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MEMORANDUM AND U S NAVY RESPONSE TO TECHNICAL REVIEW COMMITTEE COMMENTS REGARDING ESTUARINE ECOLOGICAL RISK ASSESSMENT CASE STUDY
NSY PORTSMOUTH ME
1/21/1994
NAVFAC NORTHERN

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DEPARTMENT OF THE NAVY
NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
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IN REPLY REFER TO

21 January 1994

MEMORANDUM

FOR THE MEMBERS OF THE TECHNICAL REVIEW COMMITTEE (TRC), RCRA CORRECTIVE ACTION PROGRAM, PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

Enclosed are responses to the Technical Review Comments received on the Estuarine Ecological Risk Assessment Case Study for Portsmouth Naval Shipyard: Phase I Draft Final Report, May 1993. The responses have been prepared Mr. Robert Johnston of NCCOSC in conjunction with all investigators, editors and coauthors. All responses, when appropriate, have been incorporated into the Phase I Final Report which will be ready for publication sometime in March 1994.

If you have any questions or comments with respect to the enclosure, please contact me at (215) 595-0567 extension 147.

Sincerely,

Deborah Carlson

D. E. CARLSON
Remedial Project Manager
By direction of the Commanding Officer

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RESPONSE TO COMMENTS ON: AN ESTUARINE ECOLOGICAL RISK ASSESSMENT CASE STUDY FOR PORTSMOUTH NAVAL SHIPYARD, KITTERY MAINE: PHASE I DRAFT FINAL REPORT, MAY 1993 (ERLN CONT. NO. 1471)

Prepared by Editors and Coauthors of ERLN Cont. No. 1471

December 12, 1993

MEDEP "OFF-SHORE" REVIEW COMMENTS

1. The previous Report was submitted as a Preliminary Draft. The May 1993 version is titled Draft Final. Are you planning to submit a Final version of this Report?

The Phase I Draft Preliminary Report (Blue Cover) was superseded by the Phase I Draft Final Report (Grey Cover, ERLN Contribution No. 1471) which will be superseded by the Phase I Final Report (NCCOSC RDTE DIV Technical Report 1627).

2. The Phase II Study was initiated in July 1992. What is the status of that Study? Without the Phase II portion of the Offshore Study, the data presented in this Report is meaningless. How will Media Protection Standards be developed without completion of the Phase II Study? Please provide a Phase II Study progress report, schedule, and expected completion dates.

The status of activities conducted for Phase II of the Offshore Study are documented in periodic progress reports and updates presented at Technical Review Committee meetings. We do not agree that the Phase I results are "meaningless". On the contrary, they have been critical in defining the nature and extent of the problem and are instrumental in focusing the Phase II studies to quantify ecological impact. Media protection standards will be developed using all available data (see Johnston 1993) and will be improved as the Phase II data become available.

3. There is some inconsistency in the grouping of the sampling locations. For example, Sections 3.12 and 3.13 have different group names and include different stations in the groups. The sampling location groups should remain consistent throughout the report.

Each investigator identified the grouping that best fit their analysis objective. We feel that the grouping schemes used are adequately documented and explained within the context of the report.

4. How have past dredging activities around the Shipyard affected the sampling locations? Have the effects of dredging been taken into consideration when evaluating data presented in this Report? The Department requested this information in our initial comments also.

Dredging activities have been restricted to areas immediately adjacent to drydock and berthing areas. Major dredging as part of Shipyard expansions required the removal of bedrock material and have been documented elsewhere (McLaren/Hart 1991, NEESA 1983). Depositional sampling locations were selected to obtain measurements in areas where contaminants are most likely to accumulate. Past dredging activities would have minimal impact on the data analysis presented in the report because the report documents the present conditions observed in the estuary. Dredging operations which have taken place in other areas of Portsmouth Harbor may have contributed to the overall distribution of chemicals observed.

5. Why weren't tri-butyl tins, radionucleids, and dioxin included as part of this assessment? Given the historical and present day activities at the Shipyard, it would be surprising not to find elevated levels in the lower estuary. These variables should be studied in the Phase II Study.

The suite of analytes selected for the Portsmouth study were based on what was known about the disposal practices at the Shipyard, chemicals that are known to be persistent and potentially toxic in the marine environment, and evidence that there were other sources known to exist which could contribute to stress on the ecosystem. The rationale used to assess and eliminate dioxin, radionucleids, and butyltins from the assessment are given below.

Dioxin. There are no records of dioxin disposal at any the SWMUs under investigation nor are there any know sources of dioxin in the lower estuary. For this reason dioxins were not included in the analyses performed.

Radionuclides. Radionuclides are routinely monitored by the USEPA and a recent report (Semler 1991) summarized that:

> "1. No trace of Cobalt-60 was detected in any samples at Portsmouth Naval Shipyard. All radioactivity detected in the forty sediment samples is attributed to naturally occurring radionuclides or fallout from past nuclear weapons testing.
>
> 2. Results of cores sampling did not indicate any previous deposit of Cobalt-60 in the sediment.
>
> 3. Water samples contained no detectable levels of radioactivity.
>
> 4. All radioactivity detected in the biota samples is attributed to naturally occurring radionuclides or fallout.
>
> 5. External gamma-ray measurements did not detect any increased radiation exposure to the public above natural background levels.

6. Based on this survey, current practices regarding nuclear-powered warship operations have resulted in no increases in radioactivity that would result in significant population exposure or contamination of the environment." (From Semler 1991, p.13)

Based on this information radionuclides were eliminated from the assessment.

