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NAVAL COMMAND, CONTROL AND OCEAN SURVEILLANCE CENTER
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Ernest Waterman
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Maine, New Hampshire, Vermont
Waste Regulation Section
JFK Federal Building
Boston, MA 02203

RE: OFFSHORE MEDIA PROTECTION STANDARDS PROPOSAL

Dear Mr. Waterman

On behalf of the Northern Division Naval Facilities Engineering Command and the Portsmouth Naval Shipyard the MEDIA PROTECTION STANDARDS FOR OFFSHORE MEDIA: SEDIMENTS AND SURFACE WATER is enclosed. The report is being submitted in partial fulfillment of the Portsmouth Naval Shipyard's Hazardous and Solid Waste Act Permit of March 10, 1989.

If there are any questions, please contact me at (401) 782-3128 or FAX: 401-782-3030. Thank you for your interest.

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# 3.0 MEDIA PROTECTION STANDARDS PROPOSAL FOR OFFSHORE MEDIA: SEDIMENTS AND SURFACE WATER

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*June 29, 1994*

## EXECUTIVE SUMMARY


### OBJECTIVE

The objective of this document is to satisfy the Media Protection Standards Proposal requirement for surface water and sediment, as specified in the special conditions of the Portsmouth Naval Shipyard's Hazardous and Sold Waste Act Permit, of March 10, 1989.

### APPROACH

A functional approach was applied to identify areas of the estuary with potentially adverse chemical concentration levels based on the incidence of biological effects and or elevated chemical exposure. The site-specific approach evaluated chemical concentration levels measured in surface waters (water column and seep samples) and sediments (sediment grab and core samples) collected and analyzed during the Offshore Study. The evaluation consisted of three screening levels for surface water and seven screening levels for sediment. The outcome of the site-specific screening was to determine the areas (station locations) where adverse chemical concentrations may be present, and estimate chemical concentration levels protective of marine aquatic resources in the Piscataqua and Great Bay Estuary.

Surface water chemical concentrations measured in water column and seep water samples were evaluated for unacceptable concentrations using three screening levels: (i) water quality criteria, (ii) mussel tissue residues, and (iii) toxicity to sea urchin gametes.

Adverse levels of chemicals present in sediment samples were determined by seven screening levels. The screening levels were based on: (i) sediment toxicity values reported in the literature; (ii) sediment management standards developed for the Puget Sound, Washington; (iii) crustal weathering ratios for metals; (iv) levels of acid volatile sulfide available for binding divalent metals; (v) pore water equilibrium partitioning for organic compounds; (vi) direct measures of bulk sediment toxicity; and (vii) anomalies in benthic infauna community structure.

### RESULTS

<u>Surface Water.</u> Adverse chemical concentration levels in surface water were identified for stations that exceeded water quality criteria or had indications of biological effects. Indications high exposure concentrations were determined for

stations that had elevated mussel tissue chemical concentrations above warning levels. The screening factors were functionally combined to relate effects information (toxicity) to the correspondence of exposure information (exceeding WQC and mussel tissue residue levels). Adverse chemical concentrations were identified for one station at the river mouth (station 1), four stations in Clark Cove (stations 3, 4, 7, and 1004), the seep stations located near the Police Dock (stations 1001, 1002, and 1003), and four of the seep stations in the Jamaica Island Backchannel (stations S2, 1005, 1006, 1007, and 1008). Mussel tissue warning levels (excluding the Phase II Ni and Cr data) were identified at two Piscataqua River reference stations (stations 14 and 172), the two stations in Spruce Creek (stations 20 and 21), three stations in the upper Great Bay Estuary (stations 24, 26, and 28) and twenty-three stations surrounding Seavey Island.

Sediment. Adverse chemical concentration levels were determined for stations with indications of biological effects and high exposure concentrations that were positively identified by two or more screening levels. These factors related sediment exposure to sediment effects, and allowed the assumption that the effects were chemically induced to be evaluated. The outcome of the sediment screening identified adverse chemical concentrations at total of nine stations. Six of the stations were located around Seavey Island: two stations in Clark Cove (stations 4 and 8), near the Police Dock (station 9), two stations in the vicinity of the dry docks (stations 13 and 17), and one station in the Back Channel (station 18).

## MEDIA PROTECTION STANDARDS

Media protection zones for surface water and sediments were developed from the screening level analysis to functionally estimate chemical concentration levels that are protective of marine aquatic resources in the Piscataqua and Great Bay Estuary. The media protection zones can be interpreted to define ranges of chemical concentration levels which are below levels associated with causing adverse impacts to marine aquatic organisms.

Surface water media protection standards. Alternative chemical concentration levels protective of marine aquatic life are proposed for surface water chemical concentrations that are below chronic salt water ambient water quality criteria (AWQC) and do not have an indication of bulk water column toxicity. Chemical levels above AWQC and/or water toxicity suggests that corrective measures be evaluated to control sources of contamination that may be impacting water quality. Areas where elevated mussel tissue concentrations are above warning levels, should also be evaluated for appropriate corrective measures.

Sediment media protection standards. Alternative chemical concentration levels protective of marine aquatic life are proposed for sediments if there is no indication of biological effects, either in terms of sediment toxicity or stress on the benthic infauna community. If toxicity or benthic stress is present then corrective measures should be evaluated for chemicals that exceeded two or more screening levels consisting of toxicity thresholds (ER-L, ER-M), Washington State sediment cleanup standards, enrichment relative to crustal weathering, AVS concentrations for divalent metals, and equilibrium partitioning pore water toxic units for organic chemicals.

## CONCLUSION

Adverse chemical concentrations were identified for the following locations around Seavey Island:

| | Water | Mussel | Sediment |
|---|---|---|---|
| CLARK COVE | Hg Cu Ni Zn | As Ag Cu Pb | Cr Pb Hg Ni Zn DDT |
| POLICE DOCK | Hg Cu Zn | DDT | Pb DDT |
| JAMAICA ISLAND | Hg Cu Ni Zn Pb | Hg Cu Zn Pb | Pb PHEN DDT DDE |
| BACK CHANNEL | | Hg Cu Pb | Pb PHEN DDT DDE |
| DRMO | | Cu Pb | |
| DRY DOCKS | | Hg Cu Pb Zn Ag PAH | Hg Cu Pb PAH |

The results of the screening analysis were very useful for identifying adverse levels of chemical exposure that should be evaluated for appropriate corrective measures. The surface water screen can be used to identify active sources of contamination in the estuary, while the sediment screen provides information on past releases as well as cumulative impacts on the system. The screening analyses are the necessary first step in determining the ecological risk from chemicals associated with the Shipyard SWMUs.

## INTRODUCTION

The objective of this document is to satisfy the Media Protection Standards Proposal requirement for surface water and sediment, as specified in the special conditions of the Portsmouth Naval Shipyard's Hazardous and Sold Waste Act Permit, of March 10, 1989. The permit requires the permittee to submit:

> "...proposed media protection standards for all releases of hazardous wastes and/or hazardous constituents into the following environments: groundwater, soil, surface water, and sediments. The permittee shall include data justifying and supporting the standards proposed and shall comply with ... media specific parameters" (Portsmouth Naval Shipyard Hazardous and Sold Waste Act Permit, 1989, p41).

In order to meet this specific requirement a functional approach was developed to relate observations of chemical concentration levels (Exposure) to measures of biological impacts (Effects) in order to determine the occurrence of adverse chemical concentrations (chemical concentration levels associated with biological effects). The functional approach was applied to identify areas of the lower estuary where adverse chemical concentrations could be present and estimate chemical concentration levels that are protective of marine resources. The evaluation used site-specific data collected during Phase I and Phase II of the Estuarine Ecological Risk Assessment Case Study for Portsmouth Naval Shipyard (Offshore Investigation; Johnston, Munns, Mills, Short, and Walker (eds) 1993a), and technical data and information obtained from water quality criteria documents, NOAA's Status and Trends Program, USEPA's Environmental Monitoring and Assessment Program (EMAP), Puget Sound sediment management standards, and EPA's sediment quality criteria program. Chemical concentration levels protective of marine resources were estimated for the set of chemicals that were potentially released from solid waste management units (SWMUs) associated with shipyard operations (Fred C. Hart Associates, Inc. 1989) and measured during the Offshore Investigation (Johnston, Muzzio, Cullen, and Anne' 1993b, Table 3.1, Figure 3.1). The media protection levels proposed in this section can be used to target offshore areas that require further evaluation for possible corrective actions.

In dynamic estuarine systems such as the Piscataqua River and Great Bay Estuary it is almost impossible to identify "background" locations that are "... outside the zones of contamination of all release sources to surface water and sediments" (Portsmouth Naval Shipyard Hazardous and Sold Waste Act Permit, 1989, p46). This is because the complex current and sedimentation processes (Johnston et al. 1993a, Ward 1994, Chadwick, Katz and Patterson 1993, Chadwick, Pavlos and Celikkol 1993, Swift and Celikkol 1993) tend to mix and disperse chemicals in complicated patterns. Chemical distribution patterns will be dependent on: (i) the origins and levels of chemicals released from the Shipyard as well as other input sources; (ii) physical-chemical properties of the chemical; (iii) physical mixing, flushing, and sedimentation processes; and (iv) biogeochemical transformation processes (Burgess and Scott 1992). These processes will all interact to affect a chemical's long-term availability and persistence in the system. Samples from reference areas (i.e. York River Harbor) can provide relative measures of contamination levels, however, reference locations are invariably dissimilar in certain key characteristics (grain size, flushing rate, etc.) which are related to the uniqueness of site-specific depositional and assimilative processes. In addition, "background" concentrations derived from pristine locations void of any appreciable anthropogenic input may be over protective, especially in the sense that any offshore cleanup activities for the Shipyard must be conducted in Portsmouth Harbor, an area that is irreversibly subjected to human activities (Short 1992). Furthermore, the extent of potential detrimental or adverse impact (toxicity and bioaccumulation) will depend on whether the chemical concentration has exceeded the system's ability to assimilate and detoxify the chemical present (Long and Chapman 1985, Di Toro et al. 1990, 1991, 1992), rather than if "background" concentrations have been exceeded.

Within the guidelines of the permit: "...the permittee may propose a surface water or sediment alternative concentration level for each hazardous constituent associated with a release to surface water or sediments" (Portsmouth Naval Shipyard Hazardous and Sold Waste Act Permit, 1989, p46), instead of relying solely on comparison to "background" concentrations. Therefore the functional approach was applied to identify areas with adverse chemical concentration levels based on the incidence of biological effects and or elevated chemical exposure. The site-specific approach evaluated chemical concentration levels measured in surface waters (water column and seep samples) and sediments (sediment grab and core samples) collected and analyzed during Phase I of the offshore investigation (Johnston et al. 1993a). The evaluation consisted of three screening levels for surface water and seven screening levels for sediment. The outcome of the site-specific screening was to determine the areas (station locations) where adverse chemical concentrations may be present, and estimate chemical concentration levels protective of marine aquatic resources in the Piscataqua and Great Bay Estuary.

The technical basis and justification for determining adverse chemical concentrations and estimating safe chemical levels in surface waters and sediments are provided below. It is not possible to definitively establish chemical concentration levels that "will not pose a current or future hazard to human health and the environment" (Portsmouth Naval Shipyard Hazardous and Sold Waste Act Permit, 1989, p46), because there is not a clear relationship between chemical exposure and detrimental ecosystem effects (Power and Chapman 1992, Burton 1992, Howarth 1989, Levin et al. 1989). Validation of ecological effects caused by chemical concentration levels in the estuary is part of the ecological risk assessment and monitoring activities currently being conducted for the Portsmouth Naval Shipyard (Munns, Johnston, Short, Gentile, and Walker 1993, NCCOSC and ERLN 1991, NCCOSC, ERLN, UNH, BMSL, and URI 1994).

In this document the following data sets were used in the screening analysis presented:

1. Chemical concentrations measured in sediment, mussel tissue and surface water samples collected and analyzed during Phase I of the Offshore Study (study documented in the Phase I Final Report (Johnston et al. 1993a)).

2. Results of acid volatile sulfide and simultaneous extracted metal concentrations measured in samples of selected surface sediment cores from Portsmouth Harbor. Cores were collected June-July 1993 by PNSY Navy divers and analyzed by ERLN (study documented in the Phase II workplan (NCCOSC et al. 1994)).

3. Trace metal concentrations measured in seep samples collected April 1993 by UNH-JEL and measured by BMSL (study documented in the preliminary seep sampling report Johnston et al. 1993c).

4. Mussel tissue samples collected during quarterly monitoring from spring 92 to summer 93 by UNH-JEL and analyzed by BMSL (study documented in the Phase II workplan (NCCOSC et al. 1994)).

5. Sediment marsh cores and deep cores collected and dated by UNH-JEL and analyzed for heavy metals and organics by ERLN and BMSL (study documented in the Phase II workplan (NCCOSC et al. 1994)).

Additional data sets not available for screening at this time:

1. Water chemistry samples collected and analyzed by URI-GSO (study documented in the Phase II workplan (NCCOSC et al. 1994)).

2. Mussel samples from deployments conducted by UNH-JEL fall 1993 and analyzed for heavy metals by URI-GSO (study

documented in the Phase II workplan (NCCOSC et al. 1994)).

3. Lobster, flounder, eelgrass, cord grass samples collected during Phase I and Phase II of the offshore study (Johnston et al. 1993a, NCCOSC et al. 1994).

4. Porewater samples from selected surface sediment cores from Portsmouth Harbor. Cores were collected June-July 1993 by PNSY Navy divers and analyzed by ERLN (study documented in the Phase II workplan (NCCOSC et al. 1994)).

## METHODS

### SCREENING LEVEL ANALYSIS

The analysis used in this section related exposure data (in terms of chemical concentration levels) to effects information by using a series of data screening procedures. The screening procedures compared chemical concentration levels measured in samples from the Piscataqua River and Great Bay Estuary to specific chemical concentration levels that have been associated with adverse biological effects.

Two types of screening procedures were used: (i) exposure screening, and (ii) effects screening. The following terminology was used to aide the analysis:

LEVEL is used to identify a specific chemical concentration or biological response, that has been associated with adverse effects when exceeded.

SCREENING indicates specific criterion have been developed for comparing data.

SCREENING LEVEL refers to the application of the SCREENING criterion, to sample data, in order to eliminate data falling below the LEVEL applied.

SCREENING LEVELS were developed from the most conservative (e.g. most protective) to the most likely to cause adverse impacts on the environment. The ordering of the screening levels was somewhat subjective, however the probability of adverse effects was assumed to be greater when higher screening levels were exceeded. The rationale behind the screening procedure, is that if there are chemically induced adverse impacts, then these impacts (effects) should be coupled with incidence of high chemical exposure levels. In addition, extensive evidence of high exposure levels, were also used to indicate potential problems, even though there was not an indication of adverse impact suggested by the data currently available.

#### Surface Water Screening

Surface water chemical concentrations measured in water column and seep water samples (Johnston 1993b, Johnston et al 1993c) were evaluated for unacceptable concentrations using three screening levels: (i) water quality criteria (USEPA 1991), (ii) mussel tissue residues (O'Connor 1992, NOAA 1989), and (iii) toxicity to sea urchin gametes (Mueller and Anderson

1993a). Only metal concentration levels were evaluated with the water quality criteria screen, because measurements of organic compounds (VOCs, PAHs, Pesticides, and PCBs) were below detection limits for seep (1-4 ug/L, Johnston et al. 1993b, Table 3.1) and water column (0.2 ug/L, Chadwick, Katz, and Patterson 1993) samples. Both metal and organic chemicals were evaluated in the mussel tissue residue screen. The site-specific screening levels used to evaluate chemical concentration levels in surfaces waters (Figure 3.2) were:

Water Level 1 (WL1): Water Quality Criteria (WQC). Comparisons of water column and seep sample chemical data to water quality criteria values that have been determined to be protective of marine aquatic organisms (USEPA 1991, USEPA 1980, USEPA 1976).

Water Level 2 (WL2): Mussel Watch Tissue Residue. An evaluation of chemical residue levels in the blue mussel (Mytlis edulis) relative to the NOAA Mussel Watch data (NOAA 1989, O'Connor 1992).

Water Level 3 (WL3): Water Toxicity. Direct measures of water column toxicity using the sea urchin (Arbacia punctulata) fertilization test (Mueller and Anderson 1993a).

The methodology and rationale used for each screening level are detailed below.

Water Level 1 (WL1): Ambient Water Quality Criteria. Water Quality Criteria (WQC) documents identify water quality criteria that were applicable to chemicals measured during the offshore portion of the RCRA Facility Investigation (Johnston et al. 1993a, USEPA 1976, USEPA 1991). Where possible, the chronic value was selected as the ambient concentration protective of marine aquatic species (USEPA 1991). No salt water chronic value is currently available for copper so the salt water acute criteria of 2.9 ug/L was used (USEPA 1991). In the absence of a salt water chronic value, the fresh water chronic value was used for aluminum and iron (USEPA 1991). No ambient water quality criteria were available for manganese (USEPA 1991). Since the target surface water media was saltwater, no adjustments for hardness or pH for the metals criteria were made (USEPA 1980). Water column and seep sample concentrations were compared to criteria levels to determine whether chemicals were above WQC values:

$$AMB = \frac{CONC_w \, ug/L}{WQC \; ug/L} \qquad [1]$$

where:

| | | |
|---|---|---|
| AMB | = | the ambient concentration in WQC-units |
| CONC | = | concentration of chemical measured in sample |
| WQC | = | water quality criteria value for chemical of interest |

The analytical methods used the water column and seep samples analyzed during PHASE I were incapable of achieving ambient WQC values (Johnston et al. 1993b). The surface water analytical methods used for seep samples (collected April 1993) analyzed during PHASE II were capable of achieving ambient WQC values (Johnston et al. 1993c) The method detection limits (MDLs) achieved for Phase I were used to assure that only quantified Phase I data were used to screen for unacceptable water column chemical concentrations levels. The WL1 level screen results for PHASE I were determined by:

IF [($CONC_w$> MDL) AND ($CONC_w$> WQC)] THEN WL1 = 1; [2]
ELSE WL1 = 0; [3]

The WL1 level screen results for the PHASE II seep samples were determined by:

IF ($CONC_w$> WQC) THEN WL1 = 1; [2a]
ELSE WL1 = 0; [3a]

Water Level 2 (WL2): Mussel Watch Tissue Residue. Chemical concentration levels in blue mussel (Mytilus edulis) tissues located in coastal waters of the US have been routinely monitored by the NOAA Mussel Watch Project since 1986 (NOAA 1989). Data from Mussel Watch monitoring have been compiled to characterize the distribution of chemical concentration levels on a national scale (O'Connor 1992). The purpose of the Mussel Watch Project was to:

> "...describe chemical distributions over national and regional scales. Therefore, it is important for sampling sites to be representative of large areas rather than the small-scale patches of contamination commonly referred to as 'hot spots'. To this end, no sites were knowingly selected near waste discharge points. Furthermore, since the Mussel Watch Project is based on analyzing indigenous mussels and oysters, a site must support a sufficient population of these mollusks to provide annual samples." (O'Connor 1992, p2)

About fifty-percent of the Mussel Watch stations were located in coastal waters near urban areas "within 20 km of population centers in excess of 100,000 people". The Mussel Watch Project assumed that chemical concentrations and the potential for biological effects would be higher in urban areas than in rural areas (O'Connor 1992). The distributions obtained from the Mussel Watch Data were used to identify the nationwide mean and "high" chemical residue levels measured in mussel tissues. The mean concentration was defined as the mean of the lognormal distribution and the "high" concentration was defined as the logarithmic value one standard deviation above the lognormal mean (O'Connor 1992). The Mussel Watch distributions can be compared to mussel tissue distributions obtained for the Piscataqua and Great Bay Estuary. With the inclusion of the mussel tissue samples analyzed as part of PHASE II of the Offshore Study there are more than 100 samples from which to calculate mussel chemical residue probability distributions for the Great Bay Estuary (Johnston et al. 1993b, Short and Hoven 1994, NCCOSC et al. 1994).

Data from the NOAA Mussel Watch Project (O'Connor 1992) and from the Offshore Study were used to calculate the lognormal distributions for As, Cd, Hg, Ni, Ag, Cu, Zn, Pb, Cr, total PCB (tPCB), total DDT and metabolites (tDDT), total chlordane mixtures (tCdane), the sum of 18 PAH compounds (sumPAH), and the sum of butyltin compounds (tOTIN) (Table 3.2). The resulting distributions for the Mussel Watch data and Great Bay Estuary data were compared to determine incidence of elevated exposures to marine organisms.

The mussel residue data were screened to determine whether an individual sample was above the "high" Mussel Watch level, defined as one standard deviation above the mean of the lognormal distribution. Elevated water column exposure levels were determined if the sample concentration was above the Mussel Watch "high" and above the 95th percentile of the Great Bay Estuary distribution or the 98th percentile of the Mussel Watch distribution[1].

The results of the surface water level 2 (WL2) screen were determined by:

If $\{(CONC_M > MW84) \text{ AND } [(CONC_M > GB95) \text{ OR } (CONC_M > MW98)]\}$
THEN WL2 = 1; [4]
ELSE WL2 = 0; [5]

where:

$CONC_M$ = mussel tissue concentration
MW84 = antilog {log(MWX) + log(MWSD)} [6]
MW98 = antilog {log(MWX) + 2.05·log(MWSD)} [7]
GB95 = antilog {log(GBX) + 1.64·log(GBSD)} [8]

and

MWX = the Mussel Watch geometric mean of the chemical distribution in ug/g for metals and ng/g for

[1] Analysis assumes that the Mussel Watch and Great Bay Estuary data are lognormally distributed.

organics (from O'Connor 1992)

GBX = the Great Bay Estuary geometric mean of the chemical distribution in ug/g for metals and ng/g for organics

MWSD = standard deviation of the Mussel Watch lognormal distribution

GBSD = standard deviation of the Great Bay Estuary lognormal distribution

Water Level 3 (WL3): Water Toxicity. Water column toxicity tests are routinely conducted as part of permitting discharges into estuarine waters (USEPA 1988). Bulk samples of the receiving water were collected and evaluated using bioassays with sea urchin (Arbacia punctulata) sperm cells and embryos to determine if any substances were present at levels causing toxicity at the time the sample was taken (Mueller and Anderson 1993a). The screening level used for water toxicity was if there were statistically significant differences in toxicity between the receiving water samples and control samples (USEPA 1988, Mueller and Anderson 1993a). The results of the screening level were determined by:

IF (WATOX > CONTROL) THEN WL3 = 1; [9]
ELSE WL3 = 0; [10]

Where:

WATOX = percent of unfertilized sea urchin embryos measured in bioassays of water column samples

CONTROL = percent of unfertilized sea urchin embryos measured in bioassays of control samples

**Sediment Screening**

Adverse levels of chemicals present in sediment surface and core samples were determined by seven screening levels. The screening levels were based on: (i) sediment toxicity values reported in the literature (Long and Morgan 1990); (ii) sediment management standards developed for the Puget Sound, Washington (Washington State Department of Ecology, WSDOE 1991); (iii) crustal weathering ratios for metals (EMAP 1993); (iv) acid volatile sulfide normalization for divalent metals (Di Toro et al. 1992); (v) equilibrium partitioning for organic compounds (Di Toro et al. 1991); (vi) direct measures of bulk sediment toxicity (Mueller and Anderson 1993b); and (vii) anomalies in benthic infauna community structure (Shipman 1993). The site-specific sediment screening levels were (Figure 3.3):

Sediment Level 0 (SL0): Effects Range-Low. Comparison to Effects Range Low (ER-L) and Effects Range Medium (ER-M) toxicity thresholds reported in Long and Morgan (1990).

Sediment Level 1 (SL1): WA Cleanup Standards. Comparison to Washington State Sediment Quality Standards (WA-SQ) and Sediment Cleanup Standards (WA-CL) developed for the Puget Sound (WSDOE 1991).

Sediment Level 2 (SL2): Crustal Ratios. Determination of sediment metal enrichment relative to metal concentration levels expected from weathering of the earth's crust (EMAP 1993).

Sediment Level 3 (SL3): AVS-Normalization. Evaluation of acid volatile sulfides (AVS) capacity to bind with divalent metals (Di Toto et al. 1990, Di Toro et al. 1992, Johnston 1993).

Sediment Level 4 (SL4): Equilibrium Partitioning. Calculating pore water toxic units from chemical concentrations, determined from equilibrium partitioning between the fraction of organic matter ($f_{oc}$) and interstitial water in the sediments, divided by the water quality criteria value protective of marine aquatic organisms (Di Toro et al. 1991).

Sediment Level 5 (SL5): Sediment Toxicity. Direct measures of sediment toxicity using a 10-day amphipod (<u>Amplesica abdita</u>) bioassay (Mueller and Anderson 1993b).

Sediment Level 6 (SL6): Benthic Community Anomaly. Evaluation of measures of benthic community composition (Shipman 1993).

The application of the sediment screening levels to the Offshore data is detailed below.

<u>Sediment Level 0 (SL0): Effects Range -Low and -Medium.</u> The relationship between bulk sediment chemical concentrations and biological effects has been reviewed by Long and Morgan (1990). Chemical concentration effects distributions were developed that describe the "observed or predicted" chemical concentrations that were "associated with biological effects" (Long and Morgan 1990, p1). The effects levels equal to the 10 and 50 percentile represent the low (ER-L, less than 10% of the studies reported effects below the ER-L) and midpoint (ER-M, less than 50% of the studies reported biological effects below the ER-M) concentrations of the distribution. The ER-L and ER-M were not developed for use as standards or criteria, but rather a method of comparing sites "with regard to the potential for adverse chemical effects" (Long and Morgan 1990, p1).

The sediment level 0 (SL0) screen was applied by:

$$ELOW = \frac{CONC_s \ ug/g}{ER\text{-}L \ ug/g} \qquad [11]$$

and

$$EMED = \frac{CONC_s \ ug/g}{ER\text{-}M \ ug/g} \qquad [11a]$$

where

ER-L = effects range low concentration
ER-M = effects range medium concentration
ELOW = units above ER-L (ER-L units)
EMED = units above ER-M (ER-M units)
$CONC_s$ = concentration measured in sediments

IF (ELOW ≤ 1) THEN SL0 = 0; [12]
IF (ELOW > 1) THEN SL0 = 1: [13a]
IF (EMED > 1) THEN SL0 = 2; [13b]

<u>Sediment Level 1 (SL1): WA Cleanup Standards.</u> Sediment management standards have been developed by the State of Washington for application to sediments in the Puget Sound (WSDOE 1991). The sediment management standards:

> "...are based on a range of allowable levels of contamination that are applied on a site specific basis. The low end of the range is defined by the sediment quality standards (WA-SC), and the upper end of the range is defined by the minimum cleanup levels (WA-CL). The site-specific cleanup standards are intended to be as close as practical to the sediment quality standards, with consideration of net environmental effect, cost, and technical feasibility of any cleanup action. Evaluation of the natural recovery of contaminated sediments is also an important part of the determination of site-specific cleanup levels" (Ginn and Pastorok 1992, p377).

Chemical concentrations above WA-CL were determined for metals by:

$$WASH = \frac{CONC_s \ ug/g \ sed}{WA\text{-}CL \ ug/g \ sed} \qquad [14]$$

and for organics by:

$$WASH = \frac{(CONC\ ng/g\ sed)/(f_{oc}\ g\ organic\ carbon/g\ sed) \cdot 0.001\ ug/ng}{WA\text{-}CL\ ug/g\ organic\ carbon} \quad [15]$$

Where:

WASH = units above Washington State cleanup level, in WA-CL units

$f_{oc}$ = fraction of organic content of sample (from particulate carbon data reported in Ward 1993)

and

WA-CL = Washington State sediment cleanup level

The maximum bulk sediment chemical concentration allowable for each sample, that would still be within the sediment management standard, were determined for the WA-SC ($MAX_{SC}$) and WA-CL ($MAX_{CL}$) levels for organic compounds:

$$MAX_{SC} ng/g = \frac{(WA\text{-}SC\ ug/g\ oc) \cdot (f_{oc}\ g\ oc/g\ sed)}{0.001\ ug/ng} \quad [16]$$

and

$$MAX_{CL} ng/g = \frac{(WA\text{-}CL\ ug/g\ oc) \cdot (f_{oc}\ g\ oc/g\ sed)}{0.001\ ug/ng} \quad [17]$$

The results of the sediment level 1 (SL1) screen were determined by:

IF (WASH > 1) THEN SL1 = 1; [18]
ELSE SL1 = 0; [19]

<u>Sediment Level 2 (SL2): Crustal Ratios.</u> The degree of metal enrichment was evaluated using a crustal-ratio model that relates the amount of metal in a sample to the amount expected from weathering of the earth's crust (Table 3.3). The crustal ratio model consisted of a series of linear regressions that use the percentage of Al in a sample to predict the amount of metal expected to occur from natural weathering processes (EMAP 1993, Johnston 1993b, W. Boothman, USEPA ERLN, personal communication). The measure of enrichment, or deviation above expected concentrations, indicates potential alternative sources (e.g. anthropogenic) of metals. Enrichment levels in samples were determined by:

$$ENRICH = \frac{CONC_s\ ug/g}{PRED\ ug/g} \quad [20]$$

Where

| | | | |
|---|---|---|---|
| PRED | = | $m \cdot Al + b + 2 \cdot RMS$<br>The upper bound of the predicted metal concentration, and | [21] |
| Al | = | percentage of Al in the sample | |
| m | = | slope of the regression | |
| b | = | intercept of the regression | |
| RMS | = | root mean square error of the regression | |

The results of the sediment level 2 (SL2) screen were determined by:

IF (ENRICH > 1) THEN SL2 = 1; [22]
ELSE SL2 = 0; [23]

Sediment Level 3 (SL3): AVS-Normalization. In anoxic sediments, sulfides are produced through the digenesis (breakdown) of organic matter:

$$2CH_2O + SO_4^{=} \; --> \; 2CO_2 + S^{=} + 2H_2O \qquad [24]$$

The sulfide will bind with the readily available Fe to form iron monosulfides:

$$Fe^{2+} + S^{=} <--> FeS_{solid} \qquad [25]$$

The iron monosulfides represent a reactive pool of acid volatile sulfides that are available to dissolve and bind with divalent metals (forming NiS, ZnS, CdS, PbS, CuS, HgS, etc.):

$$Cu^{2+} + FeS_{solid} --> CuS_{solid} + Fe^{2+} \qquad [26]$$

When divalent metals are bound as sulfides they are not as biologically available and toxicity and bioaccumulation potential are greatly reduced (Di Toro et al. 1990, 1991). The amount of AVS in a sample is operationally defined as the concentration of sulfide (umol/g) produced when a sample is treated with acid:

$$MeS + 2HCl --> H_2S + MeCl_{aqueous} \qquad [27]$$

The concentration of metals released ($MeCl_{aqueous}$, umol/g) are termed the simultaneously extracted metal (SEM). Reduced toxicity and bioavailablility has been demonstrated to occur (Di Toro et al. 1990) when the

$$SEM/AVS \quad < \quad 1 \qquad [28]$$

Where:

| | | |
|---|---|---|
| AVS | = | acid volatile sulfide concentration (umol/g) |
| SEM | = | simultaneously extracted metals concentration (umol/g) |

The Offshore Investigation Phase II included measurement of AVS and SEM concentrations at selected stations in the estuary (NCCOSC et al. 1994). Preliminary measures of AVS from Phase II analysis and the bulk metal concentrations from Phase I were used to identify adverse divalent metal concentrations for the sediment level 3 (SL3) screen:

$$\text{RATIO} = \frac{\text{DIVALENT umol/g}}{\text{AVS umol/g}} \qquad [29]$$

where:

DIVALENT = Sum of the SEM divalent metals (Ni, Zn, Cd, Pb, Cu, and Hg) or the sum of divalent metals measured in bulk sediment samples during Phase I of the Offshore Investigation

AVS = AVS measured in samples during Phase II of the Offshore Investigation

The screen results were determined by:

```
IF (RATIO > 1) THEN SL3 = 1;                [30]
               ELSE SL3 = 0;                [31]
```

<u>Sediment Level 4 (SL4): Equilibrium Partitioning.</u> The partitioning or distribution of an organic chemical between the bulk and pore water phases of sediment can be described by the relationship (Di Toro et al. 1991):

$$K_p = C_s/C_d = f_{oc} \cdot K_{oc} \qquad [32]$$

Where:

$K_p$ = partitioning coefficient $\frac{(\text{ng chem}\cdot\text{g}^{-1}\text{ sediment})}{(\text{ug chem}\cdot\text{L}^{-1}\text{ pore water})}$

$C_s$ = concentration of sediment (ng/g sediment)

$C_d$ = concentration of pore water (ug/L water)

$f_{oc}$ = fraction of organic carbon (g oc/g sed)

$K_{oc}$ = partition coefficient for sediment organic carbon, which can be estimated from the chemical's octanol-water partition coefficient ($K_{ow}$) as

$$K_{oc} \cong \text{antilog}\{0.00028 + 0.983[\log(K_{ow})]\} \qquad [33]$$

$$= \frac{(\text{ng chem}\cdot\text{g}^{-1}\text{ organic carbon})}{(\text{ug chem}\cdot\text{L}^{-1}\text{ pore water})}$$

Assuming that equilibrium partitioning (EP) is controlling the distribution of chemical, the pore water concentration can be predicted by:

$$C_d \text{ ug/L} = \frac{C_s \text{ ng/g}}{f_{oc} \text{ (g oc/g sed)} \cdot K_{oc} \dfrac{\text{(ng chem}\cdot\text{g-1 organic carbon)}}{\text{(ug chem}\cdot L^{-1}\text{ pore water)}}} \quad [34]$$

The predicted pore water concentration can be compared to WQC by calculating pore water toxic units to provide a measure of sediment quality:

$$\text{TOXU} = (C_d \text{ ug/L})/(\text{WQC ug/L}) \quad [35]$$

where:
TOXU = level above WQC, in WQC units

The EP approach assumes that there is similar sensitivity between benthic and water column species, and that levels of protection are appropriate for both benthic and water column organisms (Di Toro et al. 1991).

The results of the sediment level 4 (SL4) screen were determined by:

IF (TOXU > 1) THEN SL4 = 1; [36]
ELSE SL4 = 0; [37]

Sediment Level 5 (SL5): Sediment Toxicity. Bulk sediment toxicity tests have been used to assess the biological availability of contaminated sediments (Long et al. 1990), to determine the appropriateness of dredge disposal options (Scott and Redmond 1989) and to evaluate the necessity for remediation (NRC 1989). The 10-day amphipod bioassay was conducted on sediment samples collected from Portsmouth and York Harbors (Mueller and Anderson 1993b). The acute mortality of 20% or greater has been shown to have a significant impact on *Ampelisca* population ecology (Munns et al. 1992). The screening level was set to half of the population effect level (10%). The results of the sediment level 5 (SL5) were determined by:

IF (SEDTOX > 10%) THEN SL5 = 1; [38]
ELSE SL5 = 0; [39]

where
SEDTOX = the percent mortality, relative to reference sediments, measured with the 10-day amphipod test (Mueller and Anderson 1993b).

Sediment Level 6 (SL6): Benthic Community Anomaly. The benthic infauna in Portsmouth and York Harbors were also surveyed during the Phase I Offshore Investigation (Shipman 1993). Data consisting of number of infauna taxa and density encountered at each station were used to construct a lognormal distribution for number of taxa, density, and density/taxa (Table 3.4) that represented the expected benthic community composition for the lower estuary. The benthic community anomalies were identified for each station that fell outside of the 5 percentile of the distributions for taxa and outside of the 5th to 95th percentile of density and density per unit taxa. The levels were considered to be indications of elevated benthic community stress above the "normal" conditions for the lower estuary. The results of the sediment level 6 (SL6) were determined by:

```
IF {(TAXA < 5T)
     OR [(DENSITY > 95D) OR (DENSITY < 5D)]
     OR [(DENTAX > 95DT) OR (DENTAX < 5DT)]}
          THEN SL6 = 1;                                  [40]
          ELSE SL6 = 0;                                  [41]
```

where:

| | | |
|---|---|---|
| TAXA | = | number of taxa encountered per station (taxa/station) |
| DENSITY | = | density of organisms (organisms/$m^2$) measured at each station |
| DENTAX | = | density per unit taxa (organisms$\cdot m^{-2}$)/(taxa$\cdot$station$^{-1}$) |
| 5T | = | 5th percentile of taxa distribution |
| 95D | = | 95th percentile of density distribution |
| 5D | = | 5th percentile of the density distribution |
| 95DT | = | 95th percentile of the density/taxa distribution |
| 5DT | = | 5th percentile of the density/taxa distribution |

## Adverse Chemical Concentration Levels

Surface Water. Adverse chemical concentration levels in surface water were identified for stations that exceeded water quality criteria (EQU 2) or had indications of biological effects (EQU 9). Indications high exposure concentrations were determined for stations that had elevated mussel tissue chemical concentrations (EQU 7). The screening factors were functionally combined to relate effects information (toxicity) to the correspondence of exposure information (exceeding WQC and mussel tissue residue levels). Since the toxicity was measured from only one point sample, data above WQC was interpreted to be an indication of potentially adverse exposure levels. High mussel tissue concentrations could indicate a warning that potentially adverse exposure levels were present.

The definition of adverse chemical concentration levels in surface water (ADVERSE_WATER) in mathematical notation is:

```
IF    {[(WL3 = 1) OR (WL1 = 1)]
      THEN ADVERSE_WATER = 1;                              [42a]
      ELSE ADVERSE_WATER = 0;                              [42b]

IF (WL2 = 1) THEN WARNING = 1;                             [43a]
             ELSE WARNING = 0;                             [43b]
```

Sediment. Adverse chemical concentration levels were determined for stations with indications of biological effects (EQUs 38 and 40) and high exposure concentrations that were positively identified by two or more screening levels (EQUs 13a, 13b, 18, 22, 30, and 36). These factors related sediment exposure (EQUs 13a, 13b, 18, 22, 30, and 36) to sediment effects (EQUs 38 and 40), and allows the assumption that the effects are chemically induced to be evaluated. (In other words, given that a biological response was detected, what chemical concentrations are high enough to be associated with the effect?)

The definition of adverse chemical concentration levels in sediments (ADVERSE_SED) in mathematical notation is:

```
IF    {[SL6 = 1) OR (SL5 = 1)]
       AND [(SL0 + SL1 + SL2 + SL3 + SL4) ≥ 2]}
           THEN ADVERSE_SED = 1;                           [44]
           ELSE ADVERSE_SED = 0;                           [45]
```

## RESULTS

### Surface Water Screening

Water Level 1 (WL1): The results from the surface WL1 screen are presented in Table 3.5. Water samples from ten stations had chemical concentration levels exceeding the WL1 screen[2]. Two stations (S2 and 1008) exceeded chronic levels for Pb, seven station exceeded acute levels for Cu, three stations exceeded chronic levels for Ni, four station for Hg, and five stations for Zn. The WQC values reflect a knowledge of toxicity as well as the capacity for bioaccumulating in the environment, and have been developed to provide long term protection to 95% of the most sensitive marine aquatic species (USEPA 1976). However, water quality criteria values are not available for all chemical contaminants and little is know about specific modes of action when combinations of other stressors are present. The Phase I seep and water column samples screened for WQC levels were not optimal because target detection limits were not met for most of the inorganic chemicals of interest (Table 3.1, Johnston et al. 1993b). However, the methods used for analysis of Phase II seep samples resulted in much improved detection limits (Johnston et al. 1993c). The high seep sample levels (Table 3.5(B), stations S2, S3 and stations 1001 to 1008) may be due to sediment particles that could have been inadvertently included in the water samples, since none of these samples were filtered to remove particulates (Johnston et al. 1993b, Johnston et al. 1993c). Water column analysis using trace level organic analysis methods, and continuous measurements of dissolved hydrocarbons conducted as part of the Phase II ECOS survey did not detect any levels above WQC levels (Chadwick, Katz and Patterson 1993).

A major source of uncertainty in the water column and seep samples is that they are only snap-shots of the conditions at the time the samples were collected. The dynamic nature of water movement and mixing in the estuary (Chadwick, Katz, and Patterson 1993, Langan 1993, 1994, Chadwick, Pavlos, and Celikkol 1993, Swift and Celikkol 1993) means that water grab samples provide only a very course description of water column chemical conditions. Other applicable water quality parameters, that were assessed during the Phase I and Phase II investigations, such as aesthetics, ammonia, dissolved oxygen, pH, and suspended solids were well within the criteria guidelines (Langan 1993, 1994, Chadwick, Katz, and Patterson 1993). Resampling of seeps and water column concentrations

---

[2] Aluminum and iron levels above the fresh water criteria were disregarded due to the absence of toxicity associated with solubility levels of Al and Fe in marine waters.

using ultra-clean sampling techniques and improved analytical methods are being conducted during Phase II of the Offshore Investigation (NCCOSC et al. 1994, Cullen et al. in prep).

Water Level 2 (WL2): The laboratories that conducted the analysis of mussel tissues participated in an intercalibration exercise by analyzing seven-split samples. The results of the intercalibration were within acceptable QA criteria for all analytes except for Ag, Ni, and Cr. The interlaboratory comparison resulted in differences greater than a factor of four between the laboratories for Ag, Ni, and Cr, which exceeded the warning limits specified in the QA/QC plan (MESO and ERLN 1991). Laboratory "c" reported greater than 4x higher values than Laboratory "b" for Ag concentrations for 2 of the 7 samples (Figure 3.4). Laboratory "b" reported consistently higher levels of Ni and Cr than Laboratory "c" (Figure 3.5(A-B)).

It appears that there could be a laboratory bias for Ni and Cr for the samples analyzed by Lab "b". The source of the bias is currently under investigation, but the bias may be related to the fact that the mussel tissue samples were homogenized with a stainless steel blade (to assure that enough sample material would be available for both inorganic and organic analyses of the same sample), rather than with a titanium blade, which is normally done for preparation of Mussel Watch metal only samples. Reanalysis of mussel samples using the Mussel Watch metal preparation procedure is being conducted to identify and eliminate the source of any bias (E. Crecilius, BMSL, personal communication). All Ni and Cr mussel tissue data were used in the screening analyses, however the Phase I Cr and Ni data (not suspected to be biased) were analyzed separately in case the bias was due to analytical error.

The chemical residue probability distributions obtained for Mussel Watch and Great Bay Estuary data are shown in Figures 3.6(A) to 3.6(F). The Great Bay Estuary distribution showed lower chemical concentrations of As, Cd, tPCB, tDDT, tCdane, OTIN than did the Mussel Watch Distributions (Figure 3.5(A), Table 3.6(A)), and similar distributions were obtained for Ag (Figure 3.6(B)).

A total of 45 of the Great Bay Estuary stations (83%, 45/54) had mussel tissue concentration exceeding warning levels (EQU 43, Table 3.6(D)). Chromium warning levels were exceeded at 74% (40/54) of the Great Bay Estuary stations (Table 3.6(D)) for the full data set, while only three stations had mussel concentrations above the Cr warning level when the screening criterion were applied only to the Phase I data set. The Food and Drug Administration (FDA) Shellfish Levels of Concern[3] for Cr consumption by children (91 ug/g) and adults (77 ug/g) were exceeded by more than 5% of the samples (Figure 3.7(A)). Nickel warning levels were exceeded at 54% of the stations and 5% of the samples had Ni concentrations above the FDA Shellfish Level of Concern for Ni consumption by adults (546 ug/g). No stations exceeded Ni warning levels from the Phase I data set.

When Ni and Cr Phase II data were omitted from the analysis, 59% (32/54) of the stations exceeded chemical exposure warning levels. About 22% of the stations exceeded warning levels for Pb and more than 40% of the mussel samples had Pb levels greater than the FDA Level of Concern for Pb consumption by pregnant women (9.54 ug/g) and about 6% of the samples exceeded the FDA Level of Concern for Pb consumption by adults (28.6 ug/g, Figure 3.7(C)). Copper warning levels were exceeded by 26% of the stations (Figure 3.6(G)). Mercury tissue concentrations exceeded the warning level at 19% of the stations (Figure 3.6(F)). Elevated Hg concentrations nearing the FDA action level of 1.00 ug/g(wet) (Nauen 1983) were detected in mussel samples from station 166 (0.75 ug/g(wet); located in Jamaica Island Back Channel), station 151 (0.65 ug/g(wet); located near Dry Dock 3), and station 162 (0.32 ug/g(wet); located in Clark Cove). Further examination of all Hg data generated during the Offshore Study (NCCOSC et al. 1994) showed that only one sample exceeded the FDA Action Level for Hg. The sample was a juvenile lobster tail/claw tissue sample collected from station 17 (near Dry Dock 3), which had a Hg concentration of 1.04 ug/g(wet).

The mussel tissue samples provide a good measure of water column chemical levels because they are sedentary filter feeding organisms which have been shown to accumulate a wide variety of organic and inorganic pollutants (O'Connor 1992). The Mussel Watch distribution provides an excellent source of data for comparing mussel tissue concentrations measured in the Piscataqua and Great Bay Estuary because (i) similar analytical methods were used, (ii) the Mussel Watch data includes a wide range of habitats (including estuarine), and (iii) the distribution provides a probabilistic measure of exposure.

The Mussel Watch 84th percentile screening level (MW84) gives an indication of mussel tissue concentrations that are considered "high" on a nationwide basis. The Mussel Watch 98th percentile screening level (MW98) represents the chemical concentration above which there is a probability of less than 2% ($p < 0.02$) of observing Mussel Watch samples with higher

[3] The FDA Levels of Concern were converted from wet to dry weight by assuming an average dry-to-wet ratio of 22%. The Levels of Concern presented are for the midpoint (50th percentile) of the target population (USFDA 1993a, 1993b, 1993c, 1993d, 1993e).

concentrations. (Or in other words, there is less than a 2% chance of encountering samples of higher concentration at Mussel Watch stations located in coastal areas of the US.) The 98th percentile of the Mussel Watch distribution is appropriate for identifying outliers because this level identifies the highest of the "high" levels which could be an indication of sources or "hot spots" of contamination. Likewise the Great Bay Estuary 95th percentile screening level identifies the samples that are the highest of the high for the Great Bay Estuary. Clearly there is a definite indication of elevated exposure when residue levels are above the Mussel Watch 98th percentile, or the Great Bay Estuary 95th percentile. However there is no indication of biological effects to the mussel. The significance of exposure levels and their relationship to ecological effects are being evaluated during Phase II of the ecological risk assessment (NCCOSC et al. 1994).

Water Level 3 (WL3): Statistically significant reduction in sea urchin fertilization was measured at station 3 (9.7%), station 4 (29%), and station 7 (10.3%) (Mueller and Anderson 1993a). The sea urchin was used as a surrogate for sensitive invertebrate species which reproduce by broadcasting their sperm and larvae into the water column. There are many uncertainties associated with interpreting the sea urchin toxicity data. Many factors will effect the result of the test: (i) sample handling and storage, (ii) whether the toxicity is biologically significant, (iii) whether the toxicity observed is chemically induced, and (iv) the sensitivity and condition of the test species (C. Mueller, SAIC ERLN, Personal Communication). The results of WL3 are used as an indication that adverse levels of toxic substances were present at the time the sample was collected.

Adverse Surface Water Concentrations: The outcome of the surface water screen (EQU 42a) is summarized in Table 3.7. Adverse chemical concentrations were identified for one station at the river mouth (station 1), four stations in Clark Cove (stations 3, 4, 7, and 1004), the seep stations located near the Police Dock (stations 1001, 1002, and 1003), and four of the seep stations in the Jamaica Island Back Channel (stations S2, 1005, 1006, 1007, and 1008; Table 3.7(A)). Mussel tissue warning levels (excluding the Phase II Ni and Cr data; EQU 43a) were identified at two Piscataqua River reference stations (stations 14 and 172), the two stations in Spruce Creek (stations 20 and 21), three stations in the upper Great Bay Estuary (stations 24, 26, and 28) and twenty-three stations surrounding Seavey Island (Table 3.7(B)).

