N00102.PF.001062
NSY PORTSMOUTH
5090.3b

# Preliminary Remediation Goals For Operable Unit 4

## Portsmouth Naval Shipyard

Kittery, Maine

## Engineering Field Activity Northeast
## Naval Facilities Engineering Command

**Contract Number N62472-90-D-1298**

**Contract Task Order 0201**

November 2001

TETRA TECH NUS, INC.

110009/P

# PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4

FOR

PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Engineering Field Activity Northeast
Environmental Branch Code EV
Naval Facilities Engineering Command
10 Industrial Highway, Mail Stop #82
Lester, Pennsylvania 19113-2090

Submitted by:
Tetra Tech NUS, Inc.
600 Clark Avenue, Suite 3
King of Prussia, Pennsylvania 19406-1433

CONTRACT NUMBER N62472-90-D-1298
CONTRACT TASK ORDER 0201

NOVEMBER 2001


PREPARED BY:

DEBORAH J. COHEN, P.E.
PROJECT MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

APPROVED BY:

JOHN J. TREPANOWSKI, P.E.
PROGRAM MANAGER
TETRA TECH NUS, INC.
KING OF PRUSSIA, PENNSYLVANIA

# TABLE OF CONTENTS

**SECTION** **PAGE NO.**

ACRONYMS AND ABBREVIATIONS ..... iii

EXECUTIVE SUMMARY ..... ES-1

REFERENCES ..... R-1

**ATTACHMENTS**

1 DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS (PRGs) FOR OPERABLE UNIT 4
2 EXAMPLE CALCULATIONS
3 RESPONSE TO COMMENTS AND MEETING MINUTES

## TABLES

**NUMBER**

ES-1 Summary of Sediment – Based PRG Development and Implementation Steps
ES-2 Summary of Recommended PRGs for OU4

## FIGURES

ES-1 Overview of Monitoring Station Locations
ES-2 Overview Reference Station Locations

# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AOC | Area of Concern |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| BAF | Bioaccumulation Factor |
| BSAF | Biota Sediment Accumulation Factor |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act |
| CLEAN | Comprehensive Long-term Environmental Action Navy |
| COC | chemical of concern |
| CTO | Contract Task Order |
| EERA | Estuarine Ecological Risk Assessment |
| EFANE | Engineering Field Activity Northeast |
| FS | Feasibility Study |
| IRG | Interim Remediation Goal |
| LMW | low molecular weight |
| NAVFAC | Naval Facilities Engineering Command |
| Navy | U.S. Department of the Navy |
| NCP | National Contingency Plan |
| NOAA | National Oceanic and Atmospheric Administration |
| NOEC | no observable effects concentration |
| NOEQ | no observable effects quotient |
| OU | Operable Unit |
| PAH | polycyclic aromatic hydrocarbon |
| PCB | polychlorinated biphenyl |
| PNS | Portsmouth Naval Shipyard |
| PRG | Preliminary Remediation Goal |
| PW-HQ | porewater hazard quotient |
| RI | Remedial Investigation |
| ROD | Record of Decision |
| RSV | reference screening value |
| SQC | Sediment Quality Criteria |
| TEV | Threshold Effects Value |
| TEV-HQ | threshold effects value hazard quotient |
| TOC | total organic carbon |
| TtNUS | Tetra Tech NUS, Inc. |
| UCL | 95th percent upper confidence level |
| USEPA | U.S. Environmental Protection Agency |
| WQSV | water quality screening value |

# EXECUTIVE SUMMARY

## INTRODUCTION

This Preliminary Remediation Goals (PRGs) Document for Operable Unit (OU) 4 at Portsmouth Naval Shipyard (PNS) in Kittery, Maine was prepared for the U.S. Department of Navy (Navy), Engineering Field Activity Northeast (EFANE) by Tetra Tech NUS, Inc. (TtNUS) under the Comprehensive Long-Term Environmental Action Navy (CLEAN), Contract Number N62472-90-D-1298, Contract Task Order (CTO) 201.

The Executive Summary presents a brief description of the PRG development process, and presents the PRGs that were calculated for OU4. Attachment 1 presents the entire PRG development document that was prepared by Science Applications International Corporation using the process outlined in the PRG Proposal that was presented in the Interim Offshore Monitoring Plan (TtNUS, 1999; Appendix A). Attachment 2 provides the example calculations for each step of the PRG process and example calculations of the PRGs. Response to comments and PRG technical meeting minutes are provided in Attachment 3.

The PRGs were developed as part of Interim Offshore Monitoring Program that was initiated as required by the Interim Record of Decision (ROD) for OU4 (Navy, 1999). The monitoring program is designed to provide offshore monitoring in the interim period before completion of the offshore Feasibility Study (FS) and selection and implementation of a final remedy for OU4. At the time a final remedial action for OU4 is implemented, interim monitoring will be discontinued. However, the interim monitoring program was developed to provide a basis for any monitoring program that may be required as part of the final action. The Interim Offshore Monitoring Plan (TtNUS, 1999) provides additional information on the monitoring program. The PRGs provided herein will be used as the Interim Remediation Goals (IRGs) for OU4, as outlined in the Interim Offshore Monitoring Plan.

## PRG DEVELOPMENT PROCESS FOR OU4

As discussed in the Interim Offshore Monitoring Plan (TtNUS, 1999), only sediment-based ecological PRGs will be developed for OU4 using the PRG development process. The PRG development consists of a seven step process consisting of PRG Derivation (Steps 1 through 5) and the PRG Implementation (Steps 6 and 7). Table ES-1 provides a summary of the development process. The approach for PRG derivation and implementation are briefly discussed in this Executive Summary. The PRG development document (Attachment 1) presents these seven steps in detail. The PRG development document also

presents the calculations for each of the seven steps. Attachment 2 provides example calculations for the PRG development.

**PRG Derivation**

The overall objective of the PRG development process for OU4 is to select the limiting COCs and the concentrations of these COCs that, when implemented as cleanup goals, focus remedial action in the areas in which aquatic risks are greater than acceptable levels. Limiting COCs are those analytes that are responsible for much of the baseline risk; by remediating to the limiting COC PRG concentrations, collocated COCs will be remediated to levels that will not have adverse effects. In the development process, sediment-based PRGs are developed that are protective of sensitive ecological receptor exposed to COCs in sediment. An explanation of the PRG derivation steps follows.

The first step in the PRG process is to identify the Water Quality Screening Values (WQSVs) that will be compared to the pore water concentrations. The WQSVs are developed either from existing water quality criteria/guidelines, or are developed from sediment benchmarks using equilibrium partitioning. The next step is to obtain a pore water concentration for each parameter. For metals, the pore water concentrations are obtained by extracting the pore water from the sediment sample and analyzing the pore water directly. Because a large quantity of pore water is needed to achieve low detection limits for organic chemicals, the pore water concentrations for organic chemicals are estimated using an equilibrium partitioning equation. The pore water concentrations for each sample are then divided by the WQSV to obtain a pore water hazard quotient ($PW_{HQ}$) for each sample and each parameter.

Each sample is then classified as toxic or non-toxic based on the results of the toxicity tests (amphipods and sea urchins) that were conducted during Round 2. The 95$^{th}$ quantile $PW_{HQ}$ of the non-toxic samples is then calculated for the non-toxic amphipod samples and the non-toxic sea urchin samples. The maximum $PW_{HQ}$ for the toxic samples is then determined.

If the 95$^{th}$ quantile $PW_{HQ}$ of the non-toxic samples is greater than one, and if the toxic $PW_{HQ}$ is greater than the non-toxic $PW_{HQ}$, the quotient is named the No Observable Effects Quotient (NOEQ) for that receptor (amphipod or sea urchin). If the 95$^{th}$ quantile $PW_{HQ}$ of the non-toxic samples is less than 1.0, and if the toxic $PW_{HQ}$ is greater than 1.0, than the NOEQ defaults to 1.0 for that receptor. The lower of the two NOEQs that were retained for PRG development between the two receptors is selected as the Aquatic NOEQ.

The Aquatic NOEQ is then multiplied by the WQSV to convert the $PW_{HQ}$ back into a pore water concentration which is called the Aquatic No Observable Effects Concentration (NOEC). This pore water concentration is then compared to the reference pore water concentration to ensure that the PRGs will not

be set below the reference concentrations. The higher of the Aquatic NOEC or reference concentration becomes the Threshold Effects Value (TEV).

The next step is done to limit the number of chemicals for which PRGs are developed to the chemicals that are causing the highest risk at each station. The assumption is that if the chemicals that are causing the highest risk at a station are remediated, the remaining chemicals will be remediated in the same proportion. Therefore, the remaining chemicals will not be present at concentrations that are causing a risk to the aquatic receptors. This step is done by dividing the pore water concentrations by the TEVs at each station (except the reference stations) to get a TEV-Hazard Quotient ($TEV_{HQ}$). The chemical with the highest $TEV_{HQ}$ for a station is the limiting COC for that station. The list of limiting COCs across all of the stations is the list of limiting COCs for the site. Note that the same chemical may be a limiting COC at more than one station. Also, a limiting COC is not determined for a station if the sum of all the $TEV_{HQ}$s for that station is less than 1.0, because the sum of those chemicals at the site are not expected to adversely impact the aquatic organisms.

**PRG Implementation**

After identifying the limiting COCs and their porewater-based TEVs, sediment-based candidate PRGs are identified from the TEVs. Also, the effectiveness of PRG implementation for risk reduction is evaluated using candidate PRGs, and PRGs are selected.

The pore water-based TEVs are then converted into sediment-based PRGs by dividing the sediment concentration at each station by the $TEV_{HQ}$. The station-specific values are then averaged across all of the stations to calculate the OU-wide Baseline PRG. Note that the PRGs that are calculated for each station are used to calculate the average PRG for the site. They are not used as a station-specific PRG to evaluate the sediment at that station.

For the evaluation, sediment concentrations from the Estuarine Ecological Risk Assessment (EERA) and Rounds 1 and Round 2 of the interim offshore monitoring are compared with the PRGs (NCCOSC, 2000). The results of the EERA are then compared with exceedances of the PRGs (i.e., do exceedances of example PRGs coincide with areas having risks), and this comparison is used to determine if a PRG should be recommended for a chemical. Also, this comparison is used to determine if a recommended PRG can be set higher than the Baseline PRG and still be protective of aquatic life.

Exceedances of sediment-based values (e.g., PRGs) can also be evaluated using shellfish tissue data (e.g., mussel, juvenile lobster) that are converted to sediment-based concentrations and compared with PRGs. The application of sediment-based PRGs to shellfish is based on shellfish living in or being in close proximity to sediment and sediment acting as a major source of contamination to the shellfish. The

Biota Sediment Accumulation Factors (BSAF) model was selected as the best available model for predicting bioaccumulation of organics because the model incorporates site-specific (sediment total organic carbon [TOC]) and organism-specific (tissue lipid) data. The Bioaccumulation Factor (BAF) model is considered the best available model for metals. The BAF model excludes TOC and lipid normalization. These models are discussed in more detail in Attachment 1. The calculated BSAFs and BAFs are used to predict sediment concentrations using tissue data at locations where sediment is not present. The predicted sediment concentrations are then compared to PRGs.

The results of implementation of the PRGs (presented in Attachment 1) indicate that the PRGs are consistent with the findings of the risk assessment, that is, the areas identified in the EERA as having intermediate risks associated with them (i.e., Sullivan Point, Back Channel, and Dry Docks) are the same areas where sediment concentration were found above PRGs. The recommended PRGs are presented in Table ES-2.

## DATA USED IN PRG DEVELOPMENT FOR OU4

The samples used for the development of PRGs were collected during Round 2 of the Interim Offshore Monitoring Program, conducted from May 2 through 7 and May 23, 2000. During this sampling round, sediment, blue mussel (*Mytilus edulis*), and juvenile American lobster (*Homarus americanus*) samples were collected from 14 monitoring stations around PNS and 4 reference stations located in the Piscataqua River (see Figures ES-1 and ES-2). In addition, sediment samples were collected from select monitoring stations for toxicity tests of the sediment pore water (sea urchin larval development test) and sediment (amphipod 10-day survival test using *Ampelisca abdita*), and chemical analysis of the sediment pore water (metals and dissolved organic carbon) in accordance with the Interim Offshore Monitoring Plan (TtNUS, 1999). Sediment samples were collected from all of the reference stations for chemical analysis of the sediment pore water (metals and dissolved organic carbon). In addition, EERA sediment data (NCCOSC, 2000) and Round 1 sediment data (TtNUS, 2000b) were used as part of the PRG Implementation, as discussed previously. Reference station locations were identified as part of the development of the Interim Offshore Monitoring program as discussed in the Interim Offshore Monitoring Plan (TtNUS, 1999).

The Round 2 Interim Offshore Monitoring Program Data Package for Operable Unit (OU) 4 (TtNUS, 2000a) presents the sampling methodology and results. The rationale for the samples that were selected for toxicity tests were presented in Navy correspondence (Navy, 2000b). The following bullets summarize the key points of the sampling investigation as they relate to the data used to develop the PRGs:

- Two additional sediment samples (OU4-SD-M08-400B and OU4-SD-M09-400B) were collected than initially proposed. Sample OU4-SD-M08-400B was collected because sample OU4-SD-M08-300B did not produce enough pore water for the required tests. Sample OU4-SD-M09-400B was collected

because samples OU4-SD-M09-100B and OU4-SD-M09-200B had high proportions of gravel which are not ideal for toxicity tests. Therefore, the additional samples were collected to ensure an adequate number of samples of good quality were collected.

- The concentrations of organic constituents in the pore water samples were predicted using equilibrium partitioning equations, whereas, the concentrations of metals in the pore water samples were measured. The pore water samples for chemical analysis were filtered through a 0.2 um filter prior to analysis of metals (Navy, 2000a).

- An adequate volume of pore water could not be extracted from sediment sample OU4-SD-M14-100B. Therefore, a surface water sample was collected from the back channel, added to the sediment sample, and then extracted from the sediment as pore water after 24 hours.

- An adequate volume of sediment from the reference stations was not collected during the initial sampling event for extraction and chemical analysis of the pore water. Therefore, the sediment samples from the reference locations were resampled approximately two weeks later for extraction and chemical analysis of the pore water.

- The high molecular weight (HWM) and low molecular weight (LMW) polycyclic aromatic hydrocarbon (PAH) concentrations were summed according to the PAHs that were included in each group by Long et al., 1995. Attachment 1 presents the PAHs that were included in each group.

- The total polychlorinated biphenyl (PCB) concentrations were calculated by summing the positive results of the 18 individual congener PCB concentrations that are included on the National Oceanic and Atmospheric Administration (NOAA) list of PCB compounds and then multiplying that sum by 2.0. Ten additional World Health Organization PCBs were measured as part of the monitoring program at the request of USEPA are not included in the calculation because they are accounted for in the multiplication factor of 2.0, along with other PCBs that were not analyzed

Round 2 data for the OU4 COCs (PAHs, PCBs, and metals) were included in the PRG development. Pesticides have not been linked to an onshore IRP site at the current time and therefore have not been identified as COCs for OU4. However, the Navy has agreed to calculate PRGs for pesticides should they become a COC in the future. Therefore, Round 2 pesticide data were included in the PRG development.

BSAFs and BAFs provided herein were calculated using the Round 2 data. However, as provided in the Interim Offshore Monitoring Plan (TtNUS, 1999), BSAFs and BAFs will be calculated for each of the

baseline monitoring rounds (Rounds 1 through 4) and the information will be provide in the Baseline Report.

## TABLE ES-1

## SUMMARY OF SEDIMENT-BASED PRG DERIVATION AND IMPLEMENTATION STEPS
## PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
## PAGE 1 OF 2

| STEP | PROCEDURE | | ASSOCIATED TABLES |
|---|---|---|---|
| 1 | Select benchmarks (WQSV) and express porewater concentrations as hazard quotients. | - PW-HQ = PW conc./WQSV | Tables 2.2-1 and A-4 (select benchmarks)<br>Table A-2-2.1 (Kow and Koc values)<br>Table A-2-2.2a,b (sediment concentrations)<br>Table A-2.2.3 (geochemical characteristics)<br>Table A-2-2.4a,b (pore water concentrations)<br>Table A-2-2.5 (PW-HQ) |
| 2 | Evaluate COC bioavailability under site-specific conditions by estimating 95th quantile of PW-HQs associated with non-toxic samples and identify NOEQ. | - 95th quantile PW-HQ(non-tox)>1; NOEQ = 95th quantile PW-HQ(non-tox)<br>- 95th quantile PW-HQ(non-tox)<1; NOEQ = 1 | Table 2.2-2 (summary of toxic samples)<br>Table A-2-2.6 (PW-HQs of non-toxic amphipod samples)<br>Table A-2-2.7 (PW-HQs of toxic amphipod samples)<br>Table A-2-2.8 (PW-HQs of non-toxic sea urchin samples)<br>Table A-2-2.9 (PW-HQs of toxic sea urchin samples) |
| 3 | Retain COCs substantially contributing to risk at site; retain COCs with maximum PW-HQ associated with toxic samples (max PW-HQ (tox)) greater than the NOEQ. | - max PW-HQ (tox)>NOEQ; retain COC<br>- max PW-HQ (tox)<NOEQ; eliminate COC | Table 2.2-3 (determination of NOEQ) |
| 4 | Evaluate feasibility of COC-specific PRG as long-term remedial goal; compare NOEC and RSV for COC in porewater and select greater of two values as aquatic TEV. | - NOEC>RSV; TEV = NOEC<br>NOEC<RSV; TEV = RSV | Table 2.2-4 (derivation of RSV)<br>Table 2.2-5 (derivation of TEV) |
| 5 | Identify limiting COCs by evaluating TEV-HQs and sum of TEV-HQs for each location. | - sum of TEV-HQs>1; select COC with max TEV-HQ as limiting COC for that location | Table A-2-2.10 (identify limiting COC) |
| 6 | Determine sediment-based candidate PRGs. | - set $PRG\text{-}HQ_{Sta,COC} = TEV\text{-}HQ_{Sta,COC}$ | Table 2.2-6 (summary of baseline PRG)<br>Table A-3-1.1 (derivation of PRGs) |

## TABLE ES-1

## SUMMARY OF SEDIMENT-BASED PRG DERIVATION AND IMPLEMENTATION STEPS
## PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE
## PAGE 2 OF 2

| STEP | PROCEDURE | | ASSOCIATED TABLES |
|---|---|---|---|
| 7 | Evaluate practicality of candidate PRG for effective risk reduction. | - compare PRG exceedances with aquatic risk distribution | Table 3.3-1 (PRG exceedence vs. risks)<br>Table 3.3-2 (Summary of recommended PRGs)<br>Table A-3-1.3a (PRG HQs – EERA data)<br>Table A-3-1.3b (PRG HQs – Round 1 data)<br>Table A-3-1.3c (PRG HQs –Round 2 data)<br>Table A-5 (PRG comparison with benchmarks) |

These tables were used to calculate BAF/BSAFs and to predict the sediment concentrations at MS-11 stations where no sediment was present

- Tables A-3-1.2a,b Normalized sediment concentrations
- Tables A-3-1.2c,d Normalized lobster concentrations
- Table A-3-1.2e Lobster BAFs (metals) and BSAFs (organics)
- Tables A-3-1.2f,g Normalized mussel concentrations
- Table A-3-1.2h Mussel BAFs (metals) and BSAFs (organics)
- Table A-3-1.2i Summary of lobster and mussel BAFs (metals) and BSAFs (organics)
- Table A-3-1.2j Predicted sediment concentrations at MS-11 from BAF/BSAF data

| | |
|---|---|
| BAF | bioaccumulation factor |
| BSAF | biota sediment accumulation factor |
| COC | chemical of concern |
| NOEC | no observable effects concentration |
| NOEQ | no observable effects quotient (NOEC/WQSV) |
| PW-HQ | pore water hazard quotient (porewater concentration/WQSV) |
| RSV | reference screening value |
| TEV | threshold effects value |
| TEV-HQ | threshold effects value hazard quotient (porewater concentration/TEV) |
| WQSV | water quality screening value |

## TABLE ES-2

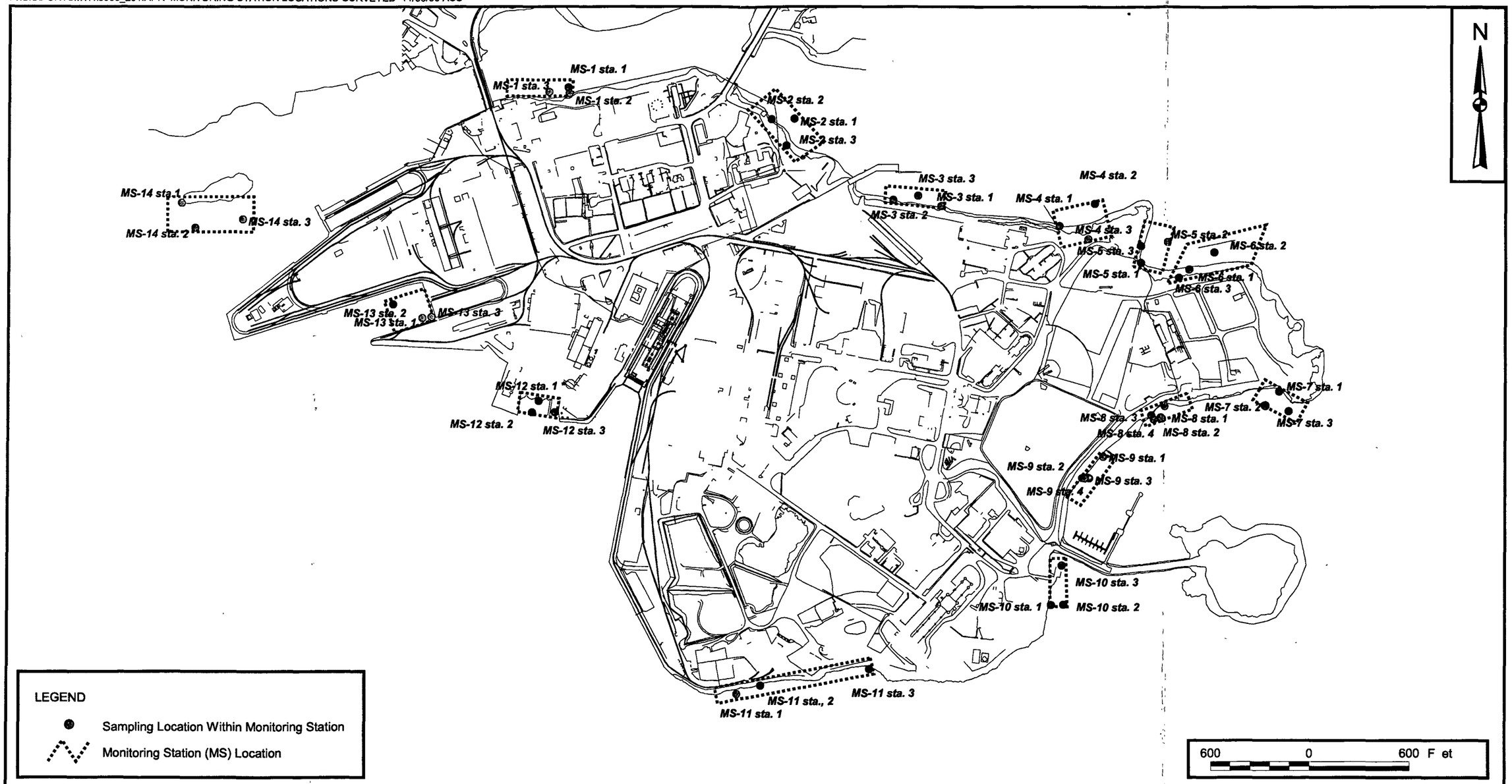
## SUMMARY OF RECOMMENDED PRGs FOR OU4[1]

| Analyte | Recommended PRG[2] |
|---|---|
| Copper | 486 |
| Nickel | 161 |
| Acenaphthylene | 210 |
| Anthracene | 1236 |
| Fluorene | 500 |
| HMW PAHs | 13057 |
| Endosulfan II | NR |
| Trans-Nonachlor | NR |
| p,p'-DDT | NR |

NR Not Recommended
1 Taken from Table 3.3-2 in Attachment 1 (page 48)
2 Organics: units = ng/g dry weight sediment
Metals: units = µg/g dry weight sediment

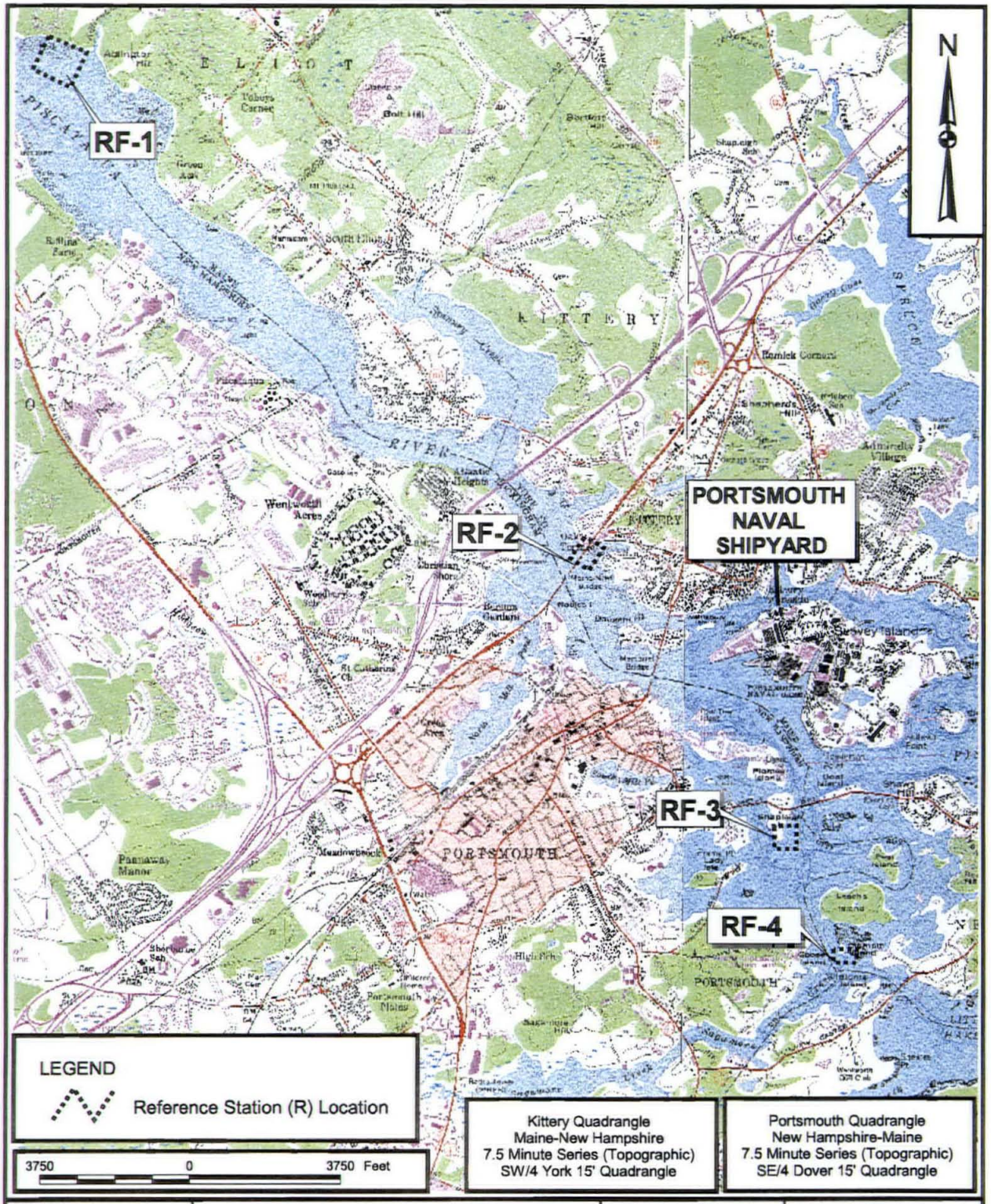
This page intentionally left blank.

P:\GIS\PORTSMTH\5003_201.APR MONITORING STATION LOCATIONS-SURVEYED 11/06/00 ACS




| NO. | DATE | REVISIONS | BY | CHKD | APPD | REFERENCES |
|---|---|---|---|---|---|---|
| | | | | | | |

| | | | |
|---|---|---|---|
| DRAWN BY J LAMEY | DATE 12/15/99 | Tetra Tech NUS, Inc. | CONTRACT NUMBER 5003 / OWNER NUMBER CTO 0201 |
| CHECKED BY D. COHEN | DATE 1/12/00 | OVERVIEW OF MONITORING STATION LOCATIONS<br>INTERIM OFFSHORE MONITORING PROGRAM<br>PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE | APPROVED BY — / DATE — |
| COST/SCHEDULE-AREA | | | APPROVED BY — / DATE — |
| SCALE AS NOTED | | | DRAWING NO. FIGURE ES-1 / REV 0 |




| | | | |
|---|---|---|---|
| DRAWN BY J. BELLONE — DATE 15-JULY-99 | Tetra Tech NUS, Inc. | CONTRACT NUMBER 5003 | OWNER NO. 0201 |
| CHECKED BY D. COHEN — DATE 2/4/00 | OVERVIEW OF REFERENCE STATION LOCATIONS<br>INTERIM OFFSHORE MONITORING PROGRAM<br>PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE | APPROVED BY — DATE — | |
| COST/SCHEDULE-AREA | | APPROVED BY — DATE — | |
| SCALE AS NOTED | | DRAWING NO. FIGURE ES-2 | REV 0 |

P:\GIS\PORTSMOUTH\5003_201.APR 11/06/00 ACS USGS MONITORING REFERENCE LOCATIONS LAYOUT

# REFERENCES

Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder, 1995. Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environ. Manage., 19(1): 81-97.

Navy (Department of Navy), 1999. Interim Record of Decision for Operable Unit 4, May.

Navy, 2000a. Navy correspondence dated January 4, 2000 to M. Cassidy, USEPA and I. McLeod, MEDEP. Subject: Interim Offshore Monitoring Plan for Installation Restoration Program at Portsmouth Naval Shipyard, Kittery, Maine.

Navy, 2000b. Navy correspondence dated March 30, 2000 to M. Cassidy, USEPA and I. McLeod, MEDEP. Subject: Spring 2000 Interim Monitoring Sampling for the Installation Restoration Program at Portsmouth Naval Shipyard, Kittery, Maine.

NCCOSC (Naval Command, Control, and Ocean Surveillance Center), 2000. "Final Estuarine Ecological Risk Assessment" for Portsmouth Naval Shipyard, Kittery, Maine. Narragansett, RI, May.

TtNUS (Tetra Tech NUS, Inc.), 1999. "Interim Offshore Monitoring Plan for Operable Unit 4" for Portsmouth Naval Shipyard, Kittery, Maine. TtNUS, King of Prussia, PA, October.

TtNUS (Tetra Tech NUS, Inc.), 2000 "Interim Offshore Monitoring Plan Round 2 Data Package" for Portsmouth Naval Shipyard, Kittery, Maine. TtNUS, King of Prussia, PA, October.

# ATTACHMENT 1

# DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS (PRGs) FOR OPERABLE UNIT 4

# FINAL

**Development of**
**Preliminary Remediation Goals (PRGs)**
**For Operable Unit 4**
**Portsmouth Naval Shipyard**

**November 2001**

**Prepared by:**

**Science Applications International Corporation**
**Admiral's Gate**
**221 Third Street**
**Newport, RI 02840**

**Under contract to:**

**Tetra Tech NUS, Inc.**
**Foster Plaza VII**
**661 Andersen Drive**
**Pittsburgh, PA 15220**

**For**

**United States Navy – Engineering Field Activity Northeast**
**10 Industrial Highway**
**Lester, PA 19113-2090**

## TABLE OF CONTENTS

Page

List of Figures ..... iii

List of Tables ..... iii

List of Appendices ..... iv

List of Acronyms and Units ..... vii

1. Background and Objectives ..... 1

2. PRG Derivation ..... 2
   2.1. Overview of PRG Development Approach ..... 3
   2.2. Aquatic PRG Derivation ..... 5

3. PRG Implementation ..... 13
   3.1. Translation of Aquatic TEV Values into PRGs ..... 13
   3.2. Spatial Implementation of PRGs ..... 15
   3.3. Assessment of PRGs for Risk Reduction ..... 17
      3.3.1. Baseline PRG evaluation ..... 18
      3.3.2. Recommended PRGs evaluation ..... 21

4. Uncertainty Analysis ..... 23

5. Literature Cited ..... 25

## LIST OF FIGURES

Figure 2.2-1. Water quality screening value selection process and associated data qualifiers.

Figure 3.2-1. Ecological risk probability for the Portsmouth Naval Shipyard offshore study area.

Figure 3.3-1. Sampling locations for PRG development in the Portsmouth Naval Shipyard offshore study area.

Figure 3.3-2. Summary of CoCs with highest baseline PRG exceedances by location for sediments from the Portsmouth Naval Shipyard offshore study area.

## LIST OF TABLES

Table 1.0-1. Potential Remedial Action Objectives for the Portsmouth Naval Shipyard offshore study area.

Table 1.0-2. Chemical-specific Federal and State Applicable or Relevant and Appropriate Requirements and To-Be-Considered requirements for Portsmouth Naval Shipyard offshore study area, Kittery, Maine.

Table 2.1-1. Procedure for Preliminary Remediation Goal (PRG) development for protecting aquatic soft-bottom and hard-bottom exposure pathways for the Portsmouth Naval Shipyard offshore study area.

Table 2.2-1. Water Quality Criteria for target analytes selected for aquatic PRG development and derived Water Quality Screening Values for the Portsmouth Naval Shipyard offshore study area.

Table 2.2-2. Summary of toxicity testing results and toxicity classification for purposes of PRG development.

Table 2.2-3. Distribution of toxic and nontoxic aquatic Hazard Quotients and derivation of No Observable Effect Quotients (NOEQs) for the aquatic receptors exposed to CoC in sediment for the Portsmouth Naval Shipyard offshore study area.

Table 2.2-4. Derivation of Aquatic Reference Screening Values (RSVs) based on measured/calculated concentrations of selected contaminants in pore water from Portsmouth Naval Shipyard EERA reference locations from the Portsmouth Naval Shipyard study area.

## LIST OF TABLES (continued)

Table 2.2-5. Derivation of Threshold Effects Values (TEVs) for the aquatic exposure pathway for the Portsmouth Naval Shipyard offshore study area.

Table 2.2-6. Summary of baseline Preliminary Remediation Goals (PRGs) for the aquatic exposure pathway in the Portsmouth Naval Shipyard study area expressed as sediment concentration-based values.

Table 3.3-1. Relationship between degree of PRG exceedance and risk for chemicals exhibiting highest PRG exceedances by sampling location in the Portsmouth Naval Shipyard study area.

Table 3.3-2. Summary of Recommended Preliminary Remediation Goals (PRGs) for protection of bedded sediment and hard-bottom aquatic biota in the Portsmouth Naval Shipyard offshore study area.

## LIST OF APPENDICES

Table A-2-2.1. Summary of Kow and Koc values used in calculations of organic contaminant concentrations in pore waters by equilibrium partitioning.

Table A-2-2.2a. Concentrations of chemical contaminants in surface sediment (0-10 cm) collected from Round 2 of the Portsmouth Naval Shipyard offshore study area.

Table A-2-2.2b. Concentrations of PCB congeners and calculation of Total PCBs in surface sediment (0-10 cm) collected from Round 2 of the Portsmouth Naval Shipyard offshore study area.

Table A-2-2.3. Geotechnical characteristics of station sediments in Round 2 of the Portsmouth Naval Shipyard EERA.

Table A-2-2.4a. Concentrations of contaminants in sediment pore waters from Round 2 of the Portsmouth Naval Shipyard EERA.

Table A-2-2.4b. Concentrations of PCB congeners and Total PCBs in surface sediment pore waters from Round 2 of the Portsmouth Naval Shipyard EERA.

Table A-2-2.5. Hazard Quotients–Low calculated from CoC concentrations in sediment pore waters from the Portsmouth Naval Shipyard study area: Comparison against WQSV-Low benchmark.

## LIST OF APPENDICES (continued)


| | |
|---|---|
| Table A-2-2.6. | Pore water Hazard Quotients (PW-HQs) based on data from the Portsmouth Naval Shipyard EERA for stations exhibiting no toxicity to amphipods (Ampelisca abdita). |
| Table A-2-2.7. | Pore water Hazard Quotients (PW-HQs) based on data from the Portsmouth Naval Shipyard EERA for stations exhibiting toxicity to amphipods (Ampelisca abdita). |
| Table A-2-2.8. | Pore water Hazard Quotients (PW-HQs) based on data from the Portsmouth Naval Shipyard EERA for stations exhibiting no toxicity to sea urchin (Arbacia punctulata) development. |
| Table A-2-2.9. | Pore water Hazard Quotients (PW-HQs) based on data from the Portsmouth Naval Shipyard EERA for stations exhibiting toxicity to sea urchin (Arbacia punctulata) development. |
| Table A-2-2.10. | Combined aquatic Threshold Effects Value Hazard Quotients for CoCs in pore water for identification of Limiting CoCs collected in the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.1. | Derivation of aquatic PRGs for CoCs in pore waters from sediments collected in the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.2a. | Normalized concentrations of chemicals in sediment in the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.2b. | Normalized concentrations of PCB congeners in sediment in the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.2c. | Normalized concentrations of contaminants in tissues of juvenile lobster in the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.2d. | Normalized concentrations of PCB congeners in tissues of juvenile lobster in sediment in the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.2e. | Bioaccumulation Factors (BAFs) for metals and Biota-Sediment Accumulation Factors (BSAFs) for organics in juvenile lobster tissue in the Portsmouth Naval Shipyard study area. |
| Table A-3-1.2f. | Normalized concentrations of contaminants in tissues of mussels in the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.2g. | Normalized concentrations of PCB congeners in tissues of mussels in the Portsmouth Naval Shipyard offshore study area. |

## LIST OF APPENDICES (continued)


| | |
|---|---|
| Table A-3-1.2h. | Bioaccumulation Factors (BAFs) for metals and Biota-Sediment Accumulation Factors (BSAFs) for organics in mussel tissue from the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.2i. | Analyte average of BAF/BSAF across stations in the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.2j. | Predicted sediment concentrations from average analyte BAF/BSAF at un-sampled stations. |
| Table A-3-1.3a. | PRG Hazard Quotients for CoCs in sediments collected during the Portsmouth Naval Shipyard EERA investigation. |
| Table A-3-1.3b. | PRG Hazard Quotients for CoCs in sediments collected in Round 1 of the Portsmouth Naval Shipyard offshore study area. |
| Table A-3-1.3c. | PRG Hazard Quotients for CoCs in sediments collected during Round 2 of the Portsmouth Naval Shipyard offshore study area investigation. |
| Table A-4. | Recommended Acute:chronic ratios to determine chronic values for chemicals that presently lack WQC-SC values for WQSV derivation for PRG development. |
| Table A-5. | Comparison of PNS baseline Preliminary Remediation Goals (PRGs) with literature-based sediment benchmarks. |
| Appendix B. | Derivation of Upper Limit 95th Percentiles for Normal and Lognormal Distributions. |

## LIST OF ACRONYMS AND UNITS

| | |
|---|---|
| AOC | Area of Concern |
| AMP | Amphipod |
| ARB | Sea urchin |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| AVS | Acid Volatile Sulfide |
| AWQC | Ambient Water Quality Criteria |
| BAF | Bioaccumulation Factor |
| BSAF | Biota-Sediment Accumulation Factor |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CoC | Contaminant of Concern |
| CWA | Clean Water Act |
| DOD | Department of Defense |
| DQ | Data Qualifier |
| EERA | Estuarine Ecological Risk Assessment |
| EMAP | Environmental Monitoring and Assessment Program |
| EPA (USEPA) | Environmental Protection Agency |
| EqP | Equilibrium Partitioning |
| ER-L | Effects Range-Low |
| ER-M | Effects Range-Medium |
| Foc | Fraction of Organic Carbon |
| FA | Freshwater Acute |
| FC | Freshwater Chronic |
| FDA | Food and Drug Administration |
| FFA | Federal Facilities Agreement |
| FS | Feasibility Study |
| HQ | Hazard Quotient |
| HMW | High Molecular Weight |
| IR | Installation Restoration |
| IRP | Installation Restoration Program |
| kg/L | kilogram per liter |
| Koc | Organic Carbon Partitioning Coefficient |
| Kow | Octanol/Water Partition Coefficient |
| L-CoC | Limiting Chemical of Concern |
| LMW | Low Molecular Weight |
| mg/L | milligrams per liter |
| NA | Not Available |
| NCP | National Contingency Plan |
| ng/g dry wt | nanograms per gram of dry weight |
| NOAA | National Oceanic and Atmospheric Administration |
| NOEC | No Observable Effect Concentration |
| NOEQ | No Observable Effect Quotient |
| NSTP | National Status and Trends Program |
| OU | Operable Unit |

## LIST OF ACRONYMS AND UNITS (continued)

| | |
|---|---|
| PAH | Polycyclic Aromatic Hydrocarbon |
| PCB | Polychlorinated Biphenyl |
| ppm | parts per million |
| PRG | Preliminary Remediation Goal |
| PW | Pore water |
| RAO | Remedial Action Objective |
| RBC | Risk-Based Concentration |
| RPRG | Recommended Preliminary Remediation Goal |
| RSV | Reference Screening Value |
| SA | Saltwater Acute |
| SAIC | Science Applications International Corporation |
| SC | Saltwater Chronic |
| SD | Standard Deviation |
| SEM | Simultaneously Extractable Metal |
| SQC | Sediment Quality Criteria |
| SQRT | Square Root |
| STDEV | Standard Deviation |
| TBC | To Be Considered |
| TEL | Threshold Effect Level |
| TEV | Threshold Effects Value |
| TEV-HQ | Threshold Effects Value Hazard Quotient |
| TOC | Total Organic Carbon |
| $95^{th}$ UL | Ninety Five Percent Upper Limit |
| USEPA | United States Environmental Protection Agency |
| WQ | Water Quality |
| WQC | Water Quality Criteria |
| WQSV | Water Quality Screening Value |
| µg/L | micro grams per liter |
| µg/g dw sediment | micrograms per gram of dry weight sediment |
| µmol/g dw | micromole per gram of dry weight |

## 1.0 BACKGROUND AND OBJECTIVES

The purpose of this document is to develop and present Preliminary Remediation Goals (PRGs) for the offshore area (Operable Unit 4[OU4]) of the Portsmouth Naval Shipyard. PRGs are chemicals and their associated concentrations that when implemented during remediation, will reduce risk to acceptable levels. The general framework for this activity was based on the "Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual" (Part B, Development of Risk-based Preliminary Remediation Goals, USEPA 1991). The general approach was provided in the Interim Offshore Monitoring Plan (TtNUS 1999).

The Portsmouth Naval Shipyard is located in the lower Piscataqua River in Kittery, Maine. As a Department of Defense (DoD) facility, investigation and cleanup are conducted as part of the Navy's Installation Restoration (IR) Program. Requirements are to be consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), pursuant to the Federal Facility Agreement (FFA) between the Navy and the U.S. Environmental Protection Agency (USEPA).

As part of the IR Program, numerous investigations have been conducted to determine the type and extent of Contaminants of Concern (CoCs) in soil, groundwater, and offshore sediment, surface water and shellfish, including associated risks to the environment and human health. Results of these investigations revealed elevated (low to intermediate) ecological risks for offshore (*e.g.*, sediment and shellfish tissue) media.

Based on the results of offshore risk assessments, the Navy will prepare a Feasibility Study (FS) for OU4 at Portsmouth Naval Shipyard describing options for remedial actions. The remedy options will be evaluated with regard to effectiveness for meeting objectives for mitigation of existing and potential threats to public health and the environment. These Remedial Action Objectives (RAOs) are based on knowledge of the types of CoCs, the environmental media (e.g., water, sediment, and shellfish) in which they are found or could be found in the future and the projected use of the site. Preliminary RAOs for OU4 are provided in Table 1.0-1. Applicable or Relevant and Appropriate Requirements (ARARs) and To-Be-Considered (TBCs) standards are also considered in determining the effectiveness for meeting RAOs.

Among the chemical-specific ARARs/TBCs described in Table 1.0-2 are the Federal ARARs/TBCs derived from promulgated USEPA Water Quality Criteria (WQC) and proposed USEPA Sediment Quality Criteria (SQC), which are intended to be protective of 95 percent of all aquatic species. The most current WQC (or sediment quality guidelines when WQC are not available) are used to develop the PRGs. The threshold chemical concentrations that comply with the ARAR or TBC criteria are called the PRGs for the site. The threshold concentrations are generally risk-based concentrations (RBCs) calculated using site-specific data. USEPA SQC are not used for PRG development because they are screening values, not cleanup goals. Also, SQC do not exist for all analytes of concern.

In this report, PRGs were developed and used to evaluate shipyard-related chemical contamination at OU4. The findings will be used to support remedial alternatives evaluation in

the FS for OU4 in accordance with the requirements of the National Contingency Plan (NCP) and CERCLA guidance.

Two threshold criteria (overall protection of human health and the environment, and compliance with ARARs) and one of five "balancing" criteria (reduction of toxicity) that are used to evaluate the remedial alternatives are directly applicable to PRG selection. The other balancing criteria (long-term effectiveness and permanence; short-term effectiveness; implementability and cost) that also directly affect the acceptability of various remedial alternatives are evaluated in the FS. Hence, the PRGs do not represent absolute levels that must be removed from the site, rather the application of the seven criteria with Trustee involvement will be necessary to select the Final Remediation Goals for the site.

Based on this information, the objectives of PRG development are to:

- Derive candidate PRGs;
- Implement candidate PRGs and compare results against ecological risk findings; and
- Recommend PRGs for evaluation in FS.

Derivation and implementation of PRGs are discussed in Sections 2 and 3, respectively. In Section 4 conclusions with regard to the effectiveness of selected PRGs are discussed relative to potential risk reduction that could be achieved versus type and concentration of CoCs constituting the PRGs. Tables and figures referenced in the text are provided at the end of the report. Supplemental tables used to support PRG calculation are provided in Appendix A.

## 2.0 PRG DERIVATION

The objective of the overall PRG development process is to select Limiting Chemicals of Concern (L-CoCs) for the site and identify their respective concentrations that, when implemented as cleanup goals, will focus remedial action in those areas where aquatic risk is higher than acceptable levels. The general approach for PRG derivation is presented in Section 2.1; detailed procedures and results are presented in Section 2.2 and Section 3, respectively.

In the PRG development process, it is assumed that implementing a PRG for a chemical causing the highest risk will lead to reduction of lesser risks caused by other CoCs. Secondly, it is assumed that those CoCs selected as PRGs adequately represent risks posed by all site-related CoCs, *e.g.*, there does not exist novel chemicals at high concentrations that have not yet been detected or are present in a form that is more bioavailable than has been previously measured. Finally, it is important to note that the limiting PRG approach will be effective only when various chemical contaminants and exposure pathways remain co-located at the sampling location. "Dislocation" of CoCs from one another might arise from application of treatment technologies that preferentially remove one CoC class over another. If such a practice is instituted, then the available data must be re-evaluated for each CoC class and exposure pathway to ensure all receptors are adequately protected.

## 2.1 Overview of PRG Development Approach

It is the objective of the PRG development to establish sediment-based concentrations that represent thresholds below which adverse effects on ecological receptors are not expected to occur. Since sediments are the primary reservoir of shipyard-related chemical contamination, the primary exposure mechanism of concern to be addressed by PRGs are the CoC exposures that occur in undisturbed (*i.e.*, bedded) sediment. Once the PRGs are developed, however, they can be applied to protect both "soft-bottom" and "hard-bottom" communities, of which the latter group receives CoC exposure via Portsmouth Naval Shipyard sources or from sediment particulates resuspended from sedimentary environments.

In the remainder of Section 2 the process for PRG derivation is presented that uses co-located information about sediment chemistry, toxicity, and geotechnical characteristics as well as related information on CoC-specific properties, benchmarks, and reference area concentrations. USEPA research has demonstrated that measurements of chemical concentration in pore water will adequately represent the sum of chemical exposure from sediments (Di Toro *et al.* 1991). Upon completion of PRG calculations, PRGs are evaluated against site chemistry to determine areas that exceed PRGs.

This evaluation also includes an assessment of hard-bottom environments wherein the tissue concentrations of indigenous biota (mussels, lobsters) are used to infer compliance with sediment-based PRGs (Section 3). Benthic species are also at potential risk because of CoCs contained in their body tissue. Thus, despite the lack of bedded sediment, species living in hard-bottom areas may be at risk to exposure to sediment that is resuspended, transported from nearby depositional areas and bioaccumulated in shellfish tissues. Hence, PRGs developed for sediment will also be used to protect species inhabiting hard-bottom environments. This assumes that the majority of site-related chemical exposure to which the [hard-bottom dwelling] organisms are exposed is derived from nearby sediments; this would appear to be the case given the low concentration of CoCs in the surface water around the shipyard (NCCOSC 2000). Site-specific factors controlling CoC bioavailability include the source, type, and concentration of CoC as well as the lipid content of species selected as surrogates for hard-bottom communities in the ecological risk assessment (indigenous mussels, lobsters).

The general approach for derivation of ecological risk-based PRGs for identified pathways involve refinement of the CoC list and calculation of protective concentrations (derivation), followed by an analysis of site-specificity and practicality for supporting risk reduction (implementation). The general procedures outlined in the five steps below and in Table 2.1-1 are discussed in detail in later sections that will be followed by derivation of candidate PRGs for the site. Steps 6 and 7 involve PRG implementation and assessment and are discussed in Section 3.

1. *Identify primary exposure pathways and select/derive benchmarks to express risks of CoC exposure.* For the aquatic exposure pathways identified in the Estuarine Ecological Risk Assessment (EERA) (NCCOSC 2000) the media of concern for PRG derivation is the concentration of CoCs in the pore water of bedded sediments (implementation of

shellfish tissue CoC concentrations for protection of hard-bottom communities are discussed in Section 3). CoC-specific WQC and/or water-based screening values derived from sediment benchmarks are used as the threshold effects values. This exposure paradigm, called Equilibrium Partitioning or EqP, presently serves as the basis for establishing Sediment Quality Criteria by USEPA, and it is fundamentally based on the applicability of WQC for protection of adverse effects of CoCs in sediment when partitioning characteristics of the chemical between water and the organic carbon content of the sediment is taken into account (Di Toro *et al.* 1991).

2. *Calculate site-specific no effect threshold concentrations for each CoC-receptor pair.* For each CoC, site-specific factors may exist that modify the degree of chemical exposure/bioavailability to target receptors. For the aquatic pathway, site-specific factors related to the bound form of the CoC in the environment (*e.g.*, some CoCs present as paint chips, scrap metal, sand blast material, etc.) cause the true CoC bioavailability to aquatic receptors (*i.e.*, infaunal and epibenthic community) in the Piscataqua River to be less than predicted directly by bulk sediment concentrations. Here, aquatic toxicity tests are used to discern possible site-specific modification in CoC bioavailability.

   Using the site-specific information the second step in the PRG development process is to calculate site-specific no observable effect concentrations (NOECs) for each CoC and exposure pathway. The NOEC represents the highest chemical concentration for which effects are unlikely to occur. For example, if an effect was observed at 2, 3, and 4 parts per million (ppm) but not at 0.5 and 1 ppm, the 1 ppm concentration would be selected as the NOEC. The NOEC derivation process is discussed in detail in Section 2.

3. *Retain CoCs substantially contributing to risk.* An objective of PRG derivation is to identify and retain CoCs for which PRG implementation will lead to effective risk reduction at the site while eliminating other CoCs for which PRG implementation would not. For this step, it was assumed that if a CoC was a substantial risk contributor, the highest concentration associated with toxic samples must be greater than the NOEC. All CoCs satisfying this requirement were retained for further consideration as PRGs.

4. *Evaluate the feasibility of the CoC and pathway-specific NOEC as a long-term remediation goal.* Because of the general exchange of water and sediment in the Piscataqua River near Portsmouth Naval Shipyard, it was assumed that it would not be technically feasible in the long term to remediate to CoC concentrations that are lower than those generally found in the Piscataqua River. For this step, regional CoC concentrations were summarized, and the greater of the NOEC and reference-based concentration was determined. The resulting value was adopted as the Threshold Effects Value (TEV) for the aquatic exposure pathway. For the purposes of PRG development, "threshold" is meant to indicate the point of departure for site-related chemistry effects that can be feasibly implemented as a long-term remediation goal. *The Threshold Effect Value is defined as the highest chemical concentration at the site used to represent the exposure pathway of the receptor that can be expected to be found but not cause toxicity.* This will ensure that the sediment will not be cleaned up to a concentration that will have an associated pore water concentration that is lower than the no effect concentration or lower than the reference concentration.

5. *Assess CoC exceedances of TEVs to identify "limiting," pathway-specific CoCs for PRG selection.* The CoCs and associated concentrations to be used as PRGs are supposed to be risk-based, *i.e.*, reflective of the results of the risk assessment with respect to the selection of those CoCs that "limit" remediation (USEPA 1991). Here, L-CoCs are those analytes that are responsible for much of the baseline risk (because of high concentrations and/or strong correlation with high toxicity), such that by remediating these CoCs to their PRG concentrations, other co-located CoCs will be reduced to levels much less than their corresponding goals. In this step, TEV Hazard Quotients (TEV-HQs),being the pore water concentration of the chemical at that location divided by the TEV for the chemical, are inter-compared for each station and CoC to identify the L-CoC, *e.g.*, the CoC-exposure pathway pair that represents the maximum TEV-HQ observed for the station. This procedure greatly reduces the reliance on assumption of CoC co-location across the site because the broad spatial distribution of sampling locations minimizes the potential that a novel CoC (unique in distribution, concentration or speciation) would be missed and thus fail to be included as a L-CoC.

6. *Calculate PRGs from TEVs.* Based on the selection of L-CoC in Step 5, the TEV values identified in Step 4 are recalculated as necessary into appropriate (sediment-based) concentration (PRG) units to be implemented during site remediation. The calculated values are also discussed relative to traditional benchmarks so as to compare the relative degree of protection afforded to receptors by site-specific and generic approaches.

7. *Evaluate the practicality of the PRGs for effective risk reduction.* In this spatial analysis, a candidate PRG that, upon implementation as part of a remedial action, would result in risk reduction in the most affected areas should be favored over other candidate PRGs that do not. Note that this step, unlike the previous steps, is a qualitative, risk-based interpretation based on best professional judgment. In this analysis, the location of PRG exceedances (*e.g.*, PRG-HQ >1) for each of the L-CoCs is reviewed with respect to the spatial distribution and likelihood of observed risks at the site as concluded from the results of the EERA (NCCOSC 2000). The relationship between the potential risk reduction and PRG exceedance is evaluated to select Recommended PRGs (RPRGs) for input into risk management decisions regarding the selection of a final alternative for the site.. As such, the discussion is intended to be primarily supportive of the FS analysis of the five balancing criteria (see Section 1) in which extent of risk reduction is assessed against monetary and engineering implications of remedial alternatives.

## 2.2 Aquatic PRG Derivation

As identified in Section 2.1, five steps required for aquatic PRG derivation include 1) benchmark selection and expression of CoC concentration data as Hazard Quotients (HQs); 2) calculation of NOECs to account for CoC bioavailability under site-specific conditions; 3) retention of CoCs substantially contributing to aquatic risk at the site, 4) reference data comparison; and 5) L-CoC selection. Each of these steps is addressed in the following sections.

1. *Pathway Identification/Benchmark selection.* The EERA identified sediments as the principal exposure pathway of concern for aquatic receptors. SQC for sediments and WQC for surface waters are logical choices as ARARs for Portsmouth Naval Shipyard and are used in EqP-based approaches for PRG derivation. The direct applicability of SQC has been limited by the number of available criteria to date (presently two non-ionic organic compounds; Dieldrin [USEPA 1993a] and Endrin [USEPA 1993b]. The SQC derivation process has demonstrated the applicability of WQC to pore water concentrations for prediction of sediment toxicity when partitioning characteristics of the CoC between water and the organic carbon fraction of the sediment ($K_{OC}$) are taken into account using the EqP model of Di Toro *et al.* (1991):

$$1) \qquad C_p = C_s/(f_{oc} * K_{oc}).$$

In the above equation, organic chemical pore water concentrations ($C_p$, µg/L) are calculated from the corresponding sediment concentration ($C_s$, µg/kg; Tables A-2-2.4a and b) based on $f_{oc}$ (the fraction of organic carbon in the site sediment; and $K_{oc}$ [the organic carbon/water partitioning coefficient [$K_{oc}$] for the CoC]). Values for $K_{oc}$ (Table A-2-2.1) were determined from the relationship developed by the USEPA (Karickhoff *et al.* 1989):

$$2) \qquad \log_{10}K_{oc} = 0.00028 + 0.983*\log_{10}K_{ow};$$

where $K_{ow}$ = the octanol/water partition coefficient.

By adopting the EqP approach for the development of aquatic PRGs for Portsmouth Naval Shipyard, the chemical concentration in pore water relative to WQC is used as the primary measure of potential adverse effects (*i.e.*, risk) to aquatic biota. The application of the EqP model also allows incorporation of station-specific conditions (principally total organic carbon [TOC] content of sediment measured at the location) that control sediment-pore water partitioning and hence chemical bioavailability in bedded sediments.

Determination of organic and metal CoCs responsible for the majority of the risk is assessed through normalizing concentrations to benchmarks so as to adjust for differences in the inherent toxicity of the chemical. For this investigation, Water Quality Screening Values (WQSVs) adopted primarily from USEPA WQC - Saltwater Chronic (WQC-SC) values (or estimated equivalents, discussed next) were used as the benchmarks.

Water-based CoC criteria are proposed for calculation following the decision tree presented in Figure 2.2-1. This approach allows for calculation of "Water Quality Criteria-Saltwater Chronic (WQC-SC) equivalent" benchmarks, and assigns a data qualifier (DQ) to identify the benchmark source for derivation of the HQ. In Table 2.2-1, the DQ "A" is applied to benchmarks derived directly from existing WQC-SC values. For CoCs possessing WQC-saltwater acute values (WQC-SA), an acute:chronic ratio is applied to derive the equivalent WQC-SC value (DQ = "B"; Appendix A-4). Where an analyte-specific ratio was not available, a conversion factor of 8:1 representing the mean overall acute:chronic ratio for paired chemical data contained in the USEPA AQUIRE database was used (Shepard 1998). Freshwater chronic data (WQC-FC) are used directly as screening values, with assigned data qualifier "C".

Some sediment-based correlative benchmarks are required to complete the assessment of site-related CoCs where water quality benchmarks are lacking (Table 2.2-1). In these cases, National Oceanic and Atmospheric Administration (NOAA) Effects Range-Low (ER-L) (Long *et al.* 1995, Long and Morgan, 1990) concentrations and if not available, Threshold Effect Level (TEL; FDEP, 1994) concentrations were selected and translated into pore water equivalent concentrations using the EqP model. In this process, it is assumed that the resultant value provides a level of protection equivalent to other water quality based benchmarks. This assumption is not unreasonable given that the WQC values are designed to be protective of 95 percent of all species, whereas ER-L and TEL values represent concentrations below which 90 percent of all sediment samples had no measurable adverse effect. Thus, sediment benchmark values were transformed into water-equivalent benchmarks using the EqP model by assuming 1 percent sediment TOC concentration (DQ = "E").

Research by USEPA into the development of SQC for divalent metals (Copper, Cadmium, Lead, Nickel, and Zinc) in sediment has shown that sediment toxicity can be predicted when the quantity of Simultaneously Extractable Metal (SEM) present in excess of the Acid Volatile Sulfide (AVS) concentration in sediment is measured (Berry *et al.* 1996). The expression of SEM relative to AVS has been historically expressed as the SEM/AVS ratio, although the difference of SEM and AVS (SEM-AVS) is now preferred, as the metric is less sensitive to conditions in which AVS is near detection limits (*i.e.*, resulting in very high SEM/AVS ratios). The use of the SEM-AVS calculation is based on the fact that AVS will bind divalent metals in direct proportion to their respective molar concentrations (Hansen *et al.* 1996). In the USEPA National Sediment Quality Survey (USEPA, 1996) the SEM-AVS value of 5-µmol/g dry wt. is recommended as a screening value for identification of sediments of concern with regard to potential divalent metal effects on aquatic biota associated with bedded sediments. In Table 2.2-1, the DQ = "F" is applied to benchmarks derived from the SEM-AVS approach. Finally, compounds for which no benchmark screening values were available is designated "Not Available (NA)" in Table 2.2-1. Thus, these chemicals are not carried further through the process but rather are incorporated in the PRG document, where applicable, by including 'aggregate' benchmarks (*e.g.*, High Molecular Weight [HMW] PAHs).

PW-HQs reported in Table A-2-2.5 were calculated as the concentration in pore water (Tables A-2-2.4a and b) divided by the corresponding WQSV presented in Table 2.2-1. These quotients are used in No Observable Effect Quotient (NOEQ) derivation, discussed in the following section.

2. *Calculate site-specific no effect threshold concentrations.* The second step of PRG derivation involves the calculation of NOECs for each CoC-receptor pair. As discussed previously, the NOEC is a site-specific and CoC-specific threshold chemical concentration below which adverse effects on the receptor are unlikely to occur. This no effect value is derived using a so-called "correlative" approach, wherein a statistical analysis of field data including chemical concentrations associated with measured effect data is performed. For example, the NOAA ER-L benchmark (Long and Morgan 1990; Long *et al.* 1995) is a "correlative" benchmark representing the sediment concentration below which no adverse effect is expected 90 percent of the time. The value is statistically derived by matching of chemical concentrations with incidence of benthic effects (*e.g.*, toxicity, reduced benthic composition, biomarker response)

measured in field samples, and statistically estimating the sediment concentration below which 90 percent of sediment samples in the NOAA/FDEP effects database had no measurable adverse effect.

As introduced in Section 1, it is expected that site-specific factors exist that control the bioavailability of CoCs in the marine sediments of the shipyard study area and thus modify the degree of chemical impacts on target receptors. The primary indicator of site-specific CoC bioavailability in bedded sediment are toxicity results using the amphipod (*Ampelisca abdita*) 10-day bulk sediment test and the sea urchin (*Arbacia punctulata*) larval development test with matching collocated sediment and/or pore water chemistry. Here, co-located data imply that bulk sediment chemistry data and biotoxicity data are generated from the same sample. Two receptor endpoints are incorporated into the analysis that represents lethal (amphipod survival) and sub-lethal (sea urchin development) effects to better assess potential acute and chronic effects of site-related CoCs. Complete toxicity results are presented in the Round Two Interim Monitoring Data Package (TtNUS 2000a).

Adapting the correlative approach for derivation of the NOEC, PW-HQ data (pore water concentration normalized to the WQSV; from Step 1) were paired with co-located amphipod and sea urchin toxicity results and segregated based on selected toxicity-based threshold values. In choosing these values, a general assumption is that some proportion exists between the degree of mortality in a toxicity test and the extent of risk, however the exact relationship is not known.

For amphipods survival $\geq$80% of control and statistically significantly different from control was classified as nontoxic. The 80 percent survival cutoff is derived from a statistical evaluation of published toxicity results to determine the minimum degree of toxicity need to result in a finding of a statistically significant reduction relative to controls. In general more instances of toxicity are identified using sea urchin than amphipods (Carr 1996). However, there may be stations where the sediment is toxic to amphipods but the pore water is non-toxic to sea urchins at that station. This may be because the two species have different sensitivities to the same chemicals.

In the previous analysis of EERA data for PRG development, none of the sea urchin samples was toxic to sea urchin fertilization (e.g., survival < 70%), despite several analytes exceeding WQC (*i.e.*, 95% UL PW-HQ >1), such that no ARB-NOEQ values were retained. Hence, for the present study, the more sensitive sea urchin endpoint, larval development, was selected in order to facilitate the development of PRGs. This test is run at four pore water concentrations for each sample (25, 50, and 100% full strength pore water; with the control sample representing 0%) in order to derive an exposure response curve and calculation of the pore water concentration resulting in 50 percent reduction in larval development success ($EC_{50}$). In order to accurately determine the EC50 value, the requirement that at least partial (and statistically significant) mortality need to be observed in two or more of the treatments must be met. From an ecological perspective, this was deemed appropriate given that epibenthic organisms such as sea urchins are not likely exposed to full strength pore water (100%). The exposure concentrations for the epibenthic organisms are conservatively expected to be reduced by at least 50 percent as the pore water leaving the sediment is mixed with the overlying surface water. In other words, if a sample showed at least partial mortality in the 100% and 50%

dilution, but not in the 25% dilution, the sample would be considered toxic. As a rule of thumb, an EC50 of ~70% or less must generally be found for the above rule to hold true.

In reviewing the sea urchin toxicity results, locations with sample dilutions having uniformly high larval development ($EC_{50}$>100%) was observed for MS-1.2, MS-4.1, MS-5.1, MS-6.1, MS-9.1, MS-10.1, MS-11.3 and MS-14.1), and thus were obviously non-toxic (Table 2.2-2). In contrast, samples with dilutions have uniformly low larval development success ($EC_{50}$ < 25%) were found at locations MS-5.2, MS-13.1, MS-13.3) and were therefore clearly toxic. Among the remaining samples, locations MS-1.3, MS-9.4 and MS-10.3 had partial mortality in two or more dilutions and were therefore determined to be toxic. Lastly samples with statistically significant mortality only in 100% pore water were determined to be non-toxic. This included samples from 13 locations (MS-2.1, 2.2, 3.1, 3.2, 4.3, 6.3, 7.1, 8.1, 8.4, 9.2, 12.1, 12.2, and 14.2). As noted above, these incidences of partial mortality are not considered to be ecologically relevant (i.e., ecologically important to sustaining the population) for purposes of PRG development.

The paired data sets were subsequently segregated in nontoxic and toxic samples based on toxicity thresholds defined for each test (Table 2.2-3). The data sets are pooled across all the sampled locations at the site in order to capture the widest possible range of chemical exposure concentrations and associated toxicity. The pooling is based on the assumption that the route of chemical exposure is the same for all the target receptors. In the resulting data sets, the chemistry values are expressed as a quotient (HQ) as opposed to a concentration in order to facilitate the intercomparison of CoCs and more easily assess the magnitude of departure from the WQSV. The HQ databases for non-toxic amphipod (Table A-2-2.6) and sea urchin (Table A-2-2.8) samples include statistical summaries of the sample number, mean, statistical distribution type (i.e., normal or log-normal), and upper 95th percentile (95% UL) of CoC-specific pore water HQs (PW-HQ) based on the distribution type. See Appendix B for derivation of statistics.

The resulting data are used to determine the highest concentration for which adverse effects are unlikely for each test type, called the test No Observable Effect Quotient (NOEQ). The test NOEQ is assumed equal to the 95% UL, or for NOEQ values <1, an NOEQ = 1 was adopted. The latter adjustment was made because low 95% UL values could be due simply due to a lack of non-toxic observations at higher chemical concentrations, as well as it being unlikely that site-specific factors could increase CoC bioavailability to levels above that occurring in water-only tests.

Summary statistics for determination of test-specific NOEQ results for the amphipod (AMP-NOEQ) and sea urchin (ARB-NOEQ) exposure endpoints are provided in Table 2.2-3. The listed CoCs include metals, (measured in pore water), and organic compounds (predicted in pore water). Also included are aggregate values for Low Molecular Weight (LMW) PAHs, High Molecular Weight (HMW) PAHs, and Total PAHs and Total PCBs, and the sediment-based measure of divalent metal bioavailability (SEM-AVS). These aggregate CoC classes were included to address the potential additive effects of PAH and metal mixtures.

Also listed in Table 2.2-3 for each CoC are the 95% UL PW-HQ values associated with nontoxic samples. The input PW-HQ samples associated with nontoxic amphipod (AMP) and sea urchin (ARB) tests are contained in Table A-2-2.6 and Table A-2-2.8, respectively. Each of the data sets (amphipod and sea urchin) includes statistical summaries (mean and confidence limits) as required for the NOEQ derivation. The value N indicates the number of observations available for the 95% UL. The formula to calculate the 95% UL was adjusted depending on the underlying statistical distribution (i.e., normal vs. log normal). For amphipods, 23 matched chemistry/toxicity data were available, whereas 21 matched chemistry/toxicity data were available for calculation of the sea urchin development NOEQ (ARB-NOEQ; Table A-2-2.8).

A 95% UL PW-HQ at unity can be interpreted to indicate that the bioavailability (hence potential toxicity) of the CoC in the sediment pore water is the same as would be expected for water-only tests from which the WQC were derived. The results presented in Table 2.2-3 show that for each test species and majority of CoCs, the 95% UL was less than unity, indicating that toxicity was not observed where criteria values predict that toxicity should not occur. In such cases where the *CoC-specific* 95% UL was less than 1, a test-specific NOEQ value of 1 was retained.

For the remainder of CoCs, the 95% UL did exceed unity and hence this value was adopted as the test NOEQ. The fact that the 95% UL was sometimes greater than unity is attributed to site-specific conditions that have apparently reduced CoC bioavailability relative to conditions under which the WQC are derived (*i.e.*, single-species, water-only laboratory bioassays). In ten and seven cases respectively for the amphipod and sea urchin test results, the test 95% UL values were between unity and three, indicating that the degree of site-specific toxicity modification was not substantial. In nine and 12 cases for the amphipod and sea urchin test results, respectively, the test NOEQs ranged from 3-10, indicating substantive reduction in site-specific bioavailability than would otherwise be predicted form the WQSV value.

3. *Retaining CoCs substantially contributing to risk.* Listed in Table 2.2-3 are the maximum PW-HQ values for sediment samples found to be toxic to amphipods and sea urchins, respectively (supporting data are reported in Appendix Tables A-2-2.7 and A-2-2.9, respectively). In evaluating this data, it was assumed that toxic samples should have CoC concentrations that are higher than the no effect concentration. Hence, those CoCs that were found to exceed the NOEQ benchmark (Max. HQ > NOEQ) for a given test endpoint were retained for further PRG derivation. The NOEQs for amphipods (AMP-NOEQ) were retained for two metals (copper, nickel), 11 PAHs, including LMW, HMW, Total PAHs, and four pesticides (Endosulfan II, Trans-Nonaclor, o,p'-DDT, and p,p'-DDT ) as indicated in Table 2.2-3. In comparison to the amphipods, only PAHs were retained (except Dibenz(a,h)anthracene) for sea urchins (ARB-NOEQ).

As part of a conservative approach to protect receptors represented by amphipods and sea urchins as well as both lethal and sub-lethal effects, the Aquatic NOEQ (AQ-NOEQ) value to be used for further PRG development was taken as the minimum of the two tests. In the present data set, there is generally good agreement in the PAHs comprising the ARB-NOEQ and AMP-NOEQ lists, hence lending confidence for their inclusion as overall aquatic NOEQs. This finding would suggest similar chemical sensitivities between the two species/endpoints. For the

CoCs that were not identified by the *Arbacia* test (Copper, Nickel, Dibenz(a,h)anthracene Endosulfan II, Trans-nonaclor, o,p'-DDT, p,p'-DDT), this may represent species/endpoint differences in sensitivity, or else a reflection of some imprecision in the process.

Of the calculated AQ-NOEQs, 10 of 17 values are three or less indicating that the site-specific benchmark for no effects for these CoCs is within a factor of three of the corresponding water quality screening values. In the case of the metal AQ-NOEQs, these responses at or near WQC thresholds indicate that *Ampelisca* and *Arbacia* are adequate surrogates for the most sensitive species in the vicinity of Portsmouth Naval Shipyard.

4. *Evaluate the feasibility of the CoC and pathway-specific NOEC as a long-term remediation goal.* The Aquatic NOEQs derived in the previous step require evaluation against regional CoC concentrations because it would not be technically feasible in the long term to remediate to CoC concentrations that are lower than those generally found in the Piscataqua River. Before performing this comparison, it was deemed necessary to demonstrate that habitats (and therefore associated receptors) in the vicinity of the shipyard are comparable to that at reference locations. Parameters selected to assess comparability were sediment grain size and TOC content as reported in the Round 2 data summary (TtNUS 2000a).

Data presented in Table A-2-2.3 show that the average sand content for reference locations (81%) is somewhat higher than that observed at the Portsmouth Naval Shipyard stations (62%). Accordingly, the average silt and clay content at the reference stations (11% and 7%, respectively) is proportionately less than that observed at the Portsmouth Naval Shipyard stations (25% and 12%, respectively). As a result, the TOC content for reference locations (1.3%) was somewhat lower than that observed for stations near the shipyard (1.8%). Still, the general geotechnical characteristics are broadly similar, implying comparability of habitats, such that the reference locations serve as suitable sites for background data.

A database of aquatic Reference Screening Value (RSV) for the candidate CoCs discussed previously was prepared and summarized in Table 2.2-4. The RSV database is assembled from predicted (organics) and measured (metals) pore water concentrations at reference locations. The RSV was calculated as the 95% UL of pore water CoC concentrations for derivation of aquatic PRGs following the same procedures used for the 95% UL values in Step 2.

To complete Step 4, each Aquatic NOEQ value (from Step 3; Table 2.2-3) was converted into a NOEC (*e.g.*, in water concentration units) by multiplying the value by the respective WQSV (i.e., NOEC = NOEQ x WQSV). This was done to permit direct comparison of the NOEQ against the pore water RSV (from Step 4; Table 2.2-4). Subsequently, the Aquatic TEV (AQ-TEV) was taken from the greater of the NOEC and RSV.

The results in Table 2.2-5 show that in nearly all cases (except Copper), the RSV is lower than the NOEC, that is, the background concentrations are lower than the site-specific CoC threshold values for protection of aquatic biota from adverse CoC impacts. This indicates that effects-based thresholds rather than regional background conditions are largely determining the selected TEV values.

5. *Assess CoC exceedances of TEVs to identify "limiting," pathway-specific CoCs for PRG selection.* The final step of PRG derivation for protection of aquatic receptors involves the straightforward application of TEV values to derive media-specific HQs. These HQ values are intercompared for each station and CoC to identify the L-CoC, *e.g.*, that CoC-exposure pair that represents the maximum TEV-HQ observed for the station. Subsequently, the corresponding TEV values are converted into PRGs, being the TEV-equivalent concentration expressed in units suitable for implementation in the FS (discussed in Section 3).

The assumption that implementing the most conservative PRG as leading to risk reduction of all CoCs at a given location is supported by literature, in that the CoCs being investigated act in the same manner or that remedial action prevents contact of receptors by CoCs with equal effectiveness. This is based on the narcosis theory, wherein CoC concentrations in target tissue affect thresholds for specific toxic action (*e.g.*, central nervous system, respiratory, digestive disruptions), may still cause nonspecific toxicity through the combined presence of the chemical mixture (McCarty *et al.* 1992). In this case, the mode of toxic action is physiological debilitation caused by CoC-related swelling of cell membranes (McCarty *et al.* 1992). Narcosis theory supports the Limiting CoC concept because if the CoCs have similar mode of action, then the total risk of all CoCs in the sample can be summed (i.e., sum HQ) and compared directly to toxicity responses in the samples. The applicability of narcosis theory to PRG development is enhanced by the fact that organic CoCs (*i.e.*, PAHs, PCBs, and pesticides) generally fall into a class of compounds that contribute to the narcotic mode of toxic action (McCarty *et al.* 1992). This approach is also believed to apply to organo-metals (*e.g.*, butyltins) and metals (McCarty and Mackay 1993).

Since narcosis theory does appear to be relevant to the various CoC classes considered in this analysis, it can be assumed that all CoCs for PNS exert risks in a comparable manner. Therefore any proposed remedial action will not result in modifying the level of protection afforded to receptors on an analyte-specific basis, since the mode of toxicity as well as the method of remediation of the collocated chemicals (e.g., by natural attenuation) is similar. Thus, it is not necessary that PRGs be developed for all risk-causing chemicals or chemical classes, because when the PRG chemical is reduced to acceptable levels, the collocated CoCs will also be reduced to levels below their corresponding remediation goals (e.g., HQ < 1, if HQ = 1 is the baseline PRG).

The L-CoC selection is based on identification of the CoC with the maximum TEV-HQ by station for the bedded sediment exposure pathway. To ensure that all the important L-CoCs are retained, the CoC with the maximum TEV-HQ for the station was selected whenever the station sum of individual analyte TEV-HQ values (excluding LMW, HMW and Total PAH values) exceeded unity. This step was taken to further address the uncertainty in the co-location assumption by identifying any CoC, which might substantially contribute to risk at the site and could be effectively incorporated into a remediation strategy. Hence, the potential that a novel CoC (unique in distribution, concentration, or speciation) would be missed and thus fail to be included as a L-CoC, is minimized. The process was repeated for all sampled locations to identify the collection of all possible L-CoCs.

Results of the L-CoC selection process are summarized in Appendix Table A-2-2.10. Among all the possible CoC candidates, only seven CoCs (Copper, Nickel, Acenapthylene, Anthracene, Fluorene, Trans-Nonaclor and p,p'-DDT) had TEV-HQs >1. Two CoCs (HMW PAHs, Endosulfan II) were carried forward from Table 2.2-5 only because the sum TEV-HQ exceeded one; the corresponding TEV-HQ value was less than one. Still, as part of a conservative approach, the analytes were retained in case unsampled locations might have higher concentrations than were observed from among the monitoring locations. Finally, the fact that only nine L-CoCs are repeatedly identified across the 42 sampling locations encompassing PNS supports the assumption that a few CoCs can be selected as PRGs for monitoring risk reduction at the site.

In the following section, the CoCs are applied to the interim monitoring sediment database to evaluate the extent PRG exceedances coincide with observed risks (determined in the EERA) and therefore, the potential risk reduction that could be achieved by using the PRGs as remediation goals.

## 3.0 PRG IMPLEMENTATION

The second phase of PRG development (Steps 6 and 7) involves a qualitative assessment of the practicality for spatial implementation, *i.e.*, whether the spatial implementation of the PRG effectively targets areas of increased risk as identified in the EERA. This requires that the TEV values, which represent the no effect threshold concentration for L-CoCs, be translated into sediment based units so available data at the site can be considered with respect to PRG compliance and risk reduction (Section 3.1). In this regard, the calculated PRG values are also intended to represent baseline risk thresholds. Subsequently, baseline PRGs are "tested" through comparison against measured chemical concentrations at the site, such that the relationship between the areas of PRG exceedance and the degree of risk as concluded in the risk assessment can be ascertained (Section 3.2). This analysis leads to the development of so-called RPRGs, which are PRGs considered to be appropriate from a risk-based perspective (Section 3.3). The baseline and RPRGs are used as input into the FS and resulting risk management decisions regarding the setting of Remediation Goals.

### 3.1 Translation of Aquatic TEV Values into PRGs

In translating the pore water TEV into sediment-based concentrations, the primary intention is to derive a PRG number that equally protects the receptor. Thus, when the PRG is applied to measured sediment chemistry, a comparable degree of risk should be indicated (*i.e.*, the TEV HQ equal the PRG HQ). For example, when sediment pore water concentration at a given location is two-fold above the TEV (*e.g.*, TEV-HQ = 2), the PRG, when compared to the corresponding sediment concentration, should also indicate a risk exceedance by a factor of two (*i.e.*, PRG-HQ = 2). Inherent in this application of PRGs is the assumption that risk at a given location when expressed as a unitless quotient is the same regardless of whether the benchmark is TEV-based or PRG-based, thus:

$$\text{PRG-HQ}_{\text{Sta., CoC, Pathway}} = \text{TEV-HQ}_{\text{Sta., CoC, Pathway}} \qquad (3)$$

Where the risk equivalency assumption in Equation 3, the previous statement holds true only for a given location, CoC, and exposure pathway.

The concept of cross-matrix risk equivalency is not new. This approach, for example, was used in the EERA to assess risks as a result of CoCs in tissues (from Shepard, 1998) based on WQC. This assumes that the tissue concentration in the biota achieved at the water-based effects threshold (*e.g.*, WQC-chronic) is the relevant tissue-based effects threshold because CoCs must reach the site of toxic action (*e.g.*, tissues) to exert their effect. Similarly, the measured risk associated with the pore water concentration (i.e., TEV-HQ) should be the same as that attributed to the bulk sediment (i.e., PRG-HQ).

The relationship described in Equation 3 can be used to solve for the location-CoC-pathway as follows. Substituting for PRG-HQ:

$$4) \qquad HQ_{TEV} = C_{Sed} / PRG,$$

Given the TEV-HQ and associated sediment concentration ($C_{Sed}$), the PRG concentration can be solved:

$$5) \qquad PRG = [\sum_{n}^{1} (C_{Sed} / HQ_{TEV})] / N,$$

The important feature of this TEV-to-PRG translation method is that the measured risk data are used to derive the PRG value. In some cases, further modification might be needed if, for example, characteristics of a particular media sampled at a given location (*e.g.*, TOC content of sediment, inert CoC materials such as metal fragments) result in an estimated PRG that is outside the expected range about the value at PRG-HQ = 1. In the present study, the high copper values from monitoring stations MS-3.2 and MS-4.1 were not used to calculate the OU4-wide PRG concentration as the elevated levels were statistical outliers and likely caused by the metal slag observed at both locations (Attachment 3.5). With this exception, the procedure described above was used to calculate station-specific PRG estimates from which the mean PRG value was taken as the site-wide PRG concentration. Results of this process are discussed in Section 3.2.

*PRG Calculation Results.* Table 2.2-6 presents a summary of baseline PRGs that were calculated for the aquatic exposure pathway using the procedure described in the above section; supporting calculations are presented in Table A-3-1.1. Note that the analyte list includes only "Limiting CoCs," *i.e.*, those CoCs identified in Table 2.2-5 as having the maximum TEV-HQ by station for the pathway. The means of station-specific PRG estimates were used to derive the site-wide baseline PRG concentration (Appendix Table A-3-1.1). The RPRG concentrations that will be determined based on comparisons of PRG exceedances to site risks will be discussed in Section 3.3.2.

Results of the L-CoC selection process are summarized in Appendix Table A-2-2.10. Among all the possible CoC candidates, only seven CoCs (Copper, Nickel, Acenapthylene, Anthracene, Fluorene, Trans-Nonaclor and p,p'-DDT) had TEV-HQs >1. Two CoCs (HMW PAHs, Endosulfan II) were carried forward from Table 2.2-5 only because the sum TEV-HQ exceeded one; the corresponding TEV-HQ value was less than one. Still, as part of a conservative approach, the analytes were retained in case unsampled locations might have higher concentrations than were observed from among the monitoring locations. Finally, the fact that only nine L-CoCs are repeatedly identified across the 42 sampling locations encompassing PNS supports the assumption that a few CoCs can be selected as PRGs for monitoring risk reduction at the site.

In the following section, the CoCs are applied to the interim monitoring sediment database to evaluate the extent PRG exceedances coincide with observed risks (determined in the EERA) and therefore, the potential risk reduction that could be achieved by using the PRGs as remediation goals.

## 3.0 PRG IMPLEMENTATION

The second phase of PRG development (Steps 6 and 7) involves a qualitative assessment of the practicality for spatial implementation, *i.e.*, whether the spatial implementation of the PRG effectively targets areas of increased risk as identified in the EERA. This requires that the TEV values, which represent the no effect threshold concentration for L-CoCs, be translated into sediment based units so available data at the site can be considered with respect to PRG compliance and risk reduction (Section 3.1). In this regard, the calculated PRG values are also intended to represent baseline risk thresholds. Subsequently, baseline PRGs are "tested" through comparison against measured chemical concentrations at the site, such that the relationship between the areas of PRG exceedance and the degree of risk as concluded in the risk assessment can be ascertained (Section 3.2). This analysis leads to the development of so-called RPRGs, which are PRGs considered to be appropriate from a risk-based perspective (Section 3.3). The baseline and RPRGs are used as input into the FS and resulting risk management decisions regarding the setting of Remediation Goals.

### 3.1 Translation of Aquatic TEV Values into PRGs

In translating the pore water TEV into sediment-based concentrations, the primary intention is to derive a PRG number that equally protects the receptor. Thus, when the PRG is applied to measured sediment chemistry, a comparable degree of risk should be indicated (*i.e.*, the TEV HQ equal the PRG HQ). For example, when sediment pore water concentration at a given location is two-fold above the TEV (*e.g.*, TEV-HQ = 2), the PRG, when compared to the corresponding sediment concentration, should also indicate a risk exceedance by a factor of two (*i.e.*, PRG-HQ = 2). Inherent in this application of PRGs is the assumption that risk at a given location when expressed as a unitless quotient is the same regardless of whether the benchmark is TEV-based or PRG-based, thus:

$$\text{PRG-HQ}_{\text{Sta., CoC, Pathway}} = \text{TEV-HQ}_{\text{Sta., CoC, Pathway}} \qquad (3)$$

Where the risk equivalency assumption in Equation 3, the previous statement holds true only for a given location, CoC, and exposure pathway.

The concept of cross-matrix risk equivalency is not new. This approach, for example, was used in the EERA to assess risks as a result of CoCs in tissues (from Shepard, 1998) based on WQC. This assumes that the tissue concentration in the biota achieved at the water-based effects threshold (*e.g.*, WQC-chronic) is the relevant tissue-based effects threshold because CoCs must reach the site of toxic action (*e.g.*, tissues) to exert their effect. Similarly, the measured risk associated with the pore water concentration (i.e., TEV-HQ) should be the same as that attributed to the bulk sediment (i.e., PRG-HQ).

The relationship described in Equation 3 can be used to solve for the location-CoC-pathway as follows. Substituting for PRG-HQ:

$$4) \qquad HQ_{TEV} = C_{Sed} / PRG ,$$

Given the TEV-HQ and associated sediment concentration ($C_{Sed}$), the PRG concentration can be solved:

$$5) \qquad PRG = [\sum_{n}^{1} (C_{Sed} / HQ_{TEV})] / N ,$$

The important feature of this TEV-to-PRG translation method is that the measured risk data are used to derive the PRG value, whereas traditionally the EqP models would be used to back-calculate PRGs. In some cases, the models may still be needed. For example, if characteristics of a particular media sampled at a given location (*e.g.*, TOC content of sediment, inert CoC materials such as metal fragments) result in an estimated PRG that is outside the expected range about the value at PRG-HQ = 1, verification with the model may be required. In these instances, the predicted values can be validated against model estimates in relation to the model parameter inputs for the given location and the cause for atypical (high or low) PRG values can be isolated. In the present study, the procedure described above was used to calculate station-specific PRG estimates from which the mean PRG value was taken as the site-wide PRG concentration. Results of this process are discussed in Section 3.2.

*PRG Calculation Results.* Table 2.2-6 presents a summary of baseline PRGs that were calculated for the aquatic exposure pathway using the procedure described in the above section; supporting calculations are presented in Table A-3-1.1. Note that the analyte list includes only "Limiting CoCs," *i.e.*, those CoCs identified in Table 2.2-5 as having the maximum TEV-HQ by station for the pathway. The means of station-specific PRG estimates were used to derive the site-wide baseline PRG concentration (Appendix Table A-3-1.1). The RPRG concentrations that will be determined based on comparisons of PRG exceedances to site risks will be discussed in Section 3.3.2.

## 3.2 Spatial Implementation of PRGs

As discussed briefly in Section 2, habitats in the vicinity of Portsmouth Naval Shipyard fall into two main categories with respect to the exposure pathways and reservoirs of site-related CoCs. These habitats include "soft-bottom" bottom communities composed primarily of soft sediment (sand, mud) and "hard-bottom" communities composed of rock ledge and/or unconsolidated gravel. Soft-bottom habitats support infaunal (*e.g.*, amphipods), epifaunal (*e.g.*, mussels), epifloral (*e.g.*, eelgrass and associated epiphytic growth), scavenger (*e.g.*, lobster), and sediment-associated fish (*e.g.*, flounder, mummichog) communities, whereas hard-bottom communities include scavenger and fish communities as well as epifloral communities, but lack the infaunal components or communities.

The approach for development of PRGs has primarily focused on protecting these receptors of soft-bottom sediments because these species are in intimate contact with the sediment and the sediment is the main reservoir of CoC contamination. However, the EERA has also determined that some hard-bottom communities in the vicinity of the shipyard also have environmental conditions posing CoC risk that is above baseline (*e.g.*, the DRMO Area of Concern [AOC]), and therefore protection of these receptors via PRG implementation is required.

Results of the EERA have been used to classify the study area polygons based on the probability of adverse ecological risk caused by site-related CoCs to aquatic receptors (Figure 3.2-1). The map shows an intermediate probability of adverse ecological risk for the western, northwestern, and southeastern portions of the shipyard whereas a low probability of risk was observed for northeastern and southern central shipyard areas. No areas of the shipyard were classified into the high-risk category. As the implementation of PRGs are intended to reduce risk, it is important to ensure that the PRGs, when compared to location-specific chemical concentrations, agree with the risk assessment findings; that is, PRG exceedances are observed where low and intermediate risks were identified in the EERA based on the full weight of evidence, discussed in Section 3.3, below.

The translation of tissue-based concentrations into sediment-based units is needed to assess PRG compliance for hard-bottom areas where tissue residue concentrations are the primary indicator of CoC exposure. The method of translation involves the application of Bioaccumulation Factors (BAFs) for metals and Biota-Sediment Accumulation Factors (BSAFs) for organics (Tracey and Hansen 1996; USEPA 1998). The BSAF model (tissue/lipid to sediment/TOC ratio) is selected as the best available model for predicting bioaccumulation of organics because it incorporates site-specific (sediment TOC) and organism-specific (tissue lipid) data. Seasonal bioaccumulation of organics in shellfish is related to lipid content of the organism (affected by spawning cycle). Measurement of lipid content and appropriate normalization of organic concentration based on lipid content is an established method that accounts for seasonally related to the spawning cycle. The BAF model (tissue/sediment ratio) is considered the best available model for metals. The BAF model excludes the TOC and lipid normalization because they are not important in predicting metals bioaccumulation. To provide the most conservative data set for PRG development, sampling for PRG needs was conducted

when metals are generally the most bioavailable in sediment during the year (late winter/early spring), because of low AVS relative to SEM.

As noted in the sampling plan (TtNUS 1999), mussels are used as the primary form of biota for interim monitoring. Because there were some sampling locations in the EERA where sediment was not generally present (i.e., in the vicinity of the DRMO AOC), mussel is being proposed as an alternative measure to sediment for the interim monitoring. Application of sediment-based PRGs/cleanup levels to mussel is based on mussel being in close proximity to sediments and that sediments act as a source of contamination to the mussels. Published studies show that BSAFs are comparable between indigenous mussels and other sediment-associated species (USEPA 1996), such that the process by which the sum accumulation of CoCs (pore water, sediment, resuspended sediment, surface water) is occurring can be adequately modeled by the BASF. The BAF model is also the most commonly used model for metals bioaccumulation; organism-specific models for metals are largely unavailable and are rarely used.

Using the Round 2 interim monitoring results, BSAF/BAF factors were calculated and used to predict sediment concentrations that would be required to explain measured concentrations in biota tissue of hard-bottom communities. The resulting predicted sediment concentrations were compared against PRGs to evaluate potential for impacts on benthic and epibenthic organisms (Section 3.3). The basic assumption in this approach is that the sensitivity of receptors of concern (*e.g.*, mussels, lobsters) to CoCs is the same regardless of the habitat they occupy (*i.e.*, soft-bottom vs. hard-bottom). Based on this assumption, PRGs developed to set thresholds for unacceptable exposure will be equally protective of these receptors regardless of habitat type. This assumption is further supported by the fact that the ultimate point of exposure are the CoCs in the tissues and the likelihood of effects is controlled by the tissue residue concentrations, regardless of the mode of transport of CoCs to the receptor (*i.e.*, sediment pore water versus resuspended particulates). Hence, PRGs will be protective of receptors if permissible exposure concentrations result in bioaccumulation below effect levels.

For metals, the sediment-based concentration (μg/g dry wt) is calculated from the tissue-based concentration (μg/g dry tissue) according to the formula:

$$\text{BAF} = \frac{\text{tissue concentration}}{\text{sediment concentration}} \quad (5)$$

therefore:

$$\text{sediment concentration} = \frac{\text{tissue concentration}}{\text{BAF}} \quad (6)$$

BAF values for metals were derived from site-specific data collected during interim monitoring. Median BAFs were calculated for each species collected.

For organic CoCs, the corresponding sediment concentration (ng/g dry wt) were estimated from the formula:

$$\text{BSAF} = \frac{\text{tissue concentration/lipid concentration}}{\text{sediment concentration/TOC concentration}}$$

therefore:

$$\text{sediment conc} = \frac{\text{TOC conc[(tissue concentration)/lipid conc]}}{\text{BSAF}} \quad (7)$$

Sample-specific BSAF factors for individual organic analytes and BAF factors for metals were aggregated to develop mean BSAF/BAFs following procedures recommended by USEPA (1996). In this analysis, data that were either non-detect ("U" flagged) or of reduced certainty ("J" flagged) were excluded to increase the accuracy of the ratio.

Summary results of the accumulation factor calculations are shown in Table A-3-1.2i; supporting calculations are provided in Table A-3-1.2a-h. For the present study, the overall mean BSAF values for PAHs, PCBs, and pesticides in mussels were 0.050, 0.79 and 1.12, respectively. In general, there was considerable overlap in central tendency about the mean BSAF value among the analytes, and generally good agreement was observed between lobsters and mussels; the overall mean BSAF values for PAHs, PCBs, and pesticides in lobster were 0.067, 1.03 and 7.34, respectively. Pesticides in lobsters were perhaps the exception, where the mean BSAF (7.3) was higher than mussels although the median value (2.3, not shown) indicates that four of the pesticides with BSAFs greater than 25 are primarily responsible. These values may be revised after BSAFs and BAFs are recalculated using data from the first four rounds of sampling.

Results of the present study are similar to BSAF values calculated in the same manner from literature values for infaunal deposit feeders, scavengers, filter feeders, and benthically-coupled fish, where mean BSAFs for PAHs (0.34) were uniformly lower than PCB (1.03) or pesticide (1.36) classes (Tracey and Hansen 1996; USEPA 1998). In another study of Narragansett Bay (RI) species (SAIC 1995), these values were 0.27, 1.57, and 1.62, respectively. The similarity in BSAFs for PCBs and pesticides across species and studies demonstrates that varying habitats of the target receptor, including epibenthic/filter feeders (indigenous and deployed mussels), infaunal (clams), epibenthic scavengers (lobsters), and epibenthic predators (fish) do not alter the bioavailability of organic chemicals in the sediments. PAHs, in contrast, appear to have lower bioavailability than is typically observed, which is perhaps due to the form of PAHs in sediment (perhaps highly weathered or combusted). Still, the agreement among BSAFs for the two species suggest that functional contaminant exposure pathways among the target receptors are similar, allowing the use of a single factor to predict tissue accumulation of organic contaminants for purposes of monitoring.

## 3.3 Assessment of PRGs for Risk Reduction

The assessment of example PRG suitability as cleanup goals for the site involves the separate evaluation of L-CoCs listed in Table 2.2-6 at baseline risk (PRG-HQ=1) concentrations.

In this section, the measured sediment concentrations are normalized to baseline PRG values (expressed as a Hazard Quotient, PRG-HQ) and results summarized with respect to where each analyte was observed to have the highest PRG exceedance (Section 3.3.1). As part of the assessment, the PRGs are also compared to literature-based benchmarks as an independent check on the reasonableness of the values obtained.

Finally, in the overall assessment of the data, the relationship between the degree of PRG exceedance and observed risk at the site is examined (Section 3.3.2). Based on this analysis, recommended PRG concentrations (RPRG) are proposed that reflect risk-proportional options (e.g., the degree of risk reduction achieved in relation to the selected PRG concentration). These risk-proportional values are meant to assist risk managers for evaluation with respect to technical and fiscal constraints of PRG implementation for various remedial alternatives.

### 3.3.1 Baseline PRG evaluation

In this section, sediment concentrations measured at the site are compared to respective Baseline PRG concentrations. Station locations are shown in Figure 3.3-1; results of this analysis are depicted in Figure 3.3-2. Raw calculations showing all PRG-HQ values for each sampling location are presented in Appendix Table A-3-1.3. The PRGs are also compared to sediment-based benchmarks (e.g., NOAA ER-L/ER-M) as a check for the degree of protection afforded by the site-specific values (Table A-5).

Copper. Copper did not exceed the PRG (486 µg/g dry wt) at any of the EERA sampling locations (Table A-3-1.3a). Sediment concentrations did exceed the baseline PRG for copper during Round 2 sampling at five sampling locations (Table A-3-1.3c), of which four were the highest PRG-HQ for that location (MS-3.2, PRG-HQ = 2.24; MS-4.1, PRG-HQ = 3.66; MS-8.3, PRG-HQ=1.55; MS-11.3, PRG-HQ=1.11). Copper also exceeded the PRG at MS-3.2 (PRG-HQ=7.65) and MS-4.1 (PRG-HQ=1.16) in Round 1 sampling (Table A-3-1.3b) and was the highest PRG-HQs for those locations.

The baseline PRG value was found to be about two-fold above the ER-M (270 µg/g dry weight) values, suggesting that site-specific bioavailability of copper is less than that found on average at the NOAA locations from which the ER-M value was derived. This finding is consistent with the observation that the SEM-AVS values in general were less than the threshold associated with onset of potential toxicity. That is, site-specific conditions at PNS result in relatively lower pore water to sediment concentration ratios of Copper than might be expected from the literature-based values. A possible cause might be the presence of inert Copper or organic binding phases (TOC, Dissolved Organic Carbon [DOC]) that retard the partitioning of copper into pore water. Because the value is based on measured toxicity at the site, the PRG value is expected to protect aquatic biota from adverse exposures to copper in sediment.

Nickel. The baseline PRG for Nickel (124 µg/g dry wt) during Round 2 sampling was exceeded at four PNS sampling locations, with the maximum exceedance observed at MS-9.1 (PRG-HQ=1.29; Table A-3-1.3c). During Round 1 sampling, the PRG was exceeded only at MS-8.3 (PRG HQ = 1.4; Table A-3-1.3b). Nickel did not exceed the PRG at any of the EERA sampling locations (Table A-3-1.3a).

The Nickel baseline PRG was found to be about two-fold higher than the ER-M (51.6 µg/g dry weight) value. As with Copper, this finding is consistent with the observation that the SEM-AVS values in general were less than the threshold associated with onset of potential toxicity, suggesting that site-specific conditions at PNS result in relatively lower pore water to sediment concentration ratios of Nickel than might be expected from the literature-based values. Also because the value is based on measured toxicity at the site, the PRG value is expected to protect aquatic biota from adverse exposures to Nickel in sediment.

Acenaphthylene. Sediment concentrations exceeding the baseline PRG for Acenapthylene (210 ng/g dry wt) during Round 2 sampling occurred at five sampling locations, one of which (MS-1.1, PRG-HQ = 1.40); was the highest PRG-HQ for that location (Table A-3-1.3c). During Round 1 sampling, two locations exceeded the PRG, but in only one case (M-10.3; PRG-HQ= 1.03) was this CoC the highest observed PRG-HQ (Table A-3-1.3b). Acenaphthylene did not exceed the PRG at any of the EERA sampling locations (Table A-3-1.3a).

The baseline PRG for Acenapthylene was found to be at the low end of the range between the ER-L (44 ng/g dry wt) and ER-M (640 ng/g dry weight) values, and thus is comparable to values expected to protect aquatic biota from adverse exposures to acenapthylene in sediment.

Anthracene. The exceedance of the baseline PRG for Anthracene (1236 ng/g dry wt) during Round 2 sampling occurred at three sampling locations, one of which was the highest PRG-HQ for the sampling location (MS-10.2, PRG-HQ = 1.33; Table A-3-1.3c). During Round 1 sampling, anthracene exceeded the baseline PRG at only one location (MS-12.1, PRG-HQ = 2.33; Table A-3-1.3b). No exceedance of the baseline PRG for anthracene was observed during EERA sampling.

As the PRG for Anthracene was derived based on predictions of chemical partitioning into pore water and compared to a WQSV benchmark based on the ER-L, there is some uncertainty in calculating the PRG. However, the value is based on measured toxicity at the site such that the PRG value is expected to protect aquatic biota from adverse exposures to Anthracene in sediment.

Fluorene. The baseline PRG for Fluorene (500 ng/g dry wt) during Round 2 sampling was exceeded at four locations (MS-1.3, PRG-HQ=1.83; MS-12.1, PRG-HQ = 1.36; MS-12.2, PRG-HQ = 1.30; and MS-13.1, PRG-HQ = 7.51) all of which were the highest values at that location (Table A-3-1.3c). During Round 1 sampling, Fluorene exceeded the baseline PRG at only one location (MS-12.1, PRG-HQ = 2.79; Table A-3-1.3b). One exceedance of the baseline PRG was also observed during EERA sampling (BC-18, PRG-HQ = 1.35; Table A-3-1.3a).

The baseline PRG for Fluorene was found to be at the high end of the range between the ER-L (19 ng/g dry wt) and ER-M (540 ng/g dry weight) values, and thus comparable to values expected to protect aquatic biota from adverse exposures to Fluorene in sediment.

HMW PAHs. The exceedance of the baseline PRG for HMW PAHs (13057 ng/g dry wt) during Round 2 sampling was observed at three locations (MS-1.3, PRG-HQ = 1.09; MS-12.1, PRG-HQ = 1.02; MS-13.1, PRG-HQ = 1.27), but none were the highest PRG-HQ value for that location (Table A-3-1.3c). During Round 1 sampling, HMW PAHs exceeded the baseline PRG at only one location (MS-12.1, PRG-HQ = 3.03, Table A-3-1.3b), while two exceedances of the baseline PRG was also observed during EERA sampling (BC-18, PRG-HQ=1.20; DD-12.5, PRG-HQ = 1.37; Table A-3-1.3a).

The baseline PRG for HMW PAHs was above the NOAA ER-M (9600 ng/g dry wt) value, but because the value is based on measured toxicity at the site such that the PRG value is expected to protect aquatic biota from adverse exposures to HMW PAHs in sediment.

Endosulfan II. The exceedance of the baseline PRG for Endosulfan II (3.95 ng/g dry wt) during Round 2 sampling was observed at one location (MS-1.1, PRG-HQ = 1.11), but was not the highest PRG-HQ value for that location (Table A-3-1.3c). Endosulfan II exceeded the baseline PRG at two locations during Round 1 sampling (MS-1.3, PRG-HQ = 1.77; MS-8.3, PRG-HQ = 1.06; Table A-3-1.3b). This compound was not measured during EERA sampling.

The baseline PRG for Endosulfan II was below the Sediment Quality Advisory Level (14 ng/g dry wt) and thus the value is expected to be protective of aquatic biota from adverse exposures to Endosulfan II in sediment.

Trans-nonaclor. An exceedance of the baseline PRG for Trans-nonaclor (3.99 ng/g dry wt) during Round 2 sampling was observed at two locations (MS-1.2, PRG-HQ = 1.38; and MS-10.1, PRG-HQ = 1.85), the latter being the highest PRG-HQ value for that location (Table A-3-1.3c). During Round 1 sampling, Trans-nonaclor exceeded the baseline PRG at three locations (MS-1.3, PRG-HQ = 1.45; MS-8.3, PRG-HQ = 1.08; MS-10.1, PRG-HQ = 5.26, Table A-3-1.3b) with the exceedance at MS-10.1 being the highest PRPG-HQ observed for that location. Trans-nonaclor was not measured during the EERA investigation, thus PRG exceedances for this chemical cannot be assessed.

The baseline PRG for Trans-nonaclor was within two-fold of the TEL (2.26 ng/g dry wt) value, and thus is expected to protect aquatic biota from adverse exposures to Trans-Nonaclor in sediment.

p,p'-DDT. The exceedance of the baseline PRG for p,p'-DDT (66.4 ng/g dry wt) during Round 2 sampling was observed at four locations of which only three (MS-1.2, PRG-HQ = 2.86, MS-4.3, PRG-HQ = 2.62; MS-8.1, PRG-HQ = 4.29) was the highest value for that location (Table A-3-1.3c). Only four locations (MS-1.2, PRG-HQ= 1.64, MS-1.3, PRG-HQ = 16.8, MS-4.3, PRG-HQ = 1.34, MS-8.3, PRG-HQ = 1.99) exceeded the baseline PRG during Round 1 sampling, and all four were the highest PRG-HQ for each location (Table A-3-1.3b). Finally, no locations exceeded the baseline PRG for p,p'-DDT during EERA sampling.

The PRG is above the NOAA ER-M (27 ng/g dry weight) value. It is noted that this CoC has not been linked to an onshore Installation Restoration Program (IRP) site at the current

time, and therefore is not a CoC for OU4. The Navy has agreed to calculate PRGs for pesticides should they becomes CoCs in the future.

### 3.3.2 Recommended PRGs evaluation

In consideration of the above patterns of maximum PRG-HQ results across the three rounds of sampling (EERA, Round 1, Round 2) Copper, Fluorene, HMW PAHs, Trans-nonaclor and p,p'-DDT appear to have the higher (PRG-HQ >2) values. Maximum PRG-HQ values for Nickel, Acenapthylene, and Anthracene were lower but also above unity, while Endosulfan II did not exhibit the highest PRG-HQ at any station. Thus, there was generally good agreement between those analytes identified as L-CoCs and those retained as baseline PRGs.

Both Round 1 and Round 2 interim monitoring locations tended to have higher PRG-HQs than was found for the EERA locations. Unlike the interim monitoring locations, the EERA stations tended to be further offshore and in deeper water. This would suggest that increased distance to potential shipyard sources has resulted in decreased sediment concentrations, and as a result, lower PRG-HQs at the EERA locations.

In the EERA, the three principal areas found to have elevated (i.e., "intermediate") risks include Back Channel, Sullivan Point, and Dry Docks, while the remaining areas (Jamaica Cove, Clark Cove and DRMO) were identified with low risks. In comparing the locations of maximum PRG exceedances with observed risk at the site (Figure 3.3-1a, Table 3.3-1a), Fluorene and HMW PAH concentrations were above baseline PRGs at only one intermediate risk station located in the back channel (BC-18) and near the Dry Dock area (DD12-5), respectively. Following a conservative approach, the selection of the Recommended PRG-HQ defaults to unity when only one location for each baseline PRG is available to assess risk to PRG-HQ relationships.

The interim monitoring locations were classified as to risk based on proximity to the EERA locations, and sediment concentrations compared to PRGs. For Round 1 sampling, four of five baseline PRGs (Copper, Acenapthylene, HMW PAHs, Trans-nonaclor) had exceedances always associated with intermediate risk stations (Figure 3.3-1b, Table 3.3-1b). As discussed above, a Recommended PRG-HQ equal to unity (1.0) was selected given that only one level of risk was observed for each analyte to assess risk to PRG-HQ relationships. The fifth chemical, p,p'-DDT, did not display reliable risk to PRG-HQ relationships since a low risk station (MS-8.3) had a higher PRG-HQ than two intermediate risk areas (MS-1.2, MS-4.3). Hence a recommended PRG-HQ could not be established for this chemical during Round 1 sampling.

For Round 2 sampling, five of the seven baseline PRG chemicals (Nickel, Acenapthylene, Anthracene, Fluorene, Trans-nonaclor) either had maximum PRG-HQ exceedances at only one location or were always associated with one level of risk (Figure 3.3-1c, Table 3.3-1c). Accordingly, the Recommended PRG-HQ for these analytes again defaults to unity. The sixth chemical, p,p'-DDT, did not display reliable risk to PRG-HQ relationships since a low risk station (MS-8.3) had a higher PRG-HQ than two intermediate risk areas (MS-1.2, MS-4.3). Hence a recommended PRG-HQ could not be established for this chemical and sampling round. Finally, in the case of copper, a departure from low to intermediate risk was observed

with higher PRG-HQ values, suggesting that elevated exposure concentrations may be related to increased risk. Hence a RPRG-HQ based on results for this sampling round was conservatively set to be equal to the point of departure between low and intermediate risks (i.e., PRG-HQ = 1.55).

Recommended PRG-HQs by sampling round and for the overall PRG development process are summarized in Table 3.3-2. Six of the nine chemicals (Copper, Nickel, Acenapthylene, Anthracene, Fluorene, HMW PAHs) identified as L-CoCs had low or intermediate risks when baseline PRGs were exceeded, hence the selected PRGs appear to address the potential impacts of site-related chemicals. The remaining L-CoCs (Endosulfan II, Trans-nonaclor and p,p'-DDT) are pesticides for which RPRGs are not recommended. It is noted that these CoCs have not been linked to an onshore Installation Restoration Program (IRP) site at the current time, and therefore are not CoCs for OU4. The Navy has agreed to calculate PRGs for pesticides should they becomes CoCs in the future. Still, risks from other collocated CoCs might be present at locations where the pesticides were found that are site-related, and thus further evaluation is needed to ensure that all site-related chemical risks are addressed by these PRGs, discussed below.

Endosulfan II was identified as a L-CoC with the highest TEV-HQ at five locations, and the analyte was carried forward into further PRG development based on a finding a sum TEV-HQ greater than one at each of these locations (Table A2-2.10). However, the associated maximum TEV-HQ was always less than one, and the corresponding PRG-HQ was never the highest value at the few locations where the baseline PRG was exceeded (i.e., for Round 1, locations MS-1.3, MS-8.3; Round 2, location MS1-1; see Table A-3-1.3). Hence it is concluded that exclusion of Endosulfan II as a Recommended PRG for interim monitoring will not result in inadequate consideration of aquatic risks posed by this chemical.

Trans-nonaclor was identified as a L-CoC due to a high TEV-HQ at a single location (MS-10.1, TEV-HQ= 1.89; Table A-2-2.10). This chemical also exceeded its corresponding PRG only at this location during Round 1 (PRG-HQ=5.26) and Round 2 (PRG-HQ= 1.85) sampling. Because no other PRG exceedances were observed at this location, it is concluded that exclusion of Trans-nonaclor as a Recommended PRG for interim monitoring will not result in inadequate consideration of aquatic risks posed by this chemical.

For p,p'-DDT, the analyte was identified as a L-CoC given highest TEV-HQ values at three locations (MS-1.1, MS-8.1, MS-8.3; Table A-2-2.10). The corresponding PRG was exceeded at four locations (MS-1.2, MS-1.3, MS-4.3, and MS-8.3) for Round 1 and three locations (MS-1.2, MS-4.3, and MS-8.1) for Round 2. Also, two of three stations (MS-1.2, MS-8.1) were not toxic during Round 2 testing suggesting that risks found for the area may not occur at this location or have attenuated since the EERA was conducted. In absence of p,p'-DDT and other baseline PRG pesticides, only exceedances for nickel (MS-4.3, Round 2; MS-8.3, Round 1) were observed. As nickel was retained as a PRG, risks at these locations due to CoCs other than p,p'-DDT should be addressed.

Finally, PRGs did not address a number of intermediate risk locations around PNS (Table 3.3-1). The reasons for this are not entirely apparent, yet it would appear that since sediment concentrations did not exceed the PRGs, the source of risks may not be caused by the CoCs being evaluated as PRGs, or that risks at these locations have abated since the EERA was conducted. Further discussion of uncertainty regarding the implementation of PRGs is discussed in Section 4. Long term monitoring will be performed and PRG concentrations will be compared against sediment concentrations measured at these locations for a number of years. Based on these data, a decision as to the need for continued monitoring at these locations will be made.

## 4.0 UNCERTAINTY ANALYSIS

The PRGs calculated for the Portsmouth Naval Shipyard Offshore area (Operable Unit 4) were developed in a manner consistent with site ARARs. The baseline PRG values can be viewed simply as calculated values that are yet to be validated against the independent benchmarks and the risk assessment findings. Although not every sampling location around PNS had a PRG exceedance, multiple sampling locations within each of the intermediate risk areas (i.e., Dry Docks, Back Channel, Sullivan Point) did exhibit PRG exceedances. Thus, areas of PRG exceedance appear to correspond well with areas of observed risk such that the implementation of baseline PRG values (i.e., as recommended PRGs) would appear to be reasonable from a risk-based perspective). The magnitude of the PRGs is generally comparable to correlative benchmarks and hence provides confirmation that minimal residual risk associated with the CoCs will remain when the PRGs are achieved. Several years of interim monitoring will occur. It is expected that RPRGs would remain approximately the same. It is possible that additional CoCs might be identified from trend analysis and additional PRGs may need to be calculated if such trends are of potential risk concern (e.g., potential to cause toxicity).

The process of calculating the baseline PRGs is largely quantitative, although considerable professional judgment and input from regulators and Trustees were incorporated into designing the process and the sampling program to collect the necessary data needed for development of PRGs. There are uncertainties in the process that may result in values that do not efficiently address risk at the site. For example, a particular baseline PRG may be calculated that would appear to suggest that much larger areas of the site pose unacceptable risks and hence conflict with the findings of the risk assessment. One factor that can cause this may happen when sources of non-CoC toxicity such as ammonia occur and therefore artificially reduce PRGs. In the present toxicity data set, three locations (MS-5.2, MS-13.1, and MS-13.2) had un-ionized ammonia concentrations above 0.2 mg/L whereas NOEC and LOEC unionized ammonia values are 0.037 and 0.090 mg/L, respectively (Carr *et al.* 1996). This would suggest that ammonia may be a contributing factor to the observed toxic response.

In contrast to the baseline PRGs, the recommended PRGs are derived by performing a check that selected CoCs and corresponding RPRG concentrations adequately represent the risk characterization provided in the EERA. Here, the RPRGs are based on interpretation of the data in light of observed distribution and severity of estimated risks at the site; other considerations and findings as presented in FS reports regarding potential onshore sources may also modify the Final Remediation Goals to be adopted by risk managers.

For purposes of PRG development, it is assumed that a fundamental change in CoC bioavailability has not occurred between the time the EERA data were collected (1990-1992) and when data for PRG development were collected (May 2000). Hence, those areas where increased risks were identified in the EERA should also be expected to have PRG exceedances. However, if substantial attenuation has occurred, or if CoCs have undergone significant weathering, they may become less toxic or bioaccumulative. Accordingly, risks also could have attenuated and hence the PRGs are likely to be overprotective. The finding that many of the PRGs identified in this report agree well with those PRGs identified from use of the EERA data (SAIC 1999) reduces this uncertainty and indicates that the necessary PRGs have been determined.

Finally, it must be stressed that the data collected for PRG development, as part of the interim offshore monitoring, should not be used to assess risks because the data were not collected to characterize risk. Even if they were, the results would not necessarily show the same risk as the EERA because of potential chemical attenuation. Rather, the interim monitoring program will determine whether attenuation is occurring and whether RPRGs that are protective of identified risks are likely to be met.

## 5.0 LITERATURE CITED


Berry, W. J.; Hansen, D. J.; Mahoney, J. D.; Robson, D. L.; Di Toro, D. M.; Shipley, B. P.; Rogers, B.; Corbin, J. M.; Boothman, W. S. 1996. Predicting the toxicity of metal-spiked laboratory sediments using acid-volatile sulfide and interstitial water normalizations. Environ. Toxicol. and Chem., 15:2067-2079.

Buchman, M.F. 1999. NOAA Screening Quick Reference Tables. NOAA HAZMAT Report 99-1, Seattle, WA, Coastal Protection and Restoration Division, National Oceanic and Atmospheric Administration, 12 pp.

Carr, R. S.; Long, E. R.; Windom, H. L.; Chapman, D. C.; Thursby, G.; Sloane, G. M.; Wolfe, D. A. 1996. Sediment Quality Assessment Studies of Tampa Bay, Florida. Environ. Toxicol. Chem., 15(7):1218-1231.

Di Toro, D. M.; Zarba, C. S.; Hansen, D. J.; Berry, W. J.; Schwartz, R. C.; Cowan, C. E.; Pavlou, S. P.; Allen, H. E.; Thomas, N. A.; Paquin, R. 1991. Technical basis for establishing sediment quality criteria for non-ionic organic chemicals using equilibrium partitioning. Environ. Toxicol. and Chem., 10:1541-1586.

Florida Department of the Environment (FDEP). 1994. Approach to the assessment of sediment quality in Florida coastal waters, Vol. 1: Development and evaluation of sediment quality assessment guidelines. Prepared for Florida Department of Environmental Protection, Office of Water Policy, Tallahassee, FL by MacDonald Environmental Sciences Ltd., Ladysmith, British Columbia.

Hansen, D. J.; Berry, W. J.; Mahony, J. D.; Boothman, W. S.; Di Toro, D. M.; Robson, D. L.; Ankley, G. T.; Ma, D.; Yan, Q.; Pesch, C. E. 1996. Predicting the toxicity of metal contaminated field sediments using interstitial concentrations of metals and acid-volatile sulfide normalizations. Environ. Toxicol. Chem., 15(12):2080-2094.

Karickhoff, S. W.; Carreira, L. A.; Melton, C.; McDaniel, V. K.; Vellino, A. N.; Nate, D. E. 1989. Computer prediction of chemical reactivity. The ultimate SAR. EPA 600/M-89-017. U.S. Environmental Protection Agency, Athens, GA.

Karickhoff, S. W.; Long, J. M. 1995. Summary of measured, calculated and recommended log $K_{ow}$ values. Office of Water, U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.002, pp. 2

Long, E. R.; Morgan, L. G. 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOS OMA 52. National Oceanic and Atmospheric Administration.

Long, E. R.; MacDonald, D. D.; Smith, S. L.; Calder, F. D. 1995. Incidence of Adverse Biological Effects within Ranges of Chemical Concentrations in Marine and Estuarine Sediments. Environ. Manage., 19 (1): 81-97.

McCarty, L. S.; McKay, D. A.; Smith, D. G.; Ozburn, W.; Dixon, D. G. 1992. Residue-based interpretation of toxicity and bioconcentration QSARs from aquatic bioassays: neutral narcotic organics. Environ. Toxicol. and Chem., 98, 11(7): 917-930.

McCarty, L. S.; McKay, D. 1993. Enhancing Ecotoxicological Modeling and Assessment. Environ. Sci. Technol., 27(9): 1719-1728.

NOAA Technical Memorandum. 1991. The potential for biological effects of sediment-sorbed contaminants tested in the National Status and Trends Program. NOAA NOS OMA 52, Seattle WA, 175 pp. and appendices.

NCCOSC (Naval Command, Control, and Ocean Surveillance Center). 2000. Final Estuarine Ecological Risk Assessment for Portsmouth Naval Shipyard, Kittery, Maine. NCCOSC, Narragansett, RI

Ott, R. Lyman. 1993. *An Introduction to Statistical Methods and Data Analysis, Fourth Edition.* Duxbury Press, Belmont, CA.

Science Applications International Corporation (SAIC). 1995. Allen Harbor Landfill and Calf Pasture Point Offshore Ecological Risk Assessment Report: Technical Report and Appendices A-D. SAIC Report to EA Engineering under U.S. Navy Northern Division Contract No. N624-92-D-1296, Contract Task Order 0032. 81 pp. + Appendices.

SAIC, 1991a. Memorandum to David. J. Hansen, EPA- Environmental Research Laboratory, Narragansett, RI. Flow-through chronic toxicity of DDT to Mysidopsis bahia.

SAIC, 1991b. Memorandum to David. J. Hansen, EPA- Environmental Research Laboratory, Narragansett, RI. Acute toxicity of DDT to Mysidopsis bahia in a flow-through test.

SAIC. 1999. Approach for Development of Preliminary Remediation Goals (PRGs) for Operable Unit 4, Portsmouth Naval Shipyard. In: Tetra Tech NUS. 1999. Interim Offshore Monitoring Plan for Operable Unit 4 Portsmouth Naval Shipyard, Kittery, ME. Northern Division Naval Facilities Engineering Command.

Shepard, B.K. 1998. Quantification of ecological risks to aquatic biota from bioaccumulated chemicals. National Sediment Bioaccumulation Conference EPA 823-R-98-002, pp. 2-31 to 2-52.

TtNUS. 1999. Interim Offshore Monitoring Plan for Operable Unit 4 Portsmouth Naval Shipyard, Kittery, ME. Northern Division Naval Facilities Engineering Command.

TtNUS. 2000a. Interim Offshore Monitoring Program Round 2 Data Package for Portsmouth Naval Shipyard, Kittery, ME. Northern Division Naval Facilities Engineering Command.

TtNUS. 2000b. Interim Offshore Monitoring Program Round 1 Data Package for Portsmouth Naval Shipyard, Kittery, ME. Northern Division Naval Facilities Engineering Command.

Tracey, G. A.; Hansen, D. J. 1996. Use of Biota-Sediment Accumulation Factors to Assess Similarity of Non-ionic Organic Chemical Exposure to Benthically-coupled Organisms of Differing Trophic Mode. Arch. of Environ. Contam. Toxicol., 30 (4): 467-475.

USEPA (United States Environmental Protection Agency). 1980. Ambient Water Quality Criteria for Naphthalene. EPA-440-5-80-059.

USEPA (United States Environmental Protection Agency). 1980b. Ambient Water Quality Criteria for DDT. EPA-440-5-80-059.

USEPA (United States Environmental Protection Agency). 1991. Risk Assessment Guidance for Superfund: Volume 1 - Human Health Evaluation Manual. Part B, Development of Risk-based Preliminary Remediation Goals.

USEPA (United States Environmental Protection Agency). 1993a. Sediment Quality Criteria for the Protection of Benthic Organisms: Dieldrin (Draft). EPA-822-R-93-013.

USEPA (United States Environmental Protection Agency). 1993b. Sediment Quality Criteria for the Protection of Benthic Organisms: Endrin (Draft). EPA-822-R-93-012.

USEPA (United States Environmental Protection Agency). 1996. The National Sediment Quality Survey: A report to congress on the extent and severity of sediment contamination in the surface waters of the United States. Office of Science and Technology, EPA-823-D-96-002.

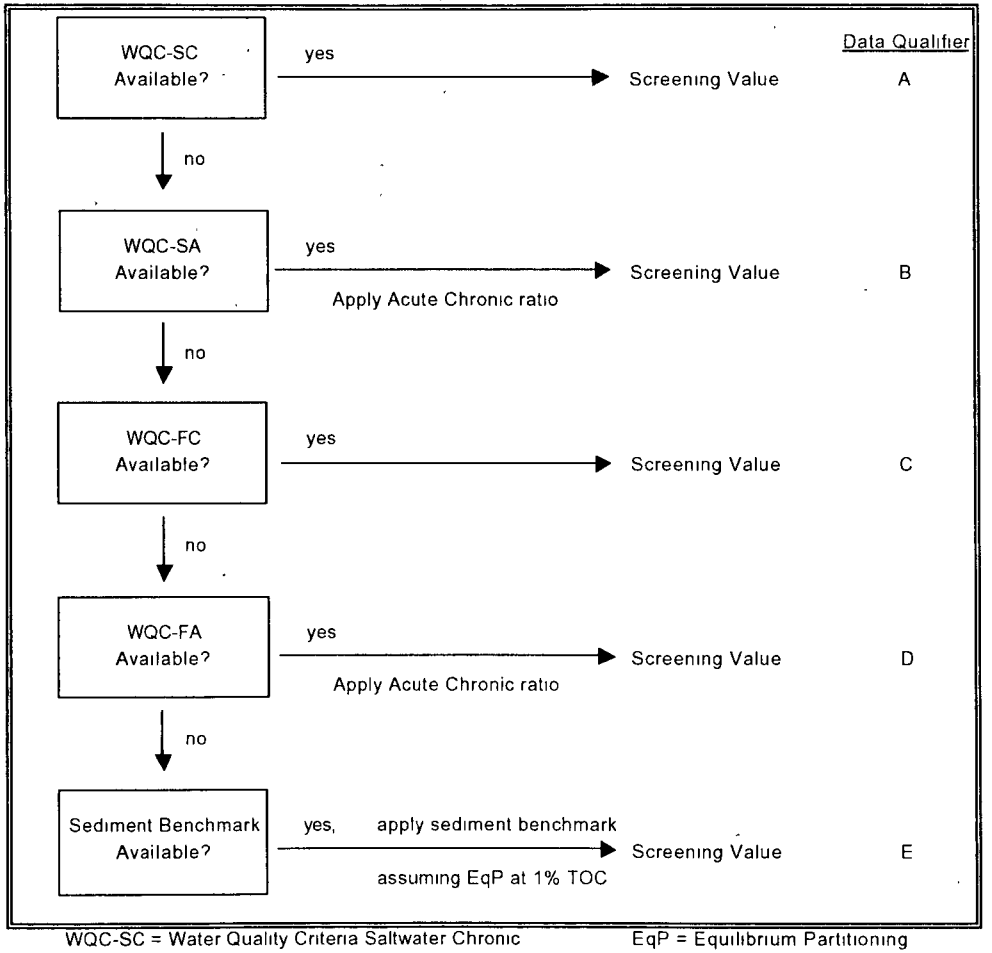
USEPA (United States Environmental Protection Agency). 1997. The incidence and severity of sediment contamination in surface waters of the United States. Vol. 1: National Sediment Quality Survey. EPA 823-R-97-006.

USEPA 1999. National Recommended Water Quality Criteria-Correction. Office of Water. EPA 822-Z-99-001.

# LIST OF FIGURES


| FIGURE | | PAGE NOS. |
|---|---|---|
| 2.2-1 | WATER QUALITY SCREENING VALUE SELECTION PROCESS AND ASSOCIATED DATA QUALIFIERS | 28 |
| 3.2-1 | ECOLOGICAL RISK PROBABILITY FOR THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA | 29 |
| 3.3-1 | SAMPLING LOCATIONS FOR PRG DEVELOPMENT IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA | 30 |
| 3.3-2 | SUMMARY OF COCS WITH HIGHEST BASELINE PRG EXCEEDANCES BY LOCATION FOR SEDIMENTS FROM THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA; A:EERA DATA, B: ROUND 1 MONITORING DATA, C: ROUND 2 MONITORING DATA | 31 - 33 |

Figure 2 2-1. Water quality screening value selection process and associated data qualifiers.




WQC-SC = Water Quality Criteria Saltwater Chronic
WQC-SA = Water Quality Criteria Saltwater Acute
WQC-FC = Water Quality Criteria Freshwater Chronic
WQC-FA = Water Quality Criteria Freshwater Acute

EqP = Equilibrium Partitioning
TOC = Total Organic Carbon

Figur 3.2-1. Ecological risk probability for th Portsmouth Naval Shipyard offshor study ar a.

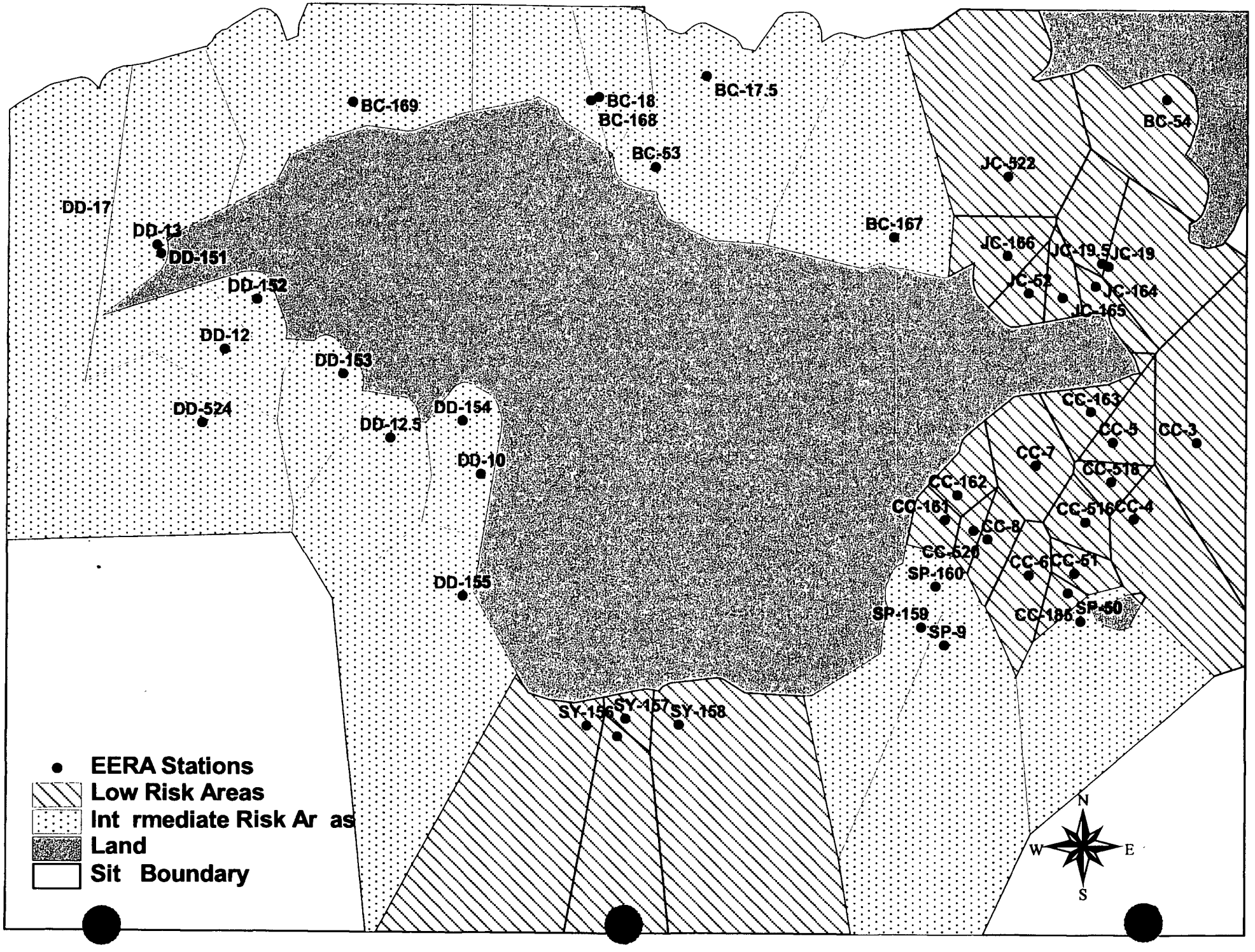


Figure 3.[illegible]. Sampling locations for PRG d velopment in th [illegible]tsmouth Naval Shipyard offshore study area.

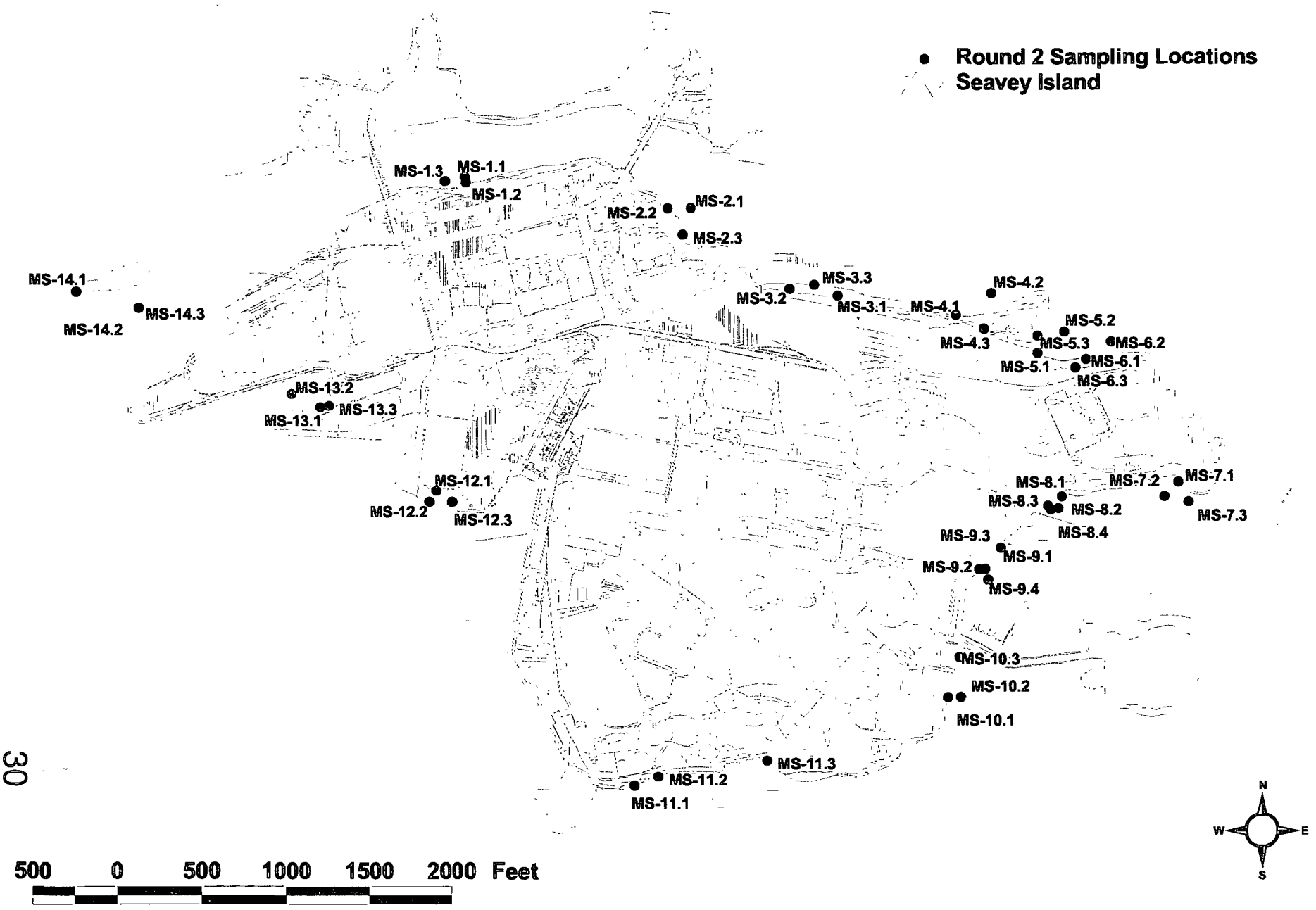


**Figure 3.3-2. Summary of CoCs with highest baseline PRG xceedances by location for sediments from the Portsmouth Naval Shipyard offshore study area: A. EERA data.**

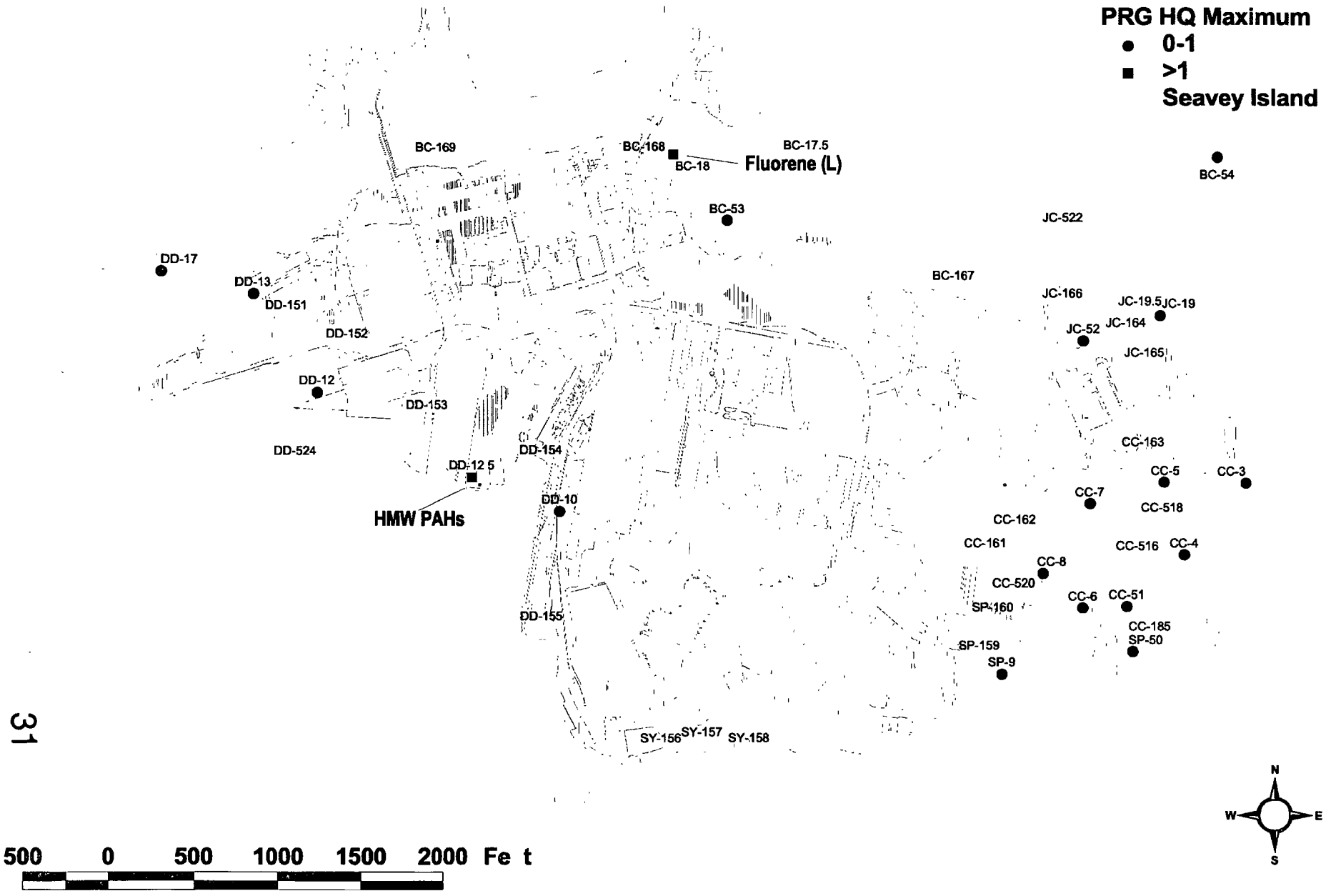


Figure 3.3-2. (Continued). B. Round 1 Monitoring Data.

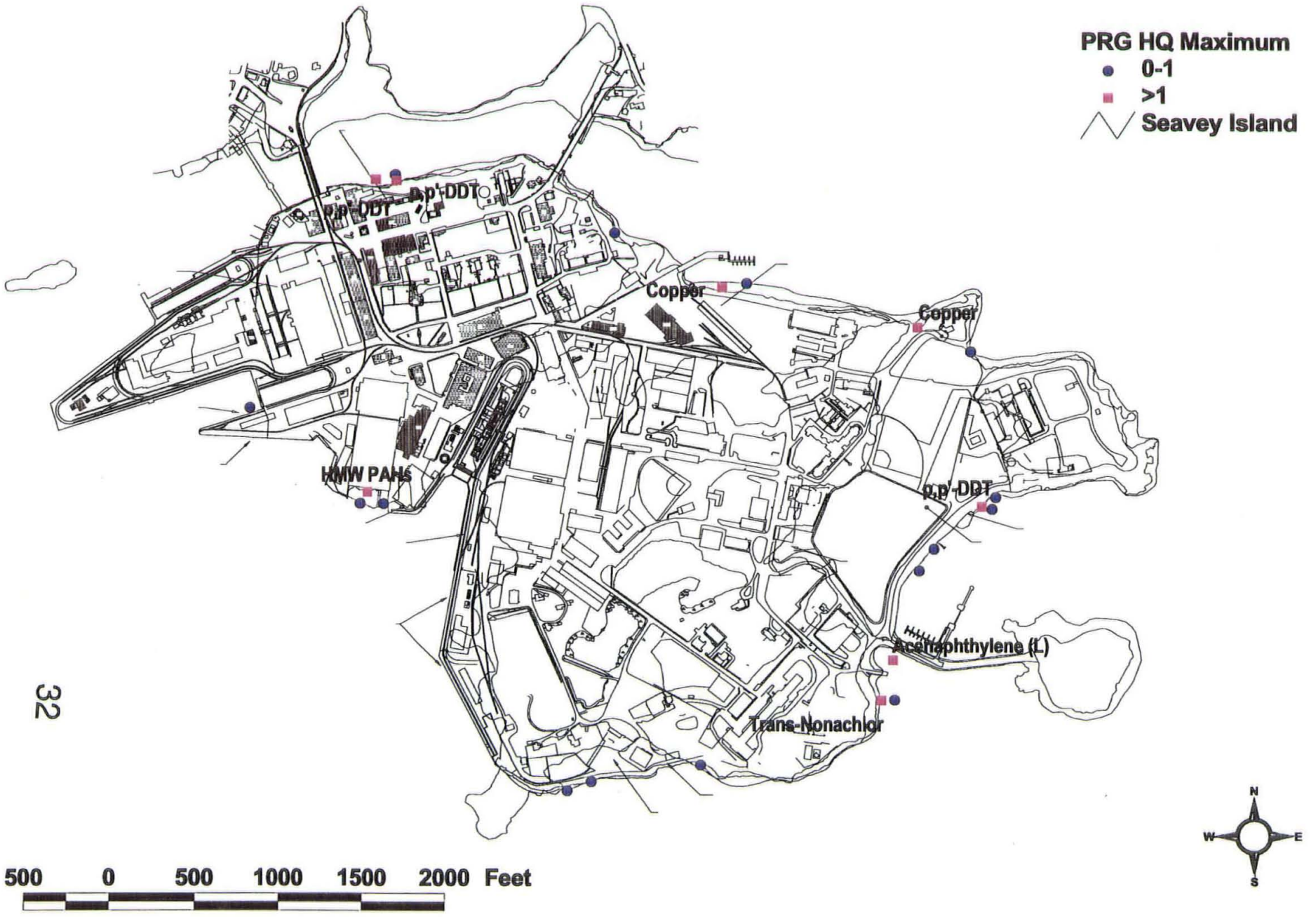


Figure 3.3-2 (Continued). B. Round 1 Monitoring Data.

