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NSY PORTSMOUTH
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DEPARTMENT OF THE NAVY
PORTSMOUTH NAVAL SHIPYARD
PORTSMOUTH, N. H. 03804-5000

IN REPLY REFER TO:

May 7, 1998

MEMORANDUM

FOR THE MEMBERS OF THE RESTORATION ADVISORY BOARD (RAB) CERCLA REMEDIAL ACTION PROGRAM, PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

RAB members are invited to attend a technical meeting on May 21, 1998. The purpose of this meeting is to discuss the proposed interim monitoring plan for the off-shore area. The meeting will begin at 9:00 a.m.

If you plan to attend this meeting, please contact Ms. Marty Raymond no later than May 18,1998 to make arrangements to attend and to obtain directions. She can be reached at 207-438-2536.

Sincerely,

Ken

Ken Plaisted
Navy Co-Chairman
Restoration Advisory Board

Distribution:

Juanita Bell	Doug Bogen	Jeff Clifford
Michele Dionne	Eileen Foley	Mary Marshall
Phil McCarthy	Jack McKenna	Guy Petty
Onil Roy	Peter Vandermark	Carolyn Lepage

EPA Region I (M. Cassidy)
MEDEP (Iver McLeod)
NOAA (K. Finkelstein)
MEDMR (D. Card)
NHFG (J. Nelson)
USFWS (K. Munney)
North Div (F. Evans)
COMSUBGRU TWO (R. Jones)
PNS(Codes 100PAO, 105, 105.5, 106, 106.3, 106.3R, NRRO)

DEPARTMENT OF THE NAVY
NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
MAIL STOP, #82
LESTER, PA 19113-2090

IN REPLY REFER TO

5090
Code 1823/FE

25 JUN 1998

Ms. Meghan Cassidy
U.S. Environmental Protection Agency, Region I
JFK Federal Building HBT
Boston, MA 02203-2211

Mr. Iver McLeod
Maine Department of Environmental Protection
State House Station 17
Augusta, ME 04333-0017

Subj: MAY 21, 1998 TECHNICAL MEETING MINUTES AT PORTSMOUTH NAVAL SHIPYARD, KITTERY, ME

Dear Ms. Cassidy/Mr. McLeod:

Enclosed are the draft meeting minutes for the May 21, 1998 Technical Meeting. Please provide any comments on the minutes by July 24, 1998.

If additional information is required, please contact Ms. Marty Raymond at 207-438-2536 or myself at 610-595-0567, x159.

Sincerely,

FREDERICK J. EVANS, P.E.
Remedial Project Manager
By direction of the
Commanding Officer

Copy to:
NOAA (K. Finkelstein)
US Fish & Wildlife Service (K. Munney)
ME Dept. of Marine Resources (D. Card)
NH Fish & Game (J. Nelson)
PNS (Code 106.3R, M. Raymond)
Ms. Juanita Bell
Mr. Jeff Clifford
Ms. Eileen Foley
Mr. Phil McCarthy
Mr. Guy Petty
Mr. Peter Vandermark
COMSUBGRU TWO (R. Jones)
Mr. Doug Bogen
Ms. Michele Dionne
Ms. Mary Marshall
Mr. Jack McKenna
Mr. Onil Roy
Ms. Carolyn Lepage
Brown and Root Environmental (L. Klink, B. Horne)
PNS Code 100PAO w/o encl

OFFSHORE TECHNICAL TEAM MEETING
PORTSMOUTH NAVAL SHIPYARD
MAY 21, 1998

The meeting began at 9:00 am and ended at 12:45 pm. Attending were Megan Cassidy (U.S. EPA), Patti Tyler (U.S. EPA), Iver McLeod (MEDEP), Katherine Zeeman (MEDEP), Ken Finkelstein (NOAA), Carolyn Lepage (TAG consultant), Marty Raymond (PNS), Fred Evans (NorthDiv), Diana Bartlett (NorthDiv), Greg Tracey (SAIC), Debbie Cohen (Tetra Tech NUS representing B&R Environmental), and Bill Starkel (Tetra Tech NUS).

INTRODUCTION

After everyone introduce himself or herself, Fred started the meeting indicating that this technical meeting was being held to start off the discussion of the interim monitoring plan.

OBJECTIVES OF THE MEETING

Diana read the objectives of the meeting and indicated that the meeting topics were from an ecological risk standpoint. The EPA and MEDEP need to let the Navy know whether human health is an issue for the offshore at PNS.

BENCHMARKS AND REMEDIAL ACTION OBJECTIVES (RAOs)

Four potential benchmarks were noted in the meeting handouts. NOAA effects range-low (ER-Ls) and effects range-median (ER-Ms) will also be added to this list. It was noted that the ER-Ls and ER-Ms are to-be-considered criteria (TBCs) that may be considered in the development of PRGs.

Surface water-based and sediment-based RAOs were provided in the handout. A change in wording from "endpoint" to "community" was suggested. This was considered an appropriate change, since the objective was to protect the community and not the endpoint. These RAOs differ from the preliminary RAOs developed in the March 5, 1998 meeting in that they are media-specific rather than endpoint-specific. Having media-specific RAOs ties in well with the PRG approach, which is also media-based and not endpoint-specific.

PRG APPROACH

Greg provided a presentation of the PRG development approach proposed for PNS. Greg noted that the presentation provides generic aspects of the process which would be applicable to a variety of offshore sites. Greg's presentation discussed these generalities and also provided specific information for PNS. It was noted that the PRG approach Greg was presenting was used at NETC and Davisville, both Rhode Island sites. Greg stressed that the major purpose of his presentation was to present the process and provide the meeting participants with a good understanding of the process and was not to discuss the results of application for PNS. Although he used PNS data to provide examples of application of the approach, these are preliminary results and, as he later discussed in his presentation, there are still data needs for the development of offshore PRGs for PNS. Although the presentation materials show where human health

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PRGs fit in the approach, the discussion for the meeting focuses on aquatic PRG development (i.e., ecological risk-based PRGs).

PRG development is based on the identified RAOs and benchmarks. Sediment PRG development relies on the equilibrium partitioning approach; chemical concentrations in sediment and porewater are in balance. Surface water criteria (i.e., ARARs) will be used as PRGs for surface water.

It was noted that partitioning was not as effective for some chemicals as for others and another method may to be considered for these chemicals. Greg said this will be addressed further in his presentation.

Greg then discussed the figure showing sediment-associated biota. He noted that eelgrass and salt marsh are not shown on this figure, but they are also sediment associated. There are four groups of biota shown in the figure. The assumption of the EPA sediment quality criteria (SQC) value is that the criteria will be protective of all the four groups by being protective of the most sensitive of the four. This method also used in the PRG approach.

In discussion on the figure on Equilibrium Partitioning (EqP), Greg noted that chemicals in the sediment-based environment are found in the organisms living in or on the sediment, in the porewater, and in the sediment. EqP is based on the understanding of the process of chemical partitioning between porewater and sediment. The sediment quality program at EPA is based on EqP and this concept is generally accepted. It was noted that EqP does not work well for compounds with higher Kow (dioxin, some pesticides). However, these are not contaminants of concern (COCs) for PNS offshore so this may not be an issue. Also it was noted that application of EqP depends on how good/applicable water quality criteria (WQC) are to the site. Greg stated that the EqP was only used for developing PRGs which were protective of sediment-based biota.

Using Biota Sediment Accumulation Factors (BSAFs) and Bioaccumulation Factors (BAFs) for organics and inorganics, respectively, sediment concentrations can be related to tissue concentrations. BSAF and BAF are equilibrium based models to relate sediment concentrations to tissue concentrations. Input numbers include carbon content of the sediment and lipid content of the organism. Greg stressed that use of EqP, BSAFs, and BAFs are well accepted. He noted a recent EPA document (The Incidence and Severity of Sediment Concentrations in Surface Waters of the United States", Volume 1, National Sediment Quality Survey, EPA 823-R-97-006, September 1997) where these were used.

Greg then moved into the discussion of the PRG process. He again stressed that any results of use of the process for PNS that he provides today are preliminary. He is providing the preliminary results for PNS to illustrate the steps in the PRG development. The PRG approach is a two-phase process; Derivation – analysis of the data and calculation of candidate PRGs, and Implementation – comparison of PRG exceedances to the results of the ecological risk assessment.

Greg referred to Figure 1 which shows the stations around PNS that could be shipyard related. An Area of Concern (AOC)-two letter identifier was added to the station number to indicate which stations are related to which AOC (BC- Back Channel, JC – Jamaica Cove, SP – Sullivan Point, DD – Dry Dock, SY – DRMO Storage Yard, PR – Piscataqua River). The PRG development for PNS takes a holistic view to develop one set of PRGs which will be applicable to all AOCs. The stations shown in Figure 1 are not all the stations included in the Estuarine Ecological Risk Assessment (EERA), but are all the locations around PNS that are in the vicinity of the AOCs. It was noted that not all measurements/analysis were conducted at all the stations.

Before discussing the derivation process Greg noted the data needs and assumptions for PRG development. The data needs (additional co-located sediment chemistry and toxicity data, co-located sediment and tissue

data, and SEM:AVS data) will be addressed by the interim offshore monitoring program.

