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NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
10 INDUSTRIAL HIGHWAY
MAIL STOP, #82
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IN REPLY REFER TO

AUG 20 1996

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Code 1823/JMC

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

Ms. Nancy Beardsley
Maine Department of Environmental Protection
State House Station 17
Augusta, ME 04333-0017

Subj: ON-SHORE/OFF-SHORE CONTAMINANT FATE AND TRANSPORT MODELING, PORTSMOUTH NAVAL SHIPYARD, KITTERY, ME

Dear Ms. Cassidy and Ms. Beardsley:

Enclosed are the response to comments on the Draft On-Shore/Off-Shore Contaminant Fate and Transport Modeling, Phase I Work Plan for Portsmouth Naval Shipyard. Following your review of these responses, we feel a meeting is appropriate to discuss resolution of these issues. Please contact me to arrange this meeting or if you have any questions; (610) 595-0567 extension 117.

Sincerely,

Jim Conroy

JAMES M. CONROY, PE
LT, CEC, USN
Remedial Project Manager
By direction of the
Commanding Officer

Encl: Response to Comments

Distribution:
NOAA (K. Finkelstein)
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RESPONSE TO EPA COMMENTS DATED JUNE 26, 1996
DRAFT ON-SHORE/OFF-SHORE CONTAMINANT FATE
AND TRANSPORT MODELING
PHASE I WORK PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

EPA GENERAL COMMENTS

1. **Comment**: The text seems to indicate that the Navy is predisposed toward performing complex modeling during Phase II. EPA recommends that the text state directly that Phase II modeling can still be simple, but just performed with additional data, an improved understanding of trends, and improved mapping of contaminant pathways and distribution.

   Response: Text will be revised in sections 1.0 and 3.0 to clarify that Phase II modeling may not be numerical in nature but a refinement of the Phase I analytical modeling. The text revision below for Section 1.0 also incorporates the revisions due to EPA Specific Comment 1. The text will be revised as follows:

   Section 1.0, Second paragraph will be replaced with the following,

   "*To date on-shore and off-shore remedial investigations at PNS have been conducted separately. In order to select appropriate site remedies, information available from these separate investigations needs to be first integrated into a multi-media contaminant fate and transport analytical model (Phase I Model).*

   The Phase I modeling task can be initiated prior to the availability of the groundwater analytical results using low-flow sampling techniques and the analytical results from the proposed seep/sediment sampling event for the following reasons.

   - *Development of the Phase I analytical models using existing groundwater data will present a conservative estimate of the on-shore contaminant impacts to off-shore receptors (i.e., previous conventional sampling techniques may have resulted in the reporting of elevated contaminant concentrations due to high turbidity conditions. Note that existing unfiltered groundwater concentrations will be used in the Phase I modeling. This estimate will identify the potential magnitude of the these impacts relatively quickly and assist in determining what additional evaluations and/or analyses may be required.*

   - *The Phase I modeling may identify potential data gaps. If the Phase I Modeling is delayed until the availability of the low-flow groundwater sampling results and the seep/sediment sampling results, these data gaps may not be identified until later which could ultimately delay the remediation process (it is understood that modeling will not be the sole basis for making remedial decisions, however, the*

modeling results will be a significant factor in the remedial decisions and it is unlikely that final remedial decisions will be made without consideration of the modeling results regarding future conditions).

- *Completing the Phase I modeling with the existing data will allow the regulatory agencies to review and comment on the modeling approach at an earlier date. This will allow the Navy and the regulatory agencies to come to a consensus on the modeling approach earlier so that as the low-flow groundwater data and the seep/sediment data becomes available the modeling can be refined quickly (if necessary), and therefore allow remedial decisions to be made sooner.*

Numerical hydraulic models have been developed for the entire Great Bay/Piscataqua River Estuary (Chadwick, 1993, Pavlos, 1994, Scott 1996, in prep), however, because the numerical model covers such a large area, the numerical model resolution is not fine enough in the vicinity of PNS to be directly incorporated into the Phase I modeling. For instance, Clarks Cove is modeled with a single one-dimensional channel segment in the numerical model. Instead of attempting to fully incorporate the numerical modeling, this work plan focuses on screening techniques and on near-shore impacts. While the existing numerical modeling may not be detailed enough for Phase I modeling, it does provide information concerning the general flow patterns surrounding PNS. Information available from the existing numerical model will be used to the greatest extent possible.

Additional modeling efforts, possibly additional analytical modeling and/or numerical modeling may be required in the future (Phase II). If a Phase II modeling effort is required, it may entail development/refinement of numerical models for groundwater and surface water surrounding PNS or the Phase II modeling may be similar in nature to the Phase I modeling but incorporate additional data, an improved understanding of trends, and an improved understanding of contaminant migration."

Section 3.0, The last sentence of the first paragraph will be replaced with the following:

"*The need for a Phase II modeling task will be evaluated after the completion of the initial phase of the modeling study. The Phase II modeling, if it is needed, could entail a refinement of the Phase I models and only incorporate additional data, an improved understanding of trends, and an improved understanding of contaminant migration or the Phase II modeling could entail development of more complex numerical models.*"

2. **Comment**: Modeling should not be used as the only, or primary, basis for saying that steady-state has been reached. Data as well as modeling should be used to establish whether steady-state has been reached. Trend analyses based on data are better than modeling based on hypothetical or estimated source area leachate concentrations. Thus, the trend analysis would be performed prior to the modeling if possible. This will establish whether the current concentrations leaving the island represent reasonable high concentrations for evaluating the future condition.

Response: It is agreed that the most scientifically defensible approach to groundwater contaminant trend analysis is using long term monitoring data and appropriate statistical methods, however, for Phase I work the groundwater data is too limited to evaluate trends. The first low-flow sampling event has yet to occur, so any long term trend analysis of this high quality data could not be done for the Phase I modeling. Furthermore, reliance on long-term monitoring will delay decisions concerning whether or not a given site requires remediation and, if so, which remedy should be selected.

The existing groundwater data from the RFI and RFI Data Gap investigations is compromised by sampling artifacts such as high turbidity. The Navy believes that the data from the RFI and RFI Data Gap can be used for the modeling since the high turbidity should cause the groundwater concentrations to be estimated high. This will produce conservatively high modeling predictions. There is more uncertainty associated with the modeling due the turbidity in the groundwater sampling, however, any error in the true groundwater concentrations due to the turbidity will result in more conservative modeling results.

Trends in the existing groundwater data will be investigated. It is anticipated that because of limitations of the existing groundwater data (limited temporal span of data) that the trend evaluation will focus on a simple comparison of data points in the same monitoring wells to see if the concentrations are increasing or decreasing with time.

3. **Comment**: Consideration of only "current day" (and not "historical") contaminant migration may not be acceptable for evaluation of off-shore contamination, especially in harbor sediments.

Response: It is the understanding of the Navy that the primary objective of the Phase I modeling is to determine which on-shore areas of contamination can continue to release contaminants to off-shore areas to aid in determining whether remediation of on-shore sites is warrented. Existing off-shore contamination is a separate issue. Since much of the on-shore contamination is either covered (with pavement, or vegetation) or present below the ground surface (e.g. contamination from leaking underground storage tanks), the most significant contaminant transport pathway is through the groundwater. The amount of contamination already deposited in off-shore areas is not directly relevant to the objective of determining which on-shore areas are continuing to release contaminants to the off-shore via groundwater.

The off-shore sediment contaminant concentrations can be compared to the model predicted sediment concentrations to estimate whether the on-shore contribution to sediment could cause the existing sediment concentrations to increase. If the model predicted sediment concentration are higher than the existing measured concentrations then the actual off-shore sediment concentrations may continue to increase due to discharge from PNS. The model predicted sediment concentrations will also be directly compared to the off-shore sediment criteria to determine the acceptability of the on-shore contaminant concentrations.

The highest sediment concentration, due to contaminant migration in the groundwater, will occur where the groundwater discharges through the sediment to the surface water. If sediments are contaminated due to groundwater discharge at several locations, (i.e. just off-shore from various sites), and the sediments are transported in the surface water to a depositional area (such as a harbor), the mixed sediment concentration in the harbor will not be any higher than the highest sediment concentration off-shore of any of the sites. Therefore the most conservative sediment concentration due to continuing on-shore sources will be the sediment concentration at the source (off-shore of the sites before transport). To make a conservative estimate of sediment concentration due to contaminant migration in groundwater, the transport of sediment in the surface water does not need to be simulated.

The simulation of all the possible sources of contamination to the off-shore areas is not practical for the Phase I modeling considering that there are numerous potential sources at PNS and many sources outside of PNS (e.g. sewage treatment plant outfalls located along the estuary). The numerous sources through out the estuary could not be accurately simulated with an analytical model. Even with an numerical model, the loading history and number of sources contributing to the estuary are not known so that it would be impossible to accurately match model predicted concentrations with measured concentrations in the off-shore areas.

The following text will be added to the end of Section 6.4:

"*The off-shore sediment contaminant concentrations can be compared to the model predicted sediment concentrations to estimate whether the on-shore contribution to sediment could cause the existing sediment concentrations to increase. If the model predicted sediment concentration are higher than the existing measured concentrations then the actual off-shore sediment concentrations may continue to increase due to discharge from PNS. The model predicted sediment concentrations will also be directly compared to the off-shore sediment criteria to determine the acceptability of the on-shore contaminant concentrations.*"

4. **Comment**: The previous modeling effort provides a large body of information on how water moves around PNS and Great Bay. The conceptual and analytical models should build from the understanding developed using the numerical model. We understand that the Phase I work will not include the level of detail provided in the previous modeling effort.

Response: It is anticipated that hydraulic data generated from the existing numerical off-shore surface water model will be incorporated as input to the analytical models and will be used in development of the site-specific conceptual models.

5. **Comment**: The Navy must interact with MEDEP to arrive at a consensus on mixing zone definition and analysis techniques. The work plan's discussion of how the technique will be defined needs to be more thorough.

Response: It is agreed that MEDEP and U.S. EPA should have the opportunity to review and comment on the mixing zone analysis before the modeling is completed. It is proposed that the Navy submits a technical letter providing interim results from the initial steps of the modeling task based on existing data. A conference call to discuss the technical letter would occur shortly there after. It is anticipated that the technical letter would outline the COC selection process (including the initial COCs) at each site to be modeled, the conceptual model developed for each area modeled, and the modeling tools (including the mixing zone) proposed to be used. This format would allow for review and comment by the regulatory agencies, and incorporation of their comments, while not significantly slowing the completion of the Phase I modeling. Additional review and comment by the regulatory agencies can made when the report is submitted.

The proposed sequence of events for on-shore/off-shore contaminant fate and transport modeling can be summarized as follows:

- Phase I Model development, based on existing (RFI and RFI Data Gap) data,
- Submission of a technical letter to the regulatory agencies concerning the site conceptual models, initial COC selection, and modeling tools,
- Review and comment by regulatory agencies, and comment resolution,
- Completion of Phase I Modeling and submission of the Phase I Modeling Report,
- Review and comment by regulatory agencies, and comment resolution,
- Phase II Modeling (if required). The Phase II modeling may involve refinement of the Phase I analytical models based on additional data (e.g., low-flow sampling results), or the Phase II modeling could be based on more complex numerical models.

6. **Comment**: The text indicates that COCs will be "dropped" before running the Phase I models. At a minimum, the Navy should give the regulators the chance to agree on dropping COCs before proceeding. Specifically, in Figure 3-2 (page 3-7) of the Work Plan, add "regulatory review" or similar to acknowledge that the Navy will confer with EPA and DEP before COCs are dropped from further consideration and modeling.