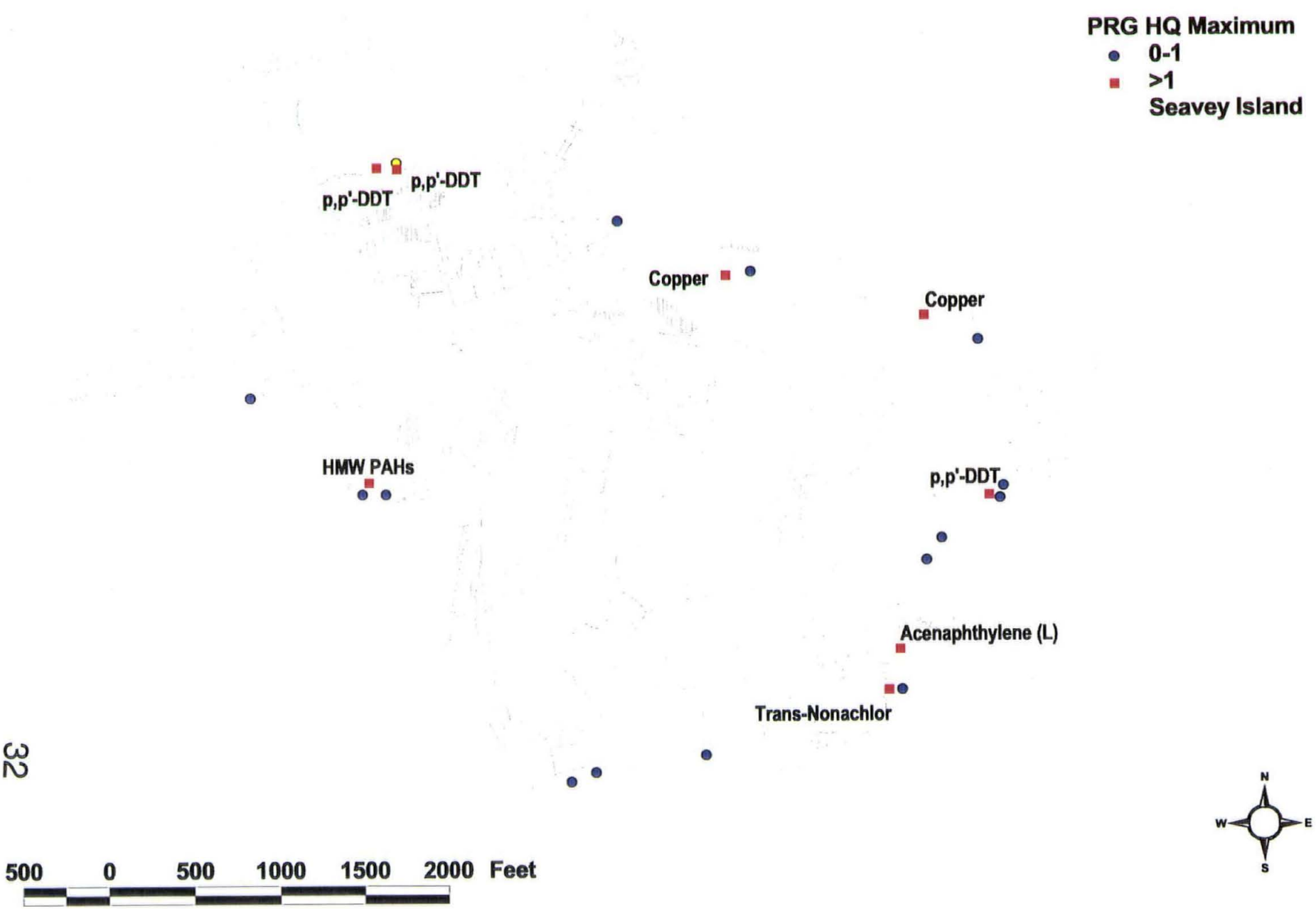
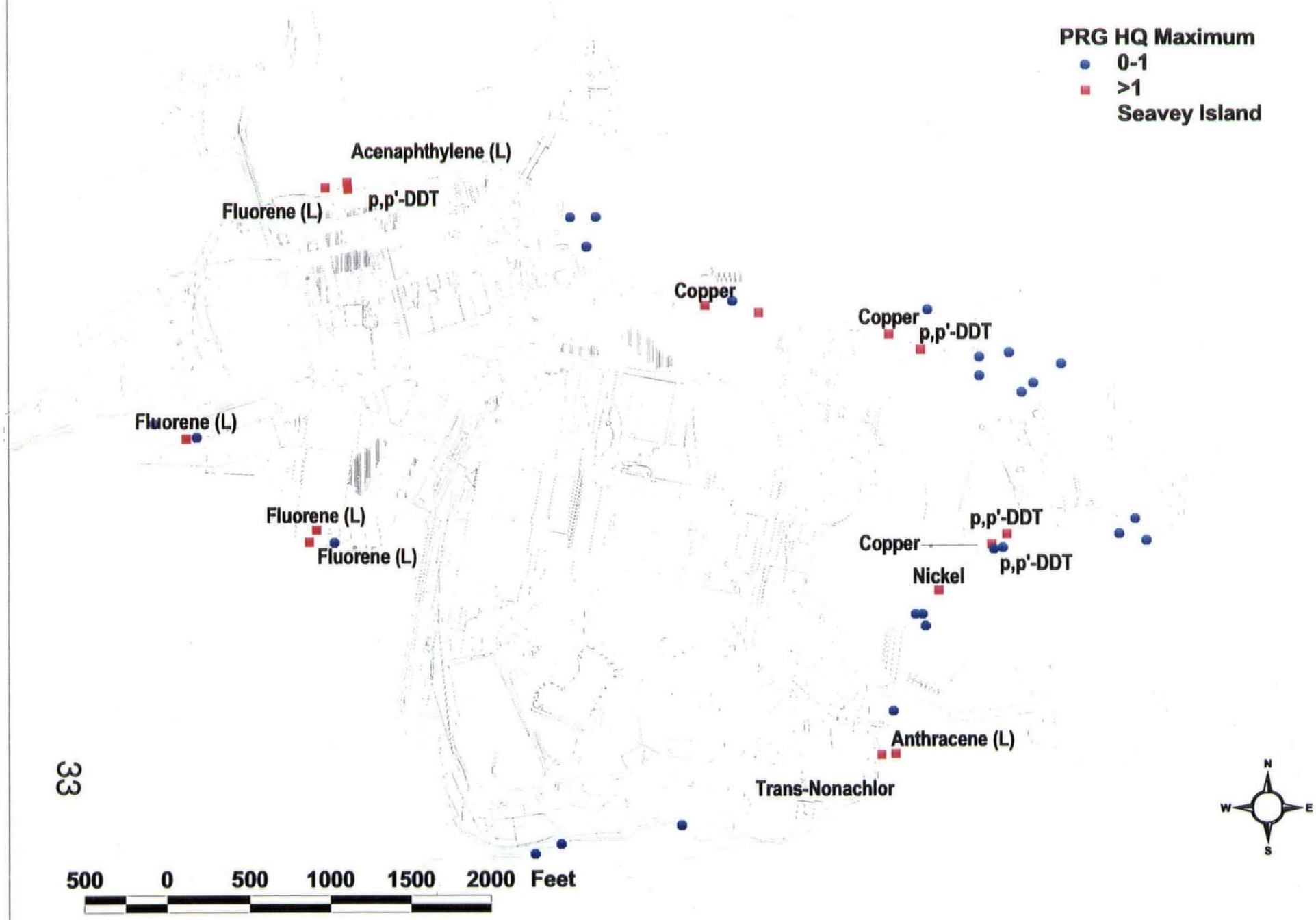


Figure 3.3-2. (Continued). C. Round 2 Monitoring Data.



## LIST OF TABLES


TABLE PAGE NOS.

1.0-1 POTENTIAL REMEDIAL ACTION OBJECTIVES FOR PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... 34

1.0-2 CHEMICAL-SPECIFIC FEDERAL AND STATE APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO-BE-CONSIDERED REQUIREMENTS FOR PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA, KITTERY, MAINE ..... 35

2.1-1 PROCEDURE FOR PRELIMINARY REMEDIATION GOAL (PRG) DEVELOPMENT FOR PROTECTING AQUATIC SOFT-BOTTOM AND HARD-BOTTOM EXPOSURE PATHWAYS FOR THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... 36

2.2-1 WATER QUALITY CRITERIA FOR TARGET ANALYTES SELECTED FOR AQUATIC PRG DEVELOPMENT AND DERIVED WATER QUALITY SCREENINB VALUES FOR THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... 37 - 38

2.2-2 SUMMARY OF TOXICITY TESTING RESULTS AND TOXICITY CLASSIFICATION FOR PURPOSES OF PRG DEVELOPMENT ..... 39

2.2-3 DISTRIBUTION OF TOXIC AND NONTOXIC AQUATIC HAZARD QUOTIENTS AND DERIVATION OF NO OBSERVABLE EFFECT QUOTIENTS (NOEQS) FOR THE AQUATIC RECEPTORS EXPOSED TO COC IN SEDIMENT FOR THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... 40 - 41

2.2-4 DERIVATION OF AQUATIC REFERENCE SCREENING VALUES (RSVS) BASED ON MEASURED/CALCULATED CONCENTRATIONS OF SELECTED CONTAMINANTS IN PORE WATER FROM PORTSMOUTH NAVAL SHIPYARD REFERENCE LOCATIONS FROM THE PORTSMOUTH NAVAL SHIPYARD STUDY AREA ..... 42

2.2-5 DERIVATION OF EXAMPLE THRESHOLD EFFECTS VALUES (TEVS) FOR THE AQUATIC EXPOSURE PATHWAY FOR THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... 43

2.2-6 SUMMARY OF BASELINE PRELIMINARY REMEDIATION GOALS (PRGS) FOR THE AQUATIC EXPOSURE PATHWAY IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA EXPRESSED AS SEDIMENT CONCENTRATION-BASED VALUES ..... 44

3.3-1 RELATIONSHIP BETWEEN DEGREE OF PRG EXCEEDANCE AND RISK FOR CHEMICALS EXHIBITING HIGHEST PRG EXCEEDANCES BY SAMPLING LOCATION IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA; A. EERA DATA, B. ROUND 1 DATA, C. ROUND 2 DATA ..... 45 - 47

3.3-2 SUMMARY OF PRELIMINARY REMEDIATION GOALS (PRGS) FOR THE AQUATIC EXPOSURE PATHWAY IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHOER STUDY AREA EXPRESSED AS SEDIMENT CONCENTRATION-BASED VALUES ..... 48

Table 1.0-1. Potential Remedial Action Objectives for the Portsmouth Naval Shipyard offshore study area.

| Media/Receptor | Remedial Action Objectives (RAOs) |
|---|---|
| Water | • Protect pelagic, epibenthic, eelgrass, and salt marsh communities by identification of exposure to chemicals of concern (COCs) at unacceptable levels in the estuarine waters (surface waters) in the Portsmouth Naval Shipyard offshore Areas of Concern (AOCs). |
| Sediment | • Protect epibenthic, benthic, eelgrass, and salt marsh communities by identification of exposure to COCs at unacceptable levels in sediments in the Portsmouth Naval Shipyard offshore AOCs. |

Table 1.0-2. Chemical-specific Federal and State Applicable or Relevant and Appropriate Requirements and To-Be-Considered requirements for Portsmouth Naval Shipyard offshore study area, Kittery, Maine.[1]

| Medium or Activity | Requirement | Status | Requirement Synopsis | Evaluation/Action to B Taken |
|---|---|---|---|---|
| **CHEMICAL SPECIFIC- FEDERAL** | | | | |
| Water | Clean Water Act (CWA); Federal Ambient Water Quality Criteria (AWQC); (33 USC §§1251 et seq, 40 CFR § 122.44; 40 CFR Part 131) | Relevant and Appropriate | CWA AWQC are health-based criteria developed for carcinogenic and noncarcinogenic compounds and water quality parameters. AWQC are set at levels that are guidelines for pollutants in surface water. AWQC are available for the protection of human health from exposure to contaminants in drinking water as well as from ingestion of aquatic biota and for the protection of freshwater and saltwater aquatic life. | AWQCs for the protection of freshwater and saltwater aquatic life will be used to develop PRGs, as appropriate. |
| Water | U.S. Food and Drug Administration (FDA) Action Levels (21 U.S.C. §§301 et seq) | TBC | Under Section 408 of the Federal Food, Drug, and Cosmetic Act, FDA action levels are established above which the FDA can take legal action to remove a food product from the market. | FDA action levels for fish and shellfish will be used to develop PRGs, as appropriate. |
| Sediment | USEPA Proposed Sediment Quality Criteria (Fed. Reg. 2652, January 18, 1994, Sq. FR) | TBC | These sediment quality criteria for the protection of benthic organisms are proposed for acenaphthene, dieldrin, endrin, fluoranthene, and phenanthrene. | These criteria will be used to develop PRGs, as appropriate. |
| Sediment | National Oceanographic Atmospheric Administration (NOAA) Incidence of Adverse Biological Effects within Ranges of Chemical Concentration in Marine and Estuarine Sediments (Long et al. 1995). | TBC | This document provides chemical concentration effects distributions that describe the observed or predicted chemical concentrations associated with biological effects. Effects range low (ER-L) and effects range median (ER-M) represent the tenth and fiftieth percentile of reported effects. | ER-L and ER-M concentrations will used to develop PRGs, as appropriate. |
| Oth r Natural Resources | NOAA National Status and Trends Program (NSTP) Approach Informal Guidelines Mussel Watch Data (1991). | TBC | Chemical concentrations in blue mussel tissues located in coastal waters of the U.S. are monitored under this program. Data from the program have been compiled to characterize the national distribution of chemical concentration levels (O'Connor, 1992). | Data will be considered in PRG development as appropriate. |
| **CHEMICAL SPECIFIC - STATE** | | | | |
| Wat r | Maine Surface Water Toxics Control Program (06-096 CMR 530) | Relevant and Appropriate | The regulations implementing this program set State-wide AWQC for toxic pollutants and procedures necessary to control levels of toxic pollutants in surface water are identified. State-wide criteria are set at Federal AWQC levels. | The ecological criteria will be used to develop PRGs, as appropriate. |

1 Applicable or Relevant and Appropriate Requirements (ARARs) consist of any standard, requirement, criterion, or limitation under Federal environmental law and any promulgated standard, requirement, criteria, or limitation under a State environmental or facility-siting law that is more stringent than the associated Federal standard, requirement, criterion, or limitation. To-Be-Considered (TBC) criteria are nonpromulgated, nonenforceable guidelines or criteria that may be useful for developing a remedial action or are necessary for determining what is protective to human health and/or the environment.

Table 2.1-1. Procedure for Preliminary Remediation Goal (PRG) development for protecting aquatic soft-bottom and hard-bottom exposure pathways for the Portsmouth Naval Shipyard offshore study area.

| PROCEDURE | EXPOSURE PATHWAY | |
|---|---|---|
| | **Aquatic-Soft Bottom** | **Aquatic - Hard Bottom** |
| 1 - Select benchmarks; Express Chemical of Concern (CoC)- and pathway-specific risk as Hazard Quotients (HQs). | Benchmark = Water Quality Screening Values (WQSVs); PW-HQ = Porewater (PW) concentration/WQSV. | NA |
| 2 - Evaluate CoC bioavailability under site-specific conditions. | Estimate 95th percentile Upper Limit (95% UL) of PW-HQs associated with nontoxic samples; set No Observable Effect Quotient (NOEQ) = 1 where 95% UL<1. | NA |
| 3 - Retain CoCs substantially contributing to risk at the site. | Retain CoCs for which the Maximum PW-HQ associated with toxic samples > NOEQ. | NA |
| 4 - Evaluate feasibility of pathway/CoC specific PRG as a long-term remedial goal. | Estimate 95% UL of reference pore water values (RSV). Compare Aquatic No Observable Effect Concentration (NOEC[1]) and RSV; select greater of two values as aquatic Threshold Effects Value (TEV). | NA |
| 5 - Rank pathway-specific TEV-HQs and select CoCs with maximum HQs by station and pathway as "limiting" CoCs. | Calculate Aquatic TEV-HQs as station-specific PW conc./TEV; identify maximum TEV-HQ by station; compile resulting list as "limiting" Aquatic CoCs for PRG development. | NA |
| 6 - Determine PRGs for "limiting" CoCs, i.e., convert TEV values in concentration-based units to be used during remediation. | PRG calculated from TEV values at HQ = 1. | Apply PRGs (units = ng/g dry wt sediment) to sediment equivalent concentrations predicted from shellfish residues using Bioaccumulation Factor (BAF) (metals) and Biota-Sediment Accumulation Factor (BSAF) (organics) models. |
| 7 - Evaluate practicality of pathway-specific PRGs for effective risk reduction. | Compare PRG exceedence to aquatic risk distribution. | Compare PRG exceedence to aquatic risk distribution. |

NA - Not Applicable

1 - NOEC = NOEQ x WQSV.

Table 2.2-1. Water Quality Criteria for target analytes selected for aquatic PRG development and derived Water Quality Screening Values for the Portsmouth Naval Shipyard offshore study area.

| Chemical | | USEPA Water Quality Criteria[1] | | | | Sediment Benchmark | | WQSV[1,2] | |
|---|---|---|---|---|---|---|---|---|---|
| Class | Analyte[3] | WQC-FA | WQC-FC | WQC-SA | WQC-SC | Value | Source | Conc. | Source |
| MET | Arsenic | 340 | 150 | 69 | 36 | 8.2 | ERL | 36 | A |
| MET | Cadmium | 4.3 | 2.2 | 42 | 9.3 | 1.2 | ERL | 9.3 | A |
| MET | Chromium | 16 | 11 | 1100 | 50 | 81 | ERL | 50 | A |
| MET | Copper | 13 | 9 | 4.8 | 3.1 | 34 | ERL | 3.1 | A |
| MET | Lead | 65 | 2.5 | 210 | 8.1 | 46.7 | ERL | 8.1 | A |
| MET | Mercury | 1.4 | 0.77 | 1.8 | 0.94 | 0.15 | ERL | 0.94 | A |
| MET | Nickel | 470 | 52 | 74 | 8.2 | 20.9 | ERL | 8.2 | A |
| MET | Silver | 3.4 | 0.12 | 1.9 | 0.79 | 1 | ERL | 0.79 | H |
| MET | Zinc | 120 | 120 | 90 | 81 | 150 | ERL | 81 | A |
| MET | SEM-AVS | | | | | 5 | EPA | 5 | F |
| PAH | 1,6,7-Trimethylnaphthalene (L) | | | | | | | | NA |
| PAH | 1-Methylnaphthalene (L) | | | | | | | | NA |
| PAH | 1-Methylphenanthrene (L) | | | | | | | | NA |
| PAH | 2,6-Dimethylnaphthalene (L) | | | | | | | | NA |
| PAH | 2-Methylnaphthalene (L) | | | | | 70 | ERL | 0.88 | E |
| PAH | Acenaphthene (L) | 1700 | 520 | 970 | 710 | 16 | ERL | 710 | A |
| PAH | Acenaphthylene (L) | | | | | 44 | ERL | 0.46 | E |
| PAH | Anthracene (L) | | | | | 85.3 | ERL | 0.29 | E |
| PAH | Benzo(a)anthracene (H) | | | | | 261 | ERL | 0.065 | E |
| PAH | Benzo(a)pyrene (H) | | | | | 430 | ERL | 0.042 | E |
| PAH | Benzo(b)fluoranthene (H) | | | | | | | | NA |
| PAH | Benzo(b+k)fluoranthene (H) | | | | | | | | NA |
| PAH | Benzo(e)pyrene (H) | | | | | | | | NA |
| PAH | Benzo(g,h,i)perylene (H) | | | | | | | | NA |
| PAH | Benzo(k)fluoranthene (H) | | | | | | | | NA |
| PAH | Biphenyl (L) | | | | | 1100 | SQAL | 14.1 | E |
| PAH | Chrysene (H) | | | | | 384 | ERL | 0.10 | E |
| PAH | Dibenz(a,h)anthracene (H) | | | | | 63.4 | ERL | 0.002 | E |
| PAH | Fluoranthene (H) | 3980 | | 40 | 16 | 600 | ERL | 16 | A |
| PAH | Fluorene (L) | | | | | 19 | ERL | 0.14 | E |
| PAH | Indeno(1,2,3-cd)pyrene (H) | | | | | | | | NA |
| PAH | Naphthalene (L) | 2300 | 620 | 2350 | | 160 | ERL | 633 | B |
| PAH | Perylene (H) | | | | | | | | NA |
| PAH | Phenanthrene (L) | 30 | 6.3 | 7.7 | 4.6 | 240 | ERL | 4.60 | A |
| PAH | Pyrene (H) | | | | | 665 | ERL | 0.63 | E |
| PAH | LMW PAHs | | | | | 552 | ERL | 5.76 | E |
| PAH | HMW PAHs | | | | | 1700 | ERL | 0.42 | E |
| PAH | Total PAHs | | | | | 4022 | ERL | 6.49 | E |
| PCB | Total PCBs | 2 | 0.014 | 10 | 0.03 | 22.7 | ERL | 0.030 | A |
| PST | Aldrin | 3 | | 1.3 | | | | 0.163 | B |
| PST | Alpha-BHC | 0.95 | | 0.16 | | 0.32 | TEL | 0.160 | B |
| PST | Alpha-chlordane | 2.4 | 0.0043 | 0.09 | 0.004 | | | 0.004 | A |
| PST | Beta-BHC | 0.95 | | 0.16 | | 0.32 | TEL | 0.160 | B |
| PST | Chlorpyrifos | 0.083 | 0.041 | 0.011 | 0.0056 | | | 0.006 | A |
| PST | CIS-Nonachlor | | | | | 2.26 | TEL | 0.000 | E |
| PST | Delta-BHC | 0.95 | | 0.16 | | 0.32 | TEL | 0.160 | B |
| PST | Dieldrin | 0.24 | 0.056 | 0.71 | 0.0019 | 0.715 | TEL | 0.002 | A |
| PST | Endosulfan II | 0.22 | 0.056 | 0.034 | 0.0087 | | | 0.009 | A |
| PST | Endrin | 0.086 | 0.036 | 0.037 | 0.0023 | | | 0.002 | A |
| PST | Gamma-BHC (Lindane) | 0.95 | | 0.16 | | 0.32 | TEL | 0.160 | B |
| PST | Gamma-Chlordane | 2.4 | 0.0043 | 0.09 | 0.004 | 2.26 | TEL | 0.004 | A |
| PST | Heptachlor | 0.52 | 0.0038 | 0.053 | 0.0036 | | | 0.004 | A |
| PST | Heptachlor epoxide | 0.52 | 0.0038 | 0.053 | 0.0036 | | | 0.004 | A |
| PST | Hexachlorobenzene | 6 | 3.68 | 160 | 129 | | | 129 | G |
| PST | Mirex | | 0.001 | | 0.001 | | | 0.001 | A |
| PST | Oxychlordane | 2.4 | 0.0043 | 0.09 | 0.004 | 2.26 | TEL | 0.004 | A |
| PST | Pentachloroanisole | | | | | | | | NA |
| PST | Pentachlorobenzene | 250 | 50 | 160 | 129 | | | 129.000 | A |

Table 2.2-1. Water Quality Criteria for target analytes selected for aquatic PRG development and derived Water Quality Screening Values for the Portsmouth Naval Shipyard offshore study area.

| Chemical | | USEPA Water Quality Criteria[1] | | | | Sediment Benchmark | | WQSV[1,2] | |
|---|---|---|---|---|---|---|---|---|---|
| Class | Analyte[3] | WQC-FA | WQC-FC | WQC-SA | WQC-SC | Value | Source | Conc. | Source |
| PST | Trans-Nonachlor | | | | | 2.26 | TEL | 0.000 | E |
| PST | 1,2,3,4-Tetrachlorobenzene | | | | | | | 129 | G |
| PST | 1,2,4,5-Tetrachlorobenzene | 250 | 50 | 160 | 129 | | | 129 | H |
| PST | o,p'-DDD | 0.6 | | 3.6 | | 1.58 | ERL | 0.837 | G |
| PST | p,p'-DDD | 0.6 | | 3.6 | | 1.58 | ERL | 0.837 | B |
| PST | o,p'-DDE | 1050 | | 14 | | 2.2 | ERL | 3.26 | B |
| PST | o,p'-DDT | 1.1 | 0.001 | 1.3 | 0.001 | 1.58 | ERL | 0.001 | A |
| PST | p,p'-DDE | 1050 | | 14 | | 2.2 | ERL | 3.26 | B |
| PST | p,p'-DDT | 1.1 | 0.001 | 1.3 | 0.001 | 1.58 | ERL | 0.001 | A |

WQC-FA = Water Quality Criteria = Freshwater Acute Value
WQC-FC = Water Quality Criteria = Freshwater Chronic Value
WQC-FA = Water Quality Criteria = Freshwater Acute Value
WQC-FC = Water Quality Criteria = Freshwater Chronic Value
WQC-SA = Water Quality Criteria = Saltwater Acute Value
WQC-SC = Water Quality Criteria = Saltwater Chronic Value
WQSV = Water Quality Screening Value
WQSV DATA QUALIFIERS:
NA= Benchmark not available to derive Screening Value
A - WQC-SC VALUE,
B - ACUTE/CHRONIC RATIO APPLIED TO WQ-SA VALUE (see Appendix Table A-4).
E - EqP PARTITIONING OF ERL/TEL SEDIMENT BENCHMARK INTO POREWATER AT 1% TOC
F - SEM-AVS benchmark of 5 µmol/g dry wt (USEPA, 1997),
G - Buchmann, 1999; Values assumed the same as 1,2,4,5 tetrachlorobenzene
H - Detection limit for silver (5 ug/L) greater than chronic criteria; all data were non-detect.
1 - Units: WQC, WQSV = µg/L; sediment benchmarks: metals- ug/g, organics ng/g
2 - See text and Figure 2.2-1 for WQSV derivation process.
3 - Analyte Sums:
**LMW PAH** = sum of 7 2-ring & 3-ring PAHs included in NOAA ER-L/ER-M benchmarks (Long et al. 1995); (methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, phenanthrene)
**HMW PAH** = sum of 6 4-ring and 5-ring PAHs included in NOAA ER-L/ER-M benchmarks (Long et al. 1995); (benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, pyrene)
**Total PAHs** - sum of LMW & HMW PAHs;
**Total PCBs** - Sum of individual PCB congeners x 2

Table 2.2-2. Summary of toxicity testing results and toxicity classification for purposes of PRG development.

| | Amphipod Survival (%) | | | Sea Urchin Normal Larval Development (%) | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Porewater Conc. (%) | | | | | |
| Sample | % of Control[1] | Test Statistic[2] | Class[3] | 100 | 50 | 25 | $EC_{50}$ | Test Statistic[4] | Class[5] |
| M01-100B | | | | | | | | | |
| M01-200B | 96 | | | 93.6 | 95 | 94.2 | >100 | | |
| M01-300B | 91 | | | 0 | 6.6 | 93.4 | 36.47 | XX | TOX |
| M02-100B | 104 | | | 0 | 94.8 | 93.2 | 70.71 | X | |
| M02-200B | 102 | | | 0 | 95 | 94.4 | 70.71 | X | |
| M02-300B | | | | | | | | | |
| M03-100B | 100 | | | 0 | 95.6 | 97.2 | 70.71 | X | |
| M03-200B | 92 | | | 32.2 | 96.4 | 94.8 | 84.53 | X | |
| M03-300B | | | | | | | | | |
| M04-100B | 5 | XX | TOX | 93.6 | 94 | 96.6 | >100 | | |
| M04-200B | | | | | | | | | |
| M04-300B | 70 | XX | TOX | 25 | 90.4 | 94.8 | 78.58 | X | |
| M05-100B | 97 | | | 94 | 96 | 97.2 | >100 | | |
| M05-200B | 97 | | | 0 | 0 | 3.4 | <25 | XXX | TOX |
| M05-300B | | | | | | | | | |
| M06-100B | 102 | | | 97.4 | 95 | 95.6 | >100 | | |
| M06-200B | | | | | | | | | |
| M06-300B | 99 | | | 15.25 | 96.2 | 96.2 | 75.54 | X | |
| M07-100B | 101 | | | 0 | 92.8 | 94.6 | 69.74 | X | |
| M07-200B | | | | | | | | | |
| M07-300B | | | | | | | | | |
| M08-100B | 102 | | | 4.2 | 94.6 | 95.8 | 71.74 | X | |
| M08-200B | | | | | | | | | |
| M08-300B | 74 | XX | TOX | | | | | | |
| M08-400B | 102 | | | 0 | 92.4 | 97.4 | 69.26 | X | |
| M09-100B | 71 | XX | TOX | 93.8 | 96 | 92.6 | >100 | | |
| M09-200B | 102 | | | 0.6 | 93.6 | 95.8 | 70.71 | X | |
| M09-300B | | | | | | | | | |
| M09-400B | 103 | | | 0 | 13.4 | 95 | 38.96 | XX | TOX |
| M10-100B | 98 | | | 94 | 95 | 94 | >100 | | |
| M10-200B | | | | | | | | | |
| M10-300B | 90 | | | 0 | 0 | 89.2 | 34.58 | XX | TOX |
| place holder | | | | | | | | | |
| place holder | | | | | | | | | |
| M11-300B | 89 | | | 95.4 | 97.4 | 94.8 | >100 | | |
| M12-100B | 97 | | | 0 | 94.8 | 93 | 70.71 | X | |
| M12-200B | 102 | | | 0 | 91.6 | 96.4 | 69.26 | X | |
| M12-300B | | | | | | | | | |
| M13-100B | 66 | XX | TOX | 0 | 0 | 0 | <25 | XXX | TOX |
| M13-200B | | | | | | | | | |
| M13-300B | 93 | | | 0 | 0 | 0 | <25 | XXX | TOX |
| M14-100B | 90 | | | 90.75 | 95 | 95.2 | >100 | | |
| M14-200B | 90 | | | 0.2 | 97 | 95.8 | 70.71 | X | |
| M14-300B | | | | | | | | | |
| REF | 97 | | | 95 | 94.5 | 94.6 | | | |

1 - Amphipod survival (%) normalized to performance control toxicity

2 - X = Statistically different from Control, XX = Stat .diff. and <80% of control

3 - For purposes of PRG development, Toxic = sample being both statistically different from control and <80% of control

4 - X = 100%, XX = 50%, XXX = 25% statistically significantly different from control (alpha <0.05)

5 - For purposes of PRG development, Toxic = sample exhibiting exposure response, e.g , statistically significant toxicity observed in two or more dilutions (see text Section 2.2)

Table 2 2-3 Distribution of toxic and nontoxic aquatic Hazard Quotients and derivation of No Observable Effect Quotients (NOEQs) for the aquatic receptors exposed to CoC in sediment for the Portsmouth Naval Shipyard offshore study area

| BEDDED SEDIMENT | | Amphipod Survival | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Nontoxic Samples | | | Toxic Samples | | | |
| Class | Analyte | N | 95% UL PW-HQ[3A] | Test NOEQ[1] | N | Max PW-HQ[3A] | Max PW-HQ > NOEQ? | AMP-NOEQ[4A] |
| MET | Arsenic | 23 | 0 42 | 1 00 | 4 | 0 43 | NO | |
| MET | Cadmium | 23 | 0 05 | 1 00 | 4 | 0 05 | NO | |
| MET | Chromium | 23 | 0 05 | 1 00 | 4 | 0 05 | NO | |
| MET | Copper | 23 | 1 14 | 1 14 | 4 | 153 | YES | 1 14 |
| MET | Lead | 23 | 0 19 | 1 00 | 4 | 0 19 | NO | |
| MET | Mercury | 23 | 0 05 | 1 00 | 4 | 0 05 | NO | |
| MET | Nickel | 23 | 1 30 | 1 30 | 4 | 3 29 | YES | 1 30 |
| MET | Silver | 0 | | | 0 | | NO | |
| MET | Zinc | 23 | 0 16 | 1 00 | 4 | 0 15 | NO | |
| MET | SEM-AVS | 23 | 110 33 | 110 33 | 5 | 0 99 | NO | |
| PAH | 2-Methylnaphthalene (L) | 23 | 1 07 | 1 07 | 5 | 1 69 | YES | 1 07 |
| PAH | Acenaphthene (L) | 23 | 0 0040 | 1 00 | 5 | 0 03 | NO | |
| PAH | Acenaphthylene (L) | 23 | 2 71 | 2 71 | 5 | 6 94 | YES | 2 71 |
| PAH | Anthracene (L) | 23 | 8 92 | 8.92 | 5 | 13 64 | YES | 8 92 |
| PAH | Benzo(a)anthracene (H) | 23 | 4 35 | 4 35 | 5 | 4 71 | YES | 4 35 |
| PAH | Benzo(a)pyrene (H) | 23 | 3 06 | 3 06 | 5 | 2 31 | NO | |
| PAH | Biphenyl (L) | 23 | 0 02 | 1 00 | 5 | 0 09 | NO | |
| PAH | Chrysene (H) | 23 | 2 97 | 2 97 | 5 | 2 80 | NO | |
| PAH | Dibenz(a,h)anthracene (H) | 23 | 3 78 | 3 78 | 5 | 3 80 | YES | 3 78 |
| PAH | Fluoranthene (H) | 23 | 0 11 | 1 00 | 5 | 0.17 | NO | |
| PAH | Fluorene (L) | 23 | 15 98 | 15 98 | 5 | 101 | YES | 15 98 |
| PAH | Naphthalene (L) | 23 | 0 01 | 1 00 | 5 | 0 01 | NO | |
| PAH | Phenanthrene (L) | 23 | 0 91 | 1 00 | 5 | 2 18 | YES | 1 00 |
| PAH | Pyrene (H) | 23 | 2 54 | 2 54 | 5 | 3 38 | YES | 2 54 |
| PAH | LMW PAHs | 23 | 3 53 | 3 53 | 5 | 8 97 | YES | 3 53 |
| PAH | HMW PAHs | 23 | 9 70 | 9 70 | 5 | 13 06 | YES | 9 70 |
| PAH | Total PAHs | 23 | 3 76 | 3 76 | 5 | 8 82 | YES | 3 76 |
| PCB | Total PCBs | 23 | 0 03 | 1 00 | 5 | 0 38 | NO | |
| PST | Aldrin | 23 | 0 21 | 1 00 | 5 | 1 14E-03 | NO | |
| PST | Alpha-BHC | 23 | 0 05 | 1 00 | 5 | 0 02 | NO | |
| PST | Alpha-chlordane | 23 | 0 03 | 1 00 | 5 | 0 04 | NO | |
| PST | Beta-BHC | 23 | 0 21 | 1 00 | 5 | 0 11 | NO | |
| PST | Chlorpyrifos | 23 | 0 05 | 1 00 | 5 | 0 05 | NO | |
| PST | CIS-Nonachlor | 23 | 0 40 | 1 00 | 5 | 0 64 | NO | |
| PST | Delta-BHC | 23 | 0 01 | 1 00 | 5 | 8 23E-03 | NO | |
| PST | Dieldrin | 23 | 1 06 | 1 06 | 5 | 0 14 | NO | |
| PST | Endosulfan II | 23 | 2 40 | 2 40 | 5 | 2 89 | YES | 2 40 |
| PST | Endrin | 23 | 0 09 | 1 00 | 5 | 0 08 | NO | |
| PST | Gamma-BHC (Lindane) | 23 | 0 05 | 1 00 | 5 | 0 05 | NO | |
| PST | Gamma-Chlordane | 23 | 0 04 | 1 00 | 5 | 0 06 | NO | |
| PST | Heptachlor | 23 | 0 01 | 1 00 | 5 | 0 01 | NO | |
| PST | Heptachlor epoxide | 23 | 0 01 | 1 00 | 5 | 0 18 | NO | |
| PST | Hexachlorobenzene | 23 | 0 000001 | 1 00 | 5 | 5 39E-06 | NO | |
| PST | Mirex | 23 | 0 01 | 1 00 | 5 | 3 87E-03 | NO | |
| PST | Oxychlordane | 23 | 0 01 | 1.00 | 5 | 0 01 | NO | |
| PST | Pentachlorobenzene | 23 | 0 00 | 1 00 | 5 | 2 24E-05 | NO | |
| PST | Trans-Nonachlor | 23 | 0 81 | 1.00 | 5 | 1 18 | YES | 1 00 |
| PST | 1,2,3,4-Tetrachlorobenzene | 23 | 0 00 | 1 00 | 5 | 3 42E-05 | NO | |
| PST | 1,2,4,5-Tetrachlorobenzene | 23 | 0 00 | 1 00 | 5 | 7 07E-05 | NO | |
| PST | o,p'-DDD | 23 | 0 00 | 1 00 | 5 | 3 20E-03 | NO | |
| PST | p,p'-DDD | 23 | 0 00 | 1 00 | 5 | 5 93E-04 | NO | |
| PST | o,p'-DDE | 23 | 0 00005 | 1 00 | 5 | 3 42E-04 | NO | |
| PST | o,p'-DDT | 23 | 1 48 | 1 48 | 5 | 2 66 | YES | 1 48 |
| PST | p,p'-DDE | 23 | 0 00008 | 1 00 | 5 | 1 39E-03 | NO | |
| PST | p,p'-DDT | 23 | 1 43 | 1 43 | 5 | 9 60 | YES | 1 43 |

See page 2 of 2 for footnotes.

Table 2.2-3. (continued)

| BEDDED SEDIMENT | | Sea Urchin Larval Developement | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Nontoxic Samples | | | Toxic Samples | | | | |
| Class | Analyte | N | 95% UL PW-HQ[3B] | Test NOEQ[1] | N | Max PW-HQ[3B] | Max PW-HQ > NOEQ? | ARB-NOEQ[4B] | Aquatic NOEQ[5] |
| MET | Arsenic | 21 | 0.32 | 1 00 | 6 | 0 43 | NO | | |
| MET | Cadmium | 21 | 0 05 | 1 00 | 6 | 0 05 | NO | | |
| MET | Chromium | 21 | 0 05 | 1 00 | 6 | 0 05 | NO | | |
| MET | Copper | 21 | 8 77 | 8 77 | 6 | 0 61 | NO | | 1 14 |
| MET | Lead | 21 | 0 19 | 1 00 | 6 | 0 19 | NO | | |
| MET | Mercury | 21 | 0 06 | 1 00 | 6 | 0 05 | NO | | |
| MET | Nickel | 21 | 2 15 | 2 15 | 6 | 0 30 | NO | | 1 30 |
| MET | Silver | 0 | | | 0 | | NO | | |
| MET | Zinc | 21 | 0 16 | 1 00 | 6 | 0 17 | NO | | |
| MET | SEM-AVS | 21 | 104 | 103 59 | 6 | -5 41E+00 | NO | | |
| PAH | 2-Methylnaphthalene (L) | 21 | 1 22 | 1 22 | 6 | 1 69 | YES | 1 22 | 1 07 |
| PAH | Acenaphthene (L) | 21 | 3 75E-03 | 1 00 | 6 | 0 03 | NO | | |
| PAH | Acenaphthylene (L) | 21 | 3 23 | 3 23 | 6 | 3 74 | YES | 3.23 | 2 71 |
| PAH | Anthracene (L) | 21 | 8 21 | 8 21 | 6 | 13 64 | YES | 8 21 | 8 21 |
| PAH | Benzo(a)anthracene (H) | 21 | 5 21 | 5 21 | 6 | 4 71 | YES | 5 21 | 4 35 |
| PAH | Benzo(a)pyrene (H) | 21 | 3 66 | 3 66 | 6 | 2 59 | NO | | |
| PAH | Biphenyl (L) | 21 | 0 02 | 1 00 | 6 | 0 09 | NO | | |
| PAH | Chrysene (H) | 21 | 3 49 | 3 49 | 6 | 2 80 | NO | | |
| PAH | Dibenz(a,h)anthracene (H) | 21 | 4 82 | 4 82 | 6 | 2 40 | NO | | 3 78 |
| PAH | Fluoranthene (H) | 21 | 0 13 | 1 00 | 6 | 0 17 | NO | | |
| PAH | Fluorene (L) | 21 | 14 90 | 14 90 | 6 | 101 | YES | 14 90 | 14 90 |
| PAH | Naphthalene (L) | 21 | 0 01 | 1 00 | 6 | 0 02 | NO | | |
| PAH | Phenanthrene (L) | 21 | 0 94 | 1 00 | 6 | 2.18 | YES | 1 00 | 1 00 |
| PAH | Pyrene (H) | 21 | 2 96 | 2 96 | 6 | 3 38 | YES | 2 96 | 2 54 |
| PAH | LMW PAHs | 21 | 3 64 | 3 64 | 6 | 8 97 | YES | 3 64 | 3 53 |
| PAH | HMW PAHs | 21 | 11 36 | 11 36 | 6 | 13.06 | YES | 11 36 | 9 70 |
| PAH | Total PAHs | 21 | 3 95 | 3 95 | 6 | 8 82 | YES | 3 95 | 3 76 |
| PCB | Total PCBs | 21 | 0 54 | 1 00 | 6 | 0 36 | NO | | |
| PST | Aldrin | 21 | 4 26E-04 | 1 00 | 6 | 1 14E-03 | NO | | |
| PST | Alpha-BHC | 21 | 0 03 | 1 00 | 6 | 0 02 | NO | | |
| PST | Alpha-chlordane | 21 | 0 04 | 1 00 | 6 | 6 78E-03 | NO | | |
| PST | Beta-BHC | 21 | 0 19 | 1 00 | 6 | 0 15 | NO | | |
| PST | Chlorpyrifos | 21 | 0 06 | 1 00 | 6 | 0 02 | NO | | |
| PST | CIS-Nonachlor | 21 | 0 57 | 1 00 | 6 | 0 10 | NO | | |
| PST | Delta-BHC | 21 | 0 01 | 1 00 | 6 | 0 01 | NO | | |
| PST | Dieldrin | 21 | 0 85 | 1 00 | 6 | 0 11 | NO | | |
| PST | Endosulfan II | 21 | 2 76 | 2 76 | 6 | 0 97 | NO | | 2 40 |
| PST | Endrin | 21 | 0 10 | 1 00 | 6 | 0 04 | NO | | |
| PST | Gamma-BHC (Lindane) | 21 | 0 03 | 1 00 | 6 | 0 03 | NO | | |
| PST | Gamma-Chlordane | 21 | 0 06 | 1 00 | 6 | 1 56E-03 | NO | | |
| PST | Heptachlor | 21 | 0 02 | 1 00 | 6 | 2 12E-03 | NO | | |
| PST | Heptachlor epoxide | 21 | 0 02 | 1 00 | 6 | 6 08E-03 | NO | | |
| PST | Hexachlorobenzene | 21 | 1 39E-06 | 1 00 | 6 | 5 76E-08 | NO | | |
| PST | Mirex | 21 | 0 01 | 1 00 | 6 | 6 43E-03 | NO | | |
| PST | Oxychlordane | 21 | 0 01 | 1 00 | 6 | 0 01 | NO | | |
| PST | Pentachlorobenzene | 21 | 4 16E-06 | 1 00 | 6 | 5 91E-07 | NO | | |
| PST | Trans-Nonachlor | 21 | 1 21 | 1 21 | 6 | 0 14 | NO | | 1 00 |
| PST | 1,2,3,4-Tetrachlorobenzene | 21 | 2 48E-05 | 1 00 | 6 | 5 12E-06 | NO | | |
| PST | 1,2,4,5-Tetrachlorobenzene | 21 | 4 76E-05 | 1 00 | 6 | 1 04E-05 | NO | | |
| PST | o,p'-DDD | 21 | 3 70E-03 | 1 00 | 6 | 9 66E-04 | NO | | |
| PST | p,p'-DDD | 21 | 2 65E-04 | 1 00 | 6 | 3 47E-05 | NO | | |
| PST | o,p'-DDE | 21 | 1 30E-04 | 1 00 | 6 | 2 53E-05 | NO | | |
| PST | o,p'-DDT | 21 | 2 54 | 2 54 | 6 | 0 73 | NO | | 1 48 |
| PST | p,p'-DDE | 21 | 2 26E-04 | 1 00 | 6 | 1 80E-05 | NO | | |
| PST | p,p'-DDT | 21 | 2 90 | 2 90 | 6 | 0 60 | NO | | 1 43 |

PW-HQ=Pore water Hazard Quotient (unitless)

1 - NOEQ = No Observable Effect Quotient = greater of 95th percentile Upper Limit (95% UL) PW-HQ or 1 (unitless)

2 - SEM-AVS expressed as µmol/g dry wt sediment (benchmark from USEPA, 1996)

3A- Hazard Quotients for amphipod survival (porewater), see Tables A-2-2 6 (no toxicity) and A-2-2.7 (toxicity), unitless

3B- Hazard Quotients. for sea urchin survival (porewater), see Table A-2-2 8 (no toxicity) and Table A-2-2 9 (toxicity), unitless

4A - AMP - Amphipod (*Ampelisca abdita*) survival endpoint. If Max PW-HQ>test NOEQ, then AMP-NOEQ = test NOEQ (unitless)

4B - ARB - Sea Urchin (*Arbacia punctulata*) survival endpoint If Max PW-HQ > test NOEQ, ARB-NOEQ = test NOEQ (unitless)

5 - Aquatic NOEQ = minimum of test-specific NOEQs (unitless)

Table 2.2-4. Derivation of Aquatic Reference Screening Values (RSVs) based on measured/calculated concentrations of selected contaminants in pore water from Portsmouth Naval Shipyard reference locations from the Portsmouth Naval Shipyard study area. [1]

| Class | Analyte[2] | Pathway | R01-100B | R01-200B | R01-300B | R01-400B | R02-100B | R02-200B | R02-300B | R02-400B | R03-100B | R03-200B | R03-300B | R03-400B | R04-100B | R04-200B | R04-300B | R04-400B | n | DIST[3] | Mean | Aquatic RSV[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | PW | 7 10 | 5 70 | 7 00 | 3 70 | 3 20 | 1 50 | 4 10 | 1 50 | 1 50 | 8 10 | 2 55 | 3 13 | 3 10 | 1 50 | 1 50 | 1 50 | 16 | LOG | 3 54 | 8 26 |
| MET | Nickel | PW | 2 50 | 2 50 | 6 00 | 2 50 | 2 50 | 5 00 | 2 50 | 2 50 | 2 50 | 2 50 | 7 00 | 2 50 | 13 00 | 2 50 | 2 50 | 2 50 | 16 | LOG | 3 81 | 7 54 |
| PAH | 2-Methylnaphthalene (L) | PW | 0 079 | 0 075 | 0 089 | 0 098 | 0 106 | 0 230 | 0 244 | 0 205 | 0 033 | 0 142 | 0 243 | 0 156 | 0 032 | 0 038 | 0 048 | 0 052 | 16 | LOG | 0 12 | 0 30 |
| PAH | Acenaphthylene (L) | PW | 0 246 | 0 195 | 0 277 | 0 813 | 0 411 | 0 801 | 0 911 | 0 724 | 0 029 | 0 451 | 0 443 | 0 420 | 0 092 | 0 094 | 0 100 | 0 169 | 16 | NORM | 0 39 | 0 86 |
| PAH | Anthracene (L) | PW | 0 126 | 0 098 | 0 373 | 0 461 | 0 317 | 1 352 | 0 651 | 0 698 | 0 047 | 1 541 | 1 520 | 0 392 | 0 058 | 0 057 | 0 061 | 0 099 | 16 | LOG | 0 49 | 2 01 |
| PAH | Benzo(a)anthracene (H) | PW | 0 018 | 0 013 | 0 063 | 0 046 | 0 055 | 0 148 | 0 121 | 0 073 | 0 009 | 0 164 | 0 134 | 0 078 | 0 008 | 0 005 | 0 005 | 0 008 | 16 | LOG | 0 06 | 0 27 |
| PAH | Dibenz(a,h)anthracene (H) | PW | 0 000 | 0 000 | 0 001 | 0 001 | 0 001 | 0 003 | 0 002 | 0 002 | 0 000 | 0 003 | 0 002 | 0 002 | 0 000 | 0 000 | 0 000 | 0 000 | 16 | LOG | 0 00 | 0 00 |
| PAH | Fluorene (L) | PW | 0 087 | 0 055 | 0 212 | 0 477 | 0 150 | 0 551 | 0 379 | 0 308 | 0 034 | 0 555 | 0 896 | 0 264 | 0 034 | 0 036 | 0 034 | 0 058 | 16 | LOG | 0 26 | 1 01 |
| PAH | Phenanthrene (L) | PW | 0 154 | 0 113 | 0 377 | 2 416 | 0 567 | 1 244 | 0 954 | 0 629 | 0 053 | 1 502 | 2 166 | 0 922 | 0 078 | 0 094 | 0 066 | 0 123 | 16 | LOG | 0 72 | 3 19 |
| PAH | Pyrene (H) | PW | 0 111 | 0 084 | 0 242 | 0 754 | 0 334 | 0 892 | 0 627 | 0 485 | 0 050 | 0 794 | 0 879 | 0 518 | 0 050 | 0 048 | 0 045 | 0 083 | 16 | LOG | 0 37 | 1 54 |
| PAH | LMW PAHs | PW | 1 389 | 0 984 | 2 038 | 5 321 | 2 287 | 6 346 | 4 999 | 4 123 | 0 408 | 5 915 | 7 870 | 3 634 | 0 561 | 0 650 | 0 768 | 0 933 | 16 | LOG | 3 01 | 10 27 |
| PAH | HMW PAHs | PW | 0 270 | 0 194 | 0 635 | 1 959 | 0 870 | 2 186 | 1 643 | 1 218 | 0 126 | 2 089 | 2 057 | 1 306 | 0 127 | 0 112 | 0 110 | 0 191 | 16 | LOG | 0 94 | 3 96 |
| PAH | Total PAHs | PW | 1 659 | 1 178 | 2 673 | 7 280 | 3 158 | 8 532 | 6 642 | 5 341 | 0 535 | 8 004 | 9 927 | 4 940 | 0 688 | 0 763 | 0 877 | 1 124 | 16 | LOG | 3 96 | 14 02 |
| PST | Endosulfan II | PW | 2 0E-03 | 8.3E-04 | 1 1E-03 | 1 6E-03 | 2 0E-03 | 8 5E-03 | 2 5E-03 | 6 1E-04 | 2 4E-04 | 5 2E-04 | 1 2E-03 | 4 9E-03 | 1 8E-03 | 1 6E-03 | 1 8E-03 | 9 6E-04 | 16 | LOG | 2 0E-03 | 5 7E-03 |
| PST | Trans-Nonachlor | PW | 1 6E-06 | 7 8E-07 | 7 6E-07 | 2 1E-06 | 1 9E-06 | 6E-06 | 5 9E-07 | 3E-06 | 3 3E-07 | 2 6E-06 | 3E-06 | 1 3E-06 | 2E-06 | 2 4E-06 | 1 6E-05 | 9 1E-07 | 16 | LOG | 2 8E-06 | 8 1E-06 |
| PST | o,p'-DDT | PW | 9E-06 | 7 6E-06 | 8 7E-06 | 1 2E-05 | 1E-05 | 0 00024 | 2 9E-05 | 0 00015 | 5 4E-06 | 2 8E-05 | 3E-05 | 2 5E-05 | 1 2E-05 | 2 5E-06 | 2 5E-05 | 3 5E-05 | 16 | LOG | 3 9E-05 | 1 3E-04 |
| PST | p,p'-DDT | PW | 6 9E-06 | 6 8E-06 | 3 3E-06 | 7 3E-06 | 1 3E-05 | 1 2E-05 | 3E-05 | 0 00043 | 1 8E-06 | 1 3E-05 | 3E-05 | 2 3E-05 | 8 7E-06 | 3 8E-06 | 1 8E-05 | 6 6E-06 | 16 | LOG | 3 8E-05 | 9 0E-05 |

1-Pore water concentration (µg/L) See Table A-2-2 4 for reference porewater values

2 - List includes analytes for which NOEQs were developed, see Table 2 2-3

3 - Aquatic Reference Screening Value (RSV, ug/L) calculated as the 95th percentile Upper Limit (95% UL) based on sample and distribution type (Appendix B)

NORM = Normal Distribution, LOG = LOG-Normal distribution

Table 2.2-5. Derivation of Example Threshold Effects Values (TEVs) for the aquatic exposure pathway for the Portsmouth Naval Shipyard offshore study area.

| Exposure Pathway | Class | Analyte[1] | Aquatic NOEQ[2] | WQSV (µg/L) | NOEC[3] (µg/L) | Aquatic RSV[4] (µg/L) | Aquatic TEV[5] (µg/L) | Limiting CoC?[6] |
|---|---|---|---|---|---|---|---|---|
| PW | MET | Copper | 1.14 | 3.10 | 3.55 | 8.26 | 8.26 | yes |
| PW | MET | Nickel | 1.30 | 8.20 | 10.7 | 7.54 | 10.7 | yes |
| PW | PAH | 2-Methylnaphthalene (L) | 1.07 | 0.88 | 0.94 | 0.30 | 0.94 | |
| PW | PAH | Acenaphthylene (L) | 2.71 | 0.46 | 1.24 | 0.86 | 1.24 | yes |
| PW | PAH | Anthracene (L) | 8.21 | 0.29 | 2.36 | 2.01 | 2.36 | yes |
| PW | PAH | Benzo(a)anthracene (H) | 4.35 | 0.065 | 0.283 | 0.268 | 0.28 | |
| PW | PAH | Dibenz(a,h)anthracene (H) | 3.78 | 1.7E-03 | 6.4E-03 | 4.7E-03 | 6.4E-03 | |
| PW | PAH | Fluorene (L) | 14.9 | 0.14 | 2.06 | 1.01 | 2.06 | yes |
| PW | PAH | Phenanthrene (L) | 1.00 | 4.60 | 4.60 | 3.19 | 4.60 | |
| PW | PAH | Pyrene (H) | 2.54 | 0.63 | 1.60 | 1.54 | 1.60 | |
| PW | PAH | LMW PAHs | 3.53 | 5.76 | 20.3 | 10.3 | 20.3 | |
| PW | PAH | HMW PAHs | 9.70 | 0.42 | 4.11 | 3.96 | 4.11 | yes |
| PW | PAH | Total PAHs | 3.76 | 6.49 | 24.4 | 14.0 | 24.4 | |
| PW | PST | Endosulfan II | 2.40 | 8.7E-03 | 2.1E-02 | 5.7E-03 | 2.1E-02 | yes |
| PW | PST | Trans-Nonachlor | 1.00 | 4.0E-05 | 4.0E-05 | 8.1E-06 | 4.0E-05 | yes |
| PW | PST | o,p'-DDT | 1.48 | 1.0E-03 | 1.5E-03 | 1.3E-04 | 1.5E-03 | |
| PW | PST | p,p'-DDT | 1.43 | 1.0E-03 | 1.4E-03 | 9.0E-05 | 1.4E-03 | yes |

NOEQ=No Observable Effect Quotient (unitless); WQSV=Water Quality Screening Value; NOEC=No Observable Effect Concentration; RSV=Reference Screening Value; TEV=Toxicity Effect Value.

1 - List includes analytes for which Aquatic NOEQs were developed; see Table 2.2-3.

2 - Aquatic NOEQ = minimum of exposure pathway-specific NOEQs; see Table 2.2-3.

3 - NOEC = Aquatic NOEQ x WQSV (Table 2.2-1).

4 - RSV = reference data, see Table 2.2-4.

5 - Aquatic TEV is the greater of the NOEC and RSV.

6 - See Table A-2-2.10 for derivation of Limiting CoC.

Table 2.2-6. Summary of baseline Preliminary Remediation Goals (PRGs) for the aquatic exposure pathway in the Portsmouth Naval Shipyard study area expressed as sediment concentration-based values.

| | | Preliminary Remediation Goal[1] |
|---|---|---|
| | | Aquatic-Bedded[3] |
| Class | Analyte[2] | HQ=1 |
| MET | Copper | 486 |
| MET | Nickel | 124 |
| PAH | Acenaphthylene (L) | 210 |
| PAH | Anthracene (L) | 1236 |
| PAH | Fluorene (L) | 500 |
| PAH | HMW PAHs | 13057 |
| PST | Endosulfan II | 3.95 |
| PST | Trans-Nonachlor | 3.99 |
| PST | p,p'-DDT | 66.4 |

RPRG - Recommended Preliminary Remediation Goals

NR - Not Recommended

1 - Pathway-specific PRGs expressed in concentration units for use during remediation.

PAHs, PSTs: units = ng/g dry weight sediment

metals: units = µg/g dry weight sediment

2 - List includes only limiting CoCs, i.e., CoCs with maximum TEV-HQs by station and pathway.

3 - Aquatic Bedded PRG at HQ=1 (see Table A-3-1.1 for PRG calculations)

Table 3.3-1. Relationship between degree of PRG exceedance and risk for chemicals exhibiting highest PRG exceedances by sampling location in the Portsmouth Naval Shipyard study area.

**A. EERA data**

| STATION | Area[1] | MAX CoC[2] | MAX PRG-HQ[2] | Risk Rank[3] | RPRG-HQ[4] |
|---|---|---|---|---|---|
| BC-18 | BC | Fluorene (L) | 1.35 | Medium | 1.0 |
| DD-12-5 | DD | HMW PAHs | 1.37 | Medium | 1.0 |
| BC-53 | BC | NA | <1 | Medium | |
| BC-54 | BC | NA | <1 | Medium | |
| CC-3 | CC | NA | <1 | Low | |
| CC-4 | CC | NA | <1 | Low | |
| CC-5 | CC | NA | <1 | Low | |
| CC-51 | CC | NA | <1 | Low | |
| CC-6 | CC | NA | <1 | Low | |
| CC-7 | CC | NA | <1 | Low | |
| CC-8 | CC | NA | <1 | Low | |
| DD-10 | DD | NA | <1 | Medium | |
| DD-12 | DD | NA | <1 | Medium | |
| DD-13 | DD | NA | <1 | Medium | |
| DD-17 | DD | NA | <1 | Medium | |
| JC-19 | JC | NA | <1 | Low | |
| JC-52 | JC | NA | <1 | Low | |
| SP-50 | SP | NA | <1 | Medium | |
| SP-9 | SP | NA | <1 | Medium | |
| PR-14 | PR | NA | <1 | Low | |

1- EERA Risk Characterization Areas:
BC= Back Channel, JC=Jamaica Cove; CC = Clark Cove; SP = Sullivan Point; SY = DRMO; DD= Dry Docks.
2- CoC with highest PRG Hazard Quotient by sampling location; NA no CoC identified (See Table A-3-1.3a)
3- Assigned sediment risk from Estuarine ERA investigation (NCCOSC, 2000).
SY- Risk at DRMO based on surface water
4- Recommended PRG-HQ; INT = indeterminate.
Units: PRG-HQ = unitless

Table 3.3-1. Relationship between degree of PRG exceedance and risk for chemicals exhibiting highest PRG exceedances by sampling location in the Portsmouth Naval Shipyard study area.

**B. Round 1 data**

| STATION | Area[1] | MAX CoC[2] | MAX PRG-HQ[2] | Risk Rank[3] | RPRG-HQ[4] |
|---|---|---|---|---|---|
| M10-3 | SP | Acenaphthylene (L) | 1.03 | Medium | 1.0 |
| M03-2 | BC | Copper | 5.95 | Medium | |
| M04-1 | BC | Copper | 1.16 | Medium | 1.0 |
| M12-1 | DD | HMW PAHs | 3.03 | Medium | 1.0 |
| M01-3 | BC | p,p'-DDT | 16.77 | Medium | |
| M08-3 | CC | p,p'-DDT | 1.99 | Low | |
| M01-2 | BC | p,p'-DDT | 1.64 | Medium | |
| M04-3 | BC | p,p'-DDT | 1.34 | Medium | INT |
| M10-1 | SP | Trans-Nonachlor | 5.26 | Medium | 1.0 |
| M01-1 | BC | NA | <1 | Medium | |
| M02-2 | BC | NA | <1 | Medium | |
| M02-3 | BC | NA | <1 | Medium | |
| M03-1 | BC | NA | <1 | Medium | |
| M03-3 | BC | NA | <1 | Medium | |
| M04-1 | BC | NA | <1 | Medium | |
| M08-1 | CC | NA | <1 | Low | |
| M08-2 | CC | NA | <1 | Low | |
| M09-1 | CC | NA | <1 | Low | |
| M11-1 | SY | NA | <1 | Low | |
| M11-2 | SY | NA | <1 | Low | |
| M12-3 | DD | NA | <1 | Medium | |
| M13-1 | DD | NA | <1 | Medium | |
| M13-2 | DD | NA | <1 | Medium | |
| M02-1 | BC | NA | | Medium | |
| M05-1 | JC | NA | | Low | |
| M05-2 | JC | NA | | Low | |
| M05-3 | JC | NA | | Low | |
| M06-1 | JC | NA | | Low | |
| M06-2 | JC | NA | | Low | |
| M06-3 | JC | NA | | Low | |
| M07-1 | CC | NA | | Low | |
| M07-2 | CC | NA | | Low | |
| M07-3 | CC | NA | | Low | |
| M08-4 | CC | NA | | Low | |
| M09-2 | CC | NA | | Low | |
| M09-3 | CC | NA | | Low | |
| M09-4 | CC | NA | | Low | |
| M10-2 | SP | NA | | Medium | |
| M11-3 | SY | NA | | Low | |
| M12-2 | DD | NA | | Medium | |
| M13-3 | DD | NA | | Medium | |
| M14-1 | DD | NA | | Medium | |
| M14-2 | DD | NA | | Medium | |
| M14-3 | DD | NA | | Medium | |

1- EERA Risk Characterization Areas:
BC= Back Channel, JC=Jamaica Cove; CC = Clark Cove; SP = Sullivan Point; SY = DRMO; DD= Dry Docks.
2- CoC with highest PRG Hazard Quotient by sampling location; NA no CoC identified (See Table A-3-1.3b)
3- Assigned sediment risk from Estuarine ERA investigation (NCCOSC, 2000).
SY- Risk at DRMO based on surface water
4- Recommended PRG-HQ; INT = Indeterminate
Units: PRG-HQ = unitless

Table 3-3-1. Relationship between degree of PRG exceedance and risk for chemicals exhibiting highest PRG exceedances by sampling location in the Portsmouth Naval Shipyard study area-

**C. Round 2 data**

| STATION | Area[1] | MAX CoC[2] | MAX PRG-HQ[2] | Risk Rank[3] | RPRG-HQ[4] |
|---|---|---|---|---|---|
| M01-100B | BC | Acenaphthylene (L) | 1.40 | Medium | 1.00 |
| M10-200B | SP | Anthracene (L) | 1.33 | Medium | 1.00 |
| M04-100B | BC | Copper | 3.66 | Medium | |
| M03-200B | BC | Copper | 2.24 | Medium | |
| M08-300B-AVG | CC | Copper | 1.55 | Low | 1.55 |
| M13-100B | DD | Fluorene (L) | 7.51 | Medium | |
| M01-300B-AVG | BC | Fluorene (L) | 1.83 | Medium | |
| M12-100B | DD | Fluorene (L) | 1.36 | Medium | |
| M12-200B-AVG | DD | Fluorene (L) | 1.30 | Medium | 1.00 |
| M09-100B | CC | Nickel | 1.29 | Low | 1.29 |
| M08-100B | CC | p,p'-DDT | 4.29 | Low | |
| M01-200B | BC | p,p'-DDT | 2.86 | Medium | |
| M04-300B | BC | p,p'-DDT | 2.62 | Medium | INT |
| M10-100B-AVG | SP | Trans-Nonachlor | 1.85 | Medium | 1.00 |
| M02-100B | BC | NA | <1 | Medium | |
| M02-200B | BC | NA | <1 | Medium | |
| M02-300B | BC | NA | <1 | Medium | |
| M03-100B | BC | NA | <1 | Medium | |
| M03-300B | BC | NA | <1 | Medium | |
| M04-200B | BC | NA | <1 | Medium | |
| M05-100B-AVG | JC | NA | <1 | Low | |
| M05-200B | JC | NA | <1 | Low | |
| M05-300B | JC | NA | <1 | Low | |
| M06-100B | JC | NA | <1 | Low | |
| M06-200B | JC | NA | <1 | Low | |
| M06-300B | JC | NA | <1 | Low | |
| M07-100B | CC | NA | <1 | Low | |
| M07-200B | CC | NA | <1 | Low | |
| M07-300B | CC | NA | <1 | Low | |
| M08-200B | CC | NA | <1 | Low | |
| M08-400B | CC | NA | <1 | Low | |
| M09-200B | CC | NA | <1 | Low | |
| M09-300B | CC | NA | <1 | Low | |
| M09-400B | CC | NA | <1 | Low | |
| M10-300B | SP | NA | <1 | Medium | |
| M11-100B2 | SY | NA | <1 | Low | |
| M-11-200B2 | SY | NA | <1 | Low | |
| M11-300B | SY | NA | <1 | Low | |
| M12-300B-AVG | DD | NA | <1 | Medium | |
| M13-200B | DD | NA | <1 | Medium | |
| M13-300B | DD | NA | <1 | Medium | |
| M14-100B | DD | NA | <1 | Medium | |
| M14-200B | DD | NA | <1 | Medium | |
| M14-300B | DD | NA | <1 | Medium | |

1- EERA Risk Characterization Areas:
BC= Back Channel, JC=Jamaica Cove; CC = Clark Cove; SP = Sullivan Point; SY = DRMO; DD= Dry Docks-
2- CoC with highest PRG Hazard Quotient by sampling location; NA no CoC identified (See Table A-3-1.3c).
3- Assigned sediment risk from Estuarine ERA investigation (NCCOSC, 2000)-
SY- Risk at DRMO based on surface water
4- Recommended PRG-HQ; INT = indeterminate
Units: PRG-HQ = unitless

Table 3.3-2. Summary of Preliminary Remediation Goals (PRGs) for the aquatic exposure pathway in the Portsmouth Naval Shipyard study area expressed as sediment concentration-based values.

| | | Preliminary Remediation Goal[1] | | | | |
|---|---|---|---|---|---|---|
| | | Baseline PRG[3] | RPRG-HQ[4] | | | Recommended PRG[4] |
| Class | Analyte[2] | (HQ=1) | EERA | Round 1 | Round 2 | (Site-Specific) |
| MET | Copper | 486 | | 1.00 | 1.55 | 486 |
| MET | Nickel | 124 | | | 1.29 | 161 |
| PAH | Acenaphthylene (L) | 210 | | | 1.00 | 210 |
| PAH | Anthracene (L) | 1236 | | | 1.00 | 1236 |
| PAH | Fluorene (L) | 500 | 1.00 | | 1.00 | 500 |
| PAH | HMW PAHs | 13057 | 1.00 | 1.00 | | 13057 |
| PST | Endosulfan II | 3.95 | | | | NR |
| PST | Trans-Nonachlor | 3.99 | | 1.00 | 1.00 | NR |
| PST | p,p'-DDT | 66.4 | | INT | INT | NR |

RPRG - Recommended Preliminary Remediation Goals.
INT - Indeterminate; NR - Not Recommended.
1 - Pathway-specific PRGs expressed in concentration units for use during remediation.
PAHs, PSTs: units = ng/g dry weight sediment
metals: units = µg/g dry weight sediment
2 - List includes only limiting CoCs, i.e., CoCs with maximum TEV-HQs by station and pathway.
3 - Aquatic Bedded PRG at HQ=1 (see Table 2.2-5).
4- RPRG = baseline PRG x minimum of study RPRG-HQs (See Table 3.3-1).

## LIST OF APPENDICES


APPENDIX A TABLE — PAGE NOS.

A-2-2.1 SUMMARY OF KOW AND KOC VALUES USED IN CALCULATIONS OF ORGANIC CONTAINMENT CONCENTRATIONS IN POREWATERS BY EQUILIBRIUM PARTITIONING ..... A-1 – A-2

A-2-2.2a CONCENTRATIONS OF CHEMICAL CONTAMINANTS IN SURFACE SEDIMENT (0-10 CM) COLLECTED FROM ROUND 2 OF THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-3 – A-8

A-2.2.2b CONCENTRATIONS OF PCB CONGENERS AND CALCULATION OF TOTAL PCBS IN SURFACE SEDIMENT (0-10 CM) COLLECTED FROM ROUND 2 OF THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-9 – A-11

A-2-2.3 GEOTECHNICAL CHARACTERISTICS OF STATION SEDIMENTS IN ROUND 2 OF THE PORTSMOUTH NAVAL SHIPYARD INVESTIGATION ..... A-12

A-2-2.4a CONCENTRATIONS OF CONTAMINANTS IN THE SEDIMENT PORE WATERS FROM ROUND 2 OF THE PORTSMOUTH NAVAL SHIPYARD INVESTIGATION ..... A-13 – A-18

A-2-2.4b CONCENTRATIONS OF PCB CONGENERS AND TOTAL PCBS IN SURFACE SEDIMENT PORE WATERS FROM ROUND 2 OF THE PORTSMOUTH NAVAL SHIPYARD INVESTIGATION ..... A-19 – A-23

A-2-2.5 HAZARD QUOTIENTS CALCULATED FOR COC CONCENTRATIONS IN SEDIMENT PORE WATER FROM THE PORTSMOUTH NAVAL SHIPYARD STUDY AREA ..... A-24 – A-27

A-2-2-6 POREWATER HAZARD QUOTIENTS (PW-HQS) BASED ON DATA FROM THE PORTSMOUTH NAVAL SHIPYARD INVESTIGATION FOR STATIONS EXHIBITING NO TOXICITY TO AMPHIPODS (AMPELISCA ABDITA) ..... A-28 – A-31

A-2-2.7 POREWATER HAZARD QUOTIENTS (PW-HQS) BASED ON DATA FROM THE PORTSMOUTH NAVAL SHIPYARD INVESTIGATION FOR STATIONS EXHIBITING TOXICITY TO AMPHIPODS (AMPELISCA ABDITA) ..... A-32 –A-35

A-2-2.8 POREWATER HAZARD QUOTIENTS (PW-HQS) BASED ON DATA FROM THE PORTSMOUTH NAVAL SHIPYARD INVESTIGATION FOR STATIONS EXHIBITING NO TOXICITY TO SEA URCHIN (ARBACIA PUNCTULATA) ..... A-36 – A-39

A-2-2.9 POREWATER HAZARD QUOTIENTS (PW-HQS) BASED ON DATA FROM THE PORTSMOUTH NAVAL SHIPYARD INVESTIGATION FOR STATIONS EXHIBITING TOXICITY TO SEA URCHIN (ARBACIA PUNCTULATA) ..... A-40 – A43

A-2-2-10 COMBINED AQUATIC THRESHOLD EFFECTS VALUE HAZARD QUOTIENTS FOR COCS IN POREWATERS FOR IDENTIFICATION OF LIMITING COCS IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-44 – A-47

## LIST OF APPENDICES (CONTINUED)


APPENDIX A TABLE — PAGE NOS.

A-3-1.1 DERIVATION OF AQUATIC PRGS FOR COCS IN PORE WATER FROM SEDIMENTS COLLECTED IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-48 – A-50

A-3-1.2a NORMALIZED CONCENTRATIONS OF CHEMICALS IN SEDIMENT IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-51 – A-55

A-3-1.2b NORMALIZED CONCENTRATIONS OF PCB CONGENERS IN SEDIMENT IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-56 – A-58

A-3-1.2c NORMALIZED CONCENTRATIONS OF CONTAMINANTS IN TISSUES OF JUVENILE LOBSTER IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-59 – A-60

A-3-1.2d NORMALIZED CONCENTRATIONS OF PCB CONGENERS IN TISSUES OF JUVENILE LOBSTER IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-61

A-3-1.2e BIOACCUMULATION FACTORS (BAFS) FOR METALS AND BIOTA-SEDIMENT ACCUMULATION FACTORS (BSAFS) FOR ORGANICS IN JUVENILE LOBSTER TISSUE IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-62 – A-64

A-3-1.2f NORMALIZED CONCENTRATIONS OF CONTAMINANTS IN TISSUES OF MUSSELS IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-65 – A-67

A-3-1.2g NORMALIZED CONCENTRATIONS OF PCB CONGENERS IN TISSUES OF MUSSELS IN PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-68 – A-69

A-3-1.2h BIOACCUMULATION FACTORS (BAFS) FOR METALS AND BIOTA-SEDIMENT ACCUMULATION FACTORS (BSAFS) FOR ORGANICS IN MUSSEL TISSUE FROM THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-70 – A-72

A-3-1.2i ANALYTE AVERAGE OF BAF/BSAF ACROSS STATIONS IN THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-73

A-3-1.2j PREDICTED SEDIMENT CONCENTRATIONS FROM AVERAGE ANALYTE BAF/BSAF AT UN-SAMPLED STATIONS ..... A-74

A-3-1.3a PRG HAZARD QUOTIENTS FOR COCS IN SEDIMENT COLLECTED DURING THE PORTSMOUTH NAVAL SHIPYARD EERA INVESTIGATION ..... A-75 – A-76

A-3-1.3b PRG HAZARD QUOTIENTS FOR COCS IN SEDIMENTS COLLECTED IN ROUND 1 OF THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-77 – A-80

## LIST OF APPENDICES (CONTINUED)


APPENDIX A TABLE — PAGE NOS.

A-3-1.3c PRG HAZARD QUOTIENTS FOR COCS IN SEDIMENTS COLLECTED DURING ROUND 2 OF THE PORTSMOUTH NAVAL SHIPYARD OFFSHORE STUDY AREA ..... A-81 – A-84

A-4 RECOMMENDED ACUTE:CHRONIC RATIOS TO DETERMINE CHRONIC VALUES FOR CHEMICALS THAT PRESENTLY LACK WQC-SC VALUES FOR WQSV DERIVATION FOR PRG DEVELOPMENT ..... A-85

A-5 COMPARISON OF PNS BASELINE PRELIMINARY REMEDIATION GOALS (PRGS) WITH LITERATURE-BASED SEDIMENT BENCHMARKS ..... A-86

APPENDIX B — PAGE NO.

DERIVATION OF CONFIDENCE INTERVALS AND PERCENTILES FOR THE NORMAL AND LOGNORMAL DISTRIBUTIONS ..... B-1

Table A-2-2.1. Summary of Kow and Koc values used in calculations of organic contaminant concentrations in pore water by equilibrium partitioning

| Class | Full Analyte Name | CAS No | LogKow | Source[1] | LogKoc[2] | Koc |
|---|---|---|---|---|---|---|
| PAH | 1,6,7-Trimethylnaphthalene | 2245387 | 4 61 | b | 4 53 | 3 40E+4 |
| PAH | 1-Methylnaphthalene | 90120 | 3 97 | b | 3 90 | 7 99E+3 |
| PAH | 1-Methylphenanthrene | 832699 | 5 08 | b | 4 99 | 9 86E+4 |
| PAH | 2,6-Dimethylnaphthalene | 581420 | 4 61 | b | 4 53 | 3 40E+4 |
| PAH | 2-Methylnaphthalene | 91576 | 3 97 | b | 3 90 | 7 99E+3 |
| PAH | Acenaphthene | 83329 | 3 92 | a | 3 85 | 7 14E+3 |
| PAH | Acenaphthylene | 208968 | 4 05 | b | 3 98 | 9 58E+3 |
| PAH | Anthracene | 120127 | 4 55 | a | 4 47 | 2 97E+4 |
| PAH | Benzo(a)anthracene | 56553 | 5 70 | a | 5 60 | 4 01E+5 |
| PAH | Benzo(a)pyrene | 50328 | 6 11 | a | 6 01 | 1 01E+6 |
| PAH | Benzo(b)fluoranthene | 205992 | 6 20 | a | 6 09 | 1 24E+6 |
| PAH | Benzo(b+k)fluoranthene | NA | 6 20 | d | 6 09 | 1 24E+6 |
| PAH | Benzo(e)pyrene | 192972 | 6 11 | b | 6 01 | 1 01E+6 |
| PAH | Benzo(g,h,i)perylene | 191242 | 6 70 | a | 6 59 | 3 86E+6 |
| PAH | Benzo(k)fluoranthene | 207089 | 6 20 | d | 6 09 | 1 24E+6 |
| PAH | Biphenyl | 92524 | 3 96 | a | 3 89 | 7 82E+3 |
| PAH | Chrysene | 218019 | 5 70 | a | 5 60 | 4 01E+5 |
| PAH | Dibenz(a,h)anthracene | 53703 | 6 69 | a | 6 58 | 3 77E+6 |
| PAH | Fluoranthene | 206440 | 5 12 | a | 5 03 | 1 08E+5 |
| PAH | Fluorene | 86737 | 4 21 | a | 4 14 | 1 38E+4 |
| PAH | Indeno(1,2,3-cd)pyrene | 193395 | 6 65 | a | 6 54 | 3 45E+6 |
| PAH | Naphthalene | 91203 | 3 36 | a | 3 30 | 2 01E+3 |
| PAH | Perylene | 198550 | 6 05 | b | 5 95 | 8 86E+5 |
| PAH | Phenanthrene | 85018 | 4 55 | a | 4 47 | 2 97E+4 |
| PAH | Pyrene | 129000 | 5 11 | a | 5 02 | 1 06E+5 |
| PAH | Low Molecular Weight PAHs[3] | NA | 4 05 | c | 3 98 | 9 58E+3 |
| PAH | High Molecular Weight PAHs[3] | NA | 5 70 | c | 5 60 | 4 01E+5 |
| PAH | Total PAHs[3] | NA | 4 88 | c | 4 79 | 6 20E+4 |
| PCB | 101 (2 2'3 5 5') | 37680732 | 6 38 | b | 6 27 | 1 87E+6 |
| PCB | 105 (2 3 3'4 4') | 32598144 | 6 65 | b | 6 54 | 3 45E+6 |
| PCB | 118 (2 3'4 4'5) | 31508006 | 6 74 | b | 6 63 | 4 22E+6 |
| PCB | 128 (2 2'3 3'4 4') | 39380073 | 6 74 | b | 6 63 | 4 22E+6 |
| PCB | 138 (2 2'3 4 4'5) | 35065282 | 6 83 | b | 6 71 | 5 18E+6 |
| PCB | 153 (2 2'4 4'5 5') | 35065271 | 6 92 | b | 6 80 | 6 35E+6 |
| PCB | 170 (2 2'3 3'4 4'5) | 35065306 | 7 27 | b | 7 15 | 1 40E+7 |
| PCB | 18 (2 2'5) | 37680652 | 5 24 | b | 5 15 | 1 42E+5 |
| PCB | 180 (2 2'3 4 4'5 5') | 35065293 | 7 36 | b | 7 24 | 1 72E+7 |
| PCB | 187 (2 2'3 4'5 5'6) | 52663680 | 7 17 | b | 7 05 | 1 12E+7 |
| PCB | 195 (2 2'3 3'4 4'5 6) | 52663782 | 7 56 | b | 7 43 | 2 70E+7 |
| PCB | 206 (2 2'3 3'4 4'5 5'6) | 40186729 | 8 09 | b | 7 95 | 8 97E+7 |
| PCB | 209 (2 2'3 3'4 4'5 5'6 6') | 2051243 | 8 18 | b | 8 04 | 1 10E+8 |
| PCB | 28 (2 4 4') | 7012375 | 5 67 | b | 5 57 | 3 75E+5 |
| PCB | 44 (2 2'3 5') | 41464395 | 5 75 | b | 5 65 | 4 49E+5 |
| PCB | 52 (2 2'5 5) | 35693993 | 5 84 | b | 5 74 | 5 51E+5 |
| PCB | 66 (2 3'4 4') | 32598100 | 6 20 | b | 6 09 | 1 24E+6 |
| PCB | 8 (2 4) | 34883437 | 5 07 | b | 4 98 | 9 64E+4 |
| PCB | Total PCBs[4] | NA | 6 54 | b | 6 43 | 2 69E+6 |

Table A-2-2.1. Summary of Kow and Koc values used in calculations of organic contaminant concentrations in pore water by equilibrium partitioning.

| Class | Full Analyte Name | CAS No | LogKow | Source[1] | LogKoc[2] | Koc |
|---|---|---|---|---|---|---|
| PST | Aldrin | 309002 | 6 50 | a | 6 39 | 2 45E+6 |
| PST | Alpha-BHC | 319846 | 3 80 | a | 3 74 | 5 44E+3 |
| PST | Alpha-chlordane | 5103719 | 6 50 | a | 6 39 | 2 45E+6 |
| PST | Beta-BHC | 319857 | 3 81 | a | 3 75 | 5 57E+3 |
| PST[1] | Chlorpyrifos | 2921882 | 5 26 | a | 5 17 | 1 48E+5 |
| PST | CIS-Nonachlor | 3734494 | 6 87 | a | 6 75 | 5 67E+6 |
| PST | Delta-BHC | | 3 81 | a | 3 74 | 5 50E+3 |
| PST | Dieldrin | 60571 | 5 37 | a | 5 28 | 1 90E+5 |
| PST | Endosulfan II | 115297 | 4 10 | a | 4 03 | 1 07E+4 |
| PST | Endrin | 72208 | 5 06 | a | 4 97 | 9 42E+4 |
| PST | Gamma-BHC (Lindane) | 58899 | 3 73 | a | 3 67 | 4 64E+3 |
| PST | Gamma-Chlordane | 57749 | 6 32 | a | 6 21 | 1 63E+6 |
| PST | Heptachlor | 76448 | 6 26 | a | 6 15 | 1 43E+6 |
| PST | Heptachlor epoxide | 1024573 | 5 00 | a | 4 92 | 8 23E+4 |
| PST | Hexachlorobenzene | 118741 | 5 89 | a | 5 79 | 6 17E+5 |
| PST | Mirex | 2385855 | 6 89 | a | 6 77 | 5 93E+6 |
| PST | Oxychlordane | 57749 | 6 32 | a | 6 21 | 1 63E+6 |
| PST | Pentachlorobenzene | 608935 | 5 26 | a | 5 17 | 1 48E+5 |
| PST | Trans-Nonachlor | 3734494 | 6 87 | a | 6 75 | 5 67E+6 |
| PST | 1,2,3,4-Tetrachlorobenzene | 634662 | 4 61 | a | 4 53 | 3 40E+4 |
| PST | 1,2,4,5-Tetrachlorobenzene | 634902 | 4 64 | a | 4 56 | 3 64E+4 |
| PST | o,p'-DDD | 72548 | 6 10 | a | 6 00 | 9 92E+5 |
| PST | p,p'-DDD | 72548 | 6 10 | a | 6 00 | 9 92E+5 |
| PST | o,p'-DDE | 2385855 | 6 76 | a | 6 65 | 4 42E+6 |
| PST | o,p'-DDT | 789026 | 6 53 | a | 6 42 | 2 63E+6 |
| PST | p,p'-DDE | 72559 | 6 76 | a | 6 65 | 4 42E+6 |
| PST | p,p'-DDT | 50293 | 6 53 | a | 6 42 | 2 63E+6 |

1 - Literature source of LogKow (L/kg) values

a - Karickhoff and Long 1995

b - Karickhoff *et al* 1989

c - Calculated value based on median Kow of analytes as defined in footnote c

d- Value assumed same as benzo(b)fluoranthene

2 - $\log_{10}$Koc) = 0 00028 + 0 983*$\log_{10}$(Kow), Karickhoff *et al.* 1989 Units L/Kg OC

3 - LMW PAH = sum of 7 2-ring & 3-ring PAHs included in NOAA ER-L/ER-M benchmarks (Long et al 1995),
(2-methylnaphthalene, acenapthene, acenaphthylene, anthracene, fluorene, naphthalene, phenanthrene)
HMW PAH = sum of 6 4-ring and 5-ring PAHs included in NOAA ER-L/ER-M benchmarks (Long et al 1995),
(benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, pyrene)
Total PAHs - sum of LMW & HMW PAHs
LMW PAH, HMW PAH Kow = median of analyte specific Kow, Total PAH Kow = mean of LMW, HMW PAH Kow

4 - Sum of Congeners X 2

NA= not applicable

A-2

Table A-2-2.2a. Concentrations of chemical contaminants in surface sediment (0-10 cm) collected from round 2 of the Portsmouth Naval Shipyard offshore study area.

| Class | Analyte3 | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 12.2 | 10 3 | 13 15 | 10 7 | 12 4 | 13 7 | 17.2 | 18 6 | 10 7 | 19 7 | 9 2 | 13 7 |
| MET | Cadmium | 0 3 | 0 13 | 0 33 | 0 49 | 0 29 | 0 6 | 0 6 | 0 79 | 0 46 | 1 | 0 25 | 0 06 |
| MET | Chromium | 93 1 | 54 3 | 93 55 | 73 4 | 85 8 | 127 | 135 | 137 | 87 4 | 132 | 74 9 | 67 8 |
| MET | Copper | 43 7 | 44 3 | 175 | 64 6 | 50 6 | 46 1 | 185 | 1090 | 106 | 1780 | 59 5 | 393 |
| MET | Lead | 77.2 | 174 | 195 5 | 202 | 170 | 94 7 | 133 | 229 | 80 6 | 316 | 46 5 | 145 |
| MET | Mercury | 0 25 | 0 13 | 0 275 | 0 27 | 1 | 0 35 | 0 62 | 0 75 | 0 48 | 3 6 | 0 27 | 0 39 |
| MET | Nickel | 29 6 | 24 8 | 29 95 | 25 8 | 35 3 | 27 1 | 45 3 | 79 | 26 5 | 193 | 23 3 | 158 |
| MET | Silver | 0 41 | 0 18 | 0 425 | 0 92 | 0 33 | 1 7 | 1 1 | 1 7 | 0 98 | 3 2 | 0 31 | 0 09 |
| MET | Zinc | 191 | 108 | 185 5 | 378 | 127 | 101 | 234 | 650 | 138 | 1510 | 79 9 | 138 |
| MET | SEM-AVS | -23 94 | 1 19 | -34 36 | -26 04 | -1 45 | -1 03 | -50 29 | -15 89 | -18 04 | -0 54 | -10 88 | 1 19 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 28 9 | 25 8 | 54 15 | 14 7 | 9 45 | 8 2 | 16 2 | 15 5 | 12 2 | 27 9 | 7 33 | 1 5 |
| PAH | 1-Methylnaphthalene (L) | 47 2 | 49 5 | 154 95 | 14 5 | 11 4 | 15 | 25 6 | 17 5 | 16 | 75 1 | 9 43 | 1 9 |
| PAH | 1-Methylphenanthrene (L) | 397 | 123 | 294 | 45 8 | 38 3 | 47 4 | 116 | 70 9 | 62 6 | 112 | 42 4 | 4 8 |
| PAH | 2,6-Dimethylnaphthalene (L) | 32 4 | 36 3 | 87 05 | 15 3 | 10 5 | 11 6 | 17 3 | 17 | 15 9 | 46 4 | 13 1 | 2 1 |
| PAH | 2-Methylnaphthalene (L) | 40 6 | 79 1 | 219 25 | 23 4 | 20 8 | 23 2 | 36 2 | 29 6 | 26 4 | 127 | 17 1 | 3 3 |
| PAH | Acenaphthene (L) | 27 7 | 108 | 489 4 | 17 9 | 15 9 | 23 4 | 113 | 47 2 | 45 3 | 59 5 | 14 | 3 9 |
| PAH | Acenaphthylene (L) | 295 | 160 | 371 | 79 5 | 75 6 | 70 2 | 143 | 78 | 88 4 | 345 | 61 4 | 9 4 |
| PAH | Anthracene (L) | 276 | 614 | 1574 5 | 191 | 190 | 161 | 621 | 281 | 247 | 715 | 160 | 24 9 |
| PAH | Benzo(a)anthracene (H) | 451 | 1250 | 2110 | 318 | 326 | 227 | 944 | 520 | 460 | 1190 | 252 | 36 8 |
| PAH | Benzo(a)pyrene (H) | 739 | 1540 | 2508 5 | 384 | 338 | 321 | 1005 | 591 | 567 | 1120 | 321 | 46 7 |
| PAH | Benzo(b)fluoranthene (H) | 706 | 1260 | 1996 5 | 371 | 287 | 360 | 1002 | 682 | 563 | 1260 | 276 | 49 1 |
| PAH | Benzo(b+k)fluoranthene (H) | 834 | 1723 | 2680 | 494 | 391 | 464 | 1423 | 840 | 775 | 1534 | 382 | 66 8 |
| PAH | Benzo(e)pyrene (H) | 581 | 872 | 1225 5 | 210 | 159 | 190 | 529 | 332 | 311 | 624 | 165 | 26 6 |
| PAH | Benzo(g,h,i)perylene (H) | 575 | 965 | 1141 5 | 203 | 172 | 175 | 496 | 381 | 321 | 772 | 155 | 28 |
| PAH | Benzo(k)fluoranthene (H) | 128 | 463 | 683.5 | 123 | 104 | 104 | 421 | 158 | 212 | 274 | 106 | 17 7 |
| PAH | Biphenyl (L) | 15 9 | 20 | 67 15 | 6 39 | 4 26 | 7 3 | 10 2 | 6 86 | 8 15 | 17 9 | 6 | 1 1 |
| PAH | Chrysene (H) | 821 | 1090 | 1807 | 321 | 299 | 299 | 972 | 532 | 470 | 1151 | 214 | 44 6 |
| PAH | Dibenz(a,h)anthracene (H) | 148 | 313 | 343 | 63 1 | 53 1 | 46 5 | 165 | 120 | 104 | 272 | 48 4 | 7 4 |
| PAH | Fluoranthene (H) | 1120 | 1530 | 3909 | 441 | 590 | 607 | 1810 | 952 | 697 | 1820 | 404 | 89 6 |
| PAH | Fluorene (L) | 187 | 182 | 914 5 | 40 8 | 34 6 | 39 5 | 176 | 78 6 | 74 3 | 157 | 37 2 | 4 2 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 452 | 938 | 1154 5 | 209 | 181 | 44 9 | 558 | 413 | 347 | 883 | 164 | 27 5 |
| PAH | Naphthalene (L) | 41 2 | 116 | 446 5 | 34 3 | 30 9 | 42 3 | 65 4 | 39 6 | 49 | 164 | 32 | 3 4 |
| PAH | Perylene (H) | 55 4 | 128 | 325 55 | 98 9 | 63 3 | 83 7 | 188 | 134 | 106 | 149 | 86 3 | 9 1 |
| PAH | Phenanthrene (L) | 1580 | 1070 | 3330 | 171 | 209 | 320 | 885 | 423 | 311 | 697 | 123 | 24 6 |
| PAH | Pyrene (H) | 1900 | 1390 | 3579 5 | 470 | 513 | 499 | 1520 | 841 | 691 | 1500 | 456 | 75 |
| PAH | LMW PAHs | 2447 5 | 2329 1 | 7345 15 | 557 9 | 576 8 | 679 6 | 2039 6 | 977 | 841 4 | 2264 5 | 444 7 | 73 7 |
| PAH | HMW PAHs | 5179 | 7113 | 14257 | 1997 1 | 2119 1 | 1999 5 | 6416 | 3556 | 2989 | 7053 | 1695 4 | 300 1 |
| PAH | Total PAHs | 7626 5 | 9442 1 | 21602 15 | 2555 | 2695 9 | 2679 1 | 8455 6 | 4533 | 3830 4 | 9317 5 | 2140 1 | 373 8 |
| PCB | Total PCBs | 104 968 | 102.702 | 77 6385 | 81 46 | 35 14 | 90 04 | 757 74 | 286 44 | 130 81 | 390 66 | 34 45 | 95 876 |
| PST | Aldrin | 0 029 | 0 0275 | 1 96625 | 0 034 | 0 0265 | 0 96 | 0 05 | 0 0395 | 0 0375 | 0 0275 | 0 0445 | 0 025 |
| PST | Alpha-BHC | 0 16 | 0 13 | 0 135 | 0 13 | 0 09 | 0 06 | 0 2 | 0 58 | 0 24 | 0 18 | 0 27 | 0 08 |
| PST | Alpha-chlordane | 4 1 | 16 | 1 5 | 0 6 | 0 53 | 0 31 | 0 56 | 0 65 | 0 53 | 1 4 | 0 12 | 0 13 |
| PST | Beta-BHC | 0 44 | 0 09 | 1 15 | 0 46 | 0 64 | 1 | 3 1 | 0 91 | 1 | 0 095 | 3 1 | 0 41 |
| PST | Chlorpyrifos | 0 14 | 0 13 | 0 1625 | 0 16 | 0 125 | 0 71 | 0 25 | 0 19 | 0 18 | 0 13 | 0 21 | 0 12 |
| PST | CIS-Nonachlor | 1 2 | 1 8 | 0 325 | 0 19 | 0 16 | 2.5 | 1 7 | 0 38 | 0 25 | 0 54 | 0 16 | 1 |
| PST | Delta-BHC | 0 03 | 0 0205 | 0 05 | 0 06 | 0 03 | 0 15 | 0 0395 | 0 15 | 0 13 | 0 0205 | 0 32 | 0 05 |
| PST | Dieldrin | 0 73 | 21 | 0 87 | 0 03 | 0 69 | 0 87 | 1 3 | 1 5 | 0 21 | 0 031 | 0 06 | 0 11 |
| PST | Endosulfan II | 4 4 | 3 2 | 2.045 | 1 2 | 1 2 | 1 6 | 2 1 | 0 85 | 1 6 | 1 7 | 0 69 | 0 16 |
| PST | Endrin | 0 12 | 0 89 | 0 15 | 0 075 | 0 06 | 0 135 | 0 12 | 0 09 | 0 085 | 0 06 | 0 1 | 0 055 |
| PST | Gamma-BHC (Lindane) | 0 57 | 0 53 | 0 26 | 0 14 | 0 21 | 0 32 | 0 48 | 0 37 | 0 22 | 0 13 | 0 07 | 0 1 |
| PST | Gamma-Chlordane | 1 4 | 15 | 0 12525 | 0 1 | 0 18 | 0 43 | 0 44 | 0 26 | 0 24 | 0 54 | 0 15 | 0 06 |
| PST | Heptachlor | 0 38 | 0 75 | 0 23 | 0 08 | 0 12 | 0 26 | 0 68 | 0 51 | 0 27 | 0 61 | 0 13 | 0 02 |
| PST | Heptachlor epoxide | 0 0145 | 0 0135 | 0 018 | 0 017 | 0 0135 | 0 0295 | 0 026 | 0 02 | 0 0185 | 0 014 | 0 0225 | 0 0125 |
| PST | Hexachlorobenzene | 0 01 | 0 07 | 0 04 | 0 07 | 0 04 | 0 044 | 0 04 | 0 09 | 0 05 | 0 08 | 0 0335 | 0 1 |
| PST | Mirex | 0 56 | 1 2 | 0 86 | 0 23 | 0 04 | 0 83 | 0 06 | 0 29 | 0 04 | 0 16 | 0 04 | 0 0125 |
| PST | Oxychlordane | 0 65 | 1 2 | 0 745 | 0 04 | 0 06 | 0 08 | 0 13 | 0 32 | 0 08 | 0 65 | 0 27 | 0 0065 |
| PST | Pentachloroanisole | 0 06 | 0 68 | 0 13 | 0 12 | 0 05 | 0 16 | 0 21 | 0 18 | 0 15 | 0 17 | 0 14 | 0 06 |
| PST | Pentachlorobenzene | 0 13 | 0 17 | 0 255 | 0 17 | 0 07 | 0 62 | 0 27 | 0 15 | 0 29 | 0 11 | 0 2 | 0 08 |
| PST | Trans-Nonachlor | 1 1 | 5 5 | 0 73 | 0 27 | 0 29 | 0 62 | 0 4 | 0 2 | 0 06 | 0 46 | 0 04 | 0 27 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 01 | 0 25 | 0 09 | 0.21 | 0 18 | 0 33 | 0 9 | 0 51 | 1 5 | 0 32 | 0 11 | 0 42 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 54 | 0 34 | 0 435 | 0 46 | 0 37 | 2 | 1 8 | 0 64 | 1 6 | 1 2 | 1 2 | 0 16 |
| PST | o,p'-DDD | 12 | 58 | 18 1 | 1 8 | 3.3 | 1 3 | 7 8 | 3 2 | 3 | 16 | 1 7 | 13 |
| PST | p,p'-DDD | 0 39 | 2.2 | 0 475 | 0 19 | 0 24 | 1 4 | 0 07 | 0 055 | 0 05 | 0 63 | 0 71 | 3 4 |
| PST | o,p'-DDE | 1 6 | 25 | 8 2 | 0 14 | 2.3 | 0 84 | 2.7 | 0 49 | 0 21 | 1 9 | 0 0165 | 34 |
| PST | o,p'-DDT | 18 | 153 | 43 5 | 2.2 | 6 3 | 3 6 | 20 | 5 1 | 4 5 | 38 | 1 1 | 28 |
| PST | p,p'-DDE | 3 | 59 | 5 85 | 1 2 | 5 2 | 10 | 5 3 | 3 | 1 8 | 11 | 0 51 | 138 |
| PST | p,p'-DDT | 2.6 | 190 | 35 5 | 0 85 | 10 | 1 75 | 6 | 1 3 | 1 2 | 2 05 | 0 59 | 174 |
| TOC | % TOC | 1 73 | 1 89 | 2.255 | 2.15 | 4 54 | 2.91 | 3 12 | 2.09 | 1 81 | 1 13 | 1 92 | 0 69 |

Units Metals= µg/g, PAHs, PCBs and Pesticides=ng/g
LMW PAH = sum of 7 2-ring & 3-ring PAHs included in NOAA ER-L/ER-M benchmarks (Long et al 1995), (2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, fluorene, naphthalene, phenanthrene)
HMW PAH = sum of 6 4-ring and 5-ring PAHs included in NOAA ER-L/ER-M benchmarks (Long et al 1995), (benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, pyrene)
Total PAHs - sum of LMW & HMW PAHs, Total PCBs - Sum of individual PCB congeners x 2
A value of 1/2 MDL substituted for non-detect data

Table A-2-2.2a.

| Class | Analyte3 | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 14 4 | 12 3 | 6 9 | 6 9 | 10 4 | 17 8 | 10 5 | 13.3 | 10 5 | 11 6 |
| MET | Cadmium | 0 54 | 0 57 | 0 64 | 0 24 | 0 66 | 0 07 | 0.27 | 0 61 | 0 41 | 0 38 |
| MET | Chromium | 119 5 | 101 | 72 7 | 61 6 | 88 6 | 57 5 | 73 6 | 122 | 87 1 | 161 |
| MET | Copper | 62 85 | 38 5 | 22 7 | 14 8 | 27 9 | 16 1 | 47 5 | 35 4 | 23.2 | 455 |
| MET | Lead | 132 5 | 48 8 | 46 7 | 36 7 | 45 7 | 19 | 43.2 | 51 4 | 44 4 | 245 |
| MET | Mercury | 0 595 | 0 35 | 0 28 | 0 27 | 0 22 | 0 02 | 0 13 | 0 49 | 0 38 | 0 21 |
| MET | Nickel | 33 4 | 28 6 | 27 5 | 21 3 | 27 2 | 36 9 | 25 7 | 31 9 | 24 6 | 92 8 |
| MET | Silver | 0 765 | 0 41 | 0 45 | 0 13 | 0 34 | 0 03 | 0 2 | 0 52 | 0 3 | 0 69 |
| MET | Zinc | 150 5 | 109 | 79 | 56 6 | 100 | 41 2 | 83 5 | 119 | 89 7 | 701 |
| MET | SEM-AVS | -56 77 | -51 14 | -1 18 | -2 77 | -36 26 | 0 17 | -9 25 | -36 27 | -37 19 | -17 06 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 20 | 17 1 | 6 3 | 3 1 | 10 8 | 1.3 | 3 9 | 11 9 | 6 4 | 14 |
| PAH | 1-Methylnaphthalene (L) | 17 3 | 25 6 | 8 8 | 4 4 | 14 1 | 1 6 | 5 4 | 13.1 | 8 1 | 16 1 |
| PAH | 1-Methylphenanthrene (L) | 59 2 | 56 2 | 19 8 | 25 5 | 36 2 | 5 2 | 14 4 | 57 2 | 20 8 | 28 1 |
| PAH | 2,6-Dimethylnaphthalene (L) | 20 7 | 21 7 | 8 6 | 4 6 | 15 4 | 2 | 5 4 | 18 | 5 6 | 14 8 |
| PAH | 2-Methylnaphthalene (L) | 25 7 | 38 2 | 14 3 | 7 6 | 24 6 | 2 4 | 9 1 | 20 4 | 10 9 | 26 8 |
| PAH | Acenaphthene (L) | 41 55 | 32 7 | 22 9 | 16 5 | 18 | 4 7 | 11 9 | 22 1 | 11 1 | 40 9 |
| PAH | Acenaphthylene (L) | 99 55 | 80 8 | 56 7 | 26 4 | 97 3 | 4 6 | 30 7 | 74 | 56 | 67 |
| PAH | Anthracene (L) | 344 | 271 | 142 | 87 9 | 186 | 18 9 | 91 7 | 168 | 65 6 | 225 |
| PAH | Benzo(a)anthracene (H) | 501 | 411 | 245 | 269 | 470 | 34 3 | 180 | 267 | 94 6 | 342 |
| PAH | Benzo(a)pyrene (H) | 559 5 | 477 | 345 | 434 | 649 | 42 7 | 241 | 381 | 130 | 375 |
| PAH | Benzo(b)fluoranthene (H) | 557 | 419 | 305 | 474 | 524 | 44 3 | 229 | 373 | 115 | 452 |
| PAH | Benzo(b+k)fluoranthene (H) | 742 | 585 | 412 | 636 | 655 | 59 | 308 3 | 470 8 | 149 6 | 615 |
| PAH | Benzo(e)pyrene (H) | 297 5 | 236 | 182 | 253 | 331 | 23 9 | 126 | 188 | 60 5 | 231 |
| PAH | Benzo(g,h,i)perylene (H) | 267 | 219 | 169 | 242 | 300 | 22 1 | 126 | 180 | 55 4 | 243 |
| PAH | Benzo(k)fluoranthene (H) | 185 | 166 | 107 | 162 | 131 | 14 7 | 79 3 | 97 8 | 34 6 | 163 |
| PAH | Biphenyl (L) | 8 8 | 7 62 | 4 1 | 2 7 | 6 84 | 1 2 | 2 7 | 6 1 | 3 1 | 7 3 |
| PAH | Chrysene (H) | 567 5 | 446 | 254 | 387 | 461 | 33 6 | 194 | 277 | 87 6 | 410 |
| PAH | Dibenz(a,h)anthracene (H) | 81 7 | 68 7 | 48 9 | 69 6 | 89 4 | 5 6 | 34 5 | 50 5 | 15 1 | 74 8 |
| PAH | Fluoranthene (H) | 1096 5 | 703 | 401 | 661 | 455 | 80 3 | 344 | 537 | 183 | 617 |
| PAH | Fluorene (L) | 85 2 | 88 | 37 2 | 34 6 | 48 5 | 7 1 | 22 7 | 42 | 22 2 | 55 7 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 296 5 | 239 | 182 | 268 | 289 | 24 7 | 134 | 194 | 64 4 | 255 |
| PAH | Naphthalene (L) | 45 45 | 43 9 | 23 6 | 12 8 | 44 1 | 3 9 | 16 3 | 36 1 | 21 5 | 33 6 |
| PAH | Perylene (H) | 141 85 | 109 | 48 | 51 | 103 | 8 6 | 73 4 | 74 8 | 21 9 | 64 4 |
| PAH | Phenanthrene (L) | 358 | 330 | 181 | 260 | 164 | 38 5 | 134 | 205 | 73 5 | 255 |
| PAH | Pyrene (H) | 947 5 | 643 | 375 | 522 | 513 | 68 2 | 310 | 494 | 174 | 615 |
| PAH | LMW PAHs | 999 45 | 884 6 | 477 7 | 445 8 | 582 5 | 80 1 | 316 4 | 567 6 | 260 8 | 704 |
| PAH | HMW PAHs | 3753 7 | 2748 7 | 1668 9 | 2342 6 | 2637 4 | 264 7 | 1303 5 | 2006 5 | 684 3 | 2433 8 |
| PAH | Total PAHs | 4753 15 | 3633 3 | 2146 6 | 2788 4 | 3219 9 | 344 8 | 1619 9 | 2574 1 | 945 1 | 3137 8 |
| PCB | Total PCBs | 95 26 | 59 25 | 22 662 | 13 206 | 42 28 | 9 16 | 43 05 | 47 78 | 8 66 | 256 34 |
| PST | Aldrin | 0 08 | 0 049 | 0 0305 | 0 029 | 0 0475 | 0 028 | 0 0295 | 0 05 | 0 06 | 0 028 |
| PST | Alpha-BHC | 0 2 | 0 27 | 0 1 | 0 0325 | 0 22 | 0 03 | 0 09 | 0 07 | 0 04 | 0 15 |
| PST | Alpha-chlordane | 0 71 | 0 26 | 0 24 | 0 27 | 0 26 | 0 12 | 0 24 | 0 3 | 0 07 | 2 8 |
| PST | Beta-BHC | 2 55 | 3 1 | 1 2 | 0 095 | 1 3 | 0 095 | 0 51 | 2 | 1 5 | 0 67 |
| PST | Chlorpyrifos | 0 6725 | 0 235 | 0 145 | 0 135 | 0 225 | 0 135 | 0 14 | 0 245 | 0 22 | 0 135 |
| PST | CIS-Nonachlor | 0 32 | 0 19 | 0 4 | 0 13 | 0 25 | 0 17 | 0 16 | 0 14 | 0 14 | 0 74 |
| PST | Delta-BHC | 0 05 | 0 0365 | 0 06 | 0 03 | 0 0355 | 0 02 | 0 022 | 0 039 | 0 04 | 0 01 |
| PST | Dieldrin | 0.225 | 0 001 | 0 24 | 0 17 | 0 02 | 0 05 | 0 39 | 0 07 | 0 1 | 0 94 |
| PST | Endosulfan II | 1 6 | 1 2 | 0 87 | 0 74 | 1 | 0 15 | 0 62 | 0 82 | 0 18 | 1 3 |
| PST | Endrin | 0 1075 | 0 11 | 0 07 | 0 065 | 0 105 | 0 065 | 0 065 | 0 115 | 0 105 | 0 15 |
| PST | Gamma-BHC (Lindane) | 0.255 | 0 61 | 0 29 | 0 14 | 0 35 | 0 11 | 0 09 | 0 12 | 0 185 | 0 12 |
| PST | Gamma-Chlordane | 0 39 | 0 24 | 0 05 | 0 08 | 0 11 | 0 03 | 0 24 | 0 15 | 0 03 | 4 4 |
| PST | Heptachlor | 0 03 | 0 14 | 0 14 | 0 05 | 0 135 | 0 09 | 0 085 | 0 16 | 0 135 | 0 12 |
| PST | Heptachlor epoxide | 0 024 | 0 0245 | 0 0155 | 0 0145 | 0 0235 | 0 014 | 0 0145 | 0 02 | 0 0235 | 0 014 |
| PST | Hexachlorobenzene | 1 66625 | 0 0365 | 0 023 | 0 02 | 0 05 | 0 021 | 0 022 | 0 08 | 0 035 | 0 14 |
| PST | Mirex | 0 18 | 0 28 | 0 11 | 0.21 | 0.25 | 0 014 | 0 13 | 0.26 | 0 0235 | 0.2 |
| PST | Oxychlordane | 0.225 | 0 04 | 0 08 | 0 11 | 0 04 | 0 17 | 0 08 | 0 013 | 0 0115 | 0.27 |
| PST | Pentachloroanisole | 0 195 | 0 5 | 0 07 | 0 06 | 0 15 | 0 04 | 0 12 | 0 17 | 0 05 | 0 25 |
| PST | Pentachlorobenzene | 0 255 | 0 19 | 0 33 | 0 09 | 0 2 | 0 09 | 0 21 | 0.16 | 0.05 | 0.21 |
| PST | Trans-Nonachlor | 0 35 | 0 26 | 0 07 | 0 03 | 0 24 | 0 0175 | 0 15 | 0 19 | 0 029 | 2 1 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 18 | 0 53 | 0.26 | 0.18 | 0 06 | 0 16 | 0.27 | 0.25 | 0 03 | 0.49 |
| PST | 1,2,4,5-Tetrachlorobenzene | 1 6 | 0 17 | 0 66 | 0 3 | 1 4 | 0 16 | 1 7 | 1.2 | 0 71 | 1 |
| PST | o,p'-DDD | 2.65 | 3 | 0 8 | 0 6 | 2 4 | 0 12 | 2.1 | 0 55 | 0 075 | 36 |
| PST | p,p'-DDD | 0 405 | 0 68 | 0.09 | 0 09 | 0.52 | 0 32 | 0 17 | 0 43 | 0 16 | 1 3 |
| PST | o,p'-DDE | 0 37475 | 0 06 | 0 175 | 0 04 | 0 04 | 0 04 | 0 16 | 0 065 | 0 005 | 6 5 |
| PST | o,p'-DDT | 2 7 | 2.5 | 1 15 | 0 5 | 1 5 | 0.21 | 2 3 | 0 95 | 0 195 | 120 |
| PST | p,p'-DDE | 2.85 | 1 1 | 0 65 | 0 355 | 0 73 | 1 9 | 3 5 | 0.55 | 0 075 | 22 |
| PST | p,p'-DDT | 1 1 | 2 8 | 0.75 | 0 355 | 1 3 | 0 39 | 1 05 | 0 65 | 0 28 | 285 |
| TOC | % TOC | 2 005 | 2 36 | 0 7 | 0 47 | 2 09 | 0 52 | 0 98 | 1 97 | 1 48 | 1 04 |

Table A-2-2.2a. (continued)

| Class | Analyte3 | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-100B | M11-200B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 10 8 | 11 45 | 10 4 | 12.6 | 7 4 | 14 3 | 15 9 | 7 45 | 8 8 | 13 8 | | |
| MET | Cadmium | 0 5 | 0 22 | 0 43 | 0 31 | 0 27 | 0 68 | 0 68 | 0 165 | 0 22 | 0 52 | | |
| MET | Chromium | 105 | 123 5 | 121 | 133 | 69 2 | 136 | 138 | 56 8 | 56 7 | 98 | | |
| MET | Copper | 77 5 | 755 5 | 157 | 511 | 207 | 73 3 | 152 | 27 65 | 33 7 | 31 2 | | |
| MET | Lead | 66 2 | 207 | 104 | 188 | 142 | 100 | 162 | 57 15 | 55 9 | 55 2 | | |
| MET | Mercury | 0 38 | 0 105 | 0 24 | 0 17 | 0 08 | 0 35 | 0 3 | 0 09 | 0 16 | 0 23 | | |
| MET | Nickel | 31 2 | 130 5 | 52 9 | 160 | 61 5 | 38 6 | 50 2 | 28 85 | 20 5 | 28 7 | | |
| MET | Silver | 0 54 | 0 355 | 0 59 | 0 7 | 0 42 | 0 66 | 0 75 | 0 145 | 0 17 | 0 38 | | |
| MET | Zinc | 146 | 913 5 | 293 | 484 | 225 | 166 | 246 | 100 6 | 75 7 | 122 | | |
| MET | SEM-AVS | -36 49 | 4 97 | -32 33 | 1 54 | -0 51 | -47 36 | -27 06 | -0 05 | -28 60 | -98 67 | | |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 18 6 | 5 22 | 10 7 | 0 64 | 11 7 | 11 3 | 6 7 | 6 15 | 56 6 | 10 7 | | |
| PAH | 1-Methylnaphthalene (L) | 20 2 | 8 42 | 20 | 1 11 | 2 41 | 15 2 | 12 6 | 8 9 | 23 3 | 12 1 | | |
| PAH | 1-Methylphenanthrene (L) | 84 2 | 35 95 | 42 3 | 1 63 | 29 4 | 50 2 | 47 7 | 26 15 | 143 | 32 4 | | |
| PAH | 2,6-Dimethylnaphthalene (L) | 18 3 | 6 585 | 16 3 | 1 19 | 4 51 | 16 2 | 9 9 | 9.25 | 51 | 10 7 | | |
| PAH | 2-Methylnaphthalene (L) | 31 7 | 15 15 | 29 9 | 1 85 | 4 41 | 23 1 | 20 5 | 16 95 | 30 1 | 22 | | |
| PAH | Acenaphthene (L) | 43 8 | 15 25 | 59 7 | 0 8 | 3 66 | 51 6 | 49.2 | 15 35 | 112 | 20 2 | | |
| PAH | Acenaphthylene (L) | 88 6 | 60 45 | 91 1 | 5 38 | 9 1 | 61 4 | 41 5 | 25 95 | 237 | 93 5 | | |
| PAH | Anthracene (L) | 276 | 230 95 | 302 | 11 8 | 78 9 | 208 | 243 | 115 | 1650 | 1130 | | |
| PAH | Benzo(a)anthracene (H) | 418 | 310 5 | 478 | 10 1 | 117 | 352 | 361 | 157 | 1640 | 386 | | |
| PAH | Benzo(a)pyrene (H) | 580 | 274 | 567 | 9 88 | 105 | 432 | 412 | 180 5 | 1750 | 407 | | |
| PAH | Benzo(b)fluoranthene (H) | 550 | 376 | 596 | 17 7 | 98 5 | 424 | 419 | 160 5 | 1440 | 388 | | |
| PAH | Benzo(b+k)fluoranthene (H) | 739 | 468 25 | 809 | 24 04 | 131 8 | 578 | 571 | 212.25 | 2004 | 540 | | |
| PAH | Benzo(e)pyrene (H) | 310 | 173 6 | 326 | 9 44 | 53 4 | 233 | 230 | 88 8 | 773 | 213 | | |
| PAH | Benzo(g,h,i)perylene (H) | 276 | 147 95 | 313 | 6 87 | 44 4 | 226 | 211 | 84 15 | 779 | 162 | | |
| PAH | Benzo(k)fluoranthene (H) | 189 | 92 25 | 213 | 6 34 | 33 3 | 154 | 152 | 51 75 | 564 | 152 | | |
| PAH | Biphenyl (L) | 8 | 2 73 | 8 1 | 1 08 | 1 38 | 7 7 | 5 9 | 4 3 | 20 9 | 5 9 | | |
| PAH | Chrysene (H) | 459 | 370 5 | 530 | 12 2 | 91 4 | 340 | 403 | 135 5 | 1350 | 414 | | |
| PAH | Dibenz(a,h)anthracene (H) | 88 2 | 47 85 | 95 8 | 2 04 | 16 | 65 5 | 61 6 | 24 15 | 254 | 48 | | |
| PAH | Fluoranthene (H) | 52 1 | 873 5 | 956 | 14 8 | 203 | 725 | 717 | 311 | 2630 | 642 | | |
| PAH | Fluorene (L) | 76 7 | 23 9 | 79 3 | 1 65 | 15 4 | 68 8 | 66 2 | 27 | 386 | 82 | | |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 293 | 168 3 | 346 | 7 4 | 49 2 | 236 | 219 | 90 | 971 | 182 | | |
| PAH | Naphthalene (L) | 57 2 | 14 35 | 45 | 3 14 | 5 95 | 37 8 | 39 6 | 48 1 | 88 | 38 6 | | |
| PAH | Perylene (H) | 95 1 | 47 6 | 166 | 2 72 | 18 7 | 96 2 | 108 | 34 45 | 285 | 63 2 | | |
| PAH | Phenanthrene (L) | 363 | 205 9 | 396 | 7 41 | 74 | 334 | 361 | 127 | 1620 | 223 | | |
| PAH | Pyrene (H) | 720 | 776 5 | 853 | 13 4 | 177 | 649 | 665 | 278 | 2070 | 568 | | |
| PAH | LMW PAHs | 937 | 565 95 | 1003 | 32 03 | 191 42 | 784 7 | 821 | 375 35 | 4123 1 | 1609 3 | | |
| PAH | HMW PAHs | 2317 3 | 2652 85 | 3479 8 | 62 42 | 709 4 | 2563 5 | 2619 6 | 1086 15 | 9694 | 2465 | | |
| PAH | Total PAHs | 3254 3 | 3218 8 | 4482 8 | 94 45 | 900 82 | 3348 2 | 3440 6 | 1461 5 | 13817 1 | 4074 3 | | |
| PCB | Total PCBs | 128 38 | 303 9585 | 213 1 | 31 3 | 48 352 | 129 34 | 138 06 | 30 81 | 53 24 | 52 33 | | |
| PST | Aldrin | 0 02 | 0 07125 | 6 1 | 0 023 | 0 024 | 4 1 | 3 6 | 0 03425 | 0 0345 | 0 07 | | |
| PST | Alpha-BHC | 0.1 | 0.055 | 0 2 | 0 03 | 0 05 | 0 38 | 0 1 | 0 08 | 0 2 | 0 16 | | |
| PST | Alpha-chlordane | 0 46 | 2 25 | 0 68 | 0 07 | 0 23 | 0 99 | 0 25 | 14 8 | 0 36 | 0 38 | | |
| PST | Beta-BHC | 1 9 | 0 1475 | 1 2 | 0 28 | 0 08 | 0 58 | 0 53 | 0 695 | 1 3 | 2 1 | | |
| PST | Chlorpyrifos | 0 195 | 0 105 | 0 185 | 0 11 | 0 115 | 0 295 | 0 165 | 1 33 | 0 165 | 0 295 | | |
| PST | CIS-Nonachlor | 0 34 | 0 565 | 0 53 | 0 07 | 0 21 | 0 25 | 0 3 | 1 54 | 0 19 | 0 23 | | |
| PST | Delta-BHC | 0 2 | 0 01675 | 0 26 | 0 0175 | 0 03 | 0 26 | 0 04 | 0 02325 | 0 026 | 0 17 | | |
| PST | Dieldrin | 0 3 | 0 28 | 0 34 | 0 001 | 0 01 | 0 18 | 0 0405 | 0 43 | 0 26 | 0 07 | | |
| PST | Endosulfan II | 1 9 | 1 47 | 0 97 | 0 11 | 0 77 | 0 64 | 0 7 | 0 245 | 1 2 | 0 56 | | |
| PST | Endrin | 0 09 | 0 05 | 0 09 | 0 05 | 0 055 | 0 14 | 0 08 | 0 0775 | 0 08 | 0 14 | | |
| PST | Gamma-BHC (Lindane) | 0 25 | 0 185 | 0 23 | 0 095 | 0 01 | 0 14 | 0 23 | 0 16 | 0 21 | 0 14 | | |
| PST | Gamma-Chlordane | 0 24 | 2 2 | 0 0455 | 0 02 | 0 28 | 0 07 | 0 0405 | 21 25 | 0 13 | 0 16 | | |
| PST | Heptachlor | 0 17 | 0 12 | 0 11 | 0 03 | 0 14 | 0 11 | 0 1 | 0 36 | 0 12 | 0 19 | | |
| PST | Heptachlor epoxide | 0 0205 | 0 011 | 0 02 | 0 15 | 0 012 | 0 0305 | 0 02 | 0 017 | 0 0175 | 0 0315 | | |
| PST | Hexachlorobenzene | 0 031 | 0 115 | 0 13 | 1 2 | 0 08 | 0 3 | 0 0255 | 0 085 | 0 02 | 0 047 | | |
| PST | Mirex | 0 19 | 0 125 | 0 02 | 0 0115 | 0 12 | 0 0305 | 0 02 | 0 08 | 0 81 | 0 03 | | |
| PST | Oxychlordane | 0 1 | 0 14275 | 0 08 | 0 006 | 0 006 | 0 035 | 0 035 | 0.35425 | 0 24 | 0 04 | | |
| PST | Pentachloroanisole | 0 14 | 0 12 | 0 42 | 0 06 | 0 06 | 0.29 | 0 21 | 0 205 | 0 08 | 0 12 | | |
| PST | Pentachlorobenzene | 0 12 | 0 14 | 0 46 | 1 2 | 0 15 | 0 54 | 0 17 | 0 09 | 0 04 | 0 1 | | |
| PST | Trans-Nonachlor | 0 3 | 1 45 | 0 77 | 0 02 | 0 16 | 0 52 | 0 23 | 7 4 | 0 22 | 0 52 | | |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 12 | 0 14 | 0 23 | 0 42 | 0 21 | 0 78 | 0.32 | 0 33 | 0 06 | 0 05 | | |
| PST | 1,2,4,5-Tetrachlorobenzene | 1 2 | 0 36 | 0 82 | 0.93 | 0 33 | 0 68 | 0 5 | 0 455 | 0 45 | 0 66 | | |
| PST | o,p'-DDD | 4 8 | 14 5 | 10 | 0 11 | 1 | 2 7 | 2 7 | 27 5 | 1 1 | 1 1 | | |
| PST | p,p'-DDD | 0 11 | 0 8 | 0 46 | 0 05 | 0 16 | 0 5 | 0 3 | 0 355 | 0 11 | 0 46 | | |
| PST | o,p'-DDE | 0 89 | 26 | 2.2 | 0 28 | 0 94 | 0.22 | 1 1 | 3 1 | 0 19 | 0 14 | | |
| PST | o,p'-DDT | 5 5 | 38 | 24 | 0 28 | 1 5 | 2 7 | 3 3 | 81 | 2 | 1 65 | | |
| PST | p,p'-DDE | 3 1 | 21 | 7 6 | 0 2 | 1 | 3 1 | 2 | 6 65 | 0 4 | 0 345 | | |
| PST | p,p'-DDT | 1 7 | 92 5 | 11 | 0 6 | 2 4 | 1 3 | 3 6 | 6 2 | 0 9 | 1 8 | | |
| TOC | % TOC | 1 63 | 0 545 | 1.88 | 0 28 | 0 54 | 2 14 | 2 56 | 1 73 | 1 15 | 1 75 | | |

Table A-2-2.2a.

| Class | Analyte3 | M11-300B | M12-100B | M12 200B AVG | M12-300B-AVG | M13-100B | M13-200B | M13 300B | M14-100B | M14-200B | M14 300B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 10 9 | 7 7 | 6 95 | 12 5 | 16 8 | 13 7 | 14 5 | 10 6 | 8 6 | 11 |
| MET | Cadmium | 0 98 | 0 6 | 0 225 | 0 365 | 1 4 | 0 5 | 0 73 | 0 48 | 0 38 | 0 47 |
| MET | Chromium | 132 | 86 1 | 67 | 112 55 | 116 | 105 | 116 | 79 7 | 72 9 | 96 |
| MET | Copper | 541 | 87 9 | 37 35 | 95 3 | 53 8 | 51 6 | 119 | 59 7 | 28 6 | 31 |
| MET | Lead | 554 | 118 | 55 45 | 115 5 | 50 7 | 49 2 | 85 | 185 | 52 6 | 44 1 |
| MET | Mercury | 1 | 0 38 | 0 16 | 0 65 | 0 26 | 0 24 | 0 34 | 0 55 | 0 24 | 0 29 |
| MET | Nickel | 75 5 | 39 8 | 22 8 | 37 25 | 32 8 | 31 1 | 34 5 | 29 7 | 20 3 | 27 3 |
| MET | Silver | 2 6 | 0 65 | 0 205 | 0 42 | 0 72 | 0 44 | 0 66 | 0 24 | 0 22 | 0 37 |
| MET | Zinc | 489 | 343 | 129 | 163 5 | 157 | 153 | 232 | 116 | 92 5 | 110 |
| MET | SEM-AVS | -2 49 | -7 35 | -1 25 | -56 70 | -110 00 | -94 51 | -173 15 | -1 46 | -15 87 | -27 04 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 17 2 | 25 4 | 24 | 17 | 201 | 32 5 | 33 6 | 9 9 | 21 1 | 24 7 |
| PAH | 1-Methylnaphthalene (L) | 23 4 | 112 | 102 75 | 17 1 | 147 | 25.2 | 23 1 | 17 8 | 20 3 | 19 7 |
| PAH | 1-Methylphenanthrene (L) | 55 | 240 | 222 5 | 89 4 | 663 | 91 2 | 124 | 44 6 | 125 | 111 |
| PAH | 2,6-Dimethylnaphthalene (L) | 26 8 | 40 7 | 37 3 | 18 35 | 383 | 30 6 | 27 9 | 13 6 | 20 8 | 22 8 |
| PAH | 2-Methylnaphthalene (L) | 49 6 | 149 | 140 45 | 27.25 | 231 | 38 2 | 39 8 | 30 4 | 34 4 | 33 4 |
| PAH | Acenaphthene (L) | 16 9 | 682 | 566 | 50 85 | 2682 | 62 6 | 93 3 | 16 | 28 6 | 32 1 |
| PAH | Acenaphthylene (L) | 47 7 | 116 | 93 35 | 80 | 212 | 188 | 119 | 115 | 103 | 173 |
| PAH | Anthracene (L) | 214 | 1220 | 1078 | 420 | 2269 | 625 | 749 | 197 | 409 | 396 |
| PAH | Benzo(a)anthracene (H) | 283 | 2170 | 1953 5 | 795 | 2398 | 856 | 1010 | 320 | 824 | 910 |
| PAH | Benzo(a)pyrene (H) | 334 | 2290 | 2086 5 | 701.5 | 1752 | 894 | 915 | 444 | 1130 | 1200 |
| PAH | Benzo(b)fluoranthene (H) | 309 | 2500 | 2024 5 | 888 5 | 1809 | 967 | 988 | 408 | 896 | 986 |
| PAH | Benzo(b+k)fluoranthene (H) | 412 | 3011 | 2760 | 1105 | 2370 | 1230 | 1346 | 567 | 1223 | 1225 |
| PAH | Benzo(e)pyrene (H) | 167 | 1240 | 1057 5 | 383 5 | 860 | 466 | 494 | 252 | 552 | 608 |
| PAH | Benzo(g,h,i)perylene (H) | 174 | 1270 | 1089 5 | 348 | 554 | 393 | 428 | 254 | 625 | 595 |
| PAH | Benzo(k)fluoranthene (H) | 103 | 511 | 735 5 | 216 5 | 561 | 263 | 358 | 159 | 327 | 239 |
| PAH | Biphenyl (L) | 13 8 | 23.5 | 25 15 | 7 8 | 186 | 12 7 | 14 9 | 7 5 | 12 2 | 10 7 |
| PAH | Chrysene (H) | 285 | 2030 | 1742 | 730 | 2095 | 865 | 1030 | 339 | 737 | 772 |
| PAH | Dibenz(a,h)anthracene (H) | 53 9 | 459 | 384 5 | 115 05 | 243 | 124 | 141 | 75 5 | 198 | 179 |
| PAH | Fluoranthene (H) | 541 | 3460 | 3366 | 1648 | 5763 | 1706 | 1830 | 533 | 1100 | 761 |
| PAH | Fluorene (L) | 52 7 | 680 | 650 | 95 5 | 3752 | 156 | 287 | 44 | 107 | 98 8 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 185 | 1560 | 1307 | 399 | 710 | 437 | 486 | 247 | 645 | 567 |
| PAH | Naphthalene (L) | 64 8 | 293 | 308 | 44 3 | 74 5 | 59 1 | 68 5 | 54 1 | 69 | 62 |
| PAH | Perylene (H) | 65 5 | 219 | 302 | 113 2 | 197 | 167 | 171 | 98 9 | 92 4 | 149 |
| PAH | Phenanthrene (L) | 251 | 2550 | 2438 5 | 438 5 | 5800 | 522 | 844 | 182 | 506 | 354 |
| PAH | Pyrene (H) | 483 | 2920 | 2719 5 | 1263 | 4383 | 1449 | 1630 | 514 | 1220 | 847 |
| PAH | LMW PAHs | 696 7 | 5690 | 5274 3 | 1156 4 | 15020 5 | 1650 9 | 2200 6 | 638 5 | 1257 | 1149 3 |
| PAH | HMW PAHs | 1979 9 | 13329 | 12252 | 5252 55 | 16634 | 5894 | 6556 | 2225 5 | 5209 | 4669 |
| PAH | Total PAHs | 2676 6 | 19019 | 17526 3 | 6408 95 | 31654 5 | 7544 9 | 8756 6 | 2864 | 6466 | 5818 3 |
| PCB | Total PCBs | 320 42 | 242 8 | 272 83 | 94 085 | 83 02 | 49 75 | 133 14 | 86 76 | 43 8 | 71 07 |
| PST | Aldrin | 1 9 | 0 037 | 10 52 | 3 22275 | 8 9 | 0 055 | 0 05 | 4 8 | 0 0355 | 0 05 |
| PST | Alpha-BHC | 0 09 | 0 48 | 0 11 | 0 1 | 0 41 | 0 09 | 0 11 | 0 16 | 0 5 | 0 02 |
| PST | Alpha-chlordane | 1 5 | 0 94 | 0 34 | 0 16 | 0 33 | 0 39 | 0 76 | 0 55 | 0 11 | 0 1 |
| PST | Beta-BHC | 0 52 | 0 86 | 1 55 | 0 8725 | 1 7 | 0 195 | 0 175 | 0 16 | 0 17 | 0 17 |
| PST | Chlorpyrifos | 0 135 | 0 175 | 0 18 | 0 2125 | 0 06 | 0 03 | 0 25 | 0 06 | 0 16 | 0 245 |
| PST | CIS-Nonachlor | 0 61 | 0 38 | 0 55 | 0 18 | 0 42 | 0 18 | 0 35 | 1 | 0 2 | 0 19 |
| PST | Delta-BHC | 0 02 | 0 0275 | 0 02775 | 0 033 | 0 0455 | 0 0455 | 0 0405 | 0 0355 | 0 0255 | 0 0405 |
| PST | Dieldrin | 2 8 | 0 22 | 0 12 | 0 17 | 0 12 | 0 43 | 0 52 | 0 055 | 0 06 | 0 13 |
| PST | Endosulfan II | 0 81 | 3 | 2 6 | 0 825 | 0 45 | 0 11 | 1 1 | 0 41 | 1 3 | 0 22 |
| PST | Endrin | 0 065 | 0 085 | 0 085 | 0 1 | 0 135 | 0 13 | 0 115 | 0 11 | 0 075 | 0 07 |
| PST | Gamma-BHC (Lindane) | 0 19 | 0 15 | 0 1525 | 0 25 | 0 25 | 0 235 | 0 205 | 0 02 | 0 135 | 0 205 |
| PST | Gamma-Chlordane | 0 0305 | 0 0415 | 0 24 | 0 205 | 0 07 | 0 19 | 0 06 | 0 055 | 0 0405 | 0 07 |
| PST | Heptachlor | 3 2 | 0 105 | 0 255 | 0 1275 | 0 175 | 0 165 | 0 145 | 0 14 | 0.095 | 0 145 |
| PST | Heptachlor epoxide | 0 015 | 0 0185 | 0 02 | 0 02275 | 0 0305 | 0 0305 | 0 0255 | 0 0255 | 0 015 | 0 0255 |
| PST | Hexachlorobenzene | 0.29 | 0 0275 | 2 46275 | 0 08275 | 0 01 | 0 1 | 0 11 | 0 07 | 0 02 | 0 04 |
| PST | Mirex | 0 015 | 0 36 | 0 205 | 0 02275 | 0 24 | 0 0305 | 0 0255 | 0 0255 | 0 015 | 0 0255 |
| PST | Oxychlordane | 0 05 | 0 38 | 0 545 | 0 12 | 1 5 | 0 1 | 0 38 | 0 05 | 0 54 | 0 015 |
| PST | Pentachloroanisole | 0 2 | 0 1 | 0 15 | 0 08 | 0 14 | 0 14 | 0 17 | 0 13 | 0 05 | 0 06 |
| PST | Pentachlorobenzene | 0 63 | 0 1 | 0 09 | 0 18 | 0 11 | 0 365 | 0.225 | 0.2 | 0 145 | 0 255 |
| PST | Trans-Nonachlor | 0 38 | 0 52 | 0 205 | 0 27 | 0 08 | 0 1 | 0.23 | 0.28 | 0 02 | 0 03 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 64 | 0 02 | 0 065 | 0 25 | 0 22 | 0 09 | 0 03 | 0.55 | 0 12 | 0 11 |
| PST | 1,2,4,5-Tetrachlorobenzene | 1 6 | 0.34 | 0 435 | 0 68 | 0 95 | 0 54 | 0 81 | 4 2 | 0 27 | 0 88 |
| PST | o,p'-DDD | 1 6 | 4 4 | 3 8 | 1 32 | 3 2 | 0 46 | 2 5 | 2 5 | 1 7 | 0 34 |
| PST | p,p'-DDD | 0 7 | 0.28 | 0.285 | 0.23 | 0 21 | 0 13 | 0 23 | 0 22 | 0 0455 | 0 41 |
| PST | o,p'-DDE | 0 76 | 0 56 | 0 93 | 0 0575 | 0 18 | 0 02 | 0.02 | 0 06 | 0 015 | 0 19 |
| PST | o,p'-DDT | 2 7 | 2 3 | 1 75 | 1 06 | 1 6 | 0 93 | 2.2 | 1 9 | 1 2 | 0 47 |
| PST | p,p'-DDE | 0 94 | 1 5 | 0 86 | 0 87 | 0.23 | 0 67 | 1 | 9 | 0 51 | 0.28 |
| PST | p,p'-DDT | 11 | 2 4 | 2 45 | 0 505 | 1 2 | 0 77 | 0 69 | 0 96 | 0 5 | 0 67 |
| TOC | % TOC | 1 34 | 1 4 | 1 14 | 1 74 | 1 95 | 2 23 | 2 4 | 3 31 | 2 18 | 2 4 |
| | | | | | | | | | | Site mean TOC% | |
| | | | | | | | | | | 1.77 | |

A-6

Table A-2-2.2a. (continued)

| Class | Analyte3 | R01-100B | R01-200B | R01-300B | R01-400B | R02-100B | R02-200B | R02-300B | R02-400B | R03-100B | R03-200B | R03-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 10.5 | 3.1 | 3.9 | 5.7 | 10.9 | 3.6 | 4.1 | 7.2 | 13.6 | 8.4 | 8.2 |
| MET | Cadmium | 0.47 | 0.12 | 0.2 | 0.16 | 0.17 | 0.13 | 0.17 | 0.28 | 0.44 | 0.38 | 0.37 |
| MET | Chromium | 96.3 | 22.3 | 30.9 | 41.7 | 52.9 | 38.2 | 39.5 | 72.2 | 67.2 | 68.7 | 71.8 |
| MET | Copper | 26.1 | 3.6 | 6.2 | 7.8 | 16.8 | 9.3 | 8.8 | 21.8 | 26.1 | 17.4 | 17.1 |
| MET | Lead | 72.4 | 17.2 | 19.8 | 22 | 59.5 | 29.6 | 25 | 87.8 | 63.7 | 39.4 | 41.2 |
| MET | Mercury | 0.4 | 0.04 | 0.06 | 0.08 | 0.13 | 0.11 | 0.07 | 0.19 | 0.13 | 0.22 | 0.14 |
| MET | Nickel | 26.7 | 9.2 | 11.1 | 13.1 | 23.7 | 20.3 | 15 | 21.1 | 38.2 | 20.3 | 20.2 |
| MET | Silver | 0.28 | 0.08 | 0.09 | 0.13 | 0.1 | 0.15 | 0.09 | 0.26 | 0.33 | 0.22 | 0.25 |
| MET | Zinc | 110 | 23.6 | 33.2 | 40.2 | 70.3 | 42.7 | 60.9 | 89.7 | 82.6 | 71.9 | 95.2 |
| MET | SEM-AVS | -2.37 | -1.37 | -1.46 | -4.71 | -0.39 | -8.35 | -4.26 | -8.25 | -0.03 | -12.27 | -12.54 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 9.1 | 1.5 | 7.9 | 5.4 | 10 | 10.3 | 8.4 | 10.5 | 9.7 | 41.5 | 58 |
| PAH | 1-Methylnaphthalene (L) | 15.3 | 1.8 | 1.4 | 4.9 | 14.5 | 7.5 | 7.8 | 11.1 | 4.5 | 16.8 | 35.6 |
| PAH | 1-Methylphenanthrene (L) | 45.1 | 3.4 | 23.2 | 46.1 | 57.3 | 38.4 | 26.1 | 47.8 | 34.6 | 240 | 368 |
| PAH | 2,6-Dimethylnaphthalene (L) | 12.9 | 2 | 2.9 | 7.7 | 10.1 | 8.2 | 8.3 | 10.6 | 6.1 | 21.4 | 35.1 |
| PAH | 2-Methylnaphthalene (L) | 24.7 | 2.7 | 2.5 | 6.6 | 18.6 | 10.3 | 11.7 | 17.5 | 8.4 | 24.5 | 39.2 |
| PAH | Acenaphthene (L) | 22.7 | 1.6 | 2.1 | 18.6 | 22.7 | 20.9 | 11.5 | 14.3 | 4.2 | 68 | 154 |
| PAH | Acenaphthylene (L) | 92 | 8.4 | 9.3 | 65.4 | 86.3 | 43 | 52.4 | 74.2 | 8.7 | 93.4 | 85.8 |
| PAH | Anthracene (L) | 146 | 13.1 | 38.8 | 115 | 206 | 225 | 116 | 222 | 44.2 | 989 | 912 |
| PAH | Benzo(a)anthracene (H) | 281 | 23.7 | 88.2 | 155 | 479 | 333 | 291 | 315 | 110 | 1421 | 1084 |
| PAH | Benzo(a)pyrene (H) | 464 | 34.9 | 78.6 | 206 | 680 | 396 | 379 | 403 | 116 | 1588 | 1204 |
| PAH | Benzo(b)fluoranthene (H) | 421 | 33.3 | 74.3 | 251 | 728 | 343 | 365 | 403 | 112 | 1352 | 950 |
| PAH | Benzo(b+k)fluoranthene (H) | 585 | 42.4 | 97.2 | 339 | 924 | 480 | 497 | 547 | 157.7 | 1801 | 1321 |
| PAH | Benzo(e)pyrene (H) | 251 | 18.6 | 37.1 | 130 | 375 | 180 | 195 | 211 | 57.4 | 704 | 527 |
| PAH | Benzo(g,h,i)perylene (H) | 249 | 18.2 | 27.4 | 101 | 377 | 171 | 173 | 198 | 44.1 | 702 | 532 |
| PAH | Benzo(k)fluoranthene (H) | 164 | 9.1 | 22.9 | 88 | 196 | 137 | 132 | 144 | 45.7 | 449 | 371 |
| PAH | Biphenyl (L) | 9.2 | 1 | 1 | 3 | 4.3 | 3.7 | 3.4 | 4.9 | 2.9 | 8.3 | 8.7 |
| PAH | Chrysene (H) | 307 | 23.9 | 69.7 | 288 | 529 | 287 | 300 | 357 | 97.4 | 1120 | 910 |
| PAH | Dibenz(a,h)anthracene (H) | 70.8 | 4.9 | 11.8 | 28.4 | 119 | 54 | 56.3 | 63.9 | 17.5 | 229 | 180 |
| PAH | Fluoranthene (H) | 461 | 37.1 | 97.3 | 951 | 921 | 572 | 457 | 621 | 192 | 2160 | 1900 |
| PAH | Fluorene (L) | 46.9 | 3.4 | 10.2 | 55.1 | 45.3 | 42.5 | 31.3 | 45.4 | 14.8 | 165 | 249 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 259 | 18.2 | 29.8 | 112 | 445 | 194 | 196 | 225 | 50 | 848 | 609 |
| PAH | Naphthalene (L) | 48.4 | 3.6 | 4.4 | 12.6 | 26 | 18.5 | 19.2 | 29.5 | 12.4 | 55.7 | 62.3 |
| PAH | Perylene (H) | 59 | 10 | 12.7 | 31.6 | 106 | 68.3 | 49.1 | 66.5 | 23.7 | 214 | 191 |
| PAH | Phenanthrene (L) | 179 | 15.1 | 39.2 | 603 | 369 | 207 | 170 | 200 | 49.5 | 964 | 1300 |
| PAH | Pyrene (H) | 458 | 39.8 | 89.4 | 668 | 772 | 527 | 397 | 548 | 168 | 1810 | 1873 |
| PAH | LMW PAHs | 559.7 | 47.9 | 106.5 | 876.3 | 773.9 | 567.2 | 412.1 | 602.9 | 142.2 | 2359.6 | 2802.3 |
| PAH | HMW PAHs | 2041.8 | 164.3 | 435 | 2296.4 | 3500 | 2169 | 1880.3 | 2307.9 | 700.9 | 8328 | 7151 |
| PAH | Total PAHs | 2601.5 | 212.2 | 541.5 | 3172.7 | 4273.9 | 2736.2 | 2292.4 | 2910.8 | 843.1 | 10687.6 | 9953.3 |
| PCB | Total PCBs | 33.44 | 8.082 | 5.912 | 10.531 | 31.18 | 222.411 | 14.411 | 32.78 | 15.25 | 57.59 | 58.08 |
| PST | Aldrin | 0.075 | 0.0305 | 0.0255 | 0.03 | 0.0355 | 0.0305 | 0.0355 | 0.0355 | 1.1 | 5.3 | 5.2 |
| PST | Alpha-BHC | 0.04 | 0.04 | 0.02 | 0.03 | 0.06 | 0.26 | 0.02 | 0.07 | 0.19 | 0.28 | 0.23 |
| PST | Alpha-chlordane | 0.34 | 0.04 | 0.04 | 0.06 | 0.44 | 0.26 | 0.21 | 0.07 | 0.04 | 0.4 | 0.14 |
| PST | Beta-BHC | 0.26 | 0.1 | 0.09 | 0.095 | 0.15 | 0.095 | 0.26 | 0.115 | 0.135 | 0.34 | 0.26 |
| PST | Chlorpyrifos | 0.36 | 0.14 | 0.01 | 0.135 | 0.165 | 0.135 | 0.16 | 0.165 | 0.03 | 0.18 | 0.17 |
| PST | CIS-Nonachlor | 0.58 | 0.05 | 0.02 | 0.14 | 1.3 | 0.42 | 0.24 | 0.15 | 0.72 | 0.26 | 0.25 |
| PST | Delta-BHC | 0.055 | 0.02 | 0.02 | 0.02 | 0.0255 | 0.02 | 0.0255 | 0.0255 | 0.05 | 0.02 | 0.0255 |
| PST | Dieldrin | 0.41 | 0.0355 | 0.0305 | 0.07 | 0.68 | 0.48 | 0.0405 | 0.4 | 0.03 | 0.07 | 0.0405 |
| PST | Endosulfan II | 0.82 | 0.04 | 0.04 | 0.14 | 0.48 | 0.51 | 0.16 | 0.07 | 0.08 | 0.12 | 0.25 |
| PST | Endrin | 0.17 | 0.065 | 0.06 | 0.065 | 0.08 | 0.065 | 0.075 | 0.08 | 0.09 | 0.085 | 0.08 |
| PST | Gamma-BHC (Lindane) | 0.305 | 0.12 | 0.105 | 0.11 | 0.14 | 0.03 | 0.05 | 0.08 | 0.24 | 0.25 | 0.145 |
| PST | Gamma-Chlordane | 0.21 | 0.03 | 0.02 | 0.03 | 0.1 | 0.04 | 0.07 | 0.12 | 0.0455 | 0.0405 | 0.0405 |
| PST | Heptachlor | 0.05 | 0.02 | 0.05 | 0.08 | 0.06 | 0.06 | 0.19 | 0.1 | 0.115 | 0.07 | 0.105 |
| PST | Heptachlor epoxide | 0.0355 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.02 | 0.02 | 0.02 |
| PST | Hexachlorobenzene | 0.055 | 0.02 | 0.02 | 0.07 | 0.07 | 0.02 | 0.02 | 12 | 0.0305 | 0.0305 | 0.0255 |
| PST | Mirex | 0.0355 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.015 | 0.02 | 0.63 | 0.52 |
| PST | Oxychlordane | 0.02 | 0.005 | 0.005 | 0.005 | 0.05 | 0.36 | 0.01 | 0.01 | 0.02 | 0.99 | 0.51 |
| PST | Pentachloroanisole | 0.14 | 0.02 | 0.03 | 0.03 | 0.16 | 0.02 | 0.06 | 0.06 | 0.12 | 0.09 | 0.2 |
| PST | Pentachlorobenzene | 0.25 | 0.125 | 0.105 | 0.105 | 0.205 | 0.1 | 0.12 | 0.19 | 0.17 | 0.36 | 0.27 |
| PST | Trans-Nonachlor | 0.35 | 0.02 | 0.015 | 0.1 | 0.24 | 0.19 | 0.02 | 0.18 | 0.06 | 0.32 | 0.34 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0.17 | 0.07 | 0.08 | 0.07 | 0.24 | 0.1 | 0.12 | 0.14 | 0.02 | 0.13 | 0.1 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0.03 | 0.44 | 0.47 | 0.17 | 0.41 | 0.19 | 0.16 | 0.24 | 0.15 | 0.52 | 0.32 |
| PST | o,p'-DDD | 0.86 | 0.07 | 0.0255 | 0.19 | 0.0355 | 1.9 | 0.34 | 0.86 | 1.2 | 5.5 | 4.2 |
| PST | p,p'-DDD | 0.59 | 0.15 | 0.2 | 0.0405 | 0.05 | 0.0405 | 0.08 | 0.21 | 0.09 | 0.05 | 0.05 |
| PST | o,p'-DDE | 0.0305 | 0.01 | 0.02 | 0.01 | 0.11 | 0.98 | 0.015 | 0.015 | 0.07 | 0.1 | 0.07 |
| PST | o,p'-DDT | 0.92 | 0.09 | 0.08 | 0.26 | 0.6 | 3.5 | 0.45 | 4.2 | 0.45 | 1.6 | 1.6 |
| PST | p,p'-DDE | 1.4 | 0.11 | 0.08 | 0.28 | 0.4 | 0.76 | 0.25 | 0.96 | 0.8 | 0.69 | 0.62 |
| PST | p,p'-DDT | 0.71 | 0.08 | 0.03 | 0.16 | 0.75 | 0.18 | 0.47 | 1.2 | 0.15 | 0.73 | 1.6 |
| TOC | % TOC | 3.91 | 0.45 | 0.35 | 0.84 | 2.19 | 0.56 | 0.6 | 1.07 | 3.17 | 2.16 | 2.02 |

Table A-2-2.2a. (continued)

| Class | Analyte3 | R03-400B | R04-100B | R04-200B | R04 300B | R04-400B |
|---|---|---|---|---|---|---|
| MET | Arsenic | 7 4 | 4 9 | 3 8 | 2 6 | 1 7 |
| MET | Cadmium | 0 18 | 0 15 | 0 08 | 0 08 | 0.08 |
| MET | Chromium | 65 | 61 2 | 55 5 | 38.2 | 30 9 |
| MET | Copper | 12 2 | 9 4 | 4 7 | 3 8 | 3 2 |
| MET | Lead | 29 6 | 31 8 | 14 5 | 13 3 | 13 1 |
| MET | Mercury | 0 23 | 0 19 | 0 03 | 0 03 | 0 03 |
| MET | Nickel | 23 3 | 18 3 | 18 2 | 13 8 | 11 3 |
| MET | Silver | 0 17 | 0 15 | 0 05 | 0 05 | 0 05 |
| MET | Zinc | 61 7 | 38 3 | 28 9 | 25 3 | 20 9 |
| MET | SEM-AVS | -1 54 | 0 21 | -3 38 | -3 89 | -6 46 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 5 | 2 2 | 0 6 | 0 4 | 0 5 |
| PAH | 1-Methylnaphthalene (L) | 5 4 | 3 7 | 0 7 | 0 6 | 0 7 |
| PAH | 1-Methylphenanthrene (L) | 24 9 | 10 9 | 2 5 | 1.2 | 2 7 |
| PAH | 2,6-Dimethylnaphthalene (L) | 5 8 | 2 6 | 1 6 | 1 5 | 1 |
| PAH | 2-Methylnaphthalene (L) | 8 6 | 5 1 | 0 9 | 1 | 1 2 |
| PAH | Acenaphthene (L) | 16 4 | 5 3 | 0 7 | 0 7 | 0 8 |
| PAH | Acenaphthylene (L) | 27 8 | 17 5 | 2 7 | 2.5 | 4 7 |
| PAH | Anthracene (L) | 80 4 | 34 3 | 5 1 | 4 7 | 8 5 |
| PAH | Benzo(a)anthracene (H) | 217 | 60 8 | 5 8 | 4 8 | 9 5 |
| PAH | Benzo(a)pyrene (H) | 282 | 90 3 | 9 2 | 9 5 | 16 2 |
| PAH | Benzo(b)fluoranthene (H) | 259 | 90 | 10 4 | 12 | 19 3 |
| PAH | Benzo(b+k)fluoranthene (H) | 361 | 121 7 | 13 4 | 15.2 | 24 6 |
| PAH | Benzo(e)pyrene (H) | 142 | 49 1 | 5 3 | 6 1 | 10 |
| PAH | Benzo(g,h,i)perylene (H) | 136 | 48 5 | 5 5 | 6 3 | 10 3 |
| PAH | Benzo(k)fluoranthene (H) | 102 | 31 7 | 3 | 3 2 | 5 3 |
| PAH | Biphenyl (L) | 2 4 | 1 9 | 0 7 | 0 7 | 0 8 |
| PAH | Chrysene (H) | 213 | 68 3 | 7 4 | 7 7 | 13 1 |
| PAH | Dibenz(a,h)anthracene (H) | 42 9 | 13 5 | 1 3 | 1 4 | 2 4 |
| PAH | Fluoranthene (H) | 440 | 120 | 46 2 | 13 7 | 25 8 |
| PAH | Fluorene (L) | 25 1 | 9 4 | 1 5 | 1 2 | 2 3 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 151 | 49 6 | 6 | 7 | 11 5 |
| PAH | Naphthalene (L) | 15 9 | 9 1 | 1 8 | 2.2 | 2 3 |
| PAH | Perylene (H) | 68 6 | 18 5 | 2 5 | 3 4 | 4 5 |
| PAH | Phenanthrene (L) | 189 | 45 7 | 8 4 | 5 1 | 10 6 |
| PAH | Pyrene (H) | 377 | 105 | 15 2 | 12 4 | 25 4 |
| PAH | LMW PAHs | 363 2 | 126 4 | 21 1 | 17 4 | 30 4 |
| PAH | HMW PAHs | 1571 9 | 457 9 | 55 1 | 49 5 | 92 4 |
| PAH | Total PAHs | 1935 1 | 584 3 | 76 2 | 66 9 | 122 8 |
| PCB | Total PCBs | 24 251 | 24 31 | 5 121 | 6 631 | 5 051 |
| PST | Aldrin | 2 6 | 0 98 | 0 15 | 0 15 | 0 32 |
| PST | Alpha-BHC | 0 09 | 0 13 | 0 1 | 0 04 | 0 03 |
| PST | Alpha-chlordane | 0 08 | 0 09 | 0 0305 | 0 04 | 0 09 |
| PST | Beta-BHC | 0 39 | 0 14 | 0 15 | 0 085 | 0 09 |
| PST | Chlorpyrifos | 0 04 | 0 16 | 0 12 | 0 12 | 0 02 |
| PST | CIS-Nonachlor | 0 07 | 0 07 | 0 02 | 0 04 | 0 07 |
| PST | Delta-BHC | 0 1 | 0 0255 | 0 02 | 0 04 | 0 02 |
| PST | Dieldrin | 0 17 | 0 0405 | 0 0305 | 0 0305 | 0.0305 |
| PST | Endosulfan II | 0 36 | 0 38 | 0 05 | 0 05 | 0 03 |
| PST | Endrin | 0 06 | 0 075 | 0 055 | 0 055 | 0 055 |
| PST | Gamma-BHC (Lindane) | 0 04 | 0 01 | 0 03 | 0 04 | 0 04 |
| PST | Gamma-Chlordane | 0 0305 | 0 11 | 0 0305 | 0 03 | 0 01 |
| PST | Heptachlor | 0 08 | 0 095 | 0 07 | 0 07 | 0 07 |
| PST | Heptachlor epoxide | 0 015 | 0 015 | 0 01 | 0 015 | 0 01 |
| PST | Hexachlorobenzene | 0 02 | 0 0255 | 0 02 | 0 02 | 0 02 |
| PST | Mirex | 0 015 | 0 015 | 0 01 | 0 015 | 0 01 |
| PST | Oxychlordane | 0 035 | 0 05 | 0 35 | 0 005 | 0 005 |
| PST | Pentachloroanisole | 0 09 | 0 11 | 0 03 | 0 06 | 0 03 |
| PST | Pentachlorobenzene | 0 07 | 0 1 | 0 06 | 0 11 | 0 04 |
| PST | Trans-Nonachlor | 0 05 | 0.22 | 0 04 | 0.23 | 0 015 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0.21 | 0 08 | 0 02 | 0 04 | 0 085 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 57 | 0 42 | 0 03 | 0 02 | 0 01 |
| PST | o,p'-DDD | 1 2 | 0 49 | 0 02 | 0 05 | 0 11 |
| PST | p,p'-DDD | 0.28 | 0 0455 | 0 36 | 0 28 | 0 19 |
| PST | o,p'-DDE | 0 07 | 0 12 | 0 01 | 0 09 | 0 1 |
| PST | o,p'-DDT | 0 46 | 0 62 | 0 02 | 0 17 | 0.27 |
| PST | p,p'-DDE | 0 34 | 1 5 | 0 06 | 0.12 | 0 13 |
| PST | p,p'-DDT | 0 42 | 0 45 | 0 03 | 0 12 | 0 05 |
| TOC | % TOC | 0 69 | 1 98 | 0 3 | 0 26 | 0 29 |

| Reference site mean TOC% |
|---|
| 1.30 |

Table A-2-2.2b. Concentrations of PCB congeners and calculation of Total PCBs in surface sediment (0-10 cm) collected from Round 2 of the Portsmouth Naval Shipyard offshore study area.

| Analyte | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB101 | 1.1 | 2.8 | 1 65 | 2.1 | 0 68 | 1.4 | 38 | 5 8 | 4 6 | 22 | 1 4 | 1 1 | 2.75 | 2.2 | 0.78 | 0.65 | 1.4 | 0.52 | 1.7 | 1 6 | 0.26 |
| PCB105 | 0.39 | 1.4 | 0.64 | 1.4 | 0.41 | 2.3 | 9.5 | 2 8 | 1 9 | 5 1 | 0.57 | 1.7 | 1.55 | 0 9 | 0.64 | 0 37 | 0.85 | 0.26 | 0 83 | 2 1 | 0 34 |
| PCB118 | 1 | 3.1 | 2.3 | 2.1 | 0 93 | 4.7 | 4.3 | 3.1 | 2.9 | 7 1 | 1 2 | 1.4 | 2.8 | 1 9 | 0 9 | 0.61 | 1.3 | 0 4 | 1 7 | 1.2 | 0 25 |
| PCB128 | 1.4 | 1.7 | 1.245 | 0.79 | 0.46 | 1 9 | 4.1 | 1 4 | 1 6 | 2 3 | 0 39 | 0.89 | 0.825 | 0.28 | 0.3 | 0.14 | 0.24 | 0 23 | 0.44 | 0.3 | 0.11 |
| PCB138 | 1.5 | 3.4 | 2 35 | 2 9 | 1 4 | 1 4 | 89 | 20 | 9 2 | 33 | 1.7 | 8.2 | 3.7 | 2.5 | 1 | 0.6 | 2 | 0.105 | 2 1 | 1.35 | 0.115 |
| PCB153 | 1.6 | 2.4 | 1.85 | 2.1 | 0.93 | 5 4 | 97 | 17 | 9.2 | 31 | 1.7 | 9 6 | 3 75 | 2 2 | 2.2 | 0 55 | 1.5 | 0.33 | 2 1 | 9.5 | 1.35 |
| PCB170 | 36 | 26 | 19 | 22 | 8 8 | 2.3 | 47 | 37 | 18 | 5 9 | 3 1 | 6 | 14 915 | 6 | 0 54 | 0.57 | 4 | 0 5 | 0 28 | 0.78 | 0 27 |
| PCB18 | 0.044 | 0 041 | 0.62425 | 0 05 | 0.04 | 0.09 | 0.08 | 0.06 | 0.055 | 0.13 | 0.065 | 0 038 | 0 3775 | 0.075 | 0.046 | 0 043 | 0 07 | 0.06 | 0.86 | 0.08 | 0.07 |
| PCB180 | 0.81 | 1.5 | 1.3 | 1.1 | 0.57 | 4.2 | 45 | 20 | 7 | 27 | 1.2 | 10 | 2.15 | 1.5 | 0.6 | 0.425 | 0 97 | 0.2 | 0.6 | 0 5 | 0.135 |
| PCB187 | 0.57 | 0.69 | 0.615 | 0.73 | 0.33 | 2.2 | 25 | 16 | 4.2 | 22 | 0 74 | 5 7 | 1 75 | 0.96 | 1 | 0.44 | 0.65 | 0.21 | 1 | 0.77 | 0 13 |
| PCB195 | 1.2 | 1.2 | 0.57 | 0 36 | 0.18 | 0.98 | 3.5 | 3.9 | 1 | 5.3 | 0.16 | 1 1 | 0.64 | 0 38 | 0.32 | 0.24 | 0.22 | 0.05 | 0.72 | 0.43 | 0.11 |
| PCB206 | 0.41 | 0 4 | 0 395 | 0.28 | 0.12 | 0.7 | 2.2 | 6 6 | 0 92 | 11 | 0.05 | 1.1 | 1.1175 | 0.13 | 0.165 | 0.2 | 0 07 | 0.065 | 1.9 | 0 475 | 0 115 |
| PCB209 | 2.1 | 0.93 | 0.395 | 0.64 | 0 48 | 0.55 | 1 7 | 2.6 | 0.77 | 13 | 0.37 | 0.205 | 1 25 | 1 | 0 32 | 0.215 | 1.1 | 0.2 | 0.365 | 0.455 | 0.065 |
| PCB28 | 0.95 | 0 66 | 1 1 | 2.1 | 0 92 | 10 | 1.4 | 2.2 | 1.4 | 1 | 2.1 | 0.14 | 3.25 | 3 | 0 77 | 0 52 | 3.6 | 0 46 | 3 1 | 1 2 | 0.15 |
| PCB44 | 0.5 | 0.79 | 0.78 | 0.35 | 0.18 | 1 | 0.6 | 0 62 | 0 32 | 1.7 | 0.39 | 0 09 | 2.2 | 0.56 | 1.1 | 0 31 | 0.25 | 0 36 | 0.92 | 1.3 | 0.48 |
| PCB52 | 0.32 | 2.5 | 0.87 | 0.87 | 0.42 | 3.3 | 10 | 3.6 | 1.7 | 5 | 1.1 | 0.19 | 2 31 | 3.1 | 0.19 | 0.39 | 1.6 | 0.08 | 1.2 | 0.76 | 0.27 |
| PCB66 | 0.49 | 0.44 | 1.085 | 0 2 | 0.22 | 0 5 | 0 35 | 0.5 | 0 51 | 1.3 | 0.2 | 0.055 | 0.645 | 0.54 | 0.12 | 0 06 | 0.37 | 0 06 | 0 85 | 0.79 | 0.1 |
| PCB8 | 2.1 | 1.4 | 2 05 | 0.66 | 0.5 | 2.1 | 0.14 | 0 04 | 0.13 | 1.5 | 0.79 | 0.43 | 1.65 | 2.4 | 0.34 | 0.27 | 0.95 | 0.49 | 0.86 | 0.3 | 0.01 |
| SUMPCB | 52.5 | 51.4 | 38.8 | 40.7 | 17.6 | 45.0 | 378 9 | 143.2 | 65.4 | 195 3 | 17 2 | 47.9 | 47 6 | 29.6 | 11.3 | 6.6 | 21.1 | 4.6 | 21.5 | 23.9 | 4.3 |
| TOTPCB | 104.968 | 102.702 | 77.6385 | 81.46 | 35.14 | 90.04 | 757.74 | 286.44 | 130.81 | 390.66 | 34.45 | 95.876 | 95.26 | 59.25 | 22.662 | 13.206 | 42.28 | 9.16 | 43.05 | 47.78 | 8.66 |
| % TOC | 1.73 | 1.89 | 2.255 | 2.15 | 4 54 | 2.91 | 3.12 | 2.09 | 1.81 | 1.13 | 1.92 | 0.69 | 2.005 | 2.36 | 0 7 | 0.47 | 2.09 | 0.52 | 0.98 | 1.97 | 1.48 |

Units=ng/g.
SUMPCB = Sum of congener concentrations.
TOTPCB = Total PCBs - SUMPCB x 2.