**Sediment Screening**

Metal Exposure: The results of the SL0, SL1, SL2, and SL3 level screens for sediment metal concentrations are presented in Table 3.8. Almost all stations exceeded the ER-L screening level (EQU 13a) and thirteen stations exceeded the ER-M screening level (EQU 13b, Table 3.8(C)). Only four samples exceeded the Washington State clean up level (EQU 18), Cr at station 5 20-30 cm depth; Cr, Cu, and Zn at station 10 132-138 cm depth; and Cu at station 10 33-38cm; and Hg at station 12 20-28 cm depth. The surface grab from station 4 had Hg concentrations at 0.59 ug/g, but did not exceed the screening level of 0.59 ug/g. The crustal ratio composition (EQU 22) indicated that Hg and Ag were enriched at 22 of the 23 stations, however Hg levels were consistently below the MDL of 0.45 ug/g (Table 3.1 and Table 3.8(B)), suggesting that the Hg sediment data may be more of an artifact of the method than actual numbers (Johnston et al. 1993b). Enriched levels of As, Cd, Cr, Cu, Pb, Ni, and Zn were observed at 11, 9, 17, 6, 13, 6, and 3 of the surface grab stations, respectively. A higher incidence of Pb, As, Cd, and Ni enrichment was observed in samples from Clark Cove. The levels of Cu and Zn appeared to be more enriched in samples collected near dry dock areas. No stations were identified where the divalent metal concentrations measured in bulk samples or SEM samples exceeded the AVS concentration (EQU 30). All seven of the salt marsh stations had elevated exposure levels for metals (Table 3.12(B)) mostly due to a combination of exceeding ER-L levels (EQU 13a) and crustal enrichment (EQU 22) (Table 3.8(C)).

Organic Contaminant Exposure Levels The results of the exposure screening for sediment concentration levels of PAHs, PCBs, and Pesticides are presented in Table 3.9, 3.10, and 3.11, respectively. Elevated exposure levels were detected in surface grab samples for PHEN at stations 12 and 18, and DDT concentrations exceeded the ER-M level at 52% (12/23) of the stations. A significant exposure level was identified for PHEN measured at station 12 (an EP-predicted pore water toxic unit of 1.3, Table 3.9(F), level SL4, EQU 36) suggesting that PHEN may be present at a toxic level at that station. Organic data from the core samples that tested positively for the metal screen (EQU 24) were examined (data not shown) to identify samples above the ER-M (SL0=2, EQU 13b, Table 3.12(A)). Most of the core samples had high exposure levels of DDT, while only four core samples had elevated exposure levels for PAH compounds (Table 3.12(A)). One salt marsh station had elevated PAH exposure (Table 3.12(B)). It was not possible to apply the SL1 and SL4 screens to the core and salt marsh organic contaminant data because the sediment carbon data was not available. The pesticide and PCB data from the salt marsh samples were also not available for screening. The low incidence of adverse organic chemical exposure levels are consistent with the low incidence of adverse organic chemical exposures identified with the surface water screen, especially in the mussel tissues (Table 3.6(A)).

The ER-L and crustal ratio screening (EQUs 13a and 22) are very conservative screening levels, because they do not take into account the biological availability of the chemical present (Long and Morgan 1990, D. Hansen, USEPA ERLN, personal communication). The Washington State clean up level (EQU 18) is less conservative because it defines maximum allowable chemical concentrations based on observations of biological responses (apparent effects threshold) of four biological tests: (i) amphipod mortality, (ii) bivalve larval abnormality, (iii) microtox luminescence, and (iv) benthic infauna composition (WSDOE 1991, Ginn and Pastorok 1992). The ER-M level, is also less conservative because it is the concentration level that has been associated with observations of affects about half the time. However, ER-L and ER-M levels were derived from data sets where all the chemicals of concern (metals and organics) covaried to a high degree (Long and Morgan 1990). The striking absence of organic contaminants in the Portsmouth data set (Table 3.12(A-B)) suggests that metal exposure is more threatening to aquatic life than exposure to organic contaminants. The AVS-normalized screen (EQU 30) accounts for the form of divalent metals and is probably more accurate in predicting of the biological availability of sulfide-forming metals (Di Toro et al. 1990, Boothman and Helmstetter 1993, Johnston 1993), although there are many factors which may affect AVS concentrations throughout the year (Boothman and Helmstetter 1993). The concentration of AVS was not measured at all stations, however, it appears that AVS production in the lower estuary is very high and in excess of the divalent metals present (Table 3.8(F)).

<u>EFFECTS</u> Amphipod toxicity was detected at 7 of the 23 stations assessed (Mueller and Anderson 1993b, EQU 38, Figure 3.7, Table 3.12(C)). Amphipod toxicity has been linked to chemical concentration, but there are other factors that can contribute to bioassay response. Factors such as grain size, physio-chemical conditions in the sediment, and sensitivity and variation of test organisms and test conditions can interfere with the toxicity assessment (Scott and Redmond 1989).

Benthic community anomalies (EQU 40) were detected at four stations (stations 2, 4, 8, and 13, Figures 3.8, 3.9, and 3.10, Table 3.12(D) Shipman 1993). Many factors can contribute to anomalous infaunal structure in the Piscataqua and Great Bay Estuary (Shipman 1993, R. Grizzle, Campbell University, Personal Communication). However, benthic structure provides a measure of the cumulative stresses operating within the ecosystem. The benthic community structure is a function of sediment characteristics, chemical exposure, nutrient-loading, and organic enrichment as well as many other factors (Levin et al. 1989, Howarth 1989).

ADVERSE LEVELS The outcome of the sediment screening (EQU 44) identified the adverse chemical concentrations at total of nine stations (Table 3.13). Six of the stations were located around Seavey Island: two stations in Clark Cove (stations 4 and 8), near the Police Dock (station 9), two stations in the vicinity of the dry docks (stations 13 and 17), and one station in the Back Channel (station 18). Elevated exposure levels of were identified for the following (Table 3.13):

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Station 2 grab | Cr | Pb | Hg | | | | | DDT | |
| Station 4 grab | Cr | Pb | Hg | Ni | | | | DDT | |
| 4 core | Cr | Pb | Hg | Ni | Zn | | | | |
| Station 8 grab | Cr | Pb | Hg | Ni | Zn | | | DDT | |
| 8 core | Cr | Pb | Hg | Ni | Zn | Cu | | | |
| Station 9 grab | | Pb | | | | | | DDT | |
| Station 13 grab | Cr | | Hg | | | | | DDT | |
| Station 17 grab | | Pb | Hg | | | | | DDT | |
| 17 core | Cr | Pb | Hg | | | | PAH | | |
| Station 18 grab | | Pb | | | | | PHEN | DDT | DDE |
| Station 23 grab | | | | | | | | DDT | |

Amphipod effects levels (EQU 38) were not concordant with adverse chemical exposure levels for stations 16, and 22, indicating that the response may be due to something other than the chemicals measured during the Offshore Study. Effects associated with the Salt Marsh stations (stations 50-57) are being evaluated by Burdick (1994).

Only Clark Cove had adverse chemical concentration identified by both the surface water (Table 3.7(A)) and sediment screens (Table 3.13). If stations with mussel concentrations above warning levels (EQU 4, Table 3.7(B) are included then elevated levels were identified by both surface water and sediment screens for the following areas:

| | Water | Mussel | Sediment |
|---|---|---|---|
| CLARK COVE | Hg Cu Ni Zn | As Ag Cu Pb | Cr Pb Hg Ni Zn DDT |
| POLICE DOCK | Hg Cu Zn | DDT | Pb DDT |
| JAMAICA ISLAND | Hg Cu Ni Zn Pb | Hg Cu Zn Pb | Pb PHEN DDT DDE |
| BACK CHANNEL | | Hg Cu Pb | Pb PHEN DDT DDE |
| DRMO | | Cu Pb | |
| DRY DOCKS | | Hg Cu Pb Zn Ag PAH | Hg Cu Pb PAH |

**Media Protection Zones**

Media protection zones for surface water and sediments were developed from the screening level analysis to functionally estimate chemical concentration levels that are protective of marine aquatic resources in the Piscataqua and Great Bay Estuary. The media protection zones were developed by identifying the chemical concentration levels that would fall below the various screening levels described above.

<u>Surface Water</u>: The media protection zones for surface water were developed from equations [1], [4], and [9] and were defined for:

water:

$$CONC_w \leq WQC \qquad [46a]$$

$$WATOX < CONTROL \qquad [46b]$$

mussel tissue warning level:

$$(CONC_M \leq MW98) \text{ AND } (CONC_M \leq GB95) \qquad [47]$$

The media protection zones can be interpreted to define ranges of chemical concentration levels which are below levels associated with causing adverse impacts to marine aquatic organisms.

<u>Surface water media protection standards.</u> Chemical concentration levels are protective of marine aquatic life if the concentrations are below chronic salt water ambient water quality criteria (AWQC) and there is an absence of bulk water column toxicity. Incidence of chemical levels above AWQC and/or water toxicity suggests that corrective measures be evaluated to control sources of contamination that may be impacting water quality. Areas where elevated mussel tissue concentrations were detected above warning levels, should also be evaluated for appropriate corrective measures.

<u>Sediment</u>. The media protection zones for sediments were developed to define ranges of protection for chemical concentration levels in sediments ($CONC_S$). The zones represent levels of protection that are afforded from adverse impacts to marine aquatic organisms. The levels range from more conservative (more protective) to more likely to represent increased probability of observing adverse biological effects.

ZONE 1 (metals and organics, from EQU 11)

$$CONC_s \leq ER\text{-}L \qquad [48]$$

$$CONC^s \leq ER\text{-}M \qquad [49]$$

ZONE 2 (metals, from EQU 14)

$$CONC_s \leq WA\text{-}CL \qquad [50]$$

ZONE 2 (organics, from EQU 17)

$$CONC_s \leq MAXCL \qquad [51]$$

ZONE 3 (metals only, from EQU 20)

$$CONC_s \leq PRED \qquad [52]$$

ZONE 4 (metals only, from EQU 29)

$$DIVALENT \leq AVS \qquad [53]$$

ZONE 5 (organics only, from EQU 34)

$$CONC_s \leq WQC \cdot f_{oc} \cdot K_{oc} \qquad [54]$$

The zones defined by toxicity thresholds and crustal ratios (EQU 48, 49, 50 and 51) for Cr (Figure 3.11), Pb (Figure 3.12), Hg (Figure 3.13), Ni (Figure 3.14) and Zn (Figure 3.15) define the lower range of elevated exposure levels for these metals. These zones are more conservative because they do not take into account the form or biological availability of the metal concentration present, and rely on extrapolation of effects from other studies (Long and Morgan 1990, Ginn and Pastorok 1992). The zone identified for divalent metals (Cd, Cu, Hg, Pb, Ni, Ag, and Zn, EQU 53, Figure 3.16) presents a more realistic assessment of divalent metal availability.

The media protection zones defined for (EQU 48, 49, 51, and 55) PHEN (Figure 3.17), fluoranthene (Figure 3.18), SUMPAH (Figure 3.19), total PCBs (Figure 3.20), and the sum of DDT metabolites (Figure 3.21) indicate the levels of protection afforded for those compounds.

The results obtained from biological assessment monitoring (sea urchin and amphipod toxicity and benthic community anomalies as well as other effects endpoints) can be used to evaluate the cumulative effects of chemical concentration levels and verify the level of protection.

<u>Sediment media protection standards.</u> Chemical concentration levels are protective of marine aquatic life if there is no indication of biological effects, either in terms of sediment toxicity or stress on the benthic infauna community. If toxicity or benthic stress is present then corrective measures should be evaluated for chemicals that exceeded two or more screening levels consisting of toxicity thresholds (ER-L,

ER-M), Washington State sediment cleanup standards, enrichment relative to crustal weathering, AVS concentrations for divalent metals, and equilibrium partitioning pore water toxic units for organic chemicals.

## DISCUSSION

The objective of this analysis was to satisfy the Media Protection Standards of the Shipyard's permit. In the process a functional approach was developed to relate exposure and effects information to determine the occurrence of adverse chemical concentrations. The concordance of exposure and effects information provides evidence that chemical stressors may be causing adverse impacts on the system (Munns et al. 1993, Johnston et al. 1993d). The fact that the biological response may be due to cumulative or nonchemical factors should also be considered when interpreting these results.

The important outcome of this analysis is that testable hypotheses can be developed to address the ecological significance of exposure levels. Hypotheses currently being evaluated during Phase II of the offshore ecological risk assessment include: (i) determining the exposure-responses of marine plants and invertebrates to sediments from Clark Cove and sediments spiked with Pb (Nacci et al. in prep, Thursby and Tagliabue in prep); (ii) the routes of bioaccumulation and uptake of Pb in blue mussels (Tracey et al. in prep); (iii) trophic transfer of chemicals through the food chain (Johnston et al. in prep-a), (iv) the levels and rates of chemical releases from seep samples (Cullen et al. in prep); (v) determining the movement and accumulation of sediments in the lower estuary (Ward 1994); (vi) determining the routes and rates of chemical transport (Bowen and Pruell 1993, Pavlos 1994), (vii) assessing the health and status of eelgrass saltmarsh, benthic, and epibenthic habitats around Seavey Island (Short 1994, Burdick 1994, Grizzle in prep., Short and Hoven 1994); (vii) determining the geochemical assimilation capacity of shoreline substrates and sediment (Johnston in prep-b); and (viii) verifying the findings with ongoing monitoring data (NCCOSC et al. 1994a).

There are two major shortcomings of the analysis presented in this section. They are (i) the fact that exposure screening levels were not available for all chemicals that may of been present, and (ii) other effects endpoints, identified as part of the ecological risk framework (Munns et al. 1993, Johnston et al. 1993d), need to be assessed to provide a complete as possible assessment of ecological risks. With respect to the first point, the implicit assumption is that the exposure of other unmeasured chemicals, which belong to similar compound families (e.g. metals, high molecular weight organic compounds, semi-volatile compounds, etc.), would have analogous distribution patterns and exposure levels as those that were evaluated using the screening analysis.

Other effects endpoints including eelgrass vitality (Short 1993a, 1994), flounder and lobster abundance and density (Short 1993b, Langan 1994a), mussel abundance and density (Hoven and Short 1993, Short and Hoven 1994), fucoid algae reproductive biology (Mathieson 1993), saltmarsh ecology (Burdick 1994), microbial contamination (Jones 1993), and toxicological effects on marine organisms (Nacci et al. in prep) also needs to be assessed. For example, it is unknown at this time why eelgrass beds are not present within Clark Cove, even though the cove appears to be suitable habitat for eelgrass (Johnston et al. 1993d). It was not possible to screen these endpoints at this time because specific evaluation criteria are not yet available. These endpoints will be assessed when the ecological risk assessment is completed (NCCOSC et al. 1994).

The results of the screening analysis were very useful for identifying adverse levels of chemical exposure that should be evaluated for appropriate corrective measures. The surface water screen can be used to identify active sources of contamination in the estuary, while the sediment screen provides information on past releases as well as cumulative impacts on the system. The screening analyses are the necessary first step in determining the ecological risk from chemicals associated with the Shipyard SWMUs.

In the course of evaluating remedial options two important points should be considered:

> "1. Have existing pollutant sources contributing to contamination been controlled?
>
> 2. Will natural recovery processes (e.g. natural sedimentation, bioturbation, contaminant degradation) result in an elimination of the problem with time?" (Ginn and Pastorok 1992, p388).

The capacity for natural recovery will be contingent on the site-specific characteristics of the system and rates of transformation processes that are governed by principals of estuarine ecology. These factors must be accurately assessed so that cleanup measures will be cost-effective and "take full advantage of natural recovery processes" (Ginn and Pastorok 1992, p388). Further information, much of which is being developed during Phase II of the ecological risk assessment, is required before risk-based cleanup levels can be established.

## SUMMARY

Two screening procedures, one for surface water and the other for sediment were used to identify adverse chemical concentration levels in the Piscataqua and Great Bay Estuary. The surface water screen consisted of three screening levels based on (i) water quality criteria (USEPA 1980), (ii) mussel tissue residues (O'Connor 1992), and (iii) toxicity to sea urchin sex cells (Mueller and Anderson 1993a). The sediment screen consisted of seven screening levels based on (i) sediment toxicity values reported in the literature (Long and Morgan 1990), (ii) sediment management standards developed for the Puget Sound, Washington (WSDOE 1991), (iii), crustal weathering ratios for metals (EMAP 1993), (iv) levels of acid volatile sulfide for binding with divalent metals (Di Toro 1992), (v) equilibrium partitioning for organic compounds (Di Toro et al. 1991), (vi) direct measures of bulk sediment toxicity (Mueller and Anderson 1993b); and (vii) anomalies in benthic infauna community structure (Shipman 1993). Adverse chemical concentrations were identified for the following locations around Seavey Island:

| | Water | Mussel | Sediment |
|---|---|---|---|
| CLARK COVE | Hg Cu Ni Zn | As Ag Cu Pb | Cr Pb Hg Ni Zn DDT |
| POLICE DOCK | Hg Cu Zn | DDT | Pb DDT |
| JAMAICA ISLAND | Hg Cu Ni Zn Pb | Hg Cu Zn Pb | Pb PHEN DDT DDE |
| BACK CHANNEL | | Hg Cu Pb | Pb PHEN DDT DDE |
| DRMO | | Cu Pb | |
| DRY DOCKS | | Hg Cu Pb Zn Ag PAH | Hg Cu Pb PAH |

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TABLE 3.1: Chemical analytes, sample matrices, target detection limits, and acheived detection limits for the chemical analyzed during the Phase I of the Offshore Study (From Johnston et al. 1993b). Abbreviations used in the text are given in parenthesis.

A. Organic compounds.

| Analyte | Sample Matrix | (Dry weight for sediment and biota) TARGET Detection Limit | ACHEIVED Detection Limit |
|---|---|---|---|
| **Volatile Organic Compounds** | **seep water** | **0.1 ug/L** | **0.3 - 0.4 ug/L** |
| vinyl chloride | trans-1,3-dichloropropene | | |
| 1,1-dichloroethene | tetrachloroethene | | |
| methylene chloride | chlorobenzene | | |
| trans-1,2-dichloroethene | bromoform | | |
| chloroform | 1,1,2,2-tetrachloroethane | | |
| 1,1,1-trichloroethane | 1,3-dichlorobenzene | | |
| carbon tetrachloride | methyl-t-butyl ether | | |
| 1,2-dichloroethane | benzene | | |
| trichloroethene | toluene | | |
| 1,2-dichloropropane | ethylbenzene | | |
| bromodichloromethane | m,p-xylene | | |
| 2-chloroethylvinyl ether | o-xylene | | |
| cis-1,3-dichloropropene | 1,2-dichlorobenzene | | |
| **Polycyclic Aromatic Hydrocarbons** | **seep water** | **1-5 ug/L** | **1- 4 ug/L** |
| | **sediment** | **1-5 ng/g** | **3-21 ng/g** |
| | **biota** | **10-20 ng/g** | **3-25 ng/g** |
| anthracene (ANTH) | phenanthrene (PHEN) | | |
| benz(a)anthracene (BAA) | $C_1$ alkyl phenanthrenes + anthracenes (C1) | | |
| benzo(a)pyrene (BAP) | $C_2$ alkyl phenanthrenes + anthracenes (C2) | | |
| benzo(e)pyrene (BEP) | $C_3$ alkyl phenanthrenes + anthracenes (C3) | | |
| chrysene (CHRYSENE) | $C_4$ alkyl phenanthrenes + anthracenes (C4) | | |
| dibenz(a,h)anthracene (DIBAHA) | pyrene (PYRENE) | | |
| fluoranthene (FLUORAN) | benzo(g,h,i)perylene (BGHIPER) | | |
| fluorene (FLUORENE) | indeno(1,2,3-cd)pyrene (INDEN123) | | |
| perylene (PERYLENE) | sum of benzofluoranthenes (SUMBENZ) | | |
| sumPAH = sum of the 18 measured PAH compounds | | | |
| **Chlorinated Pesticides** | **seep water** | **0.6 ng/L** | **0.6-0.9 ng/L** |
| | **sediment** | **0.6 ng/g** | **0.1-0.6 ng/g** |
| | **biota** | **0.6 ng/g** | **0.1-2.4 ng/g** |
| aldrin (ALDRIN) | alpha-chlordane (ACHLOR) | | |
| trans-nonachlor (TNONACHL) | Heptachlor (HEPCHLOR) | | |
| Hepachlor epoxide (HEPEPX) | hexachlorobenzene (HCB) | | |
| Lindane gamma-BHC (LINDANE) | Mirex (MIREX) | | |
| o,p'-DDD (DDDOP) | p,p'-DDD (DDDPP) | | |
| o,p'-DDE (DDEOP) | p,p'-DDE (DDEPP) | | |
| o,p'-DDT (DDTOP) | p,p'-DDT (DDTPP) | | |
| tDDT = sum of DDT and metabolites DDE and DDD | | | |
| tCdane = sum of chlordane mixtures ACHLOR, TNONACHL, HEPCHLOR and HEPEPX | | | |
| **Polychlorinated Biphenyl Congeners [Congener number and position of chlorines]** | **seep water** | **1 ug/L** | **0.5-0.6 ug/L** |
| | **sediment** | **0.5 ng/g** | **0.1-1.9 ng/g** |
| | **biota** | **0.5 ng/g** | **0.2-0.6 ng/g** |
| 8 [2,4'] (PCB8) | 18 [2,2',5] (PCB18) | | |
| 28 [2,4,4'] (PCB28) | 52 [2,2',5,5'] (PCB52) | | |
| 44 [2,2',3,5'] (PCB44) | 66 [2,3',4,4'] (PCB66) | | |
| 101 [2,2',4,5,5'] (PCB101) | 118 [2,3',4,4',5] (PCB118) | | |
| 153 [2,2',4,4',5,5'] (PCB153) | 105 [2,3,3',4,4'] (PCB105) | | |
| 138 [2,2',4,4',5,5'] (PCB138) | 187 [2,2',3,4',5,5',6] (PCB187) | | |
| 128 [2,2',3,3',4,4'] (PCB128) | 180 [2,2',3,4,4',5,5'] (PCB180) | | |
| 170 [2,2',3,3',4,4',5] (PCB170) | 195 [2,2',3,3',4,4',5,6] (PCB195) | | |
| 206 [2,2',3,3',4,4',5,5',6] (PCB206) | 209 [2,2',3,3',4,4',5,5',6,6'] (PCB209) | | |
| SUMPCB = sum of 18 PCB congeners measured | | | |
| tPCB (sediment) = 2.01 * SUMPCB - 1.55 | | | |
| tPCB (tissue) = 1.95 * SUMPCB + 2.1 | | | |

TABLE 3.1. Continued.

B. Inorganic compounds.

| Analyte | Matrix | TARGET MDL (Dry Weight for Biota and Sediment) | | ACHEIVED MDL | |
|---|---|---|---|---|---|
| Aluminum (Al) | water | 75.0 | ug/L | 84.0 | ug/L |
| Aluminum | sediment | Not Specified(NS) | | 10.7 | ug/g |
| Aluminum | biota | NS | | 8.17 | ug/g |
| Arsenic (As) | water | 3.0 | ug/L | 15.0 | ug/L |
| Arsenic | sediment | 1.1 | ug/g | 0.52 | ug/g |
| Arsenic | biota | 4.3 | ug/g | 3.2 | ug/g |
| Cadmium (Cd) | water | 0.2 | ug/L | 4.0 | ug/L |
| Cadmium | sediment | 0.35 | ug/g | 0.13 | ug/g |
| Cadmium | biota | 0.055 | ug/g | 0.05 | ug/g |
| Chromium (Cr) | water | 3.0 | ug/L | 15.0 | ug/L |
| Chromium | sediment | 3.16 | ug/g | 1.65 | ug/g |
| Chromium | biota | 0.28 | ug/g | 1.85 | ug/g |
| Copper (Cu) | water | 0.7 | ug/L | 300.0 | ug/L |
| Copper | sediment | 1.25 | ug/g | 4.55 | ug/g |
| Copper | biota | 5.0 | ug/g | 2.01 | ug/g |
| Iron (Fe) | water | 20.0 | ug/g | 90.0 | ug/L |
| Iron | sediment | NS | | 7.6 | ug/g |
| Iron | biota | NS | | 6.6 | ug/g |
| Lead (Pb) | water | 3.0 | ug/L | 1.5 | ug/L |
| Lead | sediment | 1.2 | ug/g | 0.81 | ug/g |
| Lead | biota | 0.6 | ug/g | 0.13 | ug/g |
| Manganese(Mn) | water | 0.5 | ug/L | 15.0 | ug/L |
| Manganese | sediment | NS | | 0.97 | ug/g |
| Manganese | biota | NS | | 0.60 | ug/g |
| Mercury (Hg) | water | 5.0 | ug/L | 0.6 | ug/L |
| Mercury | sediment | 0.007 | ug/g | 0.448 | ug/g |
| Mercury | biota | 0.036 | ug/g | 0.079 | ug/g |
| Nickel (Ni) | water | 3.0 | ug/L | 30.0 | ug/L |
| Nickel | sediment | 1.08 | ug/g | 2.76 | ug/g |
| Nickel | biota | 0.73 | ug/g | 3.45 | ug/g |
| Silver (Ag) | water | 3.0 | ug/L | 15.0 | ug/L |
| Silver | sediment | 0.04 | ug/g | 0.15 | ug/g |
| Silver | biota | 0.037 | ug/g | 0.091 | ug/g |
| Tin (Sn) | water | 3.0 | ug/L | | |
| Tin | sediment | 1.75 | ug/g | 0.81 | ug/g |
| Zinc (Zn) | water | 0.1 | ug/L | 1500.0 | ug/L |
| Zinc | sediment | 2.15 | ug/g | 1.1 | ug/g |
| Zinc | biota | 11.65 | ug/g | 11.3 | ug/g |
| **Butyltins** | **sediment** | **2.0** | **ug/g** | **2.0** | **ug/g** |
| | **biota** | **2.0** | **ug/g** | **2.0** | **ug/g** |

monobutyltin (MBT)
dibutyltin (DBT)
tributyltin (TBT)
TOTIN = sum of TBT, DBT, and MBT

Table 3.2. Mussel tissue chemical concentrations corresponding to the lognormal distributions of chemical residue levels from Mussel Watch data. The mean and "high" (84th percentile of the distribution) concentrations for the lognormal distributions are from O'Connor 1992. The 95th and 98th percentile levels were calculated. Units are ug/g for metals and ng/g for organics.

| Chemical | Mean-x | log(x) | "high" 84th | log84th | Log(SD) | log95th | 95th | log98th | 98th |
|---|---|---|---|---|---|---|---|---|---|
| As | 10.00 | 1.00 | 17.00 | 1.23 | 0.23 | 1.38 | 23.94 | 1.45 | 28.29 |
| Cd | 2.70 | 0.43 | 5.70 | 0.76 | 0.32 | 0.97 | 9.23 | 1.07 | 11.68 |
| Hg | 0.09 | -1.03 | 0.24 | -0.62 | 0.41 | -0.36 | 0.44 | -0.23 | 0.59 |
| Ni | 1.70 | 0.23 | 3.30 | 0.52 | 0.29 | 0.70 | 5.06 | 0.80 | 6.24 |
| Ag | 0.17 | -0.77 | 0.58 | -0.24 | 0.53 | 0.11 | 1.28 | 0.28 | 1.88 |
| Cu | 8.90 | 0.95 | 11.00 | 1.04 | 0.09 | 1.10 | 12.61 | 1.13 | 13.48 |
| Zn | 130.00 | 2.11 | 190.00 | 2.28 | 0.16 | 2.39 | 242.69 | 2.44 | 273.51 |
| Pb | 1.80 | 0.26 | 4.30 | 0.63 | 0.38 | 0.88 | 7.54 | 1.00 | 9.92 |
| Cr | 1.70 | 0.23 | 3.00 | 0.48 | 0.25 | 0.64 | 4.33 | 0.71 | 5.18 |
| TPCB | 110.00 | 2.04 | 470.00 | 2.67 | 0.63 | 3.08 | 1199.23 | 3.28 | 1894.85 |
| tDDT | 37.00 | 1.57 | 120.00 | 2.08 | 0.51 | 2.41 | 256.31 | 2.57 | 371.30 |
| Chlordane | 14.00 | 1.15 | 31.00 | 1.49 | 0.35 | 1.71 | 51.77 | 1.82 | 66.49 |
| tPAH | 260.00 | 2.41 | 890.00 | 2.95 | 0.53 | 3.29 | 1968.29 | 3.46 | 2900.21 |
| tOTIN | 81.00 | 1.91 | 350.00 | 2.54 | 0.64 | 2.95 | 899.54 | 3.15 | 1426.36 |

Table 3.3: Crustal ratio metal-Al regressions developed from the analysis of Virginian Province sediment data (EMAP 1993, W. Boothman, USEPA ERLN, personal communication). The slope of the regression (m), y-intercept (b), root mean square error of the regression (RMS), and regression coefficient ($r^2$) are given for each element. The upper bound of the predicted crustal ratio (PRED) was defined as: PRED = m·Al% + b + 2·RMS (EQU 21).

| ELEMENT | m | b | RMS | $r^2$ |
|---|---|---|---|---|
| As | 1.15 | 1.15 | 2.76 | 0.47 |
| Cd | 0.0431 | 0.0042 | 0.1099 | 0.45 |
| Cr | 10.58 | -1.43 | 16.898 | 0.667 |
| Hg | 0.0113 | 0.0062 | 0.0263 | 0.502 |
| Pb | 5.9 | 2.39 | 8.42 | 0.727 |
| Ag | 0.0096 | 0.01 | 0.0417 | 0.194 |
| Cu | 5.57 | -3.44 | 11.84 | 0.539 |
| Fe | 5792.0 | -1309.0 | 4673.9 | 0.888 |
| Mn | 94.1 | 28.8 | 157.32 | 0.61 |
| Ni | 4.98 | -2.57 | 6.077 | 0.774 |
| Zn | 21.9 | -9.6 | 30.458 | 0.729 |

TABLE 3.4: The raw data for infauna TAXA (number of TAXA per STATION), DENSITY (organisms/$m^2$) and calculated DENSITY/TAXA (organisms$\cdot m^{-2}$/TAXA$\cdot$station$^{-1}$) for each station (from Shipman 1993). The calculated mean, standard deviation, and percentiles of the normal distribution for TAXA and lognormal distributions for DENSITY and DENSITY/TAXA are also tabulated.

| Station | TAXA | DENSITY x10$^4$ | log(D) | DENSITY/ TAXA x10$^4$ | log(D/T) |
|---|---|---|---|---|---|
| 1 | 34 | 1.80 | 0.26 | 0.05 | -1.28 |
| 2 | 53 | 11.40 | 1.06 | 0.22 | -0.67 |
| 3 | 58 | 1.70 | 0.23 | 0.03 | -1.53 |
| 4 | 42 | 9.20 | 0.96 | 0.22 | -0.66 |
| 5 | 24 | 1.60 | 0.20 | 0.07 | -1.18 |
| 6 | 31 | 3.60 | 0.56 | 0.12 | -0.94 |
| 7 | 25 | 1.10 | 0.04 | 0.04 | -1.36 |
| 8 | 47 | 10.70 | 1.03 | 0.23 | -0.64 |
| 9 | 73 | 1.50 | 0.18 | 0.02 | -1.69 |
| 10 | 67 | 2.30 | 0.36 | 0.03 | -1.46 |
| 11 | 55 | 1.10 | 0.04 | 0.02 | -1.70 |
| 12 | 89 | 7.40 | 0.87 | 0.08 | -1.08 |
| 13 | 46 | 0.50 | -0.30 | 0.01 | -1.96 |
| 14 | 61 | 1.40 | 0.15 | 0.02 | -1.64 |
| 15 | 64 | 7.10 | 0.85 | 0.11 | -0.95 |
| 16 | 102 | 5.50 | 0.74 | 0.05 | -1.27 |
| 17 | 69 | 7.10 | 0.85 | 0.10 | -0.99 |
| 18 | 102 | 3.20 | 0.51 | 0.03 | -1.50 |
| 19 | 62 | 6.70 | 0.83 | 0.11 | -0.97 |
| 20 | 50 | 1.60 | 0.20 | 0.03 | -1.49 |
| 21 | 41 | 1.40 | 0.15 | 0.03 | -1.47 |
| 22 | 77 | 1.10 | 0.04 | 0.01 | -1.85 |
| 23 | 80 | 3.40 | 0.53 | 0.04 | -1.37 |
| AVG | 59 | 2.81 | | 0.05 | |
| STD | 21 | | | | |
| 95% | 94 | 11.68 | | 0.21 | |
| 84% | 80 | 6.68 | | 0.12 | |
| 16% | 37 | 1.18 | | 0.02 | |
| 5% | 23 | 0.68 | | 0.01 | |

TABLE 3.5: Screening levels, raw data, and results obtained for the Surface Water Level 1 (WL1) screen.

**TABLE 3.5(A): Chronic Water Quality Criteria (EPA 1991) used for screening LEVEL 0.**

| LEVEL 0 | Al* | Ag | As | Cd | Cr | Cu# | Fe* | Hg | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WQC ug/L (ppb) | 87.0 | 0.9 | 36.0 | 9.3 | 50.0 | 2.9 | 1000.0 | 0.025 | NA | 8.3 | 8.5 | 86.0 |

* Fresh Water Chronic Criteria
# Acute Criteria

**TABLE 3.5(B): The method detection limit (MDL) and raw data (ug/L, ppb) from PHASE I of the Offshore Study used fo the WL1 screen.**

| STATION | Date | Al | Ag | As | Cd | Cr | Cu | Fe | Hg | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MDL | | 84.0 | 15.0 | 15.0 | 4.0 | 15.0 | 300.0 | 90.0 | 0.60 | 15.0 | 30.0 | 1.5 | 1500.0 |
| S1 | 920213 | 38.0 | 3.0 | 2.0 | 3.0 | 6.0 | 3.0 | 436.0 | 0.06 | 313.0 | 3.0 | 1.0 | 4.0 |
| S1 | 920213 | 43.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 465.0 | 0.06 | 320.0 | 9.0 | 1.0 | 5.0 |
| S2 | 920213 | 2161.0 | 3.0 | 2.6 | 2.0 | 9.0 | 313.0 | 3071.0 | 0.90 | 116.0 | 13.0 | 1034.0 | 219.0 |
| S2 | 920213 | 2143.0 | 3.0 | 1.4 | 2.0 | 8.0 | 310.0 | 3013.0 | 0.88 | 115.0 | 15.0 | 972.0 | 216.0 |
| S3 | 920213 | 476.0 | 3.0 | 2.0 | 4.0 | 2.0 | 7.0 | 447.0 | 0.07 | 6.0 | 6.0 | 8.0 | 54.0 |
| 1 | 910917 | 64.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 61.0 | 0.04 | 7.0 | 10.0 | 1.1 | 5.0 |
| 1 | 911113 | 22.0 | 3.0 | 2.0 | 4.0 | 3.0 | 2.0 | 95.0 | 0.04 | 7.0 | 46.0 | 1.0 | 4.0 |
| 1 | 911217 | 163.0 | 3.0 | 2.0 | 1.0 | 2.0 | 3.0 | 88.0 | 0.04 | 7.0 | 3.0 | 1.0 | 7.0 |
| 1 | 920115 | 44.0 | 3.0 | 2.0 | 1.0 | 6.0 | 2.0 | 89.0 | 0.04 | 6.0 | 10.0 | 1.5 | 3.0 |
| 1 | 920214 | 12.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 72.0 | 0.04 | 5.0 | 10.0 | 1.0 | 2.0 |
| 1 | 920305 | 84.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 31.0 | 0.04 | 6.0 | 10.0 | 1.0 | 5.0 |
| 1 | 920423 | 130.0 | 3.0 | 1.1 | 4.0 | 6.0 | 3.0 | 220.0 | 0.04 | 9.0 | 10.0 | 1.0 | 5.0 |
| 1 | 920520 | 59.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 59.0 | 0.04 | 8.0 | 10.0 | 1.0 | 2.0 |
| 1 | 920616 | 48.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 34.0 | 0.04 | 10.0 | 10.0 | 1.0 | 2.0 |
| 2 | 910917 | 69.2 | 3.0 | 2.3 | 4.0 | 6.0 | 2.8 | 79.4 | 0.04 | 5.7 | 10.0 | 1.3 | 10.8 |
| 3 | 910916 | 23.7 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 3.0 | 0.04 | 5.5 | 10.0 | 0.5 | 17.6 |
| 4 | 910916 | 31.8 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 25.9 | 0.04 | 6.9 | 3.4 | 1.0 | 1.0 |
| 5 | 910916 | 45.5 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 30.6 | 0.04 | 6.0 | 3.4 | 1.0 | 5.5 |
| 6 | 910916 | 20.3 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 37.0 | 0.04 | 6.6 | 1.3 | 1.0 | 2.3 |
| 7 | 910916 | 35.4 | 3.0 | 2.4 | 4.0 | 6.0 | 3.0 | 26.7 | 0.04 | 6.2 | 2.4 | 1.0 | 1.3 |
| 8 | 910916 | 30.8 | 3.0 | 4.0 | 4.0 | 6.0 | 3.0 | 40.5 | 0.04 | 6.6 | 10.0 | 1.0 | 5.0 |
| 8 | 910916 | 65.5 | 3.0 | 3.8 | 4.0 | 6.0 | 3.0 | 34.6 | 0.04 | 7.1 | 2.4 | 1.0 | 5.0 |
| 8 | 911113 | 57.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 99.0 | 0.04 | 6.0 | 10.0 | 1.0 | 2.0 |
| 8 | 911217 | 82.0 | 3.0 | 2.0 | 4.0 | 13.0 | 6.0 | 86.0 | 0.04 | 4.0 | 7.0 | 1.0 | 3.0 |
| 8 | 920116 | 13.0 | 3.0 | 1.6 | 1.0 | 6.0 | 3.0 | 90.0 | 0.04 | 4.0 | 10.0 | 1.0 | 4.0 |
| 8 | 920217 | 46.0 | 3.0 | 2.0 | 1.0 | 6.0 | 2.0 | 109.0 | 0.04 | 3.0 | 10.0 | 1.1 | 6.0 |
| 8 | 920305 | 84.0 | 3.0 | 1.3 | 4.0 | 2.0 | 3.0 | 50.0 | 0.04 | 8.0 | 5.0 | 1.0 | 3.0 |
| 8 | 920423 | 35.0 | 3.0 | 2.0 | 4.0 | 5.0 | 6.0 | 45.0 | 0.04 | 5.0 | 10.0 | 1.0 | 3.0 |
| 8 | 920520 | 39.0 | 3.0 | 2.0 | 4.0 | 6.0 | 4.0 | 78.0 | 0.04 | 10.0 | 3.0 | 1.0 | 1.0 |
| 8 | 920616 | 41.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 39.0 | 0.04 | 10.0 | 10.0 | 1.0 | 5.0 |
| 9 | 910916 | 33.0 | 3.0 | 2.0 | 1.0 | 6.0 | 3.0 | 41.0 | 0.04 | 6.0 | 10.0 | 1.0 | 5.0 |
| 10 | 910916 | 32.5 | 3.0 | 1.2 | 4.0 | 6.0 | 3.0 | 25.2 | 0.04 | 5.7 | 10.0 | 1.0 | 1.2 |
| 10 | 911113 | 51.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 98.0 | 0.04 | 7.0 | 10.0 | 3.4 | 6.0 |
| 10 | 911217 | 41.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 47.0 | 0.04 | 1.0 | 10.0 | 1.0 | 3.0 |
| 10 | 911217 | 41.0 | 3.0 | 2.0 | 2.0 | 6.0 | 3.0 | 57.0 | 0.04 | 3.0 | 10.0 | 1.0 | 3.0 |
| 10 | 920116 | 24.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 79.0 | 0.04 | 2.0 | 10.0 | 1.3 | 6.0 |
| 10 | 920217 | 40.0 | 3.0 | 2.0 | 2.0 | 6.0 | 1.0 | 89.0 | 0.04 | 3.0 | 10.0 | 1.7 | 4.0 |
| 10 | 920305 | 84.0 | 3.0 | 1.7 | 4.0 | 6.0 | 3.0 | 33.0 | 0.04 | 3.0 | 10.0 | 1.0 | 5.0 |
| 10 | 920423 | 145.0 | 3.0 | 1.2 | 2.0 | 6.0 | 8.0 | 109.0 | 0.04 | 9.0 | 11.0 | 1.2 | 5.0 |
| 10 | 920423 | 62.0 | 3.0 | 2.0 | 4.0 | 6.0 | 6.0 | 107.0 | 0.04 | 9.0 | 10.0 | 1.0 | 4.0 |
| 10 | 920520 | 28.0 | 3.0 | 2.0 | 4.0 | 6.0 | 2.0 | 97.0 | 0.04 | 12.0 | 10.0 | 1.0 | 2.0 |
| 10 | 920616 | 97.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 105.0 | 0.04 | 16.0 | 10.0 | 1.0 | 2.0 |
| 11 | 910917 | 19.0 | 3.0 | 2.0 | 1.0 | 2.0 | 1.0 | 52.0 | 0.04 | 9.0 | 10.0 | 1.0 | 1.0 |
| 12 | 910917 | 27.0 | 3.0 | 2.0 | 1.0 | 6.0 | 3.0 | 39.0 | 0.04 | 5.0 | 10.0 | 1.0 | 5.0 |
| 13 | 910916 | 31.0 | 3.0 | 2.0 | 1.0 | 6.0 | 3.0 | 43.0 | 0.04 | 6.0 | 10.0 | 1.0 | 5.0 |
| 14 | 910916 | 62.8 | 3.0 | 1.2 | 4.0 | 6.0 | 2.2 | 47.2 | 0.04 | 8.2 | 10.0 | 1.0 | 5.0 |
| 15 | 910916 | 36.0 | 3.0 | 2.0 | 1.0 | 6.0 | 3.0 | 51.0 | 0.04 | 10.0 | 10.0 | 1.0 | 1.0 |
| 15 | 910916 | 27.0 | 3.0 | 2.0 | 2.0 | 6.0 | 3.0 | 51.0 | 0.04 | 10.0 | 10.0 | 1.0 | 5.0 |
| 15 | 911113 | 82.8 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 99.0 | 0.04 | 9.0 | 10.0 | 1.0 | 3.0 |
| 15 | 911217 | 153.0 | 3.0 | 2.0 | 4.0 | 5.0 | 3.0 | 194.0 | 0.04 | 11.0 | 10.0 | 1.0 | 5.0 |
| 15 | 920115 | 91.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 133.0 | 0.04 | 7.0 | 10.0 | 1.0 | 3.0 |
| 15 | 920217 | 26.0 | 3.0 | 1.1 | 4.0 | 6.0 | 12.0 | 81.0 | 0.04 | 2.0 | 10.0 | 1.0 | 5.0 |
| 15 | 920305 | 19.0 | 3.0 | 2.0 | 1.0 | 13.0 | 3.0 | 52.0 | 0.04 | 7.0 | 10.0 | 1.0 | 2.0 |
| 15 | 920423 | 115.0 | 3.0 | 2.0 | 4.0 | 6.0 | 9.0 | 143.0 | 0.04 | 12.0 | 5.0 | 1.0 | 2.0 |
| 15 | 920520 | 82.0 | 3.0 | 1.2 | 2.0 | 6.0 | 3.0 | 174.0 | 0.04 | 17.0 | 10.0 | 1.0 | 2.0 |
| 15 | 920616 | 85.0 | 3.0 | 2.0 | 4.0 | 6.0 | 15.0 | 92.0 | 0.04 | 17.0 | 10.0 | 1.0 | 4.0 |
| 15 | 920616 | 87.0 | 3.0 | 2.0 | 4.0 | 6.0 | 16.0 | 95.0 | 0.04 | 17.0 | 10.0 | 1.0 | 6.0 |
| 16 | 910917 | 49.0 | 3.0 | 2.0 | 3.0 | 6.0 | 1.0 | 70.0 | 0.04 | 11.0 | 10.0 | 1.0 | 5.0 |
| 16 | 920115 | 79.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 94.0 | 0.04 | 2.0 | 10.0 | 1.0 | 5.0 |

**TABLE 3.5(B): Continued.**

| Station | Date | Al | Ag | As | Cd | Cr | Cu | Fe | Hg | Mn | Ni | Pb | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 920217 | 54.0 | 3.0 | 2.0 | 2.0 | 6.0 | 3.0 | 89.0 | 0.04 | 5.0 | 10.0 | 1.0 | 2.0 |
| 16 | 920305 | 84.0 | 3.0 | 1.9 | 4.0 | 6.0 | 3.0 | 43.0 | 0.04 | 7.0 | 10.0 | 1.0 | 5.0 |
| 16 | 920423 | 108.0 | 3.0 | 2.0 | 4.0 | 8.0 | 6.0 | 125.0 | 0.04 | 10.0 | 10.0 | 1.0 | 1.0 |
| 16 | 920520 | 55.0 | 3.0 | 2.0 | 4.0 | 4.0 | 3.0 | 141.0 | 0.04 | 13.0 | 10.0 | 1.3 | 3.0 |
| 16 | 920616 | 79.0 | 3.0 | 2.0 | 4.0 | 6.0 | 4.0 | 88.0 | 0.04 | 18.0 | 10.0 | 1.0 | 2.0 |
| 17 | 910916 | 16.1 | 3.0 | 1.6 | 4.0 | 6.0 | 3.0 | 24.0 | 0.04 | 9.1 | 3.6 | 1.0 | 5.0 |
| 18 | 910916 | 42.3 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 41.0 | 0.04 | 6.3 | 10.0 | 1.0 | 5.0 |
| 19 | 910916 | 42.0 | 3.0 | 2.0 | 4.0 | 6.0 | 2.2 | 34.2 | 0.04 | 6.9 | 16.8 | 1.0 | 5.0 |
| 20 | 910916 | 37.2 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 38.3 | 0.04 | 7.1 | 7.7 | 1.0 | 5.0 |
| 21 | 910916 | 57.2 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 62.6 | 0.04 | 9.7 | 10.0 | 1.0 | 1.0 |
| 22 | 910913 | 44.0 | 3.0 | 2.0 | 2.0 | 6.0 | 3.0 | 59.0 | 0.04 | 4.0 | 10.0 | 1.0 | 3.0 |
| 22 | 921113 | 188.0 | 3.0 | 2.0 | 3.0 | 6.0 | 3.0 | 298.0 | 0.04 | 14.0 | 10.0 | 1.8 | 4.0 |
| 23 | 910913 | 45.2 | 3.0 | 1.6 | 4.0 | 6.0 | 3.0 | 30.5 | 0.04 | 4.0 | 5.3 | 1.0 | 5.0 |
| 23 | 911231 | 165.0 | 3.0 | 2.0 | 4.0 | 5.0 | 4.0 | 184.0 | 0.04 | 8.0 | 3.0 | 1.0 | 2.0 |
| 23 | 920115 | 171.0 | 3.0 | 2.0 | 3.0 | 6.0 | 3.0 | 189.0 | 0.04 | 6.0 | 10.0 | 1.0 | 5.0 |
| 23 | 920118 | 135.0 | 3.0 | 2.0 | 3.0 | 6.0 | 3.0 | 136.0 | 0.04 | 4.0 | 10.0 | 1.0 | 5.0 |
| 23 | 920305 | 45.0 | 3.0 | 2.0 | 7.0 | 6.0 | 3.0 | 26.0 | 0.04 | 4.0 | 10.0 | 1.0 | 10.0 |
| 23 | 920422 | 102.0 | 3.0 | 1.0 | 4.0 | 6.0 | 3.0 | 122.0 | 0.04 | 8.0 | 4.0 | 1.0 | 5.0 |
| 23 | 920521 | 72.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 77.0 | 0.04 | 7.0 | 10.0 | 1.0 | 5.0 |
| 23 | 920615 | 85.0 | 3.0 | 2.0 | 4.0 | 6.0 | 3.0 | 70.0 | 0.04 | 10.0 | 10.0 | 1.0 | 5.0 |

**April 1993 Seep Samples**

| Station | Date | Al | Ag | As | Cd | Cr | Cu | Fe | Hg | Mn | Ni | Pb | SN | Zn | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Blank | 930412 | 118.0 | 0.022 | 0.62 | 0.03 | 0.20 | 2.84 | 12.6 | 0.001 | 2.0 | 0.10 | 4.64 | 3.40 | 39.2 | 0.0 |
| Blank | 930414 | 33.2 | 0.002 | 0.30 | 0.01 | 0.20 | 0.25 | 54.4 | 0.009 | 3.4 | 0.04 | 0.30 | 3.43 | 11.1 | 0.0 |
| Blank | 930413 | 167.0 | | 0.64 | | 0.20 | | 16.7 | | 2.7 | | | 3.45 | 77.7 | 0.0 |
| 1001 | 930409 | 175.0 | 0.044 | 1.38 | 0.09 | 0.73 | 2.67 | 62.8 | 0.018 | 3.2 | 1.29 | 4.06 | 6.44 | 38.5 | 19.0 |
| 1001 | 930412 | 92.1 | 0.038 | 1.10 | 0.08 | 0.77 | 2.76 | 83.7 | 0.050 | 3.6 | 1.25 | 3.36 | 4.73 | 180.0 | 18.0 |
| 1002 | 930409 | 109.0 | 0.055 | 0.51 | 0.15 | 0.35 | 2.31 | 188.0 | 0.032 | 9.4 | 2.11 | 4.02 | 6.42 | 36.6 | 2.0 |
| 1002 | 930411 | 75.8 | 0.038 | 0.52 | 0.14 | 0.53 | 1.82 | 155.0 | 0.000 | 9.0 | 2.19 | 2.52 | 4.52 | 69.9 | 2.0 |
| 1003 | 930409 | 137.0 | | 0.39 | | | | | | | | | 3.81 | | |
| 1003 | 930409 | 255.0 | 0.024 | 0.69 | 0.33 | 0.20 | 6.41 | 230.0 | 0.000 | 144.0 | 2.94 | 5.63 | 4.10 | 432.0 | 0.0 |
| 1003 | 930410 | 138.0 | 0.028 | 0.35 | 0.32 | 0.20 | 7.07 | 272.0 | 0.000 | 129.0 | 2.80 | 4.61 | 3.81 | 159.0 | 0.0 |
| 1004 | 930409 | | | | | | | | 0.034 | | | | | | |
| 1004 | 930409 | 125.0 | 0.067 | 1.43 | 0.06 | 1.94 | 8.61 | 239.0 | 0.009 | 46.9 | 16.80 | 2.56 | 5.38 | 123.0 | 10.0 |
| 1004 | 930409 | 101.0 | 0.072 | 1.22 | 0.06 | 1.82 | 7.45 | 159.0 | 0.040 | 43.0 | 17.30 | 2.87 | 4.34 | 56.8 | 10.0 |
| 1005 | 930409 | 106.0 | 0.229 | 0.94 | 0.15 | 0.88 | 23.10 | 305.0 | 0.005 | 31.2 | 22.80 | 6.54 | 4.43 | 127.0 | 6.0 |
| 1005 | 930418 | 66.9 | 0.227 | 0.89 | 0.13 | 0.82 | 20.90 | 305.0 | 0.004 | 31.2 | 22.60 | 6.30 | 4.28 | 212.0 | 6.0 |
| 1006 | 930409 | 172.0 | 0.043 | 1.29 | 0.08 | 0.29 | 4.57 | 310.0 | 0.001 | 359.0 | 2.76 | 6.10 | 3.83 | 43.1 | 10.0 |
| 1006 | 930417 | 58.6 | 0.043 | 1.16 | 0.07 | 0.88 | 3.05 | 310.0 | 0.002 | 305.0 | 2.60 | 2.95 | 3.90 | 26.1 | 8.0 |
| 1007 | 930409 | 142.0 | 0.053 | 1.05 | 0.09 | 0.41 | 3.88 | 506.0 | 0.001 | 394.0 | 2.73 | 3.61 | 10.80 | 60.8 | 7.0 |
| 1007 | 930409 | | | | | 0.35 | | 536.0 | | 448.0 | | | | 71.2 | |
| 1007 | 930416 | 53.1 | 0.138 | 1.15 | 0.07 | 0.20 | 3.35 | 527.0 | 0.001 | 376.0 | 2.69 | 3.36 | 3.95 | 26.1 | 5.0 |
| 1008 | 930409 | 94.6 | 0.026 | 0.41 | 0.33 | 0.20 | 1.40 | 96.3 | 0.001 | 5.4 | 0.92 | 2.63 | 3.50 | 186.0 | 0.0 |
| 1008 | 930415 | 1101.0 | 0.050 | 1.07 | 0.53 | 1.12 | 8.45 | 1810.0 | 0.000 | 52.7 | 4.35 | 13.60 | 3.46 | 444.0 | 0.0 |

**TABLE 3.5(D): Results of the WL1 Screen.** IF [(CONC > MDL) AND (CONC > WQC)] THEN WL1 = 1;
ELSE WL1 = 0;

| Station | Date | Al | Ag | As | Cd | Cr | Cu | Fe | Hg | Mn | Ni | Pb | Sn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S1 | 920213 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| S1 | 920213 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| S2 | 920213 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | NA | 0 | 1 | | 0 |
| S2 | 920213 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | NA | 0 | 1 | | 0 |
| S3 | 920213 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 1 | 910917 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 1 | 911113 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 1 | 0 | | 0 |
| 1 | 911217 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 1 | 920115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 1 | 920214 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 1 | 920305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 1 | 920423 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 1 | 920520 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 1 | 920616 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 2 | 910917 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 3 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 4 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 5 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 6 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 7 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 911113 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 911217 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 920116 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 920217 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 920305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 920423 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 920520 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 8 | 920616 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 9 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 911113 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 911217 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 911217 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 920116 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 920217 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 920305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 920423 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 920423 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 920520 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 10 | 920616 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 11 | 910917 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 12 | 910917 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 13 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 14 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 911113 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 911217 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 920115 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 920217 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 920305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 920423 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 920520 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 920616 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 15 | 920616 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 16 | 910917 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 16 | 920115 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 16 | 920217 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 16 | 920305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 16 | 920423 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 16 | 920520 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 16 | 920616 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 17 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 18 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 19 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 20 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 21 | 910916 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 22 | 910913 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 22 | 921113 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |

**TABLE 3.5(D): Continued.**

| Station | Date | Al | Ag | As | Cd | Cr | Cu | Fe | Hg | Mn | Ni | Pb | Sn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | 910913 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 23 | 911231 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 23 | 920115 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 23 | 920118 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 23 | 920305 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 23 | 920422 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 23 | 920521 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |
| 23 | 920615 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | | 0 |

**April 1993 Seep Samples (if CONC > WQC)**

| Station | Date | Al | Ag | As | Cd | Cr | Cu | Fe | Hg | Mn | Ni | Pb | Sn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1000 | 930412 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1000 | 930414 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1000 | 930413 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1001 | 930409 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1001 | 930412 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | NA | 0 | 0 | NA | 1 |
| 1002 | 930409 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | NA | 0 | 0 | NA | 0 |
| 1002 | 930411 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1003 | 930409 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1003 | 930409 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 0 | 0 | NA | 1 |
| 1003 | 930410 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 0 | 0 | NA | 1 |
| 1004 | 930409 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | NA | 0 | 0 | NA | 0 |
| 1004 | 930409 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 1 | 0 | NA | 1 |
| 1004 | 930409 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | NA | 1 | 0 | NA | 0 |
| 1005 | 930409 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 1 | 0 | NA | 1 |
| 1005 | 930418 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 1 | 0 | NA | 1 |
| 1006 | 930409 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1006 | 930417 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1007 | 930409 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1007 | 930409 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1007 | 930416 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | NA | 0 | 0 | NA | 0 |
| 1008 | 930409 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | NA | 1 |
| 1008 | 930415 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | NA | 0 | 1 | NA | 1 |

Table 3.6: Screening levels, raw data, and results obtained for the Surface Water Level 2 (WL2) screen.