Response: It is agreed that MEDEP and EPA should have the opportunity to review and comment on the initial COC list before the modeling is completed. It is proposed that a technical letter from the Navy be submitted to MEDEP and the EPA followed

shortly with a conference call to discuss the technical letter as discussed in response to EPA General Comment 5.

Regulatory review will be added to Figure 3-2.

EPA SPECIFIC COMMENTS

1. **Comment**: Page 1-1, 2nd Paragraph

   Suggest changing the wording of the third sentence. Should Phase II modeling become necessary, it could be difficult to explain why the modeling results are not "questionable."

   Response: The wording will be revised. See EPA General Comment No. 1 for the revised text which will be incorporated.

2. **Comment**: Page 1-1, bottom line

   Change "determine" to "estimate" or "evaluate".

   Response: Agree. the sentence will be revised as follows:

   "Current conditions at PNS will be simulated to ~~determine~~ *estimate* the current maximum impacts at the near-shore environment."

3. **Comment**: Section 2.3.2, DRMO, page 2-6

   The text should cite groundwater as well as soil concentrations for parameters such as PCBs, because groundwater transport is the pathway of concern.

   Response: The last paragraph on page 2-6 does discuss exceedances of PCBs, pesticides, and semivolatile organic compounds above residential MPS. The text will be revised to cite the maximum concentrations detected in the groundwater. Also the MPSs will be identified as "residential" MPSs. The text will be revised as follows:

   "In general, shallow wells were more highly contaminated and contained a greater quantity of contaminants than bedrock wells. Also of note, total lead concentrations east of the DRMO (Old Incinerator Area) are elevated (up to 440 times the *residential* MPS). An exceedance of DDD occurred once (at 10 times the residential MPS) and PCB exceedances occurred sporadically (at up to 260 times the *residential* MPS). *The maximum detections for DDD and total PCBs were 0.32 and 13 ug/l, respectively.* One slight exceedance of the residential MPS for BEHP occurred in the old incinerator area.

Petroleum ID fingerprinting indicated No. 6 Fuel Oil at two wells and compressor oil at one well."

4. **Comment**: Page 2-8

While there may not be a MPSs for mercury, this does not necessarily mean that mercury will be overlooked. The text should clarify this for all contaminants.

Response: Agree. The following text will be added to the second paragraph from the bottom on page 2-8:

"*Although MPSs are not available for all chemicals (e.g., mercury) these chemicals will still be evaluated and included in the initial COC selection process described in Section 5.0.*"

5. **Comment**: Section 2.0

A table summarizing sites "in" or "out" of Phase I modeling would help. Such a table could also list sites that are "to be studied" which may need to be included in modeling at a future time.

Response: Agree. The attached table will be included and referenced in Section 2.4.

It should be noted that Site 10 is now proposed to not be included in the Phase I modeling. Recently, additional potentially contaminated areas associated with this site have been identified. Due to these additional areas, investigative work (including the installation of a monitoring well) is currently planned for this site. The Navy believes that it would be more beneficial to evaluate this site at a later date when this additional data is available. The text will be revised to reflect this change for site 10.

6. **Comment**: Section 3.1

How is "major" defined, in questions #1 and #2? What are the criteria for determining "major"? similarly, how is "abnormal" defined and judged, in question #3, and "special" in #4? also, question #10 does not really fit into this modeling work plan directly, although issues related to the feasibility of corrective actions, as well as the types of corrective actions that are being considered, will have an influence on data collection, analysis, modeling, etc.

Response: The questions presented in Section 3.1 are intended to be general questions regarding the characterization of the site and are not necessarily directly related to the Phase I modeling. For example, question # 10 does relate primarily to the

Feasibility Study portion of the overall investigation at the PNS, however, it does relate to possible future uses of the model.

In question #2 the term "major contaminant pathways" relates to the contaminant pathways which can continues to contribute significant amounts of contaminants to off-shore receptors. Determination of the "major" pathways will be qualitative based on understanding of the physical processes that are occurring at the site. For instance, the migration of contaminant from the surface soils would not be expected to be a "major" contaminant pathway since the surface soils are covered (with either pavement, clean soil, or vegetation) or contain insignificant amounts of contamination. Migration from the surface soils via surface-runoff or wind dispersal would not be considered a "major" contaminant pathway. Contaminant pathways are discussed further in section 6.2.2.2 in the Work Plan. Also, see Figure 6-1 (page 6-13) which identifies major and minor pathways.

Similarly, the "major" source areas referred to in question # 1 relate would also be determined qualitatively based on sampling results and a basic understanding of contaminant pathways and chemical conditions.

The point of reference for determining "abnormal" or "special" in questions #3 and #4 is a common non-tidal groundwater contaminant transport scenario unaffected by saltwater intrusion (i.e., no reversal of flow, groundwater table not fluctuating on an hourly time frame, a pH close to 7, no large changes in dissolved oxygen contents, etc.) The text of these two questions will be revised as follows:

"3. Are there any abnormal geochemical conditions *(relative to a fresh groundwater condition)* which might facilitate faster contaminant movements? How can these conditions be characterized?

4. Are there any special physical processes *(relative to a non-tidal flow conditions)* which might facilitate faster groundwater contaminant movements?"

7. <u>Comment</u>: <u>Section 3.1, top of page 3-2</u>

The process of developing the conceptual model should not be segregated from the process of site characterization. No site characterization can take place without having some form of model, even if it is a model only in the minds of the analysts and never put on paper or into a computer model. Thus, the data should be analyzed to provide at least a preliminary understanding of questions 7, 8 and 9 also. It is important to formulate this understanding before using analytical models.

Also, it should be acknowledged that even a trend analysis is a form of a model, used for predicting or simulating conditions. In summary, conceptual modeling is always performed; sometimes, analytical or numerical modeling is performed, too.

Response: It is acknowledged that the development of the conceptual model will involve a preliminary understanding of questions 7, 8, and 9, although those questions can not be definitively answered until after the conceptual models are developed and model predictions compared to actual conditions.

8. **Comment**: Section 3.3, page 3-3

The 2nd to last bullet at the top of the page, the one that includes "negotiate," is not appropriate in the strategy for this modeling work plan. "Solutions" are in the realm of "feasibility studies" or "design" work efforts. Also, define "conservatism" as used in the last sentence of this section.

Response: The bullets listed on page 3-3 are general guidelines for conducting a modeling project. It is agreed that the second to last bullet may not be appropriate to the modeling work plan since the Phase I Modeling will not directly be used in determining remedial designs. The models developed may at a later date be used to support the feasibility study. The second to last bullet will be eliminated.

The "level of conservatism" can be defined as how the model inputs and simplifications relate to the uncertainty in the input parameters and in the model simplifications. For instance if a model input parameter is not known with certainty and a range of possible input values is available, the input parameter can be chosen so that the predicted concentration at the receptor will be estimated high to account for the uncertainty in the knowledge of the input parameter. The model results could then be said to be conservative. If the input parameter is chosen such that it is the highest in the range of reasonable input parameters resulting in the highest receptor concentration, the model could be said to be highly conservative, or to have a high "level of conservatism".

9. **Comment**: Section 5.2, page 5-1, bottom paragraph

COCs should not be eliminated because locations are not sampled during the low-flow sampling to be conducted this summer. The last paragraph of page 5-1 is ambiguous in this regard, because it specifically says that only the summer 1996 low-flow data will be used for the groundwater COC assessment. Also, please clarify what the last sentence means, especially "generally considered more conservative." What are the criteria for determining this, and how will the criteria be applied?

Response: It is agreed that this paragraph is ambiguous in regard to the use of the low-flow sampling. As stated in the last sentence on page 5-1, to complete the Phase I modeling in a timely manner, only existing data (RFI and RFI Data investigations) will be used. The Phase I modeling will not use the low-flow sampling. It is felt that using the existing groundwater data in the Phase I Modeling will be conservative since the high turbidity should cause the groundwater concentrations to be estimated high (unfiltered

concentrations will be used). Using this data will produce corresponding high model predictions of off-shore contaminant concentrations.
The last paragraph on page 5-1 will be revised as follows:

"Contaminant detections for soil at each site will be obtained from a data base that was developed from raw data for the On-Shore Feasibility Study (Halliburton NUS, 1995a). The database has since been revised with validated data and has been re-submitted by U.S. Navy Memorandum to the U.S. EPA and MEDEP (USNAVY, 1995b). In order to perform the Phase I modeling in a timely manner, contaminant detections for groundwater will be obtained from this existing data (RFI and RFI Data Gap). Because of high turbidity in the existing groundwater data, low-flow sampling is planned for the fall of 1996 as part of the Groundwater Investigation and Monitoring Plan (B&R Environmental, 1996b). It is believed that using the existing groundwater data in the Phase I Modeling will be conservative since the high turbidity should cause the groundwater concentrations to be estimated high (unfiltered concentrations will be used). Using this data will produce corresponding high model predictions of off-shore contaminant concentrations."

10. **Comment**: Section 5.3 and Figure 5-1

The figure does not show "the general procedure ... to determine on-shore zones of contamination" as the text indicates. The figure should be expanded to include the way the zones will be determined. Alternately, the 3 right-hand boxes could be deleted, because the purpose of the figure ("Evaluation of Initial COCs") is not served by the "zones" boxes. Also, to be complete, the figure should include regulatory review and input.

Response: Figure 5-1 will be revised and replaced with the attached figure. The boxes concerning the determination of the on-shore zones of contamination have been eliminated. The boxes were originally included to indicate that determination of the initial COCs is dependent on the zones of contamination. This aspect of the COC evaluation will be discussed in the text of the Work Plan. The first sentence of Section 5.3 will be eliminated.

11. **Comment**: Section 6.1, first sentence

Change "simplifications" to "appropriate representations" or similar. Also, define "important" and how criteria will be set and applied to determine this.

Response: The text will be revised as follows:

"Before the analytical model is specified, on-shore and off-shore conceptual models need to be developed that are *appropriate representations* ~~simplifications~~ of actual site conditions"

The term "important fate and transport pathways" relates to the contaminant pathways which can continue to contribute significant amounts of contaminants to off-shore receptors. Determination of the "important" pathways will be qualitative based on understanding of physical processes that are occurring at the site. For instance, migration of contaminants from the surface soils would not be expected to be an "important" contaminant pathway since the surface soils are covered (with pavement or vegetation) or contain insignificant amounts of contamination. Migration from the surface soil via surface runoff of wind dispersal would not be considered an "important" contaminant pathway.

12. **Comment**: Page 6-2, "Hydrogeology" section

Why are the high areas the only recharge areas? Does recharge not occur in other areas, even up to the coast? For no recharge to be occurring, there would have to be upwards flow and discharge, or the surface would have to be impermeable. Neither would seem to be the case. This is important, because generation of leachate due to infiltrating rainwater is not limited to the "high" areas only. Explain this interpretation further.

Response: A groundwater recharge area by definition is an area where the net saturated flow of groundwater is downward away from the water table. This condition occurs over much of the island interior, i.e., topographically higher areas. Near the shoreline, the vertical component of groundwater flow tends to be upward toward the water table, which is the definition of a discharge area. It is considered likely that some precipitation infiltration occurs over most of the island, including the groundwater discharge areas.

The text will be revised as follows:

"Groundwater movement is from the interiors of the four historical islands (Dennett's, Seavey, Jamaica, and Clark's) to the island margins. The areas of higher topographic elevation in the island interiors, which also correspond to areas of higher bedrock surface elevation, are recharge areas *(i.e, an area where the net saturated flow of groundwater is downward away from the water table). Near the shoreline, the vertical component of groundwater flow tends to be upward toward the water table, which is a groundwater discharge area.* Groundwater moves downward and laterally through the overburden and bedrock toward the ultimate discharge areas, the Piscataqua River and the Back Channel."

