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DEPARTMENT OF THE NAVY
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE, NORTHEAST
4911 SOUTH BROAD STREET
PHILADELPHIA, PA 19112-1303

BPMO NE/TB
Ser 09-197
July 10, 2009

Mr. Michael J. Daly
Remedial Project Manager
Federal Facilities Superfund Section
U.S. Environmental Protection Agency (EPA)
1 Congress Street, Suite 1100 (HBT)
Boston, MA 02114-2023

Ms. Claudia Sait
Remedial Project Manager
Maine Department of Environmental Protection (MEDEP)
Bureau of Remediation and Waste Management
17 State House Station
Augusta, ME 04333-0017

Dear Mr. Daly and Ms. Sait:

Enclosed you will find the Navy Responses to Regulator Comments on the Draft Technical Memorandum: Evaluation of Eastern Plume Extraction Well Network and Sites 1 and 3 Remedy, Naval Air Station (NAS) Brunswick, Maine. These RTCs are provided for your review and comment.

If you have any questions or comments, please contact the Navy's Remedial Project Manager, Todd Bober at (215) 897-4911.

Sincerely,

David Drozd
Director

Enclosure:
Navy Responses to Regulator Comments on the Draft Technical Memorandum:
Evaluation of Eastern Plume Extraction Well Network and Sites 1 and 3 Remedy,
NAS Brunswick, Maine

Copy to:
MEDEP (C. Evans)
Gannet-Fleming (D. McTigue)
NASB (L. Joy, M. Fagan)
Lepage Environmental (C. Lepage)
NAVFAC MIDLANT (T. Bober)
NAVFAC ATLANTIC (J. Wright, B. Capito)
TtNUS (L. Klink, C. Race, J. Orient)
ECC (A. Easterday, G. Calderone, C. Guido)

Copy to: (w/o encl)
BRAC PMO NE (P. Burgio)
NAVFAC ATLANTIC (D. Barclift)
BACSE (E. Benedikt, C. Warren)
CO NASB (CAPT Fitzgerald)
RAB Brunswick Representative (S. Johnson)
RAB Harpswell Representative (D. Chipman)
RAB Topsham Representative (S. Libby)
MRRA (V. Boundy)

RESPONSE TO COMMENTS FROM THE STATE OF MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION – BUREAU OF REMEDIATION AND WASTE MANAGEMENT ON THE DRAFT TECHNICAL MEMORANDUM, EVALUATION OF EASTERN PLUME EXTRACTION WELL NETWORK AND SITES 1 AND 3 REMEDY NAVAL AIR STATION BRUNSWICK, MAINE

Commentor: Claudia Sait, MEDEP - Project Manager-Federal Facilities Bureau of Remediation & Waste Management	
Comment Issue Date: 10 June 2009	**Navy Response Date: 10 July 2009**

Pursuant to Section VI of the Naval Air Station, Brunswick, Maine Federal Facility Agreement (Oct 1990), as amended, the Maine Department of Environmental Protection (MEDEP) has reviewed the draft "Technical memorandum, Evaluation of Eastern Plume Extraction Well Network and Sites 1 and 3 Remedy ", dated May 2009, prepared by ECC. Based on that review MEDEP has the following comments and issues.

GENERAL COMMENTS:

1. Overall the model results are well described and suggested remedial improvements are supported by the model results.

Response: **Noted.**

2. The Ground Water Extraction Treatment System (GWETS) was designed to: (1) prevent further movement of contamination toward surface water; (2) reduce concentrations of contaminants in the portions of the plume with the highest levels; and (3) together with natural degradation, result in the attainment of cleanup levels throughout the plume over a time period estimated to be between 13 and 71 years.

The proposed changes to the extraction system will help with the first two objectives, but groundwater with Total Volatile Organic Compound (TVOC) concentrations below 100 ppb will continue to reach the surface water and objective three cannot be assessed without a transport model. Therefore the proposed remedy only partly accomplishes what it is designed to do.

Based on the travel times noted in this report and on the plume "movie" shown at the meeting on June 2, 2009, that contamination may have been feeding the stream for some time and the GWETS has not been preventing the movement of contamination. This plume does not migrate as a "typical" contaminant plume through sand. The inter-fingered silt lenses may strongly control the contaminant transport by allowing for considerable dispersion and adsorption/desorption. MEDEP urges the construction of a transport model now that the flow model has been completed. A transport model would help in estimating clean up time; determining if the known sources are continuing to contribute to the plume; and to illustrate whether there are unidentified sources.

