in 1993 and 1994 as part of an ecological assessment of Alameda Point (PRC Environmental Management, Inc. [PRC], 1992; PRC, 1994). During that investigation, four surface sediment samples were collected near stormwater discharge points for chemical and toxicity analyses. A sediment core also was collected at one of the stations to provide information about contaminant concentrations at depth. A 28-day laboratory bioaccumulation test using the clam *Macoma nasuta* was conducted using sediments from each of the four locations. In addition, the following three types of toxicity tests were conducted: a 10-day amphipod bioassay using *Eohaustorius estuarius*; a 28-day polychaete growth and survival test using *Neanthes arenaceodentata*; and a 48-hour sediment elutriate test using mussel (*Mytilus edulis*) larvae. The available sediment and tissue chemistry data and bioassay results from the previous ecological assessments were summarized and evaluated in a report entitled draft *Data Summary Memorandum, Oakland Inner Harbor Offshore Area, Alameda Point, California* (Battelle et al., 2001a). Historical data at IR Site 28 (TS) has been collected for the Port of Oakland (EVS Environmental Consultants et al., 1997) for dredged material evaluations at Todd Shipyard. No additional environmental data were collected at Todd Shipyard by the Navy prior to the Sediment Screening Study.

## 2.3 Environmental Setting

The northern boundary of Alameda Point consists of a 1.7-mile portion of the shipping channel used by the Port of Oakland. The shipping channel is an arm of San Francisco Bay and is subject to tidal flow and currents from the Bay. IR Sites 20 and 28 are located on the eastern half of the southern boundary (see Figure 2) of the channel. The habitat off of IR Sites 20 and 28 includes rocky substrate (riprap) shoreline and offshore soft sediments. The intertidal zone occurs primarily along a riprap shoreline, with limited intertidal habitat composed of sand beaches and mudflats (ENTRIX, 1997). Soft sediment extends out into the channel in a thin shelf of undredged sediment averaging approximately 246 ft in width. Beyond this shelf, within the dredged shipping channel, the sediment surface drops off precipitously. Water depth ranges up to approximately 50 ft in the center of the Oakland Inner Harbor Channel, with water depths along the sediment shelf typically ranging from less than 10 ft to 40 ft (see Figure 3).

The waters and sediment around Alameda Point support a variety of prey items such as planktonic (e.g., phytoplankton and zooplankton) and benthic (e.g., polychaete worms, mollusks and crustaceans) organisms (PRC, 1994; PRC, 1996; ENTRIX, 1997). During sampling conducted by PRC (1994), the benthic community off of IR Site 20 was found to be dominated by annelids and molluscs. Annelid species typically comprised less than 50 percent of the total number of benthic species, whereas molluscs typically comprised 80-90 percent of the total biomass at Oakland Inner Harbor sediment sampling stations. The more abundant annelid species present included *Capitella capitata*, *Exogone lourei*, and unidentified oligochaete species. *Musculista senhousia*, *Theora fragilis*, and *Tapes japonica* were the most abundant mollusc species, typically comprising less than 75 percent of the molluscs collected in Oakland Inner Harbor sediment grab samples (PRC, 1994). Although not as abundant as the annelid and mollusc species, a number of crustacean species were identified, the most abundant being *Ampelisca abdita* (PRC, 1994). These benthic species represent a food source for predators such as fish and benthic-feeding birds.

The varying depths and substrate types found in open water areas of Oakland Inner Harbor create habitat for many fish species including topsmelt (*Atherinops affinis*), three-spine stickleback (*Gasterosteus aculeatus*) and shiner perch (*Cymatogaster aggregata*). Although seasonal variations may occur, fish species such as Pacific tomcod (*Microgadus proximus*), plainfin midshipman (*Porichthys notatus*), and white croaker (*Genyonemus lineatus*) may occur more commonly in deep dredged habitats, and species including northern anchovy (*Engraulis mordax*) and Pacific herring (*Clupea harengus*) are found in shallow subtidal habitats (ENTRIX, 1997).

Field surveys of bird communities in the vicinity of the Port of Oakland and Alameda Point were conducted in the winter (January-April) and summer (June-July) of 1997 (ENTRIX, 1997). Two of the survey areas were located off of the northern side of Alameda Point and encompass the Oakland Inner Harbor Channel area. These surveys indicated that the open water habitat of the channel supports a variety of bird species including diving birds such as the double-crested cormorant (*Phalacrocorax auritus*), western and Clark's grebes (*Aechmophorus* sp.), American wigeon (*Anas americana*) and common and Pacific loons (*Gavia* sp.). Surface diving birds including the federally and state endangered California least tern (*Sterna antillarum browni*) and California brown pelican (*Pelecanus occidentalis*) are known to forage and nest in areas within and adjacent to Oakland Inner Harbor, although only one pelican was observed in Oakland Inner Harbor during the field surveys. Other water-dependent bird species such as American coots (*Fulica americana*), gulls (*Larus* sp.) and wading birds (e.g., egrets) also have been observed in Oakland Inner Harbor (ENTRIX, 1997). A full avian species list, including seasonal information, can be found in Table 1.

### 3.0 RAPID SEDIMENT SCREENING STUDY

Data collected during previous studies were insufficient to evaluate the potential environmental risks at Oakland Inner Harbor/Todd Shipyard. The historical data collected at IR Site 20 by the Navy is limited to 1993 and 1994. Since that time, there have been significant changes in shoreline and channel usage and dredging of the navigational channel to -42 ft MLLW. In addition, there is limited information regarding the lateral and vertical extent of contamination at IR Site 20. The draft *Data Summary Memorandum* (DSM) (Battelle et al., 2001a) concluded that the existing data were insufficient for completing the RI for IR Site 20. Todd Shipyard was recently identified as an IR site and, consequently, only limited investigations have been performed on this area. Additional data collection was recommended to define the nature and extent of sediment contamination, the potential for ecological risk to the benthic and benthic-supported community, and potential human health risks in order to complete the RI for IR Sites 20 and 28.

The study design of the March 2001 Sediment Screening Study was consistent with similar screening investigations conducted on behalf of the Navy at the Hunters Point Shipyard (Battelle et al., 2000). A detailed discussion of the specific analytical methods and sampling approach used in the screening study is provided in the work plan entitled *Alameda Point Oakland Inner Harbor (IR Site 20) and Todd Shipyard (IR Site 28) Sediment Screening Study Field Sampling Plan* (Battelle et al., 2001b).

For the purpose of this evaluation, a statistically based sampling design was developed (Figure 4) that included the collection of 57 sediment samples in a systematic grid pattern along the offshore soft sediment shelf. Based on this design, samples were spaced such that a hot spot with a 100 ft radius on the Oakland Inner Harbor Shelf (175 ft<sup>2</sup> grid) and a 150 ft radius in the Oakland Inner Harbor Channel (250 ft<sup>2</sup> grid) could be confidently detected. A few additional samples were selectively added in some areas to ensure sufficient coverage.

During the sampling exercise, it was found that the dredged portion of the channel extended closer to shore than expected; therefore, it was necessary to move many of the target stations closer to the shore (see Figure 5). The dredged portion of the channel was identified by its greater depth (approximately 42 ft) and the quality of the sediment (high Merritt sand content). This inward placement of the sampling stations provided a much higher sampling density over the Oakland Inner Harbor Shelf (Battelle, 2001) than originally planned.

At each location sampled, the top 5 cm of sediment were collected from a Ponar grab, homogenized, and split into two aliquots. One aliquot was sent to the U.S. Navy Space and Naval Warfare Systems Center (SPAWAR) analytical laboratories to be screened for indicator compounds including copper, lead, and zinc using x-ray fluorescence (XRF), and total polycyclic aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) using an immunoassay technique. The other aliquot was archived. Based on the results of the screening analyses (Tables 2 and 3), seven of the archived samples were selected as laboratory confirmation samples and analyzed by Battelle's Duxbury laboratory. The purpose of analyzing these confirmation samples was to verify the screening results, assess the degree of co-occurrence of various contaminants, and provide additional surface sediment data to support the RI for IR Sites 20 and 28. Samples for fixed laboratory analyses were selected based on preliminary screening results to ensure that the full range of concentrations observed in the field were being evaluated by the fixed laboratory. These analyses included PAHs, pesticides, PCBs, butyltin compounds, trace metals, total petroleum hydrocarbons (TPH) in the diesel range, total organic carbon (TOC), and grain-size distribution (Tables 4 through 9).

## 4.0 NATURE AND EXTENT OF SEDIMENT CONTAMINATION

This section discusses the spatial distribution of sediment contamination based on the screening data and confirmation sampling results for Oakland Inner Harbor/Todd Shipyard using visual aids such as box and bubble plots. Initially, statistical comparisons between the screening results and the confirmation samples were performed to ensure that a high correlation exists between the different analytical methods. Interpretation of the data and general discussion of the spatial distribution of metals and organic compounds are presented in Sections 4.3 and 4.4, respectively.

### 4.1 Data Preparation

Analytical results (including data from laboratory replicates and field duplicates from the Sediment Screening Study) were compiled and provided by SPAWAR's analytical laboratories. Confirmation data were provided by Battelle in Microsoft® Excel spreadsheets. The tabulated data were prepared for exploratory data analysis and presentation following the procedures described below:

- The laboratory replicates including single and second extracts from the screening analysis were averaged by station.
- A concentration equivalent to half of the reported detection limit was assumed for samples that were reported as below the detection limit, including individual congeners representing groups of compounds (i.e., total PCBs, total low molecular weight PAHs [LPAHs], total high molecular weight PAHs [HPAHs], and total PCBs).
- The total PCB concentration was estimated as two times the sum of the 21 PCB congeners. This approach is consistent with standard laboratory practice for estimating the total PCB concentration as the sum of the individual Aroclors. Because Aroclors breakdown quickly during analysis, two times the sum of the PCB congeners was found to be a good estimator of the total PCB concentration.
- Total analyte concentrations for fixed laboratory results were summed by individual compound concentrations found in each grouping as follows:

#### Total PCBs (two times the sum of 21 congeners)

PCB008	PCB018	PCB028	PCB044	PCB052	PCB066	PCB077
PCB101	PCB105	PCB110	PCB118	PCB126	PCB128	PCB138
PCB153	PCB170	PCB180	PCB187	PCB195	PCB206	PCB209

#### Total LPAHs (sum of seven PAHs)

2-Methylnaphthalene	Acenaphthene
Acenaphthylene	Anthracene
Fluorene	Naphthalene
Phenanthrene	

#### Total HPAHs (sum of 11 PAHs)

Benzo(a)anthracene	Benzo(a)pyrene	Chrysene
Dibenzo(a,h)anthracene	Fluoranthene	Pyrene
Benzo(b)fluoranthene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene
Indeno(1,2,3-cd)pyrene	Perylene	

#### Total DDT (sum of 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT).

## 4.2 Correlations Between Screening Data and Confirmation Samples

Several correlations were performed comparing the screening results from the XRF and immunoassay techniques to the fixed laboratory data. The purpose of performing the correlations was to ensure that the screening results were consistent with those generated by the fixed laboratory technique, which would indicate that screening results can be used to reliably characterize the nature and extent of sediment contamination. The correlation information is presented in the bivariate plots created using the fixed laboratory and screening data for lead, copper, zinc, total PCBs, and total PAHs. In addition, the bivariate plots were used to compare effects range-median quotients (ERM-Qs) using the screening data in comparison to those analyzed through the fixed laboratory. These correlations are particularly important because the screening study (i.e., five compounds) focused on a limited subset of the entire analyte list (i.e., 18 compounds) performed by the fixed laboratory. These comparisons are useful in demonstrating how much confidence may be placed on the interpretation of the screening results. Field duplicate results were not incorporated into these plots.

### 4.2.1 Bivariate Plots

Bivariate plots are x-y plots generated to visually examine the nature and strength of the relationship between the fixed laboratory and screening results. The screening results are plotted on the x-axis, and the fixed laboratory results are plotted on the y-axis. The results from linear regression analysis are printed on these plots. An  $R^2$  value is calculated to quantify the strength of the correlation or linear association between the two measurements. The  $R^2$  value is the proportion of the overall variability in one measurement that is “explained” or accounted for by the other measurement.  $R^2$  values range between 0 and 1. Strong correlations between the fixed laboratory and the screening measurements produce  $R^2$  values closer to 1. The linear regression line provides estimates of the intercept and slope of the line most closely fitted to the observed data. If the screening analysis produces results identical to those from fixed lab analysis, the intercept of the fitted line will be 0, the slope will be 1, and the  $R^2$  value will be 1. A slope greater than 1 indicates that the screening data are below those measured by the fixed laboratory, whereas a slope less than one indicates that the screening data overpredicted the concentration relative to the fixed laboratory measurements.

Figures 6a through 6e present the bivariate plots for three metals (copper, lead, and zinc), total PAHs, and total PCBs, respectively. Screening results for copper and zinc are strongly correlated to the fixed laboratory results, with squared correlation coefficients ( $R^2$ ) of 0.97 and 0.93, respectively (see Figures 6a and 6c). In Figure 6b, the correlation between screening and fixed laboratory results for lead is relatively consistent with an  $R^2$  value of 0.57. The lower correlation is due to the single elevated lead concentration of 288 mg/kg from the fixed laboratory at Station OIH28, which is nearly four times as high as the screening values. The fixed laboratory replicates for this same sample were widely divergent (values of 141 and 310 mg/kg) and may be attributable to difficulties homogenizing the sediment samples in the field which may have led to unequal portions of coarse-grained materials being placed into each sample.

Figure 6d presents the correlations for the total PAHs where the screening bioassays are compared to the sum of 17 individual PAHs measured by the fixed laboratory. Because one station had total PAH concentrations (i.e., concentration of 12,127  $\mu\text{g}/\text{kg}$ ) two times higher than those observed at any other location, this sample was considered an outlier and excluded from the regression analysis (indicated by an asterisk “\*” on the bivariate plot). In addition, the corresponding concentrations from the screening and duplicate analyses from this same station were lower than levels predicted by the fixed laboratory. Generally, the screening technique was effective in predicting the fixed laboratory results and determining the locations of elevated PAHs as indicated by the high correlation ( $R^2 = 0.97$ ) on the bivariate plot.

For PCBs, Figure 6e presents the results of the bivariate plot for PCB immunoassay results compared to fixed laboratory total PCBs based on two times the sum of the 21 congeners. The total PCB levels reported

by the fixed laboratory were higher than those determined using the screening method. Similar to the PAHs, the same single station exhibited twice the concentration of PCBs as those seen at any of the other stations, and subsequently was excluded from the regression analysis (indicated by an asterisk "\*" on the bivariate plot). As was the case for lead, the single elevated concentration is inconsistent with the remaining stations, and may be attributable to difficulties homogenizing the samples in the field which may have led to unequal portions of coarse-grained materials being placed into each sample. In addition, two of the sample stations were qualified below the detection limit. The slope of the PCB bivariate plot was considerably greater than one (1.56); whereas historically, the PCB bioassay has generated results very close to the total PCBs reported by the fixed laboratory (i.e., a slope close to 1). This result was exhibited in previous evaluation of PCB immunoassay versus fixed laboratory analysis conducted at Seaplane Lagoon in 1998, pretest data from Hunters Point Shipyard in 1999, and Hunters Point Shipyard Screening Study in 2000. The PCB data set from this screening study used to evaluate the correlation between the fixed laboratory and screening results was hampered by the fact that two samples were below the 50- $\mu\text{g}/\text{kg}$  detection limit of the screening assay, and one was above the range of the screening assay. To ensure that a conservative interpretation of the screening results was performed, the screening data were adjusted using the correlation between the methods that was observed in the bivariate plot. Specifically, the screening data were adjusted higher by entering these values as the dependent variable (i.e., "X" values) into the regression equation presented in Figure 6e. The adjusted "Y" values then were used as the screening results for the bubble plots. This adjustment greatly improved the correlation between fixed laboratory and screening ERM-Qs. The adjustment was performed on the PCB data due to difficulties calibrating the analysis in the laboratory. Descriptions of this analysis are presented in Section 4.2.2.

In general, there was a high correlation between the fixed laboratory data and the screening results. Deviations between the two methods may be attributable to difficulties homogenizing the samples in the field as well as differences due to sediment heterogeneity and analytical methods (screening versus fixed). At several locations, differences related to the quantity of sediment split between composites was found to be a significant source of variability during analytical testing. This variability may be due to the amount of relatively coarse-grained materials split into each composite. Overall, the results of the bivariate plots indicate that the screening data is consistent with the fixed laboratory measurements and can be used reliably to characterize the sediment contamination. However, further correlation plots were developed to ensure that the limited analyte list (i.e., five compounds) for the screening study was adequate to fully characterize the results being seen on the more extensive 18 chemical analyte list used by the fixed laboratory. Descriptions of the analysis and the results of the correlation are presented in Section 4.2.2.

#### 4.2.2 ERM-Qs Plots

Although the correlations between the fixed laboratory and screening results indicated that the screening results were generally accurate, it was still unclear whether the ERM-Qs based on the five indicator compounds from the screening survey fully represented the ERM-Qs from the 18 compounds analyzed by the fixed laboratory. Moreover, uncertainties were raised regarding the PCB correlations due to the limited data set available because two of the samples were below the detection limit and one sample was reported beyond the range of the screening method. To address these concerns, two additional bivariate plots were developed using correlations based on ecological toxicity benchmarks as a method for integrating chemical concentrations from multiple compounds.

ERM-Qs were calculated to provide an integrated sediment chemistry value for each of the sample stations. ERM-Qs are estimated as the sum of the ratio of the chemical concentration divided by the sediment toxicity benchmark (i.e., effects range-median [ER-M]) for the chemicals of potential ecological concern (COPECs). ER-Ms (Long and Morgan, 1990; Long et al., 1995) are sediment toxicity benchmarks used to typically identify areas where biological effects are more likely to occur. Only compounds with published ER-Ms were used in this analysis.

The ERM-Qs were calculated using the following equation:

$$\text{ERM-Q} = \frac{1}{n} \sum_{i=1}^n \frac{\text{COPEC}_i}{\text{ER-M}_i}$$

where: ERM-Q = ER-M quotient

n = number of COPECs included in the quotient, regardless of the detection status

COPEC = mean concentration of individual chemical in site sample, half the detection limit was substituted for nondetects

ER-M = effects range-median for the COPECs.

The screening results for the five indicator compounds were used to calculate a single, "screening" ERM-Q.

A similar ERM-Q was estimated for the fixed laboratory results using the same five indicator compounds. Figure 7a shows the correlation between the screening ERM-Qs calculated using screening data and fixed laboratory data. As suspected, the slope of the regression line is greater than one, largely due to the relationship between the fixed laboratory and screening study results for PCBs shown in Figure 6e. In an effort to improve the correlations, the PCB screening results were adjusted using the regression equation shown in Figure 6e to better simulate the fixed laboratory results. The screening results were input into the regression equation as the dependent "X" variable to generate the adjusted higher screening results as the "Y" values. The adjustment was performed due to calibration difficulties associated with the PCB analysis. The resulting correlation using the adjusted values presented in Figure 7b improved the correlation ( $R^2 = 0.92$ ) between the screening ERM-Qs calculated using screening data and fixed laboratory data. This adjustment was further utilized in the bubble plot shown in Figure 31.

An additional correlation evaluation was performed on the fixed laboratory results and the screening data to determine whether the results based on the limited analyte list (i.e., five chemicals) used for the screening study were consistent with levels determined using the more extensive chemical analyte list from the fixed laboratory analysis. For fixed laboratory analyses, the following 18 constituents were included in the calculation of ERM-Qs:

<u>Metals</u>			
Antimony	Chromium	Mercury	Selenium
Arsenic	Copper	Nickel	Zinc
Cadmium	Lead	Silver	
<u>Organics</u>			
4,4'-DDD	4,4'-DDT	Total HPAHs <sup>1</sup>	Total PCBs
4,4'-DDE	Total DDT	Total LPAHs	

Figure 8 shows the correlations between the screening ERM-Qs based on the five indicator compounds from the screening study, and the ERM-Qs based on 18 constituents from the fixed laboratory analysis. The plot shows a very high correlation with a slope of 1.02 and a regression coefficient of 0.94, which indicates that the limited sediment screening results are consistent with the more extensive fixed laboratory analysis. This result supports the assumption that the sediment study results may be used to identify areas of elevated sediment chemistry and potential toxicity at Oakland Inner Harbor and Todd Shipyard.

<sup>1</sup> A subset of six (listed as numbers 1-6) of the eleven measured HPAHs was used in calculating total HPAHs for ERM-Q calculation in order to be consistent with the six HPAHs included in the ER-M for HPAHs as specified in Long et al. (1995).

### 4.3 Inorganic Constituents in Sediments

Figures 9 through 13 present box plots comparing the distribution of inorganic constituents measured from the fixed laboratory analysis, sediment study, historical investigations, and ambient levels. When available, the data collected by the Bay Protection and Toxic Hotspot Cleanup Program (BPTCP) and the San Francisco Estuary Institute (SFEI) Regional Monitoring Program (RMP) were used to represent ambient conditions in San Francisco Bay and are shown side by side with the field sampling results. All available sediment chemistry results from 1993 through 1997 from stations classified as ambient in *Ambient Concentrations of Toxic Chemicals in San Francisco Bay Sediments* (RWQCB, 1998) were used for this purpose.

For aluminum and chromium, only the BPTCP data were used because those data were based on a more rigorous total digestion method that was found to be more consistent with the Navy's laboratory analysis as compared to the aqua regia analytical method used by the RMP for these chemicals. For antimony, only the BPTCP data were used because the RMP does not analyze for this compound. Six of the inorganics (i.e., barium, beryllium, cobalt, molybdenum, thallium, and vanadium) were not analyzed by the RMP or BPTCP and, consequently, no ambient concentrations are presented in the box plots.

Results from each of the sampling investigations (i.e., 1993 sampling event, 2001 screening study, and 2001 fixed laboratory analysis) are plotted separately next to a plot of the ambient data. If no box plot appears above the specific date for a specific analyte, then no data were collected for that analyte for a given year. The total number of samples collected (N) and the number of samples with detected concentrations (D) are shown in the margin text on the X-axis as "N/D." Open circles are used to plot nondetect concentrations at the reported detection limit. Closed circles represent detected values.

Each of the box plots indicates the median (50th percentile) as well as the upper (75th percentile) and lower quantiles (25th percentile) for the combined Oakland Inner Harbor and Todd Shipyard data sets. The individual concentrations are plotted with the IR Site 20 results on the left, and the IR Site 28 results on the right. As previously stated, copper, lead, and zinc are the indicator metals selected for analysis in the sediment screening study and consequently, are the only metals presented from that study. Seven stations were selected for fixed laboratory analysis to confirm the XRF screening results from March 2001 for copper, lead, and zinc. For these stations, a full suite of inorganic analyses was performed and the results are presented in the plots. A brief qualitative assessment of the inorganic data generated by the fixed laboratory is presented in the following paragraphs, followed by a discussion of the spatial distribution of the three metals measured in the sediment screening study.

Concentrations of chromium and nickel exceed the ER-M at Stations OIH28 and OIH57 on the western portion of IR Site 20 (see Figures 10 and 12). Lead was measured at concentrations greater than the ER-M at OIH57. In addition, copper, lead, and zinc levels exceed the effects range-low (ER-L) at OIH28, and copper, mercury, and zinc exceed the ER-L at OIH57. However, mercury and zinc concentrations at OIH57 were below ambient levels. All other inorganic constituents were consistent with the ambient levels and below ER-Ls.

All inorganics measured at Stations OIH02 and OIH05 in the central portion of IR Site 20 were below the ER-Ls except for chromium, which appears to be consistent with BPTCP ambient levels.

Station OIH20 is located in the eastern portion of IR Site 20 north of the pier. The only inorganic constituent exceeding an ER-M at this location is nickel, and the concentrations are consistent with ambient levels for San Francisco Bay. Six constituents at this location exceed their ER-Ls including arsenic, chromium, copper, mercury, nickel and zinc, whereas only copper and zinc appear to exceed the levels

found in ambient locations. The remaining compounds (arsenic, chromium, mercury, and nickel) were measured at concentrations below ambient levels.

Two samples from within IR Site 28 (i.e., OIH10 and OIH51) were analyzed by the fixed laboratory. Concentrations are generally greater at OIH51 than at OIH10, where chromium, mercury and nickel exceed the ER-M. At OIH10, chromium, copper, mercury, nickel, and antimony exceed their ER-Ls, but are all below their corresponding ER-Ms and consistent with ambient levels. Lead appears slightly elevated above ambient levels, but is also below its ER-M.

The spatial distribution of the screening concentrations for copper, lead, and zinc are presented in the bubble plots shown in Figures 14 through 16, respectively. A bubble plot is a simple, graphical representation of spatial data that presents the number and location of samples as well as the relative concentration observed at each location. The size of the bubbles or circles is proportional to the relative concentration of the compound with respect to the range of values measured. In these figures, the “Y” symbol denotes the location of the five outfalls potentially impacting IR Sites 20 and 28. Differently colored bubbles are used to identify concentrations exceeding specific criteria at each station. Red bubbles exceed the ER-M, blue bubbles exceed the ER-L, and black bubbles are below the ER-L. In addition, bubbles that appear as solid dots represent locations where the constituent is below the reported detection limit. Locations that were sampled in 1993 and locations that were analyzed by fixed laboratory analyses in 2001 are identified by symbols on the figures (symbols listed in plot legend); wherever bubbles coincide with symbols, the bubble reflects the 2001 screening concentrations.

Concentrations of copper are higher in the western Stations OIH28 and OIH57, and in the eastern IR Site 28 Stations OIH51 and OIH75, then in the central area of IR Site 20 (see Figure 14). At all locations, the copper concentrations are below the ER-M (270 mg/kg). The highest observed copper concentration was 136 mg/kg at Station OIH28. Concentrations of copper in the remaining portions of IR Site 20 are low, and appear consistent with ambient levels.

Figure 15 shows the spatial distribution for lead, and Figure 11 shows the box plot comparing the screening results to fixed lab analysis, 1993 historical data, and ambient levels. Lead is distributed in a similar fashion to copper and is associated with two outfalls, one in the west and one in the eastern portion of IR Site 28. The highest observed lead concentrations are in the western Stations OIH30, OIH28, and OIH57, and in IR Site 28 Stations OIH51 and OIH75. Only at Station OIH30 does the observed concentration (263 mg/kg) exceed the ER-M (218 mg/kg). Again, all stations in the remaining portions including the central part of IR Site 20 are very low, and consistent with ambient levels.

Figure 16 shows the spatial distribution of zinc, and Figure 13 shows the box plot comparing the screening results to fixed lab analyses, 1993 data, and ambient data. Zinc is only slightly elevated in eastern Oakland Inner Harbor and there are no stations exceeding the ER-M (410 mg/kg). The highest observed levels are found in the western part of IR Site 20 at Stations OIH30 and OIH28, and in IR Site 28 at Stations OIH51 and OIH75. With the exception of the four stations identified above, the concentrations of zinc appear to reflect ambient levels.

It should be noted that the samples selected for the fixed laboratory analysis were designed to represent the full range of concentrations observed in the screening study and are not necessarily representative of the area of interest. Although the attempt was to select confirmation samples based on the screening data from locations representing the full range of concentrations (i.e., highest to lowest concentrations), the result was that a disproportionate number of samples with elevated screening values were included in the data set. The highest screening values were located in the western portion of IR Site 20, from Station OIH57, and in IR Site 28, especially near Station OIH51. Given this lack of spatial representation of

IR Site 20 and IR Site 28, no statistical comparisons of the fixed laboratory data to ambient data were performed.