Butyltins. Butyltin compounds were included in the initial analytical screen of sediment and biota samples. There is a known source of butyltin compounds from commercial vessels and pleasure craft and butyltin compounds are known to be toxic to marine organisms. The initial screen showed butyltin levels to be low, especially in areas around Seavey Island (Munns et al. 1992), so these compounds were not included in the routine analysis of sediments and biota. The results from the analytical screen of butyltins have been included in the revised Final Report.

6. How were reference stations located? The York River and any portion of the Piscataqua are both highly susceptible to urban runoff. The Piscataqua has a long history of industrial and municipal discharge problems associated with toxic contamination (esp. chromium). Because of that, comparisons of Shipyard vicinity data to "reference" data is probably an underestimate. The Phase II Study should take this into account. The degree of contamination was probably underestimated due to the use of contaminated reference stations.

Reference stations were selected to determine the contamination levels present in the lower estuary. The York River stations were selected to be representative of a similar ecosystem outside of the urban/industrial influences present in the Piscataqua. We believe that these stations are extremely important in estimating the relative contribution of contamination from the Shipyard. The relevance of this approach is discussed in detail in the Media Protection Standards Proposal (Johnston 1993):

"In dynamic estuarine systems such as the Piscataqua River and Great Bay Estuary it is almost impossible to identify "background" locations that are "... outside the zones of contamination of all release sources to surface water and sediments" (Portsmouth Naval Shipyard Hazardous and Sold Waste Act Permit, 1989, p46). This is because the complex current and sedimentation processes (Johnston, Munns, Mills, Short, and Walker 1993, Ward 1993, Chadwick, Katz and Patterson 1993, Chadwick, Pavlov and Celikkol 1993, Swift and Celikkol 1993) tend to mix and disperse chemicals in complicated patterns. Chemical distribution patterns will be dependent on: (i) the origins and levels of chemicals released from the Shipyard as well as other input sources; (ii) physical-chemical properties of the chemical; (iii) physical mixing, flushing, and sedimentation processes; and (iv) biogeochemical transformation processes (Burgess and Scott 1992). These processes will all interact to affect a chemical's long-term availability and persistence in the system. Samples from reference areas (i.e. York River Harbor) can provide relative measures of contamination levels, however, reference locations are invariably dissimilar in certain key characteristics

(grain size, flushing rate, etc.) which are related to the uniqueness of site-specific depositional and assimilative processes. In addition, "background" concentrations derived from pristine locations void of any appreciable anthropogenic input may be over protective, especially in the sense that any offshore cleanup activities for the Shipyard must be conducted in Portsmouth Harbor, an area that is irreversibly subjected to human activities (Short 1992). Furthermore, the extent of potential detrimental or adverse impact (toxicity and bioaccumulation) will depend on whether the chemical concentration has exceeded the system's ability to assimilate and detoxify the chemical present (Long and Chapman 1985, Di Toro et al. 1991, Di Toro et al. 1992), rather than if "background" concentrations have been exceeded." (From Johnston 1993, pp 3-2 to 3-3).

7. There is a general lack of standardization (or at least not documented) for biological tissue collection. There did not appear, for example, to be a standard size of age of specimens to run contaminant analyses. Comparing small flounder or mussels to larger organisms is not appropriate.

As is documented in the SOPs (Mueller et al. 1992), sizes of biological specimens were standardized to the extent possible. We feel it is entirely appropriate to use the results obtained to estimate average chemical concentration levels for the various sample matrices.

8. Some of the other comparisons are not valid. Comparing mussel data to oyster data or geometric means used by NOAA to arithmetic means of this study is of limited value. Comparing benthic communities from different habitats and tissue levels from different seasons makes for difficult interpretation.

This comment stems from a lack of clarity in the text of the report. The NOAA mussel watch data contains both mussel and oyster data and it was to these data that the comparisons were made. The discussion of these comparisons has been made clearer in the Final Report. We agree that the comparisons should be consistent (e.g. geometric means for both distributions) and these changes have been made in the Final Report. Comparisons of the benthic communities were based on the fact that the communities were representative of depositional habitats in the lower estuary. Seasonal differences are important to establish trends and develop the baseline necessary for long term monitoring.

9. Comparing the edible species contamination levels to human health standards is interesting, but not that meaningful given that only *PCBs and *Hg have thresholds. Furthermore, FDA numbers were set based on both human health and market risks. I am assuming that further analysis of human health implications will be discussed in the Human Health Risk Assessment.

We agree that FDA levels have limited value in ecorisk assessments. The FDA action levels were used only for screening purposes. The human health risks are evaluated in more detail in the human health risk assessment.

10. Regarding mercury, the investigators would find it useful to deploy mussel cages for a longer period of uptake (>28 days) and also look at levels just above the I-95 bridge.

Mercury concentrations were measured in all mussel and oyster samples, including those from the upper Piscataqua, Little Bay and Great Bay. An additional mussel deployment was conducted in the lower estuary from Oct through Dec 1993.

11. Section 1, Page xi, third paragraph.
"Analysis of chemical contaminant concentrations in tissues of organisms collected from the estuary indicated that there was an up estuary source for Cr, Ni, Zn, and polycyclic aromatic hydrocarbons (PAHs)." This statement gives the impression that the possible up estuary source accounts for all the Cr, Ni, Zn, and PAH contamination found in the lower estuary. This is not an accurate statement. Please rewrite this sentence indicating that the up estuary source(s) may be contributing to contamination found in the lower estuary surrounding Seavey Island.

Sentence has been revised to read:
"Analysis of chemical concentrations in tissues of mussels collected from the upper estuary showed higher concentrations of Cr, Ni, Zn, and polycyclic aromatic hydrocarbons (PAHs) than those measured in the lower estuary. The levels of Pb were statistically higher in mussels from the lower estuary and the levels of Cr were statistically higher in mussels from the upper estuary."