Table A-2-2.2b. (continued)

| Analyte | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-100B | M11-200B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB101 | 14 | 6.3 | 6.05 | 6.5 | 0 93 | 2.6 | 4.2 | 3.7 | 1.38 | 0 92 | 2 | | | 24 | 3.6 | 6.2 | 2 45 | 0.79 | 1 8 | 3.6 | 2.2 | 0 91 | 6 1 |
| PCB105 | 5.2 | 2.6 | 3 35 | 3 3 | 0.6 | 1.6 | 2 | 1.9 | 1.05 | 0 58 | 0.57 | | | 7.9 | 1.7 | 3 04 | 1.2 | 0.55 | 1 1 | 1.6 | 1.4 | 0.6 | 3 8 |
| PCB118 | 8 | 6.2 | 2.15 | 4.3 | 0.73 | 2.2 | 3.3 | 2.9 | 2 | 2.5 | 0.93 | | | 15 | 4 8 | 3.4 | 1.95 | 3 | 2.2 | 3.6 | 3.4 | 2.1 | 5 6 |
| PCB128 | 2.7 | 1.7 | 1.7 | 2 | 0.27 | 0.89 | 0.98 | 1.2 | 0 465 | 0.37 | 0.17 | | | 3.4 | 1.1 | 2.3 | 0.53 | 0 47 | 0.24 | 0.87 | 1.3 | 0.54 | 1 2 |
| PCB138 | 20 | 8 9 | 23.5 | 12 | 1.2 | 3.7 | 5.4 | 4.1 | 1.95 | 0 7 | 0.5 | | | 30 | 4 | 17.7 | 3.4 | 1 1 | 3 | 5 | 3 7 | 1.8 | 4.8 |
| PCB153 | 22 | 15 | 29 | 13 | 1 | 2.9 | 4.3 | 5 | 1.575 | 0 6 | 5.2 | | | 17 | 3.9 | 23.2 | 3.3 | 1.1 | 2 2 | 4.7 | 4.5 | 1.3 | 3.2 |
| PCB170 | 2.6 | 1.1 | 34.5 | 29 | 0.7 | 1.6 | 13 | 31 | 2.735 | 8 9 | 12 | | | 7.7 | 63 | 38.5 | 22.375 | 19 | 0 9 | 22 | 13 | 7 | 0.85 |
| PCB18 | 0.92 | 0.06 | 0 29175 | 0.65 | 0.1 | 0.036 | 1 | 0.82 | 0.0525 | 0.05 | 0 095 | | | 0.21 | 2.8 | 0.68 | 0.8825 | 1.6 | 0.085 | 1.9 | 0.97 | 0.05 | 0.075 |
| PCB180 | 14 | 4.8 | 29.5 | 12 | 0.78 | 1.4 | 4.1 | 3 4 | 0.525 | 1.4 | 0.365 | | | 13 | 3.6 | 18 6 | 2.7 | 1.2 | 1.7 | 3.6 | 2 | 0.95 | 1.2 |
| PCB187 | 8.7 | 3.2 | 12 95 | 7.4 | 0.91 | 1.2 | 3.1 | 2 8 | 0 81 | 0.47 | 0 31 | | | 13 | 2.5 | 10 7 | 1.65 | 0.36 | 1.1 | 2.4 | 1.4 | 0.4 | 0 59 |
| PCB195 | 3.8 | 1.4 | 2.7 | 2.3 | 1 6 | 0.8 | 3.4 | 1 8 | 0.19 | 0 28 | 0.18 | | | 3 2 | 2 2 | 2.51 | 0 64 | 0.59 | 0 49 | 1 | 0.86 | 0 31 | 0.18 |
| PCB206 | 7.6 | 2.8 | 2.6 | 4.3 | 4.1 | 1.9 | 7 3 | 3.3 | 0.165 | 0 54 | 0.21 | | | 6 9 | 3.7 | 1.65 | 0.67 | 0 23 | 0.84 | 1.4 | 1.7 | 0.38 | 0.1 |
| PCB209 | 2 3 | 1 3 | 0.5325 | 1 5 | 1.1 | 0.56 | 3.3 | 0.99 | 0.2475 | 0.81 | 0.265 | | | 1.3 | 1.6 | 0 31 | 0.75 | 0.44 | 1.4 | 2 | 0 91 | 0 87 | 0.43 |
| PCB28 | 3.2 | 1.9 | 0 32 | 1 8 | 0.32 | 0.45 | 2.5 | 1.8 | 0 61 | 3 | 0.63 | | | 1.6 | 7.2 | 1.7 | 2.1 | 1 | 3.7 | 5 | 1.1 | 1.4 | 0.6 |
| PCB44 | 3.1 | 2.3 | 0.655 | 1.6 | 0 28 | 0.42 | 0 8 | 1 6 | 0.22 | 0 53 | 0.87 | | | 3 1 | 3.3 | 1 25 | 0.485 | 0.39 | 0 47 | 1.5 | 0.64 | 0.11 | 1.6 |
| PCB52 | 6 | 3 2 | 1.4 | 2.2 | 0 63 | 1.2 | 2.9 | 1.4 | 1.035 | 0 87 | 1.3 | | | 9.1 | 5.3 | 1.7 | 1.4 | 1.3 | 2 | 3 | 1 1 | 0.55 | 3.8 |
| PCB66 | 3 3 | 0.9 | 0 65 | 1.1 | 0.2 | 0.34 | 0 89 | 0.75 | 0.23 | 1.3 | 0 21 | | | 2.7 | 5 | 0.625 | 0.315 | 0.09 | 0.55 | 1.6 | 1 8 | 0.43 | 1.1 |
| PCB8 | 0.75 | 0 53 | 0.13 | 1.6 | 0.2 | 0.38 | 2.2 | 0.57 | 0.165 | 2.8 | 0.36 | | | 1.1 | 2.1 | 2.35 | 0.245 | 8.3 | 1.1 | 1.8 | 1.4 | 2.2 | 0.31 |
| SUMPCB | 128.2 | 64.2 | 152.0 | 106.6 | 15.7 | 24.2 | 64.7 | 69 0 | 15.4 | 26.6 | 26.2 | | | 160.2 | 121.4 | 136.4 | 47.0 | 41.5 | 24.9 | 66.6 | 43.4 | 21.9 | 35.5 |
| TOTPCB | 256.34 | 128.38 | 303.959 | 213.1 | 31.3 | 48.352 | 129.34 | 138 06 | 30.81 | 53.24 | 52.33 | | | 320.42 | 242.8 | 272.83 | 94.085 | 83.02 | 49.75 | 133.14 | 86.76 | 43.8 | 71 07 |
| % TOC | 1.04 | 1.63 | 0.545 | 1.88 | 0.28 | 0.54 | 2.14 | 2.56 | 1.73 | 1.15 | 1.75 | | | 1.34 | 1.4 | 1.14 | 1.74 | 1.95 | 2.23 | 2.4 | 3.31 | 2.18 | 2.4 |

| Site mean TOC% |
|---|
| 1.7654 |

Table A-2-2.2b. (continued)

| Analyte | R01-100B | R01-200B | R01-300B | R01-400B | R02-100B | R02-200B | R02-300B | R02-400B | R03-100B | R03-200B | R03-300B | R03-400B | R04-100B | R04-200B | R04-300B | R04-400B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB101 | 1.4 | 0 19 | 0 21 | 0.32 | 0.37 | 21 | 0.47 | 1.4 | 0 02 | 0 81 | 1.4 | 0.42 | 1.2 | 0 46 | 0.42 | 0 27 |
| PCB105 | 0.77 | 0.1 | 0 04 | 0.19 | 0.41 | 12 | 0.19 | 0.73 | 0 07 | 0.42 | 0.78 | 0.11 | 0 58 | 0 04 | 0.04 | 0 05 |
| PCB118 | 1.6 | 0 19 | 0 13 | 0 51 | 0.89 | 22 | 0.6 | 1.5 | 0.14 | 2.6 | 2.1 | 0.44 | 1.1 | 0 08 | 0.13 | 0 14 |
| PCB128 | 0.37 | 0.02 | 0.02 | 0.05 | 0.17 | 5 | 0 03 | 0 27 | 1 | 1.1 | 0.54 | 0 06 | 0.33 | 0 02 | 0 02 | 0.04 |
| PCB138 | 1.2 | 0 19 | 0.17 | 0.55 | 0 77 | 18 | 0.56 | 1.8 | 0 28 | 2.4 | 1:8 | 0.45 | 0 57 | 0.15 | 0.18 | 0.15 |
| PCB153 | 1.7 | 0.25 | 0 17 | 0.43 | 1.1 | 12 | 0.46 | 2 | 0 24 | 1.1 | 1 4 | 0.34 | 0 94 | 0.13 | 0 21 | 0.19 |
| PCB170 | 1.3 | 1 | 0.76 | 0.485 | 0.6 | 0.485 | 0.6 | 0 54 | 2 2 | 10 | 8.7 | 7.8 | 3.7 | 0.59 | 0.73 | 0.94 |
| PCB18 | 0.11 | 0.0455 | 0.0405 | 0.0405 | 0.05 | 0 0405 | 0.05 | 0.05 | 0.49 | 0.055 | 0.62 | 0 77 | 0.45 | 0.11 | 0.38 | 0 0355 |
| PCB180 | 0 87 | 0.075 | 0.055 | 0 3 | 0.95 | 2.4 | 0.49 | 0 99 | 0 51 | 1.1 | 0.91 | 0.29 | 0 39 | 0.05 | 0.01 | 0.08 |
| PCB187 | 0.55 | 0 09 | 0.04 | 0.14 | 0.49 | 0.7 | 0.13 | 0.7 | 0 14 | 0 51 | 0 41 | 0.16 | 0 19 | 0.13 | 0 13 | 0.09 |
| PCB195 | 0.31 | 0.04 | 0.02 | 0.12 | 0.25 | 0 24 | 0.12 | 0 51 | 0.05 | 0.66 | 0.29 | 0 13 | 0.14 | 0 02 | 0.01 | 0 02 |
| PCB206 | 0.33 | 0.0405 | 0.0355 | 0 07 | 0.12 | 0.05 | 0.0455 | 0.68 | 0.055 | 0 3 | 0 59 | 0 0355 | 0 08 | 0 0355 | 0.0355 | 0 05 |
| PCB209 | 0.82 | 0 19 | 0.19 | 0.34 | 0 82 | 1.1 | 0 46 | 1 | 0 35 | 0.33 | 0 53 | 0 31 | 0.27 | 0.09 | 0 05 | 0.03 |
| PCB28 | 2.9 | 0.75 | 0 42 | 1 | 1 6 | 0 99 | 0.99 | 1.6 | 0.18 | 1.8 | 2.3 | 0 35 | 0.75 | 0.36 | 0.38 | 0 12 |
| PCB44 | 1.3 | 0.09 | 0 12 | 0 13 | 0.22 | 3.1 | 0 22 | 0.27 | 0.13 | 0.1 | 0 24 | 0.21 | 0.38 | 0.08 | 0 07 | 0 07 |
| PCB52 | 0.45 | 0.35 | 0.14 | 0 23 | 5.6 | 7.8 | 1.4 | 1.8 | 0 59 | 1.4 | 1.7 | 0 06 | 0.075 | 0.055 | 0 09 | 0.16 |
| PCB66 | 0.32 | 0 06 | 0.055 | 0.06 | 0.24 | 3 1 | 0.15 | 0.21 | 0 18 | 0.41 | 0 23 | 0.12 | 0.25 | 0 01 | 0.24 | 0 01 |
| PCB8 | 0.42 | 0.37 | 0.34 | 0.3 | 0.94 | 1.2 | 0.24 | 0.34 | 1 | 3.7 | 4 5 | 0.07 | 0 76 | 0.15 | 0.19 | 0.08 |
| SUMPCB | 16.7 | 4.0 | 3.0 | 5.3 | 15.6 | 111.2 | 7 2 | 16.4 | 7.6 | 28.8 | 29.0 | 12.1 | 12.2 | 2.6 | 3.3 | 2.5 |
| TOTPCB | 33.44 | 8.082 | 5.912 | 10.531 | 31.18 | 222.411 | 14.411 | 32.78 | 15 25 | 57.59 | 58.08 | 24.251 | 24.31 | 5.121 | 6.631 | 5.051 |
| % TOC | 3.91 | 0.45 | 0.35 | 0.84 | 2.19 | 0.56 | 0.6 | 1.07 | 3 17 | 2.16 | 2.02 | 0.69 | 1.98 | 0.3 | 0.26 | 0.29 |

| Reference site mean TOC% |
|---|
| 1.30 |

A-11

Table A-2.2.3. Geotechnical characteristics of station sediments in Round 2 of the Portsmouth Naval Shipyard investigation.

**PNS OU-4 MONITORING LOCATIONS**

| Category 1 | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % CLAY | 10.47 | 0.85 | 11.83 | 13.42 | 4.79 | 24.38 | 26.66 | 15.41 | 14.8 | 1.41 | 16.01 | 0.37 | 22.65 | 22.64 | 6.96 | 4.79 | 19.4 | 2.35 | 7.44 | 28.85 | 23.13 |
| % SAND | 78.14 | 97.11 | 74.9 | 66.25 | 89.15 | 26.86 | 30.43 | 57.46 | 57.05 | 89.41 | 56.9 | 97.07 | 25.055 | 33.92 | 78.13 | 85.63 | 46.66 | 84.51 | 73.79 | 20.89 | 41.21 |
| % SILT | 11.39 | 2.04 | 13.27 | 20.33 | 6.06 | 48.76 | 42.91 | 27.13 | 28.15 | 9.18 | 27.09 | 2.56 | 52.295 | 43.44 | 14.91 | 9.58 | 33.94 | 13.14 | 18.77 | 50.26 | 35.66 |
| TOC | 1.73 | 1.89 | 2.255 | 2.15 | 4.54 | 2.91 | 3.12 | 2.09 | 1.81 | 1.13 | 1.92 | 0.69 | 2.005 | 2.36 | 0.7 | 0.47 | 2.09 | 0.52 | 0.98 | 1.97 | 1.48 |

| Category 1 | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % CLAY | 7.07 | 14.73 | 0.085 | 13.43 | 0.51 | 0.41 | 31.01 | 10.87 | 0.215 | 7.68 | 26.37 | 4.15 | 9.08 | 8.395 | 17.17 | 0 | 27.76 | 22.64 | 17.57 | 13.15 | 20.58 | 12.7 |
| % SAND | 78.55 | 43.71 | 99.345 | 56.94 | 98.65 | 98.77 | 12.98 | 69.49 | 98.605 | 78.18 | 31.58 | 92.7 | 73.69 | 75.93 | 54.135 | 20.18 | 32.82 | 32.08 | 35.57 | 64.45 | 48.77 | 62.1 |
| % SILT | 14.38 | 41.56 | 0.57 | 29.63 | 0.84 | 0.82 | 56.01 | 19.64 | 1.18 | 14.14 | 42.05 | 3.15 | 17.23 | 15.675 | 28.695 | 79.82 | 39.42 | 45.28 | 46.86 | 22.4 | 30.65 | 25.3 |
| TOC | 1.04 | 1.63 | 0.545 | 1.88 | 0.28 | 0.54 | 2.14 | 2.56 | 1.73 | 1.15 | 1.75 | 1.34 | 1.4 | 1.14 | 1.74 | 1.95 | 2.23 | 2.4 | 3.31 | 2.18 | 2.4 | 1.8 |

**REFERENCE LOCATIONS**

| Category 1 | R01-100B | R01-200B | R01-300B | R01-400B | R02-100B | R02-200B | R02-300B | R02-400B | R03-100B | R03-200B | R03-300B | R03-400B | R04-100B | R04-200B | R04-300B | R04-400B | Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % CLAY | 17.76 | 1.79 | 4.5 | 11.19 | 4.72 | 4.57 | 5.08 | 14.06 | 8.4 | 14.2 | 12 | 4.18 | 9.71 | 1.73 | 0.42 | 2.16 | 7.3 |
| % SAND | 47.9 | 95.4 | 95.05 | 76.69 | 89.24 | 91.07 | 88.92 | 62 01 | 69.47 | 65.82 | 68.01 | 88.65 | 70.13 | 98.1 | 96.01 | 96.12 | 81.2 |
| % SILT | 34.34 | 2.81 | 0.45 | 12.12 | 6.04 | 4.36 | 6 | 23.93 | 22.13 | 19.98 | 19.99 | 7.17 | 20.16 | 0.17 | 3.57 | 1.72 | 11.6 |
| TOC | 3.91 | 0.45 | 0.35 | 0.84 | 2.19 | 0.56 | 0.6 | 1.07 | 3.17 | 2.16 | 2.02 | 0.69 | 1.98 | 0.3 | 0.26 | 0.29 | 1.3 |

1- See TtNUS (2000a)

Table A-2-2 4a Concentrations of contaminants in the sediment pore water from Round 2 of the Portsmouth Naval Shipyard Investigation

| #REF! | Analyte[1,3] | LogKoc[2] | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | NA | | 1.55 | 6 09 | 5.56 | 4 39 | | 3 53 | 1 55 | | 1 55 | |
| MET | Cadmium | NA | | 0.50 | 0 50 | 0 50 | 0 50 | | 0 50 | 0 50 | | 0 50 | |
| MET | Chromium | NA | | 2.50 | 2.50 | 2.50 | 2.50 | | 2.50 | 2.50 | | 2.50 | |
| MET | Copper | NA | | 5 60 | 1 50 | 2.80 | 2.20 | | 1 50 | 2.20 | | 4 00 | |
| MET | Lead | NA | | 1.50 | 1.50 | 1 50 | 1 50 | | 1 50 | 1 50 | | 1 50 | |
| MET | Mercury | NA | | 0 03 | 0 03 | 0 03 | 0 03 | | 0 03 | 0 03 | | 0 03 | |
| MET | Nickel | NA | | 7 00 | 2.50 | 2.50 | 2.50 | | 2.50 | 10 00 | | 27 00 | |
| MET | Silver | NA | | 2.50 | 2.50 | 2.50 | 2.50 | | 2.50 | 2.50 | | 2.50 | |
| MET | Zinc | NA | | 8 40 | 13 50 | 5 30 | 4 60 | | 4 40 | 8 10 | | 6 20 | |
| MET | SEM-AVS | NA | -23 9 | 1 2 | -34 4 | -26 0 | -1 4 | -1 0 | -50 3 | -15 9 | -18 0 | -0 5 | -10 9 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 4 53 | 0 05 | 0 04 | 0 07 | 0 02 | 0 01 | 0.01 | 0 02 | 0 02 | 0 02 | 0 07 | 0 01 |
| PAH | 1-Methylnaphthalene (L) | 3 90 | 0 34 | 0 33 | 0 86 | 0.08 | 0 03 | 0 06 | 0 10 | 0 10 | 0 11 | 0 83 | 0 06 |
| PAH | 1-Methylphenanthrene (L) | 4 99 | 0 23 | 0.07 | 0 13 | 0 02 | 0 01 | 0 02 | 0 04 | 0 03 | 0 04 | 0 10 | 0 02 |
| PAH | 2 6-Dimethylnaphthalene (L) | 4 53 | 0 06 | 0 06 | 0 11 | 0 02 | 0 01 | 0 01 | 0 02 | 0 02 | 0 03 | 0 12 | 0 02 |
| PAH | 2-Methylnaphthalene (L) | 3 90 | 0 29 | 0.52 | 1.22 | 0 14 | 0 06 | 0 10 | 0 15 | 0 18 | 0 18 | 1 41 | 0 11 |
| PAH | Acenaphthene (L) | 3 85 | 0 22 | 0 80 | 3 04 | 0 12 | 0 05 | 0 11 | 0 51 | 0 32 | 0 35 | 0 74 | 0 10 |
| PAH | Acenaphthylene (L) | 3 98 | 1 78 | 0 88 | 1 72 | 0 39 | 0 17 | 0.25 | 0 48 | 0 39 | 0 51 | 3 19 | 0 33 |
| PAH | Anthracene (L) | 4 47 | 0 54 | 1 09 | 2.35 | 0 30 | 0 14 | 0 19 | 0 67 | 0 45 | 0 46 | 2.13 | 0 28 |
| PAH | Benzo(a)anthracene (H) | 5 60 | 0 06 | 0 16 | 0.23 | 0 04 | 0 02 | 0 02 | 0 08 | 0.06 | 0 06 | 0 26 | 0 03 |
| PAH | Benzo(a)pyrene (H) | 6 01 | 0 04 | 0 08 | 0 11 | 0 02 | 0 01 | 0.01 | 0 03 | 0 03 | 0 03 | 0 10 | 0 02 |
| PAH | Benzo(b)fluoranthene (H) | 6.09 | 0 03 | 0 05 | 0 07 | 0 01 | 0 01 | 0.01 | 0 03 | 0 03 | 0 03 | 0 09 | 0 01 |
| PAH | Benzo(b+k)fluoranthene (H) | 6 09 | 0 04 | 0 07 | 0 10 | 0 02 | 0 01 | 0 01 | 0 04 | 0.03 | 0 03 | 0 11 | 0 02 |
| PAH | Benzo(e)pyrene (H) | 6 01 | 0 03 | 0 05 | 0 05 | 0 01 | 0 00 | 0 01 | 0 02 | 0 02 | 0 02 | 0 05 | 0 01 |
| PAH | Benzo(g,h,i)perylene (H) | 6 59 | 0 01 | 0 01 | 0 01 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 02 | 0 00 |
| PAH | Benzo(k)fluoranthene (H) | 6 09 | 0 01 | 0 02 | 0.02 | 0 00 | 0 00 | 0 00 | 0 01 | 0 01 | 0 01 | 0 02 | 0 00 |
| PAH | Biphenyl (L) | 3 89 | 0 12 | 0 14 | 0.38 | 0 04 | 0 01 | 0 03 | 0 04 | 0 04 | 0 06 | 0 20 | 0 04 |
| PAH | Chrysene (H) | 5 60 | 0 12 | 0 14 | 0 20 | 0 04 | 0 02 | 0 03 | 0 08 | 0 06 | 0 06 | 0 25 | 0 03 |
| PAH | Dibenz(a,h)anthracene (H) | 6 58 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 01 | 0 00 |
| PAH | Fluoranthene (H) | 5 03 | 0 60 | 0 75 | 1 61 | 0 19 | 0 12 | 0 19 | 0 54 | 0 42 | 0 36 | 1 49 | 0 19 |
| PAH | Fluorene (L) | 4 14 | 0.79 | 0 70 | 2.95 | 0 14 | 0 06 | 0 10 | 0 41 | 0 27 | 0 30 | 1 01 | 0 14 |
| PAH | Indeno(1,2 3-cd)pyrene (H) | 6 54 | 0 01 | 0 01 | 0 01 | 0 00 | 0 00 | 0 00 | 0 01 | 0 01 | 0 01 | 0 02 | 0 00 |
| PAH | Naphthalene (L) | 3 30 | 1 18 | 3 05 | 9 85 | 0 79 | 0 34 | 0 72 | 1 04 | 0 94 | 1 35 | 7 22 | 0 83 |
| PAH | Perylene (H) | 5 95 | 0 00 | 0 01 | 0.02 | 0 01 | 0 00 | 0 00 | 0 01 | 0 01 | 0 01 | 0 01 | 0 01 |
| PAH | Phenanthrene (L) | 4 47 | 3 07 | 1.91 | 4 97 | 0 27 | 0 15 | 0 37 | 0 95 | 0 68 | 0 58 | 2 08 | 0 22 |
| PAH | Pyrene (H) | 5 02 | 1 04 | 0 70 | 1 50 | 0 21 | 0 11 | 0 16 | 0 46 | 0 38 | 0 36 | 1 26 | 0 23 |
| PAH | LMW PAHs | | 7 88 | 8 96 | 26 09 | 2 14 | 0 97 | 1 84 | 4 21 | 3 23 | 3 73 | 17 77 | 2.01 |
| PAH | HMW PAHs | | 1 87 | 1 84 | 3 66 | 0 49 | 0.27 | 0 41 | 1 19 | 0 96 | 0 88 | 3 37 | 0 50 |
| PAH | Total PAHs | | 9 75 | 10 80 | 29 75 | 2 63 | 1 24 | 2 25 | 5 39 | 4 19 | 4 60 | 21 14 | 2 51 |
| PCB | Total PCBs | | 0 004 | 0 003 | 0 003 | 0 002 | 0 000 | 0 004 | 0 006 | 0 003 | 0 002 | 0 011 | 0 002 |
| PST | Aldrin | 6 39 | 6 83E-07 | 5 93E-07 | 3 55E-05 | 6 45E-07 | 2 38E-07 | 1 34E-05 | 6 53E-07 | 7 70E-07 | 8 44E-07 | 9 92E-07 | 9 45E-07 |
| PST | Alpha-BHC | 3.74 | 1 70E-03 | 1 26E-03 | 1 10E-03 | 1 11E-03 | 3 64E-04 | 3 79E-04 | 1 18E-03 | 5 10E-03 | 2 44E-03 | 2 93E-03 | 2 58E-03 |
| PST | Alpha-chlordane | 6 39 | 9 66E-05 | 3 45E-04 | 2 71E-05 | 1 14E-05 | 4 76E-06 | 4 34E-06 | 7 32E-06 | 1 27E-05 | 1 19E-05 | 5 05E-05 | 2 55E-06 |
| PST | Beta-BHC | 3 75 | 4 57E-03 | 8.56E-04 | 9 16E-03 | 3 84E-03 | 2 53E-03 | 6 17E-03 | 1 79E-02 | 7 82E-03 | 9 93E-03 | 1 51E-03 | 2.90E-02 |
| PST | Chlorpyrifos | 5 17 | 5 46E-05 | 4 64E-05 | 4 86E-05 | 5 02E-05 | 1 86E-05 | 1 65E-04 | 5 41E-05 | 6 13E-05 | 6 71E-05 | 7 76E-05 | 7 38E-05 |
| PST | CIS-Nonachlor | 6 75 | 1 22E-05 | 1 68E-05 | 2.54E-06 | 1 56E-06 | 6 22E-07 | 1 52E-05 | 9 61E-06 | 3 21E-06 | 2 44E-06 | 8 43E-06 | 1 47E-06 |
| PST | Delta-BHC | 3 74 | 3 15E-04 | 1 97E-04 | 4 03E-04 | 5 07E-04 | 1 20E-04 | 9 37E-04 | 2 30E-04 | 1 30E-03 | 1 31E-03 | 3 30E-04 | 3 03E-03 |
| PST | Dieldrin | 5.28 | 2.22E-04 | 5 84E-03 | 2.03E-04 | 7 34E-06 | 7 99E-05 | 1 57E-04 | 2 19E-04 | 3 78E-04 | 6 10E-05 | 1 44E-05 | 1 64E-05 |
| PST | Endosulfan II | 4 03 | 2.37E-02 | 1 58E-02 | 8 45E-03 | 5.20E-03 | 2.46E-03 | 5 12E-03 | 6 27E-03 | 3 79E-03 | 8 24E-03 | 1 40E-02 | 3 35E-03 |
| PST | Endrin | 4 97 | 7 36E-05 | 5 00E-04 | 7 06E-05 | 3 70E-05 | 1 40E-05 | 4 92E-05 | 4 08E-05 | 4 57E-05 | 4 98E-05 | 5 63E-05 | 5 53E-05 |
| PST | Gamma-BHC (Lindane) | 3 67 | 7 10E-03 | 6 04E-03 | 2 48E-03 | 1 40E-03 | 9 96E-04 | 2.37E-03 | 3 31E-03 | 3 81E-03 | 2 62E-03 | 2 48E-03 | 7 85E-04 |
| PST | Gamma-Chlordane | 6.21 | 4 96E-05 | 4 86E-04 | 3.40E-06 | 2.85E-06 | 2 43E-06 | 9 05E-06 | 8 64E-06 | 7 62E-06 | 8 12E-06 | 2 93E-05 | 4 79E-06 |
| PST | Heptachlor | 6 15 | 1.54E-05 | 2.78E-05 | 7 16E-06 | 2.61E-06 | 1 85E-06 | 6 27E-06 | 1.53E-05 | 1 71E-05 | 1 05E-05 | 3 79E-05 | 4 75E-06 |
| PST | Heptachlor epoxide | 4 92 | 1 02E-05 | 8 68E-06 | 9 70E-06 | 9 61E-06 | 3 61E-06 | 1 23E-05 | 1 01E-05 | 1 16E-05 | 1.24E-05 | 1 51E-05 | 1 42E-05 |
| PST | Hexachlorobenzene | 5 79 | 9.37E-07 | 6 00E-06 | 2.88E-06 | 5.28E-06 | 1 43E-06 | 2.45E-06 | 2 08E-06 | 6 98E-06 | 4 48E-06 | 1 15E-05 | 2.83E-06 |
| PST | Mirex | 6.77 | 5 46E-06 | 1 07E-05 | 6 43E-06 | 1 80E-06 | 1 49E-07 | 4 81E-06 | 3 24E-07 | 2.34E-06 | 3 73E-07 | 2 39E-06 | 3 51E-07 |
| PST | Oxychlordane | 6 21 | 2.30E-05 | 3 89E-05 | 2.02E-05 | 1 14E-06 | 8 10E-07 | 1 68E-06 | 2.55E-06 | 9 38E-06 | 2 71E-06 | 3 52E-05 | 8 61E-06 |
| PST | Pentachloroanisole | NA | | | | | | | | | | | |
| PST | Pentachlorobenzene | 5 17 | 5.07E-05 | 6 07E-05 | 7 63E-05 | 5 34E-05 | 1 04E-05 | 1 44E-04 | 5 84E-05 | 4 84E-05 | 1 08E-04 | 6 57E-05 | 7 03E-05 |
| PST | Trans-Nonachlor | 6 75 | 1.12E-05 | 5 13E-05 | 5 71E-06 | 2.22E-06 | 1 13E-06 | 3 76E-06 | 2.26E-06 | 1 69E-06 | 5 85E-07 | 7 18E-06 | 3 68E-07 |
| PST | 1,2,3,4-Tetrachlorobenzene | 4.53 | 1 70E-05 | 3.89E-04 | 1 17E-04 | 2 87E-04 | 1 16E-04 | 3 33E-04 | 8 48E-04 | 7 17E-04 | 2 44E-03 | 8 32E-04 | 1 68E-04 |
| PST | 1,2,4,5-Tetrachlorobenzene | 4.56 | 8 57E-04 | 4 94E-04 | 5 30E-04 | 5 87E-04 | 2.24E-04 | 1 89E-03 | 1 58E-03 | 8 41E-04 | 2 43E-03 | 2 92E-03 | 1.72E-03 |
| PST | o,p'-DDD | 6.00 | 6 99E-04 | 3 09E-03 | 8 09E-04 | 8 44E-05 | 7 33E-05 | 4 50E-05 | 2.52E-04 | 1 54E-04 | 1 67E-04 | 1 43E-03 | 8 92E-05 |
| PST | p,p'-DDD | 6.00 | 2.27E-05 | 1 17E-04 | 2.12E-05 | 8 91E-06 | 5 33E-06 | 4 85E-05 | 2.26E-06 | 2 65E-06 | 2 78E-06 | 5 62E-05 | 3 73E-05 |
| PST | o,p'-DDE | 6 65 | 2.09E-05 | 2.99E-04 | 8 23E-05 | 1 47E-06 | 1 15E-05 | 6 53E-06 | 1 96E-05 | 5 31E-06 | 2 63E-06 | 3 80E-05 | 1 94E-07 |
| PST | o,p'-DDT | 6.42 | 3 96E-04 | 3 08E-03 | 7 35E-04 | 3 90E-05 | 5 28E-05 | 4 71E-05 | 2 44E-04 | 9 29E-05 | 9 47E-05 | 1 28E-03 | 2.18E-05 |
| PST | p,p'-DDE | 6 65 | 3 92E-05 | 7 06E-04 | 5.87E-05 | 1.26E-05 | 2.59E-05 | 7 78E-05 | 3 84E-05 | 3 25E-05 | 2.25E-05 | 2.20E-04 | 6 01E-06 |
| PST | p,p'-DDT | 6 42 | 5 72E-05 | 3 83E-03 | 6 00E-04 | 1 51E-05 | 8 39E-05 | 2 29E-05 | 7 32E-05 | 2 37E-05 | 2 52E-05 | 6 91E-05 | 1 17E-05 |
| TOC | % TOC | | 1 73 | 1 89 | 2 26 | 2 15 | 4 54 | 2 91 | 3 12 | 2 09 | 1 81 | 1 13 | 1 92 |

1 - Units metals (measured) = µg/L; For organics, pore water concentration (µg/L) = sediment concentration/(foc X Koc), (foc=%TOC/100).
See Table A-2-2.2a for sediment concentration values
For metals, pore water concentrations were measured One-half Method Detection Limit substituted for non-detects
2 - See Table A-2-2.1 for Koc values
3- Total PCBs = Sum of congeners x2, See Table A-2-2.4b

A-13

Table A-2-2 4a (continued)

| #REF! | Analyte[1,3] | LogKoc[2] | M04-300B | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | NA | 1.55 | 1.55 | 8.21 | | 4.55 | | 48.20 | 4.59 | | | 1.55 |
| MET | Cadmium | NA | 0.50 | 0.50 | 0.50 | | 0.50 | | 0.50 | 0.50 | | | 0.50 |
| MET | Chromium | NA | 2.50 | 2.50 | 2.50 | | 2.50 | | 2.50 | 2.50 | | | 2.50 |
| MET | Copper | NA | 474.00 | 1.50 | 1.50 | | 1.50 | | 1.50 | 1.50 | | | 1.50 |
| MET | Lead | NA | 1.50 | 1.50 | 1.50 | | 1.50 | | 1.50 | 1.50 | | | 1.50 |
| MET | Mercury | NA | 0.03 | 0.03 | 0.03 | | 0.03 | | 0.03 | 0.03 | | | 0.03 |
| MET | Nickel | NA | 6.00 | 2.50 | 2.50 | | 2.50 | | 13.00 | 2.50 | | | 6.00 |
| MET | Silver | NA | 2.50 | 2.50 | 2.50 | | 2.50 | | 2.50 | 2.50 | | | 2.50 |
| MET | Zinc | NA | 8.60 | 4.80 | 4.30 | | 3.80 | | 8.70 | 4.50 | | | 4.40 |
| MET | SEM-AVS | NA | 1.2 | -56.8 | -51.1 | -1.2 | -2.8 | -36.3 | 0.2 | -9.3 | -36.3 | -37.2 | -17.1 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 4.53 | 0.01 | 0.03 | 0.02 | 0.03 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.04 |
| PAH | 1-Methylnaphthalene (L) | 3.90 | 0.03 | 0.11 | 0.14 | 0.16 | 0.12 | 0.08 | 0.04 | 0.07 | 0.08 | 0.07 | 0.19 |
| PAH | 1-Methylphenanthrene (L) | 4.99 | 0.01 | 0.03 | 0.02 | 0.03 | 0.06 | 0.02 | 0.01 | 0.01 | 0.03 | 0.01 | 0.03 |
| PAH | 2,6-Dimethylnaphthalene (L) | 4.53 | 0.01 | 0.03 | 0.03 | 0.04 | 0.03 | 0.02 | 0.01 | 0.02 | 0.03 | 0.01 | 0.04 |
| PAH | 2-Methylnaphthalene (L) | 3.90 | 0.06 | 0.16 | 0.20 | 0.26 | 0.20 | 0.15 | 0.06 | 0.12 | 0.13 | 0.09 | 0.32 |
| PAH | Acenaphthene (L) | 3.85 | 0.08 | 0.29 | 0.19 | 0.46 | 0.49 | 0.12 | 0.13 | 0.17 | 0.16 | 0.11 | 0.55 |
| PAH | Acenaphthylene (L) | 3.98 | 0.14 | 0.52 | 0.36 | 0.85 | 0.59 | 0.49 | 0.09 | 0.33 | 0.39 | 0.39 | 0.67 |
| PAH | Anthracene (L) | 4.47 | 0.12 | 0.58 | 0.39 | 0.68 | 0.63 | 0.30 | 0.12 | 0.31 | 0.29 | 0.15 | 0.73 |
| PAH | Benzo(a)anthracene (H) | 5.60 | 0.01 | 0.06 | 0.04 | 0.09 | 0.14 | 0.06 | 0.02 | 0.05 | 0.03 | 0.02 | 0.08 |
| PAH | Benzo(a)pyrene (H) | 6.01 | 0.01 | 0.03 | 0.02 | 0.05 | 0.09 | 0.03 | 0.01 | 0.02 | 0.02 | 0.01 | 0.04 |
| PAH | Benzo(b)fluoranthene (H) | 6.09 | 0.01 | 0.02 | 0.01 | 0.04 | 0.08 | 0.02 | 0.01 | 0.02 | 0.02 | 0.01 | 0.03 |
| PAH | Benzo(b+k)fluoranthene (H) | 6.09 | 0.01 | 0.03 | 0.02 | 0.05 | 0.11 | 0.03 | 0.01 | 0.03 | 0.02 | 0.01 | 0.05 |
| PAH | Benzo(e)pyrene (H) | 6.01 | 0.00 | 0.01 | 0.01 | 0.03 | 0.05 | 0.02 | 0.00 | 0.01 | 0.01 | 0.00 | 0.02 |
| PAH | Benzo(g,h,i)perylene (H) | 6.59 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| PAH | Benzo(k)fluoranthene (H) | 6.09 | 0.00 | 0.01 | 0.01 | 0.01 | 0.03 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 |
| PAH | Biphenyl (L) | 3.89 | 0.02 | 0.06 | 0.04 | 0.07 | 0.07 | 0.04 | 0.03 | 0.04 | 0.04 | 0.03 | 0.09 |
| PAH | Chrysene (H) | 5.60 | 0.02 | 0.07 | 0.05 | 0.09 | 0.21 | 0.05 | 0.02 | 0.05 | 0.04 | 0.01 | 0.10 |
| PAH | Dibenz(a,h)anthracene (H) | 6.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAH | Fluoranthene (H) | 5.03 | 0.12 | 0.51 | 0.28 | 0.53 | 1.30 | 0.20 | 0.14 | 0.33 | 0.25 | 0.11 | 0.55 |
| PAH | Fluorene (L) | 4.14 | 0.04 | 0.31 | 0.27 | 0.39 | 0.53 | 0.17 | 0.10 | 0.17 | 0.15 | 0.11 | 0.39 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 6.54 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 |
| PAH | Naphthalene (L) | 3.30 | 0.25 | 1.13 | 0.93 | 1.68 | 1.36 | 1.05 | 0.37 | 0.83 | 0.91 | 0.72 | 1.61 |
| PAH | Perylene (H) | 5.95 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 |
| PAH | Phenanthrene (L) | 4.47 | 0.12 | 0.60 | 0.47 | 0.87 | 1.86 | 0.26 | 0.25 | 0.46 | 0.35 | 0.17 | 0.83 |
| PAH | Pyrene (H) | 5.02 | 0.10 | 0.45 | 0.26 | 0.51 | 1.05 | 0.23 | 0.12 | 0.30 | 0.24 | 0.11 | 0.56 |
| PAH | LMW PAHs | | 0.81 | 3.58 | 2.81 | 5.18 | 5.66 | 2.54 | 1.12 | 2.38 | 2.38 | 1.74 | 5.10 |
| PAH | HMW PAHs | | 0.26 | 1.12 | 0.65 | 1.27 | 2.80 | 0.58 | 0.31 | 0.75 | 0.58 | 0.27 | 1.33 |
| PAH | Total PAHs | | 1.07 | 4.70 | 3.45 | 6.44 | 8.46 | 3.11 | 1.43 | 3.13 | 2.96 | 2.01 | 6.42 |
| PCB | Total PCBs | | 0.003 | 0.004 | 0.004 | 0.003 | 0.003 | 0.002 | 0.003 | 0.006 | 0.002 | 0.000 | 0.012 |
| PST | Aldrin | 6.39 | 1.48E-06 | 1.63E-06 | 8.46E-07 | 1.78E-06 | 2.51E-06 | 9.26E-07 | 2.19E-06 | 1.23E-06 | 1.03E-06 | 1.65E-06 | 1.10E-06 |
| PST | Alpha-BHC | 3.74 | 2.13E-03 | 1.83E-03 | 2.10E-03 | 2.63E-03 | 1.27E-03 | 1.93E-03 | 1.06E-03 | 1.69E-03 | 6.53E-04 | 4.97E-04 | 2.65E-03 |
| PST | Alpha-chlordane | 6.39 | 7.68E-06 | 1.44E-05 | 4.49E-06 | 1.40E-05 | 2.34E-05 | 5.07E-06 | 9.41E-06 | 9.98E-06 | 6.21E-06 | 1.93E-06 | 1.10E-04 |
| PST | Beta-BHC | 3.75 | 1.07E-02 | 2.29E-02 | 2.36E-02 | 3.08E-02 | 3.63E-03 | 1.12E-02 | 3.28E-03 | 9.35E-03 | 1.82E-02 | 1.82E-02 | 1.16E-02 |
| PST | Chlorpyrifos | 5.17 | 1.17E-04 | 2.26E-04 | 6.72E-05 | 1.40E-04 | 1.94E-04 | 7.26E-05 | 1.75E-04 | 9.64E-05 | 8.39E-05 | 1.00E-04 | 8.76E-05 |
| PST | CIS-Nonachlor | 6.75 | 2.56E-05 | 2.82E-06 | 1.42E-06 | 1.01E-05 | 4.88E-06 | 2.11E-06 | 5.77E-06 | 2.88E-06 | 1.25E-06 | 1.67E-06 | 1.26E-05 |
| PST | Delta-BHC | 3.74 | 1.32E-03 | 4.53E-04 | 2.81E-04 | 1.56E-03 | 1.16E-03 | 3.09E-04 | 6.99E-04 | 4.08E-04 | 3.60E-04 | 4.91E-04 | 1.75E-04 |
| PST | Dieldrin | 5.28 | 8.39E-05 | 5.90E-05 | 2.23E-07 | 1.80E-04 | 1.90E-04 | 5.03E-06 | 5.06E-05 | 2.09E-04 | 1.87E-05 | 3.55E-05 | 4.75E-04 |
| PST | Endosulfan II | 4.03 | 2.16E-03 | 7.44E-03 | 4.74E-03 | 1.16E-02 | 1.47E-02 | 4.46E-03 | 2.69E-03 | 5.90E-03 | 3.88E-03 | 1.13E-03 | 1.17E-02 |
| PST | Endrin | 4.97 | 8.46E-05 | 5.69E-05 | 4.95E-05 | 1.06E-04 | 1.47E-04 | 5.33E-05 | 1.33E-04 | 7.04E-05 | 6.19E-05 | 7.53E-05 | 1.53E-04 |
| PST | Gamma-BHC (Lindane) | 3.67 | 3.12E-03 | 2.74E-03 | 5.57E-03 | 8.92E-03 | 6.41E-03 | 3.61E-03 | 4.56E-03 | 1.98E-03 | 1.31E-03 | 2.69E-03 | 2.48E-03 |
| PST | Gamma-Chlordane | 6.21 | 5.33E-06 | 1.19E-05 | 6.23E-06 | 4.38E-06 | 1.04E-05 | 3.22E-06 | 3.53E-06 | 1.50E-05 | 4.66E-06 | 1.24E-06 | 2.59E-04 |
| PST | Heptachlor | 6.15 | 2.03E-06 | 1.05E-06 | 4.16E-06 | 1.40E-05 | 7.46E-06 | 4.53E-06 | 1.21E-05 | 6.09E-06 | 5.70E-06 | 6.40E-06 | 8.10E-06 |
| PST | Heptachlor epoxide | 4.92 | 2.20E-05 | 1.45E-05 | 1.26E-05 | 2.69E-05 | 3.75E-05 | 1.37E-05 | 3.27E-05 | 1.80E-05 | 1.23E-05 | 1.93E-05 | 1.64E-05 |
| PST | Hexachlorobenzene | 5.79 | 2.35E-05 | 1.35E-04 | 2.51E-06 | 5.33E-06 | 6.90E-06 | 3.88E-06 | 6.55E-06 | 3.64E-06 | 6.58E-06 | 3.83E-06 | 2.18E-05 |
| PST | Mirex | 6.77 | 3.05E-07 | 1.51E-06 | 2.00E-06 | 2.65E-06 | 7.53E-06 | 2.02E-06 | 4.54E-07 | 2.24E-06 | 2.23E-06 | 2.68E-07 | 3.24E-06 |
| PST | Oxychlordane | 6.21 | 5.77E-07 | 6.87E-06 | 1.04E-06 | 7.00E-06 | 1.43E-05 | 1.17E-06 | 2.00E-05 | 5.00E-06 | 4.04E-07 | 4.76E-07 | 1.59E-05 |
| PST | Pentachloroanisole | NA | | | | | | | | | | | |
| PST | Pentachlorobenzene | 5.17 | 7.82E-05 | 8.58E-05 | 5.43E-05 | 3.18E-04 | 1.29E-04 | 6.46E-05 | 1.17E-04 | 1.45E-04 | 5.48E-05 | 2.28E-05 | 1.36E-04 |
| PST | Trans-Nonachlor | 6.75 | 6.90E-06 | 3.08E-06 | 1.94E-06 | 1.76E-06 | 1.13E-06 | 2.03E-06 | 5.94E-07 | 2.70E-06 | 1.70E-06 | 3.46E-07 | 3.56E-05 |
| PST | 1,2,3,4-Tetrachlorobenzene | 4.53 | 1.79E-03 | 2.64E-04 | 6.60E-04 | 1.09E-03 | 1.13E-03 | 8.44E-05 | 9.04E-04 | 8.10E-04 | 3.73E-04 | 5.96E-05 | 1.38E-03 |
| PST | 1,2,4,5-Tetrachlorobenzene | 4.56 | 6.37E-04 | 2.19E-03 | 1.98E-04 | 2.59E-03 | 1.75E-03 | 1.84E-03 | 8.45E-04 | 4.76E-03 | 1.67E-03 | 1.32E-03 | 2.64E-03 |
| PST | o,p'-DDD | 6.00 | 1.90E-03 | 1.33E-04 | 1.28E-04 | 1.15E-04 | 1.29E-04 | 1.16E-04 | 2.33E-05 | 2.16E-04 | 2.81E-05 | 5.11E-06 | 3.49E-03 |
| PST | p,p'-DDD | 6.00 | 4.97E-04 | 2.04E-05 | 2.90E-05 | 1.30E-05 | 1.93E-05 | 2.51E-05 | 6.20E-05 | 1.75E-05 | 2.20E-05 | 1.09E-05 | 1.26E-04 |
| PST | o,p'-DDE | 6.65 | 1.11E-03 | 4.23E-06 | 5.75E-07 | 5.66E-06 | 1.93E-06 | 4.33E-07 | 1.74E-06 | 3.69E-06 | 7.47E-07 | 7.64E-08 | 1.41E-04 |
| PST | o,p'-DDT | 6.42 | 1.55E-03 | 5.13E-05 | 4.03E-05 | 6.26E-05 | 4.05E-05 | 2.73E-05 | 1.54E-05 | 8.94E-05 | 1.84E-05 | 5.02E-06 | 4.39E-03 |
| PST | p,p'-DDE | 6.65 | 4.53E-03 | 3.22E-05 | 1.05E-05 | 2.10E-05 | 1.71E-05 | 7.90E-06 | 8.27E-05 | 8.08E-05 | 6.32E-06 | 1.15E-06 | 4.79E-04 |
| PST | p,p'-DDT | 6.42 | 9.60E-03 | 2.09E-05 | 4.52E-05 | 4.08E-05 | 2.88E-05 | 2.37E-05 | 2.86E-05 | 4.08E-05 | 1.26E-05 | 7.20E-06 | 1.04E-02 |
| TOC | % TOC | | 0.69 | 2.01 | 2.36 | 0.70 | 0.47 | 2.09 | 0.52 | 0.98 | 1.97 | 1.48 | 1.04 |

Table A-2-2 4a (continued)

| #REF! | Analyte[1,3] | LogKoc[2] | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | NA | | | 3.66 | 1.55 | 1.55 | | 3.54 | 1.55 | | 4.11 | 1.55 |
| MET | Cadmium | NA | | | 0.50 | 0.50 | 0.50 | | 0.50 | 0.50 | | 0.50 | 0.50 |
| MET | Chromium | NA | | | 2.50 | 2.50 | 2.50 | | 2.50 | 2.50 | | 2.50 | 2.50 |
| MET | Copper | NA | | | 1.50 | 23.20 | 3.15 | | 1.90 | 1.50 | | 1.80 | 2.45 |
| MET | Lead | NA | | | 1.50 | 1.50 | 1.50 | | 1.50 | 1.50 | | 1.50 | 1.50 |
| MET | Mercury | NA | | | 0.05 | 0.03 | 0.03 | | 0.03 | 0.03 | | 0.03 | 0.03 |
| MET | Nickel | NA | | | 2.50 | 12.00 | 15.00 | | 2.50 | 2.50 | | 2.50 | 10.00 |
| MET | Silver | NA | | | 2.50 | 2.50 | 2.50 | | 2.50 | 2.50 | | 2.50 | 2.50 |
| MET | Zinc | NA | | | 3.60 | 12.10 | 9.00 | | 5.70 | 6.50 | | 5.30 | 7.40 |
| MET | SEM-AVS | NA | -36.5 | 5.0 | -32.3 | 1.5 | -0.5 | -47.4 | -27.1 | -0.1 | -28.6 | -98.7 | -2.5 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 4.53 | 0.03 | 0.03 | 0.02 | 0.01 | 0.06 | 0.02 | 0.01 | 0.01 | 0.14 | 0.02 | 0.04 |
| PAH | 1-Methylnaphthalene (L) | 3.90 | 0.16 | 0.19 | 0.13 | 0.05 | 0.06 | 0.09 | 0.06 | 0.06 | 0.25 | 0.09 | 0.22 |
| PAH | 1-Methylphenanthrene (L) | 4.99 | 0.05 | 0.07 | 0.02 | 0.01 | 0.06 | 0.02 | 0.02 | 0.02 | 0.13 | 0.02 | 0.04 |
| PAH | 2,6-Dimethylnaphthalene (L) | 4.53 | 0.03 | 0.04 | 0.03 | 0.01 | 0.02 | 0.02 | 0.01 | 0.02 | 0.13 | 0.02 | 0.06 |
| PAH | 2-Methylnaphthalene (L) | 3.90 | 0.24 | 0.35 | 0.20 | 0.08 | 0.10 | 0.14 | 0.10 | 0.12 | 0.33 | 0.16 | 0.46 |
| PAH | Acenaphthene (L) | 3.85 | 0.38 | 0.39 | 0.44 | 0.04 | 0.09 | 0.34 | 0.27 | 0.12 | 1.36 | 0.16 | 0.18 |
| PAH | Acenaphthylene (L) | 3.98 | 0.57 | 1.16 | 0.51 | 0.20 | 0.18 | 0.30 | 0.17 | 0.16 | 2.15 | 0.56 | 0.37 |
| PAH | Anthracene (L) | 4.47 | 0.57 | 1.43 | 0.54 | 0.14 | 0.49 | 0.33 | 0.32 | 0.22 | 4.83 | 2.17 | 0.54 |
| PAH | Benzo(a)anthracene (H) | 5.60 | 0.06 | 0.14 | 0.06 | 0.01 | 0.05 | 0.04 | 0.04 | 0.02 | 0.36 | 0.05 | 0.05 |
| PAH | Benzo(a)pyrene (H) | 6.01 | 0.04 | 0.05 | 0.03 | 0.00 | 0.02 | 0.02 | 0.02 | 0.01 | 0.15 | 0.02 | 0.02 |
| PAH | Benzo(b)fluoranthene (H) | 6.09 | 0.03 | 0.06 | 0.03 | 0.01 | 0.01 | 0.02 | 0.01 | 0.01 | 0.10 | 0.02 | 0.02 |
| PAH | Benzo(b+k)fluoranthene (H) | 6.09 | 0.04 | 0.07 | 0.03 | 0.01 | 0.02 | 0.02 | 0.02 | 0.01 | 0.14 | 0.02 | 0.02 |
| PAH | Benzo(e)pyrene (H) | 6.01 | 0.02 | 0.03 | 0.02 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.07 | 0.01 | 0.01 |
| PAH | Benzo(g,h,i)perylene (H) | 6.59 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 |
| PAH | Benzo(k)fluoranthene (H) | 6.09 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.04 | 0.01 | 0.01 |
| PAH | Biphenyl (L) | 3.89 | 0.06 | 0.06 | 0.06 | 0.05 | 0.03 | 0.05 | 0.03 | 0.03 | 0.23 | 0.04 | 0.13 |
| PAH | Chrysene (H) | 5.60 | 0.07 | 0.17 | 0.07 | 0.01 | 0.04 | 0.04 | 0.04 | 0.02 | 0.29 | 0.06 | 0.05 |
| PAH | Dibenz(a,h)anthracene (H) | 6.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 |
| PAH | Fluoranthene (H) | 5.03 | 0.03 | 1.48 | 0.47 | 0.05 | 0.35 | 0.31 | 0.26 | 0.17 | 2.12 | 0.34 | 0.37 |
| PAH | Fluorene (L) | 4.14 | 0.34 | 0.32 | 0.31 | 0.04 | 0.21 | 0.23 | 0.19 | 0.11 | 2.44 | 0.34 | 0.29 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 6.54 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 |
| PAH | Naphthalene (L) | 3.30 | 1.75 | 1.31 | 1.19 | 0.56 | 0.55 | 0.88 | 0.77 | 1.38 | 3.81 | 1.10 | 2.41 |
| PAH | Perylene (H) | 5.95 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.03 | 0.00 | 0.01 |
| PAH | Phenanthrene (L) | 4.47 | 0.75 | 1.27 | 0.71 | 0.09 | 0.46 | 0.53 | 0.47 | 0.25 | 4.74 | 0.43 | 0.63 |
| PAH | Pyrene (H) | 5.02 | 0.42 | 1.35 | 0.43 | 0.05 | 0.31 | 0.29 | 0.25 | 0.15 | 1.71 | 0.31 | 0.34 |
| PAH | LMW PAHs | | 4.59 | 6.22 | 3.90 | 1.15 | 2.08 | 2.74 | 2.29 | 2.37 | 19.66 | 4.92 | 4.87 |
| PAH | HMW PAHs | | 0.62 | 3.20 | 1.07 | 0.12 | 0.77 | 0.70 | 0.60 | 0.37 | 4.63 | 0.78 | 0.85 |
| PAH | Total PAHs | | 5.21 | 9.42 | 4.96 | 1.27 | 2.86 | 3.44 | 2.89 | 2.74 | 24.29 | 5.70 | 5.72 |
| PCB | Total PCBs | | 0.004 | 0.010 | 0.005 | 0.005 | 0.005 | 0.005 | 0.002 | 0.001 | 0.008 | 0.002 | 0.011 |
| PST | Aldrin | 6.39 | 5.00E-07 | 5.33E-06 | 1.32E-04 | 3.35E-06 | 1.81E-06 | 7.81E-05 | 5.73E-05 | 8.07E-07 | 1.22E-06 | 1.63E-06 | 5.78E-05 |
| PST | Alpha-BHC | 3.74 | 1.13E-03 | 1.85E-03 | 1.96E-03 | 1.97E-03 | 1.70E-03 | 3.26E-03 | 7.18E-04 | 8.50E-04 | 3.20E-03 | 1.68E-03 | 1.23E-03 |
| PST | Alpha-chlordane | 6.39 | 1.15E-05 | 1.68E-04 | 1.47E-05 | 1.02E-05 | 1.74E-05 | 1.89E-05 | 3.98E-06 | 3.49E-04 | 1.28E-05 | 8.85E-06 | 4.56E-05 |
| PST | Beta-BHC | 3.75 | 2.09E-02 | 4.86E-03 | 1.15E-02 | 1.80E-02 | 2.66E-03 | 4.87E-03 | 3.72E-03 | 7.22E-03 | 2.03E-02 | 2.16E-02 | 6.97E-03 |
| PST | Chlorpyrifos | 5.17 | 8.07E-05 | 1.30E-04 | 6.64E-05 | 2.65E-04 | 1.44E-04 | 9.30E-05 | 4.35E-05 | 5.19E-04 | 9.68E-05 | 1.14E-04 | 6.80E-05 |
| PST | CIS-Nonachlor | 6.75 | 3.68E-06 | 1.83E-05 | 4.97E-06 | 4.41E-06 | 6.86E-06 | 2.06E-06 | 2.07E-06 | 1.57E-05 | 2.91E-06 | 2.32E-06 | 8.03E-06 |
| PST | Delta-BHC | 3.74 | 2.23E-03 | 5.59E-04 | 2.51E-03 | 1.14E-03 | 1.01E-03 | 2.21E-03 | 2.84E-04 | 2.44E-04 | 4.11E-04 | 1.77E-03 | 2.71E-04 |
| PST | Dieldrin | 5.28 | 9.68E-05 | 2.70E-04 | 9.51E-05 | 1.88E-06 | 9.74E-06 | 4.42E-05 | 8.32E-06 | 1.31E-04 | 1.19E-04 | 2.10E-05 | 1.10E-03 |
| PST | Endosulfan II | 4.03 | 1.09E-02 | 2.51E-02 | 4.81E-03 | 3.66E-03 | 1.33E-02 | 2.79E-03 | 2.55E-03 | 1.32E-03 | 9.73E-03 | 2.98E-03 | 5.63E-03 |
| PST | Endrin | 4.97 | 5.86E-05 | 9.73E-05 | 5.08E-05 | 1.89E-04 | 1.08E-04 | 6.94E-05 | 3.32E-05 | 4.75E-05 | 7.38E-05 | 8.49E-05 | 5.15E-05 |
| PST | Gamma-BHC (Lindane) | 3.67 | 3.30E-03 | 7.31E-03 | 2.63E-03 | 7.31E-03 | 3.99E-04 | 1.41E-03 | 1.93E-03 | 1.99E-03 | 3.93E-03 | 1.72E-03 | 3.05E-03 |
| PST | Gamma-Chlordane | 6.21 | 9.02E-06 | 2.47E-04 | 1.48E-06 | 4.38E-06 | 3.18E-05 | 2.00E-06 | 9.69E-07 | 7.52E-04 | 6.92E-06 | 5.60E-06 | 1.39E-06 |
| PST | Heptachlor | 6.15 | 7.32E-06 | 1.54E-05 | 4.11E-06 | 7.52E-06 | 1.82E-05 | 3.61E-06 | 2.74E-06 | 1.46E-05 | 7.32E-06 | 7.62E-06 | 1.68E-04 |
| PST | Heptachlor epoxide | 4.92 | 1.53E-05 | 2.45E-05 | 1.29E-05 | 6.51E-04 | 2.70E-05 | 1.73E-05 | 9.50E-06 | 1.19E-05 | 1.85E-05 | 2.19E-05 | 1.36E-05 |
| PST | Hexachlorobenzene | 5.79 | 3.08E-06 | 3.42E-05 | 1.12E-05 | 6.95E-04 | 2.40E-05 | 2.27E-05 | 1.61E-06 | 7.97E-06 | 2.82E-06 | 4.35E-06 | 3.51E-05 |
| PST | Mirex | 6.77 | 1.97E-06 | 3.87E-06 | 1.79E-07 | 6.92E-07 | 3.75E-06 | 2.40E-07 | 1.32E-07 | 7.80E-07 | 1.19E-05 | 2.89E-07 | 1.89E-07 |
| PST | Oxychlordane | 6.21 | 3.76E-06 | 1.60E-05 | 2.61E-06 | 1.31E-06 | 6.81E-07 | 1.00E-06 | 8.38E-07 | 1.25E-05 | 1.28E-05 | 1.40E-06 | 2.29E-06 |
| PST | Pentachloroanisole | NA | | | | | | | | | | | |
| PST | Pentachlorobenzene | 5.17 | 4.97E-05 | 1.73E-04 | 1.65E-04 | 2.89E-03 | 1.87E-04 | 1.70E-04 | 4.48E-05 | 3.51E-05 | 2.35E-05 | 3.86E-05 | 3.17E-04 |
| PST | Trans-Nonachlor | 6.75 | 3.25E-06 | 4.69E-05 | 7.23E-06 | 1.26E-06 | 5.23E-06 | 4.29E-06 | 1.58E-06 | 7.55E-05 | 3.37E-06 | 5.24E-06 | 5.00E-06 |
| PST | 1,2,3,4-Tetrachlorobenzene | 4.53 | 2.16E-04 | 7.55E-04 | 3.59E-04 | 4.41E-03 | 1.14E-03 | 1.07E-03 | 3.67E-04 | 5.60E-04 | 1.53E-04 | 8.40E-05 | 1.40E-03 |
| PST | 1,2,4,5-Tetrachlorobenzene | 4.56 | 2.02E-03 | 1.81E-03 | 1.20E-03 | 9.12E-03 | 1.68E-03 | 8.72E-04 | 5.36E-04 | 7.22E-04 | 1.07E-03 | 1.04E-03 | 3.28E-03 |
| PST | o,p'-DDD | 6.00 | 2.97E-04 | 2.68E-03 | 5.36E-04 | 3.96E-05 | 1.87E-04 | 1.27E-04 | 1.06E-04 | 1.60E-03 | 9.64E-05 | 6.34E-05 | 1.20E-04 |
| PST | p,p'-DDD | 6.00 | 6.80E-06 | 1.48E-04 | 2.47E-05 | 1.80E-05 | 2.99E-05 | 2.35E-05 | 1.18E-05 | 2.07E-05 | 9.64E-06 | 2.65E-05 | 5.27E-05 |
| PST | o,p'-DDE | 6.65 | 1.24E-05 | 1.08E-03 | 2.65E-05 | 2.26E-05 | 3.94E-05 | 2.33E-06 | 9.72E-06 | 4.05E-05 | 3.74E-06 | 1.81E-06 | 1.28E-05 |
| PST | o,p'-DDT | 6.42 | 1.29E-04 | 2.66E-03 | 4.86E-04 | 3.81E-05 | 1.06E-04 | 4.80E-05 | 4.91E-05 | 1.78E-03 | 6.62E-05 | 3.59E-05 | 7.67E-05 |
| PST | p,p'-DDE | 6.65 | 4.30E-05 | 8.72E-04 | 9.15E-05 | 1.62E-05 | 4.19E-05 | 3.28E-05 | 1.77E-05 | 8.70E-05 | 7.87E-06 | 4.46E-06 | 1.59E-05 |
| PST | p,p'-DDT | 6.42 | 3.97E-05 | 6.46E-03 | 2.23E-04 | 8.16E-05 | 1.69E-04 | 2.31E-05 | 5.36E-05 | 1.36E-04 | 2.98E-05 | 3.92E-05 | 3.13E-04 |
| TOC | % TOC | | 1.63 | 0.55 | 1.88 | 0.28 | 0.54 | 2.14 | 2.56 | 1.73 | 1.15 | 1.75 | 1.34 |

Table A-2-2 4a (continued)

| #REF! | Analyte[1,3] | LogKoc[2] | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | NA | 1.55 | 1.55 | | 15.50 | | 15.60 | 7.75 | 3.10 | |
| MET | Cadmium | NA | 0.50 | 0.50 | | 0.50 | | 0.50 | 0.50 | 0.50 | |
| MET | Chromium | NA | 2.50 | 2.50 | | 2.50 | | 2.50 | 2.50 | 2.50 | |
| MET | Copper | NA | 1.50 | 2.15 | | 1.50 | | 1.50 | 4.15 | 1.50 | |
| MET | Lead | NA | 1.50 | 1.50 | | 1.50 | | 1.50 | 1.50 | 1.50 | |
| MET | Mercury | NA | 0.03 | 0.06 | | 0.05 | | 0.03 | 0.03 | 0.10 | |
| MET | Nickel | NA | 2.50 | 2.50 | | 2.50 | | 2.50 | 7.00 | 2.50 | |
| MET | Silver | NA | 2.50 | 2.50 | | 2.50 | | 2.50 | 2.50 | 2.50 | |
| MET | Zinc | NA | 6.20 | 10.80 | | 3.20 | | 3.60 | 19.30 | 6.80 | |
| MET | SEM-AVS | NA | -7.3 | -1.3 | -56.7 | -110.0 | -94.5 | -173.1 | -1.5 | -15.9 | -27.0 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 4.53 | 0.05 | 0.06 | 0.03 | 0.30 | 0.04 | 0.04 | 0.01 | 0.03 | 0.03 |
| PAH | 1-Methylnaphthalene (L) | 3.90 | 1.00 | 1.13 | 0.12 | 0.94 | 0.14 | 0.12 | 0.07 | 0.12 | 0.10 |
| PAH | 1-Methylphenanthrene (L) | 4.99 | 0.17 | 0.20 | 0.05 | 0.34 | 0.04 | 0.05 | 0.01 | 0.06 | 0.05 |
| PAH | 2,6-Dimethylnaphthalene (L) | 4.53 | 0.09 | 0.10 | 0.03 | 0.58 | 0.04 | 0.03 | 0.01 | 0.03 | 0.03 |
| PAH | 2-Methylnaphthalene (L) | 3.90 | 1.33 | 1.54 | 0.20 | 1.48 | 0.21 | 0.21 | 0.11 | 0.20 | 0.17 |
| PAH | Acenaphthene (L) | 3.85 | 6.82 | 6.95 | 0.41 | 19.27 | 0.39 | 0.54 | 0.07 | 0.18 | 0.19 |
| PAH | Acenaphthylene (L) | 3.98 | 0.86 | 0.85 | 0.48 | 1.13 | 0.88 | 0.52 | 0.36 | 0.49 | 0.75 |
| PAH | Anthracene (L) | 4.47 | 2.93 | 3.18 | 0.81 | 3.92 | 0.94 | 1.05 | 0.20 | 0.63 | 0.56 |
| PAH | Benzo(a)anthracene (H) | 5.60 | 0.39 | 0.43 | 0.11 | 0.31 | 0.10 | 0.10 | 0.02 | 0.09 | 0.09 |
| PAH | Benzo(a)pyrene (H) | 6.01 | 0.16 | 0.18 | 0.04 | 0.09 | 0.04 | 0.04 | 0.01 | 0.05 | 0.05 |
| PAH | Benzo(b)fluoranthene (H) | 6.09 | 0.14 | 0.14 | 0.04 | 0.07 | 0.03 | 0.03 | 0.01 | 0.03 | 0.03 |
| PAH | Benzo(b+k)fluoranthene (H) | 6.09 | 0.17 | 0.19 | 0.05 | 0.10 | 0.04 | 0.05 | 0.01 | 0.05 | 0.04 |
| PAH | Benzo(e)pyrene (H) | 6.01 | 0.09 | 0.09 | 0.02 | 0.04 | 0.02 | 0.02 | 0.01 | 0.02 | 0.02 |
| PAH | Benzo(g,h,i)perylene (H) | 6.59 | 0.02 | 0.02 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |
| PAH | Benzo(k)fluoranthene (H) | 6.09 | 0.03 | 0.05 | 0.01 | 0.02 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| PAH | Biphenyl (L) | 3.89 | 0.21 | 0.28 | 0.06 | 1.22 | 0.07 | 0.08 | 0.03 | 0.07 | 0.06 |
| PAH | Chrysene (H) | 5.60 | 0.36 | 0.38 | 0.10 | 0.27 | 0.10 | 0.11 | 0.03 | 0.08 | 0.08 |
| PAH | Dibenz(a,h)anthracene (H) | 6.58 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAH | Fluoranthene (H) | 5.03 | 2.29 | 2.74 | 0.88 | 2.74 | 0.71 | 0.71 | 0.15 | 0.47 | 0.29 |
| PAH | Fluorene (L) | 4.14 | 3.53 | 4.14 | 0.40 | 13.98 | 0.51 | 0.87 | 0.10 | 0.36 | 0.30 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 6.54 | 0.03 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 |
| PAH | Naphthalene (L) | 3.30 | 10.41 | 13.44 | 1.27 | 1.90 | 1.32 | 1.42 | 0.81 | 1.57 | 1.29 |
| PAH | Perylene (H) | 5.95 | 0.02 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 |
| PAH | Phenanthrene (L) | 4.47 | 6.13 | 7.20 | 0.85 | 10.01 | 0.79 | 1.18 | 0.19 | 0.78 | 0.50 |
| PAH | Pyrene (H) | 5.02 | 1.98 | 2.26 | 0.69 | 2.13 | 0.62 | 0.64 | 0.15 | 0.53 | 0.33 |
| PAH | LMW PAHs | | 32.03 | 37.32 | 4.41 | 51.69 | 5.05 | 5.79 | 1.84 | 4.22 | 3.75 |
| PAH | HMW PAHs | | 5.18 | 5.99 | 1.83 | 5.53 | 1.56 | 1.60 | 0.36 | 1.23 | 0.85 |
| PAH | Total PAHs | | 37.21 | 43.31 | 6.24 | 57.22 | 6.60 | 7.39 | 2.20 | 5.45 | 4.60 |
| PCB | Total PCBs | | 0.013 | 0.010 | 0.003 | 0.011 | 0.003 | 0.005 | 0.002 | 0.003 | 0.002 |
| PST | Aldrin | 6.39 | 1.08E-06 | 3.76E-04 | 7.55E-05 | 1.86E-04 | 1.01E-06 | 8.49E-07 | 5.91E-05 | 6.64E-07 | 8.49E-07 |
| PST | Alpha-BHC | 3.74 | 6.30E-03 | 1.77E-03 | 1.06E-03 | 3.86E-03 | 7.42E-04 | 8.42E-04 | 8.88E-04 | 4.22E-03 | 1.53E-04 |
| PST | Alpha-chlordane | 6.39 | 2.74E-05 | 1.22E-05 | 3.75E-06 | 6.90E-06 | 7.13E-06 | 1.29E-05 | 6.77E-06 | 2.06E-06 | 1.70E-06 |
| PST | Beta-BHC | 3.75 | 1.10E-02 | 2.44E-02 | 9.01E-03 | 1.57E-02 | 1.57E-03 | 1.31E-03 | 8.69E-04 | 1.40E-03 | 1.27E-03 |
| PST | Chlorpyrifos | 5.17 | 8.43E-05 | 1.07E-04 | 8.24E-05 | 2.08E-05 | 9.08E-06 | 7.03E-05 | 1.22E-05 | 4.95E-05 | 6.89E-05 |
| PST | CIS-Nonachlor | 6.75 | 4.79E-06 | 8.51E-06 | 1.82E-06 | 3.80E-06 | 1.42E-06 | 2.57E-06 | 5.33E-06 | 1.62E-06 | 1.40E-06 |
| PST | Delta-BHC | 3.74 | 3.57E-04 | 4.42E-04 | 3.45E-04 | 4.24E-04 | 3.71E-04 | 3.07E-04 | 1.95E-04 | 2.13E-04 | 3.07E-04 |
| PST | Dieldrin | 5.28 | 8.27E-05 | 5.54E-05 | 5.14E-05 | 3.24E-05 | 1.01E-04 | 1.14E-04 | 8.74E-06 | 1.45E-05 | 2.85E-05 |
| PST | Endosulfan II | 4.03 | 2.00E-02 | 2.13E-02 | 4.42E-03 | 2.15E-03 | 4.60E-04 | 4.27E-03 | 1.15E-03 | 5.56E-03 | 8.54E-04 |
| PST | Endrin | 4.97 | 6.44E-05 | 7.91E-05 | 6.10E-05 | 7.35E-05 | 6.19E-05 | 5.08E-05 | 3.53E-05 | 3.65E-05 | 3.09E-05 |
| PST | Gamma-BHC (Lindane) | 3.67 | 2.31E-03 | 2.88E-03 | 3.09E-03 | 2.76E-03 | 2.27E-03 | 1.84E-03 | 1.30E-04 | 1.33E-03 | 1.84E-03 |
| PST | Gamma-Chlordane | 6.21 | 1.82E-06 | 1.29E-05 | 7.22E-06 | 2.20E-06 | 5.22E-06 | 1.53E-06 | 1.02E-06 | 1.14E-06 | 1.79E-06 |
| PST | Heptachlor | 6.15 | 5.26E-06 | 1.57E-05 | 5.14E-06 | 6.30E-06 | 5.19E-06 | 4.24E-06 | 2.97E-06 | 3.06E-06 | 4.24E-06 |
| PST | Heptachlor epoxide | 4.92 | 1.61E-05 | 2.13E-05 | 1.59E-05 | 1.90E-05 | 1.66E-05 | 1.29E-05 | 9.36E-06 | 8.36E-06 | 1.29E-05 |
| PST | Hexachlorobenzene | 5.79 | 3.18E-06 | 3.50E-04 | 7.71E-06 | 8.31E-07 | 7.27E-06 | 7.43E-06 | 3.43E-06 | 1.49E-06 | 2.70E-06 |
| PST | Mirex | 6.77 | 4.34E-06 | 3.03E-06 | 2.20E-07 | 2.08E-06 | 2.31E-07 | 1.79E-07 | 1.30E-07 | 1.16E-07 | 1.79E-07 |
| PST | Oxychlordane | 6.21 | 1.66E-05 | 2.93E-05 | 4.22E-06 | 4.71E-05 | 2.75E-06 | 9.70E-06 | 9.25E-07 | 1.52E-05 | 3.83E-07 |
| PST | Pentachloroanisole | NA | | | | | | | | | |
| PST | Pentachlorobenzene | 5.17 | 4.82E-05 | 5.33E-05 | 6.98E-05 | 3.81E-05 | 1.10E-04 | 6.33E-05 | 4.08E-05 | 4.49E-05 | 7.17E-05 |
| PST | Trans-Nonachlor | 6.75 | 6.55E-06 | 3.17E-06 | 2.74E-06 | 7.24E-07 | 7.91E-07 | 1.69E-06 | 1.49E-06 | 1.62E-07 | 2.21E-07 |
| PST | 1,2,3,4-Tetrachlorobenzene | 4.53 | 4.20E-05 | 1.68E-04 | 4.22E-04 | 3.31E-04 | 1.19E-04 | 3.67E-05 | 4.88E-04 | 1.62E-04 | 1.35E-04 |
| PST | 1,2,4,5-Tetrachlorobenzene | 4.56 | 6.67E-04 | 1.05E-03 | 1.07E-03 | 1.34E-03 | 6.65E-04 | 9.27E-04 | 3.48E-03 | 3.40E-04 | 1.01E-03 |
| PST | o,p'-DDD | 6.00 | 3.17E-04 | 3.36E-04 | 7.65E-05 | 1.65E-04 | 2.08E-05 | 1.05E-04 | 7.61E-05 | 7.86E-05 | 1.43E-05 |
| PST | p,p'-DDD | 6.00 | 2.02E-05 | 2.52E-05 | 1.33E-05 | 1.09E-05 | 5.88E-06 | 9.66E-06 | 6.70E-06 | 2.10E-06 | 1.72E-05 |
| PST | o,p'-DDE | 6.65 | 9.05E-06 | 1.85E-05 | 7.48E-07 | 2.09E-06 | 2.03E-07 | 1.89E-07 | 4.10E-07 | 1.56E-07 | 1.79E-06 |
| PST | o,p'-DDT | 6.42 | 6.26E-05 | 5.85E-05 | 2.32E-05 | 3.12E-05 | 1.59E-05 | 3.49E-05 | 2.19E-05 | 2.10E-05 | 7.46E-06 |
| PST | p,p'-DDE | 6.65 | 2.42E-05 | 1.71E-05 | 1.13E-05 | 2.67E-06 | 6.80E-06 | 9.43E-06 | 6.15E-05 | 5.29E-06 | 2.64E-06 |
| PST | p,p'-DDT | 6.42 | 6.53E-05 | 8.18E-05 | 1.11E-05 | 2.34E-05 | 1.31E-05 | 1.09E-05 | 1.10E-05 | 8.73E-06 | 1.06E-05 |
| TOC | % TOC | | 1.40 | 1.14 | 1.74 | 1.95 | 2.23 | 2.40 | 3.31 | 2.18 | 2.40 |

Table A-2-2 4a (continued)

| #REF! | Analyte[1,3] | LogKoc[2] | R01-100B | R01-200B | R01-300B | R01-400B | R02-100B | R02-200B | R02-300B | R02-400B | R03-100B | R03-200B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | NA | 5.17 | 7.57 | 7.75 | 1.55 | 16.10 | 4.68 | 7.78 | 1.55 | 33.70 | 7.65 |
| MET | Cadmium | NA | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| MET | Chromium | NA | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| MET | Copper | NA | 7.10 | 5.70 | 7.00 | 3.70 | 3.20 | 1.50 | 4.10 | 1.50 | 1.50 | 8.10 |
| MET | Lead | NA | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 |
| MET | Mercury | NA | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 | 0.03 |
| MET | Nickel | NA | 2.50 | 2.50 | 6.00 | 2.50 | 2.50 | 5.00 | 2.50 | 2.50 | 2.50 | 2.50 |
| MET | Silver | NA | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| MET | Zinc | NA | 9.20 | 8.70 | 15.90 | 6.30 | 9.40 | 6.30 | 13.00 | 6.60 | 7.10 | 9.30 |
| MET | SEM-AVS | NA | -2.4 | -1.4 | -1.5 | -4.7 | -0.4 | -8.4 | -4.3 | -8.2 | 0.0 | -12.3 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 4.53 | 0.01 | 0.01 | 0.07 | 0.02 | 0.01 | 0.05 | 0.04 | 0.03 | 0.01 | 0.06 |
| PAH | 1-Methylnaphthalene (L) | 3.90 | 0.05 | 0.05 | 0.05 | 0.07 | 0.08 | 0.17 | 0.16 | 0.13 | 0.02 | 0.10 |
| PAH | 1-Methylphenanthrene (L) | 4.99 | 0.01 | 0.01 | 0.07 | 0.06 | 0.03 | 0.07 | 0.04 | 0.05 | 0.01 | 0.11 |
| PAH | 2,6-Dimethylnaphthalene (L) | 4.53 | 0.01 | 0.01 | 0.02 | 0.03 | 0.01 | 0.04 | 0.04 | 0.03 | 0.01 | 0.03 |
| PAH | 2-Methylnaphthalene (L) | 3.90 | 0.08 | 0.08 | 0.09 | 0.10 | 0.11 | 0.23 | 0.24 | 0.20 | 0.03 | 0.14 |
| PAH | Acenaphthene (L) | 3.85 | 0.08 | 0.05 | 0.08 | 0.31 | 0.15 | 0.52 | 0.27 | 0.19 | 0.02 | 0.44 |
| PAH | Acenaphthylene (L) | 3.98 | 0.25 | 0.19 | 0.28 | 0.81 | 0.41 | 0.80 | 0.91 | 0.72 | 0.03 | 0.45 |
| PAH | Anthracene (L) | 4.47 | 0.13 | 0.10 | 0.37 | 0.46 | 0.32 | 1.35 | 0.65 | 0.70 | 0.05 | 1.54 |
| PAH | Benzo(a)anthracene (H) | 5.60 | 0.02 | 0.01 | 0.06 | 0.05 | 0.05 | 0.15 | 0.12 | 0.07 | 0.01 | 0.16 |
| PAH | Benzo(a)pyrene (H) | 6.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.07 | 0.06 | 0.04 | 0.00 | 0.07 |
| PAH | Benzo(b)fluoranthene (H) | 6.09 | 0.01 | 0.01 | 0.02 | 0.02 | 0.03 | 0.05 | 0.05 | 0.03 | 0.00 | 0.05 |
| PAH | Benzo(b+k)fluoranthene (H) | 6.09 | 0.01 | 0.01 | 0.02 | 0.03 | 0.03 | 0.07 | 0.07 | 0.04 | 0.00 | 0.07 |
| PAH | Benzo(e)pyrene (H) | 6.01 | 0.01 | 0.00 | 0.01 | 0.02 | 0.02 | 0.03 | 0.03 | 0.02 | 0.00 | 0.03 |
| PAH | Benzo(g,h,i)perylene (H) | 6.59 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 |
| PAH | Benzo(k)fluoranthene (H) | 6.09 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | 0.01 | 0.00 | 0.02 |
| PAH | Biphenyl (L) | 3.89 | 0.03 | 0.03 | 0.04 | 0.05 | 0.03 | 0.08 | 0.07 | 0.06 | 0.01 | 0.05 |
| PAH | Chrysene (H) | 5.60 | 0.02 | 0.01 | 0.05 | 0.09 | 0.06 | 0.13 | 0.12 | 0.08 | 0.01 | 0.13 |
| PAH | Dibenz(a,h)anthracene (H) | 6.58 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| PAH | Fluoranthene (H) | 5.03 | 0.11 | 0.08 | 0.26 | 1.05 | 0.39 | 0.95 | 0.71 | 0.54 | 0.06 | 0.93 |
| PAH | Fluorene (L) | 4.14 | 0.09 | 0.05 | 0.21 | 0.48 | 0.15 | 0.55 | 0.38 | 0.31 | 0.03 | 0.56 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 6.54 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 |
| PAH | Naphthalene (L) | 3.30 | 0.62 | 0.40 | 0.63 | 0.75 | 0.59 | 1.64 | 1.59 | 1.37 | 0.19 | 1.28 |
| PAH | Perylene (H) | 5.95 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 |
| PAH | Phenanthrene (L) | 4.47 | 0.15 | 0.11 | 0.38 | 2.42 | 0.57 | 1.24 | 0.95 | 0.63 | 0.05 | 1.50 |
| PAH | Pyrene (H) | 5.02 | 0.11 | 0.08 | 0.24 | 0.75 | 0.33 | 0.89 | 0.63 | 0.49 | 0.05 | 0.79 |
| PAH | LMW PAHs | | 1.39 | 0.98 | 2.04 | 5.32 | 2.29 | 6.35 | 5.00 | 4.12 | 0.41 | 5.92 |
| PAH | HMW PAHs | | 0.27 | 0.19 | 0.64 | 1.96 | 0.87 | 2.19 | 1.64 | 1.22 | 0.13 | 2.09 |
| PAH | Total PAHs | | 1.66 | 1.18 | 2.67 | 7.28 | 3.16 | 8.53 | 6.64 | 5.34 | 0.53 | 8.00 |
| PCB | Total PCBs | | 0.001 | 0.003 | 0.003 | 0.002 | 0.002 | 0.023 | 0.003 | 0.003 | 0.001 | 0.005 |
| PST | Aldrin | 6.39 | 7.82E-07 | 2.76E-06 | 2.97E-06 | 1.46E-06 | 6.61E-07 | 2.22E-06 | 2.41E-06 | 1.35E-06 | 1.41E-05 | 1.00E-04 |
| PST | Alpha-BHC | 3.74 | 1.88E-04 | 1.63E-03 | 1.05E-03 | 6.56E-04 | 5.04E-04 | 8.53E-03 | 6.13E-04 | 1.20E-03 | 1.10E-03 | 2.38E-03 |
| PST | Alpha-chlordane | 6.39 | 3.54E-06 | 3.62E-06 | 4.66E-06 | 2.91E-06 | 8.19E-06 | 1.89E-05 | 1.43E-05 | 2.67E-06 | 5.14E-07 | 7.55E-06 |
| PST | Beta-BHC | 3.75 | 1.19E-03 | 3.99E-03 | 4.62E-03 | 2.03E-03 | 1.23E-03 | 3.05E-03 | 7.79E-03 | 1.93E-03 | 7.65E-04 | 2.83E-03 |
| PST | Chlorpyrifos | 5.17 | 6.21E-05 | 2.10E-04 | 1.93E-05 | 1.08E-04 | 5.08E-05 | 1.63E-04 | 1.80E-04 | 1.04E-04 | 6.39E-06 | 5.62E-05 |
| PST | CIS-Nonachlor | 6.75 | 2.62E-06 | 1.96E-06 | 1.01E-06 | 2.94E-06 | 1.05E-05 | 1.32E-05 | 7.06E-06 | 2.47E-06 | 4.01E-06 | 2.12E-06 |
| PST | Delta-BHC | 3.74 | 2.56E-04 | 8.08E-04 | 1.04E-03 | 4.33E-04 | 2.12E-04 | 6.49E-04 | 7.72E-04 | 4.33E-04 | 2.87E-04 | 1.68E-04 |
| PST | Dieldrin | 5.28 | 5.52E-05 | 4.15E-05 | 4.58E-05 | 4.38E-05 | 1.63E-04 | 4.51E-04 | 3.55E-05 | 1.97E-04 | 4.98E-06 | 1.70E-05 |
| PST | Endosulfan II | 4.03 | 1.95E-03 | 8.28E-04 | 1.07E-03 | 1.55E-03 | 2.04E-03 | 8.49E-03 | 2.49E-03 | 6.10E-04 | 2.35E-04 | 5.18E-04 |
| PST | Endrin | 4.97 | 4.61E-05 | 1.53E-04 | 1.82E-04 | 8.21E-05 | 3.88E-05 | 1.23E-04 | 1.33E-04 | 7.93E-05 | 3.01E-05 | 4.18E-05 |
| PST | Gamma-BHC (Lindane) | 3.67 | 1.68E-03 | 5.74E-03 | 6.46E-03 | 2.82E-03 | 1.38E-03 | 1.15E-03 | 1.79E-03 | 1.61E-03 | 1.63E-03 | 2.49E-03 |
| PST | Gamma-Chlordane | 6.21 | 3.29E-06 | 4.08E-06 | 3.50E-06 | 2.19E-06 | 2.80E-06 | 4.38E-06 | 7.15E-06 | 6.87E-06 | 8.79E-07 | 1.15E-06 |
| PST | Heptachlor | 6.15 | 8.97E-07 | 3.12E-06 | 1.00E-05 | 6.68E-06 | 1.92E-06 | 7.52E-06 | 2.22E-05 | 6.56E-06 | 2.55E-06 | 2.27E-06 |
| PST | Heptachlor epoxide | 4.92 | 1.10E-05 | 4.05E-05 | 5.21E-05 | 2.17E-05 | 8.32E-06 | 3.26E-05 | 3.04E-05 | 1.70E-05 | 7.67E-06 | 1.13E-05 |
| PST | Hexachlorobenzene | 5.79 | 2.28E-06 | 7.21E-06 | 9.26E-06 | 1.35E-05 | 5.18E-06 | 5.79E-06 | 5.40E-06 | 1.82E-03 | 1.56E-06 | 2.29E-06 |
| PST | Mirex | 6.77 | 1.53E-07 | 5.62E-07 | 7.23E-07 | 3.01E-07 | 1.15E-07 | 4.52E-07 | 4.21E-07 | 2.36E-07 | 1.06E-07 | 4.92E-06 |
| PST | Oxychlordane | 6.21 | 3.13E-07 | 6.81E-07 | 8.75E-07 | 3.65E-07 | 1.40E-06 | 3.94E-05 | 1.02E-06 | 5.73E-07 | 3.86E-07 | 2.81E-05 |
| PST | Pentachloroanisole | NA | | | | | | | | | | |
| PST | Pentachlorobenzene | 5.17 | 4.31E-05 | 1.87E-04 | 2.02E-04 | 8.43E-05 | 6.32E-05 | 1.20E-04 | 1.35E-04 | 1.20E-04 | 3.62E-05 | 1.12E-04 |
| PST | Trans-Nonachlor | 6.75 | 1.58E-06 | 7.84E-07 | 7.56E-07 | 2.10E-06 | 1.93E-06 | 5.99E-06 | 5.88E-07 | 2.97E-06 | 3.34E-07 | 2.61E-06 |
| PST | 1,2,3,4-Tetrachlorobenzene | 4.53 | 1.28E-04 | 4.57E-04 | 6.72E-04 | 2.45E-04 | 3.22E-04 | 5.25E-04 | 5.88E-04 | 3.84E-04 | 1.85E-05 | 1.77E-04 |
| PST | 1,2,4,5-Tetrachlorobenzene | 4.56 | 2.11E-05 | 2.68E-03 | 3.69E-03 | 5.56E-04 | 5.14E-04 | 9.31E-04 | 7.32E-04 | 6.16E-04 | 1.30E-04 | 6.61E-04 |
| PST | o,p'-DDD | 6.00 | 2.22E-05 | 1.57E-05 | 7.34E-06 | 2.28E-05 | 1.63E-06 | 3.42E-04 | 5.71E-05 | 8.10E-05 | 3.82E-05 | 2.57E-04 |
| PST | p,p'-DDD | 6.00 | 1.52E-05 | 3.36E-05 | 5.76E-05 | 4.86E-06 | 2.30E-06 | 7.29E-06 | 1.34E-05 | 1.98E-05 | 2.86E-06 | 2.33E-06 |
| PST | o,p'-DDE | 6.65 | 1.77E-07 | 5.03E-07 | 1.29E-06 | 2.69E-07 | 1.14E-06 | 3.96E-05 | 5.66E-07 | 3.17E-07 | 5.00E-07 | 1.05E-06 |
| PST | o,p'-DDT | 6.42 | 8.96E-06 | 7.62E-06 | 8.70E-06 | 1.18E-05 | 1.04E-05 | 2.38E-04 | 2.86E-05 | 1.49E-04 | 5.41E-06 | 2.82E-05 |
| PST | p,p'-DDE | 6.65 | 8.10E-06 | 5.53E-06 | 5.17E-06 | 7.54E-06 | 4.13E-06 | 3.07E-05 | 9.43E-06 | 2.03E-05 | 5.71E-06 | 7.23E-06 |
| PST | p,p'-DDT | 6.42 | 6.92E-06 | 6.77E-06 | 3.26E-06 | 7.25E-06 | 1.30E-05 | 1.22E-05 | 2.98E-05 | 4.27E-04 | 1.80E-06 | 1.29E-05 |
| TOC | % TOC | | 3.91 | 0.45 | 0.35 | 0.84 | 2.19 | 0.56 | 0.60 | 1.07 | 3.17 | 2.16 |

A-17

Table A-2-2 4a. (continued)

| #REF! | Analyte[1,3] | LogKoc[2] | R03-300B | R03-400B | R04-100B | R04-200B | R04-300B | R04-400B |
|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | NA | 1.55 | | 46 10 | 44 30 | | 26 80 |
| MET | Cadmium | NA | 0.50 | 0.50 | 0.50 | 0.50 | 0 50 | 0 50 |
| MET | Chromium | NA | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| MET | Copper | NA | 2.55 | 3 13 | 3 10 | 1 50 | 1 50 | 1 50 |
| MET | Lead | NA | 1 50 | 1.50 | 1 50 | 1.50 | 1 50 | 1 50 |
| MET | Mercury | NA | 0 03 | 0 03 | 0 03 | 0 03 | 0 03 | 0 03 |
| MET | Nickel | NA | 7 00 | 2.50 | 13 00 | 2.50 | 2.50 | 2.50 |
| MET | Silver | NA | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 | 2.50 |
| MET | Zinc | NA | 11 00 | 7 15 | 18 10 | 4 60 | 7 20 | 5 30 |
| MET | SEM-AVS | NA | -12.5 | -1 5 | 0 2 | -3 4 | -3 9 | -6 5 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 4.53 | 0 08 | 0 02 | 0.00 | 0 01 | 0 00 | 0 01 |
| PAH | 1-Methylnaphthalene (L) | 3 90 | 0.22 | 0 10 | 0 02 | 0.03 | 0 03 | 0 03 |
| PAH | 1-Methylphenanthrene (L) | 4 99 | 0 18 | 0.04 | 0 01 | 0.01 | 0 00 | 0 01 |
| PAH | 2,6-Dimethylnaphthalene (L) | 4.53 | 0.05 | 0.02 | 0.00 | 0.02 | 0 02 | 0 01 |
| PAH | 2-Methylnaphthalene (L) | 3.90 | 0 24 | 0 16 | 0 03 | 0 04 | 0 05 | 0 05 |
| PAH | Acenaphthene (L) | 3.85 | 1.07 | 0 33 | 0 04 | 0 03 | 0 04 | 0 04 |
| PAH | Acenaphthylene (L) | 3.98 | 0 44 | 0.42 | 0 09 | 0 09 | 0 10 | 0 17 |
| PAH | Anthracene (L) | 4 47 | 1.52 | 0 39 | 0 06 | 0 06 | 0 06 | 0 10 |
| PAH | Benzo(a)anthracene (H) | 5 60 | 0 13 | 0 08 | 0 01 | 0 00 | 0 00 | 0.01 |
| PAH | Benzo(a)pyrene (H) | 6 01 | 0 06 | 0 04 | 0 00 | 0 00 | 0 00 | 0 01 |
| PAH | Benzo(b)fluoranthene (H) | 6.09 | 0 04 | 0 03 | 0 00 | 0 00 | 0 00 | 0 01 |
| PAH | Benzo(b+k)fluoranthene (H) | 6 09 | 0.05 | 0 04 | 0 00 | 0 00 | 0 00 | 0 01 |
| PAH | Benzo(e)pyrene (H) | 6 01 | 0 03 | 0 02 | 0.00 | 0 00 | 0.00 | 0 00 |
| PAH | Benzo(g,h,i)perylene (H) | 6.59 | 0 01 | 0.01 | 0 00 | 0 00 | 0 00 | 0 00 |
| PAH | Benzo(k)fluoranthene (H) | 6 09 | 0 01 | 0 01 | 0 00 | 0 00 | 0 00 | 0 00 |
| PAH | Biphenyl (L) | 3 89 | 0 06 | 0 04 | 0 01 | 0 03 | 0 03 | 0 04 |
| PAH | Chrysene (H) | 5 60 | 0 11 | 0 08 | 0 01 | 0 01 | 0 01 | 0 01 |
| PAH | Dibenz(a,h)anthracene (H) | 6 58 | 0.00 | 0 00 | 0 00 | 0 00 | 0 00 | 0 00 |
| PAH | Fluoranthene (H) | 5 03 | 0 87 | 0 59 | 0 06 | 0 05 | 0 05 | 0 08 |
| PAH | Fluorene (L) | 4 14 | 0 90 | 0 26 | 0 03 | 0 04 | 0 03 | 0 06 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 6 54 | 0 01 | 0 01 | 0 00 | 0 00 | 0 00 | 0 00 |
| PAH | Naphthalene (L) | 3 30 | 1.53 | 1 15 | 0 23 | 0 30 | 0 42 | 0 39 |
| PAH | Perylene (H) | 5 95 | 0 01 | 0 01 | 0 00 | 0 00 | 0 00 | 0 00 |
| PAH | Phenanthrene (L) | 4 47 | 2 17 | 0 92 | 0 08 | 0 09 | 0 07 | 0 12 |
| PAH | Pyrene (H) | 5 02 | 0 88 | 0 52 | 0 05 | 0 05 | 0 05 | 0 08 |
| PAH | LMW PAHs | | 7 87 | 3 63 | 0 56 | 0 65 | 0 77 | 0 93 |
| PAH | HMW PAHs | | 2 06 | 1.31 | 0 13 | 0 11 | 0 11 | 0 19 |
| PAH | Total PAHs | | 9 93 | 4 94 | 0 69 | 0 76 | 0 88 | 1 12 |
| PCB | Total PCBs | | 0 006 | 0 003 | 0 002 | 0 003 | 0 005 | 0 002 |
| PST | Aldrin | 6 39 | 1 05E-04 | 1 54E-04 | 2 02E-05 | 2 04E-05 | 2 35E-05 | 4 50E-05 |
| PST | Alpha-BHC | 3 74 | 2.09E-03 | 2 40E-03 | 1 21E-03 | 6 13E-03 | 2 83E-03 | 1 90E-03 |
| PST | Alpha-chlordane | 6 39 | 2 82E-06 | 4 73E-06 | 1 85E-06 | 4 14E-06 | 6 27E-06 | 1 26E-05 |
| PST | Beta-BHC | 3 75 | 2.31E-03 | 1 02E-02 | 1 27E-03 | 8 98E-03 | 5 87E-03 | 5 58E-03 |
| PST | Chlorpyrifos | 5.17 | 5 68E-05 | 3 91E-05 | 5 45E-05 | 2 70E-04 | 3 11E-04 | 4 65E-05 |
| PST | CIS-Nonachlor | 6 75 | 2 18E-06 | 1 79E-06 | 6 24E-07 | 1 18E-06 | 2.71E-06 | 4 26E-06 |
| PST | Delta-BHC | 3 74 | 2.29E-04 | 2.63E-03 | 2 34E-04 | 1 21E-03 | 2 80E-03 | 1 25E-03 |
| PST | Dieldrin | 5 28 | 1 05E-05 | 1 30E-04 | 1 08E-05 | 5.35E-05 | 6 17E-05 | 5 53E-05 |
| PST | Endosulfan II | 4 03 | 1 15E-03 | 4 86E-03 | 1 79E-03 | 1 55E-03 | 1.79E-03 | 9 64E-04 |
| PST | Endrin | 4 97 | 4 20E-05 | 9 23E-05 | 4 02E-05 | 1 95E-04 | 2.24E-04 | 2 01E-04 |
| PST | Gamma-BHC (Lindane) | 3 67 | 1.55E-03 | 1.25E-03 | 1 09E-04 | 2.15E-03 | 3 31E-03 | 2 97E-03 |
| PST | Gamma-Chlordane | 6 21 | 1.23E-06 | 2.71E-06 | 3 40E-06 | 6.23E-06 | 7 07E-06 | 2.11E-06 |
| PST | Heptachlor | 6 15 | 3.65E-06 | 8.14E-06 | 3.37E-06 | 1 64E-05 | 1 89E-05 | 1 69E-05 |
| PST | Heptachlor epoxide | 4 92 | 1.20E-05 | 2.64E-05 | 9.21E-06 | 4.05E-05 | 7 01E-05 | 4 19E-05 |
| PST | Hexachlorobenzene | 5 79 | 2.05E-06 | 4 70E-06 | 2.09E-06 | 1.08E-05 | 1 25E-05 | 1 12E-05 |
| PST | Mirex | 6 77 | 4 34E-06 | 3.67E-07 | 1.28E-07 | 5.62E-07 | 9 73E-07 | 5 81E-07 |
| PST | Oxychlordane | 6.21 | 1 55E-05 | 3 11E-06 | 1.55E-06 | 7 15E-05 | 1 18E-06 | 1.06E-06 |
| PST | Pentachloroanisole | NA | | | | | | |
| PST | Pentachlorobenzene | 5 17 | 9 02E-05 | 6 85E-05 | 3.41E-05 | 1 35E-04 | 2.85E-04 | 9 31E-05 |
| PST | Trans-Nonachlor | 6.75 | 2.97E-06 | 1 28E-06 | 1 96E-06 | 2.35E-06 | 1 56E-05 | 9 12E-07 |
| PST | 1,2,3,4-Tetrachlorobenzene | 4.53 | 1 45E-04 | 8.94E-04 | 1.19E-04 | 1 96E-04 | 4 52E-04 | 8 61E-04 |
| PST | 1,2,4,5-Tetrachlorobenzene | 4.56 | 4.35E-04 | 2.27E-03 | 5 82E-04 | 2.75E-04 | 2.11E-04 | 9 47E-05 |
| PST | o,p'-DDD | 6 00 | 2.10E-04 | 1 75E-04 | 2.49E-05 | 6 72E-06 | 1 94E-05 | 3 82E-05 |
| PST | p,p'-DDD | 6 00 | 2.49E-06 | 4 09E-05 | 2.32E-06 | 1.21E-04 | 1 09E-04 | 6 60E-05 |
| PST | o,p'-DDE | 6 65 | 7 84E-07 | 2.30E-06 | 1 37E-06 | 7 54E-07 | 7 83E-06 | 7 80E-06 |
| PST | o,p'-DDT | 6 42 | 3 02E-05 | 2 54E-05 | 1 19E-05 | 2.54E-06 | 2.49E-05 | 3 55E-05 |
| PST | p,p'-DDE | 6 65 | 6 95E-06 | 1 11E-05 | 1 71E-05 | 4.53E-06 | 1 04E-05 | 1 01E-05 |
| PST | p,p'-DDT | 6 42 | 3 02E-05 | 2 32E-05 | 8 66E-06 | 3 81E-06 | 1 76E-05 | 6 57E-06 |
| TOC | % TOC | | 2 02 | 0 69 | 1 98 | 0 30 | 0 26 | 0 29 |

A-18

Table A-2-2 4b Concentrations of PCB congeners and Total PCBs in surface sediment pore water from Round 2 of the Portsmouth Naval Shipyard Investigation

| Class | Analyte | $Log_{10}Koc$ | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB | PCB101 | 6 27 | 3 40E-05 | 7 92E-05 | 3 91E-05 | 5 22E-05 | 8 01E-06 | 2 57E-05 | 6 51E-04 | 1 48E-04 | 1 36E-04 | 1 04E-03 | 3 90E-05 |
| PCB | PCB105 | 6 54 | 6 54E-06 | 2 15E-05 | 8 24E-06 | 1 89E-05 | 2 62E-06 | 2 29E-05 | 8 84E-05 | 3 89E-05 | 3 05E-05 | 1 31E-04 | 8 62E-06 |
| PCB | PCB118 | 6 63 | 1 37E-05 | 3 88E-05 | 2 41E-05 | 2.31E-05 | 4 85E-06 | 3 82E-05 | 3 26E-05 | 3 51E-05 | 3 79E-05 | 1 49E-04 | 1 48E-05 |
| PCB | PCB128 | 6 63 | 1 92E-05 | 2 13E-05 | 1 31E-05 | 8 70E-06 | 2 40E-06 | 1 55E-05 | 3 11E-05 | 1 59E-05 | 2 09E-05 | 4 82E-05 | 4 81E-06 |
| PCB | PCB138 | 6 71 | 1 67E-05 | 3 47E-05 | 2 01E-05 | 2 60E-05 | 5 96E-06 | 9 29E-06 | 5 51E-04 | 1 85E-04 | 9 82E-05 | 5 64E-04 | 1 71E-05 |
| PCB | PCB153 | 6 80 | 1 46E-05 | 2 00E-05 | 1 29E-05 | 1 54E-05 | 3 23E-06 | 2 92E-05 | 4 90E-04 | 1 28E-04 | 8 01E-05 | 4 32E-04 | 1 39E-05 |
| PCB | PCB170 | 7 15 | 1 48E-04 | 9.81E-05 | 6 01E-05 | 7 30E-05 | 1 38E-05 | 5 64E-06 | 1 07E-04 | 1 26E-04 | 7 09E-05 | 3 72E-05 | 1 15E-05 |
| PCB | PCB18 | 5 15 | 1 80E-05 | 1 53E-05 | 1 95E-04 | 1.64E-05 | 6 22E-06 | 2 18E-05 | 1 81E-05 | 2 03E-05 | 2 15E-05 | 8 12E-05 | 2 39E-05 |
| PCB | PCB180 | 7 24 | 2 72E-06 | 4 62E-06 | 3 35E-06 | 2 98E-06 | 7 31E-07 | 8 40E-06 | 8 39E-05 | 5 57E-05 | 2 25E-05 | 1 39E-04 | 3 64E-06 |
| PCB | PCB187 | 7 05 | 2 95E-06 | 3 27E-06 | 2 44E-06 | 3 04E-06 | 6 50E-07 | 6 76E-06 | 7 17E-05 | 6 85E-05 | 2 08E-05 | 1 74E-04 | 3 45E-06 |
| PCB | PCB195 | 7 43 | 2 57E-06 | 2.35E-06 | 9 35E-07 | 6 20E-07 | 1 47E-07 | 1 25E-06 | 4 15E-06 | 6 90E-06 | 2 04E-06 | 1 74E-05 | 3 08E-07 |
| PCB | PCB206 | 7 95 | 2 64E-07 | 2 36E-07 | 1 95E-07 | 1.45E-07 | 2 95E-08 | 2 68E-07 | 7 86E-07 | 3 52E-06 | 5 67E-07 | 1 09E-05 | 2 90E-08 |
| PCB | PCB209 | 8 04 | 1 10E-06 | 4 48E-07 | 1.59E-07 | 2 71E-07 | 9 62E-08 | 1 72E-07 | 4 96E-07 | 1 13E-06 | 3 87E-07 | 1 05E-05 | 1 75E-07 |
| PCB | PCB28 | 5 57 | 1 46E-04 | 9 32E-05 | 1 30E-04 | 2 61E-04 | 5 41E-05 | 9 17E-04 | 1 20E-04 | 2 81E-04 | 2 06E-04 | 2 36E-04 | 2 92E-04 |
| PCB | PCB44 | 5 65 | 6 43E-05 | 9 30E-05 | 7 70E-05 | 3 62E-05 | 8 82E-06 | 7 65E-05 | 4 28E-05 | 6 60E-05 | 3 93E-05 | 3 35E-04 | 4 52E-05 |
| PCB | PCB52 | 5 74 | 3 36E-05 | 2 40E-04 | 7 00E-05 | 7.35E-05 | 1 68E-05 | 2 06E-04 | 5 82E-04 | 3 13E-04 | 1 71E-04 | 8 03E-04 | 1 04E-04 |
| PCB | PCB66 | 6 09 | 2 28E-05 | 1 87E-05 | 3 87E-05 | 7 48E-06 | 3 89E-06 | 1 38E-05 | 9 02E-06 | 1 92E-05 | 2 26E-05 | 9.25E-05 | 8 37E-06 |
| PCB | PCB8 | 4 98 | 1 26E-03 | 7 68E-04 | 9 43E-04 | 3 18E-04 | 1 14E-04 | 7.49E-04 | 4 65E-05 | 1 99E-05 | 7 45E-05 | 1 38E-03 | 4 27E-04 |
| PCB | SUMPCB | | 1 81E-03 | 1 55E-03 | 1 64E-03 | 9 37E-04 | 2 47E-04 | 2 15E-03 | 2 93E-03 | 1 53E-03 | 1 06E-03 | 5 68E-03 | 1 02E-03 |
| PCB | TOTPCB | | 3 61E-03 | 3 11E-03 | 3 28E-03 | 1 87E-03 | 4 93E-04 | 4 29E-03 | 5 86E-03 | 3 06E-03 | 2 11E-03 | 0 01 | 2 03E-03 |
| TOC | % TOC | | 1.7 | 1 9 | 2 3 | 2 2 | 4 5 | 2 9 | 3 1 | 2 1 | 1.8 | 1.1 | 1 9 |

Units µg/L

SUMPCB = Sum of congener concentrations

TOTPCB = Total PCBs - SUMPCB x 2

1 - Porewater concentration (µg/L) = sediment concentration/(foc X $K_{oc}$) The foc=%TOC/100, sediment PCB congener concentrations reported in Table A-2 2b

2 - See Table A-2-2 1 for Koc values

Table A-2-2 4b (continued)

| Class | Analyte | $Log_{10}Koc$ | M04-300B | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB | PCB101 | 6 27 | 8 53E-05 | 7 33E-05 | 4 99E-05 | 5 96E-05 | 7 40E-05 | 3 58E-05 | 5 35E-05 | 9 28E-05 | 4 34E-05 | 9 39E-06 | 7 20E-04 |
| PCB | PCB105 | 6 54 | 7 15E-05 | 2 24E-05 | 1 11E-05 | 2 65E-05 | 2 28E-05 | 1 18E-05 | 1 45E-05 | 2 46E-05 | 3 09E-05 | 6 67E-06 | 1 45E-04 |
| PCB | PCB118 | 6 63 | 4 80E-05 | 3 31E-05 | 1 91E-05 | 3 04E-05 | 3 07E-05 | 1 47E-05 | 1 82E-05 | 4 11E-05 | 1 44E-05 | 4 00E-06 | 1 82E-04 |
| PCB | PCB128 | 6 63 | 3 05E-05 | 9 74E-06 | 2 81E-06 | 1 01E-05 | 7 05E-06 | 2 72E-06 | 1 05E-05 | 1 06E-05 | 3 61E-06 | 1 76E-06 | 6 15E-05 |
| PCB | PCB138 | 6 71 | 2 30E-04 | 3 56E-05 | 2 05E-05 | 2 76E-05 | 2 47E-05 | 1 85E-05 | 3 90E-06 | 4 14E-05 | 1 32E-05 | 1 50E-06 | 3 71E-04 |
| PCB | PCB153 | 6 80 | 2 19E-04 | 2 95E-05 | 1.47E-05 | 4 95E-05 | 1 84E-05 | 1 13E-05 | 1 00E-05 | 3 38E-05 | 7 60E-05 | 1 44E-05 | 3 33E-04 |
| PCB | PCB170 | 7 15 | 6 20E-05 | 5 31E-05 | 1 81E-05 | 5 50E-06 | 8 65E-06 | 1 37E-05 | 6 86E-06 | 2 04E-06 | 2 82E-06 | 1 30E-06 | 1 78E-05 |
| PCB | PCB18 | 5 15 | 3 89E-05 | 1 33E-04 | 2 24E-05 | 4 64E-05 | 6 46E-05 | 2 36E-05 | 8 15E-05 | 6 20E-04 | 2 87E-05 | 3 34E-05 | 6 25E-04 |
| PCB | PCB180 | 7.24 | 8 43E-05 | 6 24E-06 | 3 70E-06 | 4 99E-06 | 5 26E-06 | 2 70E-06 | 2 24E-06 | 3 56E-06 | 1 48E-06 | 5 31E-07 | 7 83E-05 |
| PCB | PCB187 | 7 05 | 7 39E-05 | 7 81E-06 | 3 64E-06 | 1 28E-05 | 8 37E-06 | 2 78E-06 | 3 61E-06 | 9 13E-06 | 3 50E-06 | 7 86E-07 | 7 48E-05 |
| PCB | PCB195 | 7 43 | 5 90E-06 | 1 18E-06 | 5 96E-07 | 1 69E-06 | 1 89E-06 | 3 90E-07 | 3 56E-07 | 2 72E-06 | 8 08E-07 | 2 75E-07 | 1 35E-05 |
| PCB | PCB206 | 7 95 | 1 78E-06 | 6 21E-07 | 6 14E-08 | 2 63E-07 | 4 74E-07 | 3 73E-08 | 1 39E-07 | 2 16E-06 | 2 69E-07 | 8 66E-08 | 8 15E-06 |
| PCB | PCB209 | 8 04 | 2 70E-07 | 5 67E-07 | 3 85E-07 | 4 16E-07 | 4 16E-07 | 4 79E-07 | 3 50E-07 | 3 39E-07 | 2 10E-07 | 3 99E-08 | 2 01E-06 |
| PCB | PCB28 | 5 57 | 5 41E-05 | 4 32E-04 | 3 39E-04 | 2 93E-04 | 2 95E-04 | 4 59E-04 | 2 36E-04 | 8 44E-04 | 1 62E-04 | 2 70E-05 | 8 21E-04 |
| PCB | PCB44 | 5 65 | 2 90E-05 | 2 44E-04 | 5 28E-05 | 3 50E-04 | 1 47E-04 | 2 66E-05 | 1 54E-04 | 2 09E-04 | 1 47E-04 | 7 22E-05 | 6 63E-04 |
| PCB | PCB52 | 5 74 | 5 00E-05 | 2 09E-04 | 2 38E-04 | 4 93E-05 | 1 51E-04 | 1 39E-04 | 2 79E-05 | 2 22E-04 | 7 00E-05 | 3 31E-05 | 1 05E-03 |
| PCB | PCB66 | 6 09 | 6 41E-06 | 2 59E-05 | 1 84E-05 | 1 38E-05 | 1 03E-05 | 1 42E-05 | 9 27E-06 | 6 97E-05 | 3 22E-05 | 5 43E-06 | 2 55E-04 |
| PCB | PCB8 | 4 98 | 6 46E-04 | 8 54E-04 | 1.05E-03 | 5 04E-04 | 5 96E-04 | 4 72E-04 | 9 77E-04 | 9 10E-04 | 1 58E-04 | 7 01E-06 | 7 48E-04 |
| PCB | SUMPCB | | 1 74E-03 | 2 17E-03 | 1 87E-03 | 1 49E-03 | 1 47E-03 | 1 25E-03 | 1 61E-03 | 3 14E-03 | 7 89E-04 | 2 19E-04 | 6 17E-03 |
| PCB | TOTPCB | | 3 47E-03 | 4 34E-03 | 3 74E-03 | 2 97E-03 | 2 93E-03 | 2 50E-03 | 3 22E-03 | 6 28E-03 | 1 58E-03 | 4 38E-04 | 0 01 |
| TOC | % TOC | | 0 7 | 2 0 | 2 4 | 0 7 | 0 5 | 2.1 | 0 5 | 1 0 | 2.0 | 1.5 | 1.0 |

Table A-2-2 4b (continued)

| Class | Analyte | $Log_{10}Koc$ | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB | PCB101 | 6 27 | 2 07E-04 | 5 94E-04 | 1 85E-04 | 1 78E-04 | 2 57E-04 | 1 05E-04 | 7 73E-05 | 4 27E-05 | 4 28E-05 | 6 11E-05 | 9 58E-04 |
| PCB | PCB105 | 6 54 | 4 63E-05 | 1 78E-04 | 5 09E-05 | 6 22E-05 | 8 60E-05 | 2 71E-05 | 2 15E-05 | 1 76E-05 | 1 46E-05 | 9 45E-06 | 1 71E-04 |
| PCB | PCB118 | 6 63 | 9 01E-05 | 9 34E-05 | 5 42E-05 | 6 17E-05 | 9 65E-05 | 3 65E-05 | 2 68E-05 | 2 74E-05 | 5 15E-05 | 1 26E-05 | 2 65E-04 |
| PCB | PCB128 | 6 63 | 2 47E-05 | 7 39E-05 | 2 52E-05 | 2 28E-05 | 3 90E-05 | 1 08E-05 | 1 11E-05 | 6 36E-06 | 7 62E-06 | 2 30E-06 | 6 01E-05 |
| PCB | PCB138 | 6 71 | 1 05E-04 | 8 33E-04 | 1 23E-04 | 8 28E-05 | 1 32E-04 | 4 87E-05 | 3 09E-05 | 2 18E-05 | 1 18E-05 | 5 52E-06 | 4 32E-04 |
| PCB | PCB153 | 6 80 | 1 45E-04 | 8 38E-04 | 1 09E-04 | 5 63E-05 | 8 46E-05 | 3 17E-05 | 3 08E-05 | 1 43E-05 | 8 22E-06 | 4 68E-05 | 2 00E-04 |
| PCB | PCB170 | 7 15 | 4 81E-06 | 4 52E-04 | 1.10E-04 | 1 78E-05 | 2 11E-05 | 4 33E-05 | 8 64E-05 | 1 13E-05 | 5 52E-05 | 4 89E-05 | 4 10E-05 |
| PCB | PCB18 | 5 15 | 2 60E-05 | 3 78E-04 | 2 44E-04 | 2 52E-04 | 4 71E-05 | 3 30E-04 | 2 26E-04 | 2 14E-05 | 3 07E-05 | 3 83E-05 | 1 11E-04 |
| PCB | PCB180 | 7 24 | 1 71E-05 | 3 15E-04 | 3 71E-05 | 1 62E-05 | 1 51E-05 | 1 11E-05 | 7 73E-06 | 1 77E-06 | 7 08E-06 | 1 21E-06 | 5 65E-05 |
| PCB | PCB187 | 7 05 | 1 76E-05 | 2 13E-04 | 3 52E-05 | 2 91E-05 | 1 99E-05 | 1 30E-05 | 9 78E-06 | 4 19E-06 | 3 66E-06 | 1 58E-06 | 8 68E-05 |
| PCB | PCB195 | 7 43 | 3 18E-06 | 1 83E-05 | 4 53E-06 | 2 11E-05 | 5 48E-06 | 5 88E-06 | 2 60E-06 | 4 06E-07 | 9 01E-07 | 3 81E-07 | 8 84E-06 |
| PCB | PCB206 | 7 95 | 1 92E-06 | 5 32E-06 | 2 55E-06 | 1 63E-05 | 3 92E-06 | 3 80E-06 | 1 44E-06 | 1 06E-07 | 5 24E-07 | 1 34E-07 | 5 74E-06 |
| PCB | PCB209 | 8 04 | 7 25E-07 | 8 89E-07 | 7 26E-07 | 3 57E-06 | 9 43E-07 | 1 40E-06 | 3 52E-07 | 1 30E-07 | 6 41E-07 | 1 38E-07 | 8 82E-07 |
| PCB | PCB28 | 5 57 | 3 11E-04 | 1 57E-04 | 2 55E-04 | 3 05E-04 | 2 22E-04 | 3 12E-04 | 1 88E-04 | 9 41E-05 | 6 96E-04 | 9 60E-05 | 3 19E-04 |
| PCB | PCB44 | 5 65 | 3 14E-04 | 2 67E-04 | 1 89E-04 | 2 23E-04 | 1.73E-04 | 8 32E-05 | 1 39E-04 | 2 83E-05 | 1 03E-04 | 1 11E-04 | 5.15E-04 |
| PCB | PCB52 | 5 74 | 3 56E-04 | 4 66E-04 | 2 12E-04 | 4.08E-04 | 4 03E-04 | 2 46E-04 | 9 93E-05 | 1 09E-04 | 1 37E-04 | 1 35E-04 | 1 23E-03 |
| PCB | PCB66 | 6 09 | 4 44E-05 | 9 59E-05 | 4 70E-05 | 5 74E-05 | 5 06E-05 | 3 34E-05 | 2 35E-05 | 1 07E-05 | 9 09E-05 | 9 64E-06 | 1 62E-04 |
| PCB | PCB8 | 4 98 | 3 37E-04 | 2 47E-04 | 8 83E-04 | 7 41E-04 | 7 30E-04 | 1 07E-03 | 2 31E-04 | 9 89E-05 | 2 53E-03 | 2 13E-04 | 8 52E-04 |
| PCB | SUMPCB | | 2 05E-03 | 5 23E-03 | 2 57E-03 | 2 55E-03 | 2 39E-03 | 2 41E-03 | 1 21E-03 | 5 10E-04 | 3 79E-03 | 7 93E-04 | 5 48E-03 |
| PCB | TOTPCB | | 4 11E-03 | 0 01 | 5 14E-03 | 5 11E-03 | 4 78E-03 | 4 82E-03 | 2 43E-03 | 1 02E-03 | 7 57E-03 | 1.59E-03 | 0 01 |
| TOC | % TOC | | 1 6 | 0 5 | 1 9 | 0 3 | 0 5 | 2 1 | 2 6 | 1 7 | 1 2 | 1.8 | 1 3 |

Table A-2-2 4b (continued)

| Class | Analyte | $Log_{10}Koc$ | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B | R01-100B | R01-200B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB | PCB101 | 6 27 | 1 38E-04 | 2 91E-04 | 7 53E-05 | 2 17E-05 | 4 32E-05 | 8 02E-05 | 3 55E-05 | 2 23E-05 | 1 36E-04 | 1 91E-05 | 2 26E-05 |
| PCB | PCB105 | 6 54 | 3 52E-05 | 7 74E-05 | 2 00E-05 | 8 19E-06 | 1 43E-05 | 1 93E-05 | 1 23E-05 | 7 99E-06 | 4 60E-05 | 5 72E-06 | 6 45E-06 |
| PCB | PCB118 | 6 63 | 8 12E-05 | 7 06E-05 | 2 65E-05 | 3 64E-05 | 2 34E-05 | 3 55E-05 | 2 43E-05 | 2 28E-05 | 5 52E-05 | 9 69E-06 | 1 00E-05 |
| PCB | PCB128 | 6 63 | 1 86E-05 | 4 78E-05 | 7 21E-06 | 5 71E-06 | 2 55E-06 | 8 58E-06 | 9 30E-06 | 5 86E-06 | 1 18E-05 | 2 24E-06 | 1 05E-06 |
| PCB | PCB138 | 6 71 | 5 52E-05 | 3 00E-04 | 3 77E-05 | 1 09E-05 | 2 60E-05 | 4 02E-05 | 2 16E-05 | 1 59E-05 | 3 86E-05 | 5 93E-06 | 8 15E-06 |
| PCB | PCB153 | 6 80 | 4 39E-05 | 3 21E-04 | 2 99E-05 | 8 89E-06 | 1 55E-05 | 3 08E-05 | 2 14E-05 | 9 39E-06 | 2 10E-05 | 6 85E-06 | 8 75E-06 |
| PCB | PCB170 | 7 15 | 3 21E-04 | 2 41E-04 | 9.17E-05 | 6 95E-05 | 2 88E-06 | 6 54E-05 | 2 80E-05 | 2 29E-05 | 2 53E-06 | 2 37E-06 | 1 59E-05 |
| PCB | PCB18 | 5 15 | 1 41E-03 | 4 21E-04 | 3 58E-04 | 5 79E-04 | 2 69E-05 | 5 59E-04 | 2 07E-04 | 1 62E-05 | 2 21E-05 | 1 99E-05 | 7 14E-05 |
| PCB | PCB180 | 7 24 | 1 50E-05 | 9 49E-05 | 9.03E-06 | 3 58E-06 | 4 44E-06 | 8 73E-06 | 3 52E-06 | 2 54E-06 | 2 91E-06 | 1 29E-06 | 9 70E-07 |
| PCB | PCB187 | 7 05 | 1 60E-05 | 8 40E-05 | 8 48E-06 | 1 65E-06 | 4 41E-06 | 8 95E-06 | 3 78E-06 | 1 64E-06 | 2 20E-06 | 1 26E-06 | 1 79E-06 |
| PCB | PCB195 | 7 43 | 5.81E-06 | 8.15E-06 | 1 36E-06 | 1 12E-06 | 8 13E-07 | 1 54E-06 | 9 61E-07 | 5 26E-07 | 2 78E-07 | 2 93E-07 | 3 29E-07 |
| PCB | PCB206 | 7 95 | 2 95E-06 | 1 61E-06 | 4 29E-07 | 1 32E-07 | 4 20E-07 | 6 50E-07 | 5 73E-07 | 1 94E-07 | 4 65E-08 | 9 41E-08 | 1 00E-07 |
| PCB | PCB209 | 8 04 | 1 04E-06 | 2 47E-07 | 3 92E-07 | 2 05E-07 | 5 71E-07 | 7 58E-07 | 2 50E-07 | 3 63E-07 | 1 63E-07 | 1 91E-07 | 3 84E-07 |
| PCB | PCB28 | 5 57 | 1 37E-03 | 3 98E-04 | 3 22E-04 | 1 37E-04 | 4 43E-04 | 5 56E-04 | 8 86E-05 | 1 71E-04 | 6 67E-05 | 1 98E-04 | 4 45E-04 |
| PCB | PCB44 | 5 65 | 5 25E-04 | 2 44E-04 | 6 20E-05 | 4 45E-05 | 4 69E-05 | 1 39E-04 | 4.30E-05 | 1 12E-05 | 1 48E-04 | 7 40E-05 | 4 45E-05 |
| PCB | PCB52 | 5 74 | 6 87E-04 | 2 71E-04 | 1 46E-04 | 1 21E-04 | 1 63E-04 | 2 27E-04 | 6 03E-05 | 4 58E-05 | 2 87E-04 | 2 09E-05 | 1 41E-04 |
| PCB | PCB66 | 6 09 | 2 87E-04 | 4 41E-05 | 1 46E-05 | 3 71E-06 | 1 98E-05 | 5 36E-05 | 4 37E-05 | 1 59E-05 | 3 68E-05 | 6 58E-06 | 1 07E-05 |
| PCB | PCB8 | 4 98 | 1.56E-03 | 2 14E-03 | 1 46E-04 | 4 42E-03 | 5 12E-04 | 7 78E-04 | 4 39E-04 | 1 05E-03 | 1 34E-04 | 1 11E-04 | 8 53E-04 |
| PCB | SUMPCB | | 6 57E-03 | 5 05E-03 | 1 36E-03 | 5 47E-03 | 1 35E-03 | 2 61E-03 | 1 04E-03 | 1 42E-03 | 1 01E-03 | 4 86E-04 | 1 64E-03 |
| PCB | TOTPCB | | 0 01 | 0 01 | 2 71E-03 | 0 01 | 2 70E-03 | 5 23E-03 | 2 09E-03 | 2 84E-03 | 2 02E-03 | 9 71E-04 | 3 28E-03 |
| TOC | % TOC | | 1 4 | 1 1 | 1 7 | 2.0 | 2 2 | 2 4 | 3 3 | 2 2 | 2 4 | 3 9 | 0 5 |