The derivation process (which comes up with the Threshold Effects Values [TEVs]) is a four step process generic for aquatic, human health, and terrestrial receptors. Greg's presentation focuses on aquatic TEV derivation. In the first step, the identification of WQCs is important. Table 1 identifies water quality screening values (WQSVs) for the derivation process for PNS. A decision tree was used to select which WQC to select as the WQSV. In the decision process saltwater chronic (SC) criteria were selected first (footnote A), if no SC criteria then saltwater acute (SA) criteria with an acute to chronic ratio were selected (footnote B), then freshwater chronic (footnote C), and then freshwater acute (footnote D) were selected. If there was no WQC, then the WQSV was derived from the NOAA ER-L (using a TOC of 1%) (footnote E). Not Available (NA) is noted where none of these criteria were available. (ADD FOOTNOTES TO THIS TABLE FOR MEETING MINUTES)

It was mentioned that no observed effect levels (NOELs) or lowest observed effect levels (LOELs) could be considered for the NAs. In answer to a question on how comparable saltwater chronic criteria were to the ER-L based WQSVs, Greg noted that they were similar, but that metals showed the best fit.

In Step 2 of the derivation process, toxicity testing results and the bioavailability of the chemical were evaluated. Since bulk sediment concentrations do not consider the bioavailability of the chemical, a relationship between the chemistry data and toxicity data is used to evaluate bioavailability. Using sediment toxicity testing data for amphipod and sea urchin, no observed effects concentrations (NOECs) are calculated. The NOEC is converted to a no observed effects quotient (NOEQ) by dividing the NOEC by the WQSV. Table 2 shows the NOEQs for the amphipod toxicity data for PNS. The table showing NOEQs for sea urchin data (not provided at the meeting) is included in the meeting handouts attached to these minutes. In Table 2, N is the set size. It was noted that N=4 is relatively small and that additional toxicity data were necessary. The 95% upper confidence limit (UCL) on the mean was used to calculate the NOEC. This was done to be comparable with EPA's method which uses the 95% UCL to calculate WQC. It was noted that the toxicity testing represents the worst case toxicity to endpoints since the testing does not consider influence from other chemicals or other factors which may make the chemical less toxic or less available. In Table 2, if the non-toxic porewater hazard quotient was less than 1, than the NOEQ was set at 1 (i.e., the non-toxic porewater concentration was set at the WQC). If the maximum toxic porewater hazard quotient was less than the NOEQ, than the COC was not carried through the PRG process. In the present example, metals were not carried through the process because there are not sufficient toxicity data. However, it was noted that does not mean metals are not important, only that additional data are necessary to carry metals through the rest of the PRG process.

In Step 3 of the derivation process, NOECs are compared to ambient/reference concentrations; referred to as Aquatic Reference Screening Values (RSVs) for the PRG process, and the Aquatic TEVs are selected. The comparison of NOECs to the RSVs is important to ensure PRGs are not set at concentrations below regional concentrations. Table 3 shows RSVs calculated using the available reference data for PNS. In looking at the reference concentrations, stations closest to PNS (AOC-related stations) are considered most likely to be affected by PNS and the other stations around PNS, are considered ambient or reference. In calculating the RSVs, statistical analysis was used to identify outliers (one was noted for pyrene at Station PR-15). EPA procedure for identifying outliers was used. It was noted that further discussion is necessary to determine what the appropriate reference locations are for PNS and whether additional reference data are necessary for the development of PRGs. In Table 4, the NOECs are compared to the RSV and the higher of the two concentrations is selected as the Aquatic TEV.

The final step of the derivation process, Step 4, involves the identification of the limiting COCs. Identification of limiting COCs is in accordance with EPA guidance for developing PRGs. Table 5 shows the evaluation of Aquatic TEVs to identify the limiting COCs for PNS. To identify the limiting COCs, the Aquatic TEVs are

converted to TEV-hazard quotients (HQs) by dividing the predicted porewater concentration at each location with toxicity data by the Aquatic TEV. If the TEV-HQ is less than 1, than the porewater concentration is below the TEV. For each location, COCs with porewater concentrations greater than the TEV (i.e., TEV-HQ greater than 1) are identified and the COC with the highest TEV-HQ above 1 is considered the limiting COC for that station. In looking at all the stations which had TEV-HQs greater than 1, fluorene (at BC-18) and pyrene (at DD-10, DD-12, DD-17, and PR-14) had the highest TEV-HQs. These two COCs are considered the limiting COCs (based on preliminary data).

After identifying the limiting COCs, the TEVs for these COCs are converted into sediment-based values for the implementation part of the PRG process. This is done because there are much more sediment data than porewater/co-located toxicity data for PNS.

PRG implementation is a four-step process. Step 1 of the implementation involves calculation of sediment-based units from porewater concentration using EqP. Table 6 provides Kow values used for this calculation. It was noted that using the BSAF, tissue concentrations could then be calculated from the sediment-based concentrations to get tissue-based concentrations for stations where there is only tissue data, but no sediment data. Table 7 shows the candidate sediment-based PRG for the two limiting COCs.

In answer to the question of how these candidate PRG concentrations compare with the ER-Ls and ER-Ms, it was indicated that the candidate PRG concentrations were intermediate between the ER-L and ER-M.

In Step 2 of the implementation process, Thiessen polygons are identified for each AOC-associated station. The polygons for PNS are shown in Figure 3. The polygons are identified on a statistical basis and not based on chemical concentrations. The sediment concentrations for each station (where available) are then compared to the candidate PRGs.

In Step 3 of the implementation process, the results of the risk assessment are compared with the locations of exceedances of the candidate PRGs. Figure 4 shows the results of the EERA for sediment (i.e., no high risk; DD, BC, and SP had intermediate risk; and JC, CC, and SY had low risk). Figure 5 shows exceedances of the candidate PRGs for Fluorene and Pyrene. Exceedances for fluorene are seen at stations BC-18, DD-12, and DD-12.5, while exceedances of pyrene are seen at BC-18, DD-17, DD-12, DD-12.5, and DD-10. Overlaying exceedances with the EERA results shows that fluorene and pyrene account for much of the risk at PNS. However, since metals have not been sufficiently evaluated through the PRG process (because of data needs), metals may account for the rest of the risk seen at PNS. Also some stations do not have sediment data and therefore have not been included in this preliminary evaluation.

The evaluation of the candidate PRGs is completed in Step 4 of the implementation process with the assessment of whether the candidate PRGs should be selected as PRGs. For PNS, interim PRGs will be developed until the data needs are met.

A question was raised as to where DDT was in the list of COCs. It was indicated that DDT related to legal application is not considered a CERCLA release. Since DDT has not been related back to an onshore PNS site, it was not included as a COC in the PRG development. DDT needs to be brought through the risk assessment; at the risk management stage the determination is made as to whether and how to address DDT.

Before moving on to the Decision Tree, a question was asked about the status of the seep/sediment data from Rounds 7 through 10 and whether the data would be evaluated. The Navy is currently looking for funds and will task Tetra Tech NUS (representing Brown & Root Environmental) to prepare the evaluation. Although it is not expected that new offshore COCs would be identified based on the evaluation of seep/sediment data, this will be considered in the evaluation. The conclusions of the seep/sediment

evaluation will be considered in the PRG development and interim offshore monitoring plan development, as appropriate. Evaluation of whether the seep represents a source to the offshore is being conducted as part of the onshore/offshore contaminant fate and transport modeling.

DECISION TREE

Because of printer problems, last minute revisions to the decision tree were not reflected on the decision tree provided at the meeting. The decision tree showing the revisions is provided as an attachment to these minutes. This is a general decision tree. An exceedance means an exceedance of PRGs or an increasing trend. The major comment on the decision tree was that for the interim monitoring, a Feasibility Study (FS) has not been prepared and a final Record of Decision (ROD) has not been signed; therefore, completion of the response can not be determined based on this decision tree. Megan indicated that the decision tree should be specific for interim monitoring. For example the decision tree now indicates a minimum of 10 years before monitoring could be completed. But the FS/Final ROD may, based on several years of interim monitoring, determine that the final action is no action. Based on this decision tree, the interim monitoring would still be locked into 10 years of interim monitoring.

WRAP UP

Comments on the PRG approach, the PRG data needs and assumptions identified, the RAOs and benchmarks, and the decision tree presented at the meeting were requested from the offshore technical team by June 18, 1998. The review of the PRG approach should focus on whether the approach is basically acceptable and whether there are any comments or questions on the approach as presented at this meeting. The Navy will get the responses to comments out July 10, 1998. In addition, a proposed sampling plan will also be provided with the response to comments. A meeting was tentatively set for August 20, 1998 to discuss the sampling plan/approach and comments on the May 21, 1998 presentation, as necessary.