#### 4.4 Organic Constituents in Sediments

For organic compounds, both individual analytes and summed (i.e., total LPAHs, HPAHs, PAHs, PCBs, and total DDT) analytes within a group are presented. For consistency, total concentrations at ambient locations were summed from individual congeners following the same methodology applied to the field sampling results. As previously stated, one half the detection limit was used for nondetect compounds. Figures 17 through 21 show box plots of the individual PAHs, and total PAHs are presented in Figure 22. Figures 23 through 29 show various pesticides. Total DDT and PCBs are shown in Figure 29. Box plots include comparisons of the screening and fixed laboratory data to both the 1993 historical data and ambient data set (RMP and/or BPTCP). If a field is empty, then no data were collected for that constituent in a given year (e.g., perylene was not collected in 1993, as shown in Figure 19). Bubble plots of total PAHs and PCBs showing the spatial distribution of these constituents are shown in Figures 30 and 31, respectively.

The threshold toxicity benchmarks including ER-Ms, ecological screening values, and ambient values (i.e., upper tolerance limits [UTLs] for 100 percent fines from RWQCB, 1998) are plotted as lines across the box plots as a reference point. It should be noted that these criteria were presented for comparison purposes only. Data on percent fines were not collected as part of the screening method and, consequently, the UTLs for 100 percent fines were utilized for comparison. A line was not drawn for a specific benchmark if it was outside the range of the plotted data. Ecological screening values are effects range-low (ER-Ls) criteria (Long and Morgan 1990; Long et al., 1995) except for the following specific cases for which ER-Ls were not available:

- Freshwater ER-Ls (U.S. EPA, 1996) were used for benzo(g,h,i)perylene and indeno(1,2,3-cd)pyrene.
- Toxicity reference values (TRVs) (U.S. EPA, 1995) were used for endosulfan I, endosulfan II, methoxychlor, and toxaphene.
- Threshold effects levels (MacDonald et al., 1996) were used for *gamma*-BHC.
- One-tenth of freshwater lowest effects levels (Persaud et al., 1993) were used for benzo(k)fluoranthene, aldrin, *alpha*-BHC, and *beta*-BHC.

##### 4.4.1 PAHs

Generally, PAH concentrations are slightly elevated in the western most part of IR Site 20, at Stations OIH28, OIH30, and OIH57; in IR Site 28, at Station OIH51; and north of IR Site 28, at Stations OIH20 and OIH21 (Figure 30). The slightly elevated concentrations are co-located to sampling stations where slightly elevated metals concentrations also were determined. Concentrations for PAHs in the central portion of IR Site 20 are well below ambient levels and the ER-L. The highest screening value (18,160 µg/kg) for PAHs was observed in the western portion of IR Site 20 at Station OIH30. However, the duplicate taken from this same sample measured a concentration of 2,446 µg/kg, an order of magnitude (i.e., 10 times) lower than the screening value. This pattern is evident in the bubble plot (Figure 30), which shows a small bubble within a larger bubble. In addition, no other station in the vicinity showed elevated levels of PAHs. The elevated PAH level observed at Station OIH30 may be attributable to difficulties homogenizing samples in the field which may have led to unequal portions of coarse-grained materials being placed into each sample.

HPAHs generally are consistent with ambient distributions, except at one station, OIH51, which is located in the eastern portion of IR Site 28. At this station, the highest observed concentration for ten HPAHs was observed. The next highest value for HPAHs was Station OIH20, which is located on the other side of the pier and north of Station OIH51.

For specific LPAHs, 2-methylnaphthalene (Figure 19) appears elevated in 1993 due to the detection limits, which were far higher than the ER-L. By contrast, the 2001 concentrations for 2-methylnaphthalene appear quite comparable to ambient levels. This same pattern holds true for acenaphthene, acenaphthylene, and fluorene (Figure 20), and naphthalene (Figure 21), all of which had elevated detection limits in 1993, but comparable levels with ambient concentrations in 2001. Concentrations of phenanthrene (Figure 21) were detected at levels above the ER-L in 1993, but the 2001 concentrations with the exception of one station in IR Site 28 (OIH51) are comparable to ambient levels.

#### 4.4.2 Pesticides

Box plots of pesticide results are presented in Figures 23 through 29. It should be noted that 2,4-DDT isomers were not measured in 1994 and there are no benchmarks (e.g., ER-Ls, ER-Ms or ambient levels) available for these isomers. 2,4-DDD concentrations were reported at the ambient stations. The concentrations of 2,4-DDT isomers are highest in the two samples in IR Site 28 as compared to the other stations, with the highest concentration of 15 µg/kg observed at Station OIH51. The same pattern holds for all three isomers of 4,4'-DDT where the highest concentration was found at Station OIH51 in the eastern part of IR Site 28. Total DDT concentrations are consistent with ambient levels except at Station OIH51 where the maximum concentration was observed.

Aldrin was not detected in any sample and *alpha*-chlordane levels were comparable to ambient in all but one station (OIH51). The majority of the individual pesticides were not detected and below applicable threshold benchmarks. Dieldrin was detected at three of the seven stations (Figure 26); however, the concentrations are consistent with ambient levels. Endrin aldehyde was detected in three of seven stations with the concentration at OIH51 (13.4 µg/kg) much higher than at the other two sampling stations (see Figure 27). *gamma*-Chlordane was detected in only two of the fixed laboratory samples from IR Site 28. The highest *gamma*-chlordane concentration (2.2 µg/kg) again was observed at OIH51, which is consistent with the pattern shown by other pesticides.

#### 4.4.3 PCBs

In general, the elevated levels were associated with samples in IR Site 28 (Stations OIH51 and OIH10). The highest fixed laboratory result was 1,066 µg/kg at OIH51 (Figure 29). Screening results at this station ranged considerably between extraction duplicates (the first 480, and the second 253 µg/kg). Figure 31 clearly shows that the location of high concentrations of PCBs mirrors the locations of elevated metals above ER-Ms – two separate areas, one in the western portion of IR Site 20 (e.g., OIH57, OIH38 and OIH30), and one in the east that encompasses the eastern part of IR Site 28 (OIH51 and OIH10) and a few stations to the north of the pier in IR Site 20.

## 5.0 SUMMARY

A Sediment Screening Study was performed in March 2001 at Oakland Inner Harbor (IR Site 20) and Todd Shipyard (IR Site 28) to characterize the nature and extent of contamination of the offshore sediment from historical operations at these locations. Based on the field observations, the shoreline along Oakland Inner Harbor is characterized as rocky substrate (i.e., riprap) with limited intertidal areas such as sand beaches and mudflats. In addition, the results of the survey indicate that the area of soft sediment is smaller than previously assumed, only averaging approximately 246 ft in width of undredged sediment. Beyond this shelf, within the dredged shipping channel, the sediment surface drops off precipitously. Water depth ranges up to approximately 50 ft in the center of the Oakland Inner Harbor Channel, with water depths along the sediment shelf typically ranging from less than 10 ft to 40 ft (see Figure 3).

In general, elevated chemical concentrations above screening criteria and ambient levels were associated with discrete locations along the shoreline in close proximity to known outfall locations. For example, slightly elevated levels of PCBs, some metals, and PAHs were observed in the western portion of IR Site 20 from sample location OIH57, west to location OIH30, and in the eastern portion of IR Site 28. These areas correspond roughly with two outfalls, where the distribution of the contaminants are due to tidal action over time. ERM-Qs based on both the set of five screening constituents and on a larger list of 18 fixed laboratory constituents mirrored this general pattern (see Figure 32). In addition, slightly elevated levels of a number of pesticides were observed in a localized area near sample location OIH57. It is believed that the contaminants found near the outfalls are due to historical practices because the upgradient storm sewer lines have been cleaned and all contaminants found in the pipes have been removed (Tetra Tech EMI, 1997). In the central portion of IR Site 20, occupying most of the spatial area of the site, concentrations of a majority of all constituents were consistent with San Francisco Bay ambient levels.

In summary, a few chemicals were detected within IR Site 20 and IR Site 28 at concentrations elevated compared to ambient locations, indicating possible releases associated with Navy activities in the western portion of IR Site 20 and eastern portion of IR Site 28. However, the majority of the chemicals evaluated were found to be within ambient levels. In addition, the limited exceedances appear to be associated primarily with discrete locations in the vicinity of the outfalls, and appear to be isolated with restricted spatial distribution. In addition, given the water depth and the shelf dimensions, the shelf itself appears to offer limited foraging and nesting habitat. Based on these considerations, there appears to be low potential for adverse impacts to ecological and human receptors from exposure to contaminated sediment at Oakland Inner Harbor and Todd Shipyard. Consequently, there does not appear to be an immediate need to evaluate these areas further.

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## FIGURES

# FINAL TECHNICAL MEMORANDUM OAKLAND HARBOR AND TODD SHIPYARD

DATED 28 NOVEMBER 2001

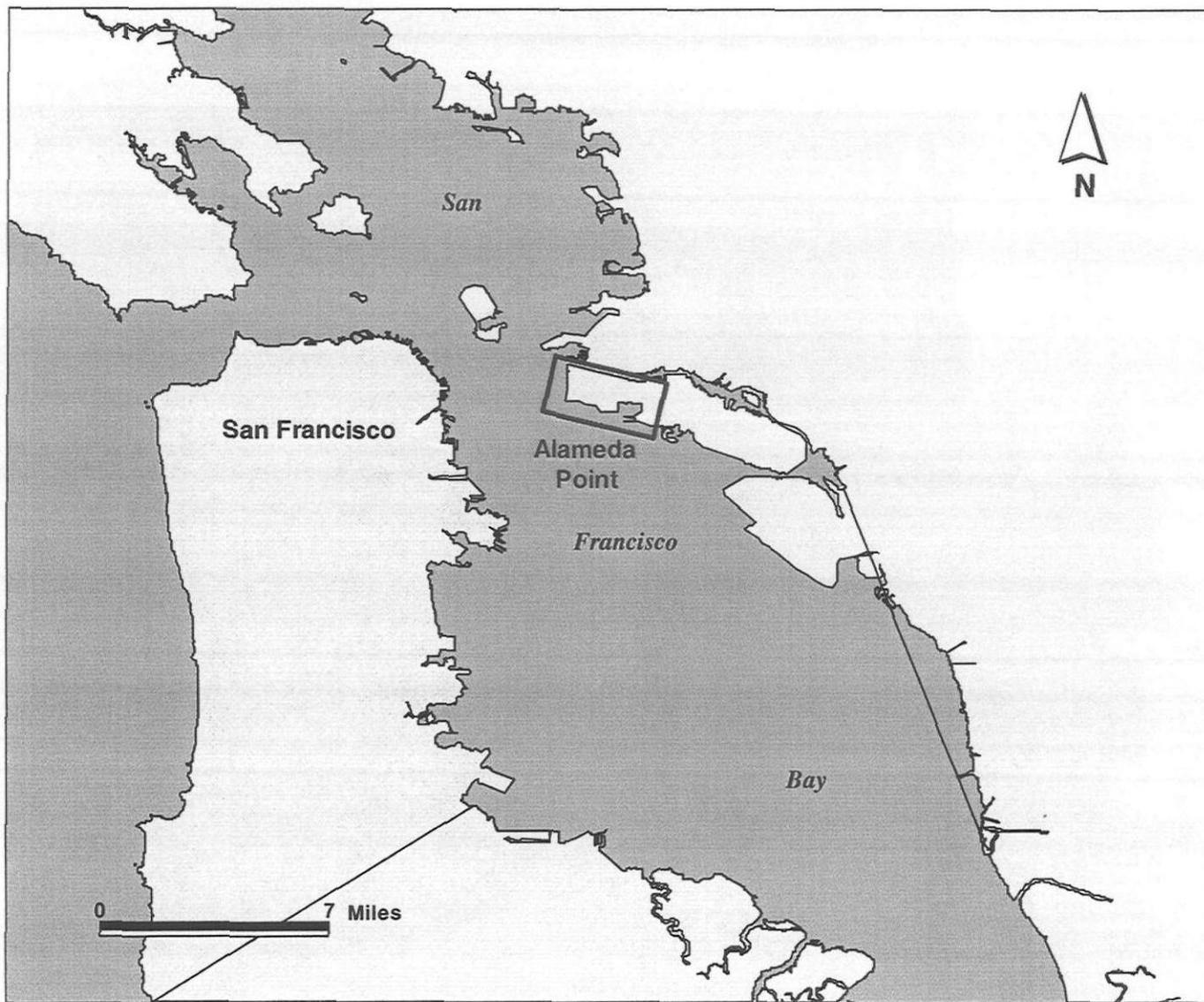


Figure 1. Location Map of Alameda Point

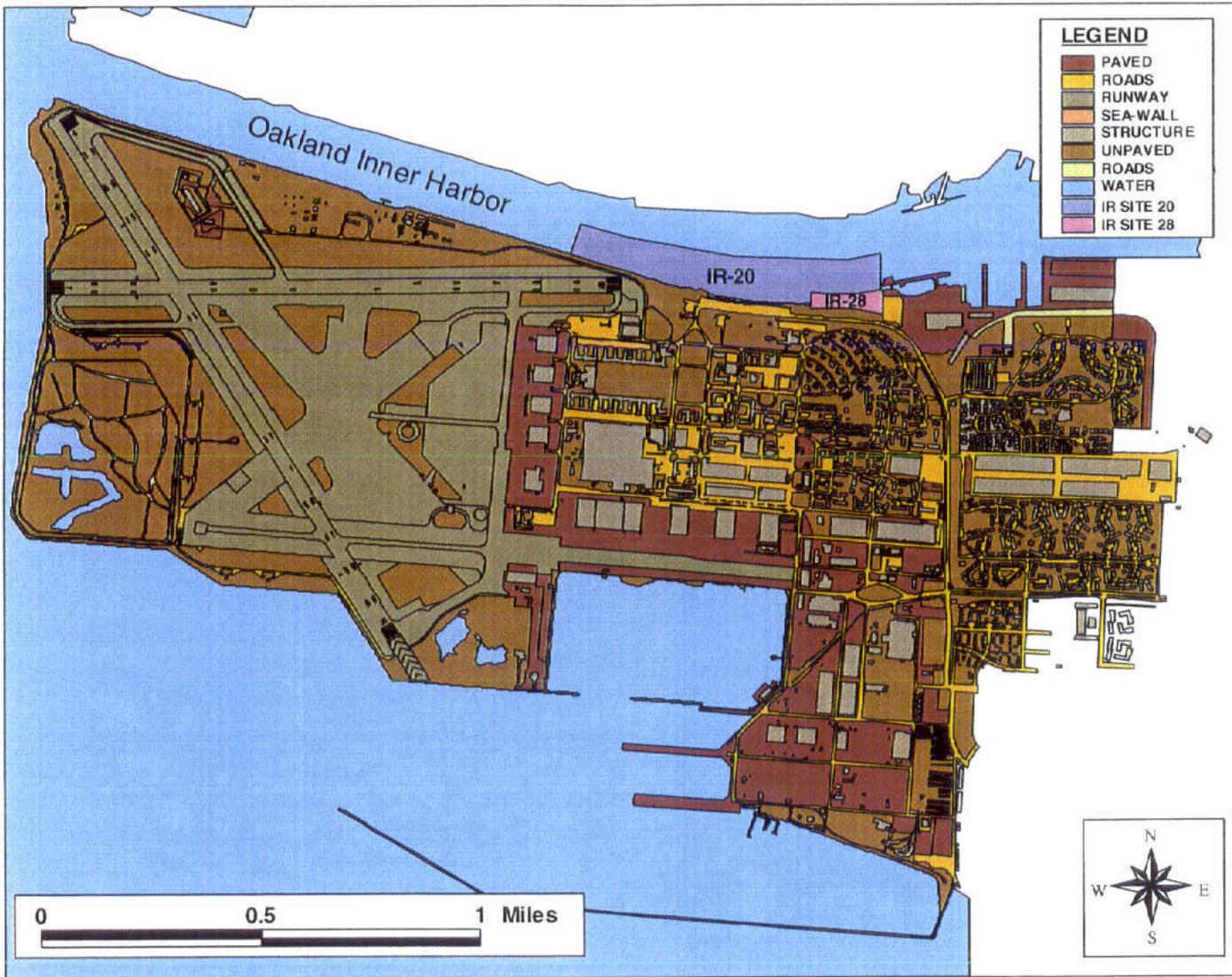


Figure 2. Location Map of IR Sites 20 and 28

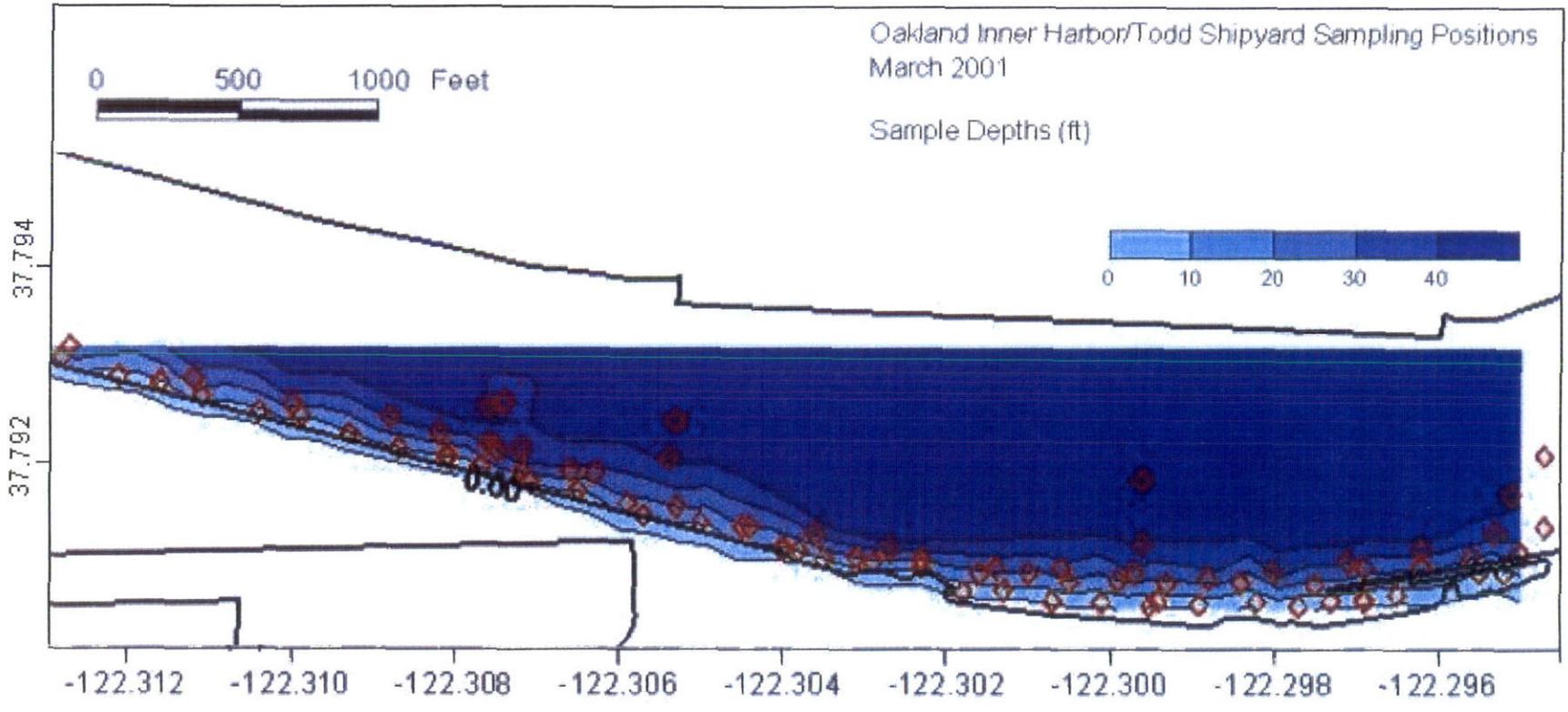


Figure 3. Bathymetry of Oakland Inner Harbor

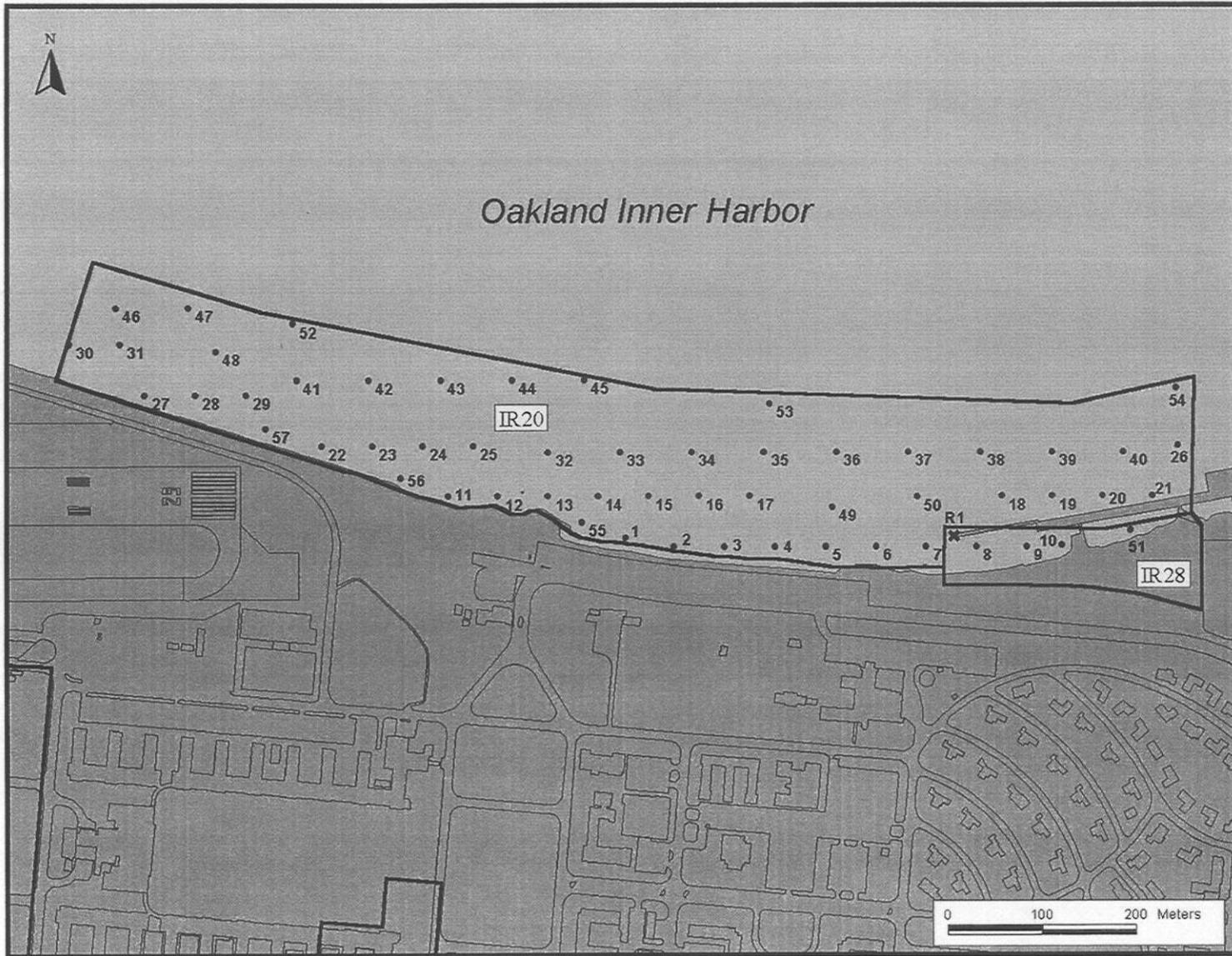
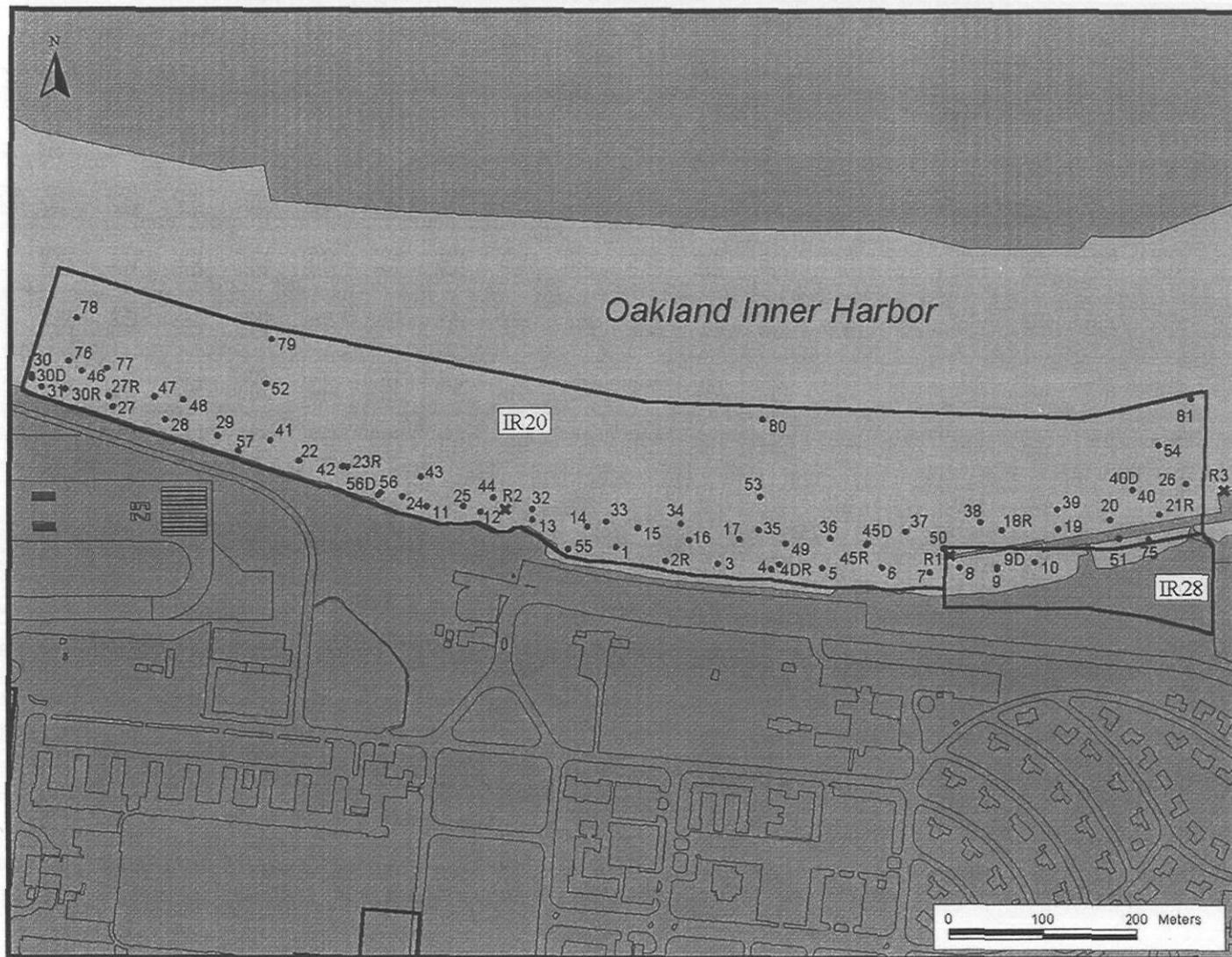


Figure 4. Proposed Sampling Locations for Oakland Inner Harbor and Todd Shipyard March 2001 Screening Study



**Figure 5. Oakland Inner Harbor and Todd Shipyard Sampling Stations for March 2001 Screening Study**

Note: Stations were moved closer to the shore from the original design because the dredged portion of the channel extended closer to the shore than expected.