12. p. 2.0-5. second paragraph. This whole paragraph is confusing. The text discusses Problem Formulation, but references Figure 3, RAF Framework. Problem Formulation is discussed in more detail in the following section. Problem Formulation discussion should be contained in the same section with correct references.

Paragraph has been revised as follows:
"The risk assessment framework (Figure 3) is iterative so that new information and ideas can be incorporated to redefine the problem. Considerations of regulatory requirements, public concerns, societal values, fiscal constraints, and other issues relative to the assessment enter into the framework during Problem Formulation. Monitoring data from past and ongoing investigations provide additional insight to frame the problem".

13. p.2.0-8. Please incorporate the contaminants of concern identified in the RFI Report in the Executive Summary.

The purpose of the Executive Summary is to provide a concise description of the results reported in the Phase I Final Report. Contaminants of concern, with respect to ecological impacts on the estuary are identified in the Executive Summary. It is not appropriate to summarize findings from another report (RFI Report) in the Executive Summary of this report.

14. p. 2.0-18. Figure 2. Please attach a legend that correlates SWMU number with a written description of the SWMU.

A legend identifying the SWMUs has been included for this figure.

15. p. 2.0-19. Figure 3. What does "RAF" stand for? If it means risk assessment framework the word "Framework" should be deleted from the title.

"RAF" stands for EPA's Risk Assessment Forum. The figure has been corrected.

16. p. 2.0-22. Figure 6. This figure does not allow for surficial sediment in the Clark's Island Embayment to be flushed out into the Greater Estuarine System. It seems that under certain conditions sediment would get transported out of the embayment.

The diagram shows surficial sediment movement by suspension to (or deposition from) the water column and movement through the water column either into or out of Clark Cove.

17. p. 3.2-1. A copy of the sampling locations map should be attached to this section.

A figure showing the sampling locations has been added to this section.

18. p. 3.2-2. Results and Discussion. Include a discussion of how the different bottom sediment textures affected the toxicity tests.

The sediment toxicity assessment section has undergone extensive revision; however, there may not be any discernable relationship between the observed sediment toxicity and sediment texture.

19. p. 3.3-2. Methods, first paragraph. Why was sampling station 16 added in January 1992?

Station 16 was added to the monthly monitoring so that the water monitoring would be coupled to the quarterly mussel sampling at that station. In addition station 16 provided information on the water quality associated with the different flow regime observed on the Maine side of that part of the Piscataqua. This has been documented in the Final Report.

20. Section 3.4. The Water Toxicity Study should be repeated. It is apparent from the results and discussion that no conclusions can be made due to the exceedance of the 48 hour holding time. This study should be performed on both the outgoing and the incoming tides.

The results of water toxicity test are useful in identifying relative toxicity between

stations. Even though the recommended holding time was exceeded, all samples were handled in the same manner (stored at 4°C over the weekend), thus any effect holding time had on the sample (increasing or decreasing toxic response) would be the same for all samples. There are no data to support or refute general changes in toxicity over periods of 48 h. The water toxicity test was not repeated because one of the outcomes of problem formulation was that ecological risks are expected to be minimal in the water column. Higher risks have been associated with the benthos in depositional areas. Therefore the Phase II analysis has focused on quantifying the effects levels associated with sediment exposure levels.

21. Section 3.5. The title, "Microbiological Contamination in Water and Sediments", is inaccurate. The title should reflect that only species affected by fecal contamination were used for this study. This report also has numerous grammatical errors.

We feel the title accurately conveys the contents of this section. Grammatical errors have been corrected throughout the report.

22. p. 3.5-1. first paragraph, first sentence. The words assessment and sediments are misspelled.

Misspelled words have been corrected throughout the report.

23. p. 3.6-12, Figure 4. According to Table 1, page 3.6-6, station 1, 11/11/91, at 1357, at a depth of -3.24, the longitudinal component of velocity should be -11.145. Figure 4 indicates that the velocity is +11.145. This error was pointed out in the last draft and was not corrected.

The table and figure have been corrected.

24. 3.7-1. second paragraph , last sentence. Consider replacing the word "signs" with causes.

Suggested correction has been made.

25. Section 3.8. The methods section only refers to Ascophyllum nodosum collection for biomass and tissue analysis. No data was provided for Z. marina. If Z. marina was used in the biomass comparison, as stated in the results and discussion section, the biomass data for Z. marina must be provided.

The *Z. marina* biomass data (methods and results) were presented in section 3.7. It is not necessary to present these data again in section 3.8.

26. p. 3.9-2, Methods. The method for collecting the Flounder and Lobster appears to bias the sample collection. The results section states that the lobsters showed consistent carapace lengths of approximately 60 mm. The sampling

method used may not allow collecting smaller lobsters. Is there any evidence from other studies that indicate the presence of lobsters with smaller carapaces in the sampling areas?

Trawl collections are usually able to sample smaller lobsters. A trawl was used in this study. During Phase II of the lobster sampling, divers were used to assure that the desired size lobsters were collected.

27. p.3.10-2. Methods, first sentence. Which 30 stations are being referred to in this sentence? Figures 7 and 8 show 34 stations. Figures in this Section show 23 sampling locations. Clarify exactly what stations were sampled and show results for all the data collected.

Section has been revised to clearly state where samples were collected. All data are presented.

28. p.3.10-3. Discussion. "The smallest mussels were found in the Clark Island Embayment, because these mussels were all collected intertidally." Is this statement indicating that the smallest mussels were collected in Clark's Cove because they were collected intertidally?

Yes.

29. 3.12-1. second paragraph, first sentence. How does the mere presence of UNH-JEL characterize the types and quantities of benthic infauna populations?