AGENDA FOR MAY 21, 1998 OFFSHORE TECHNICAL MEETING

9:00 - 9:20	INTRODUCTION/OBJECTIVES OF MEETING/RECAP OF MARCH 5, 1998 MEETING/RECAP PROGRESS TO DATE ON OFFSHORE-RELATED STUDIES
9:20 - 10:20	REVIEW OF RAOS AND IDENTIFICATION OF BENCHMARKS
10:20 - 10:30	BREAK
10:30 - 12:30	PRG DEVELOPMENT APPROACH
12:30 - 1:00	LUNCH
1:00 - 2:00	DECISION TREE
2:00 - 2:30	WRAP UP

OBJECTIVES OF MEETING

- Review RAOs and identify Benchmarks
- Familiarize technical team with PRG approach
- Discuss general decision tree for offshore monitoring

RECAP OF MARCH 5, 1998 OFFSHORE TECHNICAL TEAM MEETING

- Identified preliminary Remedial Action Objectives (RAOs) for the offshore
- Identified possible General Response Actions (GRAs) for the offshore to meet RAOs
- Identified potential Interim Actions for the offshore
- Determined that Interim Offshore Monitoring could be implemented soon (after signature of an Interim Record of Decision)

RECAP PROGRESS TO DATE ON OFFSHORE-RELATED STUDIES

- Onshore/Offshore Contaminant Fate and Transport Modeling

  - Phase I Modeling completed
  - Phase II Modeling work plan under preparation
  - Phase II Modeling to be conducted after work plan finalized

- Offshore Human Health Risk Assessment - Finalized May 1994
- Estuarine Ecological Risk Assessment

  - Revised Draft Final dated April 1997
  - Response to comments on revised draft final provided and follow-up comments received
  - Meeting held April 28, 1998 for clarification of follow-up comments
  - Navy preparing response to follow-up comments
  - Report to be finalized after resolution of follow-up comments

- Phase I/Phase II Offshore Data Comparative Analysis

  - Draft report dated October 1997
  - Response to comments on draft under preparation
  - Report to be finalized after resolution of follow-up comments

- Seep/Sediment Sampling Data

  - Four rounds of data collected in 1996/1997 (Rounds 7 through 10).

- Maine Geochemical Modeling

IDENTIFIED BENCHMARKS

- Water Pollution Control Act, as amended by Clean Water Act of 1977 (CWA) (33 USC 1251 et seq), Federal Ambient Water Quality Criteria (AWQC) (40 CFR Part 131)
- US Food and Drug Administration Action Levels and Critical Toxicity Values
- EPA Proposed Sediment Quality Criteria (Fed. Reg. Vol. 59, No. 11, 18 January 1994)
- Maine Water Quality Criteria, Maine Surface Water Toxic Control Program (06-096 CMR 530)
- NOAA ER-L/ER-M (To Be Considerered)

PROPOSED REMEDIAL ACTION OBJECTIVES

- Protect pelagic, epibenthic, eelgrass, and salt marsh communities from exposure to Chemical of Concern concentrations in the estuarine waters in excess of Preliminary Remedial Goals in the Portsmouth Naval Shipyard Offshore Areas of Concern.
- Protect epibenthic, benthic, eelgrass, and salt marsh communities from exposure to Chemical of Concern concentrations in the estuarine waters in excess of Preliminary Remedial Goals in the Portsmouth Naval Shipyard Offshore Areas of Concern.

Process for Development of Offshore Preliminary Remediation Goals (PRGs) at Portsmouth Naval Shipyard

Presented By:
Greg Tracey, SAIC
21 May 1998

PRG Definition

- PRGs are:
  - a group of "Limiting" CoCs and associated threshold effect concentrations (in remediation-based units) to which the majority of site-related, actionable risk can be attributed.
- Adopting PRGs will:
  - reduce CoC exposure to site receptors (Assessment Endpoints) to levels expected to eliminate actionable chemical risks for all site-related CoCs.

PRG Development Framework

- Approach for site-specific PRG development integrates EPA's Equilibrium Partitioning approach for protection of aquatic life and human health:
  - Aquatic: Risks based on exposure resulting from CoCs in sediment/porewater/tissue media;
  - Human Health: Risks based on exposure resulting from ingestion of bioaccumulated CoCs in fish/shellfish tissue.

PNSY PRGs address two CoC Exposure Pathways

- Aquatic:
  - CoCs in sediment, porewater and Fish/shellfish tissue.
  - Surface water pathway covered by Federal/State ARARs
- Human Health:
  - CoCs in consumed fish/shellfish.

Two Phases of the PRG Development Process

- Derivation:
  - Calculate candidate PRGs (called Threshold Effects Values; TEVs) protective of Assessment Endpoints (receptors) for all CoCs and exposure pathways associated with the site.
- Implementation:
  - Assess appropriateness of TEVs by spatial comparison of areas of TEV exceedence with observed risks found at the site during offshore HHRA/ERA investigations.

PNSY Database for PRG Development

- Site boundary for Shipyard-influenced area selected (see Figure 1).
- Distribution of porewater, sediment, tissue and toxicity data used for interim PRGs;
  - Limited co-located sediment chemistry and toxicity data (13 sta.- organics, 5 sta. -metals; amphipod only).
  - Limited availability of co-located sediment and tissue chemistry for AF modeling (e.g. BSAF).
  - Limited SEM:AVS data for assessing metals bioavailability.

PRG Development Assumptions

- Site-wide PRGs will address all AOC-specific risks; AOC-specific PRGs are not required;
- Site-wide PRGs will protect the most sensitive assesment endpoints; receptor-specific endpoints are not required;
- Sediment is the primary reservoir of COC for PNSY; PRGs will ultimately be sediment-based; and
- Federal/State Water Quality Criteria are used to evaluate surface water data.

PRG Derivation: Four Step Process

- Set CoC-specific TEVs = literature-derived benchmarks;
- Adjust TEVs for site-specific toxicity/bioavailability conditions;
- Adjust TEVs to consider regional (e.g. background) CoC concentrations; and
- Identify "limiting CoCs"

PRG Derivation: Step One

- Set CoC-specific TEVs = literature-derived benchmarks;
  - Aquatic: EPA Water Quality Criteria-Saltwater Chronic (WQC-SC) or "equivalent" (Table 1);
  - Human: Reasonable Maximum Exposure (RME) scenario, concentration equivalent to risk threshold (Carc.: $<1x10^{-6}$, Non-C: HQ <1).

PRG Derivation: Step Two

- Adjust TEVs for site-specific toxicity/bioavailability conditions:
  - Aquatic: 95% UCL of NOEC for CoCs associated with toxic samples (see Table 2);
  - Human Health: Food consumption practices of New Englanders (preference, ingestion rate).
- Retain CoCs substantially contributing to risk:
  - Aquatic: CoCs for which EC > NOEC;
  - Human Health: CoCs for which EC > risk threshold.

PRG Derivation: Step Three

- Estimate ambient CoC concentrations for areas beyond site influence (Reference Screening Values);
  - Aquatic: 95% UCL of CoC concentration in reference porewaters (see Table 3);
  - Human Health: 95% UCL of CoC concentration in shellfish tissue.
- Adjust TEVs relative to RSVs;
  - Aquatic: Where PW TEV < PW RSV, set TEV = RSV (see Table 4);
  - HH: Where Tissue TEV < Tissue RSV, set TEV = RSV.

PRG Derivation: Step Four

- Identify "limiting CoCs";
  - Rank pathway-specific TEVs (see Table 5);
  - Select CoCs exhibiting the highest station-specific TEV exceedence.

PRG Implementation: Four Step Process

- Convert TEVs into sediment-based concentration units (i.e., "Candidate" PRGs)
- Apply CPRGs to site chemistry to derive CPRG-Hazard Quotients (CPRG-HQs);
- Compare CPRG exceedences (at HQ = 1) with risk distribution; and
- Refine CPRGs to select PRGs: i.e., CoCs and associated concentrations that best address actionable risks.

PRG Implementation: Step One

- Convert TEVs into sediment-based CPRGs.
  - Aquatic Infaunal: TEV- Pore-water to CPRG-sediment using Kow/Kd partition coefficients (see Table 6)
  - Aquatic Epifaunal/HH: TEV-shellfish to CPRG-sediment using BAFs for metals (~~Fig 2~~); BSAFs for organics, (EPA, 1998).
- Compile CPRGs for each exposure pathway
  - Aquatic/HH CPRGs: (see Table 7).

•PRG Implementation: Step Two

- Apply CPRGs to site chemistry;
  - Perform CPRG-HQ calculation (see Table 7):
    - Aquatic: 20 sediment stations available for analysis (seven more stations than TEV-HQ evaluation);
    - HH: 53 species/station pairs available for analysis.
  - Select spatial extrapolation method (see Fig. 3):
    - Thiessen polygons used as unbiased statistical estimator of aerial extent represented a measurement taken at a single station;
    - Polygons represented for both sediment and biota sampling locations.

•PRG Implementation: Step Three

- Perform spatial comparison of CPRG-HQs vs. Risk:
  - Aquatic:
    - Magnitude of site-wide risk by media highest for sediment;
    - Greatest risks ("intermediate") observed for Sullivan Point (SP), Dry Docks (DD), and Back Channel (BC) locations (Fig. 4);
    - Implementation of fluorene and pyrene CPRGs indicate agreement between location of exceedences and observed risk (Fig. 5).
- Similar evaluation of HH CPRGs to be performed.

•PRG Implementation: Step Four

- Complete CPRG Assessment:
  - Aquatic:
    - CPRGs (fluorene and pyrene) effectively target areas of actionable risk;
    - CPRGs validated by comparability to independent sediment benchmarks (e.g., ERL-ERM); thus
    - Recommend selection of refined CPRGs as interim, risk-based PRGs.
  - Similar procedure conducted for HH PRGs.

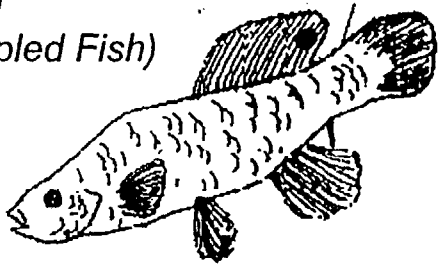
Next Steps PNSY PRG Development

- Need concurrence from ~~Trustee~~'s stakeholders on PRG approach;
- Need concurrence on offshore interim monitoring plan design to address PRG data needs; and
- Need initial monitoring results to develop final PRGs.