Table 3.6(A): The percentile levels of mussel tissue residues determined for mussel tissue residues from the NOAA Mussel Watch and Great Bay Estuary distributions. Units are ug/g (ppm) for metals and ng/g (ppb) for organics.

| | As | Cd | Hg | Ni | Ag | Cu | Zn | Pb | Cr | TPCB | TDDT | tCdane | sumPAH | TOTIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **NOAA Mussel Watch** | | | | | | | | | | | | | | |
| geoMean | 10.0 | 2.7 | 0.09 | 1.7 | 0.2 | 8.9 | 130 | 1.8 | 1.7 | 110.0 | 37.0 | 14.0 | 260 | 81.0 |
| "High" 84% | 17.0 | 5.7 | 0.24 | 3.3 | 0.6 | 11.0 | 190 | 4.3 | 3.0 | 470.0 | 120.0 | 31.0 | 890 | 350.0 |
| 95% | 23.9 | 9.2 | 0.44 | 5.0 | 1.3 | 12.6 | 242 | 7.5 | 4.3 | 1190.6 | 254.8 | 51.6 | 1956 | 893.0 |
| 98% | 29.7 | 12.5 | 0.64 | 6.6 | 2.1 | 13.7 | 283 | 10.7 | 5.4 | 2159.4 | 412.8 | 71.4 | 3240 | 1627.2 |
| **GREAT BAY ESTUARY** | | | | | | | | | | | | | | |
| geoMean | 8.4 | 2.0 | 0.41 | 6.7 | 0.3 | 9.0 | 105 | 6.6 | 10.3 | 148.5 | 34.6 | 3.6 | 916 | 33.9 |
| 84% | 12.7 | 3.3 | 0.75 | 37.8 | 0.7 | 14.3 | 134 | 17.0 | 42.4 | 223.5 | 56.0 | 6.5 | 1684 | 53.8 |
| 95% | 16.7 | 4.6 | 1.12 | 114.6 | 1.4 | 19.3 | 156 | 31.2 | 105.0 | 290.4 | 76.2 | 9.4 | 2486 | 72.2 |
| 98% | 19.9 | 5.6 | 1.45 | 233.0 | 2.1 | 23.3 | 172 | 46.0 | 187.7 | 343.4 | 92.8 | 11.9 | 3191 | 87.3 |
| n samples | 101 | 102 | 100 | 101 | 102 | 101 | 101 | 101 | 102 | 99 | 99 | 99 | 97 | 11 |

Raw Data ug/g (ppm) for metals and ng/g (ppb) for organics

Table 3.6(B): Mussel tissue residue raw data. Units are dry weight ug/g (ppm) for metals and ng/g (ppb) for organics

| EPAID | R | Lab | Sta | Cdate | As | Cd | Hg | Ni | Ag | Cu | Zn | Pb | Cr | TPCB | TDDT | tCdane | sumPAH | TOTIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 110073 | A | c | 1 | 910916 | 9.6 | 1.0 | | 1.5 | 0.2 | 6.2 | 116 | 7.6 | 3.9 | 153.9 | 33.8 | 6.8 | 570 | 32.8 |
| 110390 | A | c | 1 | 911217 | 8.8 | 2.1 | 0.34 | 1.2 | 0.2 | 5.4 | 84 | 3.8 | 3.1 | 92.8 | 14.5 | 1.5 | 795 | |
| 110401 | A | c | 1 | 920317 | 6.8 | 1.2 | 0.52 | 2.5 | 0.2 | 5.9 | 87 | 7.1 | 4.3 | 129.3 | 20.2 | 1.4 | 1141 | |
| 110407 | A | b | 1 | 920608 | 13.7 | 2.0 | 0.48 | 3.8 | 0.5 | 7.8 | 110 | 5.6 | 8.0 | 141.1 | 36.5 | 9.8 | 745 | |
| 110419 | A | b | 1 | 921008 | 13.9 | 2.2 | 0.42 | 4.0 | 0.5 | 8.1 | 126 | 6.0 | 9.3 | 140.7 | 33.7 | 6.0 | 537 | |
| 110075 | B | c | 2 | 911001 | 5.3 | 1.5 | 0.49 | 1.4 | 0.1 | 5.8 | 140 | 10.0 | 3.1 | 167.8 | 33.8 | 2.6 | 1209 | 43.7 |
| 110080 | A | b | 3 | 910930 | | 3.5 | 0.60 | 38.5 | 0.7 | | | 8.5 | 40.3 | 129.7 | 34.4 | 3.6 | 775 | |
| 110080 | A | b | 3 | 910930 | 10.9 | 3.2 | 0.63 | 40.0 | 0.5 | 12.2 | 135 | 8.8 | 43.0 | | | | | |
| 110080 | A | c | 3 | 910930 | 27.8 | 2.8 | 0.49 | 2.0 | 0.1 | 6.3 | 108 | 5.5 | 3.0 | 241.8 | 32.1 | 4.1 | 661 | |
| 110395 | A | c | 3 | 911219 | 7.3 | 1.7 | 0.51 | 1.1 | 0.1 | 5.3 | 109 | 6.6 | 3.4 | 102.1 | 26.4 | 1.8 | 685 | |
| 110403 | A | c | 3 | 920318 | 4.5 | 1.2 | 0.32 | 1.7 | 0.1 | 5.0 | 60 | 3.5 | 2.6 | 102.5 | 31.3 | 1.5 | 585 | |
| 110411 | A | b | 3 | 920617 | 9.4 | 2.6 | 0.42 | 3.2 | 0.3 | 8.7 | 115 | 6.4 | 6.4 | 128.7 | 39.3 | 6.9 | 1158 | |
| 110421 | A | b | 3 | 921008 | 12.5 | 2.4 | 0.43 | 3.7 | 0.3 | 7.6 | 93 | 6.2 | 6.9 | 139.0 | 40.2 | 6.6 | 565 | |
| 110086 | A | b | 4 | 910930 | 11.5 | 1.9 | 0.43 | 80.6 | 0.3 | 12.2 | 105 | 6.9 | 87.0 | 184.5 | 38.7 | 3.5 | 823 | |
| 110086 | A | c | 4 | 911003 | 10.5 | 0.1 | 0.22 | 1.4 | 0.6 | 7.6 | 130 | 10.3 | 4.0 | 156.0 | 20.2 | 4.5 | 758 | |
| 110081 | A | c | 5 | 910930 | 7.4 | 2.2 | 0.44 | 1.9 | 0.1 | 5.8 | 109 | 10.8 | 4.2 | 174.7 | 36.8 | 2.5 | 694 | |
| 110085 | A | c | 6 | 911003 | 8.8 | 1.9 | 0.16 | 1.8 | 1.2 | 8.4 | 132 | 9.0 | 3.7 | 262.7 | 37.2 | 8.2 | 841 | |
| 110082 | A | c | 7 | 910930 | 6.3 | 1.6 | 0.24 | 2.4 | 0.9 | 7.5 | 107 | 10.7 | 3.4 | 252.7 | 89.0 | 3.0 | 913 | |
| 110083 | A | b | 8 | 910930 | 9.2 | 2.8 | 0.49 | 53.6 | 0.3 | 22.7 | 176 | 13.6 | 44.8 | | | | | |
| 110083 | A | c | 8 | 910930 | 6.9 | 1.9 | 0.18 | 3.1 | 2.7 | 8.4 | 119 | 12.3 | 4.0 | 395.2 | 97.8 | 7.6 | 1323 | 25.7 |
| 110084 | A | c | 9 | 910930 | 6.7 | 2.6 | 0.34 | 1.6 | 0.1 | 6.1 | 132 | 10.2 | 3.7 | 136.7 | 121.8 | 3.0 | | 23.3 |
| 110394 | A | c | 9 | 911219 | 6.6 | 1.3 | 0.41 | 0.9 | 0.1 | 5.6 | 109 | 6.1 | 2.8 | 104.1 | 47.5 | 2.5 | 845 | |
| 110402 | A | c | 9 | 920318 | 4.8 | 1.5 | 0.27 | 2.0 | 0.1 | 5.3 | 74 | 5.4 | 3.1 | 106.8 | 63.2 | 1.2 | 634 | |
| 110410 | A | b | 9 | 920617 | 11.1 | 2.5 | 0.30 | 3.2 | 0.3 | 7.7 | 89 | 5.1 | 6.2 | 139.6 | 49.3 | 7.3 | 1011 | |
| 110420 | A | b | 9 | 921008 | 9.8 | 2.6 | 0.36 | 4.4 | 0.3 | 8.4 | 115 | 8.0 | 7.7 | 172.0 | 65.6 | 7.8 | 1627 | |
| 110090 | A | c | 10 | 911022 | 8.4 | 2.0 | 0.97 | 1.4 | 0.0 | 8.1 | 222 | 13.5 | 3.4 | 109.6 | 15.7 | 1.8 | 867 | |

Table 3.6(B): Continued. Mussel tissue residue raw data. Units are dry weight ug/g (ppm) for metals and ng/g (ppb) for organics

| EPAID | R | Lab | Sta | Cdate | As | Cd | Hg | Ni | Ag | Cu | Zn | Pb | Cr | TPCB | TDDT | tCdane | sumPAH | TOTIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 110079 | A | b | 10.5 | 910927 | 6.1 | 3.0 | 0.38 | 99.0 | 0.5 | 34.1 | 159 | 37.1 | 61.2 | | | | | |
| 110079 | A | c | 10.5 | 910927 | 5.1 | 1.9 | 0.13 | 1.5 | 0.0 | 6.2 | 122 | 26.0 | 2.3 | 260.1 | 27.6 | 5.4 | 612 | 16.2 |
| 110076 | A | c | 11 | 910923 | 7.3 | 1.7 | 0.27 | 1.6 | 0.2 | 7.8 | 119 | 9.2 | 4.1 | 184.3 | 32.5 | 1.1 | 890 | |
| 110091 | A | c | 12 | 911022 | 6.5 | 3.1 | 0.45 | 2.3 | 0.1 | 32.3 | 105 | 11.0 | 3.5 | 470.7 | 17.7 | 1.3 | | |
| 110400 | A | b | 12.5 | 911003 | 12.3 | 3.1 | 0.68 | 47.4 | 0.6 | 14.0 | 145 | 15.3 | 68.0 | 126.2 | 36.1 | 3.1 | 1424 | |
| 110092 | A | c | 12.5 | 911022 | 7.6 | 2.4 | 0.26 | 2.0 | 0.1 | 6.6 | 117 | 9.2 | 3.8 | 187.7 | 21.8 | 1.7 | | |
| 110391 | A | c | 12.5 | 911217 | 8.6 | 4.0 | 0.36 | 1.6 | 0.3 | 12.7 | 143 | 7.1 | 3.5 | 117.7 | 14.2 | 1.0 | 1008 | |
| 110400 | A | c | 12.5 | 920310 | 4.6 | 1.2 | 0.60 | 3.0 | 0.1 | 7.7 | 104 | 12.4 | 4.0 | 162.9 | 48.3 | 2.5 | 1045 | |
| 110408 | A | b | 12.5 | 920610 | 10.6 | 6.0 | 0.37 | 8.4 | 0.5 | 10.0 | 89 | 23.2 | 17.3 | 173.1 | 48.1 | 7.2 | 1317 | |
| 110418 | A | b | 12.5 | 921002 | 8.9 | 2.7 | 0.31 | 5.0 | 0.5 | 7.3 | 72 | 8.3 | 6.9 | 197.7 | 51.8 | 7.4 | 806 | |
| 110074 | A | c | 14 | 910916 | 10.7 | 1.5 | 0.72 | 1.7 | 0.1 | 5.8 | 89 | 5.7 | 3.8 | 126.5 | 15.2 | 1.8 | 634 | 49.5 |
| 110077 | A | c | 16 | 910923 | 5.9 | 2.1 | 0.07 | 1.7 | 0.1 | 6.2 | 110 | 9.1 | 3.9 | 169.8 | 30.1 | 2.6 | 894 | |
| 110398 | A | c | 16 | 920310 | 5.5 | 1.2 | 0.53 | 2.9 | 0.1 | 7.9 | 123 | 4.1 | 3.6 | 176.1 | 35.9 | 1.7 | 1271 | |
| 110416 | A | b | 16 | 920930 | 10.2 | 1.7 | 0.35 | 5.6 | 0.3 | 6.9 | 73 | 3.0 | 7.7 | 182.4 | 46.6 | 7.9 | 663 | |
| 110406 | A | b | 16 | 930608 | 9.9 | 0.4 | 0.34 | 0.5 | 0.3 | 9.5 | 92 | 0.1 | 0.4 | 157.0 | 36.4 | 6.5 | 536 | |
| 110406 | A | b | 16 | 930608 | 8.7 | | | | | 9.4 | 88 | | | | | | | |
| 110070 | A | c | 17 | 910912 | 5.7 | 1.1 | 0.15 | 1.7 | 2.4 | 7.0 | 98 | 6.1 | 3.3 | 218.9 | 31.8 | 3.3 | 906 | 33.7 |
| 110392 | A | c | 17 | 911217 | 4.4 | 1.1 | 0.39 | 1.5 | 0.1 | 5.7 | 83 | 2.1 | 2.7 | 123.8 | 22.6 | 1.9 | 1020 | |
| 110399 | A | c | 17 | 920310 | 5.1 | 1.2 | 0.30 | 2.7 | 0.1 | 6.5 | 100 | 7.5 | 3.9 | 130.9 | 23.4 | 1.2 | 960 | |
| 110409 | A | b | 17 | 920611 | 9.8 | 2.6 | 0.41 | 3.7 | 0.5 | 8.7 | 101 | 4.7 | 5.7 | 147.4 | 39.8 | 7.2 | 878 | |
| 110417 | A | b | 17 | 921001 | 10.4 | 2.7 | 0.43 | 3.6 | 0.5 | 7.0 | 107 | 5.3 | 6.5 | 148.9 | 42.8 | 6.0 | 893 | |
| 110087 | A | c | 18 | 911003 | 9.1 | 1.9 | 0.19 | 1.4 | 0.1 | 4.8 | 103 | 11.5 | 3.0 | 157.5 | 30.6 | 5.4 | 798 | 60.4 |
| 110397 | A | c | 18 | 911219 | 8.9 | 1.7 | 0.44 | 0.9 | 0.1 | 7.2 | 90 | 9.7 | 3.7 | 115.4 | 27.7 | 1.3 | 766 | |
| 110405 | A | b | 18 | 920310 | 12.6 | 3.2 | 0.66 | 4.9 | 0.9 | 8.3 | 98 | 10.7 | 6.9 | 101.3 | 21.6 | 3.0 | 967 | |
| 110405 | A | c | 18 | 920318 | 6.1 | 2.0 | 0.55 | 2.0 | 0.1 | 6.3 | 100 | 11.6 | 3.7 | 141.7 | 35.9 | 1.7 | 822 | |
| 110405 | B | b | 18 | 920318 | 11.3 | 2.3 | 0.60 | 2.7 | 0.5 | 7.1 | 126 | 11.2 | 4.5 | 122.8 | 36.8 | 3.4 | 978 | |
| 110413 | A | b | 18 | 920617 | 10.9 | 2.1 | 0.31 | 2.7 | 0.3 | 9.3 | 107 | 14.8 | 4.7 | 141.6 | 43.7 | 7.0 | 794 | |
| 110413 | A | b | 18 | 920617 | | | | | | | | | | | | | 790 | |
| 110413 | A | b | 18 | 920617 | | | | | | | | | | 143.1 | 43.8 | 7.3 | 712 | |
| 110423 | A | b | 18 | 921008 | 10.8 | 2.2 | 0.48 | 8.8 | 0.3 | 11.1 | 113 | 40.2 | 13.4 | 177.4 | 60.0 | 7.2 | 866 | |
| 110078 | A | c | 19 | 910927 | 9.7 | 3.0 | 0.96 | 2.8 | 0.1 | 6.5 | 110 | 7.4 | 3.9 | 306.3 | 35.4 | 2.1 | 955 | |
| 110396 | A | c | 19 | 911219 | 7.1 | 1.4 | 0.49 | 1.0 | 0.1 | 4.7 | 73 | 6.2 | 3.4 | 139.1 | 22.0 | 3.9 | 889 | |
| 110404 | A | c | 19 | 920318 | 5.9 | 1.8 | 0.59 | 2.2 | 0.1 | 6.2 | 89 | 5.0 | 4.0 | 134.2 | 47.8 | 2.2 | 682 | |
| 110412 | A | b | 19 | 920617 | 11.5 | 2.4 | 0.37 | 4.1 | 0.6 | 7.8 | 79 | 4.6 | 6.0 | 137.2 | 40.6 | 7.8 | 681 | |
| 110422 | A | b | 19 | 921008 | | 1.9 | 0.44 | | 0.3 | | | | 6.4 | | | | | |
| 110422 | A | b | 19 | 921008 | 10.1 | 1.9 | 0.44 | 3.3 | 0.3 | 7.4 | 86 | 5.5 | 6.6 | 147.9 | 49.8 | 4.9 | 577 | |
| 110071 | A | c | 20 | 910912 | 7.6 | 1.5 | 0.26 | 2.1 | 2.6 | 7.9 | 134 | 6.7 | 4.4 | 213.0 | 47.3 | 7.6 | 794 | 68.2 |
| 110072 | A | c | 21 | 910912 | 7.9 | 9.3 | | 2.1 | 0.1 | 7.4 | 125 | 6.4 | 5.8 | 192.8 | 30.3 | 2.9 | 1041 | 42.7 |
| 110088 | A | c | 22 | 911004 | 3.9 | 1.4 | 0.11 | 1.0 | 0.1 | 6.0 | 89 | 1.9 | 2.0 | 101.4 | 22.9 | 1.0 | 470 | 16.8 |
| 110069 | A | c | 23 | 911004 | 3.5 | 1.4 | 0.44 | 1.3 | 0.1 | 6.2 | 78 | 2.5 | 2.2 | 102.0 | 13.1 | 6.7 | 578 | |
| 110393 | A | c | 23 | 911218 | 6.0 | 1.7 | 0.18 | 0.8 | 0.2 | 6.2 | 95 | 1.4 | 1.7 | 60.3 | 15.3 | 2.2 | 669 | |
| 110406 | A | c | 23 | 920318 | 7.5 | 1.2 | 0.30 | 1.4 | 0.1 | 7.1 | 76 | 1.8 | 1.8 | 97.4 | 44.0 | 1.7 | 453 | |
| 110414 | A | b | 23 | 920619 | 10.8 | 1.9 | 0.21 | 2.4 | 0.3 | 9.0 | 81 | 1.8 | 4.4 | 76.9 | 27.7 | 4.1 | 447 | |
| 110415 | A | b | 23 | 920918 | 8.6 | 1.7 | 0.17 | 1.6 | 0.3 | 7.3 | 85 | 2.1 | 2.6 | 79.3 | 20.9 | 4.2 | 450 | |
| 110064 | A | c | 24 | 911001 | 9.3 | 1.9 | 0.50 | 2.7 | 2.2 | 9.1 | 134 | 5.8 | 6.2 | 335.0 | 34.1 | 5.7 | 1560 | |
| 110063 | A | c | 25 | 910930 | 6.5 | 2.0 | 0.35 | 2.0 | 1.2 | 7.0 | 120 | 3.9 | 3.8 | 188.4 | 26.4 | 5.8 | 1098 | |
| 110060 | C | b | 26 | 911010 | 12.5 | 5.1 | 0.59 | 22.9 | 0.3 | 18.1 | 104 | 7.8 | 21.3 | 216.2 | 71.2 | 5.1 | 2356 | |
| 110060 | C | c | 26 | 911010 | 11.1 | 4.3 | 0.20 | 3.1 | 2.8 | 11.4 | 125 | 5.9 | 8.6 | 459.0 | 85.2 | 5.2 | 2614 | |
| 110060 | D | b | 26 | 911010 | 8.1 | 5.1 | 0.56 | 3.5 | 0.5 | 6.5 | 110 | 5.1 | 7.3 | 215.7 | 58.8 | 3.6 | 2083 | |
| 110062 | A | c | 27 | 910920 | 8.0 | 2.5 | 0.46 | 2.6 | 1.2 | 8.2 | 140 | 5.8 | 5.1 | 266.1 | 44.4 | 7.8 | 933 | |
| 110061 | A | c | 28 | 910910 | 13.5 | 2.0 | 0.29 | 1.9 | 1.9 | 8.5 | 142 | 2.8 | 4.4 | 315.9 | 48.5 | 7.5 | 1010 | |

Table 3.6(B): Continued. Mussel tissue residue raw data. Units are dry weight ug/g (ppm) for metals and ng/g (ppb) for organics

| EPAID | R | Lab | Sta | Cdate | As | Cd | Hg | Ni | Ag | Cu | Zn | Pb | Cr | TPCB | TDDT | tCdane | sumPAH | TOTIN | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 112830 | A | b | 123 | 930628 | 8.7 | 1.4 | 0.20 | 115.0 | 0.3 | 10.8 | 83 | 2.1 | 104.0 | 58.6 | 18.6 | 4.7 | 749 | | |
| 112810 | A | b | 151 | 930625 | 8.9 | 2.2 | **4.58** | 182.0 | 0.3 | 19.3 | 90 | 4.7 | 234.0 | 105.4 | 31.9 | 3.1 | 6420 | | **Hg = 0.65 ug/g(wet)** |
| 112812 | A | b | 152 | 930625 | 8.5 | 2.7 | 0.79 | 66.0 | 0.7 | 25.7 | 98 | 4.9 | 60.5 | 111.6 | 34.5 | 3.2 | 21599 | | |
| 112813 | A | b | 152 | 930625 | | | | | | | | | | 116.7 | 35.4 | 3.2 | 21602 | | |
| 112814 | A | b | 153 | 930625 | 8.8 | 1.9 | 0.42 | 78.8 | 0.3 | 10.2 | 93 | 3.3 | 68.0 | 119.2 | 24.7 | 3.2 | 1223 | | |
| 112816 | A | b | 154 | 930625 | 8.3 | 2.3 | 0.47 | 55.3 | 0.3 | 11.0 | 90 | 5.6 | 43.9 | 159.1 | 38.2 | 2.7 | 1934 | | |
| 112818 | A | b | 155 | 930625 | 8.5 | 1.7 | 0.92 | 118.0 | 0.3 | 11.4 | 94 | 4.5 | 135.0 | 120.2 | 32.7 | 3.3 | 962 | | |
| 112818 | A | b | 155 | 930625 | 8.5 | 1.6 | 0.92 | 103.0 | 0.3 | 12.7 | 95 | 4.2 | 109.0 | | | | | | |
| 112820 | A | b | 156 | 930625 | 7.6 | 2.0 | 0.30 | 81.9 | 0.3 | 9.5 | 71 | 15.5 | 80.8 | 138.5 | 28.5 | 5.3 | 796 | | |
| 112822 | A | b | 157 | 930625 | 1.2 | 1.9 | 0.46 | 144.0 | 0.3 | 19.1 | 159 | 200.0 | 128.0 | 418.2 | 51.0 | 3.2 | 856 | | |
| 112824 | A | b | 158 | 930625 | 9.1 | 1.9 | 0.26 | 4.3 | 0.4 | 8.4 | 90 | 31.1 | 8.7 | 163.6 | 53.7 | 7.3 | 691 | | |
| 112826 | A | b | 159 | 930625 | 11.2 | 1.9 | 0.30 | 10.7 | 0.3 | 9.9 | 110 | 4.0 | 20.9 | 117.5 | 46.5 | 7.0 | 689 | | |
| 112827 | A | b | 159 | 930625 | | | | | | | | | | 110.0 | 42.1 | 6.7 | 647 | | |
| 112828 | A | b | 160 | 930625 | 9.2 | 2.8 | 0.28 | 3.8 | 0.4 | 7.6 | 97 | 15.0 | 7.8 | 202.8 | 49.2 | 7.8 | 1061 | | |
| 112832 | A | b | 161 | 930629 | 12.6 | 2.5 | 0.45 | 9.0 | 0.4 | 10.4 | 97 | 7.5 | 18.4 | 160.9 | 17.1 | 2.7 | 827 | | |
| 112834 | A | b | 162 | 930629 | 11.7 | 2.8 | **2.40** | 53.3 | 0.5 | 11.9 | 101 | 8.0 | 51.5 | 167.7 | 43.8 | 3.2 | 834 | | **Hg = 0.32 ug/g(wet)** |
| 112836 | A | b | 163 | 930629 | 10.1 | 2.1 | 0.43 | 127.0 | 0.3 | 11.8 | 97 | 6.7 | 125.0 | 134.8 | 65.4 | 4.4 | 819 | | |
| 112838 | A | b | 164 | 930629 | 10.9 | 2.0 | 0.51 | 87.8 | 0.3 | 15.5 | 116 | 6.6 | 90.7 | 130.6 | 42.9 | 3.1 | 861 | | |
| 112840 | A | b | 165 | 930629 | 13.3 | 2.2 | 0.55 | 168.0 | 0.3 | 14.5 | 127 | 7.9 | 174.0 | 133.2 | 45.8 | 3.3 | 840 | | |
| 112842 | A | b | 166 | 930629 | 1.2 | 4.0 | **5.54** | 161.0 | 0.6 | 40.6 | 254 | 178.0 | 133.0 | 134.7 | 43.4 | 3.2 | 726 | | **Hg = 0.75 ug/g(wet)** |
| 112844 | A | b | 167 | 930629 | 10.4 | 2.4 | 0.63 | 91.2 | 0.3 | 34.8 | 183 | 10.5 | 93.9 | 215.3 | 58.8 | 5.0 | 806 | | |
| 112846 | A | b | 168 | 930629 | 9.5 | 2.2 | 0.45 | 41.2 | 0.3 | 42.8 | 133 | 9.6 | 41.6 | 142.3 | 44.9 | 4.5 | 854 | | |
| 112848 | A | b | 169 | 930713 | 10.2 | 2.0 | 0.43 | 2.4 | 0.3 | 7.3 | 100 | 6.3 | 4.1 | 142.7 | 43.9 | 3.2 | 928 | | |
| 112850 | A | b | 170 | 930629 | 10.6 | 2.1 | 0.48 | 143.0 | 0.3 | 10.1 | 88 | 4.9 | 161.0 | 98.5 | 30.7 | 5.0 | 680 | | |
| 112852 | A | b | 171 | 930629 | 10.1 | 1.5 | 0.60 | 153.0 | 0.3 | 7.4 | 75 | 5.1 | 135.0 | 128.5 | 33.2 | 3.2 | 808 | | |
| 112854 | A | b | 172 | 930629 | 9.8 | 2.0 | 0.53 | 140.0 | 0.3 | 18.2 | 96 | 7.6 | 119.0 | 122.9 | 41.4 | 4.6 | 864 | | |
| 112856 | A | b | 173 | 930629 | 14.9 | 1.8 | 0.57 | 37.6 | 0.2 | 9.1 | 93 | 4.8 | 43.9 | 93.3 | 34.4 | 3.4 | 705 | | |
| 112858 | A | b | 174 | 930713 | 13.0 | 1.4 | 0.21 | 89.4 | 0.3 | 8.6 | 78 | 1.3 | 68.7 | 53.6 | 7.0 | 3.2 | 364 | | |
| 112912 | A | b | 175 | 930714 | 10.8 | 3.5 | 0.21 | 101.0 | 0.9 | 8.1 | 111 | 1.8 | 46.0 | | | | | | |
| 112912 | A | b | 175 | 930714 | 9.8 | 2.6 | 0.20 | 101.0 | 0.5 | 8.4 | 111 | 1.5 | 50.6 | 56.7 | 7.0 | 3.2 | 374 | | |

Table 3.6(B): Results of Screen WL2 mussel tissue residues: @if((mussel>MW84) AND ((mussel>MW98) OR (mussel>GB95)),@true,@false

| EPAID | R | Lab | Sta | Cdate | As | Cd | Hg | Ni | Ag | Cu | Zn | Pb | Cr | TPCB | TDDT | tCdane | sumPAH | TOTIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 110073 | A | c | 1 | 910916 | | | | | | | | | | | | | | |
| 110390 | A | c | 1 | 911217 | | | | | | | | | | | | | | |
| 110401 | A | c | 1 | 920317 | | | | | | | | | | | | | | |
| 110407 | A | b | 1 | 920608 | | | | | | | | | Cr | | | | | |
| 110419 | A | b | 1 | 921008 | | | | | | | | | Cr | | | | | |
| 110075 | B | c | 2 | 911001 | | | | | | | | | | | | | | |
| 110080 | A | b | 3 | 910930 | | | | Ni | | | | | Cr | | | | | |
| 110080 | A | b | 3 | 910930 | | | | Ni | | | | | Cr | | | | | |
| 110080 | A | c | 3 | 910930 | As | | | | | | | | | | | | | |
| 110395 | A | c | 3 | 911219 | | | | | | | | | | | | | | |
| 110403 | A | c | 3 | 920318 | | | | | | | | | | | | | | |
| 110411 | A | b | 3 | 920617 | | | | | | | | | Cr | | | | | |
| 110421 | A | b | 3 | 921008 | | | | | | | | | Cr | | | | | |
| 110086 | A | b | 4 | 910930 | | | | Ni | | | | | Cr | | | | | |
| 110086 | A | c | 4 | 911003 | | | | | | | | | | | | | | |
| 110081 | A | c | 5 | 910930 | | | | | | | | Pb | | | | | | |
| 110085 | A | c | 6 | 911003 | | | | | | | | | | | | | | |
| 110082 | A | c | 7 | 910930 | | | | | | | | | | | | | | |
| 110083 | A | b | 8 | 910930 | | | | Ni | | Cu | | Pb | Cr | | | | | |
| 110083 | A | c | 8 | 910930 | | | | | Ag | | | Pb | | | | | | |
| 110084 | A | c | 9 | 910930 | | | | | | | | | | | tDDT | | | |
| 110394 | A | c | 9 | 911219 | | | | | | | | | | | | | | |
| 110402 | A | c | 9 | 920318 | | | | | | | | | | | | | | |
| 110410 | A | b | 9 | 920617 | | | | | | | | | Cr | | | | | |
| 110420 | A | b | 9 | 921008 | | | | | | | | | Cr | | | | | |
| 110090 | A | c | 10 | 911022 | | | Hg | | | | Zn | Pb | | | | | | |
| 110079 | A | b | 10.5 | 910927 | | | | Ni | | Cu | | Pb | Cr | | | | | |
| 110079 | A | c | 10.5 | 910927 | | | | | | | | Pb | | | | | | |
| 110076 | A | c | 11 | 910923 | | | | | | | | | | | | | | |
| 110091 | A | c | 12 | 911022 | | | | | | Cu | | Pb | | tPCB | | | | |
| 110400 | A | b | 12.5 | 911003 | | | Hg | Ni | | Cu | | Pb | Cr | | | | | |
| 110092 | A | c | 12.5 | 911022 | | | | | | | | | | | | | | |
| 110391 | A | c | 12.5 | 911217 | | | | | | | | | | | | | | |
| 110400 | A | c | 12.5 | 920310 | | | | | | | | Pb | | | | | | |
| 110408 | A | b | 12.5 | 920610 | | Cd | | Ni | | | | Pb | Cr | | | | | |
| 110418 | A | b | 12.5 | 921002 | | | | | | | | | Cr | | | | | |
| 110074 | A | c | 14 | 910916 | | | Hg | | | | | | | | | | | |
| 110077 | A | c | 16 | 910923 | | | | | | | | | | | | | | |
| 110398 | A | c | 16 | 920310 | | | | | | | | | | | | | | |
| 110416 | A | b | 16 | 920930 | | | | | | | | | Cr | | | | | |
| 110406 | A | b | 16 | 930608 | | | | | | | | | | | | | | |
| 110406 | A | b | 16 | 930608 | | | | | | | | | | | | | | |
| 110070 | A | c | 17 | 910912 | | | | | Ag | | | | | | | | | |
| 110392 | A | c | 17 | 911217 | | | | | | | | | | | | | | |
| 110399 | A | c | 17 | 920310 | | | | | | | | | | | | | | |
| 110409 | A | b | 17 | 920611 | | | | | | | | | Cr | | | | | |
| 110417 | A | b | 17 | 921001 | | | | | | | | | Cr | | | | | |
| 110087 | A | c | 18 | 911003 | | | | | | | | Pb | | | | | | |
| 110397 | A | c | 18 | 911219 | | | | | | | | | | | | | | |
| 110405 | A | b | 18 | 920310 | | | Hg | | | | | | Cr | | | | | |
| 110405 | A | c | 18 | 920318 | | | | | | | | Pb | | | | | | |
| 110405 | B | b | 18 | 920318 | | | | | | | | Pb | | | | | | |

Table 3.6(B): Continued. Results of Screen WL2 mussel tissue residues: @if((mussel>MW84) AND ((mussel>MW98) OR (mussel>GB95)),@true,@false

| EPAID | R | Lab | Sta | Cdate | As | Cd | Hg | Ni | Ag | Cu | Zn | Pb | Cr | TPCB | TDDT | tCdane | sumPAH | TOTIN |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 110413 | A | b | 18 | 920617 | | | | | | | | Pb | | | | | | |
| 110413 | A | b | 18 | 920617 | | | | | | | | | | | | | | |
| 110413 | A | b | 18 | 920617 | | | | | | | | | | | | | | |
| 110423 | A | b | 18 | 921008 | | | | Ni | | | | Pb | Cr | | | | | |
| 110078 | A | c | 19 | 910927 | | | Hg | | | | | | | | | | | |
| 110396 | A | c | 19 | 911219 | | | | | | | | | | | | | | |
| 110404 | A | c | 19 | 920318 | | | | | | | | | | | | | | |
| 110412 | A | b | 19 | 920617 | | | | | | | | | Cr | | | | | |
| 110422 | A | b | 19 | 921008 | | | | | | | | | Cr | | | | | |
| 110422 | A | b | 19 | 921008 | | | | | | | | | Cr | | | | | |
| 110071 | A | c | 20 | 910912 | | | | | Ag | | | | | | | | | |
| 110072 | A | c | 21 | 910912 | | Cd | | | | | | | Cr | | | | | |
| 110088 | A | c | 22 | 911004 | | | | | | | | | | | | | | |
| 110089 | A | c | 23 | 911004 | | | | | | | | | | | | | | |
| 110393 | A | c | 23 | 911218 | | | | | | | | | | | | | | |
| 110406 | A | c | 23 | 920318 | | | | | | | | | | | | | | |
| 110414 | A | b | 23 | 920619 | | | | | | | | | | | | | | |
| 110415 | A | b | 23 | 920918 | | | | | | | | | | | | | | |
| 110064 | A | c | 24 | 911001 | | | | | Ag | | | | Cr | | | | | |
| 110063 | A | c | 25 | 910930 | | | | | | | | | | | | | | |
| 110060 | C | b | 26 | 911010 | | | | Ni | | Cu | | | Cr | | | | | |
| 110060 | C | c | 26 | 911010 | | | | | Ag | | | | Cr | | | | sPAH | |
| 110060 | D | b | 26 | 911010 | | | | | | | | | Cr | | | | | |
| 110062 | A | c | 27 | 910920 | | | | | | | | | | | | | | |
| 110061 | A | c | 28 | 910910 | | | | | Ag | | | | | | | | | |
| 112830 | A | b | 123 | 930628 | | | | Ni | | | | | Cr | | | | | |
| 112810 | A | b | 151 | 930625 | | | Hg | Ni | | Cu | | | Cr | | | | sPAH | |
| 112812 | A | b | 152 | 930625 | | | Hg | Ni | | Cu | | | Cr | | | | sPAH | |
| 112813 | A | b | 152 | 930625 | | | | | | | | | | | | | sPAH | |
| 112814 | A | b | 153 | 930625 | | | | Ni | | | | | Cr | | | | | |
| 112816 | A | b | 154 | 930625 | | | | Ni | | | | | Cr | | | | | |
| 112818 | A | b | 155 | 930625 | | | Hg | Ni | | | | | Cr | | | | | |
| 112818 | A | b | 155 | 930625 | | | Hg | Ni | | | | | Cr | | | | | |
| 112820 | A | b | 156 | 930625 | | | | Ni | | | | Pb | Cr | | | | | |
| 112822 | A | b | 157 | 930625 | | | | Ni | | Cu | | Pb | Cr | | | | | |
| 112824 | A | b | 158 | 930625 | | | | | | | | Pb | Cr | | | | | |
| 112826 | A | b | 159 | 930625 | | | | Ni | | | | | Cr | | | | | |
| 112827 | A | b | 159 | 930625 | | | | | | | | | | | | | | |
| 112828 | A | b | 160 | 930625 | | | | | | | | Pb | Cr | | | | | |
| 112832 | A | b | 161 | 930629 | | | | Ni | | | | | Cr | | | | | |
| 112834 | A | b | 162 | 930629 | | | Hg | Ni | | | | | Cr | | | | | |
| 112836 | A | b | 163 | 930629 | | | | Ni | | | | | Cr | | | | | |
| 112838 | A | b | 164 | 930629 | | | | Ni | | Cu | | | Cr | | | | | |
| 112840 | A | b | 165 | 930629 | | | | Ni | | Cu | | | Cr | | | | | |
| 112842 | A | b | 166 | 930629 | | | Hg | Ni | | Cu | Zn | Pb | Cr | | | | | |
| 112844 | A | b | 167 | 930629 | | | | Ni | | Cu | | | Cr | | | | | |
| 112846 | A | b | 168 | 930629 | | | | Ni | | Cu | | | Cr | | | | | |
| 112848 | A | b | 169 | 930713 | | | | | | | | | | | | | | |
| 112850 | A | b | 170 | 930629 | | | | Ni | | | | | Cr | | | | | |
| 112852 | A | b | 171 | 930629 | | | | Ni | | | | | Cr | | | | | |
| 112854 | A | b | 172 | 930629 | | | | Ni | | Cu | | | Cr | | | | | |
| 112856 | A | b | 173 | 930629 | | | | Ni | | | | | Cr | | | | | |
| 112858 | A | b | 174 | 930713 | | | | Ni | | | | | Cr | | | | | |
| 112912 | A | b | 175 | 930714 | | | | Ni | | | | | Cr | | | | | |
| 112912 | A | b | 175 | 930714 | | | | Ni | | | | | Cr | | | | | |

Table 3.6(C): Results of Screen WL2 mussel tissue residues for Ni and Cr from Phase I samples only
@if((mussel>MW84) AND ((mussel>MW98) OR (mussel>GB95)),@true,@false

| GREAT BAY ESTUAY (PHASE I ONLY) | | | | | Ni | Cr |
|---|---|---|---|---|---|---|
| geoMean | | | | | 1.75 | 3.5 |
| 84% | | | | | 2.48 | 4.7 |
| 95% | | | | | 3.09 | 5.7 |
| 98% | | | | | 3.56 | 6.4 |
| n | | | | | 45 | 45 |
| **EPAID** | **R** | **Lab** | **Sta** | **Cdate** | **Ni** | **Cr** |
| 110073 | A | c | 1 | 910916 | | |
| 110390 | A | c | 1 | 911217 | | |
| 110401 | A | c | 1 | 920317 | | |
| 110075 | B | c | 2 | 911001 | | |
| 110080 | A | c | 3 | 910930 | | |
| 110395 | A | c | 3 | 911219 | | |
| 110403 | A | c | 3 | 920318 | | |
| 110086 | A | c | 4 | 911003 | | |
| 110081 | A | c | 5 | 910930 | | |
| 110085 | A | c | 6 | 911003 | | |
| 110082 | A | c | 7 | 910930 | | |
| 110083 | A | c | 8 | 910930 | | |
| 110084 | A | c | 9 | 910930 | | |
| 110394 | A | c | 9 | 911219 | | |
| 110402 | A | c | 9 | 920318 | | |
| 110090 | A | c | 10 | 911022 | | |
| 110079 | A | c | 10.5 | 910927 | | |
| 110076 | A | c | 11 | 910923 | | |
| 110091 | A | c | 12 | 911022 | | |
| 110092 | A | c | 12.5 | 911022 | | |
| 110391 | A | c | 12.5 | 911217 | | |
| 110400 | A | c | 12.5 | 920310 | | |
| 110074 | A | c | 14 | 910916 | | |
| 110077 | A | c | 16 | 910923 | | |
| 110398 | A | c | 16 | 920310 | | |
| 110070 | A | c | 17 | 910912 | | |
| 110392 | A | c | 17 | 911217 | | |
| 110399 | A | c | 17 | 920310 | | |
| 110087 | A | c | 18 | 911003 | | |
| 110397 | A | c | 18 | 911219 | | |
| 110405 | A | c | 18 | 920318 | | |
| 110078 | A | c | 19 | 910927 | | |
| 110396 | A | c | 19 | 911219 | | |
| 110404 | A | c | 19 | 920318 | | |
| 110071 | A | c | 20 | 910912 | | |
| 110072 | A | c | 21 | 910912 | | Cr |
| 110088 | A | c | 22 | 911004 | | |
| 110089 | A | c | 23 | 911004 | | |
| 110393 | A | c | 23 | 911218 | | |
| 110406 | A | c | 23 | 920318 | | |
| 110064 | A | c | 24 | 911001 | | Cr |
| 110063 | A | c | 25 | 910930 | | |
| 110060 | C | c | 26 | 911010 | | Cr |
| 110062 | A | c | 27 | 910920 | | |
| 110061 | A | c | 28 | 910910 | | |

Table 3.6(D): List of stations that had mussel tissue concentrations which exceeded warning levels for chemical exposure.