Table A-2-2 4b (continued)

| Class | Analyte | $Log_{10}Koc$ | R01-300B | R01-400B | R02-100B | R02-200B | R02-300B | R02-400B | R03-100B | R03-200B | R03-300B | R03-400B | R04-100B | R04-200B | R04-300B | R04-400B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB | PCB101 | 6 27 | 3 21E-05 | 2 04E-05 | 9 04E-06 | 2 01E-03 | 4 19E-05 | 7 00E-05 | 3 37E-07 | 2 01E-05 | 3 71E-05 | 3 26E-05 | 3 24E-05 | 8 20E-05 | 8 64E-05 | 4 98E-05 |
| PCB | PCB105 | 6 54 | 3 32E-06 | 6 57E-06 | 5 43E-06 | 6 22E-04 | 9 19E-06 | 1 98E-05 | 6 41E-07 | 5 64E-06 | 1 12E-05 | 4 63E-06 | 8 50E-06 | 3 87E-06 | 4 47E-06 | 5 00E-06 |
| PCB | PCB118 | 6 63 | 8 79E-06 | 1 44E-05 | 9 62E-06 | 9 30E-04 | 2 37E-05 | 3 32E-05 | 1 05E-06 | 2 85E-05 | 2 46E-05 | 1 51E-05 | 1 32E-05 | 6 31E-06 | 1 18E-05 | 1 14E-05 |
| PCB | PCB128 | 6 63 | 1 35E-06 | 1 41E-06 | 1 84E-06 | 2 11E-04 | 1 18E-06 | 5 97E-06 | 7 47E-06 | 1 21E-05 | 6 33E-06 | 2 06E-06 | 3 95E-06 | 1 58E-06 | 1 82E-06 | 3 27E-06 |
| PCB | PCB138 | 6 71 | 9 38E-06 | 1 26E-05 | 6 79E-06 | 6 21E-04 | 1 80E-05 | 3 25E-05 | 1 71E-06 | 2 15E-05 | 1 72E-05 | 1 26E-05 | 5 56E-06 | 9 66E-06 | 1 34E-05 | 9 99E-06 |
| PCB | PCB153 | 6 80 | 7 65E-06 | 8 06E-06 | 7 91E-06 | 3 38E-04 | 1 21E-05 | 2 94E-05 | 1 19E-06 | 8 02E-06 | 1 09E-05 | 7 76E-06 | 7 48E-06 | 6 83E-06 | 1 27E-05 | 1 03E-05 |
| PCB | PCB170 | 7 15 | 1 55E-05 | 4 12E-06 | 1 95E-06 | 6 18E-06 | 7.13E-06 | 3 60E-06 | 4 95E-06 | 3 30E-05 | 3 07E-05 | 8 06E-05 | 1 33E-05 | 1 40E-05 | 2 00E-05 | 2 31E-05 |
| PCB | PCB18 | 5 15 | 8 17E-05 | 3 40E-05 | 1 61E-05 | 5.11E-05 | 5 88E-05 | 3 30E-05 | 1 09E-04 | 1 80E-05 | 2 17E-04 | 7 88E-04 | 1 60E-04 | 2 59E-04 | 1 03E-03 | 8 64E-05 |
| PCB | PCB180 | 7 24 | 9 14E-07 | 2 08E-06 | 2 52E-06 | 2 49E-05 | 4 75E-06 | 5 38E-06 | 9 36E-07 | 2 96E-06 | 2 62E-06 | 2 45E-06 | 1 15E-06 | 9 70E-07 | 2 24E-07 | 1 61E-06 |
| PCB | PCB187 | 7 05 | 1 02E-06 | 1 49E-06 | 2 00E-06 | 1 12E-05 | 1 94E-06 | 5 85E-06 | 3 95E-07 | 2 11E-06 | 1 82E-06 | 2 07E-06 | 8 58E-07 | 3 88E-06 | 4 47E-06 | 2 78E-06 |
| PCB | PCB195 | 7.43 | 2 11E-07 | 5 29E-07 | 4 22E-07 | 1 59E-06 | 7 40E-07 | 1 76E-06 | 5 84E-08 | 1 13E-06 | 5 31E-07 | 6 97E-07 | 2 62E-07 | 2 47E-07 | 1 42E-07 | 2 55E-07 |
| PCB | PCB206 | 7 95 | 1 13E-07 | 9 29E-08 | 6 11E-08 | 9 95E-08 | 8 45E-08 | 7 09E-07 | 1 93E-08 | 1 55E-07 | 3 26E-07 | 5 74E-08 | 4 50E-08 | 1 32E-07 | 1 52E-07 | 1 92E-07 |
| PCB | PCB209 | 8 04 | 4 94E-07 | 3 68E-07 | 3 41E-07 | 1 79E-06 | 6 97E-07 | 8 50E-07 | 1 00E-07 | 1 39E-07 | 2 39E-07 | 4 09E-07 | 1 24E-07 | 2 73E-07 | 1 75E-07 | 9 41E-08 |
| PCB | PCB28 | 5 57 | 3 20E-04 | 3 18E-04 | 1 95E-04 | 4 72E-04 | 4 40E-04 | 3 99E-04 | 1 51E-05 | 2 22E-04 | 3 04E-04 | 1 35E-04 | 1 01E-04 | 3 20E-04 | 3 90E-04 | 1 10E-04 |
| PCB | PCB44 | 5 65 | 7 63E-05 | 3 44E-05 | 2 24E-05 | 1 23E-03 | 8 16E-05 | 5 62E-05 | 9 13E-06 | 1 03E-05 | 2 64E-05 | 6 77E-05 | 4 27E-05 | 5 94E-05 | 5 99E-05 | 5 37E-05 |
| PCB | PCB52 | 5 74 | 7 26E-05 | 4 97E-05 | 4 64E-04 | 2 53E-03 | 4 24E-04 | 3 05E-04 | 3 38E-05 | 1 18E-04 | 1 53E-04 | 1 58E-05 | 6 88E-06 | 3 33E-05 | 6 28E-05 | 1 00E-04 |
| PCB | PCB66 | 6 09 | 1 26E-05 | 5 74E-06 | 8 81E-06 | 4 45E-04 | 2 01E-05 | 1 58E-05 | 4 56E-06 | 1 53E-05 | 9 15E-06 | 1.40E-05 | 1 01E-05 | 2 68E-06 | 7 42E-05 | 2 77E-06 |
| PCB | PCB8 | 4 98 | 1 01E-03 | 3 70E-04 | 4 45E-04 | 2 22E-03 | 4 15E-04 | 3 30E-04 | 3 27E-04 | 1 78E-03 | 2 31E-03 | 1 05E-04 | 3 98E-04 | 5 19E-04 | 7 58E-04 | 2 86E-04 |
| PCB | SUMPCB | | 1 65E-03 | 8 84E-04 | 1 20E-03 | 0 01 | 1 56E-03 | 1 35E-03 | 5 18E-04 | 2 30E-03 | 3 16E-03 | 1 29E-03 | 8 06E-04 | 1 32E-03 | 2.53E-03 | 7 57E-04 |
| PCB | TOTPCB | | 3.30E-03 | 1.77E-03 | 2 40E-03 | 0 02 | 3 12E-03 | 2 70E-03 | 1 04E-03 | 4 59E-03 | 6 33E-03 | 2 57E-03 | 1 61E-03 | 2 65E-03 | 5 07E-03 | 1 51E-03 |
| TOC | % TOC | | 0 4 | 0 8 | 2 2 | 0 6 | 0 6 | 1 1 | 3 2 | 2 2 | 2 0 | 0 7 | 2.0 | 0.3 | 0 3 | 0 3 |

Table A-2-2.5 Hazard Quotients calculated for CoC concentrations in sediment pore water from the Portsmouth Naval Shipyard study area

| Class | Analyte[3] | WQSV[2] | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 36 00 | | 0 04 | 0 17 | 0 15 | 0 12 | | 0 10 | 0.04 | | 0 04 | | 0 04 |
| MET | Cadmium | 9 30 | | 0 05 | 0 05 | 0 05 | 0.05 | | 0 05 | 0 05 | | 0 05 | | 0 05 |
| MET | Chromium | 50 00 | | 0 05 | 0 05 | 0.05 | 0 05 | | 0 05 | 0 05 | | 0 05 | | 0 05 |
| MET | Copper | 3 10 | | 1 81 | 0 48 | 0.90 | 0 71 | | 0 48 | 0 71 | | 1 29 | | 153 |
| MET | Lead | 8 10 | | 0 19 | 0 19 | 0 19 | 0 19 | | 0 19 | 0 19 | | 0 19 | | 0 19 |
| MET | Mercury | 0 94 | | 0 03 | 0 03 | 0.03 | 0 03 | | 0 03 | 0 03 | | 0 03 | | 0 03 |
| MET | Nickel | 8 20 | | 0 85 | 0 30 | 0 30 | 0 30 | | 0 30 | 1 22 | | 3 29 | | 0.73 |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | 81 00 | | 0 10 | 0 17 | 0 07 | 0 06 | | 0 05 | 0 10 | | 0 08 | | 0 11 |
| MET | SEM-AVS | 5 00 | -4 79 | 0 24 | -6 87 | -5.21 | -0 29 | -0 21 | -10 06 | -3 18 | -3 61 | -0 11 | -2 18 | 0 24 |
| PAH | 2-Methylnaphthalene (L) | 0 88 | 0 34 | 0 60 | 1 39 | 0 16 | 0 07 | 0 11 | 0 17 | 0.20 | 0 21 | 1 61 | 0 13 | 0 07 |
| PAH | Acenaphthene (L) | 710 | 3 16E-04 | 1 13E-03 | 4 28E-03 | 1 64E-04 | 6.91E-05 | 1.59E-04 | 7 15E-04 | 4 45E-04 | 4 94E-04 | 1 04E-03 | 1 44E-04 | 1 12E-04 |
| PAH | Acenaphthylene (L) | 0 46 | 3.85 | 1.92 | 3.74 | 0 84 | 0 38 | 0 55 | 1.04 | 0 85 | 1.11 | 6.94 | 0 73 | 0 31 |
| PAH | Anthracene (L) | 0 29 | 1.87 | 3.81 | 8.19 | 1 04 | 0 49 | 0 65 | 2.33 | 1 58 | 1 60 | 7.42 | 0 98 | 0 42 |
| PAH | Benzo(a)anthracene (H) | 0 07 | 1 00 | 2.53 | 3.59 | 0.57 | 0 28 | 0 30 | 1 16 | 0.95 | 0 97 | 4.03 | 0 50 | 0 20 |
| PAH | Benzo(a)pyrene (H) | 0 04 | 0.99 | 1 89 | 2.59 | 0 42 | 0 17 | 0.26 | 0 75 | 0 66 | 0 73 | 2 31 | 0 39 | 0 16 |
| PAH | Biphenyl (L) | 14 07 | 8 36E-03 | 9 62E-03 | 0 03 | 2.70E-03 | 8 53E-04 | 2.28E-03 | 2.97E-03 | 2.98E-03 | 4 09E-03 | 0 01 | 2.84E-03 | 1 45E-03 |
| PAH | Chrysene (H) | 0 10 | 1.24 | 1.50 | 2.09 | 0 39 | 0 17 | 0.27 | 0 81 | 0 66 | 0 68 | 2.65 | 0 29 | 0 17 |
| PAH | Dibenz(a,h)anthracene (H) | 1 68E-03 | 1.35 | 2 61 | 2 40 | 0 46 | 0 18 | 0 25 | 0 83 | 0 91 | 0 91 | 3 80 | 0 40 | 0 17 |
| PAH | Fluoranthene (H) | 16 00 | 0 04 | 0 05 | 0 10 | 0 01 | 7 52E-03 | 0 01 | 0 03 | 0 03 | 0 02 | 0 09 | 0 01 | 7.52E-03 |
| PAH | Fluorene (L) | 0 14 | 5 69 | 5 07 | 21 34 | 1 00 | 0.40 | 0.71 | 2 97 | 1 98 | 2 16 | 7.31 | 1.02 | 0 32 |
| PAH | Naphthalene (L) | 633 | 1 87E-03 | 4.82E-03 | 0 02 | 1.25E-03 | 5 35E-04 | 1 14E-03 | 1 65E-03 | 1 49E-03 | 2.13E-03 | 0 01 | 1 31E-03 | 3 87E-04 |
| PAH | Phenanthrene (L) | 4 60 | 0 67 | 0 41 | 1.08 | 0.06 | 0 03 | 0.08 | 0.21 | 0 15 | 0 13 | 0 45 | 0 05 | 0 03 |
| PAH | Pyrene (H) | 0 63 | 1.65 | 1.11 | 2.39 | 0 33 | 0 17 | 0 26 | 0 73 | 0 61 | 0 57 | 2.00 | 0 36 | 0 16 |
| PAH | LMW PAHs | 5 76 | 1.37 | 1.56 | 4.53 | 0 37 | 0 17 | 0.32 | 0 73 | 0 56 | 0 65 | 3.08 | 0 35 | 0 14 |
| PAH | HMW PAHs | 0 42 | 4.41 | 4.34 | 8.63 | 1 16 | 0 64 | 0 97 | 2 80 | 2 26 | 2.07 | 7.95 | 1 17 | 0 61 |
| PAH | Total PAHs | 6.49 | 1 50 | 1 66 | 4 59 | 0 40 | 0 19 | 0 35 | 0 83 | 0 65 | 0 71 | 3 26 | 0 39 | 0 17 |
| PCB | Total PCBs | 0 03 | 0 12 | 0.10 | 0 11 | 0 06 | 0 02 | 0 14 | 0 20 | 0 10 | 0 07 | 0 38 | 0.07 | 0 12 |
| PST | Aldrin | 0 16 | 4 20E-06 | 3 65E-06 | 2.19E-04 | 3 97E-06 | 1 46E-06 | 8.27E-05 | 4 02E-06 | 4 74E-06 | 5 20E-06 | 6 10E-06 | 5 81E-06 | 9 09E-06 |
| PST | Alpha-BHC | 0 16 | 0 01 | 7 90E-03 | 6 88E-03 | 6.95E-03 | 2.28E-03 | 2.37E-03 | 7 36E-03 | 0 03 | 0 02 | 0 02 | 0 02 | 0 01 |
| PST | Alpha-chlordane | 4 00E-03 | 0 02 | 0 09 | 6 78E-03 | 2.84E-03 | 1 19E-03 | 1 09E-03 | 1 83E-03 | 3 17E-03 | 2 98E-03 | 0 01 | 6 37E-04 | 1 92E-03 |
| PST | Beta-BHC | 0 16 | 0 03 | 5 35E-03 | 0.06 | 0 02 | 0 02 | 0 04 | 0 11 | 0 05 | 0 06 | 9 44E-03 | 0 18 | 0 07 |
| PST | Chlorpyrifos | 5 60E-03 | 9 75E-03 | 8.29E-03 | 8 68E-03 | 8 97E-03 | 3 32E-03 | 0 03 | 9 65E-03 | 0 01 | 0 01 | 0 01 | 0 01 | 0.02 |
| PST | CIS-Nonachlor | 3 99E-05 | 0 31 | 0 42 | 0 06 | 0 04 | 0 02 | 0 38 | 0 24 | 0 08 | 0 06 | 0 21 | 0 04 | 0 64 |
| PST | Delta-BHC | 0 16 | 1 97E-03 | 1 23E-03 | 2.52E-03 | 3 17E-03 | 7 50E-04 | 5 85E-03 | 1 44E-03 | 8 15E-03 | 8 16E-03 | 2.06E-03 | 0 02 | 8 23E-03 |
| PST | Dieldrin | 1 90E-03 | 0 12 | 3.08 | 0 11 | 3 86E-03 | 0 04 | 0 08 | 0 12 | 0 20 | 0 03 | 7 60E-03 | 8 65E-03 | 0 04 |
| PST | Endosulfan II | 8 70E-03 | 2 72 | 1 81 | 0.97 | 0 60 | 0.28 | 0 59 | 0 72 | 0 44 | 0 95 | 1 61 | 0 38 | 0.25 |
| PST | Endrin | 2.30E-03 | 0 03 | 0 22 | 0 03 | 0 02 | 6 10E-03 | 0 02 | 0 02 | 0 02 | 0 02 | 0 02 | 0 02 | 0 04 |
| PST | Gamma-BHC (Lindane) | 0 16 | 0 04 | 0 04 | 0 02 | 8 76E-03 | 6 23E-03 | 0 01 | 0 02 | 0 02 | 0 02 | 0 02 | 4 91E-03 | 0 02 |
| PST | Gamma-Chlordane | 4 00E-03 | 0 01 | 0 12 | 8 51E-04 | 7 12E-04 | 6 07E-04 | 2 26E-03 | 2 16E-03 | 1.91E-03 | 2.03E-03 | 7 32E-03 | 1 20E-03 | 1 33E-03 |
| PST | Heptachlor | 3 60E-03 | 4.28E-03 | 7 73E-03 | 1 99E-03 | 7 25E-04 | 5 15E-04 | 1 74E-03 | 4 25E-03 | 4 76E-03 | 2 91E-03 | 0 01 | 1 32E-03 | 5 65E-04 |
| PST | Heptachlor epoxide | 3 60E-03 | 2.83E-03 | 2.41E-03 | 2.69E-03 | 2.67E-03 | 1 00E-03 | 3 42E-03 | 2.81E-03 | 3 23E-03 | 3 45E-03 | 4 18E-03 | 3 96E-03 | 6 12E-03 |
| PST | Hexachlorobenzene | 129 | 7.26E-09 | 4 65E-08 | 2.23E-08 | 4 09E-08 | 1 11E-08 | 1 90E-08 | 1 61E-08 | 5 41E-08 | 3 47E-08 | 8 90E-08 | 2 19E-08 | 1 82E-07 |
| PST | Mirex | 1 00E-03 | 5.46E-03 | 0 01 | 6 43E-03 | 1 80E-03 | 1 49E-04 | 4 81E-03 | 3 24E-04 | 2 34E-03 | 3 73E-04 | 2.39E-03 | 3 51E-04 | 3 05E-04 |
| PST | Oxychlordane | 4 00E-03 | 5.75E-03 | 9 72E-03 | 5 06E-03 | 2 85E-04 | 2.02E-04 | 4 21E-04 | 6 38E-04 | 2 34E-03 | 6 77E-04 | 8 81E-03 | 2 15E-03 | 1 44E-04 |
| PST | Pentachlorobenzene | 129 | 3 93E-07 | 4 70E-07 | 5 91E-07 | 4 14E-07 | 8 06E-08 | 1 11E-06 | 4 53E-07 | 3 75E-07 | 8 38E-07 | 5 09E-07 | 5 45E-07 | 6 06E-07 |
| PST | Trans-Nonachlor | 3 99E-05 | 0 28 | 1 29 | 0 14 | 0 06 | 0 03 | 0 09 | 0 06 | 0 04 | 0 01 | 0 18 | 9 22E-03 | 0 17 |
| PST | 1,2,3,4-Tetrachlorobenzene | 129 | 1.32E-07 | 3 01E-06 | 9 09E-07 | 2.22E-06 | 9.03E-07 | 2.58E-06 | 6 57E-06 | 5 56E-06 | 1 89E-05 | 6 45E-06 | 1 30E-06 | 1 39E-05 |
| PST | 1,2,4,5-Tetrachlorobenzene | 129 | 6 64E-06 | 3 83E-06 | 4 11E-06 | 4.55E-06 | 1 73E-06 | 1 46E-05 | 1 23E-05 | 6 52E-06 | 1 88E-05 | 2.26E-05 | 1 33E-05 | 4.93E-06 |
| PST | o,p'-DDD | 0 84 | 8 35E-04 | 3 69E-03 | 9 66E-04 | 1 01E-04 | 8 75E-05 | 5 38E-05 | 3 01E-04 | 1 84E-04 | 2 00E-04 | 1 70E-03 | 1 07E-04 | 2.27E-03 |
| PST | p,p'-DDD | 0 84 | 2.71E-05 | 1.40E-04 | 2.54E-05 | 1 06E-05 | 6 36E-06 | 5 79E-05 | 2.70E-06 | 3 17E-06 | 3 33E-06 | 6 71E-05 | 4 45E-05 | 5 93E-04 |
| PST | o,p'-DDE | 3.26 | 6 43E-06 | 9 19E-05 | 2.53E-05 | 4 53E-07 | 3.52E-06 | 2.01E-06 | 6 01E-06 | 1.63E-06 | 8 06E-07 | 1 17E-05 | 5 97E-08 | 3 42E-04 |
| PST | o,p'-DDT | 1 00E-03 | 0 40 | 3 08 | 0 73 | 0 04 | 0 05 | 0 05 | 0.24 | 0 09 | 0 09 | 1 28 | 0 02 | 1 55 |
| PST | p,p'-DDE | 3 26 | 1.21E-05 | 2.17E-04 | 1.80E-05 | 3 88E-06 | 7 96E-06 | 2.39E-05 | 1 18E-05 | 9 98E-06 | 6 91E-06 | 6 77E-05 | 1 85E-06 | 1 39E-03 |
| PST | p,p'-DDT | 1 00E-03 | 0 06 | 3 83 | 0.60 | 0 02 | 0 08 | 0 02 | 0 07 | 0 02 | 0 03 | 0 07 | 0 01 | 9 60 |
| TOC | % TOC | | 1 73 | 1 89 | 2.26 | 2.15 | 4 54 | 2.91 | 3 12 | 2.09 | 1 81 | 1 13 | 1 92 | 0 69 |

1 - For organics, Hazard Quotients calculated as EqP-calculated pore water concentration (Table A-2-2.4a)/(WQSV)

For metals, hazard Quotients calculated as pore water concentration (Table A-2-2.4a)/(WQSV).

2 - Water Quality Screening Value (Table 2.2-1)

3 - List includes only analytes for which WQSV values are available

Shaded values indicate TEV-HQ>1

Units: PW-HQ = unitless

Table A-2-2 5 (continued)

| Class | Analyte[3] | WQSV[2] | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 36.00 | 0.04 | 0 23 | | 0 13 | | 1 34 | 0 13 | | | 0 04 | | |
| MET | Cadmium | 9 30 | 0.05 | 0 05 | | 0.05 | | 0 05 | 0 05 | | | 0 05 | | |
| MET | Chromium | 50 00 | 0 05 | 0 05 | | 0 05 | | 0 05 | 0 05 | | | 0 05 | | |
| MET | Copper | 3 10 | 0 48 | 0 48 | | 0 48 | | 0 48 | 0 48 | | | 0 48 | | |
| MET | Lead | 8 10 | 0 19 | 0 19 | | 0 19 | | 0 19 | 0.19 | | | 0 19 | | |
| MET | Mercury | 0 94 | | 0 03 | | 0 03 | | 0 03 | 0 03 | | | 0.03 | | |
| MET | Nickel | 8 20 | 0 30 | 0 30 | | 0 30 | | 1.59 | 0 30 | | | 0 73 | | |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | 81 00 | 0 06 | 0 05 | | 0 05 | | 0 11 | 0 06 | | | 0 05 | | |
| MET | SEM-AVS | 5 00 | -11 35 | -10 23 | -0 24 | -0.55 | -7 25 | 0 03 | -1 85 | -7 25 | -7 44 | -3 41 | -7 30 | 0 99 |
| PAH | 2-Methylnaphthalene (L) | 0 88 | 0 18 | 0 23 | 0 29 | 0 23 | 0 17 | 0 07 | 0 13 | 0 15 | 0.11 | 0 37 | 0 28 | 0 40 |
| PAH | Acenaphthene (L) | 710 | 4 09E-04 | 2.73E-04 | 6 45E-04 | 6 93E-04 | 1 70E-04 | 1 78E-04 | 2 40E-04 | 2.21E-04 | 1 48E-04 | 7 76E-04 | 5 30E-04 | 5 52E-04 |
| PAH | Acenaphthylene (L) | 0 46 | 1.13 | 0 78 | 1.84 | 1.28 | 1.06 | 0 20 | 0 71 | 0 85 | 0 86 | 1.46 | 1.24 | 2.52 |
| PAH | Anthracene (L) | 0 29 | 2 01 | 1 35 | 2.38 | 2.19 | 1 04 | 0 43 | 1 10 | 1.00 | 0 52 | 2.54 | 1.99 | 4.97 |
| PAH | Benzo(a)anthracene (H) | 0 07 | 0 96 | 0 67 | 1.34 | 2.19 | 0 86 | 0 25 | 0 70 | 0 52 | 0 24 | 1.26 | 0 98 | 2.18 |
| PAH | Benzo(a)pyrene (H) | 0 04 | 0 65 | 0 47 | 1 15 | 2 15 | 0 72 | 0 19 | 0 57 | 0 45 | 0 20 | 0 84 | 0 83 | 1 17 |
| PAH | Biphenyl (L) | 14 07 | 3 99E-03 | 2.94E-03 | 5 32E-03 | 5 22E-03 | 2.98E-03 | 2.10E-03 | 2.50E-03 | 2.81E-03 | 1 90E-03 | 6 38E-03 | 4 46E-03 | 4 55E-03 |
| PAH | Chrysene (H) | 0.10 | 0 74 | 0 49 | 0 94 | 2.14 | 0 57 | 0 17 | 0 52 | 0 37 | 0 15 | 1.03 | 0 73 | 1.77 |
| PAH | Dibenz(a,h)anthracene (H) | 1 68E-03 | 0 64 | 0 46 | 1.10 | 2 34 | 0 67 | 0 17 | 0 56 | 0 40 | 0 16 | 1.13 | 0 85 | 1.38 |
| PAH | Fluoranthene (H) | 16 00 | 0 03 | 0 02 | 0 03 | 0 08 | 0 01 | 8 94E-03 | 0 02 | 0 02 | 7 16E-03 | 0 03 | 1 85E-03 | 0 09 |
| PAH | Fluorene (L) | 0 14 | 2 24 | 1 96 | 2 80 | 3 87 | 1.22 | 0 72 | 1.22 | 1 12 | 0 79 | 2.82 | 2 48 | 2.31 |
| PAH | Naphthalene (L) | 633 | 1 78E-03 | 1 46E-03 | 2.65E-03 | 2.14E-03 | 1 66E-03 | 5 89E-04 | 1 31E-03 | 1 44E-03 | 1 14E-03 | 2 54E-03 | 2 76E-03 | 2.07E-03 |
| PAH | Phenanthrene (L) | 4 60 | 0 13 | 0 10 | 0 19 | 0 40 | 0 06 | 0 05 | 0 10 | 0 08 | 0 04 | 0 18 | 0 16 | 0 28 |
| PAH | Pyrene (H) | 0 63 | 0 71 | 0 41 | 0 81 | 1 67 | 0 37 | 0 20 | 0 48 | 0 38 | 0 18 | 0 89 | 0 66 | 2.14 |
| PAH | LMW PAHs | 5 76 | 0 62 | 0 49 | 0 90 | 0 98 | 0 44 | 0 19 | 0 41 | 0 41 | 0 30 | 0 88 | 0 80 | 1.08 |
| PAH | HMW PAHs | 0 42 | 2 63 | 1.52 | 2.99 | 6.60 | 1 36 | 0 73 | 1 76 | 1.37 | 0 63 | 3 13 | 1 46 | 7.55 |
| PAH | Total PAHs | 6 49 | 0.72 | 0 53 | 0 99 | 1 30 | 0 48 | 0.22 | 0 48 | 0 46 | 0 31 | 0 99 | 0 80 | 1.45 |
| PCB | Total PCBs | 0 03 | 0 14 | 0.12 | 0 10 | 0 10 | 0 08 | 0 11 | 0 21 | 0 05 | 0 01 | 0 41 | 0 14 | 0 35 |
| PST | Aldrin | 0 16 | 1 00E-05 | 5 21E-06 | 1 09E-05 | 1 55E-05 | 5 70E-06 | 1 35E-05 | 7 55E-06 | 6 37E-06 | 1 02E-05 | 6 75E-06 | 3 08E-06 | 3.28E-05 |
| PST | Alpha-BHC | 0 16 | 0 01 | 0 01 | 0 02 | 7 94E-03 | 0 01 | 6 63E-03 | 0 01 | 4 08E-03 | 3 10E-03 | 0 02 | 7 05E-03 | 0 01 |
| PST | Alpha-chlordane | 4 00E-03 | 3 61E-03 | 1 12E-03 | 3 49E-03 | 5 85E-03 | 1.27E-03 | 2 35E-03 | 2.50E-03 | 1 55E-03 | 4 82E-04 | 0 03 | 2 88E-03 | 0 04 |
| PST | Beta-BHC | 0 16 | 0 14 | 0 15 | 0 19 | 0 02 | 0 07 | 0 02 | 0 06 | 0 11 | 0 11 | 0 07 | 0 13 | 0 03 |
| PST | Chlorpyrifos | 5 60E-03 | 0 04 | 0 01 | 0 02 | 0 03 | 0 01 | 0 03 | 0 02 | 0 01 | 0 02 | 0 02 | 0 01 | 0 02 |
| PST | CIS-Nonachlor | 3 99E-05 | 0 07 | 0 04 | 0 25 | 0 12 | 0 05 | 0 14 | 0 07 | 0 03 | 0 04 | 0 31 | 0 09 | 0 46 |
| PST | Delta-BHC | 0 16 | 2.83E-03 | 1 76E-03 | 9 74E-03 | 7 25E-03 | 1 93E-03 | 4 37E-03 | 2 55E-03 | 2.25E-03 | 3 07E-03 | 1 09E-03 | 0 01 | 3 49E-03 |
| PST | Dieldrin | 1 90E-03 | 0 03 | 1 17E-04 | 0 09 | 0 10 | 2.65E-03 | 0 03 | 0 11 | 9 84E-03 | 0 02 | 0 25 | 0 05 | 0 14 |
| PST | Endosulfan II | 8 70E-03 | 0 85 | 0 54 | 1.33 | 1.69 | 0 51 | 0 31 | 0 68 | 0 45 | 0 13 | 1.34 | 1.25 | 2 89 |
| PST | Endrin | 2 30E-03 | 0 02 | 0 02 | 0 05 | 0 06 | 0 02 | 0 06 | 0 03 | 0 03 | 0 03 | 0 07 | 0 03 | 0 04 |
| PST | Gamma-BHC (Lindane) | 0 16 | 0 02 | 0 03 | 0 06 | 0 04 | 0 02 | 0 03 | 0 01 | 8 20E-03 | 0 02 | 0 02 | 0 02 | 0.05 |
| PST | Gamma-Chlordane | 4.00E-03 | 2.98E-03 | 1 56E-03 | 1 09E-03 | 2.61E-03 | 8 06E-04 | 8 84E-04 | 3 75E-03 | 1 17E-03 | 3 10E-04 | 0 06 | 2 25E-03 | 0 06 |
| PST | Heptachlor | 3 60E-03 | 2.92E-04 | 1 16E-03 | 3 90E-03 | 2.07E-03 | 1 26E-03 | 3 37E-03 | 1 69E-03 | 1 58E-03 | 1 78E-03 | 2 25E-03 | 2 03E-03 | 4.29E-03 |
| PST | Heptachlor epoxide | 3 60E-03 | 4 04E-03 | 3 50E-03 | 7 48E-03 | 0 01 | 3 80E-03 | 9 09E-03 | 5 00E-03 | 3 43E-03 | 5 36E-03 | 4 54E-03 | 4 25E-03 | 6 81E-03 |
| PST | Hexachlorobenzene | 129 | 1 04E-06 | 1 94E-08 | 4.13E-08 | 5 35E-08 | 3.01E-08 | 5 08E-08 | 2 82E-08 | 5 10E-08 | 2 97E-08 | 1 69E-07 | 2 39E-08 | 2.65E-07 |
| PST | Mirex | 1 00E-03 | 1 51E-03 | 2 00E-03 | 2.65E-03 | 7 53E-03 | 2.02E-03 | 4 54E-04 | 2 24E-03 | 2 23E-03 | 2 68E-04 | 3 24E-03 | 1 97E-03 | 3 87E-03 |
| PST | Oxychlordane | 4 00E-03 | 1 72E-03 | 2.60E-04 | 1 75E-03 | 3 58E-03 | 2 93E-04 | 5 01E-03 | 1 25E-03 | 1 01E-04 | 1 19E-04 | 3 98E-03 | 9 40E-04 | 4 01E-03 |
| PST | Pentachlorobenzene | 129 | 6 65E-07 | 4 21E-07 | 2.47E-06 | 1 00E-06 | 5 01E-07 | 9 05E-07 | 1 12E-06 | 4 25E-07 | 1 77E-07 | 1 06E-06 | 3 85E-07 | 1 34E-06 |
| PST | Trans-Nonachlor | 3 99E-05 | 0 08 | 0 05 | 0 04 | 0 03 | 0 05 | 0 01 | 0 07 | 0 04 | 8 67E-03 | 0 89 | 0 08 | 1 18 |
| PST | 1,2,3,4-Tetrachlorobenzene | 129 | 2.04E-06 | 5 12E-06 | 8 46E-06 | 8 72E-06 | 6 54E-07 | 7 01E-06 | 6 28E-06 | 2 89E-06 | 4 62E-07 | 1 07E-05 | 1 68E-06 | 5 85E-06 |
| PST | 1,2,4,5-Tetrachlorobenzene | 129 | 1 70E-05 | 1 53E-06 | 2 01E-05 | 1 36E-05 | 1 43E-05 | 6 55E-06 | 3 69E-05 | 1 30E-05 | 1 02E-05 | 2.05E-05 | 1 57E-05 | 1 41E-05 |
| PST | o,p'-DDD | 0 84 | 1.59E-04 | 1 53E-04 | 1 38E-04 | 1.54E-04 | 1 38E-04 | 2.78E-05 | 2 58E-04 | 3 36E-05 | 6 10E-06 | 4 17E-03 | 3 55E-04 | 3 20E-03 |
| PST | p,p'-DDD | 0 84 | 2 43E-05 | 3 47E-05 | 1 55E-05 | 2.31E-05 | 3 00E-05 | 7 41E-05 | 2 09E-05 | 2 63E-05 | 1 30E-05 | 1 50E-04 | 8 12E-06 | 1 77E-04 |
| PST | o,p'-DDE | 3 26 | 1 30E-06 | 1 77E-07 | 1 74E-06 | 5 91E-07 | 1 33E-07 | 5 35E-07 | 1 13E-06 | 2.29E-07 | 2 35E-08 | 4 34E-05 | 3 79E-06 | 3 32E-04 |
| PST | o,p'-DDT | 1 00E-03 | 0 05 | 0 04 | 0 06 | 0 04 | 0 03 | 0.02 | 0 09 | 0 02 | 5 02E-03 | 4 39 | 0.13 | 2 66 |
| PST | p,p'-DDE | 3 26 | 9.88E-06 | 3.24E-06 | 6 45E-06 | 5.25E-06 | 2.43E-06 | 2.54E-05 | 2.48E-05 | 1 94E-06 | 3.52E-07 | 1 47E-04 | 1.32E-05 | 2 68E-04 |
| PST | p,p'-DDT | 1 00E-03 | 0.02 | 0 05 | 0 04 | 0 03 | 0 02 | 0 03 | 0 04 | 0 01 | 7 20E-03 | 10 44 | 0 04 | 6 46 |
| TOC | % TOC | | 2 01 | 2 36 | 0 70 | 0 47 | 2 09 | 0 52 | 0 98 | 1 97 | 1 48 | 1 04 | 1 63 | 0 55 |

Table A-2-2 5 (continued)

| Class | Analyte[3] | WQSV[2] | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 36 00 | 0 10 | 0 04 | 0 04 | | 0.10 | 0 04 | | 0 11 | 0 04 | 0 04 | 0 04 | |
| MET | Cadmium | 9.30 | 0 05 | 0 05 | 0 05 | | 0 05 | 0 05 | | 0.05 | 0 05 | 0.05 | 0 05 | |
| MET | Chromium | 50 00 | 0 05 | 0 05 | 0 05 | | 0 05 | 0.05 | | 0 05 | 0 05 | 0 05 | 0 05 | |
| MET | Copper | 3 10 | 0 48 | 7 48 | 1 02 | | 0 61 | 0 48 | | 0 58 | 0 79 | 0 48 | 0 69 | |
| MET | Lead | 8 10 | 0 19 | 0 19 | 0 19 | | 0 19 | 0 19 | | 0 19 | 0 19 | 0 19 | 0 19 | |
| MET | Mercury | 0 94 | 0 05 | 0 03 | 0 03 | | 0 03 | 0 03 | | 0-03 | 0 03 | 0 03 | 0 06 | |
| MET | Nickel | 8 20 | 0 30 | 1 46 | 1 83 | | 0 30 | 0 30 | | 0 30 | 1 22 | 0 30 | 0 30 | |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | 81 00 | 0 04 | 0 15 | 0 11 | | 0 07 | 0 08 | | 0 07 | 0 09 | 0 08 | 0 13 | |
| MET | SEM-AVS | 5 00 | -6 47 | 0 31 | -0 10 | -9 47 | -5.41 | -0 01 | -5 72 | -19 73 | -0 50 | -1 47 | -0 25 | -11 34 |
| PAH | 2-Methylnaphthalene (L) | 0 88 | 0.23 | 0 09 | 0.12 | 0 15 | 0 11 | 0.14 | 0 37 | 0 18 | 0.53 | 1.52 | 1 76 | 0 22 |
| PAH | Acenaphthene (L) | 710 | 6 26E-04 | 5.64E-05 | 1 34E-04 | 4 76E-04 | 3 79E-04 | 1.75E-04 | 1 92E-03 | 2.28E-04 | 2.49E-04 | 9 61E-03 | 9 80E-03 | 5 77E-04 |
| PAH | Acenaphthylene (L) | 0 46 | 1.10 | 0 44 | 0 38 | 0 65 | 0 37 | 0 34 | 4.68 | 1.21 | 0 81 | 1.88 | 1.86 | 1.04 |
| PAH | Anthracene (L) | 0 29 | 1 88 | 0 49 | 1 71 | 1 14 | 1 11 | 0 78 | 16 82 | 7 57 | 1 87 | 10 22 | 11.09 | 2.83 |
| PAH | Benzo(a)anthracene (H) | 0 07 | 0 97 | 0 14 | 0 83 | 0 63 | 0 54 | 0 35 | 5.46 | 0 85 | 0 81 | 5.94 | 6.57 | 1 75 |
| PAH | Benzo(a)pyrene (H) | 0 04 | 0 70 | 0 08 | 0 45 | 0 47 | 0 37 | 0.24 | 3 54 | 0 54 | 0 58 | 3 80 | 4 26 | 0 94 |
| PAH | Biphenyl (L) | 14 07 | 3 92E-03 | 3 51E-03 | 2.32E-03 | 3 27E-03 | 2.10E-03 | 2.26E-03 | 0.02 | 3 06E-03 | 9 36E-03 | 0 02 | 0 02 | 4 08E-03 |
| PAH | Chrysene (H) | 0 10 | 0 73 | 0 11 | 0 44 | 0 41 | 0 41 | 0.20 | 3.06 | 0 62 | 0 55 | 3.78 | 3.98 | 1.09 |
| PAH | Dibenz(a,h)anthracene (H) | 1 68E-03 | 0 80 | 0 11 | 0 47 | 0 48 | 0 38 | 0.22 | 3 48 | 0 43 | 0 63 | 5 17 | 5.32 | 1.04 |
| PAH | Fluoranthene (H) | 16 00 | 0 03 | 3 06E-03 | 0 02 | 0.02 | 0 02 | 0.01 | 0 13 | 0 02 | 0 02 | 0 14 | 0 17 | 0 05 |
| PAH | Fluorene (L) | 0 14 | 2.22 | 0.31 | 1 50 | 1 69 | 1 36 | 0.82 | 17 67 | 2 47 | 2.07 | 25 56 | 30 01 | 2 89 |
| PAH | Naphthalene (L) | 633 | 1 88E-03 | 8 81E-04 | 8.66E-04 | 1 39E-03 | 1 22E-03 | 2.18E-03 | 6 01E-03 | 1 73E-03 | 3 80E-03 | 0 02 | 0 02 | 2.00E-03 |
| PAH | Phenanthrene (L) | 4 60 | 0 15 | 0 02 | 0 10 | 0.11 | 0 10 | 0 05 | 1.03 | 0 09 | 0 14 | 1.33 | 1.57 | 0 18 |
| PAH | Pyrene (H) | 0 63 | 0 68 | 0 07 | 0 49 | 0 46 | 0.39 | 0.24 | 2.71 | 0 49 | 0 54 | 3.14 | 3.59 | 1.09 |
| PAH | LMW PAHs | 5 76 | 0 68 | 0 20 | 0 36 | 0 48 | 0 40 | 0 41 | 3.41 | 0 85 | 0 85 | 5.56 | 6 48 | 0 77 |
| PAH | HMW PAHs | 0 42 | 2 52 | 0 28 | 1 83 | 1 66 | 1 41 | 0 88 | 10 92 | 1 85 | 2 00 | 12.23 | 14.14 | 4 31 |
| PAH | Total PAHs | 6 49 | 0 76 | 0 20 | 0 44 | 0.53 | 0 44 | 0 42 | 3 74 | 0 88 | 0 88 | 5 74 | 6 68 | 0 96 |
| PCB | Total PCBs | 0 03 | 0 17 | 0 17 | 0 16 | 0 16 | 0 08 | 0 03 | 0.25 | 0 05 | 0 37 | 0 44 | 0 34 | 0 09 |
| PST | Aldrin | 0 16 | 8 14E-04 | 2.06E-05 | 1 11E-05 | 4 81E-04 | 3 53E-04 | 4 97E-06 | 7 52E-06 | 1.00E-05 | 3 56E-04 | 6 63E-06 | 2.31E-03 | 4 65E-04 |
| PST | Alpha-BHC | 0 16 | 0 01 | 0 01 | 0 01 | 0 02 | 4 49E-03 | 5 31E-03 | 0 02 | 0 01 | 7 72E-03 | 0 04 | 0 01 | 6 60E-03 |
| PST | Alpha-chlordane | 4 00E-03 | 3 69E-03 | 2.55E-03 | 4 34E-03 | 4 71E-03 | 9 95E-04 | 0 09 | 3.19E-03 | 2.21E-03 | 0 01 | 6 84E-03 | 3 04E-03 | 9 37E-04 |
| PST | Beta-BHC | 0 16 | 0 07 | 0 11 | 0 02 | 0.03 | 0 02 | 0 05 | 0 13 | 0 13 | 0 04 | 0 07 | 0 15 | 0 06 |
| PST | Chlorpyrifos | 5 60E-03 | 0 01 | 0 05 | 0 03 | 0 02 | 7 77E-03 | 0 09 | 0 02 | 0 02 | 0 01 | 0 02 | 0 02 | 0 01 |
| PST | CIS-Nonachlor | 3 99E-05 | 0 12 | 0 11 | 0 17 | 0 05 | 0 05 | 0 39 | 0 07 | 0 06 | 0 20 | 0 12 | 0 21 | 0 05 |
| PST | Delta-BHC | 0 16 | 0 02 | 7 10E-03 | 6 31E-03 | 0 01 | 1.77E-03 | 1 53E-03 | 2.57E-03 | 0 01 | 1 70E-03 | 2.23E-03 | 2 76E-03 | 2.15E-03 |
| PST | Dieldrin | 1 90E-03 | 0 05 | 9.89E-04 | 5 13E-03 | 0.02 | 4 38E-03 | 0 07 | 0 06 | 0 01 | 0 58 | 0 04 | 0 03 | 0 03 |
| PST | Endosulfan II | 8 70E-03 | 0 55 | 0 42 | 1 53 | 0 32 | 0 29 | 0 15 | 1.12 | 0 34 | 0 65 | 2 30 | 2 44 | 0 51 |
| PST | Endrin | 2.30E-03 | 0 02 | 0 08 | 0 05 | 0.03 | 0 01 | 0 02 | 0 03 | 0 04 | 0 02 | 0.03 | 0 03 | 0 03 |
| PST | Gamma-BHC (Lindane) | 0 16 | 0 02 | 0 05 | 2.49E-03 | 8 80E-03 | 0 01 | 0 01 | 0 02 | 0 01 | 0 02 | 0 01 | 0 02 | 0 02 |
| PST | Gamma-Chlordane | 4 00E-03 | 3 71E-04 | 1 09E-03 | 7 94E-03 | 5 01E-04 | 2 42E-04 | 0 19 | 1 73E-03 | 1 40E-03 | 3 49E-04 | 4 54E-04 | 3.22E-03 | 1 80E-03 |
| PST | Heptachlor | 3 60E-03 | 1 14E-03 | 2.09E-03 | 5 05E-03 | 1 00E-03 | 7.61E-04 | 4 06E-03 | 2 03E-03 | 2 12E-03 | 0 05 | 1 46E-03 | 4 36E-03 | 1 43E-03 |
| PST | Heptachlor epoxide | 3 60E-03 | 3 59E-03 | 0 18 | 7.50E-03 | 4 81E-03 | 2.64E-03 | 3 32E-03 | 5 14E-03 | 6 08E-03 | 3 78E-03 | 4 46E-03 | 5 92E-03 | 4 41E-03 |
| PST | Hexachlorobenzene | 129 | 8 69E-08 | 5 39E-06 | 1 86E-07 | 1 76E-07 | 1 25E-08 | 6 17E-08 | 2 19E-08 | 3 38E-08 | 2 72E-07 | 2.47E-08 | 2 72E-06 | 5 98E-08 |
| PST | Mirex | 1 00E-03 | 1 79E-04 | 6 92E-04 | 3 75E-03 | 2 40E-04 | 1 32E-04 | 7 80E-04 | 0 01 | 2 89E-04 | 1 89E-04 | 4 34E-03 | 3 03E-03 | 2.20E-04 |
| PST | Oxychlordane | 4 00E-03 | 6 52E-04 | 3 28E-04 | 1 70E-04 | 2 50E-04 | 2 09E-04 | 3 14E-03 | 3 20E-03 | 3 50E-04 | 5 71E-04 | 4 16E-03 | 7.32E-03 | 1 06E-03 |
| PST | Pentachlorobenzene | 129 | 1 28E-06 | 2.24E-05 | 1 45E-06 | 1 32E-06 | 3 47E-07 | 2 72E-07 | 1 82E-07 | 2.99E-07 | 2 46E-06 | 3 74E-07 | 4 13E-07 | 5 41E-07 |
| PST | Trans-Nonachlor | 3 99E-05 | 0 18 | 0 03 | 0 13 | 0 11 | 0 04 | 1 89 | 0 08 | 0 13 | 0 13 | 0 16 | 0 08 | 0 07 |
| PST | 1,2,3,4-Tetrachlorobenzene | 129 | 2.79E-06 | 3 42E-05 | 8 86E-06 | 8 30E-06 | 2.85E-06 | 4.34E-06 | 1.19E-06 | 6 51E-07 | 1 09E-05 | 3 25E-07 | 1 30E-06 | 3 27E-06 |
| PST | 1,2,4,5-Tetrachlorobenzene | 129 | 9 28E-06 | 7 07E-05 | 1 30E-05 | 6 76E-06 | 4 16E-06 | 5 60E-06 | 8 33E-06 | 8 03E-06 | 2 54E-05 | 5 17E-06 | 8 12E-06 | 8 32E-06 |
| PST | o,p'-DDD | 0 84 | 6 40E-04 | 4 73E-05 | 2.23E-04 | 1.52E-04 | 1.27E-04 | 1 91E-03 | 1 15E-04 | 7 57E-05 | 1 44E-04 | 3 78E-04 | 4 01E-04 | 9 13E-05 |
| PST | p,p'-DDD | 0 84 | 2.95E-05 | 2.15E-05 | 3 57E-05 | 2.81E-05 | 1 41E-05 | 2.47E-05 | 1 15E-05 | 3 16E-05 | 6 29E-05 | 2.41E-05 | 3 01E-05 | 1 59E-05 |
| PST | o,p'-DDE | 3 26 | 8 13E-06 | 6 95E-06 | 1 21E-05 | 7 14E-07 | 2.99E-06 | 1 25E-05 | 1 15E-06 | 5 56E-07 | 3 94E-06 | 2.78E-06 | 5.67E-06 | 2.30E-07 |
| PST | o,p'-DDT | 1 00E-03 | 0 49 | 0 04 | 0 11 | 0 05 | 0.05 | 1 78 | 0 07 | 0 04 | 0.08 | 0 06 | 0 06 | 0 02 |
| PST | p,p'-DDE | 3.26 | 2.81E-05 | 4 96E-06 | 1.29E-05 | 1 01E-05 | 5 43E-06 | 2.67E-05 | 2.42E-06 | 1 37E-06 | 4 88E-06 | 7 45E-06 | 5 24E-06 | 3 47E-06 |
| PST | p,p'-DDT | 1 00E-03 | 0 22 | 0 08 | 0 17 | 0 02 | 0 05 | 0 14 | 0 03 | 0 04 | 0 31 | 0 07 | 0 08 | 0 01 |
| TOC | % TOC | | 1 88 | 0.28 | 0 54 | 2 14 | 2.56 | 1 73 | 1 15 | 1 75 | 1 34 | 1 40 | 1 14 | 1 74 |

Table A-2-2.5 (continued)

| Class | Analyte[3] | WQSV[2] | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B |
|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 36 00 | 0 43 | | 0 43 | 0 22 | 0 09 | |
| MET | Cadmium | 9 30 | 0 05 | | 0 05 | 0.05 | 0 05 | |
| MET | Chromium | 50 00 | 0 05 | | 0 05 | 0 05 | 0 05 | |
| MET | Copper | 3 10 | 0 48 | | 0 48 | 1 34 | 0 48 | |
| MET | Lead | 8 10 | 0 19 | | 0 19 | 0 19 | 0.19 | |
| MET | Mercury | 0 94 | 0 05 | | 0 03 | 0 03 | 0 11 | |
| MET | Nickel | 8 20 | 0.30 | | 0 30 | 0 85 | 0 30 | |
| MET | Silver | | | | | | | |
| MET | Zinc | 81 00 | 0 04 | | 0 04 | 0 24 | 0 08 | |
| MET | SEM-AVS | 5 00 | -22 00 | -18.90 | -34 63 | -0 29 | -3 17 | -5 41 |
| PAH | 2-Methylnaphthalene (L) | 0 88 | 1 69 | 0 24 | 0.24 | 0 13 | 0 23 | 0 20 |
| PAH | Acenaphthene (L) | 710 | 0 03 | 5 54E-04 | 7 67E-04 | 9 54E-05 | 2 59E-04 | 2 64E-04 |
| PAH | Acenaphthylene (L) | 0 46 | 2.47 | 1.92 | 1.13 | 0 79 | 1.07 | 1.64 |
| PAH | Anthracene (L) | 0 29 | 13.64 | 3.29 | 3.66 | 0 70 | 2.20 | 1.93 |
| PAH | Benzo(a)anthracene (H) | 0 07 | 4.71 | 1 47 | 1 61 | 0 37 | 1.45 | 1.45 |
| PAH | Benzo(a)pyrene (H) | 0 04 | 2.09 | 0 93 | 0 89 | 0 31 | 1.21 | 1 16 |
| PAH | Biphenyl (L) | 14 07 | 0 09 | 5 18E-03 | 5 64E-03 | 2.06E-03 | 5 09E-03 | 4 05E-03 |
| PAH | Chrysene (H) | 0 10 | 2.50 | 1 01 | 1 12 | 0 27 | 0 88 | 0 84 |
| PAH | Dibenz(a,h)anthracene (H) | 1 68E-03 | 1 97 | 0 88 | 0 93 | 0 36 | 1 43 | 1 18 |
| PAH | Fluoranthene (H) | 16 00 | 0 17 | 0 04 | 0 04 | 9 32E-03 | 0 03 | 0 02 |
| PAH | Fluorene (L) | 0 14 | 101 | 3 68 | 6 29 | 0 70 | 2 58 | 2 17 |
| PAH | Naphthalene (L) | 633 | 3 00E-03 | 2.08E-03 | 2.24E-03 | 1 28E-03 | 2.49E-03 | 2.03E-03 |
| PAH | Phenanthrene (L) | 4 60 | 2.18 | 0 17 | 0 26 | 0 04 | 0 17 | 0 11 |
| PAH | Pyrene (H) | 0 63 | 3.38 | 0 98 | 1.02 | 0 23 | 0 84 | 0 53 |
| PAH | LMW PAHs | 5 76 | 8.97 | 0 88 | 1.01 | 0 32 | 0 73 | 0 65 |
| PAH | HMW PAHs | 0 42 | 13.06 | 3.68 | 3.78 | 0 85 | 2.90 | 2.02 |
| PAH | Total PAHs | 6 49 | 8 82 | 1.02 | 1 14 | 0 34 | 0 84 | 0 71 |
| PCB | Total PCBs | 0 03 | 0.36 | 0 09 | 0 17 | 0 07 | 0 09 | 0 07 |
| PST | Aldrin | 0 16 | 1 14E-03 | 6 19E-06 | 5 23E-06 | 3 64E-04 | 4 08E-06 | 5 23E-06 |
| PST | Alpha-BHC | 0 16 | 0 02 | 4 64E-03 | 5 26E-03 | 5 55E-03 | 0 03 | 9 57E-04 |
| PST | Alpha-chlordane | 4.00E-03 | 1 72E-03 | 1 78E-03 | 3 23E-03 | 1 69E-03 | 5 14E-04 | 4 25E-04 |
| PST | Beta-BHC | 0 16 | 0 10 | 9 82E-03 | 8 19E-03 | 5 43E-03 | 8 76E-03 | 7 95E-03 |
| PST | Chlorpyrifos | 5 60E-03 | 3 71E-03 | 1 62E-03 | 0 01 | 2 18E-03 | 8 84E-03 | 0 01 |
| PST | CIS-Nonachlor | 3 99E-05 | 0 10 | 0 04 | 0 06 | 0 13 | 0 04 | 0 04 |
| PST | Delta-BHC | 0.16 | 2 65E-03 | 2.32E-03 | 1 92E-03 | 1 22E-03 | 1 33E-03 | 1 92E-03 |
| PST | Dieldrin | 1 90E-03 | 0 02 | 0 05 | 0 06 | 4 60E-03 | 7 62E-03 | 0 01 |
| PST | Endosulfan II | 8 70E-03 | 0 25 | 0 05 | 0 49 | 0 13 | 0 64 | 0.10 |
| PST | Endrin | 2.30E-03 | 0 03 | 0 03 | 0 02 | 0 02 | 0 02 | 0 01 |
| PST | Gamma-BHC (Lindane) | 0 16 | 0.02 | 0 01 | 0 01 | 8 13E-04 | 8 33E-03 | 0 01 |
| PST | Gamma-Chlordane | 4 00E-03 | 5 50E-04 | 1 30E-03 | 3 83E-04 | 2 54E-04 | 2.85E-04 | 4 47E-04 |
| PST | Heptachlor | 3 60E-03 | 1 75E-03 | 1 44E-03 | 1 18E-03 | 8 24E-04 | 8 49E-04 | 1 18E-03 |
| PST | Heptachlor epoxide | 3 60E-03 | 5.28E-03 | 4 62E-03 | 3 59E-03 | 2.60E-03 | 2 32E-03 | 3 59E-03 |
| PST | Hexachlorobenzene | 129 | 6 45E-09 | 5 64E-08 | 5 76E-08 | 2.66E-08 | 1 15E-08 | 2 09E-08 |
| PST | Mirex | 1 00E-03 | 2.08E-03 | 2.31E-04 | 1 79E-04 | 1 30E-04 | 1 16E-04 | 1 79E-04 |
| PST | Oxychlordane | 4 00E-03 | 0 01 | 6 87E-04 | 2 42E-03 | 2.31E-04 | 3 79E-03 | 9 57E-05 |
| PST | Pentachlorobenzene | 129 | 2.95E-07 | 8 56E-07 | 4 90E-07 | 3 16E-07 | 3 48E-07 | 5 56E-07 |
| PST | Trans-Nonachlor | 3 99E-05 | 0 02 | 0 02 | 0 04 | 0 04 | 4 06E-03 | 5 53E-03 |
| PST | 1,2,3,4-Tetrachlorobenzene | 129 | 2.57E-06 | 9 19E-07 | 2.85E-07 | 3 78E-06 | 1 25E-06 | 1 04E-06 |
| PST | 1,2,4,5-Tetrachlorobenzene | 129 | 1 04E-05 | 5 15E-06 | 7 18E-06 | 2 70E-05 | 2 64E-06 | 7 80E-06 |
| PST | o,p'-DDD | 0 84 | 1.98E-04 | 2.48E-05 | 1 25E-04 | 9 09E-05 | 9 39E-05 | 1 71E-05 |
| PST | p,p'-DDD | 0 84 | 1 30E-05 | 7 02E-06 | 1 15E-05 | 8 00E-06 | 2 51E-06 | 2 06E-05 |
| PST | o,p'-DDE | 3.26 | 6 42E-07 | 6 23E-08 | 5 79E-08 | 1.26E-07 | 4 78E-08 | 5 50E-07 |
| PST | o,p'-DDT | 1.00E-03 | 0 03 | 0 02 | 0 03 | 0 02 | 0 02 | 7 46E-03 |
| PST | p,p'-DDE | 3 26 | 8.20E-07 | 2 09E-06 | 2.90E-06 | 1.89E-05 | 1 63E-06 | 8 11E-07 |
| PST | p,p'-DDT | 1 00E-03 | 0 02 | 0 01 | 0.01 | 0 01 | 8 73E-03 | 0 01 |
| TOC | % TOC | | 1 95 | 2 23 | 2 40 | 3 31 | 2 18 | 2 40 |

Table A-2-2 6 Porewater Hazard Quotients[1] (PW-HQs) based on data from the Portsmouth Naval Shipyard investigation for stations exhibiting **NO TOXICITY**[2] to amphipods (*Ampelisca abdita*)

| Class | Analyte | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | 0 04 | 0 17 | 0 15 | 0 12 | | 0 10 | 0.04 | | | | | 0.04 |
| MET | Cadmium | | 0 05 | 0 05 | 0 05 | 0.05 | | 0 05 | 0 05 | | | | | 0 05 |
| MET | Chromium | | 0 05 | 0 05 | 0 05 | 0 05 | | 0 05 | 0 05 | | | | | 0 05 |
| MET | Copper | | 1.81 | 0 48 | 0 90 | 0 71 | | 0 48 | 0 71 | | | | | 0 48 |
| MET | Lead | | 0 19 | 0 19 | 0 19 | 0 19 | | 0 19 | 0 19 | | | | | 0 19 |
| MET | Mercury | | 0.03 | 0.03 | 0 03 | 0 03 | | 0 03 | 0 03 | | | | | 0 03 |
| MET | Nickel | | 0 85 | 0 30 | 0 30 | 0.30 | | 0.30 | 1.22 | | | | | 0 30 |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | | 0 10 | 0 17 | 0 07 | 0 06 | | 0 05 | 0 10 | | | | | 0 06 |
| MET | SEM-AVS | | 0 24 | -6 87 | -5 21 | -0 29 | | -10 06 | -3 18 | | | | | -11 35 |
| PAH | 2-Methylnaphthalene (L) | | 0 60 | 1 39 | 0 16 | 0 07 | | 0 17 | 0.20 | | | | | 0 18 |
| PAH | Acenaphthene (L) | | 1 13E-03 | 4 28E-03 | 1 64E-04 | 6 91E-05 | | 7 15E-04 | 4 46E-04 | | | | | 4 09E-04 |
| PAH | Acenaphthylene (L) | | 1 92 | 3 74 | 0 84 | 0 38 | | 1.04 | 0 85 | | | | | 1 13 |
| PAH | Anthracene (L) | | 3 81 | 8 19 | 1 04 | 0 49 | | 2.33 | 1 58 | | | | | 2 01 |
| PAH | Benzo(a)anthracene (H) | | 2.53 | 3.59 | 0 57 | 0 28 | | 1 16 | 0 95 | | | | | 0 96 |
| PAH | Benzo(a)pyrene (H) | | 1.89 | 2 59 | 0 42 | 0 17 | | 0 75 | 0 66 | | | | | 0 65 |
| PAH | Biphenyl (L) | | 9 62E-03 | 0.03 | 2.70E-03 | 8.53E-04 | | 2.97E-03 | 2 98E-03 | | | | | 3 99E-03 |
| PAH | Chrysene (H) | | 1 50 | 2 09 | 0.39 | 0 17 | | 0.81 | 0 66 | | | | | 0 74 |
| PAH | Dibenz(a,h)anthracene (H) | | 2 61 | 2.40 | 0 46 | 0 18 | | 0 83 | 0.91 | | | | | 0 64 |
| PAH | Fluoranthene (H) | | 0 05 | 0.10 | 0 01 | 7.52E-03 | | 0 03 | 0 03 | | | | | 0.03 |
| PAH | Fluorene (L) | | 5 07 | 21.34 | 1 00 | 0 40 | | 2 97 | 1.98 | | | | | 2.24 |
| PAH | Naphthalene (L) | | 4 82E-03 | 0 02 | 1 25E-03 | 5 35E-04 | | 1 65E-03 | 1 49E-03 | | | | | 1 78E-03 |
| PAH | Phenanthrene (L) | | 0 41 | 1 08 | 0 06 | 0 03 | | 0.21 | 0 15 | | | | | 0 13 |
| PAH | Pyrene (H) | | 1 11 | 2 39 | 0 33 | 0 17 | | 0 73 | 0 61 | | | | | 0 71 |
| PAH | LMW PAHs | | 1 56 | 4 53 | 0 37 | 0 17 | | 0 73 | 0 56 | | | | | 0 62 |
| PAH | HMW PAHs | | 4 34 | 8 63 | 1 16 | 0 64 | | 2.80 | 2 26 | | | | | 2 63 |
| PAH | Total PAHs | | 1.66 | 4 59 | 0.40 | 0 19 | | 0.83 | 0 65 | | | | | 0 72 |
| PCB | Total PCBs | | 0 10 | 0 11 | 0 06 | 0 02 | | 0.20 | 0 10 | | | | | 0 14 |
| PST | Aldrin | | 3 65E-06 | 2 19E-04 | 3.97E-06 | 1 46E-06 | | 4 02E-06 | 4 74E-06 | | | | | 1 00E-05 |
| PST | Alpha-BHC | | 7 90E-03 | 6 88E-03 | 6 95E-03 | 2 28E-03 | | 7 36E-03 | 0 03 | | | | | 0 01 |
| PST | Alpha-chlordane | | 0 09 | 6 78E-03 | 2 84E-03 | 1 19E-03 | | 1 83E-03 | 3 17E-03 | | | | | 3 61E-03 |
| PST | Beta-BHC | | 5 35E-03 | 0 06 | 0.02 | 0 02 | | 0 11 | 0 05 | | | | | 0 14 |
| PST | Chlorpyrifos | | 8 29E-03 | 8.68E-03 | 8 97E-03 | 3 32E-03 | | 9 65E-03 | 0 01 | | | | | 0 04 |
| PST | CIS-Nonachlor | | 0 42 | 0 06 | 0 04 | 0 02 | | 0 24 | 0 08 | | | | | 0 07 |
| PST | Delta-BHC | | 1 23E-03 | 2 52E-03 | 3 17E-03 | 7 50E-04 | | 1 44E-03 | 8 15E-03 | | | | | 2 83E-03 |
| PST | Dieldrin | | 3 08 | 0 11 | 3 86E-03 | 0 04 | | 0 12 | 0 20 | | | | | 0 03 |
| PST | Endosulfan II | | 1 81 | 0.97 | 0 60 | 0 28 | | 0 72 | 0 44 | | | | | 0 85 |
| PST | Endrin | | 0 22 | 0 03 | 0 02 | 6 10E-03 | | 0 02 | 0 02 | | | | | 0 02 |
| PST | Gamma-BHC (Lindane) | | 0 04 | 0 02 | 8 76E-03 | 6.23E-03 | | 0 02 | 0 02 | | | | | 0 02 |
| PST | Gamma-Chlordane | | 0 12 | 8 51E-04 | 7 12E-04 | 6 07E-04 | | 2 16E-03 | 1 91E-03 | | | | | 2 98E-03 |
| PST | Heptachlor | | 7 73E-03 | 1 99E-03 | 7.25E-04 | 5 15E-04 | | 4 25E-03 | 4 76E-03 | | | | | 2.92E-04 |
| PST | Heptachlor epoxide | | 2 41E-03 | 2 69E-03 | 2 67E-03 | 1 00E-03 | | 2 81E-03 | 3 23E-03 | | | | | 4 04E-03 |
| PST | Hexachlorobenzene | | 4 65E-08 | 2.23E-08 | 4 09E-08 | 1 11E-08 | | 1 61E-08 | 5 41E-08 | | | | | 1 04E-06 |
| PST | Mirex | | 0 01 | 6 43E-03 | 1 80E-03 | 1 49E-04 | | 3 24E-04 | 2 34E-03 | | | | | 1 51E-03 |
| PST | Oxychlordane | | 9 72E-03 | 5.06E-03 | 2 85E-04 | 2 02E-04 | | 6 38E-04 | 2 34E-03 | | | | | 1.72E-03 |
| PST | Pentachlorobenzene | | 4 70E-07 | 5 91E-07 | 4 14E-07 | 8 06E-08 | | 4.53E-07 | 3 75E-07 | | | | | 6 65E-07 |
| PST | Trans-Nonachlor | | 1.29 | 0 14 | 0.06 | 0 03 | | 0 06 | 0 04 | | | | | 0 08 |
| PST | 1,2,3,4-Tetrachlorobenzene | | 3 01E-06 | 9 09E-07 | 2.22E-06 | 9.03E-07 | | 6 57E-06 | 5.56E-06 | | | | | 2 04E-06 |
| PST | 1,2,4,5-Tetrachlorobenzene | | 3 83E-06 | 4 11E-06 | 4 55E-06 | 1 73E-06 | | 1 23E-05 | 6 52E-06 | | | | | 1 70E-05 |
| PST | o,p'-DDD | | 3.69E-03 | 9.66E-04 | 1.01E-04 | 8 75E-05 | | 3 01E-04 | 1 84E-04 | | | | | 1.59E-04 |
| PST | p,p'-DDD | | 1 40E-04 | 2.54E-05 | 1 06E-05 | 6 36E-06 | | 2 70E-06 | 3 17E-06 | | | | | 2 43E-05 |
| PST | o,p'-DDE | | 9 19E-05 | 2 53E-05 | 4 53E-07 | 3.52E-06 | | 6 01E-06 | 1 63E-06 | | | | | 1 30E-06 |
| PST | o,p'-DDT | | 3 08 | 0 73 | 0 04 | 0 05 | | 0 24 | 0 09 | | | | | 0 05 |
| PST | p,p'-DDE | | 2 17E-04 | 1.80E-05 | 3 88E-06 | 7 96E-06 | | 1 18E-05 | 9 98E-06 | | | | | 9 88E-06 |
| PST | p,p'-DDT | | 3 83 | 0 60 | 0 02 | 0 08 | | 0 07 | 0 02 | | | | | 0 02 |
| | TOX FLAG | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 1 | 2 | 1 | 0 |
| | Survival (% of Control) | | 96 | 91 | 104 | 102 | | 100 | 92 | | 5 | | 70 | 97 |

1 - Hazard Quotients from Table A-2-2.5, only values for which the corresponding sample was categorized as toxic are shown

2 - See TtNUS (2000b) for toxicity data

3 - Toxicity flag: 0= nontoxic, 1= toxic, 2= no data

4 - Aquatic Reference Screening Value (RSV) calculated as 95th percentile Upper Limit (95% UL) based on sample and distribution type

NORM = Normal Distribution

LOG = LOG-Normal distribution

Units PW-HQ = unitless

Table A-2-2 6 (continued)

| Class | Analyte | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0.23 | | 0.13 | | 1.34 | 0 13 | | | 0 04 | | | 0 10 | |
| MET | Cadmium | 0 05 | | 0 05 | | 0 05 | 0 05 | | | 0 05 | | | 0 05 | |
| MET | Chromium | 0.05 | | 0 05 | | 0 05 | 0 05 | | | 0 05 | | | 0 05 | |
| MET | Copper | 0 48 | | 0 48 | | 0 48 | 0 48 | | | 0 48 | | | 0 48 | |
| MET | Lead | 0 19 | | 0 19 | | 0 19 | 0 19 | | | 0 19 | | | 0 19 | |
| MET | Mercury | 0 03 | | 0 03 | | 0 03 | 0 03 | | | 0 03 | | | 0 05 | |
| MET | Nickel | 0 30 | | 0 30 | | 1 59 | 0 30 | | | 0 73 | | | 0 30 | |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | 0 05 | | 0 05 | | 0 11 | 0 06 | | | 0 05 | | | 0 04 | |
| MET | SEM-AVS | -10 23 | | -0 55 | | 0 03 | -1 85 | | | -3 41 | | | -6 47 | |
| PAH | 2-Methylnaphthalene (L) | 0 23 | | 0 23 | | 0 07 | 0.13 | | | 0 37 | | | 0 23 | |
| PAH | Acenaphthene (L) | 2 73E-04 | | 6 93E-04 | | 1 78E-04 | 2 40E-04 | | | 7 76E-04 | | | 6 26E-04 | |
| PAH | Acenaphthylene (L) | 0 78 | | 1 28 | | 0 20 | 0.71 | | | 1 46 | | | 1 10 | |
| PAH | Anthracene (L) | 1 35 | | 2 19 | | 0 43 | 1.10 | | | 2 54 | | | 1.88 | |
| PAH | Benzo(a)anthracene (H) | 0 67 | | 2 19 | | 0.25 | 0 70 | | | 1 26 | | | 0 97 | |
| PAH | Benzo(a)pyrene (H) | 0 47 | | 2 15 | | 0 19 | 0 57 | | | 0 84 | | | 0 70 | |
| PAH | Biphenyl (L) | 2 94E-03 | | 5 22E-03 | | 2.10E-03 | 2 50E-03 | | | 6 38E-03 | | | 3 92E-03 | |
| PAH | Chrysene (H) | 0 49 | | 2 14 | | 0 17 | 0 52 | | | 1 03 | | | 0 73 | |
| PAH | Dibenz(a,h)anthracene (H) | 0 46 | | 2 34 | | 0 17 | 0 56 | | | 1 13 | | | 0 80 | |
| PAH | Fluoranthene (H) | 0 02 | | 0 08 | | 8 94E-03 | 0 02 | | | 0 03 | | | 0 03 | |
| PAH | Fluorene (L) | 1 96 | | 3 87 | | 0 72 | 1 22 | | | 2 82 | | | 2 22 | |
| PAH | Naphthalene (L) | 1 46E-03 | | 2 14E-03 | | 5 89E-04 | 1 31E-03 | | | 2 54E-03 | | | 1 88E-03 | |
| PAH | Phenanthrene (L) | 0 10 | | 0 40 | | 0.05 | 0 10 | | | 0 18 | | | 0 15 | |
| PAH | Pyrene (H) | 0 41 | | 1 67 | | 0 20 | 0 48 | | | 0 89 | | | 0 68 | |
| PAH | LMW PAHs | 0 49 | | 0 98 | | 0 19 | 0 41 | | | 0 88 | | | 0 68 | |
| PAH | HMW PAHs | 1 52 | | 6 60 | | 0 73 | 1 76 | | | 3 13 | | | 2.52 | |
| PAH | Total PAHs | 0 53 | | 1 30 | | 0 22 | 0 48 | | | 0 99 | | | 0 76 | |
| PCB | Total PCBs | 0 12 | | 0 10 | | 0 11 | 0.21 | | | 0 41 | | | 0 17 | |
| PST | Aldrin | 5 21E-06 | | 1 55E-05 | | 1 35E-05 | 7 55E-06 | | | 6 75E-06 | | | 8 14E-04 | |
| PST | Alpha-BHC | 0 01 | | 7 94E-03 | | 6 63E-03 | 0 01 | | | 0 02 | | | 0 01 | |
| PST | Alpha-chlordane | 1 12E-03 | | 5 85E-03 | | 2 35E-03 | 2 50E-03 | | | 0 03 | | | 3 69E-03 | |
| PST | Beta-BHC | 0 15 | | 0 02 | | 0 02 | 0 06 | | | 0 07 | | | 0 07 | |
| PST | Chlorpyrifos | 0 01 | | 0 03 | | 0 03 | 0 02 | | | 0 02 | | | 0 01 | |
| PST | CIS-Nonachlor | 0 04 | | 0 12 | | 0 14 | 0 07 | | | 0 31 | | | 0 12 | |
| PST | Delta-BHC | 1 76E-03 | | 7 25E-03 | | 4 37E-03 | 2 55E-03 | | | 1 09E-03 | | | 0 02 | |
| PST | Dieldrin | 1 17E-04 | | 0 10 | | 0 03 | 0 11 | | | 0 25 | | | 0 05 | |
| PST | Endosulfan II | 0 54 | | 1 69 | | 0 31 | 0 68 | | | 1 34 | | | 0 55 | |
| PST | Endrin | 0 02 | | 0 06 | | 0 06 | 0 03 | | | 0 07 | | | 0 02 | |
| PST | Gamma-BHC (Lindane) | 0 03 | | 0 04 | | 0 03 | 0 01 | | | 0 02 | | | 0 02 | |
| PST | Gamma-Chlordane | 1 56E-03 | | 2 61E-03 | | 8 84E-04 | 3 75E-03 | | | 0 06 | | | 3 71E-04 | |
| PST | Heptachlor | 1 16E-03 | | 2 07E-03 | | 3 37E-03 | 1 69E-03 | | | 2 25E-03 | | | 1 14E-03 | |
| PST | Heptachlor epoxide | 3 50E-03 | | 0 01 | | 9 09E-03 | 5 00E-03 | | | 4 54E-03 | | | 3 59E-03 | |
| PST | Hexachlorobenzene | 1 94E-08 | | 5 35E-08 | | 5 08E-08 | 2 82E-08 | | | 1 69E-07 | | | 8 69E-08 | |
| PST | Mirex | 2 00E-03 | | 7 53E-03 | | 4.54E-04 | 2 24E-03 | | | 3 24E-03 | | | 1 79E-04 | |
| PST | Oxychlordane | 2 60E-04 | | 3 58E-03 | | 5 01E-03 | 1 25E-03 | | | 3 98E-03 | | | 6 52E-04 | |
| PST | Pentachlorobenzene | 4.21E-07 | | 1 00E-06 | | 9 05E-07 | 1 12E-06 | | | 1 06E-06 | | | 1.28E-06 | |
| PST | Trans-Nonachlor | 0 05 | | 0 03 | | 0 01 | 0 07 | | | 0 89 | | | 0 18 | |
| PST | 1,2,3,4-Tetrachlorobenzene | 5 12E-06 | | 8.72E-06 | | 7 01E-06 | 6 28E-06 | | | 1 07E-05 | | | 2 79E-06 | |
| PST | 1,2,4,5-Tetrachlorobenzene | 1 53E-06 | | 1 36E-05 | | 6 55E-06 | 3 69E-05 | | | 2 05E-05 | | | 9 28E-06 | |
| PST | o,p'-DDD | 1.53E-04 | | 1 54E-04 | | 2 78E-05 | 2.58E-04 | | | 4 17E-03 | | | 6 40E-04 | |
| PST | p,p'-DDD | 3 47E-05 | | 2 31E-05 | | 7 41E-05 | 2 09E-05 | | | 1 50E-04 | | | 2.95E-05 | |
| PST | o,p'-DDE | 1 77E-07 | | 5 91E-07 | | 5.35E-07 | 1 13E-06 | | | 4 34E-05 | | | 8 13E-06 | |
| PST | o,p'-DDT | 0 04 | | 0 04 | | 0 02 | 0 09 | | | 4 39 | | | 0 49 | |
| PST | p,p'-DDE | 3 24E-06 | | 5 25E-06 | | 2.54E-05 | 2 48E-05 | | | 1 47E-04 | | | 2 81E-05 | |
| PST | p,p'-DDT | 0 05 | | 0 03 | | 0 03 | 0 04 | | | 10 44 | | | 0 22 | |
| | TOX FLAG | 0 | 2 | 0 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 1 | 0 | 1 |
| | Survival (% of Control) | 97 | | 102 | | 99 | 101 | | | 102 | | 74 | 102 | 71 |

Table A-2-2 6 (continued)

| Class | Analyte | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0 04 | | 0 10 | 0 04 | | 0 11 | 0 04 | 0.04 | 0 04 | | | | 0 43 |
| MET | Cadmium | 0 05 | | 0 05 | 0 05 | | 0 05 | 0 05 | 0.05 | 0 05 | | | | 0 05 |
| MET | Chromium | 0 05 | | 0 05 | 0 05 | | 0 05 | 0.05 | 0 05 | 0 05 | | | | 0 05 |
| MET | Copper | 1 02 | | 0 61 | 0 48 | | 0 58 | 0 79 | 0 48 | 0 69 | | | | 0 48 |
| MET | Lead | 0 19 | | 0 19 | 0 19 | | 0 19 | 0 19 | 0 19 | 0 19 | | | | 0 19 |
| MET | Mercury | 0 03 | | 0 03 | 0 03 | | 0 03 | 0 03 | 0 03 | 0 06 | | | | 0 03 |
| MET | Nickel | 1 83 | | 0.30 | 0 30 | | 0 30 | 1.22 | 0 30 | 0 30 | | | | 0 30 |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | 0 11 | | 0 07 | 0 08 | | 0 07 | 0.09 | 0 08 | 0.13 | | | | 0 04 |
| MET | SEM-AVS | -0 10 | | -5 41 | -0 01 | | -19 73 | -0 50 | -1 47 | -0 25 | | | | -34 63 |
| PAH | 2-Methylnaphthalene (L) | 0 12 | | 0 11 | 0 14 | | 0 18 | 0.53 | 1 52 | 1.76 | | | | 0 24 |
| PAH | Acenaphthene (L) | 1 34E-04 | | 3 79E-04 | 1 75E-04 | | 2.28E-04 | 2 49E-04 | 9 61E-03 | 9 80E-03 | | | | 7 67E-04 |
| PAH | Acenaphthylene (L) | 0 38 | | 0 37 | 0 34 | | 1.21 | 0.81 | 1.88 | 1 86 | | | | 1.13 |
| PAH | Anthracene (L) | 1 71 | | 1 11 | 0 78 | | 7 57 | 1.87 | 10.22 | 11 09 | | | | 3 66 |
| PAH | Benzo(a)anthracene (H) | 0 83 | | 0 54 | 0 35 | | 0 85 | 0 81 | 5.94 | 6.57 | | | | 1.61 |
| PAH | Benzo(a)pyrene (H) | 0 45 | | 0 37 | 0.24 | | 0 54 | 0 58 | 3 80 | 4 26 | | | | 0 89 |
| PAH | Biphenyl (L) | 2 32E-03 | | 2.10E-03 | 2.26E-03 | | 3.06E-03 | 9.36E-03 | 0 02 | 0 02 | | | | 5.64E-03 |
| PAH | Chrysene (H) | 0.44 | | 0 41 | 0.20 | | 0.62 | 0 55 | 3 78 | 3 98 | | | | 1 12 |
| PAH | Dibenz(a,h)anthracene (H) | 0 47 | | 0 38 | 0.22 | | 0 43 | 0.63 | 5 17 | 5 32 | | | | 0 93 |
| PAH | Fluoranthene (H) | 0 02 | | 0 02 | 0.01 | | 0 02 | 0 02 | 0 14 | 0 17 | | | | 0 04 |
| PAH | Fluorene (L) | 1 50 | | 1 36 | 0.82 | | 2 47 | 2.07 | 25.56 | 30.01 | | | | 6 29 |
| PAH | Naphthalene (L) | 8 66E-04 | | 1.22E-03 | 2 18E-03 | | 1 73E-03 | 3 80E-03 | 0 02 | 0 02 | | | | 2 24E-03 |
| PAH | Phenanthrene (L) | 0 10 | | 0 10 | 0 05 | | 0 09 | 0 14 | 1 33 | 1.57 | | | | 0 26 |
| PAH | Pyrene (H) | 0 49 | | 0.39 | 0 24 | | 0 49 | 0 54 | 3 14 | 3 59 | | | | 1 02 |
| PAH | LMW PAHs | 0 36 | | 0 40 | 0 41 | | 0.85 | 0 85 | 5 56 | 6 48 | | | | 1 01 |
| PAH | HMW PAHs | 1 83 | | 1 41 | 0.88 | | 1.85 | 2 00 | 12 23 | 14 14 | | | | 3 78 |
| PAH | Total PAHs | 0 44 | | 0 44 | 0 42 | | 0 88 | 0 88 | 5 74 | 6 68 | | | | 1 14 |
| PCB | Total PCBs | 0 16 | | 0 08 | 0 03 | | 0 05 | 0 37 | 0 44 | 0 34 | | | | 0 17 |
| PST | Aldrin | 1 11E-05 | | 3 53E-04 | 4 97E-06 | | 1 00E-05 | 3 56E-04 | 6 63E-06 | 2 31E-03 | | | | 5 23E-06 |
| PST | Alpha-BHC | 0 01 | | 4 49E-03 | 5 31E-03 | | 0 01 | 7 72E-03 | 0 04 | 0 01 | | | | 5.26E-03 |
| PST | Alpha-chlordane | 4 34E-03 | | 9 95E-04 | 0 09 | | 2 21E-03 | 0 01 | 6 84E-03 | 3 04E-03 | | | | 3 23E-03 |
| PST | Beta-BHC | 0 02 | | 0.02 | 0 05 | | 0 13 | 0 04 | 0 07 | 0 15 | | | | 8 19E-03 |
| PST | Chlorpyrifos | 0.03 | | 7 77E-03 | 0 09 | | 0 02 | 0 01 | 0 02 | 0 02 | | | | 0 01 |
| PST | CIS-Nonachlor | 0 17 | | 0 05 | 0 39 | | 0 06 | 0.20 | 0 12 | 0 21 | | | | 0 06 |
| PST | Delta-BHC | 6 31E-03 | | 1 77E-03 | 1 53E-03 | | 0 01 | 1 70E-03 | 2.23E-03 | 2 76E-03 | | | | 1 92E-03 |
| PST | Dieldrin | 5 13E-03 | | 4 38E-03 | 0 07 | | 0 01 | 0 58 | 0 04 | 0 03 | | | | 0 06 |
| PST | Endosulfan II | 1 53 | | 0 29 | 0 15 | | 0 34 | 0 65 | 2 30 | 2 44 | | | | 0 49 |
| PST | Endrin | 0 05 | | 0 01 | 0 02 | | 0 04 | 0 02 | 0 03 | 0 03 | | | | 0 02 |
| PST | Gamma-BHC (Lindane) | 2 49E-03 | | 0 01 | 0 01 | | 0 01 | 0 02 | 0 01 | 0 02 | | | | 0 01 |
| PST | Gamma-Chlordane | 7 94E-03 | | 2 42E-04 | 0 19 | | 1 40E-03 | 3 49E-04 | 4 54E-04 | 3 22E-03 | | | | 3 83E-04 |
| PST | Heptachlor | 5.05E-03 | | 7 61E-04 | 4 06E-03 | | 2 12E-03 | 0 05 | 1 46E-03 | 4.36E-03 | | | | 1 18E-03 |
| PST | Heptachlor epoxide | 7.50E-03 | | 2 64E-03 | 3 32E-03 | | 6 08E-03 | 3 78E-03 | 4 46E-03 | 5 92E-03 | | | | 3 59E-03 |
| PST | Hexachlorobenzene | 1 86E-07 | | 1 25E-08 | 6 17E-08 | | 3 38E-08 | 2 72E-07 | 2 47E-08 | 2 72E-06 | | | | 5 76E-08 |
| PST | Mirex | 3 75E-03 | | 1 32E-04 | 7 80E-04 | | 2 89E-04 | 1 89E-04 | 4 34E-03 | 3 03E-03 | | | | 1 79E-04 |
| PST | Oxychlordane | 1 70E-04 | | 2 09E-04 | 3 14E-03 | | 3 50E-04 | 5 71E-04 | 4 16E-03 | 7 32E-03 | | | | 2 42E-03 |
| PST | Pentachlorobenzene | 1 45E-06 | | 3 47E-07 | 2 72E-07 | | 2 99E-07 | 2 46E-06 | 3.74E-07 | 4 13E-07 | | | | 4 90E-07 |
| PST | Trans-Nonachlor | 0 13 | | 0.04 | 1 89 | | 0 13 | 0 13 | 0.16 | 0.08 | | | | 0.04 |
| PST | 1,2,3,4-Tetrachlorobenzene | 8 86E-06 | | 2 85E-06 | 4.34E-06 | | 6 51E-07 | 1.09E-05 | 3.25E-07 | 1 30E-06 | | | | 2 85E-07 |
| PST | 1,2,4,5-Tetrachlorobenzene | 1 30E-05 | | 4 16E-06 | 5 60E-06 | | 8 03E-06 | 2.54E-05 | 5 17E-06 | 8 12E-06 | | | | 7 18E-06 |
| PST | o,p'-DDD | 2.23E-04 | | 1 27E-04 | 1 91E-03 | | 7 57E-05 | 1 44E-04 | 3 78E-04 | 4 01E-04 | | | | 1.25E-04 |
| PST | p,p'-DDD | 3 57E-05 | | 1 41E-05 | 2 47E-05 | | 3 16E-05 | 6.29E-05 | 2 41E-05 | 3 01E-05 | | | | 1 15E-05 |
| PST | o,p'-DDE | 1 21E-05 | | 2 99E-06 | 1 25E-05 | | 5 56E-07 | 3 94E-06 | 2 78E-06 | 5 67E-06 | | | | 5 79E-08 |
| PST | o,p'-DDT | 0 11 | | 0.05 | 1 78 | | 0 04 | 0.08 | 0 06 | 0 06 | | | | 0 03 |
| PST | p,p'-DDE | 1 29E-05 | | 5.43E-06 | 2 67E-05 | | 1.37E-06 | 4 88E-06 | 7 45E-06 | 5 24E-06 | | | | 2.90E-06 |
| PST | p,p'-DDT | 0 17 | | 0.05 | 0 14 | | 0 04 | 0 31 | 0 07 | 0 08 | | | | 0 01 |
| | TOX FLAG | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 0 |
| | Survival (% of Control) | 102 | | 103 | 98 | | 90 | 89 | 97 | 102 | | 66 | | 93 |

Table A-2-2 6 (continued)

| Class | Analyte | M14-100B | M14-200B | M14-300B | n | DIST[4] | Mean | 95% UL |
|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0 21527778 | 0 09 | | 23 | LOG | 0 17 | 0 42 |
| MET | Cadmium | 0 05376344 | 0 05 | | 23 | NA | 0.05 | 0 05 |
| MET | Chromium | 0 05 | 0 05 | | 23 | NA | 0 05 | 0.05 |
| MET | Copper | 1.33870968 | 0 48 | | 23 | LOG | 0 67 | 1 14 |
| MET | Lead | 0 18518519 | 0.19 | | 23 | NA | 0 19 | 0 19 |
| MET | Mercury | 0 02659574 | 0 11 | | 23 | LOG | 0.03 | 0 05 |
| MET | Nickel | 0 85365854 | 0 30 | | 23 | LOG | 0 57 | 1.30 |
| MET | Silver | | | | 0 | | | |
| MET | Zinc | 0 2382716 | 0 08 | | 23 | LOG | 0 09 | 0 16 |
| MET | SEM-AVS | -0 2914341 | -3 17 | | 23 | LOG | -5 42 | 110 33 |
| PAH | 2-Methylnaphthalene (L) | 0 13120414 | 0.23 | | 23 | LOG | 0 39 | 1.07 |
| PAH | Acenaphthene (L) | 9 5366E-05 | 2 59E-04 | | 23 | LOG | 1 38E-03 | 4 04E-03 |
| PAH | Acenaphthylene (L) | 0 78961824 | 1 07 | | 23 | LOG | 1 10 | 2 71 |
| PAH | Anthracene (L) | 0 6977329 | 2 20 | | 23 | LOG | 3 04 | 8 92 |
| PAH | Benzo(a)anthracene (H) | 0 37040895 | 1 45 | | 23 | LOG | 1.54 | 4.35 |
| PAH | Benzo(a)pyrene (H) | 0 3119511 | 1 21 | | 23 | LOG | 1.07 | 3.06 |
| PAH | Biphenyl (L) | 0 00205987 | 5.09E-03 | | 23 | LOG | 6 11E-03 | 0 02 |
| PAH | Chrysene (H) | 0.26671073 | 0 88 | | 23 | LOG | 1 03 | 2 97 |
| PAH | Dibenz(a,h)anthracene (H) | 0 35977394 | 1 43 | | 23 | LOG | 1.25 | 3 78 |
| PAH | Fluoranthene (H) | 0 00932265 | 0 03 | | 23 | LOG | 0 04 | 0 11 |
| PAH | Fluorene (L) | 0 69963428 | 2 58 | | 23 | LOG | 5 27 | 15 98 |
| PAH | Naphthalene (L) | 0.00128385 | 2 49E-03 | | 23 | LOG | 3 93E-03 | 0 01 |
| PAH | Phenanthrene (L) | 0 04023051 | 0 17 | | 23 | LOG | 0 30 | 0 91 |
| PAH | Pyrene (H) | 0 2335143 | 0 84 | | 23 | LOG | 0 93 | 2 54 |
| PAH | LMW PAHs | 0 31944745 | 0 73 | | 23 | LOG | 1 27 | 3 53 |
| PAH | HMW PAHs | 0 84903528 | 2.90 | | 23 | LOG | 3 50 | 9 70 |
| PAH | Total PAHs | 0 33916506 | 0 84 | | 23 | LOG | 1.35 | 3 76 |
| PCB | Total PCBs | 0 06952703 | 0 09 | | 23 | LOG | 0 16 | 0 03 |
| PST | Aldrin | 0 00036373 | 4 08E-06 | | 23 | LOG | 1 97E-04 | 0 21 |
| PST | Alpha-BHC | 0 00555254 | 0 03 | | 23 | LOG | 0 01 | 0 05 |
| PST | Alpha-chlordane | 0 00 | 5 14E-04 | | 23 | LOG | 0.01 | 0 03 |
| PST | Beta-BHC | 0 00542828 | 8 76E-03 | | 23 | LOG | 0 06 | 0 21 |
| PST | Chlorpyrifos | 0 00218411 | 8 84E-03 | | 23 | LOG | 0 02 | 0 05 |
| PST | CIS-Nonachlor | 0 13367912 | 0 04 | | 23 | LOG | 0 14 | 0 40 |
| PST | Delta-BHC | 0 00121811 | 1 33E-03 | | 23 | LOG | 3 68E-03 | 9 63E-03 |
| PST | Dieldrin | 0 00460035 | 7 62E-03 | | 23 | LOG | 0 21 | 1 06 |
| PST | Endosulfan II | 0 13269563 | 0.64 | | 23 | LOG | 0 86 | 2 40 |
| PST | Endrin | 0 01533122 | 0 02 | | 23 | LOG | 0 04 | 0 09 |
| PST | Gamma-BHC (Lindane) | 0 00081323 | 8 33E-03 | | 23 | LOG | 0 02 | 0.05 |
| PST | Gamma-Chlordane | 0 00025447 | 2 85E-04 | | 23 | LOG | 0.02 | 0 04 |
| PST | Heptachlor | 0 0008244 | 8 49E-04 | | 23 | LOG | 4 31E-03 | 0 01 |
| PST | Heptachlor epoxide | 0 00260094 | 2 32E-03 | | 23 | LOG | 4 23E-03 | 8 62E-03 |
| PST | Hexachlorobenzene | 2 6578E-08 | 1 15E-08 | | 23 | LOG | 2 19E-07 | 5 41E-07 |
| PST | Mirex | 0 00012989 | 1 16E-04 | | 23 | LOG | 2 25E-03 | 0 01 |
| PST | Oxychlordane | 0 00023134 | 3 79E-03 | | 23 | LOG | 2 48E-03 | 0 01 |
| PST | Pentachlorobenzene | 3.1605E-07 | 3 48E-07 | | 23 | LOG | 6 79E-07 | 1 74E-06 |
| PST | Trans-Nonachlor | 0 03743015 | 4 06E-03 | | 23 | LOG | 0.24 | 0.81 |
| PST | 1,2,3,4-Tetrachlorobenzene | 3 7847E-06 | 1 25E-06 | | 23 | LOG | 4 19E-06 | 1 60E-05 |
| PST | 1,2,4,5-Tetrachlorobenzene | 2 7004E-05 | 2.64E-06 | | 23 | LOG | 1 06E-05 | 3.08E-05 |
| PST | o,p'-DDD | 9 0928E-05 | 9 39E-05 | | 23 | LOG | 6 29E-04 | 1 96E-03 |
| PST | p,p'-DDD | 8 0017E-06 | 2 51E-06 | | 23 | LOG | 3 44E-05 | 1.25E-04 |
| PST | o,p'-DDE | 1 2598E-07 | 4 78E-08 | | 23 | LOG | 9 78E-06 | 5 49E-05 |
| PST | o,p'-DDT | 0 02186027 | 0.02 | | 23 | LOG | 0 50 | 1 48 |
| PST | p,p'-DDE | 1 8897E-05 | 1 63E-06 | | 23 | LOG | 2.61E-05 | 8 08E-05 |
| PST | p,p'-DDT | 0 01 | 8 73E-03 | | 23 | LOG | 0 71 | 1 43 |
| | TOX FLAG | 0 | 0 | 2 | | | | |
| | Survival (% of Control) | 90 | 90 | | | | | |

Table A-2-2 7 Porewater Hazard Quotients[1] (PW-HQs) based on data from the Portsmouth Naval Shipyard investigation for stations exhibiting **TOXICITY**[2] to amphipods (*Ampelisca abdita*)

| Class | Analyte | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | | | | | | | | 0 04 | | 0 04 | |
| MET | Cadmium | | | | | | | | | | 0 05 | | 0 05 | |
| MET | Chromium | | | | | | | | | | 0 05 | | 0 05 | |
| MET | Copper | | | | | | | | | | 1.29 | | 153 | |
| MET | Lead | | | | | | | | | | 0 19 | | 0 19 | |
| MET | Mercury | | | | | | | | | | 0 03 | | 0 03 | |
| MET | Nickel | | | | | | | | | | 3 29 | | 0 73 | |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | | | | | | | | | | 0 08 | | 0 11 | |
| MET | SEM-AVS | | | | | | | | | | -0 11 | | 0 24 | |
| PAH | 2-Methylnaphthalene (L) | | | | | | | | | | 1 61 | | 0 07 | |
| PAH | Acenaphthene (L) | | | | | | | | | | 1 04E-03 | | 1 12E-04 | |
| PAH | Acenaphthylene (L) | | | | | | | | | | 6 94 | | 0 31 | |
| PAH | Anthracene (L) | | | | | | | | | | 7 42 | | 0 42 | |
| PAH | Benzo(a)anthracene (H) | | | | | | | | | | 4 03 | | 0 20 | |
| PAH | Benzo(a)pyrene (H) | | | | | | | | | | 2.31 | | 0 16 | |
| PAH | Biphenyl (L) | | | | | | | | | | 0 01 | | 1 45E-03 | |
| PAH | Chrysene (H) | | | | | | | | | | 2 65 | | 0 17 | |
| PAH | Dibenz(a,h)anthracene (H) | | | | | | | | | | 3.80 | | 0 17 | |
| PAH | Fluoranthene (H) | | | | | | | | | | 0 09 | | 7 52E-03 | |
| PAH | Fluorene (L) | | | | | | | | | | 7.31 | | 0 32 | |
| PAH | Naphthalene (L) | | | | | | | | | | 0 01 | | 3 87E-04 | |
| PAH | Phenanthrene (L) | | | | | | | | | | 0 45 | | 0 03 | |
| PAH | Pyrene (H) | | | | | | | | | | 2 00 | | 0.16 | |
| PAH | LMW PAHs | | | | | | | | | | 3 08 | | 0 14 | |
| PAH | HMW PAHs | | | | | | | | | | 7 95 | | 0.61 | |
| PAH | Total PAHs | | | | | | | | | | 3 26 | | 0 17 | |
| PCB | Total PCBs | | | | | | | | | | 0 38 | | 0.12 | |
| PST | Aldrin | | | | | | | | | | 6 10E-06 | | 9 09E-06 | |
| PST | Alpha-BHC | | | | | | | | | | 0 02 | | 0 01 | |
| PST | Alpha-chlordane | | | | | | | | | | 0 01 | | 1 92E-03 | |
| PST | Beta-BHC | | | | | | | | | | 9 44E-03 | | 0 07 | |
| PST | Chlorpyrifos | | | | | | | | | | 0 01 | | 0 02 | |
| PST | CIS-Nonachlor | | | | | | | | | | 0 21 | | 0 64 | |
| PST | Delta-BHC | | | | | | | | | | 2 06E-03 | | 8 23E-03 | |
| PST | Dieldrin | | | | | | | | | | 7 60E-03 | | 0 04 | |
| PST | Endosulfan II | | | | | | | | | | 1 61 | | 0 25 | |
| PST | Endrin | | | | | | | | | | 0 02 | | 0 04 | |
| PST | Gamma-BHC (Lindane) | | | | | | | | | | 0 02 | | 0 02 | |
| PST | Gamma-Chlordane | | | | | | | | | | 7 32E-03 | | 1 33E-03 | |
| PST | Heptachlor | | | | | | | | | | 0 01 | | 5 65E-04 | |
| PST | Heptachlor epoxide | | | | | | | | | | 4 18E-03 | | 6 12E-03 | |
| PST | Hexachlorobenzene | | | | | | | | | | 8 90E-08 | | 1 82E-07 | |
| PST | Mirex | | | | | | | | | | 2 39E-03 | | 3 05E-04 | |
| PST | Oxychlordane | | | | | | | | | | 8 81E-03 | | 1 44E-04 | |
| PST | Pentachlorobenzene | | | | | | | | | | 5 09E-07 | | 6 06E-07 | |
| PST | Trans-Nonachlor | | | | | | | | | | 0 18 | | 0 17 | |
| PST | 1,2,3,4-Tetrachlorobenzene | | | | | | | | | | 6 45E-06 | | 1 39E-05 | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | | | | | | | 2 26E-05 | | 4 93E-06 | |
| PST | o,p'-DDD | | | | | | | | | | 1 70E-03 | | 2 27E-03 | |
| PST | p,p'-DDD | | | | | | | | | | 6 71E-05 | | 5 93E-04 | |
| PST | o,p'-DDE | | | | | | | | | | 1 17E-05 | | 3 42E-04 | |
| PST | o,p'-DDT | | | | | | | | | | 1.28 | | 1 55 | |
| PST | p,p'-DDE | | | | | | | | | | 6 77E-05 | | 1 39E-03 | |
| PST | p,p'-DDT | | | | | | | | | | 0 07 | | 9.60 | |
| | TOX FLAG[3] | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 1 | 2 | 1 | 0 |
| | Survival (% of Control) | | 96 0 | 91.0 | 104 0 | 102.0 | | 100 0 | 92 0 | | 5 0 | | 70 0 | 97 0 |

1 - Hazard Quotients from Table A-2-2.5

2 - See TtNUS (2000b) for toxicity data

3 - Toxicity flag: 0= nontoxic, 1= toxic, 2= no data

Units: PW-HQ = unitless

Table A-2-2 7 (continued)

| Class | Analyte | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | | | | | | | | | | | 0 04 |
| MET | Cadmium | | | | | | | | | | | | | 0 05 |
| MET | Chromium | | | | | | | | | | | | | 0 05 |
| MET | Copper | | | | | | | | | | | | | 7 48 |
| MET | Lead | | | | | | | | | | | | | 0 19 |
| MET | Mercury | | | | | | | | | | | | | 0 03 |
| MET | Nickel | | | | | | | | | | | | | 1 46 |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | | | | | | | | | | | | | 0 15 |
| MET | SEM-AVS | | | | | | | | | | | 0 99 | | 0 31 |
| PAH | 2-Methylnaphthalene (L) | | | | | | | | | | | 0 40 | | 0 09 |
| PAH | Acenaphthene (L) | | | | | | | | | | | 5 52E-04 | | 5 64E-05 |
| PAH | Acenaphthylene (L) | | | | | | | | | | | 2 52 | | 0 44 |
| PAH | Anthracene (L) | | | | | | | | | | | 4 97 | | 0 49 |
| PAH | Benzo(a)anthracene (H) | | | | | | | | | | | 2 18 | | 0 14 |
| PAH | Benzo(a)pyrene (H) | | | | | | | | | | | 1 17 | | 0 08 |
| PAH | Biphenyl (L) | | | | | | | | | | | 4 55E-03 | | 3 51E-03 |
| PAH | Chrysene (H) | | | | | | | | | | | 1 77 | | 0 11 |
| PAH | Dibenz(a,h)anthracene (H) | | | | | | | | | | | 1 38 | | 0 11 |
| PAH | Fluoranthene (H) | | | | | | | | | | | 0 09 | | 3 06E-03 |
| PAH | Fluorene (L) | | | | | | | | | | | 2 31 | | 0 31 |
| PAH | Naphthalene (L) | | | | | | | | | | | 2 07E-03 | | 8 81E-04 |
| PAH | Phenanthrene (L) | | | | | | | | | | | 0 28 | | 0 02 |
| PAH | Pyrene (H) | | | | | | | | | | | 2 14 | | 0 07 |
| PAH | LMW PAHs | | | | | | | | | | | 1 08 | | 0 20 |
| PAH | HMW PAHs | | | | | | | | | | | 7 55 | | 0.28 |
| PAH | Total PAHs | | | | | | | | | | | 1 45 | | 0 20 |
| PCB | Total PCBs | | | | | | | | | | | 0 35 | | 0 17 |
| PST | Aldrin | | | | | | | | | | | 3 28E-05 | | 2.06E-05 |
| PST | Alpha-BHC | | | | | | | | | | | 0 01 | | 0 01 |
| PST | Alpha-chlordane | | | | | | | | | | | 0 04 | | 2 55E-03 |
| PST | Beta-BHC | | | | | | | | | | | 0 03 | | 0 11 |
| PST | Chlorpyrifos | | | | | | | | | | | 0 02 | | 0 05 |
| PST | CIS-Nonachlor | | | | | | | | | | | 0 46 | | 0 11 |
| PST | Delta-BHC | | | | | | | | | | | 3 49E-03 | | 7 10E-03 |
| PST | Dieldrin | | | | | | | | | | | 0 14 | | 9 89E-04 |
| PST | Endosulfan II | | | | | | | | | | | 2 89 | | 0 42 |
| PST | Endrin | | | | | | | | | | | 0 04 | | 0 08 |
| PST | Gamma-BHC (Lindane) | | | | | | | | | | | 0 05 | | 0 05 |
| PST | Gamma-Chlordane | | | | | | | | | | | 0 06 | | 1 09E-03 |
| PST | Heptachlor | | | | | | | | | | | 4 29E-03 | | 2 09E-03 |
| PST | Heptachlor epoxide | | | | | | | | | | | 6 81E-03 | | 0 18 |
| PST | Hexachlorobenzene | | | | | | | | | | | 2 65E-07 | | 5 39E-06 |
| PST | Mirex | | | | | | | | | | | 3 87E-03 | | 6 92E-04 |
| PST | Oxychlordane | | | | | | | | | | | 4 01E-03 | | 3 28E-04 |
| PST | Pentachlorobenzene | | | | | | | | | | | 1 34E-06 | | 2 24E-05 |
| PST | Trans-Nonachlor | | | | | | | | | | | 1 18 | | 0 03 |
| PST | 1,2,3,4-Tetrachlorobenzene | | | | | | | | | | | 5 85E-06 | | 3 42E-05 |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | | | | | | | | 1 41E-05 | | 7 07E-05 |
| PST | o,p'-DDD | | | | | | | | | | | 3 20E-03 | | 4 73E-05 |
| PST | p,p'-DDD | | | | | | | | | | | 1 77E-04 | | 2 15E-05 |
| PST | o,p'-DDE | | | | | | | | | | | 3.32E-04 | | 6 95E-06 |
| PST | o,p'-DDT | | | | | | | | | | | 2 66 | | 0 04 |
| PST | p,p'-DDE | | | | | | | | | | | 2 68E-04 | | 4 96E-06 |
| PST | p,p'-DDT | | | | | | | | | | | 6 46 | | 0 08 |
| | TOX FLAG[3] | 0 | 2 | 0 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 1 | 0 | 1 |
| | Survival (% of Control) | 97 0 | | 102 0 | | 99 0 | 101.0 | | | 102 0 | | 74 0 | 102 0 | 71 0 |

Table A-2-2.7 (continued)

| Class | Analyte | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | | | | | | | | | 0 43 | | |
| MET | Cadmium | | | | | | | | | | | 0 05 | | |
| MET | Chromium | | | | | | | | | | | 0 05 | | |
| MET | Copper | | | | | | | | | | | 0 48 | | |
| MET | Lead | | | | | | | | | | | 0.19 | | |
| MET | Mercury | | | | | | | | | | | 0 05 | | |
| MET | Nickel | | | | | | | | | | | 0 30 | | |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | | | | | | | | | | | 0 04 | | |
| MET | SEM-AVS | | | | | | | | | | | -22 00 | | |
| PAH | 2-Methylnaphthalene (L) | | | | | | | | | | | 1.69 | | |
| PAH | Acenaphthene (L) | | | | | | | | | | | 0 03 | | |
| PAH | Acenaphthylene (L) | | | | | | | | | | | 2 47 | | |
| PAH | Anthracene (L) | | | | | | | | | | | 13 64 | | |
| PAH | Benzo(a)anthracene (H) | | | | | | | | | | | 4 71 | | |
| PAH | Benzo(a)pyrene (H) | | | | | | | | | | | 2 09 | | |
| PAH | Biphenyl (L) | | | | | | | | | | | 0.09 | | |
| PAH | Chrysene (H) | | | | | | | | | | | 2 80 | | |
| PAH | Dibenz(a,h)anthracene (H) | | | | | | | | | | | 1 97 | | |
| PAH | Fluoranthene (H) | | | | | | | | | | | 0 17 | | |
| PAH | Fluorene (L) | | | | | | | | | | | 101 | | |
| PAH | Naphthalene (L) | | | | | | | | | | | 3 00E-03 | | |
| PAH | Phenanthrene (L) | | | | | | | | | | | 2 18 | | |
| PAH | Pyrene (H) | | | | | | | | | | | 3 38 | | |
| PAH | LMW PAHs | | | | | | | | | | | 8 97 | | |
| PAH | HMW PAHs | | | | | | | | | | | 13 06 | | |
| PAH | Total PAHs | | | | | | | | | | | 8 82 | | |
| PCB | Total PCBs | | | | | | | | | | | 0 36 | | |
| PST | Aldrin | | | | | | | | | | | 1 14E-03 | | |
| PST | Alpha-BHC | | | | | | | | | | | 0 02 | | |
| PST | Alpha-chlordane | | | | | | | | | | | 1 72E-03 | | |
| PST | Beta-BHC | | | | | | | | | | | 0 10 | | |
| PST | Chlorpyrifos | | | | | | | | | | | 3 71E-03 | | |
| PST | CIS-Nonachlor | | | | | | | | | | | 0 10 | | |
| PST | Delta-BHC | | | | | | | | | | | 2 65E-03 | | |
| PST | Dieldrin | | | | | | | | | | | 0 02 | | |
| PST | Endosulfan II | | | | | | | | | | | 0 25 | | |
| PST | Endrin | | | | | | | | | | | 0 03 | | |
| PST | Gamma-BHC (Lindane) | | | | | | | | | | | 0 02 | | |
| PST | Gamma-Chlordane | | | | | | | | | | | 5 50E-04 | | |
| PST | Heptachlor | | | | | | | | | | | 1 75E-03 | | |
| PST | Heptachlor epoxide | | | | | | | | | | | 5 28E-03 | | |
| PST | Hexachlorobenzene | | | | | | | | | | | 6 45E-09 | | |
| PST | Mirex | | | | | | | | | | | 2 08E-03 | | |
| PST | Oxychlordane | | | | | | | | | | | 0 01 | | |
| PST | Pentachlorobenzene | | | | | | | | | | | 2 95E-07 | | |
| PST | Trans-Nonachlor | | | | | | | | | | | 0 02 | | |
| PST | 1,2,3,4-Tetrachlorobenzene | | | | | | | | | | | 2 57E-06 | | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | | | | | | | | 1 04E-05 | | |
| PST | o,p'-DDD | | | | | | | | | | | 1 98E-04 | | |
| PST | p,p'-DDD | | | | | | | | | | | 1 30E-05 | | |
| PST | o,p'-DDE | | | | | | | | | | | 6 42E-07 | | |
| PST | o,p'-DDT | | | | | | | | | | | 0.03 | | |
| PST | p,p'-DDE | | | | | | | | | | | 8.20E-07 | | |
| PST | p,p'-DDT | | | | | | | | | | | 0.02 | | |
| | TOX FLAG[3] | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 0 |
| | Survival (% of Control) | 102 0 | | 103 0 | 98 0 | | 90 0 | 89 0 | 97 0 | 102 0 | | 66 0 | | 93 0 |

Table A-2-2 7 (continued)

| Class | Analyte | M14-100B | M14-200B | M14-300B | N | Mean | Maximum HQ |
|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | | 4 | 0 14 | 0 43 |
| MET | Cadmium | | | | 4 | 0 05 | 0 05 |
| MET | Chromium | | | | 4 | 0 05 | 0 05 |
| MET | Copper | | | | 4 | 40 54 | 153 |
| MET | Lead | | | | 4 | 0 19 | 0 19 |
| MET | Mercury | | | | 4 | 0 03 | 0.05 |
| MET | Nickel | | | | 4 | 1 45 | 3 29 |
| MET | Silver | | | | 0 | | |
| MET | Zinc | | | | 4 | 0 09 | 0 15 |
| MET | SEM-AVS | | | | 5 | -4 11 | 0 99 |
| PAH | 2-Methylnaphthalene (L) | | | | 5 | 0 77 | 1 69 |
| PAH | Acenaphthene (L) | | | | 5 | 5 78E-03 | 0 03 |
| PAH | Acenaphthylene (L) | | | | 5 | 2.54 | 6.94 |
| PAH | Anthracene (L) | | | | 5 | 5 39 | 13.64 |
| PAH | Benzo(a)anthracene (H) | | | | 5 | 2 25 | 4 71 |
| PAH | Benzo(a)pyrene (H) | | | | 5 | 1 16 | 2 31 |
| PAH | Biphenyl (L) | | | | 5 | 0 02 | 0 09 |
| PAH | Chrysene (H) | | | | 5 | 1 50 | 2 80 |
| PAH | Dibenz(a,h)anthracene (H) | | | | 5 | 1 49 | 3 80 |
| PAH | Fluoranthene (H) | | | | 5 | 0 07 | 0 17 |
| PAH | Fluorene (L) | | | | 5 | 22.30 | 101 |
| PAH | Naphthalene (L) | | | | 5 | 3 55E-03 | 0 01 |
| PAH | Phenanthrene (L) | | | | 5 | 0 59 | 2 18 |
| PAH | Pyrene (H) | | | | 5 | 1.55 | 3.38 |
| PAH | LMW PAHs | | | | 5 | 2 70 | 8 97 |
| PAH | HMW PAHs | | | | 5 | 5 89 | 13.06 |
| PAH | Total PAHs | | | | 5 | 2 78 | 8 82 |
| PCB | Total PCBs | | | | 5 | 0 28 | 0 38 |
| PST | Aldrin | | | | 5 | 2 43E-04 | 1 14E-03 |
| PST | Alpha-BHC | | | | 5 | 0 02 | 0 02 |
| PST | Alpha-chlordane | | | | 5 | 0 01 | 0 04 |
| PST | Beta-BHC | | | | 5 | 0 06 | 0 11 |
| PST | Chlorpyrifos | | | | 5 | 0 02 | 0 05 |
| PST | CIS-Nonachlor | | | | 5 | 0 30 | 0 64 |
| PST | Delta-BHC | | | | 5 | 4 71E-03 | 8 23E-03 |
| PST | Dieldrin | | | | 5 | 0 04 | 0 14 |
| PST | Endosulfan II | | | | 5 | 1.08 | 2 89 |
| PST | Endrin | | | | 5 | 0 04 | 0 08 |
| PST | Gamma-BHC (Lindane) | | | | 5 | 0 03 | 0 05 |
| PST | Gamma-Chlordane | | | | 5 | 0 01 | 0 06 |
| PST | Heptachlor | | | | 5 | 3 84E-03 | 0 01 |
| PST | Heptachlor epoxide | | | | 5 | 0 04 | 0 18 |
| PST | Hexachlorobenzene | | | | 5 | 1 19E-06 | 5 39E-06 |
| PST | Mirex | | | | 5 | 1 87E-03 | 3 87E-03 |
| PST | Oxychlordane | | | | 5 | 5 01E-03 | 0 01 |
| PST | Pentachlorobenzene | | | | 5 | 5 03E-06 | 2 24E-05 |
| PST | Trans-Nonachlor | | | | 5 | 0 32 | 1 18 |
| PST | 1,2,3,4-Tetrachlorobenzene | | | | 5 | 1 26E-05 | 3 42E-05 |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | 5 | 2 45E-05 | 7 07E-05 |
| PST | o,p'-DDD | | | | 5 | 1 48E-03 | 3 20E-03 |
| PST | p,p'-DDD | | | | 5 | 1 74E-04 | 5 93E-04 |
| PST | o,p'-DDE | | | | 5 | 1 39E-04 | 3 42E-04 |
| PST | o,p'-DDT | | | | 5 | 1 11 | 2 66 |
| PST | p,p'-DDE | | | | 5 | 3 46E-04 | 1 39E-03 |
| PST | p,p'-DDT | | | | 5 | 3.25 | 9 60 |
| | TOX FLAG[3] | 0 | 0 | 2 | | | |
| | Survival (% of Control) | 90 0 | 90 0 | | | | |

Table A-2-2 8 Porewater Hazard Quotients[1] (PW-HQs) based on data from the Portsmouth Naval Shipyard investigation for stations exhibiting **NO TOXICITY**[2] to sea urchin (*Arbacia punctulata*)

| Class | Analyte | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | 0.04 | | 0 15 | 0 12 | | 0 10 | 0 04 | | 0 04 | | 0 04 | 0 04 |
| MET | Cadmium | | 0 05 | | 0 05 | 0 05 | | 0 05 | 0 05 | | 0 05 | | 0 05 | 0 05 |
| MET | Chromium | | 0 05 | | 0 05 | 0 05 | | 0 05 | 0 05 | | 0 05 | | 0 05 | 0 05 |
| MET | Copper | | 1 81 | | 0 90 | 0 71 | | 0 48 | 0 71 | | 1.29 | | 153 | 0 48 |
| MET | Lead | | 0 19 | | 0 19 | 0 19 | | 0 19 | 0 19 | | 0 19 | | 0 19 | 0 19 |
| MET | Mercury | | 0 03 | | 0 03 | 0 03 | | 0 03 | 0 03 | | 0 03 | | 0 03 | 0 03 |
| MET | Nickel | | 0 85 | | 0 30 | 0 30 | | 0 30 | 1 22 | | 3 29 | | 0 73 | 0 30 |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | | 0 10 | | 0 07 | 0 06 | | 0 05 | 0 10 | | 0 08 | | 0 11 | 0 06 |
| MET | SEM-AVS | | 0.24 | | -5 21E+00 | -2 90E-01 | | -1 01E+01 | -3 18E+00 | | -1 07E-01 | | 0 24 | -1 14E+01 |
| PAH | 2-Methylnaphthalene (L) | | 0 60 | | 0 16 | 0 07 | | 0 17 | 0 20 | | 1 61 | | 0 07 | 0 18 |
| PAH | Acenaphthene (L) | | 1 13E-03 | | 1.64E-04 | 6 91E-05 | | 7 15E-04 | 4 46E-04 | | 1 04E-03 | | 1 12E-04 | 4 09E-04 |
| PAH | Acenaphthylene (L) | | 1 92 | | 0.84 | 0 38 | | 1 04 | 0 85 | | 6 94 | | 0.31 | 1 13 |
| PAH | Anthracene (L) | | 3 81 | | 1.04 | 0 49 | | 2.33 | 1 58 | | 7 42 | | 0 42 | 2 01 |
| PAH | Benzo(a)anthracene (H) | | 2.53 | | 0 57 | 0 28 | | 1 16 | 0 95 | | 4 03 | | 0 20 | 0 96 |
| PAH | Benzo(a)pyrene (H) | | 1 89 | | 0 42 | 0 17 | | 0 75 | 0 66 | | 2 31 | | 0 16 | 0 65 |
| PAH | Biphenyl (L) | | 9 62E-03 | | 2 70E-03 | 8.53E-04 | | 2 97E-03 | 2 98E-03 | | 0 01 | | 1 45E-03 | 3.99E-03 |
| PAH | Chrysene (H) | | 1 50 | | 0 39 | 0 17 | | 0.81 | 0 66 | | 2 65 | | 0 17 | 0 74 |
| PAH | Dibenz(a,h)anthracene (H) | | 2 61 | | 0 46 | 0 18 | | 0 83 | 0 91 | | 3 80 | | 0 17 | 0 64 |
| PAH | Fluoranthene (H) | | 0 05 | | 0 01 | 7.52E-03 | | 0.03 | 0 03 | | 0 09 | | 7.52E-03 | 0 03 |
| PAH | Fluorene (L) | | 5 07 | | 1 00 | 0 40 | | 2 97 | 1 98 | | 7 31 | | 0 32 | 2 24 |
| PAH | Naphthalene (L) | | 4 82E-03 | | 1 25E-03 | 5 35E-04 | | 1 65E-03 | 1 49E-03 | | 0 01 | | 3 87E-04 | 1 78E-03 |
| PAH | Phenanthrene (L) | | 0 41 | | 0 06 | 0 03 | | 0 21 | 0 15 | | 0 45 | | 0 03 | 0 13 |
| PAH | Pyrene (H) | | 1 11 | | 0 33 | 0 17 | | 0 73 | 0 61 | | 2 00 | | 0 16 | 0 71 |
| PAH | LMW PAHs | | 1.56 | | 0 37 | 0 17 | | 0 73 | 0 56 | | 3 08 | | 0 14 | 0 62 |
| PAH | HMW PAHs | | 4 34 | | 1 16 | 0 64 | | 2 80 | 2 26 | | 7 95 | | 0 61 | 2 63 |
| PAH | Total PAHs | | 1 66 | | 0 40 | 0 19 | | 0 83 | 0 65 | | 3 26 | | 0 17 | 0 72 |
| PCB | Total PCBs | | 0 10 | | 0 06 | 0 02 | | 0 20 | 0 10 | | 0 38 | | 0 12 | 0 14 |
| PST | Aldrin | | 3 65E-06 | | 3 97E-06 | 1 46E-06 | | 4 02E-06 | 4 74E-06 | | 6 10E-06 | | 9 09E-06 | 1 00E-05 |
| PST | Alpha-BHC | | 7 90E-03 | | 6.95E-03 | 2 28E-03 | | 7 36E-03 | 0 03 | | 0 02 | | 0 01 | 0 01 |
| PST | Alpha-chlordane | | 0 09 | | 2 84E-03 | 1.19E-03 | | 1 83E-03 | 3 17E-03 | | 0 01 | | 1 92E-03 | 3 61E-03 |
| PST | Beta-BHC | | 5 35E-03 | | 0.02 | 0 02 | | 0.11 | 0 05 | | 9 44E-03 | | 0.07 | 0 14 |
| PST | Chlorpyrifos | | 8 29E-03 | | 8 97E-03 | 3 32E-03 | | 9 65E-03 | 0 01 | | 0.01 | | 0.02 | 0 04 |
| PST | CIS-Nonachlor | | 0 42 | | 0 04 | 0 02 | | 0 24 | 0 08 | | 0 21 | | 0 64 | 0 07 |
| PST | Delta-BHC | | 1 23E-03 | | 3.17E-03 | 7 50E-04 | | 1 44E-03 | 8 15E-03 | | 2 06E-03 | | 8 23E-03 | 2 83E-03 |
| PST | Dieldrin | | 3.08 | | 3 86E-03 | 0 04 | | 0 12 | 0 20 | | 7 60E-03 | | 0 04 | 0 03 |
| PST | Endosulfan II | | 1.81 | | 0 60 | 0 28 | | 0 72 | 0 44 | | 1 61 | | 0 25 | 0.85 |
| PST | Endrin | | 0 22 | | 0 02 | 6 10E-03 | | 0 02 | 0 02 | | 0 02 | | 0 04 | 0 02 |
| PST | Gamma-BHC (Lindane) | | 0 04 | | 8 76E-03 | 6 23E-03 | | 0 02 | 0 02 | | 0 02 | | 0 02 | 0 02 |
| PST | Gamma-Chlordane | | 0 12 | | 7 12E-04 | 6 07E-04 | | 2 16E-03 | 1 91E-03 | | 7 32E-03 | | 1 33E-03 | 2 98E-03 |
| PST | Heptachlor | | 7 73E-03 | | 7 25E-04 | 5 15E-04 | | 4 25E-03 | 4 76E-03 | | 0 01 | | 5 65E-04 | 2 92E-04 |
| PST | Heptachlor epoxide | | 2 41E-03 | | 2 67E-03 | 1 00E-03 | | 2 81E-03 | 3 23E-03 | | 4 18E-03 | | 6 12E-03 | 4 04E-03 |
| PST | Hexachlorobenzene | | 4 65E-08 | | 4 09E-08 | 1 11E-08 | | 1 61E-08 | 5 41E-08 | | 8 90E-08 | | 1 82E-07 | 1 04E-06 |
| PST | Mirex | | 0 01 | | 1 80E-03 | 1 49E-04 | | 3.24E-04 | 2 34E-03 | | 2 39E-03 | | 3 05E-04 | 1 51E-03 |
| PST | Oxychlordane | | 9 72E-03 | | 2.85E-04 | 2 02E-04 | | 6 38E-04 | 2 34E-03 | | 8 81E-03 | | 1 44E-04 | 1 72E-03 |
| PST | Pentachlorobenzene | | 4 70E-07 | | 4 14E-07 | 8 06E-08 | | 4 53E-07 | 3 75E-07 | | 5 09E-07 | | 6 06E-07 | 6.65E-07 |
| PST | Trans-Nonachlor | | 1.29 | | 0.06 | 0 03 | | 0 06 | 0 04 | | 0.18 | | 0 17 | 0 08 |
| PST | 1,2,3,4-Tetrachlorobenzene | | 3 01E-06 | | 2.22E-06 | 9.03E-07 | | 6 57E-06 | 5 56E-06 | | 6 45E-06 | | 1 39E-05 | 2 04E-06 |
| PST | 1,2,4,5-Tetrachlorobenzene | | 3 83E-06 | | 4 55E-06 | 1.73E-06 | | 1 23E-05 | 6 52E-06 | | 2 26E-05 | | 4 93E-06 | 1 70E-05 |
| PST | o,p'-DDD | | 3.69E-03 | | 1 01E-04 | 8.75E-05 | | 3 01E-04 | 1 84E-04 | | 1 70E-03 | | 2 27E-03 | 1 59E-04 |
| PST | p,p'-DDD | | 1 40E-04 | | 1.06E-05 | 6 36E-06 | | 2 70E-06 | 3 17E-06 | | 6 71E-05 | | 5 93E-04 | 2 43E-05 |
| PST | o,p'-DDE | | 9.19E-05 | | 4.53E-07 | 3 52E-06 | | 6 01E-06 | 1 63E-06 | | 1 17E-05 | | 3 42E-04 | 1 30E-06 |
| PST | o,p'-DDT | | 3.08 | | 0 04 | 0 05 | | 0 24 | 0.09 | | 1 28 | | 1 55 | 0 05 |
| PST | p,p'-DDE | | 2 17E-04 | | 3 88E-06 | 7 96E-06 | | 1 18E-05 | 9.98E-06 | | 6.77E-05 | | 1 39E-03 | 9 88E-06 |
| PST | p,p'-DDT | | 3 83 | | 0 02 | 0 08 | | 0 07 | 0 02 | | 0 07 | | 9 60 | 0 02 |
| | TOX FLAG | 2 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 2 | 0 | 0 |
| | EC50 | | >100 | 36 5 | 70 7 | 70 7 | | 70 7 | 84 5 | | >100 | | 78 6 | >100 |

1 - Hazard Quotients from Table A-2-2 5, only values for which the corresponding sample was categorized as toxic are shown

2 - See TtNUS (2000b) for toxicity data

3 - Toxicity flag. 0= nontoxic, 1= toxic, 2= no data

4 - Aquatic Reference Screening Value (RSV) calculated as 95th percentile Upper Limit (95% UL) based on sample and distribution type

NORM = Normal Distribution

LOG = LOG-Normal distribution

Units PW-HQ = unitless

Table A-2-2 8 (continued)

| Class | Analyte | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | 0 13 | | 1 34 | 0 13 | | | 0 04 | | | 0 10 | -0 04 |
| MET | Cadmium | | | 0 05 | | 0 05 | 0 05 | | | 0 05 | | | 0 05 | 0 05 |
| MET | Chromium | | | 0 05 | | 0 05 | 0 05 | | | 0 05 | | | 0 05 | 0 05 |
| MET | Copper | | | 0 48 | | 0 48 | 0 48 | | | 0 48 | | | 0 48 | 7 48 |
| MET | Lead | | | 0 19 | | 0 19 | 0 19 | | | 0 19 | | | 0 19 | 0 19 |
| MET | Mercury | | | 0 03 | | 0 03 | 0 03 | | | 0 03 | | | 0 05 | 0 03 |
| MET | Nickel | | | 0 30 | | 1.59 | 0 30 | | | 0 73 | | | 0 30 | 1 46 |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | | | 0 05 | | 0 11 | 0 06 | | | 0 05 | | | 0 04 | 0 15 |
| MET | SEM-AVS | | | -5 55E-01 | | 0 03 | -1.85E+00 | | | -3 41E+00 | | | -6 47E+00 | 0 31 |
| PAH | 2-Methylnaphthalene (L) | | | 0 23 | | 0 07 | 0 13 | | | 0 37 | | | 0.23 | 0 09 |
| PAH | Acenaphthene (L) | | | 6 93E-04 | | 1 78E-04 | 2 40E-04 | | | 7 76E-04 | | | 6 26E-04 | 5 64E-05 |
| PAH | Acenaphthylene (L) | | | 1 28 | | 0 20 | 0.71 | | | 1 46 | | | 1 10 | 0 44 |
| PAH | Anthracene (L) | | | 2 19 | | 0 43 | 1.10 | | | 2 54 | | | 1 88 | 0 49 |
| PAH | Benzo(a)anthracene (H) | | | 2 19 | | 0 25 | 0 70 | | | 1.26 | | | 0 97 | 0.14 |
| PAH | Benzo(a)pyrene (H) | | | 2 15 | | 0 19 | 0 57 | | | 0 84 | | | 0 70 | 0 08 |
| PAH | Biphenyl (L) | | | 5.22E-03 | | 2 10E-03 | 2.50E-03 | | | 6 38E-03 | | | 3 92E-03 | 3 51E-03 |
| PAH | Chrysene (H) | | | 2 14 | | 0 17 | 0 52 | | | 1.03 | | | 0 73 | 0 11 |
| PAH | Dibenz(a,h)anthracene (H) | | | 2 34 | | 0 17 | 0 56 | | | 1 13 | | | 0.80 | 0 11 |
| PAH | Fluoranthene (H) | | | 0 08 | | 8 94E-03 | 0 02 | | | 0 03 | | | 0.03 | 3 06E-03 |
| PAH | Fluorene (L) | | | 3 87 | | 0 72 | 1 22 | | | 2 82 | | | 2 22 | 0 31 |
| PAH | Naphthalene (L) | | | 2 14E-03 | | 5 89E-04 | 1 31E-03 | | | 2 54E-03 | | | 1 88E-03 | 8 81E-04 |
| PAH | Phenanthrene (L) | | | 0 40 | | 0 05 | 0.10 | | | 0 18 | | | 0 15 | 0 02 |
| PAH | Pyrene (H) | | | 1 67 | | 0.20 | 0 48 | | | 0 89 | | | 0 68 | 0 07 |
| PAH | LMW PAHs | | | 0 98 | | 0 19 | 0 41 | | | 0 88 | | | 0 68 | 0 20 |
| PAH | HMW PAHs | | | 6.60 | | 0 73 | 1 76 | | | 3 13 | | | 2 52 | 0 28 |
| PAH | Total PAHs | | | 1.30 | | 0 22 | 0 48 | | | 0 99 | | | 0 76 | 0 20 |
| PCB | Total PCBs | | | 0 10 | | 0 11 | 0 21 | | | 0 41 | | | 0 17 | 0 17 |
| PST | Aldrin | | | 1 55E-05 | | 1 35E-05 | 7 55E-06 | | | 6 75E-06 | | | 8 14E-04 | 2 06E-05 |
| PST | Alpha-BHC | | | 7 94E-03 | | 6 63E-03 | 0 01 | | | 0 02 | | | 0 01 | 0 01 |
| PST | Alpha-chlordane | | | 5 85E-03 | | 2.35E-03 | 2.50E-03 | | | 0 03 | | | 3 69E-03 | 2 55E-03 |
| PST | Beta-BHC | | | 0 02 | | 0 02 | 0 06 | | | 0 07 | | | 0 07 | 0 11 |
| PST | Chlorpyrifos | | | 0 03 | | 0 03 | 0.02 | | | 0 02 | | | 0 01 | 0 05 |
| PST | CIS-Nonachlor | | | 0 12 | | 0 14 | 0 07 | | | 0 31 | | | 0 12 | 0 11 |
| PST | Delta-BHC | | | 7 25E-03 | | 4 37E-03 | 2 55E-03 | | | 1 09E-03 | | | 0 02 | 7.10E-03 |
| PST | Dieldrin | | | 0 10 | | 0 03 | 0 11 | | | 0.25 | | | 0 05 | 9 89E-04 |
| PST | Endosulfan II | | | 1 69 | | 0 31 | 0 68 | | | 1 34 | | | 0 55 | 0 42 |
| PST | Endrin | | | 0 06 | | 0 06 | 0 03 | | | 0 07 | | | 0 02 | 0 08 |
| PST | Gamma-BHC (Lindane) | | | 0 04 | | 0 03 | 0 01 | | | 0 02 | | | 0 02 | 0 05 |
| PST | Gamma-Chlordane | | | 2 61E-03 | | 8 84E-04 | 3 75E-03 | | | 0 06 | | | 3 71E-04 | 1 09E-03 |
| PST | Heptachlor | | | 2 07E-03 | | 3 37E-03 | 1 69E-03 | | | 2 25E-03 | | | 1 14E-03 | 2 09E-03 |
| PST | Heptachlor epoxide | | | 0 01 | | 9.09E-03 | 5 00E-03 | | | 4.54E-03 | | | 3 59E-03 | 0 18 |
| PST | Hexachlorobenzene | | | 5 35E-08 | | 5 08E-08 | 2 82E-08 | | | 1 69E-07 | | | 8 69E-08 | 5 39E-06 |
| PST | Mirex | | | 7 53E-03 | | 4 54E-04 | 2.24E-03 | | | 3 24E-03 | | | 1 79E-04 | 6 92E-04 |
| PST | Oxychlordane | | | 3 58E-03 | | 5.01E-03 | 1 25E-03 | | | 3 98E-03 | | | 6.52E-04 | 3.28E-04 |
| PST | Pentachlorobenzene | | | 1.00E-06 | | 9.05E-07 | 1 12E-06 | | | 1 06E-06 | | | 1 28E-06 | 2 24E-05 |
| PST | Trans-Nonachlor | | | 0 03 | | 0.01 | 0 07 | | | 0.89 | | | 0.18 | 0 03 |
| PST | 1,2,3,4-Tetrachlorobenzene | | | 8 72E-06 | | 7 01E-06 | 6 28E-06 | | | 1 07E-05 | | | 2.79E-06 | 3.42E-05 |
| PST | 1,2,4,5-Tetrachlorobenzene | | | 1 36E-05 | | 6 55E-06 | 3 69E-05 | | | 2 05E-05 | | | 9 28E-06 | 7 07E-05 |
| PST | o,p'-DDD | | | 1 54E-04 | | 2 78E-05 | 2 58E-04 | | | 4 17E-03 | | | 6 40E-04 | 4 73E-05 |
| PST | p,p'-DDD | | | 2 31E-05 | | 7.41E-05 | 2 09E-05 | | | 1 50E-04 | | | 2.95E-05 | 2.15E-05 |
| PST | o,p'-DDE | | | 5.91E-07 | | 5 35E-07 | 1 13E-06 | | | 4 34E-05 | | | 8 13E-06 | 6 95E-06 |
| PST | o,p'-DDT | | | 0.04 | | 0 02 | 0 09 | | | 4 39 | | | 0 49 | 0 04 |
| PST | p,p'-DDE | | | 5.25E-06 | | 2 54E-05 | 2 48E-05 | | | 1 47E-04 | | | 2 81E-05 | 4 96E-06 |
| PST | p,p'-DDT | | | 0.03 | | 0 03 | 0 04 | | | 10 44 | | | 0 22 | 0 08 |
| | TOX FLAG | 1 | 2 | 0 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 2 | 0 | 0 |
| | EC50 | <25 | | >100 | | 75 5 | 69 7 | | | 71 7 | | | 69 3 | >100 |

Table A-2-2 8 (continued)

| Class | Analyte | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0 04 | | | 0 04 | | | 0 04 | 0 04 | 0 04 | | | | |
| MET | Cadmium | 0 05 | | | 0 05 | | | 0 05 | 0 05 | 0 05 | | | | |
| MET | Chromium | 0 05 | | | 0.05 | | | 0 05 | 0.05 | 0 05 | | | | |
| MET | Copper | 1.02 | | | 0 48 | | | 0 79 | 0 48 | 0 69 | | | | |
| MET | Lead | 0 19 | | | 0 19 | | | 0 19 | 0 19 | 0 19 | | | | |
| MET | Mercury | 0 03 | | | 0 03 | | | 0 03 | 0 03 | 0 06 | | | | |
| MET | Nickel | 1 83 | | | 0 30 | | | 1 22 | 0 30 | 0 30 | | | | |
| MET | Silver | | | | | | | | | | | | | |
| MET | Zinc | 0 11 | | | 0 08 | | | 0 09 | 0.08 | 0 13 | | | | |
| MET | SEM-AVS | -1 01E-01 | | | -1.09E-02 | | | -4 98E-01 | -1 47E+00 | -2 50E-01 | | | | |
| PAH | 2-Methylnaphthalene (L) | 0 12 | | | 0 14 | | | 0 53 | 1.52 | 1 76 | | | | |
| PAH | Acenaphthene (L) | 1 34E-04 | | | 1 75E-04 | | | 2 49E-04 | 9 61E-03 | 9 80E-03 | | | | |
| PAH | Acenaphthylene (L) | 0 38 | | | 0.34 | | | 0 81 | 1 88 | 1 86 | | | | |
| PAH | Anthracene (L) | 1 71 | | | 0 78 | | | 1 87 | 10.22 | 11 09 | | | | |
| PAH | Benzo(a)anthracene (H) | 0 83 | | | 0 35 | | | 0 81 | 5.94 | 6 57 | | | | |
| PAH | Benzo(a)pyrene (H) | 0 45 | | | 0 24 | | | 0 58 | 3 80 | 4 26 | | | | |
| PAH | Biphenyl (L) | 2 32E-03 | | | 2 26E-03 | | | 9 36E-03 | 0.02 | 0 02 | | | | |
| PAH | Chrysene (H) | 0 44 | | | 0.20 | | | 0 55 | 3 78 | 3.98 | | | | |
| PAH | Dibenz(a,h)anthracene (H) | 0 47 | | | 0.22 | | | 0.63 | 5 17 | 5.32 | | | | |
| PAH | Fluoranthene (H) | 0 02 | | | 0 01 | | | 0.02 | 0 14 | 0 17 | | | | |
| PAH | Fluorene (L) | 1 50 | | | 0 82 | | | 2.07 | 25 56 | 30 01 | | | | |
| PAH | Naphthalene (L) | 8 66E-04 | | | 2.18E-03 | | | 3 80E-03 | 0 02 | 0 02 | | | | |
| PAH | Phenanthrene (L) | 0 10 | | | 0.05 | | | 0 14 | 1.33 | 1 57 | | | | |
| PAH | Pyrene (H) | 0 49 | | | 0.24 | | | 0 54 | 3 14 | 3 59 | | | | |
| PAH | LMW PAHs | 0 36 | | | 0 41 | | | 0 85 | 5 56 | 6 48 | | | | |
| PAH | HMW PAHs | 1 83 | | | 0 88 | | | 2.00 | 12.23 | 14.14 | | | | |
| PAH | Total PAHs | 0 44 | | | 0 42 | | | 0 88 | 5 74 | 6 68 | | | | |
| PCB | Total PCBs | 0 16 | | | 0 03 | | | 0 37 | 0 44 | 0 34 | | | | |
| PST | Aldrin | 1 11E-05 | | | 4 97E-06 | | | 3 56E-04 | 6 63E-06 | 2 31E-03 | | | | |
| PST | Alpha-BHC | 0 01 | | | 5 31E-03 | | | 7 72E-03 | 0 04 | 0 01 | | | | |
| PST | Alpha-chlordane | 4 34E-03 | | | 0 09 | | | 0 01 | 6 84E-03 | 3 04E-03 | | | | |
| PST | Beta-BHC | 0 02 | | | 0 05 | | | 0 04 | 0 07 | 0 15 | | | | |
| PST | Chlorpyrifos | 0 03 | | | 0 09 | | | 0.01 | 0 02 | 0 02 | | | | |
| PST | CIS-Nonachlor | 0 17 | | | 0 39 | | | 0.20 | 0 12 | 0 21 | | | | |
| PST | Delta-BHC | 6 31E-03 | | | 1 53E-03 | | | 1 70E-03 | 2 23E-03 | 2 76E-03 | | | | |
| PST | Dieldrin | 5 13E-03 | | | 0 07 | | | 0 58 | 0 04 | 0 03 | | | | |
| PST | Endosulfan II | 1 53 | | | 0 15 | | | 0 65 | 2 30 | 2 44 | | | | |
| PST | Endrin | 0 05 | | | 0 02 | | | 0 02 | 0 03 | 0 03 | | | | |
| PST | Gamma-BHC (Lindane) | 2 49E-03 | | | 0 01 | | | 0 02 | 0 01 | 0 02 | | | | |
| PST | Gamma-Chlordane | 7 94E-03 | | | 0 19 | | | 3 49E-04 | 4 54E-04 | 3 22E-03 | | | | |
| PST | Heptachlor | 5 05E-03 | | | 4 06E-03 | | | 0 05 | 1 46E-03 | 4 36E-03 | | | | |
| PST | Heptachlor epoxide | 7 50E-03 | | | 3 32E-03 | | | 3 78E-03 | 4 46E-03 | 5 92E-03 | | | | |
| PST | Hexachlorobenzene | 1 86E-07 | | | 6 17E-08 | | | 2 72E-07 | 2 47E-08 | 2 72E-06 | | | | |
| PST | Mirex | 3 75E-03 | | | 7 80E-04 | | | 1.89E-04 | 4 34E-03 | 3 03E-03 | | | | |
| PST | Oxychlordane | 1 70E-04 | | | 3 14E-03 | | | 5 71E-04 | 4 16E-03 | 7 32E-03 | | | | |
| PST | Pentachlorobenzene | 1 45E-06 | | | 2 72E-07 | | | 2.46E-06 | 3 74E-07 | 4 13E-07 | | | | |
| PST | Trans-Nonachlor | 0 13 | | | 1.89 | | | 0 13 | 0 16 | 0.08 | | | | |
| PST | 1,2,3,4-Tetrachlorobenzene | 8 86E-06 | | | 4 34E-06 | | | 1 09E-05 | 3.25E-07 | 1 30E-06 | | | | |
| PST | 1,2,4,5-Tetrachlorobenzene | 1 30E-05 | | | 5 60E-06 | | | 2.54E-05 | 5 17E-06 | 8 12E-06 | | | | |
| PST | o,p'-DDD | 2.23E-04 | | | 1 91E-03 | | | 1.44E-04 | 3.78E-04 | 4.01E-04 | | | | |
| PST | p,p'-DDD | 3 57E-05 | | | 2 47E-05 | | | 6.29E-05 | 2 41E-05 | 3 01E-05 | | | | |
| PST | o,p'-DDE | 1 21E-05 | | | 1.25E-05 | | | 3.94E-06 | 2.78E-06 | 5 67E-06 | | | | |
| PST | o,p'-DDT | 0 11 | | | 1 78 | | | 0 08 | 0 06 | 0.06 | | | | |
| PST | p,p'-DDE | 1 29E-05 | | | 2 67E-05 | | | 4 88E-06 | 7 45E-06 | 5.24E-06 | | | | |
| PST | p,p'-DDT | 0 17 | | | 0 14 | | | 0 31 | 0 07 | 0.08 | | | | |
| | TOX FLAG | 0 | 2 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 2 | 1 | 2 | 1 |
| | EC50 | 70 7 | | 39 0 | >100 | | 34 6 | | 70 7 | 69 3 | | <25 | | <25 |