Sediment-Associated Biota

Hard Clam
(Epifaunal Filter Feeder)

Mummichog Fish
(Benthically-Coupled Fish)



Neried Worm
(Infaunal Deposit Feeder)

Lobster
(Epibenthic Scavenger)

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Equilibrium Partitioning

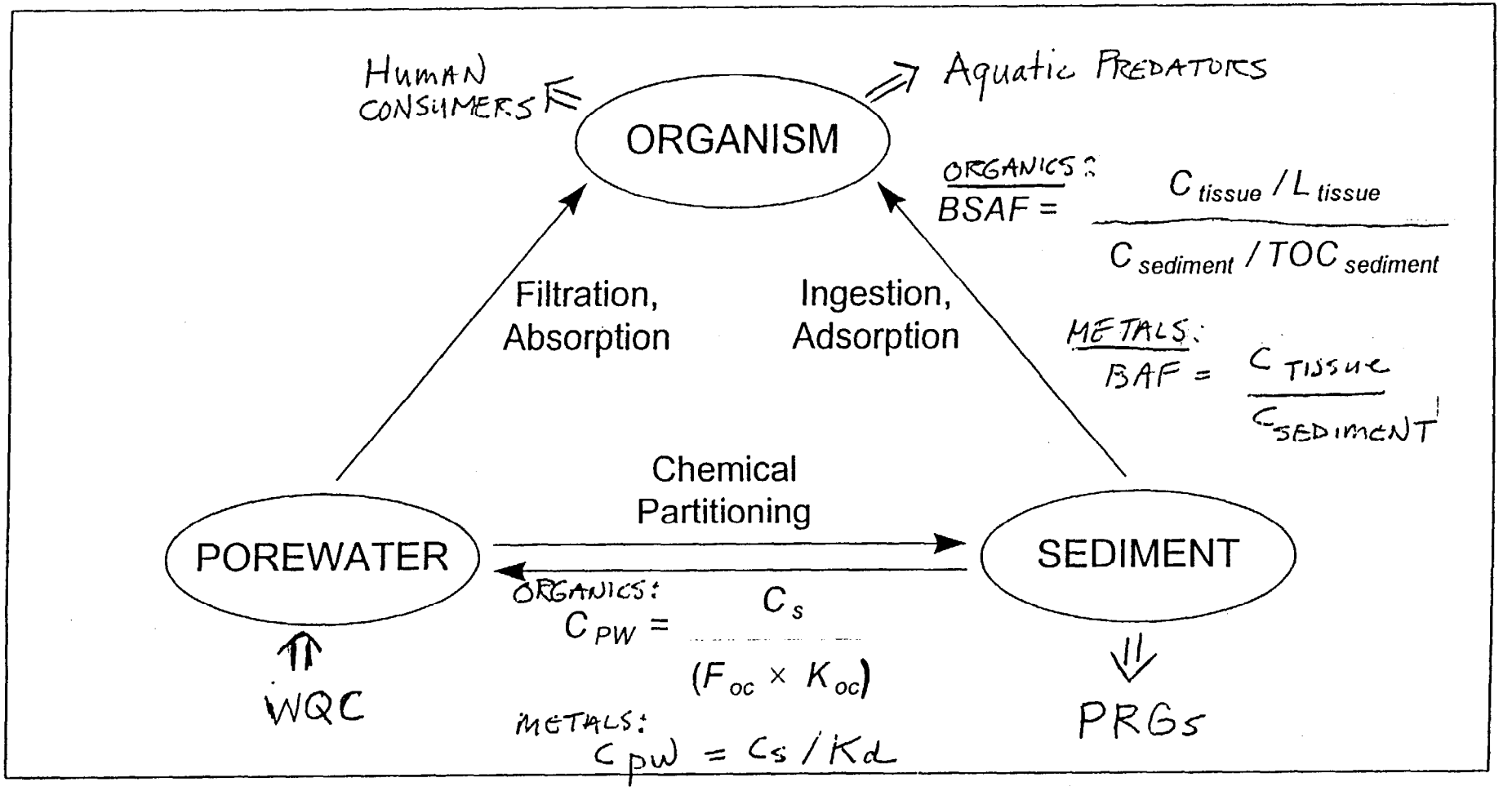

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Figure 1. Site-related sampling locations used in PRG development for the Portsmouth Shipyard study area.

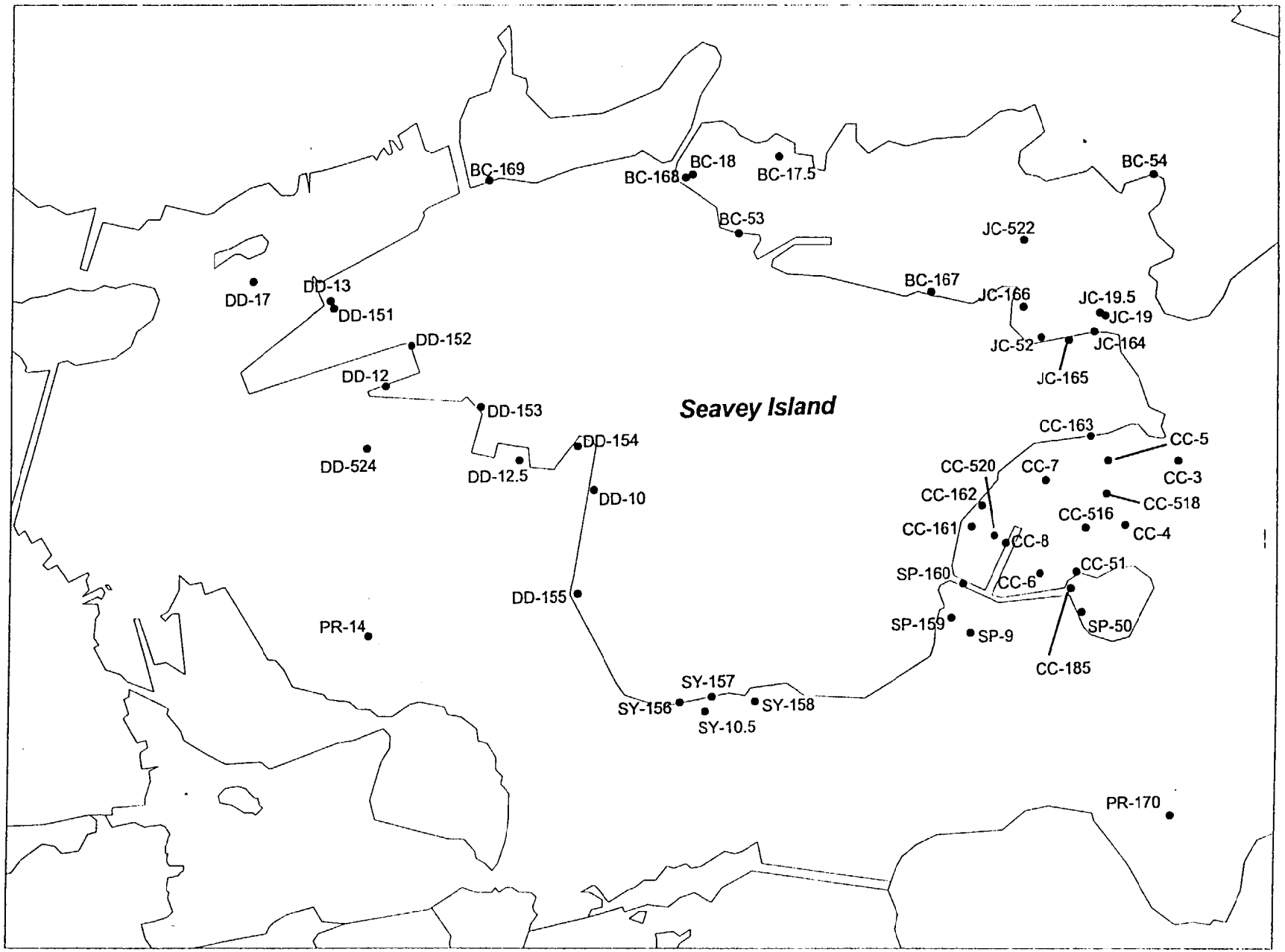


Figure 3. Thiessen polygons for PRG implementation in the Portsmouth Shipyard study area.