| **Sta** | **Chemical for which warning level was exceeded** | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | Cr | | | |
| 3 | As | | | Ni | | | | | Cr | | | |
| 4 | | | | Ni | | | | | Cr | | | |
| 5 | | | | | | | | Pb | | | | |
| 8 | | | | Ni | Ag | Cu | | Pb | Cr | | | |
| 9 | | | | | | | | | Cr | | tDDT | |
| 10 | | | Hg | | | | Zn | Pb | | | | |
| 10.5 | | | | Ni | | Cu | | Pb | Cr | | | |
| 12 | | | | | | Cu | | Pb | | tPCB | | |
| 12.5 | | Cd | Hg | Ni | | Cu | | Pb | Cr | | | |
| 14 | | | Hg | | | | | | | | | |
| 16 | | | | | | | | | Cr | | | |
| 17 | | | | | Ag | | | | Cr | | | |
| 18 | | | Hg | Ni | | | | Pb | Cr | | | |
| 19 | | | Hg | | | | | | Cr | | | |
| 20 | | | | | Ag | | | | | | | |
| 21 | | Cd | | | | | | | Cr | | | |
| 24 | | | | | Ag | | | | Cr | | | |
| 26 | | | | Ni | Ag | Cu | | | Cr | | | sPAH |
| 28 | | | | | Ag | | | | | | | |
| 123 | | | | Ni | | | | | Cr | | | |
| 151 | | | Hg | Ni | | Cu | | | Cr | | | sPAH |
| 152 | | | Hg | Ni | | Cu | | | Cr | | | sPAH |
| 153 | | | | Ni | | | | | Cr | | | |
| 154 | | | | Ni | | | | | Cr | | | |
| 155 | | | Hg | Ni | | | | | Cr | | | |
| 156 | | | | Ni | | | | Pb | Cr | | | |
| 157 | | | | Ni | | Cu | | Pb | Cr | | | |
| 158 | | | | | | | | Pb | Cr | | | |
| 159 | | | | Ni | | | | | Cr | | | |
| 160 | | | | | | | | Pb | Cr | | | |
| 161 | | | | Ni | | | | | Cr | | | |
| 162 | | | Hg | Ni | | | | | Cr | | | |
| 163 | | | | Ni | | | | | Cr | | | |
| 164 | | | | Ni | | Cu | | | Cr | | | |
| 165 | | | | Ni | | Cu | | | Cr | | | |
| 166 | | | Hg | Ni | | Cu | Zn | Pb | Cr | | | |
| 167 | | | | Ni | | Cu | | | Cr | | | |
| 168 | | | | Ni | | Cu | | | Cr | | | |
| 170 | | | | Ni | | | | | Cr | | | |
| 171 | | | | Ni | | | | | Cr | | | |
| 172 | | | | Ni | | Cu | | | Cr | | | |
| 173 | | | | Ni | | | | | Cr | | | |
| 174 | | | | Ni | | | | | Cr | | | |
| 175 | | | | Ni | | | | | Cr | | | |

Table 3.6(E): List of stations that had mussel tissue concentrations which exceeded warning levels for chemical exposure. Excluding Ni and Cr data.

| Sta | Chemical for which warning level was exceeded | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 3 | As | | | | | | | | | |
| 5 | | | | | | | Pb | | | |
| 8 | | | | Ag | Cu | | Pb | | | |
| 9 | | | | | | | | | tDDT | |
| 10 | | | Hg | | | Zn | Pb | | | |
| 10.5 | | | | | Cu | | Pb | | | |
| 12 | | | | | Cu | | Pb | tPCB | | |
| 12.5 | | Cd | Hg | | Cu | | Pb | | | |
| 14 | | | Hg | | | | | | | |
| 17 | | | | Ag | | | | | | |
| 18 | | | Hg | | | | Pb | | | |
| 19 | | | Hg | | | | | | | |
| 20 | | | | Ag | | | | | | |
| 21 | | Cd | | | | | | | | |
| 24 | | | | Ag | | | | | | |
| 26 | | | | Ag | Cu | | | | | sPAH |
| 28 | | | | Ag | | | | | | |
| 151 | | | Hg | | Cu | | | | | sPAH |
| 152 | | | Hg | | Cu | | | | | sPAH |
| 155 | | | Hg | | | | | | | |
| 156 | | | | | | | Pb | | | |
| 157 | | | | | Cu | | Pb | | | |
| 158 | | | | | | | Pb | | | |
| 160 | | | | | | | Pb | | | |
| 162 | | | Hg | | | | | | | |
| 164 | | | | | Cu | | | | | |
| 165 | | | | | Cu | | | | | |
| 166 | | | Hg | | Cu | Zn | Pb | | | |
| 167 | | | | | Cu | | | | | |
| 168 | | | | | Cu | | | | | |
| 172 | | | | | Cu | | | | | |

TABLE 3.7. Summary of Surface Water Screen Results

TABLE 3.7(A) Indications of Adverse Chemical Levels.

| Station | Water Quality | Toxicity |
|---|---|---|
| River Mouth | | |
| 1 | Ni | |
| Clark Cove | | |
| 3 | | 9.7% |
| 4 | | 29.0% |
| 7 | | 10.3% |
| Seep1004 | Hg Cu Ni Zn | NA |
| Police Dock | | |
| Seep1001 | Hg Zn | NA |
| Seep1002 | Hg | NA |
| Seep1003 | Cu Zn | NA |
| Jamaica Island Backchannel | | |
| Seep S2 | Hg Cu Pb | NA |
| Seep1005 | Cu Ni Zn | NA |
| Seep1006 | Cu | NA |
| Seep1007 | Cu | NA |
| Seep1008 | Cu Zn Pb | NA |

TABLE 3.7(B): Summary of stations that had mussel tissue concentrations which exceeded warning levels for chemical exposure. Excluding Phase II Ni and Cr data.

| Station | Chemical for which mussel tissue warning level was exceeded | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | As | | | | | | | | | | |
| 5 | | | | | | | Pb | | | | |
| 8 | | | | Ag | Cu | | Pb | | | | |
| 9 | | | | | | | | | | tDDT | |
| 10 | | | Hg | | | Zn | Pb | | | | |
| 10.5 | | | | | Cu | | Pb | | | | |
| 12 | | | | | Cu | | Pb | | tPCB | | |
| 12.5 | | Cd | Hg | | Cu | | Pb | | | | |
| 14 | | | Hg | | | | | | | | |
| 17 | | | | Ag | | | | | | | |
| 18 | | | Hg | | | | Pb | | | | |
| 19 | | | Hg | | | | | | | | |
| 20 | | | | Ag | | | | | | | |
| 21 | | Cd | | | | | | Cr | | | |
| 24 | | | | Ag | | | | Cr | | | |
| 26 | | | | Ag | Cu | | | Cr | | | sPAH |
| 28 | | | | Ag | | | | | | | |
| 151 | | | Hg | | Cu | | | | | | sPAH |
| 152 | | | Hg | | Cu | | | | | | sPAH |
| 155 | | | Hg | | | | | | | | |
| 156 | | | | | | | Pb | | | | |
| 157 | | | | | Cu | | Pb | | | | |
| 158 | | | | | | | Pb | | | | |
| 160 | | | | | | | Pb | | | | |
| 162 | | | Hg | | | | | | | | |
| 164 | | | | | Cu | | | | | | |
| 165 | | | | | Cu | | | | | | |
| 166 | | | Hg | | Cu | Zn | Pb | | | | |
| 167 | | | | | Cu | | | | | | |
| 168 | | | | | Cu | | | | | | |
| 172 | | | | | Cu | | | | | | |

## Table 3.8: Screening levels, raw data, and results of sediment exposure screens for metals.

Table 3.8(A): Sediment metal screening levels (ug/g ppm).

| Screening Level | As | Cd | Cr | ELEMENT Cu | Pb | Hg | Ni | Ag | Zn |
|---|---|---|---|---|---|---|---|---|---|
| Effects Range-Low ppm | 33.0 | 5.0 | 80.0 | 70.0 | 35.0 | 0.15 | 30.0 | 1.0 | 120.0 |
| Effects Range-Medium ppm | 85.0 | 9.0 | 145.0 | 390.0 | 110.0 | 1.3 | 50.0 | 2.2 | 270.0 |
| WA Clean Up Level ppm | 93.0 | 6.7 | 270.0 | 390.0 | 530.0 | 0.59 | NA | 6.1 | 960.0 |
| Crustal Ratio Model: | | | | | | | | | |
| Pred = m*(%Al) + b + 2*MSE | | | | | | | | | |
| m | 1.15 | 0.0431 | 10.58 | 5.57 | 5.90 | 0.0113 | 4.98 | 0.0096 | 21.90 |
| b | 1.15 | 0.0042 | -1.43 | -3.44 | 2.39 | 0.0062 | -2.57 | 0.0100 | -9.60 |
| MSE | 2.76 | 0.1099 | 16.80 | 11.84 | 8.42 | 0.0263 | 6.08 | 0.0420 | 30.46 |

Table 3.8(B): Sediment Grabs. RAW DATA (ug/g)

| Sta | Depth | Al | As | Cd | Cr | ELEMENT Cu | Pb | Hg | Ni | Ag | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0 | 27400 | 2.10 | 0.23 | 47.40 | 2.70 | 0.12 | 0.12 | 11.00 | 0.24 | 38.70 |
| 1 | 00-10 | 31300 | 2.20 | 0.15 | 48.30 | 0.64 | 19.80 | 0.21 | 11.10 | 0.19 | 36.10 |
| 1 | 10-20 | 30500 | 3.10 | 0.16 | 50.20 | 0.46 | 20.90 | 0.15 | 12.80 | 0.14 | 33.40 |
| 2 | 0 | 31700 | 13.00 | 0.27 | 99.80 | 22.40 | 61.90 | 0.19 | 21.70 | 0.74 | 82.00 |
| 3 | 0 | 28900 | 8.30 | 0.35 | 65.80 | 26.00 | 22.70 | 0.09 | 14.90 | 0.35 | 61.40 |
| 3 | 00-8 | 47500 | 5.90 | 0.35 | 81.60 | 0.63 | 43.50 | 0.28 | 19.80 | 0.34 | 77.20 |
| 3 | 02-4 | 41563 | | | 121.6 | 25.1 | 37.5 | | 26.5 | | 126.3 |
| 3 | 08-16 | 54200 | 4.50 | 0.30 | 91.80 | 0.67 | 48.80 | 0.22 | 23.50 | 0.39 | 78.80 |
| 3 | 38-40 | 7972 | | | 233.2 | 33.8 | 72.3 | | 30.1 | | 137.6 |
| 4 | 0 | 44700 | 28.70 | 0.57 | 174.00 | 55.40 | 82.40 | 0.58 | 35.60 | 0.92 | 140.00 |
| 4 | 00-10 | 72700 | 17.00 | 0.62 | 186.00 | 1.30 | 65.50 | 0.43 | 38.00 | 1.00 | 150.00 |
| 4 | 10-20 | 38600 | 18.30 | 0.83 | 208.00 | 42.00 | 87.60 | 0.31 | 40.50 | 0.86 | 300.00 |
| 5 | 0 | 22600 | 16.00 | 0.21 | 64.10 | 19.40 | 30.90 | 0.24 | 12.70 | 0.33 | 55.40 |
| 5 | 00-10 | 45000 | 12.30 | 0.79 | 189.00 | 57.10 | 84.20 | 0.32 | 44.50 | 0.93 | 149.00 |
| 5 | 10-20 | 31700 | 9.10 | 0.88 | 242.00 | 54.20 | 105.00 | 0.26 | 38.40 | 0.89 | 163.00 |
| 5 | 20-30 | 40100 | 9.70 | 1.10 | 335.00 | 82.70 | 123.00 | 0.41 | 45.70 | 1.20 | 164.00 |
| 6 | 0 | 77900 | 20.70 | 0.88 | 211.00 | 59.00 | 104.00 | 0.27 | 39.30 | 0.96 | 177.00 |
| 6 | 00-7 | 37000 | 17.10 | 0.71 | 192.00 | 44.10 | 84.10 | 0.23 | 44.10 | 0.65 | 155.00 |
| 6 | 20-28 | 19900 | 7.50 | 0.08 | 79.00 | 20.90 | 22.00 | 0.16 | 39.00 | 0.15 | 74.60 |
| 7 | 0 | 38000 | 18.28 | 0.93 | 162.07 | 65.63 | 73.05 | 0.30 | 32.50 | 1.14 | 163.45 |
| 7 | 00-8 | 31300 | 12.20 | 0.85 | 168.00 | 43.30 | 54.00 | 0.28 | 33.70 | 0.50 | 133.00 |
| 7 | 25-33 | 31800 | 8.70 | 0.82 | 241.00 | 65.60 | 68.00 | 0.22 | 38.20 | 1.00 | 172.00 |
| 7 | 42-50 | 17900 | 6.80 | 0.07 | 47.80 | 11.60 | 14.30 | 0.14 | 24.90 | 0.13 | 54.20 |
| 8 | 0 | 34800 | 15.43 | 0.85 | 148.00 | 51.70 | 61.45 | 0.27 | 34.20 | 0.84 | 138.50 |
| 8 | 00-8 | 11000 | 13.80 | 0.98 | 165.00 | 67.00 | 73.40 | 0.24 | 36.40 | 0.67 | 149.00 |
| 8 | 16-24 | 18000 | 9.40 | 1.10 | 199.00 | 82.20 | 98.40 | 0.23 | 36.00 | 0.46 | 159.00 |

Table 3.8(B): Continued. Sediment Grabs. RAW DATA (ug/g)

| | | ELEMENT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sta** | **Depth** | **Al** | **As** | **Cd** | **Cr** | **Cu** | **Pb** | **Hg** | **Ni** | **Ag** | **Zn** |
| 9 | 0 | 23900 | 12.30 | 0.15 | 64.50 | 18.00 | 55.60 | 0.15 | 18.80 | 0.25 | 69.60 |
| 10 | 0 | 39250 | 10.95 | 0.51 | 102.38 | 62.13 | 65.28 | 0.24 | 30.83 | 0.67 | 113.00 |
| 10 | 00-8 | 21600 | 10.00 | 0.73 | 151.00 | 99.20 | 45.70 | 0.27 | 91.20 | 0.45 | 148.00 |
| 10 | 10-18 | 77000 | 18.6 | 0.97 | 200 | 177.5 | 146.5 | 0.407 | 45.7 | 0.598 | 369 |
| 10 | 10-18 | 60000 | 18.8 | 0.82 | 221 | 181.9 | 148.9 | 0.444 | 44.3 | 0.587 | 409 |
| 10 | 132-138 | 52100 | 11.40 | 0.90 | 288.00 | 531.00 | 422.00 | 0.16 | 88.10 | 0.73 | 1950.00 |
| 10 | 33-38 | 16700 | 14.30 | 0.72 | 154.00 | 474.00 | 96.20 | 0.22 | 39.50 | 0.23 | 163.00 |
| 10 | 60-68 | 56300 | 16.60 | 0.56 | 149.00 | 160.00 | 84.30 | 0.19 | 53.90 | 0.84 | 167.00 |
| 10 | 90-98 | 37200 | 12.30 | 0.83 | 183.00 | 111.00 | 105.00 | 0.34 | 48.10 | 0.49 | 175.00 |
| 11 | 0 | 22500 | 4.40 | 0.22 | 69.30 | 13.90 | 43.40 | 0.15 | 15.20 | 0.27 | 62.00 |
| 12 | 0 | 28300 | 17.80 | 0.14 | 75.30 | 91.10 | 122.00 | 0.27 | 27.60 | 0.37 | 378.00 |
| 12 | 00-8 | 30000 | 9.90 | 0.35 | 87.30 | 105.00 | 124.00 | 0.19 | 24.50 | 0.34 | 530.00 |
| 12 | 10-18 | 35500 | 10.70 | 0.45 | 144.00 | 161.00 | 235.00 | 0.51 | 44.40 | 0.62 | 728.00 |
| 12 | 20-28 | 47300 | 17.30 | 0.92 | 186.00 | 265.00 | 355.00 | 1.90 | 34.50 | 1.30 | 471.00 |
| 13 | 0 | 31400 | 9.90 | 0.29 | 81.20 | 28.00 | 35.00 | 0.19 | 19.90 | 0.59 | 85.00 |
| 14 | 0 | 11200 | 3.10 | 0.06 | 31.10 | 1.80 | 17.90 | 0.10 | 8.40 | 0.28 | 22.40 |
| 14 | 00-8 | 21800 | 6.90 | 0.30 | 37.50 | 6.70 | 27.40 | 0.12 | 11.10 | 0.89 | 41.20 |
| 14 | 20-28 | 24000 | 3.50 | 0.18 | 32.40 | 4.30 | 16.90 | 0.13 | 15.90 | 0.12 | 60.00 |
| 14 | 40-48 | 19800 | 7.00 | 0.20 | 37.50 | 6.40 | 15.90 | 0.14 | 19.60 | 0.13 | 41.90 |
| 15 | 0 | 38500 | 17.70 | 0.28 | 108.00 | 22.50 | 106.00 | 0.22 | 25.20 | 0.81 | 100.00 |
| 15 | 100-108 | 22600 | 11.00 | 0.67 | 66.10 | 22.20 | 95.40 | 0.22 | 23.70 | 0.60 | 97.90 |
| 15 | 30-38 | 30100 | 5.50 | 0.55 | 111.00 | 21.50 | 49.00 | 0.14 | 27.60 | 0.51 | 79.40 |
| 15 | 60-68 | 26800 | 9.00 | 0.80 | 129.00 | 27.90 | 88.00 | 0.54 | 23.20 | 0.71 | 104.00 |
| 16 | 0 | 11900 | 5.80 | 0.06 | 32.40 | 3.30 | 19.80 | 0.13 | 12.40 | 0.11 | 25.00 |
| 17 | 0 | 30975 | 10.55 | 0.47 | 79.55 | 32.55 | 82.73 | 0.39 | 20.78 | 0.38 | 116.92 |
| 17 | 0-2 | 31100 | | | 67.6 | 28.4 | 28.1 | | 19.8 | | 104.3 |
| 17 | 00-8 | 18600 | 10.70 | 0.42 | 73.90 | 25.60 | 48.00 | 0.16 | 19.00 | 0.32 | 90.80 |
| 17 | 10-12 | 28420 | | | 86.6 | 20.8 | 35.5 | | 15.3 | | 100.6 |
| 17 | 18-20 | 14911 | | | 84.4 | 16.1 | 85.9 | | 20.4 | | 97.1 |
| 17 | 30-38 | 29800 | 9.80 | 0.36 | 58.80 | 20.70 | 67.40 | 0.15 | 18.40 | 0.30 | 82.40 |
| 17 | 36-38 | 29353 | | | 52.1 | 7.3 | 20.1 | | 19.6 | | 68 |
| 17 | 36-38 | 17255 | | | 46 | 7.2 | 25.6 | | 19.6 | | 65 |
| 17 | 70-78 | 24800 | 5.60 | 0.18 | 57.60 | 15.00 | 45.40 | 0.39 | 23.30 | 0.19 | 62.10 |
| 18 | 0 | 20100 | 7.00 | 2.00 | 56.20 | 35.10 | 86.60 | 0.10 | 20.10 | 0.21 | 76.90 |
| 19 | 0 | 42625 | 11.58 | 0.59 | 83.38 | 32.90 | 65.15 | 0.19 | 26.03 | 0.47 | 93.78 |
| 19 | 00-8 | 27400 | 9.50 | 0.50 | 113.00 | 30.00 | 46.30 | 0.20 | 29.00 | 0.61 | 112.00 |
| 19 | 02-4 | 11032 | | | 98.5 | 23.6 | 56 | | 21.1 | | 107.5 |
| 19 | 20-28 | 32500 | 7.70 | 0.65 | 163.00 | 32.30 | 51.00 | 0.22 | 28.80 | 0.80 | 113.00 |
| 19 | 50-58 | 15500 | 5.10 | 0.26 | 56.60 | 13.90 | 34.70 | 0.19 | 25.90 | 0.19 | 66.90 |
| 19 | 72-74 | 12259 | | | 44.1 | 5 | 10.4 | | 19.4 | | 62.7 |

Table 3.8(B): Continued. Sediment Grabs. RAW DATA (ug/g)

| Sta | Depth | Al | As | Cd | Cr | ELEMENT<br>Cu | Pb | Hg | Ni | Ag | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 20 | 0 | 36900 | 2.10 | 0.12 | 39.90 | 3.50 | 17.20 | 0.21 | 12.70 | 0.18 | 35.40 |
| 21 | 0 | 37600 | 3.90 | 0.19 | 81.10 | 12.50 | 41.30 | 0.24 | 15.30 | 0.40 | 61.80 |
| 21 | 00-8 | 34600 | 8.00 | 0.25 | 121.00 | 17.10 | 46.80 | 0.25 | 21.90 | 0.43 | 76.60 |
| 21 | 20-28 | 28300 | 3.70 | 0.19 | 47.80 | 6.50 | 31.00 | 0.15 | 17.00 | 0.14 | 47.60 |
| 21 | 50-58 | 33100 | 4.80 | 0.12 | 48.60 | 0.64 | 11.50 | 0.21 | 18.20 | 0.19 | 52.00 |
| 21 | 85-92 | 31000 | 5.00 | 0.12 | 46.60 | 0.62 | 12.50 | 0.21 | 15.00 | 0.19 | 43.70 |
| 22 | 0 | 16700 | 1.20 | 0.06 | 21.70 | 0.99 | 25.20 | 0.12 | 7.50 | 0.11 | 17.30 |
| 23 | 0 | 20700 | 0.27 | 0.07 | 34.00 | 1.60 | 14.60 | 0.13 | 11.10 | 0.12 | 21.70 |
| 50 | 00-20 | 50000 | 32.3 | 1.93 | 151 | 182.2 | 82.7 | 0.345 | 46.9 | 0.508 | 102.5 |
| 50 | 00-20 | 50000 | 32.9 | 0.08 | 124 | 81.1 | 154.7 | 0.516 | 53.7 | 0.263 | 129.2 |
| 51 | 00-20 | 42000 | 12.4 | 0.12 | 109 | 28.1 | 35.8 | 0.072 | 39.8 | 0.158 | 89.3 |
| 51 | 00-20 | 48000 | 11.1 | 0.18 | 97 | 88.2 | 76.5 | 0.159 | 47.9 | 0.409 | 131 |
| 52 | 00-20 | 39000 | 17.8 | 0.27 | 82 | 31.1 | 192.8 | 0.182 | 27.3 | 0.336 | 170.4 |
| 53 | 00-20 | 60000 | 21.7 | 0.45 | 141 | 42.8 | 92.1 | 0.382 | 28.7 | 1.077 | 99.5 |
| 53 | 00-20 | 64000 | 29.1 | 0.15 | 148 | 69.9 | 169.1 | 0.419 | 39.8 | 0.775 | 158.8 |
| 54 | 00-20 | 53000 | 10.3 | 0.72 | 66 | 28.9 | 35.8 | 0.287 | 34.6 | 0.055 | 60.7 |
| 55 | 00-20 | 43000 | 23.9 | 0.54 | 102 | 25.2 | 81.3 | 0.261 | 23.2 | 0.343 | 88 |
| 55 | 00-20 | 50000 | 18.1 | 0.19 | 146 | 35.9 | 116.1 | 0.379 | 35.5 | 0.317 | 75.1 |
| 56 | 00-20 | 50000 | 28.1 | 0.53 | 143 | 28.9 | 81.5 | 0.383 | 29.8 | 0.553 | 136 |
| 56 | 00-20 | 50000 | 26.3 | 0.54 | 138 | 28.3 | 90.4 | 0.577 | 28.7 | 0.439 | 111.5 |
| 57 | 00-20 | 56000 | 20.2 | 0.42 | 62 | 20.2 | 48.9 | 0.095 | 26.4 | 0.081 | 86.8 |
| 57 | 00-20 | 53000 | 20.5 | 0.29 | 43 | 16.5 | 82.4 | 0.112 | 21.5 | 0.054 | 54.4 |
| 11051 | 0-2 | 10457 | | | 90.3 | 11.2 | 31.7 | | 15.5 | | 77.9 |
| 11051 | 06-8 | 35346 | | | 101.1 | 10.2 | 15.9 | | 16.3 | | 82.5 |
| 11051 | 12-14 | 6764 | | | 44.2 | 2.4 | 18.6 | | 14.6 | | 47.9 |
| 11051 | 28-30 | 31650 | | | 43.3 | 1.8 | 6.6 | | 14.8 | | 51.6 |
| 11100 | 00-20 | 71000 | 13.4 | | 115 | 29.7 | 63.2 | | 26.2 | | 116.5 |
| 11100 | 00-20 | 62000 | 13.3 | 0.44 | 117 | 33.6 | 68.9 | 0.3 | 30.4 | 0.32 | 115.6 |

Table 3.8(C). Sediment Screen Level 0: if (CONCs > ER-L),1,0 + if (CONCs > ER-M),1,0

| Sta | Depth | Al | As | Cd | Cr | Cu | Pb | Hg | Ni | Ag | Zn | Hits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ELEMENT | | | | | | |
| 1 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1 | 00-10 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 1 | 10-20 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 0 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 3 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 3 | 00-8 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 3 | 02-4 | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 3 |
| 3 | 08-16 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 3 | 38-40 | | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 0 | 1 | 5 |
| 4 | 0 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 4 | 00-10 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 4 | 10-20 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 2 | 7 |
| 5 | 0 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 5 | 00-10 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 5 | 10-20 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 5 | 20-30 | | 0 | 0 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 9 |
| 6 | 0 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 6 | 00-7 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 6 | 20-28 | | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 2 |
| 7 | 0 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 1 | 1 | 7 |
| 7 | 00-8 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 7 | 25-33 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 7 | 42-50 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 8 | 0 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 8 | 00-8 | | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 6 |
| 8 | 16-24 | | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 1 | 7 |
| 9 | 0 | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 10 | 0 | | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 4 |
| 10 | 00-8 | | 0 | 0 | 2 | 1 | 1 | 1 | 2 | 0 | 1 | 8 |
| 10 | 10-18 | | 0 | 0 | 2 | 1 | 2 | 1 | 1 | 0 | 2 | 9 |
| 10 | 10-18 | | 0 | 0 | 2 | 1 | 2 | 1 | 1 | 0 | 2 | 9 |
| 10 | 132-138 | | 0 | 0 | 2 | 2 | 2 | 1 | 2 | 0 | 2 | 11 |
| 10 | 33-38 | | 0 | 0 | 2 | 2 | 1 | 1 | 1 | 0 | 1 | 8 |
| 10 | 60-68 | | 0 | 0 | 2 | 1 | 1 | 1 | 2 | 0 | 1 | 8 |
| 10 | 90-98 | | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 1 | 7 |
| 11 | 0 | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 12 | 0 | | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 2 | 6 |
| 12 | 00-8 | | 0 | 0 | 1 | 1 | 2 | 1 | 0 | 0 | 2 | 7 |
| 12 | 10-18 | | 0 | 0 | 1 | 1 | 2 | 1 | 1 | 0 | 2 | 8 |
| 12 | 20-28 | | 0 | 0 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 11 |
| 13 | 0 | | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 2 |

Table 3.8(C). Continued. Sediment Screen Level 0: if (CONCs > ER-L),1,0 + if (CONCs > ER-M),1,0

| | | ELEMENT | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sta | Depth | Al | As | Cd | Cr | Cu | Pb | Hg | Ni | Ag | Zn | Hits |
| 14 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 20-28 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 14 | 40-48 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 15 | 0 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 15 | 100-108 | | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| 15 | 30-38 | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| 15 | 60-68 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 16 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 0 | | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| 17 | 0-2 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 00-8 | | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| 17 | 10-12 | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| 17 | 18-20 | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| 17 | 30-38 | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 17 | 36-38 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 36-38 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 17 | 70-78 | | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 2 |
| 18 | 0 | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 19 | 0 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 19 | 00-8 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 19 | 02-4 | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| 19 | 20-28 | | 0 | 0 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 4 |
| 19 | 50-58 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 19 | 72-74 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 20 | 0 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 21 | 0 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 21 | 00-8 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 21 | 20-28 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 21 | 50-58 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 21 | 85-92 | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| 22 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 23 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Table 3.8(C). Continued. Sediment Screen Level 0: if (CONCs > ER-L),1,0 + if (CONCs > ER-M),1,0

| Sta | Depth | Al | As | Cd | Cr | Cu | Pb | Hg | Ni | Ag | Zn | Hits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ELEMENT | | | | | | |
| 50 | 00-20 | | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 6 |
| 50 | 00-20 | | 0 | 0 | 1 | 1 | 2 | 1 | 2 | 0 | 1 | 8 |
| 51 | 00-20 | | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 3 |
| 51 | 00-20 | | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 6 |
| 52 | 00-20 | | 0 | 0 | 1 | 0 | 2 | 1 | 0 | 0 | 1 | 5 |
| 53 | 00-20 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 4 |
| 53 | 00-20 | | 0 | 0 | 2 | 0 | 2 | 1 | 1 | 0 | 1 | 7 |
| 54 | 00-20 | | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 3 |
| 55 | 00-20 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 55 | 00-20 | | 0 | 0 | 2 | 0 | 2 | 1 | 1 | 0 | 0 | 6 |
| 56 | 00-20 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 4 |
| 56 | 00-20 | | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | 3 |
| 57 | 00-20 | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 57 | 00-20 | | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 |
| 11051 | 0-2 | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 11051 | 06-8 | | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 11051 | 12-14 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11051 | 28-30 | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 11100 | 00-20 | | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 2 |
| 11100 | 00-20 | | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 4 |

Table 3.8(D). Sediment Screen Level 1: Washington Clean Up levels If (CONCs > WACL,1,0)

| Sta | Depth | Al | As | Cd | Cr | Cu | Pb | Hg | Ni | Ag | Zn | Hits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ELEMENT | | | | | | |
| 1 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 1 | 00-10 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 1 | 10-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 2 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 3 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 3 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 3 | 02-4 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 3 | 08-16 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 3 | 38-40 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 4 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 4 | 00-10 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 4 | 10-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 5 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 5 | 00-10 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 5 | 10-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 5 | 20-30 | | 0 | 0 | 1 | 0 | 0 | 0 | NA | 0 | 0 | 1 |
| 6 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 6 | 00-7 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 6 | 20-28 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 7 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 7 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 7 | 25-33 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 7 | 42-50 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 8 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 8 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 8 | 16-24 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 9 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 10 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 10 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 10 | 10-18 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 10 | 10-18 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 10 | 132-138 | | 0 | 0 | 1 | 1 | 0 | 0 | NA | 0 | 1 | 3 |
| 10 | 33-38 | | 0 | 0 | 0 | 1 | 0 | 0 | NA | 0 | 0 | 1 |
| 10 | 60-68 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 10 | 90-98 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 11 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 12 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 12 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 12 | 10-18 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 12 | 20-28 | | 0 | 0 | 0 | 0 | 0 | 1 | NA | 0 | 0 | 1 |
| 13 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |

Table 3.8(D). Continued. Sediment Screen Level 1: Washington Clean Up levels  If (CONCs > WACL,1,0)

| Sta | Depth | ELEMENT Al | As | Cd | Cr | Cu | Pb | Hg | Ni | Ag | Zn | Hits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 14 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 14 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 14 | 20-28 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 14 | 40-48 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 15 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 15 | 100-108 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 15 | 30-38 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 15 | 60-68 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 16 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 0-2 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 10-12 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 18-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 30-38 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 36-38 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 36-38 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 17 | 70-78 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 18 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 19 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 19 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 19 | 02-4 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 19 | 20-28 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 19 | 50-58 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 19 | 72-74 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 20 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 21 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 21 | 00-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 21 | 20-28 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 21 | 50-58 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 21 | 85-92 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 22 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 23 | 0 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |

Table 3.8(D). Continued. Sediment Screen Level 1: Washington Clean Up levels If (CONCs > WACL,1,0)

| Sta | Depth | Al | As | Cd | Cr | Cu | Pb | Hg | Ni | Ag | Zn | Hits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | ELEMENT | | | | | | |
| 50 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 50 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 51 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 51 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 52 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 53 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 53 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 54 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 55 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 55 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 56 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 56 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 57 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 57 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 11051 | 0-2 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 11051 | 06-8 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 11051 | 12-14 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 11051 | 28-30 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 11100 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |
| 11100 | 00-20 | | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 |

Table 3.8(E): Crustal Ratio screening level for sediment cores. Value of 1 indicates element was enriched above geochemical weathering levels. Blank value indicates element was not enriched.

| | | | | | | ELEMENT | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sta** | **Depth** | **%Al** | **As** | **Cd** | **Cr** | **Cu** | **Pb** | **Hg** | **Ni** | **Ag** | **Zn** | **Hits** |
| 1 | 0 | 2.74 | | | | | | 1 | | 1 | | 2 |
| 1 | 00-10 | 3.13 | | | | | | 1 | | 1 | | 2 |
| 1 | 10-20 | 3.05 | | | | | | 1 | | 1 | | 2 |
| 2 | 0 | 3.17 | 1 | | 1 | | 1 | 1 | | 1 | | 5 |
| 3 | 0 | 2.89 | | 1 | 1 | | | | | 1 | | 3 |
| 3 | 00-8 | 4.75 | | | | | | 1 | | 1 | | 2 |
| 3 | 02-4 | 4.1563 | | | 1 | | | | | | | 1 |
| 3 | 08-16 | 5.42 | | | 1 | | | 1 | | 1 | | 3 |
| 3 | 38-40 | 0.7972 | | | 1 | 1 | 1 | | 1 | | 1 | 5 |
| 4 | 0 | 4.47 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 8 |
| 4 | 00-10 | 7.27 | 1 | 1 | 1 | | 1 | 1 | | 1 | | 6 |
| 4 | 10-20 | 3.86 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 5 | 0 | 2.26 | 1 | | 1 | | | 1 | | 1 | | 4 |
| 5 | 00-10 | 4.5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 8 |
| 5 | 10-20 | 3.17 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 5 | 20-30 | 4.01 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 6 | 0 | 7.79 | 1 | 1 | 1 | | 1 | 1 | | 1 | | 6 |
| 6 | 00-7 | 3.7 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 6 | 20-28 | 1.99 | | | 1 | | | 1 | 1 | 1 | | 4 |
| 7 | 0 | 3.8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 7 | 00-8 | 3.13 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 7 | 25-33 | 3.18 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 7 | 42-50 | 1.79 | | | | | | 1 | 1 | 1 | | 3 |
| 8 | 0 | 3.48 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 8 | 00-8 | 1.1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 8 | 16-24 | 1.8 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 9 | 0 | 2.39 | 1 | | 1 | | 1 | 1 | | 1 | | 5 |
| 10 | 0 | 3.925 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 7 |
| 10 | 00-8 | 2.16 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 10 | 10-18 | 7.7 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 | 1 | 8 |
| 10 | 10-18 | 6 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 10 | 132-138 | 5.21 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 10 | 33-38 | 1.67 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 10 | 60-68 | 5.63 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 8 |
| 10 | 90-98 | 3.72 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |
| 11 | 0 | 2.25 | | | 1 | | 1 | 1 | | 1 | | 4 |
| 12 | 0 | 2.83 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 12 | 00-8 | 3 | | | 1 | 1 | 1 | 1 | | 1 | 1 | 6 |
| 12 | 10-18 | 3.55 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 8 |
| 12 | 20-28 | 4.73 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 9 |

Table 3.8(E): Continued. Crustal Ratio screening level for sediment cores. Value of 1 indicates element was enriched above geochemical weathering levels. Blank value indicates element was not enriched.

| | | | ELEMENT | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sta | Depth | %Al | As | Cd | Cr | Cu | Pb | Hg | Ni | Ag | Zn | Hits |
| 13 | 0 | 3.14 | | | 1 | | | 1 | | 1 | | 3 |
| 14 | 0 | 1.12 | | | | | | 1 | | 1 | | 2 |
| 14 | 00-8 | 2.18 | | | | | | 1 | | 1 | | 2 |
| 14 | 20-28 | 2.4 | | | | | | 1 | | 1 | | 2 |
| 14 | 40-48 | 1.98 | | | | | | 1 | 1 | 1 | | 3 |
| 15 | 0 | 3.85 | 1 | | 1 | | 1 | 1 | | 1 | | 5 |
| 15 | 100-108 | 2.26 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | | 7 |
| 15 | 30-38 | 3.01 | | 1 | 1 | | 1 | 1 | 1 | 1 | | 6 |
| 15 | 60-68 | 2.68 | | 1 | 1 | | 1 | 1 | 1 | 1 | | 6 |
| 16 | 0 | 1.19 | | | | | | 1 | | 1 | | 2 |
| 17 | 0 | 3.0975 | 1 | 1 | 1 | | 1 | 1 | | 1 | | 6 |
| 17 | 0-2 | 3.11 | | | 1 | | | | | | | 1 |
| 17 | 00-8 | 1.86 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | | 7 |
| 17 | 10-12 | 2.842 | | | 1 | | | | | | | 1 |
| 17 | 18-20 | 1.4911 | | | 1 | | 1 | | 1 | | 1 | 4 |
| 17 | 30-38 | 2.98 | | 1 | | | 1 | 1 | | 1 | | 4 |
| 17 | 36-38 | 2.9353 | | | | | | | | | | 0 |
| 17 | 36-38 | 1.7255 | | | | | | | 1 | | | 1 |
| 17 | 70-78 | 2.48 | | | | | 1 | 1 | 1 | 1 | | 4 |
| 18 | 0 | 2.01 | | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 7 |
| 19 | 0 | 4.2625 | 1 | 1 | 1 | | 1 | 1 | | 1 | | 6 |
| 19 | 00-8 | 2.74 | | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | 7 |
| 19 | 02-4 | 1.1032 | | | 1 | | 1 | | 1 | | 1 | 4 |
| 19 | 20-28 | 3.25 | | 1 | 1 | | 1 | 1 | 1 | 1 | | 6 |
| 19 | 50-58 | 1.55 | | | 1 | | 1 | 1 | 1 | 1 | | 5 |
| 19 | 72-74 | 1.2259 | | | | | | | 1 | | | 1 |
| 20 | 0 | 3.69 | | | | | | 1 | | 1 | | 2 |
| 21 | 0 | 3.76 | | | 1 | | | 1 | | 1 | | 3 |
| 21 | 00-8 | 3.46 | | | 1 | | 1 | 1 | | 1 | | 4 |
| 21 | 20-28 | 2.83 | | | | | | 1 | | 1 | | 2 |
| 21 | 50-58 | 3.31 | | | | | | 1 | | 1 | | 2 |
| 21 | 85-92 | 3.1 | | | | | | 1 | | 1 | | 2 |
| 22 | 0 | 1.67 | | | | | | 1 | | | | 1 |
| 23 | 0 | 2.07 | | | | | | 1 | | 1 | | 2 |

Table 3.8(E): Continued. Crustal Ratio screening level for sediment cores. Value of 1 indicates element was enriched above geochemical weathering levels. Blank value indicates element was not enriched.

| | | | | | | ELEMENT | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sta** | **Depth** | **%Al** | **As** | **Cd** | **Cr** | **Cu** | **Pb** | **Hg** | **Ni** | **Ag** | **Zn** | **Hits** |
| 50 | 00-20 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | 8 |
| 50 | 00-20 | 5 | 1 | | 1 | 1 | 1 | 1 | 1 | 1 | | 7 |
| 51 | 00-20 | 4.2 | 1 | | 1 | | | | 1 | 1 | | 4 |
| 51 | 00-20 | 4.8 | | | 1 | 1 | 1 | 1 | 1 | 1 | | 6 |
| 52 | 00-20 | 3.9 | 1 | | 1 | | 1 | 1 | | 1 | 1 | 6 |
| 53 | 00-20 | 6 | 1 | | 1 | | 1 | 1 | | 1 | | 5 |
| 53 | 00-20 | 6.4 | 1 | | 1 | 1 | 1 | 1 | | 1 | | 6 |
| 54 | 00-20 | 5.3 | | 1 | | | | 1 | | | | 2 |
| 55 | 00-20 | 4.3 | 1 | 1 | 1 | | 1 | 1 | | 1 | | 6 |
| 55 | 00-20 | 5 | 1 | | 1 | | 1 | 1 | 1 | 1 | | 6 |
| 56 | 00-20 | 5 | 1 | 1 | 1 | | 1 | 1 | | 1 | | 6 |
| 56 | 00-20 | 5 | 1 | 1 | 1 | | 1 | 1 | | 1 | | 6 |
| 57 | 00-20 | 5.6 | 1 | | | | | | | | | 1 |
| 57 | 00-20 | 5.3 | 1 | | | | 1 | | | | | 2 |
| 11051 | 0-2 | 1.0457 | | | 1 | | 1 | | 1 | | 1 | 4 |
| 11051 | 06-8 | 3.5346 | | | 1 | | | | | | | 1 |
| 11051 | 12-14 | 0.6764 | | | 1 | | | | 1 | | | 2 |
| 11051 | 28-30 | 3.165 | | | | | | | | | | 0 |
| 11100 | 00-20 | 7.1 | | | 1 | | 1 | | | | | 2 |
| 11100 | 00-20 | 6.2 | | | 1 | | 1 | 1 | | 1 | | 4 |

Table 3.8(F): Results of screening acid volatile sulfide metal-binding capacity. The concentration of AVS for the bulk metal samples was obtained from the average AVS measured at the respective station.

| | | | Metal Concentration in umol/g | | | | | | Sum | umol/g | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | SampType | Cd | Cu | Pb | Hg | Ni | Ag | Zn | Divalent | AVS | metal/AVS |
| 1 | Bulk | 0.002 | 0.042 | 0.001 | 0.001 | 0.187 | 0.002 | 0.592 | 0.827 | | |
| 2 | Bulk | 0.002 | 0.353 | 0.299 | 0.001 | 0.370 | 0.007 | 1.254 | 2.285 | | |
| 3 | Bulk | 0.003 | 0.409 | 0.110 | 0.000 | 0.254 | 0.003 | 0.939 | 1.718 | 45.6 | 0.038 |
| 3 | SEM | 0.002 | 0.011 | 0.084 | | 0.032 | | 0.408 | 0.538 | 32.2 | 0.017 |
| 3 | SEM | 0.002 | 0.011 | 0.125 | | 0.036 | | 0.574 | 0.747 | 66.5 | 0.011 |
| 3 | SEM | 0.003 | 0.017 | 0.125 | | 0.051 | | 0.541 | 0.738 | 38.1 | 0.019 |
| 4 | Bulk | 0.005 | 0.872 | 0.398 | 0.003 | 0.606 | 0.009 | 2.141 | 4.034 | | |
| 5 | Bulk | 0.002 | 0.305 | 0.149 | 0.001 | 0.216 | 0.003 | 0.847 | 1.524 | | |
| 6 | Bulk | 0.008 | 0.928 | 0.502 | 0.001 | 0.670 | 0.009 | 2.707 | 4.825 | | |
| 7 | Bulk | 0.008 | 1.033 | 0.353 | 0.001 | 0.554 | 0.011 | 2.500 | 4.459 | 71.7 | 0.062 |
| 7 | SEM | 0.004 | 0.024 | 0.260 | | 0.075 | | 1.028 | 1.391 | 72.7 | 0.019 |
| 7 | SEM | 0.004 | 0.057 | 0.193 | | 0.060 | | 0.820 | 1.133 | 56.7 | 0.020 |
| 7 | SEM | 0.004 | 0.020 | 0.258 | | 0.058 | | 1.074 | 1.413 | 85.7 | 0.016 |
| 8 | Bulk | 0.008 | 0.814 | 0.297 | 0.001 | 0.583 | 0.008 | 2.118 | 3.828 | | |
| 9 | Bulk | 0.001 | 0.283 | 0.268 | 0.001 | 0.320 | 0.002 | 1.065 | 1.941 | 23.8 | 0.082 |
| 9 | SEM | 0.001 | 0.234 | 0.226 | | 0.065 | | 1.083 | 1.609 | 14.7 | 0.109 |
| 9 | SEM | 0.002 | 0.175 | 0.120 | | 0.056 | | 0.751 | 1.103 | 31.0 | 0.036 |
| 9 | SEM | 0.002 | 0.137 | 0.185 | | 0.060 | | 1.104 | 1.488 | 25.6 | 0.058 |
| 10 | Bulk | 0.005 | 0.978 | 0.315 | 0.001 | 0.525 | 0.006 | 1.728 | 3.558 | | |
| 11 | Bulk | 0.002 | 0.219 | 0.209 | 0.001 | 0.259 | 0.003 | 0.948 | 1.641 | | |
| 12 | Bulk | 0.001 | 1.434 | 0.589 | 0.001 | 0.470 | 0.003 | 5.782 | 8.280 | | |
| 12.5 | SEM | 0.002 | 0.022 | 0.270 | | 0.055 | | 1.271 | 1.620 | 71.1 | 0.023 |
| 12.5 | SEM | 0.002 | 0.198 | 0.506 | | 0.083 | | 2.545 | 3.335 | 102.6 | 0.033 |
| 12.5 | SEM | 0.002 | 0.087 | 0.512 | | 0.063 | | 1.745 | 2.408 | 47.4 | 0.051 |
| 13 | Bulk | 0.003 | 0.441 | 0.169 | 0.001 | 0.339 | 0.005 | 1.300 | 2.258 | | |
| 14 | Bulk | 0.001 | 0.028 | 0.086 | 0.001 | 0.143 | 0.003 | 0.343 | 0.604 | | |
| 15 | Bulk | 0.002 | 0.282 | 0.314 | 0.001 | 0.319 | 0.006 | 1.174 | 2.098 | 75.6 | 0.028 |
| 16 | Bulk | 0.001 | 0.052 | 0.096 | 0.001 | 0.211 | 0.001 | 0.382 | 0.743 | | |
| 17 | Bulk | 0.004 | 0.512 | 0.399 | 0.002 | 0.354 | 0.004 | 1.788 | 3.063 | 59.9 | 0.051 |
| 18 | Bulk | 0.018 | 0.552 | 0.418 | 0.001 | 0.342 | 0.002 | 1.176 | 2.509 | | |
| 19 | Bulk | 0.005 | 0.518 | 0.314 | 0.001 | 0.443 | 0.004 | 1.434 | 2.720 | 41.2 | 0.066 |
| 20 | Bulk | 0.001 | 0.055 | 0.083 | 0.001 | 0.216 | 0.002 | 0.541 | 0.900 | | |
| 21 | Bulk | 0.002 | 0.197 | 0.199 | 0.001 | 0.261 | 0.004 | 0.945 | 1.609 | | |
| 22 | Bulk | 0.001 | 0.016 | 0.122 | 0.001 | 0.128 | 0.001 | 0.265 | 0.532 | | |
| 23 | Bulk | 0.001 | 0.025 | 0.070 | 0.001 | 0.189 | 0.001 | 0.332 | 0.619 | | |
| 100 | SEM | 0.003 | 0.016 | 0.215 | | 0.044 | | 0.762 | 1.039 | 20.2 | 0.051 |
| 100 | SEM | 0.004 | 0.019 | 0.355 | | 0.092 | | 1.002 | 1.471 | 28.8 | 0.051 |
| 100 | SEM | 0.004 | 0.022 | 0.338 | | 0.063 | | 0.974 | 1.401 | 48.3 | 0.029 |

TABLE 3.9: Results of sediment exposure screening for PAH compounds.