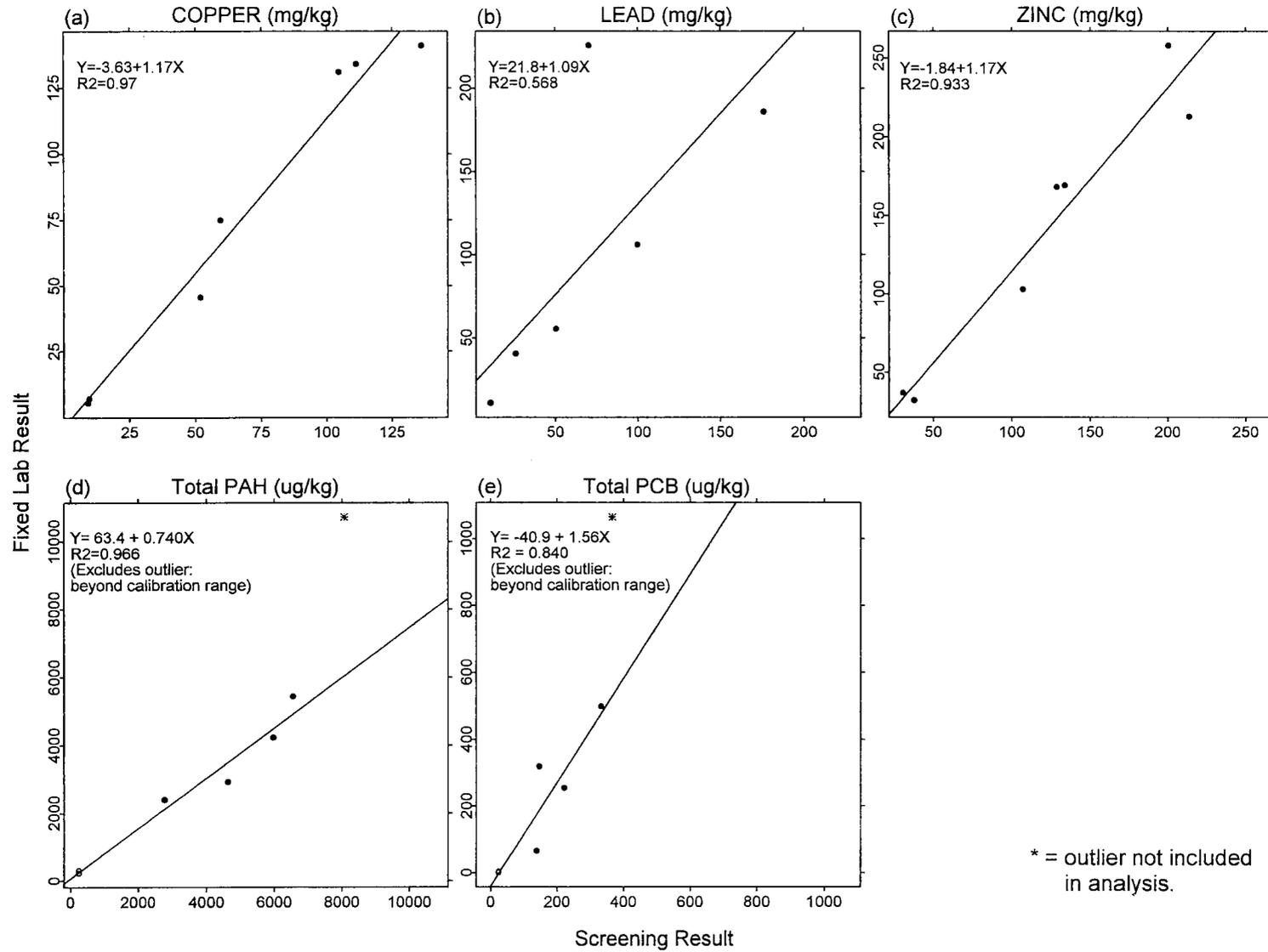


Figure 6. Bivariate Plots of Fixed Laboratory Versus Screening Results

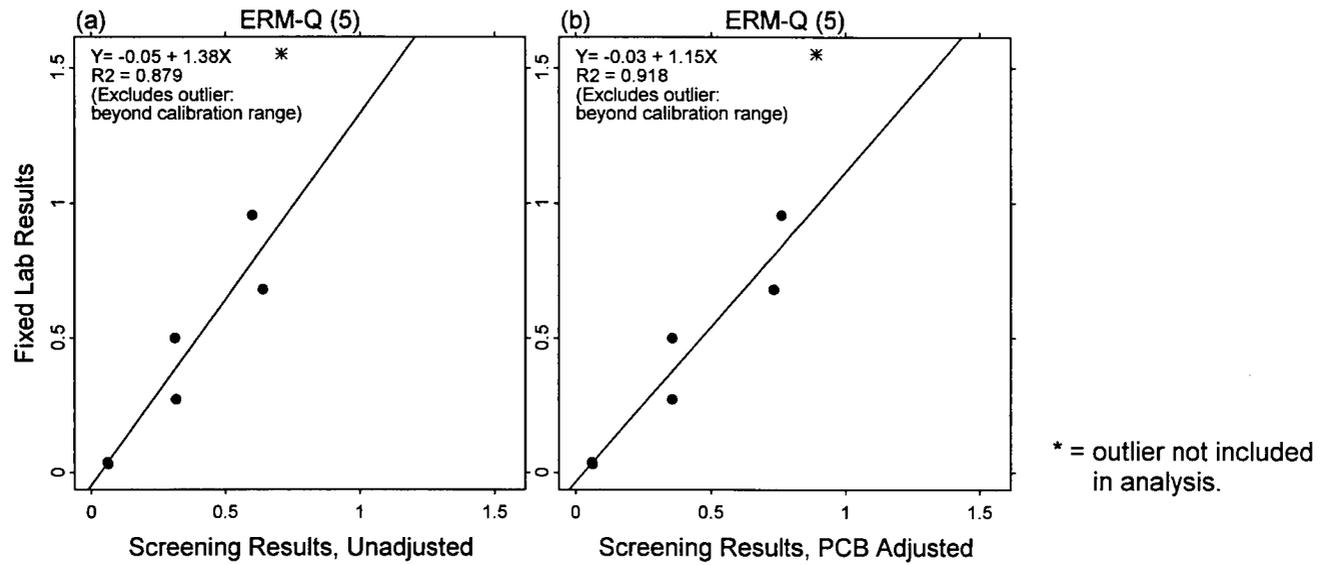


Figure 7. Bivariate Plots of Fixed Laboratory Versus Screening ERM-Qs with and without Adjusting Screening Results Based on Least Square Fit Regressions

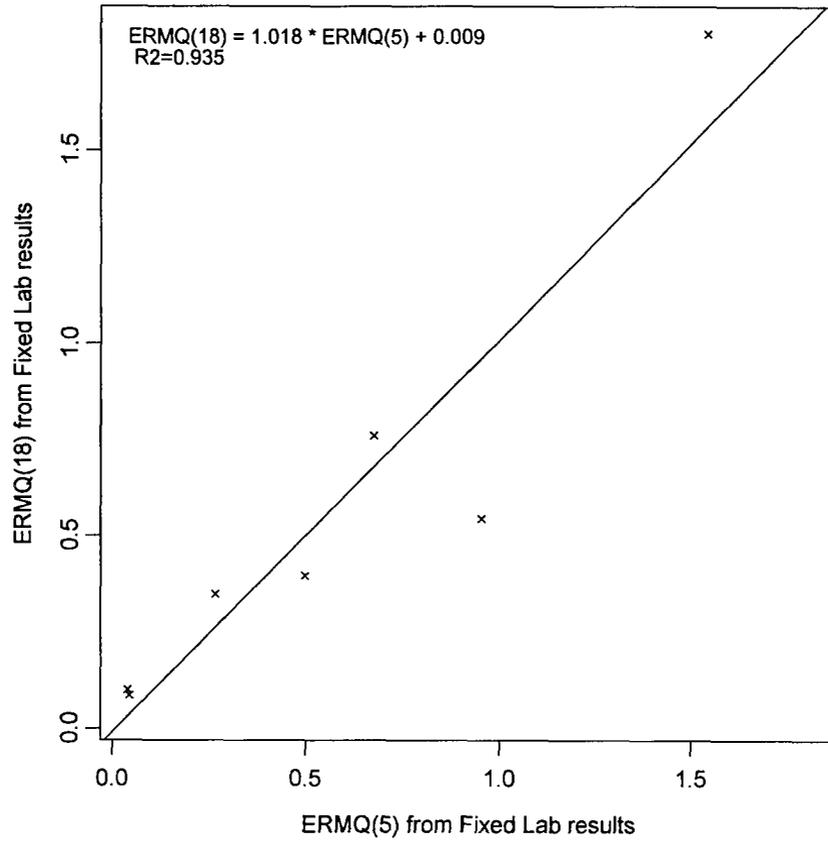


Figure 8. Comparison of ERM-Qs Calculated Using the Five Screening Constituents to 18 COPECs

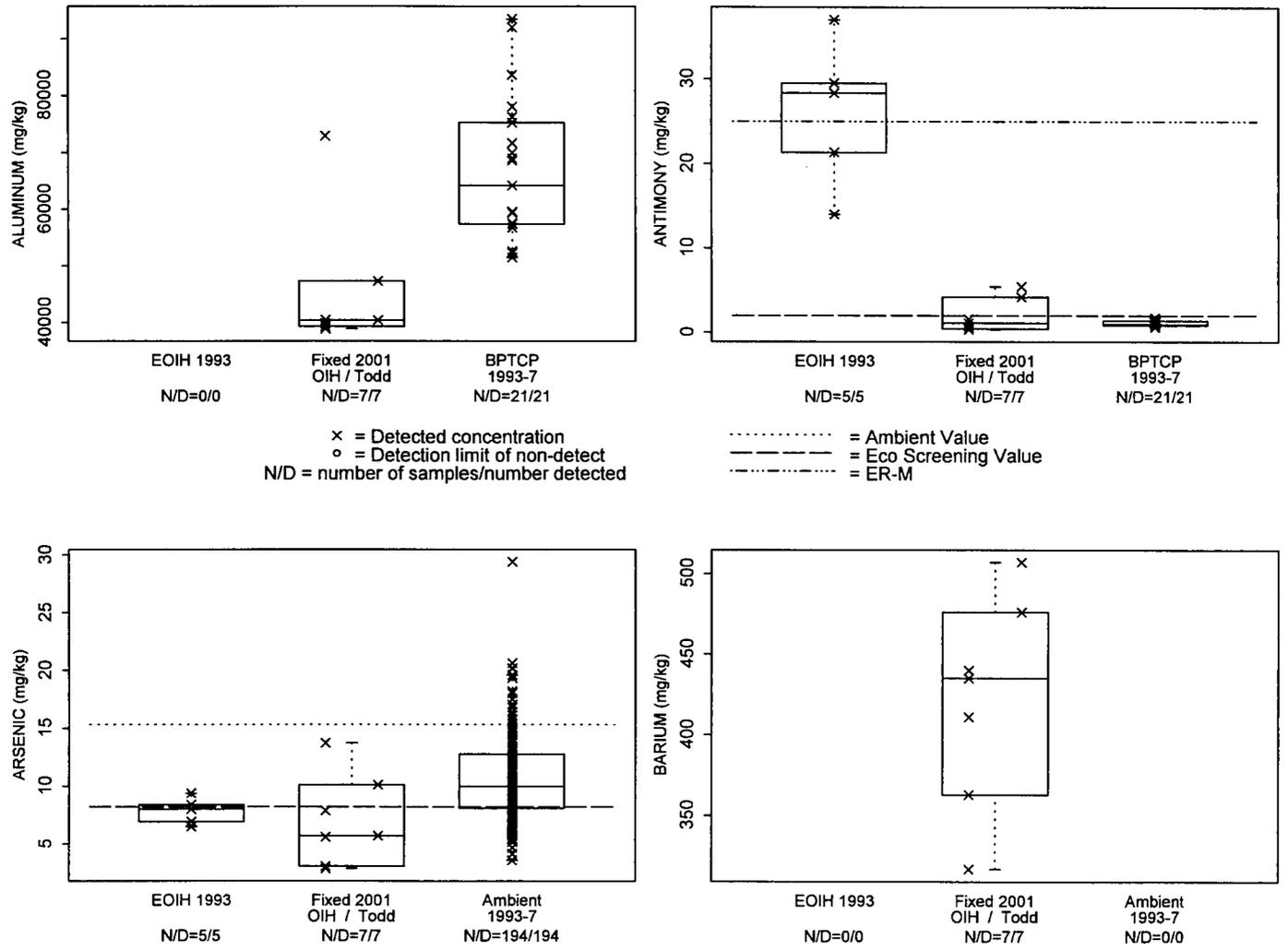


Figure 9. Box Plots of Surface Sediment Concentrations of Inorganics: Aluminum, Antimony, Arsenic, and Barium

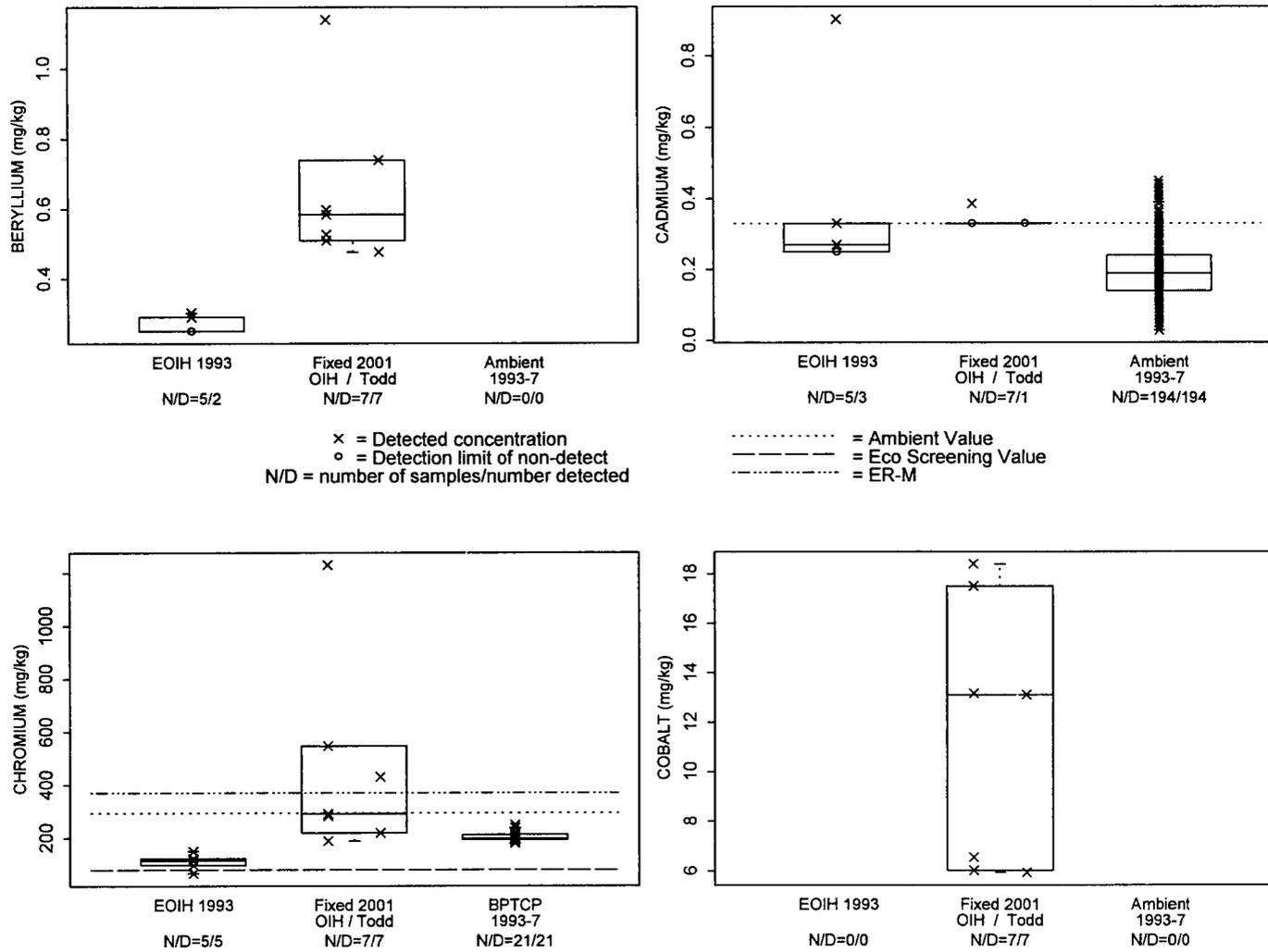


Figure 10. Box Plots of Surface Sediment Concentrations of Inorganics: Beryllium, Cadmium, Chromium, and Cobalt

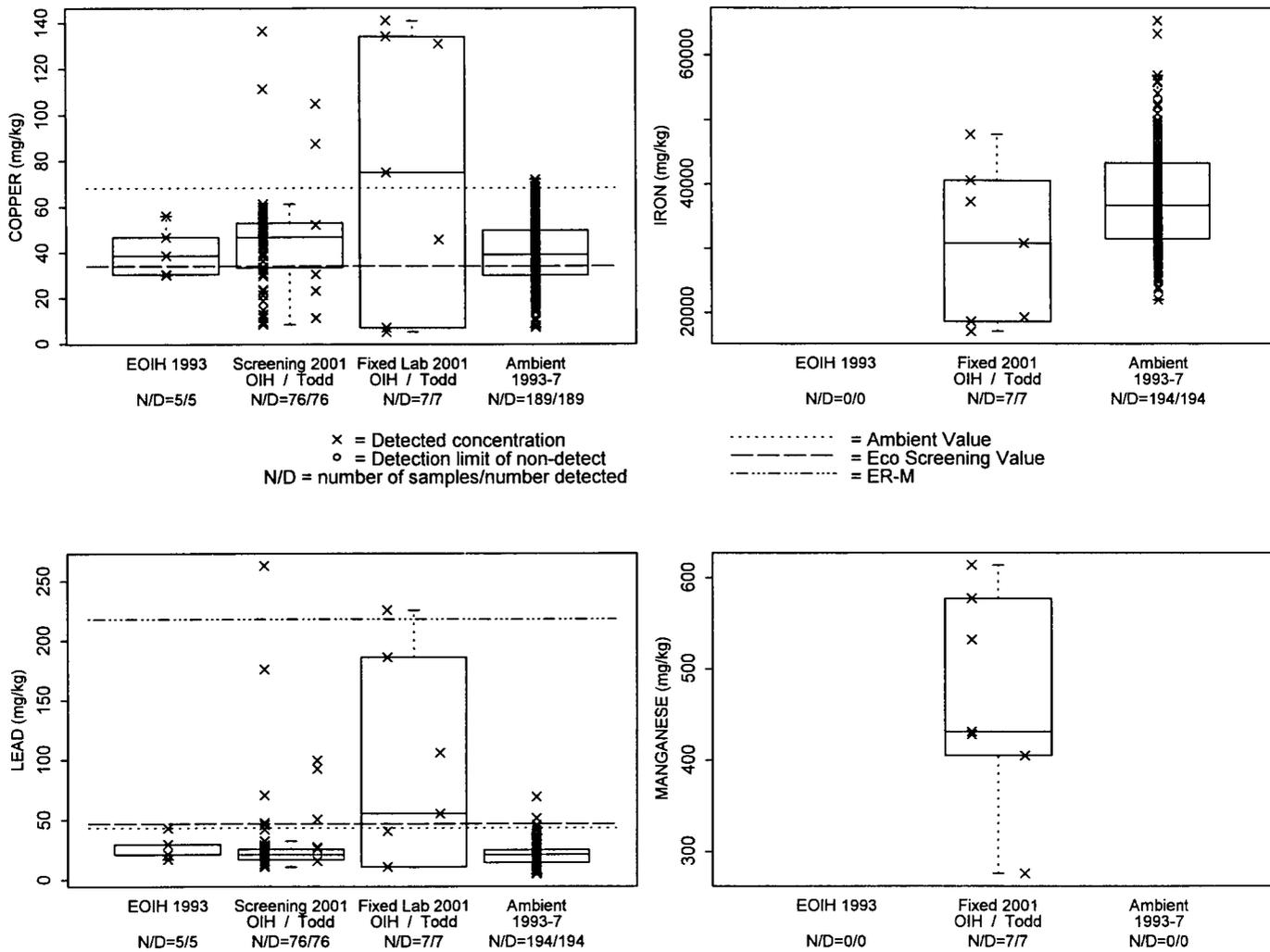


Figure 11. Box Plots of Surface Sediment Concentrations of Inorganics: Copper, Iron, Lead, and Manganese

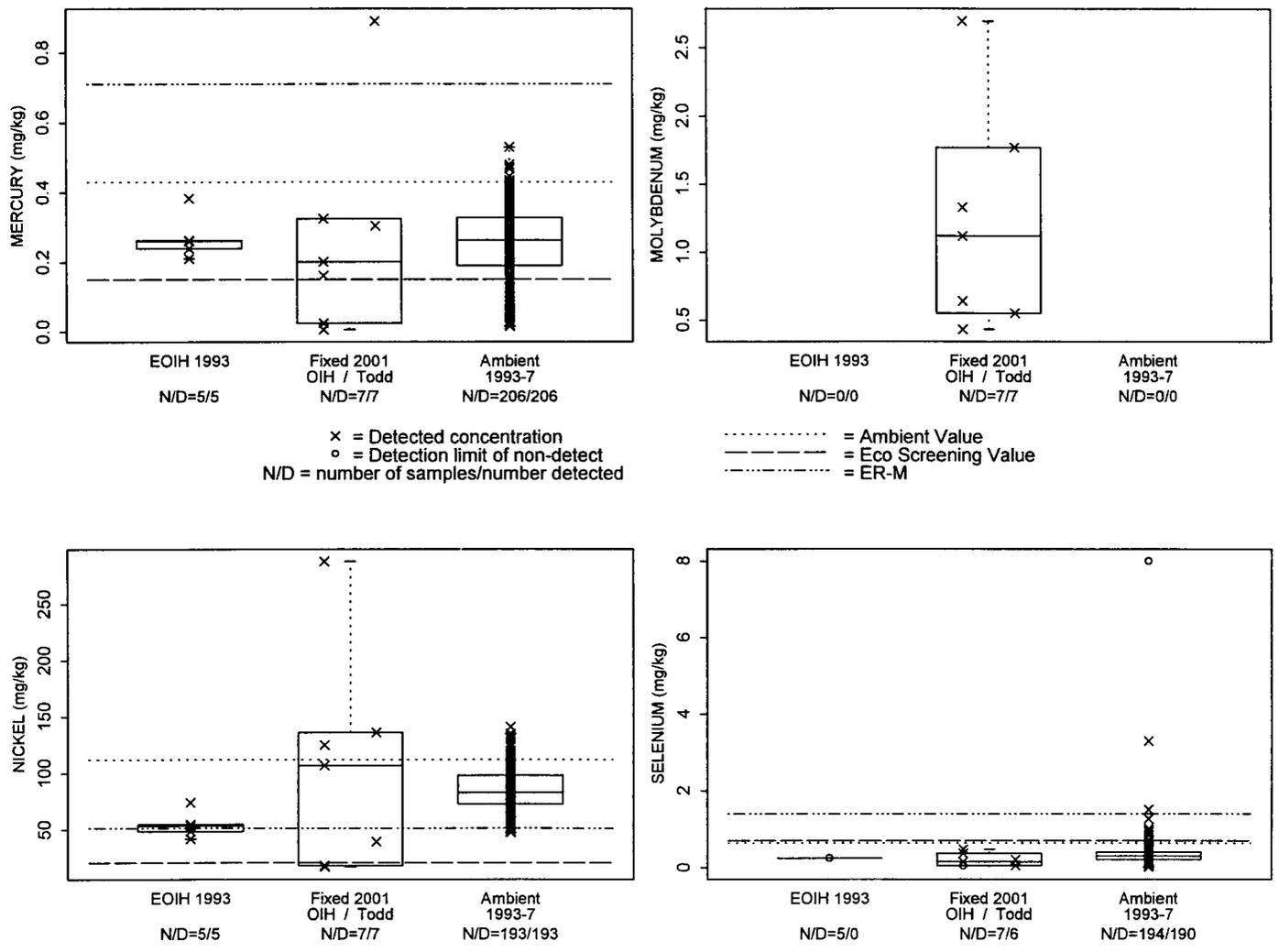


Figure 12. Box Plots of Surface Sediment Concentrations of Inorganics: Mercury, Molybdenum, Nickel, and Selenium

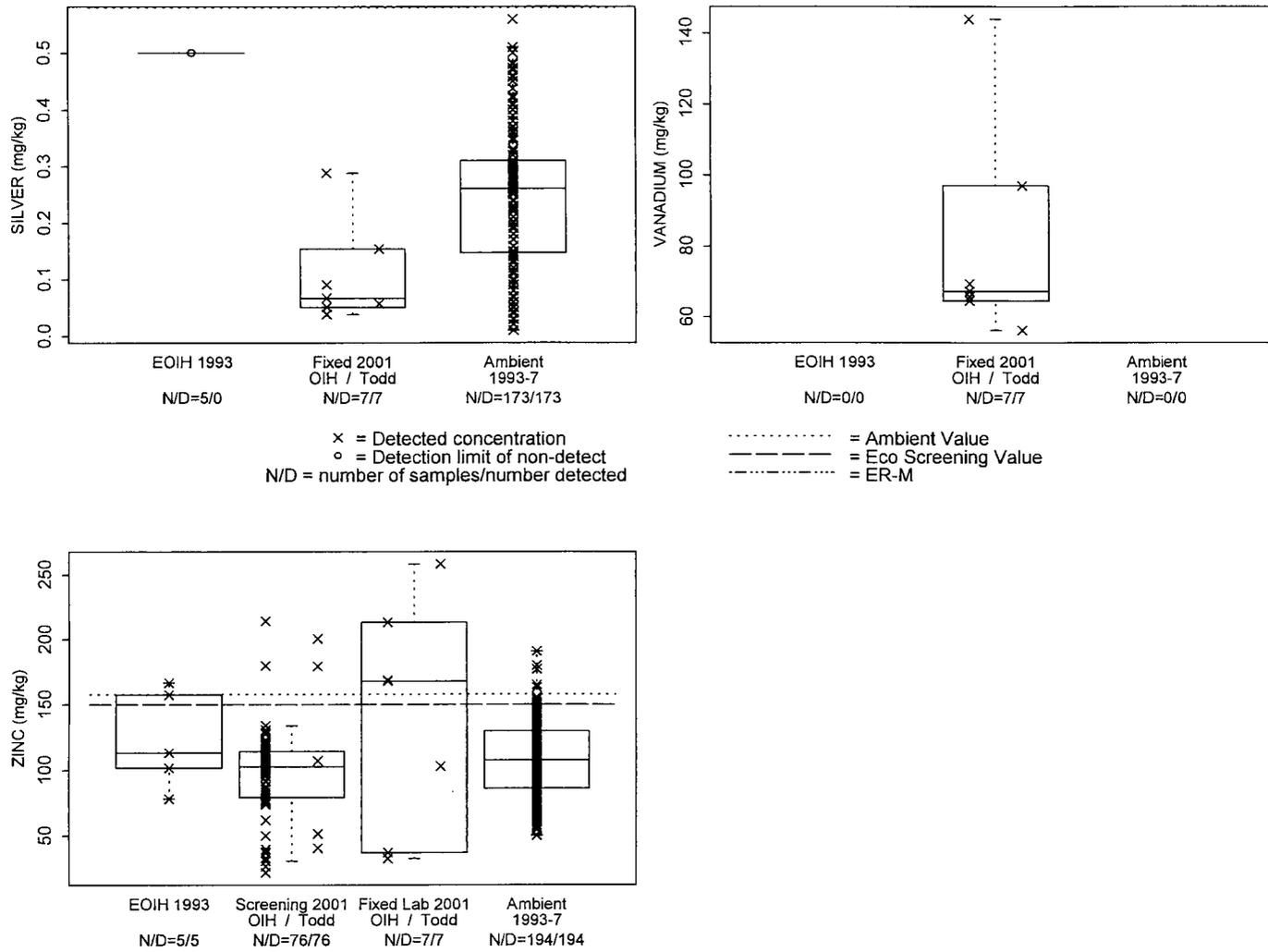


Figure 13. Box Plots of Surface Sediment Concentrations of Inorganics: Silver, Vanadium, and Zinc