Table A-2-2 8 (continued)

| Class | Analyte | M14-100B | M14-200B | M14-300B | n | DIST[4] | Mean | 95% UL |
|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0 22 | 0 09 | | 21 | LOG | 0.07 | 0 32 |
| MET | Cadmium | 0 05 | 0 05 | | 21 | NA | 0 05 | 0 05 |
| MET | Chromium | 0 05 | 0 05 | | 21 | NA | 0 05 | 0 05 |
| MET | Copper | 1 34 | 0 48 | | 21 | LOG | 0 74 | 8 77 |
| MET | Lead | 0 19 | 0 19 | | 21 | NA | 0 19 | 0 19 |
| MET | Mercury | 0 03 | 0 11 | | 21 | LOG | 0 03 | 0 06 |
| MET | Nickel | 0 85 | 0.30 | | 21 | LOG | 0.63 | 2.15 |
| MET | Silver | | | | 0 | | | |
| MET | Zinc | 0 24 | 0 08 | | 21 | LOG | 0 08 | 0 16 |
| MET | SEM-AVS | -2 91E-01 | -3 17E+00 | | 21 | LOG | -2 53 | 103 59 |
| PAH | 2-Methylnaphthalene (L) | 0 13 | 0.23 | | 21 | LOG | 0.27 | 1.22 |
| PAH | Acenaphthene (L) | 9 54E-05 | 2 59E-04 | | 21 | LOG | 4 0E-04 | 3 8E-03 |
| PAH | Acenaphthylene (L) | 0 79 | 1.07 | | 21 | LOG | 0 89 | 3 23 |
| PAH | Anthracene (L) | 0 70 | 2.20 | | 21 | LOG | 1 84 | 8 21 |
| PAH | Benzo(a)anthracene (H) | 0 37 | 1 45 | | 21 | LOG | 1 05 | 5.21 |
| PAH | Benzo(a)pyrene (H) | 0 31 | 1 21 | | 21 | LOG | 0 75 | 3 66 |
| PAH | Biphenyl (L) | 2 06E-03 | 5 09E-03 | | 21 | LOG | 4 4E-03 | 1.6E-02 |
| PAH | Chrysene (H) | 0.27 | 0 88 | | 21 | LOG | 0 74 | 3 49 |
| PAH | Dibenz(a,h)anthracene (H) | 0 36 | 1 43 | | 21 | LOG | 0 94 | 4 82 |
| PAH | Fluoranthene (H) | 9 32E-03 | 0 03 | | 21 | LOG | 0 03 | 0 13 |
| PAH | Fluorene (L) | 0 70 | 2 58 | | 21 | LOG | 2 11 | 14.90 |
| PAH | Naphthalene (L) | 1 28E-03 | 2 49E-03 | | 21 | LOG | 2 3E-03 | 1.2E-02 |
| PAH | Phenanthrene (L) | 0 04 | 0 17 | | 21 | LOG | 0 15 | 0 94 |
| PAH | Pyrene (H) | 0 23 | 0 84 | | 21 | LOG | 0 64 | 2 96 |
| PAH | LMW PAHs | 0 32 | 0 73 | | 21 | LOG | 0 70 | 3 64 |
| PAH | HMW PAHs | 0 85 | 2 90 | | 21 | LOG | 2 41 | 11 36 |
| PAH | Total PAHs | 0 34 | 0 84 | | 21 | LOG | 0 78 | 3 95 |
| PCB | Total PCBs | 0 07 | 0 09 | | 21 | LOG | 0 15 | 0 54 |
| PST | Aldrin | 3 64E-04 | 4 08E-06 | | 21 | LOG | 4 49E-05 | 4 26E-04 |
| PST | Alpha-BHC | 5 55E-03 | 0 03 | | 21 | LOG | 0 01 | 0 03 |
| PST | Alpha-chlordane | 1 69E-03 | 5 14E-04 | | 21 | LOG | 5 23E-03 | 0 04 |
| PST | Beta-BHC | 5 43E-03 | 8 76E-03 | | 21 | LOG | 4 4E-02 | 1 9E-01 |
| PST | Chlorpyrifos | 2 18E-03 | 8 84E-03 | | 21 | LOG | 0 02 | 0 06 |
| PST | CIS-Nonachlor | 0 13 | 0 04 | | 21 | LOG | 0 15 | 0.57 |
| PST | Delta-BHC | 1 22E-03 | 1 33E-03 | | 21 | LOG | 3 11E-03 | 0 01 |
| PST | Dieldrin | 4 60E-03 | 7.62E-03 | | 21 | LOG | 6 0E-02 | 8 5E-01 |
| PST | Endosulfan II | 0 13 | 0 64 | | 21 | LOG | 0 77 | 2 76 |
| PST | Endrin | 0.02 | 0 02 | | 21 | LOG | 0 03 | 0 10 |
| PST | Gamma-BHC (Lindane) | 8 13E-04 | 8 33E-03 | | 21 | NORM | 0 02 | 0 03 |
| PST | Gamma-Chlordane | 2.54E-04 | 2 85E-04 | | 21 | LOG | 5 42E-03 | 0 06 |
| PST | Heptachlor | 8 24E-04 | 8 49E-04 | | 21 | LOG | 2 53E-03 | 0 02 |
| PST | Heptachlor epoxide | 2 60E-03 | 2.32E-03 | | 21 | LOG | 4 14E-03 | 0 02 |
| PST | Hexachlorobenzene | 2 66E-08 | 1 15E-08 | | 21 | LOG | 1 29E-07 | 1.39E-06 |
| PST | Mirex | 1 30E-04 | 1 16E-04 | | 21 | LOG | 1 5E-03 | 1 1E-02 |
| PST | Oxychlordane | 2 31E-04 | 3 79E-03 | | 21 | LOG | 2 1E-03 | 1 4E-02 |
| PST | Pentachlorobenzene | 3 16E-07 | 3 48E-07 | | 21 | LOG | 6 4E-07 | 4 2E-06 |
| PST | Trans-Nonachlor | 0 04 | 4 06E-03 | | 21 | LOG | 1.2E-01 | 1 2E+00 |
| PST | 1,2,3,4-Tetrachlorobenzene | 3 78E-06 | 1 25E-06 | | 21 | LOG | 4 90E-06 | 2 48E-05 |
| PST | 1,2,4,5-Tetrachlorobenzene | 2 70E-05 | 2 64E-06 | | 21 | LOG | 1 11E-05 | 4 76E-05 |
| PST | o,p'-DDD | 9 09E-05 | 9 39E-05 | | 21 | LOG | 4 83E-04 | 3 70E-03 |
| PST | p,p'-DDD | 8 00E-06 | 2.51E-06 | | 21 | LOG | 3 22E-05 | 2 65E-04 |
| PST | o,p'-DDE | 1 26E-07 | 4 78E-08 | | 21 | LOG | 6 45E-06 | 1.30E-04 |
| PST | o,p'-DDT | 0 02 | 0 02 | | 21 | LOG | 0 32 | 2.54 |
| PST | p,p'-DDE | 1 89E-05 | 1 63E-06 | | 21 | LOG | 2.23E-05 | 2.26E-04 |
| PST | p,p'-DDT | 0 01 | 8 73E-03 | | 21 | LOG | 2 8E-01 | 2 9E+00 |
| | TOX FLAG | 0 | 0 | 2 | | | | |
| | EC50 | >100 | 70 7 | | | | | |

Table A-2-2 9. Porewater Hazard Quotients[1] (PW-HQs) based on data from the Portsmouth Naval Shipyard investigation for stations exhibiting TOXICITY[2] to sea urchin (*Arbacia punctulata*).

| Class | Analyte | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | 0 17 | | | | | | | | | |
| MET | Cadmium | | | 0 05 | | | | | | | | | |
| MET | Chromium | | | 0 05 | | | | | | | | | |
| MET | Copper | | | 0 48 | | | | | | | | | |
| MET | Lead | | | 0 19 | | | | | | | | | |
| MET | Mercury | | | 0 03 | | | | | | | | | |
| MET | Nickel | | | 0.30 | | | | | | | | | |
| MET | Silver | | | | | | | | | | | | |
| MET | Zinc | | | 0 17 | | | | | | | | | |
| MET | SEM-AVS | | | -6 87 | | | | | | | | | |
| PAH | 2-Methylnaphthalene (L) | | | 1 39 | | | | | | | | | |
| PAH | Acenaphthene (L) | | | 0.00 | | | | | | | | | |
| PAH | Acenaphthylene (L) | | | 3 74 | | | | | | | | | |
| PAH | Anthracene (L) | | | 8 19 | | | | | | | | | |
| PAH | Benzo(a)anthracene (H) | | | 3.59 | | | | | | | | | |
| PAH | Benzo(a)pyrene (H) | | | 2 59 | | | | | | | | | |
| PAH | Biphenyl (L) | | | 0 03 | | | | | | | | | |
| PAH | Chrysene (H) | | | 2 09 | | | | | | | | | |
| PAH | Dibenz(a,h)anthracene (H) | | | 2 40 | | | | | | | | | |
| PAH | Fluoranthene (H) | | | 0.10 | | | | | | | | | |
| PAH | Fluorene (L) | | | 21.34 | | | | | | | | | |
| PAH | Naphthalene (L) | | | 0 02 | | | | | | | | | |
| PAH | Phenanthrene (L) | | | 1 08 | | | | | | | | | |
| PAH | Pyrene (H) | | | 2.39 | | | | | | | | | |
| PAH | LMW PAHs | | | 4 53 | | | | | | | | | |
| PAH | HMW PAHs | | | 8 63 | | | | | | | | | |
| PAH | Total PAHs | | | 4 59 | | | | | | | | | |
| PCB | Total PCBs | | | 0 11 | | | | | | | | | |
| PST | Aldrin | | | 2 2E-04 | | | | | | | | | |
| PST | Alpha-BHC | | | 6 9E-03 | | | | | | | | | |
| PST | Alpha-chlordane | | | 6 8E-03 | | | | | | | | | |
| PST | Beta-BHC | | | 5 7E-02 | | | | | | | | | |
| PST | Chlorpyrifos | | | 8 7E-03 | | | | | | | | | |
| PST | CIS-Nonachlor | | | 6 4E-02 | | | | | | | | | |
| PST | Delta-BHC | | | 2 5E-03 | | | | | | | | | |
| PST | Dieldrin | | | 1 1E-01 | | | | | | | | | |
| PST | Endosulfan II | | | 9 7E-01 | | | | | | | | | |
| PST | Endrin | | | 3 1E-02 | | | | | | | | | |
| PST | Gamma-BHC (Lindane) | | | 1 6E-02 | | | | | | | | | |
| PST | Gamma-Chlordane | | | 8.5E-04 | | | | | | | | | |
| PST | Heptachlor | | | 2 0E-03 | | | | | | | | | |
| PST | Heptachlor epoxide | | | 2 7E-03 | | | | | | | | | |
| PST | Hexachlorobenzene | | | 2 2E-08 | | | | | | | | | |
| PST | Mirex | | | 6 4E-03 | | | | | | | | | |
| PST | Oxychlordane | | | 5 1E-03 | | | | | | | | | |
| PST | Pentachlorobenzene | | | 5.9E-07 | | | | | | | | | |
| PST | Trans-Nonachlor | | | 1 4E-01 | | | | | | | | | |
| PST | 1,2,3,4-Tetrachlorobenzene | | | 9 1E-07 | | | | | | | | | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | 4 1E-06 | | | | | | | | | |
| PST | o,p'-DDD | | | 9 7E-04 | | | | | | | | | |
| PST | p,p'-DDD | | | 2.5E-05 | | | | | | | | | |
| PST | o,p'-DDE | | | 2 5E-05 | | | | | | | | | |
| PST | o,p'-DDT | | | 7.3E-01 | | | | | | | | | |
| PST | p,p'-DDE | | | 1.8E-05 | | | | | | | | | |
| PST | p,p'-DDT | | | 6 0E-01 | | | | | | | | | |
| | TOX FLAG | 2 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 2 | 0 |
| | EC50 | | >100 | 36 5 | 70 7 | 70 7 | | 70 7 | 84 5 | | >100 | | 78 6 |

1 - Hazard Quotients from Table A-2-2.5
2 - See TtNUS (2000b) for toxicity data
3 - Toxicity flag: 0= nontoxic, 1= toxic, 2= no data
Units PW-HQ = unitless

Table A-2-2.9 (continued)

| Class | Analyte | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | 0 23 | | | | | | | | | | |
| MET | Cadmium | | 0 05 | | | | | | | | | | |
| MET | Chromium | | 0 05 | | | | | | | | | | |
| MET | Copper | | 0 48 | | | | | | | | | | |
| MET | Lead | | 0 19 | | | | | | | | | | |
| MET | Mercury | | 0 03 | | | | | | | | | | |
| MET | Nickel | | 0 30 | | | | | | | | | | |
| MET | Silver | | | | | | | | | | | | |
| MET | Zinc | | 0 05 | | | | | | | | | | |
| MET | SEM-AVS | | -10 23 | | | | | | | | | | |
| PAH | 2-Methylnaphthalene (L) | | 0 23 | | | | | | | | | | |
| PAH | Acenaphthene (L) | | 0 00 | | | | | | | | | | |
| PAH | Acenaphthylene (L) | | 0 78 | | | | | | | | | | |
| PAH | Anthracene (L) | | 1 35 | | | | | | | | | | |
| PAH | Benzo(a)anthracene (H) | | 0 67 | | | | | | | | | | |
| PAH | Benzo(a)pyrene (H) | | 0 47 | | | | | | | | | | |
| PAH | Biphenyl (L) | | 0 00 | | | | | | | | | | |
| PAH | Chrysene (H) | | 0 49 | | | | | | | | | | |
| PAH | Dibenz(a,h)anthracene (H | | 0 46 | | | | | | | | | | |
| PAH | Fluoranthene (H) | | 0.02 | | | | | | | | | | |
| PAH | Fluorene (L) | | 1 96 | | | | | | | | | | |
| PAH | Naphthalene (L) | | 0 00 | | | | | | | | | | |
| PAH | Phenanthrene (L) | | 0 10 | | | | | | | | | | |
| PAH | Pyrene (H) | | 0 41 | | | | | | | | | | |
| PAH | LMW PAHs | | 0 49 | | | | | | | | | | |
| PAH | HMW PAHs | | 1 52 | | | | | | | | | | |
| PAH | Total PAHs | | 0 53 | | | | | | | | | | |
| PCB | Total PCBs | | 0 12 | | | | | | | | | | |
| PST | Aldrin | | 5 2E-06 | | | | | | | | | | |
| PST | Alpha-BHC | | 1 3E-02 | | | | | | | | | | |
| PST | Alpha-chlordane | | 1 1E-03 | | | | | | | | | | |
| PST | Beta-BHC | | 1 5E-01 | | | | | | | | | | |
| PST | Chlorpyrifos | | 1 2E-02 | | | | | | | | | | |
| PST | CIS-Nonachlor | | 3 6E-02 | | | | | | | | | | |
| PST | Delta-BHC | | 1.8E-03 | | | | | | | | | | |
| PST | Dieldrin | | 1 2E-04 | | | | | | | | | | |
| PST | Endosulfan II | | 5 4E-01 | | | | | | | | | | |
| PST | Endrin | | 2 2E-02 | | | | | | | | | | |
| PST | Gamma-BHC (Lindane) | | 3 5E-02 | | | | | | | | | | |
| PST | Gamma-Chlordane | | 1 6E-03 | | | | | | | | | | |
| PST | Heptachlor | | 1 2E-03 | | | | | | | | | | |
| PST | Heptachlor epoxide | | 3 5E-03 | | | | | | | | | | |
| PST | Hexachlorobenzene | | 1 9E-08 | | | | | | | | | | |
| PST | Mirex | | 2 0E-03 | | | | | | | | | | |
| PST | Oxychlordane | | 2 6E-04 | | | | | | | | | | |
| PST | Pentachlorobenzene | | 4.2E-07 | | | | | | | | | | |
| PST | Trans-Nonachlor | | 4 9E-02 | | | | | | | | | | |
| PST | 1,2,3,4-Tetrachlorobenzei | | 5.1E-06 | | | | | | | | | | |
| PST | 1,2,4,5-Tetrachlorobenzei | | 1 5E-06 | | | | | | | | | | |
| PST | o,p'-DDD | | 1 5E-04 | | | | | | | | | | |
| PST | p,p'-DDD | | 3 5E-05 | | | | | | | | | | |
| PST | o,p'-DDE | | 1.8E-07 | | | | | | | | | | |
| PST | o,p'-DDT | | 4 0E-02 | | | | | | | | | | |
| PST | p,p'-DDE | | 3.2E-06 | | | | | | | | | | |
| PST | p,p'-DDT | | 4 5E-02 | | | | | | | | | | |
| | TOX FLAG | 0 | 1 | 2 | 0 | 2 | 0 | 0 | 2 | 2 | 0 | 2 | 2 |
| | EC50 | >100 | <25 | | >100 | | 75 5 | 69 7 | | | 71 7 | | |

A-41

Table A-2-2.9. (continued)

| Class | Analyte | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | | | 0 10 | | | 0 11 | | | | |
| MET | Cadmium | | | | | 0 05 | | | 0 05 | | | | |
| MET | Chromium | | | | | 0.05 | | | 0 05 | | | | |
| MET | Copper | | | | | 0 61 | | | 0 58 | | | | |
| MET | Lead | | | | | 0 19 | | | 0 19 | | | | |
| MET | Mercury | | | | | 0 03 | | | 0 03 | | | | |
| MET | Nickel | | | | | 0 30 | | | 0.30 | | | | |
| MET | Silver | | | | | | | | | | | | |
| MET | Zinc | | | | | 0 07 | | | 0 07 | | | | |
| MET | SEM-AVS | | | | | -5 41 | | | -19 73 | | | | |
| PAH | 2-Methylnaphthalene (L) | | | | | 0 11 | | | 0 18 | | | | |
| PAH | Acenaphthene (L) | | | | | 0.00 | | | 0 00 | | | | |
| PAH | Acenaphthylene (L) | | | | | 0 37 | | | 1.21 | | | | |
| PAH | Anthracene (L) | | | | | 1 11 | | | 7.57 | | | | |
| PAH | Benzo(a)anthracene (H) | | | | | 0 54 | | | 0 85 | | | | |
| PAH | Benzo(a)pyrene (H) | | | | | 0.37 | | | 0.54 | | | | |
| PAH | Biphenyl (L) | | | | | 0·00 | | | 0.00 | | | | |
| PAH | Chrysene (H) | | | | | 0 41 | | | 0 62 | | | | |
| PAH | Dibenz(a,h)anthracene (H | | | | | 0 38 | | | 0 43 | | | | |
| PAH | Fluoranthene (H) | | | | | 0 02 | | | 0 02 | | | | |
| PAH | Fluorene (L) | | | | | 1 36 | | | 2 47 | | | | |
| PAH | Naphthalene (L) | | | | | 0 00 | | | 0 00 | | | | |
| PAH | Phenanthrene (L) | | | | | 0 10 | | | 0 09 | | | | |
| PAH | Pyrene (H) | | | | | 0 39 | | | 0 49 | | | | |
| PAH | LMW PAHs | | | | | 0 40 | | | 0 85 | | | | |
| PAH | HMW PAHs | | | | | 1 41 | | | 1 85 | | | | |
| PAH | Total PAHs | | | | | 0 44 | | | 0 88 | | | | |
| PCB | Total PCBs | | | | | 0.08 | | | 0 05 | | | | |
| PST | Aldrin | | | | | 3 5E-04 | | | 1 0E-05 | | | | |
| PST | Alpha-BHC | | | | | 4 5E-03 | | | 1 1E-02 | | | | |
| PST | Alpha-chlordane | | | | | 1 0E-03 | | | 2 2E-03 | | | | |
| PST | Beta-BHC | | | | | 2 3E-02 | | | 1 3E-01 | | | | |
| PST | Chlorpyrifos | | | | | 7 8E-03 | | | 2 0E-02 | | | | |
| PST | CIS-Nonachlor | | | | | 5 2E-02 | | | 5 8E-02 | | | | |
| PST | Delta-BHC | | | | | 1 8E-03 | | | 1 1E-02 | | | | |
| PST | Dieldrin | | | | | 4 4E-03 | | | 1 1E-02 | | | | |
| PST | Endosulfan II | | | | | 2 9E-01 | | | 3 4E-01 | | | | |
| PST | Endrin | | | | | 1 4E-02 | | | 3 7E-02 | | | | |
| PST | Gamma-BHC (Lindane) | | | | | 1 2E-02 | | | 1 1E-02 | | | | |
| PST | Gamma-Chlordane | | | | | 2 4E-04 | | | 1 4E-03 | | | | |
| PST | Heptachlor | | | | | 7 6E-04 | | | 2 1E-03 | | | | |
| PST | Heptachlor epoxide | | | | | 2 6E-03 | | | 6 1E-03 | | | | |
| PST | Hexachlorobenzene | | | | | 1 3E-08 | | | 3 4E-08 | | | | |
| PST | Mirex | | | | | 1 3E-04 | | | 2 9E-04 | | | | |
| PST | Oxychlordane | | | | | 2 1E-04 | | | 3 5E-04 | | | | |
| PST | Pentachlorobenzene | | | | | 3.5E-07 | | | 3 0E-07 | | | | |
| PST | Trans-Nonachlor | | | | | 4 0E-02 | | | 1.3E-01 | | | | |
| PST | 1,2,3,4-Tetrachlorobenzer | | | | | 2 8E-06 | | | 6.5E-07 | | | | |
| PST | 1,2,4,5-Tetrachlorobenzer | | | | | 4 2E-06 | | | 8.0E-06 | | | | |
| PST | o,p'-DDD | | | | | 1 3E-04 | | | 7.6E-05 | | | | |
| PST | p,p'-DDD | | | | | 1 4E-05 | | | 3 2E-05 | | | | |
| PST | o,p'-DDE | | | | | 3 0E-06 | | | 5 6E-07 | | | | |
| PST | o,p'-DDT | | | | | 4 9E-02 | | | 3 6E-02 | | | | |
| PST | p,p'-DDE | | | | | 5.4E-06 | | | 1.4E-06 | | | | |
| PST | p,p'-DDT | | | | | 5 4E-02 | | | 3 9E-02 | | | | |
| | TOX FLAG | 0 | 0 | 0 | 2 | 1 | 0 | 2 | 1 | 0 | 0 | 0 | 2 |
| | EC50 | 69 3 | >100 | 70 7 | | 39 0 | >100 | | 34 6 | | 70 7 | 69 3 | |

Table A-2-2.9 (continued)

| Class | Analyte | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B | N | Mean | Maximum HQ |
|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0 43 | | 0 43 | | | | 6 | 0 25 | 0 43 |
| MET | Cadmium | 0 05 | | 0 05 | | | | 6 | 0 05 | 0 05 |
| MET | Chromium | 0 05 | | 0 05 | | | | 6 | 0 05 | 0 05 |
| MET | Copper | 0 48 | | 0.48 | | | | 6 | 0 52 | 0 61 |
| MET | Lead | 0 19 | | 0 19 | | | | 6 | 0 19 | 0 19 |
| MET | Mercury | 0 05 | | 0 03 | | | | 6 | 0 03 | 0 05 |
| MET | Nickel | 0 30 | | 0 30 | | | | 6 | 0 30 | 0 30 |
| MET | Silver | | | | | | | 0 | | |
| MET | Zinc | 0 04 | | 0 04 | | | | 6 | 0 07 | 0 17 |
| MET | SEM-AVS | -22 00 | | -34 63 | | | | 6 | -16 48 | -5 41 |
| PAH | 2-Methylnaphthalene (L) | 1 69 | | 0 24 | | | | 6 | 0 64 | 1 69 |
| PAH | Acenaphthene (L) | 0 03 | | 0 00 | | | | 6 | 0 01 | 0 03 |
| PAH | Acenaphthylene (L) | 2 47 | | 1 13 | | | | 6 | 1 62 | 3 74 |
| PAH | Anthracene (L) | 13 64 | | 3 66 | | | | 6 | 5 92 | 13 64 |
| PAH | Benzo(a)anthracene (H) | 4 71 | | 1 61 | | | | 6 | 1 99 | 4 71 |
| PAH | Benzo(a)pyrene (H) | 2 09 | | 0.89 | | | | 6 | 1 16 | 2.59 |
| PAH | Biphenyl (L) | 0 09 | | 0 01 | | | | 6 | 0.02 | 0.09 |
| PAH | Chrysene (H) | 2.80 | | 1 12 | | | | 6 | 1 25 | 2.80 |
| PAH | Dibenz(a,h)anthracene (H | 1 97 | | 0.93 | | | | 6 | 1 09 | 2 40 |
| PAH | Fluoranthene (H) | 0 17 | | 0 04 | | | | 6 | 0 06 | 0 17 |
| PAH | Fluorene (L) | 101 27 | | 6.29 | | | | 6 | 22 45 | 101 27 |
| PAH | Naphthalene (L) | 0 00 | | 0 00 | | | | 6 | 0.00 | 0 02 |
| PAH | Phenanthrene (L) | 2 18 | | 0 26 | | | | 6 | 0 64 | 2 18 |
| PAH | Pyrene (H) | 3 38 | | 1 02 | | | | 6 | 1 35 | 3 38 |
| PAH | LMW PAHs | 8 97 | | 1 01 | | | | 6 | 2 71 | 8 97 |
| PAH | HMW PAHs | 13 06 | | 3 78 | | | | 6 | 5 04 | 13 06 |
| PAH | Total PAHs | 8 82 | | 1 14 | | | | 6 | 2 73 | 8 82 |
| PCB | Total PCBs | 0 36 | | 0 17 | | | | 6 | 0 15 | 0 36 |
| PST | Aldrin | 1 1E-03 | | 5 2E-06 | | | | 6 | 2.9E-04 | 1 1E-03 |
| PST | Alpha-BHC | 2 4E-02 | | 5 3E-03 | | | | 6 | 1 1E-02 | 2 4E-02 |
| PST | Alpha-chlordane | 1 7E-03 | | 3 2E-03 | | | | 6 | 2 7E-03 | 6 8E-03 |
| PST | Beta-BHC | 9 8E-02 | | 8 2E-03 | | | | 6 | 7 8E-02 | 1 5E-01 |
| PST | Chlorpyrifos | 3 7E-03 | | 1 3E-02 | | | | 6 | 1 1E-02 | 2 0E-02 |
| PST | CIS-Nonachlor | 9 5E-02 | | 6 5E-02 | | | | 6 | 6.2E-02 | 9 5E-02 |
| PST | Delta-BHC | 2 7E-03 | | 1.9E-03 | | | | 6 | 3 6E-03 | 1 1E-02 |
| PST | Dieldrin | 1 7E-02 | | 6 0E-02 | | | | 6 | 3 3E-02 | 1 1E-01 |
| PST | Endosulfan II | 2.5E-01 | | 4 9E-01 | | | | 6 | 4 8E-01 | 9 7E-01 |
| PST | Endrin | 3 2E-02 | | 2 2E-02 | | | | 6 | 2 6E-02 | 3 7E-02 |
| PST | Gamma-BHC (Lindane) | 1 7E-02 | | 1 1E-02 | | | | 6 | 1 7E-02 | 3 5E-02 |
| PST | Gamma-Chlordane | 5 5E-04 | | 3 8E-04 | | | | 6 | 8 3E-04 | 1 6E-03 |
| PST | Heptachlor | 1 7E-03 | | 1 2E-03 | | | | 6 | 1 5E-03 | 2 1E-03 |
| PST | Heptachlor epoxide | 5 3E-03 | | 3 6E-03 | | | | 6 | 4 0E-03 | 6 1E-03 |
| PST | Hexachlorobenzene | 6 4E-09 | | 5 8E-08 | | | | 6 | 2 5E-08 | 5 8E-08 |
| PST | Mirex | 2 1E-03 | | 1 8E-04 | | | | 6 | 1 9E-03 | 6 4E-03 |
| PST | Oxychlordane | 1.2E-02 | | 2 4E-03 | | | | 6 | 3 3E-03 | 1 2E-02 |
| PST | Pentachlorobenzene | 3 0E-07 | | 4 9E-07 | | | | 6 | 4 1E-07 | 5 9E-07 |
| PST | Trans-Nonachlor | 1 8E-02 | | 4 2E-02 | | | | 6 | 7 1E-02 | 1 4E-01 |
| PST | 1,2,3,4-Tetrachlorobenzei | 2 6E-06 | | 2 8E-07 | | | | 6 | 2.1E-06 | 5 1E-06 |
| PST | 1,2,4,5-Tetrachlorobenzei | 1 0E-05 | | 7 2E-06 | | | | 6 | 5.9E-06 | 1 0E-05 |
| PST | o,p'-DDD | 2 0E-04 | | 1.3E-04 | | | | 6 | 2 7E-04 | 9.7E-04 |
| PST | p,p'-DDD | 1.3E-05 | | 1.2E-05 | | | | 6 | 2 2E-05 | 3 5E-05 |
| PST | o,p'-DDE | 6 4E-07 | | 5 8E-08 | | | | 6 | 4.9E-06 | 2 5E-05 |
| PST | o,p'-DDT | 3.1E-02 | | 3 5E-02 | | | | 6 | 1.5E-01 | 7 3E-01 |
| PST | p,p'-DDE | 8 2E-07 | | 2 9E-06 | | | | 6 | 5 3E-06 | 1 8E-05 |
| PST | p,p'-DDT | 2 3E-02 | | 1 1E-02 | | | | 6 | 1 3E-01 | 6 0E-01 |
| | TOX FLAG | 1 | 2 | 1 | 0 | 0 | 2 | | | |
| | EC50 | <25 | | <25 | >100 | 70 7 | | | | |

Table A-2-2.10 Combined aquatic Threshold Effects Value Hazard Quotients[1] for CoCs in porewaters for identification of Limiting CoCs in the Portsmouth Naval Shipyard offshore study area

| Class | Analyte | Aquatic TEV | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 8 26 | | 0 68 | 0 18 | 0 34 | 0 27 | | 0 18 | 0 27 | | 0 48 | | 57 40 |
| MET | Nickel | 10 67 | | 0 66 | 0 23 | 0 23 | 0 23 | | 0 23 | 0 94 | | 2 53 | | 0 56 |
| PAH | 2-Methylnaphthalene (L) | 0 94 | 0 31 | 0 56 | 1 29 | 0 14 | 0 06 | 0 11 | 0 15 | 0 19 | 0 19 | 1 49 | 0 12 | 0 06 |
| PAH | Acenaphthylene (L) | 1 24 | 1 43 | 0 71 | 1 38 | 0 31 | 0 14 | 0 20 | 0 39 | 0 31 | 0 41 | 2 57 | 0 27 | 0 11 |
| PAH | Anthracene (L) | 2 36 | 0 23 | 0 46 | 1 00 | 0 13 | 0 06 | 0 08 | 0 28 | 0 19 | 0 19 | 0 90 | 0 12 | 0 05 |
| PAH | Benzo(a)anthracene (H) | 0 28 | 0 23 | 0 58 | 0 82 | 0 13 | 0 06 | 0 07 | 0 27 | 0 22 | 0 22 | 0 93 | 0 12 | 0 05 |
| PAH | Dibenz(a,h)anthracene (H) | 0 01 | 0 36 | 0 69 | 0 63 | 0 12 | 0 05 | 0 07 | 0 22 | 0 24 | 0 24 | 1 00 | 0 11 | 0 04 |
| PAH | Fluorene (L) | 2 06 | 0 38 | 0 34 | 1 43 | 0 07 | 0 03 | 0 05 | 0 20 | 0 13 | 0 14 | 0 49 | 0 07 | 0 02 |
| PAH | Phenanthrene (L) | 4 60 | 0 67 | 0 41 | 1 08 | 0 06 | 0 03 | 0 08 | 0 21 | 0 15 | 0 13 | 0 45 | 0 05 | 0 03 |
| PAH | Pyrene (H) | 1 60 | 0 65 | 0 43 | 0 94 | 0 13 | 0 07 | 0 10 | 0 29 | 0 24 | 0 23 | 0 78 | 0 14 | 0 06 |
| PAH | LMW PAHs | 20 32 | 0 39 | 0 44 | 1 28 | 0 11 | 0 05 | 0 09 | 0 21 | 0 16 | 0 18 | 0 87 | 0 10 | 0 04 |
| PAH | HMW PAHs | 4 11 | 0 45 | 0 45 | 0 89 | 0 12 | 0 07 | 0 10 | 0 29 | 0 23 | 0 21 | 0 82 | 0 12 | 0 06 |
| PAH | Total PAHs | 24 40 | 0 40 | 0 44 | 1 22 | 0 11 | 0 05 | 0 09 | 0 22 | 0 17 | 0 19 | 0 87 | 0 10 | 0 04 |
| PST | Endosulfan II | 0 021 | 1 14 | 0 76 | 0 41 | 0 25 | 0 12 | 0 25 | 0 30 | 0 18 | 0 40 | 0 67 | 0 16 | 0 10 |
| PST | Trans-Nonachlor | 3 99E-05 | 0 28 | 1 29 | 0 14 | 0 06 | 0 03 | 0 09 | 0 06 | 0 04 | 0 01 | 0 18 | 0 01 | 0 17 |
| PST | o,p'-DDT | 1 48E-03 | 0 27 | 2 08 | 0 50 | 0 03 | 0 04 | 0 03 | 0 17 | 0 06 | 0 06 | 0 87 | 0 01 | 1 04 |
| PST | p,p'-DDT | 1 43E-03 | 0 04 | 2.67 | 0 42 | 0 01 | 0 06 | 0 02 | 0 05 | 0 02 | 0 02 | 0 05 | 0 01 | 6 71 |
| | SUM TEV-HQ[2] | | 5 98 | 12 33 | 10 46 | 2 00 | 1 24 | 1 14 | 3 00 | 3 18 | 2 25 | 13 40 | 1 18 | 66 42 |
| | MAX TEV-HQ | | 1 43 | 2 67 | 1 43 | 0 34 | 0 27 | 0 25 | 0 39 | 0 94 | 0 41 | 2 57 | 0 27 | 57 40 |
| | Limiting CoC | | Acenaphthylene (L) | p,p'-DDT | Fluorene (L) | Copper | Copper | Endosulfan II | Acenaphthylene (L) | Nickel | Acenaphthylene (L) | Acenaphthylene (L) | Acenaphthylene (L) | Copper |

1 - Threshold Effects Value Hazard Quotient (TEV-HQ) = CoC pore water concentration(Table A-2-2 4a)/Threshold Effect Value (TEV) (Table 2 2-5)

2- Sum TEV-HQ = sum of analyte HQs (excluding LMW, HMW, Total PAH and SEM-AVS sums)

Units TEV-HQ = unitless

Table A-2-2 10 (continued)

| Class | Analyte | Aquatic TEV | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 8 26 | 0 18 | 0 18 | | 0 18 | | 0 18 | 0 18 | | | 0 18 | | |
| MET | Nickel | 10 67 | 0 23 | 0 23 | | 0 23 | | 1 22 | 0 23 | | | 0 56 | | |
| PAH | 2-Methylnaphthalene (L) | 0 94 | 0 17 | 0 22 | 0 27 | 0 22 | 0 16 | 0 06 | 0 12 | 0 14 | 0 10 | 0 34 | 0 26 | 0 37 |
| PAH | Acenaphthylene (L) | 1 24 | 0 42 | 0 29 | 0 68 | 0 47 | 0 39 | 0 07 | 0 26 | 0 32 | 0 32 | 0 54 | 0 46 | 0 93 |
| PAH | Anthracene (L) | 2 36 | 0 25 | 0 16 | 0 29 | 0 27 | 0 13 | 0.05 | 0 13 | 0 12 | 0 06 | 0 31 | 0 24 | 0 61 |
| PAH | Benzo(a)anthracene (H) | 0 28 | 0 22 | 0 15 | 0 31 | 0 50 | 0 20 | 0 06 | 0 16 | 0 12 | 0 06 | 0 29 | 0 23 | 0 50 |
| PAH | Dibenz(a,h)anthracene (H) | 0 01 | 0 17 | 0 12 | 0 29 | 0 62 | 0 18 | 0 04 | 0 15 | 0 11 | 0 04 | 0 30 | 0 23 | 0 37 |
| PAH | Fluorene (L) | 2 06 | 0 15 | 0 13 | 0 19 | 0 26 | 0 08 | 0 05 | 0 08 | 0 08 | 0 05 | 0 19 | 0 17 | 0 15 |
| PAH | Phenanthrene (L) | 4 60 | 0 13 | 0 10 | 0 19 | 0 40 | 0 06 | 0 05 | 0 10 | 0 08 | 0 04 | 0 18 | 0 16 | 0 28 |
| PAH | Pyrene (H) | 1 60 | 0 28 | 0 16 | 0 32 | 0 66 | 0 15 | 0 08 | 0 19 | 0 15 | 0 07 | 0 35 | 0 26 | 0 84 |
| PAH | LMW PAHs | 20 32 | 0 18 | 0 14 | 0 25 | 0 28 | 0 12 | 0 06 | 0 12 | 0 12 | 0 09 | 0 25 | 0 23 | 0 31 |
| PAH | HMW PAHs | 4 11 | 0 27 | 0 16 | 0 31 | 0 68 | 0 14 | 0 08 | 0 18 | 0 14 | 0 06 | 0 32 | 0 15 | 0 78 |
| PAH | Total PAHs | 24 40 | 0 19 | 0 14 | 0 26 | 0 35 | 0 13 | 0 06 | 0 13 | 0 12 | 0 08 | 0 26 | 0 21 | 0 39 |
| PST | Endosulfan II | 0 021 | 0 36 | 0 23 | 0 56 | 0 70 | 0 21 | 0 13 | 0 28 | 0 19 | 0 05 | 0 56 | 0 52 | 1 21 |
| PST | Trans-Nonachlor | 3 99E-05 | 0 08 | 0 05 | 0 04 | 0 03 | 0 05 | 0 01 | 0 07 | 0 04 | 0 01 | 0 89 | 0 08 | 1 18 |
| PST | o,p'-DDT | 1 48E-03 | 0 03 | 0 03 | 0 04 | 0 03 | 0 02 | 0 01 | 0 06 | 0 01 | 0 00 | 2 97 | 0 09 | 1 80 |
| PST | p,p'-DDT | 1 43E-03 | 0 01 | 0 03 | 0 03 | 0 02 | 0 02 | 0 02 | 0 03 | 0 01 | 0 01 | 7 29 | 0 03 | 4 51 |
| | SUM TEVHQ[2] | | 2 68 | 2 09 | 3 21 | 4 59 | 1 64 | 2 04 | 2 05 | 1.35 | 0 81 | 14 96 | 2 72 | 12 74 |
| | MAX TEV-HQ | | 0 42 | 0 29 | 0 68 | 0 70 | 0 39 | 1 22 | 0 28 | 0 32 | | 7 29 | 0 52 | 4.51 |
| | Limiting CoC | | Acenaphthylene (L) | Acenaphthylene (L) | Acenaphthylene (L) | Endosulfan II | Acenaphthylene (L) | Nickel | Endosulfan II | Acenaphthylene (L) | | p,p'-DDT | Endosulfan II | p,p'-DDT |

Table A-2-2 10 (continued)

| Class | Analyte | Aquatic TEV | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 8 26 | 0 18 | 2 81 | 0 38 | | 0 23 | 0 18 | | 0 22 | 0 30 | 0 18 | 0 26 | |
| MET | Nickel | 10.67 | 0 23 | 1 12 | 1 41 | | 0 23 | 0 23 | | 0 23 | 0 94 | 0 23 | 0 23 | |
| PAH | 2-Methylnaphthalene (L) | 0 94 | 0 21 | 0 09 | 0 11 | 0 14 | 0 11 | 0 13 | 0 35 | 0 17 | 0 49 | 1 42 | 1 64 | 0 21 |
| PAH | Acenaphthylene (L) | 1 24 | 0 41 | 0 16 | 0 14 | 0 24 | 0 14 | 0 13 | 1 73 | 0 45 | 0 30 | 0 70 | 0 69 | 0 39 |
| PAH | Anthracene (L) | 2 36 | 0 23 | 0 06 | 0 21 | 0 14 | 0 14 | 0 09 | 2 05 | 0 92 | 0 23 | 1 24 | 1 35 | 0 34 |
| PAH | Benzo(a)anthracene (H) | 0 28 | 0 22 | 0 03 | 0 19 | 0 14 | 0 12 | 0 08 | 1 26 | 0 19 | 0 19 | 1 37 | 1 51 | 0 40 |
| PAH | Dibenz(a,h)anthracene (H) | 0 01 | 0 21 | 0 03 | 0 12 | 0 13 | 0 10 | 0 06 | 0 92 | 0 11 | 0 17 | 1 37 | 1 41 | 0 28 |
| PAH | Fluorene (L) | 2 06 | 0 15 | 0 02 | 0 10 | 0 11 | 0 09 | 0 06 | 1 19 | 0 17 | 0 14 | 1 72 | 2 01 | 0 19 |
| PAH | Phenanthrene (L) | 4 60 | 0 15 | 0 02 | 0 10 | 0 11 | 0 10 | 0 05 | 1 03 | 0 09 | 0 14 | 1 33 | 1 57 | 0 18 |
| PAH | Pyrene (H) | 1 60 | 0 27 | 0 03 | 0 19 | 0 18 | 0 15 | 0 09 | 1 06 | 0 19 | 0 21 | 1 23 | 1 41 | 0 43 |
| PAH | LMW PAHs | 20 32 | 0 19 | 0 06 | 0 10 | 0 13 | 0 11 | 0 12 | 0.97 | 0 24 | 0 24 | 1 58 | 1 84 | 0 22 |
| PAH | HMW PAHs | 4 11 | 0 26 | 0 03 | 0 19 | 0 17 | 0 15 | 0 09 | 1 13 | 0 19 | 0 21 | 1 26 | 1 46 | 0 44 |
| PAH | Total PAHs | 24 40 | 0 20 | 0 05 | 0 12 | 0 14 | 0 12 | 0 11 | 1 00 | 0 23 | 0 23 | 1 52 | 1 77 | 0 26 |
| PST | Endosulfan II | 0 021 | 0 23 | 0 18 | 0 64 | 0 13 | 0 12 | 0 06 | 0 47 | 0 14 | 0 27 | 0 96 | 1 02 | 0 21 |
| PST | Trans-Nonachlor | 3 99E-05 | 0 18 | 0 03 | 0 13 | 0 11 | 0 04 | 1 89 | 0 08 | 0 13 | 0 13 | 0 16 | 0 08 | 0 07 |
| PST | o,p'-DDT | 1 48E-03 | 0 33 | 0 03 | 0 07 | 0 03 | 0 03 | 1 21 | 0 04 | 0 02 | 0 05 | 0 04 | 0 04 | 0 02 |
| PST | p,p'-DDT | 1 43E-03 | 0 16 | 0 06 | 0 12 | 0 02 | 0 04 | 0.10 | 0 02 | 0 03 | 0 22 | 0 05 | 0 06 | 0 01 |
| | SUM TEVHQ[2] | | 3 17 | 4 66 | 3 91 | 1 49 | 1 65 | 4 37 | 10 20 | 3 08 | 3 76 | 12 00 | 13 27 | 2 73 |
| | MAX TEV-HQ | | 0.41 | 2 81 | 1.41 | 0 24 | 0 23 | 1 89 | 2 05 | 0 92 | 0 94 | 1.72 | 2 01 | 0 44 |
| | Limiting CoC | | Acenaphthylene (L) | Copper | Nickel | Acenaphthylene (L) | Nickel | Trans-Nonachlor | Anthracene (L) | Anthracene (L) | Nickel | Fluorene (L) | Fluorene (L) | HMW PAHs |

Table A-2-2.10. (continued)

| Class | Analyte | Aquatic TEV | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B |
|---|---|---|---|---|---|---|---|---|
| MET | Copper | 8 26 | 0 18 | | 0 18 | 0 50 | 0 18 | |
| MET | Nickel | 10 67 | 0 23 | | 0 23 | 0 66 | 0 23 | |
| PAH | 2-Methylnaphthalene (L) | 0 94 | 1 58 | 0 23 | 0 22 | 0 12 | 0 21 | 0 19 |
| PAH | Acenaphthylene (L) | 1 24 | 0 91 | 0 71 | 0 42 | 0 29 | 0 40 | 0 61 |
| PAH | Anthracene (L) | 2 36 | 1 66 | 0 40 | 0 45 | 0 09 | 0 27 | 0 24 |
| PAH | Benzo(a)anthracene (H) | 0 28 | 1 08 | 0 34 | 0 37 | 0 09 | 0 33 | 0 33 |
| PAH | Dibenz(a,h)anthracene (H) | 0 01 | 0 52 | 0 23 | 0 25 | 0 10 | 0 38 | 0 31 |
| PAH | Fluorene (L) | 2 06 | 6 80 | 0 25 | 0 42 | 0 05 | 0 17 | 0 15 |
| PAH | Phenanthrene (L) | 4 60 | 2 18 | 0 17 | 0 26 | 0 04 | 0 17 | 0 11 |
| PAH | Pyrene (H) | 1 60 | 1 33 | 0 38 | 0 40 | 0 09 | 0 33 | 0 21 |
| PAH | LMW PAHs | 20 32 | 2 54 | 0 25 | 0 29 | 0 09 | 0 21 | 0 18 |
| PAH | HMW PAHs | 4 11 | 1 35 | 0 38 | 0 39 | 0 09 | 0 30 | 0 21 |
| PAH | Total PAHs | 24 40 | 2 34 | 0 27 | 0 30 | 0 09 | 0 22 | 0 19 |
| PST | Endosulfan II | 0 021 | 0 10 | 0 02 | 0 20 | 0 06 | 0 27 | 0 04 |
| PST | Trans-Nonachlor | 3 99E-05 | 0 02 | 0 02 | 0 04 | 0 04 | 0 00 | 0 01 |
| PST | o,p'-DDT | 1 48E-03 | 0 02 | 0 01 | 0 02 | 0 01 | 0 01 | 0 01 |
| PST | p,p'-DDT | 1 43E-03 | 0 02 | 0 01 | 0 01 | 0 01 | 0 01 | 0 01 |
| | SUM TEVHQ[2] | | 16 63 | 2 77 | 3 47 | 2 13 | 2 97 | 2 19 |
| | MAX TEV-HQ | | 6 80 | 0 71 | 0 45 | 0 66 | 0 40 | 0 61 |
| | Limiting CoC | | Fluorene (L) | Acenaphthylene (L) | Anthracene (L) | Nickel | Acenaphthylene (L) | Acenaphthylene (L) |

Table A-3-1.1. Derivation of aquatic PRGs for CoCs in pore water from sediments collected in the Portsmouth Naval Shipyard offshore study area[1].

| Class | Analyte[2] | Aquatic Pathway | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | PW | | 65 3 | 963 5 | 190 5 | 189 9 | | 1018 5 | | | | | 6 8 | 346 0 | 212.0 | | 81 5 | | 88 6 |
| MET | Nickel | PW | | 37.8 | 127.8 | 110.1 | 150.6 | | 193 3 | 84.3 | | 76.3 | | 280.9 | 142.5 | 122 0 | | 90 9 | | 30 3 |
| PAH | Acenaphthylene (L) | PW | 205.9 | 225.0 | 268 4 | 255 9 | 540.4 | 346.4 | 371 4 | 248.8 | 215 4 | 134 5 | 228.5 | 82.1 | 238.7 | 280 9 | 83 3 | 55.9 | 248 8 | 61 9 |
| PAH | Anthracene (L) | PW | 1211.3 | 1323.4 | 1578.9 | 1505.4 | 3178 8 | 2037.5 | 2184.6 | 1463.4 | 1267 3 | 791.2 | 1344 4 | 483.1 | 1403.9 | 1652.4 | 490 1 | 329 1 | 1463 4 | 364 1 |
| PAH | Fluorene (L) | PW | 489.8 | 535.1 | 638 4 | 608.7 | 1285.3 | 823 8 | 883 3 | 591.7 | 512.4 | 319 9 | 543.6 | 195.3 | 567 6 | 668.1 | 198 2 | 133 1 | 591.7 | 147.2 |
| PST | Endosulfan II | PW | 3.9 | 4.2 | 5 0 | 4 8 | 10 2 | 6 5 | 7 0 | 4.7 | 4 0 | 2 5 | 4 3 | 1 5 | 4 5 | 5.3 | 1.6 | 1 1 | 4 7 | 1.2 |
| PST | Trans-Nonachlor | PW | 3.9 | 4.3 | 5 1 | 4 9 | 10 3 | 6 6 | 7.1 | 4.7 | 4 1 | 2 6 | 4.3 | 1 6 | 4 5 | 5 3 | 1.6 | 1.1 | 4.7 | 1.2 |
| PST | p,p'-DDT | PW | 65.1 | 71.1 | 84 8 | 80.8 | 170.7 | 109.4 | 117 3 | 78.6 | 68.1 | 42.5 | 72.2 | 25.9 | 75.4 | 88.7 | 26.3 | 17.7 | 78 6 | 19 6 |

1 - Station-specific estimate of PRG = sediment concentration (Table A-2-2.2a)/TEV-HQ (Table A-2-2.10.)

2 - Analytes include Limiting CoCs identified in Table A-2-2 10; locations M03-200B and M04-100B identified as outlier data and therefor excluded

Units PRG· metals = ug/g, organics ng/g

Table A-3-1.1. (continued)

| Class | Analyte[2] | Aquatic Pathway | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | PW | 261.5 | | | 2505.1 | | | 864.4 | 181 9 | 542 7 | | 660 7 | 152 2 | | 143 1 | 1823 6 | 483 9 | 143 5 | | 296 2 |
| MET | Nickel | PW | 109.7 | | | 165.0 | | | 225 7 | 142.2 | 43 7 | | 214 2 | 123 1 | | 122 5 | 80.5 | 169 8 | 97 3 | | 140.0 |
| PAH | Acenaphthylene (L) | PW | 116 6 | 234.5 | 176.2 | 123.8 | 194 0 | 64 9 | 223.8 | 33.3 | 64.3 | 254.7 | 304.7 | 205 9 | 136 9 | 208 3 | 159 5 | 166 6 | 135 7 | 207.1 | 232 1 |
| PAH | Anthracene (L) | PW | 686.2 | 1379 4 | 1036 3 | 728 2 | 1141.3 | 381 6 | 1316 4 | 196.1 | 378 1 | 1498.4 | 1792.5 | 1211.3 | 805 2 | 1225.3 | 938 3 | 980.3 | 798.2 | 1218 3 | 1365 4 |
| PAH | Fluorene (L) | PW | 277.4 | 557 7 | 419.0 | 294 4 | 461.5 | 154.3 | 532 2 | 79 3 | 152 9 | 605.9 | 724.8 | 489.8 | 325.6 | 495 4 | 379 4 | 396.4 | 322.7 | 492 6 | 552.1 |
| PST | Endosulfan II | PW | 2 2 | 4 4 | 3 3 | 2 3 | 3.6 | 1 2 | 4.2 | 0 6 | 1 2 | 4 8 | 5 7 | 3 9 | 2.6 | 3 9 | 3 0 | 3.1 | 2 5 | 3 9 | 4 4 |
| PST | Trans-Nonachlor | PW | 2.2 | 4.5 | 3.3 | 2 4 | 3 7 | 1.2 | 4.2 | 0.6 | 1.2 | 4 8 | 5.8 | 3.9 | 2.6 | 4 0 | 3 0 | 3 2 | 2.6 | 3 9 | 4.4 |
| PST | p,p'-DDT | PW | 36.8 | 74.1 | 55 6 | 39 1 | 61 3 | 20.5 | 70.7 | 10.5 | 20.3 | 80.5 | 96.3 | 65.1 | 43.2 | 65 8 | 50.4 | 52 6 | 42.9 | 65.4 | 73.3 |

Table A-3-1.1. (continued)

| Class | Analyte[2] | Aquatic Pathway | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B | n | T0.975 | PRG (Mean) |
|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | PW | | 655 2 | 118 8 | 157.5 | | 25 | 2 1 | 486 1 |
| MET | Nickel | PW | | 147 2 | 45.3 | 86.6 | | 27 | 2 1 | 124 4 |
| PAH | Acenaphthylene (L) | PW | 265 4 | 285 7 | 394.0 | 259.5 | 285.7 | 42 | 2 0 | 210.1 |
| PAH | Anthracene (L) | PW | 1561.4 | 1680.4 | 2317 6 | 1526 4 | 1680 4 | 42 | 2 0 | 1236.1 |
| PAH | Fluorene (L) | PW | 631.3 | 679 5 | 937 1 | 617 2 | 679 5 | 42 | 2 0 | 499 8 |
| PST | Endosulfan II | PW | 5 0 | 5.4 | 7.4 | 4.9 | 5 4 | 42 | 2.0 | 3 9 |
| PST | Trans-Nonachlor | PW | 5.0 | 5.4 | 7.5 | 4.9 | 5 4 | 42 | 2 0 | 4 0 |
| PST | p,p'-DDT | PW | 83.9 | 90.2 | 124.5 | 82.0 | 90.2 | 42 | 2.0 | 66.4 |

Table A-3-1.2a. Normalized[1] concentrations of chemicals in sediment in the Portsmouth Naval Shipyard offshore study area.

| Class | Analyte3 | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 12.20 | 10 30 | 13 15 | 10 70 | 12 40 | 13 70 | 17.20 | 18 60 | 10 70 | 19.70 |
| MET | Cadmium | 0 30 | 0.13 | 0.33 | 0 49 | 0 29 | 0.60 | 0 60 | 0 79 | 0 48 | 1.00 |
| MET | Chromium | 93 10 | 54 30 | 93 55 | 73 40 | 85 80 | 127.00 | 135 00 | 137 00 | 87 40 | 132 00 |
| MET | Copper | 43 70 | 44.30 | 175 00 | 64.60 | 50 60 | 46 10 | 185 00 | 1090.00 | 106 00 | 1780 00 |
| MET | Lead | 77.20 | 174 00 | 195 50 | 202 00 | 170 00 | 94 70 | 133 00 | 229 00 | 80 60 | 316 00 |
| MET | Mercury | 0.25 | 0 13 | 0 28 | 0 27 | 1 00 | 0 35 | 0 62 | 0 75 | 0 48 | 3 60 |
| MET | Nickel | 29 60 | 24 80 | 29 95 | 25 80 | 35 30 | 27 10 | 45 30 | 79 00 | 26 50 | 193 00 |
| MET | Silver | 0 41 | 0 18 | 0 43 | 0.92 | 0 33 | 1 70 | 1 10 | 1 70 | 0 98 | 3 20 |
| MET | Zinc | 191 00 | 108 00 | 185 50 | 378 00 | 127 00 | 101 00 | 234 00 | 650 00 | 138 00 | 1510 00 |
| MET | SEM-AVS | -23 94 | 1 19 | -34 36 | -26 04 | -1 45 | -1 03 | -50 29 | -15 89 | -18 04 | -0 54 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 16 71 | 13.65 | 24 01 | 6 84 | 2 08 | 2 82 | 5 19 | 7 42 | 6 74 | 24 69 |
| PAH | 1-Methylnaphthalene (L) | 27 28 | 26 19 | 68 71 | 6 74 | 2 51 | 5.15 | 8 21 | 8 37 | 8 84 | 66 46 |
| PAH | 1-Methylphenanthrene (L) | 229 48 | 65 08 | 130 38 | 21.30 | 8 44 | 16 29 | 37 18 | 33 92 | 34 59 | 99 12 |
| PAH | 2,6-Dimethylnaphthalene (L) | 18 73 | 19 21 | 38 60 | 7 12 | 2 31 | 3 99 | 5 54 | 8 13 | 8.78 | 41 06 |
| PAH | 2-Methylnaphthalene (L) | 23 47 | 41 85 | 97 23 | 10 88 | 4 58 | 7 97 | 11 60 | 14 16 | 14 59 | 112 39 |
| PAH | Acenaphthene (L) | 16 01 | 57 14 | 217 03 | 8 33 | 3.50 | 8 04 | 36 22 | 22 58 | 25 03 | 52 65 |
| PAH | Acenaphthylene (L) | 170 52 | 84 66 | 164 52 | 36 98 | 16.65 | 24 12 | 45 83 | 37 32 | 48 84 | 305 31 |
| PAH | Anthracene (L) | 159 54 | 324 87 | 698 23 | 88 84 | 41 85 | 55 33 | 199 04 | 134 45 | 136 46 | 632 74 |
| PAH | Benzo(a)anthracene (H) | 260 69 | 661 38 | 935 70 | 147 91 | 71 81 | 78 01 | 302 56 | 248 80 | 254 14 | 1053 10 |
| PAH | Benzo(a)pyrene (H) | 427 17 | 814 81 | 1112 42 | 178 60 | 74 45 | 110 31 | 322 12 | 282 78 | 313.26 | 991 15 |
| PAH | Benzo(b)fluoranthene (H) | 408 09 | 666 67 | 885 37 | 172 56 | 63.22 | 123.71 | 321.15 | 326.32 | 311 05 | 1115 04 |
| PAH | Benzo(b+k)fluoranthene (H) | 482.08 | 911 64 | 1168.47 | 229 77 | 86 12 | 159 45 | 456.09 | 401 91 | 428 18 | 1357 52 |
| PAH | Benzo(e)pyrene (H) | 335 84 | 461.38 | 543.46 | 97 67 | 35 02 | 65.29 | 169.55 | 158 85 | 171.82 | 552.21 |
| PAH | Benzo(g,h,i)perylene (H) | 332 37 | 510.58 | 506.21 | 94.42 | 37 89 | 60 14 | 158 97 | 182 30 | 177 35 | 683 19 |
| PAH | Benzo(k)fluoranthene (H) | 73 99 | 244 97 | 303 10 | 57 21 | 22 91 | 35 74 | 134 94 | 75 60 | 117 13 | 242.48 |
| PAH | Biphenyl (L) | 9 19 | 10 58 | 29 78 | 2 97 | 0 94 | 2.51 | 3 27 | 3.28 | 4 50 | 15 84 |
| PAH | Chrysene (H) | 474 57 | 576 72 | 801 33 | 149 30 | 65.86 | 102.75 | 311 54 | 254 55 | 259 67 | 1018 58 |
| PAH | Dibenz(a,h)anthracene (H) | 85 55 | 165 61 | 152 11 | 29 35 | 11 70 | 15 98 | 52 88 | 57 42 | 57 46 | 240 71 |
| PAH | Fluoranthene (H) | 647 40 | 809 52 | 1733 48 | 205 12 | 129 96 | 208 59 | 580 13 | 455 50 | 385 08 | 1610 62 |
| PAH | Fluorene (L) | 108 09 | 96 30 | 405 54 | 18 98 | 7 62 | 13 57 | 56 41 | 37 61 | 41 05 | 138 94 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 261.27 | 496 30 | 511 97 | 97 21 | 39 87 | 15 43 | 178 85 | 197 61 | 191 71 | 781 42 |
| PAH | Naphthalene (L) | 23 82 | 61 38 | 198 00 | 15 95 | 6 81 | 14 54 | 20 96 | 18 95 | 27 07 | 145 13 |
| PAH | Perylene (H) | 32 02 | 67 72 | 144 37 | 46.00 | 13 94 | 28 76 | 60 26 | 64 11 | 58 56 | 131 86 |
| PAH | Phenanthrene (L) | 913.29 | 566 14 | 1476.72 | 79.53 | 46 04 | 109 97 | 283 65 | 202 39 | 171 82 | 616.81 |
| PAH | Pyrene (H) | 1098 27 | 735 45 | 1587 36 | 218 60 | 113 00 | 171 48 | 487 18 | 402 39 | 381 77 | 1327 43 |
| PAH | LMW PAHs | 1414 74 | 1232 33 | 3257 27 | 259 49 | 127 05 | 233 54 | 653 72 | 467 46 | 464 86 | 2003 98 |
| PAH | HMW PAHs | 2993 64 | 3763 49 | 6322 39 | 928 88 | 466 76 | 687 11 | 2056 41 | 1701 44 | 1651 38 | 6241 59 |
| PAH | Total PAHs | 4408 38 | 4995 82 | 9579 67 | 1188 37 | 593 81 | 920 65 | 2710 13 | 2168 90 | 2116 24 | 8245 58 |
| PCB | Total PCBs | 60 68 | 54 34 | 34 43 | 37 89 | 7 74 | 30 94 | 242 87 | 137 05 | 72 27 | 345 72 |
| PST | Aldrin | 0 02 | 0 01 | 0 87 | 0 02 | 0 01 | 0 33 | 0 02 | 0 02 | 0.02 | 0 02 |
| PST | Alpha-BHC | 0 09 | 0 07 | 0 06 | 0 06 | 0 02 | 0 02 | 0 06 | 0 28 | 0 13 | 0 16 |
| PST | Alpha-chlordane | 2 37 | 8 47 | 0 67 | 0 28 | 0 12 | 0 11 | 0 18 | 0 31 | 0 29 | 1 24 |
| PST | Beta-BHC | 0 25 | 0 05 | 0 51 | 0 21 | 0 14 | 0 34 | 0 99 | 0 44 | 0 55 | 0 08 |
| PST | Chlorpyrifos | 0 08 | 0 07 | 0 07 | 0 07 | 0 03 | 0 24 | 0 08 | 0 09 | 0 10 | 0 12 |
| PST | CIS-Nonachlor | 0 69 | 0 95 | 0 14 | 0 09 | 0 04 | 0 86 | 0 54 | 0 18 | 0 14 | 0 48 |
| PST | Delta-BHC | 0 02 | 0 01 | 0 02 | 0 03 | 0 01 | 0 05 | 0 01 | 0 07 | 0 07 | 0 02 |
| PST | Dieldrin | 0 42 | 11 11 | 0.39 | 0 01 | 0 15 | 0 30 | 0 42 | 0 72 | 0 12 | 0 03 |
| PST | Endosulfan II | 2 54 | 1 69 | 0 91 | 0 56 | 0 26 | 0 55 | 0 67 | 0 41 | 0 88 | 1 50 |
| PST | Endrin | 0 07 | 0 47 | 0.07 | 0 03 | 0 01 | 0 05 | 0 04 | 0 04 | 0 05 | 0 05 |
| PST | Gamma-BHC (Lindane) | 0 33 | 0 28 | 0 12 | 0 07 | 0 05 | 0 11 | 0 15 | 0 18 | 0 12 | 0 12 |
| PST | Gamma-Chlordane | 0 81 | 7 94 | 0 06 | 0 05 | 0.04 | 0 15 | 0 14 | 0 12 | 0 13 | 0 48 |
| PST | Heptachlor | 0 22 | 0 40 | 0.10 | 0 04 | 0 03 | 0 09 | 0 22 | 0 24 | 0 15 | 0 54 |
| PST | Heptachlor epoxide | 0 01 | 0.01 | 0 01 | 0 01 | 0 00 | 0 01 | 0 01 | 0 01 | 0 01 | 0 01 |
| PST | Hexachlorobenzene | 0 01 | 0.04 | 0 02 | 0 03 | 0 01 | 0 02 | 0.01 | 0.04 | 0.03 | 0 07 |
| PST | Mirex | 0.32 | 0 63 | 0 38 | 0.11 | 0 01 | 0 29 | 0 02 | 0 14 | 0 02 | 0 14 |
| PST | Oxychlordane | 0 38 | 0 63 | 0 33 | 0 02 | 0 01 | 0 03 | 0 04 | 0 15 | 0.04 | 0.58 |
| PST | Pentachloroanisole | 0 03 | 0 36 | 0 06 | 0 06 | 0.01 | 0 05 | 0 07 | 0 09 | 0 08 | 0 15 |
| PST | Pentachlorobenzene | 0 08 | 0 09 | 0 11 | 0 08 | 0 02 | 0.21 | 0 09 | 0 07 | 0 16 | 0 10 |
| PST | Trans-Nonachlor | 0 64 | 2.91 | 0 32 | 0 13 | 0 06 | 0 21 | 0 13 | 0 10 | 0 03 | 0 41 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 01 | 0.13 | 0 04 | 0 10 | 0 04 | 0 11 | 0 29 | 0 24 | 0 83 | 0 28 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 31 | 0 18 | 0 19 | 0 21 | 0 08 | 0 69 | 0 58 | 0 31 | 0 88 | 1.06 |
| PST | o,p'-DDD | 6.94 | 30.69 | 8.03 | 0 84 | 0.73 | 0 45 | 2 50 | 1 53 | 1 66 | 14 16 |
| PST | p,p'-DDD | 0 23 | 1 16 | 0.21 | 0 09 | 0 05 | 0 48 | 0.02 | 0.03 | 0 03 | 0 56 |
| PST | o,p'-DDE | 0 92 | 13 23 | 3 64 | 0 07 | 0 51 | 0 29 | 0 87 | 0.23 | 0 12 | 1 68 |
| PST | o,p'-DDT | 10 40 | 80 95 | 19.29 | 1 02 | 1 39 | 1.24 | 6 41 | 2 44 | 2 49 | 33 63 |
| PST | p,p'-DDE | 1 73 | 31.22 | 2 59 | 0 56 | 1 15 | 3 44 | 1 70 | 1 44 | 0 99 | 9 73 |
| PST | p,p'-DDT | 1 50 | 100 53 | 15 74 | 0 40 | 2 20 | 0 60 | 1 92 | 0 62 | 0 66 | 1 81 |
| TOC | % TOC | 1 73 | 1 89 | 2 26 | 2 15 | 4 54 | 2 91 | 3 12 | 2 09 | 1 81 | 1 13 |

1- For organics, sediment concentration is normalized by total organic carbon (NORM = CONC [See Table A-2-2.2a]/% Metals are not normalized.

units. metals (µg/g); organics (ng/% TOC).

Table A-3-1.2a (continued)

| Class | Analyte3 | M04-200B | M04-300B | M05-100B-AVG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 9.20 | 13.70 | 14 40 | 12 30 | 6.90 | 6.90 | 10 40 | 17 80 | 10 50 | 13 30 |
| MET | Cadmium | 0 25 | 0 06 | 0 54 | 0 57 | 0 64 | 0 24 | 0 66 | 0 07 | 0 27 | 0 61 |
| MET | Chromium | 74 90 | 67 80 | 119 50 | 101 00 | 72 70 | 61.60 | 88 60 | 57 50 | 73 60 | 122 00 |
| MET | Copper | 59 50 | 393 00 | 62 85 | 38 50 | 22 70 | 14.80 | 27.90 | 16 10 | 47.50 | 35 40 |
| MET | Lead | 46 50 | 145 00 | 132 50 | 48.80 | 46 70 | 36 70 | 45 70 | 19 00 | 43.20 | 51 40 |
| MET | Mercury | 0 27 | 0 39 | 0 60 | 0 35 | 0 28 | 0 27 | 0.22 | 0 02 | 0 13 | 0 49 |
| MET | Nickel | 23 30 | 158 00 | 33 40 | 28 60 | 27.50 | 21 30 | 27.20 | 36 90 | 25 70 | 31 90 |
| MET | Silver | 0 31 | 0 09 | 0 77 | 0 41 | 0 45 | 0 13 | 0.34 | 0 03 | 0.20 | 0.52 |
| MET | Zinc | 79 90 | 138 00 | 150 50 | 109 00 | 79 00 | 56 60 | 100.00 | 41 20 | 83 50 | 119 00 |
| MET | SEM-AVS | -10 88 | 1 19 | -56 77 | -51 14 | -1 18 | -2 77 | -36 26 | 0 17 | -9 25 | -36 27 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 3 82 | 2 17 | 9 98 | 7 25 | 9.00 | 6 60 | 5 17 | 2.50 | 3 98 | 6.04 |
| PAH | 1-Methylnaphthalene (L) | 4 91 | 2 75 | 8 63 | 10 85 | 12 57 | 9.38 | 6.75 | 3 08 | 5 51 | 6 65 |
| PAH | 1-Methylphenanthrene (L) | 22 08 | 6 96 | 29 53 | 23 81 | 28.29 | 54 26 | 17.32 | 10.00 | 14 69 | 29 04 |
| PAH | 2,6-Dimethylnaphthalene (L) | 6 82 | 3 04 | 10 32 | 9 19 | 12 29 | 9 79 | 7.37 | 3.85 | 5 51 | 9 14 |
| PAH | 2-Methylnaphthalene (L) | 8.91 | 4.78 | 12 82 | 16 19 | 20 43 | 16 17 | 11 77 | 4 62 | 9 29 | 10 36 |
| PAH | Acenaphthene (L) | 7.29 | 5 65 | 20 72 | 13 86 | 32.71 | 35 11 | 8 61 | 9 04 | 12 14 | 11.22 |
| PAH | Acenaphthylene (L) | 31.98 | 13 62 | 49 65 | 34.24 | 81.00 | 56 17 | 46.56 | 8.85 | 31.33 | 37 56 |
| PAH | Anthracene (L) | 83.33 | 36 09 | 171.57 | 114 83 | 202.86 | 187 02 | 89.00 | 36 35 | 93.57 | 85 28 |
| PAH | Benzo(a)anthracene (H) | 131.25 | 53 33 | 249 88 | 174 15 | 350 00 | 572 34 | 224 88 | 65 96 | 183 67 | 135 53 |
| PAH | Benzo(a)pyrene (H) | 167 19 | 67 68 | 279.05 | 202 12 | 492 86 | 923 40 | 310 53 | 82 12 | 245 92 | 193 40 |
| PAH | Benzo(b)fluoranthene (H) | 143 75 | 71 16 | 277.81 | 177 54 | 435.71 | 1008.51 | 250 72 | 85 19 | 233 67 | 189.34 |
| PAH | Benzo(b+k)fluoranthene (H) | 198 96 | 96 81 | 370 07 | 247 88 | 588 57 | 1353 19 | 313 40 | 113 46 | 314 59 | 238 98 |
| PAH | Benzo(e)pyrene (H) | 85.94 | 38.55 | 148.38 | 100.00 | 260 00 | 538.30 | 158 37 | 45 96 | 128.57 | 95 43 |
| PAH | Benzo(g,h,i)perylene (H) | 80 73 | 40 58 | 133 17 | 92.80 | 241.43 | 514 89 | 143 54 | 42 50 | 128 57 | 91 37 |
| PAH | Benzo(k)fluoranthene (H) | 55 21 | 25 65 | 92.27 | 70 34 | 152 86 | 344 68 | 62 68 | 28.27 | 80 92 | 49 64 |
| PAH | Biphenyl (L) | 3.13 | 1.59 | 4 39 | 3 23 | 5 86 | 5 74 | 3 27 | 2 31 | 2 76 | 3 10 |
| PAH | Chrysene (H) | 111 46 | 64 64 | 283 04 | 188.98 | 362.86 | 823 40 | 220 57 | 64 62 | 197 96 | 140 61 |
| PAH | Dibenz(a,h)anthracene (H) | 25.21 | 10 72 | 40.75 | 29 11 | 69 86 | 148 09 | 42 78 | 10 77 | 35 20 | 25 63 |
| PAH | Fluoranthene (H) | 210 42 | 129 86 | 546 88 | 297 88 | 572 86 | 1406 38 | 217.70 | 154 42 | 351 02 | 272 59 |
| PAH | Fluorene (L) | 19 38 | 6 09 | 42 49 | 37 29 | 53 14 | 73 62 | 23 21 | 13 65 | 23 16 | 21 32 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 85 42 | 39 86 | 147 88 | 101.27 | 260 00 | 570.21 | 138.28 | 47 50 | 136 73 | 98 48 |
| PAH | Naphthalene (L) | 16 67 | 4 93 | 22 67 | 18 60 | 33 71 | 27 23 | 21 10 | 7 50 | 16 63 | 18 32 |
| PAH | Perylene (H) | 44 95 | 13 19 | 70 75 | 46 19 | 68 57 | 108 51 | 49 28 | 16 54 | 74 90 | 37 97 |
| PAH | Phenanthrene (L) | 64 06 | 35 65 | 178.55 | 139 83 | 258 57 | 553 19 | 78 47 | 74 04 | 136 73 | 104 06 |
| PAH | Pyrene (H) | 237.50 | 108 70 | 472 57 | 272 46 | 535 71 | 1110 64 | 245 45 | 131 15 | 316 33 | 250 76 |
| PAH | LMW PAHs | 231.61 | 106 81 | 498 48 | 374 83 | 682 43 | 948 51 | 278 71 | 154 04 | 322 86 | 288 12 |
| PAH | HMW PAHs | 883.02 | 434 93 | 1872 17 | 1164 70 | 2384 14 | 4984 26 | 1261 91 | 509 04 | 1330 10 | 1018 53 |
| PAH | Total PAHs | 1114 64 | 541 74 | 2370 65 | 1539 53 | 3066 57 | 5932 77 | 1540 62 | 663 08 | 1652 96 | 1306 65 |
| PCB | Total PCBs | 17 94 | 138.95 | 47.51 | 25 11 | 32 37 | 28 10 | 20 23 | 17.62 | 43 93 | 24.25 |
| PST | Aldrin | 0 02 | 0 04 | 0 04 | 0 02 | 0 04 | 0 06 | 0 02 | 0 05 | 0 03 | 0 03 |
| PST | Alpha-BHC | 0 14 | 0 12 | 0 10 | 0 11 | 0 14 | 0 07 | 0 11 | 0 06 | 0 09 | 0 04 |
| PST | Alpha-chlordane | 0 06 | 0 19 | 0 35 | 0 11 | 0 34 | 0 57 | 0 12 | 0 23 | 0 24 | 0 15 |
| PST | Beta-BHC | 1 61 | 0 59 | 1 27 | 1 31 | 1 71 | 0 20 | 0 62 | 0 18 | 0 52 | 1 02 |
| PST | Chlorpyrifos | 0 11 | 0 17 | 0 34 | 0 10 | 0 21 | 0 29 | 0 11 | 0 26 | 0 14 | 0 12 |
| PST | CIS-Nonachlor | 0.08 | 1 45 | 0 16 | 0.08 | 0.57 | 0 28 | 0 12 | 0 33 | 0 16 | 0 07 |
| PST | Delta-BHC | 0 17 | 0 07 | 0 02 | 0 02 | 0 09 | 0 06 | 0 02 | 0 04 | 0 02 | 0 02 |
| PST | Dieldrin | 0.03 | 0 16 | 0 11 | 0 00 | 0 34 | 0 36 | 0 01 | 0 10 | 0 40 | 0 04 |
| PST | Endosulfan II | 0 36 | 0 23 | 0 80 | 0 51 | 1 24 | 1 57 | 0 48 | 0 29 | 0 63 | 0 42 |
| PST | Endrin | 0 05 | 0 08 | 0 05 | 0 05 | 0.10 | 0 14 | 0 05 | 0 13 | 0 07 | 0 06 |
| PST | Gamma-BHC (Lindane) | 0 04 | 0 14 | 0 13 | 0 26 | 0 41 | 0 30 | 0 17 | 0 21 | 0 09 | 0 06 |
| PST | Gamma-Chlordane | 0 08 | 0 09 | 0 19 | 0 10 | 0 07 | 0 17 | 0 05 | 0 06 | 0 24 | 0 08 |
| PST | Heptachlor | 0.07 | 0.03 | 0 01 | 0 06 | 0.20 | 0 11 | 0 06 | 0 17 | 0.09 | 0 08 |
| PST | Heptachlor epoxide | 0.01 | 0.02 | 0.01 | 0 01 | 0.02 | 0.03 | 0 01 | 0 03 | 0 01 | 0.01 |
| PST | Hexachlorobenzene | 0.02 | 0.14 | 0 83 | 0 02 | 0 03 | 0 04 | 0.02 | 0.04 | 0.02 | 0.04 |
| PST | Mirex | 0.02 | 0 02 | 0 09 | 0 12 | 0.16 | 0 45 | 0.12 | 0.03 | 0.13 | 0 13 |
| PST | Oxychlordane | 0 14 | 0 01 | 0 11 | 0.02 | 0 11 | 0.23 | 0.02 | 0 33 | 0 08 | 0 01 |
| PST | Pentachloroanisole | 0 07 | 0.09 | 0 10 | 0.21 | 0 10 | 0.13 | 0.07 | 0 08 | 0 12 | 0.09 |
| PST | Pentachlorobenzene | 0.10 | 0 12 | 0 13 | 0 08 | 0.47 | 0 19 | 0.10 | 0 17 | 0 21 | 0.08 |
| PST | Trans-Nonachlor | 0.02 | 0.39 | 0 17 | 0 11 | 0 10 | 0 06 | 0.11 | 0.03 | 0 15 | 0 10 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 06 | 0 61 | 0 09 | 0.22 | 0.37 | 0.38 | 0 03 | 0 31 | 0.28 | 0 13 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 63 | 0.23 | 0 80 | 0 07 | 0 94 | 0 64 | 0 67 | 0.31 | 1 73 | 0 61 |
| PST | o,p'-DDD | 0.89 | 18 84 | 1.32 | 1.27 | 1 14 | 1.28 | 1.15 | 0 23 | 2 14 | 0 28 |
| PST | p,p'-DDD | 0.37 | 4 93 | 0.20 | 0.29 | 0 13 | 0 19 | 0 25 | 0 62 | 0 17 | 0 22 |
| PST | o,p'-DDE | 0 01 | 49 28 | 0 19 | 0.03 | 0 25 | 0.09 | 0 02 | 0 08 | 0 16 | 0.03 |
| PST | o,p'-DDT | 0 57 | 40 58 | 1.35 | 1 06 | 1 64 | 1.06 | 0.72 | 0 40 | 2 35 | 0.48 |
| PST | p,p'-DDE | 0.27 | 200.00 | 1 42 | 0 47 | 0 93 | 0.76 | 0 35 | 3 65 | 3 57 | 0.28 |
| PST | p,p'-DDT | 0 31 | 252 17 | 0 55 | 1 19 | 1 07 | 0 76 | 0 62 | 0 75 | 1 07 | 0 33 |
| TOC | % TOC | 1 92 | 0 69 | 2 01 | 2 36 | 0 70 | 0 47 | 2 09 | 0 52 | 0 98 | 1 97 |

%TOC).

Table A-3-1.2a. (continued)

| Class | Analyte3 | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 10 50 | 11 60 | 10 80 | 11 45 | 10 40 | 12 60 | 7 40 | 14 30 | 15 90 | 7 45 |
| MET | Cadmium | 0 41 | 0 38 | 0 50 | 0.22 | 0 43 | 0 31 | 0.27 | 0 68 | 0 68 | 0 17 |
| MET | Chromium | 87 10 | 161.00 | 105 00 | 123 50 | 121 00 | 133 00 | 69.20 | 136 00 | 138 00 | 56 80 |
| MET | Copper | 23 20 | 455 00 | 77 50 | 755 50 | 157.00 | 511 00 | 207 00 | 73 30 | 152 00 | 27 65 |
| MET | Lead | 44 40 | 245 00 | 66 20 | 207 00 | 104 00 | 188 00 | 142 00 | 100 00 | 162 00 | 57 15 |
| MET | Mercury | 0 38 | 0 21 | 0 38 | 0 11 | 0 24 | 0 17 | 0 08 | 0 35 | 0 30 | 0 09 |
| MET | Nickel | 24 60 | 92 80 | 31 20 | 130 50 | 52 90 | 160 00 | 61 50 | 38 80 | 50 20 | 28 85 |
| MET | Silver | 0 30 | 0 69 | 0 54 | 0 36 | 0 59 | 0 70 | 0 42 | 0 66 | 0 75 | 0 15 |
| MET | Zinc | 89 70 | 701 00 | 148 00 | 913 50 | 293 00 | 484 00 | 225 00 | 166 00 | 246 00 | 100 60 |
| MET | SEM-AVS | -37 19 | -17 06 | -38 49 | 4 97 | -32 33 | 1 54 | -0 51 | -47 36 | -27 06 | -0 05 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 4 32 | 13 46 | 11 41 | 9 58 | 5 69 | 2.29 | 21 67 | 5.28 | 2.62 | 3 55 |
| PAH | 1-Methylnaphthalene (L) | 5.47 | 15 48 | 12 39 | 15 45 | 10.64 | 3 96 | 4 46 | 7 10 | 4 92 | 5 14 |
| PAH | 1-Methylphenanthrene (L) | 14 05 | 27 02 | 51 66 | 65 96 | 22 50 | 5 82 | 54 44 | 23 46 | 18 63 | 15 12 |
| PAH | 2,6-Dimethylnaphthalene (L) | 3 78 | 14 23 | 11.23 | 12 08 | 8 67 | 4 25 | 8 35 | 7 57 | 3 87 | 5 35 |
| PAH | 2-Methylnaphthalene (L) | 7 36 | 25 77 | 19 45 | 27.80 | 15 90 | 6 61 | 8 17 | 10 79 | 8 01 | 9 80 |
| PAH | Acenaphthene (L) | 7 50 | 39.33 | 26 87 | 27 98 | 31 76 | 2.86 | 6 78 | 24 11 | 19 22 | 8 87 |
| PAH | Acenaphthylene (L) | 37 84 | 64 42 | 54 36 | 110 92 | 48 46 | 19.21 | 16 85 | 28.69 | 16 21 | 15 00 |
| PAH | Anthracene (L) | 44.32 | 216 35 | 169.33 | 423.76 | 160 64 | 42 14 | 146 11 | 97 20 | 94 92 | 66 47 |
| PAH | Benzo(a)anthracene (H) | 63 92 | 328 85 | 256 44 | 569 72 | 254.26 | 36 07 | 216 67 | 164 49 | 141 02 | 90 75 |
| PAH | Benzo(a)pyrene (H) | 87 84 | 360 58 | 355 83 | 502 75 | 301.60 | 35.29 | 194 44 | 201 87 | 160 94 | 104 34 |
| PAH | Benzo(b)fluoranthene (H) | 77 70 | 434 62 | 337 42 | 689 91 | 317 02 | 63 21 | 182 41 | 198 13 | 163 67 | 92 77 |
| PAH | Benzo(b+k)fluoranthene (H) | 101 08 | 591 35 | 453 37 | 859 17 | 430 32 | 85 86 | 244 07 | 270 09 | 223 05 | 122 69 |
| PAH | Benzo(e)pyrene (H) | 40 88 | 222 12 | 190.18 | 318.53 | 173 40 | 33 71 | 98 89 | 108 88 | 89 84 | 51 33 |
| PAH | Benzo(g,h,i)perylene (H) | 37 43 | 233 65 | 169 33 | 271 47 | 166 49 | 24 54 | 82 22 | 105 61 | 82 42 | 48 64 |
| PAH | Benzo(k)fluoranthene (H) | 23 38 | 156 73 | 115 95 | 169.27 | 113 30 | 22 64 | 61 67 | 71 96 | 59 38 | 29 91 |
| PAH | Biphenyl (L) | 2 09 | 7 02 | 4 91 | 5 01 | 4 31 | 3 86 | 2 56 | 3 60 | 2 30 | 2 49 |
| PAH | Chrysene (H) | 59 19 | 394.23 | 281 60 | 679 82 | 281 91 | 43 57 | 169.26 | 158 88 | 157 42 | 78 32 |
| PAH | Dibenz(a,h)anthracene (H) | 10.20 | 71.92 | 54 11 | 87 80 | 50 96 | 7 29 | 29 63 | 30 61 | 24 06 | 13 96 |
| PAH | Fluoranthene (H) | 123 65 | 593.27 | 31 96 | 1602.75 | 508 51 | 52 86 | 375 93 | 338 79 | 280 08 | 179 77 |
| PAH | Fluorene (L) | 15 00 | 53 56 | 47 06 | 43 85 | 42 18 | 5 89 | 28 52 | 32 15 | 25 86 | 15 61 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 43.51 | 245 19 | 179 75 | 308 81 | 184 04 | 26 43 | 91 11 | 110.28 | 85 55 | 52 02 |
| PAH | Naphthalene (L) | 14 53 | 32 31 | 35 09 | 26 33 | 23 94 | 11.21 | 11 02 | 17 66 | 15 47 | 27 80 |
| PAH | Perylene (H) | 14 80 | 61 92 | 58.34 | 87.34 | 88 30 | 9 71 | 34 63 | 44 95 | 42 19 | 19 91 |
| PAH | Phenanthrene (L) | 49 66 | 245 19 | 222 70 | 377 80 | 210 64 | 26 46 | 137 04 | 156 07 | 141 02 | 73 41 |
| PAH | Pyrene (H) | 117 57 | 591 35 | 441 72 | 1424 77 | 453 72 | 47 86 | 327 78 | 303 27 | 259 77 | 160 69 |
| PAH | LMW PAHs | 176.22 | 676.92 | 574 85 | 1038 44 | 533 51 | 114 39 | 354 48 | 366 68 | 320 70 | 216 97 |
| PAH | HMW PAHs | 462 36 | 2340 19 | 1421 66 | 4867.61 | 1850 96 | 222 93 | 1313 70 | 1197 90 | 1023 28 | 627 83 |
| PAH | Total PAHs | 638 58 | 3017 12 | 1996 50 | 5906 06 | 2384 47 | 337 32 | 1668 19 | 1564 58 | 1343 98 | 844 80 |
| PCB | Total PCBs | 5 85 | 246.48 | 78 76 | 557 72 | 113 35 | 111 79 | 89 54 | 80 44 | 53 93 | 17 81 |
| PST | Aldrin | 0 04 | 0 03 | 0 01 | 0.13 | 3 24 | 0 08 | 0 04 | 1 92 | 1 41 | 0 02 |
| PST | Alpha-BHC | 0 03 | 0 14 | 0 06 | 0 10 | 0 11 | 0 11 | 0 09 | 0 18 | 0 04 | 0 05 |
| PST | Alpha-chlordane | 0 05 | 2 69 | 0 28 | 4 13 | 0 36 | 0 25 | 0 43 | 0 46 | 0 10 | 8 55 |
| PST | Beta-BHC | 1 01 | 0 64 | 1 17 | 0 27 | 0 64 | 1 00 | 0 15 | 0 27 | 0 21 | 0 40 |
| PST | Chlorpyrifos | 0 15 | 0 13 | 0 12 | 0 19 | 0 10 | 0 39 | 0 21 | 0 14 | 0 06 | 0 77 |
| PST | CIS-Nonachlor | 0 09 | 0 71 | 0 21 | 1 04 | 0 28 | 0 25 | 0 39 | 0 12 | 0 12 | 0 89 |
| PST | Delta-BHC | 0 03 | 0 01 | 0 12 | 0 03 | 0 14 | 0 06 | 0 06 | 0 12 | 0 02 | 0 01 |
| PST | Dieldrin | 0 07 | 0 90 | 0 18 | 0 51 | 0 18 | 0 00 | 0 02 | 0 08 | 0 02 | 0 25 |
| PST | Endosulfan II | 0 12 | 1 25 | 1 17 | 2.70 | 0 52 | 0 39 | 1 43 | 0 30 | 0 27 | 0 14 |
| PST | Endrin | 0 07 | 0 14 | 0 06 | 0 09 | 0 05 | 0 18 | 0 10 | 0.07 | 0 03 | 0 04 |
| PST | Gamma-BHC (Lindane) | 0 13 | 0 12 | 0 15 | 0 34 | 0.12 | 0 34 | 0 02 | 0 07 | 0.09 | 0 09 |
| PST | Gamma-Chlordane | 0 02 | 4 23 | 0 15 | 4.04 | 0 02 | 0 07 | 0.52 | 0 03 | 0 02 | 12 28 |
| PST | Heptachlor | 0 09 | 0.12 | 0 10 | 0 22 | 0 06 | 0.11 | 0.26 | 0 05 | 0 04 | 0 21 |
| PST | Heptachlor epoxide | 0 02 | 0 01 | 0 01 | 0 02 | 0.01 | 0 54 | 0 02 | 0 01 | 0 01 | 0 01 |
| PST | Hexachlorobenzene | 0 02 | 0 13 | 0 02 | 0.21 | 0 07 | 4 29 | 0 15 | 0 14 | 0 01 | 0 05 |
| PST | Mirex | 0 02 | 0 19 | 0 12 | 0.23 | 0 01 | 0 04 | 0.22 | 0 01 | 0 01 | 0 05 |
| PST | Oxychlordane | 0 01 | 0.26 | 0 06 | 0 26 | 0 04 | 0 02 | 0 01 | 0 02 | 0 01 | 0 20 |
| PST | Pentachloroanisole | 0 03 | 0.24 | 0.09 | 0.22 | 0.22 | 0 21 | 0 11 | 0 14 | 0 08 | 0 12 |
| PST | Pentachlorobenzene | 0 03 | 0 20 | 0 07 | 0 26 | 0.24 | 4 29 | 0.28 | 0 25 | 0 07 | 0 05 |
| PST | Trans-Nonachlor | 0.02 | 2 02 | 0 18 | 2 66 | 0 41 | 0 07 | 0 30 | 0.24 | 0.09 | 4 28 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 02 | 0 47 | 0 07 | 0 26 | 0 12 | 1.50 | 0 39 | 0 36 | 0 13 | 0 19 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 48 | 0 96 | 0 74 | 0 66 | 0.44 | 3.32 | 0 61 | 0 32 | 0 20 | 0 26 |
| PST | o,p'-DDD | 0 05 | 34 62 | 2 94 | 26.61 | 5 32 | 0 39 | 1 85 | 1 26 | 1 05 | 15 90 |
| PST | p,p'-DDD | 0 11 | 1.25 | 0 07 | 1 47 | 0 24 | 0 18 | 0 30 | 0 23 | 0 12 | 0 21 |
| PST | o,p'-DDE | 0 00 | 6.25 | 0 55 | 47 71 | 1 17 | 1 00 | 1 74 | 0 10 | 0 43 | 1.79 |
| PST | o,p'-DDT | 0.13 | 115.38 | 3 37 | 69 72 | 12.77 | 1 00 | 2 78 | 1 26 | 1 29 | 46 82 |
| PST | p,p'-DDE | 0 05 | 21.15 | 1 90 | 38 53 | 4 04 | 0 71 | 1 85 | 1 45 | 0 78 | 3 84 |
| PST | p,p'-DDT | 0 19 | 274 04 | 1 04 | 169 72 | 5 85 | 2 14 | 4 44 | 0 61 | 1 41 | 3 58 |
| TOC | % TOC | 1 48 | 1 04 | 1 63 | 0 55 | 1 88 | 0 28 | 0 54 | 2 14 | 2 56 | 1 73 |

Table A-3-1 2a. (continued)

| Class | Analyte3 | M10-200B | M10-300B | M11-100B | M11-200B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B |
|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 8 80 | 13 80 | | | 10.90 | 7.70 | 6 95 | 12.50 | 16 80 |
| MET | Cadmium | 0.22 | 0 52 | | | 0 98 | 0 60 | 0.23 | 0 37 | 1 40 |
| MET | Chromium | 56 70 | 98.00 | | | 132 00 | 86 10 | 67.00 | 112 55 | 116 00 |
| MET | Copper | 33 70 | 31.20 | | | 541.00 | 87.90 | 37.35 | 95 30 | 53 80 |
| MET | Lead | 55 90 | 55 20 | | | 554 00 | 118 00 | 55 45 | 115 50 | 50 70 |
| MET | Mercury | 0 16 | 0 23 | | | 1 00 | 0.38 | 0 16 | 0 65 | 0 26 |
| MET | Nickel | 20 50 | 28 70 | | | 75 50 | 39 80 | 22 60 | 37.25 | 32 80 |
| MET | Silver | 0 17 | 0.38 | | | 2 60 | 0 65 | 0.21 | 0 42 | 0 72 |
| MET | Zinc | 75 70 | 122 00 | | | 489 00 | 343 00 | 129.00 | 163 50 | 157 00 |
| MET | SEM-AVS | -28 60 | -98 67 | | | -2 49 | -7 35 | -1.25 | -56 70 | -110 00 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 49.22 | 6 11 | | | 12 84 | 18 14 | 21.05 | 9.77 | 103 08 |
| PAH | 1-Methylnaphthalene (L) | 20 26 | 6 91 | | | 17 46 | 80 00 | 90.13 | 9 83 | 75 38 |
| PAH | 1-Methylphenanthrene (L) | 124 35 | 18 51 | | | 41 04 | 171 43 | 195.18 | 51 38 | 340 00 |
| PAH | 2,6-Dimethylnaphthalene (L) | 44 35 | 6 11 | | | 20.00 | 29 07 | 32 72 | 10 55 | 196 41 |
| PAH | 2-Methylnaphthalene (L) | 26 17 | 12 57 | | | 37 01 | 106.43 | 123.20 | 15 66 | 118 46 |
| PAH | Acenaphthene (L) | 97 39 | 11.54 | | | 12.61 | 487.14 | 496 49 | 29.22 | 1375 38 |
| PAH | Acenaphthylene (L) | 206 09 | 53 43 | | | 35 60 | 82 86 | 81.89 | 45 98 | 108 72 |
| PAH | Anthracene (L) | 1434 78 | 645 71 | | | 159 70 | 871.43 | 945.61 | 241 38 | 1163.59 |
| PAH | Benzo(a)anthracene (H) | 1426 09 | 220.57 | | | 211.19 | 1550 00 | 1713 60 | 456 90 | 1229 74 |
| PAH | Benzo(a)pyrene (H) | 1521 74 | 232.57 | | | 249.25 | 1635.71 | 1830 26 | 403 16 | 898 46 |
| PAH | Benzo(b)fluoranthene (H) | 1252.17 | 221 71 | | | 230.60 | 1785 71 | 1775 88 | 510.63 | 927 69 |
| PAH | Benzo(b+k)fluoranthene (H) | 1742.61 | 308 57 | | | 307 46 | 2150 71 | 2421 05 | 635 06 | 1215 38 |
| PAH | Benzo(e)pyrene (H) | 672 17 | 121.71 | | | 124 63 | 885 71 | 927.63 | 220 40 | 441 03 |
| PAH | Benzo(g,h,i)perylene (H) | 677 39 | 92 57 | | | 129 85 | 907 14 | 955 70 | 200 00 | 284 10 |
| PAH | Benzo(k)fluoranthene (H) | 490 43 | 86 86 | | | 76 87 | 365 00 | 645 18 | 124 43 | 287 69 |
| PAH | Biphenyl (L) | 18 17 | 3.37 | | | 10 30 | 16 79 | 22 06 | 4 48 | 95 38 |
| PAH | Chrysene (H) | 1173.91 | 236.57 | | | 212 69 | 1450 00 | 1528 07 | 419 54 | 1074 36 |
| PAH | Dibenz(a,h)anthracene (H) | 220 87 | 27 43 | | | 40 22 | 327.86 | 337.28 | 66 12 | 124 62 |
| PAH | Fluoranthene (H) | 2288 96 | 366 86 | | | 403 73 | 2471.43 | 2952.63 | 947 13 | 2955 38 |
| PAH | Fluorene (L) | 335 65 | 46 86 | | | 39 33 | 485 71 | 570 18 | 54 89 | 1924 10 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 844 35 | 104 00 | | | 138 06 | 1114.29 | 1146 49 | 229 31 | 364.10 |
| PAH | Naphthalene (L) | 76 52 | 22 06 | | | 48 36 | 209.29 | 270 18 | 25 46 | 38 21 |
| PAH | Perylene (H) | 247 83 | 36 11 | | | 48 88 | 156 43 | 264 91 | 65 06 | 101 03 |
| PAH | Phenanthrene (L) | 1408 70 | 127 43 | | | 187 31 | 1821.43 | 2139 04 | 252.01 | 2974 36 |
| PAH | Pyrene (H) | 1800 00 | 324 57 | | | 360 45 | 2085 71 | 2385 53 | 725 86 | 2247 69 |
| PAH | LMW PAHs | 3585 30 | 919 60 | | | 519 93 | 4064 29 | 4626 58 | 664 60 | 7702 82 |
| PAH | HMW PAHs | 8429 57 | 1408 57 | | | 1477 54 | 9520 71 | 10747 37 | 3018 71 | 8530 26 |
| PAH | Total PAHs | 12014 87 | 2328 17 | | | 1997 46 | 13585 00 | 15373 95 | 3683 30 | 16233 08 |
| PCB | Total PCBs | 46 30 | 29 90 | | | 239 12 | 173 43 | 239 32 | 54 07 | 42 57 |
| PST | Aldrin | 0 03 | 0 04 | | | 1 42 | 0 03 | 9 23 | 1 85 | 4 56 |
| PST | Alpha-BHC | 0 17 | 0 09 | | | 0 07 | 0 34 | 0 10 | 0 06 | 0 21 |
| PST | Alpha-chlordane | 0 31 | 0 22 | | | 1 12 | 0 67 | 0 30 | 0 09 | 0 17 |
| PST | Beta-BHC | 1 13 | 1 20 | | | 0 39 | 0 61 | 1.36 | 0 50 | 0 87 |
| PST | Chlorpyrifos | 0 14 | 0 17 | | | 0 10 | 0.13 | 0 16 | 0 12 | 0 03 |
| PST | CIS-Nonachlor | 0.17 | 0 13 | | | 0 46 | 0 27 | 0 48 | 0 10 | 0 22 |
| PST | Delta-BHC | 0 02 | 0 10 | | | 0 01 | 0 02 | 0 02 | 0 02 | 0 02 |
| PST | Dieldrin | 0.23 | 0 04 | | | 2 09 | 0 16 | 0 11 | 0 10 | 0 06 |
| PST | Endosulfan II | 1 04 | 0 32 | | | 0 60 | 2 14 | 2 28 | 0 47 | 0 23 |
| PST | Endrin | 0 07 | 0 08 | | | 0 05 | 0 06 | 0 07 | 0 06 | 0 07 |
| PST | Gamma-BHC (Lindane) | 0.18 | 0 08 | | | 0 14 | 0 11 | 0 13 | 0 14 | 0 13 |
| PST | Gamma-Chlordane | 0 11 | 0 09 | | | 0 02 | 0 03 | 0 21 | 0.12 | 0 04 |
| PST | Heptachlor | 0.10 | 0 11 | | | 2 39 | 0.08 | 0.22 | 0 07 | 0.09 |
| PST | Heptachlor epoxide | 0 02 | 0 02 | | | 0 01 | 0 01 | 0.02 | 0 01 | 0.02 |
| PST | Hexachlorobenzene | 0 02 | 0 03 | | | 0.22 | 0 02 | 2 16 | 0.05 | 0 01 |
| PST | Mirex | 0.70 | 0 02 | | | 0.01 | 0.26 | 0.18 | 0 01 | 0 12 |
| PST | Oxychlordane | 0.21 | 0.02 | | | 0 04 | 0.27 | 0 48 | 0 07 | 0 77 |
| PST | Pentachloroanisole | 0.07 | 0 07 | | | 0 15 | 0 07 | 0 13 | 0 05 | 0 07 |
| PST | Pentachlorobenzene | 0 03 | 0 06 | | | 0 47 | 0 07 | 0 08 | 0 10 | 0 06 |
| PST | Trans-Nonachlor | 0 19 | 0 30 | | | 0.28 | 0 37 | 0.18 | 0 16 | 0 04 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 05 | 0 03 | | | 0 48 | 0 01 | 0 06 | 0 14 | 0 11 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 39 | 0.38 | | | 1 19 | 0.24 | 0 38 | 0.39 | 0 49 |
| PST | o,p'-DDD | 0.96 | 0 63 | | | 1 19 | 3 14 | 3 33 | 0.76 | 1 64 |
| PST | p,p'-DDD | 0 10 | 0.26 | | | 0 52 | 0.20 | 0.25 | 0.13 | 0 11 |
| PST | o,p'-DDE | 0 17 | 0.08 | | | 0 57 | 0 40 | 0 82 | 0.03 | 0 09 |
| PST | o,p'-DDT | 1 74 | 0 94 | | | 2 01 | 1.64 | 1 54 | 0.61 | 0.82 |
| PST | p,p'-DDE | 0.35 | 0.20 | | | 0 70 | 1.07 | 0 75 | 0 50 | 0 12 |
| PST | p,p'-DDT | 0 78 | 1 03 | | | 8 21 | 1 71 | 2 15 | 0 29 | 0 62 |
| TOC | % TOC | 1 15 | 1 75 | | | 1 34 | 1 40 | 1 14 | 1 74 | 1 95 |

Table A-3-1.2a (continued)

| Class | Analyte3 | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B |
|---|---|---|---|---|---|---|
| MET | Arsenic | 13 70 | 14 50 | 10.60 | 8 60 | 11 00 |
| MET | Cadmium | 0.50 | 0 73 | 0 48 | 0 38 | 0 47 |
| MET | Chromium | 105 00 | 116.00 | 79 70 | 72 90 | 96 00 |
| MET | Copper | 51 60 | 119 00 | 59 70 | 28 60 | 31 00 |
| MET | Lead | 49 20 | 85 00 | 185 00 | 52 60 | 44 10 |
| MET | Mercury | 0 24 | 0 34 | 0 55 | 0 24 | 0 29 |
| MET | Nickel | 31 10 | 34 50 | 29 70 | 20 30 | 27 30 |
| MET | Silver | 0 44 | 0 66 | 0 24 | 0.22 | 0.37 |
| MET | Zinc | 153 00 | 232 00 | 116 00 | 92 50 | 110 00 |
| MET | SEM-AVS | -84 51 | -173 15 | -1 46 | -15 87 | -27 04 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 14 57 | 14 00 | 2.99 | 9 68 | 10 29 |
| PAH | 1-Methylnaphthalene (L) | 11 30 | 9 63 | 5 38 | 9 31 | 8 21 |
| PAH | 1-Methylphenanthrene (L) | 40 90 | 51 67 | 13 47 | 57 34 | 46 25 |
| PAH | 2,6-Dimethylnaphthalene (L) | 13 72 | 11 63 | 4 11 | 9 54 | 9.50 |
| PAH | 2-Methylnaphthalene (L) | 17 13 | 16 58 | 9 16 | 15 78 | 13 92 |
| PAH | Acenaphthene (L) | 28 07 | 38 88 | 4 83 | 13 12 | 13 38 |
| PAH | Acenaphthylene (L) | 84 30 | 49 58 | 34 74 | 47 25 | 72.08 |
| PAH | Anthracene (L) | 280 27 | 312 08 | 59 52 | 187 61 | 165 00 |
| PAH | Benzo(a)anthracene (H) | 383 86 | 420 83 | 96 68 | 377 98 | 379 17 |
| PAH | Benzo(a)pyrene (H) | 400 90 | 381.25 | 134 14 | 518 35 | 500 00 |
| PAH | Benzo(b)fluoranthene (H) | 433 63 | 411 67 | 123.26 | 411 01 | 410 83 |
| PAH | Benzo(b+k)fluoranthene (H) | 551 57 | 560 83 | 171 30 | 561 01 | 510 42 |
| PAH | Benzo(e)pyrene (H) | 208 97 | 205 83 | 76 13 | 253.21 | 253 33 |
| PAH | Benzo(g,h,i)perylene (H) | 176.23 | 178 33 | 76 74 | 286 70 | 247 92 |
| PAH | Benzo(k)fluoranthene (H) | 117 94 | 149 17 | 48 04 | 150 00 | 99.58 |
| PAH | Biphenyl (L) | 5 70 | 6 21 | 2 27 | 5 60 | 4 46 |
| PAH | Chrysene (H) | 387.89 | 429 17 | 102 42 | 338 07 | 321 67 |
| PAH | Dibenz(a,h)anthracene (H) | 55.61 | 58 75 | 22 81 | 90 83 | 74 58 |
| PAH | Fluoranthene (H) | 765 02 | 762 50 | 161 03 | 504 59 | 317 08 |
| PAH | Fluorene (L) | 69 96 | 119 58 | 13 29 | 49 08 | 41.17 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 195 96 | 202 50 | 74 62 | 295 87 | 236.25 |
| PAH | Naphthalene (L) | 26 50 | 28 54 | 16 34 | 31 65 | 25 83 |
| PAH | Perylene (H) | 74 89 | 71 25 | 29 88 | 42 39 | 62 08 |
| PAH | Phenanthrene (L) | 234 08 | 351 67 | 54.98 | 232 11 | 147 50 |
| PAH | Pyrene (H) | 649 78 | 679 17 | 155.29 | 559 63 | 352.92 |
| PAH | LMW PAHs | 740 31 | 916 92 | 192 90 | 576 61 | 478 88 |
| PAH | HMW PAHs | 2643 05 | 2731.67 | 672.36 | 2389 45 | 1945 42 |
| PAH | Total PAHs | 3383 36 | 3648 58 | 865 26 | 2966 06 | 2424 29 |
| PCB | Total PCBs | 22 31 | 55 48 | 26 21 | 20 09 | 29 61 |
| PST | Aldrin | 0 02 | 0 02 | 1 45 | 0 02 | 0 02 |
| PST | Alpha-BHC | 0 04 | 0 05 | 0 05 | 0 23 | 0 01 |
| PST | Alpha-chlordane | 0 17 | 0 32 | 0 17 | 0 05 | 0 04 |
| PST | Beta-BHC | 0 09 | 0 07 | 0 05 | 0 08 | 0 07 |
| PST | Chlorpyrifos | 0 01 | 0 10 | 0 02 | 0 07 | 0.10 |
| PST | CIS-Nonachlor | 0 08 | 0 15 | 0 30 | 0 09 | 0 08 |
| PST | Delta-BHC | 0 02 | 0 02 | 0 01 | 0.01 | 0 02 |
| PST | Dieldrin | 0 19 | 0 22 | 0 02 | 0 03 | 0 05 |
| PST | Endosulfan II | 0 05 | 0 46 | 0.12 | 0 60 | 0 09 |
| PST | Endrin | 0 06 | 0 05 | 0 03 | 0 03 | 0 03 |
| PST | Gamma-BHC (Lindane) | 0 11 | 0.09 | 0 01 | 0 06 | 0 09 |
| PST | Gamma-Chlordane | 0 09 | 0 03 | 0 02 | 0 02 | 0 03 |
| PST | Heptachlor | 0 07 | 0.06 | 0 04 | 0 04 | 0 06 |
| PST | Heptachlor epoxide | 0 01 | 0 01 | 0 01 | 0 01 | 0 01 |
| PST | Hexachlorobenzene | 0 04 | 0.05 | 0 02 | 0 01 | 0 02 |
| PST | Mirex | 0 01 | 0.01 | 0 01 | 0.01 | 0 01 |
| PST | Oxychlordane | 0 04 | 0 16 | 0 02 | 0 25 | 0 01 |
| PST | Pentachloroanisole | 0 06 | 0 07 | 0 04 | 0 02 | 0.03 |
| PST | Pentachlorobenzene | 0.16 | 0 09 | 0.06 | 0 07 | 0 11 |
| PST | Trans-Nonachlor | 0 04 | 0 10 | 0 08 | 0 01 | 0 01 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0.04 | 0 01 | 0 17 | 0 06 | 0 05 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 24 | 0 34 | 1.27 | 0 12 | 0 37 |
| PST | o,p'-DDD | 0.21 | 1 04 | 0 76 | 0.78 | 0 14 |
| PST | p,p'-DDD | 0 06 | 0.10 | 0.07 | 0 02 | 0 17 |
| PST | o,p'-DDE | 0 01 | 0 01 | 0 02 | 0 01 | 0 08 |
| PST | o,p'-DDT | 0 42 | 0.92 | 0 57 | 0.55 | 0 20 |
| PST | p,p'-DDE | 0 30 | 0.42 | 2 72 | 0 23 | 0 12 |
| PST | p,p'-DDT | 0.35 | 0 29 | 0 29 | 0 23 | 0 28 |
| TOC | % TOC | 2 23 | 2 40 | 3 31 | 2 18 | 2 40 |
| | | | | | Site mean TOC% | |
| | | | | | 1 77 | |

Table A-3-1.2b. Normalized[1] concentrations of PCB congeners in sediment in the Portsmouth Naval Shipyard offshore study area.

| Analyte | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG | M05-200B | M05-300B | M06-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB101 | 0.64 | 1.48 | 0.73 | 0.98 | 0.15 | 0.48 | 12.18 | 2.78 | 2.54 | 19.47 | 0.73 | 1.59 | 1.37 | 0.93 | 1.11 | 1.38 |
| PCB105 | 0.23 | 0.74 | 0.28 | 0.65 | 0.09 | 0.79 | 3.04 | 1.34 | 1.05 | 4.51 | 0.30 | 2.46 | 0.77 | 0.38 | 0.91 | 0.79 |
| PCB118 | 0.58 | 1.64 | 1.02 | 0.98 | 0.20 | 1.62 | 1.38 | 1.48 | 1.60 | 6.28 | 0.63 | 2.03 | 1.40 | 0.81 | 1.29 | 1 30 |
| PCB128 | 0.81 | 0.90 | 0.55 | 0.37 | 0.10 | 0.65 | 1.31 | 0.67 | 0.88 | 2.04 | 0.20 | 1.29 | 0.41 | 0.12 | 0.43 | 0.30 |
| PCB138 | 0.87 | 1.80 | 1.04 | 1.35 | 0.31 | 0.48 | 28.53 | 9.57 | 5.08 | 29.20 | 0.89 | 11.88 | 1.85 | 1.06 | 1.43 | 1.28 |
| PCB153 | 0.92 | 1.27 | 0.82 | 0.98 | 0.20 | 1.86 | 31.09 | 8.13 | 5.08 | 27.43 | 0.89 | 13.91 | 1.87 | 0.93 | 3.14 | 1.17 |
| PCB170 | 20.81 | 13.76 | 8.43 | 10.23 | 1.94 | 0.79 | 15.06 | 17.70 | 9.94 | 5.22 | 1.61 | 8.70 | 7.44 | 2.54 | 0.77 | 1.21 |
| PCB18 | 0.03 | 0.02 | 0.28 | 0.02 | 0.01 | 0.03 | 0.03 | 0.03 | 0.03 | 0.12 | 0.03 | 0.06 | 0.19 | 0.03 | 0.07 | 0.09 |
| PCB180 | 0.47 | 0.79 | 0.58 | 0.51 | 0.13 | 1.44 | 14.42 | 9.57 | 3.87 | 23.89 | 0.63 | 14.49 | 1.07 | 0.64 | 0.86 | 0.90 |
| PCB187 | 0.33 | 0.37 | 0.27 | 0.34 | 0.07 | 0.76 | 8.01 | 7.66 | 2.32 | 19.47 | 0.39 | 8.26 | 0.87 | 0.41 | 1.43 | 0.94 |
| PCB195 | 0.69 | 0.63 | 0.25 | 0.17 | 0.04 | 0.34 | 1.12 | 1.87 | 0.55 | 4.69 | 0.08 | 1.59 | 0.32 | 0.16 | 0.46 | 0.51 |
| PCB206 | 0.24 | 0.21 | 0.18 | 0.13 | 0.03 | 0.24 | 0.71 | 3.16 | 0.51 | 9.73 | 0.03 | 1.59 | 0.56 | 0.06 | 0.24 | 0.43 |
| PCB209 | 1.21 | 0.49 | 0.18 | 0.30 | 0.11 | 0.19 | 0.54 | 1.24 | 0.43 | 11.50 | 0.19 | 0.30 | 0.62 | 0.42 | 0.46 | 0.46 |
| PCB28 | 0.55 | 0.35 | 0.49 | 0.98 | 0.20 | 3.44 | 0.45 | 1.05 | 0.77 | 0.88 | 1.09 | 0.20 | 1.62 | 1.27 | 1.10 | 1.11 |
| PCB44 | 0.29 | 0.42 | 0.35 | 0.16 | 0.04 | 0.34 | 0.19 | 0.30 | 0.18 | 1.50 | 0.20 | 0.13 | 1.10 | 0.24 | 1.57 | 0.66 |
| PCB52 | 0.18 | 1.32 | 0.39 | 0.40 | 0.09 | 1.13 | 3.21 | 1.72 | 0 94 | 4.42 | 0.57 | 0.28 | 1.15 | 1.31 | 0.27 | 0.83 |
| PCB66 | 0.28 | 0.23 | 0.48 | 0.09 | 0.05 | 0.17 | 0.11 | 0.24 | 0.28 | 1.15 | 0.10 | 0.08 | 0.32 | 0.23 | 0.17 | 0.13 |
| PCB8 | 1.21 | 0.74 | 0.91 | 0.31 | 0.11 | 0.72 | 0.04 | 0.02 | 0.07 | 1.33 | 0.41 | 0.62 | 0.82 | 1.02 | 0.49 | 0.57 |
| TOTPCB | 60.68 | 54.34 | 34.43 | 37.89 | 7.74 | 30.94 | 242.87 | 137.05 | 72.27 | 345.72 | 17.94 | 138.95 | 47.51 | 25.11 | 32.37 | 28.10 |
| % TOC | 1.73 | 1.89 | 2.26 | 2.15 | 4.54 | 2.91 | 3.12 | 2.09 | 1.81 | 1.13 | 1.92 | 0.69 | 2.01 | 2.36 | 0.70 | 0.47 |

1- Sediment concentration is normalized by total organic carbon (NORM = CONC [See Table A-2-2.2b]/%TOC).
Units=ng/g.
TOTPCB = Total PCBs - SUMPCB x 2.
See Table A-2-2.2b for sediment PCB congener concentrations and SUMPCB values.

Table A-3-1.2b. (continued)

| Analyte | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB101 | 0.67 | 1.00 | 1.73 | 0.81 | 0.18 | 13.46 | 3.87 | 11.10 | 3.46 | 3.32 | 4.81 | 1.96 | 1.45 | 0.80 | 0.80 | 1.14 |
| PCB105 | 0.41 | 0.50 | 0.85 | 1.07 | 0.23 | 5.00 | 1.60 | 6.15 | 1.76 | 2.14 | 2.96 | 0.93 | 0.74 | 0.61 | 0.50 | 0.33 |
| PCB118 | 0.62 | 0.77 | 1.73 | 0.61 | 0.17 | 7.69 | 3.80 | 3.94 | 2.29 | 2.61 | 4.07 | 1.54 | 1.13 | 1.16 | 2.17 | 0.53 |
| PCB128 | 0.11 | 0.44 | 0.45 | 0.15 | 0.07 | 2.60 | 1.04 | 3.12 | 1.06 | 0.96 | 1.65 | 0.46 | 0.47 | 0.27 | 0.32 | 0.10 |
| PCB138 | 0.96 | 0.20 | 2.14 | 0.69 | 0.08 | 19.23 | 5.46 | 43.12 | 6 38 | 4.29 | 6.85 | 2.52 | 1.60 | 1.13 | 0.61 | 0.29 |
| PCB153 | 0.72 | 0.63 | 2.14 | 4.82 | 0.91 | 21.15 | 9.20 | 53.21 | 6.91 | 3.57 | 5.37 | 2.01 | 1.95 | 0.91 | 0.52 | 2.97 |
| PCB170 | 1.91 | 0.96 | 0.29 | 0.40 | 0.18 | 2.50 | 0.67 | 63.30 | 15.43 | 2.50 | 2 96 | 6.07 | 12.11 | 1.58 | 7.74 | 6.86 |
| PCB18 | 0.03 | 0.12 | 0.88 | 0.04 | 0.05 | 0.88 | 0.04 | 0.54 | 0.35 | 0.36 | 0.07 | 0.47 | 0.32 | 0.03 | 0.04 | 0.05 |
| PCB180 | 0.46 | 0.38 | 0.61 | 0.25 | 0.09 | 13.46 | 2.94 | 54.13 | 6.38 | 2.79 | 2.59 | 1.92 | 1 33 | 0.30 | 1.22 | 0.21 |
| PCB187 | 0.31 | 0.40 | 1.02 | 0.39 | 0.09 | 8.37 | 1.96 | 23.76 | 3.94 | 3.25 | 2.22 | 1.45 | 1.09 | 0.47 | 0.41 | 0.18 |
| PCB195 | 0.11 | 0.10 | 0.73 | 0.22 | 0.07 | 3.65 | 0.86 | 4.95 | 1.22 | 5.71 | 1.48 | 1.59 | 0.70 | 0.11 | 0.24 | 0.10 |
| PCB206 | 0.03 | 0.13 | 1.94 | 0.24 | 0.08 | 7.31 | 1.72 | 4.77 | 2.29 | 14.64 | 3.52 | 3.41 | 1.29 | 0.10 | 0.47 | 0.12 |
| PCB209 | 0.53 | 0.38 | 0.37 | 0.23 | 0.04 | 2.21 | 0.80 | 0.98 | 0.80 | 3.93 | 1.04 | 1.54 | 0.39 | 0.14 | 0.70 | 0.15 |
| PCB28 | 1.72 | 0.88 | 3.16 | 0.61 | 0.10 | 3.08 | 1.17 | 0.59 | 0.96 | 1.14 | 0.83 | 1.17 | 0.70 | 0.35 | 2.61 | 0.36 |
| PCB44 | 0.12 | 0.69 | 0.94 | 0.66 | 0.32 | 2.98 | 1.41 | 1.20 | 0.85 | 1.00 | 0.78 | 0 37 | 0.63 | 0.13 | 0.46 | 0.50 |
| PCB52 | 0.77 | 0.15 | 1.22 | 0.39 | 0.18 | 5.77 | 1.96 | 2.57 | 1.17 | 2.25 | 2.22 | 1.36 | 0.55 | 0.60 | 0.76 | 0.74 |
| PCB66 | 0.18 | 0.12 | 0.87 | 0.40 | 0.07 | 3.17 | 0.55 | 1.19 | 0.59 | 0.71 | 0.63 | 0.42 | 0.29 | 0.13 | 1.13 | 0.12 |
| PCB8 | 0.45 | 0.94 | 0.88 | 0.15 | 0.01 | 0.72 | 0.33 | 0.24 | 0.85 | 0.71 | 0.70 | 1.03 | 0.22 | 0.10 | 2.43 | 0.21 |
| TOTPCB | 20.23 | 17.62 | 43.93 | 24.25 | 5.85 | 246.48 | 78.76 | 557.72 | 113.35 | 111.79 | 89.54 | 60.44 | 53.93 | 17.81 | 46.30 | 29.90 |
| % TOC | 2.09 | 0.52 | 0.98 | 1.97 | 1.48 | 1.04 | 1.63 | 0.55 | 1.88 | 0.28 | 0.54 | 2.14 | 2.56 | 1.73 | 1.15 | 1.75 |

Table A-3-1.2b. (continued)

| Analyte | M11-100B | M11-200B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB101 | | | 17.91 | 2.57 | 5.44 | 1.41 | 0.41 | 0.81 | 1.50 | 0.66 | 0.42 | 2.54 |
| PCB105 | | | 5.90 | 1.21 | 2.67 | 0.69 | 0.28 | 0.49 | 0.67 | 0.42 | 0.28 | 1.58 |
| PCB118 | | | 11.19 | 3.43 | 2.98 | 1.12 | 1.54 | 0.99 | 1.50 | 1.03 | 0.96 | 2.33 |
| PCB128 | | | 2.54 | 0.79 | 2.02 | 0.30 | 0.24 | 0.11 | 0.36 | 0.39 | 0.25 | 0.50 |
| PCB138 | | | 22.39 | 2.86 | 15.53 | 1.95 | 0.56 | 1.35 | 2.08 | 1.12 | 0.83 | 2.00 |
| PCB153 | | | 12.69 | 2.79 | 20.35 | 1.90 | 0.56 | 0.99 | 1.96 | 1.36 | 0.60 | 1.33 |
| PCB170 | | | 5.75 | 45.00 | 33.77 | 12.86 | 9.74 | 0.40 | 9.17 | 3.93 | 3.21 | 0.35 |
| PCB18 | | | 0.16 | 2.00 | 0.60 | 0.51 | 0.82 | 0.04 | 0.79 | 0.29 | 0.02 | 0.03 |
| PCB180 | | | 9.70 | 2.57 | 16.32 | 1.55 | 0.62 | 0.76 | 1.50 | 0.60 | 0.44 | 0.50 |
| PCB187 | | | 9.70 | 1.79 | 9.39 | 0.95 | 0.18 | 0.49 | 1.00 | 0.42 | 0.18 | 0.25 |
| PCB195 | | | 2.39 | 1.57 | 2.20 | 0.37 | 0.30 | 0.22 | 0.42 | 0.26 | 0.14 | 0.08 |
| PCB206 | | | 5.15 | 2.64 | 1.45 | 0.39 | 0.12 | 0 38 | 0.58 | 0.51 | 0.17 | 0.04 |
| PCB209 | | | 0.97 | 1.14 | 0.27 | 0.43 | 0.23 | 0.63 | 0.83 | 0.27 | 0.40 | 0.18 |
| PCB28 | | | 1.19 | 5.14 | 1.49 | 1.21 | 0.51 | 1.66 | 2.08 | 0.33 | 0.64 | 0.25 |
| PCB44 | | | 2.31 | 2.36 | 1.10 | 0.28 | 0.20 | 0.21 | 0.63 | 0.19 | 0.05 | 0.67 |
| PCB52 | | | 6.79 | 3.79 | 1.49 | 0.80 | 0.67 | 0.90 | 1.25 | 0.33 | 0.25 | 1.58 |
| PCB66 | | | 2.01 | 3.57 | 0.55 | 0.18 | 0.05 | 0.25 | 0.67 | 0.54 | 0.20 | 0.46 |
| PCB8 | | | 0.82 | 1.50 | 2.06 | 0.14 | 4.26 | 0.49 | 0.75 | 0.42 | 1.01 | 0.13 |
| TOTPCB | | | 239.12 | 173.43 | 239.32 | 54.07 | 42.57 | 22.31 | 55.48 | 26.21 | 20.09 | 29.61 |
| % TOC | | | 1.34 | 1.40 | 1.14 | 1.74 | 1.95 | 2.23 | 2.40 | 3.31 | 2.18 | 2.40 |

Table A-3-1 2c Normalized concentrations of contaminants in tissues of juvenile lobster in the Portsmouth Naval Shipyard offshore study area

| Class | Analyte | M01-100B | M02-100B | M03-100B | M04-100B | M05-100B-AVG | M06-100B | M07-100B | M08-100B | M09-100B | M10-100B-AVG | M11-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 14 20 | 14 60 | 19 10 | 22.80 | 13 60 | 15.80 | 15 30 | 24 65 | 20 80 | 17 10 | 23 75 |
| MET | Cadmium | 0 05 | 0 03 | 0 03 | 0 03 | 0 03 | 0 04 | 0 03 | 0 07 | 0 07 | 0 05 | 0 07 |
| MET | Chromium | 0 17 | 0 25 | 0 26 | 0.26 | 0.26 | 0.25 | 0 25 | 0 16 | 0 26 | 0 26 | 0 17 |
| MET | Copper | 63 40 | 56 90 | 35.20 | 22 30 | 64 30 | 47 40 | 44 60 | 63 50 | 45 50 | 34 60 | 77 10 |
| MET | Lead | 10 45 | 0 18 | 0 15 | 0 12 | 0 34 | 0 04 | 0 20 | 0 07 | 0 12 | 0 17 | 0 13 |
| MET | Mercury | 0 71 | 8 20 | 0 50 | 0 58 | 0 56 | 0 65 | 0 52 | 0 56 | 0 98 | 0 50 | 1 05 |
| MET | Nickel | 0 22 | 0 25 | 0 65 | 0 26 | 0 51 | 0 70 | 0.25 | 0 36 | 0 26 | 0 26 | 0 85 |
| MET | Silver | 0 28 | 0 27 | 0 19 | 0 13 | 0 29 | 0 28 | 0 26 | 0 35 | 0.27 | 0 21 | 0 33 |
| MET | Zinc | 136 50 | 111 00 | 107 00 | 72 60 | 94 90 | 124 00 | 100 00 | 104 35 | 85 00 | 93 00 | 108 50 |
| MET | SEM-AVS | -23 94 | -26 04 | -50 29 | -0 54 | -56 77 | -2 77 | -9 25 | -17 06 | 1 54 | -0 05 | |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 1 30 | 0 72 | 0 63 | 0 53 | 0 64 | 0 71 | 0 44 | 0 19 | 0 61 | 0 58 | 0 79 |
| PAH | 1-Methylnaphthalene (L) | 16 41 | 3 22 | 3 13 | 1 33 | 4 07 | 4 64 | 1 18 | 2 23 | 2 17 | 2.16 | 3 03 |
| PAH | 1-Methylphenanthrene (L) | 3 19 | 1.00 | 0.69 | 0 80 | 1.21 | 0 79 | 0 86 | 0 58 | 1 06 | 1 05 | 0.82 |
| PAH | 2,6-Dimethylnaphthalene (L) | 4 44 | 0.50 | 0 81 | 0 53 | 0 64 | 0.57 | 0 28 | 0 58 | 0 61 | 0 68 | 0 88 |
| PAH | 2-Methylnaphthalene (L) | 8 89 | 3 83 | 3 63 | 2.27 | 4 79 | 5.00 | 1.51 | 2 42 | 2 61 | 2 53 | 2 91 |
| PAH | Acenaphthene (L) | 3 37 | 1.28 | 2.50 | 1 13 | 1 43 | 1 14 | 0 63 | 0 65 | 1 39 | 1 00 | 1 18 |
| PAH | Acenaphthylene (L) | 5 67 | 0 94 | 0 56 | 0.47 | 0 57 | 0 64 | 0 25 | 0 38 | 0 50 | 0 11 | 0 27 |
| PAH | Anthracene (L) | 4.96 | 1 78 | 1 06 | 0 93 | 0 86 | 0 93 | 0 45 | 0 46 | 0 94 | 0 58 | 1 30 |
| PAH | Benzo(a)anthracene (H) | 9 44 | 3 28 | 2.63 | 1 40 | 1 71 | 1.36 | 1 47 | 0 85 | 1 61 | 1 37 | 3 15 |
| PAH | Benzo(a)pyrene (H) | 22.56 | 6.83 | 5.00 | 3 47 | 4 64 | 5 07 | 4 90 | 2.85 | 4 83 | 5 79 | 9.88 |
| PAH | Benzo(b)fluoranthene (H) | 11.19 | 6 06 | 5 94 | 4 07 | 4.29 | 3 71 | 4 52 | 2.38 | 4 39 | 5 21 | 9 09 |
| PAH | Benzo(b+k)fluoranthene (H) | 15 15 | 8 17 | 7 81 | 5 53 | 5 93 | 5.50 | 7 10 | 3 50 | 6 39 | 7 26 | 12 85 |
| PAH | Benzo(e)pyrene (H) | 12 63 | 5 39 | 4 06 | 4 53 | 3 79 | 2 64 | 3 32 | 2.35 | 3 50 | 3 89 | 4 94 |
| PAH | Benzo(g,h,i)perylene (H) | 11 67 | 4 56 | 3 56 | 4 87 | 3 50 | 2 64 | 2 91 | 1 85 | 3 06 | 3 16 | 4 09 |
| PAH | Benzo(k)fluoranthene (H) | 3 96 | 2 11 | 1.88 | 1 47 | 1 64 | 1 79 | 2 58 | 1 12 | 2 00 | 2 05 | 3 76 |
| PAH | Chrysene (H) | 13 59 | 8.06 | 5 69 | 5 00 | 4 57 | 3 79 | 4 89 | 2 62 | 4 33 | 5.53 | 7 21 |
| PAH | Dibenz(a,h)anthracene (H) | 0 81 | 0 39 | 0.31 | 0 67 | 0 36 | 0 36 | 0 52 | 0 15 | 0 28 | 0 26 | 0 21 |
| PAH | Fluoranthene (H) | 16 93 | 14 94 | 11 06 | 8 00 | 8 71 | 8 29 | 4 69 | 5 27 | 8 11 | 8 89 | 18 67 |
| PAH | Fluorene (L) | 6 11 | 2 44 | 2 94 | 1 67 | 2 21 | 2 07 | 0 63 | 1 27 | 2 06 | 1.68 | 2 21 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 7 70 | 3 89 | 3 25 | 3 47 | 3 00 | 2 86 | 3 73 | 1 73 | 2 94 | 3 74 | 5 03 |
| PAH | Naphthalene (L) | 16 07 | 7.56 | 7 69 | 5 33 | 10 64 | 12 14 | 2 78 | 6 08 | 5 78 | 6 47 | 7 94 |
| PAH | Perylene (H) | 6 93 | 3 11 | 3 88 | 4 13 | 3 93 | 2 79 | 1 79 | 2 31 | 4 06 | 3 26 | 4 00 |
| PAH | Phenanthrene (L) | 15 11 | 7.39 | 6.69 | 3 73 | 3.64 | 4 00 | 2 32 | 2 42 | 4 06 | 4 16 | 5 03 |
| PAH | Pyrene (H) | 26 48 | 12 44 | 11 88 | 7 67 | 8 29 | 7 50 | 6 24 | 4 42 | 9 33 | 8 68 | 13 70 |
| PAH | LMW PAHs | 87 96 | 31 56 | 31 56 | 19 93 | 31 64 | 33.64 | 11 75 | 18 08 | 22 61 | 21 84 | 27 76 |
| PAH | HMW PAHs | 143 89 | 71 06 | 59 13 | 48 73 | 48.43 | 42.79 | 41.56 | 27 88 | 48 44 | 51 84 | 83 73 |
| PAH | Total PAHs | 231 85 | 102 61 | 90 69 | 68 67 | 80 07 | 76 43 | 53 31 | 45 96 | 71.06 | 73 68 | 111 48 |
| PCB | Total PCBs | 25 32 | 23 89 | 57 23 | 33 96 | 27 89 | 16 51 | 17 73 | 20 52 | 22 71 | 32 34 | 41 99 |
| PST | Aldrin | 0 14 | 0 11 | 0 13 | 0 14 | 0 13 | 0 13 | 0 11 | 0 08 | 0 10 | 0 11 | 0 18 |
| PST | Alpha-BHC | 0 23 | 0 08 | 0 09 | 0 19 | 0 07 | 0 06 | 0 08 | 0 06 | 0 08 | 0 08 | 0 28 |
| PST | Alpha-chlordane | 0 11 | 0 08 | 0.10 | 0 11 | 0 10 | 0 10 | 0 08 | 0 06 | 0 08 | 0 08 | 0 09 |
| PST | Beta-BHC | 0 10 | 0 07 | 0 08 | 0 08 | 0 09 | 0 08 | 0 07 | 0 05 | 0 06 | 0 07 | 0 04 |
| PST | Chlorpyrifos | 3 78 | 2 06 | 1 50 | 1 80 | 2.21 | 2 21 | 1 85 | 1 71 | 1 67 | 1 76 | 6 21 |
| PST | CIS-Nonachlor | 0 10 | 0.03 | 0 10 | 0 10 | 0 09 | 0 09 | 0 07 | 0 01 | 0 02 | 0 08 | 0 04 |
| PST | Delta-BHC | 0 06 | 0 04 | 0 05 | 0 15 | 0 05 | 0 05 | 0 04 | 0 03 | 0 04 | 0 04 | 0 05 |
| PST | Dieldrin | 1.93 | 0 94 | 1 13 | 1 27 | 1 07 | 1 07 | 0 82 | 1 15 | 1 50 | 1 11 | 1 73 |
| PST | Endosulfan II | 0 11 | 0 08 | 0 10 | 1.20 | 0 10 | 0 10 | 0 08 | 0 06 | 0 08 | 0 18 | 0 15 |
| PST | Endrin | 0 29 | 0 22 | 0.27 | 1 20 | 0.27 | 0.26 | 0 22 | 0 15 | 0 20 | 0 23 | 0.24 |
| PST | Gamma-BHC (Lindane) | 0 72 | 0 61 | 0 58 | 0 22 | 0 67 | 0.54 | 0 24 | 0 25 | 0 34 | 0 36 | 0 68 |
| PST | Gamma-Chlordane | 0 12 | 0 08 | 0 10 | 0 12 | 0 11 | 0.10 | 0 09 | 0 06 | 0.08 | 0.08 | 0 10 |
| PST | Heptachlor | 0 16 | 0 12 | 0 14 | 0 16 | 0 15 | 0 15 | 0 12 | 4 23 | 0 11 | 0 12 | 0 13 |
| PST | Heptachlor epoxide | 0 11 | 0 08 | 0 10 | 0 12 | 0 11 | 0 10 | 0 09 | 0 06 | 0 08 | 0 09 | 0 10 |
| PST | Hexachlorobenzene | 0 21 | 0 16 | 0 14 | 0 14 | 0 15 | 0 17 | 0 05 | 0 12 | 0 17 | 0.13 | 0 24 |
| PST | Mirex | 0 26 | 0 67 | 0.23 | 0 26 | 0 46 | 0 24 | 0 20 | 0.14 | 0 18 | 0.07 | 0 33 |
| PST | Oxychlordane | 0 71 | 0 48 | 1 06 | 0 93 | 0 49 | 0 27 | 0 88 | 0 50 | 0 31 | 0.24 | 0.61 |
| PST | Pentachloroanisole | 0 23 | 0.21 | 0.26 | 0.31 | 0 17 | 0 17 | 0 21 | 0 09 | 0 21 | 0 25 | 0 24 |
| PST | Pentachlorobenzene | 0 24 | 0 13 | 0 12 | 0 07 | 0 16 | 0 11 | 0 04 | 0 22 | 0 14 | 0 10 | 0 20 |
| PST | Trans-Nonachlor | 0 07 | 0 14 | 0 06 | 0 07 | 0 02 | 0 06 | 0.71 | 0 04 | 0 05 | 1 00 | 0 63 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 70 | 6.67 | 2.25 | 5.73 | 5 21 | 1 00 | 0.57 | 0 88 | 1.33 | 1 16 | 3 18 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 44 | 0.36 | 0.26 | 0 50 | 0 50 | 0 34 | 0 28 | 0 29 | 0 36 | 0 32 | 0 36 |
| PST | o,p'-DDD | 0.09 | 1.28 | 0 00 | 0 09 | 0 93 | 0.08 | 0 07 | 0 05 | 0 51 | 0 34 | 0 43 |
| PST | p,p'-DDD | 0 69 | 0 09 | 0 58 | 0 13 | 0 27 | 0 11 | 0.09 | 0 07 | 0 09 | 0 74 | 0 64 |
| PST | o,p'-DDE | 0 11 | 0 08 | 0 36 | 0 21 | 0 09 | 0 10 | 0.09 | 0 06 | 0.08 | 0 12 | 0 16 |
| PST | o,p'-DDT | 0.28 | 0 14 | 0 14 | 0 11 | 0 10 | 0 10 | 0 08 | 0 24 | 0 08 | 0 17 | 0 12 |
| PST | p,p'-DDE | 1.37 | 2.00 | 1 50 | 1.87 | 1 14 | 0 56 | 0 71 | 1.54 | 1 11 | 1 47 | 1.70 |
| PST | p,p'-DDT | 0 98 | 4 22 | 1 44 | 0 17 | 4 29 | 1 07 | 0 12 | 1 58 | 1 61 | 1 47 | 0 61 |
| lipid | PERCENT LIPIDS % | 1.35 | 1 80 | 1 60 | 1 50 | 1 40 | 1 40 | 1 70 | 2 60 | 1 80 | 1 90 | 1 65 |

1- For organics, tissue concentration is normalized by lipid value (NORM = CONC [See TtNUS (2000b)]/%LIP).
Metals are not normalized
units: metals (µg/g dry wt); organics (ng/% lipid)

Table A-3-1.2c Continued

| Class | Analyte | M12-100B | M13-100B | M14-100B |
|---|---|---|---|---|
| MET | Arsenic | 16 50 | 17.60 | 12 60 |
| MET | Cadmium | 0 07 | 0 10 | 0.22 |
| MET | Chromium | 0 27 | 0.28 | 0.25 |
| MET | Copper | 61 00 | 56.00 | 42 60 |
| MET | Lead | 0 04 | 0 04 | 0 11 |
| MET | Mercury | 0 93 | 0 60 | 0 78 |
| MET | Nickel | 0 93 | 0 56 | 0.25 |
| MET | Silver | 0.26 | 0 24 | 0 17 |
| MET | Zinc | 112 00 | 111 00 | 90 80 |
| MET | SEM-AVS | -7 35 | -110 00 | -1 46 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 0 56 | 0 63 | 0 39 |
| PAH | 1-Methylnaphthalene (L) | 1 89 | 1.31 | 0.86 |
| PAH | 1-Methylphenanthrene (L) | 1 00 | 1 31 | 0.39 |
| PAH | 2,6-Dimethylnaphthalene (L) | 0.67 | 0 81 | 0.57 |
| PAH | 2-Methylnaphthalene (L) | 2.72 | 2.19 | 1 68 |
| PAH | Acenaphthene (L) | 1.61 | 2.25 | 0 75 |
| PAH | Acenaphthylene (L) | 0 67 | 0 81 | 0 25 |
| PAH | Anthracene (L) | 3 44 | 8 50 | 0 50 |
| PAH | Benzo(a)anthracene (H) | 8.22 | 10.94 | 0.54 |
| PAH | Benzo(a)pyrene (H) | 19.11 | 25 31 | 0.86 |
| PAH | Benzo(b)fluoranthene (H) | 16.39 | 21 13 | 0.89 |
| PAH | Benzo(b+k)fluoranthene (H) | 23 06 | 28 00 | 1 25 |
| PAH | Benzo(e)pyrene (H) | 9 17 | 9.94 | 1 61 |
| PAH | Benzo(g,h,i)perylene (H) | 8 28 | 9 06 | 1 61 |
| PAH | Benzo(k)fluoranthene (H) | 6 67 | 6 88 | 0.36 |
| PAH | Chrysene (H) | 16 39 | 23.25 | 2 39 |
| PAH | Dibenz(a,h)anthracene (H) | 0 61 | 0 75 | 0 11 |
| PAH | Fluoranthene (H) | 34 72 | 69 38 | 4 36 |
| PAH | Fluorene (L) | 2 39 | 3 94 | 1 25 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 9 50 | 11 44 | 0 61 |
| PAH | Naphthalene (L) | 7 44 | 6 69 | 3 50 |
| PAH | Perylene (H) | 6 72 | 7 56 | 1.68 |
| PAH | Phenanthrene (L) | 11 50 | 11 44 | 2 57 |
| PAH | Pyrene (H) | 25 39 | 47.25 | 2 50 |
| PAH | LMW PAHs | 34 72 | 41 06 | 13.32 |
| PAH | HMW PAHs | 161 17 | 242 88 | 17 50 |
| PAH | Total PAHs | 195 89 | 283 94 | 30 82 |
| PCB | Total PCBs | 25 81 | 31 55 | 34 32 |
| PST | Aldrin | 0.09 | 0 18 | 0.09 |
| PST | Alpha-BHC | 0 17 | 0 18 | 0 14 |
| PST | Alpha-chlordane | 0 08 | 0 11 | 0 05 |
| PST | Beta-BHC | 0 04 | 0 09 | 0 04 |
| PST | Chlorpyrifos | 0 69 | 6 88 | 6 07 |
| PST | CIS-Nonachlor | 0 04 | 0 10 | 0 08 |
| PST | Delta-BHC | 0.04 | 0 06 | 0 03 |
| PST | Dieldrin | 1 39 | 1 44 | 1.29 |
| PST | Endosulfan II | 0.08 | 0 11 | 0.05 |
| PST | Endrin | 0 22 | 0.29 | 0 14 |
| PST | Gamma-BHC (Lindane) | 0 72 | 0 75 | 0 36 |
| PST | Gamma-Chlordane | 0 13 | 0 19 | 0 09 |
| PST | Heptachlor | 0 12 | 0.16 | 0.08 |
| PST | Heptachlor epoxide | 0.09 | 0 11 | 0 06 |
| PST | Hexachlorobenzene | 0 12 | 0.31 | 0 18 |
| PST | Mirex | 0 13 | 0.13 | 0 05 |
| PST | Oxychlordane | 0.33 | 0 53 | 0 61 |
| PST | Pentachloroanisole | 0.28 | 0.31 | 0.25 |
| PST | Pentachlorobenzene | 0 35 | 0 43 | 0 24 |
| PST | Trans-Nonachlor | 0 04 | 0.07 | 0 39 |
| PST | 1,2,3,4-Tetrachlorobenzene | 5 06 | 4 69 | 0 03 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 27 | 0.27 | 0 16 |
| PST | o,p'-DDD | 1 00 | 1 25 | 0.31 |
| PST | p,p'-DDD | 0.08 | 0 19 | 0 06 |
| PST | o,p'-DDE | 0 09 | 0 11 | 0 28 |
| PST | o,p'-DDT | 0 11 | 0 13 | 0.21 |
| PST | p,p'-DDE | 1.28 | 1 63 | 2 64 |
| PST | p,p'-DDT | 1 83 | 2 25 | 0 82 |
| lipid | PERCENT LIPIDS % | 1 80 | 1 60 | 2 80 |

Table A-3-1.2d. Normalized concentrations of PCB congeners in tissues of juvenile lobster in sediment in the Portsmouth Naval Shipyard offshore study area.

| Analyte | M01-100B | M02-100B | M03-100B | M04-100B | M05-100B-AVG | M06-100B | M07-100B | M08-100B | M09-100B | M10-100B-AVG | M11-100B | M12-100B | M13-100B | M14-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB-101/90 | 0.89 | 0.48 | 2.00 | 0 33 | 0.93 | 0.46 | 0.36 | 0.32 | 1.00 | 0.26 | 0 53 | 0.25 | 0.34 | 0.09 |
| PCB-105 | 0.40 | 0.43 | 0.28 | 0.59 | 0.33 | 0.16 | 0.26 | 0.30 | 0.28 | 0.42 | 0.45 | 0.67 | 0 94 | 0.57 |
| PCB-118 | 1.78 | 1.67 | 1.56 | 2.33 | 1.29 | 0.70 | 1.06 | 1.19 | 1.28 | 2.00 | 2.30 | 2.83 | 3 25 | 2 82 |
| PCB-128 | 0.31 | 0.37 | 0.55 | 0.41 | 0 29 | 0.14 | 0.19 | 0.20 | 0.26 | 0.41 | 0.50 | 0 38 | 0.58 | 0.46 |
| PCB-138/160 | 2.26 | 2.11 | 6.13 | 2.73 | 2.93 | 1.00 | 1.29 | 2.42 | 2.17 | 2.21 | 3 94 | 2.50 | 3.00 | 3.57 |
| PCB-153/132 | 1.35 | 1.67 | 4.38 | 2.10 | 1.64 | 0.79 | 0.88 | 0.90 | 1 39 | 1.21 | 2 68 | 1.75 | 2.13 | 2.86 |
| PCB-170/190 | 0.87 | 0.61 | 1.34 | 0.93 | 0.71 | 0.43 | 0.44 | 0.35 | 0.58 | 0 53 | 1.48 | 0.56 | 0 59 | 0.66 |
| PCB-18/17 | 0.50 | 0.29 | 0.69 | 1.13 | 0 33 | 0.93 | 0.29 | 0 15 | 0.29 | 0.58 | 0.85 | 0.14 | 1.00 | 0 12 |
| PCB-180 | 0 83 | 0.94 | 5.69 | 1.27 | 1.50 | 0 37 | 0.54 | 0.54 | 1.11 | 0.95 | 4.24 | 1.17 | 1.25 | 2.29 |
| PCB-187 | 0.73 | 0.89 | 3.56 | 1.27 | 1.29 | 0.46 | 0.59 | 0.62 | 0 94 | 1.53 | 2.18 | 0.94 | 1.13 | 2.14 |
| PCB-195/208 | 0.33 | 0.07 | 0 36 | 0.08 | 0.12 | 0.30 | 0.25 | 0.05 | 0.08 | 1.16 | 0.36 | 0.09 | 0.10 | 0.20 |
| PCB-206 | 0.34 | 0.06 | 0.13 | 0.07 | 0.08 | 0.31 | 0.05 | 0.05 | 0 04 | 2.84 | 0.23 | 0.07 | 0.10 | 0.21 |
| PCB-209 | 0.20 | 0.33 | 0.41 | 0.47 | 0.06 | 0.39 | 0.32 | 0.23 | 0.31 | 0.34 | 0.11 | 0.33 | 0.14 | 0 10 |
| PCB-28 | 0.31 | 0.48 | 0.28 | 1.07 | 0.69 | 0 28 | 0.24 | 1.15 | 0.22 | 0.58 | 0.41 | 0 22 | 0.11 | 0.30 |
| PCB-44 | 0 07 | 0.17 | 0.21 | 0.23 | 0.14 | 0.21 | 0 17 | 0.07 | 0.16 | 0.18 | 0 08 | 0 07 | 0.08 | 0.04 |
| PCB-52 | 0.55 | 0.53 | 0.24 | 0.17 | 0.61 | 0.58 | 1.18 | 0.54 | 0.54 | 0.21 | 0 28 | 0.23 | 0.26 | 0.13 |
| PCB-66 | 0.29 | 0.37 | 0.26 | 0.67 | 0.41 | 0 19 | 0.28 | 0.85 | 0.25 | 0.28 | 0.28 | 0.38 | 0.49 | 0 50 |
| PCB-8/5 | 0.65 | 0.47 | 0.56 | 1.13 | 0.61 | 0.57 | 0.47 | 0.33 | 0.44 | 0.50 | 0.07 | 0.32 | 0.28 | 0.10 |
| TOTAL PCBs | 25.32 | 23.89 | 57.23 | 33.96 | 27.89 | 16.51 | 17.73 | 20.52 | 22.71 | 32.34 | 41.99 | 25.81 | 31.55 | 34.32 |
| PERCENT LIPIDS % | 1.35 | 1.80 | 1.60 | 1.50 | 1.40 | 1.40 | 1.70 | 2.60 | 1.80 | 1.90 | 1.65 | 1.80 | 1.60 | 2.80 |

1- For organics, tissue concentration is normalized by lipid value (NORM = CONC [See TtNUS (2000b)]/%LIP).
Metals are not normalized.
units: organics (ng/% lipid).