Response: The Navy acknowledges that the possibility of developing a solute transport model warrants further discussion with site stakeholders. A transport model simulating advection, dispersion and retardation could shed some light on contaminant distributions and contaminant transport mechanisms at the Eastern Plume and Sites 1 and 3, and may prove useful in identifying as yet unidentified potential sources. However, the Navy cautions that an adequate degree of confidence in a transport model's ability to predict clean-up times may not be achievable. This lack of confidence is due to a number of reasons. For instance, there is a lack of site-specific data on parameters such as chemical reactions and retardation. There is a high potential for non-unique solutions. Furthermore, the representation of the transition unit using two model layers may be adequate for a groundwater flow model but may not be adequate for a solute transport model since contaminant transport is sensitive to small scale changes in hydraulic conductivity (as is present in the transition unit) as mentioned in the comment above. It is acknowledged that these issues could be solved through the use of stochastic modeling. However, given the instability and complexity of the groundwater flow model, and the addition of more levels of complexity of a stochastic transport model, the level of effort required to achieve the objective of estimating clean-up times may be substantial. Estimating clean-up times could be completed using simpler methods such as chemical modeling or trend graph analysis for instance.

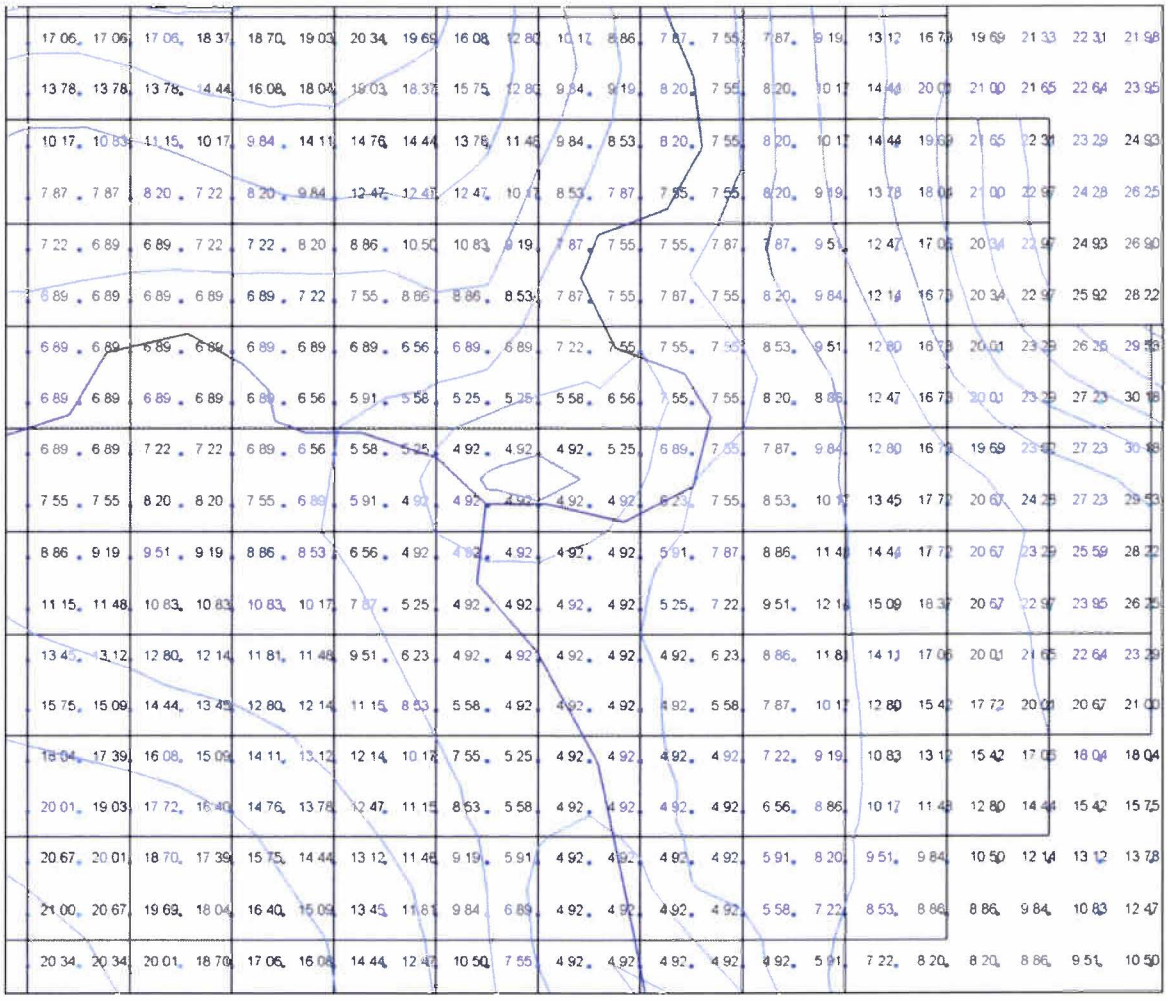
3. Based on the current vinyl chloride data for MW-216A and for wells at the slurry wall gap, Landfills 1 & 3 were possible sources for chlorinated VOCs to the southern portion of the Eastern Plume prior to the installation of the slurry wall. The particle tracking for the sources to the north (Sites 4 and 13) does not explain why VOCs are found in the vicinity of EW-01, or to some extent at the southern boundary of the plume. Running a simulation starting particles at the former landfills would indicate the relative importance of Sites 1&3 to the persistence of VOCs at the southern boundary of the plume. (See comment 10.b below.)