TABLE 3.9(A): Screeing levels for PAH Compounds.

| | FLUOR | PHEN | ANTH | C1 | C2 | C3 | C4 | FLRAN | PYRENE | BAA | CHRYSENE | SUMBENZ | BEP | BAP | PERYLENE | INDEN123 | DIBAHA | BGHIPER | SUMPAH | LPAH | HPAH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [4] | [4] | [4] | [4] | | | | [4] | [4] | [4] | [4] | [1] | [4] | [4] | [4] | [4] | [4] | [1] | | | |
| Log(Kow) | 4.18 | 4.49 | 4.54 | 5.18 | | | | 4.95 | 4.95 | 5.91 | 5.79 | 5.32 | 6.42 | 6.42 | 6.05 | 4.95 | 5.91 | 6.77 | | | |
| Log(Koc) [7] | 4.11 | 4.41 | 4.46 | 5.09 | 5.00 | 5.00 | 5.00 | 4.87 | 4.87 | 5.81 | 5.69 | 5.23 | 6.31 | 6.31 | 5.95 | 4.87 | 5.81 | 6.66 | | | |
| Koc | 12859 | 25939 | 29047 | 123657 | 100000 | 100000 | 100000 | 73473 | 73473 | 645372 | 491870 | 169762 | 2047104 | 2047104 | 885992 | 73473 | 645372 | 4520537 | 675835.3 | | |
| ER-L ug/g | 35 | 225 | 85 | | | | | 600 | 350 | 230 | 400 | | | 400 | | | 60 | | 4000 | | |
| ER-M ug/g | 640 | 1380 | 960 | | | | | 3600 | 2200 | 1600 | 2800 | | | 2500 | | | 260 | | 35000 | | |
| WA-Cleanup Levels | | | | | | | | | | | | | | | | | | | | | |
| ug/g TOC | 79 | 480 | 1200 | | | | | 1200 | 1400 | 270 | 460 | 450 | | 210 | | 88 | 33 | 78 | | | |
| LPAH ug/g TOC | FLUOR | PHEN | ANTH | | | | | | | | | | | | | | | | | 780 | |
| HPAH ug/g TOC | | | | | | | | FLUORAN | PYRENE | BAA | CHRYSENE | SUMBENZ | | BAP | | INDEN123 | DIBAHA | BGHIPER | | | 5300 |
| Water Quality Criteria | | [5] | | | | | | [5] | | | | | | | | | | | [5] | | |
| ug/L | | 4.6 | | | | | | 5.0 | | | | | | | | | | | 300.0 | | |

TABLE 3.9(B): RAW DATA - Sediment Grabs (ng/g)

| Station | PC | FLUOR | PHEN | ANTH | C1 | C2 | C3 | C4 | FLRAN | PYRENE | BAA | CHRYSENE | SUMBENZ | BEP | BAP | PERYLENE | INDEN123 | DIBAHA | BGHIPER | SUMPAH | LPAH | HPAH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0054 | 6 | 50 | 13 | 50 | 37 | 13 | 27 | 96 | 92 | 41 | 49 | 120 | 47 | 58 | 17 | 45 | 7 | 37 | 805 | 69 | 545 |
| 2 | 0.0182 | 82 | 630 | 280 | 660 | 470 | 200 | 150 | 1000 | 960 | 600 | 630 | 1400 | 480 | 700 | 200 | 380 | 120 | 290 | 9232 | 992 | 6080 |
| 3 | 0.0135 | | | | | | | | | | | | | | | | | | | | 0 | 0 |
| 4 | 0.0222 | 29 | 210 | 79 | 210 | 183 | 71 | 50 | 360 | 400 | 210 | 260 | 780 | 250 | 330 | 120 | 210 | 53 | 180 | 3985 | 318 | 2783 |
| 5 | 0.0235 | 20 | 150 | 42 | 150 | 120 | 62 | 40 | 240 | 270 | 150 | 160 | 440 | 160 | 200 | 79 | 140 | 31 | 110 | 2564 | 212 | 1741 |
| 6 | 0.0215 | | | | | | | | | | | | | | | | | | | | 0 | 0 |
| 7 | 0.0242 | 41 | 337 | 113 | 186 | 177 | 48 | 28 | 622 | 620 | 298 | 307 | 765 | 275 | 340 | 113 | 188 | 39 | 168 | 4666 | 491 | 3347 |
| 8 | 0.0242 | 20 | 332 | 96 | 195 | 74 | 79 | 71 | 672 | 632 | 288 | 327 | 700 | 272 | 368 | 116 | 210 | 44 | 233 | 4731 | 448 | 3474 |
| 9 | 0.0114 | 75 | 490 | 250 | 490 | 580 | 290 | 840 | 570 | 500 | 330 | 320 | 850 | 240 | 380 | 110 | 170 | 44 | 120 | 6649 | 815 | 3284 |
| 10 | 0.0202 | 35 | 240 | 86 | 215 | 145 | 65 | 21 | 480 | 437 | 238 | 237 | 447 | 167 | 208 | 74 | 115 | 37 | 111 | 3360 | 361 | 2310 |
| 11 | 0.0108 | 42 | 410 | 230 | 350 | 230 | 80 | 140 | 760 | 670 | 340 | 360 | 1000 | 290 | 430 | 130 | 190 | 44 | 130 | 5826 | 682 | 3924 |
| 12 | 0.0094 | 150 | 1500 | 650 | 760 | 360 | 140 | 29 | 1800 | 1500 | 800 | 1300 | 2100 | 580 | 820 | 230 | 320 | 84 | 240 | 13363 | 2300 | 8964 |
| 13 | 0.0262 | 66 | 550 | 224 | 494 | 345 | 127 | 35 | 1100 | 920 | 450 | 480 | 1100 | 340 | 490 | 150 | 260 | 57 | 220 | 7408 | 840 | 5077 |
| 14 | 0.0047 | 31 | 360 | 260 | 380 | 250 | 130 | 21 | 890 | 770 | 400 | 380 | 840 | 280 | 460 | 130 | 290 | 84 | 220 | 6176 | 651 | 4334 |
| 15 | 0.0161 | 42 | 340 | 110 | 340 | 310 | 170 | 150 | 800 | 680 | 310 | 360 | 800 | 300 | 400 | 150 | 220 | 55 | 170 | 5707 | 492 | 3795 |
| 16 | 0.0047 | 6 | 57 | 16 | 71 | 66 | 44 | 25 | 160 | 130 | 77 | 12 | 190 | 72 | 170 | 30 | 52 | 14 | 42 | 1234 | 79 | 847 |
| 17 | 0.0114 | 35 | 275 | 139 | 347 | 212 | 43 | 19 | 582 | 642 | 395 | 360 | 795 | 290 | 423 | 117 | 180 | 63 | 205 | 5123 | 449 | 3645 |
| 18 | 0.0148 | 250 | 1600 | 570 | 1300 | 740 | 370 | 50 | 1800 | 1400 | 750 | 830 | 1700 | 570 | 860 | 250 | 430 | 98 | 310 | 13878 | 2420 | 8178 |
| 19 | 0.0161 | 28 | 252 | 103 | 280 | 287 | 108 | 20 | 517 | 560 | 370 | 352 | 677 | 287 | 388 | 111 | 190 | 50 | 223 | 4805 | 383 | 3327 |
| 20 | 0.0074 | 5 | 12 | 4 | 8 | 12 | 24 | 24 | 32 | 30 | 17 | 19 | 44 | 14 | 18 | 17 | 5 | 10 | 3 | 298 | 21 | 178 |
| 21 | 0.0108 | 6 | 71 | 25 | 84 | 74 | 37 | 18 | 160 | 150 | 74 | 87 | 260 | 94 | 120 | 40 | 60 | 14 | 48 | 1422 | 102 | 973 |
| 22 | 0.0034 | 5 | 55 | 17 | 32 | 10 | 25 | 25 | 74 | 59 | 24 | 25 | 52 | 18 | 27 | 8 | 12 | 12 | 8 | 488 | 77 | 293 |
| 23 | 0.0027 | 6 | 74 | 13 | 66 | 49 | 17 | 28 | 150 | 130 | 65 | 76 | 170 | 60 | 84 | 24 | 57 | 14 | 45 | 1128 | 93 | 791 |


DATA SOURCES:
[1] Mackay et al. 1980
[2] Capel and Eisenreich 1990
[3] Hawker and Connel 1988
[4] EPA ACQUIRE database
[5] EPA 1980
[6] EPA 1976
[7] Di Toro et al. 1991

TABLE 3.9(C): ER-L Screening Level For Sediment Grab (ER-L Units)

| STATION | FLUOR | PHEN | ANTH | C1 | C2 | C3 | C4 | FLRAN | PYRENE | BAA | CHRYSENE | SUMBENZ | BEP | BAP | PERYLENE | INDEN123 | DIBAHA | BGHIPER | SUMPAH | LPAH | HPAH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.2 | 0.2 | 0.2 | | | | | 0.2 | 0.3 | 0.2 | 0.1 | | | 0.1 | | | 0.1 | | 0.2 | | |
| 2 | 2.3 | 2.8 | 3.3 | | | | | 1.7 | 2.7 | 2.6 | 1.6 | | | 1.8 | | | 2.0 | | 2.3 | | |
| 3 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 | | | 0.0 | | 0.0 | | |
| 4 | 0.8 | 0.9 | 0.9 | | | | | 0.6 | 1.1 | 0.9 | 0.7 | | | 0.8 | | | 0.9 | | 1.0 | | |
| 5 | 0.6 | 0.7 | 0.5 | | | | | 0.4 | 0.8 | 0.7 | 0.4 | | | 0.5 | | | 0.5 | | 0.6 | | |
| 6 | 0.0 | 0.0 | 0.0 | | | | | 0.0 | 0.0 | 0.0 | 0.0 | | | 0.0 | | | 0.0 | | 0.0 | | |
| 7 | 1.2 | 1.5 | 1.3 | | | | | 1.0 | 1.8 | 1.3 | 0.8 | | | 0.9 | | | 0.7 | | 1.2 | | |
| 8 | 0.6 | 1.5 | 1.1 | | | | | 1.1 | 1.8 | 1.3 | 0.8 | | | 0.9 | | | 0.7 | | 1.2 | | |
| 9 | 2.1 | 2.2 | 2.9 | | | | | 1.0 | 1.4 | 1.4 | 0.8 | | | 1.0 | | | 0.7 | | 1.7 | | |
| 10 | 1.0 | 1.1 | 1.0 | | | | | 0.8 | 1.2 | 1.0 | 0.6 | | | 0.5 | | | 0.6 | | 0.8 | | |
| 11 | 1.2 | 1.8 | 2.7 | | | | | 1.3 | 1.9 | 1.5 | 0.9 | | | 1.1 | | | 0.7 | | 1.5 | | |
| 12 | 4.3 | 6.7 | 7.6 | | | | | 3.0 | 4.3 | 3.5 | 3.3 | | | 2.1 | | | 1.4 | | 3.3 | | |
| 13 | 1.9 | 2.4 | 2.6 | | | | | 1.8 | 2.6 | 2.0 | 1.2 | | | 1.2 | | | 1.0 | | 1.9 | | |
| 14 | 0.9 | 1.6 | 3.1 | | | | | 1.5 | 2.2 | 1.7 | 1.0 | | | 1.2 | | | 1.4 | | 1.5 | | |
| 15 | 1.2 | 1.5 | 1.3 | | | | | 1.3 | 1.9 | 1.3 | 0.9 | | | 1.0 | | | 0.9 | | 1.4 | | |
| 16 | 0.2 | 0.3 | 0.2 | | | | | 0.3 | 0.4 | 0.3 | 0.0 | | | 0.4 | | | 0.2 | | 0.3 | | |
| 17 | 1.0 | 1.2 | 1.6 | | | | | 1.0 | 1.8 | 1.7 | 0.9 | | | 1.1 | | | 1.1 | | 1.3 | | |
| 18 | 7.1 | 7.1 | 6.7 | | | | | 3.0 | 4.0 | 3.3 | 2.1 | | | 2.2 | | | 1.6 | | 3.5 | | |
| 19 | 0.8 | 1.1 | 1.2 | | | | | 0.9 | 1.6 | 1.6 | 0.9 | | | 1.0 | | | 0.8 | | 1.2 | | |
| 20 | 0.1 | 0.1 | 0.0 | | | | | 0.1 | 0.1 | 0.1 | 0.0 | | | 0.0 | | | 0.2 | | 0.1 | | |
| 21 | 0.2 | 0.3 | 0.3 | | | | | 0.3 | 0.4 | 0.3 | 0.2 | | | 0.3 | | | 0.2 | | 0.4 | | |
| 22 | 0.1 | 0.2 | 0.2 | | | | | 0.1 | 0.2 | 0.1 | 0.1 | | | 0.1 | | | 0.2 | | 0.1 | | |
| 23 | 0.2 | 0.3 | 0.2 | | | | | 0.3 | 0.4 | 0.3 | 0.2 | | | 0.2 | | | 0.2 | | 0.3 | | |

TABLE 3.9(D): WA-CL Screening Level For Sediment Grab (Wa-Criteria Units)

| STATION | PC | FLUOR | PHEN | ANTH | C1 | C2 | C3 | C4 | FLRAN | PYRENE | BAA | CHRYSENE | SUMBENZ | BEP | BAP | PERYLENE | INDEN123 | DIBAHA | BGHIPER | SUMPAH | LPAH | HPAH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0054 | 0.01 | 0.02 | 0.00 | | | | | 0.01 | 0.01 | 0.03 | 0.02 | 0.05 | | 0.05 | | 0.10 | 0.04 | 0.09 | | 0.02 | 0.02 |
| 2 | 0.0182 | 0.06 | 0.07 | 0.01 | | | | | 0.05 | 0.04 | 0.12 | 0.08 | 0.17 | | 0.18 | | 0.24 | 0.20 | 0.20 | | 0.07 | 0.06 |
| 3 | 0.0135 | 0.00 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| 4 | 0.0222 | 0.02 | 0.02 | 0.00 | | | | | 0.01 | 0.01 | 0.04 | 0.03 | 0.08 | | 0.07 | | 0.11 | 0.07 | 0.10 | | 0.02 | 0.02 |
| 5 | 0.0235 | 0.01 | 0.01 | 0.00 | | | | | 0.01 | 0.01 | 0.02 | 0.01 | 0.04 | | 0.04 | | 0.07 | 0.04 | 0.06 | | 0.01 | 0.01 |
| 6 | 0.0215 | 0.00 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | 0.00 | | 0.00 | 0.00 | 0.00 | | 0.00 | 0.00 |
| 7 | 0.0242 | 0.02 | 0.03 | 0.00 | | | | | 0.02 | 0.02 | 0.05 | 0.03 | 0.07 | | 0.07 | | 0.09 | 0.05 | 0.09 | | 0.03 | 0.03 |
| 8 | 0.0242 | 0.01 | 0.03 | 0.00 | | | | | 0.02 | 0.02 | 0.04 | 0.03 | 0.06 | | 0.07 | | 0.10 | 0.06 | 0.12 | | 0.02 | 0.03 |
| 9 | 0.0114 | 0.08 | 0.09 | 0.02 | | | | | 0.04 | 0.03 | 0.11 | 0.06 | 0.17 | | 0.16 | | 0.17 | 0.12 | 0.13 | | 0.09 | 0.05 |
| 10 | 0.0202 | 0.02 | 0.02 | 0.00 | | | | | 0.02 | 0.02 | 0.04 | 0.03 | 0.05 | | 0.05 | | 0.06 | 0.06 | 0.07 | | 0.02 | 0.02 |
| 11 | 0.0108 | 0.05 | 0.08 | 0.02 | | | | | 0.06 | 0.04 | 0.12 | 0.07 | 0.21 | | 0.19 | | 0.20 | 0.12 | 0.15 | | 0.08 | 0.07 |
| 12 | 0.0094 | 0.20 | 0.33 | 0.06 | | | | | 0.16 | 0.11 | 0.31 | 0.30 | 0.50 | | 0.41 | | 0.39 | 0.27 | 0.33 | | 0.31 | 0.18 |
| 13 | 0.0262 | 0.03 | 0.04 | 0.01 | | | | | 0.03 | 0.03 | 0.06 | 0.04 | 0.09 | | 0.09 | | 0.11 | 0.07 | 0.11 | | 0.04 | 0.04 |
| 14 | 0.0047 | 0.08 | 0.16 | 0.05 | | | | | 0.16 | 0.12 | 0.31 | 0.18 | 0.40 | | 0.47 | | 0.70 | 0.54 | 0.60 | | 0.18 | 0.17 |
| 15 | 0.0161 | 0.03 | 0.04 | 0.01 | | | | | 0.04 | 0.03 | 0.07 | 0.05 | 0.11 | | 0.12 | | 0.15 | 0.10 | 0.14 | | 0.04 | 0.04 |
| 16 | 0.0047 | 0.02 | 0.03 | 0.00 | | | | | 0.03 | 0.02 | 0.06 | 0.01 | 0.09 | | 0.17 | | 0.13 | 0.09 | 0.11 | | 0.02 | 0.03 |
| 17 | 0.0114 | 0.04 | 0.05 | 0.01 | | | | | 0.04 | 0.04 | 0.13 | 0.07 | 0.15 | | 0.18 | | 0.18 | 0.17 | 0.23 | | 0.05 | 0.06 |
| 18 | 0.0148 | 0.21 | 0.23 | 0.03 | | | | | 0.10 | 0.07 | 0.19 | 0.12 | 0.26 | | 0.28 | | 0.33 | 0.20 | 0.27 | | 0.21 | 0.10 |
| 19 | 0.0161 | 0.02 | 0.03 | 0.01 | | | | | 0.03 | 0.02 | 0.08 | 0.05 | 0.09 | | 0.11 | | 0.13 | 0.09 | 0.18 | | 0.03 | 0.04 |
| 20 | 0.0074 | 0.01 | 0.00 | 0.00 | | | | | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | | 0.01 | | 0.01 | 0.04 | 0.01 | | 0.00 | 0.00 |
| 21 | 0.0108 | 0.01 | 0.01 | 0.00 | | | | | 0.01 | 0.01 | 0.03 | 0.02 | 0.05 | | 0.05 | | 0.06 | 0.04 | 0.06 | | 0.01 | 0.02 |
| 22 | 0.0034 | 0.02 | 0.03 | 0.00 | | | | | 0.02 | 0.01 | 0.03 | 0.02 | 0.03 | | 0.04 | | 0.04 | 0.11 | 0.03 | | 0.03 | 0.02 |
| 23 | 0.0027 | 0.03 | 0.06 | 0.00 | | | | | 0.05 | 0.03 | 0.09 | 0.06 | 0.14 | | 0.15 | | 0.24 | 0.16 | 0.21 | | 0.04 | 0.06 |

TABLE 3.9(E): PORE WATER CONCENTRATION (ug/L)

| STATION | PC | FLUOR | PHEN | ANTH | C1 | C2 | C3 | C4 | FLRAN | PYRENE | BAA | CHRYSENE | SUMBENZ | BEP | BAP | PERYLENE | INDEN123 | DIBAHA | BGHIPER | SUMPAH | LPAH | HPAH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0054 | 8.7E-02 | 3.6E-01 | 8.3E-02 | 7.5E-02 | 6.9E-02 | 2.4E-02 | 5.0E-02 | 2.4E-01 | 2.3E-01 | 1.2E-02 | 1.9E-02 | 1.3E-01 | 4.3E-03 | 5.3E-03 | 3.6E-03 | 1.1E-01 | 2.0E-03 | 1.5E-03 | 1.5E+00 | 1.5E+00 | |
| 2 | 0.0182 | 3.5E-01 | 1.3E+00 | 5.3E-01 | 2.9E-01 | 2.6E-01 | 1.1E-01 | 8.3E-02 | 7.5E-01 | 7.2E-01 | 5.1E-02 | 7.1E-02 | 4.5E-01 | 1.3E-02 | 1.9E-02 | 1.2E-02 | 2.8E-01 | 1.0E-02 | 3.5E-03 | 5.4E+00 | 5.3E+00 | |
| 3 | 0.0135 | | | | | | | | | | | | | | | | | | | | | |
| 4 | 0.0222 | 1.0E-01 | 3.6E-01 | 1.2E-01 | 7.7E-02 | 8.2E-02 | 3.2E-02 | 2.3E-02 | 2.2E-01 | 2.5E-01 | 1.5E-02 | 2.4E-02 | 2.1E-01 | 5.5E-03 | 7.3E-03 | 6.1E-03 | 1.3E-01 | 3.7E-03 | 1.8E-03 | 1.7E+00 | 1.7E+00 | |
| 5 | 0.0235 | 6.6E-02 | 2.5E-01 | 6.1E-02 | 5.2E-02 | 5.1E-02 | 2.6E-02 | 1.7E-02 | 1.4E-01 | 1.6E-01 | 9.9E-03 | 1.4E-02 | 1.1E-01 | 3.3E-03 | 4.2E-03 | 3.8E-03 | 8.1E-02 | 2.0E-03 | 1.0E-03 | 1.0E+00 | 1.0E+00 | |
| 6 | 0.0215 | | | | | | | | | | | | | | | | | | | | | |
| 7 | 0.0242 | 1.3E-01 | 5.4E-01 | 1.6E-01 | 6.2E-02 | 7.3E-02 | 2.0E-02 | 1.2E-02 | 3.5E-01 | 3.5E-01 | 1.9E-02 | 2.6E-02 | 1.9E-01 | 5.5E-03 | 6.9E-03 | 5.3E-03 | 1.1E-01 | 2.5E-03 | 1.5E-03 | 2.1E+00 | 2.1E+00 | |
| 8 | 0.0242 | 6.4E-02 | 5.3E-01 | 1.4E-01 | 6.5E-02 | 3.1E-02 | 3.3E-02 | 2.9E-02 | 3.8E-01 | 3.6E-01 | 1.8E-02 | 2.7E-02 | 1.7E-01 | 5.5E-03 | 7.4E-03 | 5.4E-03 | 1.2E-01 | 2.8E-03 | 2.1E-03 | 2.0E+00 | 2.0E+00 | |
| 9 | 0.0114 | 5.1E-01 | 1.7E+00 | 7.5E-01 | 3.5E-01 | 5.1E-01 | 2.5E-01 | 7.3E-01 | 6.8E-01 | 6.0E-01 | 4.5E-02 | 5.7E-02 | 4.4E-01 | 1.0E-02 | 1.6E-02 | 1.1E-02 | 2.0E-01 | 6.0E-03 | 2.3E-03 | 6.8E+00 | 6.8E+00 | |
| 10 | 0.0202 | 1.3E-01 | 4.6E-01 | 1.5E-01 | 8.6E-02 | 7.2E-02 | 3.2E-02 | 1.0E-02 | 3.2E-01 | 2.9E-01 | 1.8E-02 | 2.4E-02 | 1.3E-01 | 4.0E-03 | 5.0E-03 | 4.1E-03 | 7.8E-02 | 2.8E-03 | 1.2E-03 | 1.8E+00 | 1.8E+00 | |
| 11 | 0.0108 | 3.0E-01 | 1.5E+00 | 7.4E-01 | 2.6E-01 | 2.1E-01 | 7.4E-02 | 1.3E-01 | 9.6E-01 | 8.5E-01 | 4.9E-02 | 6.8E-02 | 5.5E-01 | 1.3E-02 | 2.0E-02 | 1.4E-02 | 2.4E-01 | 6.3E-03 | 2.7E-03 | 6.0E+00 | 6.0E+00 | |
| 12 | 0.0094 | 1.2E+00 | 6.1E+00 | 2.4E+00 | 6.5E-01 | 3.8E-01 | 1.5E-01 | 3.1E-02 | 2.6E+00 | 2.2E+00 | 1.3E-01 | 2.8E-01 | 1.3E+00 | 3.0E-02 | 4.3E-02 | 2.8E-02 | 4.6E-01 | 1.4E-02 | 5.6E-03 | 1.8E+01 | 1.8E+01 | |
| 13 | 0.0262 | 2.0E-01 | 8.1E-01 | 2.9E-01 | 1.5E-01 | 1.3E-01 | 4.8E-02 | 1.3E-02 | 5.7E-01 | 4.8E-01 | 2.7E-02 | 3.7E-02 | 2.5E-01 | 6.3E-03 | 9.1E-03 | 6.5E-03 | 1.3E-01 | 3.4E-03 | 1.9E-03 | 3.2E+00 | 3.2E+00 | |
| 14 | 0.0047 | 5.1E-01 | 2.9E+00 | 1.9E+00 | 6.5E-01 | 5.3E-01 | 2.8E-01 | 4.5E-02 | 2.6E+00 | 2.2E+00 | 1.3E-01 | 1.6E-01 | 1.1E+00 | 2.9E-02 | 4.8E-02 | 3.1E-02 | 8.4E-01 | 2.8E-02 | 1.0E-02 | 1.4E+01 | 1.4E+01 | |
| 15 | 0.0161 | 2.0E-01 | 8.1E-01 | 2.3E-01 | 1.7E-01 | 1.9E-01 | 1.1E-01 | 9.3E-02 | 6.7E-01 | 5.7E-01 | 3.0E-02 | 4.5E-02 | 2.9E-01 | 9.1E-03 | 1.2E-02 | 1.0E-02 | 1.9E-01 | 5.3E-03 | 2.3E-03 | 3.6E+00 | 3.6E+00 | |
| 16 | 0.0047 | 9.9E-02 | 4.7E-01 | 1.2E-01 | 1.2E-01 | 1.4E-01 | 9.3E-02 | 5.3E-02 | 4.6E-01 | 3.8E-01 | 2.5E-02 | 5.2E-03 | 2.4E-01 | 7.5E-03 | 1.8E-02 | 7.2E-03 | 1.5E-01 | 4.6E-03 | 2.0E-03 | 2.4E+00 | 2.4E+00 | |
| 17 | 0.0114 | 2.4E-01 | 9.3E-01 | 4.2E-01 | 2.5E-01 | 1.9E-01 | 3.8E-02 | 1.7E-02 | 6.9E-01 | 7.6E-01 | 5.4E-02 | 6.4E-02 | 4.1E-01 | 1.2E-02 | 1.8E-02 | 1.2E-02 | 2.1E-01 | 8.5E-03 | 4.0E-03 | 4.3E+00 | 4.3E+00 | |
| 18 | 0.0148 | 1.3E+00 | 4.2E+00 | 1.3E+00 | 7.1E-01 | 5.0E-01 | 2.5E-01 | 3.4E-02 | 1.7E+00 | 1.3E+00 | 7.9E-02 | 1.1E-01 | 6.8E-01 | 1.9E-02 | 2.8E-02 | 1.9E-02 | 4.0E-01 | 1.0E-02 | 4.6E-03 | 1.3E+01 | 1.3E+01 | |
| 19 | 0.0161 | 1.3E-01 | 6.0E-01 | 2.2E-01 | 1.4E-01 | 1.8E-01 | 6.7E-02 | 1.2E-02 | 4.4E-01 | 4.7E-01 | 3.6E-02 | 4.4E-02 | 2.5E-01 | 8.7E-03 | 1.2E-02 | 7.8E-03 | 1.6E-01 | 4.8E-03 | 3.1E-03 | 2.8E+00 | 2.8E+00 | |
| 20 | 0.0074 | 5.3E-02 | 6.3E-02 | 1.9E-02 | 8.7E-03 | 1.6E-02 | 3.2E-02 | 3.2E-02 | 5.9E-02 | 5.5E-02 | 3.6E-03 | 5.2E-03 | 3.5E-02 | 9.2E-04 | 1.2E-03 | 2.6E-03 | 9.2E-03 | 2.1E-03 | 9.0E-05 | 4.0E-01 | 4.0E-01 | |
| 21 | 0.0108 | 4.3E-02 | 2.5E-01 | 8.0E-02 | 6.3E-02 | 6.9E-02 | 3.4E-02 | 1.7E-02 | 2.0E-01 | 1.9E-01 | 1.1E-02 | 1.6E-02 | 1.4E-01 | 4.3E-03 | 5.4E-03 | 4.2E-03 | 7.6E-02 | 2.0E-03 | 9.9E-04 | 1.2E+00 | 1.2E+00 | |
| 22 | 0.0034 | 1.2E-01 | 6.3E-01 | 1.7E-01 | 7.7E-02 | 3.0E-02 | 7.4E-02 | 7.4E-02 | 3.0E-01 | 2.4E-01 | 1.1E-02 | 1.5E-02 | 9.1E-02 | 2.6E-03 | 3.9E-03 | 2.7E-03 | 4.9E-02 | 5.5E-03 | 5.3E-04 | 1.9E+00 | 1.9E+00 | |
| 23 | 0.0027 | 1.7E-01 | 1.1E+00 | 1.7E-01 | 2.0E-01 | 1.8E-01 | 6.3E-02 | 1.0E-01 | 7.6E-01 | 6.6E-01 | 3.7E-02 | 5.7E-02 | 3.7E-01 | 1.1E-02 | 1.5E-02 | 1.0E-02 | 2.9E-01 | 8.1E-03 | 3.7E-03 | 4.2E+00 | 4.2E+00 | |

TABLE 3.9(F): Amount Above Threshold (Pore Water Toxic Units).

| STATION | FLUOR | PHEN | ANTH | C1 | C2 | C3 | C4 | FLRAN | PYRENE | BAA | CHRYSENE | SUMBENZ | BEP | BAP | PERYLENE | INDEN123 | DIBAHA | BGHIPER | SUMPAH | LPAH | HPAH |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | 0.1 | | | | | | 0.0 | | | | | | | | | | | 0.0 | | |
| 2 | | 0.3 | | | | | | 0.2 | | | | | | | | | | | 0.0 | | |
| 3 | | 0.0 | | | | | | 0.0 | | | | | | | | | | | 0.0 | | |
| 4 | | 0.1 | | | | | | 0.0 | | | | | | | | | | | 0.0 | | |
| 5 | | 0.1 | | | | | | 0.0 | | | | | | | | | | | 0.0 | | |
| 6 | | 0.0 | | | | | | 0.0 | | | | | | | | | | | 0.0 | | |
| 7 | | 0.1 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 8 | | 0.1 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 9 | | 0.4 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 10 | | 0.1 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 11 | | 0.3 | | | | | | 0.2 | | | | | | | | | | | 0.0 | | |
| 12 | | 1.3 | | | | | | 0.5 | | | | | | | | | | | 0.1 | | |
| 13 | | 0.2 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 14 | | 0.6 | | | | | | 0.5 | | | | | | | | | | | 0.0 | | |
| 15 | | 0.2 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 16 | | 0.1 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 17 | | 0.2 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 18 | | 0.9 | | | | | | 0.3 | | | | | | | | | | | 0.0 | | |
| 19 | | 0.1 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 20 | | 0.0 | | | | | | 0.0 | | | | | | | | | | | 0.0 | | |
| 21 | | 0.1 | | | | | | 0.0 | | | | | | | | | | | 0.0 | | |
| 22 | | 0.1 | | | | | | 0.1 | | | | | | | | | | | 0.0 | | |
| 23 | | 0.2 | | | | | | 0.2 | | | | | | | | | | | 0.0 | | |

TABLE 3.10: Results of sediment exposure screening for PCB congeners and Total PCBs.

TABLE 3.10(A): Screeing levels for sediment PCB concentrations.

| Screeing Level | PCB Congener 8 | 18 | 28 | 52 | 44 | 66 | 101 | 118 | 153 | 105 | 138 | 187 | 128 | 180 | 170 | 195 | 206 | TPCB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Log(Kow) [3] | 5.07 | 5.24 | 5.67 | 5.84 | 5.75 | 6.20 | 6.38 | 6.74 | 6.92 | 6.65 | 6.83 | 7.17 | 6.74 | 7.36 | 7.27 | 7.56 | 8.09 | |
| Log(Koc) [7] | 4.98 | 5.15 | 5.57 | 5.74 | 5.65 | 6.09 | 6.27 | 6.63 | 6.80 | 6.54 | 6.71 | 7.05 | 6.63 | 7.24 | 7.15 | 7.43 | 7.95 | |
| Koc | 96403 | 141645 | 374878 | 550808 | 449293 | 1244171 | 1869907 | 4223767 | 6348045 | 3445323 | 5178095 | 11178667 | 4223767 | 17185414 | 14018127 | 27024645 | 89691234 | |
| ER-L ug/g sed. | | | | | | | | | | | | | | | | | | 50 |
| ER-M ug/g sed. | | | | | | | | | | | | | | | | | | 400 |
| WA-CL ug/g TOC | | | | | | | | | | | | | | | | | 65000 | |
| Water Quality Criteria (ppb) [5] | | | | | | | | | | | | | | | | | | 0.03 |

TABLE 3.10(B): RAW DATA - Sediment Grabs (ng/g)

| STATION | PC | PCB Congener 8 | 18 | 28 | 52 | 44 | 66 | 101 | 118 | 153 | 105 | 138 | 187 | 128 | 180 | 170 | 195 | 206 | TPCB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0054 | 0.5 | 0.1 | 0.1 | 0.4 | 0.1 | 0.7 | 0.6 | 0.5 | 0.8 | 1.1 | 0.7 | 0.3 | 0.2 | 0.5 | 0.1 | 0.5 | 0.5 | 14.9 |
| 2 | 0.0182 | 1.1 | 2.1 | 3.8 | 1.6 | 1.1 | 3.6 | 1.2 | 1.5 | 2.3 | 1.7 | 2 | 0.8 | 0.6 | 0.9 | 0.5 | 0.5 | 1.6 | 54.4 |
| 3 | 0.0135 | | | | | | | | | | | | | | | | | | |
| 4 | 0.0222 | 0.6 | 0.5 | 0.8 | 1.4 | 0.7 | 1 | 1.6 | 1.7 | 3.3 | 1.7 | 2.7 | 1.8 | 1 | 1 | 1.1 | 0.6 | 0.7 | 44.9 |
| 5 | 0.0235 | 0.7 | 1.1 | 1.3 | 1.3 | 1 | 1 | 1 | 1.4 | 2.5 | 1 | 2.1 | 1.7 | 0.8 | 1 | 0.9 | 0.5 | 2.4 | 43.4 |
| 6 | 0.0215 | | | | | | | | | | | | | | | | | | |
| 7 | 0.0242 | 0.7 | 2.9 | 1.9 | 1.6 | 1.1 | 3.1 | 2.6 | 3 | 7.3 | 3.4 | 5.5 | 5.5 | 2.9 | 5.5 | 2.9 | 1.8 | 2.8 | 111.06 |
| 8 | 0.0242 | 0.9 | 1.4 | 1.3 | 1.1 | 0.8 | 3.4 | 2 | 2.1 | 4.3 | 1.9 | 3.5 | 1.9 | 1 | 1.8 | 1.6 | 1.2 | 1.9 | 65.3 |
| 9 | 0.0114 | 1.9 | 0.8 | 0.5 | 0.5 | 1.3 | 2.7 | 1.1 | 1.4 | 2.1 | 1.4 | 2.8 | 1.9 | 1.9 | 0.5 | 0.7 | 0.5 | 1.7 | 49 |
| 10 | 0.0202 | 0.6 | 1.6 | 1.3 | 1.2 | 0.8 | 4 | 1.9 | 1.5 | 3.5 | 1.1 | 2.8 | 1.4 | 0.8 | 1.5 | 1.6 | 0.6 | 0.9 | 53.6 |
| 11 | 0.0108 | 0.5 | 0.9 | 0.5 | 0.6 | 0.4 | 1.3 | 0.5 | 0.8 | 1.1 | 0.4 | 0.9 | 0.8 | 0.5 | 0.5 | 0.6 | 0.4 | 0.7 | 21.7 |
| 12 | 0.0094 | 0.6 | 0.8 | 0.8 | 1.8 | 2.9 | 4.2 | 2.9 | 2.9 | 5.9 | 1.8 | 5 | 2.2 | 2.2 | 3.1 | 2.3 | 0.5 | 2 | 85.2 |
| 13 | 0.0262 | 0.8 | 0.6 | 0.9 | 0.9 | 0.9 | 1.8 | 1 | 1.2 | 3.1 | 2 | 2.1 | 1.8 | 0.7 | 1.4 | 1.5 | 0.6 | 3 | 48.6 |
| 14 | 0.0047 | 0.2 | 1 | 1.3 | 1.5 | 1.3 | 2.5 | 1 | 1.1 | 1.1 | 5.2 | 1 | 0.5 | 0.4 | 0.2 | 0.4 | 0.3 | 0.5 | 38.3 |
| 15 | 0.0161 | 1.1 | 2.1 | 2.3 | 2 | 1.9 | 3.9 | 1.8 | 2.3 | 3.4 | 3.8 | 3 | 1.7 | 0.9 | 1.3 | 0.9 | 0.7 | 1.1 | 67.7 |
| 16 | 0.0047 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 | 0.5 | 0.3 | 0.3 | 0.6 | 1.2 | 0.4 | 0.3 | 0.2 | 0.1 | 0.3 | 0.5 | 0.3 | 10.4 |
| 17 | 0.0114 | 0.5 | 2 | 0.6 | 0.5 | 0.5 | 1.9 | 0.6 | 0.8 | 3.7 | 0.9 | 1.5 | 1.5 | 0.7 | 0.7 | 0.7 | 0.5 | 0.9 | 36.7 |
| 18 | 0.0148 | 0.4 | 0.5 | 0.5 | 1.6 | 0.6 | 1.5 | 0.8 | 0.7 | 3.3 | 1.2 | 2.5 | 2.4 | 0.6 | 5.4 | 4.4 | 1 | 1.2 | 56.9 |
| 19 | 0.0161 | 0.5 | 2 | 0.5 | 0.6 | 0.5 | 1.6 | 0.8 | 0.9 | 3.6 | 0.5 | 2.2 | 1.4 | 0.7 | 1.8 | 1.5 | 0.5 | 0.6 | 39.9 |
| 20 | 0.0074 | 0 | 0.2 | 0.1 | 0.2 | 0.1 | 0.5 | 0.1 | 0.2 | 0.3 | 0.5 | 0.3 | 0.5 | 0.3 | 0.5 | 0.5 | 0.1 | 0.5 | 8.7 |
| 21 | 0.0108 | 0.5 | 0.3 | 0.2 | 0.5 | 0.2 | 0.9 | 0.3 | 0.6 | 1.3 | 1.4 | 1.1 | 0.5 | 0.5 | 0.1 | 0.4 | 0.5 | 0.7 | 19.2 |
| 22 | 0.0034 | 0.5 | 0.1 | 0.1 | 0.3 | 0.1 | 0.3 | 0.3 | 0.3 | 0.3 | 1.2 | 0.3 | 0.5 | 0.3 | 0.5 | 0.5 | 0.5 | 0.5 | 12.8 |
| 23 | 0.0027 | 0.2 | 0.2 | 0.1 | 0.2 | 0.1 | 0.2 | 0.1 | 0.1 | 0.2 | 0.9 | 0.1 | 0.5 | 0.1 | 0.5 | 0.3 | 0.1 | 0.1 | 6.4 |

DATA SOURCES:
[1] Mackay et al. 1980
[2] Capel and Eisenreich 1990
[3] Hawker and Connel 1988
[4] EPA ACQUIRE database
[5] EPA 1980
[6] EPA 1976
[7] Di Toro et al. 1991

TABLE 3.10(C): ER-L Screening Level For Sediment Grabs (ER-L Units).

| | PCB Congener | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Station | 8 | 18 | 28 | 52 | 44 | 66 | 101 | 118 | 153 | 105 | 138 | 187 | 128 | 180 | 170 | 195 | 206 | TPCB |
| 1 | | | | | | | | | | | | | | | | | | 0.3 |
| 2 | | | | | | | | | | | | | | | | | | 1.1 |
| 3 | | | | | | | | | | | | | | | | | | 0.0 |
| 4 | | | | | | | | | | | | | | | | | | 0.9 |
| 5 | | | | | | | | | | | | | | | | | | 0.9 |
| 6 | | | | | | | | | | | | | | | | | | 0.0 |
| 7 | | | | | | | | | | | | | | | | | | 2.2 |
| 8 | | | | | | | | | | | | | | | | | | 1.3 |
| 9 | | | | | | | | | | | | | | | | | | 1.0 |
| 10 | | | | | | | | | | | | | | | | | | 1.1 |
| 11 | | | | | | | | | | | | | | | | | | 0.4 |
| 12 | | | | | | | | | | | | | | | | | | 1.7 |
| 13 | | | | | | | | | | | | | | | | | | 1.0 |
| 14 | | | | | | | | | | | | | | | | | | 0.8 |
| 15 | | | | | | | | | | | | | | | | | | 1.4 |
| 16 | | | | | | | | | | | | | | | | | | 0.2 |
| 17 | | | | | | | | | | | | | | | | | | 0.7 |
| 18 | | | | | | | | | | | | | | | | | | 1.1 |
| 19 | | | | | | | | | | | | | | | | | | 0.8 |
| 20 | | | | | | | | | | | | | | | | | | 0.2 |
| 21 | | | | | | | | | | | | | | | | | | 0.4 |
| 22 | | | | | | | | | | | | | | | | | | 0.3 |
| 23 | | | | | | | | | | | | | | | | | | 0.1 |

TABLE 3.10(D) WA-CL screening level for sediment grab (WA-CL Units).

| | | PCB Congener | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | PC | 8 | 18 | 28 | 52 | 44 | 66 | 101 | 118 | 153 | 105 | 138 | 187 | 128 | 180 | 170 | 195 | 206 | TPCB |
| 1 | 0.0054 | | | | | | | | | | | | | | | | | | 0.043 |
| 2 | 0.0182 | | | | | | | | | | | | | | | | | | 0.046 |
| 3 | 0.0135 | | | | | | | | | | | | | | | | | | 0.000 |
| 4 | 0.0222 | | | | | | | | | | | | | | | | | | 0.031 |
| 5 | 0.0235 | | | | | | | | | | | | | | | | | | 0.028 |
| 6 | 0.0215 | | | | | | | | | | | | | | | | | | 0.000 |
| 7 | 0.0242 | | | | | | | | | | | | | | | | | | 0.071 |
| 8 | 0.0242 | | | | | | | | | | | | | | | | | | 0.041 |
| 9 | 0.0114 | | | | | | | | | | | | | | | | | | 0.066 |
| 10 | 0.0202 | | | | | | | | | | | | | | | | | | 0.041 |
| 11 | 0.0108 | | | | | | | | | | | | | | | | | | 0.031 |
| 12 | 0.0094 | | | | | | | | | | | | | | | | | | 0.139 |
| 13 | 0.0262 | | | | | | | | | | | | | | | | | | 0.029 |
| 14 | 0.0047 | | | | | | | | | | | | | | | | | | 0.125 |
| 15 | 0.0161 | | | | | | | | | | | | | | | | | | 0.065 |
| 16 | 0.0047 | | | | | | | | | | | | | | | | | | 0.034 |
| 17 | 0.0114 | | | | | | | | | | | | | | | | | | 0.049 |
| 18 | 0.0148 | | | | | | | | | | | | | | | | | | 0.059 |
| 19 | 0.0161 | | | | | | | | | | | | | | | | | | 0.038 |
| 20 | 0.0074 | | | | | | | | | | | | | | | | | | 0.018 |
| 21 | 0.0108 | | | | | | | | | | | | | | | | | | 0.027 |
| 22 | 0.0034 | | | | | | | | | | | | | | | | | | 0.059 |
| 23 | 0.0027 | | | | | | | | | | | | | | | | | | 0.037 |

TABLE 3.10(E): PORE WATER CONCENTRATION (ug/L).

| | | PCB Congener | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STATION | PC | 8 | 18 | 28 | 52 | 44 | 66 | 101 | 118 | 153 | 105 | 138 | 187 | 128 | 180 | 170 | 195 | 206 | TPCB | SUMPCB |
| 1 | 0.0054 | 1E-03 | 1.3E-04 | 5.0E-05 | 1.3E-04 | 4.1E-05 | 1.0E-04 | 6.0E-05 | 2.2E-05 | 2.3E-05 | 5.9E-05 | 2.5E-05 | 5.0E-06 | 8.8E-06 | 5.4E-06 | 1.3E-06 | 3.4E-06 | 1.0E-06 | | 1.6E-03 |
| 2 | 0.0182 | 6E-04 | 8.2E-04 | 5.6E-04 | 1.6E-04 | 1.3E-04 | 1.6E-04 | 3.5E-05 | 2.0E-05 | 2.0E-05 | 2.7E-05 | 2.1E-05 | 3.9E-06 | 7.8E-06 | 2.9E-06 | 2.0E-06 | 1.0E-06 | 9.8E-07 | | 2.6E-03 |
| 3 | 0.0135 | | | | | | | | | | | | | | | | | | | |
| 4 | 0.0222 | 3E-04 | 1.6E-04 | 9.6E-05 | 1.1E-04 | 7.0E-05 | 3.6E-05 | 3.9E-05 | 1.8E-05 | 2.3E-05 | 2.2E-05 | 2.3E-05 | 7.3E-06 | 1.1E-05 | 2.6E-06 | 3.5E-06 | 1.0E-06 | 3.5E-07 | | 9.1E-04 |
| 5 | 0.0235 | 3E-04 | 3.3E-04 | 1.5E-04 | 1.0E-04 | 9.5E-05 | 3.4E-05 | 2.3E-05 | 1.4E-05 | 1.7E-05 | 1.2E-05 | 1.7E-05 | 6.5E-06 | 8.0E-06 | 2.5E-06 | 2.7E-06 | 7.9E-07 | 1.1E-06 | | 1.1E-03 |
| 6 | 0.0215 | | | | | | | | | | | | | | | | | | | |
| 7 | 0.0242 | 3E-04 | 8.5E-04 | 2.1E-04 | 1.2E-04 | 1.0E-04 | 1.0E-04 | 5.7E-05 | 2.9E-05 | 4.7E-05 | 4.1E-05 | 4.4E-05 | 2.0E-05 | 2.8E-05 | 1.3E-05 | 8.5E-06 | 2.8E-06 | 1.3E-06 | | 2.0E-03 |
| 8 | 0.0242 | 4E-04 | 4.1E-04 | 1.4E-04 | 8.2E-05 | 7.4E-05 | 1.1E-04 | 4.4E-05 | 2.1E-05 | 2.8E-05 | 2.3E-05 | 2.8E-05 | 7.0E-06 | 9.8E-06 | 4.3E-06 | 4.7E-06 | 1.8E-06 | 8.8E-07 | | 1.4E-03 |
| 9 | 0.0114 | 2E-03 | 4.9E-04 | 1.2E-04 | 7.9E-05 | 2.5E-04 | 1.9E-04 | 5.1E-05 | 2.9E-05 | 2.9E-05 | 3.6E-05 | 4.7E-05 | 1.5E-05 | 3.9E-05 | 2.5E-06 | 4.4E-06 | 1.6E-06 | 1.7E-06 | | 3.1E-03 |
| 10 | 0.0202 | 3E-04 | 5.6E-04 | 1.7E-04 | 1.1E-04 | 8.8E-05 | 1.6E-04 | 5.0E-05 | 1.8E-05 | 2.7E-05 | 1.6E-05 | 2.7E-05 | 6.2E-06 | 9.4E-06 | 4.3E-06 | 5.7E-06 | 1.1E-06 | 5.0E-07 | | 1.6E-03 |
| 11 | 0.0108 | 5E-04 | 5.9E-04 | 1.2E-04 | 1.0E-04 | 8.3E-05 | 9.7E-05 | 2.5E-05 | 1.8E-05 | 1.6E-05 | 1.1E-05 | 1.6E-05 | 6.7E-06 | 1.1E-05 | 2.7E-06 | 4.0E-06 | 1.4E-06 | 7.3E-07 | | 1.6E-03 |
| 12 | 0.0094 | 7E-04 | 6.0E-04 | 2.3E-04 | 3.5E-04 | 6.9E-04 | 3.6E-04 | 1.6E-04 | 7.3E-05 | 9.9E-05 | 5.5E-05 | 1.0E-04 | 2.1E-05 | 5.5E-05 | 1.9E-05 | 1.7E-05 | 2.0E-06 | 2.4E-06 | | 3.5E-03 |
| 13 | 0.0262 | 3E-04 | 1.6E-04 | 9.2E-05 | 6.2E-05 | 7.6E-05 | 5.5E-05 | 2.0E-05 | 1.1E-05 | 1.9E-05 | 2.2E-05 | 1.5E-05 | 6.1E-06 | 6.3E-06 | 3.1E-06 | 4.1E-06 | 8.5E-07 | 1.3E-06 | | 8.7E-04 |
| 14 | 0.0047 | 4E-04 | 1.5E-03 | 7.4E-04 | 5.8E-04 | 6.1E-04 | 4.3E-04 | 1.1E-04 | 5.5E-05 | 3.7E-05 | 3.2E-04 | 4.1E-05 | 9.5E-06 | 2.0E-05 | 2.5E-06 | 6.1E-06 | 2.4E-06 | 1.2E-06 | | 4.9E-03 |
| 15 | 0.0161 | 7E-04 | 9.2E-04 | 3.8E-04 | 2.2E-04 | 2.6E-04 | 1.9E-04 | 6.0E-05 | 3.4E-05 | 3.3E-05 | 6.8E-05 | 3.6E-05 | 9.4E-06 | 1.3E-05 | 4.7E-06 | 4.0E-06 | 1.6E-06 | 7.6E-07 | | 3.0E-03 |
| 16 | 0.0047 | 2E-04 | 1.5E-04 | 1.1E-04 | 7.7E-05 | 9.5E-05 | 8.5E-05 | 3.4E-05 | 1.5E-05 | 2.0E-05 | 7.4E-05 | 1.6E-05 | 5.7E-06 | 1.0E-05 | 1.2E-06 | 4.5E-06 | 3.9E-06 | 7.1E-07 | | 9.3E-04 |
| 17 | 0.0114 | 5E-04 | 1.2E-03 | 1.4E-04 | 7.9E-05 | 9.7E-05 | 1.3E-04 | 2.8E-05 | 1.7E-05 | 5.1E-05 | 2.3E-05 | 2.5E-05 | 1.2E-05 | 1.4E-05 | 3.6E-06 | 4.4E-06 | 1.6E-06 | 8.8E-07 | | 2.3E-03 |
| 18 | 0.0148 | 3E-04 | 2.4E-04 | 9.0E-05 | 2.0E-04 | 9.0E-05 | 8.1E-05 | 2.9E-05 | 1.1E-05 | 3.5E-05 | 2.4E-05 | 3.3E-05 | 1.5E-05 | 9.6E-06 | 2.1E-05 | 2.1E-05 | 2.5E-06 | 9.0E-07 | | 1.2E-03 |
| 19 | 0.0161 | 3E-04 | 8.7E-04 | 8.3E-05 | 6.7E-05 | 6.9E-05 | 8.0E-05 | 2.7E-05 | 1.3E-05 | 3.5E-05 | 9.0E-06 | 2.6E-05 | 7.8E-06 | 1.0E-05 | 6.5E-06 | 6.6E-06 | 1.1E-06 | 4.1E-07 | | 1.6E-03 |
| 20 | 0.0074 | 0E+00 | 1.9E-04 | 3.6E-05 | 4.9E-05 | 3.0E-05 | 5.4E-05 | 7.2E-06 | 6.4E-06 | 6.4E-06 | 2.0E-05 | 7.8E-06 | 6.0E-06 | 9.6E-06 | 3.9E-06 | 4.8E-06 | 5.0E-07 | 7.5E-07 | | 4.3E-04 |
| 21 | 0.0108 | 5E-04 | 2.0E-04 | 5.0E-05 | 8.4E-05 | 4.1E-05 | 6.7E-05 | 1.5E-05 | 1.3E-05 | 1.9E-05 | 3.8E-05 | 2.0E-05 | 4.2E-06 | 1.1E-05 | 5.4E-07 | 2.7E-06 | 1.7E-06 | 7.3E-07 | | 1.0E-03 |
| 22 | 0.0034 | 2E-03 | 2.1E-04 | 7.9E-05 | 1.6E-04 | 6.6E-05 | 7.2E-05 | 4.8E-05 | 2.1E-05 | 1.4E-05 | 1.0E-04 | 1.7E-05 | 1.3E-05 | 2.1E-05 | 8.7E-06 | 1.1E-05 | 5.5E-06 | 1.7E-06 | | 2.4E-03 |
| 23 | 0.0027 | 8E-04 | 5.2E-04 | 9.9E-05 | 1.3E-04 | 8.3E-05 | 6.0E-05 | 2.0E-05 | 8.8E-06 | 1.2E-05 | 9.7E-05 | 7.2E-06 | 1.7E-05 | 8.8E-06 | 1.1E-05 | 8.0E-06 | 1.4E-06 | 4.1E-07 | | 1.9E-03 |

TABLE 3.11: Results of sediment screening levels for pesticide compounds.