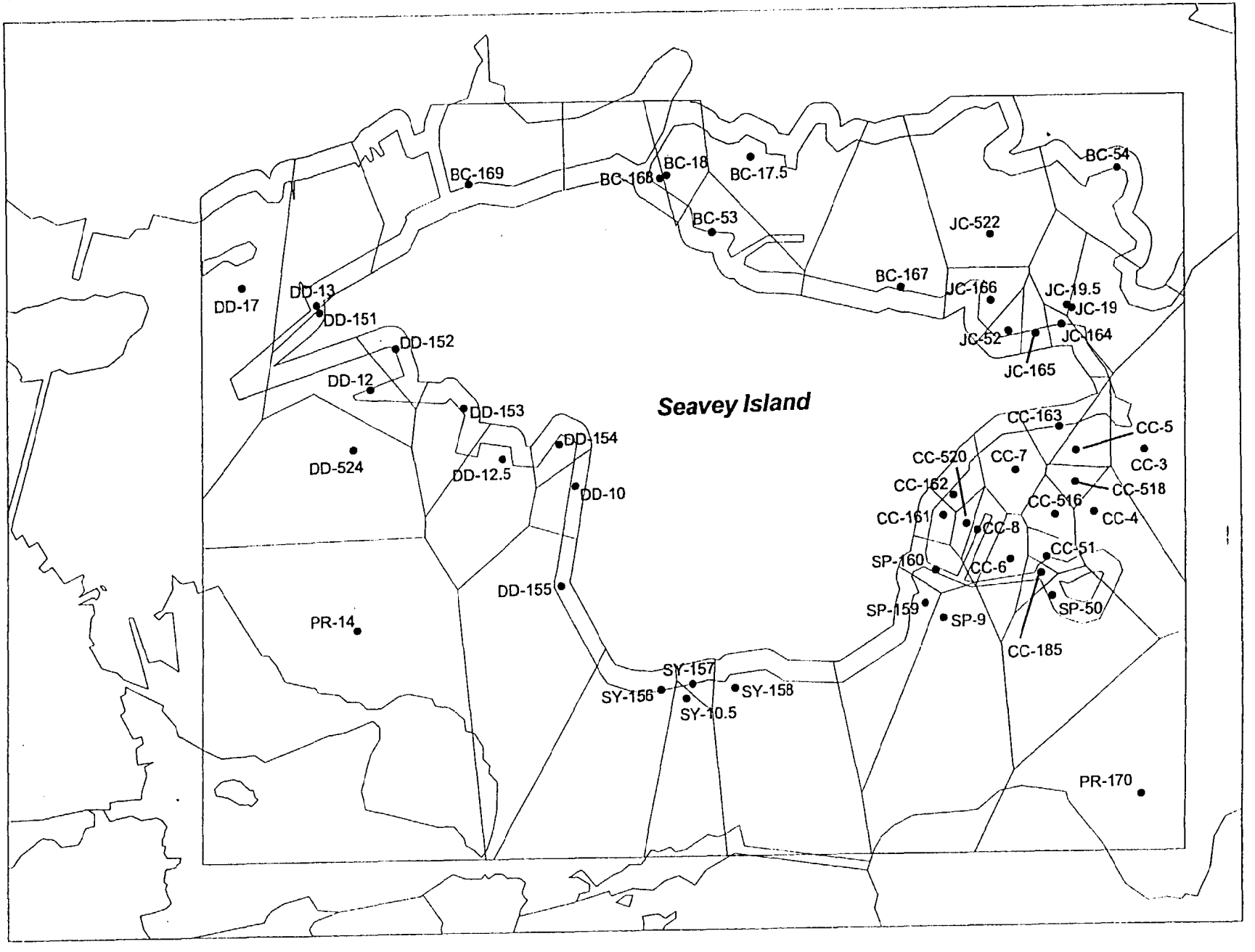


Figure 4. Magnitude of ecological risks from sediment by Area of Concern for the Portsmouth Shipyard study area.

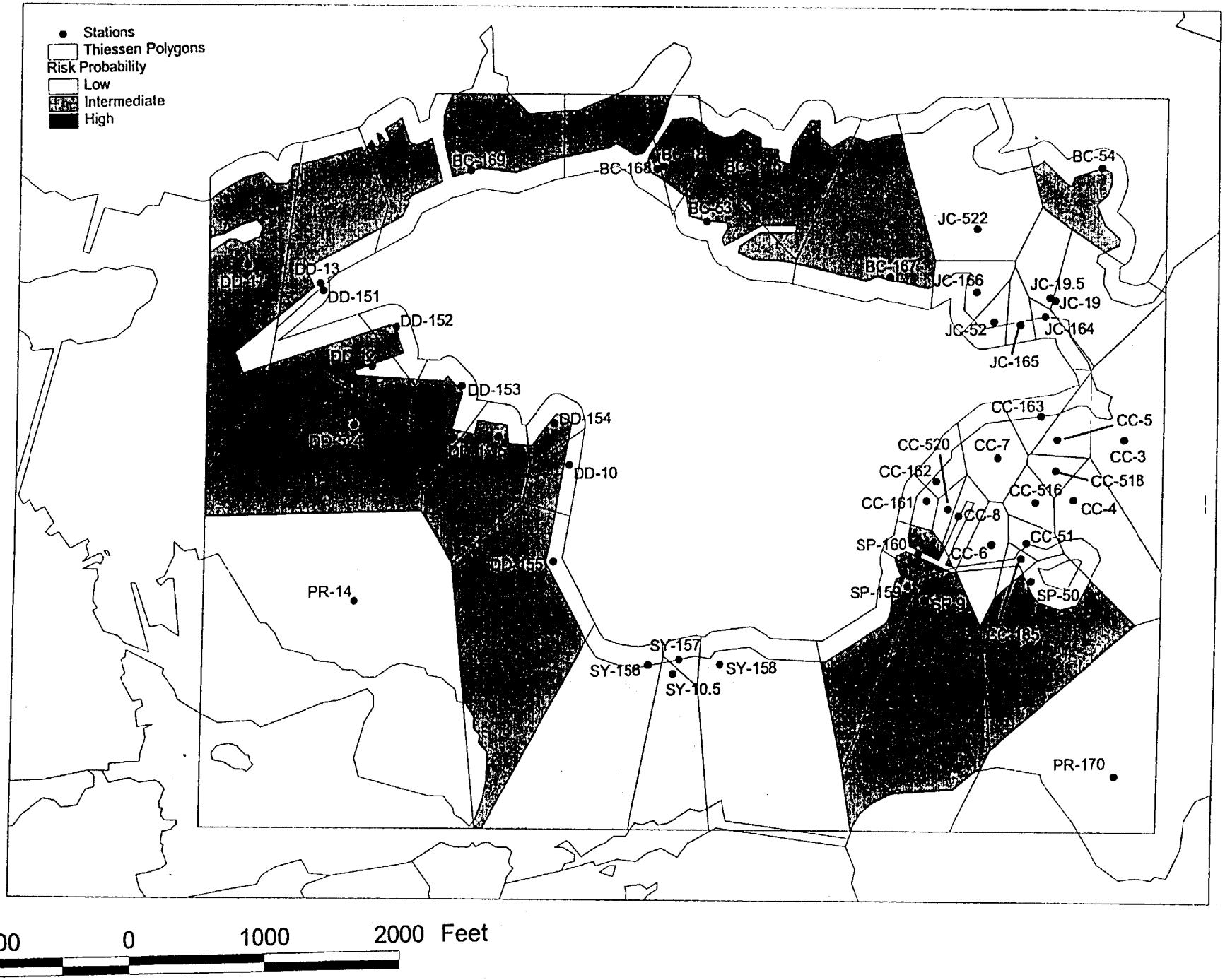


Figure 5 Summary of CoCs exceeding PRGs by location for sediments from the Portsmouth Naval Shipyard study area:*

Aquatic Exposure Pathway for Fluorene

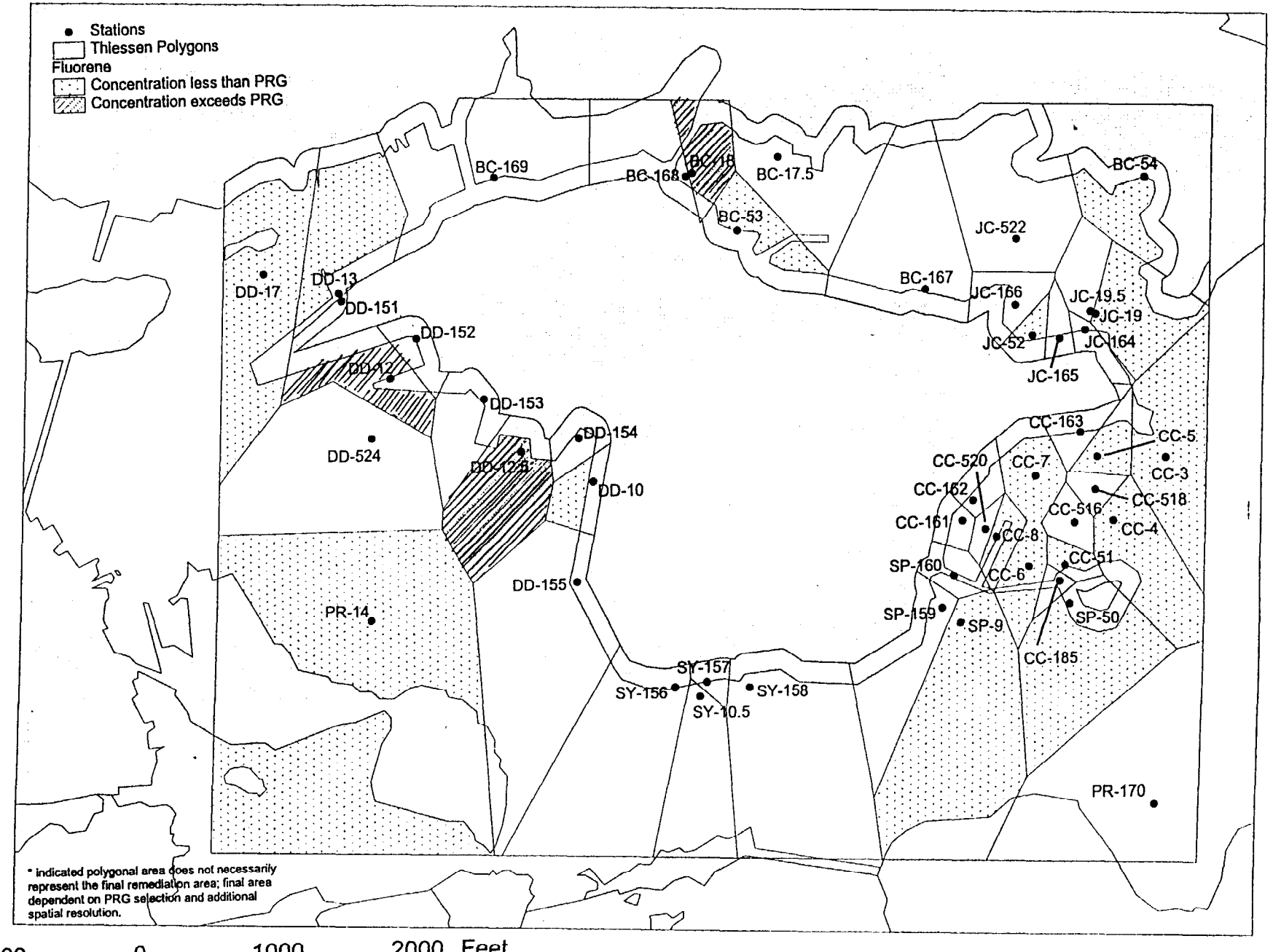


Figure 5 (con't). Summary of CoCs exceeding PRGs by location for sediments from the Portsmouth Naval Shipyard study area:*