Sentence revised to state "due to the studies conducted by UNH-JEL"

30. Section 3.13. The Tables in this section should be renumbered and should more accurately correspond to the text.

Tables have been renumbered. The text has been improved for accuracy of table and figure callouts.

31. p. 3.13-19, third paragraph. The UPR may contain some sources for contaminants which are showing up around Seavey Island, but that possibility does not exclude other sources in the lower estuary. Around the Shipyard, concentrations of Cr, Ni, Ag, PAH's and PCB's were found at levels close to levels found in the UPR and Great Bay.

We agree, however on average Cr, Ag, PAHs, and PCBs were almost two times higher for mussel samples collected from the upper estuary than those measured around Seavey Island (compare Table 12b Seavey with Table 12a GB). So if there are other sources in the lower estuary for Cr, Ag, PAHs, and PCBs, the sources are not as strongly evident.

32. p.3.13-25. First paragraph, first.sentence. What is **sampling** station S2? What is its location and where is that location shown?

S2 is a seep sampling station. The location of all seep sampling stations S1, S2, and S3 are shown in the revised report.

33. p. 3.13-25. The Department would, like the opportunity to review the Phase II Study workplan for seep sampling.

The Phase II work plan will be provided upon completion.

34. p. 3.13-57. Define what "S" means on this Figure.

"S" denotes seep station location.

35. p. 3.13-91. Figure 35. The statement, "The levels of Cr, Zn, and Ni were significantly higher in Upper Bay Estuary.", is not supported by data presented in Table 13, page 3.13-48 for Zn and Ni. Zn and Ni levels in the area close to the Shipyard have levels as high or higher than the Upper Great Bay Estuary.

Figure caption revised to read: "The levels of Pb were statistically higher in the lower estuary and the levels of Cr were statistically higher in the upper estuary."

36. Section 3.14. The title of this Section does not match the title in the Table of Contents. What happened to the inorganic marker study?

The table of contents have been corrected. An inorganic chemical marker study was not developed for this project.

37. p. 3.14-5. A sample of Lafayette 70 was used to develop a chemical marker for current operations at the Shipyard. Has this type *of.cutting oil always been used at the Shipyard? It was noted that an upriver source of petroleum contamination was found. Why were these areas not investigated for this marker?

Lafayette 70 has been used at PNSY since the early 1980s. It was <u>not</u> noted that an up river source of petroleum contamination was found. The focus of the investigation is to provide support for the Shipyard's RCRA permit not to determine all sources of pollution in the estuary.

38. p. 4.0-10. First sentence. ...Mussel Watch Stations." Where are the stations that this sentence is referring to?

Mussel watch consists of a network of about 200 stations located in coastal and estuarine areas around the US. The sentence has been revised to read:

"However, mussels collected from the Piscataqua River and Great Bay Estuary had higher geometric mean concentrations of Pb, Hg, Cr, and Ni than the geometric mean concentrations reported from the Mussel Watch database (O'Connor 1992)."

39. **p 4.0-11.** What unique data will be provided by studying the salt marsh communities independent of the rest of the depositional areas? The salt marshes shown on Figure 1, p.4.0-19, appear to be located in depositional areas that are currently being studied.

The salt marshes are an additional habitat in the lower estuary that needs to be assessed according the assessment endpoints identified during problem formulation. The salt marsh data will provide information on the accumulation and potential effects of chemical exposure in the marshy areas fringing the subtidal depositional areas already being studied.

USEPA REGION I COMMENTS

41. The document should possess a list of figures to ease the location of the various figures.

A list of figures and tables will be included in the Final Report.

42. It would be helpful to have a figure which includes the identification of sampling locations and specific studies location (ie. sediment toxicity tests sample locations) included within each data report.

Figure showing station locations will be included in each section as appropriate.

43. **Report 3.4 Water Toxicity**
Page 3.4-2 The methods section states that "Storage and transport of all samples exceeded the recommended 48 h limit, which may have resulted in some degradation and loss of toxicity." Therefore, the results of these tests are questionable and it may be useful to repeat these tests.

Please see response to comment **20**.

44. **Section 3.13 Chemical Contamination in marine sediment, Tissue and Water Samples from the Piscataqua River and Great Bay Estaury Page 3.13-4** This report mentions that organotin compounds tributyltin, dibutyltin and monobutyltin compounds were analyzed but there is no discussion of these analyses in the report.

The results of the butyltin analyses are summarized and discussed in the revised Final Report. Please see response to comment **5**.

45. **Page 3.13-7** Has the Navy been able to evaluate analytical methods for lower detection levels in seawater samples?

Improved methods for sampling and analysis of seep and estuarine waters have been developed and implemented for Phase II sampling. The status of the seep investigations is documented in Johnston et al. (1993b).

46. Section 4.0 Estuarine Ecological Risk Assessment Synthesis of Phase I Findings
Page 4.0-4 I believe that PAHs should be included as a contaminant of concern since the highest PAHs were detected at the Dry Dock I (station 12), back channel station 18 and the Coast Guard station 2.

We feel that an objective (albeit qualitative) ranking scheme was developed to identify contaminants of concern for risk characterization activities. PAHs did not score high enough to be identified as a contaminant of concern. However stations with high concentrations were identified. PAH concentrations are still being measured in Phase II sampling, but the emphasis of the investigation is to better characterize heavy metal contamination and potential effects from exposure. If additional data show that PAH contamination can be linked to Shipyard sources, more emphasis will be placed on those compounds.

47. In summary, those areas of concern have been identified through the Phase I results but it appears that media protection standards will not be developed until results from Phase II are available. I look forward to reviewing the Phase II report.

Media Protection Standards have been developed using existing data. Estimates of what these standards will be improved as more data become available.