13. **Comment**: Page 6-2, bottom

Is there direct evidence that groundwater does not flow from the mainland and into the PNS area, or is there merely no evidence that it does? This distinction may be

important, because if the former is true, then there may be deep groundwater flowing under the facility that is preventing contaminated groundwater from flowing more deeply, and thereby helping to limit the spread of contamination. In addition, such mainland-origin flow would also help limit the effects of saltwater intrusion. Consider whether it would be useful to perform further evaluation of the deeper groundwater, because of the potential for helping to further focus (and simplify?) the analysis and modeling efforts.

Response: The evidence looked at to determine whether groundwater from the mainland was upwelling beneath the island was the vertical gradient information - an upward gradient from deep bedrock to shallow bedrock within the island interiors would suggest some regional flow from the mainland to the island, while a downward gradient would suggest that the island groundwater is recharged from the island itself. To the depths we investigated, a downward vertical gradient was observed within the island interiors. The text will be modified to clarify this point.

It is expected that at some depth, regional groundwater flow would act to limit the further migration of groundwater associated with the local, island groundwater flow system. This regional groundwater system is part of the river basin hydrologic system and likely includes some groundwater from the nearby mainland. Hydrogeologic work performed at the base to date, however, have not included groundwater studies at this scale.

The text will be revised as follows:

"Within the bedrock, groundwater elevations decrease with depth *(downward gradient)* in the island interiors, an indication that the historical islands are the source of water to the deeper bedrock. Groundwater conditions in the deep bedrock wells are fresh. *An upward gradient from deep bedrock to shallow bedrock within the island interiors would suggest some regional flow from the mainland to the island, while a downward gradient would suggest that the island groundwater is recharged from the island itself. Based on the downward vertical gradient at PNS,* there is no evidence of regional groundwater flow from the mainland, at least to the depths investigated (i.e., 150 feet below ground surface). Near the shoreline, deep bedrock groundwater levels are comparable to the shallow groundwater and Piscataqua River water levels. Groundwater conditions are brackish to saline, an indication of a hydraulic connection to the Piscataqua River or Back Channel."

14. **Comment**: Page 6-2, bottom

Seasonal precipitation does not determine tide levels, it affects salinity levels and the location of the freshwater/saltwater interface. Please rephrase the sentence.

Response: The text will be modified as follows:

"Throughout the year, freshwater input to the estuary typically represents only two percent or less of the tidal volume (Short, 1992). Therefore, *the water* ~~tide~~ level in the

estuary is less influenced by *freshwater input* ~~seasonal precipitation~~ and more influenced by *tidal effects (*variations in the relative positions of the earth, moon, and sun*)*. When the sun and moon are in-line with the earth, their gravitational forces work together to produce higher tides..."

15. **Comment**: Section 6.2.2.1

Since all groundwater on the site must ultimately discharge to back channel or the Piscataqua River, it is unclear how these depths will be used. Provide further information.

Response: Based on the equipotential lines on the cross section plots contained in the RFI Data Gap Report (HNUS, 1995) the major component of groundwater flow is horizontal, however, there is an upward component near the shoreline. For deep groundwater, upward gradients near the shoreline can be used to project the discharge area to the river. In addition, the conductivity generally decreases with depth and is much less in the bedrock than in the overburden. In determining contaminated discharge to off-shore areas, the depth of bedrock, the depth of the Piscataqua River and the Back Channel, and the vertical profile of contamination in the groundwater will be considered. Due to the generally higher contaminant concentrations in the overburden and higher hydraulic conductivity in the overburden, it is anticipated that the majority of the contaminant release will be from the overburden. The depth of groundwater contamination in the overburden may be used as the thickness of the contamination plume to estimate the volume rate of the contaminated discharge to the off-shore, however, this will be more fully evaluated during the Phase I modeling.

The text will be clarified as follows:

"The zones of contamination will be defined both for an area of the facility and with depth. *Based on the equipotential lines on the cross section plots contained in the RFI Data Gap Report (HNUS, 1995) the major component of groundwater flow is horizontal; however, there is an upward component near the shoreline. For deep groundwater, upward gradients near the shoreline can be used to project the discharge area to the river. In addition, the conductivity generally decreases with depth and is much less in the bedrock than in the overburden. In determining contaminated discharge to off-shore areas, the depth of bedrock, the depth of the Piscataqua River and the Back Channel, and the vertical profile of contamination in the groundwater will be considered. Due to the generally higher contaminant concentrations in the overburden and higher hydraulic conductivity in the overburden, it is anticipated that the majority of the contaminant release will be from the overburden. The depth of groundwater contamination in the overburden may be used as the thickness of the contamination plume to estimate the volume rate of the contaminated discharge to the off-shore, however, this will be more fully evaluated during the Phase I modeling.* ~~The depth of contaminated groundwater that can potentially discharge to the off-shore will be estimated based on depths of the~~

~~Piscataqua River and the Back Channel. Groundwater contamination in the overburden and shallow bedrock will be considered together to the determined depths of discharge.~~"

16. **Comment**: Section 6.2.2.2, Page 6-5, bottom

Does the groundwater gradient reverse during all portions of the high tide? Net groundwater flow is "out" and therefore, by simple mass balance considerations, groundwater flow must be "out" during at least some portion of the high tide. Also, why does groundwater in the deep bedrock not discharge to the surface water along the PNS perimeter? where does it discharge? How is "the PNS perimeter" defined?

Response: During low tide, groundwater flow is out into the river. During high tide, groundwater flow across most of the islands is still towards the river, with an offsetting flow from the river inland along the island margins. The net effect of this groundwater flow pattern during high tide is a rise in groundwater elevations along and near the shore, kind of a "reservoir filling up" effect along the island edges, with contributions of water from both the island interiors and the river. As the tide goes out, the water in this "reservoir" area flows out into the river. After this stored up water from both the island interior and river is discharged, then the island groundwater system continues to discharge to the river during the low tide cycle. As the tide slowly rises again, the groundwater discharge continues for a period of time, but the flow gradient decreases as the river level increases. During the period of "average" tide level (when the river level is 1/2 way between the maximum high tide and minimum low tide levels), it is expected that the groundwater flow gradient is outward, discharging to the river. The overall effect of this is a net discharge of groundwater to the river.

It is our interpretation that groundwater in the deep bedrock does discharge to the river, but not along the island perimeter (the island perimeter was considered to be the shoreline area). The discharge point for the deeper groundwater is likely further out in the river. The deep bedrock groundwater has both lateral and vertical components of flow gradient, thus the directional movement is not straight up (in the case where the vertical component of the gradient is upward), but upward at some angle which would result in groundwater discharge to the river at points further out from the island shore.

The text will be revised as follows:

"Groundwater in the deep bedrock does not discharge to off-shore surface water and sediment *immediately* along the PNS facility perimeter *(shoreline area). The discharge point for the deeper groundwater is likely further out in the river. Due to the higher hydraulic head expected in the mainland area in comparison to PNS and the short distance between the mainland and the PNS, deep groundwater discharge from the island to the Back Channel area is expected to be minimal (if any).*"

17. **Comment**: Section 6.2.2.2, Page 6-6

It is not obvious how the conclusion that "the offshore modeling will be conservative because sediment transport is not considered" is reached. This is especially true if the offshore area being considered is a net depositional area that will receive contaminated sediments from several on-shore areas. In preparing the conceptual and Phase I models, particular emphasis should be placed on areas where sediment accumulate.

Response: See response to EPA General Comment 3. Revised text is presented in response to EPA Specific Comment 18.

18. **Comment**: Section 6.2.2.2, last paragraph

It is unclear how high levels of groundwater TSS will be used to determine if erosion is significant. Potential for erosion of shoreline areas should be made using tidal currents and grain size distribution, and most importantly a visual inspection of the site.

Response: The primary objective of using the TSS concentration is to determine if significant erosion is occurring within the soil matrix near the shoreline due to the action of the tidal fluctuation of the groundwater, not the actual erosion of the shoreline due to tidal and wave action of the surface water. It is acknowledged that erosion by the surface water has a potential to be significant; however, since most of the shoreline adjacent to the sites being considered for the Phase I modeling are protected by hard surfaces (e.g., riprap, seawall) or are calm waters (e.g. Back Channel) it is believed that erosion by the surface water will not be a controlling factor. In conjunction with the planned seep/sediment sampling, visual inspections of the sites could be conducted to confirm this.

Upon further review of existing data, groundwater TSS data is not presently available. It is not anticipated that any TSS data will be available during the Phase I Modeling. The Phase I Modeling will, however, account for contaminated suspended solids in the groundwater by using the existing unfiltered groundwater data.

When TSS data is available, the amount of erosion could be estimated by multiplying the TSS concentration by the estimated groundwater flow to yield a mass of solids being flushed from the soil matrix. This would be a conservative estimation procedure since it assumes that all of the TSS concentration is actually flushed from the soil matrix, when portions of the TSS may remain trapped in the soil matrix.

The text will be revised as follows:

In general, tidal erosion of contaminated soil is expected to be minimal, because the rocky intertidal zone provides protection along the facility perimeter. However, at the DRMO (~~SWMU~~ Site #6), fill may have been placed along the shoreline and may be subject *to the washing of fine particles (colloids) from the soil matrix by tidally induced groundwater flow fluctuations* ~~to tidal erosion~~. *The Phase I Modeling will account for*

contaminants being released by this mechanism through the use of the existing unfiltered groundwater data (the unfiltered groundwater concentration data will account for the contaminant mass of suspended solids being released to the surface water).

The analytical model will not consider sediment transport, but the predicted sediment concentrations will be higher without considering sediment transport. *Since much of the on-shore contamination is either covered (with pavement, and/or vegetation) or present below the ground surface (e.g. contamination from leaking underground storage tanks), the most significant sediment generating contaminant transport pathway is through the groundwater. The highest sediment concentration, due to contaminant migration in the groundwater, will occur where the groundwater discharges through the sediment to the surface water. If sediments are contaminated due to groundwater discharge at several locations, (i.e. just off-shore from various sites), and the sediments are transported in the surface water to a depositional area (such as a harbor), the mixed sediment concentration in the harbor will not be any higher than the highest sediment concentration off-shore of any of the sites. Therefore the most conservative sediment concentration due to current day sources will be the sediment concentration at the source (off-shore of the site before transport). To make a conservative estimate of sediment concentration due to contaminant migration in groundwater, the transport of sediment in the surface water does not need to be simulated.* ~~Therefore, the modeling approach is conservative even when tidal erosion at the DRMO is not considered.~~

~~While shoreline erosion due to tidal effects is not anticipated to be a major contaminant transport pathway at most of the source areas, the washing of fine particles (colloids) from the soil matrix by tidally induced groundwater flow fluctuations will be investigated at the DRMO. Groundwater totals suspended solids (TSS) groundwater data will be evaluated to ascertain if high levels of TSS are present which may indicate a potentially significant erosion pathway.~~

19. **Comment**: Section 6.3.1, Page 6-8

Define the difference between "total suspended solids" and "total suspended sediments" measurements.

Response: The information contained in the referenced paragraph was summarized from two separate investigations. Total suspended solids were sampled and analyzed by Jackson Estuarine Laboratory Standard Operating Procedures 1.05 and 1.06 (JEL SOP 1.05 and JEL SOP 1.06), respectively. Total suspended sediments were sampled and analyzed by JEL SOP 1.16. Based on discussions with JEL personnel, total suspended sediment and total suspended solids are essentially the same.