Aquatic Exposure Pathway for Pyrene

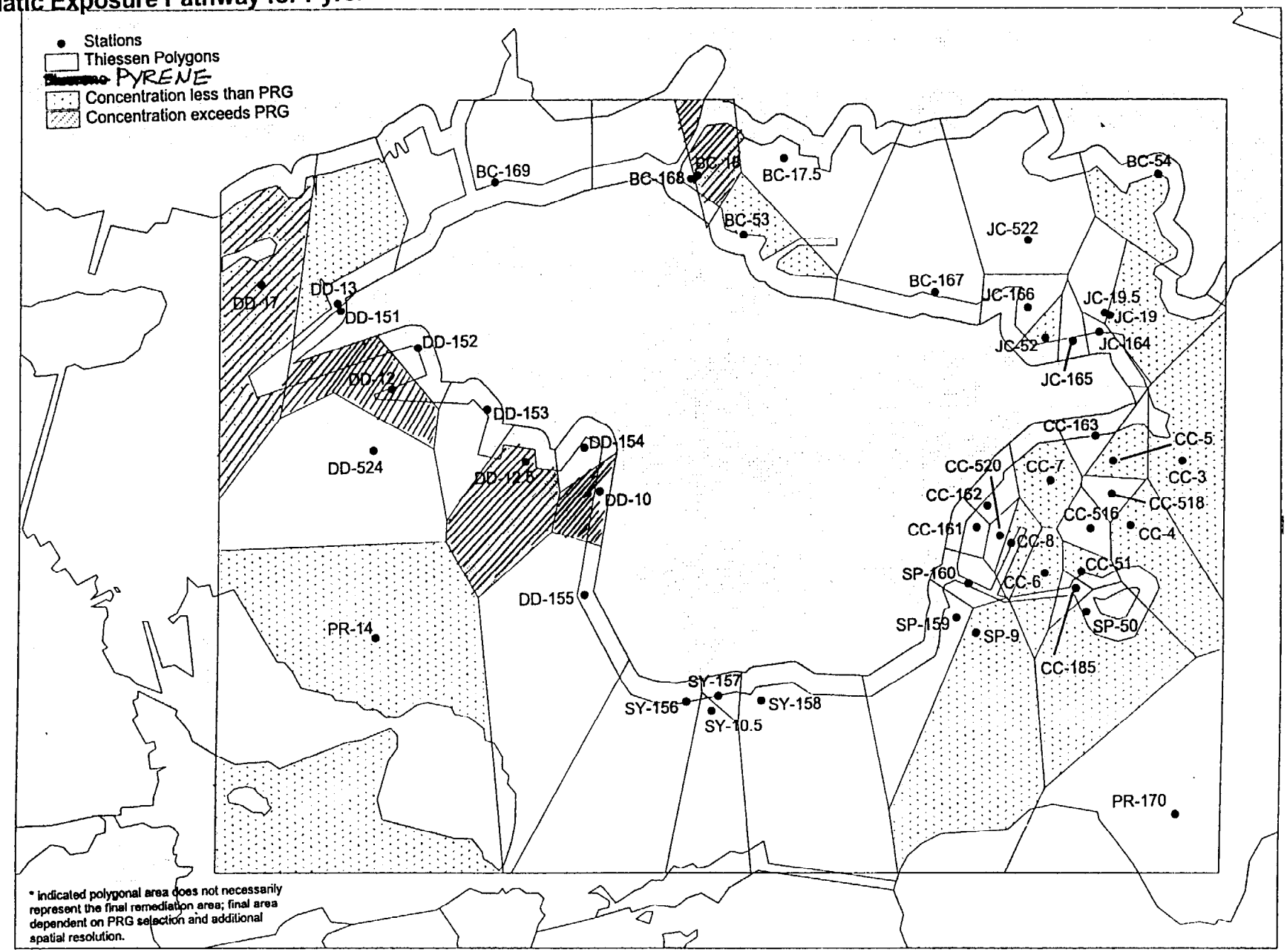


Table 1. Water Quality Criteria for target analytes selected for aquatic PRG development and derived Water Quality Screening Values.

Chemical		EPA Water Quality Criteria				WQSV	
Class	Analyte	WQC-FA	WQC-FC	WQC-SA	WQC-SC	Conc.	Source
Metals	Arsenic	360	190	69	36	36	A
	Cadmium	3.9	1.1	43	9.3	9.3	A
	Chromium	1700	210	1100	50	50	A
	Copper	18	12	2.9	2.9	2.9	A
	Lead	83	3.2	220	8.5	8.5	A
	Mercury	2.4	0.012	2.1	0.025	0.025	A
	Nickel	1400	160	75	8.3	8.3	A
	Silver	0.92	0.12	7.2	0.92	0.92	A
	Zinc	120	110	95	86	86	A
PAHs	1,6,7-Trimethylnaphthalene						NA
	1-Methylnaphthalene						NA
	1-Methylphenanthrene						NA
	2,6-Dimethylnaphthalene						NA
	2-Methylnaphthalene					0.88	E
	Acenaphthene	1700	520	970	710	710	A
	Acenaphthylene					0.46	E
	Anthracene					0.29	E
	Benzo(a)anthracene					0.07	E
	Benzo(a)pyrene					0.04	E
	Benzo(b)fluoranthene						NA
	Benzo(e)pyrene						NA
	Benzo(g,h,i)perylene						NA
	Benzo(k)fluoranthene						NA
	Biphenyl						NA
	Chrysene					0.10	E
	Dibenz(a,h)anthracene					0.0017	E
	Fluoranthene	3980		40	16	16	A
	Fluorene					0.14	E
	High Molecular Weight PAHs						NA
	Indeno(1,2,3-cd)pyrene						NA
	Low Molecular Weight PAHs						NA
	Naphthalene	2300	620	2350		620	C
	Perylene						NA
	Phenanthrene	30	6.3	7.7	4.6	0.81	A
	Pyrene					0.63	E
	Total PAHs						NA
PCBs	Total PCBs (Sum Congenersx2)	2	0.014	10	0.03	0.03	A

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 CODES:
NA= Benchmark not available to derive Screening Value
A- WQC-SC VALUE
B- 8:1 ACUTE/CHRONIC RATIO APPLIED TO WQ-SA VALUE (Shepard, 1995).
C- WQC-FC VALUE
D- 8:1 ACUTE/CHRONIC RATIO APPLIED TO WQ-FA VALUE (Shepard, 1995).
E- EqP PARTITIONING OF ER-L SEDIMENT BENCHMARK INTO POREWATER AT 1% TOC
1- Units: µg/L.
2- See text and Figure 1 for WQSV derivation process.
3 - Assumed to be the same as DDT.

Table 2. Distribution of toxic and non-toxic aquatic Hazard Quotients and derivation of No Observable Effect Quotients (NOEQs) Portsmouth Naval Shipyard aquatic exposure pathway.