NOAA "OFF-SHORE" REVIEW COMMENTS

48. Clark Island Cove (including nearby Station #9), the back channel station #18, and the CIA/dry dock areas (e.g., Station #12) appear to be significantly impacted by Portsmouth NSY activities. Sediment toxicity; water toxicity; eelgrass and fucoid algae populations; and benthic community structure all suggest the presence of environmental stress within the cove which is in concordance with the general trend observed in sediment contamination and proximity to the landfill. Leachate has been observed from the landfill with elevated levels of trace metals. (Whether these samples contained entrained sediment or not, they still represent a source signal as surface water runoff.) Likewise, observations at Station #18 and at stations near the CIA/dry dock area suggest some environmental stress. Levels of sediment contaminants in all these areas surpass those known to be associated with toxic responses. Future efforts should be focuses on delineating the sources, contaminant migration pathways, and the full geographic extent of impacts (on finer scale) within these areas associated with the site. Future assessments of sediment toxicity should utilize more than a single measurement endpoint *(i.e. Ampelisca).*

Clark Cove sediment was found to have a number of metals (As, Cd, Cr, Cu, Pb, Ni, Hg, Ag, Zn) enriched above potentially natural levels , plus elevated levels of PAHs and PCBS. This area had the highest or next highest concentrations for nearly all analytes. Other areas which were observed as grossly and broadly contaminated include the dry dock area, the back channel (especially near Station #18), and the USCG station (#2; for PAHs and PCBs). Some Clark Cove sediment cores and the dry dock stations indicated higher concentrations of several analytes with increasing depth.

Resident mussels in Clark Cove contained significantly more Cr, Ni, Ag, Pb, PCBS, PAHs than reference stations. Water toxicity was indicated in Clark Cove at Stations 3, 4, and 7. Eelgrass was absent in areas of Clark Cove where

the substrate should have supported a population. For a low energy area, the biomass of fucoid algae was found to be low in Clark Cove (also Station #10).

Significant sediment toxicity was indicated at Stations 9, 18, 13, 16, 17, and the York River. However, the reason that the two York River stations (i.e., background) showed toxicity likely is due to their sandy substrate. *Ampelisca* are much more tolerant of muddy environments.

The significance of these observations and their relationship to risk characterization is the focus of the phase II investigations.

49. Section 3.1 The results of the physical sediment evaluation indicate that the two York River stations are significantly different (sandier) from the remainder of the estuary sites.
Moisture, particulate carbon, and combustibles were all well correlated with grain size. Yet there were "outliers" noted in the graphs, though the points could not be identified by station. Station 16 near the sewage outfall was highly variable. Station 18 was gravel and sand.

No response required.

50. Section 3.2. Bulk sediment toxicity bioassay results with *Ampelisca* were highly variable among replicates for Stations #22 and #13. This could be indicative of poor laboratory performance. All of the bulk sediment toxicity data have an added variance beyond that indicated by the raw data: native, indigenous *Ampelisca* were not completely removed from the sediment prior to testing. At least five replicates were known to contain more than the 20 individuals to be exposed in these bioassays. The counts of live animals in other replicates could be off by the unnoticed inclusion of native amphipods. Indications of toxicity at the York River stations are likely reflections of *Ampelsica's* preference for mud, not sand, more than any chemical reaction/toxicity.

We feel that the results of the amphipod assay were not due to poor laboratory performance, based on control survival and the results obtained from the reference toxicant. All samples were sieved with 2.0 mm sieve, and, if native amphipods were present, the sediment was further sieved through a 1.0 mm sieve. The extra amphipod reported in a few of the samples was probably a result of an additional test organisms that were inadvertently added to the test chamber.

The cause of toxicity in the York River samples is unknown. It could be due to sediment texture, although texture has not been observed as a cause of toxicity in other *Ampelisca* tests (Scott and Redmond 1989). Toxicity could also be caused by increased biological availability of the chemical present, the presence of an unmeasured toxicant, or some combination of factors. Further analysis of the chemical marker data suggests the presence of fresh (unweathered) petroleum compounds at the York Harbor station.

51. Section 3.5. The analysis of fecal indicators and chemical markers suggests that allegations of sources having widespread impact are unfounded. Fecal pathogens levels were generally low throughout the estuary. Although stations immediately near the sewage outfall (#15 and 16) show some limited impact by sewage effluent, there are not obvious and significant impacts or influences due to municipal effluent around Seavey Island. Isolated observations of fecal coliform are not conclusive evidence of sewage effluent anyway; both seabirds and marine mammals have been shown to be capable of having significant and overwhelming impact on total fecal coliform

distributions. This might explain the levels observed at Station #1, for instance.

No allegations of widespread sewage impact have been made, however there is widespread evidence of the accumulation of sewage-related contaminants. The evidence is based on fecal indicators, sewage-related chemical markers, and high levels of nitrate and ammonia. There is no doubt that sewage is affecting the ecology of the lower estuary.

52. Section 3.7. All of the metrics presented for eelgrass beds are open to interpretation (i.e., argument) according to a number of other factors, many of which covary. For instance, although root biomass can be an indicator of contaminant stress, eelgrass in high current, exposed locations will naturally have longer root systems than those in more quiescent, depositional areas. These depositional areas will also be fine-grained sediments and therefore be more likely to accumulate contaminants. But observations of root length by themselves could be totally unrelated to contamination. Likewise, deeper plants will be larger (i.e., more biomass) than shallower plants. Observations of biomass by itself could be interpreted as being indicative of healthy plants, but could in fact be more related to depth. Epiphytes growing on the blades of eelgrass, indicative of a nutrient problem, could account for an apparent observation of metal accumulation by the eelgrass. Or, eelgrass plants of different ages have different uptake rates which could also explain the note of preferential accumulation of some trace metals. Flowering, as observed at Station #9 (one of the more contaminated sites) has been observed to be an indicator of environmental stress. This stress could be contamination, but could also be high turbidity or large salinity changes. (It could be another observation of an annual population of eelgrass too.) The bottom line is that all of the metrics presented for eelgrass are essentially uninterpretable by *themselves*. These data would best be interpreted by the PI in connection with other parameters (i.e., the Navy should collate the PI's discussions of results, not attempt to decide themselves what the significance of the observations is). For future work, plant specific growth rates might be a better, more evenly based, indicator of overall health of the eelgrass.