The text will be revised as follows:

"Based on the EEAR investigation near the PNS facility, measured total suspended solids averaged 10 mg/l and ranged from 7.5 to 13 mg/l. *Based on the investigations for*

the Sedimentology Report (Ward, 1995), total suspended *solids* ~~sediment~~ concentrations ranged from 1.5 to 6 mg/l."

20. **Comment**: Section 6.3.2.2 and figure 6.2

Why does all groundwater pass through the "sediment layer" in the intertidal zone? Is there no other pathway, including flow through near-shore zone sediment or direct seepage.

Response: It is acknowledged that groundwater can pass through other pathways including the near-shore zone. Due to the uncertainty of what pathways and the relative flow through each of these pathways that the groundwater can pass through, all of the groundwater is assumed to pass through the intertidal sediment as a conservative assumption. If all of the contaminated groundwater is assumed to pass through the relatively small intertidal zone it will result in conservatively high sediment and surface water concentrations.

21. **Comment**: Section 6.3.2.2

What is the source of the density driven currents referred to in the third paragraph? How are these different from river currents?

Response: The density driven currents refer to currents and stratified flow conditions caused by the difference in density between saltwater and fresh water.

The text will be revised as follows:

Inter-tidal and near-shore river currents and density-driven currents *(currents and stratified flow conditions caused by the difference in density between saltwater and fresh water)* cause the erosion, re-suspension, transport, and deposition of sediments within these areas.

22. **Comment**: Section 6.4

Modify the end of the first sentence to add "and the near-shore zone".

Response: The text will be modified as follows:

"The hydraulic connection between on-shore groundwater and near-shore surface water and sediment occurs *primarily* in the inter-tidal zone *and the near-shore zone. As a conservative assumption, all of the groundwater flow is assumed to discharge to the intertidal zone* (refer to Figure 6-2). *This is a conservative assumption because it will*

result in higher contaminant concentrations in the surface water and sediments in the intertidal zone. In order to model the integration. . ."

23. **Comment**: Section 7 and 10

The Navy should include regulatory review and approval of the modeling tools. This review/approval should be obtained before the Navy performs the modeling. The Navy could perform "test modeling" but this would be done with the risk that the regulatory agencies might not approve the tool(s).

Response: Agree. See response to EPA General Comment 5.

24. **Comment**: Page 7-4

EPA recommends that groundwater flow rates be estimated based primarily on water balance (i.e., recharge) estimates, instead of based on Darcy's Law, using parameter estimates that are relatively more uncertain. Also, we would suggest that the simple mixing cell model (as shown in Figure 7-1) is adequate, and it is therefore unnecessary to complicate it by estimating the vertical mixing depth.

Response: It is believed that there are many uncertainties associated with performing a water balance as well as the input parameters to a Darcy's law approach. Because both methods are uncertain, both approaches will be conducted, a water balance will be performed as well as flow rate calculation using Darcy's law. The two methods should produce similar results, and should confirm one another. This will reduce the overall uncertainty in the estimate of groundwater flow.

The vertical mixing depth may not be used in the final equations depending on whether the contaminated groundwater flow can be based on the depth of contamination in the groundwater or the thickness of various layers (e.g., overburden, bedrock) under the sites to be modeled. If the groundwater flow can not be estimated by methods such as those mentioned above, the vertical mixing depth may be used to assist estimation of the cross sectional groundwater flow area used to estimate the total groundwater flow shown on Figure 7-1.

The following text will be added following the equation for the vertical mixing depth on page 7-4.

"*The vertical mixing depth may not be used in the final equations depending on whether the contaminated groundwater flow can be based on the depth of contamination in the groundwater or the thickness of various layers (e.g., overburden, bedrock) under the sites to be modeled. If the groundwater flow can not be estimated by methods such as those mentioned above, the vertical mixing depth may be used to assist estimation of*

the cross sectional groundwater flow area used to estimate the total groundwater flow shown on Figure 7-1."

25. **Comment**: Page 7-6, 2nd to last paragraph, last sentence

The model-predicted groundwater concentrations should not be used to evaluate whether stead-state has been reached. If the model's concentrations are higher than measured values, then the analysts should evaluate why the model is higher and attempt to "calibrate" the model to the data. More importantly, only measured data trends can be used to determine whether steady-state has truly been reached.

Response: See response to EPA General Comment 2.

26. **Comment**: Page 7-8

In Section 6.2.2.2, the text states that the analytical model would be conservative because sediment transport was not considered. Because there are sediment deposition areas adjacent to PNS, it would appear to be necessary to examine sediment contamination contributions from all PNS source areas. The concentration of contaminants in sediment is not simply a function of the groundwater flowing through the sediment but also depends on whether other PNS contaminated sediments are being transported to the location, dilution of that sediment from non-PNS sediment sources, and biotrubation. Rather than not evaluating this type of potential cumulative impact, existing data should be used to determine if today's sediment concentrations are likely to increase because of continuing discharge from the island.

Response: See response to EPA General Comment 3.

27. **Comment**: Figures 7-1 and 7-2

The text should be revised to cite references for the equations shown, and/or they should include derivations in the work plan. In general, this should be done for any equations in the work plan. This information is necessary before EPA can fully evaluate the appropriateness of the equations as presented.

Response: Agree. The text will be revised so that the derivation of the analytical equations will be presented in the text. Each equation in the text will then be followed by the parameter definitions contained in the equation.

The equations and derivations will also be included in the proposed interim technical letter as described in response to EPA General Comment 5. This will allow the regulatory agencies the opportunity to evaluate the equations before the modeling is completed.

28. **Comment**: Figure 7-2

If the analytical model assumes that all the groundwater discharges through intertidal sediments, how is the concentration of the sediment in the near-shore zone determined?

Response: The sediment concentration in the near-shore zone is conservatively assumed to equal the sediment concentration in the intertidal zone. This is stated on page 6-12.

This will be clarified in the last paragraph of on page 7-8:

"Preliminary equations for the intertidal zone, near-shore zone, and sediment layer concentrations are shown in Figure 7-2 with a conceptual cross-sectional view of the shoreline. Definitions of the model parameters are summarized in Table 7-2. These equations are developed by defining an initial concentration in the intertidal zone under constant groundwater contaminant loading, a constant dilution factor in the near-shore mixing volume after one 6-hour ebb tide, and a mixing ratio of surface water and groundwater in the sediment pore space. *The sediment concentration in the near-shore zone is conservatively assumed to equal the sediment concentration in the intertidal zone.* Detailed descriptions of the derivation of these equations will be presented in the Phase I Modeling Report."

RESPONSE TO MEDEP COMMENTS DATED JULY 3, 1996
DRAFT ON-SHORE/OFF-SHORE CONTAMINANT FATE
AND TRANSPORT MODELING
PHASE I WORK PLAN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

MEDEP GENERAL COMMENTS

1. Comment: Any modeling effort requires validation using actual contaminant analysis of the media involved. The MEDEP believes greater understanding of contaminant transport mechanisms would be derived by focusing on high quality monitoring of groundwater and sediment including monitoring proposed in the interim groundwater monitoring and seep sampling work plans.

   The MEDEP believes that the interpretation of geochemical conditions at individual operable units (OUs) using geochemical models may be beneficial. A high degree of physical and geochemical complexity is associated with the migration of inorganic contaminants from the on-shore to the off-shore environment such as:

   - mixing of high ionic strength salt water and low ionic strength fresh water;
   - mixing of reduced groundwater and oxygenated estuarine water; and
   - heterogeneity of fill materials.

   The MEDEP suggests the geochemical modeling of groundwater chemistry would provide a more reliable method of assessing the solubility, and therefore the transportability of metal contaminants. Several geochemical models (e.g. MINTEQ; PHREEQUE) should be evaluated for this purpose.

   Response: At this time, low-flow sampling results are not expected to be available until at least November 1996 and seep/sediment results until at least December 1996. This MEDEP comment concerning focusing on monitoring data conflicts with the EPA direction to expedite the modeling activities. Furthermore, reliance on long-term monitoring will delay decisions concerning whether or not a given site requires remediation and, if so, which remedy should be selected. The Navy believes that the Phase I modeling task can proceed, prior to the availability of the groundwater analytical results using low-flow sampling techniques and the analytical results from the seep/sediment sampling event, for the following reasons:

   - Development of the Phase I analytical models using existing groundwater data will present a conservative estimate of the on-shore contaminant impacts to off-shore receptors (i.e., previous conventional sampling techniques may have resulted in the reporting of elevated contaminant concentrations due to high turbidity conditions. Note that existing unfiltered groundwater concentrations will

be used in the Phase I modeling. This estimate will identify the potential magnitude of the these impacts relatively quickly and assist in determining what additional evaluations and/or analyses may be required.

- The Phase I modeling may identify potential data gaps. If the Phase I Modeling is delayed until the availability of the low-flow groundwater sampling results and the seep/sediment sampling results, these data gaps may not be identified until later which could ultimately delay the remediation process (it is understood that modeling will not be the sole basis for making remedial decisions, however, the modeling results will be a significant factor in the remedial decisions and it is unlikely that final remedial decisions will be made without consideration of the modeling results regarding future conditions).

- Completing the Phase I modeling with the existing data will allow the regulatory agencies to review and comment on the modeling approach at an earlier date. This will allow the Navy and the regulatory agencies to come to a consensus on the modeling approach earlier so that as the low-flow groundwater data and the seep/sediment data becomes available the modeling can be refined quickly (if necessary), and therefore allowing remedial decisions to be made sooner.

It is proposed that the Navy submit a technical letter providing interim results from the initial steps of the modeling task based on existing data. A conference call to discuss the technical letter would occur shortly there after. It is anticipated that the technical letter would outline the COC selection process (including the initial list of COCs) at each site to be modeled, the conceptual model developed for each area modeled, and the modeling tools (including the mixing zone analysis) proposed to be used. This format would allow for review and comment by the regulatory agencies, and incorporation of their comments, while not significantly slowing the completion of the Phase I modeling. Additional review and comment by the regulatory agencies can be made when the report is submitted.

The proposed sequence of events for on-shore/off-shore contaminant fate and transport modeling can be summarized as follows:

- Phase I Model development, based on existing (RFI and RFI Data Gap) data,

- Submission of a technical letter to the regulatory agencies concerning the site conceptual models, initial COC selection, and modeling tools,

- Review and comment by regulatory agencies, and comment resolution,

- Completion of Phase I Modeling and submission of the Phase I Modeling Report,

- Review and comment by regulatory agencies, and comment resolution,

- Phase II Modeling (if required). The Phase II modeling may involve refinement of the Phase I analytical models based on additional data (e.g., low-flow

sampling results), or the Phase II modeling could be based on more complex numerical models.

The Navy disagrees with the reliance on geochemical modeling. Geochemical modeling of the fate of contaminants in the natural environment is best used to interpret field and/or laboratory measurements. However, the uncertainty of typical geochemical modeling is still too high to be used alone as a predictive tool for remedial decision making in complex environments.

At the present time, not enough data exists to complete geochemical modeling. After completion of the interim groundwater monitoring and seep/sediment sampling programs, more data required for geochemical modeling will be available, however, not all. Most geochemical models require data from a typical chemical analysis (i.e., the concentrations of various elements or species). Other inputs such as alkalinity, pH, Eh, temperature, and solution density are also required, as well as specification of the aqueous species needed to balance the charge and ensure electrical neutrality. In general, two types of codes are used to model aqueous and solution geochemistry: distribution-of-species codes, which represent the thermodynamics of a static system, and reaction-progress codes, which examine the consequences of an evolving system in which various phases in a system react with one another. The comment suggests the use of distribution-of-species codes assuming the site is under equilibrium conditions. However, under steady-state equilibrium conditions, the direct measurements of contaminant concentrations in groundwater and seep samples will reflect the effects of all the on-going geochemical processes between the source and discharge point. Therefore, the measured contaminant concentrations will provide all the necessary information for fate and trapnsport analysis purposes. Geochemical modeling can only confirm the direct measurements.