		Amphipod Survival							Sea Urchin Fertilization							
		Non-Toxic Samples			Toxic Samples			Amph.	Non-Toxic Samples			Toxic Samples			Urch.	Aquatic
Class	Analyte	N	95% UCL PW-HQ	NOEQ1	N	Max. PW-HQ	Max. PW-HQ > NOEQ?	Surv. NOEQ	N	95% UCL PW-HQ	NOEQ1	N	Max. PW-HQ	ax. PW-H > NOEQ?	Fert. NOEQ	NOEQ2
MET	Arsenic	4	4.01	4.01	0				4	4.01	4.01	0				
MET	Chromium	4	0.43	1.00	0				4	0.43	1.00	0				
MET	Lead	4	0.17	1.00	0				4	0.17	1.00	0				
MET	Nickel	4	0.83	1.00	0				4	0.83	1.00	0				
MET	Zinc	4	0.37	1.00	0				4	0.37	1.00	0				
MET	SEM-AVS	4	-31.8	1.00	1	-22.3	NO		5	-24.56	1.00	0				
PAH	Anthracene	10	2.77	2.77	3	8.87	YES	2.77	13	3.59	3.59	0				2.77
PAH	Benzo(a)anthracene	10	1.35	1.35	3	3.36	YES	1.35	13	1.58	1.58	0				1.35
PAH	Benzo(a)pyrene	10	0.87	1.00	3	2.35	YES	1.00	13	1.06	1.06	0				1.00
PAH	Chrysene	10	1.33	1.33	3	2.19	YES	1.33	13	1.31	1.31	0				1.33
PAH	Dibenz(a,h)anthracene	10	0.68	1.00	3	1.65	YES	1.00	13	0.80	1.00	0				1.00
PAH	Fluoranthene	10	4.2E-2	1.00	3	0.11	NO		13	5.0E-2	1.00	0				
PAH	Fluorene	10	3.03	3.03	3	22.7	YES	3.03	13	6.93	6.93	0				3.03
PAH	Phenanthrene	10	2.31	2.31	3	7.98	YES	2.31	13	3.09	3.09	0				2.31
PAH	Pyrene	10	0.50	1.00	3	1.20	YES	1.00	13	0.58	1.00	0				1.00
PAH	Sum of PAHs	10	12.8	12.8	3	50.4	YES	12.8	13	18.7	18.7	0				12.8
PCB	Total PCBs	10	9.5E-2	1.00	3	8.3E-2	NO		13	8.7E-2	1.00	0				

PW-HQ=Porewater Hazard Quotient.

1 - NOEQ = No Observable Effect Quotient = greater of 95% Upper Confidence Limit (UCL) HQ or 1.

2 - Aquatic NOEQ = minimum of endpoint-specific NOEQs.

Table 3. Derivation of Aquatic Reference Screening Values (RSVs) based on concentrations of selected contaminants in porewaters from reference locations for the Portsmouth Naval Shipyard Study Area.

Analyte	PR-1	PR-2	PR-11	PR-15	PR-16	SC-20	SC-21	YR-22	YR-23	Mean	Aquatic RSV
Anthracene	7.6E-2	0.50	0.64	0.69	8.5E-2	1.5E-2	6.8E-2	0.10	8.9E-2	0.25	0.46
Benzo(a)anthracene	1.6E-2	7.9E-2	7.0E-2	0.10	0.03	4.7E-3	1.5E-2	1.1E-2	3.3E-2	4.0E-2	6.7E-2
Benzo(a)pyrene	7.6E-3	3.6E-2	3.5E-2	4.1E-2	2.6E-2	2.0E-3	8.7E-3	4.8E-3	1.7E-2	2.0E-2	3.2E-2
Chrysene	1.9E-2	8.3E-2	7.4E-2	0.10	4.7E-3	5.3E-3	1.5E-2	1.1E-2	3.9E-2	3.9E-2	6.7E-2
Dibenz(a,h)anthracene	3.8E-4	1.7E-3	9.7E-4	1.2E-3	5.8E-4	3.0E-4	3.4E-4	5.8E-4	7.6E-4	7.6E-4	1.1E-3
Fluorene	6.2E-2	0.31	0.25	0.32	6.9E-2	4.1E-2	4.5E-2	6.6E-2	8.9E-2	0.14	0.23
Phenanthrene	0.24	1.12	1.14	1.42	0.30	4.5E-2	0.17	0.34	0.51	0.59	0.98
Pyrene	0.12	0.48	0.53	0.92	0.19	3.2E-2	0.10	0.10	0.25	0.23	0.38
Sum of PAHs	0.55	2.61	2.74	3.60	0.71	0.14	0.43	0.64	1.03	1.38	2.35
% TOC	0.80	1.89	1.21	1.70	0.64	0.90	1.19	0.55	0.49	1.04	1.42

Shaded cells indicate statistical outliers, excluded from mean and Reference Screening Value calculations.

PW concentration (µg/L) = sediment concentration/(foc X Koc).

foc = %TOC/100.

1 - List includes analytes for which NOEQs were developed; see Table 2.

2 - Aquatic Reference Screening Value (RSV) calculated as 95% Upper Confidence Limit based on sample size as follows:

Mean + ($t_{0.975}(df)$*(STDEV/(SQRT(n))); where STDEV=standard deviation; n=sample size;

$t_{0.975}(df)$ = sample size-dependent percentage points of the t distribution, (Ott, 1993).

Table 4. Derivation of Threshold Effects Values (TEVs) for the aquatic exposure pathway in the Portsmouth Naval Shipyard study area.

Chemical Class	Chemical of Concern[1]	Aquatic NOEQ[2]	X	WQSV[3] (µg/L)	=	Aquatic NOEC[4,6] (µg/L)	Aquatic RSV[5] (µg/L)	RSV > NOEC?	Aquatic TEV[6] (µg/L)
PAHs	Anthracene	2.77		0.29		0.80	0.46	NO	**0.80**
	Benzo(a)anthracene	1.35		6.5E-2		8.8E-2	6.7E-2	NO	**8.8E-2**
	Benzo(a)pyrene	1.00		4.2E-2		4.2E-2	3.2E-2	NO	**4.2E-2**
	Chrysene	1.33		0.10		0.13	6.7E-2	NO	**0.13**
	Dibenz(a,h)anthracene	1.00		1.7E-3		1.7E-3	1.1E-3	NO	**1.7E-3**
	Fluorene	3.03		0.14		0.42	0.23	NO	**0.42**
	Phenanthrene	2.31		0.81		1.86	0.98	NO	**1.86**
	Pyrene	1.00		0.63		0.63	0.38	NO	**0.63**
	Sum of PAHs	12.8		37.5		481	2.35	NO	**481**

NOEQ=No Observable Effect Quotient; 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 - *Aquatic NOEQ = minimum of endpoint-specific NOEQs; see Table 2.*

3 - Water Quality Screening Value; see Table 1.

4 - NOEC = Aquatic NOEQ x WQSV.

5 - RSV = 95% Upper Confidence Limit of porewater reference data; see Table 6.

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

Table 5. Aquatic Threshold Effects Value Hazard Quotients[1] for CoCs in porewaters from the Portsmouth Naval Shipyard study area.

Threshold Effects Value Hazard Quotient (TEV-HQ)

Analyte	*Aquatic TEV*[2]	BC-18	CC-3	CC-4	CC-5	CC-6	CC-7	CC-8	DD-10	DD-12	DD-13	DD-17	JC-19	PR-14	SP-9
Anthracene	*0.80*	3.20	0.51	0.15	0.12	7.4E-2	0.15	0.16	0.80	1.79	0.36	1.01	0.29	0.89	0.54
Benzo(a)anthracene	*8.8E-2*	2.48	0.73	0.26	0.24	0.15	0.33	0.31	1.21	1.72	0.48	1.55	0.66	1.04	0.68
Benzo(a)pyrene	*4.2E-2*	2.35	0.55	0.33	0.27	0.13	0.33	0.33	0.71	1.72	0.43	1.34	0.60	0.85	0.57
Chrysene	*0.13*	1.65	0.45	0.21	0.19	0.13	0.24	0.24	0.89	2.02	0.36	0.97	0.44	0.65	0.52
Dibenz(a,h)anthracene	*1.7E-3*	1.65	0.47	0.41	0.26	0.11	0.33	0.25	0.61	1.28	0.34	1.16	0.50	0.92	0.43
Fluorene	*0.42*	7.49	0.52	0.21	0.20	0.13	0.19	0.23	0.74	1.90	0.44	0.77	0.29	0.54	0.59
Phenanthrene	*1.86*	3.46	0.55	0.16	0.16	0.10	0.21	0.23	0.98	1.78	0.38	0.78	0.28	0.59	0.51
Pyrene	*0.63*	2.30	0.81	0.28	0.26	0.16	0.45	0.34	1.52	2.14	0.53	1.97	0.69	1.12	0.75
Sum of PAHs	*481*	2.9E-2	4.8E-3	1.6E-3	1.4E-3	8.8E-4	1.9E-3	1.9E-3	8.3E-3	1.5E-2	3.3E-3	8.6E-3	3.0E-3	6.1E-3	4.7E-3
	MAX TEV-HQ[1,4]	7.49	0.81	0.41	0.27	0.16	0.45	0.34	1.52	2.14	0.53	1.97	0.69	1.12	0.75
	L-CoC	Fluorene							Pyrene	Pyrene		Pyrene		Pyrene	

Shaded cells indicate TEV-HQ>1.

1 - Threshold Effects Value Hazard Quotient (TEV-HQ) = predicted porewater concentration)/Threshold Effect Value (TEV).

2 - TEV units: µg/L; see Table 4 for TEV derivation.

Table 6. Summary of Kow and Koc values used in calculations of organic contaminant concentrations in porewaters by equilibrium partitioning for Portsmouth Naval Shipyard PRG development.