Table A-3-1.2e Bioaccumulation Factors (BAFs) for metals[1] and Biota-Sediment Accumulation Factors (BSAFs) for organics[2] in juvenile lobster tissue[3] in the Portsmouth Naval Shipyard study area

| Class | Analyte | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG | M05-200B | M05-300B | M06-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 1 16 | | | 1 36 | | | 1 11 | | | 1 16 | | | 0 94 | | | 2 29 |
| MET | Cadmium | 0 17 | | | 0 06 | | | 0 05 | | | 0 03 | | | 0 06 | | | 0 17 |
| MET | Chromium | | | | | | | | | | | | | | | | |
| MET | Copper | 1 45 | | | 0.88 | | | 0 19 | | | 0 01 | | | 1 02 | | | 3 20 |
| MET | Lead | 0 14 | | | 0 00 | | | 0 00 | | | 0 00 | | | 0 00 | | | |
| MET | Mercury | 2 82 | | | 30 37 | | | 0 81 | | | 0 16 | | | 0 94 | | | 2 41 |
| MET | Nickel | | | | | | | | | | | | | | | | |
| MET | Silver | 0 67 | | | 0.29 | | | 0.17 | | | | | | | | | |
| MET | Zinc | 0 71 | | | 0.29 | | | 0 46 | | | 0 05 | | | 0 63 | | | 2 19 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | | | | | | | | | | | | | | | | |
| PAH | 1-Methylnaphthalene (L) | 0 60 | | | 0 48 | | | | | | | | | 0 47 | | | 0 50 |
| PAH | 1-Methylphenanthrene (L) | | | | | | | | | | | | | | | | |
| PAH | 2,6-Dimethylnaphthalene (L) | | | | | | | | | | | | | | | | |
| PAH | 2-Methylnaphthalene (L) | 0 38 | | | 0 35 | | | | | | | | | 0 37 | | | 0 31 |
| PAH | Acenaphthene (L) | | | | | | | | | | | | | | | | |
| PAH | Acenaphthylene (L) | 0 03 | | | | | | | | | | | | | | | |
| PAH | Anthracene (L) | 0 03 | | | | | | | | | | | | | | | |
| PAH | Benzo(a)anthracene (H) | | | | 0 02 | | | 0 01 | | | | | | | | | |
| PAH | Benzo(a)pyrene (H) | | | | 0 04 | | | 0.02 | | | | | | | | | 0 01 |
| PAH | Benzo(b)fluoranthene (H) | 0 03 | | | | | | | | | | | | | | | |
| PAH | Benzo(b+k)fluoranthene (H) | 0 03 | | | 0 04 | | | 0 02 | | | 0 00 | | | 0 02 | | | 0 00 |
| PAH | Benzo(e)pyrene (H) | | | | | | | | | | | | | | | | |
| PAH | Benzo(g,h,i)perylene (H) | 0 04 | | | | | | | | | | | | | | | |
| PAH | Benzo(k)fluoranthene (H) | | | | | | | | | | | | | | | | |
| PAH | Chrysene (H) | 0 03 | | | 0 05 | | | 0.02 | | | 0 00 | | | | | | 0 00 |
| PAH | Dibenz(a,h)anthracene (H) | | | | | | | | | | | | | | | | |
| PAH | Fluoranthene (H) | 0 03 | | | | | | 0 02 | | | | | | | | | 0 01 |
| PAH | Fluorene (L) | | | | | | | | | | | | | | | | |
| PAH | Indeno(1,2,3-cd)pyrene (H) | | | | | | | | | | | | | | | | |
| PAH | Naphthalene (L) | 0 67 | | | 0 47 | | | 0.37 | | | | | | 0 47 | | | 0 45 |
| PAH | Perylene (H) | | | | | | | | | | | | | | | | |
| PAH | Phenanthrene (L) | | | | | | | | | | | | | | | | 0 01 |
| PAH | Pyrene (H) | 0 02 | | | | | | 0 02 | | | | | | | | | |
| PAH | LMW PAHs | 0 06 | | | 0 12 | | | 0 05 | | | 0 01 | | | 0 06 | | | 0 04 |
| PAH | HMW PAHs | 0 05 | | | 0 08 | | | 0 03 | | | 0 01 | | | 0 03 | | | 0 01 |
| PAH | Total PAHs | 0 05 | | | 0.09 | | | 0 03 | | | 0 01 | | | 0 03 | | | 0 01 |
| PCB | Total PCBs | 0 42 | | | 0 63 | | | 0 24 | | | 0 10 | | | 0 59 | | | 0 59 |
| PST | Aldrin | | | | | | | | | | | | | | | | |
| PST | Alpha-BHC | | | | | | | | | | | | | | | | |
| PST | Alpha-chlordane | | | | | | | | | | | | | | | | |
| PST | Beta-BHC | | | | | | | | | | | | | | | | |
| PST | Chlorpyrifos | | | | | | | | | | | | | | | | |
| PST | CIS-Nonachlor | | | | | | | | | | | | | | | | |
| PST | Delta-BHC | | | | | | | | | | | | | | | | |
| PST | Dieldrin | | | | | | | | | | | | | | | | |
| PST | Endosulfan II | | | | | | | | | | 0 80 | | | | | | |
| PST | Endrin | | | | | | | | | | | | | | | | |
| PST | Gamma-BHC (Lindane) | 2 19 | | | | | | 3 74 | | | | | | | | | |
| PST | Gamma-Chlordane | | | | | | | | | | | | | | | | |
| PST | Heptachlor | | | | | | | | | | | | | | | | |
| PST | Heptachlor epoxide | | | | | | | | | | | | | | | | |
| PST | Hexachlorobenzene | | | | | | | | | | | | | | | | |
| PST | Mirex | | | | | | | | | | | | | | | | |
| PST | Oxychlordane | | | | | | | | | | | | | | | | |
| PST | Pentachloroanisole | | | | | | | | | | | | | | | | |
| PST | Pentachlorobenzene | | | | | | | | | | | | | | | | |
| PST | Trans-Nonachlor | | | | 1.11 | | | | | | | | | | | | |
| PST | 1,2,3,4-Tetrachlorobenzene | | | | | | | 7.80 | | | 20.25 | | | | | | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | | | | | | | | | | | | | |
| PST | o,p'-DDD | | | | | | | | | | | | | | | | |
| PST | p,p'-DDD | | | | | | | | | | | | | | | | |
| PST | o,p'-DDE | | | | | | | 0 41 | | | | | | | | | |
| PST | o,p'-DDT | | | | | | | | | | | | | | | | |
| PST | p,p'-DDE | | | | 3 58 | | | 0.88 | | | 0 19 | | | 0 80 | | | |
| PST | p,p'-DDT | | | | | | | | | | | | | | | | |
| lipid:toc | PERCENT LIPIDS/PERCENT T | 0 78 | | | 0 84 | | | 0.51 | | | 1.33 | | | 0 70 | | | 2 98 |

1- BAF = (tissue/sediment ratio)
2- BSAF = (tissue/lipid to sediment/TOC ratio)
3- Concentration data below detectable limits and qualified with a "J" qualifier in Tables A-3-3 2a-c are excluded above
Units: metal- ug tissue/ug sediment; organics (ng tissue/%lipid)/(ng sediment/%TOC)

Table A-3-1.2e (continued)

| Class | Analyte | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | 1 46 | | | 2 13 | | | | 1 65 | | | | 2 30 | | |
| MET | Cadmium | | | 0 11 | | | 0 17 | | | | 0 23 | | | | 0 30 | | |
| MET | Chromium | | | | | | | | | | | | | | | | |
| MET | Copper | | | 0 94 | | | 0 14 | | | | 0 09 | | | | 1 25 | | |
| MET | Lead | | | 0 00 | | | 0.00 | | | | 0 00 | | | | 0 00 | | |
| MET | Mercury | | | 4 00 | | | 2 64 | | | | 5 76 | | | | 5 56 | | |
| MET | Nickel | | | | | | | | | | | | | | | | |
| MET | Silver | | | | | | 0 51 | | | | 0 39 | | | | | | |
| MET | Zinc | | | 1.20 | | | 0 15 | | | | 0 18 | | | | 0 92 | | |
| PAH | 1,6,7-Trimethylnaphthalene (L) | | | | | | | | | | | | | | | | |
| PAH | 1-Methylnaphthalene (L) | | | | | | 0 14 | | | | | | | | | | |
| PAH | 1-Methylphenanthrene (L) | | | | | | | | | | | | | | | | |
| PAH | 2,6-Dimethylnaphthalene (L) | | | | | | | | | | | | | | | | |
| PAH | 2-Methylnaphthalene (L) | | | | | | | | | | | | | | | | |
| PAH | Acenaphthene (L) | | | | | | | | | | | | | | | | |
| PAH | Acenaphthylene (L) | | | | | | | | | | | | | | | | |
| PAH | Anthracene (L) | | | | | | | | | | | | | | | | |
| PAH | Benzo(a)anthracene (H) | | | | | | | | | | | | | | | | |
| PAH | Benzo(a)pyrene (H) | | | 0 02 | | | 0.01 | | | | 0 14 | | | | | | |
| PAH | Benzo(b)fluoranthene (H) | | | | | | | | | | | | | | | | |
| PAH | Benzo(b+k)fluoranthene (H) | | | 0 02 | | | 0 01 | | | | 0 07 | | | | 0 06 | | |
| PAH | Benzo(e)pyrene (H) | | | | | | | | | | | | | | | | |
| PAH | Benzo(g,h,i)perylene (H) | | | | | | | | | | | | | | | | |
| PAH | Benzo(k)fluoranthene (H) | | | | | | | | | | | | | | | | |
| PAH | Chrysene (H) | | | 0 02 | | | 0 01 | | | | 0 10 | | | | | | |
| PAH | Dibenz(a,h)anthracene (H) | | | | | | | | | | | | | | | | |
| PAH | Fluoranthene (H) | | | 0 01 | | | 0 01 | | | | 0 15 | | | | | | |
| PAH | Fluorene (L) | | | | | | | | | | | | | | | | |
| PAH | Indeno(1,2,3-cd)pyrene (H) | | | | | | | | | | | | | | | | |
| PAH | Naphthalene (L) | | | | | | 0.19 | | | | 0 52 | | | | 0 23 | | |
| PAH | Perylene (H) | | | | | | | | | | | | | | | | |
| PAH | Phenanthrene (L) | | | | | | 0.01 | | | | 0 15 | | | | 0 06 | | |
| PAH | Pyrene (H) | | | | | | | | | | 0 20 | | | | | | |
| PAH | LMW PAHs | | | 0 04 | | | 0 03 | | | | 0 20 | | | | 0 10 | | |
| PAH | HMW PAHs | | | 0 03 | | | 0 01 | | | | 0 22 | | | | 0 08 | | |
| PAH | Total PAHs | | | 0 03 | | | 0 02 | | | | 0 21 | | | | 0 09 | | |
| PCB | Total PCBs | | | 0 40 | | | 0 08 | | | | 0 20 | | | | 1 82 | | |
| PST | Aldrin | | | | | | | | | | | | | | | | |
| PST | Alpha-BHC | | | | | | | | | | | | | | | | |
| PST | Alpha-chlordane | | | | | | | | | | | | | | | | |
| PST | Beta-BHC | | | | | | | | | | | | | | | | |
| PST | Chlorpyrifos | | | | | | | | | | | | | | | | |
| PST | CIS-Nonachlor | | | | | | | | | | | | | | | | |
| PST | Delta-BHC | | | | | | | | | | | | | | | | |
| PST | Dieldrin | | | | | | | | | | | | | | | | |
| PST | Endosulfan II | | | | | | | | | | | | | | 1 30 | | |
| PST | Endrin | | | | | | | | | | | | | | | | |
| PST | Gamma-BHC (Lindane) | | | | | | | | | | | | | | | | |
| PST | Gamma-Chlordane | | | | | | | | | | | | | | | | |
| PST | Heptachlor | | | | | | | | | | | | | | | | |
| PST | Heptachlor epoxide | | | | | | | | | | | | | | | | |
| PST | Hexachlorobenzene | | | | | | | | | | | | | | | | |
| PST | Mirex | | | | | | | | | | | | | | | | |
| PST | Oxychlordane | | | | | | | | | | | | | | | | |
| PST | Pentachloroanisole | | | | | | | | | | | | | | | | |
| PST | Pentachlorobenzene | | | | | | 1.09 | | | | | | | | | | |
| PST | Trans-Nonachlor | | | 4 61 | | | | | | | | | | | | | |
| PST | 1,2,3,4-Tetrachlorobenzene | | | 2.07 | | | 1 88 | | | | 0 89 | | | | | | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | | | | | | | | | | | | | |
| PST | o,p'-DDD | | | | | | | | | | | | | | | | |
| PST | p,p'-DDD | | | | | | | | | | | | | | | | |
| PST | o,p'-DDE | | | | | | | | | | | | | | | | |
| PST | o,p'-DDT | | | | | | | | | | | | | | | | |
| PST | p,p'-DDE | | | 0 20 | | | 0 07 | | | | 1.56 | | | | 0 38 | | |
| PST | p,p'-DDT | | | | | | | | | | | | | | | | |
| pid.tox | PERCENT LIPIDS/PERCENT T | | | 1.73 | | | 2 50 | | | | 6 43 | | | | 1 10 | | |

Table A-3-1.2e (continued)

| Class | Analyte | M11-100B | M11-200B | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | | | | 2 14 | | | 1.05 | | | 1 19 | | |
| MET | Cadmium | | | | 0 12 | | | 0 07 | | | 0 46 | | |
| MET | Chromium | | | | 0 00 | | | 0 00 | | | 0.00 | | |
| MET | Copper | | | | 0 69 | | | 1.04 | | | 0.71 | | |
| MET | Lead | | | | 0 00 | | | 0 00 | | | 0 00 | | |
| MET | Mercury | | | | 2 45 | | | 2 31 | | | 1 42 | | |
| MET | Nickel | | | | 0 02 | | | 0 02 | | | 0 01 | | |
| MET | Silver | | | | 0 40 | | | 0.33 | | | 0.71 | | |
| MET | Zinc | | | | 0.33 | | | 0 71 | | | 0 78 | | |
| PAH | 1,6,7-Trimethylnaphthalene (L) | | | | 0 03 | | | 0 01 | | | 0.13 | | |
| PAH | 1-Methylnaphthalene (L) | | | | 0 02 | | | | | | 0 16 | | |
| PAH | 1-Methylphenanthrene (L) | | | | 0 01 | | | 0 00 | | | 0.03 | | |
| PAH | 2,6-Dimethylnaphthalene (L) | | | | 0 02 | | | 0 00 | | | 0 14 | | |
| PAH | 2-Methylnaphthalene (L) | | | | 0 03 | | | | | | 0 18 | | |
| PAH | Acenaphthene (L) | | | | 0 00 | | | 0 00 | | | 0 16 | | |
| PAH | Acenaphthylene (L) | | | | 0 01 | | | 0.01 | | | 0 01 | | |
| PAH | Anthracene (L) | | | | 0 00 | | | 0 01 | | | 0 01 | | |
| PAH | Benzo(a)anthracene (H) | | | | 0 01 | | | 0.01 | | | 0.01 | | |
| PAH | Benzo(a)pyrene (H) | | | | 0 01 | | | | | | 0 01 | | |
| PAH | Benzo(b)fluoranthene (H) | | | | 0 01 | | | 0 02 | | | 0 01 | | |
| PAH | Benzo(b+k)fluoranthene (H) | | | | 0 01 | | | 0 02 | | | 0 01 | | |
| PAH | Benzo(e)pyrene (H) | | | | 0 01 | | | 0 02 | | | | | |
| PAH | Benzo(g,h,i)perylene (H) | | | | 0 01 | | | 0 03 | | | 0 02 | | |
| PAH | Benzo(k)fluoranthene (H) | | | | 0 02 | | | 0.02 | | | 0 01 | | |
| PAH | Chrysene (H) | | | | 0 01 | | | 0 02 | | | 0 02 | | |
| PAH | Dibenz(a,h)anthracene (H) | | | | 0 00 | | | | | | | | |
| PAH | Fluoranthene (H) | | | | 0 01 | | | 0 02 | | | 0 03 | | |
| PAH | Fluorene (L) | | | | 0 00 | | | | | | 0 09 | | |
| PAH | Indeno(1,2,3-cd)pyrene (H) | | | | 0 01 | | | 0 03 | | | | | |
| PAH | Naphthalene (L) | | | | 0 04 | | | | | | 0.21 | | |
| PAH | Perylene (H) | | | | 0 04 | | | 0.07 | | | 0 06 | | |
| PAH | Phenanthrene (L) | | | | 0 01 | | | | | | | | |
| PAH | Pyrene (H) | | | | 0 01 | | | 0.02 | | | 0 02 | | |
| PAH | LMW PAHs | | | | 0 01 | | | 0 01 | | | 0 07 | | |
| PAH | HMW PAHs | | | | 0 02 | | | 0 03 | | | 0 03 | | |
| PAH | Total PAHs | | | | 0 01 | | | 0 02 | | | 0 04 | | |
| PCB | Total PCBs | | | | 0 15 | | | 0 74 | | | 1 31 | | |
| PST | Aldrin | | | | 3.57 | | | | | | | | |
| PST | Alpha-BHC | | | | 0 50 | | | 0 86 | | | | | |
| PST | Alpha-chlordane | | | | 0 12 | | | 0 63 | | | 0 31 | | |
| PST | Beta-BHC | | | | 0 06 | | | 0 10 | | | | | |
| PST | Chlorpyrifos | | | | 5.56 | | | | | | | | |
| PST | CIS-Nonachlor | | | | 0 14 | | | 0 45 | | | 0.26 | | |
| PST | Delta-BHC | | | | 2 12 | | | | | | | | |
| PST | Dieldrin | | | | 8 84 | | | | | | 77 38 | | |
| PST | Endosulfan II | | | | 0 04 | | | 0 46 | | | | | |
| PST | Endrin | | | | 3 61 | | | | | | | | |
| PST | Gamma-BHC (Lindane) | | | | 6 74 | | | | | | | | |
| PST | Gamma-Chlordane | | | | 4.31 | | | 5.22 | | | 5 37 | | |
| PST | Heptachlor | | | | 1 63 | | | 1 74 | | | | | |
| PST | Heptachlor epoxide | | | | 6 52 | | | | | | | | |
| PST | Hexachlorobenzene | | | | 6.22 | | | 59 72 | | | 8 28 | | |
| PST | Mirex | | | | 0 50 | | | 1 07 | | | | | |
| PST | Oxychlordane | | | | 1 21 | | | | | | 40.19 | | |
| PST | Pentachloroanisole | | | | 3 89 | | | | | | | | |
| PST | Pentachlorobenzene | | | | 4 90 | | | | | | | | |
| PST | Trans-Nonachlor | | | | 0 10 | | | 1 68 | | | 4.64 | | |
| PST | 1,2,3,4-Tetrachlorobenzene | | | | 353.89 | | | | | | | | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | 1 10 | | | | | | | | |
| PST | o,p'-DDD | | | | 0 32 | | | 0 76 | | | 0 41 | | |
| PST | p,p'-DDD | | | | 0 42 | | | 1 74 | | | | | |
| PST | o,p'-DDE | | | | 0.22 | | | 1.22 | | | | | |
| PST | o,p'-DDT | | | | 0 06 | | | 0 16 | | | 0 37 | | |
| PST | p,p'-DDE | | | | 1.19 | | | 13 78 | | | 0 97 | | |
| PST | p,p'-DDT | | | | 1.07 | | | 3 66 | | | 2 83 | | |
| lipid:toc | PERCENT LIPIDS/PERCENT T | | | | 1 29 | | | 0 82 | | | 0 85 | | |

Table A-3-1.2f Normalized[1] concentrations of contaminants in tissues of mussel in the Portsmouth Naval Shipyard offshore study area

| Class | Analyte | M01-200B | M01-300B-AVG | M02-200B | M02-300B | M03-100B | M03-200B | M04-100B | M05-100B-AVG | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 8 40 | 10 40 | 10 00 | 9 40 | 9 80 | 9.25 | 9 50 | 8 75 | 9 60 | 8 50 | 8 10 | 10 45 | 10.60 |
| MET | Cadmium | 1 40 | 1 50 | 1 50 | 1 40 | 1 60 | 1 55 | 1.90 | 2 15 | 2 10 | 1 40 | 1 40 | 1.65 | 1 40 |
| MET | Chromium | 1 80 | 1 80 | 2 30 | 2 10 | 2 90 | 3 90 | 2 50 | 2.20 | 2 10 | 2 50 | 2 30 | 2 45 | 2 30 |
| MET | Copper | 7 10 | 7 80 | 7 50 | 7 60 | 9 60 | 17 60 | 27 90 | 8 80 | 8 10 | 8 00 | 9 00 | 8 00 | 8 30 |
| MET | Lead | 3 40 | 3 90 | 4 30 | 4 10 | 4 20 | 5 40 | 7.60 | 14 55 | 4 00 | 3 60 | 4 10 | 3 15 | 3 40 |
| MET | Mercury | 0 25 | 0 27 | 0 30 | 0 27 | 0 29 | 0 31 | 0 48 | 0 46 | 0 28 | 0 27 | 0 28 | 0 29 | 0 27 |
| MET | Nickel | 1 60 | 1 40 | 2 00 | 1 60 | 3 40 | 3 45 | 3 20 | 1 90 | 2 20 | 1 70 | 1 60 | 1 70 | 1 70 |
| MET | Silver | 0 05 | 0 04 | 0 04 | 0 05 | 0 04 | 0 07 | 0 18 | 0 05 | 0 10 | 0 05 | 0 09 | 0 08 | 0 07 |
| MET | Zinc | 86 80 | 107 00 | 90 00 | 80 10 | 99 80 | 107.50 | 151 00 | 92 90 | 98 10 | 89 90 | 105 00 | 83 95 | 89 10 |
| MET | SEM-AVS | 1 19 | -34 36 | -1 45 | -1 03 | -50 29 | -15 89 | -0 54 | -56 77 | -1 18 | -2 77 | -36 26 | 0 17 | -9 25 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 0 46 | 0 55 | 0 41 | 0 43 | 0 39 | 0 63 | 0 43 | 0 46 | 0 36 | 0 40 | 0 45 | 0 51 | 0 35 |
| PAH | 1-Methylnaphthalene (L) | 0 62 | 0 61 | 0 95 | 0 66 | 0 72 | 1 11 | 0 62 | 0 66 | 0 58 | 0 60 | 0 81 | 0 83 | 0 53 |
| PAH | 1-Methylphenanthrene (L) | 0 89 | 0 61 | 0 69 | 0 78 | 0 61 | 0 62 | 0.63 | 0 61 | 0 47 | 0 55 | 0 61 | 0.86 | 0 45 |
| PAH | 2,6-Dimethylnaphthalene (L) | 0 55 | 0 67 | 0 66 | 0 50 | 0 41 | 0.68 | 0 48 | 0 44 | 0 41 | 0 46 | 0 61 | 0 55 | 0 43 |
| PAH | 2-Methylnaphthalene (L) | 1.01 | 1 00 | 1 59 | 1.04 | 1.08 | 1 65 | 1.03 | 0.97 | 0 85 | 0 91 | 1 21 | 1 18 | 0 81 |
| PAH | Acenaphthene (L) | 1.15 | 0.99 | 0 98 | 1 38 | 1 13 | 1 48 | 0 85 | 1.01 | 0 95 | 1 42 | 1 16 | 1 92 | 1 16 |
| PAH | Acenaphthylene (L) | 1 75 | 2 41 | 1 60 | 2 22 | 1 76 | 2 32 | 2.09 | 1.62 | 1 64 | 1 83 | 1 78 | 1.72 | 1 61 |
| PAH | Anthracene (L) | 3 26 | 4 20 | 3 38 | 4 44 | 3 52 | 5 30 | 4.28 | 3 00 | 3 07 | 3 56 | 3.34 | 4 06 | 3 06 |
| PAH | Benzo(a)anthracene (H) | 1 87 | 1 77 | 1 59 | 2 06 | 1 45 | 2 06 | 1 81 | 1 19 | 1.07 | 1 82 | 1 30 | 2 66 | 1.11 |
| PAH | Benzo(a)pyrene (H) | 1 53 | 1 27 | 1 30 | 1.96 | 1 18 | 2 14 | 2 04 | 0 94 | 0 97 | 1.81 | 1 24 | 2 75 | 0 95 |
| PAH | Benzo(b)fluoranthene (H) | 3 07 | 3 00 | 2 53 | 3 50 | 3 14 | 4 54 | 3 85 | 2.29 | 1 95 | 3 84 | 2 96 | 4 70 | 2 09 |
| PAH | Benzo(b+k)fluoranthene (H) | 3 73 | 3 74 | 3 51 | 4 79 | 3 86 | 5 70 | 5 21 | 3 18 | 2 59 | 5 10 | 3 58 | 6 37 | 2 91 |
| PAH | Benzo(e)pyrene (H) | 2 45 | 2 66 | 2 05 | 3 10 | 2.51 | 3 46 | 3 28 | 2 11 | 1 98 | 3 15 | 2 45 | 3 59 | 1 94 |
| PAH | Benzo(g,h,i)perylene (H) | 1 43 | 1 50 | 1 25 | 1 79 | 1 50 | 2.17 | 2 13 | 1 07 | 1 01 | 1 76 | 1 25 | 2.07 | 1 20 |
| PAH | Benzo(k)fluoranthene (H) | 0 66 | 0 74 | 0 98 | 1 29 | 0 72 | 1 16 | 1 36 | 0 88 | 0 64 | 1.26 | 0 63 | 1 66 | 0 82 |
| PAH | Biphenyl (L) | 0 34 | 0 35 | 0 41 | 0 30 | 0.26 | 0 60 | 0 30 | 0 32 | 0.23 | 0 26 | 0 55 | 0 48 | 0 25 |
| PAH | Chrysene (H) | 3 66 | 3 41 | 3 48 | 4 52 | 3.50 | 5 41 | 4 06 | 2 94 | 3 12 | 5 31 | 3 25 | 6.20 | 3 06 |
| PAH | Dibenz(a,h)anthracene (H) | 0 27 | 0 26 | 0 35 | 0 31 | 0 30 | 0 43 | 0 37 | 0 16 | 0 16 | 0 29 | 0 22 | 0 42 | 0 17 |
| PAH | Fluoranthene (H) | 6 48 | 6 21 | 5 68 | 9 70 | 6 64 | 10 32 | 7.07 | 5 15 | 5 99 | 11 15 | 6 33 | 12 20 | 5 56 |
| PAH | Fluorene (L) | 1.37 | 1 54 | 1 34 | 1 54 | 1 25 | 1 52 | 1 18 | 0 96 | 0 99 | 1 20 | 1 19 | 1 52 | 0 86 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 1.22 | 1 14 | 0 95 | 1.49 | 1.22 | 1 67 | 1 78 | 0 83 | 0 74 | 1 52 | 1 01 | 1 89 | 0 85 |
| PAH | Naphthalene (L) | 1 35 | 0 63 | 1 61 | 1 23 | 1 10 | 2 62 | 1.26 | 1 43 | 0 91 | 1 10 | 1 85 | 1 92 | 0 96 |
| PAH | Perylene (H) | 1 08 | 1 17 | 1.15 | 1 77 | 1.02 | 1 68 | 2 03 | 1 09 | 1 14 | 1 48 | 1 28 | 2 35 | 1.25 |
| PAH | Phenanthrene (L) | 3 42 | 2.83 | 2 79 | 4 74 | 2 62 | 4 11 | 2 82 | 2 29 | 2 51 | 4 17 | 2 82 | 4 80 | 2 42 |
| PAH | Pyrene (H) | 5 49 | 5 65 | 4 68 | 7.52 | 5 52 | 7.86 | 6.27 | 4 22 | 4 26 | 7 66 | 5 36 | 8 04 | 4 16 |
| PAH | LMW PAHs | 16 16 | 16 41 | 16 42 | 19 28 | 14 85 | 22.65 | 15 98 | 13 74 | 12 97 | 16 46 | 16 39 | 20 34 | 12.90 |
| PAH | HMW PAHs | 29.22 | 28 78 | 26 00 | 39 00 | 28 72 | 42 90 | 36 06 | 22 88 | 23 03 | 41 05 | 27 28 | 48 54 | 23 16 |
| PAH | Total PAHs | 45 38 | 45 19 | 42 42 | 58 28 | 43 58 | 65 56 | 52 03 | 36 62 | 36 01 | 57 51 | 43 67 | 68 87 | 36 06 |
| PCB | Total PCBs | 12 10 | 10 74 | 13 35 | 11 92 | 27 17 | 26 08 | 14 87 | 14 07 | 9 77 | 12 11 | 16 16 | 13 70 | 9 67 |
| PST | Aldrin | 0 13 | 0 03 | 0 23 | 0 16 | 0 24 | 0 08 | 0 07 | 0 06 | 0 01 | 0 05 | 0 06 | 0 18 | 0 05 |
| PST | Alpha-BHC | 0 15 | 0 15 | 0 09 | 0 09 | 0 13 | 0 08 | 0 09 | 0 08 | 0 07 | 0 08 | 0 09 | 0 07 | 0 09 |
| PST | Alpha-chlordane | 0 14 | 0 30 | 0 90 | 0 18 | 1 38 | 0 22 | 0 10 | 0 51 | 0 15 | 0 19 | 0 25 | 0 24 | 0 18 |
| PST | Beta-BHC | 0 13 | 0 07 | 0 18 | 0 38 | 0 67 | 3 97 | 1 01 | 0 16 | 0 58 | 0 16 | 0 01 | 0 49 | 0 51 |
| PST | Chlorpyrifos | 0 06 | 0 05 | 0 08 | 0 08 | 0 57 | 0 44 | 0 10 | 0 43 | 0 06 | 0 08 | 0 34 | 0 15 | 0 08 |
| PST | CIS-Nonachlor | 0 27 | 0 12 | 0 47 | 0 10 | 1.28 | 0 49 | 0 10 | 0 36 | 0 14 | 0 16 | 0 28 | 0 25 | 0.24 |
| PST | Delta-BHC | 0 00 | 0 00 | 0 00 | 0 01 | 0 02 | 0.01 | 0 01 | 0 01 | 0 00 | 0 00 | 0 01 | 0 01 | 0.00 |
| PST | Dieldrin | 0 14 | 0 07 | 0 01 | 0 11 | 0 06 | 0 05 | 0 08 | 0 10 | 0 09 | 0 10 | 0 07 | 0 11 | 0 09 |
| PST | Endosulfan II | 0 09 | 0 17 | 0 01 | 0 05 | 0.13 | 0 08 | 0 07 | 0 11 | 0 06 | 0 11 | 0 05 | 0 08 | 0 17 |
| PST | Endrin | 0 02 | 0 02 | 0.37 | 0.03 | 0 31 | 0 09 | 0 03 | 0 02 | 0 02 | 0.02 | 0 03 | 0 05 | 0 02 |
| PST | Gamma-BHC (Lindane) | 0.11 | 0 03 | 0 07 | 0 08 | 0.03 | 0 17 | 0 06 | 0 03 | 0.07 | 0 07 | 0.21 | 0 08 | 0 09 |
| PST | Gamma-Chlordane | 0.20 | 0.10 | 0 16 | 0 12 | 0.07 | 0 17 | 0 15 | 0 11 | 0 13 | 0 20 | 0 28 | 0 21 | 0 14 |
| PST | Heptachlor | 0 02 | 0 02 | 0.01 | 0 03 | 0 01 | 0.07 | 0 04 | 0 03 | 0 02 | 0 04 | 0 09 | 0 10 | 0 08 |
| PST | Heptachlor epoxide | 0 13 | 0 10 | 0 30 | 0 04 | 0 18 | 0.01 | 0 01 | 0 03 | 0 03 | 0 05 | 0 01 | 0 04 | 0 05 |
| PST | Hexachlorobenzene | 0 08 | 0 04 | 0.07 | 0 04 | 0.04 | 0 21 | 0 04 | 0 07 | 0 05 | 0 06 | 0 18 | 0 13 | 0 11 |
| PST | Mirex | 0 05 | 0.12 | 0 02 | 0 02 | 0 02 | 0 03 | 0 03 | 0 02 | 0 02 | 0 02 | 0 02 | 0.04 | 0.02 |
| PST | Oxychlordane | 0 06 | 0 03 | 0 01 | 0 01 | 0 07 | 0 01 | 0 11 | 0 04 | 0 01 | 0 05 | 0.01 | 0.04 | 0 01 |
| PST | Pentachloroanisole | 0 18 | 0 17 | 0 14 | 0 18 | 0 14 | 0 24 | 0 16 | 0 18 | 0 18 | 0 19 | 0 21 | 0 18 | 0 18 |
| PST | Pentachlorobenzene | 0 10 | 0 08 | 0 16 | 0 05 | 0 22 | 0 02 | 0 04 | 0.19 | 0 05 | 0 08 | 0 01 | 0 13 | 0 08 |
| PST | Trans-Nonachlor | 0 14 | 0 17 | 0 17 | 0 14 | 0.28 | 0.13 | 0 11 | 0.21 | 0.16 | 0 20 | 0 14 | 0 18 | 0 10 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 16 | 0 08 | 0 05 | 0 12 | 0.24 | 0 32 | 0 11 | 0 15 | 0.11 | 0 06 | 0 28 | 0 44 | 0.13 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0.02 | 0 02 | 0 13 | 0.05 | 0 07 | 0 19 | 0 05 | 0.12 | 0.07 | 0 05 | 0 19 | 0 03 | 0.04 |
| PST | o,p'-DDD | 0.34 | 0.22 | 0 01 | 0 16 | 0 01 | 0 16 | 0 19 | 0 11 | 0 24 | 0.23 | 0 13 | 0.27 | 0 18 |
| PST | p,p'-DDD | 0 34 | 0.25 | 0 38 | 0 02 | 0 01 | 0 08 | 0.01 | 0 15 | 0.02 | 0 02 | 0 06 | 0 11 | 0.02 |
| PST | o,p'-DDE | 0 21 | 0.21 | 0 16 | 0 26 | 0 19 | 0 16 | 0 33 | 0.24 | 0 19 | 0 16 | 0 01 | 0 15 | 0 25 |
| PST | o,p'-DDT | 0 47 | 0 41 | 0 12 | 0 36 | 0 44 | 0 44 | 0 36 | 0.25 | 0.36 | 0 30 | 0.30 | 0 61 | 0 38 |
| PST | p,p'-DDE | 2.59 | 1 55 | 0 65 | 1 11 | 0 88 | 0 98 | 1.01 | 0 67 | 0 81 | 0 85 | 0 73 | 0 75 | 0 79 |
| PST | p,p'-DDT | 0.07 | 0 09 | 0 02 | 0 08 | 0 06 | 0 15 | 0 12 | 0 10 | 0 07 | 0 08 | 0 06 | 0 12 | 0 10 |
| lipid | PERCENT LIPIDS % | 11 60 | 15 50 | 11 10 | 9 00 | 10 90 | 6 30 | 8 90 | 11 70 | 14 80 | 9 60 | 6 70 | 7 10 | 9 90 |

1- For organics, tissue concentration is normalized by lipid value (NORM = CONC [See TtNUS (2000b)]/%LIP)
Metals are not normalized.
units: metals (µg/g dry wt.), organics (ng/% lipid).

Table A-3-1.2f (continued)

| Class | Analyte | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M09-100B | M09-200B | M10-100B-AVG | M10-200B | M10-300B | M11-100B | M11-200B | M11-300B | M12-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 8 70 | 9.00 | 8 40 | 7 70 | 9 00 | 9 30 | 8.20 | 8 90 | 10 10 | 6 80 | 7.05 | 7 50 | 7.70 |
| MET | Cadmium | 1.80 | 1.30 | 1.30 | 1 40 | 1.80 | 1.50 | 1 70 | 3 00 | 2 10 | 1 50 | 1 75 | 1 30 | 1 10 |
| MET | Chromium | 1 60 | 2 30 | 2 70 | 3.00 | 2.20 | 2.50 | 2.05 | 2.00 | 2 90 | 1 60 | 2 30 | 1 50 | 2 40 |
| MET | Copper | 7 40 | 9 00 | 8 00 | 11 00 | 10 00 | 11 20 | 8 60 | 8.50 | 11 40 | 8 30 | 8 70 | 8 30 | 8 40 |
| MET | Lead | 4 20 | 4 20 | 5 60 | 4 10 | 3 10 | 4.20 | 3.05 | 8 60 | 9 40 | 7 60 | 22.25 | 2 40 | 3.90 |
| MET | Mercury | 0 27 | 0.25 | 0 26 | 0.26 | 0.29 | 0 27 | 0 23 | 0.37 | 0 33 | 0 17 | 0 32 | 0 18 | 0.21 |
| MET | Nickel | 1 80 | 2 00 | 1.90 | 3.20 | 3.10 | 2 90 | 1 85 | 3 40 | 1.90 | 1 80 | 1 75 | 1.50 | 2 10 |
| MET | Silver | 0 07 | 0 04 | 0 09 | 0 05 | 0 15 | 0 06 | 0.07 | 0.55 | 0.29 | 0 05 | 0 03 | 0 06 | 0 04 |
| MET | Zinc | 102 00 | 84 60 | 97 10 | 91 70 | 98 10 | 111 00 | 108 00 | 404 00 | 130 00 | 117 00 | 116 50 | 88 20 | 97 70 |
| MET | SEM-AVS | -37 19 | -17.06 | -36.49 | 4 97 | 1 54 | -0 51 | -0 05 | -28 60 | -98 67 | | | -2 49 | -7 35 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 0 38 | 0 75 | 0 45 | 0 85 | 0.33 | 0 44 | 0 41 | 0 33 | 0 48 | 0 68 | 0 58 | 0 76 | 0 66 |
| PAH | 1-Methylnaphthalene (L) | 0 55 | 1 05 | 0 73 | 1.19 | 0 58 | 0 72 | 0.67 | 0.62 | 0 89 | 0 82 | 1 04 | 0 91 | 1 09 |
| PAH | 1-Methylphenanthrene (L) | 0 49 | 0 69 | 0 52 | 1.33 | 1 03 | 0.77 | 0 65 | 0 52 | 0 79 | 1 23 | 0.92 | 0 62 | 2.23 |
| PAH | 2,6-Dimethylnaphthalene (L) | 0 46 | 0 71 | 0.60 | 1.04 | 0 41 | 0 54 | 0 48 | 0 49 | 0 69 | 0 57 | 0 61 | 0 73 | 0 80 |
| PAH | 2-Methylnaphthalene (L) | 0 90 | 1 49 | 1.21 | 2 00 | 0 94 | 1.23 | 1.08 | 1 07 | 1 51 | 1.27 | 1 47 | 1 36 | 1.66 |
| PAH | Acenaphthene (L) | 1 02 | 2 04 | 1 13 | 2 33 | 1 17 | 1.37 | 1.18 | 0.67 | 1 15 | 0.97 | 1.63 | 0 90 | 3 76 |
| PAH | Acenaphthylene (L) | 1 91 | 2 39 | 1 99 | 4 40 | 2 18 | 2 04 | 1 53 | 1 50 | 1 81 | 1 70 | 1 87 | 1 67 | 2.94 |
| PAH | Anthracene (L) | 3 69 | 5.23 | 3.96 | 8 17 | 5.24 | 4 56 | 3 17 | 2 73 | 4.27 | 3 49 | 4 20 | 3 23 | 12.20 |
| PAH | Benzo(a)anthracene (H) | 1.27 | 1.60 | 1 48 | 4 15 | 2.93 | 2 05 | 1.20 | 1 41 | 1.65 | 1.28 | 2 08 | 1 21 | 6.32 |
| PAH | Benzo(a)pyrene (H) | 1 11 | 1 44 | 1 65 | 4 52 | 2.80 | 1.77 | 0 89 | 1.23 | 1.60 | 1.20 | 1 53 | 1 25 | 4 57 |
| PAH | Benzo(b)fluoranthene (H) | 2 39 | 3 19 | 2 94 | 7 79 | 4 61 | 3 64 | 2 09 | 2.71 | 3 33 | 2.81 | 3 31 | 2 71 | 7 38 |
| PAH | Benzo(b+k)fluoranthene (H) | 3 31 | 4.29 | 3.96 | 10.63 | 6.35 | 4 46 | 2 74 | 3 71 | 4 53 | 3 47 | 4.29 | 3 30 | 9 30 |
| PAH | Benzo(e)pyrene (H) | 2.18 | 2.83 | 2.61 | 6.21 | 3 67 | 2 88 | 1 92 | 2.25 | 2 65 | 2 16 | 2 68 | 2 35 | 4.73 |
| PAH | Benzo(g,h,i)perylene (H) | 1 21 | 1 76 | 1 73 | 4.27 | 2 47 | 1 59 | 1 02 | 1 20 | 1 48 | 1 26 | 1 36 | 1 17 | 2 84 |
| PAH | Benzo(k)fluoranthene (H) | 0.92 | 1 11 | 1 03 | 2 85 | 1 74 | 0 82 | 0 65 | 1.00 | 1.20 | 0 66 | 0 98 | 0 60 | 1 93 |
| PAH | Biphenyl (L) | 0.25 | 0 43 | 0 31 | 0 60 | 0.24 | 0.31 | 0 27 | 0 28 | 0 40 | 0 49 | 0 64 | 0 39 | 0 61 |
| PAH | Chrysene (H) | 3 08 | 4 63 | 3 35 | 9 19 | 4 77 | 4 18 | 2.99 | 3 20 | 3 96 | 3 01 | 4 11 | 3 12 | 8 74 |
| PAH | Dibenz(a,h)anthracene (H) | 0 20 | 0.29 | 0 30 | 0.79 | 0 49 | 0 28 | 0 20 | 0.25 | 0 28 | 0 22 | 0 26 | 0 23 | 0 66 |
| PAH | Fluoranthene (H) | 5 82 | 9 00 | 6 43 | 15 98 | 11.93 | 10 90 | 5 57 | 5 47 | 6 84 | 4 99 | 9 25 | 5 08 | 30 12 |
| PAH | Fluorene (L) | 1 15 | 2 04 | 1 14 | 2 44 | 1 19 | 1 35 | 1 04 | 1 07 | 1 35 | 1 12 | 1 87 | 1 07 | 4 45 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 0 90 | 1 27 | 1 36 | 3 62 | 2 19 | 1.31 | 0 76 | 1 06 | 1.27 | 1 08 | 1 12 | 0 82 | 2 83 |
| PAH | Naphthalene (L) | 1 00 | 1 68 | 1 38 | 2.25 | 1 19 | 1 32 | 1 11 | 0 99 | 1 64 | 1.81 | 2 51 | 1.57 | 2 73 |
| PAH | Perylene (H) | 1.22 | 1 64 | 1 52 | 2 94 | 1 83 | 1.50 | 1 11 | 1 08 | 1 39 | 1 16 | 1 18 | 1.30 | 2 02 |
| PAH | Phenanthrene (L) | 2 72 | 3 99 | 2 78 | 6 48 | 5 17 | 4 73 | 2 52 | 2.87 | 2.88 | 2 74 | 5 19 | 2 48 | 15 85 |
| PAH | Pyrene (H) | 4.48 | 6 88 | 5.17 | 13 15 | 9 04 | 8 36 | 4 16 | 4 34 | 5 75 | 4 41 | 6 94 | 4 27 | 20 24 |
| PAH | LMW PAHs | 14 51 | 22 48 | 16 19 | 33 08 | 19 68 | 19 37 | 14.11 | 13 14 | 17 85 | 16 89 | 22.54 | 15 68 | 48 98 |
| PAH | HMW PAHs | 24 79 | 35 63 | 29 56 | 75 46 | 48 45 | 39 28 | 22 56 | 25.20 | 31 40 | 24 24 | 34 81 | 24 10 | 92.39 |
| PAH | Total PAHs | 39 30 | 58 11 | 45 75 | 108 54 | 68 13 | 58 65 | 36 67 | 38.34 | 49 25 | 41 14 | 57 34 | 39 78 | 141 37 |
| PCB | Total PCBs | 13 03 | 17 98 | 14 50 | 27 67 | 18 92 | 19 26 | 10 80 | 9 27 | 19 78 | 29 96 | 21 07 | 18 55 | 23 84 |
| PST | Aldrin | 0 16 | 0 04 | 0 25 | 0 23 | 0.30 | 0.06 | 0.05 | 0 18 | 0 44 | 0 06 | 0 07 | 0 09 | 0 17 |
| PST | Alpha-BHC | 0 16 | 0 08 | 0 11 | 0.29 | 0 10 | 0 11 | 0 07 | 0 09 | 0 19 | 0 12 | 0 11 | 0 09 | 0 10 |
| PST | Alpha-chlordane | 0 16 | 0.25 | 0.08 | 0 37 | 0.17 | 0 24 | 0 54 | 0 19 | 0 12 | 0 22 | 0 20 | 0.26 | 0 21 |
| PST | Beta-BHC | 0 68 | 0 23 | 0 65 | 0 79 | 0 77 | 1 19 | 0 47 | 0 21 | 1 07 | 0 01 | 0 37 | 0 22 | 1 71 |
| PST | Chlorpyrifos | 0 07 | 0 10 | 0 10 | 0 14 | 0 08 | 0 08 | 0.08 | 0 07 | 0 11 | 0 30 | 0 27 | 0 28 | 0.33 |
| PST | CIS-Nonachlor | 0 40 | 0 11 | 0 21 | 1 17 | 0 50 | 0 23 | 0 44 | 0 07 | 0 73 | 0 38 | 0.31 | 0 21 | 0 37 |
| PST | Delta-BHC | 0 00 | 0 01 | 0.01 | 0 01 | 0 01 | 0 00 | 0 00 | 0 00 | 0 01 | 0 00 | 0 01 | 0 00 | 0 01 |
| PST | Dieldrin | 0.10 | 0 10 | 0 13 | 0.21 | 0.11 | 0 15 | 0 14 | 0 07 | 0 12 | 0 08 | 0 14 | 0 07 | 0 08 |
| PST | Endosulfan II | 0.22 | 0.15 | 0 08 | 0 18 | 0 18 | 0 15 | 0.23 | 0 05 | 0.53 | 0 03 | 0 09 | 0 16 | 0 21 |
| PST | Endrin | 0.02 | 0 03 | 0 05 | 0.21 | 0.13 | 0.02 | 0 14 | 0 02 | 0 03 | 0.02 | 0 03 | 0.37 | 0 35 |
| PST | Gamma-BHC (Lindane) | 0.11 | 0 06 | 0 05 | 0.21 | 0.05 | 0 17 | 0 03 | 0.03 | 0.13 | 0.28 | 0 10 | 0 12 | 0 30 |
| PST | Gamma-Chlordane | 0.21 | 0 19 | 0 18 | 0 48 | 0 18 | 0.27 | 0 45 | 0.18 | 0.20 | 0.23 | 0 22 | 0 30 | 0.23 |
| PST | Heptachlor | 0 01 | 0 03 | 0.02 | 0 02 | 0 01 | 0 01 | 0 07 | 0 03 | 0 02 | 0 02 | 0 01 | 0 07 | 0 04 |
| PST | Heptachlor epoxide | 0.10 | 0 04 | 0.13 | 0 09 | 0.10 | 0 04 | 0.11 | 0 05 | 0 11 | 0 02 | 0.06 | 0 01 | 0 01 |
| PST | Hexachlorobenzene | 0.10 | 0 03 | 0 05 | 0.16 | 0 06 | 0 05 | 0 11 | 0 06 | 0 06 | 0 08 | 0 07 | 0.08 | 0 11 |
| PST | Mirex | 0.05 | 0.03 | 0 07 | 0 04 | 0 02 | 0 02 | 0.03 | 0.01 | 0 03 | 0 02 | 0 03 | 0 02 | 0 02 |
| PST | Oxychlordane | 0 05 | 0.04 | 0 05 | 0 11 | 0.13 | 0 03 | 0 08 | 0 03 | 0 04 | 0 01 | 0 01 | 0 01 | 0 01 |
| PST | Pentachloroanisole | 0 19 | 0.19 | 0 18 | 0.37 | 0 16 | 0.22 | 0.25 | 0 10 | 0 19 | 0 19 | 0 15 | 0 13 | 0 20 |
| PST | Pentachlorobenzene | 0 11 | 0 07 | 0 11 | 0 14 | 0 08 | 0 04 | 0.07 | 0.07 | 0.06 | 0 01 | 0 19 | 0 05 | 0 07 |
| PST | Trans-Nonachlor | 0 16 | 0.23 | 0 11 | 0 29 | 0 17 | 0 21 | 0 24 | 0.16 | 0.12 | 0.23 | 0.20 | 0 14 | 0 12 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 17 | 0 13 | 0 17 | 0.33 | 0.13 | 0 13 | 0 46 | 0.34 | 0.40 | 0 10 | 0 11 | 0.03 | 0 13 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0.03 | 0 05 | 0 10 | 0 04 | 0 05 | 0 03 | 0 03 | 0 03 | 0.07 | 0.17 | 0 01 | 0.07 | 0 15 |
| PST | o,p'-DDD | 0 09 | 1 73 | 0 16 | 1 10 | 0 43 | 0 12 | 1 69 | 0.11 | 0 24 | 0.27 | 0 08 | 0 16 | 0.34 |
| PST | p,p'-DDD | 0 08 | 0 04 | 0 02 | 0 14 | 0 07 | 0 03 | 0 04 | 0.01 | 0 06 | 0.09 | 0 07 | 0 07 | 0 09 |
| PST | o,p'-DDE | 0 24 | 0 27 | 0.23 | 0.54 | 0 31 | 0 14 | 0 60 | 0.10 | 0.33 | 0 14 | 0 08 | 0 18 | 0 18 |
| PST | o,p'-DDT | 0 33 | 3 87 | 0 43 | 3 27 | 0 46 | 0 44 | 2.58 | 0.30 | 0 39 | 0 28 | 0 28 | 0 37 | 0 35 |
| PST | p,p'-DDE | 0.62 | 1 87 | 0 92 | 2 31 | 0 85 | 0 78 | 1 46 | 0 76 | 0 87 | 0 76 | 0 74 | 0 66 | 0 76 |
| PST | p,p'-DDT | 0 17 | 0 27 | 0 19 | 0 65 | 0 15 | 0 07 | 0 19 | 0.05 | 0 25 | 0 11 | 0 06 | 0 01 | 0 04 |
| lipid | PERCENT LIPIDS % | 10 30 | 7 50 | 7 70 | 5 20 | 10 90 | 7 80 | 8 90 | 10 00 | 7 50 | 7 40 | 5 70 | 9 20 | 8 20 |

Table A-3-1.2f. (continued)

| Class | Analyte | M12-200B-AVG | M13-100B | M13-300B | M14-100B | M14-200B |
|---|---|---|---|---|---|---|
| MET | Arsenic | 7 30 | 7.20 | 7 10 | 8.50 | 8 00 |
| MET | Cadmium | 1.20 | 1 80 | 1 60 | 1.30 | 1 30 |
| MET | Chromium | 1 70 | 2.20 | 2 00 | 2 70 | 2 00 |
| MET | Copper | 7.65 | 9.90 | 8 40 | 8 70 | 7.80 |
| MET | Lead | 2.95 | 2.90 | 2.90 | 2 80 | 3 00 |
| MET | Mercury | 0 22 | 0 28 | 0 22 | 0 30 | 0.29 |
| MET | Nickel | 1 95 | 1 80 | 1.80 | 2 20 | 1.90 |
| MET | Silver | 0 04 | 0 04 | 0 03 | 0 08 | 0 05 |
| MET | Zinc | 93 85 | 120 00 | 84 50 | 87 70 | 91 30 |
| MET | SEM-AVS | -1 25 | -110 00 | -173 15 | -1 46 | -15 87 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 0 52 | 0 57 | 0.58 | 0 58 | 0 46 |
| PAH | 1-Methylnaphthalene (L) | 1 24 | 1 02 | 1 08 | 1 04 | 1.10 |
| PAH | 1-Methylphenanthrene (L) | 0 96 | 1 61 | 1 44 | 0 96 | 0 79 |
| PAH | 2,6-Dimethylnaphthalene (L) | 0 58 | 0.72 | 0 67 | 0 65 | 0 68 |
| PAH | 2-Methylnaphthalene (L) | 1 60 | 1 56 | 1 47 | 1.53 | 1 73 |
| PAH | Acenaphthene (L) | 1 62 | 2 32 | 1 71 | 1.57 | 1 20 |
| PAH | Acenaphthylene (L) | 2 69 | 4 14 | 3.65 | 2 24 | 2 39 |
| PAH | Anthracene (L) | 5.03 | 10.23 | 7 89 | 4 42 | 4.27 |
| PAH | Benzo(a)anthracene (H) | 2 14 | 4 60 | 4.07 | 1 71 | 2.72 |
| PAH | Benzo(a)pyrene (H) | 1 53 | 3.12 | 2.73 | 1 64 | 3 42 |
| PAH | Benzo(b)fluoranthene (H) | 3 27 | 7.05 | 5 59 | 3 36 | 3.72 |
| PAH | Benzo(b+k)fluoranthene (H) | 4 27 | 8 95 | 7 07 | 4 15 | 4 85 |
| PAH | Benzo(e)pyrene (H) | 2 84 | 5 10 | 4 26 | 2.74 | 3 30 |
| PAH | Benzo(g,h,i)perylene (H) | 1.63 | 2 60 | 2 19 | 1 50 | 2 03 |
| PAH | Benzo(k)fluoranthene (H) | 1 00 | 1 90 | 1 48 | 0 79 | 1 13 |
| PAH | Biphenyl (L) | 0 61 | 0 41 | 0 66 | 0 61 | 0.45 |
| PAH | Chrysene (H) | 4 17 | 8 05 | 5 87 | 3 97 | 4 20 |
| PAH | Dibenz(a,h)anthracene (H) | 0 27 | 0 53 | 0 38 | 0 24 | 0 45 |
| PAH | Fluoranthene (H) | 10 39 | 23 46 | 16 12 | 6 43 | 6 68 |
| PAH | Fluorene (L) | 2 26 | 2 42 | 2 11 | 1 38 | 1.35 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 1 28 | 2 35 | 1 95 | 1 13 | 1 69 |
| PAH | Naphthalene (L) | 2 74 | 2.12 | 2 45 | 2 44 | 2 11 |
| PAH | Perylene (H) | 1 42 | 2 40 | 1 99 | 1 56 | 1 65 |
| PAH | Phenanthrene (L) | 5 16 | 8 20 | 7 68 | 2 96 | 2 80 |
| PAH | Pyrene (H) | 7 58 | 16.32 | 11 76 | 5 53 | 6 34 |
| PAH | LMW PAHs | 25 00 | 35 32 | 31 38 | 20 38 | 19 34 |
| PAH | HMW PAHs | 37 51 | 77 47 | 58 39 | 30.58 | 37 31 |
| PAH | Total PAHs | 62 51 | 112 79 | 89 76 | 50 96 | 56 65 |
| PCB | Total PCBs | 18 46 | 18 91 | 13 73 | 17 01 | 17 22 |
| PST | Aldrin | 0 04 | 0 05 | 0 15 | 0 03 | 0 10 |
| PST | Alpha-BHC | 0 11 | 0 04 | 0 08 | 0 05 | 0 07 |
| PST | Alpha-chlordane | 0 58 | 0 20 | 0 24 | 0 22 | 0 31 |
| PST | Beta-BHC | 0 48 | 0.35 | 0 01 | 0 24 | 0.39 |
| PST | Chlorpyrifos | 0 59 | 0.30 | 0 08 | 0 25 | 0 39 |
| PST | CIS-Nonachlor | 0 41 | 0 33 | 0 16 | 0 11 | 0 35 |
| PST | Delta-BHC | 0 01 | 0 00 | 0 00 | 0 01 | 0 01 |
| PST | Dieldrin | 0 06 | 0.12 | 0 01 | 0 01 | 0 09 |
| PST | Endosulfan II | 0 12 | 0 13 | 0 07 | 0 12 | 0 24 |
| PST | Endrin | 0 10 | 0 19 | 0 02 | 0.08 | 0.24 |
| PST | Gamma-BHC (Lindane) | 0 07 | 0 20 | 0 02 | 0 09 | 0 12 |
| PST | Gamma-Chlordane | 0.13 | 0.25 | 0 08 | 0.26 | 0.18 |
| PST | Heptachlor | 0.02 | 0.02 | 0 01 | 0 03 | 0 03 |
| PST | Heptachlor epoxide | 0.01 | 0.05 | 0.01 | 0 06 | 0 01 |
| PST | Hexachlorobenzene | 0 08 | 0.06 | 0.02 | 0 05 | 0 10 |
| PST | Mirex | 0 06 | 0 02 | 0.02 | 0 03 | 0 02 |
| PST | Oxychlordane | 0 02 | 0.01 | 0 01 | 0.01 | 0 01 |
| PST | Pentachloroanisole | 0 21 | 0 20 | 0 13 | 0.12 | 0 17 |
| PST | Pentachlorobenzene | 0 18 | 0 02 | 0 03 | 0 10 | 0 08 |
| PST | Trans-Nonachlor | 0 19 | 0.15 | 0.24 | 0.22 | 0 35 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 08 | 0.08 | 0 12 | 0 06 | 0.28 |
| PST | 1,2,4,5-Tetrachlorobenzene | 0 04 | 0.14 | 0 04 | 0.13 | 0 19 |
| PST | o,p'-DDD | 0.26 | 0.31 | 0 07 | 0.05 | 0 10 |
| PST | p,p'-DDD | 0.20 | 0 03 | 0 01 | 0 10 | 0.07 |
| PST | o,p'-DDE | 0 19 | 0.23 | 0 11 | 0 10 | 0 34 |
| PST | o,p'-DDT | 0.29 | 0.39 | 0.32 | 0 32 | 0 41 |
| PST | p,p'-DDE | 0 70 | 0.90 | 0 49 | 0 79 | 0 62 |
| PST | p,p'-DDT | 0 07 | 0 13 | 0 13 | 0 02 | 0 06 |
| lipid | PERCENT LIPIDS % | 11 60 | 13 30 | 8 50 | 7.20 | 7 10 |

Table A-3-1.2g. Normalized[1] concentrations of PCB congeners in tissues of mussel in the Portsmouth Naval Shipyard offshore study area.

| Analyte | M01-200B | M01-300B-AVG | M02-200B | M02-300B | M03-100B | M03-200B | M04-100B | M05-100B-AVG | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-300B | M08-100B | M08-200B | M08-300B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB-101/90 | 0.33 | 0 35 | 0 60 | 0.43 | 0 73 | 0 98 | 0.42 | 0 71 | 0 31 | 0 38 | 0 84 | 0.47 | 0 28 | 0.36 | 0 67 | 0.35 | 0 81 |
| PCB-105 | 0 25 | 0 22 | 0.44 | 0.40 | 0.78 | 0 35 | 0 38 | 0 43 | 0 28 | 0 31 | 0 22 | 0 42 | 0.28 | 0 31 | 0.57 | 0 44 | 0 75 |
| PCB-118 | 0.47 | 0 17 | 0 56 | 0 68 | 0.83 | 0 67 | 0 61 | 0 72 | 0.57 | 0 67 | 0 46 | 0.73 | 0 47 | 0.50 | 0.91 | 0 55 | 1.06 |
| PCB-128 | 0 12 | 0.05 | 0 24 | 0 20 | 0 29 | 0 37 | 0 19 | 0 21 | 0 17 | 0 30 | 0 21 | 0 20 | 0 21 | 0 43 | 0 43 | 0 38 | 0 44 |
| PCB-138/160 | 0.65 | 0.52 | 1 44 | 0 94 | 4.04 | 2 70 | 1 07 | 1 28 | 0 64 | 0 83 | 1 64 | 1 13 | 0 61 | 0 68 | 1 20 | 0 97 | 1.73 |
| PCB-153/132 | 0.60 | 0 48 | 0.54 | 0.89 | 2 34 | 2 86 | 1 24 | 0 68 | 0 64 | 0.83 | 1 79 | 0.92 | 0 56 | 0 63 | 1 33 | 0 91 | 1 63 |
| PCB-170/190 | 0.08 | 0 22 | 0 16 | 0.08 | 0.17 | 0 10 | 0 11 | 0 10 | 0 08 | 0 17 | 0 07 | 0.20 | 0 09 | 0 13 | 0 15 | 0.13 | 0 25 |
| PCB-18/17 | 0.36 | 0.37 | 0.08 | 0.21 | 0 07 | 0.17 | 0 36 | 0 29 | 0 27 | 0.40 | 0 08 | 0 55 | 0.26 | 0 38 | 0 33 | 0.36 | 0 65 |
| PCB-180 | 0 47 | 0 45 | 0 50 | 0 56 | 1.01 | 1 43 | 0 62 | 0 55 | 0 47 | 0 57 | 1 07 | 0 63 | 0 43 | 0 49 | 0 73 | 0 55 | 1 06 |
| PCB-187 | 0 27 | 0 19 | 0.26 | 0 31 | 1.01 | 0 83 | 0.56 | 0 26 | 0 24 | 0 29 | 0 24 | 0 34 | 0 21 | 0 26 | 0 52 | 0 38 | 0.74 |
| PCB-195/208 | 0 02 | 0.03 | 0 03 | 0.03 | 0.02 | 0 33 | 0 03 | 0 03 | 0 02 | 0 03 | 0 03 | 0.05 | 0 03 | 0 03 | 0 03 | 0.04 | 0 05 |
| PCB-206 | 0.02 | 0 02 | 0.03 | 0.03 | 0 02 | 0.01 | 0 04 | 0 03 | 0 02 | 0.03 | 0 03 | 0 05 | 0 03 | 0.03 | 0 04 | 0 04 | 0 05 |
| PCB-209 | 0 05 | 0 10 | 0.06 | 0.05 | 0 05 | 0 02 | 0.05 | 0 05 | 0.04 | 0 05 | 0 03 | 0 06 | 0 03 | 0 05 | 0.04 | 0 05 | 0 09 |
| PCB-28 | 0 26 | 0.24 | 0.18 | 0 09 | 0.17 | 0 35 | 0 31 | 0 31 | 0.19 | 0.22 | 0 31 | 0 05 | 0.29 | 0 30 | 0 33 | 0.27 | 0 67 |
| PCB-44 | 0 58 | 0 77 | 0 32 | 0.18 | 0.53 | 0 25 | 0 34 | 0 35 | 0 11 | 0 11 | 0 18 | 0.21 | 0 14 | 0.48 | 0 43 | 0 36 | 1 00 |
| PCB-52 | 0 86 | 0 84 | 0 36 | 0.50 | 0 77 | 1 06 | 0 85 | 0 56 | 0 49 | 0 55 | 0.52 | 0 51 | 0 46 | 0 92 | 0 93 | 1 08 | 1.88 |
| PCB-66 | 0 21 | 0.17 | 0.59 | 0 16 | 0.44 | 0 04 | 0 11 | 0 29 | 0 14 | 0 21 | 0 09 | 0.21 | 0 21 | 0 26 | 0 21 | 0 25 | 0.48 |
| PCB-8/5 | 0.45 | 0.17 | 0.30 | 0 23 | 0.31 | 0.52 | 0 15 | 0.19 | 0.20 | 0 10 | 0.25 | 0.13 | 0.23 | 0.29 | 0.13 | 0.16 | 0.48 |
| TOTAL PCBs | 12.10 | 10.74 | 13 35 | 11.92 | 27.17 | 26.08 | 14 87 | 14 07 | 9.77 | 12.11 | 16.16 | 13.70 | 9 67 | 13 03 | 17.98 | 14.50 | 27.67 |
| PERCENT LIPIDS % | 11.60 | 15.50 | 11.10 | 9 00 | 10.90 | 6.30 | 8 90 | 11.70 | 14.80 | 9.60 | 6.70 | 7.10 | 9.90 | 10.30 | 7.50 | 7.70 | 5.20 |

1- For organics, tissue concentration is normalized by lipid value (NORM = CONC [See TtNUS (2000b)]/%LIP).
units: organics (ng/% lipid).

Table A-3-1.2g. (continued)

| Analyte | M09-100B | M09-200B | M10-100B-AVG | M10-200B | M10-300B | M11-100B | M11-200B | M11-300B | M12-100B | M12-200B-AVG | M13-100B | M13-300B | M14-100B | M14-200B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PCB-101/90 | 0 55 | 0.47 | 0.34 | 0 41 | 0.73 | 1 62 | 1 17 | 0 82 | 0 78 | 0 75 | 0 71 | 0 59 | 0 57 | 0 83 |
| PCB-105 | 0 58 | 0 41 | 0.29 | 0.29 | 0 63 | 0 45 | 0 38 | 0 26 | 0 29 | 0 31 | 0 26 | 0 34 | 0 28 | 0 21 |
| PCB-118 | 0 69 | 0 69 | 0.49 | 0.59 | 1 03 | 1 22 | 0 71 | 0 73 | 0 79 | 0 59 | 0 71 | 0 46 | 0 58 | 0 55 |
| PCB-128 | 0.38 | 0 19 | 0 20 | 0 14 | 0 40 | 0 54 | 0 38 | 0.35 | 0 37 | 0.25 | 0 30 | 0 21 | 0 35 | 0 45 |
| PCB-138/160 | 1 42 | 0.90 | 0 42 | 0 70 | 1.07 | 2.97 | 2 17 | 1 96 | 2 20 | 1 77 | 1.73 | 1 41 | 1 81 | 1.41 |
| PCB-153/132 | 1 28 | 0.77 | 0.52 | 0 60 | 0 80 | 3 24 | 1 61 | 1 85 | 2.32 | 1 27 | 1 80 | 1 76 | 2 08 | 1 41 |
| PCB-170/190 | 0.36 | 2 31 | 0.11 | 0 09 | 0 19 | 0 15 | 0.11 | 0 07 | 0 09 | 0 09 | 0 06 | 0.03 | 0 02 | 0 09 |
| PCB-18/17 | 0 38 | 0 29 | 0 40 | 0.17 | 0 60 | 0 31 | 0 57 | 0.09 | 0 10 | 0 24 | 0 06 | 0 09 | 0 10 | 0 12 |
| PCB-180 | 0.69 | 0 71 | 0.47 | 0.55 | 0 51 | 1 62 | 0 99 | 1.04 | 1.13 | 1 12 | 1.35 | 0 95 | 1 15 | 1 06 |
| PCB-187 | 0 69 | 0 32 | 0 19 | 0 21 | 0 26 | 0.59 | 0 37 | 0 27 | 0 80 | 0 66 | 0 52 | 0 19 | 0 17 | 0 25 |
| PCB-195/208 | 0.03 | 0.03 | 0.03 | 0 03 | 0 04 | 0.31 | 0.05 | 0 04 | 0 24 | 0 05 | 0 05 | 0 01 | 0 05 | 0 08 |
| PCB-206 | 0 03 | 0 03 | 0 03 | 0.03 | 0 04 | 0 01 | 0 04 | 0 03 | 0.03 | 0 03 | 0 02 | 0 03 | 0.04 | 0.03 |
| PCB-209 | 0 05 | 0 12 | 0 05 | 0 05 | 0.04 | 0 06 | 0 04 | 0 07 | 0 04 | 0.06 | 0 08 | 0 03 | 0 02 | 0.05 |
| PCB-28 | 0.32 | 0 40 | 0.28 | 0.10 | 0 28 | 0 34 | 0 45 | 0 33 | 0 32 | 0 17 | 0 25 | 0 03 | 0 11 | 0 35 |
| PCB-44 | 0.47 | 0 38 | 0 35 | 0.10 | 0 84 | 0 55 | 0 56 | 0 40 | 0 71 | 0 42 | 0.43 | 0 02 | 0 21 | 0 41 |
| PCB-52 | 1 01 | 1.10 | 0 99 | 0.35 | 1.73 | 0 68 | 0 61 | 0 91 | 1 11 | 0.91 | 0 98 | 0 60 | 0.93 | 0 99 |
| PCB-66 | 0.41 | 0 32 | 0.13 | 0 13 | 0 48 | 0 05 | 0 17 | 0.07 | 0.27 | 0 32 | 0 10 | 0 02 | 0 03 | 0.15 |
| PCB-8/5 | 0.13 | 0 19 | 0.11 | 0.11 | 0 23 | 0 27 | 0 17 | 0 01 | 0.34 | 0.22 | 0.05 | 0.09 | 0.01 | 0.17 |
| TOTAL PCBs | 18 92 | 19 26 | 10.80 | 9.27 | 19 78 | 29.96 | 21.07 | 18 55 | 23.84 | 18 46 | 18.91 | 13.73 | 17.01 | 17.22 |
| PERCENT LIPIDS % | 10.90 | 7.80 | 8 90 | 10.00 | 7 50 | 7.40 | 5.70 | 9.20 | 8.20 | 11.60 | 13.30 | 8.50 | 7.20 | 7.10 |

Table A-3-1.2h Bioaccumulation Factors (BAFs) for metals[1] and Biota-Sediment Accumulation Factors (BSAFs) for organics[2] in mussel tissue[3] from the Portsmouth Naval Shipyard offshore study area.

| Class | Analyte | M01-200B | M01-300B-AVG | M02-200B | M02-300B | M03-100B | M03-200B | M04-100B | M05-100B-AVG | M05-300B | M06-100B | M06-200B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0.82 | 0.79 | 0.81 | 0.69 | 0.57 | 0.50 | 0.48 | 0.61 | 1.39 | 1.23 | 0.78 |
| MET | Cadmium | 10.77 | 4.55 | 5.17 | 2.33 | 2.67 | 1.96 | 1.90 | 3.98 | 3.28 | 5.83 | 2.12 |
| MET | Chromium | 0.03 | 0.02 | 0.03 | 0.02 | 0.02 | 0.03 | 0.02 | 0.02 | 0.03 | 0.04 | 0.03 |
| MET | Copper | 0.16 | 0.04 | 0.15 | 0.16 | 0.05 | 0.02 | 0.02 | 0.14 | 0.36 | 0.54 | 0.32 |
| MET | Lead | 0.02 | 0.02 | 0.03 | 0.04 | 0.03 | 0.02 | 0.02 | 0.11 | 0.09 | 0.10 | 0.09 |
| MET | Mercury | 1.92 | 0.98 | 0.30 | 0.77 | 0.47 | 0.41 | 0.13 | 0.76 | 1.00 | 1.00 | 1.27 |
| MET | Nickel | 0.06 | 0.05 | 0.06 | 0.06 | 0.08 | 0.04 | 0.02 | 0.06 | 0.08 | 0.08 | 0.06 |
| MET | Silver | | | | | | | | | | | |
| MET | Zinc | 0.80 | 0.58 | 0.71 | 0.79 | 0.43 | 0.17 | 0.10 | 0.62 | 1.24 | 1.59 | 1.05 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 0.03 | | 0.20 | 0.15 | 0.07 | 0.09 | | | 0.04 | 0.06 | 0.09 |
| PAH | 1-Methylnaphthalene (L) | 0.02 | | 0.38 | 0.13 | 0.09 | 0.13 | 0.01 | 0.08 | 0.05 | 0.06 | 0.12 |
| PAH | 1-Methylphenanthrene (L) | 0.01 | | 0.08 | | 0.02 | 0.02 | | | 0.02 | 0.01 | 0.04 |
| PAH | 2,6-Dimethylnaphthalene (L) | 0.03 | | 0.28 | 0.13 | 0.07 | 0.08 | 0.01 | | 0.03 | 0.05 | 0.08 |
| PAH | 2-Methylnaphthalene (L) | 0.02 | | 0.35 | 0.13 | 0.09 | 0.12 | 0.01 | 0.08 | 0.04 | 0.06 | 0.10 |
| PAH | Acenaphthene (L) | 0.02 | | | | | | | | | | |
| PAH | Acenaphthylene (L) | 0.02 | | | 0.09 | | 0.06 | 0.01 | | 0.02 | 0.03 | 0.04 |
| PAH | Anthracene (L) | 0.01 | | | 0.08 | | 0.04 | 0.01 | | 0.02 | 0.02 | 0.04 |
| PAH | Benzo(a)anthracene (H) | 0.00 | | | 0.03 | 0.00 | 0.01 | 0.00 | | 0.00 | 0.00 | 0.01 |
| PAH | Benzo(a)pyrene (H) | | | | 0.02 | 0.00 | | 0.00 | 0.00 | 0.00 | 0.00 | |
| PAH | Benzo(b)fluoranthene (H) | 0.00 | | | 0.03 | 0.01 | 0.01 | 0.00 | | | | 0.01 |
| PAH | Benzo(b+k)fluoranthene (H) | 0.00 | 0.00 | 0.04 | 0.03 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 |
| PAH | Benzo(e)pyrene (H) | | | | 0.05 | | 0.02 | 0.01 | | | | 0.02 |
| PAH | Benzo(g,h,i)perylene (H) | 0.00 | | | 0.03 | 0.01 | 0.01 | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 |
| PAH | Benzo(k)fluoranthene (H) | 0.00 | | | 0.04 | 0.01 | 0.02 | 0.01 | | 0.00 | 0.00 | 0.01 |
| PAH | Biphenyl (L) | | | | | | | | | | | |
| PAH | Chrysene (H) | 0.01 | | 0.05 | 0.04 | 0.01 | 0.02 | 0.00 | | 0.01 | 0.01 | 0.01 |
| PAH | Dibenz(a,h)anthracene (H) | | | | | | | | | | | |
| PAH | Fluoranthene (H) | 0.01 | | 0.04 | | 0.01 | 0.02 | | | 0.01 | 0.01 | 0.03 |
| PAH | Fluorene (L) | | | | | | | | | | | |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 0.00 | | | | | 0.01 | | | | | |
| PAH | Naphthalene (L) | 0.02 | | 0.24 | 0.08 | 0.05 | 0.14 | 0.01 | | 0.03 | 0.04 | 0.09 |
| PAH | Perylene (H) | 0.02 | | 0.08 | | | 0.03 | | | | | 0.03 |
| PAH | Phenanthrene (L) | | | | 0.04 | | | 0.00 | | 0.01 | 0.01 | |
| PAH | Pyrene (H) | 0.01 | | 0.04 | | 0.01 | 0.02 | | | | | 0.02 |
| PAH | LMW PAHs | 0.01 | 0.01 | 0.13 | 0.08 | 0.02 | 0.05 | 0.01 | 0.03 | 0.02 | 0.02 | 0.06 |
| PAH | HMW PAHs | 0.01 | 0.00 | 0.06 | 0.06 | 0.01 | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 |
| PAH | Total PAHs | 0.01 | 0.00 | 0.07 | 0.06 | 0.02 | 0.03 | 0.01 | 0.02 | 0.01 | 0.01 | 0.03 |
| PCB | Total PCBs | 0.22 | 0.31 | 1.73 | 0.39 | 0.11 | 0.19 | 0.04 | 0.30 | 0.30 | 0.43 | 0.80 |
| PST | Aldrin | | | | 0.47 | | | | | | | |
| PST | Alpha-BHC | 2.13 | | 4.41 | | 2.00 | 0.27 | 0.59 | 0.84 | 0.52 | | 0.82 |
| PST | Alpha-chlordane | 0.02 | | 7.72 | 1.67 | 7.67 | 0.71 | 0.08 | | 0.43 | 0.33 | 2.04 |
| PST | Beta-BHC | | | 1.28 | 1.10 | 0.67 | 9.11 | | | 0.34 | | |
| PST | Chlorpyrifos | | | | | | | | | | | |
| PST | CIS-Nonachlor | 0.28 | | 13.29 | 0.12 | 2.36 | 2.71 | 0.22 | | 0.24 | 0.56 | 2.37 |
| PST | Delta-BHC | | | | | | | | | | | |
| PST | Dieldrin | 0.01 | | | 0.35 | 0.14 | 0.07 | | | 0.26 | 0.29 | |
| PST | Endosulfan II | 0.06 | | | 0.09 | 0.19 | 0.19 | 0.04 | | 0.05 | 0.07 | 0.10 |
| PST | Endrin | | | | | | | | | | | |
| PST | Gamma-BHC (Lindane) | 0.40 | | | | | 0.99 | | | 0.16 | | |
| PST | Gamma-Chlordane | 0.02 | | 4.09 | 0.83 | 0.50 | 1.40 | 0.31 | | | 1.16 | 5.39 |
| PST | Heptachlor | | | | | | 0.27 | 0.08 | | | | |
| PST | Heptachlor epoxide | | | | | | | | | | | |
| PST | Hexachlorobenzene | 2.12 | | | | | 4.79 | 0.52 | | | | |
| PST | Mirex | 0.08 | | | | | | | | | | |
| PST | Oxychlordane | | | | | | | | | | | |
| PST | Pentachloroanisole | 0.50 | | | | | | | | | | |
| PST | Pentachlorobenzene | | | | | | | | | | | |
| PST | Trans-Nonachlor | 0.05 | | 2.68 | 0.68 | 2.22 | 1.31 | 0.28 | | 1.55 | | 1.20 |
| PST | 1,2,3,4-Tetrachlorobenzene | 1.17 | | | | 0.83 | 1.30 | 0.39 | | 0.31 | | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | | 0.12 | | | 0.15 | | | |
| PST | o,p'-DDD | 0.01 | | | | | 0.10 | 0.01 | | | | 0.11 |
| PST | p,p'-DDD | 0.29 | | 7.16 | | | | | | 0.19 | 0.12 | 0.25 |
| PST | o,p'-DDE | 0.02 | | | 0.89 | 0.22 | 0.68 | 0.19 | | | | |
| PST | o,p'-DDT | 0.01 | | | | 0.07 | 0.18 | 0.01 | 0.19 | | | 0.42 |
| PST | p,p'-DDE | 0.08 | | | 0.32 | 0.52 | 0.69 | 0.10 | | | | 2.09 |
| PST | p,p'-DDT | 0.00 | | | | 0.03 | | | | | | |
| lipid toc | PERCENT LIPIDS/PERCENT TO | 6.14 | 6.87 | 2.44 | 3.09 | 3.49 | 3.01 | 7.88 | 5.84 | 21.14 | 20.43 | 3.21 |

1- BAF = (tissue/sediment ratio)
2- BSAF = (tissue/lipid to sediment/TOC ratio)
3- Concentration data below detectable limits and qualified with a "J" qualifier in Tables A-3-3.2a-c are excluded above
Units. metal- ug tissue/ug sediment; organics (ng tissue/%lipid)/(ng sediment/%TOC)

Table A-3-1.2h. (continued)

| Class | Analyte | M06-300B | M07-100B | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M09-100B | M09-200B | M10-100B-AVG | M10-200B | M10-300B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0.59 | 1 01 | 0 83 | 0 78 | 0 78 | 0 67 | 0 71 | 1.26 | 1 10 | 1.01 | 0 73 |
| MET | Cadmium | 23 57 | 5 19 | 4 39 | 3 42 | 2.60 | 6 36 | 5 81 | 5 56 | 10 30 | 13 64 | 4 04 |
| MET | Chromium | 0 04 | 0 03 | 0 02 | 0 01 | 0.03 | 0 02 | 0 02 | 0 04 | 0 04 | 0 04 | 0 03 |
| MET | Copper | 0.50 | 0 17 | 0 32 | 0 02 | 0.10 | | 0.02 | 0.05 | 0 31 | 0 25 | 0 37 |
| MET | Lead | 0 17 | 0 08 | 0 09 | 0 02 | 0 08 | 0 02 | 0 02 | 0.03 | 0 05 | 0 15 | 0 17 |
| MET | Mercury | 14 50 | 2 08 | 0 71 | 1 19 | 0 68 | 2 48 | 1.71 | 3 38 | 2 50 | 2 31 | 1 43 |
| MET | Nickel | 0 05 | 0 07 | 0 07 | 0 02 | 0 06 | 0.02 | 0.02 | 0 05 | 0 06 | 0 17 | 0.07 |
| MET | Silver | | | | | | | | | | | |
| MET | Zinc | 2 04 | 1 07 | 1 14 | 0 12 | 0 67 | 0.10 | 0 20 | 0 49 | 1 07 | 5 34 | 1 07 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | | | | 0 06 | | | | 0 02 | 0 12 | | |
| PAH | 1-Methylnaphthalene (L) | | 0 10 | | 0 07 | | 0 08 | | 0 16 | 0 13 | 0 03 | 0 13 |
| PAH | 1-Methylphenanthrene (L) | 0 09 | 0 03 | 0 03 | 0 03 | | | 0 18 | 0 01 | | | |
| PAH | 2,6-Dimethylnaphthalene (L) | | 0 08 | | 0 05 | 0 05 | 0 09 | | 0 06 | 0.09 | 0 01 | 0 11 |
| PAH | 2-Methylnaphthalene (L) | 0 26 | 0.09 | | 0 06 | | 0 07 | | 0 15 | 0 11 | 0 04 | 0 12 |
| PAH | Acenaphthene (L) | | | | | 0 04 | | 0 41 | 0.20 | | | 0 10 |
| PAH | Acenaphthylene (L) | 0 19 | 0 05 | | 0 04 | 0 04 | | 0.11 | 0 12 | 0 10 | 0 01 | 0 03 |
| PAH | Anthracene (L) | 0 11 | 0 03 | 0 08 | 0 02 | 0 02 | | 0 12 | 0 03 | 0 05 | 0 00 | 0 01 |
| PAH | Benzo(a)anthracene (H) | 0 04 | 0 01 | 0.02 | 0 00 | 0.01 | | 0 08 | 0 01 | | 0 00 | 0 01 |
| PAH | Benzo(a)pyrene (H) | 0.03 | 0 00 | 0.01 | 0 00 | | | | | | 0 00 | |
| PAH | Benzo(b)fluoranthene (H) | 0 06 | | 0.03 | | 0 01 | | | | | 0 00 | 0 02 |
| PAH | Benzo(b+k)fluoranthene (H) | 0 06 | 0 01 | 0 03 | 0 01 | 0 01 | 0.01 | 0 07 | 0 02 | 0 02 | 0 00 | 0 01 |
| PAH | Benzo(e)pyrene (H) | 0 08 | | 0 05 | | 0 01 | | 0 11 | 0 03 | | 0 00 | 0 02 |
| PAH | Benzo(g,h,i)perylene (H) | 0 05 | 0 01 | 0 03 | 0 01 | 0 01 | | 0 10 | 0 02 | | 0 00 | 0 02 |
| PAH | Benzo(k)fluoranthene (H) | 0 06 | 0 01 | 0 04 | 0 01 | 0 01 | | 0 08 | 0 01 | | 0 00 | 0 01 |
| PAH | Biphenyl (L) | | | | | | | | | | | |
| PAH | Chrysene (H) | 0 10 | 0 02 | 0 05 | 0 01 | 0 01 | | 0 11 | 0 02 | | 0 00 | 0 02 |
| PAH | Dibenz(a,h)anthracene (H) | | | | | | | | | | | |
| PAH | Fluoranthene (H) | 0 08 | 0 02 | 0 05 | 0 02 | | | 0 23 | 0 03 | | | |
| PAH | Fluorene (L) | | | | | | | | | | | |
| PAH | Indeno(1,2,3-cd)pyrene (H) | | | | | | | | | | | |
| PAH | Naphthalene (L) | 0.26 | 0 06 | | 0 05 | | 0 09 | 0 11 | 0 12 | 0 04 | 0 01 | 0 07 |
| PAH | Perylene (H) | | | | | | | 0 19 | 0 04 | | | |
| PAH | Phenanthrene (L) | 0 06 | 0 02 | 0 05 | 0 02 | 0 01 | | 0 20 | 0 03 | 0 03 | 0 00 | 0 02 |
| PAH | Pyrene (H) | 0 06 | | 0 04 | | | | 0 19 | 0 03 | | | |
| PAH | LMW PAHs | 0 13 | 0 04 | 0 08 | 0 03 | 0 03 | 0 03 | 0 17 | 0 05 | 0 07 | 0 00 | 0 02 |
| PAH | HMW PAHs | 0 10 | 0 02 | 0 05 | 0 02 | 0 02 | 0 02 | 0 22 | 0 03 | 0 04 | 0 00 | 0 02 |
| PAH | Total PAHs | 0 10 | 0 02 | 0 06 | 0 02 | 0 02 | 0 02 | 0 20 | 0 04 | 0 04 | 0 00 | 0 02 |
| PCB | Total PCBs | 0 78 | 0 22 | 2 23 | 0 07 | 0 18 | 0 05 | 0 17 | 0 22 | 0 61 | 0 20 | 0 66 |
| PST | Aldrin | | | | | | | | | | | |
| PST | Alpha-BHC | | 0 99 | | 0 55 | 1 76 | | | 1 16 | | 0 49 | 2 04 |
| PST | Alpha-chlordane | 1 04 | 0.74 | | 0 09 | 0 27 | 0 09 | 0 66 | 0 57 | | 0.61 | 0 55 |
| PST | Beta-BHC | | 0 97 | 0 67 | 0 35 | 0 56 | | 0 77 | | 1 17 | 0 19 | 0 89 |
| PST | Chlorpyrifos | | | | | | | | | | | |
| PST | CIS-Nonachlor | 0.78 | 1 48 | 4.21 | 0 15 | 1 00 | | 2.02 | 0 59 | | 0 43 | 5 58 |
| PST | Delta-BHC | | | | | | | | | | | |
| PST | Dieldrin | | 0 22 | | 0 11 | 0 71 | | | | | 0 32 | |
| PST | Endosulfan II | 0.28 | 0 27 | 1 84 | 0 12 | 0 07 | | 0 47 | 0 11 | 1 63 | 0 04 | 1 67 |
| PST | Endrin | | | | | | | | | | | |
| PST | Gamma-BHC (Lindane) | | | | | | 0 62 | | | | | |
| PST | Gamma-Chlordane | | 0 58 | | 0 04 | 1.23 | 0 12 | | 0.52 | | 1.59 | 2 19 |
| PST | Heptachlor | | | | | | | | | | | |
| PST | Heptachlor epoxide | | | | | | | 0 19 | | | | |
| PST | Hexachlorobenzene | | | | 0.25 | | 0 74 | 0 01 | 0 35 | | | |
| PST | Mirex | | | | | 0 57 | | | | | | |
| PST | Oxychlordane | | | | | | | | | | | |
| PST | Pentachloroanisole | | | | | | | | | | | |
| PST | Pentachlorobenzene | | | | | | | | | | | |
| PST | Trans-Nonachlor | | 0.66 | | 0 11 | 0.61 | 0 11 | | 0 69 | | 0 84 | 0 39 |
| PST | 1,2,3,4-Tetrachlorobenzene | | 0 48 | | 0 28 | | | 0.09 | 0 33 | | | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | | | | | | | | |
| PST | o,p'-DDD | | 0.08 | | 0 05 | 0.05 | 0.04 | 1 10 | 0 07 | 0 11 | | |
| PST | p,p'-DDD | 0 17 | | 0 73 | 0 03 | | 0 09 | | 0 11 | 0 18 | | 0 22 |
| PST | o,p'-DDE | | | | 0 04 | 0 43 | | 0 31 | 0 08 | 0.34 | | |
| PST | o,p'-DDT | | | | 0 03 | | | 0.46 | 0 16 | | | |
| PST | p,p'-DDE | 0 20 | 0 22 | | 0 09 | 0 48 | | 1 19 | 0 42 | 0 38 | | |
| PST | p,p'-DDT | | | | 0 00 | | | 0 07 | 0 02 | | | |
| lipid:toc | PERCENT LIPIDS/PERCENT TO | 13 65 | 10 10 | 6 96 | 7.21 | 4 72 | 9 54 | 38 93 | 14 44 | 5 14 | 8 70 | 4.29 |

Table A-3-1.2h (continued)

| Class | Analyte | M11-300B | M12-100B | M12-200B-AVG | M13-100B | M13-300B | M14-100B | M14-200B |
|---|---|---|---|---|---|---|---|---|
| MET | Arsenic | 0.69 | 1.00 | 1.05 | 0 43 | 0 49 | 0 80 | 0 93 |
| MET | Cadmium | 1 33 | 1.83 | 5.33 | 1.29 | 2 19 | 2 71 | 3 42 |
| MET | Chromium | 0 01 | 0.03 | 0.03 | 0 02 | 0 02 | 0 03 | 0 03 |
| MET | Copper | 0.02 | 0 10 | 0 20 | 0 18 | 0 07 | 0 15 | 0.27 |
| MET | Lead | 0 00 | 0 03 | 0 05 | 0 06 | 0 03 | 0 02 | 0 06 |
| MET | Mercury | 0 18 | 0 55 | 1 34 | 1 08 | 0 65 | 0 55 | 1 21 |
| MET | Nickel | 0 02 | 0 05 | 0 09 | 0 05 | 0.05 | 0 07 | 0 09 |
| MET | Silver | | | | | | 0.33 | |
| MET | Zinc | 0 18 | 0.28 | 0 73 | 0 76 | 0.36 | 0.76 | 0 99 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 0 06 | | 0 02 | 0.01 | 0 04 | 0.20 | 0 05 |
| PAH | 1-Methylnaphthalene (L) | 0 05 | 0 01 | 0 01 | | 0 11 | 0 19 | |
| PAH | 1-Methylphenanthrene (L) | 0 02 | 0.01 | 0 00 | 0 00 | 0 03 | 0 07 | 0 01 |
| PAH | 2,6-Dimethylnaphthalene (L) | 0 04 | 0 03 | 0 02 | 0 00 | 0 06 | 0 16 | 0.07 |
| PAH | 2-Methylnaphthalene (L) | 0 04 | 0.02 | 0 01 | | 0 09 | 0 17 | |
| PAH | Acenaphthene (L) | | | | | | 0.32 | |
| PAH | Acenaphthylene (L) | 0 05 | 0 04 | | | | 0 06 | 0 05 |
| PAH | Anthracene (L) | 0.02 | 0 01 | | 0.01 | | 0 07 | 0 02 |
| PAH | Benzo(a)anthracene (H) | 0 01 | 0 00 | 0 00 | 0 00 | 0 01 | 0.02 | 0 01 |
| PAH | Benzo(a)pyrene (H) | 0 01 | | 0 00 | | 0 01 | 0 01 | 0 01 |
| PAH | Benzo(b)fluoranthene (H) | 0 01 | 0.00 | 0.00 | 0 01 | 0 01 | 0 03 | 0 01 |
| PAH | Benzo(b+k)fluoranthene (H) | 0 01 | 0 00 | 0 00 | 0 01 | 0 01 | 0 02 | 0 01 |
| PAH | Benzo(e)pyrene (H) | 0 02 | 0 01 | 0.00 | 0 01 | 0 02 | | |
| PAH | Benzo(g,h,i)perylene (H) | 0 01 | 0.00 | 0 00 | 0 01 | 0 01 | 0.02 | 0 01 |
| PAH | Benzo(k)fluoranthene (H) | 0 01 | 0 01 | 0 00 | 0 01 | 0.01 | 0.02 | 0 01 |
| PAH | Biphenyl (L) | 0.04 | 0 04 | | | | 0.27 | 0 08 |
| PAH | Chrysene (H) | 0 01 | 0 01 | 0 00 | 0 01 | 0 01 | 0 04 | 0 01 |
| PAH | Dibenz(a,h)anthracene (H) | | | | | 0 01 | | |
| PAH | Fluoranthene (H) | 0 01 | 0 01 | | 0 01 | | 0 04 | 0 01 |
| PAH | Fluorene (L) | | | | | | 0 10 | |
| PAH | Indeno(1,2,3-cd)pyrene (H) | | | | 0 01 | 0 01 | | |
| PAH | Naphthalene (L) | 0 03 | 0 01 | 0 01 | | 0 09 | 0.15 | |
| PAH | Perylene (H) | 0 03 | | | 0 02 | | 0 05 | |
| PAH | Phenanthrene (L) | 0 01 | 0 01 | 0 00 | | 0.02 | | |
| PAH | Pyrene (H) | 0 01 | 0 01 | | 0 01 | | 0 04 | 0 01 |
| PAH | LMW PAHs | 0 03 | 0 01 | 0 01 | 0 00 | 0 03 | 0 11 | 0 03 |
| PAH | HMW PAHs | 0 02 | 0 01 | 0.00 | 0 01 | 0.02 | 0 05 | 0 02 |
| PAH | Total PAHs | 0 02 | 0 01 | 0 00 | 0 01 | 0 02 | 0 06 | 0 02 |
| PCB | Total PCBs | 0 08 | 0 14 | 0 08 | 0 44 | 0 25 | 0 65 | 0 86 |
| PST | Aldrin | 0 06 | 6 46 | 0.00 | | 7 34 | | |
| PST | Alpha-BHC | 1 28 | | 1 13 | | 1 80 | | |
| PST | Alpha-chlordane | 0.23 | | 1.94 | | 0 74 | 1 34 | 6 14 |
| PST | Beta-BHC | | | 0 36 | | 0 10 | | |
| PST | Chlorpyrifos | | | | | | | |
| PST | CIS-Nonachlor | 0 45 | | 0 86 | | 1 13 | 0 35 | 3 84 |
| PST | Delta-BHC | | | | | | | |
| PST | Dieldrin | 0 03 | 0 51 | 0 53 | | | 0 84 | |
| PST | Endosulfan II | 0.27 | 0 10 | 0 05 | | 0.15 | | 0 40 |
| PST | Endrin | | | | | | | |
| PST | Gamma-BHC (Lindane) | 0 84 | 2.85 | | | | | |
| PST | Gamma-Chlordane | 13.37 | | | | | 15 88 | |
| PST | Heptachlor | | | 0 09 | | | | |
| PST | Heptachlor epoxide | 0 87 | | | | | | |
| PST | Hexachlorobenzene | 0.37 | | 0 04 | 12 02 | | 2.56 | 10 44 |
| PST | Mirex | | | | | | | |
| PST | Oxychlordane | | | | | | 0.83 | |
| PST | Pentachloroanisole | 0.87 | 2.73 | | | | | |
| PST | Pentachlorobenzene | | 0 94 | | | | | |
| PST | Trans-Nonachlor | 0 50 | 0.32 | 1 08 | | 2.46 | 2.63 | 38 38 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0.07 | 9 39 | 1 44 | | | | |
| PST | 1,2,4,5-Tetrachlorobenzene | | | | | | | |
| PST | o,p'-DDD | 0 14 | | 0 08 | 0 19 | 0 07 | 0.06 | 0 12 |
| PST | p,p'-DDD | 0.13 | | 0 81 | | 0 11 | | |
| PST | o,p'-DDE | 0 33 | | 0 23 | | 12 85 | | |
| PST | o,p'-DDT | 0 18 | | 0 19 | 0 48 | 0 35 | 0 56 | 0 74 |
| PST | p,p'-DDE | 0.95 | 0 71 | 0.93 | | 1.19 | 0 29 | 2.65 |
| PST | p,p'-DDT | | | | | | 0 06 | |
| lipid:toc | PERCENT LIPIDS/PERCENT TO | 6 87 | 5.86 | 10 18 | 6 82 | 3 54 | 2 18 | 3 26 |

Table A-3-1.2i. Analyte average of BAF/BSAF across stations in the Portsmouth Naval Shipyard offshore study area

| | | Lobster BAF/BSAF[2] | | Mussel BAF/BSAF[3] | | Average[4] |
|---|---|---|---|---|---|---|
| Class | Analyte[1] | n | AVE | n | AVE | AVE |
| MET | Arsenic | 13 | 1.53 | 29 | 0 81 | 1 17 |
| MET | Cadmium | 13 | 0 15 | 29 | 5 09 | 2.62 |
| MET | Chromium | 3 | 0 00 | 29 | 0 03 | 0 01 |
| MET | Copper | 13 | 0 89 | 28 | 0 18 | 0.54 |
| MET | Lead | 12 | 0 01 | 29 | 0 06 | 0.04 |
| MET | Mercury | 13 | 4 74 | 29 | 1.64 | 3 19 |
| MET | Nickel | 3 | 0.02 | 29 | 0.06 | 0 04 |
| MET | Silver | 8 | 0 43 | 1 | 0.33 | 0 38 |
| MET | Zinc | 13 | 0 66 | 29 | 0.88 | 0.77 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 3 | 0 06 | 17 | 0 08 | 0 07 |
| PAH | 1-Methylnaphthalene (L) | 7 | 0 34 | 22 | 0 10 | 0.22 |
| PAH | 1-Methylphenanthrene (L) | 3 | 0 01 | 20 | 0 04 | 0 02 |
| PAH | 2,6-Dimethylnaphthalene (L) | 3 | 0 06 | 24 | 0.07 | 0 06 |
| PAH | 2-Methylnaphthalene (L) | 6 | 0.27 | 23 | 0 10 | 0 18 |
| PAH | Acenaphthene (L) | 3 | 0.05 | 6 | 0 18 | 0.12 |
| PAH | Acenaphthylene (L) | 4 | 0.01 | 20 | 0 06 | 0.04 |
| PAH | Anthracene (L) | 4 | 0.01 | 22 | 0 04 | 0 03 |
| PAH | Benzo(a)anthracene (H) | 5 | 0 01 | 24 | 0 01 | 0 01 |
| PAH | Benzo(a)pyrene (H) | 8 | 0 03 | 16 | 0 01 | 0.02 |
| PAH | Benzo(b)fluoranthene (H) | 4 | 0 02 | 18 | 0.01 | 0 02 |
| PAH | Benzo(b+k)fluoranthene (H) | 13 | 0 02 | 29 | 0 02 | 0 02 |
| PAH | Benzo(e)pyrene (H) | 2 | 0 02 | 16 | 0.03 | 0 02 |
| PAH | Benzo(g,h,i)perylene (H) | 4 | 0 02 | 25 | 0 02 | 0 02 |
| PAH | Benzo(k)fluoranthene (H) | 3 | 0 02 | 24 | 0.02 | 0.02 |
| PAH | Biphenyl (L) | 0 | | 4 | 0.11 | 0 11 |
| PAH | Chrysene (H) | 11 | 0.03 | 25 | 0 02 | 0.03 |
| PAH | Dibenz(a,h)anthracene (H) | 1 | 0 00 | 1 | 0 01 | 0 00 |
| PAH | Fluoranthene (H) | 9 | 0 03 | 18 | 0 04 | 0 03 |
| PAH | Fluorene (L) | 2 | 0.05 | 1 | 0 10 | 0 08 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 2 | 0 02 | 4 | 0 01 | 0.01 |
| PAH | Naphthalene (L) | 10 | 0.36 | 23 | 0 08 | 0 22 |
| PAH | Perylene (H) | 3 | 0 06 | 9 | 0 05 | 0 06 |
| PAH | Phenanthrene (L) | 5 | 0 05 | 18 | 0 03 | 0.04 |
| PAH | Pyrene (H) | 6 | 0 05 | 14 | 0 04 | 0 04 |
| PAH | LMW PAHs | 17 | 0 13 | 37 | 0 05 | 0 09 |
| PAH | HMW PAHs | 17 | 0 06 | 37 | 0 03 | 0 05 |
| PAH | Total PAHs | 17 | 0.08 | 37 | 0 04 | 0 06 |
| | average | | 0 067 | | 0 050 | 0 059 |
| PCB | Total PCBs | 10 | 1 03 | 17 | 0 79 | 0.91 |
| PST | Aldrin | 1 | 3 57 | 5 | 2 87 | 3 22 |
| PST | Alpha-BHC | 2 | 0 68 | 17 | 1 34 | 1 01 |
| PST | Alpha-chlordane | 3 | 0 35 | 23 | 1 55 | 0 95 |
| PST | Beta-BHC | 2 | 0 08 | 15 | 1 24 | 0 66 |
| PST | Chlorpyrifos | 1 | 5.56 | 0 | | 5 56 |
| PST | CIS-Nonachlor | 3 | 0 28 | 23 | 1 96 | 1 12 |
| PST | Delta-BHC | 1 | 2 12 | 0 | | 2 12 |
| PST | Dieldrin | 2 | 43 11 | 14 | 0 31 | 21 71 |
| PST | Endosulfan II | 4 | 0 65 | 23 | 0 36 | 0.50 |
| PST | Endrin | 1 | 3 61 | 0 | | 3 61 |
| PST | Gamma-BHC (Lindane) | 3 | 4 22 | 6 | 0 98 | 2 60 |
| PST | Gamma-Chlordane | 3 | 4 97 | 17 | 2 90 | 3.93 |
| PST | Heptachlor | 2 | 1.69 | 3 | 0 15 | 0 92 |
| PST | Heptachlor epoxide | 1 | 6 52 | 2 | 0 53 | 3 52 |
| PST | Hexachlorobenzene | 3 | 24.74 | 12 | 2 85 | 13.79 |
| PST | Mirex | 2 | 0 78 | 2 | 0.32 | 0 55 |
| PST | Oxychlordane | 2 | 20 70 | 1 | 0 83 | 10.76 |
| PST | Pentachloroanisole | 1 | 3 89 | 3 | 1 37 | 2.63 |
| PST | Pentachlorobenzene | 2 | 2.99 | 1 | 0.94 | 1.97 |
| PST | Trans-Nonachlor | 5 | 2 43 | 21 | 2 80 | 2 61 |
| PST | 1,2,3,4-Tetrachlorobenzene | 6 | 64 46 | 12 | 1 34 | 32 90 |
| PST | 1,2,4,5-Tetrachlorobenzene | 1 | 1.10 | 2 | 0 13 | 0.61 |
| PST | o,p'-DDD | 3 | 0.50 | 17 | 0 14 | 0 32 |
| PST | p,p'-DDD | 2 | 1.08 | 15 | 0 71 | 0 89 |
| PST | o,p'-DDE | 3 | 0 62 | 13 | 1.28 | 0 95 |
| PST | o,p'-DDT | 3 | 0 20 | 15 | 0.27 | 0.23 |
| PST | p,p'-DDE | 11 | 2 15 | 19 | 0 71 | 1.43 |
| PST | p,p'-DDT | 3 | 2 52 | 6 | 0 03 | 1.27 |
| | average | | 7 34 | | 1.12 | 4 37 |
| lipid toc | PERCENT LIPIDS/PERCENT TOC | 13 | 1 68 | 29 | 8 48 | 5.08 |

units: unitless

1 - Analytes reported in TtNUS (2000b)

2- See Table A-3-1.2e for sample-specific BAF/BSAF values

3- See Table A-3-1.2h for sample-specific BAF/BSAF values

4- Average of lobster and mussel BAF/BSAF values

Table A-3-1 2j Predicted sediment concentrations from average analyte BAF/BSAF at un-sampled stations

| Class | Analyte | M11-100B[1] | M11-200B[1] |
|---|---|---|---|
| MET | Arsenic | 8 39 | 8 70 |
| MET | Cadmium | 0 29 | 0 34 |
| MET | Chromium | 61 81 | 88 85 |
| MET | Copper | 45 87 | 48 08 |
| MET | Lead | 128 98 | 377 60 |
| MET | Mercury | 0 10 | 0 20 |
| MET | Nickel | 30 25 | 29 41 |
| MET | Silver | 0 15 | 0 09 |
| MET | Zinc | 133 39 | 132 82 |
| PAH | 1,6,7-Trimethylnaphthalene (L) | 15 62 | 13 39 |
| PAH | 1-Methylnaphthalene (L) | 14 95 | 18 77 |
| PAH | 1-Methylphenanthrene (L) | 61 11 | 45 77 |
| PAH | 2,6-Dimethylnaphthalene (L) | 14 22 | 15 39 |
| PAH | 2-Methylnaphthalene (L) | 23 33 | 27 06 |
| PAH | Acenaphthene (L) | 9 37 | 15 72 |
| PAH | Acenaphthylene (L) | 51 51 | 56 52 |
| PAH | Anthracene (L) | 162 13 | 195 39 |
| PAH | Benzo(a)anthracene (H) | 193 32 | 313 07 |
| PAH | Benzo(a)pyrene (H) | 289 62 | 367 55 |
| PAH | Benzo(b)fluoranthene (H) | 345 02 | 405 93 |
| PAH | Benzo(b+k)fluoranthene (H) | 386 27 | 477 08 |
| PAH | Benzo(e)pyrene (H) | 133 16 | 164 78 |
| PAH | Benzo(g,h,i)perylene (H) | 142 49 | 154 16 |
| PAH | Benzo(k)fluoranthene (H) | 76 14 | 112.97 |
| PAH | Biphenyl (L) | 8 09 | 10 65 |
| PAH | Chrysene (H) | 219 50 | 299 66 |
| PAH | Dibenz(a,h)anthracene (H) | 59 57 | 72.50 |
| PAH | Fluoranthene (H) | 251 19 | 466 18 |
| PAH | Fluorene (L) | 19 14 | 31 89 |
| PAH | Indeno(1,2,3-cd)pyrene (H) | 282 83 | 293 75 |
| PAH | Naphthalene (L) | 41 00 | 56 80 |
| PAH | Perylene (H) | 38 10 | 38 82 |
| PAH | Phenanthrene (L) | 153 94 | 291 42 |
| PAH | Pyrene (H) | 221 72 | 349 21 |
| PAH | LMW PAHs | 569 48 | 759 74 |
| PAH | HMW PAHs | 1377 38 | 1977 56 |
| PAH | Total PAHs | 2032 75 | 2833 64 |
| PCB | Total PCBs | 66 80 | 46 99 |
| PST | Aldrin | 0 04 | 0 04 |
| PST | Alpha-BHC | 0 15 | 0 14 |
| PST | Alpha-chlordane | 0 25 | 0 23 |
| PST | Beta-BHC | 0 01 | 0 53 |
| PST | Chlorpyrifos | | |
| PST | CIS-Nonachlor | 0 34 | 0 28 |
| PST | Delta-BHC | | |
| PST | Dieldrin | 0 47 | 0 76 |
| PST | Endosulfan II | 0.13 | 0.46 |
| PST | Endrin | | |
| PST | Gamma-BHC (Lindane) | 0 51 | 0 18 |
| PST | Gamma-Chlordane | 0 14 | 0.13 |
| PST | Heptachlor | 0 24 | 0 17 |
| PST | Heptachlor epoxide | 0 06 | 0.18 |
| PST | Hexachlorobenzene | 0 05 | 0.04 |
| PST | Mirex | 0 12 | 0.16 |
| PST | Oxychlordane | 0 02 | 0.03 |
| PST | Pentachloroanisole | 0 24 | 0.20 |
| PST | Pentachlorobenzene | 0 02 | 0 36 |
| PST | Trans-Nonachlor | 0 15 | 0.13 |
| PST | 1,2,3,4-Tetrachlorobenzene | 0 13 | 0 15 |
| PST | 1,2,4,5-Tetrachlorobenzene | 2.26 | 0.16 |
| PST | o,p'-DDD | 3.38 | 1.01 |
| PST | p,p'-DDD | 0 23 | 0.17 |
| PST | o,p'-DDE | 0 19 | 0 12 |
| PST | o,p'-DDT | 1 87 | 1.82 |
| PST | p,p'-DDE | 1 88 | 1.83 |
| PST | p,p'-DDT | 6.94 | 3.91 |

units metals (µg/g dry wt) organics (ng/g dry wt)

1 - sediment concentration predicted as normalized tissue concentration (Table a-3-1 2f)/average BAF/BSAF value (Table A-3-1 2j)* Avg TOC (organics only, Table A3-1-2a)

Table A-3-1.3a. PRG Hazard Quotients[1] for CoCs in sediments collected during the Portsmouth Naval Shipyard EERA investigation.

| Class | Analyte[3] | PRG | BC-18 | BC-53 | BC-54 | CC-3 | CC-4 | CC-5 | CC-51 | CC-6 | CC-7 | CC-8 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486 | 0.07 | 0 12 | 0 06 | 0 03 | 0 08 | 0.09 | 0 12 | 0.09 | 0.11 | 0 13 |
| MET | Nickel | 124 | 0 16 | 0 28 | 0.28 | 0 14 | 0 30 | 0 22 | 0.35 | 0 32 | 0.26 | 0 28 |
| PAH | Acenaphthylene (L) | 210 | | 0 05 | 0.03 | | | | 0 05 | | | |
| PAH | Anthracene (L) | 1236 | 0 96 | 0.04 | 0 05 | 0.14 | 0 06 | 0 05 | 0 02 | 0 03 | 0 07 | 0 07 |
| PAH | Fluorene (L) | 500 | 1.35 | 0.04 | 0 03 | 0 09 | 0 06 | 0.05 | 0.02 | 0 03 | 0 05 | 0.06 |
| PAH | HMW PAHs | 13057 | 1.20 | 0 18 | 0.37 | 0 30 | 0.24 | 0 21 | 0 10 | 0 11 | 0.31 | 0.27 |
| PST | Endosulfan II | 3.95 | | | | | | | | | | |
| PST | Trans-Nonachlor | 3.99 | | | | | | | | | | |
| PST | p,p'-DDT | 66.4 | 0.26 | | | 0 43 | 0.16 | 0 43 | | 0 07 | 0.29 | 0.16 |
| | SUM PRG-HQ[4] | | 2.80 | 0.52 | 0 46 | 0.83 | 0 66 | 0.85 | 0 56 | 0 55 | 0.78 | 0.70 |
| | MAX PRG-HQ | | 1.35 | 0.28 | 0 37 | 0 43 | 0 30 | 0.43 | 0 35 | 0.32 | 0.31 | 0 28 |
| | MAX PRG-HQ | | 1.35 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | MAX CoC | | Fluorene (L) | NA | NA | NA | NA | NA | NA | NA | NA | NA |

1- Aquatic PRG-HQ = sediment CoC concentration (Table A-2-2 2)/Aquatic pathway-specific PRG (Table 2 2-6), unitless.
2- Station estimate based on sediment CoC concentration predicted from average BAF/BSAF ratio for analyte in mussel tissue.
3- PRG concentration units: metals- mg/kg, organics- ug/kg dry wt
4- Sum PRG-HQ = sum of analyte HQs (excluding LMW, HMW, and Total PAH sums)

Table A-3-1.3a. (continued)

| Class | Analyte[3] | DD-10 | DD-12 | DD-12-5 | DD-13 | DD-17 | JC-19 | JC-52 | PR-14 | SP-50 | SP-9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 0 28 | 0 28 | | 0 06 | 0 05 | 0 06 | 0 06 | 0 01 | 0 27 | 0 04 |
| MET | Nickel | 0.35 | 0.25 | | 0.16 | 0.16 | 0.22 | 0 22 | 0 09 | 0 40 | 0 15 |
| PAH | Acenaphthylene (L) | 0.67 | | | | | | 0 04 | | 0 11 | |
| PAH | Anthracene (L) | 0.28 | 0 35 | 0.44 | 0 18 | 0 25 | 0.09 | 0 03 | 0.12 | 0 06 | 0 13 |
| PAH | Fluorene (L) | 0 16 | 0 23 | 0 30 | 0.13 | 0 12 | 0 06 | 0 03 | 0 05 | 0.05 | 0.09 |
| PAH | HMW PAHs | 0 83 | 0.66 | 1.37 | 0.43 | 0.62 | 0 33 | 0 14 | 0 22 | 0.27 | 0 28 |
| PST | Endosulfan II | | | | | | | | | | |
| PST | Trans-Nonachlor | | | | | | | | | | |
| PST | p,p'-DDT | 0.46 | 0.95 | 0 02 | 0 01 | 0.12 | 0.65 | | 0.16 | | 0 93 |
| | SUM PRG-HQ[4] | 2 19 | 2 05 | 0 76 | 0.54 | 0 71 | 1.08 | 0 38 | 0 43 | 0.89 | 1.34 |
| | MAX PRG-HQ | 0 83 | 0.95 | 1.37 | 0.43 | 0 62 | 0.65 | 0 22 | 0 22 | 0.40 | 0.93 |
| | MAX PRG-HQ | <1 | <1 | 1.37 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| | MAX CoC | NA | NA | HMW PAHs | NA | NA | NA | NA | NA | NA | NA |

Table A-3-1.3b. PRG Hazard Quotients[1] for CoCs in sediments collected in Round 1 of the Portsmouth Naval Shipyard offshore study area

| Class | Analyte[3] | PRG | M01-199A | M01-299A | M01-399A-AVG | M02-199A | M02-299A | M02-399A | M03-199A | M03-299A | M03-399A | M04-199A | M04-299A | M04-399A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486 | 0.10 | 0 06 | 0 09 | 0.06 | 0 06 | 0 09 | 0 42 | 7 65 | 0 26 | 1.16 | 0 05 | 0 29 |
| MET | Nickel | 124 | 0 19 | 0 17 | 0 22 | 0 22 | 0 25 | 0 26 | 0 37 | 0 69 | 0 24 | 0 49 | 0 16 | 0 31 |
| PAH | Acenaphthylene (L) | 210 | 0.34 | 0 90 | 0 79 | 0 31 | 0.29 | 0 32 | 0 53 | 0 37 | 0.30 | 0.38 | 0 25 | 0.12 |
| PAH | Anthracene (L) | 1236 | 0.08 | 0 62 | 0.41 | 0.13 | 0 10 | 0 14 | 0.23 | 0.29 | 0.12 | 0.16 | 0 10 | 0.05 |
| PAH | Fluorene (L) | 500 | 0.05 | 0.40 | 0 39 | 0 07 | 0 07 | 0 09 | 0 11 | 0.25 | 0 07 | 0 08 | 0.03 | 0 02 |
| PAH | HMW PAHs | 13057 | 0.07 | 0.63 | 0.56 | 0 14 | 0 13 | 0.16 | 0.30 | 0 34 | 0 18 | 0.23 | 0 09 | 0 15 |
| PST | Endosulfan II | 3.95 | 0 48 | 0.01 | 1 77 | 0.35 | 0.33 | 0 28 | 0.47 | 0 48 | 0.43 | 0.33 | 0 02 | 0 10 |
| PST | Trans-Nonachlor | 3.99 | 0.15 | 0 40 | 1.45 | 0 07 | 0.05 | 0.40 | 0.10 | 0.03 | 0.06 | 0.03 | 0 01 | 0.02 |
| PST | p,p'-DDT | 66.4 | 0.69 | 1.64 | 16.77 | 0 03 | 0 36 | 0 07 | 0 07 | 0 10 | 0.03 | 0.07 | 0.01 | 1.34 |
| | SUM PRG-HQ[4] | | 2.08 | 4 21 | 21.89 | 1.25 | 1 50 | 1 65 | 2.29 | 9.86 | 1 49 | 2.70 | 0.62 | 2 26 |
| | MAX PRG-HQ | | <1 | 1.64 | 16 77 | <1 | <1 | <1 | <1 | 7.65 | <1 | 1.16 | | 1.34 |
| | MAX CoC | | NA | p,p'-DDT | p p'-DDT | NA | NA | NA | NA | Copper | NA | Copper | NA | p,p' DDT |

1- Aquatic PRG-HQ = sediment CoC concentration (Table A-2-2 2)/Aquatic pathway-specific PRG (Table 2.2-6), unitless.
2- Not calculated for Round One data
3- PRG concentration units. metals- mg/kg, organics- ug/kg dry wt
4- Sum PRG-HQ = sum of analyte HQs (excluding LMW, HMW, and Total PAH sums).

Table A-3-1.3b. (continued)

| Class | Analyte[3] | PRG | M05-199A-AVG | M05-299A | M05-399A | M06-199A | M06-299A | M06-399A | M07-199A | M07-299A | M07-399A | M08-199A | M08-299A | M08-399A-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486 | 0.22 | 0.07 | 0 05 | 0 05 | 0 05 | 0 02 | 0 04 | 0 07 | 0 09 | 0 76 | 0 20 | 0 58 |
| MET | Nickel | 124 | 0 26 | 0 23 | 0 24 | 0.17 | 0 19 | 0 21 | 0.21 | 0 25 | 0.21 | 0 67 | 0 29 | 1.40 |
| PAH | Acenaphthylene (L) | 210 | 0.41 | 0 30 | 0.26 | 0 34 | 0.43 | 0 05 | 0 10 | 0 28 | 0 55 | 0.26 | 0 51 | 0.38 |
| PAH | Anthracene (L) | 1236 | 0 24 | 0.10 | 0 10 | 0 10 | 0.21 | 0 02 | 0.03 | 0 10 | 0.23 | 0.19 | 0 23 | 0.23 |
| PAH | Fluorene (L) | 500 | 0.13 | 0.04 | 0 05 | 0.05 | 0.12 | 0 01 | 0.02 | 0 05 | 0.15 | 0.14 | 0 15 | 0.12 |
| PAH | HPW PAHs | 13057 | 0.38 | 0.13 | 0 12 | 0 12 | 0 23 | 0 03 | 0.05 | 0 12 | 0.31 | 0.24 | 0 35 | 0.29 |
| PST | Endosulfan II | 3 95 | 0.02 | 0.16 | 0 01 | 0 01 | 0 03 | 0 01 | 0 11 | 0 03 | 0.02 | 0.01 | 0.02 | 1.06 |
| PST | Trans-Nonachlor | 3.99 | 0.07 | 0.06 | 0 01 | 0.01 | 0 03 | 0 02 | 0.03 | 0 05 | 0 07 | 0.35 | 0.21 | 1 05 |
| PST | p,p'-DDT | 66 4 | 0.05 | 0.01 | 0.02 | 0.01 | 0 02 | 0 00 | 0 02 | 0.01 | 0.09 | 0 63 | 0.26 | 1 99 |
| | SUM PRG-HQ[4] | | 1.40 | 0.97 | 0.74 | 0.73 | 1.07 | 0 34 | 0 57 | 0.84 | 1 40 | 3.02 | 1 86 | 6.82 |
| | MAX PRG-HQ | | <1 | | | | <1 | | | | <1 | <1 | <1 | 1.99 |
| | MAX CoC | | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | NA | p,p'-DDT |

Table A-3-1.3b. (continued)

| Class | Analyte[3] | PRG | M08-499A | M09-199A | M09-299A | M09-399A | M09-499A | M10-199A-AVG | M10-299A | M10-399A | M-11-199B[2] | M-11-299B[2] | M11-399A | M12-199A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486 | | 0 20 | 0.24 | 0.22 | | 0 04 | 0.03 | 0 22 | | | 0 29 | 0.33 |
| MET | Nickel | 124 | | 0.92 | 0.33 | 0 34 | | 0 34 | 0.17 | 0 22 | | | 0 55 | 0.41 |
| PAH | Acenaphthylene (L) | 210 | | 0.03 | 0.07 | 0.32 | | 0.02 | 0 75 | 1 03 | | | 0.04 | 1.03 |
| PAH | Anthracene (L) | 1236 | | 0 02 | 0.07 | 0 20 | | 0 01 | 0.65 | 0.48 | | | 0 01 | 2.33 |
| PAH | Fluorene (L) | 500 | | 0 02 | 0.03 | 0.16 | | 0 01 | 0 33 | 0 13 | | | 0 01 | 2.79 |
| PAH | HMW PAHs | 13057 | | 0.03 | 0 12 | 0.23 | | 0 02 | 0.60 | 0 88 | | | 0 02 | 3 03 |
| PST | Endosulfan II | 3.95 | | 0.01 | 0.01 | 0 02 | | 0 01 | 0 06 | 0.02 | | | 0 06 | 0 25 |
| PST | Trans-Nonachlor | 3 99 | | 0.09 | 0 13 | 0.17 | | 5 26 | 0 09 | 0 05 | | | 0 05 | 0 02 |
| PST | p,p'-DDT | 66.4 | | 0.04 | 0.02 | 0.04 | | 0 72 | 0 02 | 0.03 | | | 0.03 | 0.05 |
| | SUM PRG-HQ[4] | | | 1.32 | 0.90 | 1.47 | | 6.42 | 2.10 | 2.18 | | | 1.02 | 7.21 |
| | MAX PRG-HQ | | <1 | <1 | | <1 | <1 | 5.26 | <1 | 1.03 | <1 | <1 | <1 | 3 03 |
| | MAX CoC | | NA | NA | NA | NA | NA | Trans-Nonachlor | NA | Acenaphthylene (L) | NA | NA | NA | HMW PAHs |

Table A-3-1.3b. (continued)

| Class | Analyte[3] | PRG | M12-299A-AVG | M12-399A-AVG | M13-199A | M13-299A | M13-399A | M14-199A | M14-299A | M14-399A |
|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486 | 0.06 | 0.10 | 0 10 | 0 09 | 0 13 | 0.06 | 0.05 | 0 08 |
| MET | Nickel | 124 | 0.20 | 0.21 | 0.25 | 0 30 | 0.25 | 0 21 | 0.16 | 0 22 |
| PAH | Acenaphthylene (L) | 210 | 0.33 | 0.35 | 0.41 | 0 59 | 0 52 | 0.20 | 0 57 | 0.37 |
| PAH | Anthracene (L) | 1236 | 0.29 | 0.32 | 0 37 | 0 37 | 0 28 | 0.07 | 0 25 | 0.12 |
| PAH | Fluorene (L) | 500 | 0.29 | 0.28 | 0.32 | 0.17 | 0 19 | 0.05 | 0 15 | 0.06 |
| PAH | HMW PAHs | 13057 | 0.41 | 0 47 | 0.47 | 0.40 | 0 35 | 0 12 | 0.34 | 0.16 |
| PST | Endosulfan II | 3.95 | 0.21 | 0.67 | 0 43 | 0.56 | 0.21 | 0.15 | 0.24 | 0.14 |
| PST | Trans-Nonachlor | 3.99 | 0.04 | 0 03 | 0.04 | 0 04 | 0 02 | 0.06 | 0.02 | 0 03 |
| PST | p,p'-DDT | 66 4 | 0.01 | 0 00 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.02 |
| | SUM PRG-HQ[4] | | 1.42 | 1.96 | 1 92 | 2 13 | 1.61 | 0.81 | 1 45 | 1.02 |
| | MAX PRG-HQ | | <1 | <1 | <1 | <1 | <1 | | <1 | <1 |
| | MAX CoC | | NA | NA | NA | NA | NA | NA | NA | NA |

Table A-3-1.3c. PRG Hazard Quotients[1] for CoCs in sediments collected during Round 2 of the Portsmouth Naval Shipyard offshore study area investigation.

| Class | Analyte[3] | PRG | M01-100B | M01-200B | M01-300B-AVG | M02-100B | M02-200B | M02-300B | M03-100B | M03-200B | M03-300B | M04-100B | M04-200B | M04-300B | M05-100B-AVG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486.1 | 0.09 | 0.09 | 0 36 | 0 13 | 0.10 | 0 09 | 0 38 | 2 24 | 0.22 | 3 66 | 0.12 | 0.81 | 0 13 |
| MET | Nickel | 124 4 | 0.24 | 0 20 | 0.24 | 0 21 | 0.28 | 0 22 | 0 36 | 0.63 | 0 21 | 1.55 | 0 19 | 1.27 | 0 27 |
| PAH | Acenaphthylene (L) | 210.1 | 1 40 | 0.76 | 1.77 | 0 38 | 0 36 | 0 33 | 0 68 | 0 37 | 0 42 | 1.64 | 0 29 | 0 04 | 0 47 |
| PAH | Anthracene (L) | 1236 1 | 0.22 | 0.50 | 1.27 | 0 15 | 0.15 | 0 13 | 0 50 | 0 23 | 0 20 | 0 58 | 0 13 | 0 02 | 0 28 |
| PAH | Fluorene (L) | 499 8 | 0 37 | 0 36 | 1 83 | 0 08 | 0 07 | 0 08 | 0 35 | 0.16 | 0 15 | 0 31 | 0 07 | 0.01 | 0 17 |
| PAH | HMW PAHs | 13057.1 | 0.40 | 0 54 | 1.09 | 0 15 | 0.16 | 0 15 | 0 49 | 0 27 | 0 23 | 0 54 | 0 13 | 0.02 | 0 29 |
| PST | Endosulfan II | 3 95 | 1 11 | 0.81 | 0 52 | 0 30 | 0 30 | 0 41 | 0 53 | 0 22 | 0.41 | 0 43 | 0 17 | 0 04 | 0 41 |
| PST | Trans-Nonachlor | 3.99 | 0.28 | 1.38 | 0 18 | 0.07 | 0 07 | 0 16 | 0.10 | 0 05 | 0 02 | 0.12 | 0 01 | 0 07 | 0 09 |
| PST | p,p'-DDT | 66.4 | 0 04 | 2 86 | 0.53 | 0 01 | 0 15 | 0.03 | 0 09 | 0.02 | 0 02 | 0.03 | 0 01 | 2 62 | 0 02 |
| | SUM PRG-HQ[4] | | 3 76 | 6.96 | 6 71 | 1 34 | 1 50 | 1.44 | 3 00 | 3.92 | 1.64 | 8.32 | 1.00 | 4 88 | 1.83 |
| | MAX PRG-HQ | | 1 40 | 2.86 | 1 83 | <1 | <1 | <1 | <1 | 2.24 | <1 | 3 66 | <1 | 2 62 | <1 |
| | MAX CoC | | Acenaphthylene (L) | p,p'-DDT | Fluorene (L) | NA | NA | NA | NA | Copper | NA | Copper | NA | p,p'-DDT | NA |

1- Aquatic PRG-HQ = sediment CoC concentration (Table A-2-2.2)/Aquatic pathway-specific PRG (Table 2 2-6), unitless

2- Station estimate based on sediment CoC concentration predicted from average BAF/BSAF ratio for analyte in mussel tissue

3- PRG concentration units: metals- mg/kg, organics- ug/kg dry wt

4- Sum PRG-HQ = sum of analyte HQs (excluding LMW, HMW, and Total PAH sums)

Table A-3-1.3c. (continued)

| Class | Analyte[3] | PRG | M05-200B | M05-300B | M06-100B | M06-200B | M06-300B | M07-100B | M07-200B | M07-300B | M08-100B | M08-200B | M08-300B-AVG | M08-400B | M09-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486.1 | 0.08 | 0 05 | 0 03 | 0 06 | 0 03 | 0.10 | 0 07 | 0 05 | 0 94 | 0.16 | 1 55 | 0.32 | 1 05 |
| MET | Nickel | 124.4 | 0 23 | 0 22 | 0 17 | 0.22 | 0 30 | 0 21 | 0 26 | 0.20 | 0 75 | 0 25 | 1 05 | 0 43 | 1.29 |
| PAH | Acenaphthylene (L) | 210 1 | 0.38 | 0 27 | 0 13 | 0 46 | 0 02 | 0 15 | 0 35 | 0 27 | 0 32 | 0.42 | 0.29 | 0 43 | 0 03 |
| PAH | Anthracene (L) | 1236.1 | 0.22 | 0 11 | 0.07 | 0 15 | 0.02 | 0 07 | 0 14 | 0 05 | 0.18 | 0 22 | 0 19 | 0 24 | 0 01 |
| PAH | Fluorene (L) | 499.8 | 0.18 | 0.07 | 0 07 | 0 10 | 0 01 | 0.05 | 0 08 | 0 04 | 0 11 | 0 15 | 0 05 | 0.16 | 0 00 |
| PAH | HMW PAHs | 13057.1 | 0.21 | 0.13 | 0 18 | 0 20 | 0.02 | 0 10 | 0.15 | 0 05 | 0.19 | 0.18 | 0 20 | 0 27 | 0.00 |
| PST | Endosulfan II | 3.95 | 0.30 | 0 22 | 0.19 | 0 25 | 0.04 | 0.16 | 0 21 | 0 05 | 0 33 | 0.48 | 0 37 | 0.25 | 0 03 |
| PST | Trans-Nonachlor | 3.99 | 0 07 | 0 02 | 0 01 | 0 06 | 0.00 | 0 04 | 0 05 | 0 01 | 0 53 | 0.08 | 0.36 | 0.19 | 0.01 |
| PST | p,p'-DDT | 66.4 | 0.04 | 0.01 | 0 01 | 0.02 | 0 01 | 0 02 | 0.01 | 0.00 | 4.29 | 0.03 | 1.39 | 0 17 | 0.01 |
| | SUM PRG-HQ[4] | | 1.50 | 0 98 | 0 67 | 1 32 | 0.43 | 0 78 | 1.17 | 0 67 | 7.44 | 1.79 | 5.25 | 2 19 | 2 42 |
| | MAX PRG-HQ | | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 | 4.29 | <1 | 1.55 | <1 | 1.29 |
| | MAX CoC | | NA | NA | NA | NA | NA | NA | NA | NA | p,p'-DDT | NA | Copper | NA | Nickel |

Table A-3-1.3c. (continued)

| Class | Analyte[3] | PRG | M09-200B | M09-300B | M09-400B | M10-100B-AVG | M10-200B | M10-300B | M11-100B[2] | M-11-200B[2] | M11-300B | M12-100B | M12-200B-AVG | M12-300B-AVG | M13-100B |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486.1 | 0 43 | 0 15 | 0 31 | 0 06 | 0 07 | 0 06 | 0.09 | 0 14 | 1.11 | 0.18 | 0 08 | 0.20 | 0 11 |
| MET | Nickel | 124 4 | 0.49 | 0 31 | 0.40 | 0.23 | 0.16 | 0 23 | 0 24 | 0.33 | 0 61 | 0 32 | 0.18 | 0 30 | 0 26 |
| PAH | Acenaphthylene (L) | 210.1 | 0 04 | 0.29 | 0.20 | 0 12 | 1 13 | 0 44 | 0 25 | 0 20 | 0 23 | 0 55 | 0 44 | 0 38 | 1 01 |
| PAH | Anthracene (L) | 1236.1 | 0 06 | 0 17 | 0 20 | 0 09 | 1 33 | 0 91 | 0.13 | 0.14 | 0 17 | 0.99 | 0 87 | 0.34 | 1.84 |
| PAH | Fluorene (L) | 499.8 | 0.03 | 0 14 | 0 13 | 0 05 | 0 77 | 0 16 | 0 04 | 0.10 | 0 11 | 1 36 | 1.30 | 0 19 | 7 51 |
| PAH | HMW PAHs | 13057.1 | 0 05 | 0 20 | 0 20 | 0 08 | 0 74 | 0 19 | 0 11 | 0 14 | 0.15 | 1 02 | 0 94 | 0 40 | 1.27 |
| PST | Endosulfan II | 3 95 | 0.19 | 0.16 | 0 18 | 0 06 | 0 30 | 0 14 | 0.03 | 0 07 | 0 21 | 0.76 | 0.66 | 0 21 | 0 11 |
| PST | Trans-Nonachlor | 3.99 | 0.04 | 0.13 | 0.06 | 1 85 | 0.06 | 0 13 | 0 04 | 0 08 | 0 10 | 0.13 | 0 05 | 0 07 | 0 02 |
| PST | p,p'-DDT | 66.4 | 0 04 | 0.02 | 0.05 | 0.09 | 0 01 | 0 03 | 0 10 | 0 06 | 0.17 | 0 04 | 0 04 | 0.01 | 0 02 |
| | SUM PRG-HQ[4] | | 1.33 | 1.37 | 1 53 | 2 57 | 3 84 | 2 12 | 0 92 | 1.11 | 2.69 | 4 33 | 3.62 | 1.69 | 10 88 |
| | MAX PRG-HQ | | <1 | <1 | <1 | 1 85 | 1.33 | <1 | <1 | <1 | 1.11 | 1.36 | 1.30 | <1 | 7 51 |
| | MAX CoC | | NA | NA | NA | Trans-Nonachlor | Anthracene (L) | NA | NA | NA | Copper | Fluorene (L) | Fluorene (L) | NA | Fluorene (L) |

Table A-3-1.3c. (continued)

| Class | Analyte[3] | PRG | M13-200B | M13-300B | M14-100B | M14-200B | M14-300B |
|---|---|---|---|---|---|---|---|
| MET | Copper | 486.1 | 0.11 | 0.24 | 0 12 | 0.06 | 0 06 |
| MET | Nickel | 124.4 | 0.25 | 0 28 | 0.24 | 0 16 | 0 22 |
| PAH | Acenaphthylene (L) | 210.1 | 0.89 | 0 57 | 0 55 | 0.49 | 0 82 |
| PAH | Anthracene (L) | 1236.1 | 0.51 | 0 61 | 0.16 | 0.33 | 0 32 |
| PAH | Fluorene (L) | 499.8 | 0.31 | 0 57 | 0 09 | 0 21 | 0.20 |
| PAH | HMW PAHs | 13057.1 | 0 45 | 0 50 | 0 17 | 0.40 | 0 36 |
| PST | Endosulfan II | 3.95 | 0 03 | 0.28 | 0.10 | 0 33 | 0 06 |
| PST | Trans-Nonachlor | 3.99 | 0.03 | 0 06 | 0 07 | 0 01 | 0 01 |
| PST | p,p'-DDT | 66.4 | 0 01 | 0.01 | 0.01 | 0.01 | 0.01 |
| | SUM PRG-HQ[4] | | 2.13 | 2.62 | 1.34 | 1.60 | 1.70 |
| | MAX PRG-HQ | | <1 | <1 | <1 | <1 | <1 |
| | MAX CoC | | NA | NA | NA | NA | NA |

Table A-4. Recommended Acute:chronic ratios to determine chronic values for chemicals that presently lack WQC-SC values for WQSV derivation for PRG development.

| Chemical | WQC SA | Proposed ACR Ratio | WQSV | Rationale |
|---|---|---|---|---|
| Silver (Proposed) | | | 0.79 | WQC-SC presented in the draft revised silver criteria (0.92; EPA, 1987), and adjusted to represent dissolved metal (f= 0.85, EPA, 1999). |
| Naphthalene | 2350 | 3.71 | 633 | Saltwater chronic data not available. Use freshwater ACR (EPA, 1980) because WQC-FA and WQC-SA are equivalent (i.e., data suggest that freshwater and saltwater responses for sensitive species are the same. |
| Aldrin | 1.3 | 8 | 0.16 | No chronic data available for either freshwater or saltwater sensitive species. ACR ratios available for insensitive species are not applicable because the corresponding chronic effect values were higher than the WQC-SA. Hence, default (ACR=8; Shepard, 1998) ACR ratio is recommended. |
| BHC (gamma, beta, delta and alpha isomers) | 0.16 | 1 | 0.16 | No chronic data available for saltwater sensitive species. Insensitive chronic ACR data are low (and thus ACR values for sensitive species expected to approach unity). Recommend ACR =1. Resulting WQSV value is the same as the WQC-SA. |
| DDD | 3.6 | 4.3 | 0.84 | Recommend DDT ACR=4.3 based on saltwater sensitive species (mysid chronic data from an early life stage test; (SAIC, 1991a,b). Freshwater ACR data available but not appropriate given difference in acute responses between freshwater and saltwater sensitive species (EPA, 1980b). Saltwater Acute value (3.6 µg/L) based on Lowest observed Effect level (Buchman, 1999) |
| DDE | 14 | 4.3 | 3.26 | Recommend DDT ACR=4.3 based on saltwater sensitive species (mysid chronic data from an early life stage test; SAIC, 1991a,b). Freshwater ACR data available but not appropriate given difference in acute responses between freshwater and saltwater sensitive species. Saltwater Acute Value (14 µg/L) based on Lowest observed Effect level (Buchman, 1999) |

Units: WQC SA, WQSV = µg/L, ACR ratio = unitless

Table A-5. Comparison of PNS baseline Preliminary Remediation Goals (PRGs) with literature-based sediment benchmarks.

| Class | Analyte | B-PRG[1] (HQ=1) | R-PRG[2] (Site-Specific) | Available Benchmarks[3] ER-L | ER-M | TEL | PEL | AET-L | AET-H | SQAL |
|---|---|---|---|---|---|---|---|---|---|---|
| MET | Copper | 486 | 486 | 34 | 270 | 18.7 | 108 | 390 | 1300 | |
| MET | Nickel | 124 | 161 | 20.9 | 51.6 | 15.9 | 42.8 | | | |
| PAH | Acenaphthylene (L) | 210 | 210 | 44 | 640 | 5.9 | 128 | 1300 | 1300 | |
| PAH | Anthracene (L) | 1236 | 1236 | 85.3 | 1100 | 46.9 | 245 | 960 | 13000 | |
| PAH | Fluorene (L) | 500 | 500 | 19 | 540 | 21.2 | 144 | 540 | 3600 | 540 |
| PAH | HMW PAHs | 13057 | 13057 | 1700 | 9600 | 655 | 6676 | 17000 | 69000 | |
| PST | Endosulfan II | 3.95 | NR | | | | | | | 14 |
| PST | Trans-Nonachlor | 3.99 | NR | | | 2.3 | 4.8 | | | |
| PST | p,p'-DDT | 66.4 | NR | 1.6 | 27 | 1.2 | 4.8 | 34 | 34 | |

Units: Metals= ug/g; organics= ng/g;

1- Baseline Preliminary Remediation Goal; See Table 2.2-6.