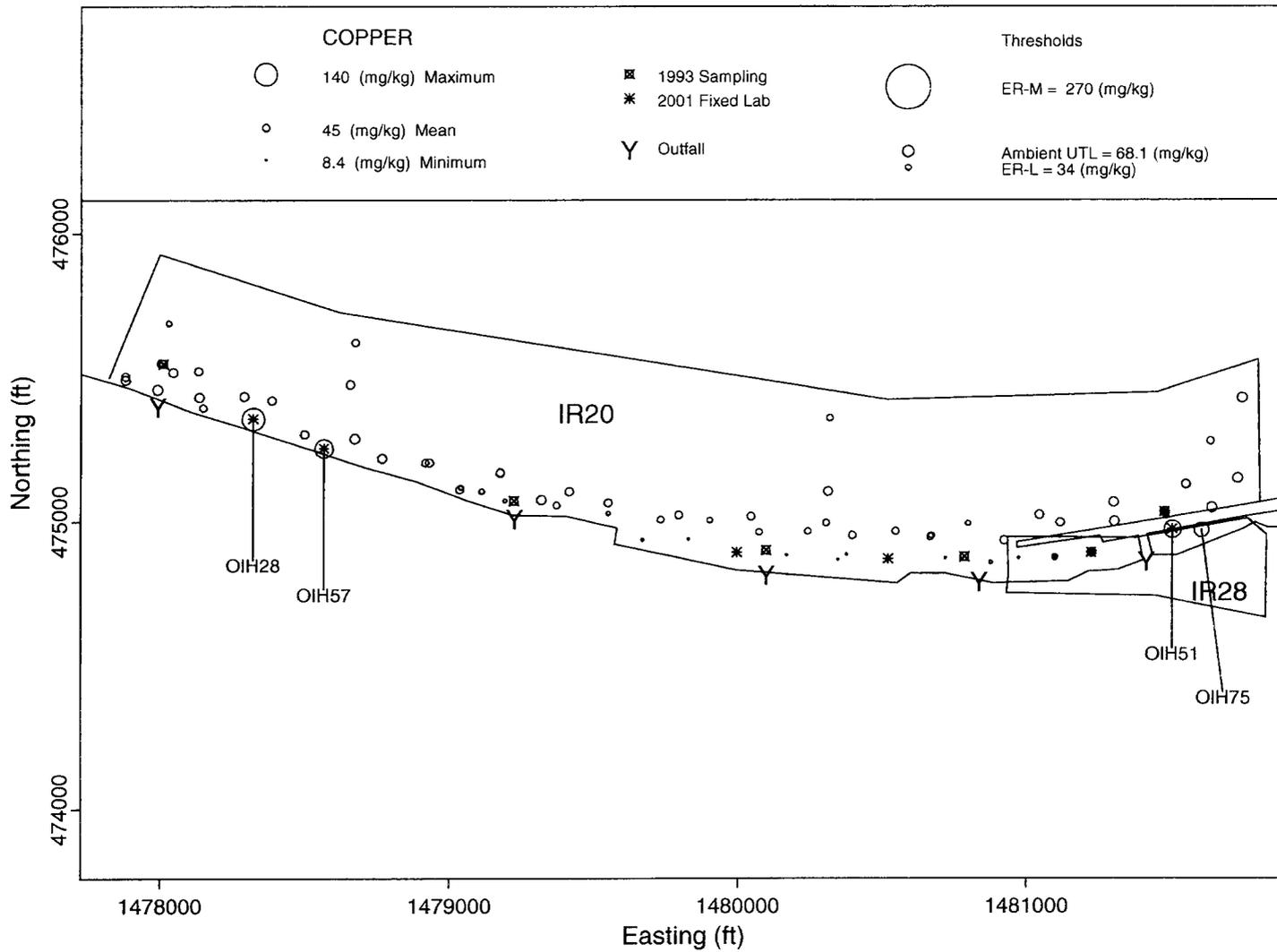


Figure 14. Bubble Plot of Surface Sediment Concentrations of Copper from 2001 Screening Results

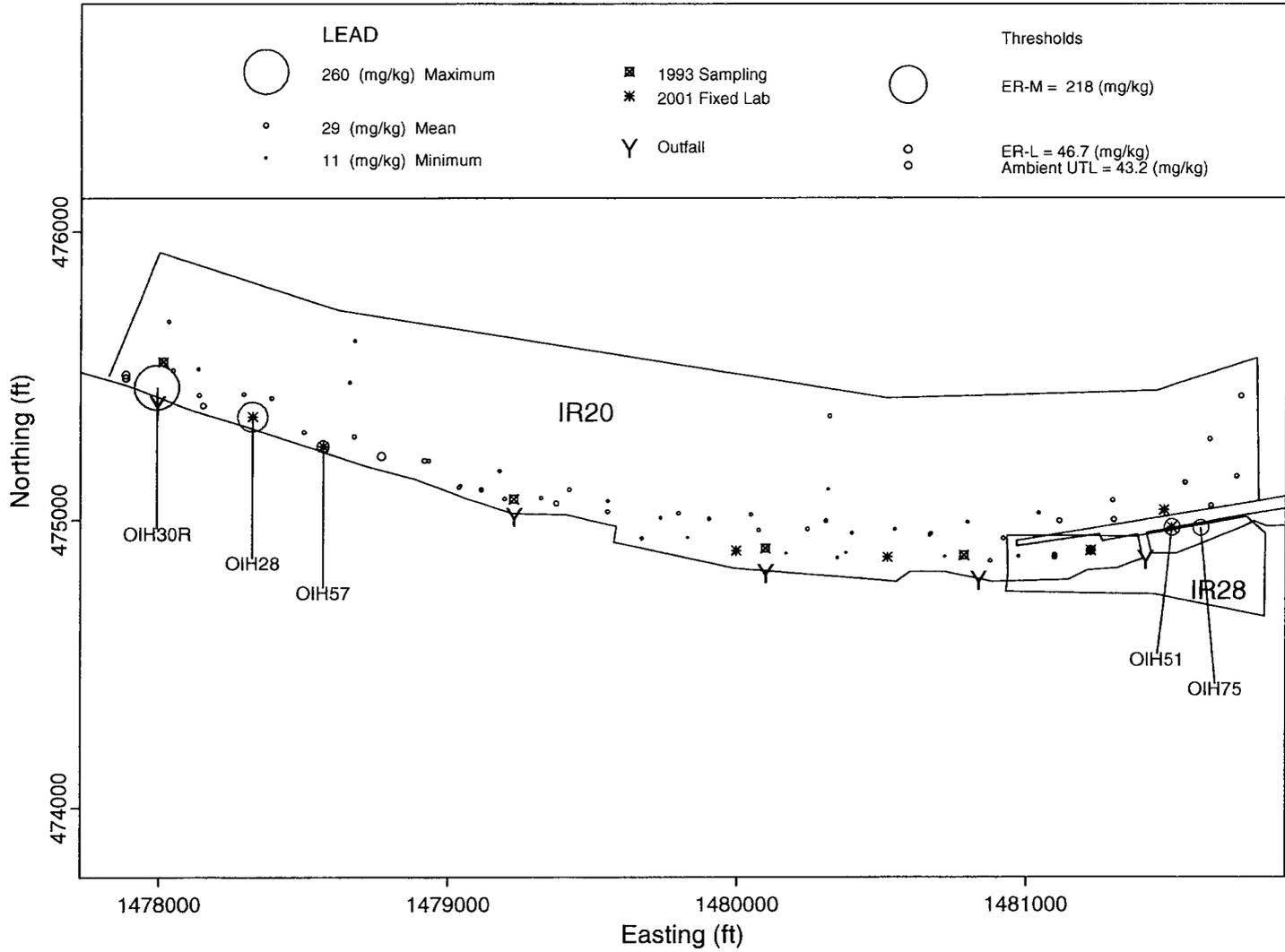


Figure 15. Bubble Plot of Surface Sediment Concentrations of Lead from 2001 Screening Results

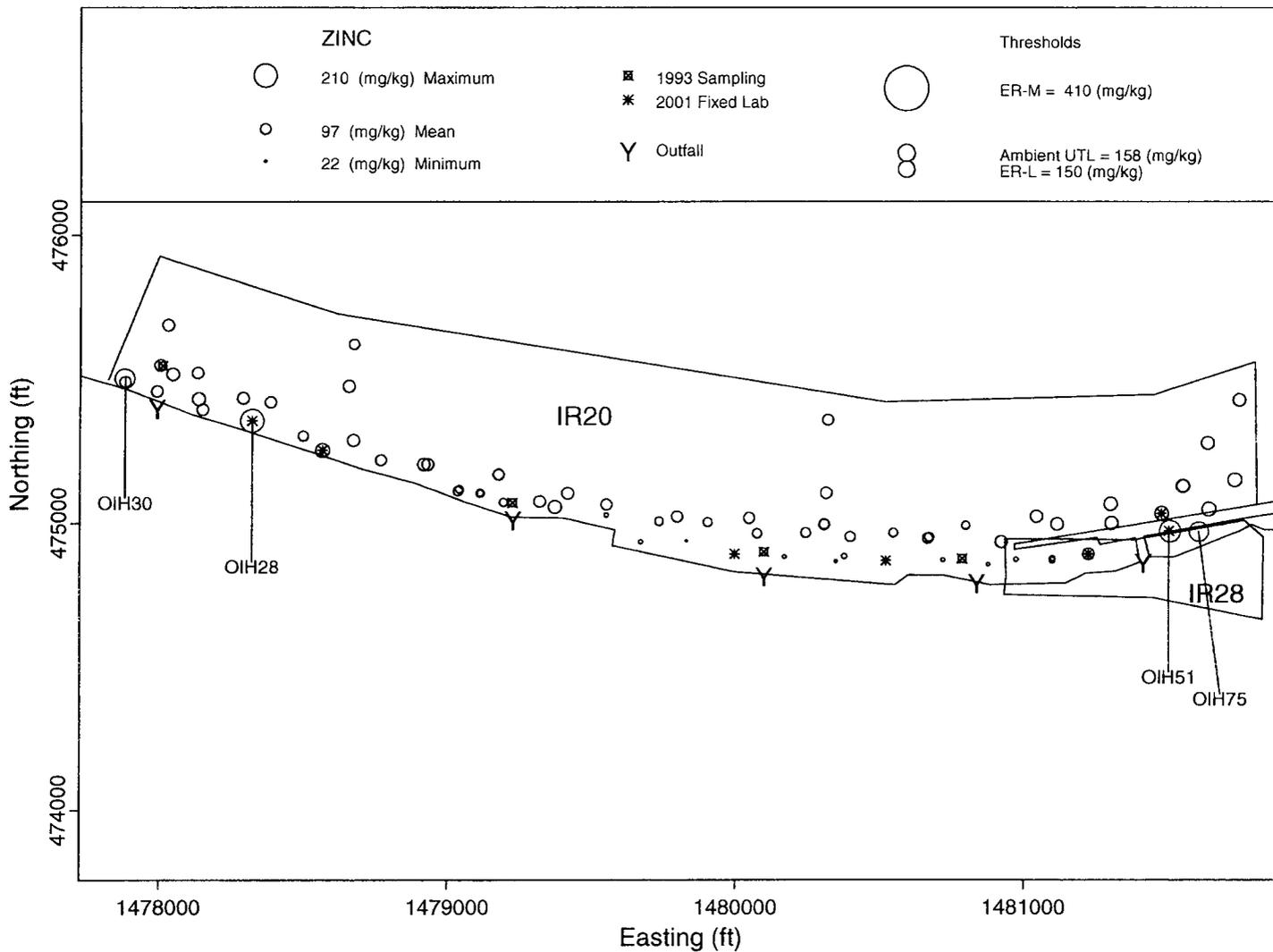


Figure 16. Bubble Plot of Surface Sediment Concentrations of Zinc from 2001 Screening Results

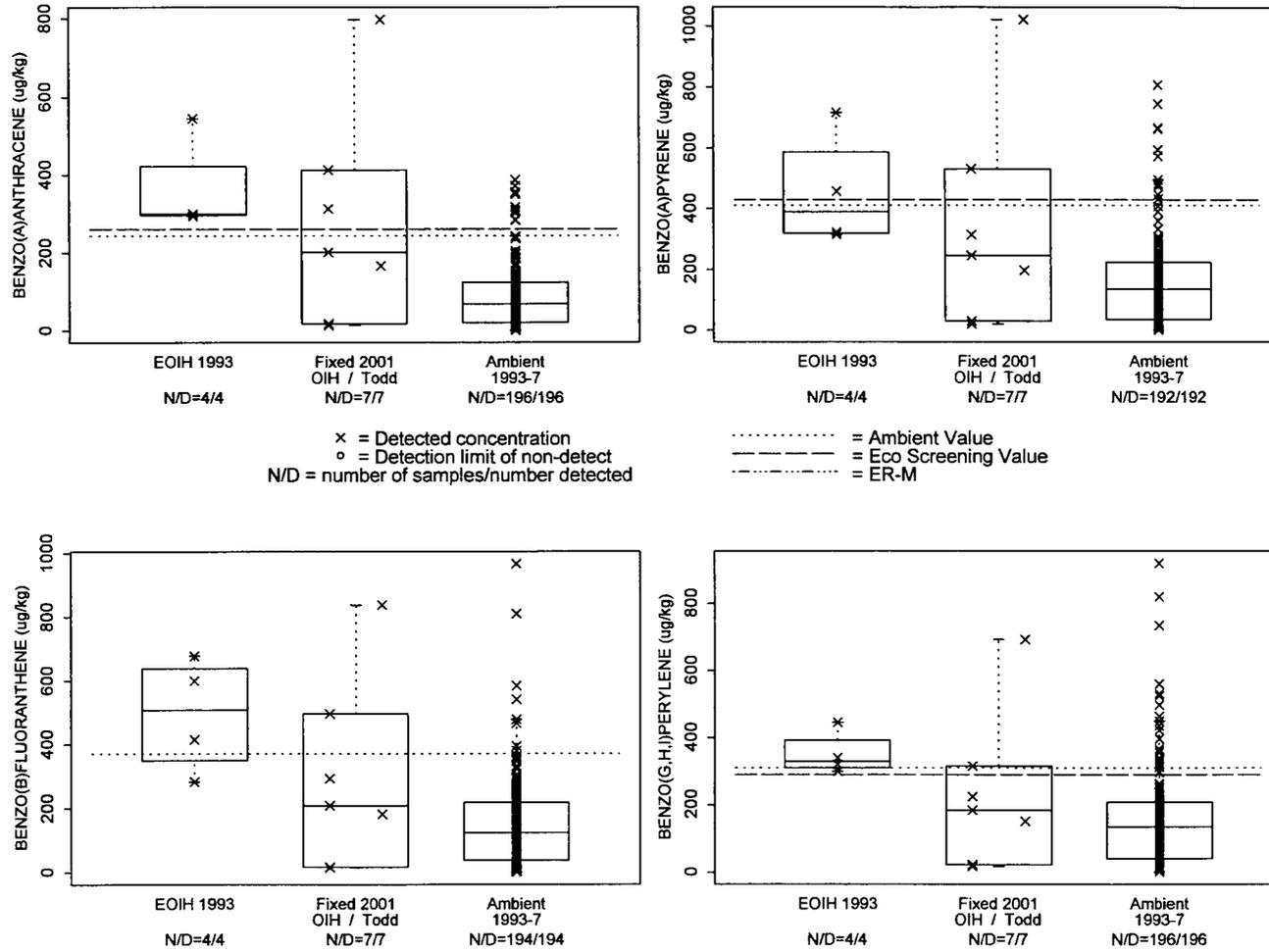


Figure 17. Plots of Surface Sediment Concentrations of Organics: Benz(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, and Benzo(g,h,i)perylene

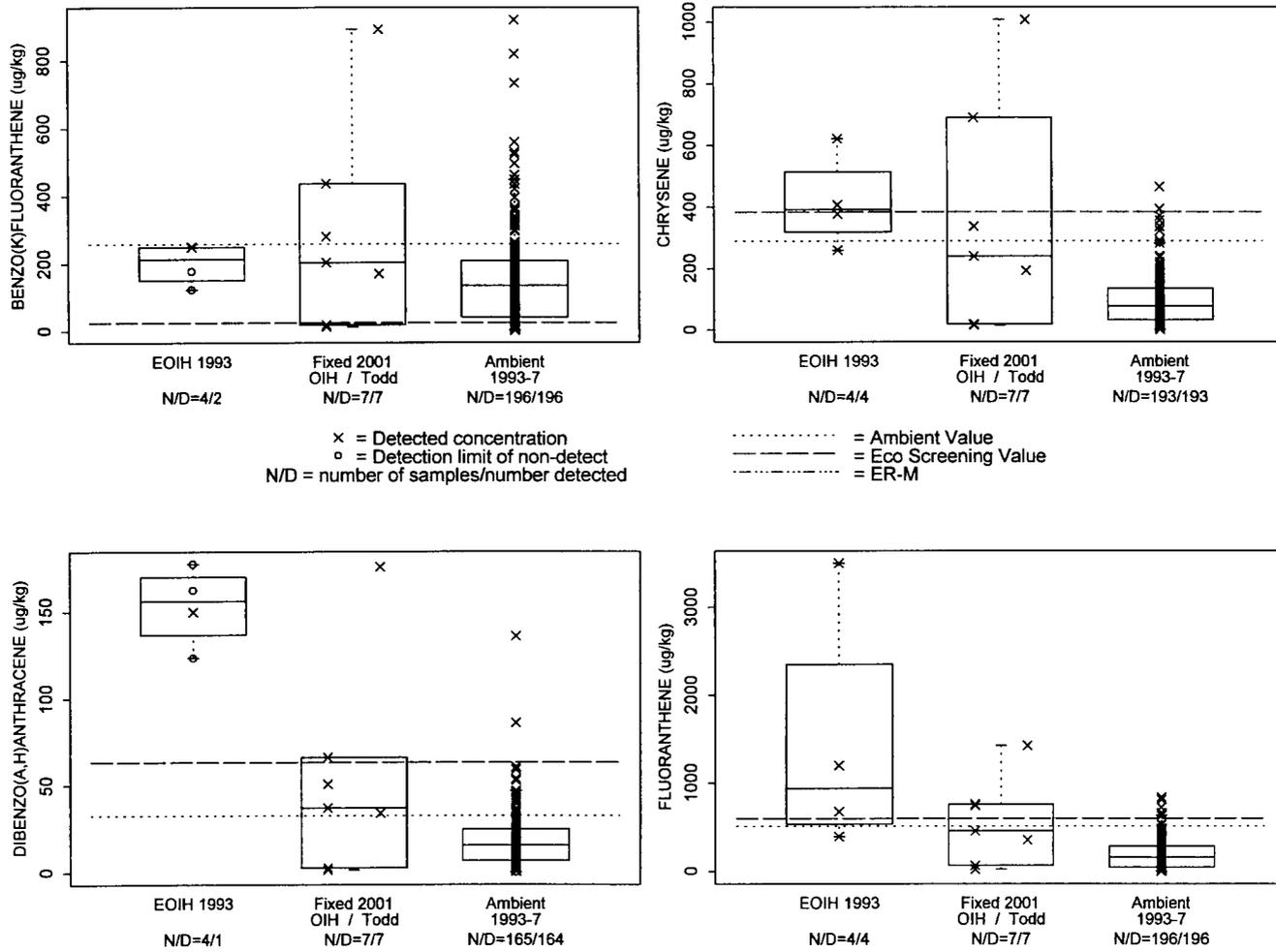


Figure 18. Plots of Surface Sediment Concentrations of Organics: Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, and Fluoranthene

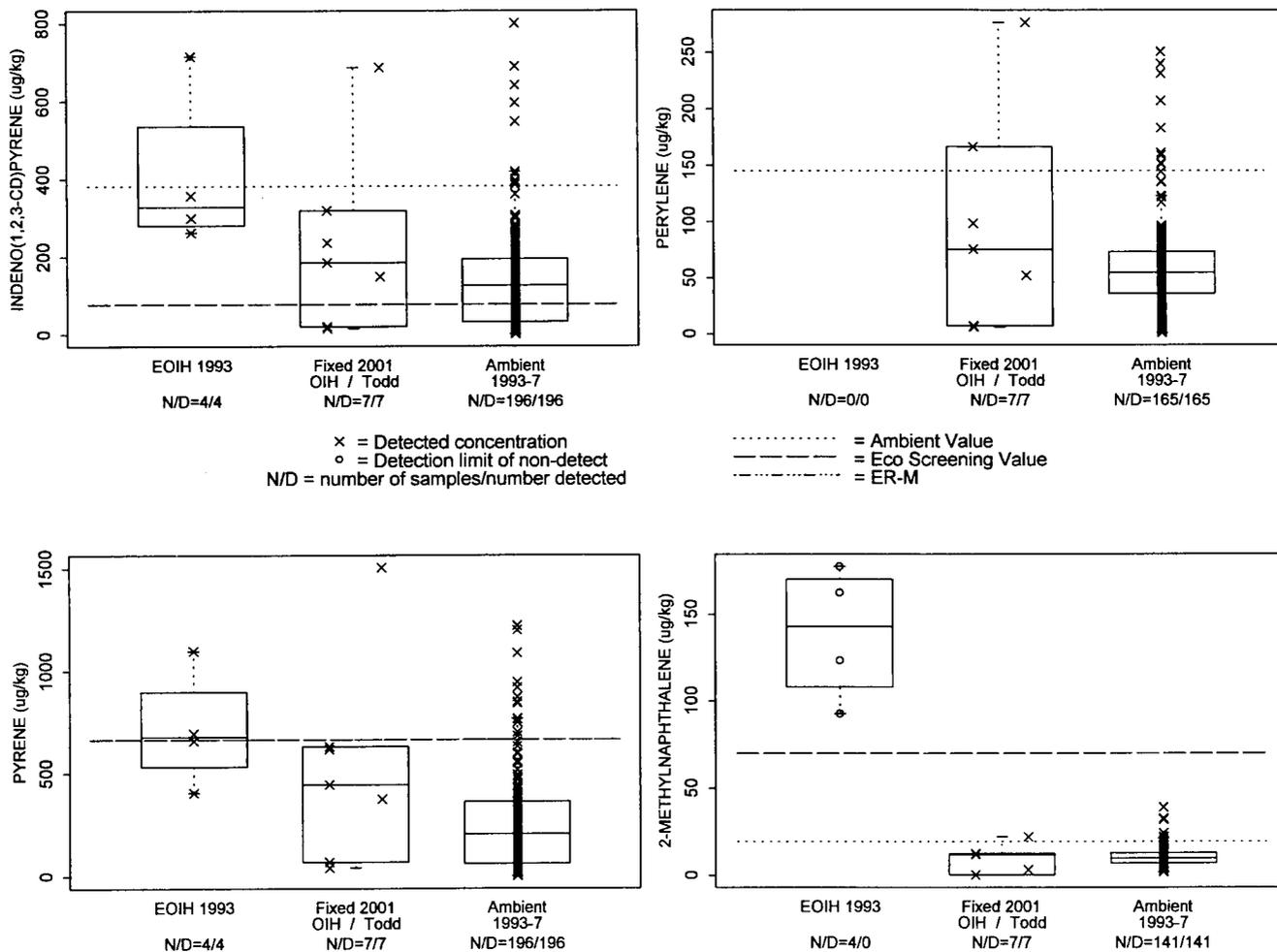


Figure 19. Plots of Surface Sediment Concentrations of Organics: Indeno(1,2,3-cd)pyrene, Perylene, Pyrene, and 2-Methylnaphthalene

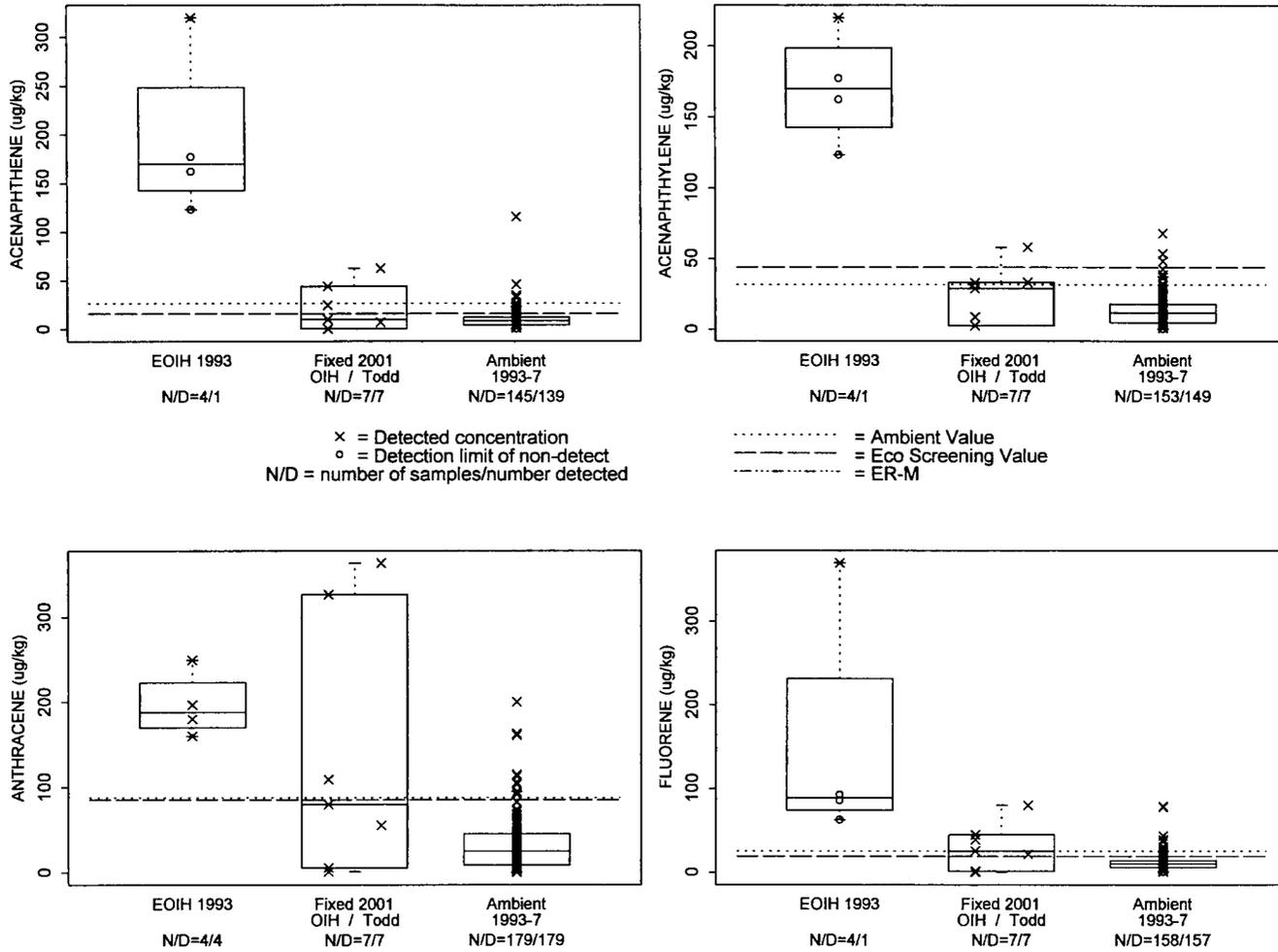


Figure 20. Plots of Surface Sediment Concentrations of Organics: Acenaphthene, Acenaphthylene, Anthracene, and Fluorene