Response: While particle tracking was useful to demonstrate the relationship between the known source areas and hot spots, it may be misleading when used to identify any as yet unidentified sources of areas with lesser impacted groundwater. Since contaminant distributions in these areas are likely the result of transport mechanisms other than advection (dispersion, for instance), particle tracking which simulates advective transport only would give an erroneous result.

4. As noted in MEDEP's letter (January 22, 2009) on the Groundwater Modeling Summary Report the stream heads in the calibrated model show undulation in stream elevation. It is difficult to see in Figure E-3 (layer 1) which way the contour lines are going, but there are some suspicious points. The process of obtaining stream elevations from Digital Elevation Models (DEMs) in GMS can result in values that do not consistently decrease. The response to comment discusses flow field depressions in layers 3 and 5 and explains the depressions as a result of layer thinning. However MEDEP is mostly concerned about the stream elevations themselves, which must be addressed to minimize impacts to the model.

Response: The DEM file on which stream stage elevations were based was checked and is shown in the graphic below. The graphic shows the confluence area and specifically shows: the DEM points with their elevations; the "undulation" in simulated contours in the confluence area for model layer 2; the model grid; and the stream outline. As shown in the graphic, the DEM

points appear to consistently decrease over the length of the "undulation". We maintain that the "undulations" are a result of the changing thickness of model layers as described in Response to MEDEP Comment 14 on the Groundwater Modeling Summary Report.



5. The focus on the areas where concentrations exceed 100ug/L to identify where the extraction network can have its greatest impact is reasonable, and the general locations appear acceptable provided the data from the new monitoring wells installed for the dioxane study do not alter existing boundaries of the high concentration VOCs significantly. One effect of the proposed optimization that warrants consideration or discussion in the report is the possible expansion of the plume boundaries at levels below 100 ug/L of total volatile organic compounds (TVOC), but in excess of the Maine Maximum Exposure Guidelines (MEG).

Response: A sentence will be added at the end of the second full paragraph of Page 7 that states, *"One of the recommendations of this Technical Memorandum is to complete the type of evaluation described in this Technical Memorandum on a regular basis. In future evaluations, it is expected that target capture zones may have to be re-defined based on revisions to the site*

conceptual model as new data become available, and as the plume geometries change with time."

6. Figures 18 and 19 predict an area of upward gradients in the vicinity of Seeps 10 and 11 along Mere Brook. Additional porewater sampling along this stretch of the brook would provide information on whether any significant discharge is presently occurring here. Seep 10 continues to have low VOC detections despite being located in the trailing edge of the plume, and the remedy effectiveness is unclear in this region of the brook. It is important for the Navy to establish a sampling program that monitors that amount of contamination that reaches the surface water. Evaluation of whether GWETS is reaching its goals should be done regularly to prevent another long period of ineffective remediation.

Response: **Noted.** Four porewater sampling locations were added to the Long-Term Monitoring Program for Eastern Plume in February 2008. It is known that the plume is discharging to Mere Brook in the confluence area of Mere Brook and Merriconeag along the eastern edge of the plume and it is notable that other than Seep samples 10 and 11, there have not been shallow groundwater studies conducted to the west in the vicinity Seeps 10 and 11. It is recommended that the need for additional seep sampling locations in this area be discussed and is further evaluated during the Long-Term Monitoring Program optimization effort. It is agreed that the GWETS and extraction well network performance be evaluated during the five-year review process in order to optimize its effectiveness.

7. If available please provide an electronic spreadsheet or text file version of Table 1 that details the locations utilized and reference elevations for the associated stratigraphic units as an appendix to the report.

Response: An electronic version of Table 1 will be provided to MEDEP separately by e-mail.

SPECIFIC COMMENTS:

8. Figure 2: Please add the dashed blue line to the legend.

Response: The dashed blue line will be added to the legend.

9. Section 2, Model Development, paragraph 3: The model re-calibration based upon the new hydrostratigraphic data was completed following the same process as the original calibration and should represent a more accurate basis for the model than the data from the geophysical interpretation by Hager-Richter for Site 11. One potentially important location not included is the EW5B-PZ-04B boring (located southeast of EW5B-PZ-04) where the lower sand was not found. If possible the information needs to be added for any future work with the model, and the lower sand outline shown on Figures 4, 8, and 10 through 19, and 22 revised near EW-5B.