The Navy believes that at this time geochemical modeling will not add significant value to the project since not enough data presently exists to complete geochemical modeling and, once the analytical results of the interim groundwater monitoring and seep/sediment sampling programs are available, the measured contaminant concentrations will provide all of the information necessary for risk assessment purposes.

It is anticipated that soil/water partitioning coefficients (K_d) will be used to estimate the mobility of contaminants in the Phase I modeling. If literature K_d values need to be incorporated into the modeling, water quality parameters (such as those to be taken during the groundwater monitoring and seep/sediment sampling) can be used to qualitatively aid in the fate and transport analysis. When additional water quality parameter results are available, they can be used to qualitatively determine what range of literature K_d values are reasonable.

MEDEP SPECIFIC COMMENTS

1. **Comment**: 2.2.1 On-shore Investigations, Page 2-3, Para 2

   "Because of questions on previous sampling methods, techniques, and reporting methods..."

   Cite the most recent Air Monitoring Report dated June 1996.

   Response: Agree. The most recent Air Monitoring Report will be cited in the text. The text will be revised as follows:

   "Because of questions on previous sampling methods, techniques, and reporting methods, the Phase II Ambient Air Quality and Meteorological Monitoring Report (~~Halliburton NUS, 1995b~~ *Brown & Root Environmental, 1996d*) was prepared as a confirmation air monitoring study."

   The reference list will be updated as well.

2. **Comment**: 2.3.3 SWMU #8, Page 2-8, Para 3

   "The estimated risks associated with the soil contamination were within the U.S. EPA acceptable risk range..."

   The State of Maine's acceptable incremental lifetime cancer risk is 1×10^{-5}. Risks exceeding this level must be considered.

   Response: The U.S. EPA acceptable risk range was provided for reference only to provide a benchmark of comparison in describing the site conditions. The accumulated risk of the contaminants in soil at site 8 exceed MEDEP incremental lifetime cancer risk of 1×10^{-5}. The text will be revised to indicate this. The Navy was anticipating implementing a soil cover to address this minimal risk. Final determination of the acceptability of soil concentrations will be made in the Feasibility Study. Acceptability of the on-shore soil concentrations will be determined by comparison to on-shore MPSs, and the comparison of final on-shore/off-shore modeling results with off-shore MPSs (Human Health and Ecological [being developed]), Applicable Maine acceptable risk levels will be incorporated in development of the MPSs.

   The text will be revised as follows:

   "The estimated risks associated with the soil contamination were within the U.S. EPA acceptable risk range (10^{-4} to 10^{-6}); h*owever, the risks exceeded MEDEP level range of 10^{-5}*." (Of note, the Navy was planning on selecting a soil cover alternative to address low site risks).

3. **Comment**: 2.3.4 SWMU #9, Page 2-9, Para 4

"The poured concrete blocks and precast concrete pipes at MBI were excavated and inspected for integrity."

The concrete blocks were never excavated. The soil around the blocks was excavated.

Response: The sentence will be revised as follows:

"*The soil around* the poured concrete blocks and around the precast concrete pipe at MBI was excavated ~~and inspected for integrity~~. *The concrete blocks and precast concrete pipe were inspected for integrity.*"

The last sentence of the paragraph explicitly states that the concrete blocks and pipe were left in place during the RFI investigation, so no additional clarification will be required.

4. **Comment**: 2.3.6 SWMU #11, Page 2-11, Para 5

"The main contaminant of concern in soil is lead and other contaminants."

Consider rewriting the sentence.

Response: The paragraph containing the referenced sentence will be revised as follows:

"Following tank removal, sampling was conducted by PNS and MEDEP, *and contamination was found in the excavated material.* ~~The main contaminant of concern in soil is lead and other contaminants.~~ As a result of ~~the~~ elevated levels of lead and other contaminants, 332 tons of soil were excavated and disposed in an off-site RCRA permitted land disposal facility. *The excavation effort was terminated because of the proximity of the JILF and not because all contaminated soils were removed.* Soils and groundwater were investigated in both the RFI and RFI Data Gap investigations."

5. **Comment**: 2.3.6 SWMU #11, Page 2-12, Para 2

"For soils exceedances occurred for PAHs..."

Change "For" to "Four".

Response: The sentence will be revised as noted.

6. **Comment**: 2.3.14 Site #29 - Incinerator Site, Page 2-18, Para 2

"Site 29 will be part of future site investigations. It will not be considered in the Phase I modeling effort, because there is no field data or analysis to support the modeling effort."

There are currently three test boring/monitoring wells (DSB/DW-8, -8B, -9) located in the vicinity of the Incinerator Site Ash Landfill. Subsurface soil samples indicated fill materials located to depths of 20 to 40 feet below ground surface which exceed media protection standards for lead. The MEDEP suggests these test boring/monitoring wells be included in all evaluations of the DRMO.

Response: Boring/Monitoring wells DSB/DW-8, -8B and -9 (as well as all data taken in the vicinity of the DRMO) will be evaluated and used to the greatest extent possible in the on-shore/off-shore modeling effort to be completed for the DRMO.

7. **Comment**: 3.1 Major Site Characterization Questions, Page 3-1, Para 2

The MEDEP requests the opportunity to review and comment on the Navy's responses to questions 1-8 when responses are developed.

Response: The questions presented in section 3.1 are intended to be general questions regarding the characterization of the site and are not necessarily directly related to the Phase I modeling. For example, question No. 10 relates primarily to the Feasibility Study portion of the overall investigation at the PNS, however, it does relate to possible future uses of the model.

The answers to questions 1-7 will be presented in the technical letter to be submitted prior to the submission of the Phase I modeling report as described in response to the General Comment. The responses to questions 8 and 9 will be presented in the Phase I modeling report. Question 10 would be addressed in the Feasibility Study.

8. **Comment**: 3.2 Role of The Modeling Study, Page 3-2, Para 3

"Based on the data conditions at the PNS, examples of appropriate model applications are to link and interpret all of the available data, to identify potential data gaps, to evaluate sensitivities of important factors, and support remedial decisions by predicting future conditions with acceptable uncertainties."

The MEDEP agrees there is a need to link and interpret all available data, identify data gaps, and evaluate important factors related to the fate and transport of contaminants. However, the MEDEP will not accept model results alone for determining remedial actions at Operable Units (OUs). Extensive monitoring of both the on-shore and off-shore environments is required to support any remedial decisions.

Response: It is understood that modeling alone can not be the sole basis for remedial decisions, however, it is the intent of modeling to support the remedial decisions. The text will be clarified as follows:

"Based on the data conditions at the PNS, examples of appropriate model applications are to link and interpret all of the available data, to identify potential data gaps, to evaluate sensitivities of important factors, and ~~support~~ *to provide an additional tool to be used in making remedial decisions. Modeling can assist in making* remedial decisions by predicting future conditions with acceptable uncertainties."

9. **Comment**: 3.2 Role of The Modeling Study, Page 3-2, Para 4

"In summary, the modeling study will first interpret the existing data and develop reasonable conceptual models of the hydrogeological conditions and contaminant fate and transport processes at major source areas within the PNS."

The MEDEP requests the opportunity to review and comment on the conceptual models once they are developed.

Response: The response to the MEDEP General Comment outlines a sequence of regulatory review including review of the conceptual models.

10. **Comment**: 3.3 General Modeling Strategy, Page 3-3, Para 3

"Important features of this framework include up-front identification of issues and questions to be answered about the study area, utilization of previous study results, ..."

Will the models incorporate analytical data from the proposed interim groundwater monitoring and seep sampling programs as they become available? Due to the proposed improvements in sampling (i.e. low-flow Sampling), this data should be more representative of groundwater quality.

Response: As discussed in response to the MEDEP General Comment, it is anticipated that the Phase I modeling will be completed prior to the availability of the low-flow sampling results and that the results Phase I modeling will be conservative. The low-flow sampling results will be incorporated into the Phase II modeling, if it is required.

11. **Comment**: 3.3.1 Phases of Study, Page 3-3, Para 4

"The primary focuses of the Phase I modeling include COC screening and conservative estimation of baseline impacts to the near-shore receptor locations."

Model estimation of impacts to the near-shore receptor locations is only useful as a comparison to near-shore water and sediment quality monitoring results.

Response: The measured off-shore sampling concentrations are the result of impacts from PNS and other sources located in the estuary. It is the understanding of the Navy that the primary objective of the Phase I modeling is to determine which on-shore areas of contamination can continue to release contaminants to off-shore areas. The amount of contamination already deposited in off-shore areas (as represented by the off-shore sampling results) is not directly relevant to the objective of determining which on-shore areas are continuing to release contaminants to the off-shore. Since the Phase I modeling will only model impacts from PNS, the modeling results can not be directly compared to the sample results.

The simulation of all the possible sources of contamination to the off-shore areas is not practical for the Phase I modeling considering that there are numerous potential sources at PNS and many sources outside of PNS (e.g., sewage treatment plant outfalls located along the estuary). The numerous sources throughout the estuary could not be accurately simulated with an analytical model. Even with an numerical model, the loading history and number of sources contributing to the estuary are not known so that it would be impossible to accurately match model predicted concentrations with measured concentrations in the off-shore areas.

While it is understood that direct measurement of soil and water quality always has less uncertainty associated with it as compared to modeling results, direct measurement is limited to discrete sample points and discrete points in time. Modeling, however, can predict future water and sediment quality due to continued on-shore sources. The modeling can then assist in providing a more complete estimation of baseline impacts along with the direct measurement of water and sediment quality.

The text will be revised as follows:

"The primary focuses of the Phase I modeling include COC screening and conservative estimation of baseline impacts to the near-shore receptor locations. *The modeling results combined with the analytical sampling results at the receptor locations will be used in the Feasibility Study to develop the final estimation of baseline impacts.*"

12. Comment: 3.3.2 Levels of Conservatism, Page 3-4, Para 4

"The models will be as realistic and site-specific as can be supported by available data and field observations."

Model results are considered secondary to field and laboratory results.

Response: Disagree. As discussed in the response to MEDEP Specific Comment 11, it is agreed that direct field measurement is less uncertain that modeling results, however,

modeling does provide additional information (e.g., future conditions) that the direct measurements can not.

13. Comment: 4.1 Purpose, Page 4-1, Para 1

"In order to assess the impact of on-shore contamination to the near-shore zone, predicted surface water and sediment concentrations will be compared to surface water and sediment criteria."

Additional sampling and analysis may be required, particularly in the near-shore environment, for comparison to model results.

Response: As discussed in response to MEDEP Specific Comment 11, the model prediction can not be directly compared to off-shore sampling results. It should be noted that the anticipated Phase I modeling approach will result in the prediction of conservative long term water concentrations which may not be directly comparable to results measured at a discrete point in time. It is not believed that additional sampling will be required for the Phase I modeling. One of the objectives of the Phase I modeling, however, will be the identification of any data gaps.

14. Comment: 4.2 Potential Sources of Preliminary Criteria, page 4-1, Para 2

"Draft off-shore Media Protection Standards (MPSs) are available for surface water and sediment quality based on ecological and human health MPSs."

Draft off-shore ecological MPSs are not available for surface water and sediment quality based on ecological MPSs.