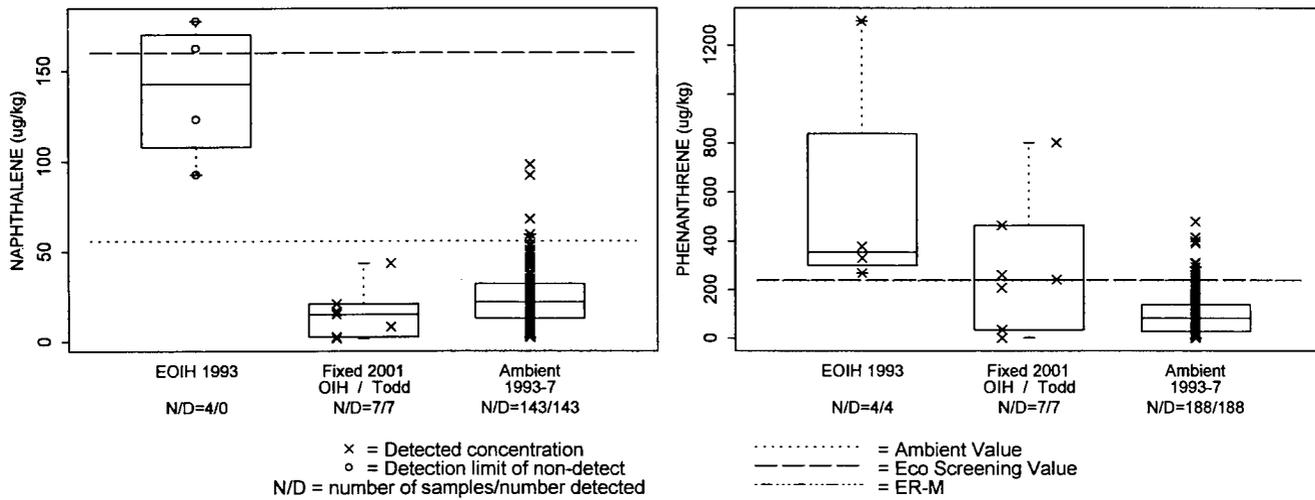


Figure 21. Plots of Surface Sediment Concentrations of Organics: Naphthalene and Phenanthrene

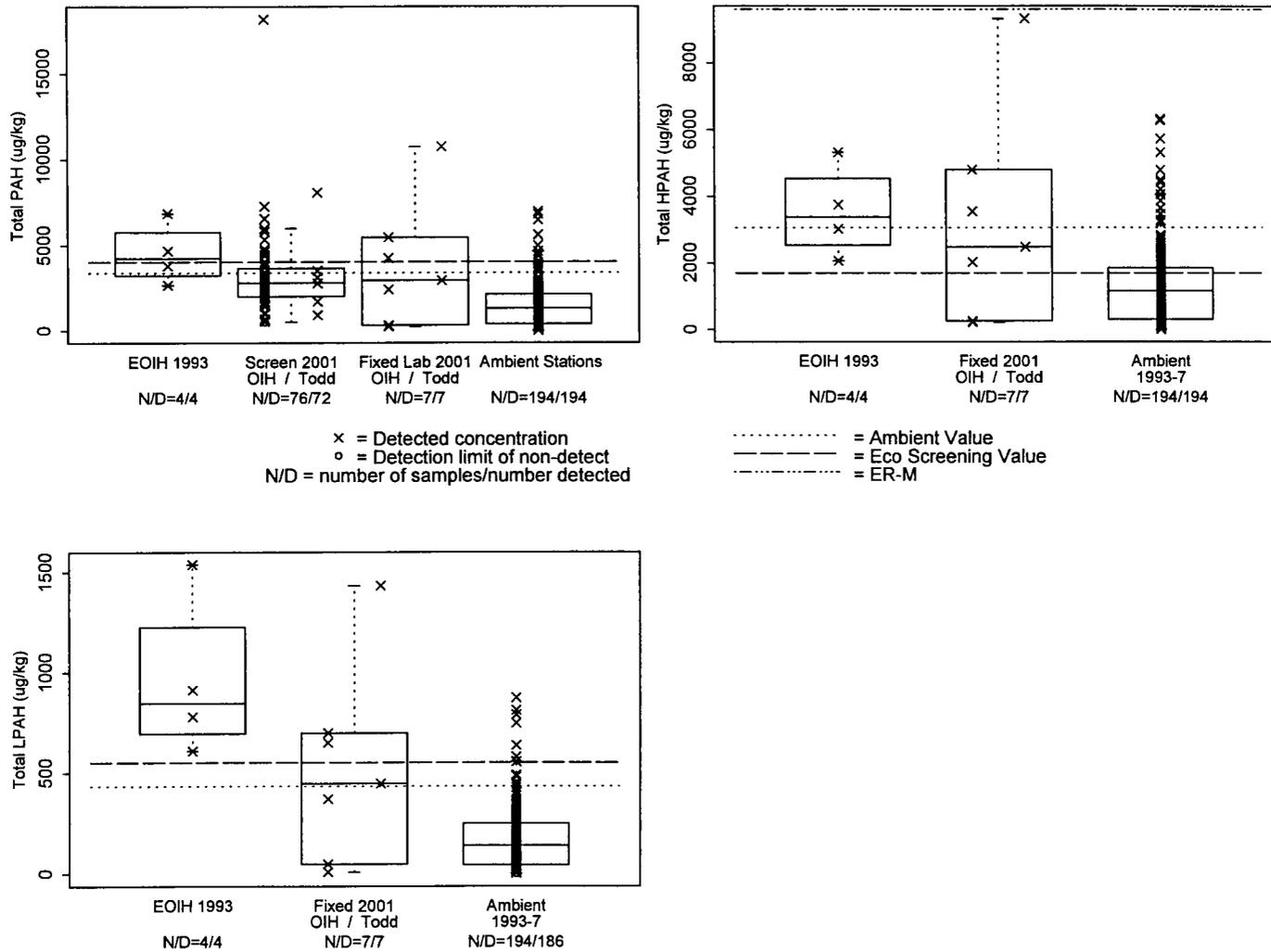


Figure 22. Plots of Surface Sediment Concentrations of Organics: Total PAH, Total HPAH, and Total LPAH

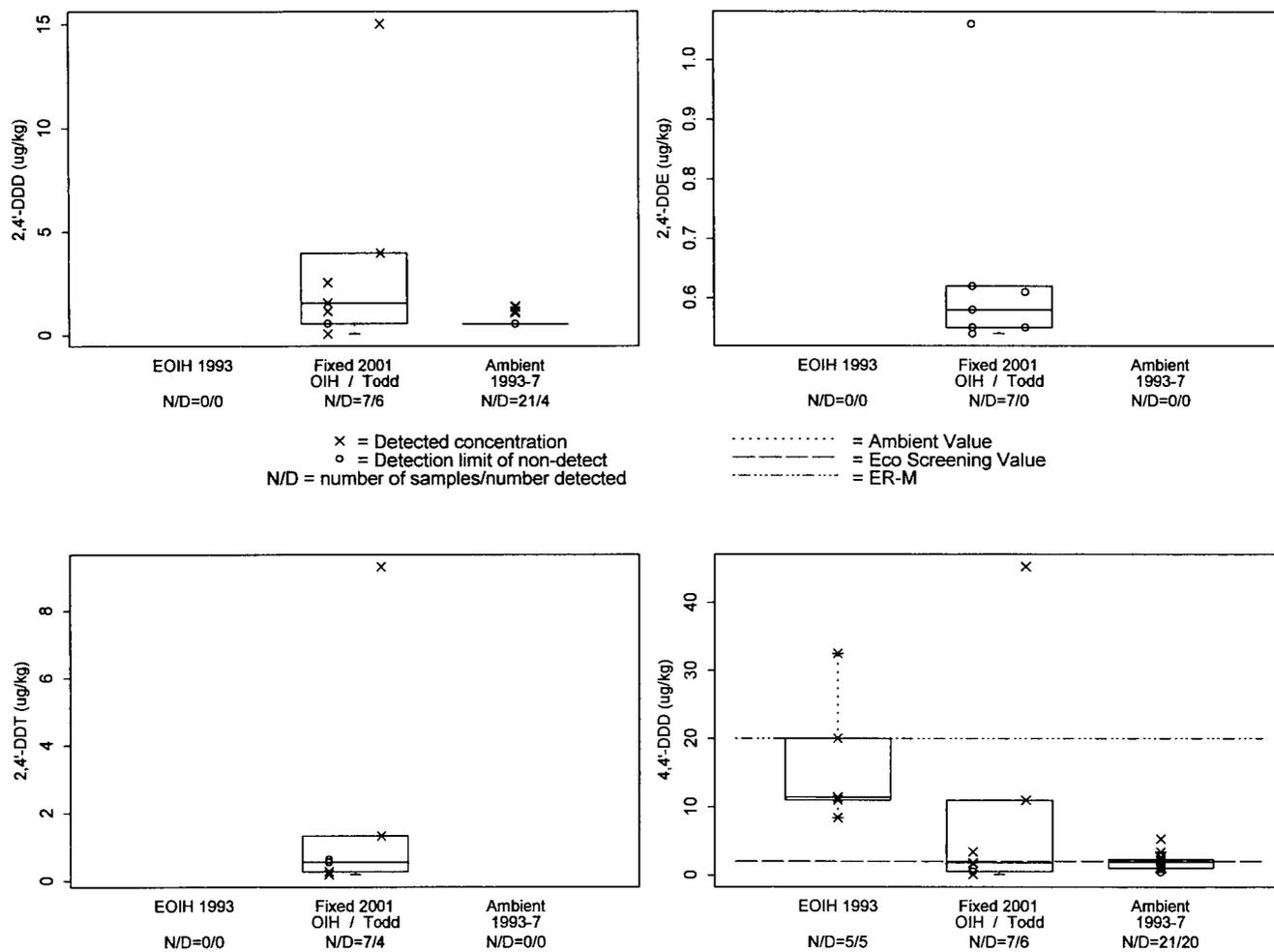


Figure 23. Plots of Surface Sediment Concentrations of Organics: 2,4'-DDD, 2,4'-DDE, 2,4'-DDT, and 4,4'-DDD

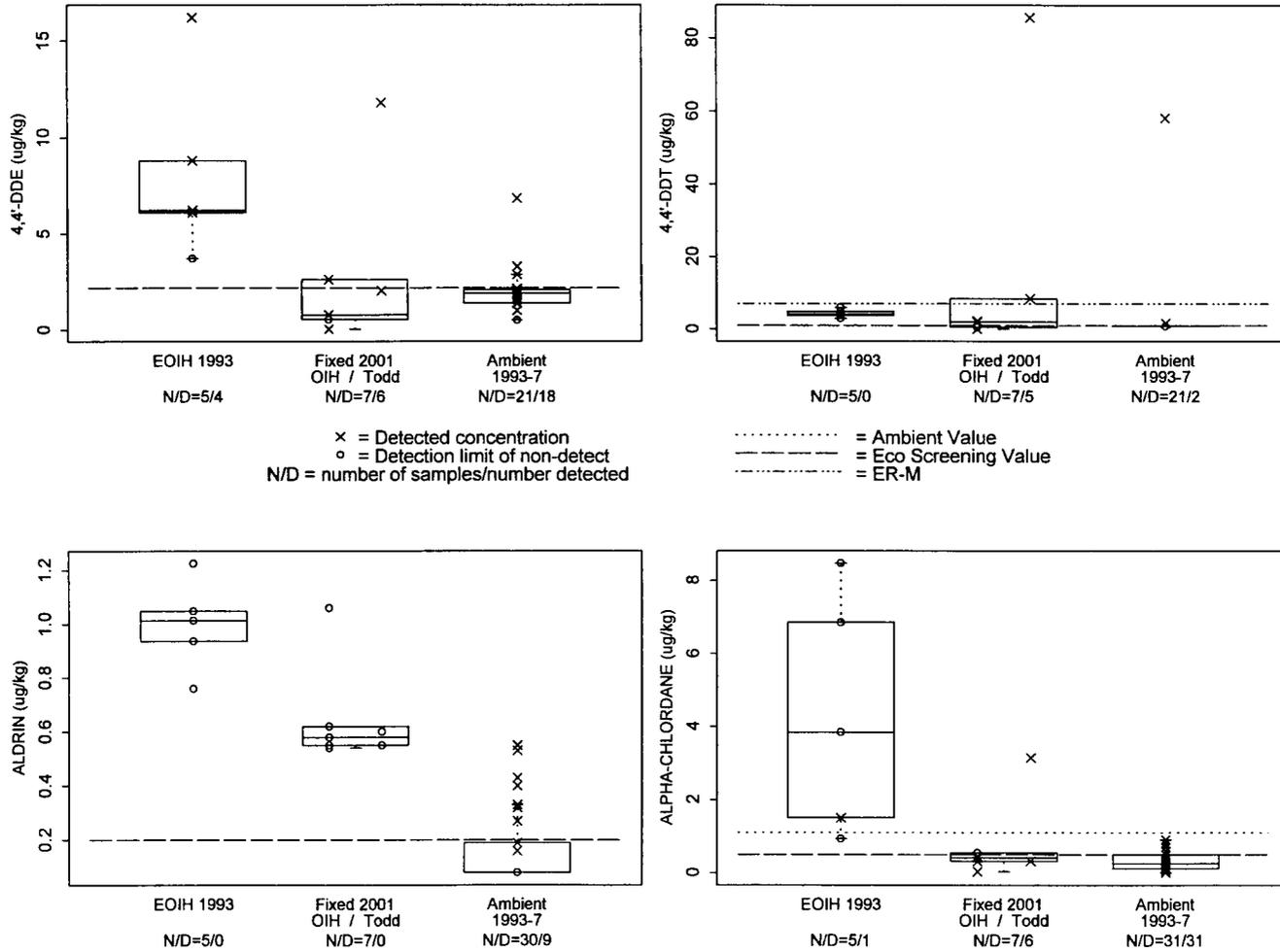


Figure 24. Plots of Surface Sediment Concentrations of Organics: 4,4'-DDE, 4,4'-DDT, Aldrin, and *alpha*-Chlordane

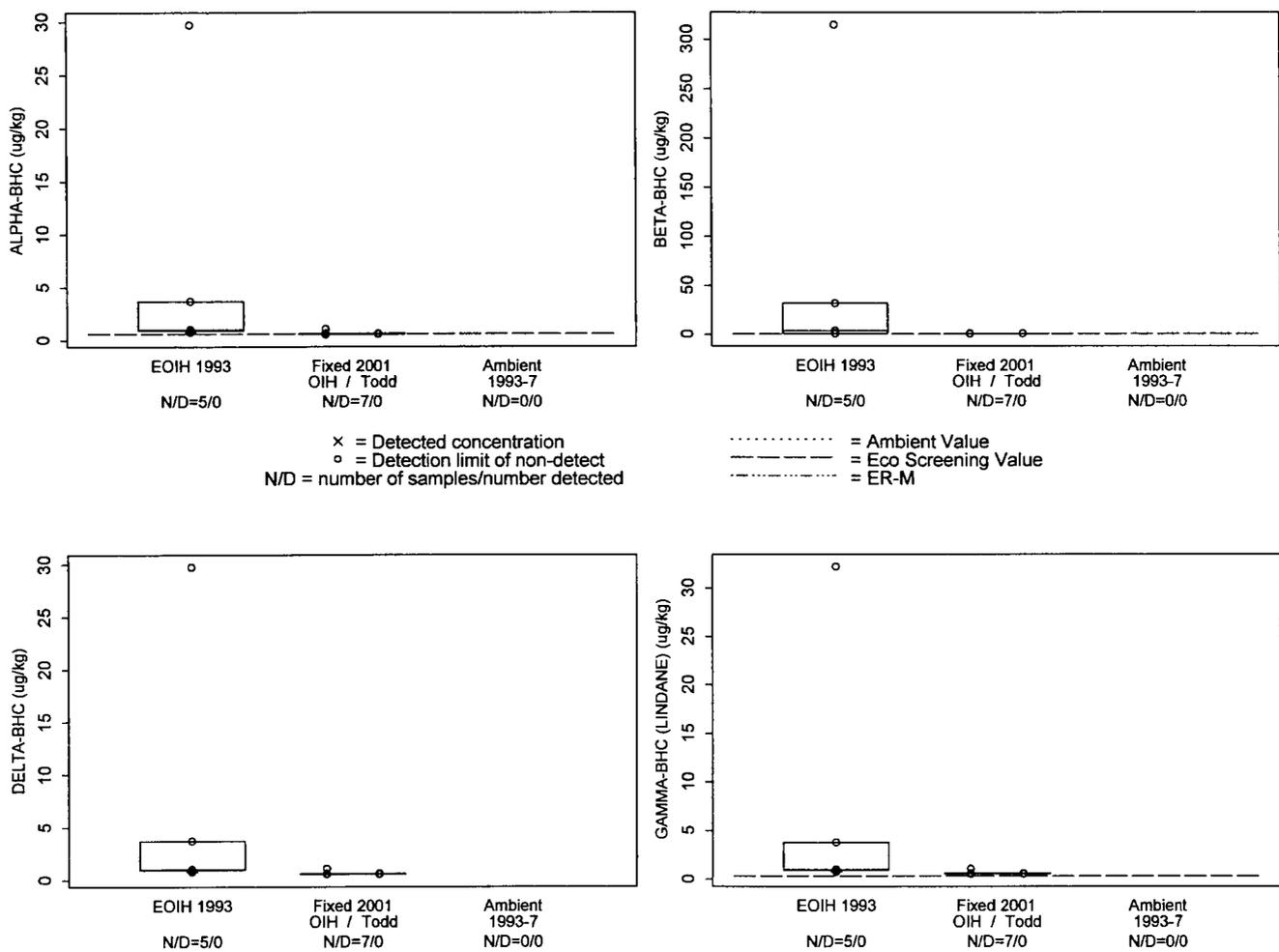


Figure 25. Plots of Surface Sediment Concentrations of Organics: *alpha*-BHC, *beta*-BHC, *delta*-BHC, and *gamma*-BHC

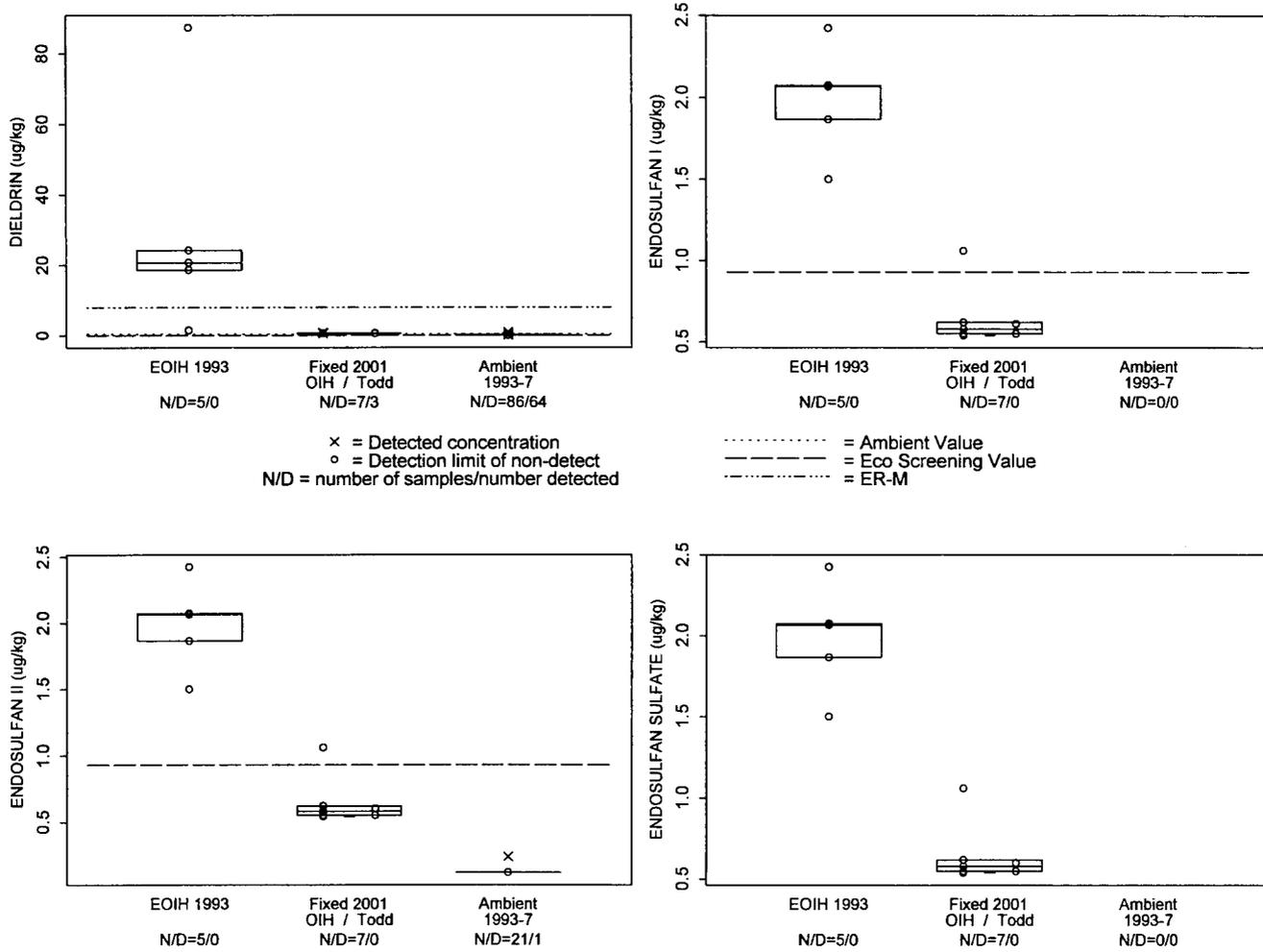


Figure 26. Plots of Surface Sediment Concentrations of Organics: Dieldrin, Endosulfan, Endosulfan II, and Endosulfan Sulfate

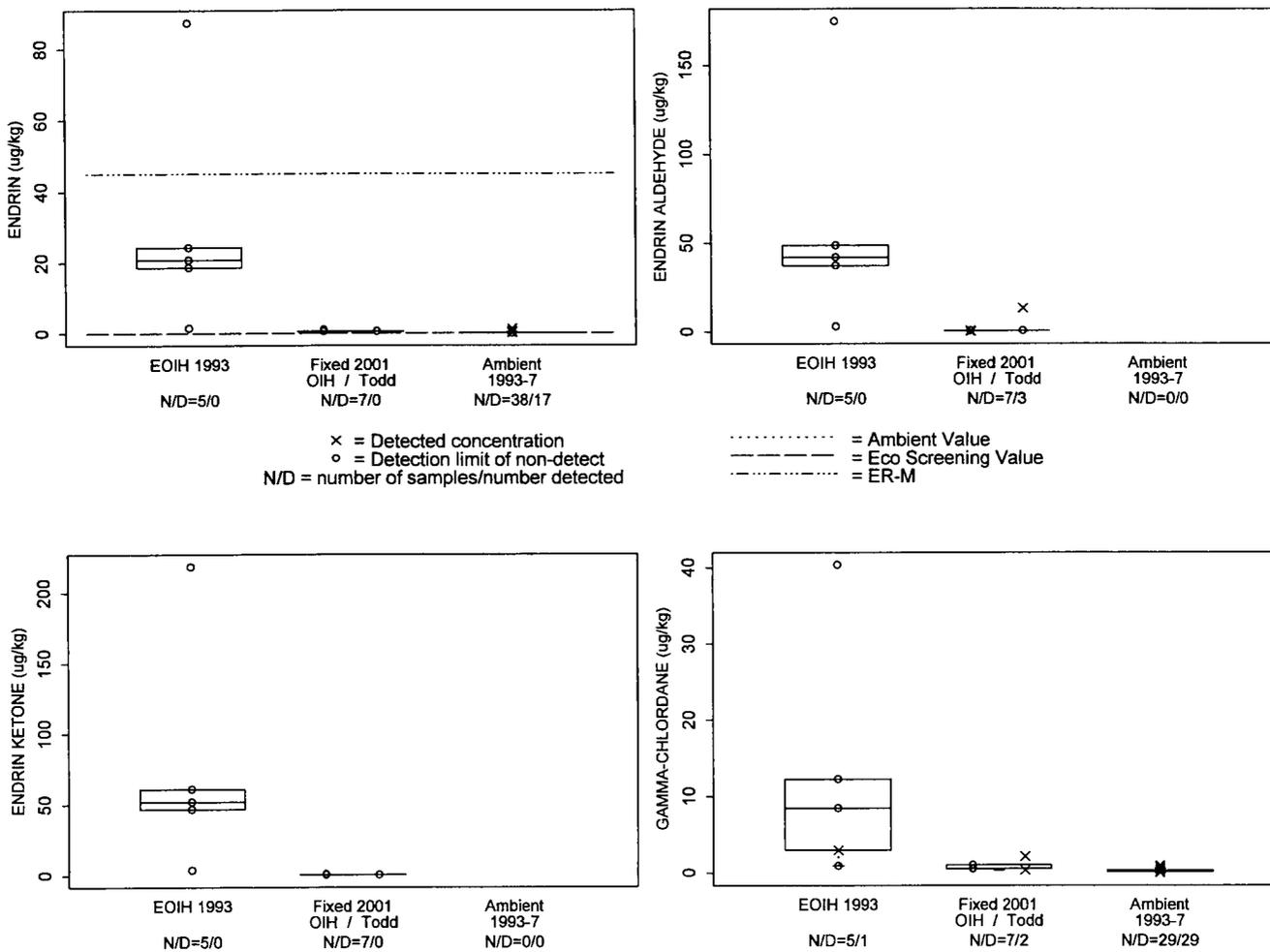
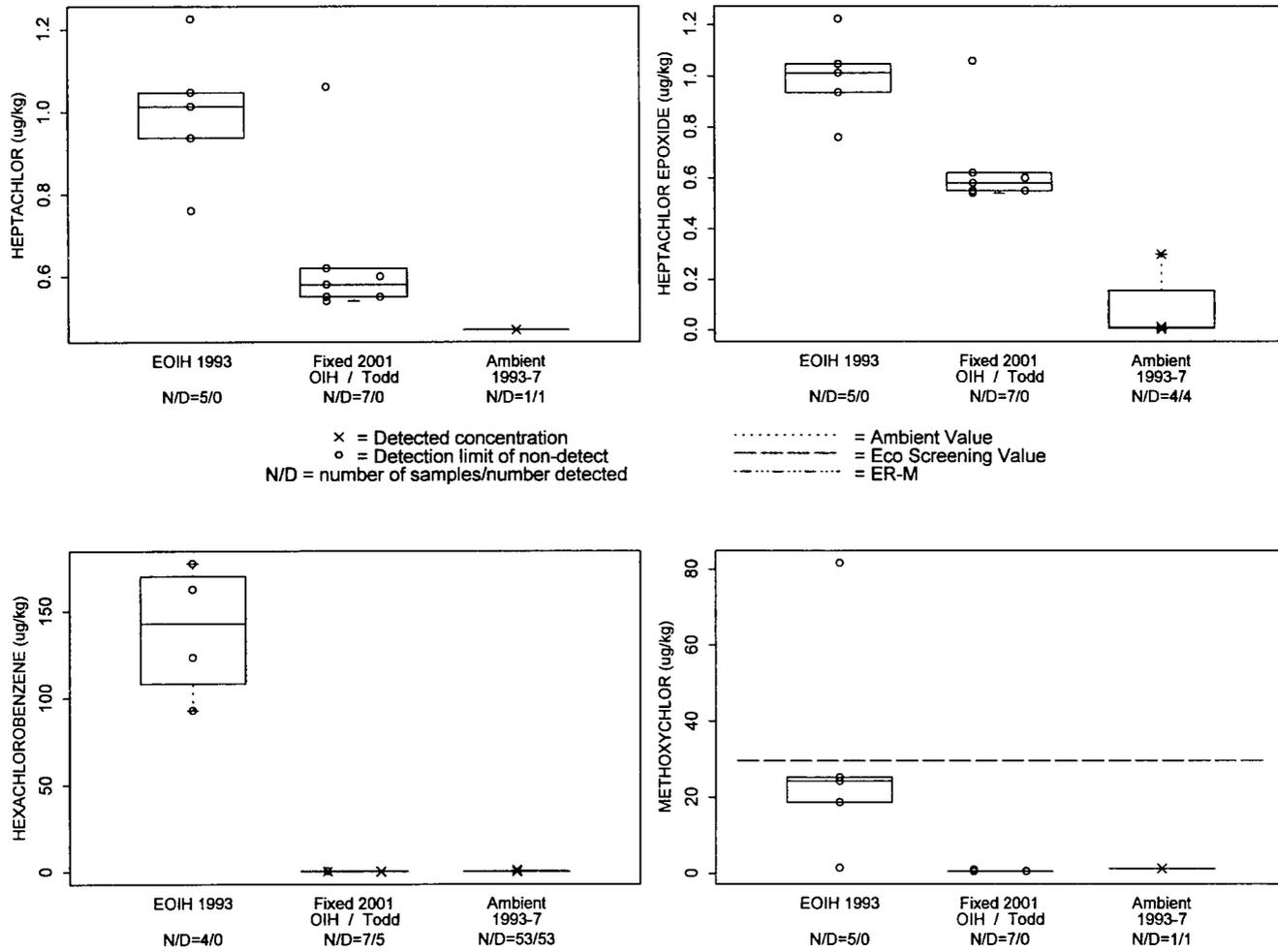