TABLE 3.11(A): Screening levels for sediment pesticide concentrations.

| Screen Level 0 | ALDRIN | ACHLOR | TNONACHL | HEPCHR | HEPEPX | HCB | LIND | MIREX | DDT | DDD | DDE | SUMDDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Reference | [ ] | [4] | [4] | [ ] | [4] | [2] | [4] | [4] | [4]* | [4] | [4] | [1]* |
| Log(Kow) | ? | 5.54 | 5.54 | ? | 2.65 | 5.47 | 6.42 | 6.9 | 5.75 | 5.69 | 6.19 | 5.87 |
| Log(Koc) [7] | 0.00 | 5.45 | 5.45 | 0.00 | 2.61 | 5.38 | 6.31 | 6.78 | 5.65 | 5.59 | 6.09 | 5.78 |
| Koc | 10^C4 | 279319 | 279319 | 10^F4 | 403 | 238391 | 2047104 | 6067084 | 449293 | 392238 | 1216326 | 598471 |
| ER-L ug/g sediment | | 0.5 | | | | | | | 1.0 | 2.0 | 2.0 | 3.0 |
| ER-M ug/g sediment | | 6.0 | | | | | | | 7.0 | 20.0 | 15.0 | 350.0 |
| Water Quality Criteria[5] | 1.3 | 4.3 | | LC50 0.03 | | | LC50 0.077 | 0.001 | LC50 20 | LC50 20 | LC50 14 | 0.13 |

TABLE 3.11(B): RAW DATA - Sediment Grabs (ng/g).

| Station | PC | ALDRIN | ACHLOR | TNONACHL | HEPCHR | HEPEPX | HCB | LIND | MIREX | DDT | DDD | DDE | SUMDDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0054 | 0.36 | 0.33 | 0.23 | 0.60 | 0.07 | 0.05 | 0.60 | 0.60 | 1.20 | 0.92 | 0.86 | 2.98 |
| 2 | 0.0182 | 0.59 | 0.85 | 0.55 | 0.07 | 0.11 | 0.22 | 0.60 | 0.60 | 12.39 | 4.22 | 2.64 | 19.25 |
| 3 | 0.0135 | | | | | | | | | | | | |
| 4 | 0.0222 | 1.26 | 1.36 | 0.91 | 0.14 | 0.15 | 0.39 | 0.75 | 0.75 | 14.86 | 4.72 | 3.12 | 22.70 |
| 5 | 0.0235 | 0.81 | 0.44 | 0.51 | 0.32 | 0.06 | 0.24 | 0.60 | 0.60 | 10.29 | 4.56 | 1.93 | 16.78 |
| 6 | 0.0215 | | | | | | | | | | | | |
| 7 | 0.0242 | 1.07 | 0.93 | 0.83 | 0.85 | 0.85 | 0.85 | 0.85 | 1.18 | 4.83 | 10.30 | 6.47 | 21.60 |
| 8 | 0.0242 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 7.20 | 1.00 | 1.70 | 8.80 | 18.60 | 7.20 | 34.60 |
| 9 | 0.0114 | 6.04 | 1.08 | 0.31 | 0.60 | 0.36 | 0.86 | 1.02 | 0.60 | 63.51 | 5.92 | 2.57 | 72.00 |
| 10 | 0.0202 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.70 | 0.78 | 0.82 | 2.40 | 3.20 | 3.38 | 8.98 |
| 11 | 0.0108 | 0.70 | 0.60 | 0.39 | 0.21 | 0.24 | 0.28 | 0.60 | 0.60 | 8.20 | 1.02 | 1.38 | 10.60 |
| 12 | 0.0094 | 19.75 | 1.52 | 0.28 | 0.60 | 0.60 | 0.26 | 1.06 | 0.60 | 92.94 | 4.23 | 2.01 | 99.18 |
| 13 | 0.0262 | 2.20 | 0.60 | 0.51 | 0.09 | 0.04 | 1.62 | 0.27 | 0.60 | 1.20 | 1.39 | 2.54 | 5.13 |
| 14 | 0.0047 | 0.68 | 0.60 | 0.10 | 0.03 | 0.01 | 0.03 | 0.60 | 0.60 | 7.52 | 1.55 | 1.05 | 10.12 |
| 15 | 0.0161 | 1.78 | 1.18 | 0.45 | 0.12 | 0.07 | 1.45 | 0.77 | 0.60 | 12.68 | 5.09 | 3.79 | 21.56 |
| 16 | 0.0047 | 1.76 | 0.31 | 0.16 | 0.04 | 0.06 | 0.11 | 0.14 | 0.60 | 10.52 | 1.37 | 1.08 | 12.97 |
| 17 | 0.0114 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.70 | 6.88 | 3.13 | 1.90 | 11.91 |
| 18 | 0.0148 | 0.89 | 1.07 | 0.60 | 0.60 | 0.05 | 0.17 | 0.49 | 0.60 | 16.75 | 21.30 | 6.30 | 44.35 |
| 19 | 0.0161 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 0.60 | 2.17 | 2.05 | 2.25 | 6.47 |
| 20 | 0.0074 | 0.82 | 0.60 | 0.20 | 0.60 | 0.60 | 2.40 | 0.12 | 0.60 | 1.20 | 0.79 | 1.01 | 3.00 |
| 21 | 0.0108 | 0.75 | 0.46 | 0.19 | 0.04 | 0.11 | 0.23 | 0.12 | 0.60 | 5.59 | 1.22 | 0.94 | 7.75 |
| 22 | 0.0034 | 0.64 | 0.10 | 0.10 | 0.03 | 0.02 | 0.12 | 0.06 | 0.60 | 5.65 | 1.15 | 0.31 | 7.11 |
| 23 | 0.0027 | 0.72 | 0.12 | 0.10 | 0.02 | 0.03 | 0.12 | 0.04 | 0.60 | 7.14 | 0.82 | 0.93 | 8.89 |

DATA SOURCES:
[1] Mackay et al. 1980
[2] Capel and Eisenreich 1990
[3] Hawker and Connel 1988
[4] EPA ACQUIRE database
[5] EPA 1980
[6] EPA 1976
[7] Di Toro et al. 1991

TABLE 3.11(C): ER-L screening level results for sediment grabs (ER-L Units).

| Station | PC | ALDRIN | ACHLOR | TNONACHL | HEPCHR | HEPEPX | HCB | LIND | MIREX | DDT | DDD | DDE | SUMDDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 0.7 | | | | | | | 1.2 | 0.5 | 0.4 | 1.0 |
| 2 | | | 1.7 | | | | | | | 12.4 | 2.1 | 1.3 | 6.4 |
| 3 | | | | | | | | | | 0.0 | 0.0 | 0.0 | 0.0 |
| 4 | | | 2.7 | | | | | | | 14.9 | 2.4 | 1.6 | 7.6 |
| 5 | | | 0.9 | | | | | | | 10.3 | 2.3 | 1.0 | 5.6 |
| 6 | | | | | | | | | | 0.0 | 0.0 | 0.0 | 0.0 |
| 7 | | | 1.9 | | | | | | | 4.8 | 5.2 | 3.2 | 7.2 |
| 8 | | | 2.0 | | | | | | | 8.8 | 9.3 | 3.6 | 11.5 |
| 9 | | | 2.2 | | | | | | | 63.5 | 3.0 | 1.3 | 24.0 |
| 10 | | | 1.4 | | | | | | | 2.4 | 1.6 | 1.7 | 3.0 |
| 11 | | | 1.2 | | | | | | | 8.2 | 0.5 | 0.7 | 3.5 |
| 12 | | | 3.0 | | | | | | | 92.9 | 2.1 | 1.0 | 33.1 |
| 13 | | | 1.2 | | | | | | | 1.2 | 0.7 | 1.3 | 1.7 |
| 14 | | | 1.2 | | | | | | | 7.5 | 0.8 | 0.5 | 3.4 |
| 15 | | | 2.4 | | | | | | | 12.7 | 2.5 | 1.9 | 7.2 |
| 16 | | | 0.6 | | | | | | | 10.5 | 0.7 | 0.5 | 4.3 |
| 17 | | | 1.2 | | | | | | | 6.9 | 1.6 | 1.0 | 4.0 |
| 18 | | | 2.1 | | | | | | | 16.8 | 10.7 | 3.2 | 14.8 |
| 19 | | | 1.2 | | | | | | | 2.2 | 1.0 | 1.1 | 2.2 |
| 20 | | | 1.2 | | | | | | | 1.2 | 0.4 | 0.5 | 1.0 |
| 21 | | | 0.9 | | | | | | | 5.6 | 0.6 | 0.5 | 2.6 |
| 22 | | | 0.2 | | | | | | | 5.7 | 0.6 | 0.2 | 2.4 |
| 23 | | | 0.2 | | | | | | | 7.1 | 0.4 | 0.5 | 3.0 |

TABLE 3.11(D): PORE WATER CONCENTRATION ug/L (ppb).

| Station | PC | ALDRIN | ACHLOR | TNONACHL | HEPCHR | HEPEPX | HCB | LIND | MIREX | DDT | DDD | DDE | SUMDDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.0054 | | 2.2E-04 | 1.5E-04 | | 3.2E-02 | 3.9E-05 | 5.4E-05 | 1.8E-05 | 5.0E-04 | 4.4E-04 | 1.3E-04 | 9.3E-04 |
| 2 | 0.0182 | | 1.7E-04 | 1.1E-04 | | 1.5E-02 | 5.1E-05 | 1.6E-05 | 5.4E-06 | 1.5E-03 | 5.9E-04 | 1.2E-04 | 1.8E-03 |
| 3 | 0.0135 | | | | | | | | | | | | |
| 4 | 0.0222 | | 2.2E-04 | 1.5E-04 | | 1.7E-02 | 7.4E-05 | 1.7E-05 | 5.6E-06 | 1.5E-03 | 5.4E-04 | 1.2E-04 | 1.7E-03 |
| 5 | 0.0235 | | 6.7E-05 | 7.8E-05 | | 6.3E-03 | 4.3E-05 | 1.2E-05 | 4.2E-06 | 9.7E-04 | 4.9E-04 | 6.7E-05 | 1.2E-03 |
| 6 | 0.0215 | | | | | | | | | | | | |
| 7 | 0.0242 | | 1.4E-04 | 1.2E-04 | | 8.7E-02 | 1.5E-04 | 1.7E-05 | 8.0E-06 | 4.4E-04 | 1.1E-03 | 2.2E-04 | 1.5E-03 |
| 8 | 0.0242 | | 1.5E-04 | 1.5E-04 | | 1.0E-01 | 1.2E-03 | 2.0E-05 | 1.2E-05 | 8.1E-04 | 2.0E-03 | 2.4E-04 | 2.4E-03 |
| 9 | 0.0114 | | 3.4E-04 | 9.7E-05 | | 7.8E-02 | 3.2E-04 | 4.4E-05 | 8.7E-06 | 1.2E-02 | 1.3E-03 | 1.8E-04 | 1.1E-02 |
| 10 | 0.0202 | | 1.2E-04 | 1.2E-04 | | 8.6E-02 | 1.5E-04 | 1.9E-05 | 6.7E-06 | 2.6E-04 | 4.0E-04 | 1.4E-04 | 7.4E-04 |
| 11 | 0.0108 | | 2.0E-04 | 1.3E-04 | | 5.5E-02 | 1.1E-04 | 2.7E-05 | 9.2E-06 | 1.7E-03 | 2.4E-04 | 1.1E-04 | 1.6E-03 |
| 12 | 0.0094 | | 5.8E-04 | 1.1E-04 | | 1.6E-01 | 1.2E-04 | 5.5E-05 | 1.1E-05 | 2.2E-02 | 1.1E-03 | 1.8E-04 | 1.8E-02 |
| 13 | 0.0262 | | 8.2E-05 | 7.0E-05 | | 3.8E-03 | 2.6E-04 | 5.0E-06 | 3.8E-06 | 1.0E-04 | 1.4E-04 | 8.0E-05 | 3.3E-04 |
| 14 | 0.0047 | | 4.6E-04 | 7.6E-05 | | 5.3E-03 | 2.7E-05 | 6.2E-05 | 2.1E-05 | 3.6E-03 | 8.4E-04 | 1.8E-04 | 3.6E-03 |
| 15 | 0.0161 | | 2.6E-04 | 1.0E-04 | | 1.1E-02 | 3.8E-04 | 2.3E-05 | 6.1E-06 | 1.7E-03 | 8.0E-04 | 1.9E-04 | 2.2E-03 |
| 16 | 0.0047 | | 2.4E-04 | 1.2E-04 | | 3.2E-02 | 9.8E-05 | 1.5E-05 | 2.1E-05 | 5.0E-03 | 7.4E-04 | 1.9E-04 | 4.6E-03 |
| 17 | 0.0114 | | 1.9E-04 | 1.9E-04 | | 1.3E-01 | 2.2E-04 | 2.6E-05 | 1.0E-05 | 1.3E-03 | 7.0E-04 | 1.4E-04 | 1.7E-03 |
| 18 | 0.0148 | | 2.6E-04 | 1.5E-04 | | 8.4E-03 | 4.8E-05 | 1.6E-05 | 6.7E-06 | 2.5E-03 | 3.7E-03 | 3.5E-04 | 5.0E-03 |
| 19 | 0.0161 | | 1.3E-04 | 1.3E-04 | | 9.2E-02 | 1.6E-04 | 1.8E-05 | 6.1E-06 | 3.0E-04 | 3.2E-04 | 1.1E-04 | 6.7E-04 |
| 20 | 0.0074 | | 2.9E-04 | 9.7E-05 | | 2.0E-01 | 1.4E-03 | 7.9E-06 | 1.3E-05 | 3.6E-04 | 2.7E-04 | 1.1E-04 | 6.8E-04 |
| 21 | 0.0108 | | 1.5E-04 | 6.3E-05 | | 2.5E-02 | 9.0E-05 | 5.4E-06 | 9.2E-06 | 1.2E-03 | 2.9E-04 | 7.2E-05 | 1.2E-03 |
| 22 | 0.0034 | | 1.1E-04 | 1.1E-04 | | 1.5E-02 | 1.5E-04 | 8.7E-06 | 2.9E-05 | 3.7E-03 | 8.7E-04 | 7.6E-05 | 3.5E-03 |
| 23 | 0.0027 | | 1.6E-04 | 1.3E-04 | | 2.8E-02 | 1.9E-04 | 7.3E-06 | 3.7E-05 | 5.9E-03 | 7.8E-04 | 2.8E-04 | 5.5E-03 |



TABLE 3.11(E): Amount Above Threshold (Pore Water Toxic Units).

| Station | PC | ALDRIN | ACHLOR | TNONACHL | HEPCHR | HEPEPX | HCB | LIND | MIREX | DDT | DDD | DDE | SUMDDT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | 0.00 | | | | | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | | | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | | | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | | | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 |
| 10 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.02 |
| 13 | | | 0.00 | | | | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 14 | | | 0.00 | | | | | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 15 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 16 | | | 0.00 | | | | | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 |
| 17 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 18 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 |
| 19 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 20 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 21 | | | 0.00 | | | | | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 |
| 22 | | | 0.00 | | | | | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 |
| 23 | | | 0.00 | | | | | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.01 |

Table 3.12. Results of Sediment Screen.

Table 3.13(A). Sediment grabs (grab) and core (depth, cm) samples. PAH indicates that sample exceeded screening level for one or more PAH compounds.

| Sta | depth | Cr | Cu | Pb | Hg | Ni | Ag | Zn | DDT | PAH |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 00-10 | | | | Hg | | | | DDT | |
| 2 | grab | Cr | | Pb | Hg | | | | DDT | |
| 3 | 00-8 | | | | Hg | | | | DDT | |
| 3 | 02-4 | Cr | | | | | | | DDT | |
| 3 | 08-16 | Cr | | | Hg | | | | DDT | |
| 3 | 38-40 | Cr | | Pb | | Ni | | Zn | DDT | |
| 4 | grab | Cr | | Pb | Hg | Ni | | | DDT | |
| 4 | 00-10 | Cr | | Pb | Hg | | | | | |
| 4 | 10-20 | Cr | | Pb | Hg | Ni | | Zn | DDT | |
| 5 | grab | | | | Hg | | | | DDT | |
| 5 | 00-10 | Cr | | Pb | Hg | Ni | | | DDT | |
| 5 | 10-20 | Cr | | Pb | Hg | Ni | | Zn | | |
| 5 | 20-30 | Cr | Cu | Pb | Hg | Ni | Ag | Zn | DDT | |
| 6 | grab | Cr | | Pb | Hg | | | | DDT | |
| 6 | 00-7 | Cr | | Pb | Hg | Ni | | Zn | DDT | |
| 6 | 20-28 | | | | Hg | Ni | | | | |
| 7 | grab | Cr | | Pb | Hg | Ni | Ag | Zn | | |
| 7 | 00-8 | Cr | | Pb | Hg | Ni | | Zn | DDT | |
| 8 | grab | Cr | | Pb | Hg | Ni | | Zn | DDT | |
| 8 | 00-8 | Cr | | Pb | Hg | Ni | | Zn | DDT | |
| 8 | 16-24 | Cr | Cu | Pb | Hg | Ni | | Zn | DDT | |
| 9 | grab | | | Pb | | | | | DDT | |
| 10 | grab | Cr | | Pb | Hg | Ni | | | | |
| 10 | 00-8 | Cr | Cu | Pb | Hg | Ni | | Zn | DDT | |
| 10 | 10-18 | Cr | Cu | Pb | Hg | | | Zn | DDT | |
| 10 | 10-18 | Cr | Cu | Pb | Hg | Ni | | Zn | DDT | |
| 10 | 132-138 | Cr | Cu | Pb | Hg | Ni | | Zn | DDT | PAH |
| 10 | 33-38 | Cr | Cu | Pb | Hg | Ni | | Zn | DDT | PAH |
| 10 | 60-68 | Cr | Cu | Pb | Hg | Ni | | | | |
| 10 | 90-98 | Cr | Cu | Pb | Hg | Ni | | Zn | DDT | PAH |
| 11 | grab | | | Pb | | | | | DDT | |
| 12 | grab | | Cu | Pb | Hg | | | Zn | DDT | PHEN |
| 12 | 00-8 | Cr | Cu | Pb | Hg | | | Zn | DDT | |
| 12 | 10-18 | Cr | Cu | Pb | Hg | Ni | | Zn | | |
| 12 | 20-28 | Cr | Cu | Pb | Hg | Ni | Ag | Zn | | |
| 13 | grab | Cr | | | Hg | | | | | |
| 15 | grab | Cr | | Pb | Hg | | | | DDT | |
| 15 | 100-108 | | | Pb | Hg | | | | DDT | |
| 15 | 30-38 | Cr | | Pb | | | | | DDT | |
| 15 | 60-68 | Cr | | Pb | Hg | | | | | PAH |
| 17 | grab | | | Pb | Hg | | | | | |
| 17 | 00-8 | | | Pb | Hg | | | | | |
| 17 | 10-12 | Cr | | | | | | | DDT | |
| 17 | 18-20 | Cr | | Pb | | | | | DDT | |
| 17 | 30-38 | | | Pb | | | | | DDT | PAH |
| 17 | 70-78 | | | Pb | Hg | | | | | |
| 18 | grab | | | Pb | | | | | DDT | PHEN |
| 19 | grab | Cr | | Pb | Hg | | | | | |
| 19 | 00-8 | Cr | | Pb | Hg | | | | DDT | |
| 19 | 02-4 | Cr | | Pb | | | | | DDT | |
| 19 | 20-28 | Cr | | Pb | Hg | | | | DDT | |
| 19 | 50-58 | | | | Hg | | | | DDT | |
| 20 | grab | | | | Hg | | | | DDT | |
| 21 | grab | Cr | | | Hg | | | | DDT | |
| 21 | 00-8 | Cr | | Pb | Hg | | | | DDT | |
| 21 | 50-58 | | | | Hg | | | | DDT | |
| 21 | 85-92 | | | | Hg | | | | DDT | |
| 23 | grab | | | | | | | | DDT | |

Table 3.12. Continued.

Table 3.12(B). Results of Metal Sediment Screen for Salt Marsh Composite Cores for metals (SL0 + SL1 + SL2 + SL3 > 1) and organics (SL0 >1). PAH indicates that the sample exceeded screening level for one or more PAH compounds. (NOTE: Data not available to screen for PCB and Pesticide compounds).

| Sta | depth | Cr | Cu | Pb | Hg | Ni | Ag | Zn | PAH |
|---|---|---|---|---|---|---|---|---|---|
| 50 | 00-20 | Cr | Cu | Pb | Hg | Ni | | | |
| 50 | 00-20 | Cr | Cu | Pb | Hg | Ni | | | |
| 51 | 00-20 | Cr | | | | Ni | | | |
| 51 | 00-20 | Cr | Cu | Pb | Hg | Ni | | | |
| 52 | 00-20 | Cr | | Pb | Hg | | | Zn | |
| 53 | 00-20 | Cr | | Pb | Hg | | Ag | | |
| 53 | 00-20 | Cr | | Pb | Hg | | | | |
| 54 | 00-20 | | | | Hg | | | | |
| 55 | 00-20 | Cr | | Pb | Hg | | | | PAH |
| 55 | 00-20 | Cr | | Pb | Hg | Ni | | | |
| 56 | 00-20 | Cr | | Pb | Hg | | | | |
| 56 | 00-20 | Cr | | Pb | Hg | | | | |
| 57 | 00-20 | | | | | | | | |
| 57 | 00-20 | | | Pb | | | | | |
| 11051 | 0-2 | Cr | | | | | | | |
| 11051 | 06-8 | Cr | | | | | | | |
| 11100 | 00-20 | Cr | | Pb | | | | | |
| 11100 | 00-20 | Cr | | Pb | Hg | | | | |

Table 3.12. Continued.

Table 3.12(C). Sediment effects screening level (SL5).

| LEVEL 5: AMPHIPOD TOXICITY | |
|---|---|
| Station | Percent Mortality |
| 9 | 95% |
| 13 | 62% |
| 16 | 15% |
| 17 | 12% |
| 18 | 73% |
| 22 | 35% |
| 23 | 55% |

Table 3.12(D). Sediment effects screening level (SL6).

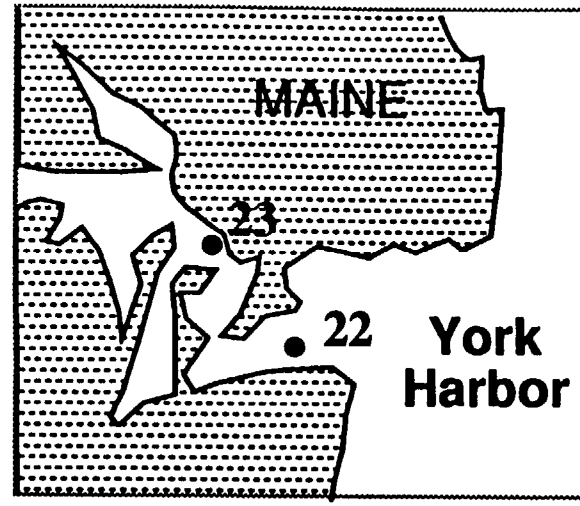
| LEVEL 6: Benthic Community Anomalies | | | | | |
|---|---|---|---|---|---|
| | TAXA number | DENSITY organism $m^{-2}$ | | DENSITY/TAXA organism $m^{-2}$ $taxa^{-1}$ | |
| Station | <5% | <5% | >95% | <5% | >95% |
| 2 | | | | | 2150 |
| 4 | | | | | 2196 |
| 8 | | | | | 2281 |
| 13 | | 4962 | | | |

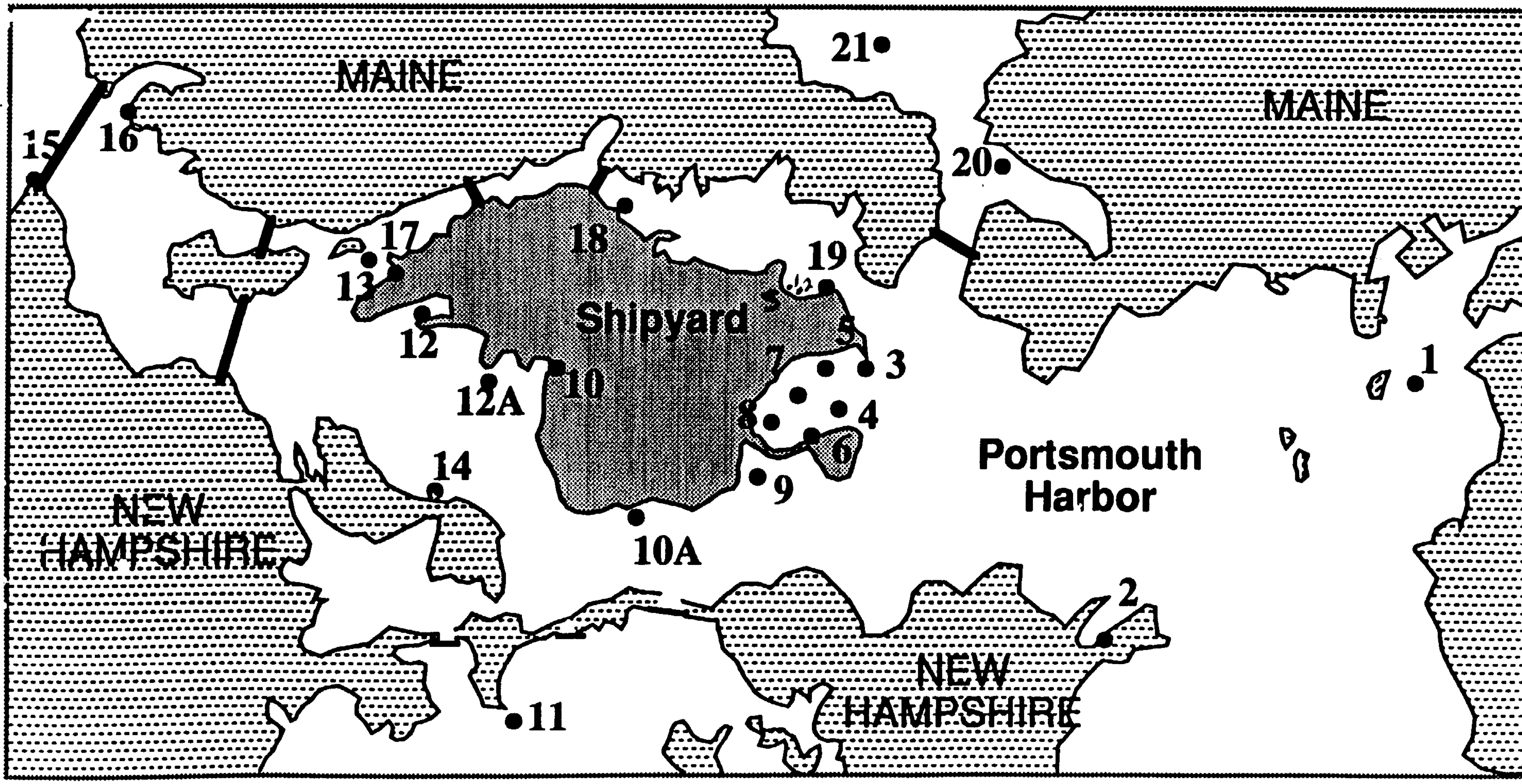
Table 3.13 Summary of stations with potential adverse chemical concentrations in sediments.

| Sta | depth | Chemical for which screening level was exceeded | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | grab | Cr | | Pb | Hg | | | | DDT | |
| 4 | grab | Cr | | Pb | Hg | Ni | | | DDT | |
| 4 | 00-10 | Cr | | Pb | Hg | | | | | |
| 4 | 10-20 | Cr | | Pb | Hg | Ni | Zn | | | |
| 8 | grab | Cr | | Pb | Hg | Ni | Zn | | DDT | |
| 8 | 00-8 | Cr | | Pb | Hg | Ni | Zn | | | |
| 8 | 16-24 | Cr | Cu | Pb | Hg | Ni | Zn | | | |
| 9 | grab | | | Pb | | | | | DDT | |
| 13 | grab | Cr | | | Hg | | | | | |
| 16 | grab | | | | | | | | DDT | |
| 17 | grab | | | Pb | Hg | | | | DDT | |
| 17 | 00-8 | | | Pb | Hg | | | | | |
| 17 | 10-12 | Cr | | | | | | | | |
| 17 | 18-20 | Cr | | Pb | | | | | | |
| 17 | 30-38 | | | Pb | | | | PAH | | |
| 17 | 70-78 | | | Pb | Hg | | | | | |
| 18 | grab | | | Pb | | | | PHEN | DDT | DDE |
| 23 | grab | | | | | | | | DDT | |

Figure 3.1 Station locations.

Figure 3.1(A) Station locations for sediment grabs, sediment cores, and mussel collections for Phase I of the Offshore Study. ("S" shows Phase I seep sample locations.



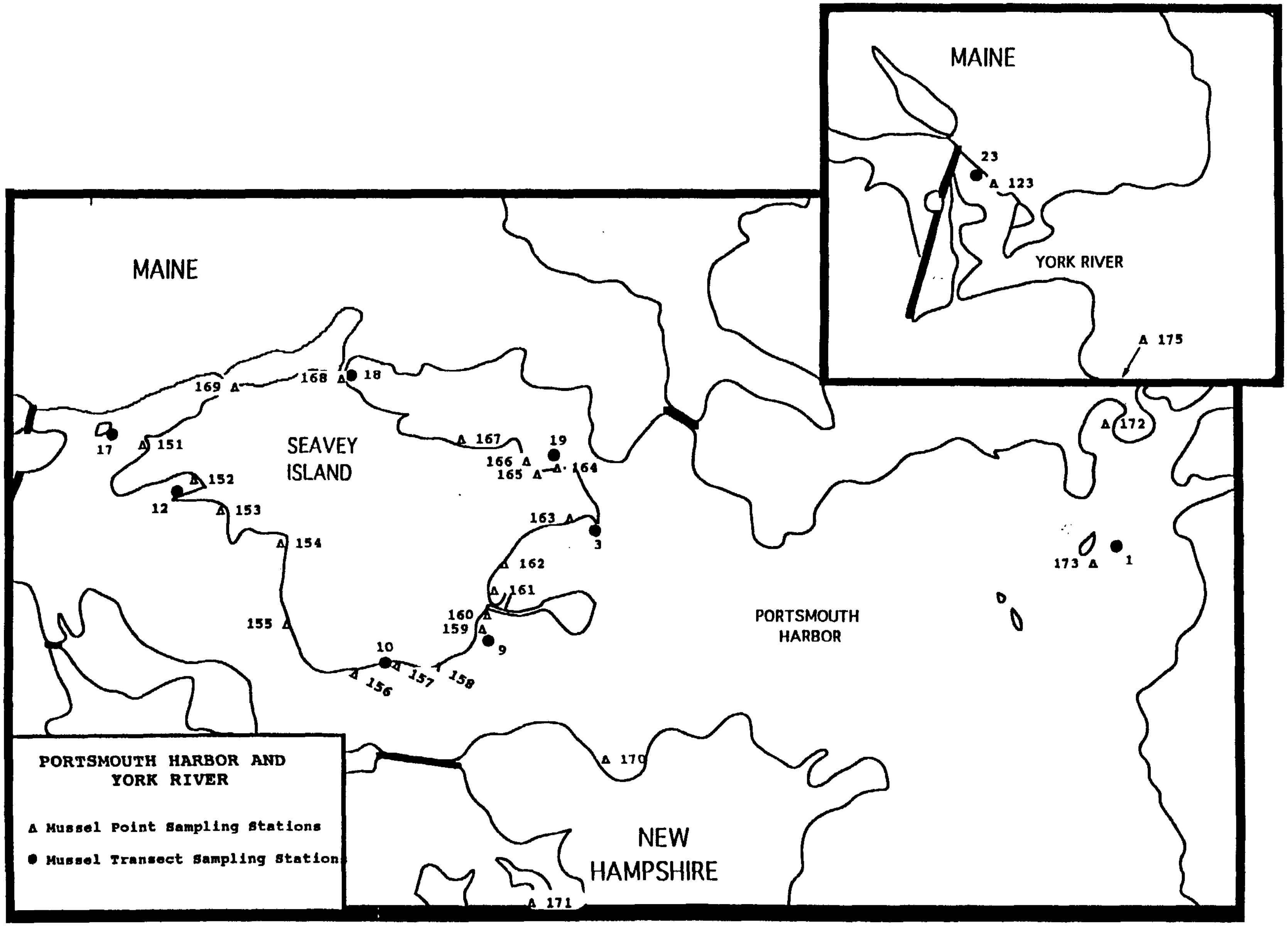



Figure 3.1(B). Mussel collection locations for quarterly monitoring and point samples from Phase II of the Offshore Study (from Short and Hoven 1994).

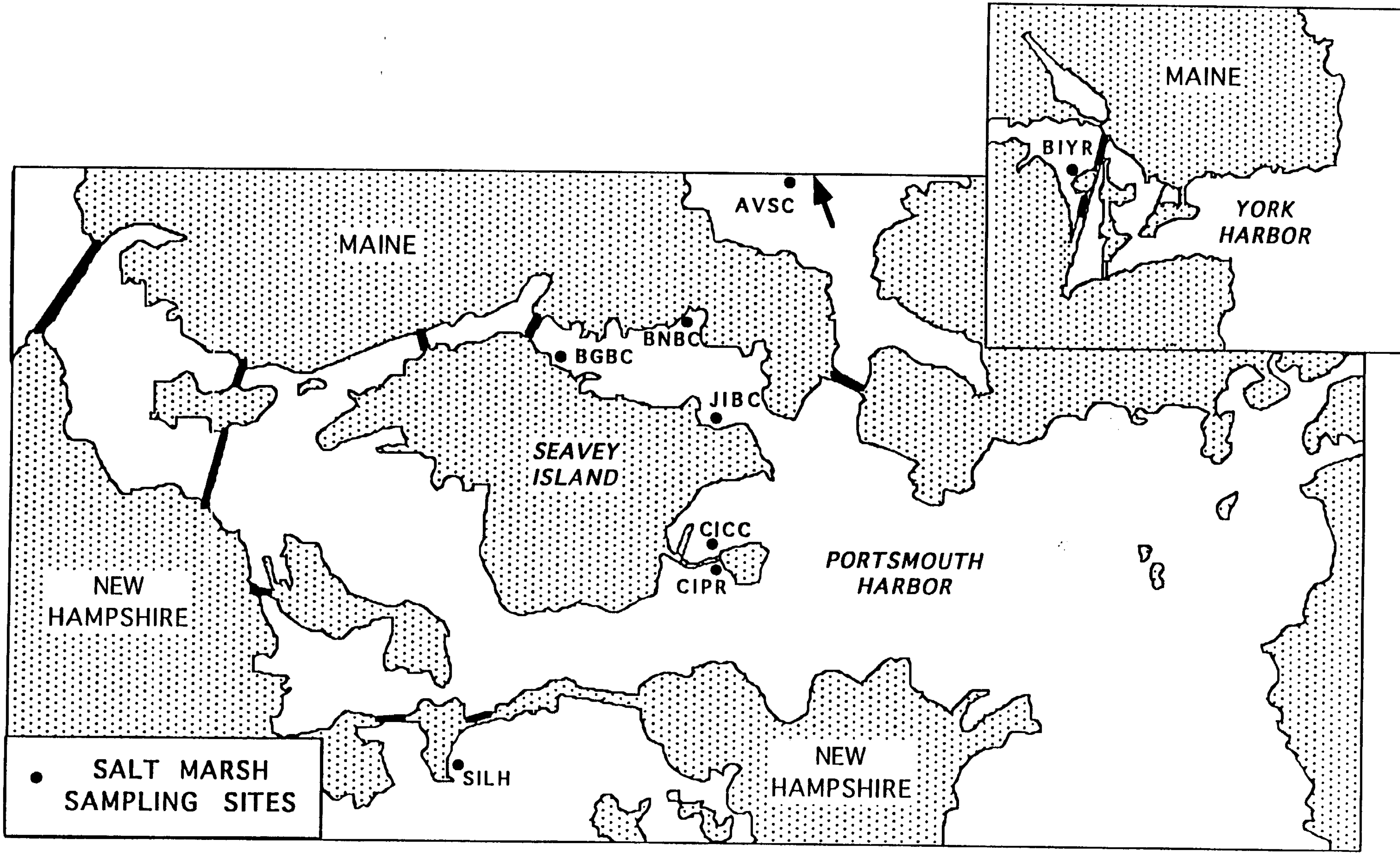



Figure 3.1(C) Salt marsh sample locations. (From Burdick 1994)

50 - CIPR
51 - CICC
52 - JIBC
53 - BGBC
54 - BNBC
55 - SHIM
56 - ADVM
57 - YKRM

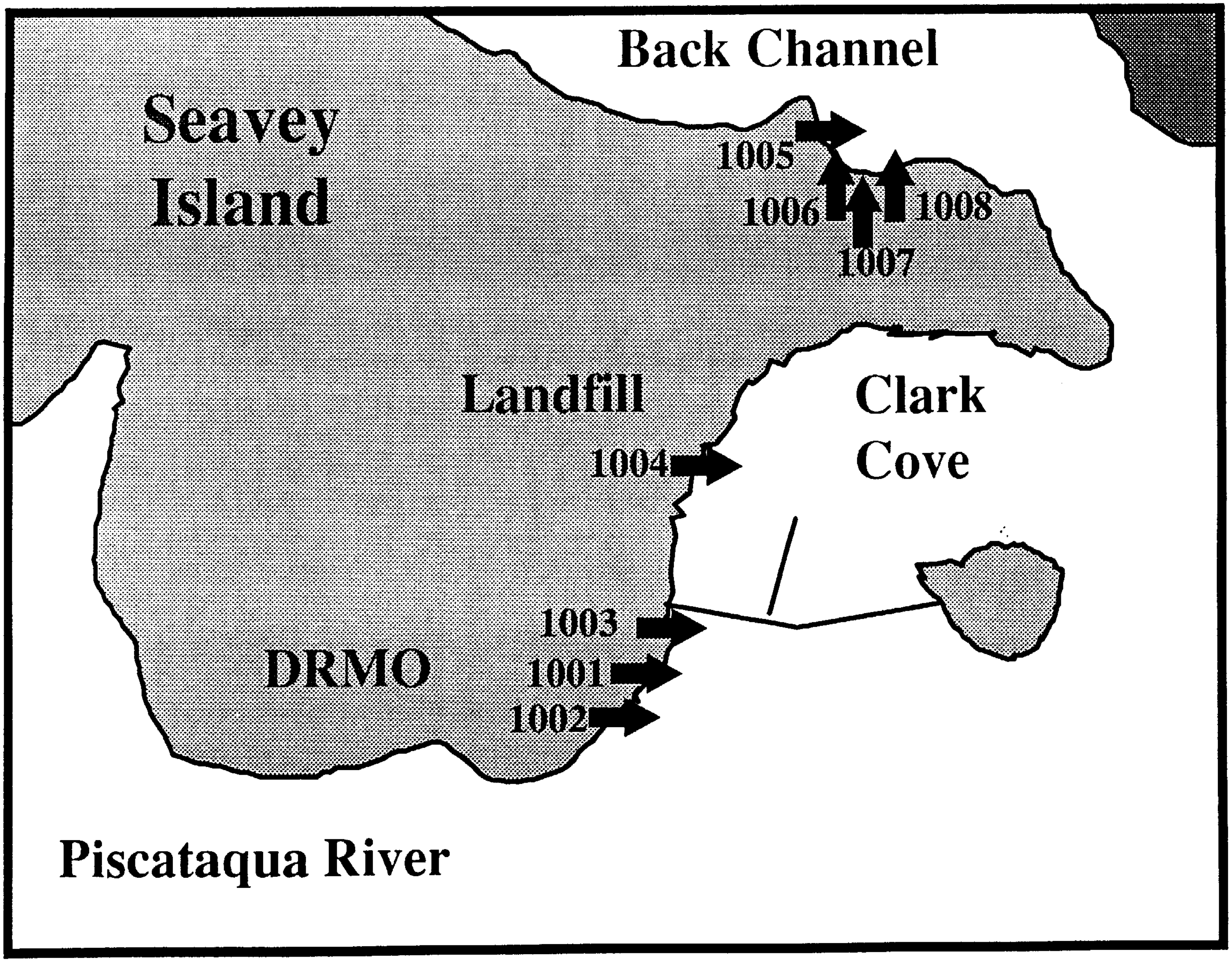



Figure 3.1(D). Station locations of the April 1993 seep samples.

Figure 3.2: A diagram of the screening levels and data requirements used to evaluate surface water chemical concentration levels.

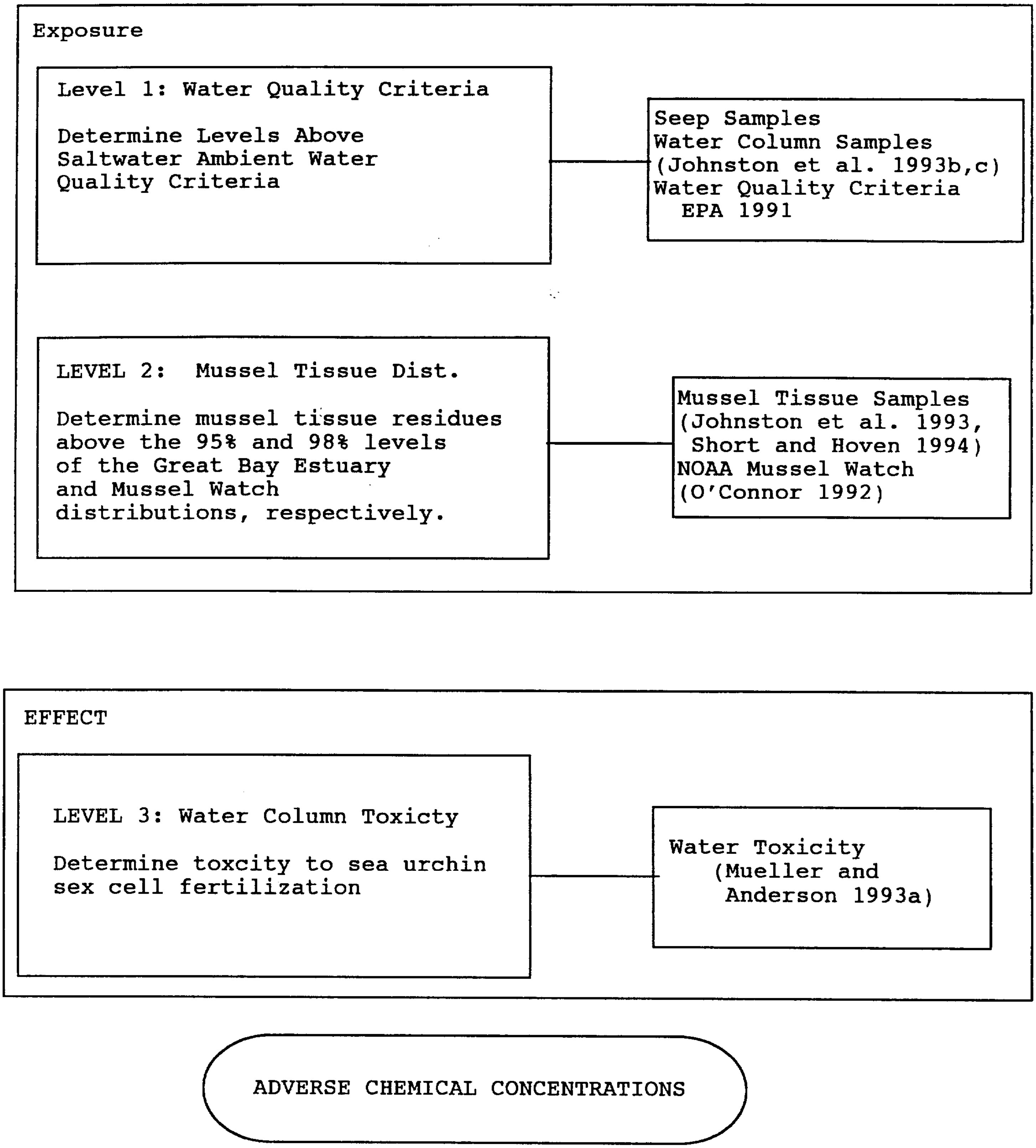


Figure 3.3 Diagram of sediment screening levels and data needs.

| SCREEN | DATA |
|---|---|
| LEVEL 0: Effects Range-Low, -Med<br><br>Determine concentrations above Effects Range-Low and -Med levels. | Sediment Grab Samples<br>Sediment Core Samples<br>(Johnston et al. 1993a, NCCOSC et al. 1994)<br>Effects Range-Low, -Med<br>(Long and Morgan 1990) |
| LEVEL 1: WA State Clean Up Level<br><br>Determine concentrations above Sediment Cleanup Standards developed for the Puget Sound. | Sediment Chemistry<br>Fraction organic carbon (foc)<br>(Ward 1993)<br><br>Sediment Management Stds.<br>(WA. Dept. of Ecology 1991) |
| LEVEL 2: Crustal Ratios<br><br>Determine metal enrichment relative to crustal weathering. | Sediment Metal Chemistry<br>Crustal Ratio Regressions<br>(EMAP 1993, Boothman, In Prep.) |
| LEVEL 3. AVS-Normalization<br><br>Evaluate divalent metal binding capacity of sediments due to acid volatile sulfides (AVS). | Sediment bulk metals<br>SEM/AVS data<br><br>AVS Predicts Acute Toxcity<br>(Di Toro, et al. 1992) |
| LEVEL 4. Equilibrium Partitioning<br><br>Calculate pore water toxic units using EP procedures and Water Quality Criteria protection levels. | Sediment Chemistry<br>Organic Carbon<br><br>Tech. Basis for EP<br>(Di Toro et al. 1991) |

| | |
|---|---|
| LEVEL 5. Amphipod Toxicity<br><br>Determine toxicity to amphipod survival. | Sediment Toxicity<br>(Mueller and Anderson 1993b) |
| LEVEL 6. Benthic Community<br><br>Evaluate anomalies in benthic community composition. | Benthic Infauna<br>(Shipman 1993) |

ADVERSE CHEMICAL CONCENTRATIONS

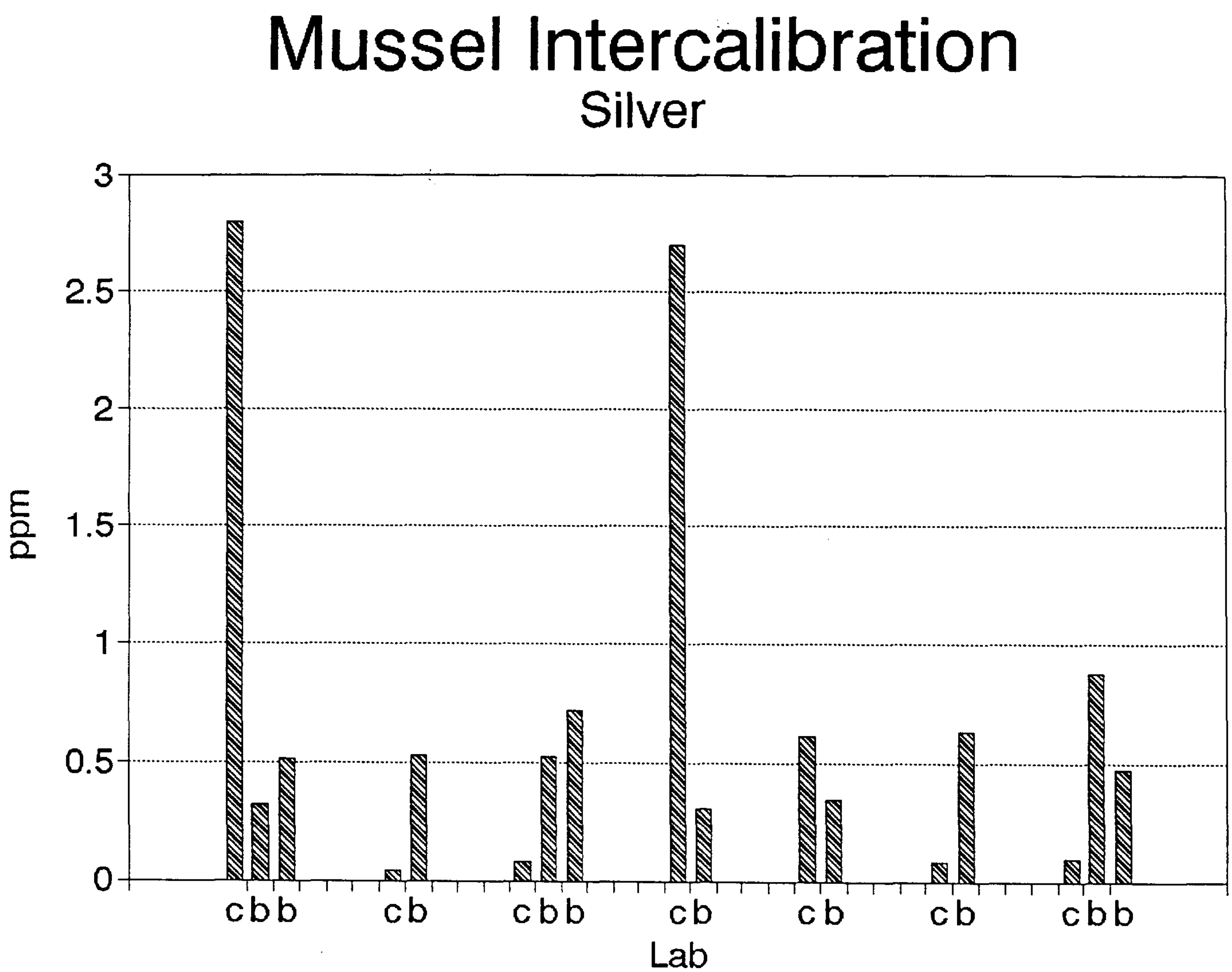



FIGURE 3.4 Silver interlaboratory calibration for mussel tissue samples.