Dr. Finkelstein's observations on the eelgrass results maybe correct, although additional analyses are required to evaluate the importance and meaning of the various eelgrass measurements. As was stated in the introduction (and throughout the report) the objective of the report was to define the problem, not to present a final detailed analysis of risk at this stage. Furthermore, each investigator is given full access to all data, as the data become available. The investigators are fully capable of analyzing and determining the significance of the results.

53. Section 3. 1 0-1 1; Section 3.13. The bioaccumulation data from deployed mussels should not be evaluated as absolute evidence of the lack of bioaccumulation potential. Bivalves are able to sense the presence of certain pollutants and respond by essentially shutting down their filtering rate. This sort of impact can be seen in a lack of growth, but results in little to no bioaccumulafion of available contaminants. Any future studies should investigate growth rates of individual deployed mussels.

Bioaccumulation data from the deployed mussel stations were evaluated relative to each other and not taking as absolute evidence of anything. The scope-for-growth measurement takes into account differences in filtering and physiological assimilation.

54. Section 3.12. The results of the benthic community analyses is another set of data which appears to have received minimal analysis. Observations of very low density and very low diversity are more clearly indicative of potential

problems. However, there are observations whose significance is not so clear. For instance, there are stations with both amphipods, a pollution intolerant taxa, and Capitella, a pollution tolerant species. This is most likely due to the muddy nature of these areas, since both organisms prefer mud. Community similarity analyses should be conducted, and these results interpreted relative to both physical parameters at each station and levels of contamination.

Further analysis of the benthic infaunal data as well as additional confirmatory sampling are currently being conducted.

55. Section 3.13. The sediment chemistry suggests only a few trace metals are of potential concern based on the observation that they do not exceed the ER-L values. However, this single-analyte comparison does not account for the cumulative impact of concurrent exposure to all site-related contaminants. Nevertheless, chromium was elevated above the ER-M in Clark Cove, lead and zinc were elevated above the ER-M at Dry Dock 1 (station #12), and back channel station #18 showed elevated PAH levels. The text, describing the core profile data, appears incorrect. The data displayed in Table 6 and Figures 24-32 indicate elevated inorganic concentrations at depth. Much of this likely will remain isolated but the document should consider these concentrations. Note Table 6 does not show that the maximum chromium and copper are above the ER-M.

The ER-L and ER-M toxicity thresholds are useful for screening chemical concentration levels, however exceeding the threshold levels does not, in and of it self constitute risk. Many factors govern the bioavailability of sediment-bound chemicals, including the interaction and cumulative effects of the contaminants present.

The text describing the core profiles has been revised to read:
"Core profiles revealed a general decrease in concentration levels with depth for most cores, except for the cores sampled from stations 10 and 12. The core from station 10 had elevated concentrations of Al, Zn, Pb, and Cu measured at depths greater than 50 cm. The station 12 core had elevated concentrations of As, Cd, Cr, Cu, Pb, Ni, and Zn at depths greater than 20 cm."

Values exceeding ER-Ls and ER-Ms have been correctly flagged in Tables 6 through 8.

56. Section 3.13. Mussels have some ability to metabolize PAHs (and other organic compounds). The observation of lower levels of PAHs in mussel tissue *versus* sediments is not unexpected. The absence of PAHs in flounder is to be expected given their high degree of metabolism.

No response required.

57. Table 12 (section 3.13) should state p values (in the effect column) for all tests rather than predetermine what is significant or not.

The tables present p values at significance levels of $p \leq 0.05$. At significance levels above 0.05 the test was considered to be nonsignificant (NS). The p value was not reported because the purpose was to test for significant differences. At any rate the raw data are provided in the report.

58. Figure 4 page 4.0-22 is missing Station 18.

Station 18 was not included in the cluster analysis because there were only two replicate grain size measurements made. A minimum of four replicates were required for the analysis.

59. Figure 6 page 4.0-25 - FDA action levels are not based on toxicology (to humans or the fish) and have no bearing in an Eco Risk Assessment.

Please see response to comment **9**.

60. Table 2 Section 4.0 treats density of benthic community as the only parameter of importance, and totally disregards diversity, species richness, et cetera. As noted above, the benthic community data needs to be explored in greater detail. High densities of a very limited number of species (e.g., Station #4) does not imply healthy conditions.

Please see response to comment **54**.

NORTHERN DIVISION "OFF-SHORE" REVIEW COMMENTS

61. Request the title of the document be revised to "Estuarine Ecological Risk Assessment for Portsmouth Naval Shipyard, Kittery, Maine" since the requirement is driven by regulatory action rather than as a experimental case study. The fact that NCCOSC and EPA Narangansett have developed a cooperative research and monitoring agreement is discussed in the report.

Title of the Final Report is Estuarine Ecological Risk Assessment for Portsmouth Naval Shipyard, Kittery, Maine: Phase I Problem Formulation

62. Request the cover of the Phase I Final Report be revised not to include the conceptual model. The model is little misleading on the size of the arrow with respect to any confirmed amounts of contamination being released from the SWMU's and should not be the first diagram the reader sees.

There will be no figure on the cover of the Technical Report.