Figure 27. Plots of Surface Sediment Concentrations of Organics: Endrin, Endrin Aldehyde, Endrin Ketone, and gamma-Chlordane



**Figure 28. Plots of Surface Sediment Concentrations of Organics: Heptachlor, Heptachlor Epoxide, Hexachlorobenzene, and Methoxychlor**

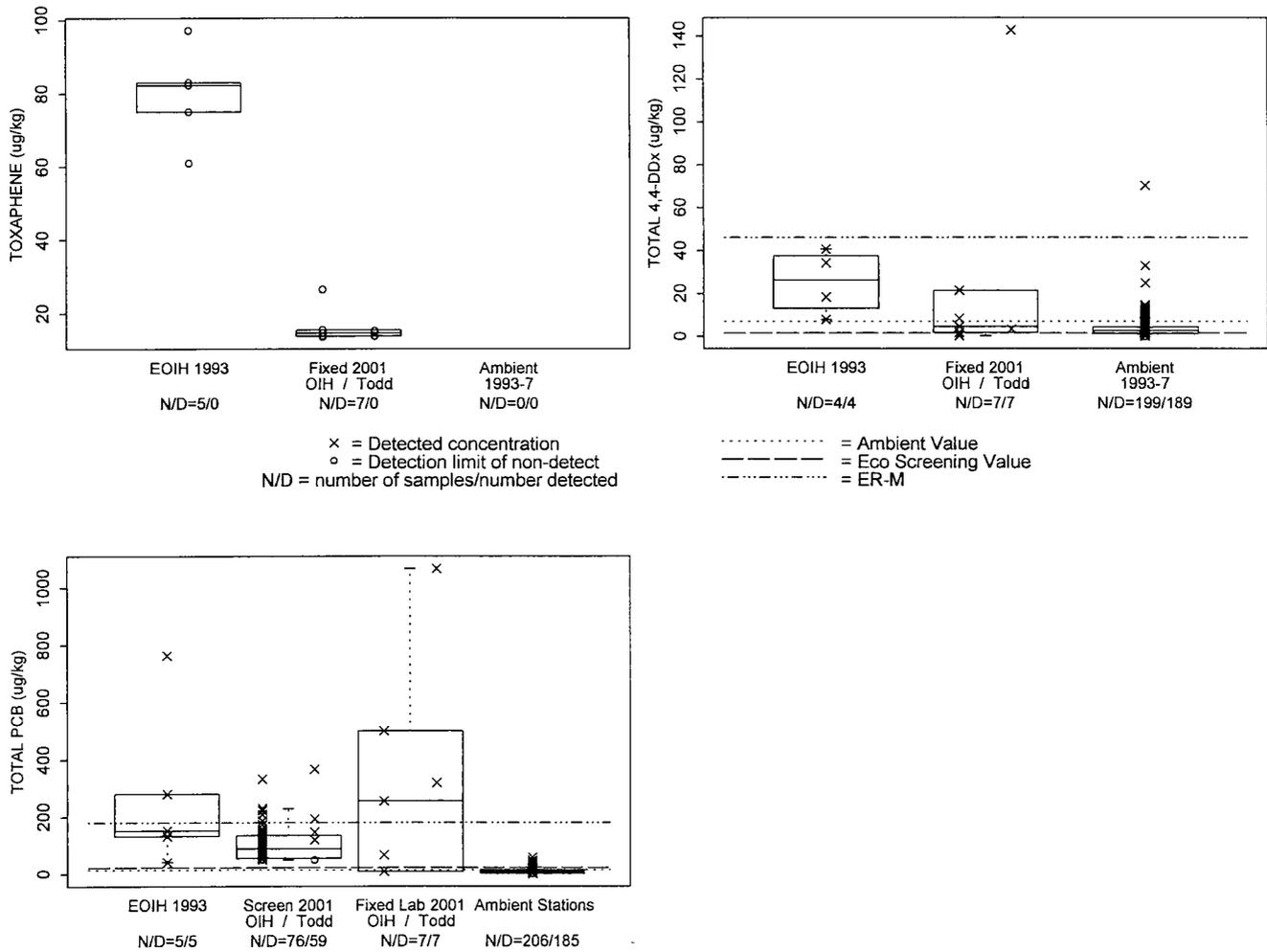


Figure 29. Plots of Surface Sediment Concentrations of Organics: Toxaphene, Total 4,4'-DDT, and Total PCB

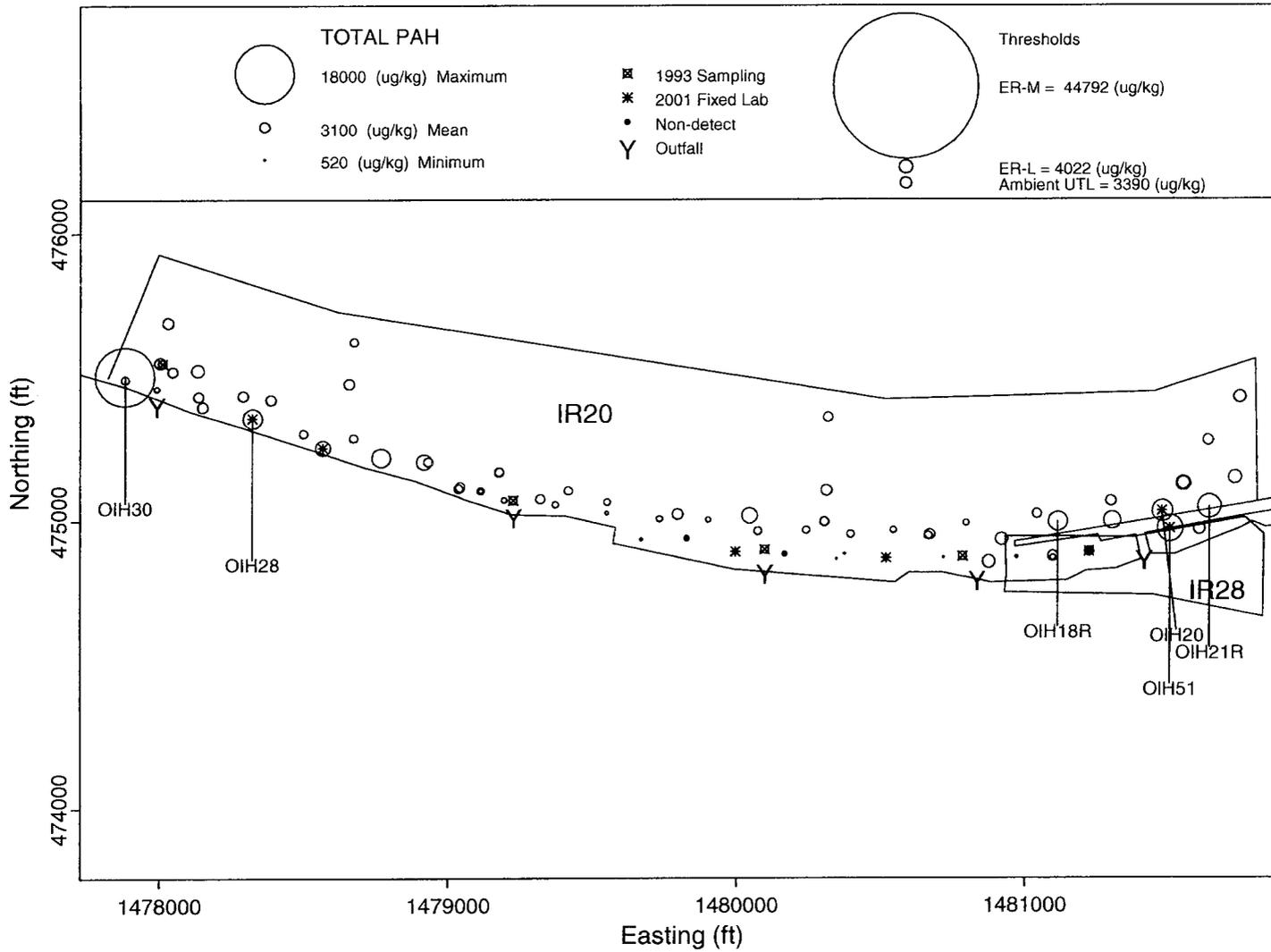


Figure 30. Bubble Plot of Surface Sediment Concentrations of Total PAH from 2001 Screening Results

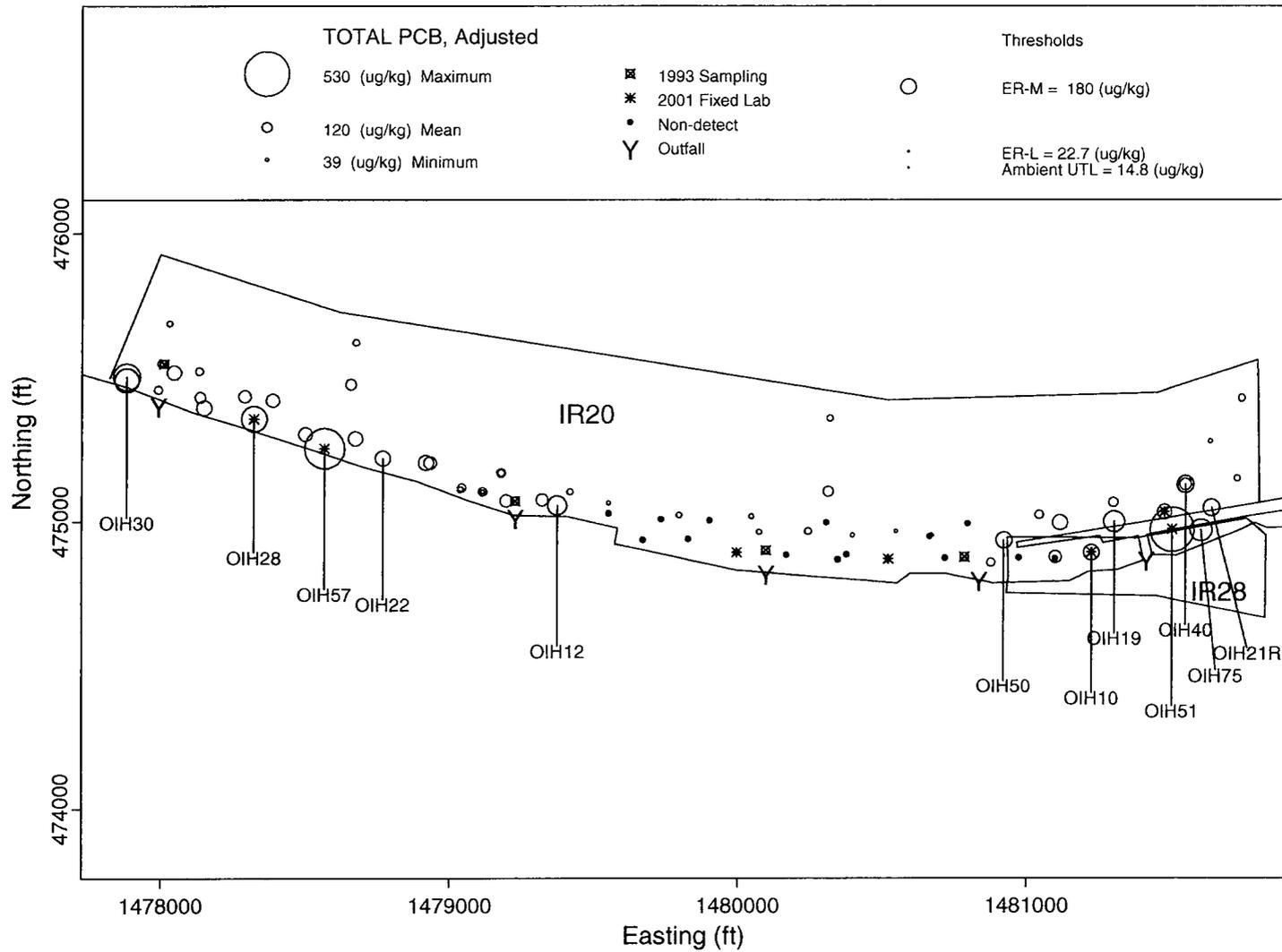


Figure 31. Bubble Plot of Surface Sediment Concentrations of Total PCB, with Adjusted Screening Results Based on Regression

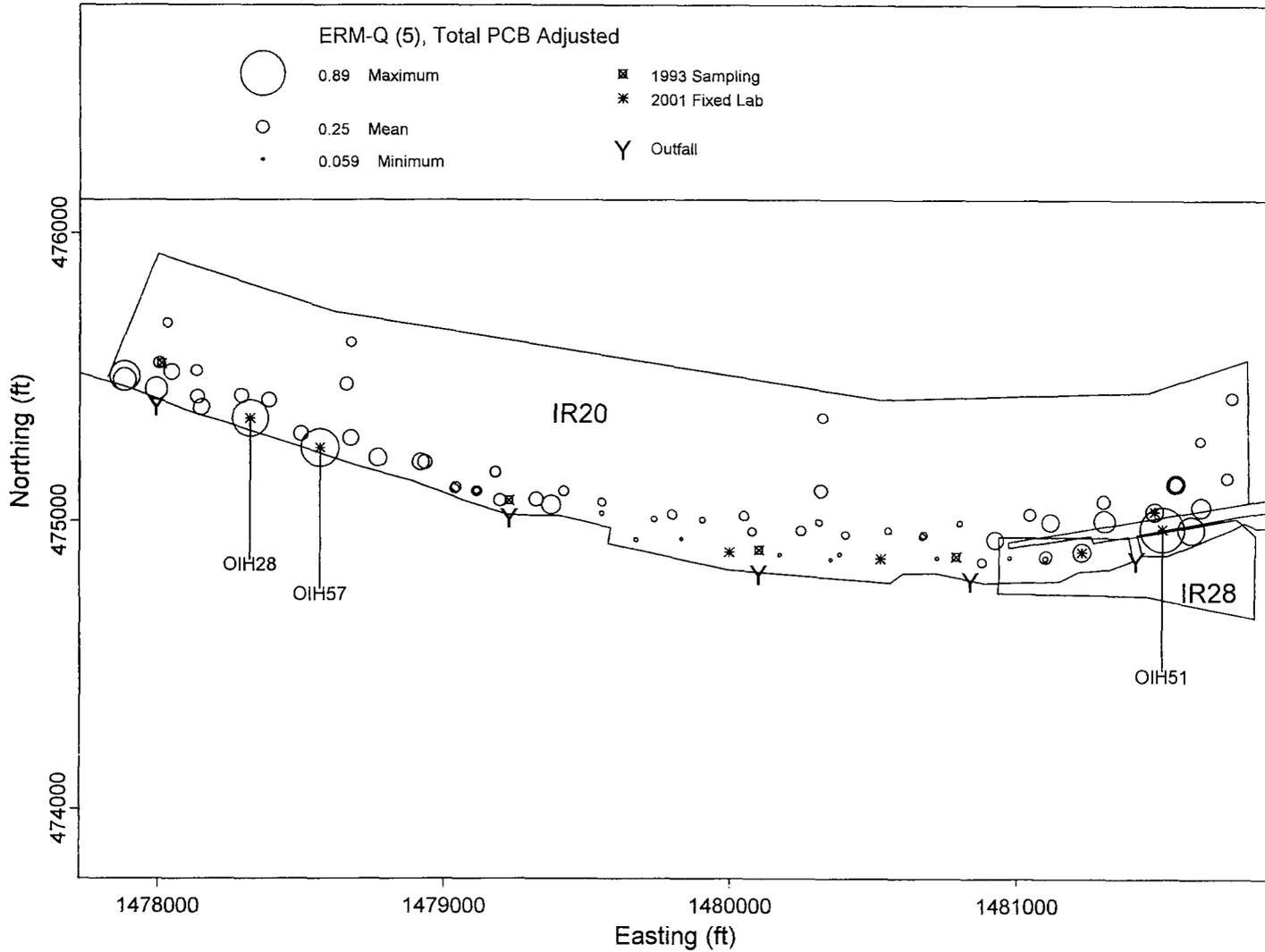


Figure 32. Bubble Plot of Surface Sediment Concentrations of ERM-Q(5) with Total PCB Adjusted Results Based on Regression

# TABLES

FINAL  
TECHNICAL MEMORANDUM  
OAKLAND HARBOR AND TODD SHIPYARD  
DATED 28 NOVEMBER 2001

Table 1. Summary of Bird Survey Data Collected in Oakland Inner Harbor

Common Name	Scientific Name	Total Number Observed In Winter	Total Number Observed In Summer	Primary Feeding Habitat	Observed Feeding at Oakland Inner Harbor?
Common loon	<i>Gavia immer</i>	7	–	Water column	Y
Pacific loon	<i>Gavia pacifica</i>	1	–	Water column	Y
Red-throated loon	<i>Gavia stellata</i>	2	–	Water column	Y
Pied-billed grebe	<i>Podilymbus podiceps</i>	4	–	Benthos	Y
Horned grebe	<i>Podiceps auritus</i>	18	–	Benthos	Y
Western grebe	<i>Aechmophorus occidentalis</i>	45	–	Benthos	Y
Clark's grebe	<i>Aechmophorus clarkii</i>	9	–	Benthos	Y
Unspecified grebe species	<i>Aechmophorus sp.</i>	198	–	Benthos	Y
California brown pelican <sup>(a)</sup>	<i>Pelecanus occidentalis</i>	–	1	Water column	NR <sup>(b)</sup>
Double-crested cormorant	<i>Phalacrocorax auritus</i>	29	3	Water column	Y
Great egret	<i>Casmerodius albus</i>	–	2	Shoreline	NR
Snowy egret	<i>Egretta thula</i>	1	7	Shoreline	Y
Black-crowned night heron	<i>Nycticorax nycticorax</i>	–	1	Upland/tidal edge	NR
Great blue heron	<i>Ardea herodias</i>	–	1	Shoreline	NR
Canada goose	<i>Branta canadensis</i>	–	2	Upland/shoreline	NR
Mallard	<i>Anas platyrhynchos</i>	13	6	Shoreline	Y
American wigeon	<i>Anas americana</i>	44	–	Shoreline	Y
Common goldeneye	<i>Bucephala clangula</i>	6	–	Shoreline/shallow benthos	Y
Bufflehead	<i>Bucephala albeola</i>	5	–	Water column/benthos	Y
American coot	<i>Fulica americana</i>	146	–	Shoreline/shallow benthos	Y
Black bellied plover	<i>Pluvialis squatarola</i>	1	–	Shoreline	N
Willet	<i>Catoptrophorus semipalmatus</i>	3	–	Tidal edge	Y
Mew gull	<i>Larus canus</i>	107	–	Upland	Y
California gull	<i>Larus californicus</i>	161	19	Upland	N
Western gull	<i>Larus occidentalis</i>	203	31	Upland	Y
Glaucous-winged gull	<i>Larus hyperboreus</i>	1	2	Upland	Y

Table 1. Summary of Bird Survey Data Collected in Oakland Inner Harbor (Continued)

Common Name	Scientific Name	Total Number Observed In Winter	Total Number Observed In Summer	Primary Feeding Habitat	Observed Feeding at Oakland Inner Harbor?
Unspecified gull species	<i>Larus sp.</i>	692	488	Upland	Y
Forster's tern	<i>Sterna forsteri</i>	2	5	Water column	Y
California least tern <sup>(a)</sup>	<i>Sterna antillarum browni</i>	–	34	Water column	NR
Caspian tern	<i>Sterna caspia</i>	–	12	Water column	NR
Rock dove	<i>Columba livia</i>	79	33	Upland	Y
Mourning dove	<i>Zenaida macroura</i>	2	1	Upland	Y
American crow	<i>Corvus brachyrhynchos</i>	10	–	Upland	N
European starling	<i>Sturnus vulgaris</i>	4	–	Upland	N
Red-winged blackbird	<i>Agelaius phoeniceus</i>	–	2	Upland	NR
House finch	<i>Carpodacus mexicanus</i>	6	–	Upland	Y
Black phoebe	<i>Sayornis nigricans</i>	–	1	Upland	Y
House sparrow	<i>Passer domesticus</i>	15	4	Upland	Y

(a) Designated endangered species under state and federal regulations (U.S. Fish and Wildlife Service, 2001).

(b) NR = Behavioral descriptions were not included in summer surveys.