2- Recommended Preliminary Remediation Goal; See Table 3.3-2.

3- Available benchmarks:

ER-L/M = NOAA Effects Range-Low/Median (Long et al. 1995 in U.S. EPA 1997).

TEL/PEL = Threshold Effects Levels/Probable Effects Levels (FDEP 1994 in U.S. EPA 1997).

AET-L/H = Apparent Effects Threshold Low/High; normalized to dry weight (U.S. EPA 1997).

SQAL = EPA Sediment Quality Advisory Levels, based on 1% TOC (U.S. EPA 1997).

# APPENDIX B

## Derivation of Upper Limit 95th Percentiles for the Normal and Lognormal Distributions

The Shapiro-Wilks statistic (W) is conducted to assess whether the data have a normal distribution.. If normality can not be verified, then it is assumed that the data are log-normally distributed.

The mean and variance of a population from a random sample of n identically independent and normally distributed observations are estimated as:

$$\hat{\mu} = \bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i , \qquad \hat{\sigma}^2 = s^2 = \frac{1}{n-1}\sum_{i=1}^{n}( x_i - \hat{\mu} )^2$$

For a ***normal distribution***, an 95th percentile upper limit (95% UL) for the mean is computed as follows:

$$UL_{95} = \bar{x} + z_{.95} * s$$

Where x is the sample arithmetic mean, s is the standard deviation, and Z.95 is the 95th percentile of the standard normal distribution.

If the distribution is ***log-normal*** then the log-transformed sample data follow a normal distribution. Then a 95th percentile upper limit for the mean is computed as follows:

$$UL_{95} = \exp( \hat{\mu} + Z_{.95} * \hat{\sigma} )$$

Where μ is the mean of the log-transformed data, sigma is the standard deviation of the log-transformed data, and Z.95 is the 95th percentile of the standard normal distribution.

# ATTACHMENT 2

## Example Calculation of Preliminary Remediation Goals For Portsmouth Naval Shipyard Offshore Operable Unit 4 (OU4)

## Step 1. Benchmark Consolidation and Hazard Calculation

### 1A. Derivation of Water Quality Screening Value (WQSV) Benchmarks.

Calculate a WQSV using acute criteria and an acute/chronic ratio (Table 2.2-1, p. 10):

Formula: WQSV = Water Quality Criteria-Saltwater Acute/Acute to Chronic Ratio
Where: Acute Water Quality Criteria (Table 2-2.1, p. 10)
Acute to Chronic Ratio (Table A-4, p. A-81)

Example Calculation:

| Parameter | Acute Water Quality Criteria | Acute/Chronic Ratio | WQSV |
|---|---|---|---|
| Naphthalene | 2350 µg/L | 3.71 | 633 µg/L |

Calculate a WQSV using a sediment screening level (Table 2.2-1, p. 10):

Formula: WQSV = (Sediment Screening Level)/($K_{oc}$*$f_{oc}$) (Di Toro et al., 1991)
Where: Koc - Organic Carbon Partition Coefficient (L/kg) (Table A-2-2.1, p. A-1)
$f_{oc}$ - fraction of organic carbon (%TOC/100)
TOC - total organic carbon of the sediment (assume 1% TOC in sediment)

Example Calculation:

| Parameter | Sediment Screening Level | Koc | TOC | $F_{oc}$ | WQSV |
|---|---|---|---|---|---|
| Fluorene | 19 µg/kg | 13800 (L/kg) | 1% | 0.01 | 0.138 µg/L |

### 1B. Estimate pore water concentrations for organics from bulk sediment concentrations.

Formula: $C_p = C_s/(f_{oc} * K_{oc})$ (Di Toro *et al.*, 1991)
Where: $C_p$ - organic chemical porewater concentrations (µg/L) (Tables A-2-2.4a,b, pp. A-13 and A-18)
$C_s$ - sediment concentration (µg/kg dry weight) (Tables A-2-2.2a,b, pp. A-3 and A-9)
$f_{oc}$ - fraction of organic carbon (%TOC/100) (sample-specific) (Tables A-2-2.2a,b, pp. A-3 and A-9)
$K_{oc}$ - organic carbon/water partitioning coefficient; derived from $\log_{10}K_{ow}$ (Table A-2-2.1, p. A-1)
($\log_{10}K_{oc} = 0.00028 + 0.983*\log_{10}K_{ow}$); where $K_{ow}$ = the octanol/water partition coefficient

Example Calculation:

| Parameter | Station | $C_s$ (µg/kg dry weight) | $F_{oc}$ (unit-less) | $K_{oc}$ (L/kg) | $C_p$ (g/L) |
|---|---|---|---|---|---|
| Copper | M01-200B | NA | NA | NA | 5.6 |
| Acenaphthylene | M01-200B | 160 | 0.0189 | 9580 | 0.88 |
| Fluorene | M01-200B | 182 | 0.0189 | 13800 | 0.70 |
| P,p'-DDT | M01-200B | 190 | 0.0189 | 2630000 | 0.0038 |

NA – Not Applicable

Notes:
- The EqP process uses the chemical concentration of pore water as the preferred measure of potential adverse exposure to aquatic biota.
- The EqP model incorporates sample-specific conditions (principally total organic carbon content

of sediment measured at the location) that control sediment-pore water partitioning and hence chemical bioavailability in bedded sediments.

- For organics, Because of a lack of published water-based benchmarks and difficulty in obtaining sufficient sample, benchmarks and concentrations of organic chemicals in pore water are calculated from a corresponding sediment benchmark/concentration using the EqP model.
- For metals, direct measurements of CoCs in pore water are feasible and water-based benchmarks are available.

### 1C. Derivation of Pore Water Hazard Quotient (PW-HQ)

Formula: PW-HQ = $C_p$/WQSV
Where: PW-HQ – Porewater Hazard Quotient (Table A-2-2.5, p. A-23)
$C_p$ - chemical pore water concentrations (µg/L) (Tables A-2-2.4a,b, pp. A-13 and A-18)
WQSV – Water Quality Screening Value (Table 2.2-1, p. 10)

Example Calculation:

| Parameter | Station | $C_p$ (µg/L) | WQSV (µg/L) | PW-HQ (unitless) |
|---|---|---|---|---|
| Copper | M01-200B | 5.6 | 3.1 | 1.81 |
| Acenaphthylene | M01-200B | 0.88 | 0.46 | 1.91 |
| Fluorene | M01-200B | 0.70 | 0.14 | 5.07 |
| p,p'-DDT | M01-200B | 0.0038 | 0.001 | 3.8 |

## Step 2: Evaluate analyte exposure under site-specific conditions

### 2A. Classify samples as toxic or non-toxic for each receptor (amphipods and sea urchins.

Formula: Amphipods < 80% survival and stat. Dif. From control = toxic:
Sea Urchins: partial mortality in two dilutions (LC50 ~< 70%) = toxic.
Results: Provided in Table 2.2-2, (p. 12)

### 2B. Segregate pore water hazard quotient data based on toxicity groupings for each receptor.

Formula: None.
Results: Non-toxic data: Table A2.2-6 (amphipods, p. A-27), Table A2.2-8 (sea urchins, A-35)
Toxic data: Table A2.2-7 (amphipods, p. A-31), Table A2.2-9 (sea urchins, p. A-39)

### 2C. Assess type of statistical distribution for the non-toxic monitoring station data sets.

Formula: Perform Shapiro-Wilks test. See Gilbert, 1987, p. 158)
Results: Data distribution type normal (NORM) or Non-normal (LOG) for the non-toxic monitoring station data sets are reported in Tables A-2-2.6 (p. A-27) (amphipods) and A-2-2-8 (p. A-35) (sea urchins).

### 2D. Calculate the 95% Upper Limit for the Non-Toxic Monitoring Station Data Sets

Formula: For normal distributions: $UL_{95} = \bar{x} + z_{.95} * s$ (see Gilbert, 1987, p. 138)
Where: $UL_{95}$ = 95th percentile upper limit,
x is the sample arithmetic mean,
s is the standard deviation,
$Z_{.95}$ is the 95th percentile of the standard normal distribution (one-tailed Students t statistic for n-1 degrees of freedom at the desired significance level (alpha =0.25)

Formula: For log-normal distributions: $UL_{95} = \exp(\hat{\mu} + Z_{.95} * \hat{\sigma})$ (see Gilbert, 1987; p. 186)

Where: $\mu$ is the mean of the log-transformed data,
sigma is the standard deviation of the log-transformed data,
$Z_{.95}$ is the 95th percentile of the standard normal distribution of the log-transformed data.

Results: 95% UL values for the non-toxic monitoring station data sets are reported in Table A-2-2.6 (amphipods, p. A-27) and Table A-2-2.8 (sea urchins, p. A-35)

Example: Copper (Table A2-2-2.6, p. A-30); Distribution = Log
Where: x' = ln(x); mean of x' = -.4765
Z.95 = 1.645 (from Excel formula: NORMSINV(0.95))
sigma = 0.371 (from Excel formula (STDDEV(X1, X2,...Xn))

$UL_{95}$ = exp (-0.4765+1.645*0.371)
= exp (-0.4765+0.608)
= exp (0.131)
= 1.14

**2E. Compare 95%UL of non-toxic PW-HQ data with the default NOEQ.**

Formula: If $UL_{95} < 1$, then test NOEQ = 1.
If $UL_{95} > 1$, then NOEQ = $UL_{95}$

Results: Results of comparison provided in Table 2.2-3 (p. 13) for amphipods (AMP-NOEQ), sea urchins (ARB-NOEQ)

Example Calculation:

| | Non-toxic Amphipod Samples | | |
|---|---|---|---|
| Parameter | n | 95% UL PW-HQ | Test NOEQ |
| Copper | 23 | 1.14 | 1.14 |
| Acenaphthylene | 23 | 2.71 | 2.71 |
| Fluoranthene | 23 | 0.11 | 1.00 |
| Fluorene | 23 | 15.98 | 15.98 |
| Phenanthrene | 23 | 0.91 | 1.00 |
| p.p'-DDT | 23 | 1.43 | 1.43 |

Note: For fluoranthene, $UL_{95} < 1$, hence NOEQ = 1 is adopted.

## STEP 3. Retain CoCs substantially contributing to risk.

**3A. Determine the maximum detected concentration in the toxic monitoring station data sets (Tables A-2-2.7, p. A-31 and A-2-2.9, p. A-39)**

**3B. Compare test NOEQ with maximum of toxic PW-HQ data for each test**

Formula: If test NOEQ < Max PW-HQ, then NOEQ = test NOEQ.
If test NOEQ > Max PW-HQ, then NOEQ = undefined.

Results: Results of comparison for amphipods (AMP-NOEQ), sea urchins (ARB-NOEQ) provided in Table 2.2-3 (p. 13);

Example Calculation: Amphipod Survival

| | Nontoxic Samples | | | Toxic Samples | | | |
|---|---|---|---|---|---|---|---|
| Parameter | N | $UL_{95}$ PW-HQ | Test NOEQ | n | Maximum PW-HQ | Max PW-HQ>test NOEQ? | AMP NOEQ |
| Copper | 23 | 1.14 | 1.14 | 4 | 153 | YES | 1.14 |
| Acenaphthylene | 23 | 2.71 | 2.71 | 5 | 6.94 | YES | 2.71 |
| Fluoranthene | 23 | 0.11 | 1.00 | 5 | 0.17 | NO | |
| Fluorene | 23 | 15.98 | 15.98 | 5 | 101 | YES | 15.98 |
| Phenanthrene | 23 | 0.91 | 1.00 | 5 | 2.18 | YES | 1.00 |
| p.p'-DDT | 23 | 1.43 | 1.43 | 5 | 9.6 | YES | 1.43 |

Note: Those CoCs where the maximum PW-HQ of toxic samples exceeds the test NOEQ are retained for further PRG derivation. Hence, in the above example, fluoranthene is not retained.

**3C. Compare species-specific NOEQs to select the final Aquatic NOEQ**

Formula: If AMP NOEQ < ARB-NOEQ, then Aquatic NOEQ = AMP-NOEQ.
If AMP NOEQ > ARB-NOEQ, then Aquatic NOEQ = ARB-NOEQ

Results: Results of the comparison are reported as Aquatic NOEQ in Table 2.2-3 (p. 13).

Note: The Aquatic NOEQ is the lower of the NOEQs from the amphipod and sea urchin tests.

## STEP 4: Reference Comparison/Threshold Effect Value Calculation

**4A. Calculate the No Effect Concentration (NOEC) from the NOEQ.**

Formula: NOEC = NOEQ * WQSV
Where: WQSV = Water Quality Screening Value (µg/L) (Table 2.2-1, p. 10)
NOEQ = No Observable Effect Quotient (unit-less) (Table 2.2-3, p. 13)
NOEC = No Observable Effect Concentration (µg/l) (Table 2.2-5, p. 16)
Result: NOEC values reported in Table 2.2-5 (p. 16).

Notes:
- The NOEQ values are converted into NOEC (e.g., water concentration units) values to permit comparison against pore water RSVs.
- The NOEC is a site and CoC-specific threshold pore water chemical concentration below which adverse effects on the receptor are unlikely to occur.

**4B. Assess type of statistical distributi n f r th ref rence data s t.**

Formula: Perform Shapiro-Wilks test (See Gilbert, 1987, p. 158).

Results: Data distribution type normal (NORM) or Non-normal (LOG) for the reference stations are reported in Table 2.2-4 (p. 15).

**4C. Calculate the Upper 95% Limit for the Reference Data Set (RSV).**

Formula: For normal distributions: $UL_{95} = \bar{x} + z_{.95} * s$ (see Gilbert, 1987, p. 138)

Where: $UL_{95}$ = 95th percentile upper limit,
x is the sample arithmetic mean,
s is the standard deviation,
$Z_{.95}$ is the 95th percentile of the standard normal distribution (one-tailed Students t statistic for n-1 degrees of freedom at the desired significance level (alpha =0.25)

Formula: For log-normal distributions: $UL_{95} = \exp(\hat{\mu} + Z_{.95} * \hat{\sigma})$ (see Gilbert, 1987; p. 137)

Where: $\mu$ is the mean of the log-transformed data,
sigma is the standard deviation of the log-transformed data,
$Z_{.95}$ is the 95th percentile of the standard normal distribution of the log transformed data.

Results: $UL_{95}$ values for the reference data set (RSVs) are reported in Table 2.2-4 (p. 15).

Example: Copper (Table 2.2-4, p. 15); Distribution = Log
Where: x' = ln(x); mean of x' = 1.079
Z.95 = 1.645 (from Excel formula: NORMSINV(0.95))
sigma = 0.628 (from Excel formula (STDDEV(X1, X2,...Xn))
$UL_{95}$ = exp (1.08+1.645*0.628)
= exp (1.079+1.033)
= exp (2.112)
= 8.26

**4D. Determine the Aquatic Threshold Effect Value.**

Formula: TEV = the greater of the NOEC and RSV (µg/l)

Where: TEV = Threshold Effects Level (Table 2.2-5, p. 16)
NOEC = No Observable Effect Concentration (µg/l) (Table 2.2-5, p. 16)
RSV = Reference Station Value (µg/l) (Table 2.2-4, p. 15)
Result: TEV values are reported in Table 2.2-5.

Example Calculation:

| Parameter | NOEQ | WQSV (µg/l) | NOEC (µg/l) | RSV (µg/l) | TEV (µg/l) |
|---|---|---|---|---|---|
| Copper | 1.14 | 3.1 | 3.55 | 8.26 | 8.26 |
| Acenaphthylene | 2.71 | 0.46 | 1.24 | 0.86 | 1.24 |
| Fluorene | 14.9 | 0.14 | 2.06 | 1.01 | 2.06 |
| p,p'-DDT | 1.43 | 0.001 | 0.0014 | 0.00009 | 0.0014 |

## STEP 5. Limiting CoC Selection

### 5A. Derivation of Threshold Effects Value Hazard Quotient

Formula: TEV-HQ = $C_p$/TEV
Where: TEV-HQ - Threshold Effects Value Hazard Quotient
$C_p$ - Porewater concentration (µg/l) (Table A-2-2.4a,b, pp. A-13 and A-18)
TEV - Threshold Effects Value (µg/l) (Table 2.2-5, p. 16)

Results: TEV-HQ data reported in Table A-2-2.10 (p. A-43)

Example Calculation:

| Parameter | Station | $C_p$ (µg/L) | TEV (µg/L) | TEV-HQ (unitless) |
|---|---|---|---|---|
| Copper | M01-200B | 5.6 | 8.26 | 0.68 |
| Acenaphthylene | M01-200B | 0.88 | 1.24 | 0.71 |
| Fluorene | M01-200B | 0.70 | 2.06 | 0.34 |
| Pyrene | M01-200B | 0.70 | 1.6 | 0.44 |
| p,p'-DDT | M01-200B | 0.0038 | 0.0014 | 2.67 |

### 5B. Limiting CoC Selection

Formula: Rank TEV-HQ values for all analytes at each station.
Identify analyte with maximum TEV-HQ where sum TEV-HQs> 1
Select that analyte as the Limiting CoC.

Result: Sum TEV-HQ, Max TEV-HQ and Limiting Coc reported in Table A-2-2.10 (p. A-43)
Total list of limiting CoCs at all stations is the list of limiting CoCs for offshore area
Summary of results carried forward to Table 2.2-5 (p. 16).

Example Calculation:

| CoC | TEV-HQ | |
|---|---|---|
| | Sampling Location | |
| | M01-200B | M07-300B |
| Copper | 0.68 | Not measured |
| Acenaphthylene | 0.71 | 0.32 |
| Fluorene | 0.34 | 0.05 |
| Pyrene | 0.43 | 0.07 |
| --- | --- | --- |
| p,p'-DDT | 2.67 | 0.01 |
| Sum TEV-HQ | 12.33 | 0.81 |
| Max TEV-HQ | 2.67 | not applicable |
| Limiting CoC | p.p'-DDT | not applicable |

Notes:
- Max Tex-HQ and Limiting CoC not identified for M07-300B since Sum TEV-HQ < 1
- Same procedure repeated for all sampling locations.
- Pyrene eliminated as a PRG because it was not a limiting CoC at any of the stations

## STEP 6: Baseline Preliminary Rem diation Goal (BPRG) Calculation

### 6A. Derivation of Baseline PRG

Formula: BPRG = $[\Sigma(C_s/\text{TEV-HQ})]/N$
Where: BPRG – Baseline Preliminary Remediation Goal (µg/kg)
TEV-HQ - Threshold Effect Value-Hazard Quotient (unitless) (Table A-2-2.10, p. A-43)
$C_s$ - Sediment concentration (µg/kg) (Table A-2-2.2a,b, pp. A-3 and A-9)
N - Observations
Result: Baseline PRG calculations reported in Table A-3-1.1 (p. A-46)
Summary results reported in Table 2.2-6 (p. A-17)

Example Calculation:

| "Limiting" CoC | Station | $C_S$ | TEV-HQ | $C_S$/TEV-HQ |
|---|---|---|---|---|
| Fluorene | M01-100B | 187 | 0.383 | 489.8 |
| | M01-200B | 182 | 0.340 | 535.1 |
| | M01-300B | 915 | 1.433 | 638.4 |
| | ... | ... | | |
| | M14-200B | 107 | 0.175 | 617.2 |
| | M14-300B | 98.8 | 0.146 | 679.5 |
| | | | Sum: | 20992 |
| | | | n: | 42 |
| | | | Baseline PRG: | 499.8 |

## STEP 7: Recommended PRG Evaluation

### 7A. Express available sediment data as PRG Hazard Quotients

Formula: PRG-HQ = $C_s$/BPRG
Where: PRG-HQ - Preliminary Remediation Goal-Hazard Quotient
BPRG – Baseline Preliminary Remediation Goal (µg/kg) (Table A-3-1.1, p. A-46)
$C_s$ - Sediment concentration (µg/kg) (Tables A-2-2.2a,b, pp. A-3 and A-9)
Results: PRG-HQ values for three data sets (EERA, Round 1, Round 2) (Tables A-3-1.3a,b,c, pp. A-71, A-73, and A-77)

Example Calculation (Round 2 data):

| Parameter | Station | $C_s$ (µg/kg dry weight) | PRG (µg/kg dry weight) | PRG-HQ (unitless) |
|---|---|---|---|---|
| Copper | M01-200B | 44.3 | 625 | 0.071 |
| Acenaphthylene | M01-200B | 160 | 210 | 0.76 |
| Fluorene | M01-200B | 182 | 500 | 0.36 |
| ... | ... | ... | ... | ... |
| p,p'-DDT | M01-200B | 190 | 66.4 | 2.86 |
| Sum PRG-HQ | | | | 6.94 |
| Max PRG HQ | | | | 2.86 |
| Max CoC | | | | p,p'-DDT |

**7B. Determin Max PRG-HQ by Station and Sampling R und**

Formula: Rank PRG-HQ values for all analytes at each station.
Identify CoC with maximum PRG-HQ where PRG-HQ> 1

Results: Max PRG-HQ values for EERA, Round 1, Round 2 data (Tables A-3-1.3a, b, c, pp. A-71, A-73, and A-77).

**7C. Assess relationship between risk findings and baseline PRG exceedance**

Formula: Rank Max PRG-HQ relative risk
If direct correlation is observed, select lowest PRG-HQ value
If direct correlation is not observed, assign indeterminate (INT)
Result: Ranked PRG-HQ by sampling round reported in Table 3.3-1a,b,c (pp. 18, 19, and 20).
Summary RPRG-HQ values provided in Table 3.3-2 (p. 21)

Example Calculation RPRG Evaluation for Round 2 data)

| Parameter | Station | PRG-HQ | Risk | RPRG-HQ |
|---|---|---|---|---|
| Fluorene | M13-100B | 7.51 | Medium | 1.00 |
| | M01-300B | 1.83 | Medium | |
| | M12-100B | 1.36 | Medium | |
| | M12-200B | 1.30 | Medium | |
| Nickel | M09-100B | 1.29 | Low | 1.29 |
| p,p'-DDT | M08-100B | 4.29 | Low | |
| | M01-200B | 2.86 | Medium | |
| | M04-300B | 2.62 | Medium | |
| | M08-300B-AVG | 1.39 | Low | INT |

Notes:
- INT = A RPRG-HQ for p,p'-DDT could not be selected because a risk vs. PRG-HQ relationship was not observed.

**7D: Calculate Recommended PRG concentration**

Formula: RPRG = Minimum (RPRG-HQ by round) X Baseline PRG (Table 2.2-6, p. 17)
Result: RPRG results shown in Table 3.3-2 (p. 21).

Example Calculation:

| Parameter | RPRG-HQ (unitless) | Baseline PRG (µg/kg dry weight) | Recommended PRG (µg/kg dry weight) |
|---|---|---|---|
| Nickel | 1.29 | 124 | 161 |
| Fluorene | 1.0 | 500 | 500 |

Notes:
- RPRG for nickel derived only from Round 2 data
- RPRG for fluorene based on EERA and Round 2 data.

# ATTACHMENT 3

## RESPONSE TO COMMENTS AND MEETING MINUTES

3.1 RESPONSE TO COMMENTS ON DRAFT PRG DOCUMENT

3.2 RESPONSE TO FOLLOW-UP COMMENTS ON DRAFT PRG DOCUMENT

3.3 MEETING MINUTES FROM APRIL 3, 2001 TECHNICAL MEETING

3.4 ACTION ITEMS FROM MAY 29, 2001 TELECONFERENCE CALL

3.5 RATIONALE FOR REMOVING A SAMPLE FROM STEP 6 OF THE PRG CALCULATION FOR COPPER

3.6 RESPONSE TO COMMENTS ON THE INTERIM SUBMITTAL

3.7 RESPONSE TO COMMENTS ON THE DRAFT FINAL PRG DOCUMENT

## 3.1 RESPONSE TO COMMENTS ON DRAFT PRG DOCUMENT

**RESPONSES TO COMMENTS EPA COMMENTS DATED JANUARY 25, 2001 ON DRAFT PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

## General

1. **Comment:** This document proceeds through a series of well-intentioned steps for the derivation of the PRGs. However, there are numerous questions about the execution of the PRG derivation process that need to be addressed. The details of the text and tables were sometimes confusing and difficult to cross- reference. Refinement of the general format of the document may answer many of my questions or provide an easier interpretation of the data.

   **Response:** Addition of text explanation related to the PRG derivation process and refinement of the general format will be made as indicated in the Navy's responses to the EPA specific comments below.

## Specific

1. **Comment:** **Section 2.2**: The foundation of the PRG development is based on Round 2 monitoring data. Therefore, there should be some discussion of the use and representativeness of Round 2 sediment and pore water concentration data, as well as toxicity test results, compared to Round 1 and EERA data. It would also be beneficial to have a detailed figure/flow chart for the individual steps of the PRG process, similar to Figure 2.2-1. The inclusion of primary characteristics and formulas for the derivation of pivotal components within each step would be helpful.

   **Response:** As part of the development of the Interim Offshore Monitoring Plan (TtNUS, October 1999), it was determined that the PRG data needs would be collected during the first late winter sampling round (i.e., Round 2) (see Page 3-25 of the Monitoring Plan). Collocated toxicity testing, sediment concentrations, and measured pore water concentrations are not available for Round 1 and insufficient numbers of these samples from the EERA were available. A comparison of the sediment data for the baseline monitoring rounds (Rounds 1 through 4) will be conducted as part of the Interim Offshore Monitoring Baseline Report. The data will also be qualitatively compared to historical data (which includes the EERA data).

   The concept of a figure as described is essentially what was presented in the Executive Summary Table ES-1, where the sequential Steps are ordered top to bottom. A reference to tables associated with each step of the process will be added to Table ES-1. The Navy proposes additional discussion of each step of the process at the PRG technical meeting, currently being scheduled.

2. **Comment:** **Subsection 1**: It is unclear if both saltwater (SW) and freshwater (FW) data from the AQUIRE database were used to derive the overall mean acute:chronic ratio (ACR). SW and FW ACRs should only be based on their respective data and not combined.

   Please explain why several inorganic analytes have the identical or a consistently repeated porewater concentration/ hazard quotient (PW-HQ) across all monitoring stations (Tables A-2-

2.4a/5). Reporting units for metals should be footnoted for Table A-2-2.4a. It appears that one-half the value of the method detection limit (MDL) was used for non-detects for inorganics and is probably the cause for the identical porewater concentrations. However, it also appears that this value is significantly above all Water Quality Screening Values (SQVC) for respective inorganics. Therefore, this contributes to a potentially erroneous concentration range for toxic and non-toxic porewater results. Additionally, this could effectively change all subsequent calculations of hazard quotients and PRGs. This warrants further discussion.

There is a difference in the number of toxic samples for amphipods and sea urchins stated for Table 2.2-2 versus Table 2.2-3.

**Response:** The referenced ACR from the literature was based on the value reported by Shepard (1998) and is the same ACR used in the Interim Offshore Monitoring Plan (TtNUS, October, 1999, Appendix A, pages 7 and 8). The Shepard reference in Table 2.2.-1 will be updated to reference the 1998 publication. The study did not state whether the ACR value was derived from freshwater or saltwater or combined data sets. A cursory review of the AQUIRE database was conducted to approximate the ACR ratio for saltwater species. In this analysis, the data selected included laboratory, water-only, measured concentration data from flow-through exposures. Acute endpoints included EC50, IC50, LC50 and LD50 (though predominantly EC50). Chronic endpoints were LOEC and NOEC values. The geometric mean of acute and chronic values were taken by chemical, species, and study, then averaged by study to generate two lists of ACR values by chemical and species. The final ACR results by species and chemical were 6.1 and 9.3, respectively. The overall average of the two methods is 7.7, in good agreement with the ACR value of 8 used in PRG development. The above analysis did not include static exposure results that tend to produce less sensitive (higher) acute and chronic values. Inclusion of these data would likely lower the ACR value. Thus it is concluded that the selected ACR value for purposes of PRG development is appropriate and adequately conservative.

The analytical laboratory re-analyzed the pore water samples for lead to achieve a lower detection limit (3 ug/L) which was below the WQSV. All of the values were below the WQSV so no changes are expected from the lead. The laboratory also re-evaluated the existing data for copper in the pore water and was able to report a lower detection limit of 3 ug/L, which is below the WQSV. Some of the samples that previously had non-detects for copper (less than 5 ug/L) had detections between 3 ug/L and 5 ug/L. These data will be included in the PRG document and may change the PRG for copper. For non-detected data, ½ of the MDL was used. Hence the HQs are the same for samples in which a parameter was not detected. The ½ MDL values do exceed the WQSV for silver. The laboratory indicated that they were not able to achieve a lower detection limit for silver because of interferences from the sample matrix. The Navy agrees that PRGs for these analytes are not adequately developed because both the thresholds for toxicity are below the MDL, particularly for silver. Therefore differences between concentrations associated with non-toxic vs. toxic samples cannot be established. However, silver has not specifically been identified as a COC for any of the IRP sites or for the offshore so the uncertainty with not having a PRG for this chemical is not significant. Also, the Navy indicated in the Interim Offshore Monitoring Plan that the detection limit for silver would be greater than the WQSV.

An insufficient volume of pore water was collected from Station M08-300B, so sea urchin toxicity tests could not be conducted on this sample and measured pore water metals concentrations for this sample could not be obtained. Therefore, for the toxic samples for amphipod survival, there are 4 samples under N for the metals. Three sea urchin samples

were incorrectly classified as toxic samples (i.e., MS 7-100, MS8-400, and MS12-200) that should have been counted as non-toxic samples and one sample (MS11-300) was not included in the set of non-toxic samples in Table A-2-2.8. All associated tables will be corrected.

3. **Comment: Subsection 2**: It is unclear why the toxic response cutoff for sea urchin fertilization was previously determined to be lower (survival<70%) than that used for amphipods (survival<80%). The rationale used to determine that 25-50% dilution concentrations are conservatively acceptable for determining toxic/non-toxic pore water exposure concentrations to epibenthic organisms should be further discussed. This method eliminates 13 locations that were found to be potentially toxic at 100% pore water concentrations.

   The process for determining the NOEQ is confusing and needs to be explained further. Details concerning the determination of normal/log normal distributions and respective formula variations for the calculation of 95%UCL of PW-HQs need to be provided.

   It is unclear why inorganic maximum PW-HQs for toxic samples equal 95%UCL PW-HQs for non-toxic samples(Table 2.2-3). Additionally, the sea urchin and amphipod inorganic toxic/non-toxic PW-HQs and NOEQs data are the same for several metals. Furthermore, in at least two cases (lead and silver), the max PW-HQ equals the NOEQ and thereby fails to meet the threshold criteria for NOEQ inclusion. Please explain.

   Sample locations on Table 2.2-2 do not correspond to locations mentioned in the text or on Figure 3.3-1.

   The basis for the derivation of the amphipod - no observable effect quotient, AMP-NOEQ, on Table 2.2-3, needs to be provided, as well as the term, AQ BED-NOEQ cited in the footnotes. The rationale for the derivation of total PCBs in Table A-2-2.4b should be provided.

   **Response:** The use of larval development toxicity testing for sea urchin was identified in the Interim Offshore Monitoring Plan (TtNUS, October 1999, see the analytic program provided in Table 6-2). The PRG process intended the use of LC50 data for larval development to determine toxicity. The development of the example PRGs provided in the Interim Offshore Monitoring Plan used available toxicity data to provide an example of the PRG calculation. Fertilization data were available, therefore the data were used as part of the example calculation. The larval development test including the dilutions was proposed for PRG development. As explained in the PRG text, a partial mortality in two or more dilutions is needed to calculate the value. The fifth sentence in the last paragraph on Page 8 will be replaced with the following text:

   "From an ecological perspective, this was deemed appropriate given that epibenthic organisms such as sea urchins are not likely exposed to full strength pore water (100%). The exposure concentrations for the epibenthic organisms are conservatively expected to be reduced by at least 50 percent as the pore water leaving the sediment is mixed with the overlying surface water."

   Please see Attachment A of the responses to EPA comments for the formulas and references for calculation of the 95% UCL values. This attachment will be included as an Appendix to the PRG document. The Navy would like to discuss the NOEQ derivation steps at the PRG technical meeting, currently being scheduled, to discern what part of the process is difficult to

understand. Text revisions will then be made accordingly and will be indicated in the meeting minutes for the technical meeting.

In the case of chromium, lead, cadmium, silver, and mercury, the maximum PW-HQs for toxic samples equal 95%UCL PW-HQs for non-toxic samples because there is no variation in the data as all samples were non-detect. These are the only cases where this occurs.

Sample locations on Figure 3.3-1 and in the text were abbreviated to improve clarity. For example, Sample MS-1.1 in the figure corresponds to M01-100B in Table 2.2-2.

The footnote in Table2.2-3 will be revised to read as follows for each endpoint: "*If Max PW-HQ>test NOEQ, then AMP-NOEQ = test NOEQ*". The footnote for total PCBs in Tables 2.2-1 and A-2.2-1 will be modified to include the reference for calculating total PCBs, which is NOAA, 1989 – A Summary of Data on Tissue Contamination from the First Three Years (1986-1988) of the mussel Watch Project, NOAA Technical Memorandum, NOS OMA 49, Rockville, MD.

4. **Comment:** **Subsection 3**: The NOEQs retained for sea urchins should be provided in the text for comparison similar to those for amphipods.

   **Response:** The text will be revised as requested.

5. **Comment:** **Subsection 4**: The location of all 16 locations used to determine the reference screening values (RSVs) is unclear. There were 10 locations originally sampled as reference stations for the EERA. Additional locations have been added during monitoring Rounds 1 and 2. A figure with all reference locations and citations of sample dates used for determination of RSVs would be helpful. There is a marked similarity in the reference inorganic porewater concentrations. Please explain.

   The process for conversion of the aquatic NOEQs into NOECs should be provided in the text. It is unclear why NOECs are not calculated directly from the porewater toxicity test results instead of the multi-layered hazard quotient approach provided.

   Aquatic TEV (AQ-TEV) should be defined. It is unclear what criteria is used to determine that the selected value for the AQ-TEV should be the greater of the NOEC and RSV.

   **Response:** The criteria used to select the reference stations are provided in the Interim Offshore Monitoring Plan (Section 3.1.2 and Appendix B). Only Round 2 reference data were used for calculation of the RSV. Reference stations are shown in Figure ES-2. There are four sampling locations within each reference station. Three of the four interim offshore monitoring reference stations were also included as reference stations in the EERA. RS-4 is a newly identified reference station that was not included in the EERA. Similarity of inorganic pore water reference data is due to homogeneity in background hydrography (e.g. thoroughly mixed) and the fact that analyte concentrations are in many cases near or less than the method detection limits.

   Footnote 3 in Table 2.2-5 is the process for conversion of the aquatic NOEQs into NOECs (NOEC = NOEQ x WQSV). This explanation will also be added as text in Section 2.2, Step 4. The NOECs calculated for purposes of PRG development are calculated from the toxicity data per the procedures described in Steps 1 through 3. The HQ normalization step provides a

mechanism to determine which chemicals should be the focus of site-specific PRG development (e.g., chemicals associated with toxic samples should be higher than non-toxic samples).

The following definition for the Threshold Effect Value will be provided: "*The Threshold Effect Value is the highest chemical concentration at the site used to represent the exposure pathway of the receptor that can be expected to be found but not cause toxicity*". As explained in Section 4, a PRG (or TEV) cannot be lower than the background concentration (RSV) to be practical for implementation, since regional concentrations will determine the lower limit at the site because of exchange of water and particulates throughout the estuary. Therefore, if the NOEC is lower than the RSV, it should not be selected as the AQ-TEV.

6. **Comment:** **Subsection 5**: The process for the derivation of media-specific HQs from TEVs should be provided in the text. It is unclear why specific "remaining COCs will also have HQs<1" in the context of PRG assignment.

   **Response:** It will be emphasized in the text that the media-specific HQ for a given chemical at a given sampling location is equal to the pore water concentration of the chemical at that location divided by the TEV for the chemical. The text to be revised to read as follows:

   "Therefore any proposed remedial action will not result in modifying the level of protection afforded to receptors on an analyte-specific basis, since the mode of toxicity as well as the method of remediation of the collocated chemicals (e.g., by natural attenuation) is similar. Thus, it is not necessary that PRGs be developed for all risk-causing chemicals or chemical classes, because when the PRG chemical is reduced to acceptable levels, the collocated CoCs will also be reduced to levels below their corresponding remediation goals (e.g., HQ < 1, if HQ = 1 is the baseline PRG)."

7. **Comment:** **Section 3.1**: Table 2.2.6 should have a footnote that denotes the formula for the derivation of the PRG. It would be helpful to also be able to compare back-calculated PRGs from sediment benchmark and EqP modeling for the limiting CoCs.

   **Response:** A footnote will be added to indicate that the PRGs are calculated in Table A-3-1.1. Both PRGs and sediment benchmarks are already sediment concentrations. The Navy requests EPA provide clarification on this comment at the PRG technical meeting, currently being scheduled, and the meeting minutes will indicate any additional revisions necessary based on the meeting discussion.

8. **Comment:** **Section 3.2**: BSAF values for lobster should be stated in the text for comparison to mussel values. It would be helpful to have a table with lobster and mussel mean BSAF/BAF values for the L-COCs to enable comparison.

   **Response:** Text discussing Lobster BSAF will be provided. Lobster/mussel BSAF table will be provided as Table A-3-1.2i.

9. **Comment:** **S ction 3.3.1:** It would be beneficial to have the NOAA ER-L/ER-M values in tabular format with the PRGs for comparison. There is no mention of the role of AVS-SEM in the explanation for the elevated PRGs relative to benchmark values.

   **Response:** A table comparing PRGs and benchmarks will be provided as an Appendix table. With regard to the discussion of PRGs for copper and nickel, text will be added that the role of these metals as primary sources of toxicity across the site is discounted by the fact that SEM-AVS values in general were less than the threshold associated with onset of potential toxicity.

10. **Comment:** **Section 3.3.2**: PRG concentration units should be footnoted for Tables A-3-1.3a/b. Individual station PRGs for inorganics, especially copper, are markedly elevated for several locations. This may be due to the aforementioned detection limit problem and leads to potentially inflated overall PRGs for inorganics.

    **Response:** The referenced table contains PRG-HQ values and the aquatic pathway-specific PRG concentrations for COCs. Footnotes will be added to the table to clarify that the PRG-HQ values are unitless and to indicate the appropriate units for the aquatic pathway-specific PRG concentrations (mg/kg for inorganics and ug/kg for organics). The PRG-HQ values for inorganics in this table, especially copper, do not appear elevated.

11. **Comment:** The weight-of-evidence approach used for the determination of risk in the EERA evaluated many different data sources compared to those being utilized for the development of the PRGs. Therefore, there should be some discrepancy in their coverage of risk. However, those areas of intermediate risk not covered by PRG numbers should be addressed in some other manner.

    **Response:** Although the weight-of-evidence approach evaluated many different data sources, the risks were summarized based on sediment and surface water exposure for each of the areas of concern (AOCs). There were three AOCs that were identified as having intermediate risk for endpoint exposure to sediment (i.e., Dry Docks AOC, Back Channel AOC, and Sullivan Point AOC). All of these AOCs had at least one location that exceeded PRGs; therefore there are no areas of intermediate risk that are not covered by PRG exceedances. In addition, the data for all monitoring stations will be evaluated as indicated in the Interim Offshore Monitoring Plan (TtNUS, October 1999).

## Attachment A

## Derivation of Confidence Intervals and Percentiles for the Normal and Lognormal Distributions

The Shapiro-Wilks statistic (W) was conducted to assess whether the data have a normal distribution. Normality was assessed using the Shapiro-Wilks Statistic. If normality can not be verified, then it is assumed that the data are lognormally distributed.

The mean and variance of a population from a random sample of n identically independent and normally distributed observations are estimated as:

$$\hat{\mu} = \bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i , \qquad \hat{\sigma}^2 = s^2 = \frac{1}{n-1}\sum_{i=1}^{n}( x_i - \hat{\mu} )^2$$

For a normal distribution, an upper confidence limit for the mean is computed as follow:

$$UCL = \bar{x} + s * t_{(1-\alpha,n-1)}/\sqrt{n}$$

Where x is the sample arithmetic mean, s is the standard deviation, and the one-tailed Students t statistics for n-1 degrees of freedom at the desired significance level alpha and the 95% percentile is calculated as:

$$P_{95} = \bar{x} + z_{.95} * s$$

Where Z.95 is the 95th percentile of the standard normal distribution.

If the distribution is log-normal then the log-transformed sample data follow a normal distribution. Then an upper confidence limit for the mean is computed as follow

$$UCL_{mean} = \exp [ \hat{\mu} + \frac{1}{2}\hat{\sigma}^2 + \hat{\sigma}\, L_u/\sqrt{(n-1)} ]$$

Where mu is the mean of the log-transformed data, sigma is the standard deviation of the log-transformed data, and Lu the Land□s tabulated constant for the upper confidence limit.

The 95% Upper percentile is calculated as:

$$P_{.95} = \exp( \hat{\mu} + Z_{.95} * \hat{\sigma} )$$

Where Z.95 is the 95th percentile of the standard normal distribution.

**RESPONSE TO NOAA COMMENTS DATED JANUARY 10, 2001 ON DRAFT PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

1. **Comment:** Section 2.2 Aquatic PRG Derivation, Page 6. The EqP model equation is incorrect. The sediment and pore water should be reversed.

   **Response:** The Equilibrium Partitioning (EqP) model equation (Equation 1) (Di Toro et al, 1991) is correct as provided; the EqP model is used to predict pore water concentration ($C_p$) from the sediment concentration ($C_s$) divided by the faction of organic carbon times the organic carbon partitioning coefficient ($f_{oc}$ x $K_{oc}$), as indicated.

2. **Comment:** Section 2.2 Aquatic PRG Derivation, Page 7-8. The ER-L is incorrectly defined. It does not represent the sediment concentration below which no adverse effect is expected 90% of the time. The ER-L is the 10th percentile of the effects concentration for a specific chemical. Toxicity may occur below this concentration but is not expected. In fact, Long and others have consistently defined the ER-L as a concentration below which adverse effects upon sediment-dwelling fauna would be expected only infrequently; no percentages are provided.

   **Response**: For clarity, the text will be revised to state "whereas ER-L/TEL values represent concentrations below which 90% of sediment samples in the NOAA/FDEP effects database had no measurable adverse effect".

3. **Comment:** Section 3.3.1 Baseline PRG Evaluation, Total PCBs, Page 19. The NOAA ER-M is 180 ng/g not 9600 ng/g. Nevertheless, the baseline PRG for total PCBs of 409 ng/g is above the NOAA ER-M.

   **Response**: The referenced text in Section 3.3.1, Baseline PRG Evaluation, Total PCBs, Page 19 will be revised to indicate that the ER-M for Total PCBs is 180 ng/g.

4. **Comment:** According to Table 2.2-2, Summary of toxicity testing results, the toxic samples found from the amphipod survival test and the sea urchin developmental test are different except for station 13-1. An explanation of why this may have occurred is not provided although it is stated that sea urchins are considered more sensitive than amphipod tests (Page 8). Hence, one would have expected that those other stations found toxic in the amphipod test (4-1, 4-3, 8-3, and 9-1) would also show toxicity in the sea urchin larval development test.

   **Response:** The second sentence in the last paragraph on Page 8 is indicating that the sea urchin development test is more sensitive than the sea urchin fertilization test, and not the amphipod test. The sea urchin test might be more sensitive than the amphipod test for certain chemicals, which could explain the differences in toxicity between the sea urchin and amphipod toxicity tests.

5. **Comment:** As discussed in Part 3 of Section 2.2 (Page 10) and shown in Table 2.2-3, the maximum pore water hazard quotient is used to determine if the toxic sample is above the

nontoxic or test NOEQ. Granted, if below 1, it should be eliminated, but if above 1, then the minimum pore water hazard quotient should be used. In this way, a nontoxic test NOEQ much greater than 1 is not used because of an even greater maximum pore water hazard quotient. This of course means using the lowest concentration that shows a toxic effect rather than the highest concentration that does not show an effect; but that is appropriate because a test (nontoxic) NOEQ (pore water concentration over the NOEC for a non toxic sample) much greater than 1 implies no toxicity resulting from the chemical of concern where toxicity may actually exist at much lower concentrations elsewhere.

**Response:** The Navy believes the present process is correct and changes are unnecessary. The minimum HQ for the test NOEQ defaults to unity assuming that chemicals in the field are not more toxic than when tested in the laboratory. It is also assumed that site-specific conditions can cause a chemical to be less toxic; this is in fact, why toxicity tests on field samples are being conducted and PRGs different from screening benchmarks are being developed. If toxicity tests are assumed to be reflective of site-specific chemical availability, and a sample is non-toxic, then a case for the maximum non-toxic NOEQ is supportable. The PRG process, however, has selected a more conservative approach, allowing that 5% of the time (e.g., 95% UCL of non-toxic HQs), a sample should have been toxic even though the test did not exhibit toxicity.

6. **Comment:** Does using the above argument, that a minimum pore water hazard quotient should be used, change the nickel or total PAH aquatic TEV value as shown on Table 2.2-5?

   **Response:** Yes, if the process were changed to a minimum HQ approach, more conservative values would be calculated for any PRG that is above background. For example, the nickel TEV is a mere 30% above the WQC-Saltwater Chronic value, and the criterion is in turn, just 0.7 µg/L above background. Using a minimum HQ approach would reduce the TEV for nickel to background. However, obtaining background is not the PRG objective, rather it is risk reduction. Thus, the Navy does not intend to adjust the PRG derivation process.

7. **Comment:** Table 2.2-5, Derivation of TEVs for the aquatic exposure pathway is clear but Table 2.2-6, Summary of baseline PRGs, is not. How do you get from aquatic TEV in Table 2.2-5 to the sediment concentration-based PRGs of Table 2.2-6? As shown in Section 3.1, the unknown PRG is calculated by dividing sediment concentration by the TEV-HQ; but only the latter is known.

   **Response:** Formula 5 in Section 3.1 (p. 13) will be expanded to indicate that the PRG is calculated as the mean of all station-specific sediment/TEV-HQ ratios, where the sediment concentration is the measured value at each sampling location. These calculations are presented in Appendix Table A-3-1.1 as follows:

   Following this assumption, the relationship described in Equation 3, above, can be used to solve for the PRG. Substituting for $HQ_{PRG}$:

   4) $HQ_{TEV} = C_{Sed} / PRG$,

   and given the $HQ_{TEV}$ and associated sediment concentration ($C_S$) at each location, the baseline PRG concentration is determined as follows:

5) $PRG = [\sum_{n}^{1} (C_{Sed} / HQ_{TEV})] / N$ ,

where N is the number of locations at the site.

8. **Comment:** The copper at Station MS-4.1 is clearly a problem as shown by the PRG-HQ of 6.47 and a PRG of 546 mg/kg. Is there a seep at this location? When comparing Figures 3.3-1 with 3.3-2 (the second one!) Station 4.1 exceeds >2 PRG-HQ Maximum but it is displayed as exceeding only 1-2 PRG-HQ Maximum.

   **Response:** Copper is identified as a PRG and therefore the Navy agrees that some of the site-related risk may be caused by this chemical. Figure 3.3-2 B and Figure 3.3-2C represent Round 1 and Round 2 data respectively. Differences in the magnitude of copper exceedence may be related to seasonality. However, at MS-4.1 it was recently noticed during a site visit that metal debris, some of which was identified as copper items, were located near this station. Therefore, the Navy proposes to remove the metals portion of this sample from the final baseline PRG calculation step in Table A-3-1.1 because the copper (and other associated metals) will not be as bioavailable as the metals at other stations. The subsequent removal of metals data from this particular station will cause the PRG for copper to decrease.

**RESPONSES TO COMMENTS MEDEP COMMENTS DATED JANUARY 23, 2001 ON DRAFT PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

1. **Comment:** The overall approach was a generally satisfactory, albeit convoluted, approach for developing site-specific PRGs. As developed, the PRGs are for protection of benthic biota against adverse effects from exposure to contaminants in porewater. The PRGs do not account for exposure via ingestion of contaminants associated with sediment particles. The relative contribution of the particle ingestion route to total exposure depends partly on the compound in question. For many compounds, the concentration in porewater explains the bulk of the toxicity to directly exposed organisms (i.e., the contribution of particle ingestion appears to be insignificant). Unfortunately, there is insufficient time to review the literature to determine if there are exceptions among the COCs for OU4. However, the approach has conservative aspects and the basic premise is considered acceptable at this time.

   Overall, the approach used to develop the PRGs is fine to the point where OU4-wide averages are recommended. The presentation is convoluted and may be viewed by individuals that have difficulty working with ratios as an attempt to disguise unfavorable data. The use of OU4-wide average PRGs, especially for copper, raises concerns that need to be addressed as does the way the PRGs were used.

   **Response:** The basic premise of the Equilibrium Partitioning (EqP) approach is that the bioavailability of chemical from pore water or sediment is the same, hence either fraction can be measured to estimate the exposure. Pore water is selected as the measurement endpoint since the methods are available, and chemical-specific benchmarks are available for comparison with measured concentrations. The process presented addresses ingestion (by aquatic organisms) of contaminants associated with sediment particulates. The use of an EqP pore water approach is fundamentally based on the premise that because contaminants in pore water and bioavailable contaminant on sediment particles are in equilibrium, either contaminant phase could be measured to represent the chemical exposure. We measure pore water and assume that the chemicals in the pore water are 100% bioavailable because there is no direct way to measure the bioavailable fraction associated with the sediment. The basis of this approach has been presented in past meetings as part of the interim offshore monitoring.

   Development of OU4-wide averages as PRGs is in accordance with the Interim Offshore Monitoring Plan (TtNUS, October 1999). Using other than OU-wide numbers would suggest some other basis for site segregation for PRG application would be possible. The PRGs are based on exposure pathways that are assumed to be similar facility-wide. The method of application of PRGs is similar to comparisons performed with ER-L benchmarks during screening level assessments. However, the development of ERLs are based on national data sets that contain a wide range of conditions. The development of PRGs for OU4 was initiated to account for the site-specific conditions present in OU4. The Navy, therefore, believes the process used to derive PRGs is appropriate for their intended use as Interim Remediation Goals (IRG) for the interim offshore monitoring program. The Navy would like to discuss the uncertainty with using these numbers as PRGs for the OU4 FS at the PRG technical meeting currently being planned.

   In terms of the copper PRG, please see the Navy's response to NOAA Comment No. 8 dated January 10, 2001.

2. **Comment:** It is noted in the text that PRGs may be modified after data from more sampling rounds are obtained. This is critical to keep in mind because the PRGs are based on porewater concentrations, which are in turn driven by factors that affect the tendency for COCs to partition between sediment particles and porewater. The factors, and subsequently the PRGs may vary significantly over space and time. There is already evidence of spatial variation (see summary Table below). Data on seasonal variation is forthcoming and may result in significant modifications to the PRGs.

   **Response:** The Navy does not envision significant modification of the PRGs due to seasonality. The PRG data set was collected per regulatory agreement to represent worst-case seasonal exposure conditions for metals (e.g., AVS minima). This was based on the seep-sediment report. Other changes such as long-term, site-wide TOC trends affecting organics exposure, however unlikely, would also be detected in the monitoring program, and if found, could drive reconsideration of PRGs. However, the Navy may conduct additional investigations (e.g., additional toxicity study to determine the impact of ammonia on the results of the toxicity testing) to refine the PRGs for use in the OU4 Feasibility Study. The Navy would like to discuss this further during the PRG technical meeting currently being planned.

3. **Comment:** The reference screening values (RSVs) are essentially local reference concentrations. The means and confidence limits for copper and nickel, among others (Table 2.2-4) were calculated from log-transformed values, because the data were found to be log-normally distributed. However, it appears that copper was detected in only four and nickel in only three of the sixteen reference samples. How does the predominance of detection limit-based concentrations affect the ability to determine the nature of the data distribution?

   **Response:** The more skewed the data are because of a large number of non-detects, the more certain the data are not normally distributed. Also, as presented in the Navy's response to EPA Comment No. 2 dated January 25, 2001, the copper data were re-evaluated to determine whether the detection limit could be lowered. Based on the re-evaluation, the detection limit was lowered so additional detections were observed. This data will be submitted to the PNS distribution list and the PRG document updates as appropriate based on this data.

4. **Comment:** The document provides PRG's for individual compounds and gives a lengthy description of how PRG's were calculated in general. However, the Navy should provide a detailed description of how the PRG for each compound was derived. These descriptions should show the actual values used in the derivation.

   **Response:** The calculations for each chemical using actual values are shown in the Tables and Appendix Tables. The method of calculation is the same for each chemical. The Navy suggests a presentation, discussion, resolution of the EqP process be included as part of the agenda for a technical meeting currently being scheduled.

5. **Comment:** The numbering system for the tables is confusing. For instance, it is not clear why some table designations are prefaced by an "A" and some are not when all the tables are part of Appendix A. Please revise the numbering system to make them easier to reference.

   **Response:** The numbering system used for the tables is the same numbering system that was used in the "Approach for Development of Preliminary Remediation Goals (PRGs) for Operable

Unit 4" provided as Appendix A of the Interim Offshore Monitoring Plan. However, to differentiate between appendices in the present document, the "Development of Preliminary Remediation Goals (PRGs) for Operable Unit 4" will be referred to as Attachment 1 and the text in the Executive Summary will be revised accordingly. As provided in the table of contents for the "Development of Preliminary Remediation Goals (PRGs) for Operable Unit 4", the tables references with an "A" are part of the document's appendix. The following sentences will be added to the last paragraph of Section 1.0 referencing the appendix tables. In addition, an "Appendix A" cover page will be added before the presentation of the "A" tables.

"Tables and figures referenced in the text are provided at the end of the report. Supplemental tables used to support PRG calculation are provided in Appendix A."

6. **Comment:** Please include a "definitions" section, perhaps in conjunction with the acronyms page. A definitions section would simply state, e.g., what the TEV is, what the TEV-HQ is, etc. While these terms are defined in the text it is difficult and frustrating to search within the text for the definition.

   **Response:** A list of definitions will be provided.

7. **Comment:** Exec. Summary, PRG Background, p. ES-1

   "...uses the results from the human health and ecological risk assessments..." Please provide the references for these risk assessments, e.g. "Tetratech NUS 1999".

   **Response:** The discussion under "PRG Background" discusses the PRG process in general and indicates that the process uses results of risk assessments for a site to develop the PRGs. The specifics for the OU4 PRG development are provided in the next section "PRG Development Process for OU4" (starting on Page ES-2).

8. **Comment:** Exec. Summary, PRG Background, p. ES-2, para 1

   Please explain, or rephrase, the term "sanity check", as used in this context.

   **Response:** The last sentence in the first paragraph on page ES-2 will be revised to read as follows "In the implementation phase, the data are qualitatively evaluated to determine whether the PRGs effectively target areas of increased risk and meet Applicable or Relevant and Appropriate Requirements (ARARs).

9. **Comment:** Page ES-4, 2nd bullet

   It should be clear in the executive summary that porewater concentrations of metals were measured, whereas porewater concentrations of organics were estimated.

   **Response:** The following sentence will be added to the beginning of the second bullet: *"The concentrations of organic constituents in the pore water samples were predicted using equilibrium partitioning equations, whereas the concentrations of metals in the pore water samples were measured."*

10. **Comm nt:** Appendix A, Development of Preliminary Remediation Goals (PRGs) for Operable Unit 4

It is unclear why this section is included as an appendix. Since development of PRGs is the focus of this document it would be more appropriate to include it in the main body of the document.

**Response:** The PRG document was included as an appendix so that the document could maintain consistency with the previous presentation of the PRG development (in the Interim Offshore Monitoring Plan) such that the body of the report could meet TtNUS' document format requirements without impacting the format of SAIC's document. The Executive Summary clearly indicates that the PRG development is provided in Appendix A and references the appendix appropriately. Please see the Navy's response to MEDEP Comment No. 5 for text revisions to clarify the document format.

11. **Comment:** App. A, 1.0 Background and Objectives, p. 1, para 5

"The most current WQC and SQC are used to develop the PRGs...For PRG Development USEPA SQC are not used..."

These two sentences are contradictory. Please clarify.

**Response:** The second to last sentence in the referenced paragraph was meant to indicate that SQC are not used as PRGs. However, various sediment quality guidelines are used to back-calculate water quality values when WQC are not available. This is discussed in the first full paragraph on Page 7. The text in the referenced paragraph on page 1 will be revised to clarify the use of SQCs. The text will be revised to read as follows:

Second sentence: "The most current WQC (or sediment quality guidelines when WQC are not available) are used to develop the PRGs."

Second to last sentence: "USEPA SQC are not used as PRGs because they are screening values, not cleanup goals."

12. **Comment:** App. A, 2.1 Overview of PRG Development Approach, p. 3, para 1

Please define within the text the term "ecologically significant".

**Response:** The text will be revised to *"ecologically important to sustaining the population."*

13. App. A, Overview of PRG Development Approach, page 5

a) **Comment:** Note that, focusing on an individual limiting contaminant of concern (L-COC) at each station does not address potential cumulative toxicity posed by multiple compounds. That said, data presented in Table A-2-2.10 suggests that actions to reduce the hazard quotient for the L-COC at each station to 1.0 will reduce the total HQ to between 1.0 and 2.0.

**Response:** The incorporation of the toxicity test into the development of the PRG accounts for cumulative toxicity because the test species are exposed to all COCs in the media. The procedure is conservative when considering a given COC because it assumes all of the toxicity being observed is due to that COC alone. Also, at the time PRGs are applied, the PRGs are assessed as to whether they address the risk from the EERA.

b) **Comment:** In Step 7, the location of PRG exceedances for each of the L-COCs was reviewed with respect to the spatial distribution and likelihood of observed risks at the site as concluded from results of the ecological risk assessment (ERA). "The relationship between the apparent risk reduction and remediated area is discussed and presented as Recommended PRGs (RPRGs) so as to provide input into risk management decisions regarding the setting of Final Remediation Goals." The first piece appears to be an attempt to discuss where potential risks as identified with PRGs agree with where risks were predicted based on generic benchmarks in the ERA. The meaning and intent of the second part is far too ambiguous to even venture a guess. The latter needs to be clarified at least. Upon clarification, it may be determined that the exercise is not acceptable.

**Response:** The Navy believes the process used to derive PRGs is appropriate for use as IRGs for the interim offshore monitoring program. The Navy would like to discuss the uncertainty of using these PRGs for the OU4 FS at the PRG technical meeting currently being planned.

In addition, the text will be revised as follows: "*The relationship between the potential risk reduction and PRG exceedance is evaluated to select Recommended PRGs (RPRGs) for input into risk management decisions regarding the selection of a final alternative for the site.*"

14. **Comment:** App. A, 2.2 Aquatic PRG Derivation, p. 5

"As identified in Section 1..."

Change this to "Section 2.1".

**Response:** The revision will be made as requested.

15. **Comment:** Appendix A, page 6

Note that the water quality criteria (WQCs) used for developing PRGs are for effects on directly exposed organisms and do not necessarily account for bioaccumulation. Presumably, bioaccumulation was to be addressed through the use of Food and Drug Administration (FDA) action levels (Table 1.0-2). However, it does not appear that such was done. Bioaccumulation can be factored into PRG development by using final residue values (FRVs) identified by the USEPA as part of WQC development. Alternatively, the site-specific BSAFs/BAFs can be used to calculate sediment PRGs from either human health risk-based (e.g., FDA action levels) or ecological risk-based target tissue concentrations.

**Response:** In the Interim Offshore Monitoring Plan (based on the Interim ROD and the results of the EERA and HHRA), trophic transfer to pelagic fish, birds or semi-aquatic mammals and

human exposure to sediment or seafood were not identified as site-related risks, and therefore PRGs were not needed for these receptors. The present process accounts for risks due to chemical accumulation for the identified receptor groups. It is agreed that the BSAF/BAF values could be used for either human health or ecological risk-based target tissue concentration comparisons, if needed. This was not included in the present assessment, as such risks have not been identified.

16. **Comment:** App. A, 2.2 Aquatic PRG Derivation, p. 7, para 1
"...whereas ER-L/TEL values..."

Given the prevalence of ratios in this document please change this to "...whereas ER-L and TEL values..."

**Response:** The text will be revised as requested.

17. **Comment:** Appendix A, page 8

Porewater was classified as toxic only if effects in test solutions were 20% different from controls and if the difference was statistically significant. Then, only tests that had two or more partial effect levels were considered for developing no observed effect concentrations (NOECs). The latter is a standard approach that reflects limitations of statistical analysis of dose-response data. This means there may be porewater samples that are toxic, but not to the extent that a statistical dose-response-based toxicity value can be developed. The summary of test results in Table 2.2-1 indicates that, for sea urchin larval development, pore water from 13 of the 27 locations fell into a toxic-but-not-quantifiable category. At a minimum, the spatial distribution of the sediments in question should be discussed, for example in Section 3.3.

**Response:** Agree. The following discussion will be added in Section 3.3:

The following text will be added to the last sentence of page 9, paragraph 1:

"Lastly samples with statistically significant mortality were determined to be non-toxic. This included samples from 13 locations (MS-2.1, 2.2, 3.2, 4.3, 6.3, 7.1, 8.1, 8.4, 9.2, 12.1, 12.2, and 14.2). As noted above, these incidences of partial mortality are not considered to be ecologically relevant for purposes of PRG development."

18. **Comment:** App. A, 2.2 Aquatic PRG Derivation, Step 2, p. 8, para 2

"Here, co-located data imply that a bulk sediment chemistry sample was collected at each location where an amphipod and sea urchin biotoxicity test was conducted."

This wording is confusing as the samples were collected in the field but the biotoxicity tests themselves were conducted in a lab. Please rephrase.

**Response:** The text will be revised to read as follows: *"Here, co-located data imply that bulk sediment chemistry data and biotoxicity data are generated from the same sample".*

19. App. A, 2.2 Aquatic PRG Derivation, Step 2, p. 8, last paragraph

a) **Comment:** The acronym ARB-NOEQ is not in the acronym list (more specifically, ARB is not in the list though we presume it refers to *Arbacia*). Please add this to the list.

**Response:** AMP (amphipod) and ARB (sea urchin) will be added to the acronym list as requested.

b) **Comment:** "In order to accurately determine the $EC_{50}$ value, the requirement that at least partial (and statistically significant) mortality must be observed in two or more of the treatments.

This is an incomplete sentence. Please correct.

**Response:** The sentence will be revised to read as follows: "In order to accurately determine the $EC_{50}$ value, the requirement that at least partial (and statistically significant) mortality need to be observed in two or more of the treatments must be met.

c) **Comment:** "From an ecological perspective, this was deemed appropriate given that epibenthic organisms such as sea urchins are not likely to be exposed to full strength seawater (100%)..."

This is an odd statement to make about a marine organism. Of course, all marine epibenthic organisms are exposed to full strength seawater. Please clarify this sentence.

**Response:** The text will be revised. Please see the Navy's response to EPA Comment No. 3 dated January 25, 2001 for the text revisions to this sentence.

20. **Comment:** Appendix A, page 9

The 95 percent upper confidence limits (UCL) of porewater HQ values associated with nontoxic samples are discussed. Please provide some discussion to support pooling data for all of the test locations.

**Response:** The following text will be added: "The data sets are pooled across all the sampled locations at the site in order to capture the widest possible range of chemical exposure concentrations and associated toxicity. The pooling is based on the assumption that the route of chemical exposure is the same for all the target receptors."

21. **Comment:** 3.1 Translation of Aquatic TEV Values into PRGs, p. 13

"Similarly, the degree of risk associated with porewater concentration of causing the effect in bedded sediment..."

This phrase appears to be missing some words. Please correct or clarify.

**Response:** The text will be revised to read as follows: "Similarly, the measured risk associated with the pore water concentration (i.e., TEV-HQ) should be the same as that attributed to the bulk sediment (i.e., PRG-HQ)."

22. **Comment:** Appendix A, PRG Calculation Results, page 14

The proposed PRGs are averages for all of the stations. The ranges of the estimated PRGs are shown in the table below and indicate that an average for all of OU4 might be inappropriate, especially for copper. The mean PRG for copper is unacceptably high, driven in part by at least one, and maybe two values that appear to be statistical outliers. Station-specific PRGs are unnecessary. However, other ways to group the PRGs need to be considered. The use of OU4-wide averages is questionable at this time. Other options that might be considered are (1) OU4-wide medians, or (2) averages over smaller areas.

**Proposed preliminary remediation goals (PRGs) for limiting contaminants of concern (L-COCs).**

| L-COC | PRG (mg/kg) | | Basis of the TEV (therefore the PRG) |
|---|---|---|---|
| | Mean | Range | |
| Copper | 547 | 6 - 4910 | Local reference |
| Nickel | 124 | 30 - 281 | Risk |
| Acenaphthylene | 0.210 | 0.033 - 0.540 | Risk |
| Anthracene | 1.344 | 0.213 - 3.456 | Risk |
| Fluorene | 0.536 | 0.085 - 1.379 | Risk |
| HMW PAHs | 13.057 | 2.177 - 32.325 | Risk |
| Total PCBs | 0.409 | 0.024 - 1.454 | Risk |
| Trans-Nanochlor | 0.003 | 0.001 - 0.008 | Risk |
| P,p'DDT | 0.066 | 0.018 - 0.171 | Risk |

**Response:** The use of site-wide averages, as stated, is to avoid area- or station-specific PRGs that would be unmanageable to implement. Also, the effect of incorporating sample data from locations where limiting CoC concentrations are low generally drive down the calculated site wide PRG, thus making the PRG more conservative. Also, please see the Navy's response to NOAA Comment No. 8 dated January 10, 2001 related to copper. The Navy suggests this issue be included on the agenda for the technical meeting currently being scheduled. Resolution of the issue will be documented in the minutes for the meeting.

23. **Comment:** Appendix A, 3.2 Spatial Implementation of PRGs, p. 14

"...results of the EERA have been used to classify the study area polygons based on the likelihood of adverse ecological risk caused by site-related COCs to aquatic receptors (Figure 3.2-1).....Because the implementation of PRGs are intended to reduce risk, the spatial distribution of risk should be considered when evaluating the results of PRG implementation."

The MEDEP is not entirely sure what is meant by the statement. It suggests that there is no sense in considering PRGs for those areas that were not previously determined to be associated with low to intermediate levels of risk. Such appears to be the case (see comment

26). The exercise as described is inappropriate. The PRGs are site-specific benchmarks to be applied in the same way as the more generic benchmarks used in the ERA. If the PRGs indicate that there may be some risk in an area that was previously determined to be at no risk, then the previous determination may have been in error. At a minimum, it may be concluded that the previous determination of no risk did not account for all possibilities, which is a given in ecological risk assessment.

**Response:** The inferred meaning of the sentence is incorrect. The Navy suggests revising the sentence as follows: "As the implementation of PRGs are intended to reduce risk, it is important to ensure that the PRGs, when compared to location-specific chemical concentrations, agree with the risk assessment findings; that is, PRG exceedances are observed where intermediate risks were identified in the EERA based on the full weight of evidence". Also, note that there are no areas where "no risk" was determined for sediment. All the AOCs were either determined to be low or intermediate risk for sediment.

24. **Comment:** Appendix A, 3.2 Spatial Implementation of PRGs, p. 15

The BSAF/BAF factors were calculated from monitoring data and used to predict sediment concentrations that would be required to explain measured concentrations in biota of hard-bottomed communities (i.e., where there are no bed sediments for collection). The Navy stated, "The resulting predicted sediment concentrations were compared against PRGs to assess concentration levels in biota." Why not just compare contaminant levels in biota to biota benchmarks? Or does the statement mean "...to evaluate potential for impacts on benthic and epibenthic organisms?"

**Response:** Navy will revise sentence as follows: "...to evaluate potential for impacts on benthic and epibenthic organisms"

25. **Comment:** Appendix A, page 16

Overall, mean BSAF values were calculated for polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) in mussel tissue. It is argued that there was considerable overlap in central tendency about the mean BSAF value among analytes, and generally good agreement between lobsters and mussels. A cursory review of the data in tables A-3-1.2e and A-3-1.2h suggest that the BSAFs for OCPs may vary with the analyte, between stations, and perhaps between species. A more detailed presentation of the BSAFs for OCPs is needed to agree that 1.1 is representative of all OCs in both species and at all stations.

**Response:** It is recognized that the observed variation is likely the result of limited sample size, and as more values are incorporated into the average, the variation will be lower. BSAFs and BAFs will be further evaluated in the Interim Offshore Monitoring Report using all four rounds of baseline interim offshore monitoring data.

26. Appendix A, page 17

a) **Comment:** Concentrations of COCs are compared with their respective PRGs, but only in areas that were previously characterized as posing low to intermediate ecological risk.

This focus is unacceptable (see comment 23). Data from all OU4 stations should be compared with PRGs, at least initially.

**Response:** The PRGs were compared to all locations and sampling rounds where chemical data were available, irrespective of risks (see Table A-3.1-3). It is true that some locations did not have a sum PRG-HQ value > 1 (blank values for MaX-PRG-HQ in Table 3.3-1), or otherwise did not have a PRG chemical at the location that was above the calculated baseline PRG (noted as "< 1" for MaX-PRG-HQ in Table 3.3-1). Hence, the data from these stations were not used to evaluate the Recommended PRG. However, all data from all monitoring stations will be continued to be compared against the PRGs until such time there is a consensus opinion that reduced monitoring is appropriate.

b) **Comment:** The use of OU4-wide average PRGs, particularly the PRG for copper is questionable. Consequently, the MEDEP has no comments at this time on the specific results reported in this section (3.3.1). See Comment 22.

**Response:** Please, see the Navy's response to MEDEP Comment No. 1 related to OU-wide PRGs and to MEDEP Comment No. 22.

27. App. A, 3.3.1 Baseline PRG evaluation, Copper, pp. 17 and 18

a) **Comment:** The ER-M for copper is 270 $\mu$g/g, not 270 ng/g. Please correct this.

**Response:** The text will be revised as requested.

b) **Comment:** last sentence, top of p. 18: change "nickel" to "copper".

**Response:** The text will be revise as requested.

28. **Comment:** App. A, 3.3.1 Baseline PRG evaluation, Total PCBs, p. 19

Change the stated ER-M for total PCBs from 9600 ng/g to 180 ng/g.

**Response:** The text will be revised as requested.

29. **Comment:** App. A, 3.3.1 Baseline PRG evaluation, p,p'-DDT, p. 19

In the first sentence, change o,p'-DDT to p,p'-DDT.

**Response:** The text will be revised as requested.

30. **Comment:** 3.3.2 Recommended PRGs evaluation, p. 20

While comparing the derived PRGs to results of the EERA is appropriate it appears that the Navy is placing more weight on the results of the EERA. That is, when the PRGs indicate that

there should be some level of unacceptable risk at a specific location, and the EERA doesn't indicate risk at that location, then the Navy seems to be modifying the PRG to reflect the results of the EERA. This is inappropriate for this stage of the process.

Furthermore, this section of the document gives the impression that these modified PRGs are being accepted as the final PRGs. The corresponding paragraph on page 5 (paragraph 7) more appropriately indicate that these values are for discussion purposes only. Also see Comment 23.

**Response:** The manner in which the results of the three rounds (ERRA, Rounds 1 and 2 from interim monitoring) of data are used to modify the PRGs is to follow the most conservative path; that is, the lowest recommended PRG that addresses the risk is selected based on the EERA weight of evidence determination of risk (see Table 3.3-2). In the case of the Round 2 data, this was true only for nickel. Given that this is a conservative approach, the Navy feels the process is acceptable for development of PRGs for use as the IRGs. However, as discussed in the Navy's response to MEDEP Comment No. 1, there are uncertainties with using the PRGs developed at this point as the PRGs for development of the FS for OU4. Additional investigation/study may be necessary to develop appropriate PRGs for use in the FS. The Navy would like to discuss this further at the PRG technical meeting currently being planned.

31. **Comment:** 3.3.2 Recommended PRGs evaluation, p. 20, para 2

"Given that only one location for each analyte is available to assess risk to PRG-HQ relationships, the selection of a Recommended PRG-HQ must default to unity (1.0) since the point of departure between low and intermediate risks cannot be discerned..."

What is the connection between "the point of departure between low and intermediate risks" and selecting a Recommended PRG-HQ? Please explain this more clearly. The risk management decisions for both low risk and intermediate risk as stated in the EERA are the same: "Development of preliminary remediation goals (PRGs) and feasibility study are recommended." Therefore, it is unclear why any effort is being made to differentiate low risk and intermediate risk areas.

In addition, the parties involved in the EERA never intended there to be a precise point differentiating low and intermediate risk. Rather the level of risk was determined through a combination of evidence of exposure and evidence of effect.

**Response:** It is agreed that for the present purposes of developing the IRGs, and the conduct of interim monitoring, differentiation between low and intermediate risks is unnecessary. However, the Navy believes it is useful to demonstrate that there is a PRG-risk relationship, where possible. Hence, the last sentence of p. 20, par. 2, will be revised as follows: "Following a conservative approach, the selection of the Recommended PRG-HQ defaults to unity when only one location for each analyte is available to assess risk to PRG-HQ relationships (Figure 3.3-1a, Table 3.3-1a)".

32. **3.3.2 Recommend d PRGs valuation, p. 21 para 2**

"...no reliable relationship between PRG exceedance and risk was observed such that it was not possible to select a PRG-HQ that would represent a point of departure between low and intermediate risks. Hence, a PRG for p,p'-DDT is not recommended."

a) **Comment:** Please change this to "...no reliable relationship between PRG exceedance and risk was observed, therefore it was not possible to select a PRG-HQ..."

**Response:** The text will be revised as requested.

b) **Comment:** As indicated above, the MEDEP sees no need to find a point of departure between low and intermediate risks. Furthermore, the MEDEP does not understand how failure to select a PRG-HQ that would represent a point of departure between low and intermediate risk leads to a conclusion that a PRG for p,p'-DDT is not recommended.

As MEDEP has stated repeatedly in the past, we hold the Navy responsible for DDT in the sediments around the Shipyard, regardless of its status as a CoC. Therefore a PRG acceptable to the MEDEP for DDT must be developed.

**Response:**
The Navy recognizes the MEDEP's position on pesticides and therefore, the Navy has agreed to include pesticides in the PRG development process. As provided in the Interim Offshore Monitoring Plan (page 2-1), "Pesticides have not been linked to an onshore IRP site at the current time and therefore have not been identified as COCs for OU4. However, the Navy has agreed to calculate PRGs for pesticides should they become a COC in the future." Therefore, although included in the PRG development process through calculation of baseline PRGs, as appropriate, a PRG for pesticides cannot be recommended at this time because pesticides have not been identified as offshore COCs.

33. **Comment:** 4.0 Uncertainty Analysis, p. 21

"...the implementation of the baseline PRG values (i.e., as recommended PRGs)..."

Again, the difference between baseline and recommended PRG values is confusing. How does this phrase compare with the second paragraph on p. 22 that indicates that the baseline PRGs are contrasted with the recommended PRGs? Please clarify.

**Response:** The following text will be added "The baseline PRG values can be viewed simply as calculated values that are yet to be validated against the independent benchmarks and the risk assessment findings". This explains the page 22 sentence that reads: "In contrast to the baseline PRGs, the recommended PRGs are derived by performing a check that the selected CoCs and corresponding PRG concentrations adequately represent the risk characterization provided in the EERA"

34. **Comment:** 4.0 Uncertainty Analysis, p. 22, para 3

"The finding that many of the PRGs identified in this report agree well with those PRGs identified from use of the EERA data...reduces this uncertainty [of whether or not attenuation has occurred]..."

This statement seems to state that there is little uncertainty (not just less uncertainty) of the potential for chemicals to attenuate since samples were collected for the EERA. However, the following paragraph indicates that chemical attenuation is possible. Also, the second full paragraph on p. 21 states, "...it would appear that since sediment concentrations did not exceed the PRGs [at certain specific sites with intermediate risk]...or that risks at these locations have abated since the EERA was conducted."

The statement on p. 22 paragraph 3 seems to dismiss a strong possibility of attenuation of chemicals. Please clarify these contradictory statements.

**Response:** The emphasis was wrongly placed on attenuation. Rather, the discussion is meant to convey that the primary CoCs contributing to risk are assumed to be the same between the EERA and the subsequent sampling rounds, and thus in the interim, the list of CoCs had not completely changed. Hence, the first sentence of p. 22, par. 3 will be revised to read: "For purposes of PRG development, it is assumed that a fundamental change in CoC bioavailability has not occurred..."

35. **Comment:** Table A-2-2.5

This is a table of hazard quotients where values greater than or equal to 1.0 are significant. Therefore, it would be useful to highlight those values greater than or equal to 1.0 within the table.

**Response:** The requested change will be made.

36. **Comment:** Table A-2-2.10.

The footnote to this table should also reference Table 2.2-5 as Table 2.2-4 only shows concentrations, not TEVs.

**Response:** The requested change will be made.

**RESPONSES TO COMMENTS SAPL COMMENTS DATED JANUARY 25, 2001 ON DRAFT PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

1. **General Comment:** We found the document very difficult to read and understand. While we understand the overall process for developing Preliminary Remediation Goals (PRGs), we were unable to follow the actual PRG development and we cannot say at this time that the PRG values presented are acceptable. To do so, we would have to recreate the work performed, which time and budget do not allow. Therefore, our comments below do not reflect sufficient understanding to say if the report and its conclusions are accurate and appropriate. We are also relying on comments dated January 23, 2001, that were submitted by the Maine Department of Environmental Protection (MEDEP), and, in the interest of efficiency, our comments below do not repeat most of the issues and questions already covered by MEDEP. We are particularly concerned with the interpretation and application of OU4-wide average PRGs (MEDEP comments 1 and 21).

   **Response:** The process used in this document is the same process outline in the Interim Offshore Monitoring Plan. The Navy hopes that additional explanation of the process at the PRG technical meeting and discussion of issues raised in the comments related to the process will assist in providing a better discussion of the development of PRGs. Please see the Navy's responses to MEDEP Comments dated January 23, 2001, including the responses to MEDEP Comment Nos. 1 and 22 related to OU4-wide average PRGs.

2. **Comment: Page ES-1, PRG BACKGROUND.** The text states that the PRG development approach uses data to "*...establish sediment-based concentrations that represent thresholds below which adverse effects on ecological and human receptors are not expected to occur.*" As MEDEP points out in their comment number 1, the PRGs do not account for exposure via ingestion of contaminants associated with sediment particles. It is appropriate to check at this time if there are contaminants of concern (CoCs) for which the ingestion pathway is significant.

   We also find the statement quoted above to be at odds with passages later in the document. For example, page 3 in Appendix A states that the objective of PRG development is "*...to determine sediment-based concentrations that represent thresholds below which adverse effects on sediment-associated aquatic biota (i.e., benthic organisms) are not expected to be ecologically significant.*" Does "ecologically significant" mean there will be no effects? If so, the text on page 3 and elsewhere should be revised. If not, the text on page ES-1 and elsewhere should be revised.

   **Response:** Please see the Navy's response to MEDEP Comment No. 1 dated January 23, 2001 related to the comment on the exposure via ingestion of contaminants (by aquatic organisms).

   Following a conservative approach, it is assumed that all adverse effects are ecologically significant hence the meanings are the same. This clarification will be provided on page 3 in Appendix A "*...to determine sediment-based concentrations that represent thresholds below which adverse effects on sediment-associated aquatic biota (i.e., benthic organisms) are not expected to be ecologically important to maintenance of the population".*

3. **Comment: Pag ES-2, PRG BACKGROUND.** The basic assumption of the PRG development approach is that concentrations of chemicals in sediment, porewater, surface water, and biota are in equilibrium. Does the currently-available date support this assumption? How will the on-going monitoring data be evaluated to check this assumption? What action will be taken if the monitoring data or other information indicates this assumption is incorrect? What is the "sanity check" mentioned later in the paragraph?

   **Response:** The assumption being made is widely applied in sediment toxicology, not just to this site. It has been demonstrated by EPA to be sufficiently defensible so as to support the development of Sediment Quality Criteria. The agreement between site-specific BSAFs and literature values is evidence that the sediment and tissue are in equilibrium. The agreement between calculated pore water effect concentrations and the Water Quality criteria also supports the assumption. Hence, the Navy does not foresee the need to continually validate the assumption. Please see the Navy's response to MEDEP Comment No. 8 dated January 23, 2001 for the response and text revision related to the last sentence in the first paragraph on ES-2.

4. **Comment: Page ES-2, PRG Derivation.** This paragraph covers the assumption regarding selection and remediation of limiting CoCs, those CoCs that are responsible for much of the baseline risk. By remediating limiting CoCs, collocated CoCs will be remediated to levels that will not have adverse effects. Does the data support this assumption? We also reiterate MEDEP's comment number 11, that focusing on a limiting CoC does not address potential cumulative toxicity.

   **Response:** MEDEP Comment No. 13a dated January 23, 2001 discusses the limiting COCs related to cumulative toxicity. Please see the Navy's response to MEDEP Comment No. 13a.

5. **Comment: Page ES-3, PRG Implementation.** The description of Step 7 at the top of page ES-3 doesn't seem to Evaluate practicality of candidate PRG for effective risk reduction.", as stated in Table ES-1. We do not understand the use of "practicality" in this situation.

   **Response:** The meaning of the term is provided in Step 7 on p. 5, in that it is not practical to adopt PRGs that do not address risk at the site.

6. **Comment: Page ES-3, PRG Implementation.** The final paragraph states that the PRGs are consistent with the findings of the risk assessment. What does that mean? (See comment 15, below.)

   **Response:** The statement means that the areas (i.e., Sullivan Point, Back Channel, and Dry Docks) identified in the EERA as having intermediate risks associated with them are the same areas where sediment concentrations were found to be above the PRGs.

7. **Comment: Page ES-3, DATA USED IN PRG DEVELOPMENT FOR OU4.** The text should state why Round 2 data was used for PRG development, and how PRGs will be evaluated and possibly modified based on additional monitoring data in the future.

**Response:** The text will be revised to indicate that in accordance with the Interim Offshore Monitoring Plan for OU4, only the Round 2 spring sampling data set contained both chemistry and toxicity data required for the derivation portion of the PRG development process. The Round 1, Round 2, and EERA data were used to evaluate reasonableness of the calculated PRGs for addressing risks at the site. Also please see the Navy's response to EPA Comment No. 1 dated January 25, 2001 and MEDEP comment No. 2 dated January 23, 2001.

8. **Comment: Page ES-4, DATA USED IN PRG DEVELOPMENT FOR OU4.** A couple of problems encountered during the Round 2 sampling and analysis are presented in the third and fourth bullets. Sufficient pore water could not be extracted from sediment sample OU4-SD-M14-300B, so surface water from the back channel was added to the sample, and then extracted from the sample as pore water after 24 hours. Is 24 hours sufficient for concentrations in the water and sediment to equilibrate? Where was the surface water sample collected in relation to the sediment sample? What effect might this have on the results? The initial volume of sediment collected at the reference stations was insufficient, so resampling was conducted two weeks later. What effect, if any, did the delay in sampling have on the results?

   **Response:** The text will be revised to indicate that sufficient pore water could not be extracted from sediment sample OU4-SD-M14-100B. The treatment of the sample was intended to mimic tidally influenced sediments where daily flushing and draining of sediments occur with the rise and fall of the tide. It is not known if the sample was completely equilibrated, but the procedure should present worst-case conditions of the potential for partitioning. The surface water was from sub-tidal water collected in proximity to the sediment.

   The short length of time between the sampling efforts is of the same scale as required to complete a single sampling effort. This should have no effect on the results.

9. **Comment: Page ES-4, DATA USED IN PRG DEVELOPMENT FOR OU4.** The paragraph beneath the bullets states that pesticides have not been linked to an onshore IRP site at the current time and so are not identified as COCs for OU4. We agree with the MEDEP's position (MEDEP comment number 31) that a PRG for DDT must be developed.

   **Response:** Please see the Navy's response to MEDEP Comment No. 32 dated January 23, 2001 related to PRG for pesticides.

10. **Comment: Table ES-2.** Why do the recommended PRGs in this table differ from those in Table 2.2-6 in Appendix A? Comment 9, above, also applies to Table ES-2. We had commented in our June 18, 1998, letter on the PRG development approach about the need to consider health advisories pertaining to fish consumption as part of the process. How do the recommended PRGs compare with fish consumption advisory thresholds?

    **Response:** As provided in the footnote for the Table ES-2, the values in the table are from the Recommended PRGs column of Table 3.3-2. The PRGs in Table 2.2-6 are the baseline PRGs. The PRGs are sediment-based concentrations and are thus not directly comparable to tissue-based thresholds.

SAPL Comment No. 4 dated June 18, 1998 pertains to fish consumption. The Navy responded in their response to comments letter dated July 20, 1998 as follows: "Based on information currently available, the Navy believes that PRGs for protection of human health will not need to be developed for PNS." And, as part of the interim remedy, it was determined that PRGs for the protection of human health were not necessary. The PRG process was conducted in accordance with decisions documented in the Interim ROD (Navy, 1999) and implemented in the Interim Offshore Monitoring Plan (TtNUS, 1999). The Interim Offshore Monitoring Plan provides the presentation of the PRG development approach that was used in the current document. As provided in the Interim Monitoring Plan, PRG development for OU4 addresses ecological receptors. PRGs to address human receptors is not necessary based on the results of the risk assessments.

11. **Comment: Appendix A, Page 1, Section 1.0 BACKGROUND AND OBJECTIVES.** The conflicting statements in the last full paragraph on the page regarding the use/non-use of the proposed Sediment Quality Criteria (SQCs) should be revised. Also, are the SQCs intended to protect 95 percent of all individuals present, or 95 percent of species present regardless of the number of individuals present.

    **Response:** Please see the Navy's response to MEDEP Comment No. 11 dated January 23, 2001 for text revision to clarify how the SQC were used in the PRG process. The SQCs are intended to protect for chronic effects in 95% of the species. The criteria do not attempt to predict population effects (e.g., nos. of individuals) for a given species, but the tests are based on changes in the numbers of individuals that are used in the test.

12. **Comment: Appendix A, Page 2, Section 2.0 PRG DERIVATION.** In addition to the assumption regarding co-located CoCs (see our comment number 4, above), the PRG development process also assumes that the "...*CoCs selected as* [for?] *PRGs adequately represent risks posed by all site-related CoCs, e.g., there does not exist novel chemicals at high concentrations that have not yet been detected...*" As we noted in our September 2, 1999, comments on this aspect of the PRG process description in the *Draft Final Interim Offshore Monitoring Plan for OU4*, dioxin, for example, had not been an analyte in previous offshore sampling and we questioned how detection of dioxin would affect PRG development. How was dioxin considered in the PRG development? If"novel" chemicals are detected, how will they be addressed via PRGs?

    **Response:** As provided in the response to SAPL's Comment F dated September 2, 1999 on the Draft Final Interim Offshore Monitoring Plan (see Appendix B.5, page 28 of the final Interim Offshore Monitoring Plan, TtNUS, October 1999), "The dioxin concentration data will require a screening evaluation for assessment of potential ecological risk. That is, the concentration results will need to be evaluated against literature-based benchmarks for toxicological effects and evidence of toxicity from testing of collocated samples. If dioxin is determined to be a potential risk contributor, then additional data will be necessary to address PRG data needs. When dioxins detected in the offshore are determined to be from a PNS site, dioxin PRGs will be developed by the Navy."

    The dioxin data are being collected and will be evaluated as part of the Baseline Interim Offshore Monitoring Report (which will be prepared after the fourth round of baseline monitoring).

13. **Comment: Appendix A, Page 11, S ction 2.2 Aquatic PRG Derivation.** The last paragraph on the page requires additional explanation about how narcosis theory supports the first sentence in the paragraph.

**Response:** The Navy agrees that clarification would be helpful. Hence, the following text will be added as the second sentence of the indicated paragraph: "Narcosis theory supports the Limiting CoC concept because if the CoCs have similar mode of action, then the total risk of all CoCs in the sample can be summed (i.e., sum HQ) and compared directly to toxicity responses in the samples".

14. **Comment: Appendix A, Pages 17-19, Section 3.3.1 Baseline PRG Evaluation.** It would be helpful to have a table summarizing the information presented in this section.

**Response:** A table presenting the comparison of site-specific PRGs with the literature benchmarks will be provided.

15. **Comment: Appendix A, Page 21, Section 4.0 UNCERTAINTY ANALYSIS.** The second sentence in the section states that "*Areas of PRG exceedence also appear to correspond well with areas of observed risk such that the implementation of baseline PRG values (i.e., as recommended PRGs) would appear to be reasonable from a risk-based perspective.*" This statement appears to be at odds with the passage in the previous paragraph that states the PRGs did not address a number of intermediate risk locations around PNS. Additional explanation is required.

**Response:** The following text will be substituted for the 2nd sentence of Section 4 to provide additional explanation: "Although every sampling location around PNS did not have a PRG exceedance, multiple sampling locations within each of the intermediate risk areas (i.e., Dry Docks, Back Channel, Sullivan Point) did exhibit PRG exceedances. Thus, a*reas of PRG exceedance appear to correspond well with areas of observed risk such that the implementation of baseline PRG values (i.e., as recommended PRGs) would appear to be reasonable from a risk-based perspective*".

16. **Comment: Appendix A, Page 21, Section 4.0 UNCERTAINTY ANALYSIS.** The second paragraph opens with the statement that the process leading to the calculated baseline PRGs is largely quantitative and devoid of professional judgement. We find that statement misleading as it implies that deriving a PRG is not much more than a standardized "plug and chug" exercise. Instead, designing the PRG development process required professional judgement all along the way, particularly with regard to formulating the underlying assumptions. These underlying assumptions contribute significantly to the uncertainties both with the resulting PRG values and with how those PRGs should be applied in making decisions about risk and remediation. The text should be revised appropriately.

**Response:** The text will be revised as follows: "The process of calculating the baseline PRGs is largely quantitative, although considerable professional judgement and input from regulators and Trustee's were incorporated into designing the process and the sampling program to collect the necessary data needed for development of PRGs".

17. **Comment:** **App ndix A, Tables 2.2-2 - A-3-1.3c.** It is unclear how the data in the tables in the second half of Appendix A were used, and what information (and why) is included or dropped. Perhaps a sample calculation would help the reader track the process.

**Response:** The "A" tables were used to support the PRG calculations. Please see the Navy's response to MEDEP Comment No. 1 for text revisions to clarify the "A" tables.

## 3.2 RESPONSE TO FOLLOW-UP COMMENTS ON DRAFT PRG DOCUMENT

**RESPONSES TO USEPA FOLLOW-UP COMMENTS DATED APRIL 12, 2001 ON DRAFT PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

The following are EPA's comments on the Navy's responses to EPA's comments on the draft Preliminary Remediation Goals Report. These responses were dated March 9, 2001.

The comments below also reflect discussions held during the technical meeting regarding these responses. This meeting was held April 3, 2001.

1. **Comment:** EPA does not have any further comments regarding the specific responses provided by the Navy.

   **Response:** Comment noted.

The following comments are related to discussions regarding issues raised during the technical meeting.

2. **Comment:** The Acute Chronic Ratio (ACR) should be based on chemical-specific studies using flow-through exposure with measured toxicant concentrations. The generic ACR (=8) may be used if such studies do not exist. Table 2.2-1 should be updated if chemical-specific flow-through ACR values can be obtained from the literature for DDT, aldrin, silver, and naphthalene.

   **Response:** The Navy has investigated the availability of chemical-specific ACR values and has summarized this information in a new Table A-4 to be added to the PRG document. Updated values for the affected chemicals will be reflected in Table 2.2-1. These chemicals include silver, aldrin, naphthalene, BHC (alpha, beta, gamma, delta isomers), DDD (o,p', p,p' isomers), and DDE (o,p', p,p').

3. **Comment:** Some of the EPA Water Quality Criteria should be updated in Table 2.2-1 based on EPA, 1999.

   **Response:** In addition to changes being made as indicated in the Navy's response to USEPA Comment No. 2 above, updated values will provided in Table 2.2-1 based on EPA (1999). This change modified some of the values listed for metals, but none of changes affect the Water Quality Screening Values (WQSVs). However, additional updates to the table were made based on values for pesticides obtained from NOAA (Buchman, 1999). The analytes included 1,2,3,5-tetrachlorobenzene (and by assumption of similarity, 1,2,3,4-tetrachlorobenzene) and hexachlorobenzene, which previously did not have WQSVs. This change will provide a more complete assessment of the measured analytes for PRG development.

   Also, a slight change in the calculated WQSV for Low Molecular Weight (LMW), High Molecular Weight (HMW), and Total Polycyclic Aromatic Hydrocarbon (PAH) values was made because of a change in the predicted partitioning coefficient (Kow) of these chemical class aggregates. Presently, the Kow is calculated as the median of the analytes as defined in the footnote of the table whereas previously additional analytes within that PAH class had been included in the

calculation. This change was made such that the same analytes used to derive the Kow values are the same as used to derive the field-based sediment and pore water concentrations (i.e., same analyte lists used in each case). While the resulting values are slightly higher, the consistency in the approach should provide an improved assessment of PRGs for these chemical class aggregates.

4. **Comment:** Please identify which of the proposed PRGs are based on a reference-based TEV, rather than a NOEC-based TEV. For those TEV based on a reference-based TEV, please provide tables of contaminant concentration data and the results a statistical analyses that show that the site samples are consistent with background.

   **Response:** The information containing the comparison of the No Observable Effects Concentration (NOEC) with the reference value is provided in Table 2.2-4. Chemicals where the reference value is greater than the NOEC will have PRGs that are reference-based. The table including the updated list of PRGs will be provided with the draft final interim submittal. The use of the reference concentration does not indicate that the site samples are consistent with the background concentrations. The NOEC, which is used to set the PRGs if it is greater than the reference concentrations, is only based on the non-toxic samples, not the toxic samples. Therefore, the chemical concentrations in all of the site samples are not expected to be consistent with background. The reference concentration is used to ensure that the PRGs are not lower than the reference concentrations.

5. **Comment:** EPA would like to see a sensitivity analysis in which PRGs are calculated under two alternate procedures: 1) sea urchin toxicity test samples are designated "Toxic" if effects are significant at any pore water concentration (e.g. those samples marked with one or more X in table 2.2-2), and 2) PRGs are calculated based only on amphipod toxicity test data.

   **Response:** The Navy does not agree to provide the requested sensitivity analysis because the rational for selecting the toxic samples is based on commonly accepted scientific practices. For example, NOAA (1994), in a study of pore water toxicity to sea urchin fertilization for samples taken from Tampa Bay, FL, reported the following:

   > *"Since the sea urchin tests with the 100% pore water indicated the majority of the samples were significantly toxic, the data from the 25% pore water tests were used as more conservative indicators."*[1]

   (1) - NOAA, 1994. Magnitude and Extent of Sediment Toxicity in Tampa Bay, Florida. NOS Technical Memorandum NOS ORCA 78, p. 38

   Thus, the NOAA approach, essentially eliminated the consideration of the 100% (and apparently 50%) samples in assessing sediment toxicity. In the present study, the Navy's use of samples with toxicity in dilutions of 50% or more represents an equivalent and perhaps more conservative approach than that used in the NOAA study.

   The example PRG document indicated that the PRGs would be calculated using results from both the amphipod and sea urchin toxicity tests. Both species are used to develop the PRGs because the two species may have different sensitivities to the same chemical. Therefore, it would not be appropriate to only use the data from one species to develop a PRG when the data from both species were collected.

6. **Comment:** Many of the PRGs are higher than Effect Range Median (ERM) concentrations of Long et al (1995). The ERM is the concentration above which adverse effects are likely, based on the results of numerous studies. As shown in the table below, the proposed PRGs for copper, nickel, anthracene, high molecular weight PAHs, PCBs, and DDT are higher than the ERM by factors of 1.2 to 2.4. The differences between the proposed PRGs and ERMs are discussed in section 3.3.1 of the report, but the text is confusing because the PRGs and the ERMs are presented in different concentration units. I recommend that the PRGs be compared with ERMs in a table similar to the table below in which all parameters have identical concentration units.

| Chemical | PRG (ug/kg) | ERL (ug/kg) | ERM (ug/kg) |
|---|---|---|---|
| Copper | 546,600 | 34,000 | 270,000 |
| Nickel | 124,400 | 20,900 | 51,600 |
| Acenaphthylene | 210.1 | 44 | 640 |
| Anthracene | 1,343.9 | 85.3 | 1,100 |
| Fluorene | 536 | 19 | 540 |
| HMW PAHs | 13,057 | 1,700 | 9,600 |
| Total PCBs | 409.26 | 22.7 | 180 |
| Trans-Nonachlor | 3.24 | NA | NA |
| p,p'-DDT | 66.4 | 1.5 | 46.1 |

PRG = Preliminary Remedial Goal (Tetra Tech NUS, Inc. 2000)
ERL = Effects Range Low (Long et al, 1995)
ERM = Effects Range Median (Long et al, 1995)
HMW PAHs = High Molecular Weight Polynuclear Aromatic Hydrocarbons

**References**

EPA. 1999. *National recommended water quality criteria-correction.* EPA 822-Z-99-001.

Long, E. R., D. D. MacDonald, S. L. Smith, and F. D. Calder. 1995. *Incidence of adverse biological effects within ranges of chemicals concentrations in marine and estuarine sediments.* Environmental Management 19(1): 81-97.

Tetra Tech NUS, Inc. 2000. *Preliminary remediation goals for operable unit 4 Portsmouth Naval Shipyard, Kittery, Maine.* November, 2000.

**Response:** PRGs are developed using site-specific data, which is why they are different that the ER-M values. However, as indicated in the Navy's response to EPA Comment No. 9 dated January 25, 2001 (provided in TtNUS correspondence dated March 9, 2001), the requested table will be included as an appendix to the PRG document.

**RESPONSES TO MEDEP FOLLOW-UP COMMENTS DATED APRIL 10, 2001 ON DRAFT PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

The Maine Department of Environmental Protection has reviewed the document referenced above. Many of the Navy's responses and State's concerns were discussed at the April 3, 2001 technical meeting. For the most part the Navy addressed our concerns at that meeting. However, the Department still has minor concerns regarding the potential for increased (over that calculated by the PRG process) bioavailability of contaminants to deposit feeding benthic organisms. The following comment discusses our concern.

1. **Comment:**

MEDEP Comment 1

MEDEP: "The PRGs do not account for exposure via ingestion of contaminants associated with sediment particles."

Navy response: "The process presented addresses ingestion (by aquatic organisms) of contaminants associated with sediment particulates. The use of an EqP pore water approach is fundamentally based in the premise that because contaminants in pore water and bioavailable contaminant on sediment particles are in equilibrium, either contaminant phase could be measured to represent the chemical exposure."

MEDEP followup comment: The MEDEP's concern regarding ingestion of contaminants has to do with the equilibration of contaminants between sediment particles and digestive fluids within the gut of deposit feeders, not porewater. It is this issue (porewater vs. digestive fluids) that we wanted the Navy to address. Mayer et. al. (1996)1 (attached) found good correlations on a relative level between gut fluid-sediment partitioning and seawater-sediment partioning. However, they also found that solubilization of contaminants during digestive attack is considerably greater than predicted from seawater-solid partitioning. As stated in Mayer et. al. (1996):

> "Estimates of contaminant impact are increasingly based on partitioning of contaminant between water and the solid phase...Our results for Cu show highly significant correlations ($p<0.01$) between the amounts solubilized by clean seawater attack vs extraction by digestive fluid from each of the two species of animal used in this study [the polychaete worm *Arenicola marina* and the sea cucumber *Parastichopus californicus*]...This finding is consistent with the good correlations found between toxicity and pore water concentrations...in that each measure may provide predictive value regarding which sediments have relatively high bioavailable concentrations.

Solubilization of contaminants during digestive attack is however considerably greater than predicted from seawater-solid partitioning, so that the correlations of Figure 3 [charts showing correlation between digestive fluid extraction and seawater extraction] implicate only the rank

1 Mayer, L. M., Z. Chen, R.H. Findlay, J. Fang, S. Sampson, R.F.L. Self, P.A. Jumars, C.Quetel, and O.F.X. Donard. 1996. Bioavailability of Sedimentary Contaminants Subject to Deposit-Feeder Digestion. Env. Sci. Tech. 30:8, pp. 2641-2645.

order of sediments. The actual exposure to Cu during digestive attack is much greater than can be explained by pore water concentrations. Enrichment factors, defined as ratios of the amount solubilized by digestive fluid relative to that by seawater, ranged from 9 to 235 for PAH experiments in which measurable release was found for the seawater incubations. Even greater factors are implied for samples with PAH levels below detection in the seawater incubations. **For Cu release from contaminated sediments, enrichment factors ranged from 5 to 2389, showing that digestive fluids solubilize much more metal than does seawater. Seawater-solid partitioning models, therefore, would underestimate absolute bioavailability under digestive conditions**, a conclusion consistent with previous studies [emphasis added]...Furthermore, the high variability in enrichment factors reduces the predictive power of water-solid partitioning or models for patterns of relative contaminant impact."

It should also be noted that some of the contaminated sediments used in this study were collected from Portsmouth Harbor, although the exact locations were not stated.

The Navy's response states "We measure pore water and assume that the chemicals in the pore water are 100% bioavailable...". But this only accounts for the concentration of chemicals that are sea-water extractable. As indicated in Mayer et. al. (1996) the concentration of chemicals that are bioavailable within the gut of deposit feeders may be significantly higher. The MEDEP's main concern is that the Equilibrium Partitioning approach does not seem to apply within a deposit feeding organism. Therefore, while the PRGs may be appropriate for organisms not ingesting contaminated sediment, they may not be protective of deposit feeding organisms.

During the April 3 technical meeting Greg Tracey indicated that some researchers have found that solubilization of contaminants during digestive attack is not that significant compared with solubilization by seawater. It would be helpful to include some of these references in your response to this comment.

My notes from the April 3 meeting indicate that Greg Tracey also stated that ingestion of sediments did not seem to be a significant factor leading to risk at OU4 as there were no areas of risk found during the offshore Ecological Risk Assessment that aren't covered by the draft PRGs. According to the November 2000 Draft PRG document, the only exceedances of a PRG at Clark Cove were for nickel and DDT when using the Round 2 monitoring data, and the Navy is not recommending a PRG for DDT. When using Round 1 data, DDT is the only PRG that is exceeded at Clark Cove, and when using the EERA data, no PRGs are exceeded at Clark Cove (or most other AOCs for that matter). Clark Cove is significant when discussing deposit feeders as the EERA identified Clark Cove as having benthic communities different from all other areas in OU4, namely in terms of reduction of species. The EERA indicates that 55.3% of the variation in total species in the benthic communities were explained by variations in mean sediment grain size and eelgrass biomass. However, an additional 17.6% of the variation is explained by "several contaminant parameters" (total metals and PCBs).

At this stage, the MEDEP does not believe that ingestion of contaminated sediment is a highly significant source of risk to benthic infauna, primarily because in general the EERA found that benthic community density, richness, and evenness in all of OU4 were not significantly different to reference sediments. However, the potential for increased bioavailability of contaminants due to digestion of contaminated sediments needs to be kept in mind throughout the PRG development/FS/remediation stages of OU4.

**Response:** The Navy does not discount that studies exist that indicate possible additive exposure from ingested sediment. However, in developing the PRGs, the Navy has followed

EPA's procedures for estimating exposure per the Sediment Quality Criteria program which has been peer-reviewed by the EPA Science Advisory Board. The process represents a consensus opinion regarding available information to date, includes site specific toxicity tests as an integral part in the process of developing the PRGs, and includes organisms (i.e., amphipods) that do integrate all sources of chemical exposure (including ingestion). Therefore, the potential for increased bioavailability of contaminants due to digestion of contaminated sediments is included in the PRG process, and through the application of PRG will be considered in subsequent steps of the CERCLA process for OU4.

2. **Comment:**

MEDEP Comment 4

MEDEP: "...the Navy should provide a detailed description of how the PRG for each compound was derived."

Based on the discussions at the April 3 meeting it is our understanding that the Navy will provide one or more examples of how the PRG was derived for a particular compound.

**Response:** The Navy has agreed to provide example "walk-through" narratives for representative PRG chemicals (e.g., one metal and one organic) that explain how the PRGs were developed, with specific references to appropriate tables at each step. Example calculations are provided in the PRG approach document.

**RESPONSES TO SAPL FOLLOW-UP COMMENTS DATED APRIL 11, 2001 ON DRAFT PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4 PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

We are transmitting comments on behalf of the Seacoast Anti-Pollution League (SAPL) concerning the Navy's March 9, 2001, responses to our comments on the Draft *Preliminary Remediation Goals for Operable Unit 4*. Most of the Navy's responses to our January 25, 2001, comments, and the information provided at the April 3, 2001, technical meeting, satisfied our concerns. We have repeated our original comments below where we still have unanswered questions or issues.

1. **Comment:**

**Original Comment 1. General Comment.** We found the document very difficult to read and understand. While we understand the overall process for developing Preliminary Remediation Goals (PRGs), we were unable to follow the actual PRG development and we cannot say at this time that the PRG values presented are acceptable. To do so, we would have to recreate the work performed, which time and budget do not allow. Therefore, our comments below do not reflect sufficient understanding to say if the report and its conclusions are accurate and appropriate. We are also relying on comments dated January 23, 2001, that were submitted by the Maine Department of Environmental Protection (MEDEP), and, in the interest of efficiency, our comments below do not repeat most of the issues and questions already covered by MEDEP. We are particularly concerned with the interpretation and application of OU4-wide average PRGs (MEDEP comments 1 and 21).

**Navy Response:** The Navy's response focuses on having discussions at a PRG technical meeting to address comments regarding the PRG process.

**Additional Comment:** Reviewing the PRG development process at the April 3, 2001, technical meeting was helpful. Regarding the difficulty in reading and understanding the document, the Navy and the EPA acknowledged at the technical meeting that the readibility of the report needed to be improved so that the regulatory agencies' technical experts could express confidence in the PRG development. Example calculations should be included in the revisions. The Executive Summary should also be rewritten so that the public can understand the process and results.

**Response:** As discussed at the April 3, 2001 technical meeting, the Navy will add table references for the equations provided in Table ES-1 and example calculations will be provided in the PRG report.

As the Navy indicated in the April 3, 2001 technical meeting, the Navy agreed to review the Executive Summary to try to provide additional explanation of the PRG development process; however, the document is a very technical document and the Navy does not believe that it is appropriate to try to revise the document to provide non-technical discussions. The Navy will also prepare a fact sheet for the public to provide a non-technical explanation of the PRG development process.

2. **Comment:**

**Original Comment 2. Page ES-1, PRG BACKGROUND.** The text states that the PRG development approach uses data to "*...establish sediment-based concentrations that represent thresholds below which adverse effects on ecological and human receptors are not expected to occur.*" As MEDEP points out in their comment number 1, the PRGs do not account for exposure via ingestion of contaminants associated with sediment particles. It is appropriate to check at this time if there are contaminants of concern (CoCs) for which the ingestion pathway is significant.

We also find the statement quoted above to be at odds with passages later in the document. For example, page 3 in Appendix A states that the objective of PRG development is "*...to determine sediment-based concentrations that represent thresholds below which adverse effects on sediment-associated aquatic biota (i.e., benthic organisms) are not expected to be ecologically significant.*" Does "ecologically significant" mean there will be no effects? If so, the text on page 3 and elsewhere should be revised. If not, the text on page ES-1 and elsewhere should be revised.

**Navy Response:** The first portion of the response refers to the response to MEDEP's comment number 1. The second portion reads "Following a conservative approach, it is assumed that all adverse effects are ecologically significant hence the meanings are the same. This clarification will be provided on page 3 in Appendix A "*...to determine sediment-based concentrations that represent thresholds below which adverse effects on sediment-associated aquatic biota (i.e., benthic organisms) are not expected to be ecologically important to maintenance of the population.*"

**Additional Comment:** The revised text quoted in the second part of the response suggests that there are adverse effects that occur that are not ecologically important. This is not the same as saying that all adverse effects are ecologically significant. We suggest that the passage in Appendix A be revised to read the same as on page ES-1.

We also note that the MEDEP cited data in their April 10, 2001, comment letter that demonstrates that ingestion can be an important pathway for enhanced uptake of contaminants by organisms. This information should be considered with the on-going data collection and in the application of PRGs to decisions and remedial measures in the future.

**Response:** The first sentence of Section 2.1 will be revised to read "It is the objective of the PRG development to establish sediment-based concentrations that represent thresholds below which adverse effects on ecological receptors are not expected to occur." Regarding the ingestion of chemicals, please see the Navy response to MEDEP comment 1, above.

3. **Comment:**

**Original Comment 3. Page ES-2, PRG BACKGROUND.** The basic assumption of the PRG development approach is that concentrations of chemicals in sediment, porewater, surface water, and biota are in equilibrium. Does the currently-available date support this assumption? How will the on-going monitoring data be evaluated to check this assumption? What action will be taken if the monitoring data or other information indicates this assumption is incorrect? What is the "sanity check" mentioned later in the paragraph?

**Navy Respons :** The Navy states that the equilibrium assumption made is widely applied in sediment toxicology, and that the agreement between site-specific and literature values, and between calculated concentrations causing effects and water quality criteria as supporting the assumption. Therefore, the Navy does not foresee the need to continually validate the assumption.

**Additional Comment:** We disagree with the Navy's position that the monitoring data collected in the future does not need to be checked to verify the validity of the equilibrium assumption. While we do not believe it is necessary to check the assumption continually, the data collected in the future should be checked. Otherwise, inappropriate PRG values could be applied in making decisions and implementing remedial measures.

**Response:** The assumptions regarding equilibrium partitioning have been presented in various USEPA documents. As discussed in the technical meeting, USEPA has a Draft Sediment Quality Guidelines document for PAHs that is based on equilibrium partitioning which has been peer-reviewed by the USEPA Science Advisory Board. Many years of research has gone into investigating these assumptions.

The Navy notes that as part of the during the Data Quality Assessment (DQA) for the project, assumptions are evaluated to determine whether they are still valid. For example, if there is a change in scientific knowledge or in regulatory policy that affect assumptions made, then the impact on the project needs to be considered or if the data collected indicate a different understanding of the project. Not all assumptions are verifiable as part of a project particularly when it is determined in the Data Quality Objectives (DQOs) that verification is not an objective (and the necessary data to verify the assumption is not collected). The assumptions regarding equilibrium partitioning were developed based on current scientific knowledge and collection of data to verify the assumption is not an objective of the interim offshore monitoring program.

4. **Comment:**

**Original Comment 4. Page ES-2, PRG Derivation.** This paragraph covers the assumption regarding selection and remediation of limiting CoCs, those CoCs that are responsible for much of the baseline risk. By remediating limiting CoCs, collocated CoCs will be remediated to levels that will not have adverse effects. Does the data support this assumption? We also reiterate MEDEP's comment number 11, that focusing on a limiting CoC does not address potential cumulative toxicity.

**Navy Response:** The Navy's response refers to the response to MEDEP comment number 13a.

**Additional Comment:** Our question regarding does the data support the assumption of limiting COCs does not appear to be answered directly in the response to MEDEP comment 13a.

**Response:** The referenced text is an assumption used in the development of the PRGs. Thus, there is no site-specific data to support the assumption because all chemical concentrations around PNS are not yet below PRG concentrations. Rather the assumption is taken from USEPA (1991) where the concept of the adoption of a Limiting CoC approach was recommended. The Navy has adopted EPA's guidance in the development of the PRGs.

USEPA, 1991. Risk Assessment Guidance for Superfund: Vol. 1 –Human Health Evaluation Manual. Part B. Development of Risk Based Preliminary Remediation Goals.

5. **Comment:**

**Original Comment 6. Page ES-3, PRG Implementation.** The final paragraph states that the PRGs are consistent with the findings of the risk assessment. What does that mean? (See comment 15, below.)

**Navy Response:** The statement means that the areas (i.e., Sullivan Point, Back Channel, and Dry Docks) identified in the EERA as having intermediate risks associated with them are the same areas where sediment concentrations were found to be above [the] PRGs.

**Additional Comment:** This is an important clarification that should be added to the text of the document.

We also note that, while dioxin is included in the on-going offshore monitoring, it was not evaluated as part of the EERA.

**Response:** The recommended clarification will be added to the discussion of PRG Implementation in the Executive Summary as follows:

"The results of implementation of the PRGs (presented in *Attachment 1* ~~Appendix A~~) indicate that the PRGs are consistent with the findings of the risk assessment, *that is, the areas identified in the EERA as having intermediate risks associated with them (i.e., Sullivan Point, Back Channel, and Dry Docks) are the same areas where sediment concentrations were found to be above PRGs.*"

Dioxin data were not collected during the EERA sampling (as per the work plan for the EERA) and therefore dioxin data were not included in the EERA. Please see the Navy's Response to SAPL Comment No. 6 below for additional information related to dioxins.

6. **Comment:**

**Original Comment 10. Table ES-2.** Why do the recommended PRGs in this table differ from those in Table 2.2-6 in Appendix A? Comment 9, above, also applies to Table ES-2. We had commented in our June 18, 1998, letter on the PRG development approach about the need to consider health advisories pertaining to fish consumption as part of the process. How do the recommended PRGs compare with fish consumption advisory thresholds?

**Navy Response:** The Navy's response notes that the PRGs are sediment-based concentrations and are thus not directly comparable to tissue-based thresholds. It also states that it was determined that PRGs protective of human health were not necessary as part of the OU4 interim remedy, and that PRGs to address human receptors are not necessary based on the results of the risk assessments.

**Additional Comment:** With regard to the final statement in the Navy's response, the risk assessments did not evaluate dioxin, as dioxin has only recently been tested in various sampling programs around the Shipyard.

In addition, as was noted at the April 3, 2001, technical meeting, the State of Maine recently issued updated Fish Tissue Action Levels. How do these Action Levels compare with the PRGs?

The basic assumption of the PRG process is that concentrations of chemicals in sediment, porewater, surface water and biota are in equilibrium. Based on this assumption, can the concentrations of chemicals in tissue be estimated?

**Response:** The Navy understands the SAPL's concerns related to dioxin. As the Navy has indicated previously (in the Navy's response to SAPL Comment F dated September 2, 1999 on the Draft Final Interim Offshore Monitoring Plan and the Navy's response to SAPL Comment No. 12 dated January 25, 2001 on the draft PRG report), the dioxin concentration data will require a screening evaluation for assessment of potential ecological risk. The dioxin data will be evaluated as part of the Baseline Monitoring Report. This was also discussed at the April 3, 2001 technical meeting. The resolution based on the meeting discussion was that a PRG for dioxins is not necessary at this time. The dioxin data available for the offshore will be evaluated. All participants at the meeting were given an action item to look into what dioxin screening levels are available for sediment and fish tissue (mussel and juvenile lobster, in particular)

The Navy believes that the Fish Tissue Action Levels are not comparable to PRGs because the levels are applicable only to protection of human health whereas the PRGs are applicable to ecological protection.

The estimation of tissue concentrations from sediment requires the collection of collocated sediment and tissue samples. For the Interim Offshore Monitoring Program for OU4, collocated sediment and mussel tissue samples were collected and analyzed. Juvenile lobster tissue samples for each monitoring station were also collected and analyzed. The Navy used this data to calculate BSAF and BAF values, which could be used to predict sediment concentrations from tissue concentrations and vice versa.

## 3.3 MEETING MINUTES FROM APRIL 3, 2001 TECHNICAL MEETING

**DEPARTMENT OF THE NAVY**
ENGINEERING FIELD ACTIVITY, NORTHEAST
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
MAIL STOP, #82
LESTER, PA 19113-2090

IN REPLY REFER TO
5090
Code 1823/FE
3 May 2001

Ms. Meghan Cassidy
U.S. Environmental Protection Agency, Region I
1 Congress Street
Suite 1100
Mail Code HBT
Boston, MA 02114-2023

Mr. Iver McLeod
Maine Department of Environmental Protection
State House Station 17
Augusta, ME 04333-0017

Dear Ms. Cassidy/Mr. McLeod:

SUBJECT: PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4 (OU4), INSTALLATION RESTORATION PROGRAM FOR PORTSMOUTH NAVAL SHIPYARD, KITTERY, ME

Enclosed are the meeting minutes for the April 3, 2001 technical meeting on the Preliminary Remediation Goals for Operable Unit 4.

Comments on the enclosed minutes are requested on or before May 21, 2001.

If additional information is required please contact Mr. Fred Evans at (610) 595-0567 x159.

For the Community Restoration Advisory Board (RAB) members; if you have any comments or questions on these issues, they can be provided to the Navy at a RAB meeting, by calling the Public

5090
Code 1823/FE
3 May 2001

Affairs Office at (207) 438-1140 or by writing to:

Portsmouth Naval Shipyard
Code 106.3R Bldg 44
Attn Marty Raymond
Portsmouth, NH 03804-5000

Sincerely,

Frederick J. Evans
Remedial Project Manager
By Direction of the
Commanding Officer

Copy to:
NOAA (K. Finkelstein)
USFWS (K. Munney)
MEDMR (D. Card)
NHFG (C. McBane)
Mr. Doug Bogen
Mr. Jeff Clifford
Ms. Michele Dionne
Ms. Eileen Foley
Ms. Mary Marshall
Mr. Phil McCarthy
Mr. Jack McKenna
Mr. Onil Roy
Ms. Johanna Lyons
Dr. Roger Wells
Ms. Carolyn Lepage
PNS Code 100PAO
COMSUBGRU TWO (R. Jones)
PNS (Code 106.3R)
TtNUS (D. Cohen)

**OFFSHORE PRELIMINARY REMEDIATION GOAL (PRG) TECHNICAL TEAM MEETING**
**PORTSMOUTH NAVAL SHIPYARD**
**April 3, 2001**

The technical team meeting on Preliminary Remediation Goal (PRG) for Operable Unit 4 (OU4) was held from 9:25 a.m. to 2:45 p.m. on April 3, 2001 at Portsmouth Naval Shipyard, Kittery, Maine. Attending were Meghan Cassidy and Rick Sugatt (USEPA), Iver McLeod and Katie Zeeman (MEDEP), Ken Finkelstein (NOAA), Carolyn Lepage (TAG consultant), Jim Horrigan (SAPL representative for RAB) and the Navy project team consisting of Marty Raymond (PNS), Fred Evans (NorthDiv), Jason Speicher (NorthDiv), Greg Tracey (SAIC), and Debbie Cohen and Aaron Bernhardt (TtNUS).

Copies of the meeting presentation on the process for development of offshore Preliminary Remediation Goals (PRGs), acronyms list, and a table showing the results of the laboratory re-evaluation of pore water copper and lead data were provided to the meeting attendees.

ATTACHMENTS
(1) Agenda
(2) Meeting Handouts

## INTRODUCTION AND REVIEW OF THE AGENDA

Fred Evans welcomed everyone and indicated the purpose of the meeting is to discuss and resolve the major issues brought out in the U.S. Environmental Protection Agency (USEPA) (including U.S. Fish and Wildlife Service), National Oceanic and Atmospheric Administration (NOAA), Maine Department of Environmental Protection (MEDEP), Seacoast Anti-Pollution League (SAPL) comments on draft PRG report (dated November 2000). After everyone introduced himself or herself, Mr. Evans reviewed the agenda. Ken Finkelstein requested that the issues identified in NOAA Comment Nos. 4 and 5 be added to the agenda.

Mr. Evans also indicated that the Navy division that he works out of, formerly known as Northdiv, is now being referred to as Engineering Field Activity Northeast (EFANE). Effective April 2001, email addresses for this division will be changed from "@efdnorth.navfac.navy.mil" to "@efane.navfac.navy.mil".

## OVERVIEW THE PRG DEVELOPMENT PROCESS

Greg Tracey provided a presentation of an overview of the PRG development process because various issues raised relate to the general process. The presentation facilitated discussion of these issues. In addition, the presentation was provided to help familiarize new members of the project team with the process. Mr. Tracey indicated that the process was the same one presented as part of the Interim Offshore Monitoring Plan (TtNUS, October 1999, Appendix A).

Mr. Tracey clarified that the PRGs being developed with this process are site-specific values to address the ecological risks for the PNS offshore area (Operable Unit 4, or OU4). He noted that this meaning of PRGs differs from the meaning that is currently being used on the

west coast (e.g., USEPA Region IX), where the term "PRG" is being used interchangeably with "screening level." In answer to a question of whether site-specific meant for the whole offshore area or to an offshore area by a specific onshore site, Mr. Tracey indicated that "site-specific" refers to the whole offshore area, which is OU4.

Data used for development of PRGs for OU4 include the Interim Offshore Monitoring Round 2 chemistry data and Round 2 toxicity data collocated with the chemistry data. In accordance with the Interim Offshore Monitoring plan, toxicity testing was conducted in the first late winter sampling round (Round 2) because the chemicals are expected to be more bioavailable in the late winter round versus the late summer sampling round. The Interim Offshore Monitoring Rounds 1 and 2 results and the Estuarine Ecological Risk Assessment (EERA) results were used to develop recommended PRGs.

The PRG development process relies on equilibrium partitioning (EqP) relationships. The EqP assumes that the chemical partitioning between sediment and sediment pore water and exposure to the benthic community are in equilibrium. The process focuses on pore water because there are methods available to directly measure (or estimate) the chemical concentrations in the pore water, and there are criteria available for evaluation of the concentrations (water quality screening values, or WQSVs). The assumptions regarding the EqP relationship rely on the chemicals having a certain level of bioavailability. Therefore, the assumptions may not be valid if the chemical is not bioavailable. For example, if chemical concentrations in the sediment are from non-biologically available sources (e.g., metal pieces in the sediment), then the sediment concentration may not be in equilibrium with the pore water concentration.

In the PRG process, the EqP is used to estimate pore water concentrations for organics; however, the inorganic pore water concentrations are measured. This was done because only a small volume of pore water is needed for the inorganic analysis (approximately 50 to 100 ml). However, 3 to 4 liters of pore water are needed for the organic analysis. This would require the collection of several gallons of sediment from each station. Therefore, the organic pore water concentrations are estimated based on the sediment concentration, the sediment organic carbon content, and empirically derived chemical-specific partitioning coefficients (Koc).

In answer to a question of how the sediment and pore water can be related when the exposure pathway is different, it was indicated that based on the EqP relationship, the sediment and pore water are in equilibrium. Therefore, the risks factors to the benthic organisms will be the same whether sediment or pore water are evaluated. A question was raised whether macro benthos diversity sampling was conducted for the offshore. It was indicated that the sampling was conducted as part of the EERA and the results considered in the estimation of ecological risks for the offshore during the EERA.

There was some discussion about a recent draft USEPA guidance for evaluation sum polycyclic aromatic hydrocarbons (PAHs). This approach relies on evaluating the sum of measured PAHs (approximately 30 PAHs) as well as the individual PAHs. Mr. Tracey indicated that a similar approach was used for PRG development, that is the Hazard Quotient (HQ)s for each location were summed and evaluated. High molecular weight (HMW) and low molecular weight (LMW) PAHs were summed and evaluated too.

There was also a question on the uncertainty in the Koc values used to estimate pore water concentrations. It was indicated that the Koc values were obtained from a USEPA document, and were developed using empirical measurements. The estimation of the pore water concentrations is intended to reduce the uncertainty regarding the extent of chemical exposures by incorporating both chemical- (i.e., Koc) and site-specific (i.e., TOC) factors. This approach has the advantage over use of literature based benchmarks because site-specific conditions are included in the calculation of the pore water concentrations.

In the PRG development process, the results of toxicity tests are used to determine the No Observable Effects Concentration (NOEC) for the chemicals detected. The samples included in the toxicity testing are grouped based on whether the results showed the sample was toxic or non-toxic to the test organism. For the pore water toxicity testing, three concentration dilutions for each sample were tested (100%, 50%, and 25%). To be considered a toxic sample, the sample needed to be toxic in at least two of the three dilutions. Samples showing toxicity in only the 100% concentration sample were not considered toxic samples. This is because the species would not be exposed to 100% concentration pore water and an LC50 can be calculated with more confidence if at least two dilutions are toxic. Dilution series are conducted as part of the toxicity testing because the sensitivity of the test organism may cause a lot of false positives. Sediment particles and other confounding factors can cause toxicity to the species. Therefore, samples that have toxicity in at least two of the dilutions are more likely to be truly toxic samples.

There was also discussion about checking the data to see whether anything detected in the samples that were toxic at 100% but included in non-toxic group may be of interest and may account for the toxicity. The Navy indicated that the 100% pore water samples were not included in the toxic group because the sea urchins and other similar organisms are not exposed to 100% pore water in the field.

To ensure that the PRGs concentrations are not less than background concentrations, the NOEC is compared to the concentration for the reference stations. Overall the concentrations at the Shipyard stations are similar to or greater than the concentrations at the reference stations. Therefore, in most cases the NOEC is greater than the reference concentration.

## PRIMARY DISCUSSION POINTS AND RESOLUTION

As part of the PRG development process presentation, several of the issues were discussed. After the presentation, the remaining issues were discussed. The following provides a summary of the issues and the discussion and resolution of the issues in the order the issues were identified on the agenda.

**BULLET 1** Overview of PRG Process including Assumptions:

<u>Example calculations/presentation of calculations for each step (EPA Comment 1):</u>
**Issue** – A detailed figure or flow chart for the individual steps of the process and inclusion of primary characteristics and formulas for each step would be helpful to follow the process better.

**Discussion** – Table ES-1 provides the steps and formulas. References to the specific tables in the PRG process and example calculations would be helpful.
**Resolution** – The Navy will add table references for the equations provided in Table ES-1 and example calculations similar to those provided in the Interim Offshore Monitoring Plan (Appendix A) will be provided in the PRG report for OU4.

Sediment particle ingestion (MEDEP Comment 1 and SAPL Comment 2):
**Issue** - The contribution of sediment particle ingestion by benthic organisms to the toxicity is not accounted for in the PRG process.
**Discussion** – In the EqP approach, everything is assumed to be in balance and exposure is simultaneous. Therefore, either looking at pore water concentrations or sediment concentrations would provide the same evaluation of toxicity (because they are in equilibrium). However, because it is easier to measure (or estimate) the pore water concentrations that the organisms would be exposed to than the sediment concentrations that the organisms would be exposed to (surficial chemicals and not the chemicals in the entire sediment particle), pore water is used in the PRG process. Although there may be more exposure over time from release of chemicals from the ingested sediment because of digestive juices in the organism's stomach, this release of chemicals is a time dependent function. In general, the exposure to pore water and the release of chemicals into the organism's stomach over the lifetime of the organism are considered to be in equilibrium. Therefore, using pore water concentrations should account for the toxicity from sediment ingestion. Also, the sediment toxicity test does incorporate all routes of chemical exposure.
**Resolution** – There are some compounds where sediment ingestion is more significant than pore water exposure. This is an uncertainty, but for OU4, PRGs correlate with risks identified in the EERA, so ingestion does not appear to be a significant issue for the COCs at OU4.

Fish consumption (SAPL Comment 10):
**Issue** – Health advisories for fish consumption need to be considered as part of the PRG process.
**Discussion** - PRGs are only required at this time for ecological receptors based on the evaluation of offshore human health and ecological risks (as documented in the Interim Record of Decision for OU4 and the Interim Offshore Monitoring Plan). The EERA indicated that the major risk concerns are exposure to benthic organisms; therefore, the PRGs are developed to address exposure of benthic organisms.
**Resolution** – As part of the Interim Offshore Monitoring, data that can also be used to evaluate human health concerns are being collected. Should human health risks need to be addressed in the future, the Navy believes that the appropriate data are available. The MEDEP indicated that the State has tissue action levels for human consumption of fish. However, at the current time, the Navy will not develop PRGs for human consumption of fish.

**BULLET 2** Reanalysis of pore water data (EPA Comment 2)

**Issue** – Detection limits for copper and lead pore water data were above the WQSV; therefore, the Navy had the pore water samples reevaluated by the laboratory.
**Discussion** – Aaron Bernhardt explained that the initial detection limit for copper was 5 ug/l, which is above the WQSV (3.1 ug/L). The laboratory re-evaluated the data to see whether there were any detections below the 5 ug/l. They were able to identify all detections above 3 ug/l. Aaron explained that there were some additional detections. However, because of

blank contamination (not detected at 5 ug/l, but detected above 3 ug/l) there were changes in the copper data where some samples will now be qualified as nondetect. The reevaluated data will be used for revision to PRGs that will be presented in the draft final PRGs. For lead the laboratory was unable to identify detections lower than 20 ug/l and therefore, the laboratory reanalyzed the samples using a lower detection limit. The new detection limit achieved was 3 ug/l, which is below the WQSV (8.1 ug/L). There were no detections of lead in the pore water samples above 3 ug/L.
**Resolution** – The reevaluated pore water data for copper will be used for the PRG calculation presented in the draft final PRG report.

**BULLET 3** Copper data at M4-1 (NOAA Comment 8, MEDEP Comment 1)

**Issue** – The copper concentration in the sediment at M4-1 appears to be very high.
**Discussion** - After Round 3 of the interim offshore monitoring, the Navy noticed that copper concentrations at Monitoring Station 4, sample location 1 (M4-1) were increasing noticeably. Jason Speicher explained that he went to the monitoring station to see whether there was anything obvious that may be accounting for the copper concentrations. Mr. Speicher found small pieces of metals debris that included copper. There appeared to be some debris around the concrete blocks and under the blocks. It is likely that because the copper at M4-1 is associated with the particles that it is not leaching to water (copper oxide is not soluble). The copper debris does not appear to be a wide spread area, but tidal exchange could be moving the copper to the offshore sediment. This is an example of where the assumptions of the EqP may not be valid because the copper in the sediment apparently is not available to partition to the pore water, and therefore, is not in equilibrium. It was noted that copper concentrations in some other samples also appeared to be high in Round 2 and could be outliers.
**Resolution** – The Navy will evaluate the locations with concentrations greater than 500 mg/kg (M9-1, M3-2, M8-3, and M11-3 in addition to M4-1) to determine whether the concentrations of copper at these locations represent outliers. The Navy believes that M4-1 is an outlier based on finding copper metal in the sediment. It will be removed from the calculation of the average sediment PRG concentration step. The Navy will also do a visual inspection of the other locations during Round 4 sampling to see whether there may be some physical reason for the higher copper concentrations. In addition, the Navy indicated that 3 extra sediment samples at M4-1 will be collected during Round 4 and analyzed for metals.

**BULLET 4** - OU4-wide averages versus AOC-wide PRGs (MEDEP Comments 1, 20, 22, 26b, SAPL Comment 1)

**Issue** – Are OU4-wide average PRGs appropriate or should AOC-wide PRGs be developed?
**Discussion** – Two concerns are associated with this issue. The first concern relates to using an average rather than an upper confidence limit (UCL). An average is used because the PRGs are being developed to address average conditions. This will provide a more conservative (lower) average sediment concentration. The second concern relates to using an OU4-wide PRG versus an AOC-wide PRG. The PRG development process presented in the meeting (and as part of the Interim Offshore Monitoring Plan) was considered to develop a single set of PRGs for all of OU4. A basis for developing AOC-specific PRGs has not

been identified and sufficient data are not available to develop AOC-specific PRGs. The assumption is that the conditions that impact the sediment conditions in the OU4 area are the same everywhere. In answer to a concern about whether the different onshore sources will impact the offshore area differently, it was explained that the difference in chemical impact is accounted for in the process through the identification of the Limiting COCs. The sediment conditions that are important with respect to the development of PRGs and application of PRGs to various habitats around OU4 are the TOC and grain-size.
**Resolution** – The Navy will look at sediment conditions (TOC and grain-size) to see whether there are conditions that suggest a difference in the sediment in one AOC versus another. If there are significant differences then further discussion will be necessary to determine how to address the differences. If there are no significant differences, then OU4-wide PRGs are appropriate.

**BULLET 5** Recommended PRGs(MEDEP Comments 13b, 23, 30, 31)
**Issue** – Areas characterized as having "no risk" that also have PRG exceedances will be not be considered. In addition, the PRG process is trying to identify the point of departure between low and intermediate risk.
**Discussion** - There are no AOCs characterized as having "no risk". All areas, regardless of the risk characterization in the EERA will be evaluated for PRG exceedances and trends as part of the Interim Offshore Monitoring Program. The Navy noted that for use for the interim offshore monitoring data evaluation, the numbers calculated in the PRG development process for OU4 are adequate for use as IRGs. However, there are uncertainties with using the PRGs for the OU4 Feasibility Study, particularly because it appears that ammonia may be accounting for some of the toxicity identified in the offshore areas.
**Resolution** – The PRGs are not trying to make a distinction between risk to identify areas that will or will not be included in remedial actions. This is a Feasibility Study decision. The Recommended PRGs will be used as IRGs for the interim offshore monitoring program, but re-evaluation of the appropriateness of these numbers for use in the OU4 FS will be necessary and additional investigation may be required.

**BULLET 6** PRGs for pesticides and dioxin

PRGs for pesticides (MEDEP Comment 32b, SAPL Comment 9)
**Issue** – PRGs for pesticides must be developed.
**Discussion** – Pesticide PRGs were calculated but not carried through to a Recommended PRG and will not be an Interim Remediation Goal (IRG) for the evaluation of interim offshore monitoring at this time. The data is there to develop a PRG if pesticides are identified as a COC for OU4. However, based on the results of the evaluation of PRG exceedances compared with the ecological risk results, higher concentrations of pesticides were detected in areas of low risk than areas of intermediate risk. Therefore, at this point the implementation of a PRG for pesticides is uncertain.
**Resolution** – The issue as to whether pesticides are COCs for OU4 needs to be resolved between the Navy and MEDEP and it will need to be resolved separately from this PRG document. Pesticides need to be carried through the PRG process at least as far as development of a sediment-based concentration so that a PRG will be available if necessary in the future.

PRGs for dioxin (SAPL Comment 12)
**Issue** – How will dioxins be considered in the PRG process?
**Discussion** – Dioxins have not been identified as a COC for OU4 and the data necessary to calculate a PRG are not available. The dioxin data available for the offshore need to be evaluated and if it is determined that a PRG for dioxins is needed, then additional data may need to be collected.
**Resolution** – A PRG for dioxins is not necessary at this time. The dioxin data available for the offshore will be evaluated. All participants at the meeting were given an action item to look into what dioxin screening levels are available for sediment and fish tissue.

**BULLET 7** Clarification of comments (EPA Comment 7 and MEDEP Comment 4)

These comments were clarified during the discussion of Bullet 1, under Example calculations/presentation of calculations for each step (EPA Comment 1).

**BULLET 8** Other Issues/Comments

Two additional issues were added to the agenda and are discussed below.

NOAA Comment 4
**Issue** – The text indicates that the sea urchin toxicity test is more sensitive than amphipod toxicity test (third paragraph on page 8 of the draft report). However, looking at Table 2.2-2, there does not seem to be a correlation between the results for the toxicity testing for sea urchin and amphipod. If sea urchin is more sensitive then it would be expected that wherever the amphipod test showed toxicity, the sea urchin test should also show toxicity.
**Discussion** – No correlation between the tests was intended. The testing for pore water and sediment use different species. In general more instances of toxicity are identified using sea urchins than amphipods; however, this does not mean that where there is toxicity based on amphipod testing that the sea urchin testing will also show toxicity.
**Resolution** - The text on page 8, paragraph 3, last sentence of the PRG report will be revised as follows: "In general, more instances of toxicity are identified using sea urchins than amphipods (Carr 1996). However, there may be stations where the sediment is toxic to amphipods but the pore water at that station is not toxic to sea urchins. This may be because the two species have different sensitivities to the same chemicals."

NOAA Comment 5
**Issue** – Should the low observable effects concentration (LOEL) be the number carried forward through the process rather than the no observable effects level (NOEL)?:
**Discussion** - If the site had only one (or very few) contaminants and there were a sufficient number of toxic samples, then it would be possible to identify a LOEL with sufficient confidence to use in the process. However, with multiple contaminants, using the NOEL is a safer more conservative approach.
**Resolution** – Use of the NOEL is appropriate for OU4.

## OTHER ISSUES/COMMENTS

Carolyn Lepage raised a concern that source/onshore sites are not considered in the PRG process. The Navy indicated that the purpose of this exercise is to develop PRGs for sediment for the offshore. That is for each Limiting COC, to identify a sediment concentration below which organisms exposed to sediment will have no observable effects. It is not clear how the PRG could address sources/onshore sites, except to ensure that the list of Limiting COCs includes COCs related to each of the sources. The process for identifying the Limiting COCs accounts for the differences in the sources/onshore sites, therefore, the Navy believes the list of Limiting COCs is appropriate for OU4. The way to link the onshore impacts to the offshore is part of the interim monitoring program and decisions based on the program (based on evaluation of concentration trends). Therefore, the Navy believes that the concern for linkage of the onshore and offshore is being addressed appropriately.

The USEPA requested that the Acute:Chronic Ratio (ACR) used in the WQSV selection (see Figure 2.2-1 and Table 2.2-1) be chemical specific where possible. If a chemical-specific ACR is not available, than the generic value identified (8:1) is acceptable. This impacts silver, naphthalene, aldrin, gamma BHC, and DDE. The Navy will look to see whether chemical-specific ACRs are available for these chemicals. It is noted that this is a departure from the PRG development process proposed as part of the Interim Offshore Monitoring Plan, but should not significantly impact the PRG development.

A question was raised whether sediment quality criteria were used as screening values and whether they were ARARs. The sediment quality criteria are not promulgated and therefore are not ARARs. Sediment benchmarks (ER-Ls, TELs, SQALs) were used only when water quality criteria were not available. The USEPA noted that some of the water quality criteria needed to be updated per USEPA (1999) and the Navy indicated that this would be done for the draft final PRG report.

Ms. Lepage indicated that the PRG report was very difficult for the public to understand and requested that the Executive Summary be revised to provide a non-technical explanation of the PRG development. The Navy indicated that they would review the Executive Summary to try to provide additional explanation of the PRG development process; however, the document is a very technical document and the Navy does not believe that it is appropriate to try to revise the document to provide non-technical discussions. The Navy prefers to prepare a fact sheet for the public to provide a non-technical explanation.

## WRAP UP

The Navy believes that the discussion of the issues and resolutions identified should resolve most of the comments on the draft PRG report. Follow-up comments are due April 11, 2001 and the Navy will address any follow-up comments and provided the responses as part of the draft final PRG report.

**ATTACHMENT 1**

**AGENDA**

**AGENDA**
**OFFSHORE PRG TECHNICAL MEETING**
**APRIL 3, 2001**

| | |
|---|---|
| 9:00 a.m. – 9:15 a.m. | Introduction, Review of Agenda, and Objectives of the Meeting |
| 9:15 a.m. – 10:00 a.m. | Overview of PRG Process |
| 10:00 a.m. – 2:30 p.m. | Primary Discussion Points |
| 2:30 p.m.– 3:00 p.m. | Wrap Up |

10 minute break each hour

30 minute break for lunch between Noon and 1:00 p.m.