Response: Agree. The text will be revised as follows:

"Draft off-shore Media Protection Standards (MPSs) are available for surface water and sediment quality (based on human health ~~MPSs~~ *risk scenarios*). *Off-shore MPSs based on ecological receptors are being developed and will be used as a source of preliminary criteria if they become available during the Phase I modeling effort. If the off-shore ecological MPSs are not available during the Phase I modeling,* ~~These standards along with~~ other established surface water and sediment criteria will be used. Examples of other established surface water and sediment criteria are listed below. "

15. Comment: 4.2 Potential Sources of Preliminary Criteria, Page 4-1, Para 3

"These two documents ["Quality Criteria for Water" (EPA, 1986); "Origin of Human Health" (EPA, 1991)] represent a comprehensive list of surface water quality criteria for the off-shore COCs."

Maine Ambient Water Quality Criteria must also be considered for off-shore COCs.

Response: Agree, Maine Ambient Water Quality Criteria will also be considered for off-shore COCs. The text will be revised as follows:

"Surface water quality criteria have been ~~developed~~ *established by both the Maine Department of Environmental Protection (MEDEP) and* the U.S. Environmental Protection Agency (EPA). *Maine Ambient Water Quality Criteria and the following two EPA documents will be considered in developing off-shore COCs.* The original EPA document entitled, "Quality Criteria for Water, 1986" (EPA, 1986), has been revised for human health consumption of organisms and water in a later document entitled, "Origin of Human Health" (EPA, 1991). These two EPA documents *and the Maine Ambient Water Quality Criteria* represent a comprehensive list of surface water quality criteria for the off-shore COCs. "

16. **Comment**: 5.2 List of Initial COCs for Screening Model, Page 5-1, Para 3

"First, on-shore contaminant detections will be compared to on-shore Media Protection Standards (MPSs) to determine which contaminants have exceeded MPSs. Second, on-shore contaminant detections for groundwater will also be compared to off-shore criteria."

As stated in Section 5.2 of this work plan, on-shore MPSs are based on future land use designations for soil (industrial and residential) and groundwater (residential only). On-shore MPSs were not intended for assessment of off-shore impacts. COCs should include all contaminants that may have a detrimental effect to the off-shore environment. This should include contaminants associated with off-shore human health risks and ecological impacts. The MEDEP requests the opportunity to review and comment on the List of Initial COCs for Screening Model as they are developed.

Response: The on-shore contaminant detection comparison to on-shore MPS are proposed to be included in the COC screening process to account for the possibility that the on-shore groundwater receptor could become relevant due to unexpected changes in exposure scenarios. The top box on the left side of Figure 5-1 was intended to represent on-shore contaminant detections with on-shore criteria as well as on-shore contaminant detections related to off-shore receptors which would be compared to off-shore criteria. An example of how the on-shore soil concentrations can be related to off-shore receptors follows by calculating the maximum leachate concentration originating from the on-shore soils. This will calculated by dividing the maximum on-shore soil concentration by the soil/water partitioning coefficient (K_d). For the initial COC screening, the maximum leachate concentration will be compared to off-shore surface water human health MPS and ecological surface water criteria as described in the response to MEDEP Specific Comment 15.

As discussed in response to the General Comment, it is proposed that a technical letter be issued during the modeling process after the COCs have been selected and the conceptual models are completed followed by a conference call. This would give the regulatory agencies a chance to review and comment on these initial portions of the modeling. The comments can then be incorporated as appropriate before completion of the Phase I Modeling.

The text will be revised as follows and a revised Figure 5-1 is attached to this comment response letter.

The second and third paragraphs of Section 5.2 will be replaced with the following text:

"*On-shore soil and groundwater sampling results will be compared to both on-shore and off-shore criteria. The primary objective of the Phase I modeling is to predict impacts to off-shore receptors, however, comparison to on-shore criteria is also proposed to account for the possibility that unexpected changes in risk scenarios may result in the need for remediation of groundwater due to on-shore receptors. Although on-shore groundwater will not be used as a drinking water source in the future, comparison with on-shore MPSs will be retained in developing the initial list of COCs, as a conservative measure. As a result, some COCs may be deleted from the final list of COCs upon further assessment (and regulatory review).*

First, on-shore contaminant detections will be compared to on-shore Media Protection Standards (MPSs) to determine which contaminants have exceeded MPSs. Second, on-shore contaminant detections for soil and groundwater will also be related to off-shore receptors (surface water) and compared to off-shore surface water criteria. As an example of how the on-shore soil concentration can be related to off-shore surface water concentration, the maximum leachate concentration originating from the on-shore soils could be calculated by dividing the maximum on-shore soil concentration by the soil/water partitioning coefficient (K_d). The maximum leachate concentration could then be compared to off-shore surface water human health MPS and ecological surface water criteria as described section 4.2. The on-shore groundwater concentrations would also be compared to the off-shore surface water criteria. Third, off-shore COCs for ecological and human health criteria which have been detected on-shore and can be attributed to the on-shore source area would also be considered an initial COC. For example, the heavy metal contamination located off-shore of Berth 6 may not be related to site #27 (Fuel Oil Spill at Berth 6). The contaminants that exceed the on-shore MPSs, or off-shore surface water criteria, or have been defined as off-shore ecological or human health COCs and can be attributed to a contaminant source area would be considered as initial COCs for the screening model.

Contaminant detections for soil at each site will be obtained from a data base that was developed from raw data for the On-Shore Feasibility Study (Halliburton NUS, 1995a). The data base has since been revised with validated data and has been re-submitted by U.S. Navy Memorandum to the U.S. EPA and MEDEP (USNAVY, 1995b). In order to perform the Phase I modeling in a timely manner, contaminant detections for

groundwater will be obtained from this existing data (RFI and RFI Data Gap). Because of high turbidity in the existing groundwater data, low-flow sampling is planned for the fall of 1996 as part of the Groundwater Investigation and Monitoring Plan (B&R Environmental, 1996b). It is believed that using the existing groundwater data in the Phase I Modeling will be conservative since the high turbidity should cause the groundwater concentrations to be estimated high (unfiltered concentrations will be used). Using this data will produce corresponding high model predictions of off-shore contaminant concentrations."

17. **Comment**: 5.2 List of Initial COCs for Screening Model, Page 5-1, Para 4

"In order to perform the Phase I modeling in a timely manner, the Phase I modeling will only use existing data (RFI and RFI Data Gap investigations) which is generally considered more conservative."

Groundwater data from the RFI and RFI Data Gap investigations is compromised by sampling artifacts such as high turbidity. These results will not be as representative of aquifer conditions as samples collected using low-flow sampling techniques. The MEDEP suggests using analytical results for groundwater samples collected using low-flow sampling as they become available.

Understanding of geochemical processes which occur as a result of mixing low-ionic strength, potentially low Eh fresh water with oxygenated, high ionic strength salt water is essential to characterization of these aquifer systems. The interim groundwater monitoring program will provide data more suited to geochemical assessment than previous water quality data. Assessment of low-flow groundwater data in combination with proposed seep water and sediment sampling data may provide an understanding of the geochemical transition from areas like the JILF to Clark Cove.

Response: As discussed in response to MEDEP General Comment, the Navy believes that the Phase I modeling task can proceed prior to the availability of the groundwater analytical results using low-flow sampling techniques and the analytical result from the seep/sediment sampling event. The reasons that the Phase I modeling can be initiated based on the existing data are discussed in the response to General Comment.

It is agreed that understanding of the geochemical conditions in the groundwater and surface water in and around PNS would be beneficial, however, as discussed in response to the MEDEP General Comment, the Navy believes that geochemical modeling would not provide significant value due to the limitations of geochemical modeling. It is anticipated that adsorption/desorption in the groundwater (in both tidally influenced and non-tidally influenced areas) will be based on site specific data (e.g., groundwater and soil samples taken at the sample location could be used to estimate a soil/water partitioning coefficient) or, if this data is not available, based on conservative literature values of soil/water partitioning coefficients. Whether a value is conservative or not will depend on the receptor. Qualitative evaluation of site-specific groundwater chemistry will also be conducted during the selection of literature values.

18. **Comment**: 6.2.1 Site Conditions, Hydrogeology, Page 6-2, Para 4

"Slug test results confirm that overburden materials have hydraulic conductivities that are 1 to 2 orders of magnitude higher than those in the shallow bedrock."

Generally this is true. However, the RFI Data Gap Report reports bedrock wells with hydraulic conductivities as high as 184 feet/day (DW-10B) and overburden wells with hydraulic conductivities as low as 3.8 feet/day (WOT-4). Assessment of aquifer hydrology should be specific to site areas and nested well pairs.

Response: The intent of this statement was to give a general description of the aquifer hydrology. It is agreed that site and area of contamination specific assessment of aquifer hydrology should be and will be made during the Phase I modeling. The level of complexity of the types of models to be used will not allow data for each individual nested well pair to be inputted into the Phase I model, however, data from each well will be evaluated and incorporated into typical input values.

19. **Comment**: 6.2.1 Site Conditions, Hydrogeology, Page 6-2, Para 5

"Groundwater flow in the bedrock does not seem to be structurally controlled, at least to the depths of the wells at the PNS facility."

What is the basis for this statement? The MEDEP is unaware of any effort to assess bedrock structure at PNS at a scale that would support this statement. A dye test was performed as part of the RFI Data Gap Investigation but assessment of flow directions was not compared to bedrock structure.

Additional work such as a bedrock fracture trace analysis is required to assess groundwater flow within the bedrock aquifer. Based on limited site observations, the MEDEP suspects horizontal anisotropy within the bedrock aquifer with preferential groundwater flow along dominant, vertically dipping, bedrock joints and fractures.

Response: The basis for the statement made is that groundwater flow patterns at the facility appear to be related more to topography and the locations of groundwater recharge and discharge areas, rather than being controlled by bedrock structure (i.e., strike/dip of bedrock units, major lineaments, etc.). Groundwater flow patterns do not indicate any preferential directional flow along a structural feature or structural trend. We agree that groundwater flows preferentially within fractures in the bedrock, and that there may be some horizontal anisotropy at a fracture-specific scale, however we feel that the overall groundwater flow through the bedrock is through a large-scale network of intersecting fractures, from topographically high areas to the island margins. We have seen no evidence that on a large scale groundwater flows preferentially along one or more

preferential alignments related to bedrock structure, including preferred fracture orientations.

The text will be revised as follows:

"Groundwater in the bedrock occurs principally in fractures. Near the bedrock surface, fractures are pervasive because of weathering. With depth, the size and interconnectedness of fractures generally decrease, potentially limiting the movement of groundwater. At PNS, hydraulic conductivity generally decreases with depth. Groundwater flow in the bedrock does not seem to be structurally controlled, at least to the depths of the wells at the PNS facility. *Groundwater flow patterns at the facility appear to be related more to topography and the locations of groundwater recharge and discharge areas, rather than being controlled by bedrock structure (i.e., strike/dip of bedrock units, major lineaments, etc.). Groundwater flow patterns do not indicate any preferential directional flow along a structural feature or structural trend. While groundwater flows preferentially within fractures in the bedrock, and that there may be some horizontal anisotropy at a fracture-specific scale, the overall groundwater flow through the bedrock is through a large-scale network of intersecting fractures, from topographically high areas to the island margins. There is no evidence that on a large scale groundwater flows preferentially along one or more preferential alignments related to bedrock structure, including preferred fracture orientations.* Variability in the hydraulic conductivity with depth could not be related to any structural trend."

20. **Comment**: 6.2.1 Site Conditions, Contaminant Fate and Transport, Page 6-4, Para 5

"Dissolved contaminants are transported via advection, dispersion, and retardation in the groundwater. Natural decay of contaminants occurs."

Retardation is not a transport mechanism but rather inhibits transport.

Inorganic contaminants (i.e. metals) do not decay.

Response: Agree. The sentence will be clarified as follows:

"*Transportation of* dissolved contaminants are ~~transported via~~ *governed by* advection, dispersion, and retardation in the groundwater. Natural decay of *organic* contaminants *may* occur."