Table 2. Metals in Sediment Screening Samples, Oakland Inner Harbor and Todd Shipyard

IR Site	Station	Date	Type of Sample	Metals (mg/kg dry weight)																							
				As ppm	As Q	As Stdev	Cr ppm	Cr Q	Cr Stdev	Cu ppm	Cu Q	Cu Stdev	Fe ppm	Fe Q	Fe Stdev	Mn ppm	Mn Q	Mn Stdev	Ni ppm	Ni Q	Ni Stdev	Pb ppm	Pb Q	Pb Stdev	Zn ppm	Zn Q	Zn Stdev
20	OIH1	03/12/2001	Surface Sample	3	b		392			13	b		10,590			244			7	b		11			22		
20	OIH2R	03/12/2001	Surface Sample	2	b		1628			7	b		20,630			484			ND	a		11			39		
20	OIH2R-E	03/13/2001	Surface Sample	3	b		737			11	b		13,470			324			17	b		10			36		
20	OIH3	03/12/2001	Surface Sample	3	b		596			13	b		14,760			375			24	b		11			37		
20	OIH4	03/12/2001	Surface Sample	2	b		300			8	b		10,260			318			10	b		13			26		
20	OIH4 DUP R	03/13/2001	Surface Sample	5	b		347			15	b		14,910			368			29	b		11			50		
20	OIH5	03/12/2001	Surface Sample	2	b	1	690		137	10	b	1	14,793		0.194	377		40	13	b	6	11		2	30		0
20	OIH6	03/12/2001	Surface Sample	6	b		379			11	b		12,470			321			19	b		12			37		
20	OIH7	03/12/2001	Surface Sample	ND	a		190			21			10,920			314			16	b		20			33		
20	OIH11	03/12/2001	Surface Sample	6	b		214			23			14,390			447			13	b		20			77		
20	OIH12	03/12/2001	Surface Sample	7	b		243			42			28,480			372			53			29			119		
20	OIH13	03/12/2001	Surface Sample	4	b		318			24			14,720			361			11	b		22			40		
20	OIH14	03/12/2001	Surface Sample	7	b		146			40			30,210			376			38			13			78		
20	OIH15	03/12/2001	Surface Sample	2	b		188			34			30,670			501			41			17			83		
20	OIH16	03/12/2001	Surface Sample	5	b		165			39			31,400			419			48			20			87		
20	OIH17	03/12/2001	Surface Sample	9	b		240			39			30,370			445			49			21			92		
20	OIH18R	03/13/2001	Surface Sample	9	b		129			50			35,400			357			56			27			116		
20	OIH19	03/12/2001	Surface Sample	11	b		132			58			35,620			416			71			28			120		
20	OIH20	03/12/2001	Surface Sample	9	b		145			59			37,390			376			59			26			134		
20	OIH21R	03/13/2001	Surface Sample	7	b		139			61			36,430			341			82			27			131		
20	OIH22	03/12/2001	Surface Sample	3	b	0	282		35	54	b	6	24,090		0.054	301		16	70		14	48		5	99		6
20	OIH23R	03/13/2001	Surface Sample	9	b		177			49			33,030			325			66			21			108		
20	OIH24	03/12/2001	Surface Sample	3	b		160			33			18,060			303			32	b		23			62		
20	OIH24 COMP DUP	03/12/2001	Surface Sample	5	b		217			32			19,330			286			39			16			75		
20	OIH25	03/12/2001	Surface Sample	9	b		122			55			33,500			330			61			18			106		
20	OIH26	03/13/2001	Surface Sample	9	b		140			58			37,290			313			71			25			127		
20	OIH27	03/13/2001	Surface Sample	8	b		160			43			22,790			268			51			32			106		
20	OIH27R	03/14/2001	Surface Sample	9	b		141			56			35,130			362			52			25			120		
20	OIH28	03/13/2001	Surface Sample	ND	a		558			136			31,480			448			164			176			214		
20	OIH29	03/13/2001	Surface Sample	9	b		175			49			30,010			341			50			22			91		
20	OIH30	03/13/2001	Surface Sample	9	b		204			48			25,780			409			34			46			180		
20	OIH30 DUP	03/13/2001	Surface Sample	6	b		205			54			28,210			395			64			42			100		
20	OIH30R	03/14/2001	Surface Sample	15	b		152			60			24,320			418			44			263			104		
20	OIH31	03/13/2001	Surface Sample	10	b		141			52			35,710			330			72			23			114		
20	OIH32	03/12/2001	Surface Sample	6	b		151			47			35,080			296			70			18			103		
20	OIH33	03/12/2001	Surface Sample	8	b		152			45			34,750			345			88			19			102		
20	OIH34	03/12/2001	Surface Sample	8	b		173			46			34,760			342			49			19			101		
20	OIH35	03/12/2001	Surface Sample	10	b		150			38			32,530			294			58			19			92		
20	OIH35 COMP DUP	03/12/2001	Surface Sample	10	b		218			39			32,860			344			56			13			99		
20	OIH36	03/12/2001	Surface Sample	5	b		152			43			31,480			347			46			16			81		
20	OIH37	03/12/2001	Surface Sample	5	b		157			31			30,160			334			70			16			75		
20	OIH38	03/12/2001	Surface Sample	12	b		140			53			35,380			298			65			18			115		
20	OIH39	03/13/2001	Surface Sample	11	b		133			57			36,410			372			56			22			123		
20	OIH40	03/13/2001	Surface Sample	9	b	0	133		9	54		8	35,483		0.051	402		11	67		9	25		3	118		2
20	OIH40 DUP	03/13/2001	Surface Sample	8	b		137			50			35,940			352			66			24			122		
20	OIH40 COMP DUP	03/13/2001	Surface Sample	11	b		123			51			36,010			402			66			23			114		

Table 2. Metals in Sediment Screening Samples, Oakland Inner Harbor and Todd Shipyard (Continued)

IR Site	Station	Date	Type of Sample	Metals (mg/kg dry weight)																								
				As ppm	Q	As Stdev	Cr ppm	Q	Cr Stdev	Cu ppm	Q	Cu Stdev	Fe ppm	Q	Fe Stdev	Mn ppm	Q	Mn Stdev	Ni ppm	Q	Ni Stdev	Pb ppm	Q	Pb Stdev	Zn ppm	Q	Zn Stdev	
20	OIH41	03/13/2001	Surface Sample	8	b		232			58			33,170			333			83			23			110			
20	OIH42	03/13/2001	Surface Sample	13	b		149			45			35,190			271			75			28			115			
20	OIH43	03/13/2001	Surface Sample	9	b		149			46			31,810			305			69			16			97			
20	OIH43 COMP DUP	03/13/2001	Surface Sample	9	b		142			51			34,890			320			59			18			103			
20	OIH44	03/13/2001	Surface Sample	13	b		131			50			36,560			327			69			21			110			
20	OIH45R	03/13/2001	Surface Sample	9	b		185			39			31,380			337			48			18			95			
20	OIH45 DUP	03/12/2001	Surface Sample	7	b		215			36			25,870			349			48			18			81			
20	OIH46	03/13/2001	Surface Sample	7	b		130			53			35,330			381			73			24			114			
20	OIH47	03/13/2001	Surface Sample	8	b		111			53			35,620			376			63			21			109			
20	OIH48	03/13/2001	Surface Sample	10	b		147			49			34,720			359			71			21			105			
20	OIH49	03/12/2001	Surface Sample	8	b		187			45			31,240			351			52			16			92			
20	OIH50	03/12/2001	Surface Sample	6	b		142			49			32,740			360			69			23			109			
20	OIH52	03/13/2001	Surface Sample	11	b		164			51			35,480			367			67			16			111			
20	OIH53	03/13/2001	Surface Sample	11	b		128			52			36,320			342			79			14			106			
20	OIH54	03/13/2001	Surface Sample	10	b		145			45			38,440			341			61			24			121			
20	OIH55	03/13/2001	Surface Sample	4	b	2	428		126	19		5	13,903		0.058	286		14	13		b	3	18		2	40		5
20	OIH56	03/13/2001	Surface Sample	5	b		195			30			24,900			364			46			18			74			
20	OIH56 DUP	03/13/2001	Surface Sample	4	b		267			47			24,990			339			54			22			85			
20	OIH57	03/13/2001	Surface Sample	1	b		401			111			28,530			530			85			70			129			
20	OIH76	03/14/2001	Surface Sample	7	b		153			49			35,710			320			58			21			106			
20	OIH77	03/14/2001	Surface Sample	9	b		141			47			35,260			346			56			15			106			
20	OIH78	03/14/2001	Surface Sample	9	b		158			33			35,220			346			58			20			107			
20	OIH79	03/14/2001	Surface Sample	7	b		151			44			35,320			307			63			16			95			
20	OIH80	03/14/2001	Surface Sample	10	b		137			39			35,020			340			61			20			100			
20	OIH81	03/14/2001	Surface Sample	12	b		137			59			37,770			405			84			28			116			
28	OIH8	03/14/2001	Surface Sample	4	b		429			11		b	12,220			369			21		b	16			40			
28	OIH9	03/14/2001	Surface Sample	5	b		476			23			13,700			374			20		b	27			51			
28	OIH9 DUP	03/14/2001	Surface Sample	1	b		221			30			13,020			269			25		b	26			52			
28	OIH10	03/14/2001	Surface Sample	3	b	1	314		76	52		16	14,237		0.123	178		21	38			20	50		7	107		19
20	OIH51	03/14/2001	Surface Sample	6	b		374			105			30,580			331			76			100			200			
28	OIH75	03/14/2001	Surface Sample	1	b		688			87			29,150			429			201			93			179			

a = No detection (ND) by instrument.

b = Value less than reliable detection limit (RDL).

**Table 3. Total Polychlorinated Biphenyls and Total Polycyclic Aromatic Hydrocarbons in Sediment Screening Samples, Oakland Inner Harbor and Todd Shipyard**

IR Site	Station	Polychlorinated Biphenyls and Polycyclic Aromatic Hydrocarbons (µg/kg dry weight)							
		PCB				PAH			
		(µg/kg)	Q	Stdev	%RSD	(µg/kg)	Q	Stdev	%RSD
20	OIH1	4	U	-	-	490	U	9	1.82%
20	OIH2R	46	U	0.2	0.52%	455	U	8	1.67%
20	OIH2R-E	8	U	4	54.55%	462	U	7	1.46%
20	OIH3	3	U	-	-	458	U	18	3.88%
20	OIH4	7	U	7	91.36%	519	J	24	4.57%
20	OIH4 DUP R	8	U	3	41.57%	667	J	-	-
20	OIH5	23	U	1	3.04%	498	U	12	2.50%
20	OIH5-E	16	U	10	63.87%	480	U	10	2.16%
20	OIH6	48	U	-	-	565	J	-	-
20	OIH7	89	J	18	20.22%	3,937		368	9.34%
20	OIH11	120		-	-	1,709	J	199	11.62%
20	OIH12	172		19	10.80%	1,965	J	-	-
20	OIH13	44	U	-	-	1,043	J	-	-
20	OIH14	24	U	-	-	1,913	J	-	-
20	OIH15	33	U	-	-	1,562	J	-	-
20	OIH16	66	J	-	-	2,419		-	-
20	OIH17	78	J	-	-	2,282		-	-
20	OIH18R	142		-	-	5,848		-	-
20	OIH19	186		35	18.72%	5,338		-	-
20	OIH20	149		33	22.11%	7,191		1,619	22.51%
20	OIH20-E	128		6	4.48%	5,929		425	7.17%
20	OIH21R	154		6	3.97%	7,271		1,561	21.46%
20	OIH22	142		-	-	5,791		1,738	30.02%
20	OIH23R	121		-	-	2,705		-	-
20	OIH24	90	J	14	15.72%	2,125		135	6.36%
20	OIH24 COMP DUP	55	J	30	54.95%	1,409	J	-	-
20	OIH25	118		-	-	2,812		-	-
20	OIH26	75	J	-	-	4,041		759	18.77%
20	OIH27	141		22	15.93%	3,290		367	11.15%
20	OIH27R	107		-	-	3,117		-	-
20	OIH28	313		6	2.00%	6,822		1,093	16.02%
20	OIH28-E	132		5	3.87%	5,123		325	6.34%
20	OIH29	131		-	0.00%	2,558		-	-
20	OIH30	230		26	11.51%	18,160		7,158	39.42%
20	OIH30 DUP	209		32	15.19%	2,446		-	-
20	OIH30R	86	J	6	7.46%	1,625	J	-	-
20	OIH31	144		-	-	2,337		-	-
20	OIH32	56	J	6	10.82%	2,045		-	-
20	OIH33	68	J	-	-	3,270		-	-
20	OIH34	64	J	-	-	4,779		192	4.02%
20	OIH35	44	U	18	41.31%	2,647		-	-
20	OIH35 COMP DUP	48	U	6	13.35%	2,795		-	-
20	OIH36	51	J	-	-	1,982	J	-	-
20	OIH37	33	U	-	-	1,887	J	-	-
20	OIH38	90	J	-	-	2,867		-	-

**Table 3. Total Polychlorinated Biphenyls and Total Polycyclic Aromatic Hydrocarbons in Sediment Screening Samples, Oakland Inner Harbor and Todd Shipyard (Continued)**

IR Site	Station	Polychlorinated Biphenyls and Polycyclic Aromatic Hydrocarbons ( $\mu\text{g}/\text{kg}$ dry weight)							
		PCB ( $\mu\text{g}/\text{kg}$ )				PAH ( $\mu\text{g}/\text{kg}$ )			
		Q	Stdev	%RSD	Q	Stdev	%RSD		
20	OIH39	99	J	-	-	3,131	-	-	
20	OIH40	157		5	3.18%	4,393	723	16.45%	
20	OIH40 DUP	119		24	20.10%	4,451	-	-	
20	OIH40 COMP DUP	116		11	9.79%	3,898	-	-	
20	OIH41	135		58	42.62%	2,484	-	-	
20	OIH42	141		-	-	4,680	1,848	39.49%	
20	OIH43	92	J	31	33.80%	2,611	-	-	
20	OIH43 COMP DUP	79	J	14	17.27%	2,777	-	-	
20	OIH44	72	J	-	-	2,548	-	-	
20	OIH45 DUP	58	J	16	28.40%	3,014	-	-	
20	OIH45R	46	U	8	16.62%	2,329	-	-	
20	OIH46	134		36	26.74%	3,039	-	-	
20	OIH47	119		-	-	3,067	-	-	
20	OIH48	126		-	-	3,183	-	-	
20	OIH49	57	J	-	-	2,237	-	-	
20	OIH50	150		27	17.88%	3,792	532	14.03%	
20	OIH52	106		-	-	3,159	-	-	
20	OIH53	104		-	-	3,338	-	-	
20	OIH54	60	J	-	-	3,243	-	-	
20	OIH55	9	U	-	-	976	J	-	-
20	OIH56	89	J	-	-	2,959	53	1.78%	
20	OIH56 DUP	71	J	1	2.09%	2,668	-	-	
20	OIH57	298		21	6.97%	3,933	460	11.70%	
20	OIH57-E	368		5	1.44%	5,342	366	6.85%	
20	OIH76	90	J	-	-	3,432	225	6.54%	
20	OIH77	85	J	-	-	3,902	413	10.60%	
20	OIH78	70	J	-	-	3,356	176	5.25%	
20	OIH79	76	J	-	-	2,540	81	3.18%	
20	OIH80	75	J	-	-	2,907	394	13.55%	
20	OIH81	80	J	-	-	3,771	480	12.72%	
				-	-		-	-	
28	OIH8	34	U	-	-	900	J	-	-
28	OIH9	44	U	5	11.33%	1,696	J	95	5.59%
28	OIH9 DUP	120		26	21.39%	3,117	717	22.99%	
28	OIH10	142		7	5.10%	2,683	256	9.55%	
28	OIH10-E	151		4	2.34%	2,871	37	1.27%	
20	OIH51	480		30	6.19%	7,858	1,835	23.35%	
20	OIH51-E	253		12	4.55%	8,293	41	0.49%	
28	OIH75	193		24	12.36%	3,518	210	5.97%	

Stdev = Standard Deviation from duplicate assay analyses (n=2...4).

% RSD = Percent Relative Standard Deviation whereby;  $\left\{ \frac{\text{stdev}}{\text{mean}} \right\} * 100$ .

E = Full method extraction duplicate; J = Estimated value; R = Resample; U = Nondetected.

DUP = Field duplicate.

DUP R = Field duplicate Resample.

COMP DUP = Composite duplicate.

**Table 4. Metals in Sediment Laboratory Confirmation Samples, Oakland Inner Harbor and Todd Shipyard**

Metal	Digestion/Analyses	IR Site 20						IR Site 28	
		OIH2R	OIH5	OIH20	OIH28	OIH57	OIH57	OIH10	OIH51
		03/12/01			03/13/01			03/14/01	
Surface Samples (µg/g dry weight)									
Ag	#1/GFAA <sup>(a)</sup>	0.038 J	0.051 J	0.288 J	0.067 J	0.112 J	0.069 J	0.057 J	0.154 J
Al	#2/ICP-AES <sup>(b)</sup>	38900	39800	72900	39300	39700	41200	40400	47300
As	#1/ICP-MS <sup>(a)</sup>	2.89	3.10	13.7	5.61	8.40	7.37	5.69	10.1
Ba	#2/ICP-AES <sup>(b)</sup>	440	411	435	317	355	371	476	507
Be	#1/ICP-MS <sup>(a)</sup>	0.597	0.527	1.14	0.509	0.632	0.535	0.476	0.739
Cd	#1/ICP-MS <sup>(a)</sup>	0.043 J	0.064 J	0.294 J	0.217 J	0.444 J	0.305 J	0.115 J	0.166 J
Co	#1/ICP-MS <sup>(a)</sup>	6.02	6.54	17.5	18.4	13.9	12.4	5.93	13.1
Cr	#2/ICP-AES <sup>(b)</sup>	283	291	189	1230	581	512	219	430
Cu	#1/ICP-MS <sup>(a)</sup>	5.18	6.94	74.9	141 D	119 D	149 D	45.6	131
Fe	#2/ICP-AES <sup>(b)</sup>	17100	18600	47700	37300	52100	29000	29000	30800
Hg	#1/CVAA <sup>(a)</sup>	0.0244 B	0.00660 B	0.325	0.161	0.230	0.172	0.304	0.890
Mn	#2/ICP-AES <sup>(b)</sup>	428	431	532	614	638	517	276	405
Mo	#1/ICP-MS <sup>(a)</sup>	0.434	0.641	1.12	1.33	2.84	2.55	0.552	1.77
Ni	#1/ICP-MS <sup>(a)</sup>	17.2	18.5	107	288 D	139 D	111 D	39.5	136
Pb	#1/ICP-MS <sup>(a)</sup>	10.7	10.9	40.5	186 D	310 D	141 D	55.3	106
Sb	#1/ICP-MS <sup>(a)</sup>	0.420	0.363	1.12	0.703	1.76	1.34	4.21	5.41
Se	#1/FIAS <sup>(a)</sup>	0.368 J	0.046 U	0.471 J	0.154 J	0.141 J	0.156 J	0.057 J	0.204 J
V	#2/ICP-AES <sup>(b)</sup>	65.6	69.2	144	64.5	67.5	66.7	56.2	97.0
Zn	#1/ICP-MS <sup>(a)</sup>	32.2	37.0	169	213 D	190 D	146 D	103	258

NOTE: Data are not blank corrected.

(a) Digestion #1, Sediment Evaporation Digestion SOP MSL-I-004.

(b) Digestion #2, Total Digestion with Boric Acid Dissolution, in Mixed Acid Digestion, SOP MSL-I-006.

D = Dilution run. Initial run outside linear range of instrument.

J = Estimated value; reported value is greater than achieved MDL and less than RL.

U = Not detected at or above DL shown.

**Table 5. Chlorinated Pesticides and Polychlorinated Biphenyls in Sediment Laboratory Confirmation Samples, Oakland Inner Harbor and Todd Shipyard**

Pesticide/PCB	IR Site 20					IR Site 28	
	OIH2R	OIH5	OIH20	OIH28	OIH57	OIH10	OIH51
	03/12/2001			03/13/2001		03/14/2001	
	Surface Sample (µg/kg dry weight)						
4,4'-DDD	0.55 U	0.10 J	3.40	1.65	1.80	10.97	45.29
2,4'-DDD	0.55 U	0.06 J	2.54	1.56	1.15	3.97	15.01
4,4'-DDE	0.55 U	0.05 J	2.63	0.80	0.79	2.04	11.80
2,4'-DDE	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.61 U
4,4'-DDT	0.55 U	0.06 J	2.26	2.01	0.62 U	8.45	85.64 D
2,4'-DDT	0.55 U	0.54 U	0.18 J	0.27 J	0.62 U	1.32	9.30
<i>alpha</i> -Chlordane	0.55 U	0.04 J	0.42 J	0.32 J	0.45 J	0.32 J	3.14
<i>gamma</i> -Chlordane	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.38 J	2.15
Aldrin	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.60 U
Dieldrin	0.55 U	0.54 U	0.78 J	0.61	0.56 J	0.55 U	0.61 U
Endrin	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.60 U
Endrin Aldehyde	0.55 U	0.54 U	0.23 J	0.54 J	0.62 U	0.55 U	13.43
Endrin Ketone	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.60 U
Endosulfan I	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.61 U
Endosulfan II	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.60 U
Endosulfan sulfate	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.60 U
Heptachlor	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.60 U
Heptachlor Epoxide	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.60 U
Hexachlorobenzene	0.55 U	0.54 U	0.30 J	0.19 J	0.21 J	0.06 J	0.31 J
<i>alpha</i> -BHC	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.61 U
<i>beta</i> -BHC	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.61 U
<i>gamma</i> -BHC	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.60 U
<i>delta</i> -BHC	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.61 U
Methoxychlor	0.55 U	0.54 U	1.06 U	0.58 U	0.62 U	0.55 U	0.61 U
Toxaphene	13.72 U	13.52 U	26.46 U	14.49 U	15.36 U	13.69 U	15.09 U

**Table 5. Chlorinated Pesticides and Polychlorinated Biphenyls in Sediment Laboratory Confirmation Samples, Oakland Inner Harbor and Todd Shipyard (Continued)**

Pesticide/PCB	IR Site 20					IR Site 28	
	OIH2R	OIH5	OIH20	OIH28	OIH57	OIH10	OIH51
	03/12/2001			03/13/2001		03/14/2001	
	Surface Sample (µg/kg dry weight)						
Cl2(8)	0.55 U	0.54 U	0.49 J	1.66	0.41 J	1.14	0.60 U
Cl3(18)	0.55 U	0.54 U	0.75 J	11.63	1.98	3.04	3.78
Cl3(28)	0.55 U	0.54 U	0.90 J	6.62	1.90	2.93	4.19
Cl4(44)	0.55 U	0.54 U	1.01 J	9.27	3.93	4.41	18.39 D
Cl4(52)	0.55 U	0.54 U	1.69	12.64	6.73	9.27	39.88 D
Cl4(66)	0.55 U	0.54 U	0.97 J	6.18	2.48	2.58	7.66
Cl4(77)	0.55 U	0.54 U	1.06 U	0.80	0.62 U	0.46 J	1.13
Cl5(110)	0.06 J	0.16 J	4.07	0.58 DU	0.62 U	17.91 D	86.23 D
Cl5(101)	0.04 J	0.13 J	3.56	13.81 D	19.17 D	19.66 D	78.56
Cl5(105)	0.55 U	0.03 J	1.19	3.45	3.17	3.96	21.24 D
Cl5(118)	0.04 J	0.08 J	2.65	7.83	8.76	13.66	62.13
Cl5(126)	0.55 U	0.54 U	1.06 U	0.58 U	0.61 U	0.55 U	0.60 U
Cl6(128)	0.55 U	0.54 U	0.65 J	2.26	3.08	3.40	15.20 D
Cl6(138)	0.09 J	0.31 J	3.99	13.91 D	38.30 D	25.51 D	76.66 D
Cl6(153)	0.09 J	0.37 J	4.76	19.38 D	56.76 D	32.84 D	89.57 D
Cl7(170)	0.55 U	0.16 J	1.12	3.23	18.83 D	4.15	6.09
Cl7(180)	0.55 U	0.30 J	2.58	7.92	47.25 D	8.17	12.18
Cl7(187)	0.04 J	0.14 J	1.42	5.25	30.56 D	5.71	8.84
Cl8(195)	0.55 U	0.03 J	0.34 J	0.79	4.16	0.36 J	0.66
Cl9(206)	0.55 U	0.54 U	0.27 J	0.37 J	1.80	0.17 J	0.32 J
Cl10(209)	0.55 U	0.54 U	0.33 J	0.10 J	0.10 J	0.55 U	0.17 J
Aroclor 1016	6.86 U	6.76 U	13.23 U	7.25 U	7.68 U	6.84 U	7.55 U
Aroclor 1221	6.86 U	6.76 U	13.23 U	7.25 U	7.68 U	6.84 U	7.55 U
Aroclor 1232	6.86 U	6.76 U	13.23 U	7.25 U	7.68 U	6.84 U	7.55 U
Aroclor 1242	6.86 U	6.76 U	13.23 U	7.25 U	7.68 U	6.84 U	7.55 U
Aroclor 1248	6.86 U	6.76 U	13.23 U	240.86	7.68 U	6.84 U	145.04
Aroclor 1254	6.86 U	6.76 U	65.24	231.57	7.68 U	355.83	917.65
Aroclor 1260	6.86 U	6.76 U	13.23 U	7.25 U	488.01	6.84 U	7.55 U
Total PCBs	0.43 J	1.61 J	28.65	126.31	249.36	140.96	445.51

D = Dilution run.

J = Estimate, below RL.

U = Not detected, RL reported.

**Table 6. Polycyclic Aromatic Hydrocarbons in Sediment Laboratory Confirmation Samples, Oakland Inner Harbor and Todd Shipyard**

PAH	IR Site 20					IR Site 28	
	OIH2R	OIH5	OIH20	OIH28	OIH57	OIH10	OIH51
	03/12/2001			03/13/2001		03/14/2001	
	Surface Sample (µg/kg dry weight)						
Naphthalene	2.52 B	1.74 B	20.82 B	16.80 B	15.14 B	8.19 B	43.61
2-Methyl naphthalene	0.33 J, B	0.32 J, B	12.52 B	11.92 B	12.38 B	3.30 B	22.12
Acenaphthylene	2.64	2.63	33.13	8.82	29.12	33.46	58.16
Acenaphthene	0.11 J	0.66 J	10.10	44.28	24.73	7.26	62.82
Fluorene	0.19 J	1.49	39.22	44.69	25.25	21.61	80.04
Phenanthrene	1.73 B	35.13 B	207.25 B	463.69 B	261.37 B	240.93 B	802.24 B
Anthracene	0.99	5.79	326.81	109.21	79.97	55.53	363.5
Fluoranthene	24.28	68.50	745.39	760.69	459.12	357.77	1,425.7
Pyrene	40.66 B	69.62 B	618.33 B	631.62 B	445.89 B	374.63 B	1,504.19 B
Perylene	7.16	6.18	166.23	98.40	75.27	52.16	276.4
Benzo(a)anthracene	17.60	13.60	413.62	313.34	201.35	166.30	797.51
Chrysene	18.40 B	15.73 B	691.06 B	336.80 B	240.15 B	192.86 B	1,008.8 B
Benzo(b)fluoranthene	17.15	14.10	495.66	293.90	209.27	181.84	837.59
Benzo(k)fluoranthene	17.50	12.32	436.83	279.92	203.42	170.67	891.76
Benzo(a)pyrene	29.61	20.34	530.98	313.91	245.52	197.39	1,022.04
Indeno-(1,2,3-c,d)pyrene	20.02 B	15.39 B	319.10 B	235.86 B	185.14 B	149.21 B	686.74 B
Dibenz(a,h)anthracene	2.74	1.52	66.31	50.91	37.10	34.19	175.78
Benzo(g,h,i)perylene	23.01 B	17.99 B	315.42 B	224.30 B	184.43 B	151.15 B	692.58 B
Total PAHs	226.33	302.72	5,436.26	4,227.15	2,922.22	2,395.15	10,729.44

B = Analyte found in both sample and blank.

E = Estimate, outside linear range.

J = Estimate, below RL.

**Table 7. Organotins in Sediment Laboratory Confirmation Samples, Oakland Inner Harbor and Todd Shipyard**

Organotin	IR Site 20					IR Site 28		
	OIH2R	OIH5	OIH20	OIH28	OIH57	OIH10 Duplicate	OIH10	OIH51
	03/13/2001	03/12/2001		03/13/2001		03/14/2001		
	Surface Sample (µg/kg dry weight)							
TTBT	1.50 U	1.49 U	2.92 U	1.51 U	1.68 U	1.55 U	1.55 U	1.71 U
TBT	4.30*	4.14*	47.09*	138.24 D,*	191.85 D,*	37.15*	50.24*	80.29*
DBT	1.20 U	1.19 U	36.84*	217.02 D,*	205.80 D,*	31.23*	30.83*	65.45*
MBT	0.63 U	0.63 U	1.23 U	22.31*	15.52*	3.20*	3.75*	7.62*
Total Butyltins	4.30	4.14	83.94	377.58	413.16	71.58	84.82	153.35
TPET % Recovery	66.43	63.55	18.61 N	87.05	53.17	97.10	70.10	86.39

Total Butyltins = Sum of detected butyltins.

Surrogate recoveries: 40-120%.

D= Dilution run. Initial run outside linear range of instrument.

N - Spiked sample recovery not within control limits.

U = Analyte not detected, sample-specific MDL reported.

\* = Manually integrated peak.

**Table 8. Grain Size in Sediment Laboratory Confirmation Samples, Oakland Inner Harbor and Todd Shipyard**

Sieve Size	Particle Size (µm)	IR Site 20						IR Site 28	
		OIH2R	OIH5	OIH20	OIH28	OIH57	OIH57 Replicate	OIH10	OIH51
		03/13/01	03/12/01		03/13/01			03/14/01	
<b>Surface Samples (percent in particle size range)</b>									
3 inch	>75,000	0	0	0	0	0	0	0	0
2 inch	50,000-75,000	0	0	0	0	0	0	0	0
1.5 inch	37,500-50,000	0	0	0	0	0	0	0	0
1 inch	25,000-37,500	0	0	0	0	0	0	0	0
3/4 inch	19,000-25,000	0	0	0	0	0	0	0	0
3/8 inch	9,500-19,000	0	0	0	0	0	0	0	0
#4	4,750-9,500	0	0	0	0.3	0	1.3	0.5	0.5
#10	2,000-4,750	0	0	0	1.3	0.8	1.1	0.5	0.4
#20	850-2,000	0.1	0.2	0.1	7.4	4.1	3.9	2.2	1.4
#40	425-850	2.4	1.9	0.1	9	3.5	3.4	2.8	2.3
#60	250-425	43.4	39.6	1.3	19.4	12.3	12	11.1	11.4
#80	180-250	39.2	43.4	2.7	22.3	23.9	23	41.5	27.3
#100	150-180	7.6	6.5	1.5	13.3	16.9	16.5	25.4	16.1
#200	75-150	3.3	2.4	2.4	11.3	16.6	16.3	12.3	14.5
Hydrometer	34.1-75	2.5	4	6.3	0.7	1.1	3.1	1.1	5.1
	21.7-34.1	0	0	5.6	1.2	1	1.2	0.5	1.9
	12.6-21.7	0	0	7.5	0.6	1.9	2.4	0	0.9
	9-12.6	0.5	0	3.8	1.2	1.9	1.2	0	1.9
	6.4-9	0	0.4	7.5	0.6	0.9	1.2	0.5	0.9
	3.1-6.4	0	0	9.6	2.5	2	0	0	2
	1.3-3.1	0	0	113	1.3	2.9	3.5	0	2.8
<1.3	1.1	1.5	40.2	7.6	10.2	10.1	1.6	10.7	

**Table 9. Percent Moisture, Total Organic Carbon, and Total Petroleum Hydrocarbons in Sediment Laboratory Confirmation Samples, Oakland Inner Harbor and Todd Shipyard**

Parameter	IR Site 20					IR Site 28	
	OIH2R	OIH5	OIH20	OIH28	OIH57	OIH10	OIH51
	03/13/01	03/12/01		03/13/01		03/14/01	
	Surface Samples						
Percent Moisture	16.3	18.8	61*	24.5	31	21	32.4
TOC (mg/kg)	432	818	20,800	10,800	8,020	2,220	7,400
TPH-DRO (mg/kg)	1.2 U	1.2 U	2.6 U	1.3 U	1.4 U	1.3 U	1.5 U

\* Higher percent moisture due to the higher percent fines found in this offshore sample.