63. Section 1.0
- Page xi: The last sentence should include a statement that the study was "initiated for NSY Portsmouth's RCRA Corrective Action Permit as a cooperative research effort ..." or "initiated in August 1991 for the Navy's Installation Restoration Program as a cooperative research ...."

The following sentence has been added to paragraph 1: "Results from the study were provided in partial fulfillment of the Shipyard's Resource Conservation and Recovery Act Corrective Measures Permit."

64. - Page xi: Clarify that heavy metal concentrations in the estuary as a whole were elevated relative to Mussel Watch data.

Sentence was revised to read: "However, heavy metal concentrations of Pb, Cr, Hg, and Ni in tissues of mussels collected from the Piscataqua River and Great Bay Estuary were high relative to Mussel Watch data from coastal and estuarine areas of the United States."

65. - Page x: What study is McLaren/Hart conducting to develop information on the source and strength of stressors and routes and rates of releases from the site?

The study that is being referred to is the RFI onshore investigation.

66. Section 2.0
Correct the sentence stating "The SHIPYARD was issued a RCRA Corrective Action Hazardous and Solid Waste Amendments (HSWA) Corrective Action Permit." to read "The SHIPYARD was issued a RCRA Hazardous and Solid Waste Amendments (HSWA) Corrective Action Permit."

Sentence has been corrected.

67. - Page 2.0-9 Include stormwater run-off as a non-point source of stress to the estuary.

Stormwater run-off was included.

68. - Page 2.0-10 Are the ecological risks to shorebirds (i.e. egrets, herons, osprey, etc) going to be assessed in the offshore or on-shore ecological assessment?

Risks to shorebirds will be assessed indirectly by measuring chemical residues in prey.

69. - Page 2.0-11 Does the hydrodynamic model and sediment distribution maps actually predict that a contaminant released from Jamaica Island, DRMO, or the dry docks would disperse rapidly over much of the lower estuary? Is this for both hydrophobic and hydrophilic compounds? The sediment map indicates that there are depositional areas around each of these sites. The conceptual models portray that are contaminants are dispersing over a wide area. This increases are responsibility in potential corrective measures. The discussion on page 2.0-11 suggests that particle bound contaminants released from Jamaica Island would settle in Clarks Cove. The Discussion in Section 3.6 also indicates that little transport is taking place at Clark Cove.

Text in this section describes initial hypothesis of how chemicals would most likely be transported. Based on the findings so far it appears that the more soluble chemicals would be rapidly transported out of the system, while particle active chemicals (e.g. Pb) would subject to far more complex dispersion processes, probably entailing successive deposition and resuspension episodes until the particle was eventually buried or flushed from the system.

70. Section 3.0
- Section 3.1: I think that the results section should be modified slightly to provide the reader more information. For instance describe phi (the larger the number the smaller the grain size). Also discuss sorting and skewness.

Section has been revised to describe phi. Sorting and skewness data are presented accurately.

71. - Section 3.2: What were the results (LC50's) of the 96 hr water only reference toxicity tests?

The results of the LC50s calculated from the reference toxicant were within normal limits (ie. trimmed Spearman-Karber LC50s were within the upper and lower boundaries of the control chart or plus and minus two standard deviations from the established mean).

72. - Section 3.3-1: The goal of the study is to determine risks. The statement in the introduction that risks have been determined is not necessarily true. In the caption of figures 1-3 in chapter 3.3-1 the units of measurement should be reported.

Intro has been corrected. Units of measurement are phi units. These are labeled on the graph.

73. - Section 3.7 Page 3.7.1. It is mentioned that "it is not expected that contaminants from the SHIPYARD would effect wasting disease ... However further down it is mentioned that "Nationwide eelgrass populations are declining at a rapid rate, primarily as the result of pollution in addition to disease outbreaks .." Is it possible to interpret the results without distinguishing effects from pollution versus wasting disease (i.e sampling the eelgrass tissue)?

Yes. This was done by Dr. Short.

74. - Page 3.8-2 I do not understand the statement that "An increase in standing stock seemed to occur between stations 10, 10a, 17, and 19."

Sentence was revised to read: "There was an increase in standing stock along stations 10 to 10a to 17 to 19 (Figure 2)".

75. - Page 3.9-3 Discussion: The fact that the flounder and lobsters were small in size does not necessarily suggest that there is reduced abundance. Other factors such as habitat and collection methods may be important.

Section was revised to clarify.

76. - Page 3.8-5 Figure 2: Is the biomass value the average or the sum of the six samples from each site?

The average.

77. - Section 3.10. Suggest that a map of the sampling locations be included in this as well as all applicable sections. It makes the document easier to read by not requiring the reader to go back to Figure 7 on page 2.0-23. In addition there is a mistake in the page numbering as there are two page 2.0-23's and 2.0-24's. Figure 8 on page 2.0-24 appears to show 9 sampling stations in the upper Great Bay estuary instead of 7 as stated in the methods section. The sampling locations are not clearly identified.

Maps and figures have been added.

78. - Section 3.11 How does the SFG for the various sites compare to previous measurements in Great Bay Estuary and at other sites? Although the SFG for sites 2,8,19, and 22 are reduced in comparison to site 15, are the SFG measurements indicative of stress? Figure 1 or the discussion should explain what the unit of measure for the SFG is.

The following text has been added to section 3.11:

"The scope for growth (SFG) in joules per hour (J/h), is an index of physiological well being that takes into account feeding rates and assimilation efficiency. The SFG is determined by:

$$SFG = (C \cdot A) - R$$

where

C = energy assimilated (J/h)
A = assimilation efficiency (%)
R = energy lost through respiration (J/h)"

The SFG is a relative measure between "reference" and "treatment" stations. Differences in SFG measurements between "reference" and "treatment" stations have been correlated to chemical exposure. In this study, station 22 in York Harbor was used as the "reference" station. The interpretation of the results obtained is that there were no differences in SFG between stations 2, 8, 19, and the "reference", but there was a statistically significant difference detected for station 15, indicating there was some sort of stress that affected the mussels deployed at station 15. It is unknown what the source of stress was, but it is consistent with the fact that indigenous mussels were not observed at station 15.