21. **Comment**: 6.2.1 Site Conditions, Contaminant Fate and Transport, Page 6-4, Para 6

"Groundwater in the deep bedrock does not discharge to off-shore surface water and sediment along the PNS facility perimeter."

Tidal survey results reported in Appendix I of the RFI Data Gap Report indicate that water levels at two deep bedrock wells, DW-7DB and FA-01DB, are effected by the tidal cycle. Water levels recorded at DW-7, DW-7B, and DW-7DB indicated a slight upward groundwater flow gradient suggesting migration of deep bedrock groundwater to off-shore surface water.

Response: It is our interpretation that groundwater in the deep bedrock does discharge to the river, but not along the island perimeter (the island perimeter was considered to be the shoreline area). The discharge point for the deeper groundwater is likely further out in the river. The deep bedrock groundwater has both lateral and vertical components of flow gradient, thus the directional movement is not straight up (in the case where the vertical component of the gradient is upward), but upward at some angle which would result in groundwater discharge to the river at points further out from the island shore.

The text will be revised as follows:

"Groundwater in the deep bedrock does not discharge to off-shore surface water and sediment *immediately* along the PNS facility perimeter *(shoreline area). The discharge point for the deeper groundwater is likely further out in the river. Due to the higher hydraulic head expected in the mainland area in comparison to PNS and the short distance between the mainland and the PNS, deep groundwater discharge from the island to the backchannel area is expected to be minimal (if any).*"

22. **Comment**: 6.2.2.1 Source Characterization, Page 6-5, Para 3

"Based on an evaluation of the initial contaminants of concern (discussed in Section 5.0), a list of COCs for soil and groundwater and corresponding on-shore zones of contamination will be defined for the analytical modeling."

The proposed list of COCs should be included with this work plan. Conceptualization of contaminant fate and transport must be based on the geochemical properties associated with individual contaminants. For example, a conceptual model of lead fate and transport would include the solubility of lead within the context of anticipated Eh/pH aquifer conditions; adsorptive properties of dissolved lead relative to solid and aqueous conditions; and other physical and geochemical processes which would contribute to the migration of lead in groundwater. This conceptual process must be outlined for each individual contaminant of concern in order to justify the validity of the models assumptions.

Response: As discussed in response to the MEDEP General Comment, it is proposed that the regulatory agencies be given a chance to review and comment on the COCs selected and the conceptual model of each site and/or area of contamination. Selection of the initial list of COCs is part of the modeling effort and will not be included in the work plan.

23. **Comment**: 6.2.2.1 Source Characterization, Page 6-5, Para 4

"The zone of contamination will be defined both for an area of the facility and with depth. The depth of contaminated groundwater that can potentially discharge to the off-shore will be estimated based on depths of the Piscataqua River and the Back Channel."

Vertical groundwater flow gradients must be considered at individual sites and nested piezometer to assess potential discharge of contaminated water to the river.

Response: Vertical gradients will be considered when assessing the contaminated groundwater discharge to off-shore. Based on the equipotential lines on the cross section plots contained in the RFI Data Gap Report (HNUS, 1995) the major component of groundwater flow is horizontal, however, there is an upward component near the shoreline. For deep groundwater, upward gradients near the shoreline can be used to project the discharge area to the river. In addition, the conductivity generally decreases with depth and is much less in the bedrock than in the overburden. In determining contaminated discharge to off-shore areas, the depth of bedrock, the depth of the Piscataqua River and the Back Channel, and the vertical profile of contamination in the groundwater will be considered. Due to the generally higher contaminant concentrations in the overburden and higher hydraulic conductivity in the overburden, it is anticipated that the majority of the contaminant release will be from the overburden. The depth of groundwater contamination in the overburden may be used as the thickness of the contamination plume to estimate volume rate of the contaminated discharge to the off-shore, however, this will be more fully evaluated during the Phase I modeling.

The text will be revised as follows:

"The zones of contamination will be defined both for an area of the facility and with depth. *Based on the equipotential lines on the cross section plots contained in the RFI Data Gap Report (HNUS, 1995) the major component of groundwater flow is horizontal however, there is an upward component near the shoreline. For deep groundwater, upward gradients near the shoreline can be used to project the discharge area to the river. In addition, the conductivity generally decreases with depth and is much less in the bedrock than in the overburden. In determining contaminated discharge to off-shore areas, the depth of bedrock, the depth of the Piscataqua River and the Back Channel, and the vertical profile of contamination in the groundwater will be considered. Due to the generally higher contaminant concentrations in the overburden and higher hydraulic conductivity in the overburden, it is anticipated that the majority of the contaminant release will be from the overburden. The depth of groundwater contamination in the overburden may be used as the thickness of the contamination plume to estimate volume rate of the contaminated discharge to the off-shore, however, this will be more fully evaluated during the Phase I modeling.* ~~The depth of contaminated groundwater that can potentially discharge to the off-shore will be estimated based on depths of the Piscataqua River and the Back Channel. Groundwater contamination in the overburden and shallow bedrock will be considered together to the determined depths of discharge.~~"

24. <u>Comment</u>: <u>6.2.2.2 Important Contaminant Pathways, Page 6-5, Para 6</u>

"Because surface soils are either covered with pavement or have insignificant contamination, the transport of contamination via surface run-off or wind dispersal is considered to be insignificant."

The JILF is not covered with pavement and significant sources of contamination are located within the landfill. The soil and vegetative cover over the landfill is presumed to prevent transport of contamination via surface run-off or wind dispersal.

<u>Response</u>: Agree. The sentence will be revised as follows:

"Because surface soils are either covered *(i.e.,* with pavement, *and/or vegetation)* or have insignificant contamination, the transport of contamination via surface run-off or wind dispersal is considered to be insignificant."

25. <u>Comment</u>: <u>6.2.2.2 Important Contaminant Pathways, Page 6-6, Para 1</u>

"However, at the DRMO (SWMU #6), fill may have been placed along the shoreline and may be subject to erosion. The analytical model will not consider sediment transport, but the predicted sediment concentrations will be higher without considering sediment transport."

Fill was placed along the shoreline. Visual observation of the shoreline provides ample evidence of erosion. Predicted sediment values must be compared to analytically determined sediment contaminant values.

<u>Response</u>: As discussed in response to MEDEP Specific Comment 11, measured sediment concentrations can not be directly compared to the model predicted sediment concentrations since the measured sediment concentrations may contain loading from sources other that at PNS which are not included in the modeling. Additionally, the modeling addresses only sources which are can potentially continue to release contaminants to the environment and not previous releases.

Since much of the on-shore contamination is either covered (with pavement, and/or vegetation) or present below the ground surface (e.g. contamination from leaking underground storage tanks), the most significant contaminant transport pathway is through the groundwater. The highest sediment concentration, due to contaminant migration in the groundwater, will occur where the groundwater discharges through the sediment to the surface water. If sediments are contaminated due to groundwater discharge at several locations, (i.e. just off-shore from various sites), and the sediments are transported in the surface water to a depositional area (such as a harbor), the mixed

sediment concentration in the harbor will not be any higher than the highest sediment concentration off-shore of any of the sites. Therefore the most conservative sediment concentration due to current day sources will be the sediment concentration at the source (off-shore of the site before transport). To make a conservative estimate of sediment concentration due to contaminant migration in groundwater, the transport of sediment in the surface water does not need to be simulated.

This section of text will be clarified and is presented in response to MEDEP Specific Comment 26.

26. Comment: 6.2.2.2 Important Contaminant Pathways, Page 6-6, Para 2

"Groundwater total suspended solids (TSS) data will be evaluated to ascertain if high levels of TSS are present near the shoreline, which may indicate a potentially significant erosion pathway."

How does the Navy propose to evaluate TSS in groundwater. It is the understanding of the MEDEP this can only be accomplished using low-flow sampling techniques. The highest energy in the fill areas adjacent to the river would occur during a storm event. TSS should be evaluated during or soon after a storm event to assess the maximum possible TSS measurements.

Response: The primary objective of using the TSS concentration is to determine if significant erosion is occurring within the soil matrix near the shoreline due to the action of the tidal fluctuation of the groundwater, not the actual erosion of the shoreline due to tidal and wave action of the surface water. It is acknowledged that erosion by the surface water has the potential to be very significant, however, since most of the shoreline adjacent to the sites being considered for the Phase I modeling are protected by hard surfaces (e.g., riprap, seawall) or calm (e.g. Back Channel) it is felt that erosion by the surface water will not be a controlling factor. In conjunction with the planned seep/sediment sampling, visual inspections of the sites could be conducted to confirm this.

Upon further review of existing data, groundwater TSS data is not presently available. It is not anticipated that any TSS data will be available during the Phase I Modeling. The Phase I Modeling will, however, account for contaminated suspended solids in the groundwater by using the existing unfiltered groundwater data.

When TSS data is available, the amount of erosion could be estimated by multiplying the TSS concentration by the estimated groundwater flow to yield a mass of solids being flushed from the soil matrix. This would be a conservative estimation procedure since it assumes that all of the TSS concentration is actually flushed from the soil matrix, when portions of the TSS may remain trapped in the soil matrix.

The text will be revised as follows:

In general, tidal erosion of contaminated soil is expected to be minimal, because the rocky intertidal zone provides protection along the facility perimeter. However, at the DRMO (SWMU #6), fill may have been placed along the shoreline and may be subject *to the washing of fine particles (colloids) from the soil matrix by tidally induced groundwater flow fluctuations* ~~to tidal erosion~~. *The Phase I Modeling will, however, account for contaminants being released by this mechanism through the use of the existing unfiltered groundwater data (the unfiltered groundwater concentration data will account for the contaminant mass of suspended solids being released to the surface water).*

The analytical model will not consider sediment transport, but the predicted sediment concentrations will be higher without considering sediment transport. *Since much of the on-shore contamination is either covered (with pavement, and/or vegetation) or present below the ground surface (e.g. contamination from leaking underground storage tanks), the most significant sediment generating contaminant transport pathway is through the groundwater. The highest sediment concentration, due to contaminant migration in the groundwater, will occur where the groundwater discharges through the sediment to the surface water. If sediments are contaminated due to groundwater discharge at several locations, (i.e. just off-shore from various sites), and the sediments are transported in the surface water to a depositional area (such as a harbor), the mixed sediment concentration in the harbor will not be any higher than the highest sediment concentration off-shore of any of the sites. Therefore the most conservative sediment concentration due to current day sources will be the sediment concentration at the source (off-shore of the site before transport). To make a conservative estimate of sediment concentration due to contaminant migration in groundwater, the transport of sediment in the surface water does not need to be simulated.* ~~Therefore, the modeling approach is conservative even when tidal erosion at the DRMO is not considered.~~

~~While shoreline erosion due to tidal effects is not anticipated to be a major contaminant transport pathway at most of the source areas, the washing of fine particles (colloids) from the soil matrix by tidally induced groundwater flow fluctuations will be investigated at the DRMO. Groundwater totals suspended solids (TSS) groundwater data will be evaluated to ascertain if high levels of TSS are present which may indicate a potentially significant erosion pathway.~~

27. **Comment**:6.2.2.3 Important Contaminant Fate and Transport Processes, Pg 6-6, Para 4

"Parameters that are utilized to describe the transport processes in the analytical model (e.g. solid/liquid distribution coefficient) will be estimated with site-specific data if available or literature values."