Class	Analyte	CAS No.	Full Analyte Name	LogKow	Source[1]	LogKoc[2]	Koc
PAH	ACENAPH	83329	Acenaphthene	3.92	a	3.85	7.14E+3
PAH	ACENAPL	208968	Acenaphthylene	4.05	b	3.98	9.58E+3
PAH	ANTHRAC	120127	Anthracene	4.55	a	4.47	2.97E+4
PAH	BENAAN	56553	Benzo(a)anthracene	5.70	a	5.60	4.01E+5
PAH	BENAPYR	50328	Benzo(a)pyrene	6.11	a	6.01	1.01E+6
PAH	BENBFLU	205992	Benzo(b)fluoranthene	6.20	a	6.09	1.24E+6
PAH	BENBKFLU		Benzo(b+k)fluoranthene	6.71	c	6.60	3.95E+6
PAH	BENEPYR	192972	Benzo(e)pyrene	6.11	b	6.01	1.01E+6
PAH	BENKFLU	207089	Benzo(k)fluoranthene	6.20	a	6.09	1.24E+6
PAH	BGHIPER	191242	Benzo(g,h,i)perylene	6.70	a	6.59	3.86E+6
PAH	BIPHEN	92524	Biphenyl	3.96	a	3.89	7.82E+3
PAH	CHRYSEN	218019	Chrysene	5.70	a	5.60	4.01E+5
PAH	D26NAPH	581420	2,6-Dimethylnaphthalene	4.61	b	4.53	3.40E+4
PAH	DBAHANT	53703	Dibenz(a,h)anthracene	6.69	a	6.58	3.77E+6
PAH	FLUORAN	206440	Fluoranthene	5.12	a	5.03	1.08E+5
PAH	FLUOREN	86737	Fluorene	4.21	a	4.14	1.38E+4
PAH	I123CDP	193395	Indeno(1,2,3-cd)pyrene	6.65	a	6.54	3.45E+6
PAH	M1NAPH	90120	1-Methylnaphthalene	3.97	b	3.90	7.99E+3
PAH	M1PHEN	832699	1-Methylphenanthrene	5.08	b	4.99	9.86E+4
PAH	M2NAPH	91576	2-Methylnaphthalene	3.97	b	3.90	7.99E+3
PAH	NAPH	91203	Naphthalene	3.36	a	3.30	2.01E+3
PAH	PERYL	198550	Perylene	6.05	b	5.95	8.86E+5
PAH	PHENAN	85018	Phenanthrene	4.55	a	4.47	2.97E+4
PAH	PYRENE	129000	Pyrene	5.11	a	5.02	1.06E+5
PAH	T167NAP	2245387	1,6,7-Trimethylnaphthalene	4.61	b	4.53	3.40E+4
PCB	PCB101	37680732	101 (2 2'3 5 5')	6.38	b	6.27	1.87E+6
PCB	PCB105	32598144	105 (2 3 3'4 4')	6.65	b	6.54	3.45E+6
PCB	PCB118	31508006	118 (2 3'4 4'5)	6.74	b	6.63	4.22E+6
PCB	PCB128	39380073	128 (2 2'3 3'4 4')	6.74	b	6.63	4.22E+6
PCB	PCB138	35065282	138 (2 2'3 4 4'5)	6.83	b	6.71	5.18E+6
PCB	PCB153	35065271	153 (2 2'4 4'5 5')	6.92	b	6.80	6.35E+6
PCB	PCB170	35065306	170 (2 2'3 3'4 4'5)	7.27	b	7.15	1.40E+7
PCB	PCB18	37680652	18 (2 2'5)	5.24	b	5.15	1.42E+5
PCB	PCB180	35065293	180 (2 2'3 4 4'5 5')	7.36	b	7.24	1.72E+7
PCB	PCB187	52663680	187 (2 2'3 4'5 5'6)	7.17	b	7.05	1.12E+7
PCB	PCB195	52663782	195 (2 2'3 3'4 4'5 6)	7.56	b	7.43	2.70E+7
PCB	PCB206	40186729	206 (2 2'3 3'4 4'5 5'6)	8.09	b	7.95	8.97E+7
PCB	PCB209	2051243	209 (2 2'3 3'4 4'5 5'6 6')	8.18	b	8.04	1.10E+8
PCB	PCB28	7012375	28 (2 4 4')	5.67	b	5.57	3.75E+5
PCB	PCB44	41464395	44 (2 2'3 5')	5.75	b	5.65	4.49E+5
PCB	PCB52	35693993	52 (2 2'5 5)	5.84	b	5.74	5.51E+5
PCB	PCB66	32598100	66 (2 3'4 4')	6.20	b	6.09	1.24E+6
PCB	PCB8	34883437	8 (2 4)	5.07	b	4.98	9.64E+4

1 - Literature source of LogKow values:
a - Karickhoff and Long, 1995.
b - Karickhoff *et al*., 1989.
c - Ferraro *et al*., 1990.
2 - log(Koc) = 0.00028 + 0.983*log(Kow); Karickhoff *et al.*, 1989.

Table 7. Calculation of Candidate PRGs (C-PRGs) for the aquatic exposure pathways for the Portsmouth Naval Shipyard study area.

			C-PRG[2]
Chemical Class	Limiting Chemical of Concern[1]	BSAF/BAF Factor[7]	Aquatic[3] (at TEV-HQ=1)
	Fluorene[a]	0.29	104
	Pyrene[a]	0.29	1197

Shaded value indicates PRG under combined exposure pathway scenario.

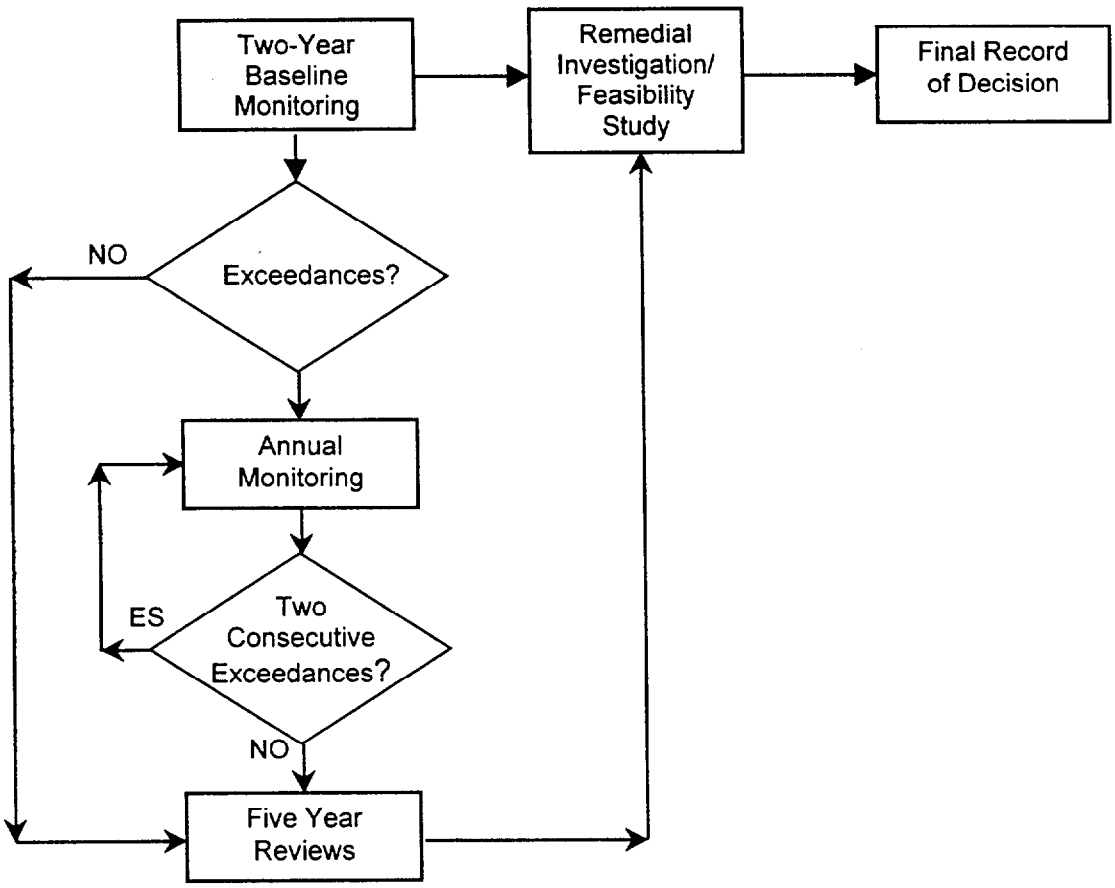
1 - List includes only limiting CoCs, i.e., CoCs with maximum TEV-HQs by station and pathway. See Table 15.

2 - Pathway-specific PRGs expressed in concentration units for use during remediation.
a - concentration units = ng/g dry weight sediment.
b - concentration units = µg/g dry weight sediment.

3 - PRG (ng/g dry weight sediment) = Aquatic TEV (µg/L) x Koc x f_{oc}; f_{oc} = %TOCavg./100;

7- BSAF Factors from EPA (1998), BAFs from SAIC, 1997.

INTERIM OFFSHORE MONITORING
DECISION TREE
PORTSMOUTH NAVAL SHIPYARD
KITTERY, MAINE



Notes:
Baseline monitoring intervals will be included sampling plan.
Decision Tree may be modified based on new data with concurrence from USEPA and Maine DEP.

Off-Shore Technical Meeting
May 21, 1998

Marty Raymond	PNS	207-438-2536
Fred Evans	NORTHDIV	610-595-0567 x159
GREG TRACEY	SAIC	411-782-1900
Debbie Cohen	B&RE/TetraTechNUS	412-921-7118
Bill Starkel	B&RE/TetraTech NUS	770-413-0965
Patti Tyler	U.S. EPA Region I	781-860-4342
Diana Bartlett	NORTHDIV	610-595-0567
Carolyn Lepage	SAPL TAG advisor	207-777-1049
CATHERINE ZEEMAN	MEDEP/toxicologist	207-287-2657
Meghan Cassidy	EPA	617-573-5785
Iver McLeod	MEDEP	207-287-8010
Ken Finkelstein	NOAA	617-223-55[illegible]