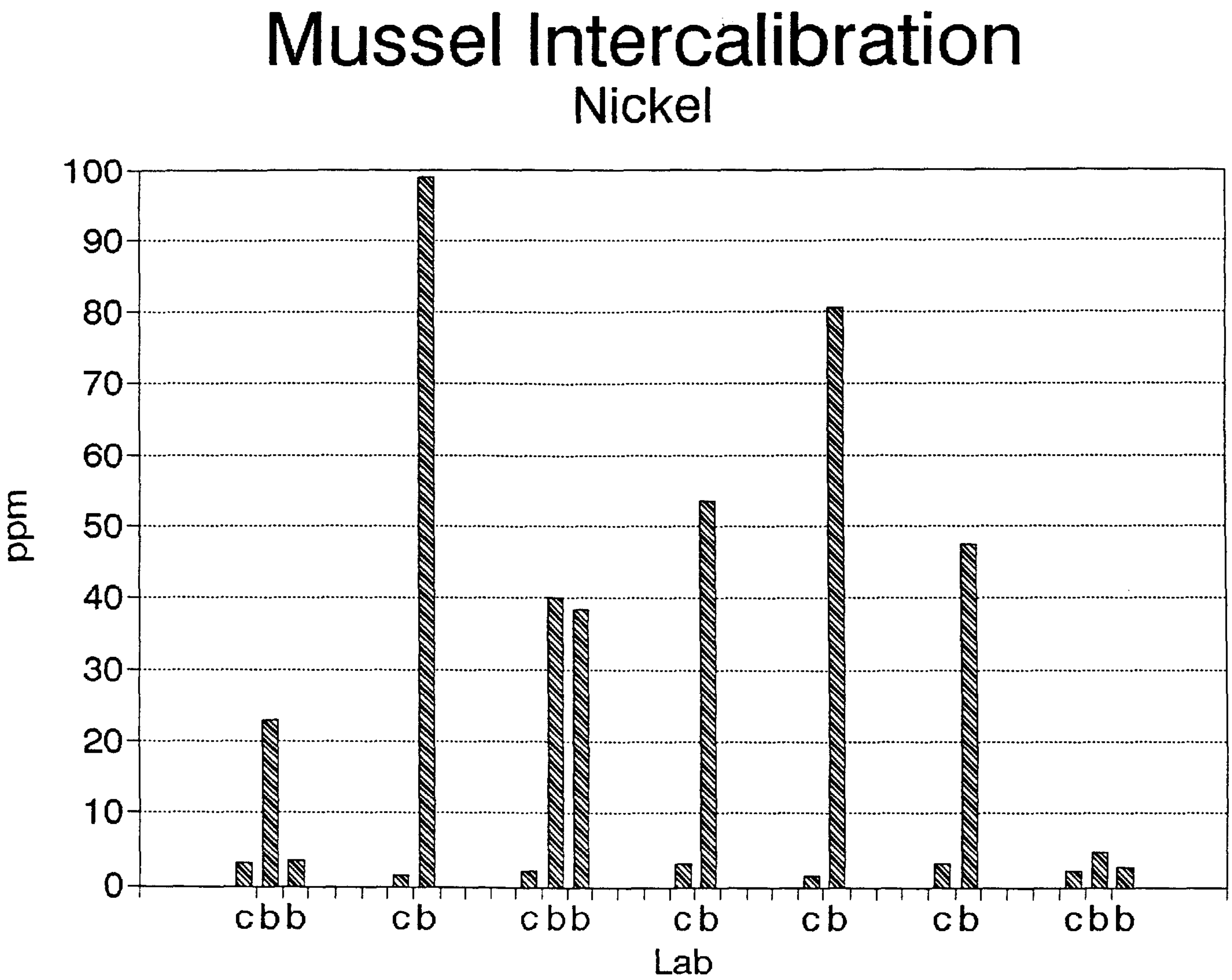



FIGURE 3.5(A) Nickel interlaboratory calibration for mussel tissue samples.

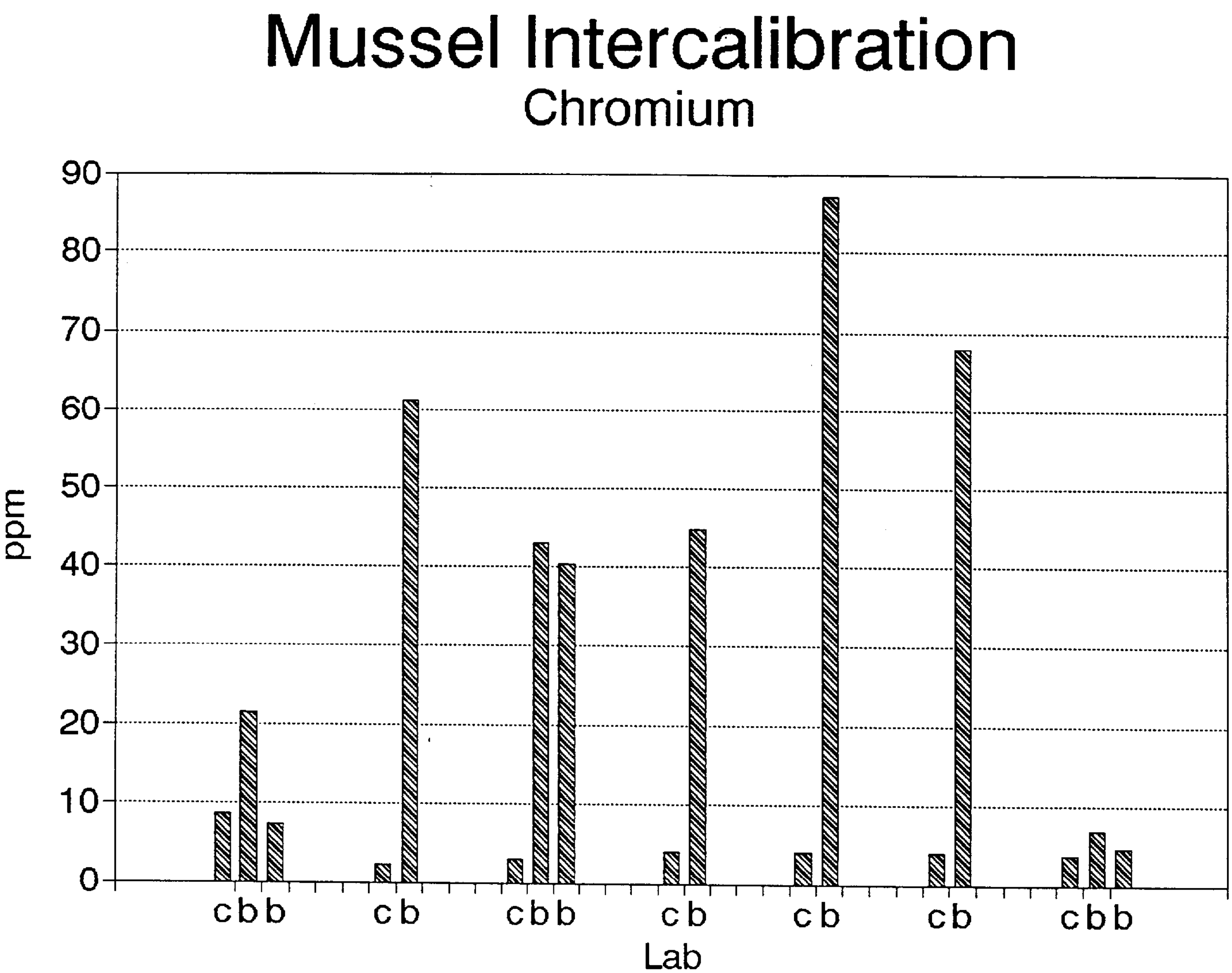


FIGURE 3.5(B) Chromium interlaboratory calibration for mussel tissue samples.

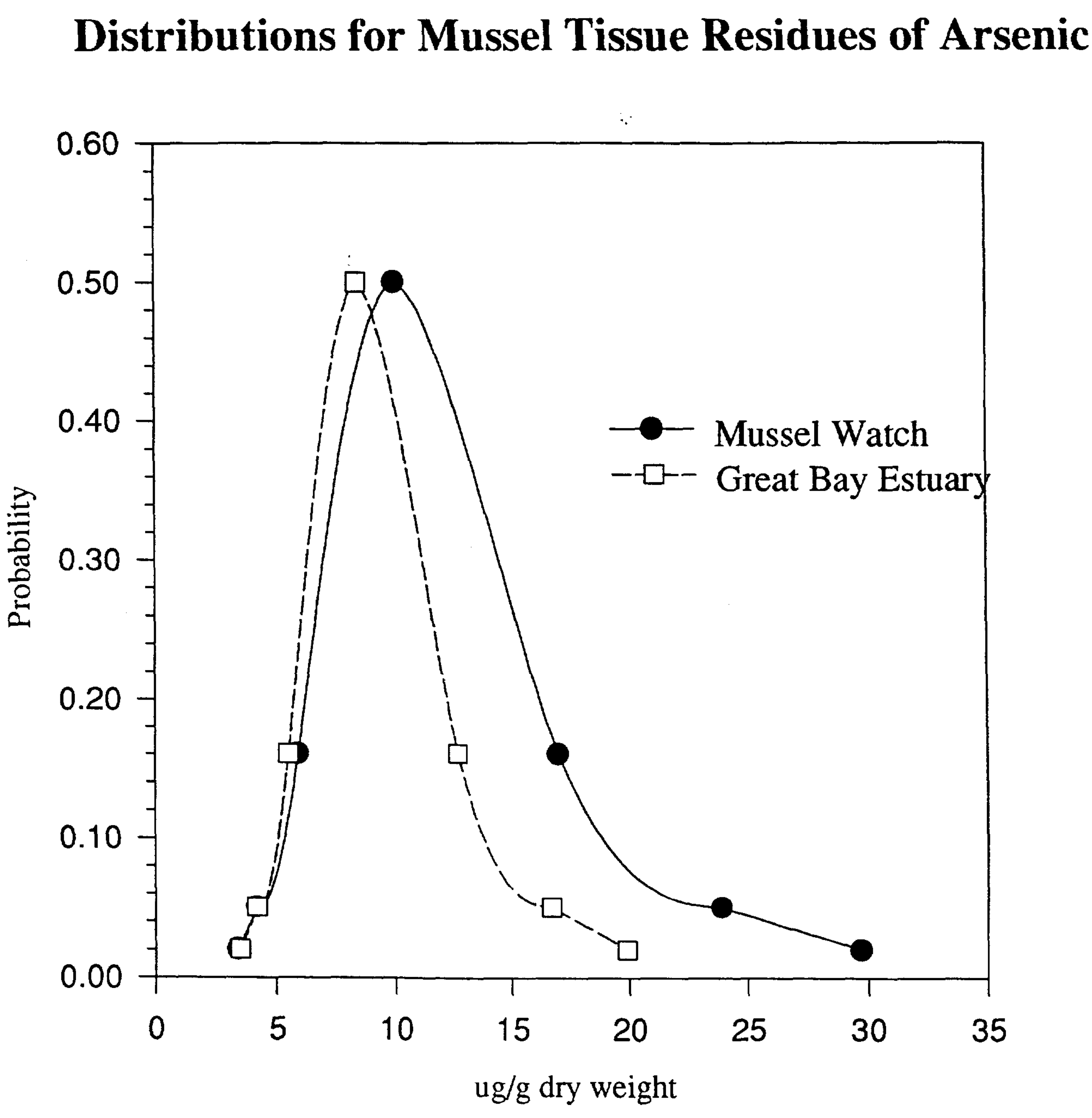



FIGURE 3.6(A) Proability distribution for mussel tissue concentrations of Arsenic.

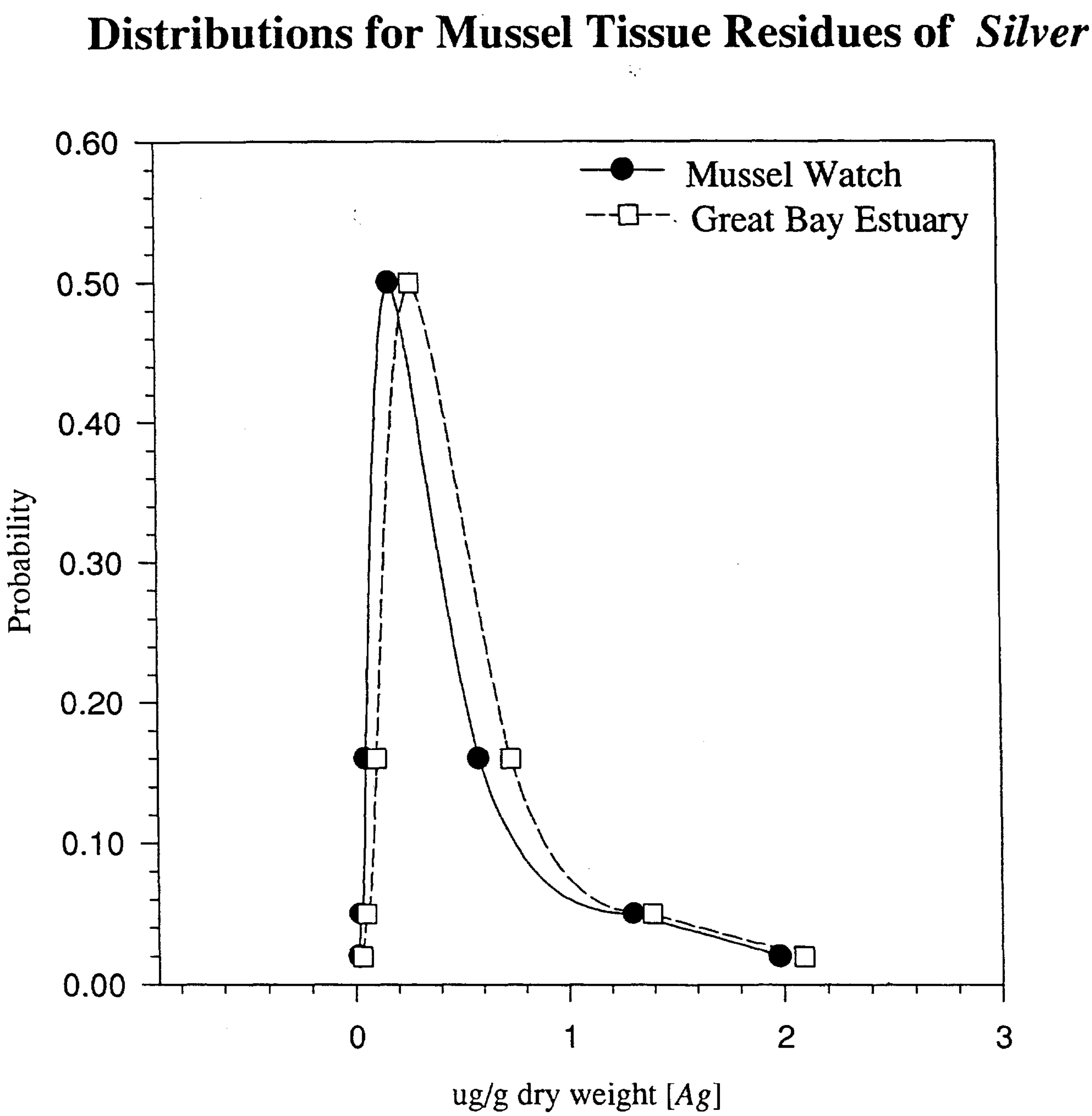



FIGURE 3.6(B) Probability distribution for mussel tissue concentrations of Silver.

# Distributions for Mussel Tissue Residues of Chromium

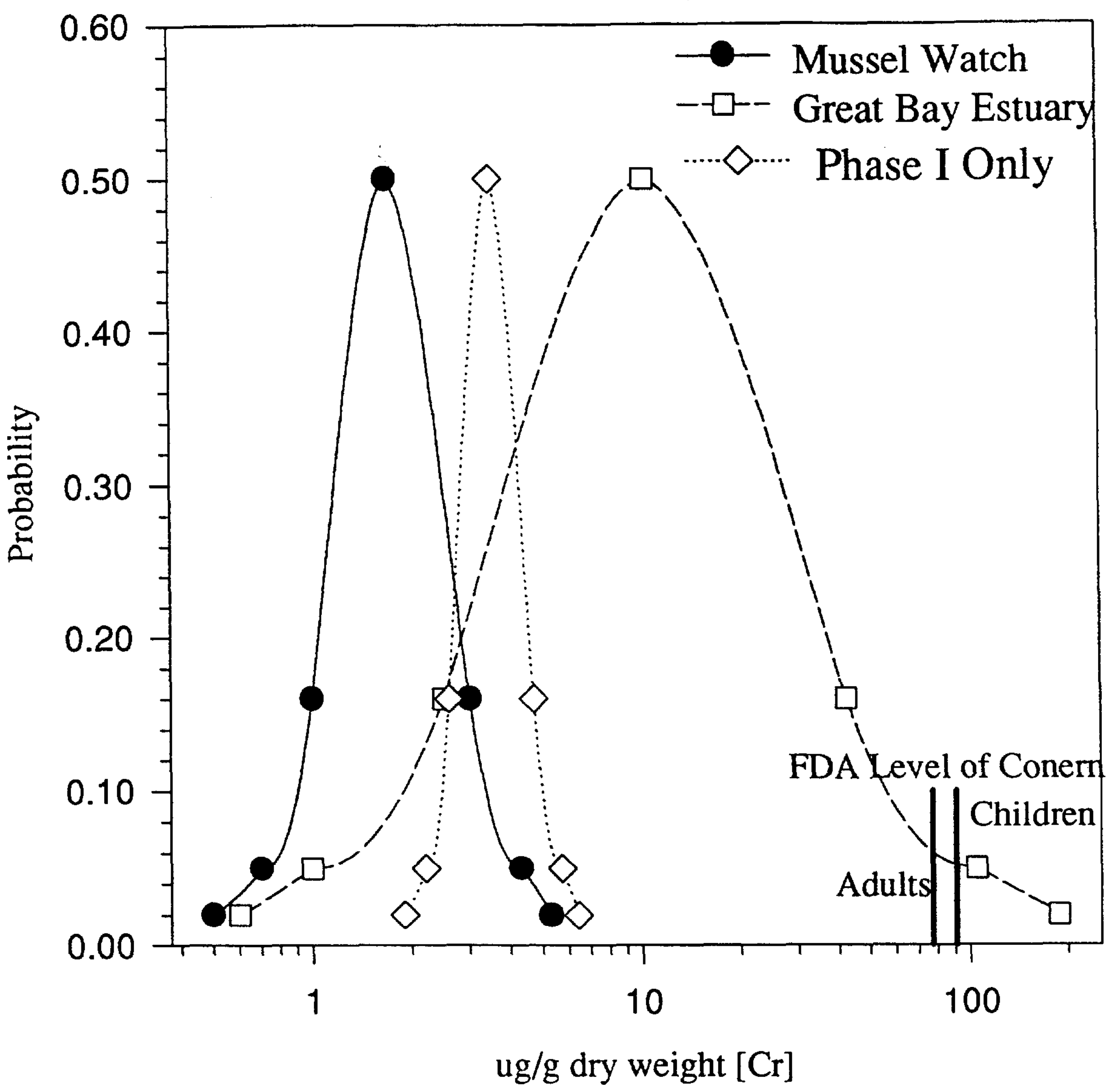



FIGURE 3.6(C) Probability distribution for chromium.

## Distributions for Mussel Tissue Residues of Nickel

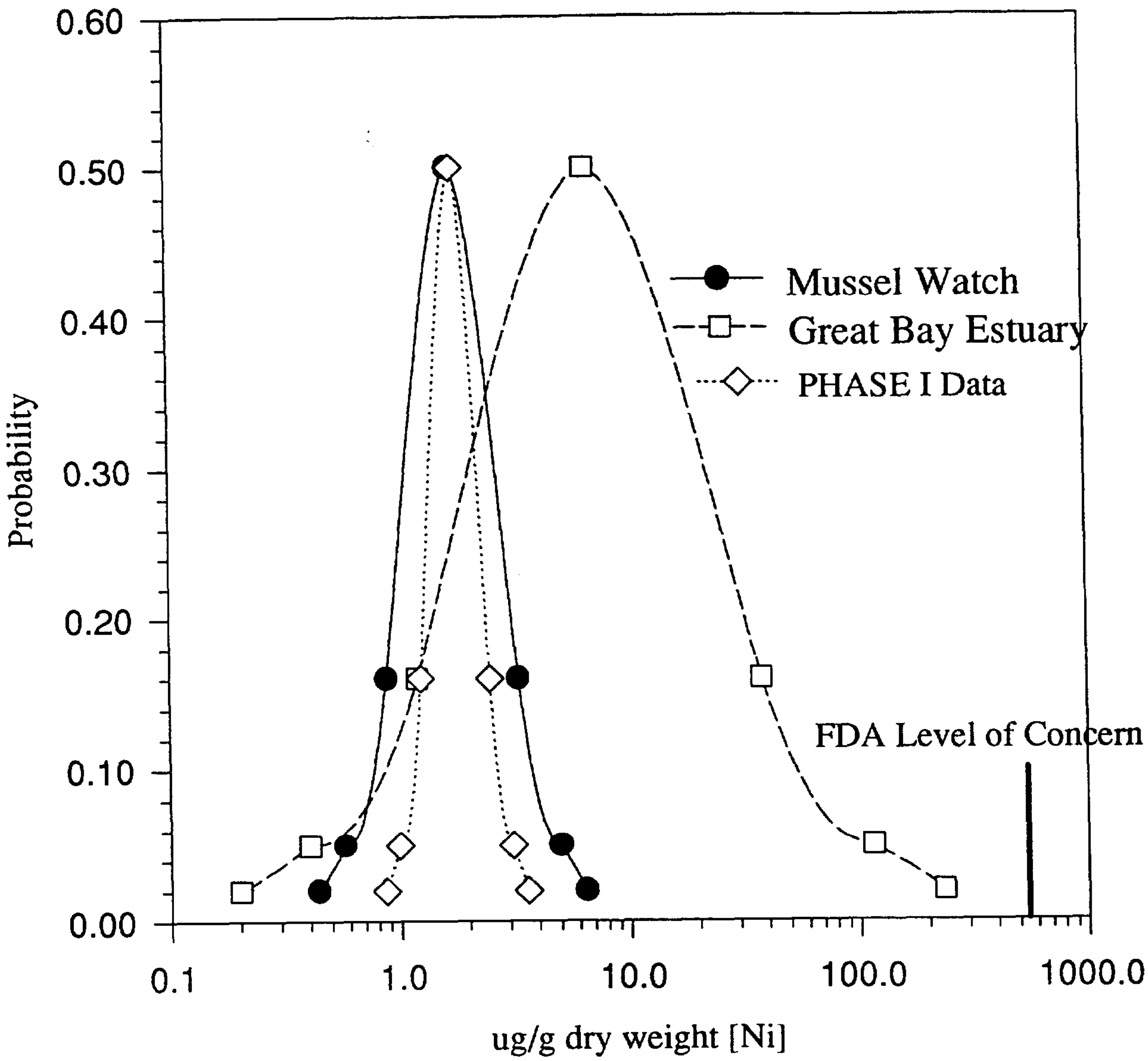



FIGURE 3.6(D) Probability distribution for nickel.

# Distributions for Mussel Tissue Residues of Lead

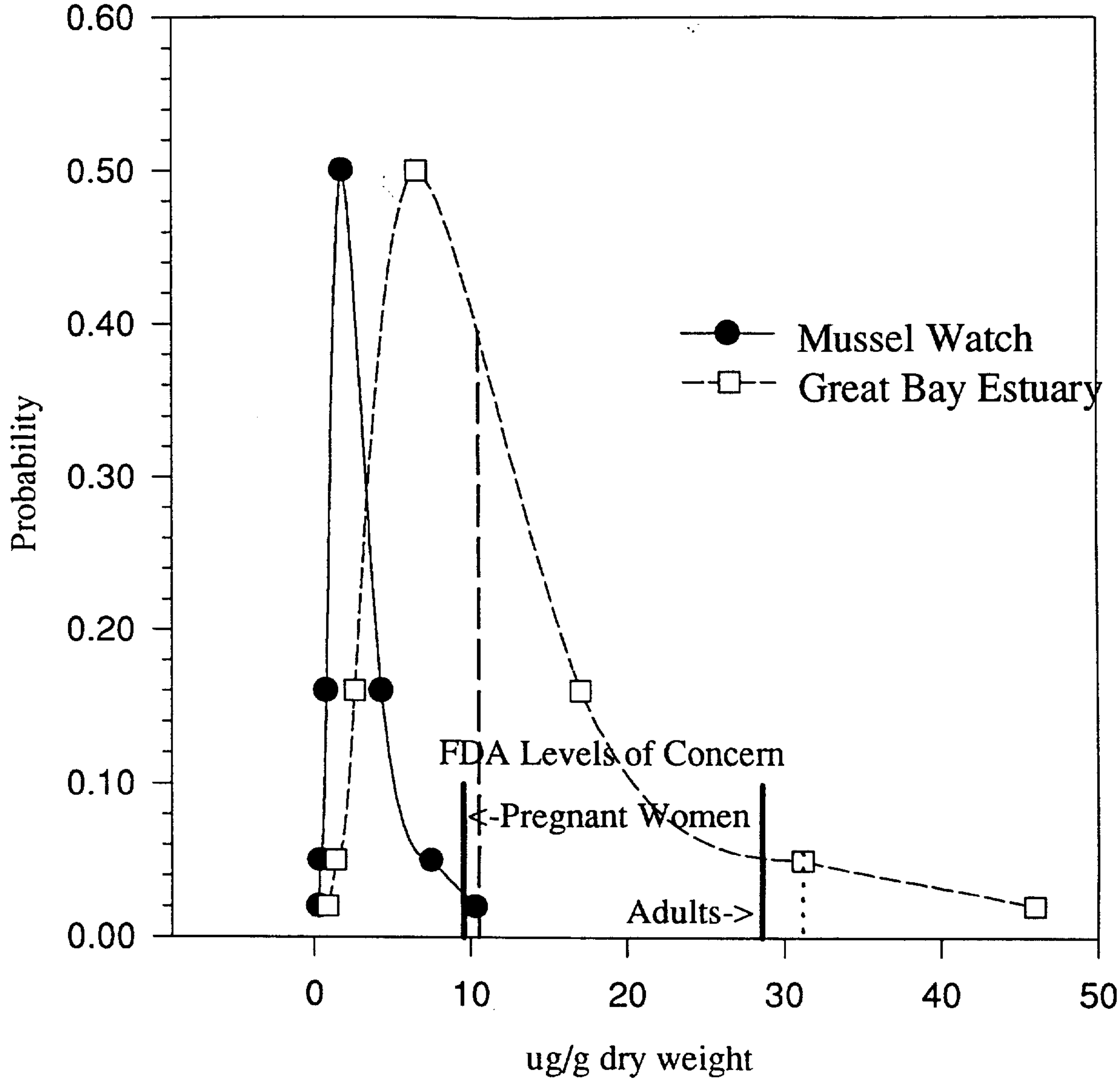



FIGURE 3.6(E) Probability distribution for lead.

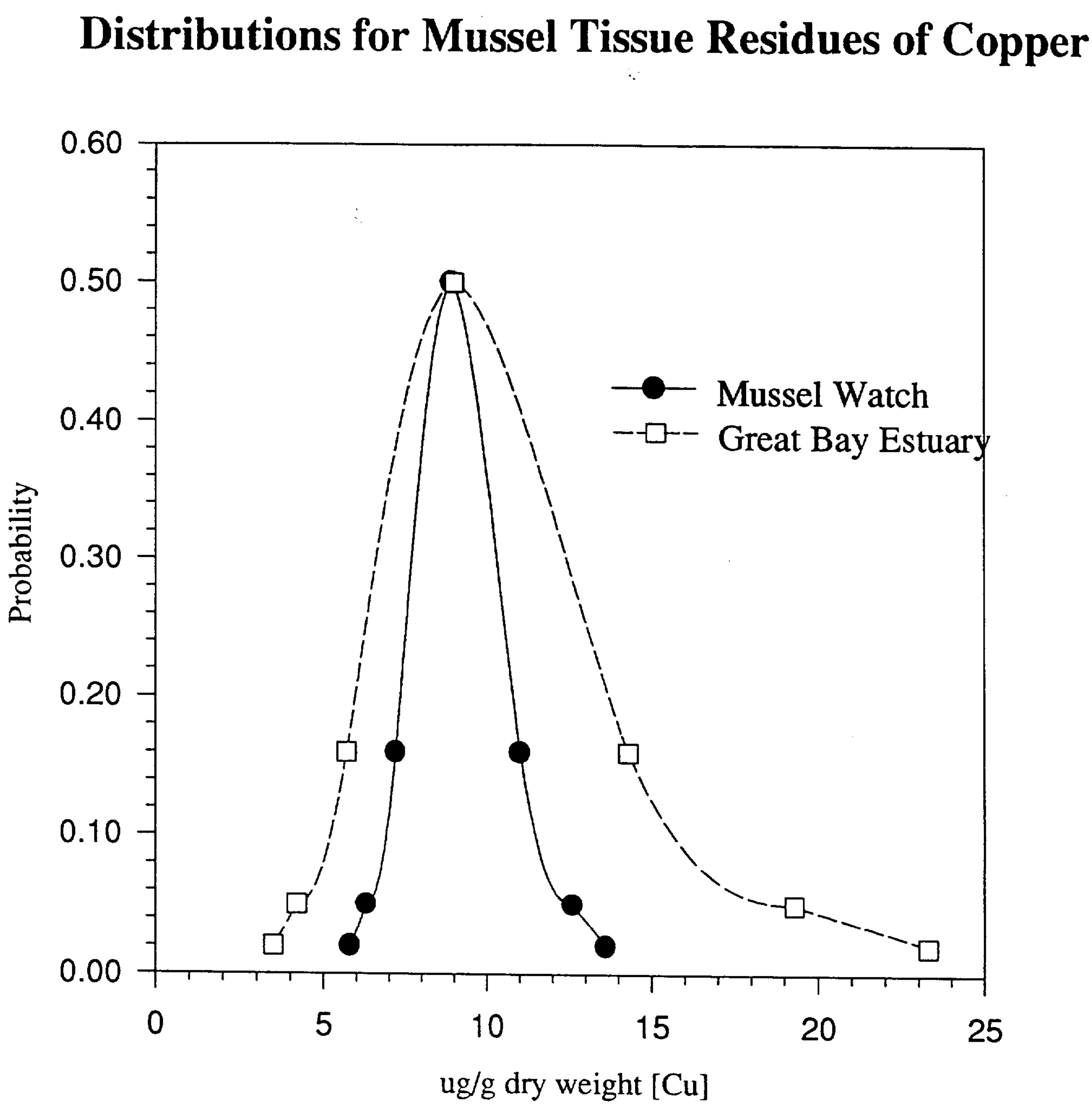



FIGURE 3.6(G) Probability distribution for Copper.

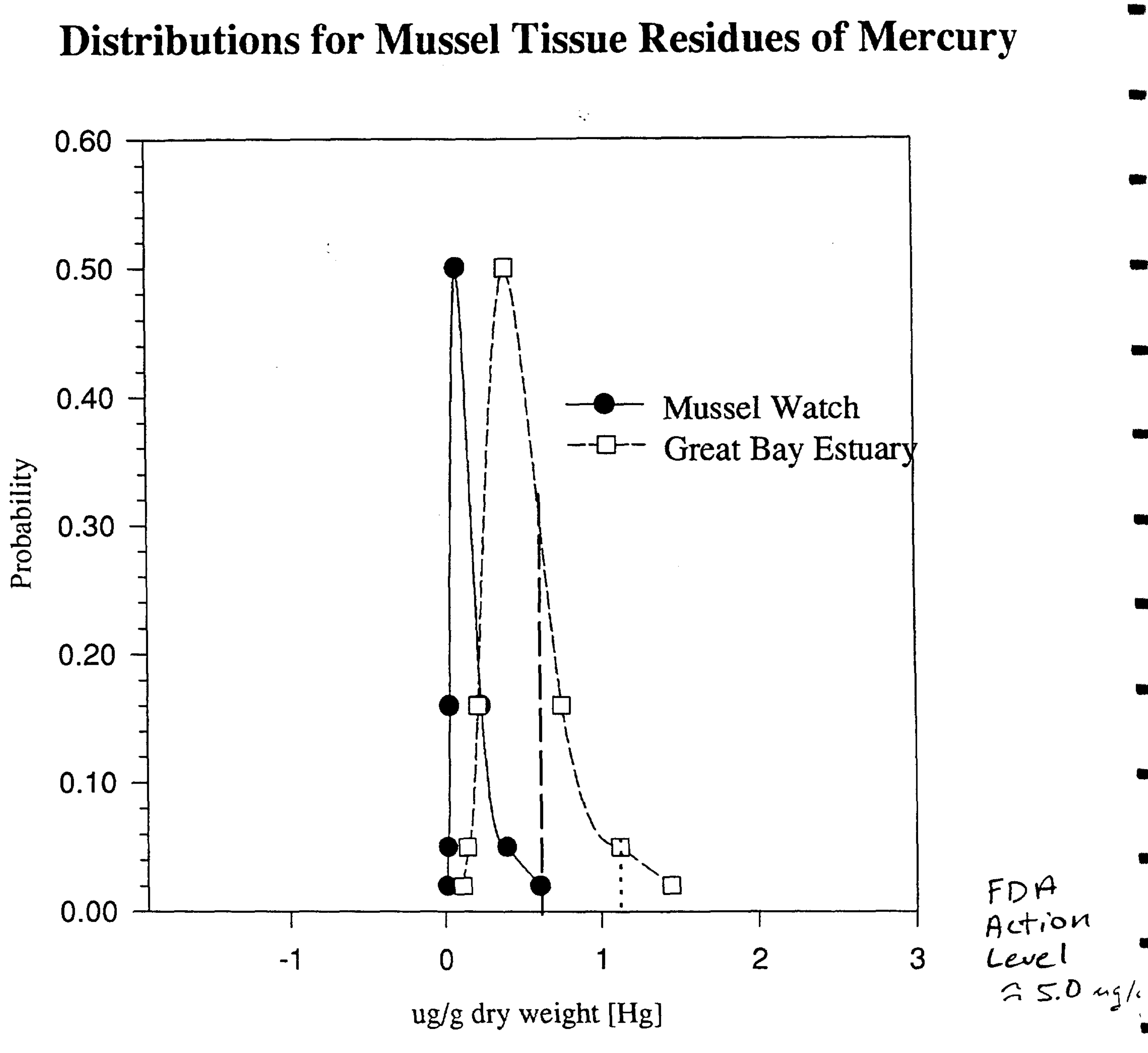



FIGURE 3.6(F) Probability distribution for Mercury.

# Distributions for Mussel Tissue Residues of *sumPAH*

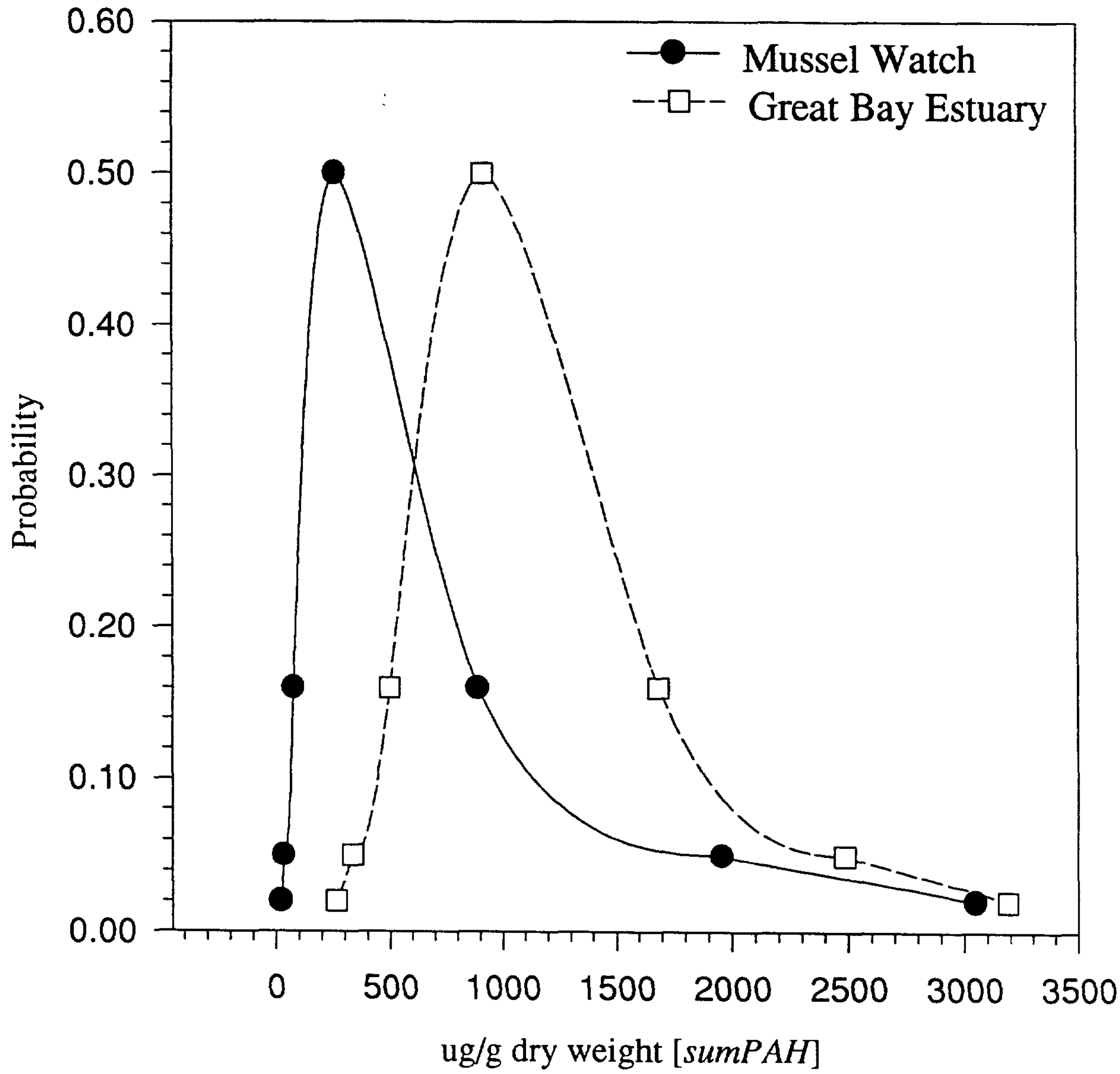



FIGURE 3.6(G) Probability distribution for sumPAH.

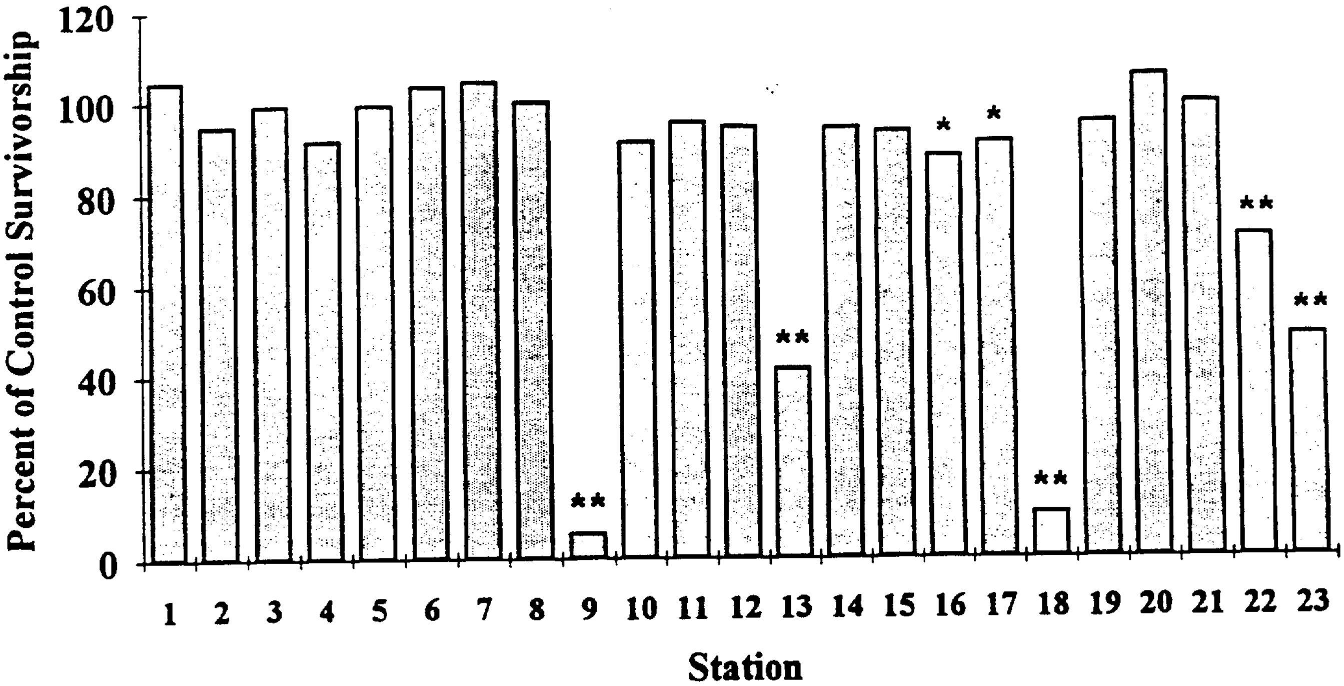



Figure 3.7 Amphipod toxicity (Please see figure 1 of Section 3.2 in Estuarine Ecological Risk Assessment Case Study for Portsmouth Naval Shipyard: Phase I Draft Final Report, Mueller and Anderson 1993b.

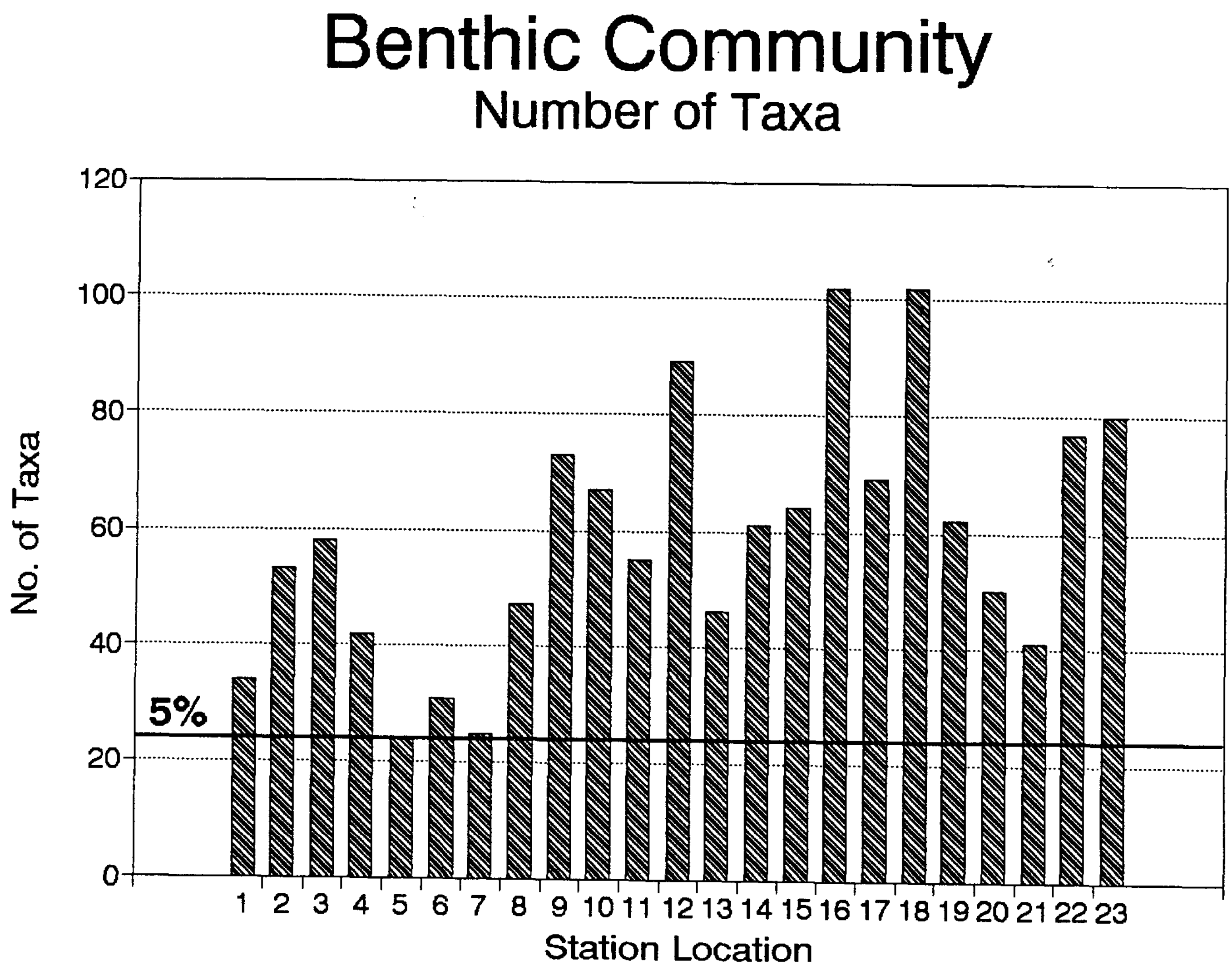



Figure 3.8 Number of taxa per station and 5th percentile level.