The following information regarding solid/liquid distribution coefficients (K_d) was extracted from a draft copy of EPA's Technical Background Document for Soil Screening Guidance[1]:

> The soil-water distribution coefficient (K_d) for metals and other inorganic compounds is affected by numerous geochemical parameters and processes, including pH; sorption to clays, organic matter, iron oxides, and other soil constituents; oxidation/reduction conditions; major ion chemistry; and the chemical form of the metal. The number of significant influencing parameters, their variability in the field, and differences in experimental methods result in as much as seven orders of magnitude variability in measured K_d values reported in the literature. This variability makes it much more difficult to derive generic K_d values for metals that for organics.

Response: It is understood that there can be a high degree of variability in K_d values reported in literature (especially for inorganic contaminants). Prior to the availability of the low-flow groundwater and seep/sediment sampling results, It is anticipated that adsorption/desorption in the groundwater (in both tidally influence and non-tidally influenced areas) will be based on site-specific data (e.g. existing groundwater and soil samples taken at the same location could be used to estimate a soil/water partitioning coefficient) or, if this data is not available, based on conservative literature values. If literature values are needed to be used they will be chosen from the range of values cited so that high concentrations at the receptor locations will result. Using these ranges of literature values should ensure that the estimated mobility of the contaminants is not under estimated. Once the low-flow groundwater and seep/sediment sampling results are available sediment partitioning coefficients can be estimated by dividing the solid sediment concentration by the liquid seep concentration; this would be conducted as part of the Phase II modeling, if necessary.

28. **Comment**: 7.2.3 Basic Analytical Equations, Page 7-3, Para 4, Bullet 10

"No cumulative impact from multiple sources."

Please provide further explanation for this aspect of the models assumptions.

Response: It will be assumed in the modeling that the upgradient groundwater flow to each source is uncontaminated. The subject bullet 10 will be revised as follows:

"No cumulative impact from multiple sources *(i.e., upgradient groundwater flow is uncontaminated)*."

29. **Comment**: 7.2.3 Basic Analytical Equations, Page 7-4, Para 4

"V_{z0} is the vertical seepage velocity (ft/yr)."

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[1]EPA, Office of Solid Waste and Emergency Response, Technical Background Document for Soil Screening Guidance, Review Draft, November 1994.

What assumptions will be used to determine the V_{z0}.

Response: Based on comments from EPA (Specific Comment 24) the vertical mixing depth may not be used in the Phase I modeling, however, if the vertical seepage velocity is required during the Phase I modeling it will be estimated based on the procedures in the Superfund Exposure Assessment Manual (U.S. EPA, 1988), Section 3.5.2.2.

30. **Comment**: Table 7-1 Definitions of the On-Shore Model Parameters, Page 7-5

It would be helpful to the reader if the parameter definitions were included on the same page as the model equations.

Response: Agree. The text will be revised so that the derivation of the analytical equations will be presented in the text. Each equation in the text will then be followed by the parameter definitions contained in the equation.

31. **Comment**: 7.2.5 On-Shore Model Parameter Estimation and Model Application Procedure, Page 7-6, Para 5

"One of the objectives of the Phase I modeling will be the determination of whether the contaminant concentrations at the PNS are in "steady state conditions" (i.e. flushing mode with stable or decreasing groundwater discharge concentrations) or if the contaminant groundwater concentrations are increasing with time."

Due to the large potential variability of K_d values (see Specific Comment 19) and other model parameters, the MEDEP does not feel the model can realistically predict groundwater trends. The most scientifically defensible approach to groundwater contaminant trend analysis is using long term monitoring data and appropriate statistical methods.

Response: It is agreed that the most scientifically defensible approach to groundwater contaminant trend analysis is using long term monitoring data and appropriate statistical methods, however, for Phase I work the groundwater data is too limited to statistically evaluate trends. The first low-flow sampling event has yet to occur, so any long term trend analysis of this high quality data could not be done for the Phase I modeling. Furthermore, reliance on long-term monitoring will delay decisions concerning whether or not a given site requires remediation and, if so, which remedy should be selected.

The existing groundwater data from the RFI and RFI Data Gap investigations is compromised by sampling artifacts such as high turbidity. The Navy believes that the data from the RFI and RFI Data Gap can be used for the modeling since the high turbidity should cause the groundwater concentrations to be estimated high. This will produce conservatively high modeling predictions. There is more uncertainty associated with the modeling due to the turbidity in the groundwater sampling, however, any error in

the true groundwater concentrations due to the turbidity will result in more conservative modeling results.

Trends in the existing groundwater data will be investigated. It is anticipated that because of limitations of the existing groundwater data (limited temporal span of data) that the trend evaluation will focus on a simple comparison of data points in the same monitoring wells to see if the concentrations are increasing or decreasing with time.

32. **Comment**: Figure 7-1, Basic On-shore Analytical Equations, PNS, Kittery, Maine, Page 7-12

The MEDEP does not believe the analytical model presented in this work plan provides any meaningful contribution toward the characterization of contaminant transport at PNS. The MEDEP believes the monitoring of groundwater, surface water, and sediment quality required to calibrate and prove the validity of any fate and transport model would in itself provide more value for interpreting contaminant migration. See Specific Comment 19.

Response: It is felt that the Phase I modeling will provide a meaningful contribution as outlined in response to the MEDEP General Comment.

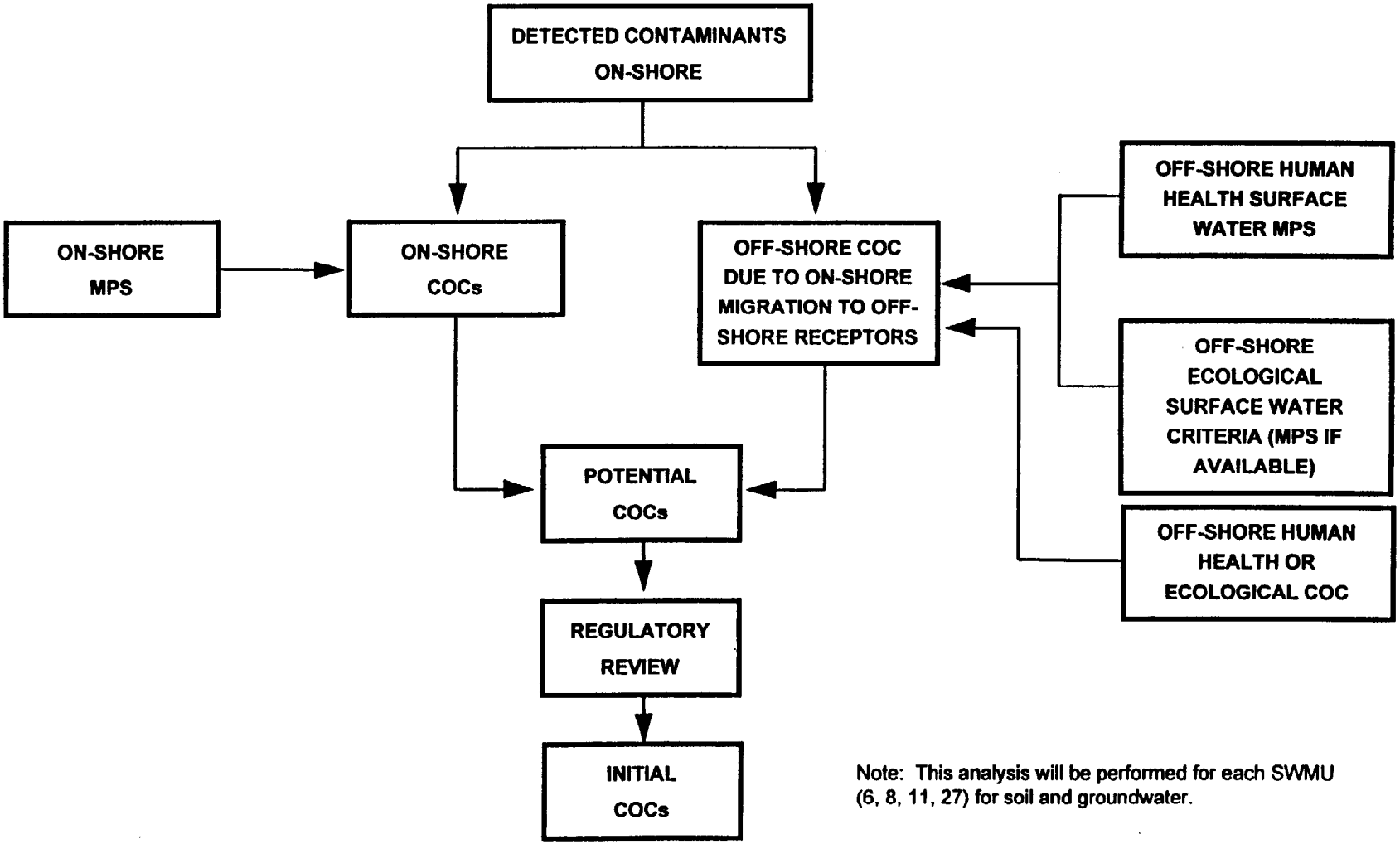
33. **Comment**: 11.0 Proposed Outline, Page 11-2

Sections 2-8 should be provided for the MEDEP's review and comment as they are developed. It's important that the MEDEP is allowed the opportunity to provide input during the process, so that consensus can be reached on crucial elements of the model before the model is completed. It would be helpful if the Navy could provide a time frame for completion of each report section.

Response: It is agreed that regulatory input during the modeling process is beneficial, however, the Navy believes that a separate review and comment period for each section of the Phase I modeling report could very seriously delay the completion of the modeling effort and subsequently the completion of the on-shore feasibility studies and ultimately the site remediation.
As discussed in response to the MEDEP General Comment, it is proposed that the conceptual models, the initial COC list, and the modeling tools be submitted to the regulatory agencies when they are available during the modeling process. This would be followed by a conference call to discuss the agencies comments. This format would allow for review and comment by the regulatory agencies, and incorporation of their comments, while not significantly slowing the completion of the Phase I modeling. Additional review and comment by the regulatory agencies could be made when the report is submitted.

FIGURE 5-1

EVALUATION OF INITIAL CONTAMINANTS OF CONCERN
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE



Note: This analysis will be performed for each SWMU (6, 8, 11, 27) for soil and groundwater.

TABLE 2-1

SUMMARY OF SITES TO BE INCLUDED IN THE PHASE I MODELING
PORTSMOUTH NAVAL SHIPYARD, KITTERY, MAINE

	Included in Phase I Modeling	Not Considered as Continuing Source of Contamination Not in Phase I Modeling	Not Enough Data to Support Modeling, Sites Part of Future Investigation
SWMU #5 - Industrial Waste Outfalls		X	
SWMU #6 - Defense Reutilization and Marketing Office (DRMO) Storage Yard	X		
SWMU #8 - Jamaica Island Landfill (JILF)	X		
SWMU #9 - Mercury Burial Site I and Mercury Burial Site II (MBI and MBII)	X*		
SWMU #10 -Battery Acid Tank No. 24			X
SWMU #11 - Former Waste Oil Tanks Nos. 6 and 7	X		
SWMU #12 - Boiler Blowdown Tank No. 25		X	
SWMU #13 - Rinse Water Tank No. 27		X	
SWMU #16 - Rinse Water Tank No. 34		X	
SWMU #21 - Acid/Alkaline Drain Tank		X (soil)	X (ground water)
SWMU #23 - Chemical Cleaning Facility Tank (Building 174)		X	
SWMU #26 - Portable Oil/Water Tanks		X	
SWMU #27 - Industrial Area at Berth 6	X		
Site #29 - Incinerator Site			X
Site #30 - Galvanizing Plant Building 184			X
Site #31 - West Timber Basin Landfill			X
Site #32 - Topeka Pier Site			X
Oil Gasification Plant, Building 62			X

* To be included as part of SWMU #8 in modeling.