79. - Page 3.12-3 What is the substrate at station 13? I think it is important to discuss this in relation to the summarized findings in the discussion section. How is the information going to be synthesized into the risk assessment. I do not think that it should be beyond the scope of this report. Is there evidence of stress in areas where pollution tolerant species dominate the density of organisms?

The bottom is sandy mud at station 13. The synthesis of ecological risk information is ongoing and will be completed at the end of Phase II. It is not known what is causing the stress to the benthic community.

80. - Page 3.13-8 Is it correct to state that there is not (and never was) an anthropogenic source of AL in the Piscatagua and Great Bay estuary? Page 3.13-14 The data results for Fe and Mn do not really give an indication of the validity of the model. What it says is that according to the model these compounds are not enriched in the environment. I am not trying to be critical of the model, however I think we have to realize some of the assumptions. The model seems to be a good tool in evaluating the data.

To the best of our knowledge there is not a major anthropogenic source of Al in the Piscataqua and Great Bay Estuary. Al along with Fe and Mn are major crustal elements (percentage levels) and their distribution will not be as affected by anthropogenic sources as the other trace metals (ppm levels). The data results of Fe and Mn are consistent with the expected crustal ratios obtained using the crustal ratio model indicating that model could be used to predict the expected concentrations of the trace metals. If the model had not accurately predicted the Fe and Mn distributions (ie. shown that they were enriched), then the model would of had to have been rejected for application to the trace metals.

81. - Section 3.13 If it has not been previously mentioned before, the form of the metals for analysis should be reported.

The form (species) of the metals present are unknown. The methods section documents that samples for metal analysis underwent total digestion with HFl acid. The results report total metal present.

82. - Table 3: Technically the predeployed mussels are not background. They are a reference group and should be identified as such.

Please see response to comment 6. The use of "background" and "reference" are consistent throughout the report.

83. - Section 3: Would it be appropriate to compare concentrations of contaminants to Ambient Water Quality Criteria as well as ERL, ER-M, and AET'S. The AWQC are federal and state specific ARAR's. Are the forms of the metal being analyzed the same forms which were used in developing the ER-L, ER-M, and AET? If not, this should be discussed?

Water Quality Criteria apply to water concentrations. Water analysis during Phase I did not meet the data quality objectives, hence there is no discussion on WQC. Total metal concentrations were used to develop ER-Ls, ER-Ms, and AETs. Total metal concentrations were measured in this study.

84. - Page 3.13 -18: If it is going to be reported that "the average mercury concentrations increased by more than a factor of 2 above predeployed concentrations... ", then it should be reiterated that nearly all the data were below the level of quantification.

A footnote has been added to this sentence which states: "Hg concentrations were below the LOQ, see Appendix XII.E".

85. - Page 3.13-19: The site from which the predeployed mussels originated should be referred to as a reference site rather than a background site according to EPA definitions of background.

Please see response to comment **82**.

86. - Page 3.13-20: What is the relationship between oyster tissue values and Mussel Watch data? Can any conclusions be drawn from these data sets?

The Mussel Watch database includes oyster data. This paragraph has been revised to clarify comparisons being made. Please see response to comment **8**.

87. - Is the data for mercury in lobster tail flesh on page XII. (E) 6 missing qualifiers? How could a value of 1.60 be below the MDL but a value of 0.93, 1.5, or 1.07 not be? Is the method detection limit actually a sample quantification limit?

No qualifiers are missing. We are not sure what is meant by the sample quantification limit. The detection level achieved for a particular analysis is dependent on the MDL (accuracy of the method), the sample size, and the amount of analyte present in the sample. Combinations of these variables will cause the apparent discrepancy noted.

88. - Page 3.13-22: the statement that "evidence that of potential contamination of Cd, Cu, Ag, and Zn is not as convincing, probably because these elements were not associated with the contaminant event" needs clarification. Was there no source or process which involved any of these compounds? Were they not found in any on-shore sampling?

The contamination that is being referred to is the contamination which may have occurred when the eelgrass samples were dried. The paragraph has been rewritten to provide clarification.

89. - Page 3.13-25: The purpose of sampling flounder and lobster was not necessarily to screen for pollutants that could contaminate seafood (especially from the Ecological perspective). The purpose was to try to quantify exposure and characterize potential ecological effects and risks to these receptors.

The flounder and lobster sampling was multipurpose as stated.

90. - Table 1: Page 3.13-31 Should clarify what detection limit this is (i.e. sample , method, instrument, etc)

Method Detection Limits (MDLs) were tabulated. Table was revised.

91. - Table 4: Page 3.13 -35 The table should be consistent in terms of capitalization for all quantifiers which are in the data sets.

There is no difference between upper or lower case qualifier codes.

92. - Page 4.0 -12: I think it is premature at this time to discuss possible courses of action in terms of remediation.

We do not agree. Please note that no recommendation was made as to which course of action should be taken.

93. - I am looking forward to seeing the Phase II Work Plan. The work plan should include additional efforts to try to characterize stress and ecological effects based on sampling data and also risk characterization activities.

The Phase II work plan will be provided when completed.

NOTE TO REVIEWERS:

We found your comments to be extremely useful and valuable in improving both the quality and content of the report. We sincerely appreciate your time and effort in reviewing the document and for your continued contribution and assistance in completing the study for the Shipyard.

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