**Primary Discussion Points and related comment numbers**

- Overview of PRGs Process including Assumptions (EPA Comment No. 1; MEDEP Comment Nos. 1 and 20; SAPL Comment Nos. 2 and 10)
- Reanalysis/Re-Evaluation of Pore Water Data and Additional Analyses of Round 2 Samples and how it affects PRGs (EPA Comment No. 2)
- Copper concentrations at MS4-1 (NOAA Comment No. 8)
- PNS-wide versus AOC-wide PRGs (MEDEP Comment Nos. 1, 22, and 26b; SAPL Comment No. 1)
- Recommended PRG calculation (MEDEP Comment Nos. 13b, 23, 30, and 31)
- Pesticides and Dioxins as PRGs (MEDEP Comment No. 32b; SAPL Comment Nos. 9 and 12)
- Comments requiring clarification (EPA Comment No. 7 and MEDEP Comment No. 4)
- Other Issues/Comments

# ATTACHMENT 2

# MEETING HANDOUTS

# Process for Development of Offshore Preliminary Remediation Goals (PRGs) at Portsmouth Naval Shipyard

3 April 2001
Technical meeting at PNS

1

## What are Site-specific PRGs and what are they used for?

- Site-specific PRGs:
  - *are* a group of "Limiting" Chemicals of Concern (CoCs) and associated concentrations that, when exceeded, account for the majority of site-related risk.
  - *are not* screening values (e.g. Generic PRGs).
- Using site-specific PRGs:
  - *will* reduce CoC exposure to site receptors to levels expected to eliminate actionable chemical risks for all site-related CoCs.
  - *Can* address multiple pathways and receptors for protection of environment.

2

## Objectives

- Describe the approach for development of site-specific, sediment-based PRGs for aquatic health for Operable Unit 4 (OU4);
- Present example calculations demonstrating the process.

3

## Data Requirements

Assemble necessary data for derivation from Round 2 Interim monitoring:

- Sediment chemistry (metals, organics, TOC, SEM-AVS)
- Porewater chemistry (metals)
- Sediment toxicity (amphipod survival)
- Porewater toxicity (sea urchin larval development)

Implement PRGs by comparison against:

- Estuarine Ecological Risk Assessment (EERA) risk findings
- EERA chemistry results
- Round 1 and Round 2 chemistry results (all site stations)

4

## Overall Approach (2 Phases)

Derivation (5 Steps)

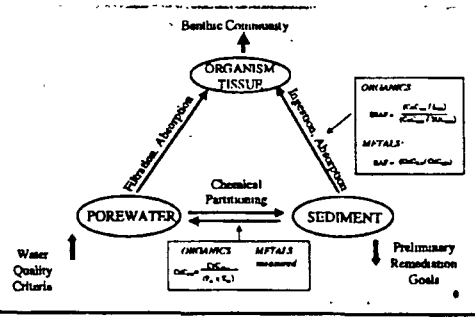
- Calculate protective concentrations in porewater that represent a threshold for toxicity (called Threshold Effects Values).

Implementation (2 Steps)

- Convert TEVs into sediment-based units (Baseline PRGs); and assess effectiveness for addressing risks identified in the EERA investigations (*i.e.*, Recommended PRGs).

5

## Equilibrium partitioning relationships for CoCs among environmental media.




6

## Advantages of using the EqP Approach in PRG Development

**The PRG derivation process uses the chemical concentration of pore water as the primary measure of potential adverse effects (*i.e.*, risk) to aquatic biota.**

**Advantages of proposed PRG process include:**

- For metals and some organics, direct measurements of CoCs in pore water are used to predict exposure, hence benchmarks (i.e., water quality criteria) based on single chemical exposures can be applied.
- For organic chemicals, the EqP model is used to estimate pore water concentrations, based on site specific environmental conditions.

7

## PRG Development: Step 1.

**PRG Step 1 includes:**

1. Select screening level benchmarks representing no effect concentrations, in order of preference to obtain Water Quality Screening Values :
   - EPA marine or freshwater Water Quality Criteria,
   - Values calculated from other water criteria, and
   - Values calculated from comparably protective sediment benchmarks using Equilibrium Partitioning model.
2. Normalize exposure concentrations to benchmarks:
   - Facilitates ranking of chemicals according to potential for risk.

8

**Exhibit 1A. Example calculation of porewater concentration for organic contaminants using Equilibrium Partitioning.**

EqP model for organics:
$C_p = C_s/(f_{oc} * K_{ow})$ (DiToro *et al.*, 1991)

| Station | CoC | $C_s$ | $f_{oc}$ | $K_{ow}$ | $C_p$ |
|---|---|---|---|---|---|
| A | Benzo(a)anthracene (H) | 254 | 0.0148 | 1.01E+05 | 0.04 |
| | Benzo(a)pyrene (H) | 317 | 0.0148 | 1.01E+08 | 0.02 |
| | Chrysene (H) | 444 | 0.0148 | 4.01E+05 | 0.07 |
| | Dibenzo(a,h)anthracene (H) | 52.7 | 0.0148 | 3.77E+06 | 0.0010 |
| | Fluoranthene (H) | 779 | 0.0148 | 1.08E+05 | 0.49 |
| | Pyrene (H) | 1190 | 0.0148 | 1.08E+05 | 0.75 |
| | HMW PAHs | | | | 1.36 |

$C_p$ = organic chemical porewater concentration (kg/L)
$C_s$ = sediment concentration (kg/kg dry weight)
$f_{oc}$ = fraction of organic carbon (% TOC/100)
$K_{ow}$ = organic octanol/water partitioning coefficient derived from $\log_{10}K_{ow}$
$(\log_{10}K_{ow} = 0.00028 + 0.997*\log_{10}K_{oc})$ where $K_{oc}$ = the octanol/water partition coefficient
$HQ_{PW} = C_p / WQSV$

9

## Exhibit 1B. Example Calculation of Pore Water Hazard Quotients for organic contaminants.

| Station | CoC | $C_{pw}$ | WQSV | $HQ_{pw}$ |
|---|---|---|---|---|
| A | Total PCBs | 2.30E-03 | 0.03 | 0.08 |
| | Anthracene (L) | 0.54 | 0.29 | 1.87 |
| | Benzo(a)anthracene (H) | 0.04 | 0.07 | 0.61 |
| | Benzo(a)pyrene (H) | 0.02 | 0.04 | 0.50 |
| | Chrysene (H) | 0.07 | 0.10 | 0.70 |
| | Dibenz(a,h)anthracene (H) | 9.52E-04 | 1.70E-03 | 0.57 |
| | Fluoranthene (H) | 0.49 | 16.00 | 0.03 |
| | Pyrene (H) | 0.76 | 0.63 | 1.22 |
| | HMW PAHs | 1.30 | 0.42 | 3.29 |

WQSV = Water Quality Screening Value

$HQ_{pw}$ = Pore water Hazard Quotient (unitless, $C_{pw}$/WQSV)

(L) = Low Molecular Weight PAH analyte, (H) = High Molecular Weight analyte

10

## PRG Development: Step 2.

Calculate site-specific screening level benchmarks based on measured toxicity:

1. Assemble chemical database consisting of samples found to be non-toxic
   - Amphipod survival not affected in bulk sediment (> 80% survival),
   - Sea urchin development not affected in pore water (~dilutions less than 50% full strength seawater)
2. Determine threshold concentration where onset of toxicity is likely.
   - Determine statistical distribution type (i.e., normal or log-normal),
   - Calculate 95% quantile (mean + upper 95% confidence limit) of the data distribution.
   - Select the larger of generic (literature-based) and site-specific benchmarks

11

## Exhibit 2. Example calculation of the site-specific no-effects quotient from the collocated chemistry/toxicity data.

**Site-specific no-effect quotient = Upper bound 95th quantile of non-toxic $HQ_{PW}$ values.**

PW conc = Pore water concentration, (ug/L)
95th quantile = Mean + Upper 95% Confidence Limit (unit less; derived from t-test statistical analyses)
$HQ_{pw}$ = PW Hazard Quotient (unitless)
= PW conc/WQSV
HMW PAH $HQ_{pw}$ = sum of $HQ_{pw}$ for PAH analytes with High Molecular Weight (HMW)

*When eq 1 the maximum non-toxic PW HQ is used instead of the 95th quantile due to small sample size.

| Bulk Sediment | | Bulk Sed Non-Toxic to Amphipods | Pore Water Non Toxic to Sea Urchins |
|---|---|---|---|
| Station | PW Conc | $HQ_{pw}$[1] | $HQ_{pw}$ |
| A | 0.72 | 7.97 | |
| B | 1.16 | 4.61 | |
| C | 0.88 | | 7.32 |
| D | 0.32 | | |
| E | 1.89 | 3.98 | |
| --- | | | |
| Y | 1.41 | 3.72 | 0.74 |
| Z | 1.3E-1 | 3.E-01 | 1.89 |
| Sample size (N) | | 15 | 3 |
| $T_{critical}$ | | 2.131 | * |
| Mean | | 1.88 | * |
| Max | | | 7.32 |
| 95% UCL $HQ_{pw}$ | | 2.87 | 7.32 |

12

## PRG Development: Step 3.

Retain all CoCs potentially contributing to risk:

For each analyte:

1. Compare site-specific no-effect HQ (NOEQ) with maximum observed HQ associated with a toxic sample (Max PW-$HQ_{TOX}$);
2. Retain only those CoCs and NOEQs where the Max PW-$HQ_{TOX}$ is greater than the NOEQ.

13

## Exhibit 3. Example Derivation of the No Effect Quotient (NOEQ) for a bedded sediment exposure pathway.

- The NOEQ is the highest departure from the HQ = 1 equivalent concentration (i.e., WQSV) for which site-specific adverse effects are unlikely to occur.
- Only those CoCs for which the maximum $HQ_{PW}$ of toxic samples exceeds the site-specific benchmark are retained for further PRG development.

| Amphipod Exposure | Non-toxic Samples | | | Toxic Samples | | |
|---|---|---|---|---|---|---|
| CoC | n | 95th Quantile $HQ_{PW}$ | NOEQ | n | Max PW-HQ | Max PW HQ>NOEQ? |
| Anthracene | 15 | 1.38 | 1.38 | 2 | 1.21 | NO |
| HMW PAHs | 15 | 2.87 | 2.87 | 2 | 3.41 | YES |
| Total PCBs | 15 | 0.11 | 1.00 | 2 | 1.76 | YES |

For 95th quantile values < 1, an NOEQ = 1 is adopted.

14

## PRG Development: Step 4.

**Derivation of Threshold Effects Values (TEVs)**

**Threshold Effects Values are the lowest feasible NOEC concentrations (e.g. above background) that can be used as PRGs for the site.**

The Threshold Effect Value is calculated as follows:

1. The NOEQ values are converted into NOEC (*e.g.*, water concentration units) for comparison against background concentrations;
2. The Reference Screening Value (RSV), representing the background concentration for a chemical, is calculated as the 95th upper quantile of the reference dataset.
3. The greater of the NOEC and RSV is taken as the TEV. This ensures that the PRG will not be set lower than the background concentration.

15

## Exhibit 4. Example Derivation of Threshold Effect Values

### Threshold Effect Value Calculations:

- NOEC = NOEQ x WQSV
- RSV = upper 95th quantile of reference pore water concentrations.
- TEV = Max (NOEC, RSV).

| CoC | NOEQ * | WQSV = | NOEC | RSV | TEV |
|---|---|---|---|---|---|
| HMW PAHs | 2.87 | 0.29 | 0.82 | 0.18 | 0.82 |
| Total PCBs | 1.00 | 0.03 | 0.03 | 1.96E-04 | 0.03 |
| o,p'-DDE | 2.8 | 1.00E-03 | 2.80E-03 | 3.59E-03 | 3.59E-03 |

NOEQ = No Observable Effect Quotient (unitless)
WQSV = Water Quality Screening Value (µg/L)
NOEC = No Observable Effect Concentration (µg/L)
RSV = Reference Screening Value (µg/L)
TEV = Threshold Effects Value (µg/L)

16

## PRG Development: Step 5.

### Limiting CoC Selection

**"Limiting" CoCs are the chemicals that when addressed by the remedial action will reduce risk of all chemicals to acceptable levels (EPA, 1991)**

***Limiting CoC selection process:***

For chemicals with NOEQs from Step 4,

1. Normalize CoC concentrations to TEVs:
   - Divide pore water concentrations by aquatic TEVs (TEV HQ = [PW] / TEV)
2. Identify the chemical contributing the most risk at the station.
   - Rank and sum TEV HQs across analytes within stations.
   - Select CoC with highest HQ as Limiting CoC wherever sum TEV HQ > 1
3. Process repeated at all stations to identify L-CoCs for site.

17

## Exhibit 5. Example of "Limiting" CoC selection process

**Limiting CoCs are the chemical contributing the most risk at the station. Addressing the L-CoCs will also address risks from collocated CoCs.**

***L-CoC calculations:***

For TEVs derived from Step 4;

- PW $HQ_{TEV}$ = [PW]/TEV.
- L-CoC = Maximum $HQ_{TEV}$ where Sum $HQ_{TEV}$ > 1.

| CoC | PW $HQ_{TEV}$ | | | |
|---|---|---|---|---|
| | Station | | | |
| | A | B | C | D |
| HMW PAHs | 0.95 | 1.13 | 0.42 | 1.80 |
| Total PCBs | 0.15 | 1.78 | 0.06 | 0.06 |
| Sum $HQ_{TEV}$ | 1.09 | 2.91 | 0.48 | 1.86 |
| Max $HQ_{TEV}$ | 0.95 | 1.87 | - | 1.80 |
| "Limiting" CoC | HMW PAHs | Total PCBs | - | HMW PAHs |

18

# PRG Development: Step 6.

**Calculation of Baseline Preliminary Remediation Goals**

- Baseline PRGs are TEVs converted into sediment concentration units.
- Conversion method assumes that risk of chemicals in the benthic environment is the same whether measured as pore water (TEV-HQ) or bulk sediment (PRG HQ) exceedences.
- The PRG is estimated for every sample. The baseline PRG to be applied across the site is calculated as an average of all sample-specific PRG estimates.

19

**Exhibit 6. Example Calculation of Baseline Preliminary Remediation Goals**

Formula Derivation:

1. $HQ_{TEV} = HQ_{PRG}$
2. $HQ_{TEV} = (Sed)/PRG$
3. PRG estimate = $(Sed) / HQ_{TEV}$)
4. PRG baseline = $\Sigma(C_s/TEV\text{-}HQ)/n$

| "Limiting" CoC | Station | $C_s$ | $HQ_{TEV}$ | $C_s/HQ_{TEV}$ |
|---|---|---|---|---|
| HMW PAHs | A | 4065 | 0.95 | 4298 |
| | B | 4939 | 1.50 | 3300 |
| | C | 9818 | 1.13 | 8714 |
| | .. | | | |
| | Y | 4613 | 1.80 | 2558 |
| | Z | 241 | 0.15 | 1604 |
| | | | Sum | 105459 |
| | | | n | 17 |
| | | | Baseline PRG | 6204 |

PRG = Preliminary Remediation Goal (µg/kg), $HQ_{TEV}$ = Threshold Effect Value-Hazard Quotient (unit less)
$C_s$ = Sediment concentration (µg/kg) N = Number of Observations

20

# PRG Development: Step 7.

**Baseline PRG Evaluation and selection of Recommended PRGs**

- **Baseline PRGs are evaluated to determine whether CoCs and concentrations will be suitable for addressing risk as identified in the EERA.**
- **The Baseline PRGs that address the risks are selected as "Recommended" PRGs.**

**The baseline PRG evaluation procedures include:**

1. Compare PRG exceedences against risk assessment findings; elevated PRG-HQs should be observed with increasing risk;
2. Compare PRG values against generic benchmarks; PRGs should be generally comparable or likely causes for site-specific deviations from generic values should be identified

21

## Exhibit 7. Example Evaluation of Baseline PRGs

**The baseline and RPRGs are calculated for use in the Feasibility Study and to assist in risk management decisions regarding the setting of Remediation Goals.**

**Baseline PRG evaluation procedures:**

1. Select PRG chemical;
2. Identify samples where chemical has highest PRG HQ;
3. Rank PRG HQ against ERA findings;
4. Determine whether possible trend for higher PRG HQ with higher risk exists;
5. Identify discernable breakpoints in PRG HQ-risk relationship as input into risk management decisions;
6. Assess protectiveness of PRG by qualitative evaluation against generic sediment benchmarks
7. Repeat process for remaining PRGs

| Station | Risk | HQ$_{PRG}$ Max | |
|---|---|---|---|
| A | Low | 1.4 | |
| B | Low | 1.5 | 2.0* |
| C | Intermediate | 2.0 | |
| D | Intermediate | 3.1 | |
| E | High | 4.6 | |
| F | High | 9.7 | |
| G | High | 11.0 | |

*In consideration of all PRG/risk comparisons, a RPRG = 2X the BPRG was adopted for the case study

22

## Implementation of PRGs

- RPRGs developed with this process are specific to OU4;
- Appropriate as Interim Remediation Goals for the offshore interim monitoring program;
- IRGs may be revised for use in the FS depending on risk management input.
  - More likely to be more conservative than not,
  - Could change depending on findings of the interim monitoring program (i.e., additional investigation/study may be necessary to develop appropriate PRGs for use in the FS)

23

## Summary of PRG Process

- PRG process implemented at other Navy and EPA sites;
- PRG process provides a site-specific sediment number protective of benthic community for OU4;
- RPRGs are used as IRGs for interim monitoring only; further risk management input needed to refine PRGs for the Feasibility Study.

24

## 3.4 ACTION ITEMS FROM MAY 29,2001 TELECONFERENCE CALL

## Evans, Fr d J (EFANE)

**From:** Evans, Fred J (EFANE)
**Sent:** Thursday, May 31, 2001 8:56 AM
**To:** 'Cassidy, Meghan'; 'McLeod, Iver'; 'Finkelstein, Ken'; 'Lepage, Carolyn'; 'katie.zeeman@state.me.us'
**Cc:** 'Cohen, Deborah'; 'Bernhardt, Aaron'; 'Tracey, Greg'; 'Bartlett, Diana'; 'Speicher, Jason'; 'Raymond, Marty'
**Subject:** ACTION ITEMS FOR PRG TELECONFERENCE ON MAY 29, 2001

May 29 2001 Conf Call Action I

Attached are the action items for the PRG teleconference on May 29, 2001.

We are currently working on a schedule to provide the information in the action items.

Thank you,
Frederick J. Evans PE
Remedial Project Manager
Engineering Field Activity Northeast
10 Industrial Highway, Mail Stop # 82
Lester, PA 19113-2090
Phone: (610) 595-0567 ext. 159
FAX: (610) 595-0555
evansfj@efane.navfac.navy.mil

**NOTES FOR PRG TELECONFERENCE ON MAY 29, 2001**

1:00 PM: Greg Tracey (SAIC); Aaron Bernhardt and Debbie Cohen (TtNUS); Carolyn Lepage (TAG consultant to SAPL); Iver McLeod and Katie Zeeman (MEDEP); Meghan Cassidy and Rick Sugatt (EPA); Ken Munney (USFW); Ken Finklestein (NOAA); and Fred Evans and Diana Bartlett

EPA Comment on Sensitivity Analysis

Discussion: EPA asked where the requirement to have 2 toxic dilutions to consider the sample as toxic was referenced and if the PRG would decrease if the samples with only one toxic concentration were considered toxic samples.

Action Item: The Navy discussed the basis for classifying the samples as toxic and indicated that the direction of the PRG (higher or lower) could not be determined without actually doing the calculation. EPA indicated that the Navy's response was acceptable. No action is needed.

EPA Comment on Digestive Juices

Discussion: The EPA's request to hear more about effect of digestive juices on bioavailability was directed at the MEDEP. MEDEP was looking for documentation that discusses in more detail how sediment criteria/EPA equilibrium partitioning accounts for digestive juices.

Action Item: EPA (Rick) will provide MEDEP will additional documentation related to equilibrium partitioning (Draft equilibrium approach document for metals)

MEDEP Comment on the Change in Copper Concentrations/PRGs

Discussion: MEDEP had trouble recreating some of the numbers in the PRG document; specifically the 95% UCLs for the reference stations. Also, they did not understand why the copper PRG would increase to the degree it did, when the high value was removed from the calculation of the PRG.

Action items: The Navy will provide the following information to clarify the PRG process, and specific issues related to the copper PRG (also see the next discussion point):

- A calculation of the 95% upper quantile for the reference samples
- The results of the outlier analysis and visual inspection for copper and a recommendation from the Navy as to whether or not the copper values from other stations should be removed from the PRG calculation step

MEDEP walk through comment:

Discussion: MEDEP needed a more detailed walk through to fully comprehend the different steps in the process.

Action Items: The following actions will be completed by the Navy and MDEP

- The Navy will forward the web site link to the Director Shipyard example PRG calculations to the regulators and SAPL.
- MDEP will review this example calculation to determine if the format is acceptable for use at PNS.
- After MDEP indicates that the format of the example PRG calculation is acceptable, the Navy will prepare an example calculation document for 4 chemicals using PNS-specific data.

What's Next

- The Navy will send the regulators and SAPL preliminary PRGs tables prior to submitting the draft final version of the PRG document. A whole new document will be provided for the draft final and the interim submittal will not be used as replacement pages. The draft final will be bound in a 3-ring binder.
- Need to schedule a later date than June 10th for comments from regulators and set the schedule for submittal of the additional information/review. The Navy will discuss the schedule with TtNUS and SAIC and propose the schedule to the regulators and SAPL
- Navy will let Carolyn know about the extension for date for comments on interim submittal.

## Evans, Fr d J (EFANE)

**From:** Evans, Fred J (EFANE)
**Sent:** Wednesday, June 06, 2001 7:44 AM
**To:** 'Cassidy, Meghan'; 'McLeod, Iver'; 'Finkelstein, Ken'; 'Lepage, Carolyn'; 'katie.zeeman@state.me.us'; 'sugat.rick@epa.gov'; 'Dr. Kenneth Munney PhD (E-mail)'
**Cc:** 'Cohen, Deborah'; 'Bernhardt, Aaron'; 'Tracey, Greg'; 'Bartlett, Diana'; 'Speicher, Jason'; 'Raymond, Marty'
**Subject:** RE: ACTION ITEMS FOR PRG TELECONFERENCE ON MAY 29, 2001

The following is the schedule for providing information from the May 29, 2001 PRG Teleconference:

1. Provided web site link and document to the Director Shipyard example PRG calculations to the regulators and SAPL via email on May 29, 2001.

2. Provide example PRG calculation for review.
   June 14, 2001

3. Provide outlier evaluation for PRG Development.
   June 14, 2001

Please call me if you have any questions.

Thank you,
Fred Evans

Attachments not printed, included in PRG document

**Evans, Fred J (EFANE)**

**From:** Evans, Fred J (EFANE)
**Sent:** Thursday, Jun 14, 2001 5:37 PM
**To:** 'Cassidy, Meghan'; 'McLeod, Iver'; 'Finkelstein, Ken'; 'Lepage, Carolyn'; 'katie.zeeman@state.me.us'; 'sugat.rick@epa.gov'; 'Dr. Kenneth Munney PhD (E-mail)'
**Cc:** 'Cohen, Deborah', 'Bernhardt, Aaron'; 'Tracey, Greg'; 'Bartlett, Diana'; 'Speicher, Jason'; 'Raymond, Marty'
**Subject:** RE: ACTION ITEMS FOR PRG TELECONFERENCE ON MAY 29, 2001

PRG Ex_Calc.pdf  Table A2-2 10_p4 pdf  Table A3-1.2a_p5.pdf  Table A-4 pdf

Attached is the example for the PRG Calculations as discussed in the May 29, 2001 conference call.

The Navy also determined the last columns in a few tables in the Interim Submittal were cut off. Please amend the Interim Submittal, as follows with the attached PDF files:

Table A.2-2.10-_p4 gets added as age A-45a
Table A.3-1.2.a-_p5 gets added as age A-51a

Also, a few references were missing from Table A-4 on Page A-81 of the interim submittal. Please replace Table A-4 on Page A-81 with the attached Table A-4.

We also acknowledge receipt of MEDEP comments dated June 11, 2001 and SAPL comments dated June 11, 2001 on the May 2000 interim PRG submittal. We do appreciate and encourage the early submittal of comments either verbally and/or in writing whenever possible. However, we have not been able to evaluate the recommendations and incorporate them into the example calculations at this time.

Thank you,
Fred Evans

-----Original Message-----
From: Evans, Fred J (EFANE)
Sent: Wednesday, June 06, 2001 7:44 AM
To: 'Cassidy, Meghan'; 'McLeod, Iver'; 'Finkelstein, Ken'; 'Lepage, Carolyn'; 'katie.zeeman@state.me.us'; 'sugat.rick@epa.gov'; 'Dr. Kenneth Munney PhD (E-mail)'
Cc: 'Cohen, Deborah'; 'Bernhardt, Aaron'; 'Tracey, Greg'; 'Bartlett, Diana'; 'Speicher, Jason'; 'Raymond, Marty'
Subject: RE: ACTION ITEMS FOR PRG TELECONFERENCE ON MAY 29, 2001

The following is the schedule for providing information from the May 29, 2001 PRG Teleconference:

1. Provided web site link and document to the Director Shipyard example PRG calculations to the regulators and SAPL via email on May 29, 2001.

2. Provide example PRG calculation for review.
   June 14, 2001

3. Provide outlier evaluation for PRG Development.
   June 14, 2001

Please call me if you have any questions.

Thank you,
Fred Evans

## Cohen, Deborah

**From:** Evans, Fred J (EFANE) [Evansfj@efane.navfac.navy.mil]
**Sent:** Wednesday, August 15, 2001 2:08 PM
**To:** 'McLeod, Iver J'
**Cc:** 'Cassidy, Meghan'; 'Raymond, Marty'
**Subject:** Statistical Review of PNS PRG Process

Review pdf

Iver,

As discussed in our telephone conversation, the Navy requested the PRG statistics be reviewed based on MEDEP's comment no. 2 dated June 11, 2001.

The attached report was generated based on our request. This report and our responses to MEDEP's dated June 11, 2001 and SAPL's comments dated June 11, 2001 will go out this Friday and include this report as an attachment.

Based on the attached report, the Navy is not planning to change the way the PRGs are calculated (i.e. the 95th percentile will be used, not the 95% UCL, as suggested by MEDEP.

My goal is to determine whether additional discussion is necessary on the PRG statistics.

Thank you,
Fred Evans

b

## Cohen, Deborah

**From:** McLeod, Iver J [Iver.J.Mcleod@state.me.us]
**Sent:** Thursday, August 16, 2001 12:05 PM
**To:** Evans, Fred J (EFANE)
**Cc:** Messier, Denise L; Zeeman, Katie; 'MEGHAN CASSIDY'; 'Marty Raymond'; Dr. Kenneth Finkelstein (E-mail); Ken Munney (E-mail); 'Carolyn Lepage'
**Subject:** PRG statistical issues

**Importance:** High

Fred, I propose that we start discussions of this during our conference call today and then decide where to go from here.

In the email you sent with the statistical report attachment you wrote, "Based on the attached report, the Navy is not planning to change the way the PRGs are calculated (i.e. the 95th percentile will be used, not the 95% UCL, as suggested by MEDEP."

The DEP did not request that the Navy change from using the 95 percentile concentration to using the 95% UCL of the mean. Our actual comment 2(b) in our 6/11/01 comment letter on the Interim Submittal was:

"The values reported as the 95% UCLs are actually the estimated 95 percentile concentrations (see Attachment 3 of this memo). The RSVs for all contaminants measured at reference stations (Table 2.2-4, page 15 of the report) should be 95% UCL of the mean. The correct RSV and TEV for copper is 5.12 $\mu$g/L."

The DEP was lead to believe from text in the 11/00 Draft PRG document and the 5/01 Interim Submittal that the 95%UCL was what was being used for PRG development (see below). The DEP thus requested in our 6/11/01 letter that the tables in the PRG document be corrected to be consistent with the Navy's own statements and what DEP had essentially agreed to. The 95 percentile concentration might be agreeable. However, the DEP will have to consider this. Using the 95th percentile for four reference stations is not necessarily any better than using the maximum, provided the max is not an outlier.

From our view it is the Navy that is changing the way the PRGs are calulated by now stating they are using the 95th percentile.

Following I have provided statements from the 11/00 Draft PRG document and Interim Submittal.

Draft Preliminary Remediation Goals for Operable Unit 4

Appendix A, p. 9 para. 2: "The HQ databases for non-toxic amphipod...and sea urchin...samples include statistical summaries of the sample number, mean, statistical distribution type (i.e., normal or log-normal), and upper 95 percent of CoC-specific HQs (95% UCL PW-HQ) based on the distribution type...The test NOEQ is assumed equal to the 95% UCL, or for NOEQ values<1, an NOEQ = 1 was adopted."

Appendix A, p. 9 para. 4: "Also listed in Table 2.2-3 for each CoC are the 95 percent UCL of porewater HQ values (PW-HQ associated with nontoxic samples."

The following paragraphs also indicate that the 95% UCL was used in these calculations:

App. A, p. 9 para. 5
p. 10, para. 1 & 2
p. 11, 2nd full paragraph: "The RSV was calculated as the 95% UCL of porewater COC concentrations for derivation of aquatic PRGs following the same procedures used for the 95% UCL values in Step 2."

Table 2.2-3 has a column titled "95% UCL PW-HQ"
Table 2.2-4, footnote 3: "Aquatic Reference Screening Value (RSV) calculated as 95% Upper Confidence Limit based on sample and distribution type..."

May 2001 Interim Submittal

Tables ES-1 and 2.1-1: Step 2 indicates 95% UCL PW-HQ was used.
Table 2.2-3: has a column titled "95% UCL PW-HQ" (reprinted from 11/00 Draft PRG document)

There may be other references to using the 95% UCL PW-HQ in the Interim Submittal but I did not review the entire document to be sure.

However, on Table 2.2-4, footnote 3 states "Aquatic Reference Screening Valu (RSV) calculated as the mean + 95% Upper Confidence Limit based on sample and distribution type."

This (mean + 95%UCL) is a change from all previous references to calculating the RSV. As stated in our 6/11/01 comment letter,

Comment 2(a): "The definition given for the UCL in Table 2.2-4 is confusing, because it is not consistent with equations used to calculate UCLs...As stated, the definition suggests that means are added into UCL calculations twice." and

As I stated above the MEDEP was under the impression that the Navy was using the proper 95% UCL of the mean all along. It was only until Katie thoroughly analyzed the calculations that she determined the Navy was not using the 95% UCL but was using the 95th percentile.

A conference call may be necessary to resolve this situation.

Iver McLeod
Project Manager
Bureau of Remediation and Waste Management
Maine DEP
Augusta, ME 04333

iver.j.mcleod@state.me.us
(207) 287-8010

## 3.5 RATIONAL FOR REMOVING A SAMPLE FROM STEP 6 OF THE PRG CALCULATION FOR COPPER

## Coh n, Deborah

**From:** Evans, Fred J (EFANE) [Evansfj@efane.navfac.navy.mil]
**Sent:** Wednesday, June 06, 2001 11:03 AM
**To:** 'Cassidy, Meghan'; 'McLeod, Iver'; 'Finkelstein, Ken'; 'Lepage, Carolyn'; katie.zeeman@state.me.us; sugatt.rick@epa.gov; Dr. Kenneth Munney PhD (E-mail)
**Cc:** 'Cohen, Deborah'; 'Bernhardt, Aaron'; 'Tracey, Greg'; Bartlett, Diana R (EFANE); Speicher, Jason A (EFANE); 'Raymond, Marty'
**Subject:** FW: Outlier - ACTION ITEMS FOR PRG TELECONFERENCE ON MAY 29, 2001

Outlier Table-Round 2.pdf

-----Original Message-----
From: Evans, Fred J (EFANE)
Sent: Wednesday, June 06, 2001 7:44 AM
To: 'Cassidy, Meghan'; 'McLeod, Iver'; 'Finkelstein, Ken'; 'Lepage, Carolyn'; 'katie.zeeman@state.me.us'; 'sugatt.rick@epa.gov'; 'Dr. Kenneth Munney PhD (E-mail)'
Cc: 'Cohen, Deborah'; 'Bernhardt, Aaron'; 'Tracey, Greg'; 'Bartlett, Diana'; 'Speicher, Jason'; 'Raymond, Marty'
Subject: RE: ACTION ITEMS FOR PRG TELECONFERENCE ON MAY 29, 2001

The following is the schedule for providing information from the May 29, 2001 PRG Teleconference:

1. Provided web site link and document to the Director Shipyard example PRG calculations to the regulators and SAPL via email on May 29, 2001.

2. Provide example PRG calculation for review.
   June 14, 2001

3. Provide outlier evaluation for PRG Development.
   June 14, 2001

Please call me if you have any questions.

Thank you,
Fred Evans

**RATIONAL FOR REMOVING A SAMPLE FROM STEP 6 OF THE PRG CALCULATION FOR COPPER**
**PORTSMOUTH NAVY SHIPYARD, KITTERY, MAINE**

| Station | Round | Sediment Concentration (mg/kg) | Pore Water Concentration (ug/L) | Toxic Results? | | Visual Inspection During Rd 4 | Recommendation |
|---|---|---|---|---|---|---|---|
| | | | | Sea Urchin | Amphipod | | |
| M03-200B | 2 | 1090 | 4.4 U | no | no | - Many pieces of green-tinted metal debris, looks like old slag<br>- Copper debris within 15 to 20 feet of sample | Remove(1) |
| M04-100B | 2 | 1780 | 4 | no | yes | - Many pieces of copper debris within granite blocks; large and small chunks of old slag.<br>- Copper debris within 10 to 15 feet of sample<br>- Stands of copper wire<br>- Other metal debris | Remove(1) |
| M04-300B | 2 | 393 | 311 | no | yes | - No debris near station | Do Not Remove(2,3) |
| M08-100B | 2 | 455 | 3 U | no | no | - Sample is located in the mudflat<br>- Metal debris in rip rap along bank<br>- Some cable with copper wires and a few pieces of copper<br>- Copper debris at least 50 feet from sample<br>- Many insects in sediment | Do Not Remove(3,4) |
| M08-300B-AVG | 2 | 755.5 | No Sample | No Sample | yes | - A few copper pieces<br>- Rebar<br>- Copper debris at least 30 feet from sample | Do Not Remove(3,4) |
| M09-100B | 2 | 511 | 23.2 | no | yes | - Metals debris along slope<br>- No copper observed | Do Not Remove(5) |
| M11-300B | 2 | 541 | 4.9 U | no | no | - No sediment present<br>- Metal debris (rusty steel/iron)<br>- No copper observed | Do Not Remove(5) |

1 - This sample is recommended for removal from the PRG calculation step because non-bioavailable forms of copper (e.g., copper oxide) are likely causing the elevatedcopper concentrations in the sediment.
2 - This sample is not recommended for removal because copper was only an outlier during one round and there is no visible copper debris near the sample location.
3 - The samples, while statistical outliers, do not appear to be grossly elevated.
4 - The copper in the sediment may not be related to the small amount of copper debris observed along the bank.
5 - No copper debris was observed near the sample location.

## 3.6 RESPONSE TO COMMENTS ON THE INTERIM SUBMITTAL

**RESPONSES TO MEDEP COMMENTS DATED JUNE 11, 2001**
**INTERIM SUBMITTAL FOR PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4**
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

Preliminary Remediation goals were first proposed in a November 2000 draft of the same document. Our comments on the initial draft were documented in a letter dated January 23, 2001, and discussed at the technical meeting held in Kittery on April 3, 2001. In general, the MEDEP determined that the approach for generating PRGs is convoluted but acceptable. There were concerns about the PRG proposed for copper, which are summarized as follows:

(a) Concentrations at more than half of the stations were reported as ½ the detection limit of 5 $\mu$g/L, which was greater than the screening concentration of 3.1 $\mu$g/L.; and,

(b) Some of the PRGs calculated for copper at monitoring stations were very high and perhaps should not be included in estimates of the mean.

A third general concern was that each COC would have only one final PRG for application at all areas of concern in OU4. Concern about the universal applicability of single benchmarks was raised due to the observed range of station-specific PRGs that were identified for copper.

During the April 3 meeting, it was reported that the analytical laboratory re-evaluated the detection limits for copper in porewater and subsequently reduced them from 5 $\mu$g/L to 3 $\mu$g/L. It was agreed at the April 3 meeting that data on copper in porewater could be re-evaluated relative to the lower detection limit. It was also agreed that the PRGs would be analyzed for outliers, which would then be excluded form calculations of the mean. These changes were to be reflected in the May 2001 report.

The May 2001 interim report was reviewed to determine whether the proposed changes address questions about the PRGs, particularly the PRG for copper. The subject report raised more questions about the copper PRG than it answered. Copper concentrations and PRGs from the two drafts of the report are summarized, for reference in Attachments 1 and 2 of this memorandum. It is specifically noted that the mean PRG for copper at monitoring stations increased from 547 mg/kg in the November 2000 report to 625 mg/kg in the May 2001 report. The increase was not expected because high values thought to be outliers were to be excluded from the calculation. The changes in the copper PRGs are explained by the following.

(a) Concentrations of copper in porewater at monitoring and reference stations were adjusted consistent with a detection limit of 3 $\mu$g/L;

(b) The one potential outlier PRG that was discussed in April (station M4.1) was removed from the data set used to estimate the mean (the new mean would otherwise be 738 mg/kg); and,

(c) The Threshold Effect Value (TEV) used to compute PRGs for copper at each of the monitoring stations was increased from 6.9 $\mu$g/L to 8.26 $\mu$g/L.

Questions and/or comments on the aforementioned actions are discussed below.

1. **Comment:** Revising the detection limit for copper in porewater affected more of the data points than anticipated (for comparison, see Attachment 1 of this memo). As expected, measured concentrations are reported for more stations than before. However, copper concentrations at Stations M1.2, M2.1, M9.2, and M14.1, which were previously reported to be between 6.0 and 11.0 $\mu$g/L were essentially halved by the change in the detection limit. Halving the concentration doubles the PRGs for the affected stations (Attachment 2). The impact that changing the detection limit has should be discussed and explained. In general, this highlights problems with manipulating data when concentrations are close to the detection limits. The Navy should consider a more sensitive analytical method for copper.

   **Response:** The analytical method for copper was sensitive enough to achieve the data quality objectives. The detection limit was initially reported as 5 ug/L because the laboratory "rounded up" the actual detection limits. The Navy asked the laboratory to review the analytical data to determine if a lower detection limit could be reported. The laboratory indicated that they could report the results down to 3 ug/L, which are the detection limits used in the Interim Submittal. The reason why the detections at Stations M1.2, M2.1, M9.2, and M14.1 are now considered non-detects is because there was a detection in the blank sample associated with those samples that was not detected at 5 ug/L, but was detected when the detection limit is reported as 3 ug/L. Copper is not a common laboratory contaminant. Therefore in accordance with USEPA, 1994] the concentration in the blank sample (4.1 ug/L) was multiplied by 5 to obtain an action level of 20.5 ug/L. Therefore, all samples associated with the blank (sample nos. OU4-PW-M01-200B, OU4-PW-M09-200B and OU4-PW-M14-100B) that had concentrations of less than 20.5 ug/L were determined to be associated with blank contamination, and were qualified as non-detect during the data validation process.

   Reference:

   USEPA, 1994. Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses. USEPA Data Review Workgroup. February.

2. **Comment:** The TEV for copper is the reference screening value (RSV) which is defined in Table 2.2-4 (page 15 of the report) as the "mean + 95% Upper Confidence Limit (UCL) based on the sample distribution type." As stated earlier, the TEV was increased from 6.9 $\mu$g/L to 8.26 $\mu$g/L (Table 2.2-5, page 16 of the report). During my efforts to understand the changes, I determined the following:

   (a) The definition given for the UCL in Table 2.2-4 is confusing, because it is not consistent with equations used to calculate UCLs (see Attachment 3 of this memo). As stated, the definition suggests that means are added into UCL calculations twice.

   (b) The values reported as the 95% UCLs are actually the estimated 95 percentile concentrations (see Attachment 3 of this memo). The RSVs for all contaminants measured at reference stations (Table 2.2-4, page 15 of the report) should be 95% UCL of the mean. The correct RSV and TEV for copper is 5.12 $\mu$g/L.

   (c) The PRGs computed in Table A-3-1.1 (page A-46 of the report) need to be adjusted to reflect corrections to the TEV. The PRGs that would be obtained using 5.12 $\mu$g/L are shown in Attachment 4 of this memorandum. The revised values are approximately 0.6 times the PRGs presented in the May 2001 report.

**Response:** The Navy agrees Note 3 of Table 2.2-4 is in error. Note 3 of Table 2.2-4 should identify the Aquatic Reference Screening Value as the 95th percentile equation, not the mean + 95% Upper Confidence Limit. Note 3 of Table 2.2-4 will be revised to:

"3 - Aquatic Reference Screening Value (RSV) calculated as the *95th percentile* based on sample and distribution type."

The Navy agrees the values reported as the 95% UCLs are actually the estimated 95th percentile concentrations. However, the Navy's believes the 95th percentile approach is more appropriate than the UCL approach as it is consistent with EPA's technical guidance (EPA, 1990) for assessing and regulating the discharge of toxic substances to the waters of the United States. It is the Navy's understanding on January 12, 2001 EPA approved the NPDES program for most of Maine. In the Navy's review of Maine's NPDES program, no specific changes to the method of discharge limit calculation were found. Thus, although concentrations of chemicals in sediment or sediment pore water do not constitute a discharge *per se*, the Navy has generically adopted the framework of EPA's approach for purposes of PRG development as the best available practice, as described below:

Appendix E of EPA 1990 prescribes the statistical methods to set discharge limits. Two similar procedures are discussed; the monthly average permit procedure and the daily average permit procedure. Both are based on quantile distributions (e.g., point estimator approach). The Navy has adopted the monthly average procedure as discussed below.

- The monthly average procedure is based on the 95th percentile of the distribution of the daily values that are in compliance. In this calculation for purposes of PRG development, our "daily values" are individual concentrations of chemicals in sampling locations that were found to be non-toxic (i.e., monitoring stations), or assumed to be not site-related (i.e., background chemical concentrations).

- In Table E-3, "Monthly Average Permit Limit Calculation for More Than 10 Samples", the formula and procedure that is presented is also the same formula the Navy uses to calculate the 95th percentiles for the Reference Screening Value and NOEC concentrations in the PRG document.

- In the most recent guidance, (EPA, 1996, Chapter 5, p. 74), it is discussed that a modified delta-lognormal distribution can be fit to the data, wherein "*the distribution assumes that all non-detects have a value equal to the detection limit and that the detected values follow a log-normal distribution.*" Further detail of the statistical methods is referenced to EPA 1990. The Navy has used 1/2 or the Method Detection Limit (MDL) values instead of MDL values, the 95th percentile values are lower than would be calculated by EPA's procedures.

Therefore, the Navy concludes the 95th percentile approach is technically defensible and most applicable approach that is presently available for use in PRG development, and is also consistent with the conservative approach that has been employed throughout all phases of the process. The Navy acknowledges the confusion caused by incorrect interchange of the UCL and 95th percentile terminology in the text and footnotes, and will correct these discrepancies. Also, the Navy proposes to append the above explanation to Appendix B (p. B-1) to explain that only the 95th percentile (i.e. quantile) approach was employed for PRG development.

The Navy also feels that the use of the 95th percentile to determine the aquatic No Observed Effects Concentration (NOEC) and the reference station value (RSV) is appropriate as the PRG process is very conservative because the PRG is based on either a NOEC or a reference concentration. The NOEC is the concentration where adverse effects are not expected to occur. Therefore, adverse effects are not expected to occur even if the maximum concentration in the non-toxic samples were used as the NOEC. Since the PRG process uses the 95th percentile to derive the NOEC, a PRG based on this value is expected to be protective of aquatic receptors. The reference data set is also biased for sampling locations that were selected to provide data on regional concentrations of chemicals in the Piscataqua River at locations with similar sediment type as PNS that are not influenced directly by PNS" (TtNUS, 1999) ". Also, the PRG procedure for calculating the 95th percentile uses ½ MDL values instead of the MDL values recommended by EPA (1996). Hence the resulting 95th percentile distribution of the reference and other data sets are shifted to lower values than would otherwise occur if EPA's procedure was used exactly.

The Navy also requested an independent review of the PRG Statistics through the Naval Facilities Engineering Service Center (Attachment 5 to the Response to Comments on the Interim Submittal) to determine which method, the 95% UCL or the 95th percentile, was more appropriate for calculating the PRGs for PNS.

References

TtNUS (Tetra Tech NUS, Inc.), 1999. "Interim Offshore Monitoring Plan for Operable Unit 4" for Portsmouth Naval Shipyard, Kittery, Maine. TtNUS, King of Prussia, PA, October.

USEPA, 1990. Technical Support Document for Water Quality-based Toxics Control (EPA/505/90-001) Office of Water.

USEPA, 1996. NPDES Permit Writers' Manual. EPA Office of Water.

3. **Comment:** The PRG that was eliminated as an outlier (Station 4.1) was the highest value in the November 2000 report, but not in the May 2001 report (see Attachment 2 of this memo). If the PRG from Station 4.1 is an outlier, the PRG from Station 3.2 should also be considered a potential outlier. If both values are eliminated, the mean PRG for copper becomes **301 mg/kg**.

   **Response:** In a email dated June 6, 2001 from Mr. Fred Evans, the Navy recommended deleting Stations 3.2 and 4.1 from the calculation of the PRG. The PRG using the 95th percentile is decreased to 486 mg/kg by removing the stations recommended by the Navy as outliers.

4. **Comment:** The following corrections are needed.

   (a) The RSV and TEV for copper needs to be changed to 5.12 µg/L and/or calculations for PRGs modified accordingly in Tables 2.2-4 (p. 15), 2.2-5 (p. 16), A-2-2.10 (p. A-43), A-3-1.1 (p. A-46)

(b) The PRG for copper should be changed to 301 mg/kg (from 625 mg/kg) and calculations of whole sediment hazard quotients modified accordingly in Tables 2.2-6 (p. 17), 3.3-1 (p. 18), 3.3-2 (p. 21), A-3-1.3a (p. A-71), A-3-1.3b (p. A-73), A-3-1.3c (p. A-77) and A-5 (p. A-82).

**Response:** Based on the reasons provided in the Navy's response to MEDEP Comment No. 2, the Navy disagrees with calculating the RSV, TEV, and PRG using the 95% UCL instead of the 95$^{th}$ percentile. Therefore, the numbers will be revised using the 95$^{th}$ percentile, excluding outliers.

Comments on other aspects of the May 2001 Interim PRG report are given below.

5. **Comment:** In general, show concentration units on all pages of all tables. In addition, please check tables for completeness. Some are missing entries for stations that apparently did not fit on the page (e.g., R4.3. R4.4, M14.2 and M14.3).

   **Response:** The concentration units will be added to all tables, where appropriate. Also, the corrected tables (Tables A2-2.10_p4, Table A3-1.2a_p5, and Table A-4) were forwarded to MEDEP et. al. in a June 14, 2001 e-mail from Mr. Fred Evans. These corrected tables will be included in the Draft Final PRG document.

6. **Comment:** Table A-3-1.2c (p. A-55)

   In the endnote it is stated that "for metals, tissue concentration equals sediment concentration." This is confusing. I am guessing the end note means that for metals, concentrations in tissue (mg/kg dry weight) are compared directly with concentrations (as mg/kg dry weight) in sediment. The assumption is being made that metal concentrations reported in this table are dry weight values. If they aren't, they need to be corrected.

   **Response:** The footnote will be changed to "Metals are not normalized." The tissue concentrations are in dry weight and this will be added as a footnote.

7. **Comment:** Table A-3-1.2a (p. A-51)

   Table is missing data for stations M14.1, M14.2 and M14.3

   **Response:** Please see the Navy's response to MEDEP Comment No. 5 above.

8. **Comment:** Table A-3-1.2f (p. A-61)

   See comment 6.

   **Response:** Please see the Navy's response to MEDEP Comment No. 6 above.

**RESPONSES TO SAPL COMMENTS DATED JUNE 11, 2001**
**INTERIM SUBMITTAL FOR PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4**
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

1. **Comment: Proposed Preliminary Remediation Goals for Copper.** Concerns regarding the Preliminary Remediation Goal (PRG) proposed for copper in the November 2000 report were discussed at the April 3, 2001 technical meeting. These concerns included a detection limit for copper that exceeded the screening concentration, and a particularly high value for copper at one station that appeared to be an outlier that should not be included in determining the mean. The Navy agreed to submit revised calculations that considered a lower detection limit and elimination of outliers. These revised calculations are included in the May 2001 Interim Submittal. As the Maine Department of Environmental Protection (MEDEP) states in their June 11, 2001 comment letter, the Interim Submittal raised more questions about the copper PRG than it answered. The MEDEP found that, even though the high values thought to be outliers were to be eliminated from consideration, the mean PRG for copper for monitoring stations increased, from 547 mg/kg in the November 2000 report to 625 mg/kg in the May 2001 Interim Submittal.

   We concur with the MEDEP's position that the effect on the copper PRG of revising the detection limit should be discussed and explained. If the MEDEP's analysis is correct, the reference screening value (RSV) and the threshold effects value (TEV) should be adjusted downward, and the PRG and whole sediment hazard quotients should be recalculated. In addition, the PRG from Station 3.2 should also be considered a potential outlier.

   **Response:** Please see the Navy's response to MEDEP Comment Nos. 1, 2, and 3 dated June 11, 2001.

2. **Comment: Readability of the Document.** SAPL had commented in the original comment letter (dated January 25, 2001) on the November 2000 Draft *Preliminary Remediation Goals for Operable Unit 4* that the document was very difficult to read and understand. MEDEP expressed similar concerns regarding the document. This issue was discussed at the April 3, 2001, technical meeting, with both the Navy and the Environmental Protection Agency (USEPA) acknowledging at the technical meeting that the readibility of the report needed to be improved so that the regulatory agencies' technical experts could express confidence in the PRG development. Suggestions for improving the document included adding example calculations and rewriting the Executive Summary so that the public could understand the process and the results.

   The Navy's May 10th response on this issue states that the report is a very technical document and the Navy does not believe that it is appropriate to revise the document to provide non-technical discussions. The Navy will also prepare a fact sheet for the public that will provide a non-technical explanation of the PRG development process.

   Although a revised Executive Summary is preferable, SAPL welcomes the fact sheet and suggests that it be inserted into the final version of the report that will be sent to the information repositories and to Restoration Advisory Board members. However, as discussed at the April technical meeting, it is not just the public that has difficulty with the document. It is crucial that the technical experts also be able to follow and understand the

PRG document and all other technical documents. If they cannot, how can the public have any confidence in the process or the results? It appears that additional revision is still necessary before the PRG document will be acceptable. With regard to other technical documents in the future, an effort must be made to improve readability. It is not unreasonable to expect that the Executive Summary, at a minimum, should be understandable to the interested layperson.

**Response:** The Navy recognizes SAPL's preference for a revised Executive Summary to a fact sheet. However, the purpose of the Executive Summary is to provide brief explanation of the statement of purpose of the proposed work, scope of work, methods used, results, conclusions, and recommendations (if any). The Executive Summary should not include any information which does not appear, in some form, in the body of the document. Therefore, as previously discussed, the Navy will issue a fact sheet to assist the community in understanding this document. A draft copy of the fact sheet will be provided to the regulators and select RAB Community members (i.e. the RAB Community members who volunteer to review and comment on fact sheets) to review and provide comments.

The Navy also recognizes SAPL's concerns regarding the ability of the technical experts ability to follow and understand the PRG document and all other technical documents. The Navy has worked with and will continue to work with USEPA, MEDEP, and others to assist them in following and understanding the PRG document and all other technical documents.

3. **Comment: Verifying Assumptions.** SAPL had a couple of comments in the January 25th letter regarding verification of some assumptions made in developing the PRG process. One of these was the assumption regarding selection and remediation of limiting contaminants of concern (CoCs), those CoCs that are responsible for much of the baseline risk. The assumption is that by remediating limiting CoCs, collocated CoCs will be remediated to levels that will not have adverse effects. SAPL asked if the data support this assumption. The Navy's May 10th response states that the assumption was taken from a USEPA document recommending the limiting CoC approach, and there is no site-specific data to support the assumption because all chemical concentrations around the Shipyard are not yet below PRG concentrations. How will the Navy test this assumption once site-specific data is available?

   **Response:** The intent of the interim monitoring program is to determine whether the PRG CoCs are self-remediating, i.e., attenuating over time and trending to fall below PRG concentrations. At the 5-Year Review, trend analysis will be conducted on the limiting CoCs. The Navy will also assess the other chemicals as part of the Data Quality Assessment to determine if other chemicals need to be evaluated at that time. Based on the trend analysis and other data quality assessments at the 5-Year Review, the Navy would propose a course of action if required.

4. **Comment: Dioxin Information.** In one of its April 11th additional comments regarding human health risks, SAPL pointed out that dioxin was not evaluated in the risk assessments and has only recently been tested in various sampling programs around the Shipyard. The Navy stated in its May 10th response that dioxin concentration data will require a screening evaluation for assessment of potential ecological risk. The Navy also states that participants at the April 3rd technical meeting were given an action item to look into what dioxin screening levels are available for sediment and fish tissue (mussel and juvenile

lobster, in particular). SAPL notes that the Maine Bureau of Health recently updated its Fish Tissue Action Levels. When fish tissue concentrations exceed action levels, the development of Fish Consumption Advisories is considered. The table identifying current action levels (the table is dated 12/00) used by the Bureau of Health for screening evaluations lists the Cancer Action Level for dioxin as 0.0015 ppb, and the NonCancer Action Level as 0.0019 ppb. A footnote to the table states that these values are scheduled for review upon completion of the USEPA's draft health assessment for dioxin. What other screening levels were gathered by the meeting participants? How will this information be incorporated into the evaluation of the OU4 data and the PRG process?

**Response:** The Navy also obtained the Maine Bureau of Health Cancer Action Level for dioxin of 0.0015 ppb (wet weight), and the Non-Cancer Action Level as 0.0019 ppb (wet weight). As indicated in the footnote of the Maine document, the action levels assumes that one 8-ounce meal per week is consumed; and the Cancer Action Level is based on a $10^5$ Risk Level. In the USEPA Guidance (USEPA, 2000), the carcinogenic consumption limit for four 8-ounce meals per month is 0.00015 ppb (based on a $10^5$ Risk Level). A Non-Cancer Action Level has not been developed in the USEPA document. Table 5-1 in USEPA, 1993 lists TCDD sediment concentrations associated with low risk to fish, mammals, and birds, and concentrations that would cause a high risk to sensitive species. The following table summarizes the information in Table 5-1:

| Organism | Sediment Concentration (ppb) | |
|---|---|---|
| | Low Risk | High Risk to Sensitive Species |
| Fish | 0.060 | 0.100 |
| Mammal | 0.0025 | 0.025 |
| Bird | 0.021 | 0.210 |

In the Baseline Report, the data collected during the Offshore Monitoring Program will first be compared to reference concentrations to determine if the dioxin levels may be related to site activities. If the dioxin levels in the site data are greater than the dioxin levels in the reference data, the site data will be compared to the human health action levels and the ecological sediment screening levels. The dioxins will not be used in the PRG process at this time. However, the Navy may develop PRGs for dioxins in the future, if dioxins are determined to be a chemical of concern for OU4.

References

USEPA, 2000. Guidance for Assessing Chemical Contaminant Data for Use In Fish Advisories, Volume 2: Risk Assessment and Fish Consumption Limits, 3rd Edition, EPA823B00008

USEPA, 1994. Interim report on Data and Methods for Assessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin Risks to Aquatic Life and Associated Wildlife

# ATTACHMENTS 1 – 4

## ATTACHMENTS TO MEDEP COMMENTS DATED JUNE 11, 2001 ON THE INTERIM SUMBITTAL FOR PRGS FOR OU4

**Attachment 1 - Copper concentrations in porewater - using different analytical detecti n limits (dl)**

| Concentration (ug/L) | | |
|---|---|---|
| | From Nov. 2000 | From May 2001 |
| Station | dl = 5.0 | dl = 3.0 |
| M1.1 | | |
| M1.2 | 11 | 5.6 |
| M1.3 | 2.5 | 1.5 |
| M2.1 | 6 | 2.8 |
| M2.2 | 2.5 | 2.2 |
| M2.3 | | |
| M3.1 | 2.5 | 1.5 |
| M3.2 | 2.5 | 2.2 |
| M3.3 | | |
| M4.1 | 2.5 | 4 |
| M4.2 | | |
| M4.3 | 474 | 474 |
| M5.1 | 2.5 | 1.5 |
| M5.2 | 2.5 | 1.5 |
| M5.3 | | |
| M6.1 | 2.5 | 1.5 |
| M6.2 | | |
| M6.3 | 2.5 | 1.5 |
| M7.1 | 2.5 | 1.5 |
| M7.2 | | |
| M7.3 | | |
| M8.1 | 2.5 | 1.5 |
| M8.2 | | |
| M8.3 | | |
| M8.4 | 2.5 | 1.5 |
| M9.1 | 23 | 23.2 |
| M9.2 | 6 | 3.15 |
| M9.3 | | |
| M9.4 | 2.5 | 1.9 |
| M10.1 | 2.5 | 1.5 |
| M10.2 | | |
| M10.3 | 2.5 | 1.8 |
| M11.3 | 2.5 | 2.45 |
| M12.1 | 2.5 | 1.5 |
| M12.2 | 2.5 | 2.15 |
| M12.3 | | |
| M13.1 | 2.5 | 1.5 |
| M13.2 | | |
| M13.3 | 2.5 | 1.5 |
| M14.1 | 8 | 4.15 |
| M14.2 | 2.5 | 1.5 |
| M14.3 | | |
| | | |
| Table | | 2.2-4 (p.15), A-2-2.4a (p. A-13) |

| Concentration (ug/L) | | |
|---|---|---|
| | From Nov. 2000 | From May 2001 |
| Station | dl = 5.0 | dl = 3.0 |
| R1.1 | 7 | 7.1 |
| R1.2 | 6 | 5.7 |
| R1.3 | 7 | 7 |
| R1.4 | 2.5 | 3.7 |
| R2.1 | 2.5 | 3.2 |
| R2.2 | 2.5 | 1.5 |
| R2.3 | 2.5 | 4.1 |
| R2.4 | 2.5 | 1.5 |
| R3.1 | 2.5 | 1.5 |
| R3.2 | 8 | 8.1 |
| R3.3 | 2.5 | 2.55 |
| R3.4 | 2.5 | 3.13 |
| R4.1 | 2.5 | 3.1 |
| R4.2 | 2.5 | 1.5 |
| R4.3 | 2.5 | 1.5 |
| R4.4 | 2.5 | 1.5 |
| Table | | 2.2-4 (p.15), A-2-2.4a (p. A-13) |
| | | |
| R-Mean | 3.63 | 3.54 |
| R-SD | 2.05 | 2.26 |
| R-Var | 4.18 | 5.12 |
| | | |
| Table 2.2-4 missing last 3 Ref stas. | | |

**Attachment 2 - Copper PRGs from the Nov 2000 versus those from th May 2001 report.**

PRG (mg/kg)
(PRG = measured concentration in sediment / TEV-HQ)

See Attachment 4 for TEV-HQ values

| Station | Nov. 2000 report dl = 5.0, TEV = 6.9 | May 2001 report dl = 3.0, TEV = 8.26 |
|---|---|---|
| M1.1 | | |
| M1.2 | 27.79 | 65.3 |
| M1.3 | 483.00 | 963.7 |
| M2.1 | 74.29 | 190.6 |
| M2.2 | 139.66 | 190.0 |
| M2.3 | | |
| M3.1 | 510.60 | 1018.7 |
| M3.2 | 3008.40 | 4092.5 |
| M3.3 | | |
| M4.1 | 4912.80 | 3675.7 |
| M4.2 | | |
| M4.3 | 5.72 | 6.8 |
| M5.1 | 173.60 | 346.4 |
| M5.2 | 106.26 | 212.0 |
| M5.3 | | |
| M6.1 | 40.85 | 81.5 |
| M6.2 | | |
| M6.3 | 44.44 | 88.7 |
| M7.1 | 131.10 | 261.6 |
| M7.2 | | |
| M7.3 | | |
| M8.1 | 1255.80 | 2505.5 |
| M8.2 | | |
| M8.3 | | |
| M8.4 | 433.32 | 864.5 |
| M9.1 | 153.30 | 181.9 |
| M9.2 | 238.05 | 542.8 |
| M9.3 | | |
| M9.4 | 419.52 | 660.8 |
| M10.1 | 76.31 | 152.3 |
| M10.2 | | |
| M10.3 | 86.11 | 143.2 |
| M11.3 | 1493.16 | 1823.9 |
| M12.1 | 242.60 | 484.0 |
| M12.2 | 103.09 | 143.5 |
| M12.3 | | |
| M13.1 | 148.49 | 296.3 |
| M13.2 | | |
| M13.3 | 328.44 | 655.3 |
| M14.1 | 51.49 | 118.8 |
| M14.2 | 78.94 | 157.5 |
| M14.3 | | |
| Table | | A-3-1.1 (p. A-46) |
| M-Mean | 546.93 | 737.92 |
| M-SD | 1077.10 | 1070.92 |
| Mean w/o Sta. 4.1 | | 626.00 |

## Attachment 3

**One-sided 95% upper confidence limit of the mean Cu concentration in reference porewater (May 2001 values)**

**With Untransformed Data** (Sokal and Rohlf, 1981; Zar 1999; Gilbert 1987)

$$UCL_{.95} = \text{mean} + [(t_{n-1,.05})(\text{standard deviation} / \sqrt{n-1})]$$

Mean = 3.54
Standard deviation = 2.26
n = 16
$t_{15,.05} = 1.753$

$$UCL_{.95} = 3.54\mu g/L + [(1.753)(2.26/\sqrt{15})$$

$$\underline{UCL_{.95} = 4.56\ \mu g/L}$$

**With Ln-transformed Data** (Zar, 1999)

Same as above, after concentrations (x) are transformed (to x') as follows:

$$x' = Ln\ (x + 1)$$

Mean x' = 1.405
Standard deviation = 0.472
n = 16
$t_{15,.05} = 1.753$

$$UCL_{.95}\ x' = 1.405 + [(1.753)(0.472/\sqrt{15}) = 1.619$$
$$UCL_{.95}\ x = \exp(1.619) - 1 = 4.05\ \mu g/L$$

$$\underline{UCL_{.95} = 4.05\ \mu g/L}$$

**With Ln-transformed data & critical value (H) for ln-normal distribution** (Gilbert 1987; PRG report)

$$UCL_{.95} = \exp\{\text{mean } x' + \text{variance}/2 + [(H_{0.95})(\text{standard deviation} / \sqrt{n-1})]$$

$$x' = Ln\ x$$

$H_{0.95}$ = critical value for the 95% UCL (Table by Land, in Gilbert 1987)

Mean x' = 1.08
Standard deviation = 0.628
Variance = 0.394
n = 16
$H_{0.95}$ = approximately 2.2 (based on the standard deviation and n = 16)

$$UCL_{.95} = \exp\{1.08 + 0.394/2 + [(2.2)(0.628 / \sqrt{15})]$$

$$\underline{UCL_{.95} = 5.12\ \mu g/L}$$

**95th percentile Cu concentration in reference porewater (May 2001 concentrations)**

**With Untransformed data** (PRG report; Gilbert 1987)

$$P_{.95} = (\text{mean } x) + (\text{standard deviation})(Z_{.95})$$

$Z_{.95}$ = the 95th percentile of a standard normal distribution

Mean = 3.54
Standard deviation = 2.26
n = 16
$Z_{.95}$ = 1.6449

$$P_{.95} = 3.54\mu g/L + [(1.6449)\ (2.26)]$$

$$\underline{P_{.95} = 7.26\ \mu g/L}$$

**With Ln-transformed data** (PRG report)

$$P_{.95} = \exp[\text{mean } x' + (\text{standard deviation})(Z_{.95})]$$

Mean x' = 1.08
Standard deviation = 0.628
n = 16
$Z_{.95}$ = 1.6449

$$P_{.95} = \exp[1.08 + (0.628)(1.6449)]$$

$$\underline{P_{.95} = 8.27\ \mu g/L}$$

**Attachment 4 - PRGs for copper in sediment using TEVs based on RSVs that ar upper 95 percentile concentrations (May 2001 report) vs 95% UCLs of the mean at reference stations (May 2001-corrected).**

PRG (mg/kg)

(PRG = measured concentration in sediment / TEV-HQ)

| Station | Cu in sediment (mg/kg) | May 2001 report dl = 3.0, TEV = 8.26 | May 2001-corrected dl = 3.0, TEV = 5.12 | From May 2001 dl = 3.0, TEV = 8.26 | May 2000-corrected dl = 3.0, TEV = 5.12 |
|---|---|---|---|---|---|
| M1.1 | 43.7 | | | | |
| M1.2 | 44.3 | 65.3 | 40.50 | | |
| M1.3 | 175 | 963.7 | 597.33 | | |
| M2.1 | 64.6 | 190.6 | 118.13 | | |
| M2.2 | 50.6 | 190.0 | 117.76 | | |
| M2.3 | 46.1 | | | | |
| M3.1 | 185 | 1018.7 | 631.47 | | |
| M3.2 | 1090 | 4092.5 | 2536.73 | | |
| M3.3 | 106 | | | | |
| M4.1 | 1780 | 3675.7 | 2278.40 | | |
| M4.2 | 59.5 | | | | |
| M4.3 | 393 | 6.8 | 4.25 | | |
| M5.1 | 62.9 | 346.4 | 214.70 | | |
| M5.2 | 38.5 | 212.0 | 131.41 | | |
| M5.3 | 22.7 | | | | |
| M6.1 | 14.8 | 81.5 | 50.52 | | |
| M6.2 | 27.9 | | | | |
| M6.3 | 16.1 | 88.7 | 54.95 | | |
| M7.1 | 47.5 | 261.6 | 162.13 | | |
| M7.2 | 35.4 | | | | |
| M7.3 | 23.2 | | | | |
| M8.1 | 455 | 2505.5 | 1553.07 | | |
| M8.2 | 77.5 | | | | |
| M8.3 | 755.5 | | | | |
| M8.4 | 157 | 864.5 | 535.89 | | |
| M9.1 | 511 | 181.9 | 112.77 | | |
| M9.2 | 207 | 542.8 | 336.46 | | |
| M9.3 | 73.3 | | | | |
| M9.4 | 152 | 660.8 | 409.60 | | |
| M10.1 | 27.65 | 152.3 | 94.38 | | |
| M10.2 | 33.7 | | | | |
| M10.3 | 31.2 | 143.2 | 88.75 | | |
| M11.3 | 541 | 1823.9 | 1130.58 | | |
| M12.1 | 87.9 | 484.0 | 300.03 | | |
| M12.2 | 37.35 | 143.5 | 88.95 | | |
| M12.3 | 95.3 | | | | |
| M13.1 | 53.8 | 296.3 | 183.64 | | |
| M13.2 | 51.6 | | | | |
| M13.3 | 119 | 655.3 | 406.19 | | |
| M14.1 | 59.7 | 118.8 | 73.65 | | |
| M14.2 | 28.6 | 157.5 | 97.62 | | |
| M14.3 | 31 | | | | |
| Table | A-2-2.2a (p. A-3) | A-3-1.1 (p. A-46) | CTZ memo Attachment 3 | (less M3.2 & M4.1) | (less M3.2 & M4.1) |
| | | With outliers | With outliers | Minus two outliers | Minus two outliers |
| M-Mean | | 737.92 | 457.40 | 486.23 | **301.39** |
| M-SD | | 1070.92 | 663.82 | 589.90 | 365.65 |

**Attachment 4 - PRGs for copper in sedim nt using TEVs based on RSVs that are upper 95 percentile concentrations (May 2001 report) vs 95% UCLs of the mean at referenc stations (May 2001-corrected).**

TEV-HQs

(TEV-HQ = measured concentration in porewater / TEV)

| Station | Nov. 2000 report dl = 5.0, TEV = 6.9 | May 2001 report dl = 3.0, TEV = 8.26 | May 2001- corrected dl = 3.0, TEV = 5.12 |
|---|---|---|---|
| | (conc in pw/6.9) | (adj conc/8.3) | (adj conc/5.12) |
| M1.1 | | | |
| M1.2 | 1.59 | 0.68 | 1.09 |
| M1.3 | 0.36 | 0.18 | 0.29 |
| M2.1 | 0.87 | 0.34 | 0.55 |
| M2.2 | 0.36 | 0.27 | 0.43 |
| M2.3 | | | |
| M3.1 | 0.36 | 0.18 | 0.29 |
| M3.2 | 0.36 | 0.27 | 0.43 |
| M3.3 | | | |
| M4.1 | 0.36 | 0.48 | 0.78 |
| M4.2 | | | |
| M4.3 | 68.70 | 57.38 | 92.58 |
| M5.1 | 0.36 | 0.18 | 0.29 |
| M5.2 | 0.36 | 0.18 | 0.29 |
| M5.3 | | | |
| M6.1 | 0.36 | 0.18 | 0.29 |
| M6.2 | | | |
| M6.3 | 0.36 | 0.18 | 0.29 |
| M7.1 | 0.36 | 0.18 | 0.29 |
| M7.2 | | | |
| M7.3 | | | |
| M8.1 | 0.36 | 0.18 | 0.29 |
| M8.2 | | | |
| M8.3 | | | |
| M8.4 | 0.36 | 0.18 | 0.29 |
| M9.1 | 3.33 | 2.81 | 4.53 |
| M9.2 | 0.87 | 0.38 | 0.62 |
| M9.3 | | | |
| M9.4 | 0.36 | 0.23 | 0.37 |
| M10.1 | 0.36 | 0.18 | 0.29 |
| M10.2 | | | |
| M10.3 | 0.36 | 0.22 | 0.35 |
| M11.3 | 0.36 | 0.30 | 0.48 |
| M12.1 | 0.36 | 0.18 | 0.29 |
| M12.2 | 0.36 | 0.26 | 0.42 |
| M12.3 | | | |
| M13.1 | 0.36 | 0.18 | 0.29 |
| M13.2 | | | |
| M13.3 | 0.36 | 0.18 | 0.29 |
| M14.1 | 1.16 | 0.50 | 0.81 |
| M14.2 | 0.36 | 0.18 | 0.29 |
| M14.3 | | | |
| Table | | A-2-2.10 (p. A-43) | CTZ memo Attachment 3 |

# ATTACHMENT 5

# REVIEW OF PRG STATISTICS BY THE NAVAL FACILITIES ENGINEERING SERVICE CENTER

NEWFIELDS

Statistical Peer Review of:

# *Calculation of Preliminary Remediation Goals (PRGs)*
# *Operable Unit 4*
# *Portsmouth Naval Shipyard (PNS), Kittey, Maine*

Developed by:
Science Applications International Corporation
Newport, RI
and
Tetra Tech NUS, Inc.
Pittsburgh, PA

Review Prepared by:
Shahrokh Rouhani, P.E., Ph.D.
NewFieldes, Inc.

Prepared for:
United State Navy
Engineering Field Activity-Northeast
Lester, PA

Under Battelle Delivery Order 135, Task 23
Battelle Point of Contact:
Susan Brauning
Battelle
505 King Avenue
Columbus, Ohio 43201

July 23, 2001

**NEWFIELDS, INC.**
*1349 West Peachtree Street, Suite 2000, Atlanta, Georgia, 30309*
*Tel: (404)347-9050/Fax: (404) 347-9080*

## Introduction

This document presents review comments of statistical components of the calculation of preliminary remediation goals (PRGs) for Operable Unit 4, Portsmouth Naval Shipyard (PNS), Kittery, Maine, developed by Science Applications International Corporation (SAIC) and Tetra Tech NUS, Inc. (TtNUS). For this purpose, the following documents were reviewed:

- SAIC and TtNUS, "Example Calculation of Preliminary Remediation Goals," 14 June 2001.
- TtNUS, Selected excerpts from "Preliminary Remediation Goals for Operable Unit 4 Report," May 2001.
- Description of the statistical treatment of data during the interim offshore monitoring program (IOMP)

The main focus of this review is the statistical components of the PRG calculation process as defined in SAIC and TtNUS (2001). As noted in this document, the PRG calculation process involves a number of steps, including:

- Step 1. Benchmark Consolidation and Hazard Calculation
- Step 2. Evaluation of Site-specific Analyte Exposure
- Step 3. Retaining Constituents of Concern (COCs)
- Step 4. Reference Comparison and Threshold Effect Value (TEV) Calculations
- Step 5. Selection of Limiting COCs
- Step 6. Baseline PRG Calculations
- Step 7. Recommended PRG Evaluation

The statistical components of the above steps are listed below:

- Step 1 does not include any specific statistical computations.
- Step 2 includes the following statistical components:
    - Step 2C. Assess type of statistical distribution for the non-toxic monitoring station data sets using Shapiro-Wilk test.
    - Step 2D. Calculate the 95% upper limit (UL) for the non-toxic monitoring station data sets assuming either normal or log-normal distribution.
- Step 3 includes the determination of the maximum detected concentration in the toxic monitoring station data sets, which is not discussed in this review.
- Step 4 includes the following statistical components:
    - Step 4B. Assess type of statistical distribution for the reference data set using Shapiro-Wilks test.
    - Step 4C. Calculate the 95% UL for the reference dataset assuming either normal or log-normal distribution.
- Step 5 includes numerical ranking of TEV hazard quotient (TEV-HQ) of various analytes in each monitoring station, which is not discussed in this review.

- Step 6 includes the following statistical computations:
    - Step 6A. Derive Baseline PRGs as arithmetic mean of ratio of sediment concentration over TEV-HQ for each sample from all monitoring stations.
- Step 7 includes the assessment of the correlation between risk findings and baseline PRG exceedences. This assessment, however, is qualitative in nature and is not discussed in this review.

Additionally the IOMP includes the following proposed statistical components:

- Parametric trend analysis (linear regression) of average concentration of each limiting COC for the sediment samples collected within the monitoring and reference station for each sampling round (or sediment-based mussel samples collected within monitoring stations where sediment is not present).
- Identification of statistical outliers (i.e., values beyond the 95% confidence interval, if normally or lognormally distributed, otherwise values beyond the upper quartile range plus 1.5 times the quartile range). Those outliers with an assignable physiochemical cause will be omitted.
- Comparison of coefficients of variation across monitoring/reference stations during the same sampling round (spatial variation) and across sampling rounds at the same monitoring/reference stations (temporal variations) using the Levene's test to check homogeneity of variance.
- Parametric or non-parametric one-way analysis of variance tests (ANOVA) to assess the difference between average concentrations at monitoring versus reference stations, supported by the Shapiro-Wilk and Levene tests.
- Comparison of mean concentrations and standard deviations among different habitats.

## Review Comments

This section presents the review comments as related to the above statistical components. Each comment also includes the reviewer's recommendations when appropriate.

1. Step 2C and 2D include assessment of the type of the statistical distribution for the non-toxic monitoring station data sets using Shapiro-Wilk test, followed by calculating the 95% UL for the non-toxic monitoring station data sets, assuming either normal or log-normal distribution. Basically, the proposed process is a statistically reasonable approach for the following reasons:
    - The objective of these computations is to determine the threshold value of *point* concentrations representative of non-toxic monitoring stations. Therefore, it is imperative that the computed statistics to be representative of point values. For this reason, ULs are most appropriate. Use of other measures, such as mean or its upper confidence level (UCL) is inappropriate, because these latter measures are representative of *average* values over the entire investigated sediment basin. Specifically, in risk assessment computations, UCLs are only intended for cases where average concentrations over an entire exposure area are desired.

- Non-toxic stations are identified according to highly conservative criteria in Steps 2A and 2B as a distinct population. The use of these criteria ensures that the selected samples from non-toxic monitoring stations constitute values that can be grouped together as a single statistical population.
- Despite the above stringent criteria, the use of 95% UL implies that the procedure conservatively considers 5% of the data as non-representative, even when those measurements are confirmed to belong to the non-toxic population.
- Use of the cited UL equations to compute threshold values are common approaches in environmental site investigations. For example guidance, see U.S. EPA (1995 and 1998).
- Given that all subsequent comparisons are defined in terms of point concentrations, the use of UL ensures the spatial consistency of the computed values.
- The selected process for UL calculations in the reviewed document is based on conservative assumptions. The conservative nature of these calculations is demonstrated in the following example.

**Example:** The statistical computations associated with Steps 2C and 2D are discussed in details in SAIC and TtNUS (2001). Consider copper pore water hazard quotient (PW-HQ) for samples indicating no toxicity to amphipods (Table A-2-2.6, pages A-27 through 30). Of the 23 reported PW-HQ values 13 of them are 0.48, while the rest range between 0.51 and 1.81, as listed in Attachment A of this review. The 0.48 values appear to be related to below detection results, which are substituted by one-half of the method detection limits.

Attachment A of this review shows the exploratory statistical analysis of PW-HQ values, logarithm of PW-HQ values, PW-HQ above 0.48, and logarithm of PW-HQ values above 0.48, respectively. As this attachment indicates, the complete dataset is neither normally nor log-normally distributed using a 90 or 95% confidence limit. However, if 0.48 values are removed, the remaining data would exhibit a strong tendency toward log-normality.

Given that there only 23 values, of which a significant portion appear to be related to non-detects, non-parametric procedures are appropriate to determine the 95% UL. This approach is conducted by ranking the measured values in an ascending order. Then the $k = 0.95(n+1)$ is calculated, where n is the number of data values. If k is an integer, the 95-percentile is the $k^{th}$ largest value in the ordered dataset. If k is not an integer, the 95-percentile is obtained by linear interpolation between two values in the ordered dataset that are closest to k. The 95 and other percentile values for the complete dataset are shown in Attachment A of this review. As noted, this procedure is a versatile, non-parametric technique (i.e., does not require any specific

distribution), which can be applied to any dataset, as long as the $k^{th}$ largest value is not associated with a below detection sample (DON, 1999).

In this case, k = 0.95(24+1) = 23.75. The above non-parametric approach would result in a 95% UL for copper PW-HQ of 1.716 (Attachment A of this review). This value is more than 50% higher than the reported value of 1.14 in Table A-2-2.6, which is computed based on the assumption of log-normality. This example highlights the built-in conservatism in Steps 2C and 2D computations.

2. Step 4B and 4C include assessment of the type of the statistical distribution for the reference data sets using Shapiro-Wilk test, followed by calculating the 95% UL for the reference data sets assuming either normal or log-normal distribution. Basically, the proposed computations are statistically reasonable for the following reasons:
   - The objective of these computations is to determine the threshold value of risk screening values (RSVs) for screening of *point* concentrations. Therefore, it is imperative that the computed statistics to be representative of point values. For this purpose, ULs are most appropriate. Use of other measures, such as mean or its upper confidence level (UCL) is inappropriate, because these latter measures are representative of *average* values over the entire reference area. In this instance, given the screening nature of RSVs, which are used as benchmarks against point measurements, the UL must be used.
   - Reference areas are identified based on the results of extensive site investigations. These investigations ensure that the selected samples from the reference stations constitute values that can be grouped together as a single statistical population.
   - Despite the above findings, the use of 95% UL implies that the procedure conservatively considers 5% of the reference data as non-representative, even when those measurements are confirmed to belong to the reference population.
   - Use of the cited UL equations to compute RSVs are common approaches in environmental site investigations. For example guidance, see U.S. EPA (1995 and 1998).
   - Given that all subsequent comparisons are defined in terms of point concentrations, the use of ULs for RSV calculations ensures the spatial consistency of the computed values.
   - The selected process for UL calculations in the reviewed document is based on overly conservative assumptions. The reasonable nature of these calculations is demonstrated in the following example.

   **Example:** The statistical computations associated with Steps 4B and 4C are discussed in details in SAIC and TtNUS (2001). Consider copper concentrations for reference samples (Table 2.2-4, page 15). Of the 16 reported values 6 of them are 1.5 ppb, while the rest range between 2.55 and

8.10 ppb, as listed in Attachment B of this review. The 1.5 ppb values appear to be related to non-detects, which are substituted by one-half of the method detection limits.

Attachment B of this review shows the exploratory statistical analysis of the above copper concentrations, their logarithms, concentrations above 1.5 ppb, and logarithm of concentrations above 1.5 ppb, respectively. As this attachment indicates, the complete dataset is neither normally nor log-normally distributed using a 90 or 95% confidence limit. However, if 1.5 ppb values are removed, the remaining data would exhibit a log-normal tendency.

Given that there are only 16 values, of which a significant portion appear to be related to non-detects, the non-parametric procedure discussed earlier can be used. In this case, $k = 0.95(16+1) = 16.15$, resulting in a 95%UL of 8.25 ppb, which is the practically the same as the reported value of 8.26 ppb in Table 2.2-4. This example highlights the fact that the procedure described in SAIC and TtNUS (2001) is reasonable and yields results consistent with conservative statistical procedures.

3. At this stage, it should be reiterated that the statistical measures discussed above, i.e., the 95% UL of PW-HQ (Steps 2C/2D) and Aquatic RSVs (Steps 4B/4C), are computed mainly for screening and comparison to individual sample results. These comparisons eventually lead to determination of individual $C_s$/TEV-HQ, i.e., the ratio of sediment concentration over TEV-HQ, for each sample, before their arithmetic mean is considered as the baseline PRG in Step 6A. This clearly indicates that determination of PRGs is mainly driven by point results. Given the fact that the investigated sample results are all point measurements, and the fact that all decisions are based on such point sample results, it is imperative that above statistical measures to be also representative of point values. The use of 95% UL ensures this necessary condition. Any deviation from this principal yields intermediate values that cannot be compared or applied to point values. For example, comparison or screening of point values based on the UCL of mean concentrations is a statistically inconsistent and inappropriate procedure. Such inconsistencies must be avoided in order to assure the reliability of the resulting PRGs.

4. The IOMP includes a series of comprehensive statistical tests. These tests assess both temporal and spatial trends of the resulting monitoring data. Almost all the cited procedures consider both parametric and non-parametric methods. This provides adequate flexibility to accommodate various outcomes. The following are some supplementary suggestions for further improvement of the proposed program:
   - The trend analysis proposed in the IOMP currently considers either normal or log-normal distributions, such that the appropriate parametric linear regression can be applied. To ensure the applicability of the proposed methods, the trend analysis should also consider the cases when neither distributional assumption

is applicable. For this purpose, the non-parametric trend analyses, such as Mann-Kendall test (Helsel and Hirsch, 1995, p. 326), should also be included among the proposed techniques.

5. Another component of the IOMP is the comparison of station-average concentrations to the recommended PRGs. The baseline PRGs derived in Step 6A are arithmetic averages of point values. Upon evaluation of these values in Step 7, they are proposed to be used for comparison against station-average concentrations during each monitoring round. These station-averages would typically represent three samples. This comparison is a highly conservative procedure, as discussed below:
    - The above PRGs are arithmetic mean values. This implies that even if all the samples during a given monitoring rounds are from the same statistical population as before (i.e., no change in their conditions), depending on the distribution of the measured values, there is as much as 50% chance that the exceedences are erroneously reported. Statistically, this is a very high *Type I error*.
    - The above error rate is further compounded when considering that the PRGs are representative of the entire basin, while the computed station averages represent much smaller areas. As the *regularization* principle (Matheron, 1971) indicates, variability of measured values tend to decrease as their averaging domain increases. This implies that the PRGs are not only representative of the entire sediment basin, but also are expected to be far less variable that the station-averages. This discrepancy further increases the chances of the Type I error.
    - As noted in numerous U.S. EPA guidance documents, such as U.S. EPA (1994), a reasonable Type I error is usually between 1% to 10%. In fact, the most common value for Type I error used in environmental site investigations is 5%. Given this typical value of 5%, a Type I error in excess of 50% can be considered as overly conservative.

## References


Department of the Navy (DON). 1999. *Handbook for Statistical Analysis of Environmental Background Data.* San Diego: DON SWDIV and EFA West. April.

Helsel, D. R., and Hirsch, R.M. 1995. *Statistical Methods in Water Resources.* Elsevier Science Publishers, Amsterdam. 529 p.

Matheron, G. 1971. *The Theory of Regionalized Variables and Its Applications.* Les Cahiers du Centre de Morphologie Mathématique de Fontainebleau, No. 5.

United States Environmental Protection Agency. 1994. *Statistical Methods for Evaluating the Attainment of Cleanup Standards, Vol. 3: Reference-Based Standards for Soils and Solid Media.* EPA 230-R-94-004. Washington, DC: Office of Policy, Planning, and Evaluation.

United States Environmental Protection Agency. 1995. *Determination of Background Concentrations of Inorganics in Soils and Sediments at Hazardous Waste Sites.*

U.S. EPA Engineering Forum Issue paper. EPA/540/S-96/500. Washington, DC: Office of Solid Waste and Emergency Response. December.

United States Environmental Protection Agency, Region 4 (U.S. EPA Region 4). 1998. *Statistical Tests for Background Comparison at Hazardous Waste Sites.* Interim Draft Supplemental Guidance to RAGS. Atlanta.

# ATTACHMENT A

## Exploratory Analysis of Copper PW-HQ in Point Samples from Non-toxic Monitoring Stations (23 data points)

## Copper PW-HQ Data

| | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.48 | 0.48 | 0 48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.48 | 0.51 | 0.58 | 0.69 | 0.71 | 0.71 | 0.79 | 0.90 | 1.02 | 1.34 | 1.81 |

**Descriptives**

| | | Statistic | Std. Error |
|---|---|---|---|
| PWHQ | Mean | .6652 | .06950 |
| | Median | .4800 | |
| | Variance | .111 | |
| | Std. Deviation | .33333 | |
| | Minimum | .48 | |
| | Maximum | 1.81 | |
| | Range | 1.33 | |
| | Interquartile Range | .2300 | |
| | Skewness | 2.393 | .481 |
| | Kurtosis | 6.027 | .935 |
| LNPWHQ | Mean | -.4892 | .07861 |
| | Median | -.7340 | |
| | Variance | .142 | |
| | Std. Deviation | .37699 | |
| | Minimum | -.73 | |
| | Maximum | .59 | |
| | Range | 1.33 | |
| | Interquartile Range | .3915 | |
| | Skewness | 1.637 | .481 |
| | Kurtosis | 2.129 | .935 |

**Percentiles**

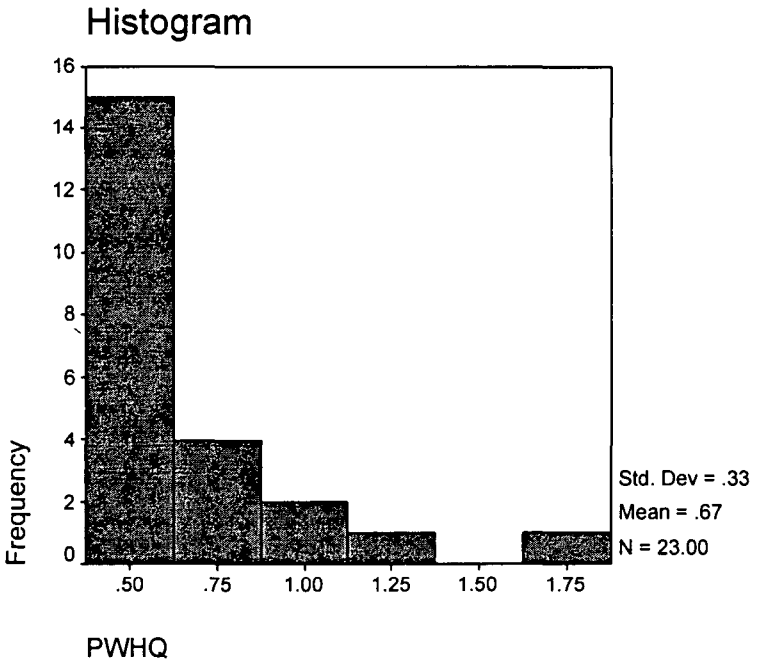
| | | Percentiles | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 5 | 10 | 25 | 50 | 75 | 90 | 95 |
| Weighted Average(Definition 1) | PWHQ | .4800 | .4800 | .4800 | .4800 | .7100 | 1.2120 | 1.7160 |
| | LNPWHQ | -.7340 | -.7340 | -.7340 | -.7340 | -.3425 | .1835 | .5332 |
| Tukey's Hinges | PWHQ | | | .4800 | .4800 | .7100 | | |
| | LNPWHQ | | | -.7340 | -.7340 | -.3425 | | |

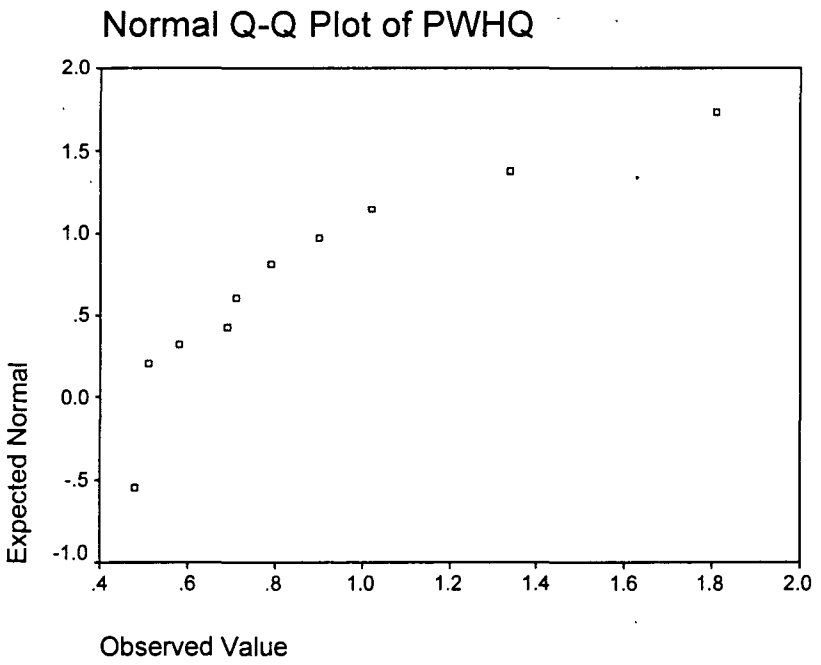
**Tests of Normality**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| PWHQ | .289 | 23 | .000 | .636 | 23 | .000 |
| LNPWHQ | .307 | 23 | .000 | .716 | 23 | .000 |

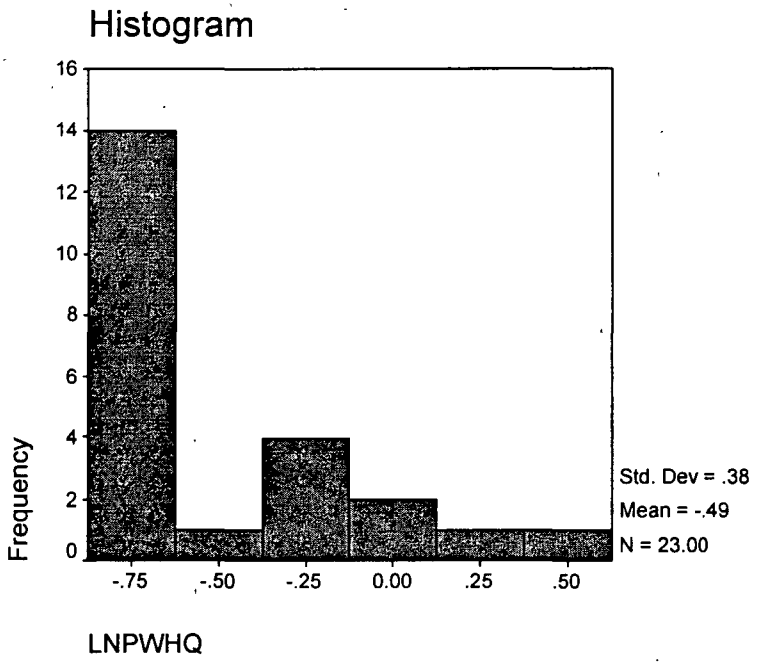
a. Lilliefors Significance Correction

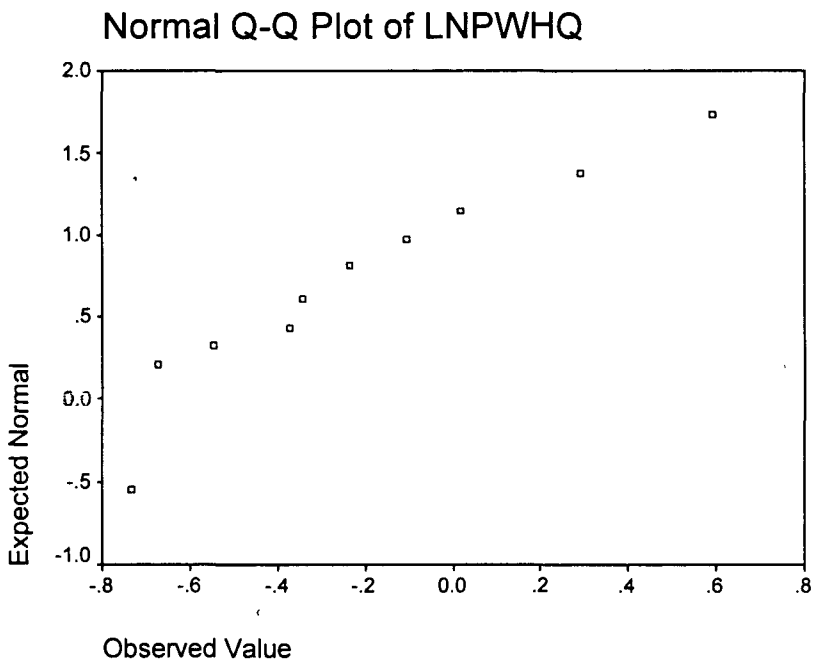
## PWHQ




Normal Q-Q Plot of PWHQ
Expected Normal
2.0
1.5
1.0
.5
0.0
-.5
-1.0
.4
.6
.8
1.0
1.2
1.4
1.6
1.8
2.0
Observed Value

**LNPWHQ**


Histogram
Frequency
16
14
12
10
8
6
4
2
0
-.75
-.50
-.25
0.00
.25
.50
Std. Dev = .38
Mean = -.49
N = 23.00
LNPWHQ




## Exploratory Analysis of Copper PW-HQ above 0.48 in Point Samples from Non-toxic Monitoring Stations (10 data points)

**Descriptives**

| | | Statistic | Std. Error |
|---|---|---|---|
| PWHQ | Mean | .9060 | .12555 |
| | Median | .7500 | |
| | Variance | .158 | |
| | Std. Deviation | .39702 | |
| | Minimum | .51 | |
| | Maximum | 1.81 | |
| | Range | 1.30 | |
| | Interquartile Range | .4375 | |
| | Skewness | 1.550 | .687 |
| | Kurtosis | 2.202 | 1.334 |
| LNPWHQ | Mean | -.1709 | .12179 |
| | Median | -.2891 | |
| | Variance | .148 | |
| | Std. Deviation | .38513 | |
| | Minimum | -.67 | |
| | Maximum | .59 | |
| | Range | 1.27 | |
| | Interquartile Range | .5025 | |
| | Skewness | .865 | .687 |
| | Kurtosis | .376 | 1.334 |

**Percentiles**

| | | Percentiles | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 5 | 10 | 25 | 50 | 75 | 90 | 95 |
| Weighted Average(Definition 1) | PWHQ | .5100 | .5170 | .6625 | .7500 | 1.1000 | 1.7630 | . |
| | LNPWHQ | -.6733 | -.6605 | -.4145 | -.2891 | .0880 | .5633 | . |
| Tukey's Hinges | PWHQ | | | .6900 | .7500 | 1.0200 | | |
| | LNPWHQ | | | -.3711 | -.2891 | .0198 | | |

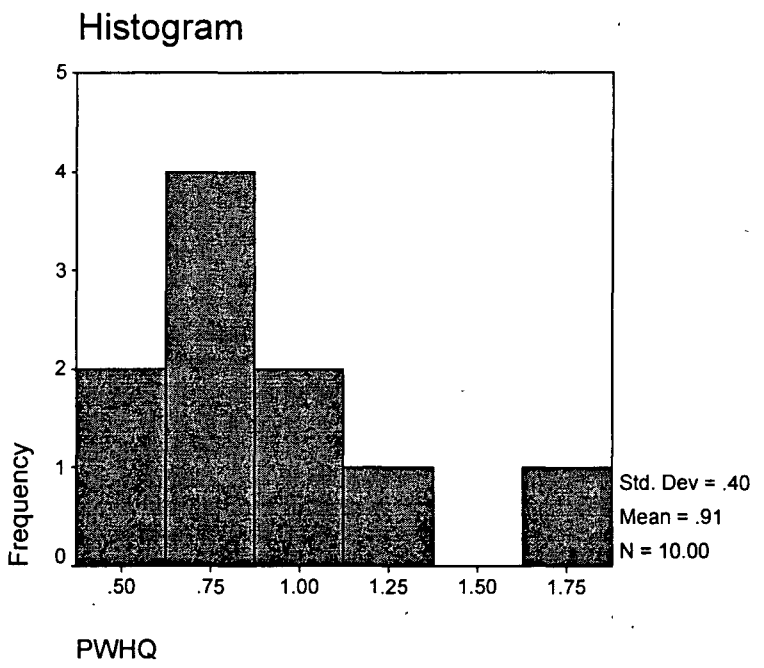
**Tests of Normality**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| PWHQ | .215 | 10 | .200* | .842 | 10 | .047 |
| LNPWHQ | .172 | 10 | .200* | .939 | 10 | .537 |

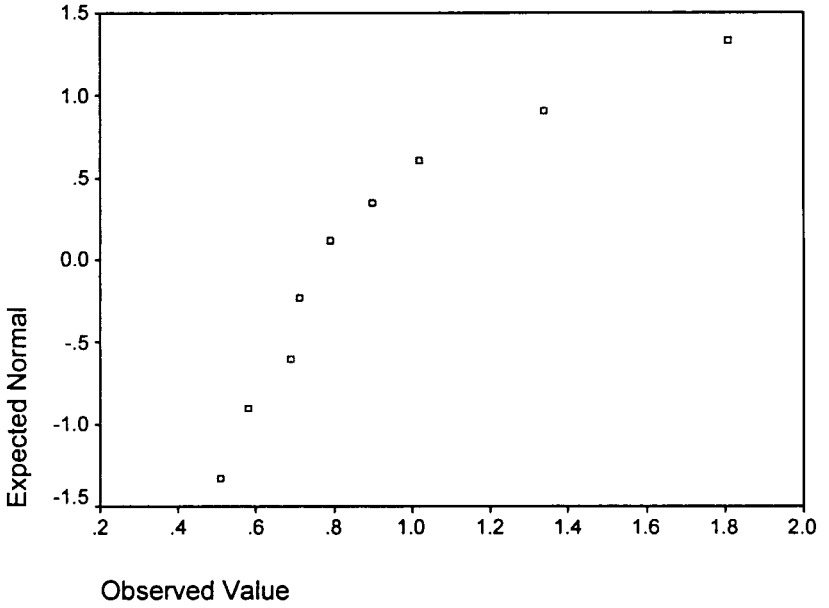
*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

## PWHQ

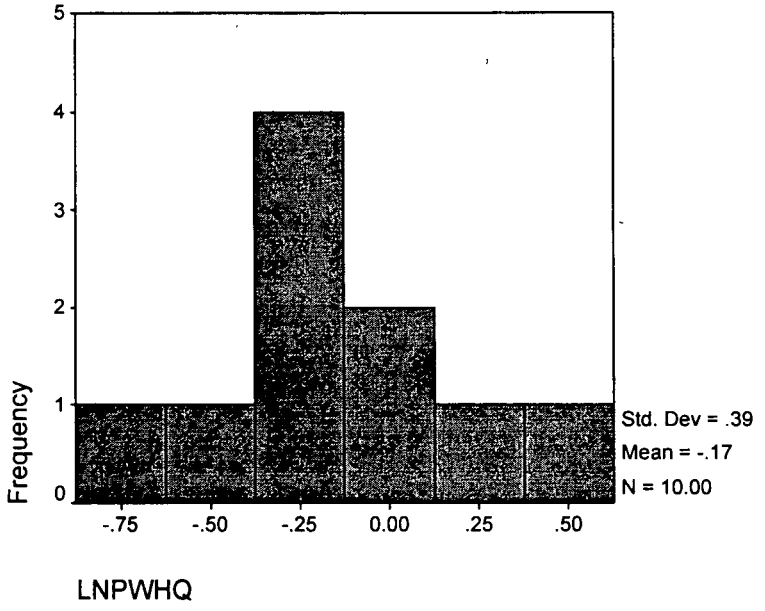


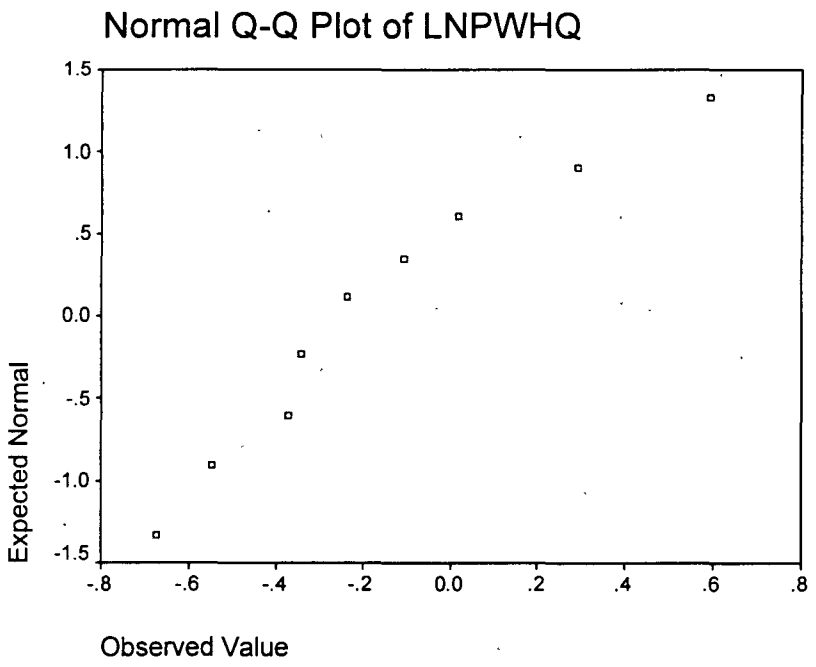
Normal Q-Q Plot of PWHQ




**LNPWHQ**

Histogram




Normal Q-Q Plot of LNPWHQ
Expected Normal
Observed Value
1.5
1.0
.5
0.0
-.5
-1.0
-1.5
-.8
-.6
-.4
-.2
0.0
.2
.4
.6
.8

# ATTACHMENT B

## Exploratory Analysis of Copper Pore Water Concentrations in Reference Station Samples (16 data points)

## Copper Pore Water Concentrations (ppb)

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 1.50 | 2.55 | 3.10 | 3.13 | 3.20 | 3.70 | 4.10 | 5.70 | 7.00 | 7.10 | 8.10 |

**Descriptives**

| | | Statistic | Std. Error |
|---|---|---|---|
| COPPER | Mean | 3.5425 | .56595 |
| | Median | 3.1150 | |
| | Variance | 5.125 | |
| | Std. Deviation | 2.26378 | |
| | Minimum | 1.50 | |
| | Maximum | 8.10 | |
| | Range | 6.60 | |
| | Interquartile Range | 3.8000 | |
| | Skewness | .912 | .564 |
| | Kurtosis | -.440 | 1.091 |
| LNCOPPER | Mean | 1.0789 | .15692 |
| | Median | 1.1362 | |
| | Variance | .394 | |
| | Std. Deviation | .62770 | |
| | Minimum | .41 | |
| | Maximum | 2.09 | |
| | Range | 1.69 | |
| | Interquartile Range | 1.2526 | |
| | Skewness | .271 | .564 |
| | Kurtosis | -1.359 | 1.091 |

**Percentiles**

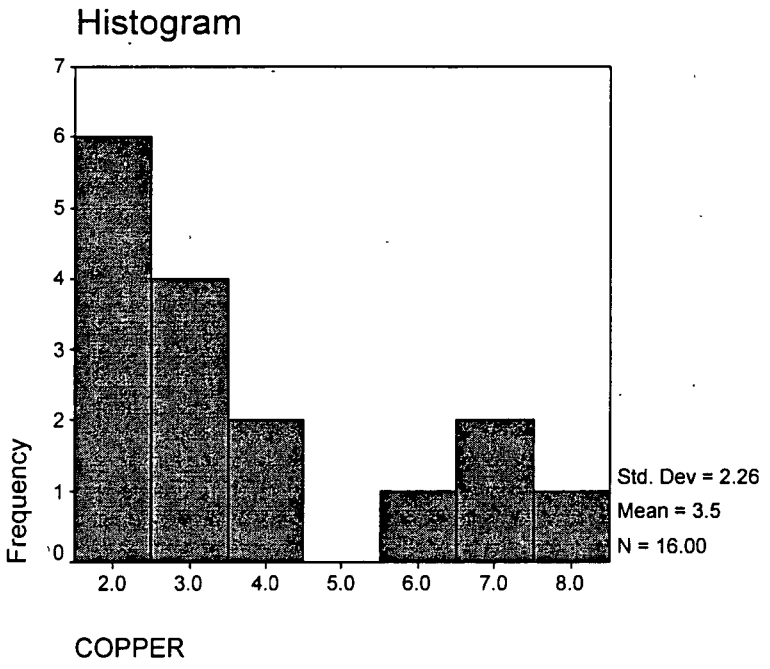
| | | Percentiles | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 5 | 10 | 25 | 50 | 75 | 90 | 95 |
| Weighted Average(Definition 1) | COPPER | 1.5000 | 1.5000 | 1.5000 | 3.1150 | 5.3000 | 7.4000 | . |
| | LNCOPPER | .4055 | .4055 | .4055 | 1.1362 | 1.6581 | 1.9996 | . |
| Tukey's Hinges | COPPER | | | 1.5000 | 3.1150 | 4.9000 | | |
| | LNCOPPER | | | .4055 | 1.1362 | 1.5757 | | |

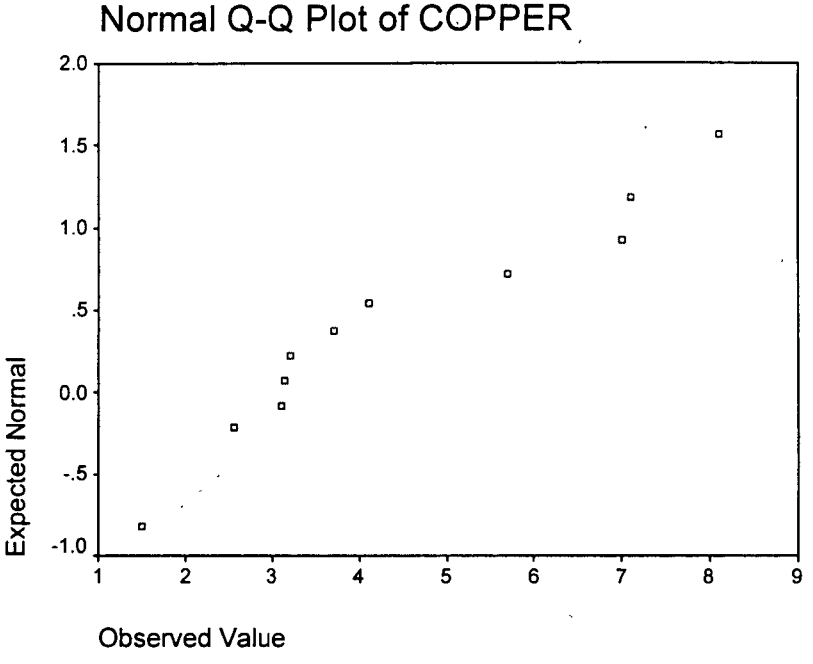
**Tests of Normality**

| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| COPPER | .192 | 16 | .120 | .836 | 16 | .009 |
| LNCOPPER | .233 | 16 | .020 | .865 | 16 | .023 |

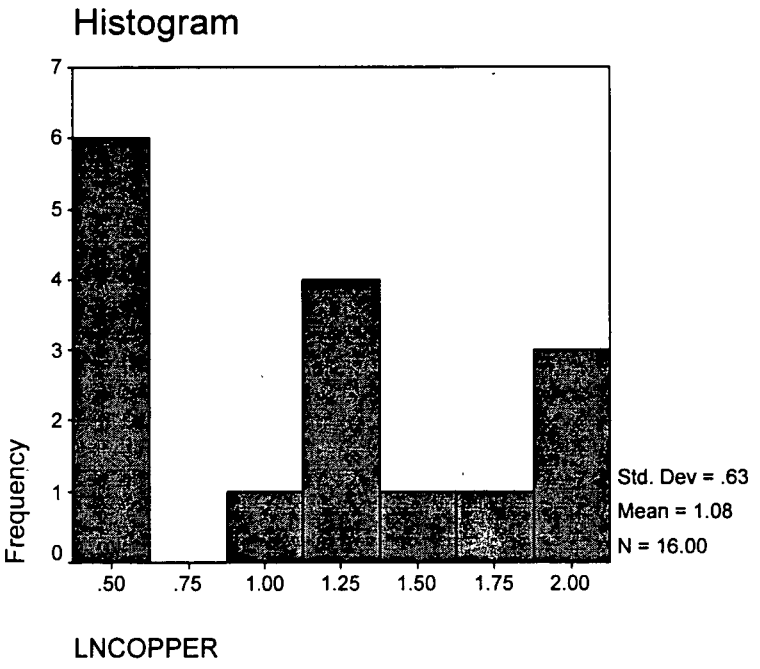
a. Lilliefors Significance Correction

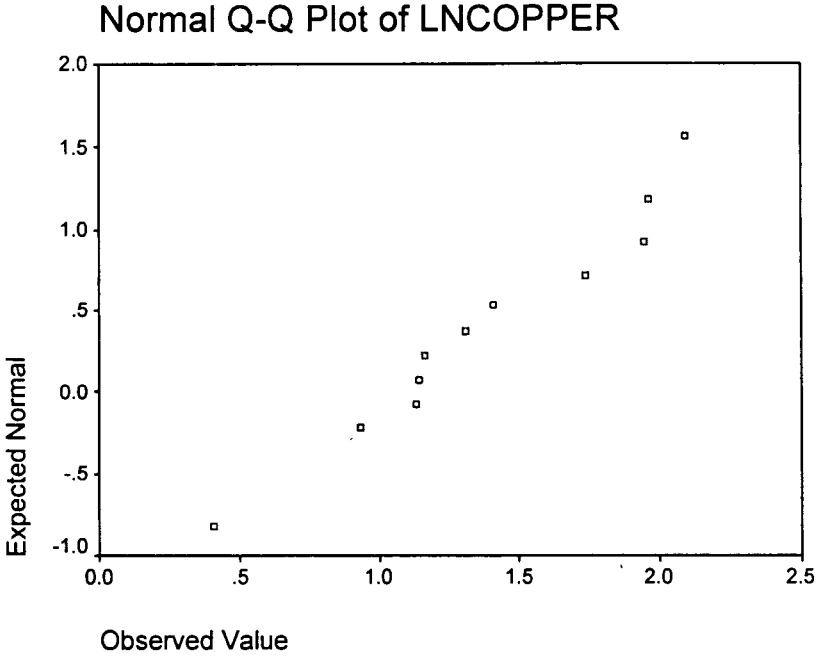
## COPPER


Histogram
Frequency
7
6
5
4
3
2
1
0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
COPPER
Std. Dev = 2.26
Mean = 3.5
N = 16.00


Normal Q-Q Plot of COPPER
Expected Normal
2.0
1.5
1.0
.5
0.0
-.5
-1.0
1
2
3
4
5
6
7
8
9
Observed Value

## LNCOPPER


Histogram
Frequency
7
6
5
4
3
2
1
0
.50
.75
1.00
1.25
1.50
1.75
2.00
Std. Dev = .63
Mean = 1.08
N = 16.00
LNCOPPER


Normal Q-Q Plot of LNCOPPER
Expected Normal
2.0
1.5
1.0
.5
0.0
-.5
-1.0
0.0
.5
1.0
1.5
2.0
2.5
Observed Value

# Exploratory Analysis of Detected Copper Pore Water Concentrations in Reference Station Samples (10 data points)

**Descriptives**

| | | Statistic | Std. Error |
|---|---|---|---|
| COPPER | Mean | 4.7680 | .63963 |
| | Median | 3.9000 | |
| | Variance | 4.091 | |
| | Std. Deviation | 2.02268 | |
| | Minimum | 2.55 | |
| | Maximum | 8.10 | |
| | Range | 5.55 | |
| | Interquartile Range | 3.9025 | |
| | Skewness | .609 | .687 |
| | Kurtosis | -1.404 | 1.334 |
| LNCOPPER | Mean | 1.4829 | .13151 |
| | Median | 1.3597 | |
| | Variance | .173 | |
| | Std. Deviation | .41588 | |
| | Minimum | .94 | |
| | Maximum | 2.09 | |
| | Range | 1.16 | |
| | Interquartile Range | .8108 | |
| | Skewness | .319 | .687 |
| | Kurtosis | -1.644 | 1.334 |

**Percentiles**

| | | Percentiles | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 5 | 10 | 25 | 50 | 75 | 90 | 95 |
| Weighted Average(Definition 1) | COPPER | 2.5500 | 2.6050 | 3.1225 | 3.9000 | 7.0250 | 8.0000 | . |
| | LNCOPPER | .9361 | .9556 | 1.1386 | 1.3597 | 1.9495 | 2.0787 | . |
| Tukey's Hinges | COPPER | | | 3.1300 | 3.9000 | 7.0000 | | |
| | LNCOPPER | | | 1.1410 | 1.3597 | 1.9459 | | |

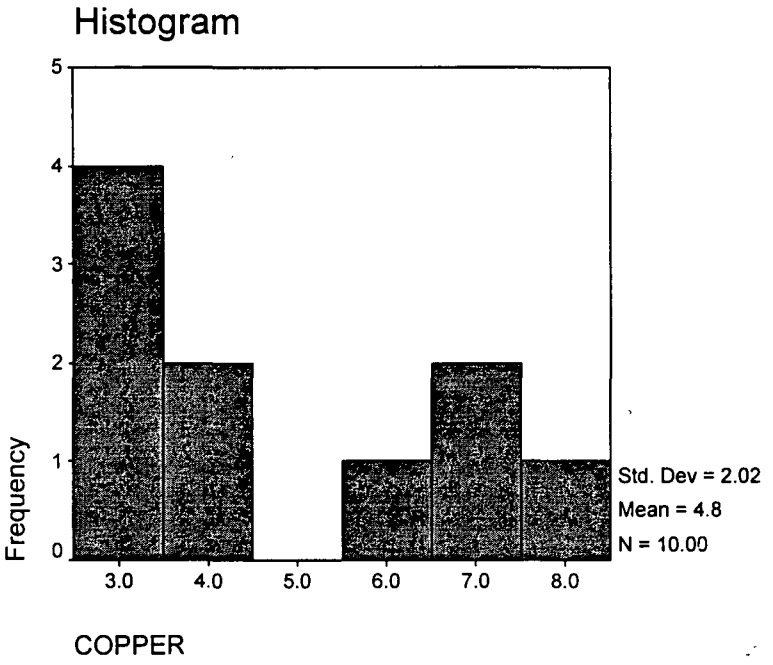
**Tests of Normality**

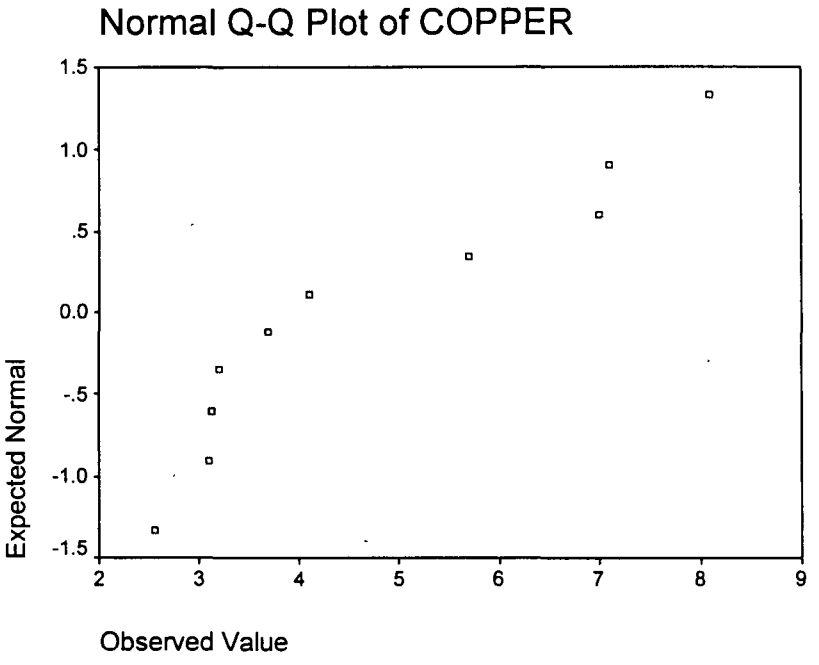
| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
|---|---|---|---|---|---|---|
| | Statistic | df | Sig. | Statistic | df | Sig. |
| COPPER | .229 | 10 | .145 | .868 | 10 | .094 |
| LNCOPPER | .179 | 10 | .200* | .899 | 10 | .216 |

*. This is a lower bound of the true significance.

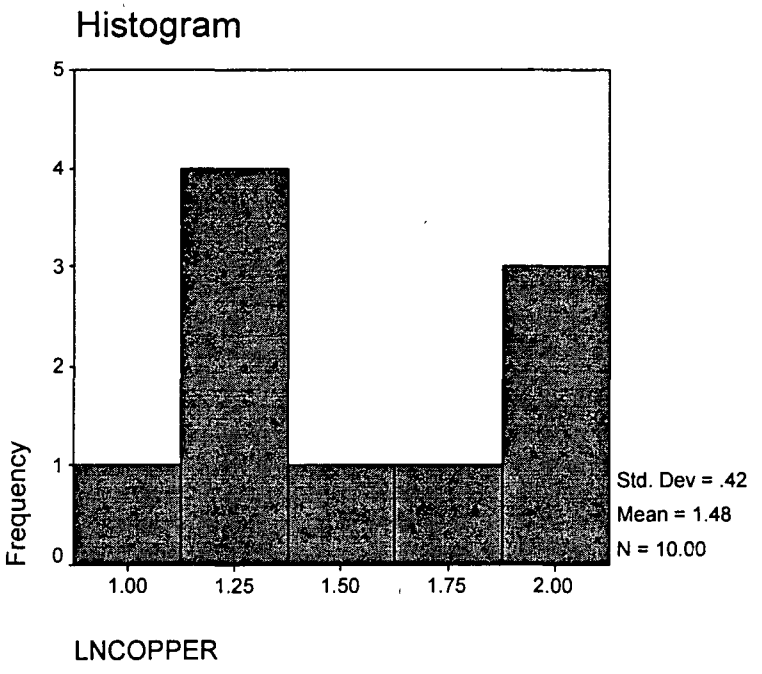
a. Lilliefors Significance Correction

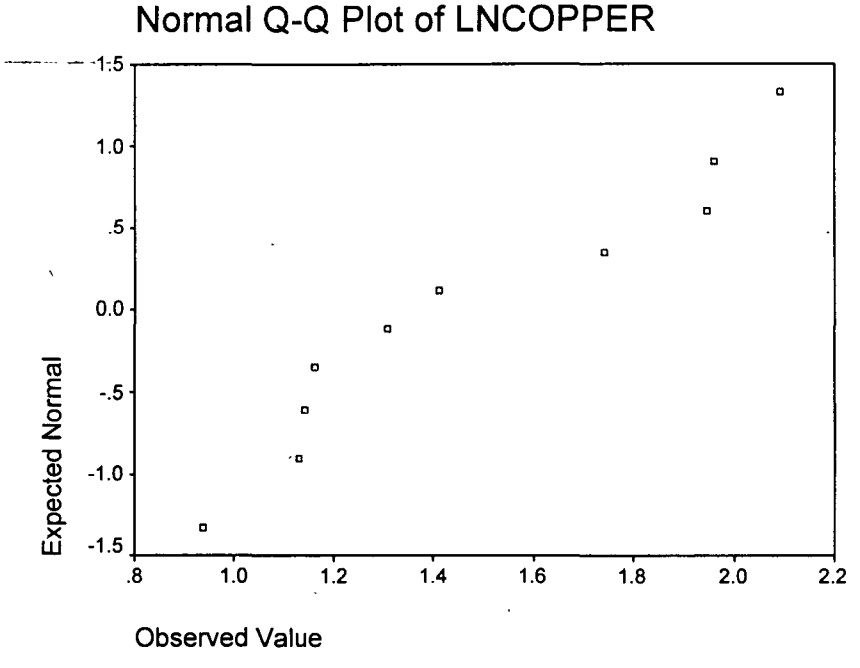
## COPPER


Histogram
Frequency
5
4
3
2
1
0
3.0
4.0
5.0
6.0
7.0
8.0
COPPER
Std. Dev = 2.02
Mean = 4.8
N = 10.00


Normal Q-Q Plot of COPPER
Expected Normal
1.5
1.0
.5
0.0
-.5
-1.0
-1.5
2
3
4
5
6
7
8
9
Observed Value

## LNCOPPER


Histogram
Frequency
5
4
3
2
1
0
1.00
1.25
1.50
1.75
2.00
LNCOPPER
Std. Dev = .42
Mean = 1.48
N = 10.00


Normal Q-Q Plot of LNCOPPER
Expected Normal
1.5
1.0
.5
0.0
-.5
-1.0
-1.5
.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
Observed Value

# ATTACHMENT 3.7

# RESPONSE TO COMMENTS ON THE DRAFT FINAL PRG DOCUMENT

**RESPONSES TO NOAA COMMENTS DATED OCTOBER 3, 2001**
**DRAFT FINAL PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4**
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

(Comment numbers added)

1. **Comment:** Previously, we discussed the removal of stations with much metal debris because inorganic constituents likely are not bioavailable there. I see this briefly addressed in the April/2001 minutes that followed our meeting and in Appendix 3.5 but there is no mention of this step in the body of the document. Section 3.1 translates the aquatic TEV values into PRGs and equation #5 provides the reader with the quantification for this method. But as you are aware, if the high concentrations found at Stations 4-1 and 3-2 are used, the PRG is greatly increased despite some question of the copper availability. We discussed this at length during our spring meeting, and I am certain the Navy removed them in the calculation, but the report does not show the reader where and how you did this.

   **Response:** Text will be added to indicate that high copper values from the two locations were not used to calculate PRGs. The following paragraph will replace the second to last paragraph on page 14 (of Attachment 1):

   "The important feature of this TEV-to-PRG translation method is that the measured risk data are used to derive the PRG value. In some cases, further modification might be needed if, for example, characteristics of a particular media sampled at a given location (*e.g.*, TOC content of sediment, inert CoC materials such as metal fragments) result in an estimated PRG that is outside the expected range about the value at PRG-HQ = 1. In the present study, the high copper values from monitoring stations MS-3.2 and MS-4.1 were not used to calculate the OU4-wide PRG concentration as the elevated levels were statistical outliers and likely caused by the metal slag observed at both locations (Attachment 3.5). With this exception, the procedure described above was used to calculate station-specific PRG estimates from which the mean PRG value was taken as the site-wide PRG concentration. Results of this process are discussed in Section 3.2."

2. **Comment:** When reviewing the PRG Hazard Quotients for Round 1 (Table A-3-1.3b), I note that Station M-11 was not included. Or was it? Previously NOAA observed that these two samples were collected in the intertidal zone of the Piscataqua River near Sites 6 and 29 of the PNS. MS-11 was dominated by sand (>93% in both samples), and only two samples were collected due to the lack of sediment. The high metals values at this station (especially Pb) were due to the likely failure of the revetment allowing contaminated soil to fall in the area. We stated that re-calculating the averages without the inclusion of MS-11 would provide a more realistic assessment of the distribution of metals values in sediment. Did the Navy do this? If so, can you help me find where this is explained in the report?

   **Response:** Only Round 2 data were used to develop the baseline PRGs. Once the PRGs were developed, the values were compared to both Round 1 and EERA sediment data. During Round 1, sediment was present at MS-11 at two locations (location 2 and location 3). The sediment sample from location 2 during Round 1 (MS-11-299A) was collected from some sediment behind mussels near the area of eroding soil at Site 6. This sediment sample had very high levels of metals (particularly lead, copper, and nickel); however,

sediment sample collected at location 3 during Round 1 (MS-11-399A), which was collected near Site 29, did not have high levels of metals. In Round 2, sediment could only be collected at location 3 (MS-11-300B). The copper concentration for this sediment sample was evaluated as part of the evaluation for removing a sample from Step 6 of the PRG calculation and it was determined that the sediment data for copper (from Round 2) for this location would be included in the PRG calculation. The information was provided in an email from the Navy dated June 6, 2001 and a copy of the email is included as Attachment 3.5 of the PRG Report.

The data for Round 1 in Table A-3-1.3b (pages A-77 to A-80) are correct, though the "00B" portion of the label needs to be changed to "99A". The footnote is not correct, and should be changed to "Not calculated for Round 1 data." See below.

For MS-11, although sediment was collected at MS-11.2, it was really soil that became trapped behind clumps of mussels, and not a true benthic habitat. Also, going forward, if bivalve data will be used to monitor here, then the PRG process should be applied consistently. If the sediment is only available for one round, then sediment monitoring at this location is not a reliable long term monitoring method.

Although tissue data were available, the BAF/BSAF approach was not applied to Round 1 data because the BAF/BSAF values were not developed for Round 1 data per agreement by the group that the issue of average BAF/BSAF would be addressed with the full data sets (all rounds), and that the round two calculations were more an example of how the PRG process would be applied.

Note that Table A-3-1.2j (page A-74) was corrected by removing the TOC value (TOC was not measured for the samples because sediment was not present at these locations).

3. **Comment:** Concerning Round 4, I noted that the inorganics, particularly copper remain very high at Station #4. Furthermore, two out of three additional Station 4 samples (see Appendix G.5 of the Round 4 data package) also showed very high inorganic concentrations, as did monitoring stations 3, 8, 11. The discussion above likely explains the high concentrations at stations 3, 4, and 11. Station 8 concentrations appear to have increased to those values found during Round 2. The Navy should address the source of this contamination.

   **Response:** The Navy is evaluating the four rounds of interim offshore monitoring data as part of the Baseline Monitoring Report. The Navy will conduct the evaluation in accordance with the Interim Offshore Monitoring Plan (TtNUS, October 1999). However, as indicated in the Interim Offshore Monitoring Plan (TtNUS, October 1999), trending to determine whether concentrations are increasing significantly will be conducted after the first 4 years of monitoring data are available (i.e., after Round 6 sampling) because a minimum of 4 years of sediment data are required to adequately discern a trend. The Navy recognizes that copper concentrations at MS-3 and MS-4 are very high at some of the sampling locations. These two monitoring stations are located offshore of Site 32 and the Navy is currently in the planning stages for a Remedial Investigation for Site 32. Therefore, the Navy is also evaluating the offshore data for MS-3 and MS-4 as part of the planning process for Site 32.

**RESPONSES TO MEDEP COMMENTS DATED OCTOBER 18, 2001**
**DRAFT FINAL PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4**
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

## General Comment

1. **Comment:** As stated in our Sept. 19, 2001 letter all references to using the 95% UCL must be replaced with the 95th percentile concentration and the basis for the change needs to be clearly stated.

   **Response:** Table ES-1 of Attachment 1 will be revised to indicate "95$^{th}$ quantile". Also, the use of the "95% UCL" terminology in the Interim Offshore Monitoring Plan was an error. The plan correctly indicated the formula for the 95$^{th}$ percentile concentration would be used; however, the formula was incorrectly labeled as the "95% UCL," instead of the"95$^{th}$ percentile" concentration. Therefore, the approach did not change; there was just an error in terminology.

## Specific Comments

2. **Comment:** Executive Summary, p. ES-4, last paragraph before bullet

   Change "rational" to "rationale".

   **Response:** The text will be corrected as requested.

3. **Comment:** 4.0 Uncertainty Analysis, p. 23

   a) "Although every sampling location around PNS did not have a PRG exceedance, multiple sampling locations within each of the intermediate risk areas...did exhibit PRG exceedances."

   This sentence is confusing. Should the first phrase read, "Although not every sampling location around PNS had a PRG exceedance..." ? Otherwise it sounds as if there were no PRG exceedances at any sampling locations around PNS.

   **Response:** The text will be revised to read "Although not every sampling location around PNS had a PRG exceedance, multiple sampling locations within each of the intermediate risk areas (i.e., Dry Docks, Back Channel, Sullivan Point) did exhibit PRG exceedances."

   b) 2nd paragraph of section: Change "Trustee's" to "Trustees".

   **Response:** The text will be corrected as requested.

4. **Comment:** Fig. 3.3-2 B. Round 1 Monitoring Data

The area of BC-169 has a yellow circle associated with it but there is no corresponding symbol in the legend. Please correct.

**Response:** The indicated location is MS-1.1. The symbol color should be blue, because the PRG-HQ is less than 1 at this location. Figure 3.3.2 B (page 32 of Attachment 1) will be corrected.

5. **Comment:** Table 1.0-1 Potential Remedial Action Objectives for the Portsmouth Naval Shipyard offshore study area

"Protect...communities by identification of exposure to chemicals of concern (COCs) at unacceptable levels..."

Identification alone does not protect these communities. The Potential RAOs should include addressing/mitigating exposures to COCs at unacceptable levels.

**Response:** The potential RAOs are the RAOs identified for the Interim Offshore Monitoring (see Section 2.8 of the Interim Record of Decision for OU4, Navy, May 1999), and are correct as they apply to the interim remedy. The current interim monitoring program triggers additional investigation, not remedial action. No revision is required.

6. **Comment:** Table A-2.2.2a

The last footnote for this table indicates that "a value of 1/2 MDL substituted for non-detects". Those results that were designated ND should be noted in the table either by highlighting, an asterisk, or some other designator such as the data qualifier U. Approximate results should also be indicated by a J.

**Response:** The data provided in Table A-2.2.2a are the Round 2 data as they were used in the PRG development process. The reported data (with the appropriate data qualifiers) for Round 2 can be found in the Interim Offshore Monitoring Round 2 Data Package (TtNUS, October 2000).

7. **Comment:** Table A-2-2.4a, Concentrations of contaminants in the sediment pore water from Round 2

See Comment 6.

**Response:** Please see the Navy's response to MEDEP Comment No. 6, above.

8. **Comment:** Attachment 2, Example Calculations

The example calculations go only part way towards presenting the calculations as the MEDEP requested. In my email to the Navy dated 5/25/01, which dealt specifically with copper, I stated, "I want to see the actual equations with the values specific to copper

plugged in." In the DF PRG document the Navy provided the formulae with the variables stated, and then the values of the variables were indicated separately. This is appropriate however, the final step would be to show the formulae with the values of the variables plugged in. For example, for Step 1A the final part of the example would be:

$$\text{WQSV} = \frac{19\mu g / kg}{(13{,}800 L / kg)(0.01)} = 0.138\ \mu g/L$$

The MEDEP is not sure why this request apparently was difficult to understand. Nevertheless, we will accept the presentation as shown in the Draft Final document.

**Response:** Comment noted. However, no change will be made to the example calculations as shown in the Draft Final document.

9. **Comment:** Response to MEDEP Comment 1

MEDEP comment: "However, copper concentrations at Stations M1.2, M2.1, M9.2, and M14.1...were essentially halved by the change in the detection limit...The impact that changing the detection limit has should be discussed and explained."

Navy response: "The reason why the detections at Stations M1.2, M2.1, M9.2, and M14.1 are now considered non-detects is because there was a detection in the blank sample associated with those samples that was not detected at 5 ug/L, but was detected when the detection limit is reported as 3 ug/L."

This is apparently the only indication in the document that some samples were reclassified as non-detect. Table A-2.2.4a does not indicate they are non-detect (in fact, that table doesn't indicate that any samples are non-detect, see Comments 6 and 7). The table must be revised. In addition the reclassification should be discussed in the text. How does this reclassification affect the PRG for copper?

It is worth pointing out again that the PRG process seems overly complex in terms of all the calculations as well as the frequent revision of numbers. The reclassifications of the samples listed above is an example of raw data being revised for one reason or another. The prediction of organic constituents in pore water using equilibrium partitioning is another example. We are not saying these revisions are unnecessary, however it is important to bear in mind that it does make it difficult for the reader to follow the process through and understand how the end results (the PRGs) are obtained.

In addition, our original question was not answered. Though it is somewhat academic at this point please explain how halving the detection limit could halve the concentrations of the samples listed above.

**Response:** The qualification of the porewater data results based on the laboratory re-evaluation of the detection limit for copper was discussed at the April 3, 2001 technical meeting and tables with the revised data tables for the Round 2 data package were submitted on August 8, 2001. The re-evaluation was conducted for the Interim Offshore Monitoring porewater data because the data quality objective for the detection limit for porewater analysis for copper was not met. After the detection limits for copper porewater

samples were re-evaluated, the data were validated and the database for the Interim Offshore Monitoring program was updated to include the revised Round 2 porewater data. Therefore, the PRG development process is not revising the "source" or "raw" porewater data based on the re-evaluation of the copper detection limit for copper, rather the "source" or "raw" porewater data has been revised. Discussion of the re-evaluation will not be included in the PRG development text as the re-evaluation was specifically conducted under the Interim Offshore Monitoring Program.

As provided in the Navy's response to MEDEP Comment 1 on the Interim Submittal (dated June 11, 2001), the reason why the detections at select locations were requalified as non-detects is because there was a detection in the blank sample associated with those samples that was not detected at 5 ug/L, but was detected when the detection limit is reported as 3 ug/L. Therefore, the porewater data for copper for these 4 samples were qualified with a "U", indicating non-detects. In the PRG process, ½ of the non-detect value is used; therefore, the data for these samples is halved.

For example, the porewater data for copper at M1.2 is 11.2 U ug/L (based on the qualification after the re-evaluation of detection limits); therefore, a value of 5.6 ug/L was used in the PRG process.

10. **Comment:** Response to MEDEP Comment 2 , p. 3

Our comment dealt with the issue of using the 95% UCL versus the 95th percentile for deriving a reference value for concentrations of analytes in porewater. As the State indicated in a letter to the Navy dated September 19, 2001 we have concluded that the 95 percentile concentration is acceptable to use for determination of background porewater concentrations for PRG development. Therefore this comment and response no longer applies to the issue.

However, in responding to our June 11 comment, the Navy justified its use of the 95th percentile by indicating that it is consistent with EPA's technical guidance (EPA, 1990) for assessing and regulating the discharge of toxic substance to the waters of the US. Based on further text in the Navy's response the EPA document appears to provide guidance for the method of discharge limit calculation under the NPDES program (a copy of this guidance was not available to review). The Navy goes on to state, "It is the Navy's understanding on January 12, 2001 EPA approved the NPDES program for most of Maine. In the Navy's review of Maine's NPDES program, no specific changes to the method of discharge limit calculation were found. Thus, although concentrations of chemicals in sediment or sediment pore water do not constitute a discharge *per se*, the Navy has generically adopted the framework of EPA's approach for purposes of PRG development as the best available practice, as discussed below..."

It appears that the Navy is stating that aspects of the NPDES program may apply to porewater and sediment at OU4. However, in our earlier discussions regarding WET testing of the seeps at OU6, we believed the Navy was stating that NPDES doesn't apply to the seeps since the Navy believes they aren't the type of discharges that are covered under NPDES. The MEDEP believes that if the Navy can adopt the framework of NPDES technical guidance for sediment and porewater, it should certainly do so for seeps which are a discharge. The MEDEP is not requesting the Navy to change the approach with which we are addressing OU6 at this time. In fact, at our OU6 DQO technical meeting Oct.

2 and 3, we discussed what type of toxicity testing we would perform if such testing was necessary. The resulting test we all agreed on is essentially a WET test. However, we would like the Navy to clarify its adoption of portions or "framework" of NPDES for OU4 but not for OU6.

**Response:** The Navy did not adopt portions of the NPDES program for OU4. The discussion in the original response provides an example of another program that uses a similar statistical approach.

11. **Comment:** Response to MEDEP Comment 2, p. 4

"The reference data set is also biased for sampling locations that were selected to provide data on regional concentrations of chemicals in the Piscataqua River at locations with similar sediment type as PNS that are not directly influenced by PNS..."

Please clarify the use of the word "biased". By definition reference locations should be selected as the Navy described in this response. It is unclear how the reference data set would be biased for such locations. Could a reference data set be a result of some other type of reference location?

**Response:** The reference stations were selected to provide data on regional concentrations of chemicals in the Piscataqua River at locations with similar sediment type as PNS that are not influenced by PNS in accordance with the Interim Offshore Monitoring Plan (TtNUS, October 1999).

**RESPONSES TO SAPL COMMENTS DATED JUNE 11, 2001**
**INTERIM SUBMITTAL FOR PRELIMINARY REMEDIATION GOALS FOR OPERABLE UNIT 4**
**PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE**

1. **Comment: Page ES-4, PRG IMPLEMENTATION.** SAPL had commented in previous letters (dated 1/25/01 and 4/11/01) on the November 2000 draft *Preliminary Remediation Goals for Operable Unit 4* regarding the first sentence in the last paragraph of this section. In its 5/10/01 response to SAPL's 4/11/01 Followup Comment on Original Comment 6, the Navy agreed to revise the text as follows: "The results of implementation of the PRGs are consistent with the findings of the risk assessment, that is, the areas identified in the EERA as having intermediate risks associated with them (i.e., Sullivan Point, Back Channel, and Dry Docks) are the same areas where sediment concentrations were found above PRGs." However, this text revision has not been made. The document must be corrected.

   **Response:** The second paragraph on page ES-4 will be revised as follows:

   "The results of implementation of the PRGs (presented in Attachment 1) indicate the PRGs are consistent with the findings of the risk assessment, *that is, the areas identified in the EERA as having intermediate risks associated with them (i.e., Sullivan Point, Back Channel, and Dry Docks) are the same areas where sediment concentrations were found above PRGs.* The recommended PRGs are presented in Table ES-2."

2. **Comment: Attachment 1, Page 3, Section 2.1 Overview of PRG Development Approach.** In its 5/10/01 response to SAPL's 4/11/01 Followup Comment on Original Comment 2, the Navy agreed to revise the first sentence in Section 2.1 as follows: "It is the objective of the PRG development to establish sediment-based concentrations that represent thresholds below which adverse effects on ecological receptors are not expected to occur." However, this text revision was not made. The document must be corrected.

   **Response:** The first sentence of the first paragraph in Section 2.1 will be revised as requested.

3. **Comment: Attachment 1, Page 34, Table 1.0-1.** This table lists the proposed Remedial Action Objectives (RAOs) for water and sediment as "Protect ... communities by identification of exposure to chemicals of concern (COCs) as unacceptable levels in the estuarine waters (surface waters)/sediments in the Portsmouth Naval Shipyard offshore Areas of Concern (AOCs)." While identification of such exposure is important, it is only a first step toward protection and does not constitute protection by itself. The RAOs must be revised.

   **Response:** Please see the Navy's response to MEDEP Comment No. 5 dated October 18, 2001.

4. **Comment: Attachment 1, Page A-3, Table A-2-2.2a.** The last footnote on the first page of the table states that a value of ½ MDL is substituted for non-detect data. However, the reader has no way of knowing which of the concentrations listed in the table are actual

measured values and which are ½ MDLs. An appropriate qualifier must be added to identify the non-detect entries. Approximated values should also be marked with a qualifier. This comment also applies to Table A-2-2.4a that begins on Page A-13.

**Response:** Please see the Navy's response to MEDEP Comment No. 6 dated October 18, 2001.

5. **Comment:** **Attachment 3.6, Response to Comments on Interim Submittal.** The Navy's response to SAPL's Comment Number 1 (Comment dated 6/11/01) refers the reader to the responses to MEDEP Comments 1, 2, and 3 (Comments dated 6/11/01). The MEDEP recently provided comments on the subject document in a letter dated 10/18/01. Regarding the Navy's response to MEDEP Comment 1, SAPL concurs with the MEDEP's Comment 9, dated 10/18/01, that the reclassification of some samples as non-detects should be discussed in the text. The effect of the reclassification on the PRG for copper should also be addressed. SAPL also concurs with MEDEP's Comment 10 (dated 10/18/01) that the Navy should clarify why it is willing to apply aspects of the NPDES program for porewater and sediment sampling at OU4, but not to seeps at OU6, and Comment 11 (dated 10/18/01) regarding clarifying the use of the term "biased" with regard to reference data.

**Response:** Please see the Navy's response to MEDEP Comment Nos. 9, 10, and 11 dated October 18, 2001.