**APPENDIX A – RESPONSE TO COMMENTS FROM  
BCT MEMBERS AND STAKEHOLDERS**

**FINAL  
TECHNICAL MEMORANDUM  
OAKLAND HARBOR AND TODD SHIPYARD**

**DATED 28 NOVEMBER 2001**

United States Environmental Protection Agency  
Ms. Anna Marie Cook, October 26, 2001

**General Comment:**

- 1. While the presentation of the data and associated conclusions in this report are acceptable, EPA would like to know explicitly what the Navy proposes to do regarding these sediments and the relevant stormwater pathways. The Navy should perform an investigation and interim cleanup of the stormwater system itself to halt any further contamination of the sediments at IR Sites 20 and 28. It is unclear from this report that the stormwater system is or was a source of contamination to the Inner Harbor, and any on-going contamination must be halted as soon as possible. If this step has already been taken, a description of which stormwater drains were investigated and cleaned, and what levels of contamination were found during the clean up, should be included in the document.**

Response: The Navy will address the sediments at the outfalls further in the draft Data Gap Work Plan scheduled for submittal in April 2003. The Navy believes that the contaminants being measured at the outfalls are due to previous historical practices and are not a current source of contamination. Sediments from the upgradient storm sewer lines were removed during the 1997 removal action described in Tetra Tech's Draft Storm Sewer Sediment Removal Action Closure Report. All lines from the outfall to the first manhole were not cleaned because the outfalls could not be plugged and the lines could not be dewatered due to tidal influences. Ongoing stormwater monitoring for National Pollutant Discharge Elimination System (NPDES) compliance currently is being addressed by the City of Alameda. A description of the 1997 cleanup was added to this report.

**Reference:**

Tetra Tech EMI. 1997. Site 18 Storm Sewer System, Solids and Debris Removal Action, Removal Action Closeout Report, Naval Air Station, Alameda, California – DRAFT. Prepared for Department of the Navy, Engineering Field Activity West. December 1997.

- 2. EPA also noted that discrepancy between the width of the shallow sediment shelf described in this report as compared to reports prepared by the Navy several years ago on sediments associated with stormwater outfalls from the Alameda Annex. The Navy should confirm the dimensions of the shallow sediment shelf.**

Response: There appears to be some confusion regarding the area of IR Site 28 (called "Todd Shipyard") and the location of original Todd Shipyard, west of the Fleet and Industrial Supply Center (FISCO). Both properties are not associated with Alameda Annex and were not owned or operated by the Navy. Alameda Annex was transferred to the City of Alameda as a separate facility. The original Todd Shipyard was used as a turning basin for ships docking in Oakland and Alameda. Because of the historical use of the shipyard site for docking large draft ships, the pier areas were regularly dredged which may explain the discrepancies between the widths of the shallow sediment shelf found in Outfall 1 of the FISCO property versus IR Site 20. The Port of Oakland plans to dredge the turning basin further as part of its 50-foot deepening project. A more accurate shelf reading will require a bathymetric survey to be performed which will not be feasible until after the OIH channel has been dredged as part of the 50-foot deepening project.

California Department of Toxic Substances Control  
Mr. James Polisini, PhD, September 24, 2001

**General Comment:**

- 1. This report provides no recommendation for action based on the findings, beyond stating that there is no immediate need for further investigation. The Navy should submit a proposed course of action for consideration by regulatory agencies and natural resource trustees.**

Response: Comment acknowledged. As stated in an e-mail sent on October 15, 2001 from the Navy, the Navy proposes to postpone further action at Oakland Inner Harbor to address concerns at higher priority sites. The Federal Facilities Agreement (FFA) schedule shows that the Navy will submit a draft Data Gap Work Plan in April 2003 for further investigations of the outfalls.

- 2. Given the proposed deepening of the Oakland Inner Harbor channel to 50 feet below mean lower low water (MLLW) (Section 2.0, page 2), any offshore remedial action should be delayed until after completion of that dredging project.**

Response: The Navy concurs that any potential offshore remedial action be proposed after the OIH channel has been deepened to 50 feet below MLLW.

**Specific Comment:**

- 1. The term “Todd Shipyard” for the area outlined as IR 28 should be more fully described in the text (Section 2.0, page 2 and Figure 2). IR 28 does not include all of the operating area of Todd Shipyard, but only the western portion. The pre-dredged sediment assessment for the Oakland Inner Harbor deepening, and/or Regional Monitoring Program (RMP) sediment concentrations for all of Todd Shipyard should be included for comparison to these results for the western portion of Todd Shipyard.**

Response: Please see response to U.S. EPA’s General Comment #2. The area identified as IR Site 28 Todd Shipyard will be clarified in the final Technical Memorandum. The original Todd Shipyard and FISCO site was not owned or operated by the Navy. Areas surrounding the turning basin and the piers have been regularly dredged to accommodate the deep draft ships from Oakland and Alameda. Because this area has been disturbed due to propeller wash and scour, the pre-dredged data from the original Todd Shipyard and FISCO properties would not be comparable to conditions being shown for IR Sites 20 and 28. It should be noted that Tetra Tech (1998) performed an Ecological Assessment of the sediment at Outfall 1 of the FISCO property and concluded that the site posed minimal, if any, ecological hazard given the degraded habitat under the piers and low bioavailability of the chemicals in sediment. Comparisons of the chemical concentrations found in Outfall 1 at FISCO to Oakland Inner Harbor are shown in Table 17 of the 1998 report.

**Reference:**

Tetra Tech EMI. 1998. Ecological Assessment of the Sediment at Outfall 1, Fleet and Industrial Supply Center, Oakland Alameda Facility/Alameda Annex Site, Alameda, California – FINAL. Prepared for Department of the Navy, Engineering Field Activity West. August 1998.

2. **A small investigation was performed on sediments surrounding the stormwater outfall at the Alameda Annex several years ago. The “shelf” of undredged sediments at that outfall was approximately 40 feet +/- 10 feet in width. This report states that the “shelf” of undredged sediments averages approximately 246 feet in width (Section 2.3, page 2). Please check this statement of size and correct it if untrue. Otherwise a statement of the area where the “shelf” of undredged sediments averages 246 feet should be included, as it doesn’t apply to the area near the Alameda Annex outfall.**

Response: Comment acknowledged and the sentence will be revised to state that the shelf of undredged sediments averages 246 feet along the Oakland Inner Harbor.

3. **Please indicate, by name, some examples of the sites or Navy bases where “the PCB bioassay has generated results very close to the total PCBs reported by the fixed laboratory” for the Polychlorinated Biphenyls (PCB) immunoassay screening analyses (Section 4.2.1, page 7).**

Response: Previous evaluation of PCB immunoassay versus fixed laboratory analysis of PCB congeners was performed on data collected in 1998 at Alameda stations in Seaplane Lagoon, from the Hunters Point Shipyard "Pretest" in 1999, and the Hunters Point Screening Study in 2000. In all three cases, the immunoassay results were actually higher than the fixed laboratory results. In the Sediment Screening Study of IR Sites 20 and 28, the reverse was observed, which prompted the decision to "correct" (adjust) the immunoassay results (resulting in increasing the screening values) to ensure that they did not underestimate the true PCB levels. The "corrected" values were presented in the technical memorandum.

4. **This report indicates elevated sediment chemical concentrations in IR 20 from sample location OIH 57 west to location OIH 30 and in the eastern portion of IR 28 at sample locations OIH 51, OIH 38, and OIH 30 (Section 4.3, page 9, Section 4.4.3, page 12, and Section 5.0, page 13). The proposed sources of these elevated sediment concentrations are known outfalls. HERD would agree that there does not appear to be an “immediate need to evaluate these areas further” (Section 5.0, page 13). However, as an interim measure, the storm drain system should be searched to determine whether there are sediment containment basins, or accumulated sediment in the drains which could serve as a future source. A similar investigation and removal action, with associated outfall sediment assessment, was performed at the Alameda Annex.**

Response: Please see response to U.S. EPA General Comment #1.

5. **Several sampling locations indicate elevated concentrations of chromium (Figure 10, page 26), copper (Figure 11, page 27), lead (Figure 11, page 27), mercury (Figure 12, page 28), nickel (Figure 12, page 28), and zinc (Figure 13, page 29) in IR 20/IR 28. These individual samples of elevated sediment concentrations are not always associated with the Todd Shipyard grouping. It seems incredible that a shipyard could operate without associated sediment concentrations exceeding nearby sediments only contaminated by stormwater discharge. This comment is similar to Specific Comment 1 in requesting presentation of the dredge sampling and RMP sampling data from the area of Todd Shipyard to the east of those samples reported here.**

Response: Please see response to Specific Comment #1. Sediment concentrations for mercury, zinc, PAHs, and PCBs were above effect range-lows (ERLs) in Outfall 1 while copper and lead concentrations were above ERLs but less than effect range-medians (ERMs).

6. **Please provide some rationale for the disparity between the sediment concentrations of some polyaromatic hydrocarbon compounds (PAHs) detected in 1993 and those detected in 2001 (e.g. dibenzo(a,h)anthracene [Figure 18] and fluoranthene [Figure 18]). In the two examples cited, the previous detected concentration is two to three times the sediment concentration measured in the 2001 study.**

Response: Two circumstances explain the disparity between the 1993 and 2001 results for PAHs. First, the detection limits in 1993 were elevated for many of the PAH analytes, which led to the question regarding the reliability of quantification including detected concentrations reported within the range of the reported detection limits. Second, the 1993 samples were replicated, and the overall average of all replicates was not used.

The 1993 values plotted in Figure 18 of the Technical Memorandum were the average of the detected replicate values (if any were detects) or the average of detection limits if all replicates were nondetects. There were typically four replicates at each station. For example, the 3,500 µg/kg value for fluoranthene was the only detected concentration for the four replicates at station E07. If this concentration was averaged with the nondetects, the representative concentration from all replicates would be within the range of the values observed in 2001. The results for dibenzo(a,h)anthracene were similar. Three of the four dibenzo(a,h)anthracene results in 1993 were nondetects (plotted as open circles in Figure 18). The one detect was actually the mean of two replicates where this constituent was detected, with the other two replicates being nondetects. Given the detects were within the range of the detection limits, these values may not be reliable, however, the plotted value is actually lower than one of the seven detected values in the 2001 study (from IR Site 28).

7. **Please consult the field notes and explain why the percent moisture for sample OIH 20 in IR 20 is at least two times the percent moisture measurements for any other sample (Table 9, page 62). A footnote on Table 9 would be adequate if sufficient basis can be found in the field notes.**

Response: The percent moisture is correlated to the percent fines found in the samples. The majority of the samples selected for fixed laboratory analysis were collected near the shore and consisted of coarse sand, which had lower percent moisture. The only offshore sample (i.e., OIH 20) consisted of denser material and consequently, retained higher percent moisture in comparison to the sandy shore samples.

A footnote will be added to Table 9 to clarify this further.

San Francisco Bay Region Water Quality Control Board  
Ms. Naomi Feger, October 31, 2001

**General Comments:**

1. **Board Staff would like to have further discussions with the Navy regarding the perceived magnitude of the contamination at these sites. Board Staff is concerned about elevated levels of PCBs in surface sediments and the possibility that the storm water outfalls serve as continuous sources of contaminants. It is recommended that vertical cores be collected adjacent to the outfalls to better understand the depositional history at these locations. Staff is in agreement with both the EPA and DTSC that an interim cleanup of the storm drain system is warranted.**

Response: Please see response to U.S. EPA General Comment #1.

2. **Lead, zinc, and copper were selected as “indicator” compounds for purposes of the screening study. Chromium should have been one of the “indicator” compounds. Please provide a bubble plot for this COPC. Board Staff would like to make sure that other contaminants, mercury, cadmium, silver, selenium, organotin, pesticides, and radionuclides are considered in the data gap work plan.**

Response: The selection of indicator compounds was identified in the Sediment Screening Study, dated March 7, 2001. Chromium was not selected as an indicator compound due to the potential artifact of the XRF technique in which the elevated iron content present in the sediment was found to confound the chromium measurements. The Navy had previously correlated the chromium concentration to those measured using the fixed laboratory results. The correlation of this relationship shown in Figure A-1 indicates the presence of two distinct curves that may be dependent on the grain size. Figure A-2 presents the bubble plot for chromium. The draft Data Gap Work Plan will include evaluation of PAHs, pesticides, PCBs, butyltin compounds, and trace metals. Radionuclides will not be evaluated in the Data Gap Work Plan because there is no evidence of radium dials being utilized in this area.

3. **Please explain how you selected specific PCB congeners to analyze for. For PCBs, the highest fixed laboratory result was 1,066 µg/kg at OIH51 at the Todd Shipyard site. This result is shown in Figure 31 at 530 µg/kg. Please explain this discrepancy. Please provide an unadjusted bubble plot of total PCBs. Staff notes that ERM-Q analyses are only pertinent to evaluating potential toxicity to benthic invertebrates and they do not evaluate other potential water quality impacts, including bioaccumulation of PCBs, an ongoing important concern of the Regional Board Staff.**

Response: All values plotted in the bubble plot including Figure 31 (PCBs) are screening results. In the case of PCBs, these values were adjusted based on the regression in Figure 6 to ensure that the PCB values were not underestimated. The 1,066 µg/kg value is a fixed laboratory result, which in Figure 6 was noted as a possible outlier, and was excluded from the regression analysis.

A new bubble plot is presented as Figure A-3 for PCB. In this plot, the raw PCB screening values (unadjusted) are plotted, and instead of simply showing the location of the fixed lab samples with stars, green bubbles are presented to facilitate comparison at these locations. It may be of interest to note that only six of the unadjusted PCB screening results are greater than the ER-M.

The Screening Study Work Plan clearly specifies the analytical methods to be employed, and lists the congeners to be measured using the NOAA status and trends methods.

4. **Figure 3, a graph depicting the bathymetry of Oakland Inner Harbor, was a bit difficult to interpret; a larger scale map might be helpful.**

Response: A revised Figure 3 will be presented in the Final Technical Memorandum.

**Specific Comments:**

1. **There are some discrepancies between the text portions of Section 4 and the tables. For example, paragraph 5 on page 9 states that lead exceeds the ER-M at OIH57. Table 2 (page 52) and paragraph 3 on page 10 state that lead exceeds the ER-M at OIH30. Please review these sections.**

Response: Section 4 will be reviewed and revisions incorporated into the Final Technical Memorandum. Page 9 refers to the fixed laboratory data, where a value of 225.5 µg/kg was measured at OIH-57. Table 4 shows the fixed laboratory result. The discussion on Page 10 refers to the screening results, where the highest value (260 µg/kg) was measured at OIH-30.

**U.S. Fish and Wildlife Service**

**Mr. James Haas, Comment provided via e-mail on October 18, 2001**

**General Comment:**

- 1. U.S. Fish and Wildlife Services will not be providing comments on this document.**

Response: Comment acknowledged.

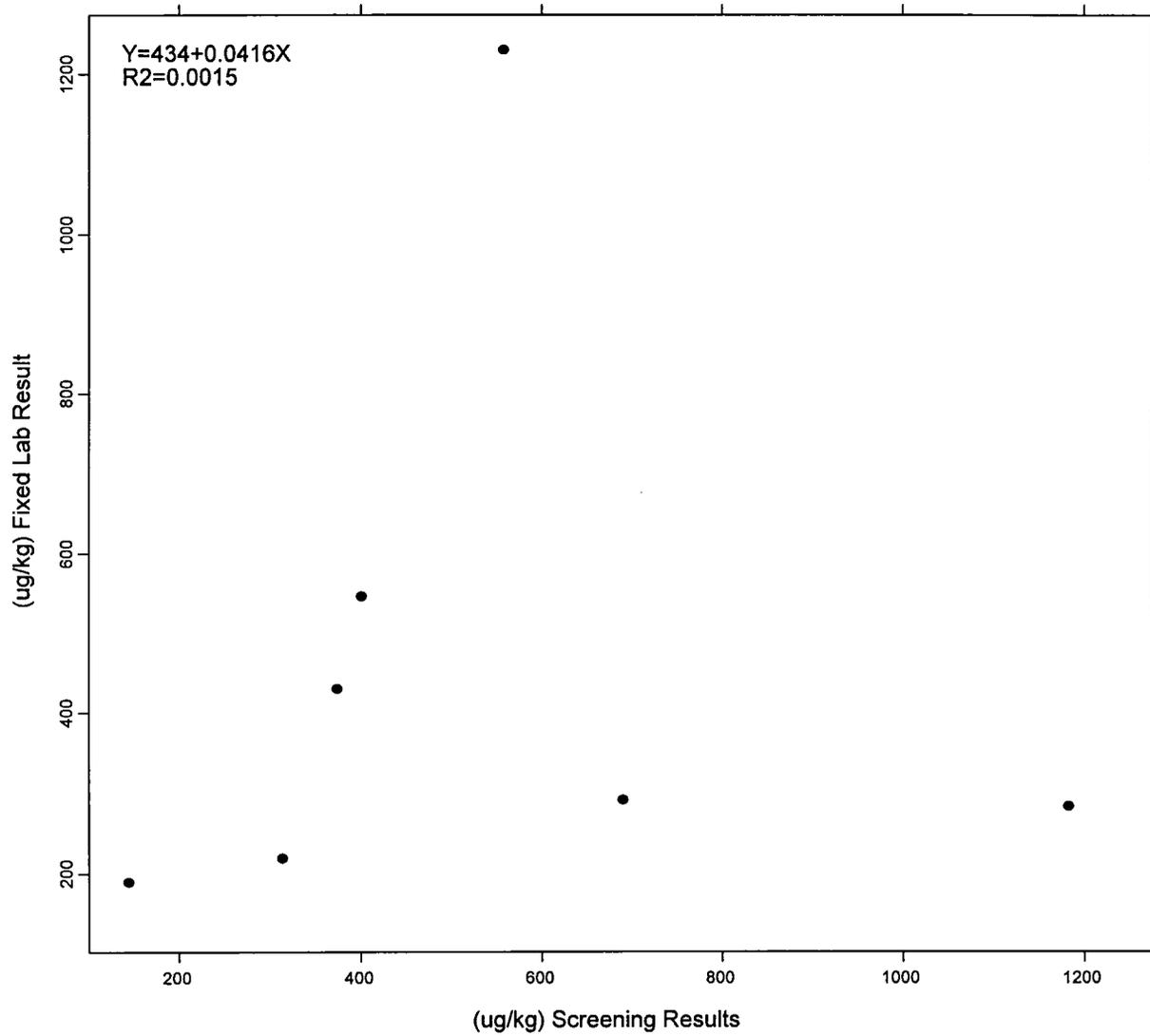
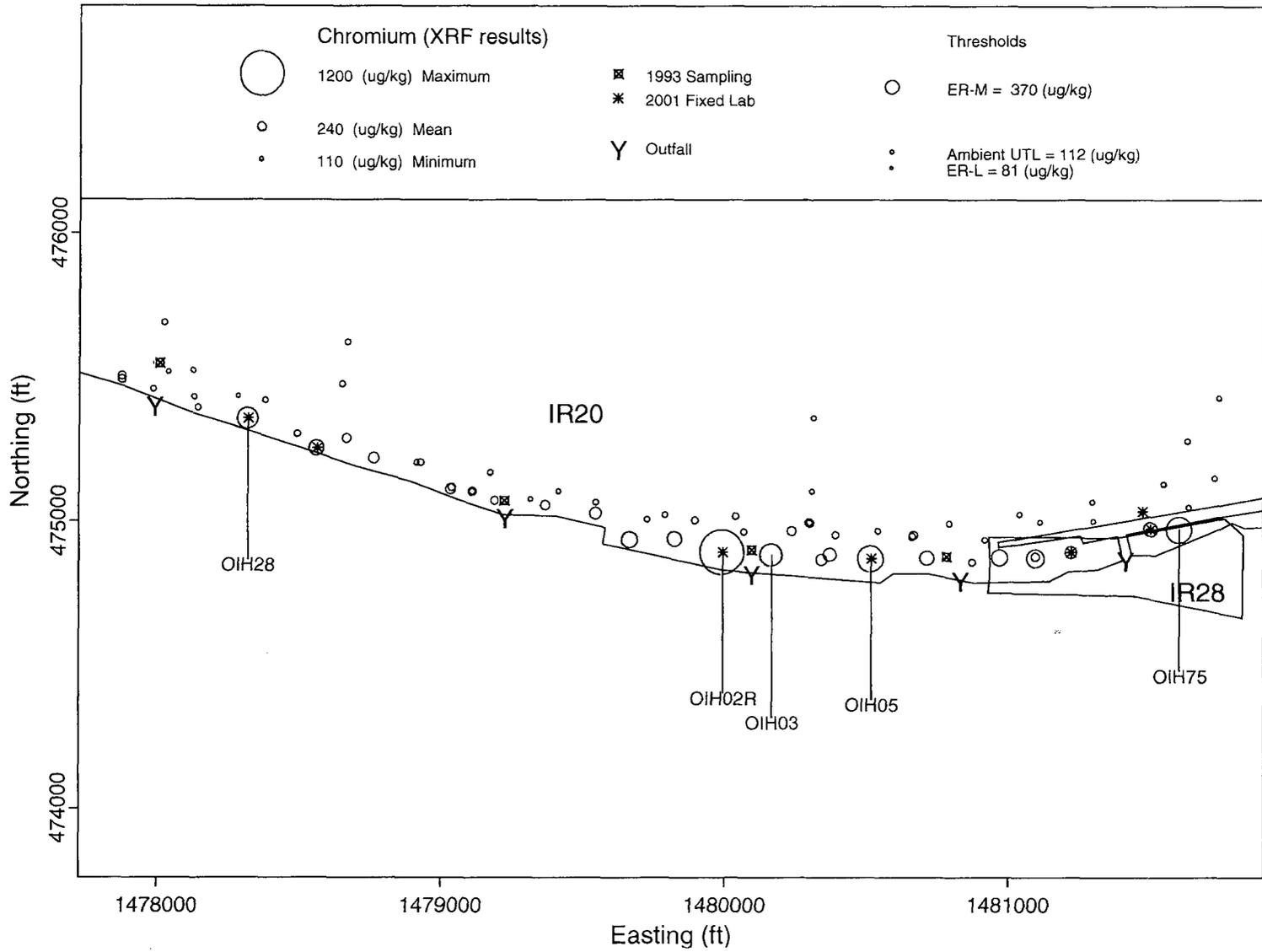


Figure A-1. Bivariate plot of Chromium Results for Fixed Laboratory Versus Screening



A-9

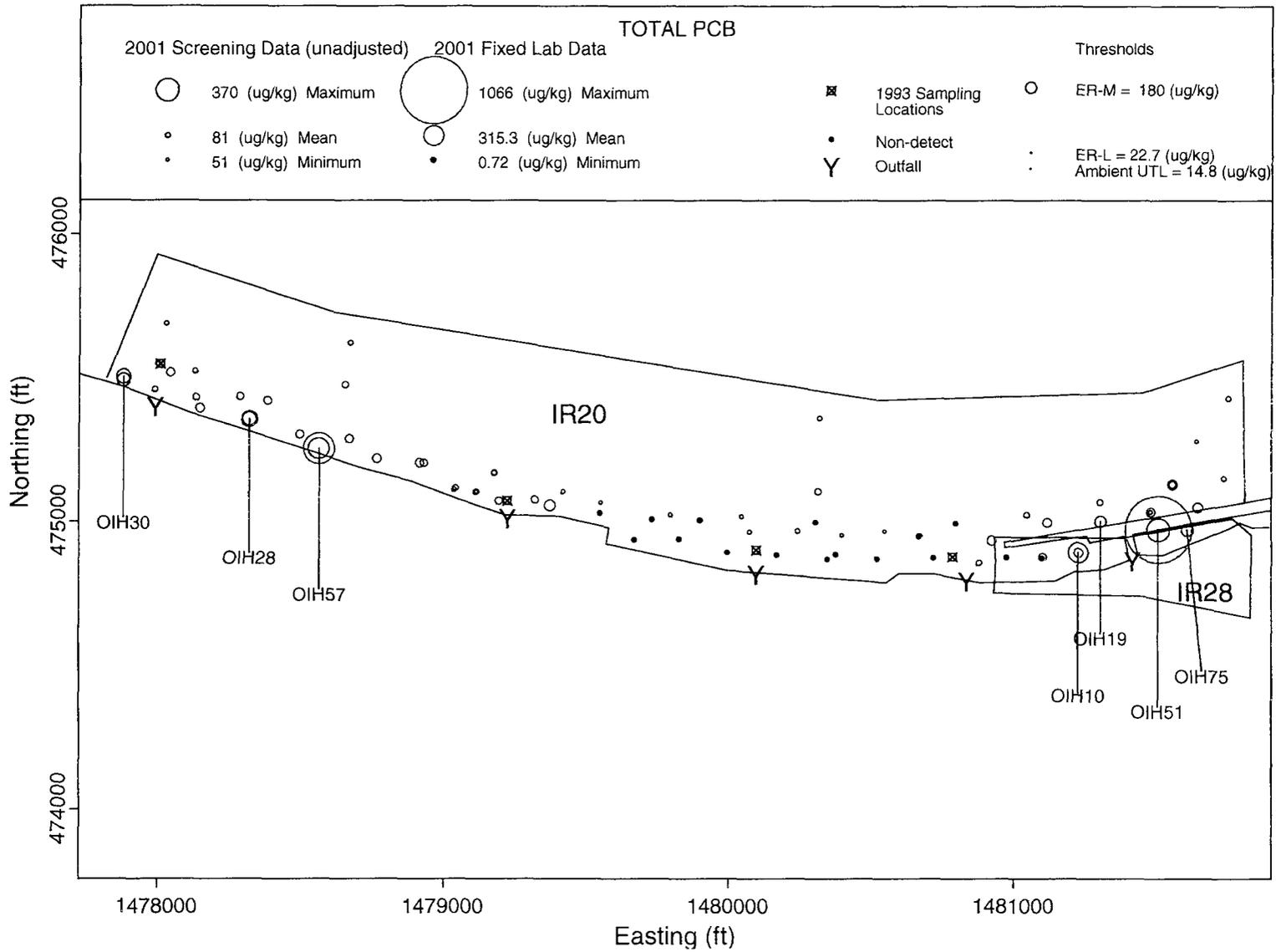


Figure A-3. Bubble Plot of Surface Sediment Concentrations of Total PCB, with Unadjusted Screening Results