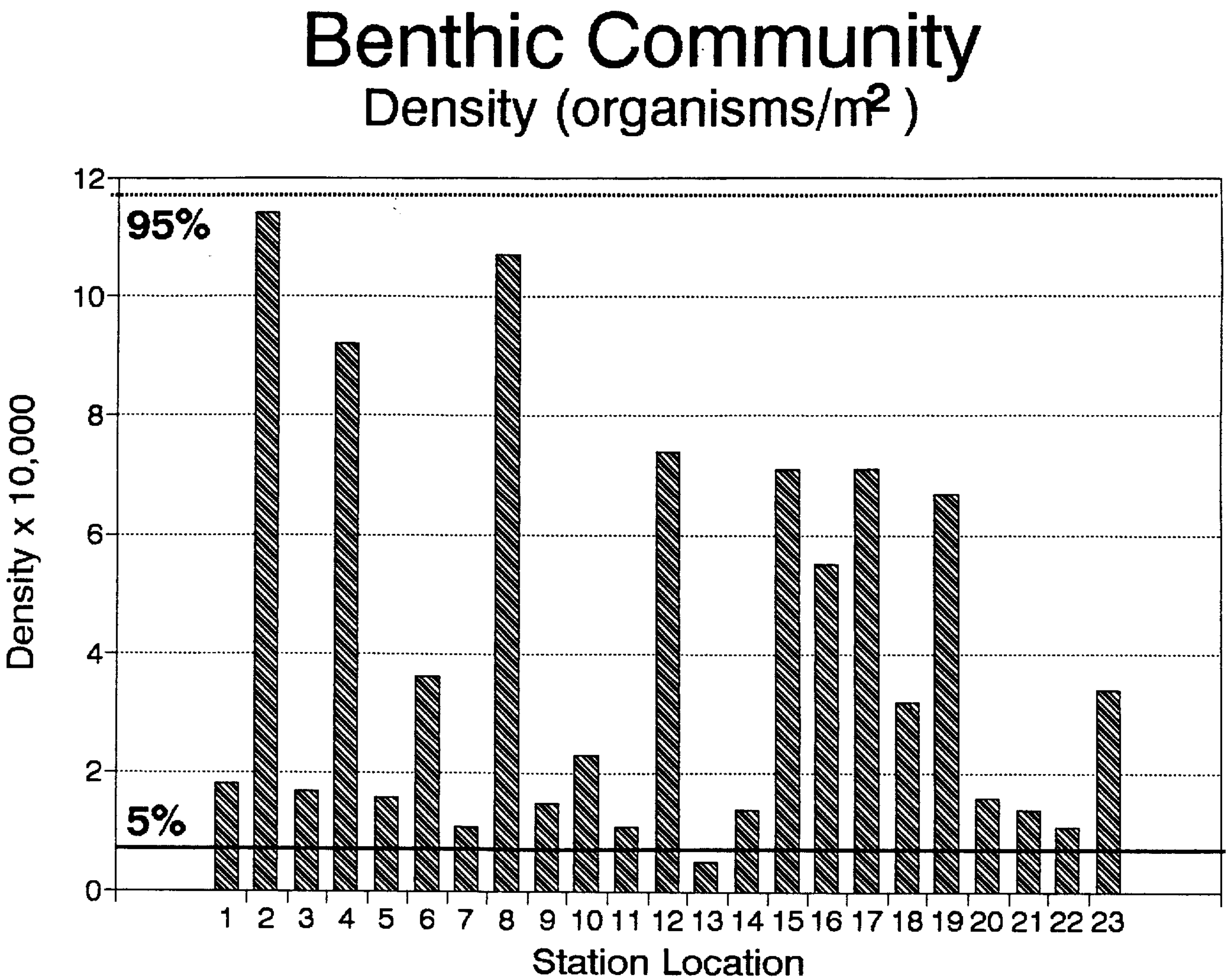



Figure 3.9 Benthic infauna and the 5th and 95th percentile levels.

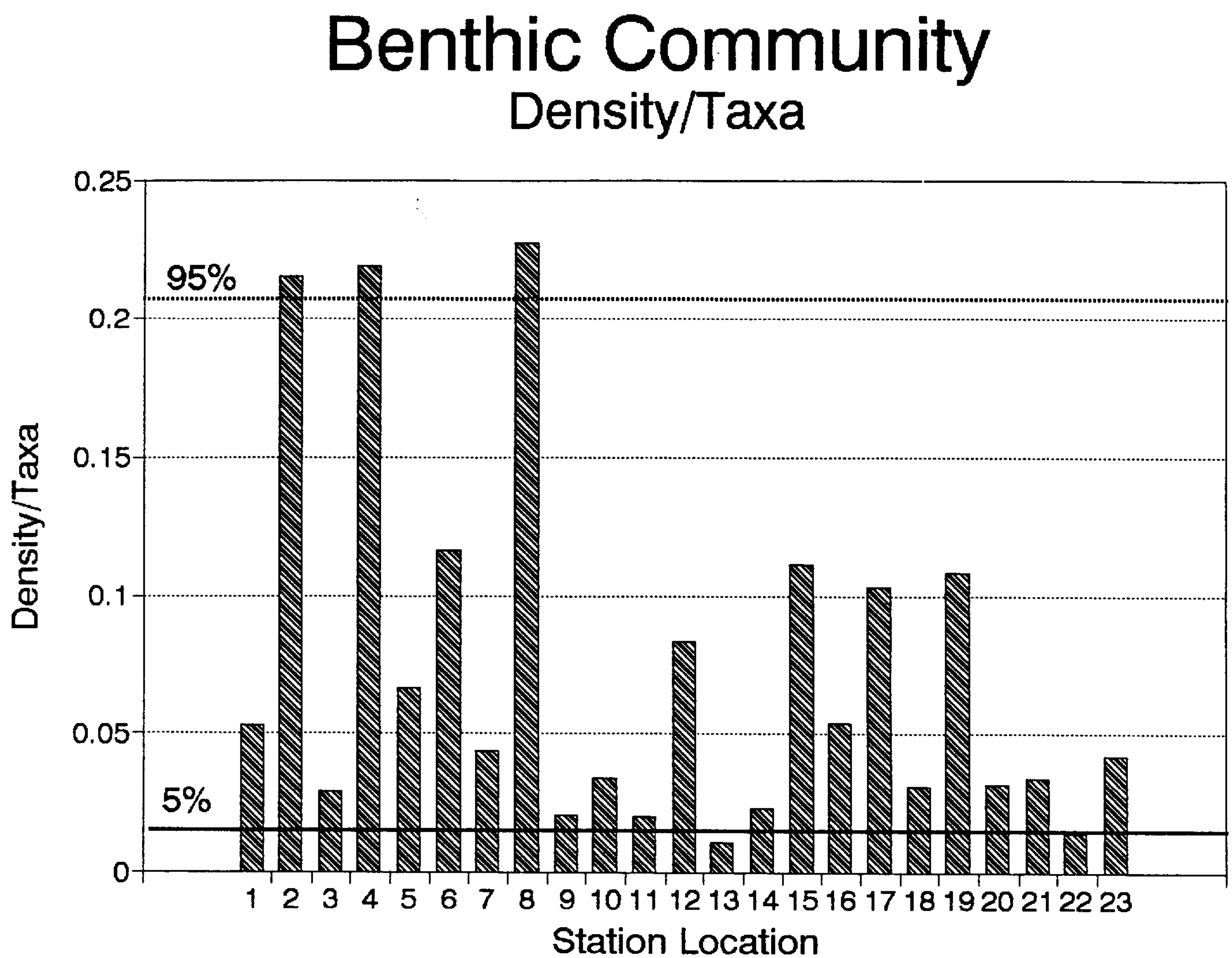



Figure 3.10 Density per unit taxa and 5th and 95th percentile levels.

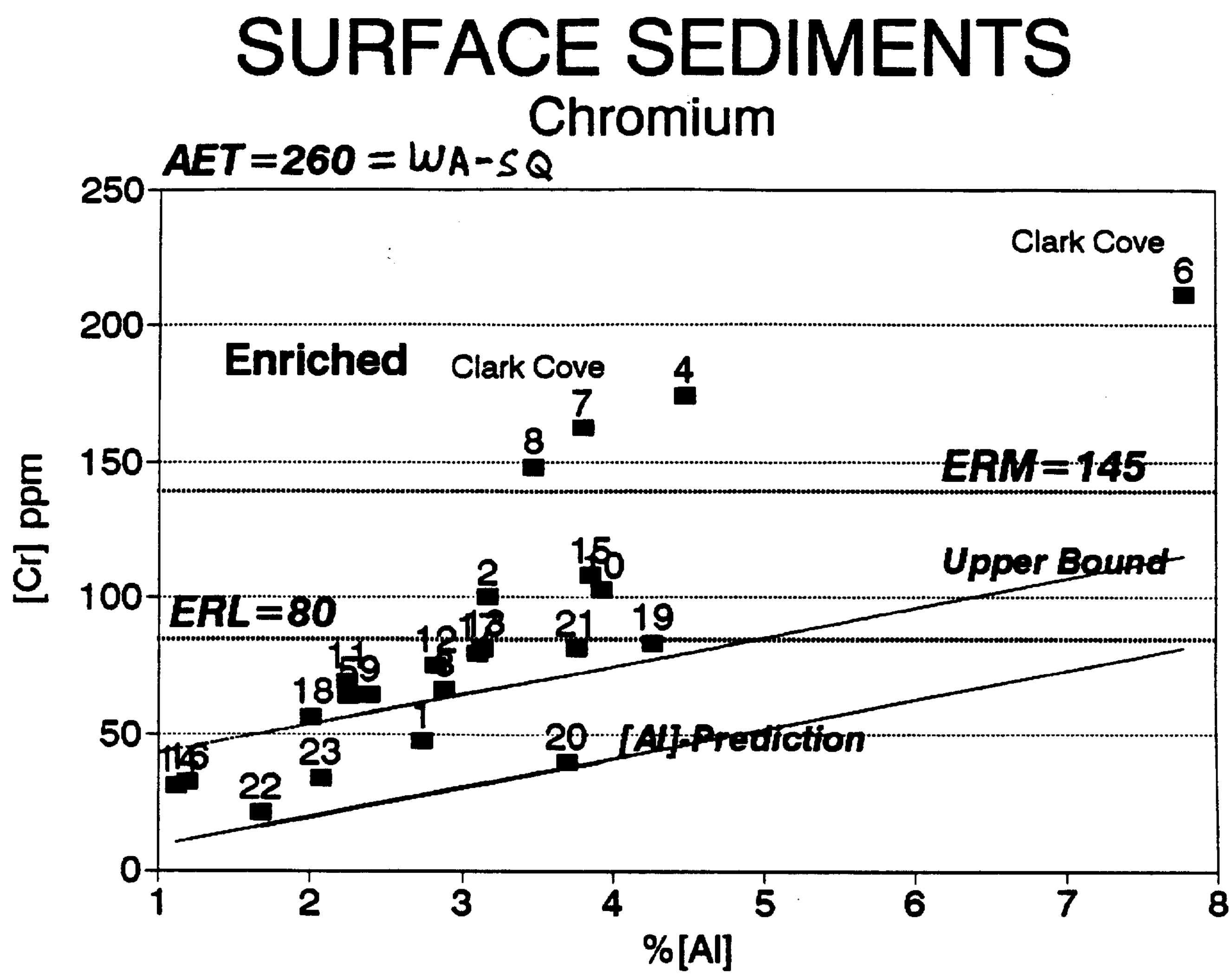



Figure 3.11 Scatter plot of Cr (ug/g) and %Al measured in sediment samples from the Lower Piscataqua River estuary.

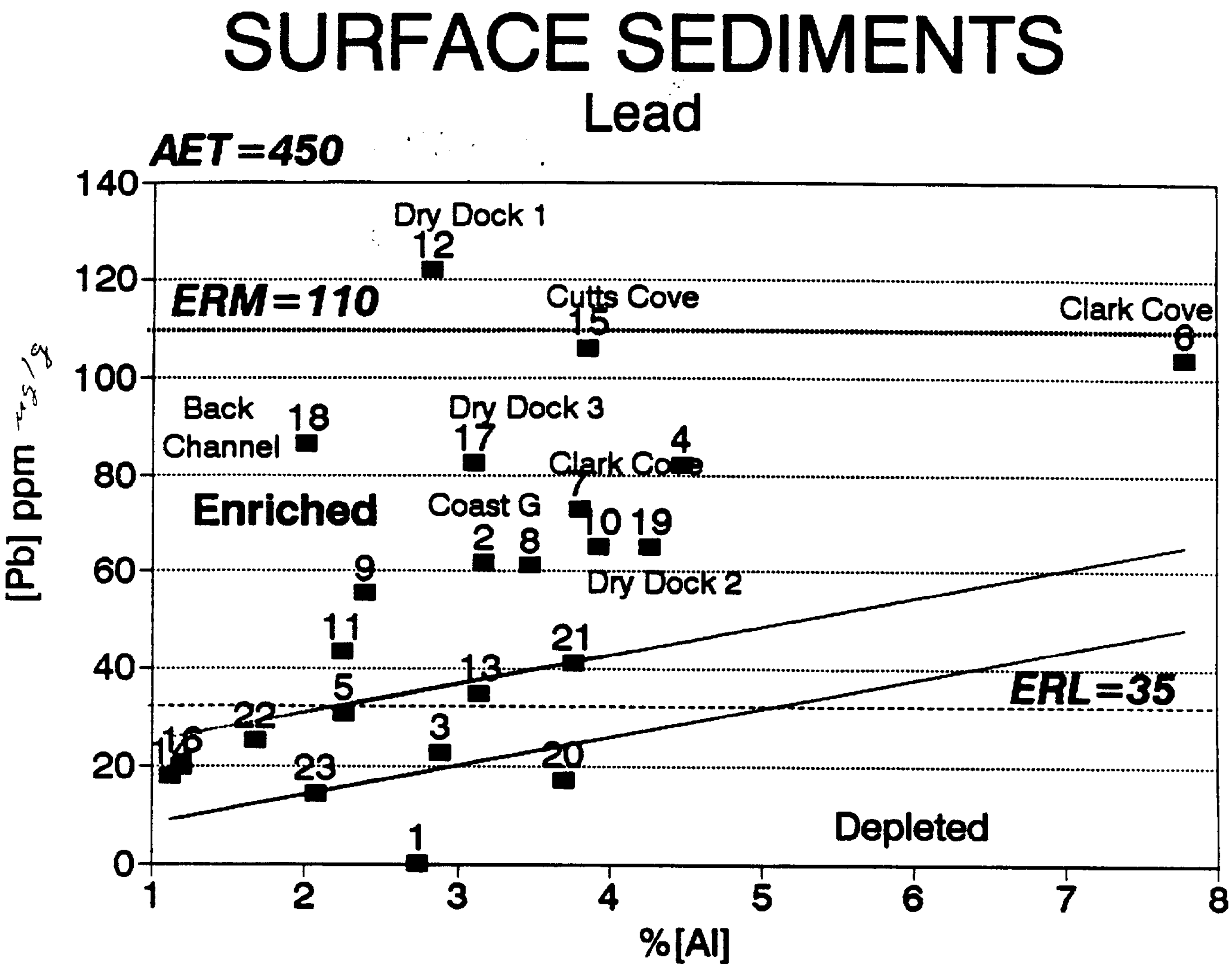



Figure 3.12 Scatter plot of Pb (ug/g) and %Al measured in sediment samples from the Lower Piscataqua River estuary.

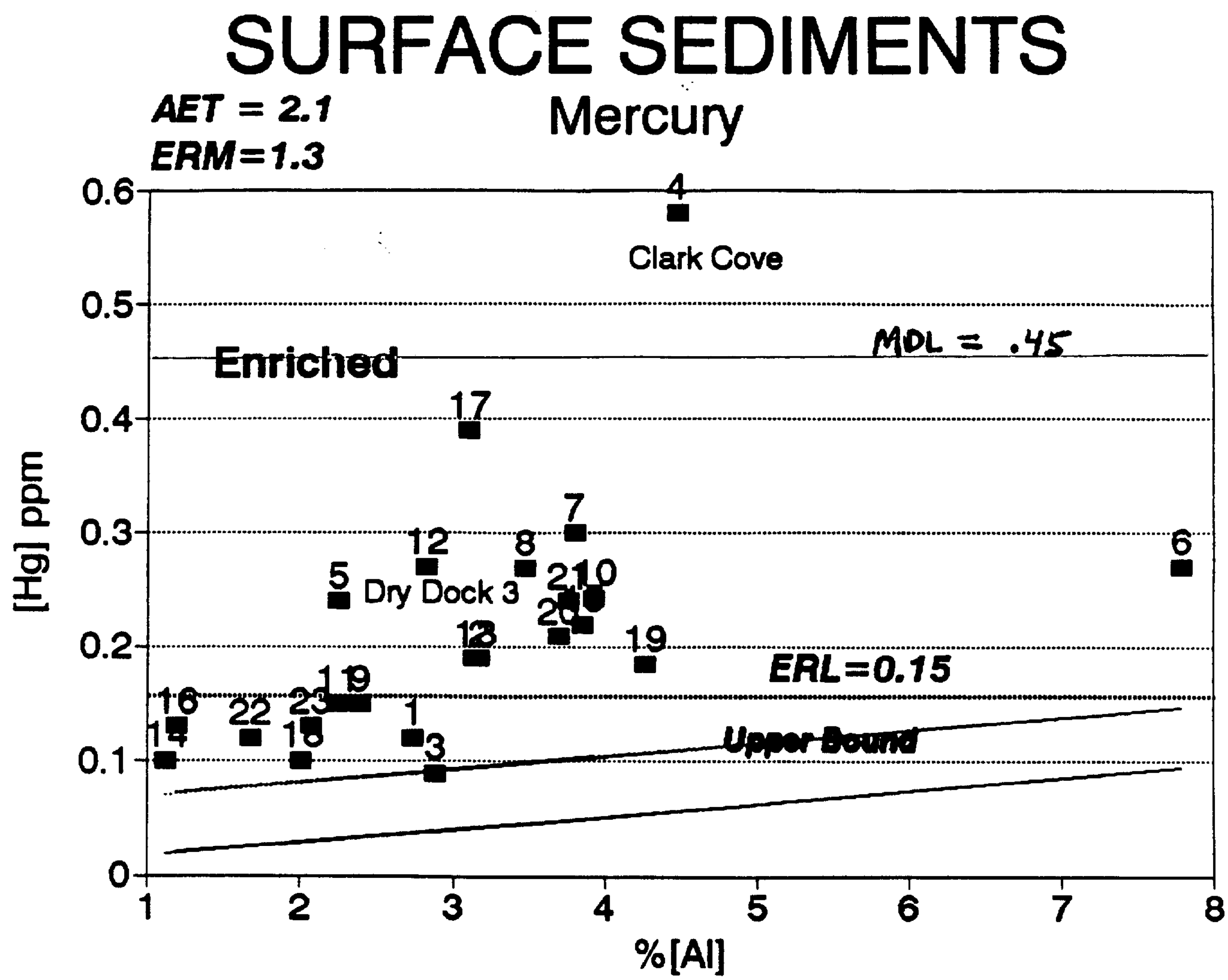



Figure 3.13 Scatter plot of Hg (ug/g) and %Al measured in sediment samples from the Lower Piscataqua River estuary.

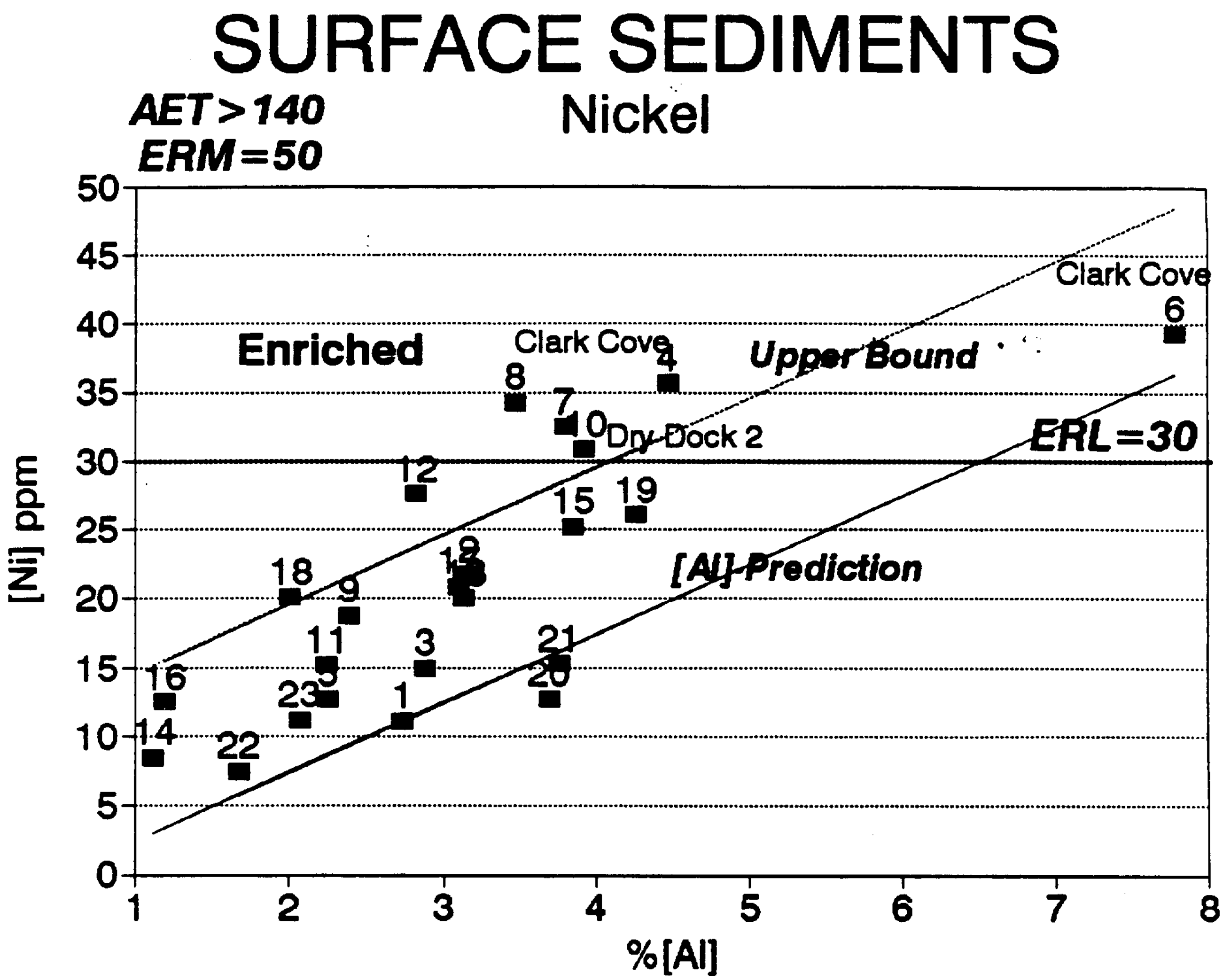



Figure 3.14 Scatter plot of Ni (ug/g) and %Al measured in sediment samples from the Lower Piscataqua River estuary.

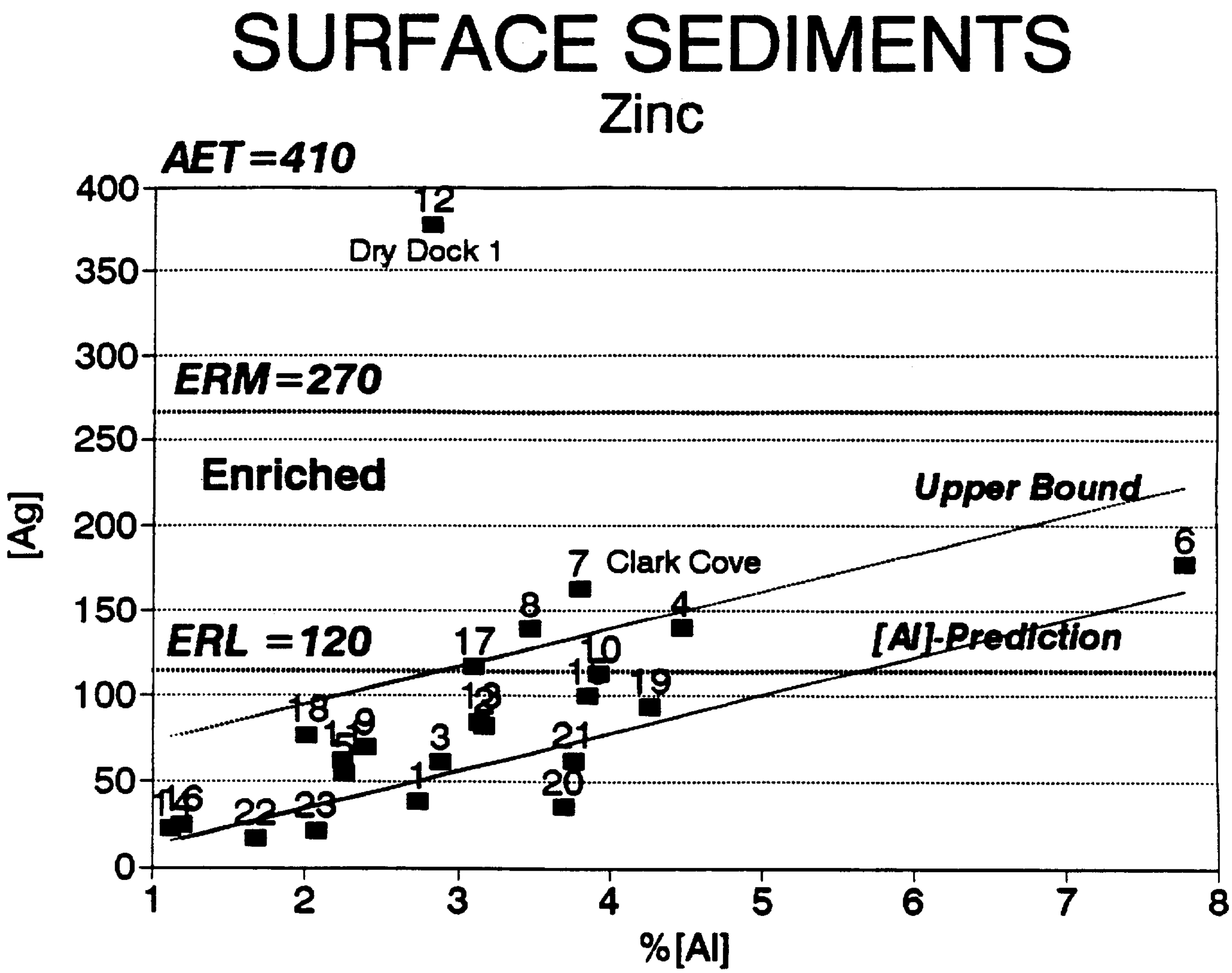



Figure 3.15 Scatter plot of Zn (ug/g) and %Al measured in sediment samples from the Lower Piscataqua River estuary.

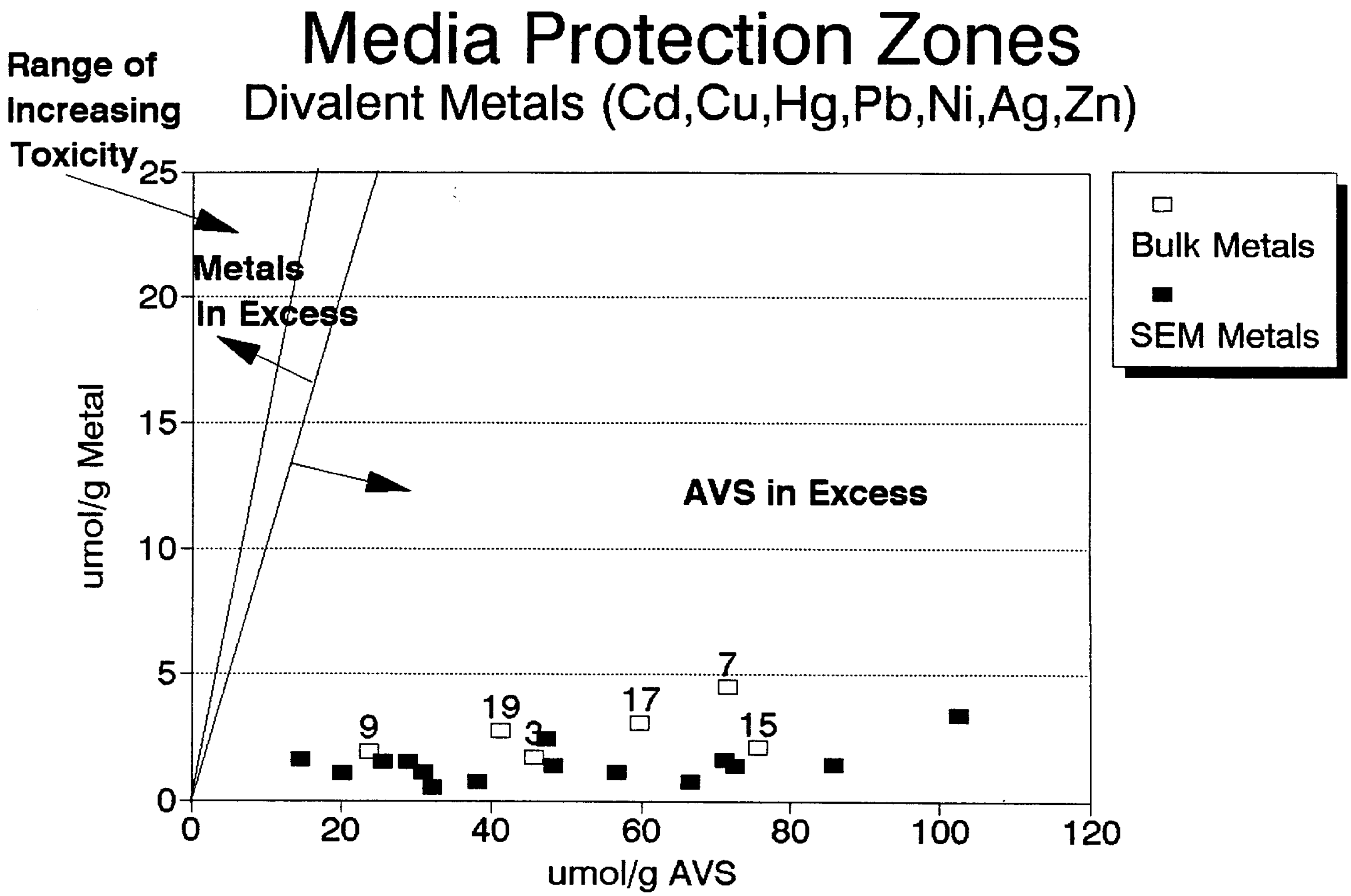



FIGURE 3.16 Media protection zones for divalent metals.

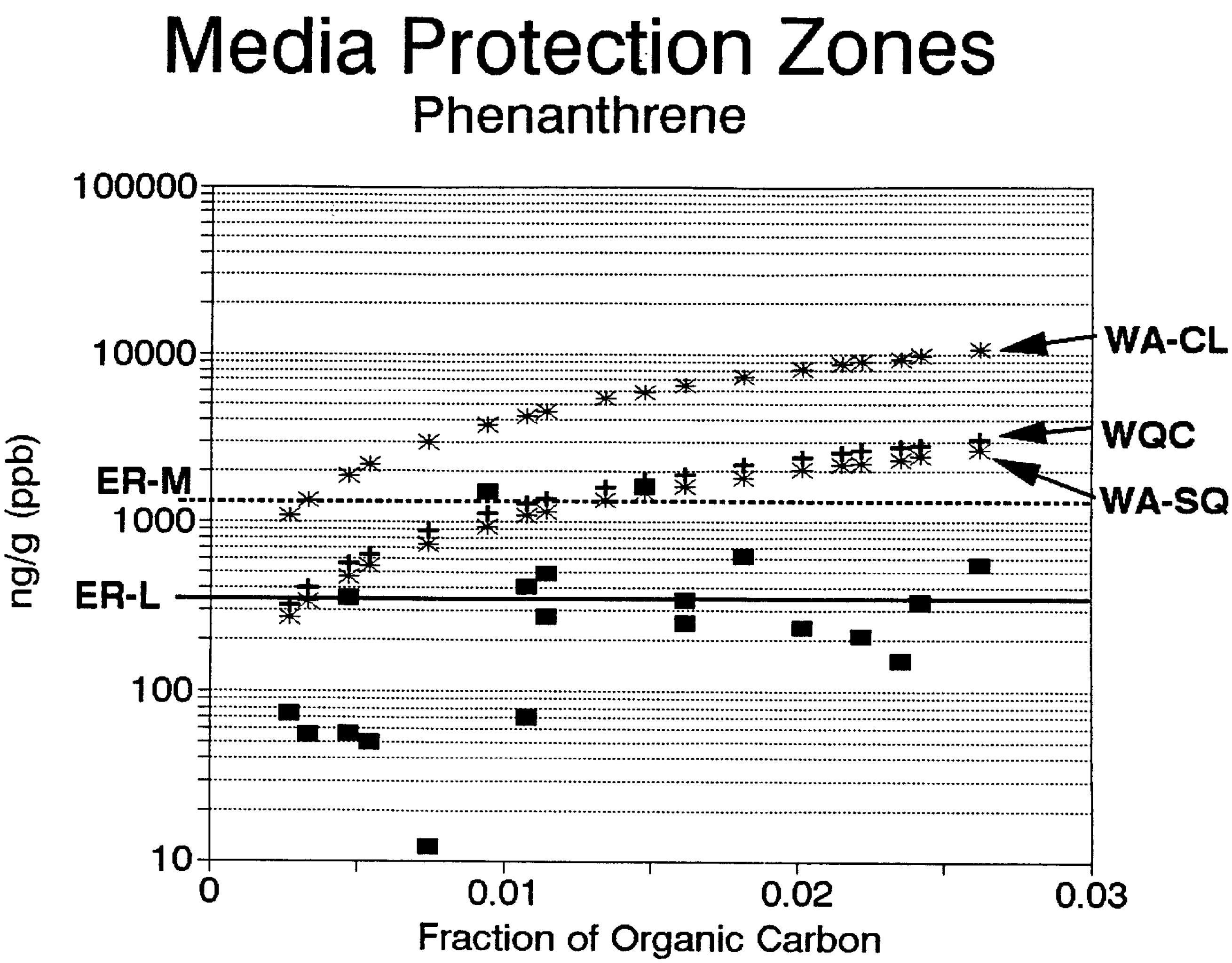



Figure 3.17 Media protection zones for phenanthrene.

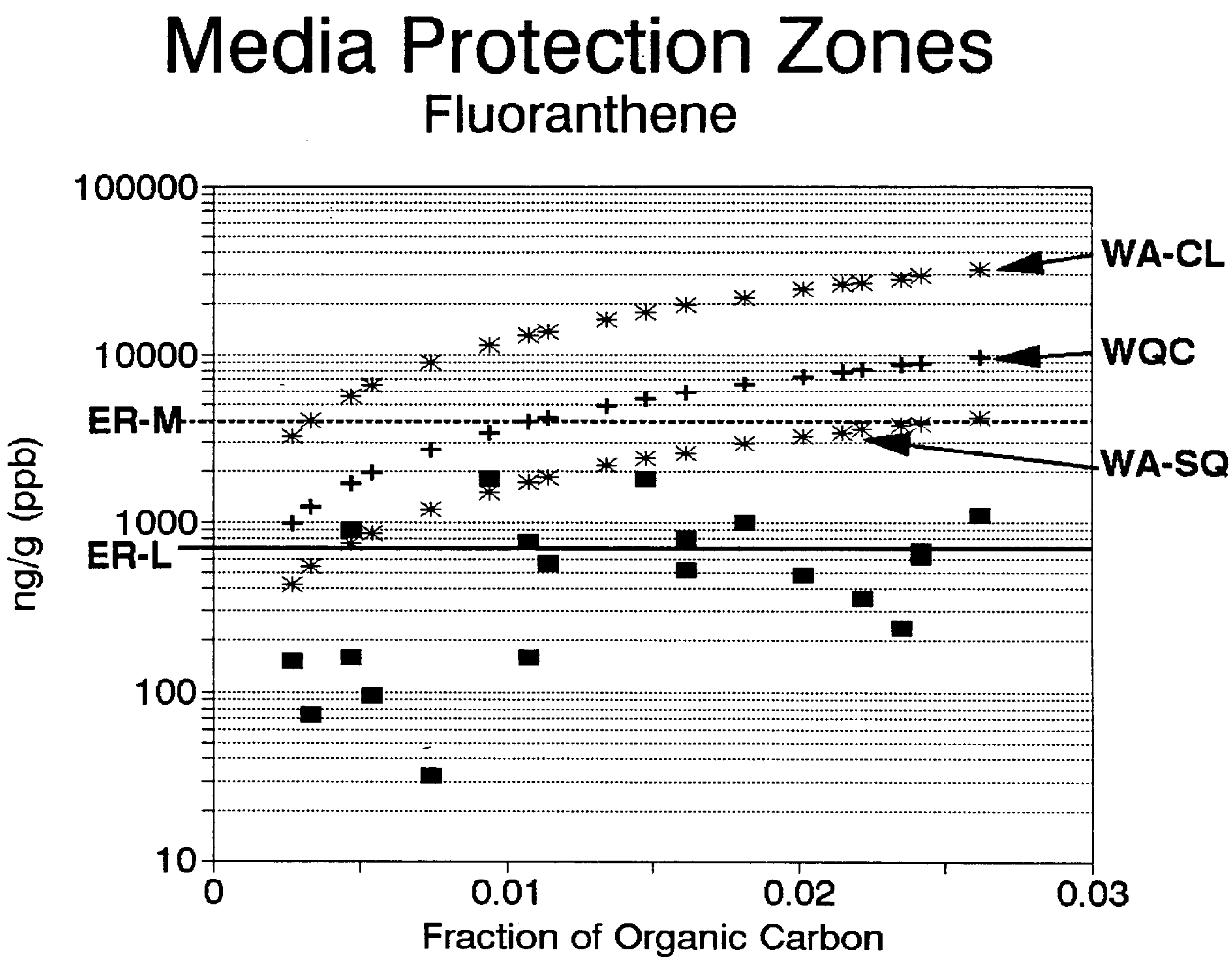



Figure 3.18 Media protection zones for fluoranthene.

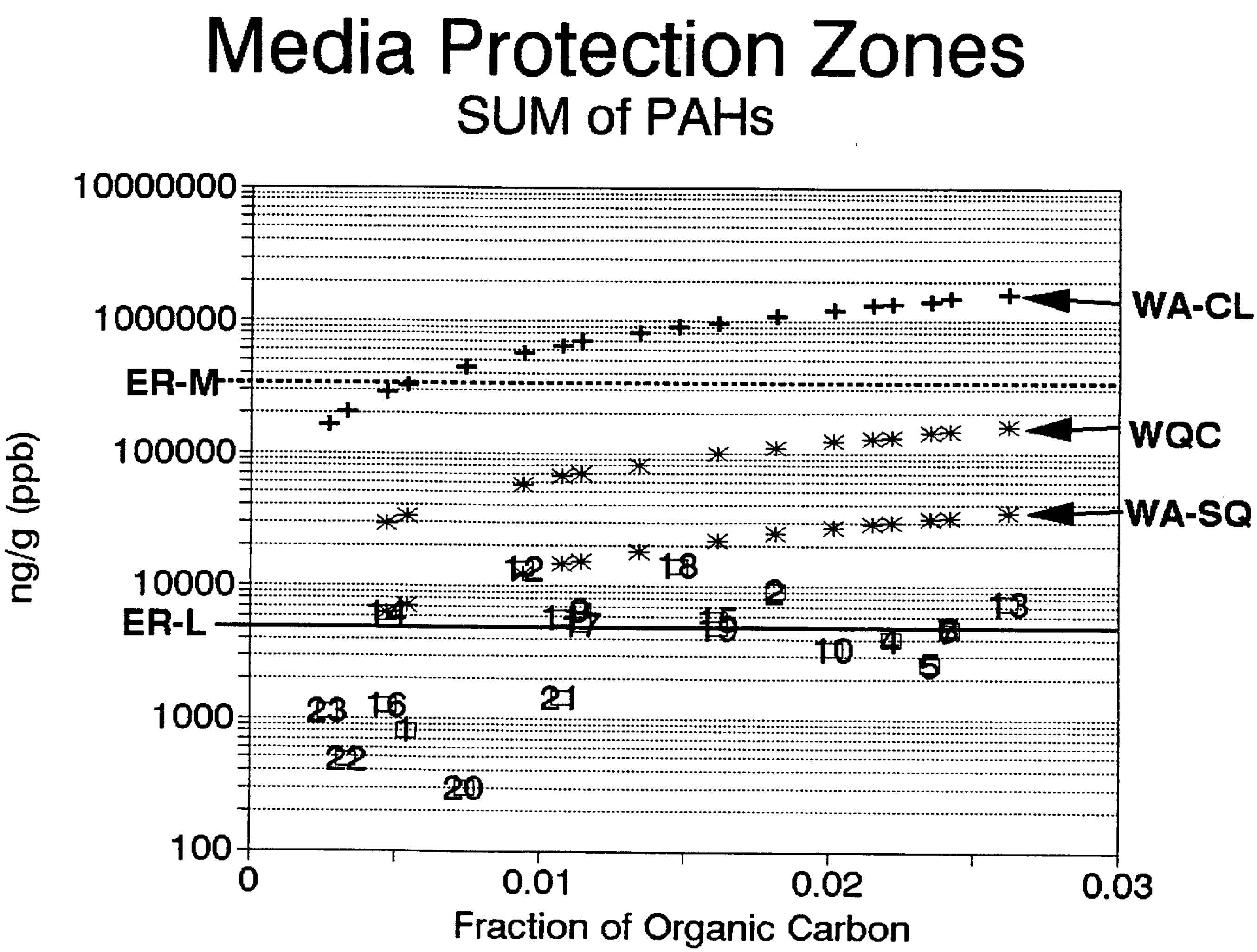



Figure 3.19 Media protection zones for PAHs.

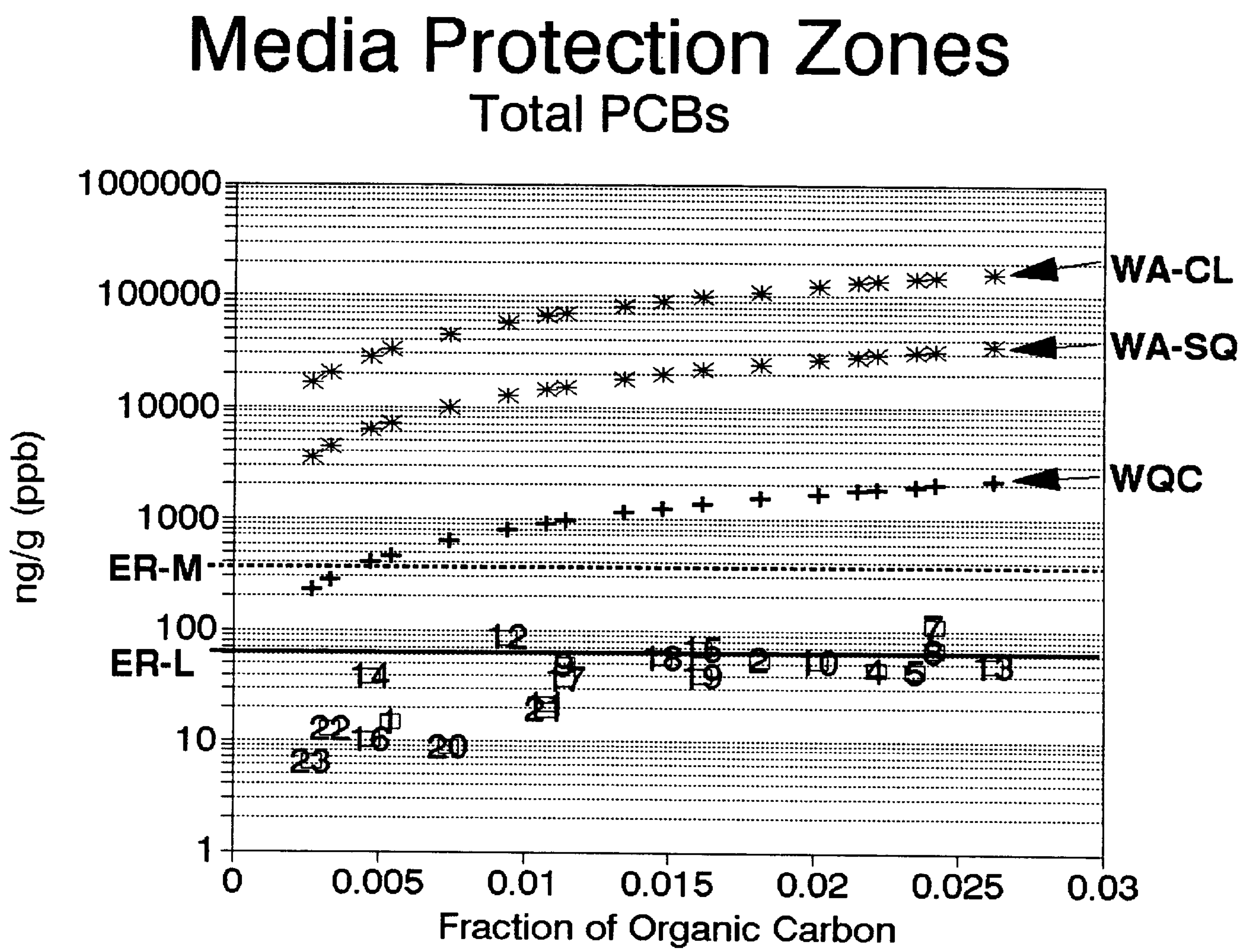



Figure 3.20 Media protection zones for PCBs.

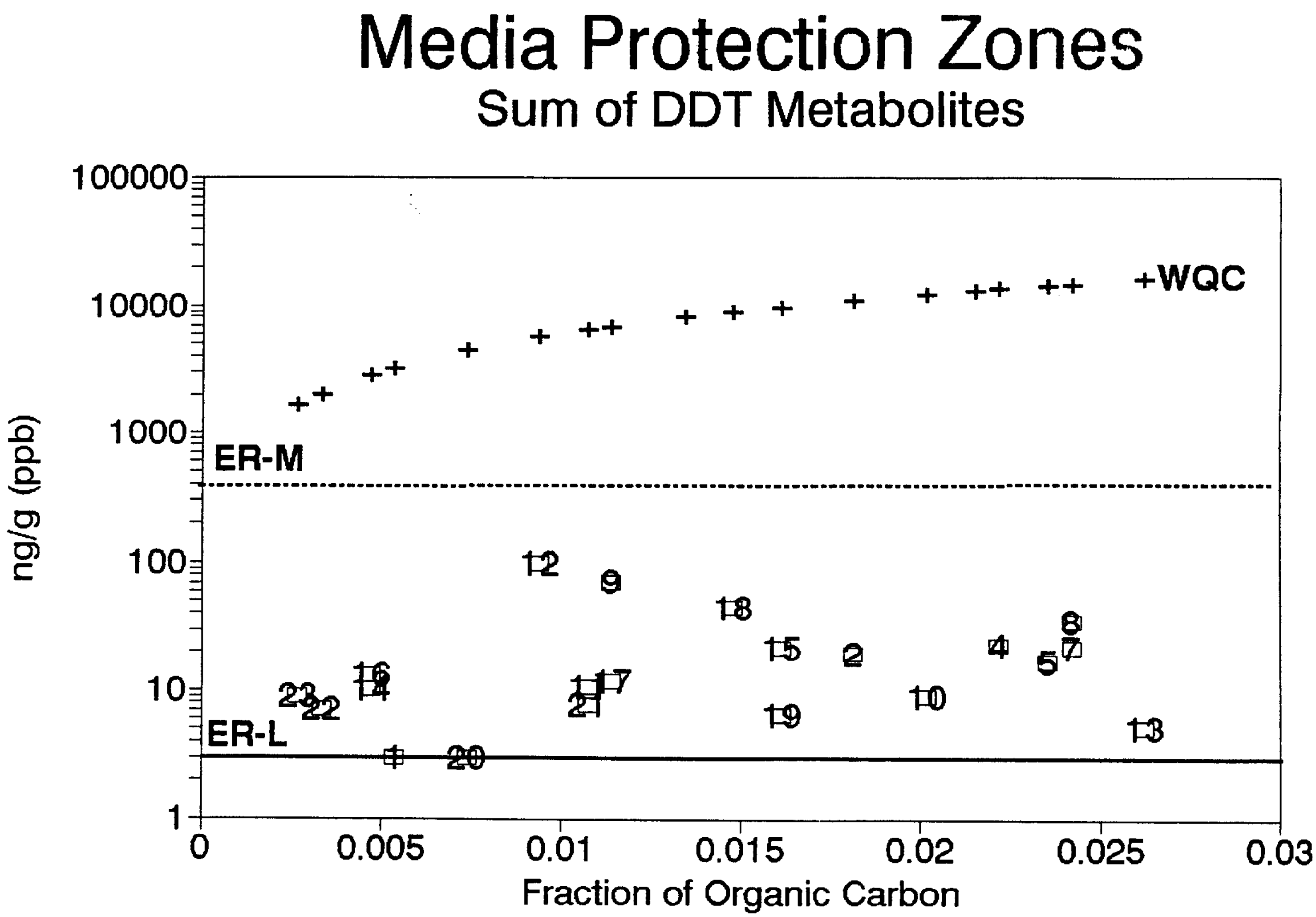



Figure 3.21 Media protection zones for DDT and metabolite s.