Response: One of the recommendations of the Technical Memorandum is to complete this type of evaluation on a routine basis as new data become available, as extraction well efficiencies can diminish with time, and as the plume geometries change with time. Subsequent evaluations will

be based on an updated model that will incorporate new hydrostratigraphic data including data from boring EW-05B-PZ-04B.

10. Pages 4 and 5, Section 3.1.1 Model Insights – Pre-Remedy and Figures 4 and 5:

a.) Para 1: Please note the percentage value used for recharge in the text.

Response: A sentence will be added to this paragraph which states, *"The percentages used to simulate pre-remedy conditions were the same as the percentages used for the steady-state pumping verification as shown in Table A-2 of Appendix A of this Technical Memorandum."*

b.) Para 2 &3: The narrow plumes and rapid travel times predicted by the model compared to the widely dispersed and persistent plume predicted by the long-term monitoring program indicate that dispersion and adsorption are very significant processes in the Eastern Plume. As noted in the text the thinning/narrowing of the lower sand and the lower conductivities in the transition unit appear to slow migration to the east.

Response: **Agreed.**

c.) The possibility of additional sources needs to be considered in the next revision of the conceptual model, based on the predicted flowpaths. The extension of the plume to the north toward MW-NASB-212 is not predicted, and the presence of the plume in the southwest near EW-01 is also not apparently related to the three main source areas.

Response: **Noted.**

d.) Para 3: Please discuss briefly whether the travel times to the 1996 hot spots (Figure 5) correspond with the estimated time of contamination.

Response: This is a difficult question to answer using particle travel times alone. First, particle tracking simulates advective transport, and does not take into account retardation which can slow contaminant migration travel times. Secondly, there was a prolonged period of release at the three known source areas of the Eastern Plume and an exact record of release dates and quantities is unavailable. For instance, releases from Site 11 occurred over a 40 year period so, assuming an initial release in 1955, the first impacted groundwater would have reached the associated hotspot by 1970, well before 1996. The last release at Site 11 reportedly occurred during 1987. Given a simulated advective travel time of 15 years from the source to the hotspot, the last release occurring in 1987, and a period of release of over 40 years, one might expect to see in 1996 a well established and stabilized hot spot with a trailing edge of impacted groundwater upgradient of the hotspot that gradually diminishes with time as residual impacted groundwater migrates to the eastern limit of the lower sand. One sees this diminishing upgradient trailing edge in the animations presented for 1,1,1-TCA, 1,1-DCE, and TCE during the 23 June 2009 technical meeting.

e.) Para 4: There appears to be a linking statement missing between the two sentences, please revise the text. MEDEP suggests "*The model results indicate that the two streams along the eastern boundary of the plume are the primary discharge areas for the groundwater migrating in the lower sand.*"

Response: **Agreed.** The suggested sentence will be added to the text.

11. Page 6, Section 3.1.2 Defining Capture Zones paragraph 2 and Figures 6 & 7: MW-209 (screened 25.8 to 30.8 feet bgs) and MW-224 (screened 34 to 44 feet bgs) are relatively shallow wells (although are perhaps the only choice west of the Weapons Road), why are they used for the lower sand interpolation and not the upper sand interpolation? Please explain their use, as they appear to be "in between" the upper and lower sand units. EP-07 is the nearest location that was logged to clay, at a depth of 70 feet bgs. Screening the Lower Sand would require a well at or near that depth. The lack of adequate monitoring in the lower sand in this region of the plume needs to be addressed in the future, although MEDEP supports the focus on the leading edge and discharge areas.

Response: Firstly, the interpolations are largely unaffected by these two locations since their concentrations were non-detect for the data set that was used, and there are points east that are also non-detect. Secondly, the upper and lower sand units are undifferentiated in these areas, i.e., they are not separated by the Transition unit; the transition unit pinches out east of this area (see Figure 8-28 of the Supplemental RI). Since data points were grouped in part to determine what areas could and could not be targeted by the GWETS, it seemed more accurate to group these two points with the lower sand data points in order to render a picture of the distribution of impacted groundwater that can be treated by the GWETS remedy rather with data points that represent the distribution of impacted groundwater that has already migrated through the Lower Sand and is now making its way up through the Transition and Upper Sand units towards the discharge areas, i.e. those areas where the GWETS in generally ineffective.

12. Page 8, Section 3.1.3 Particle Tracking Table #2: An article in a 1996 publication by the Geological Society of Maine evaluated recharge rates in the State for different geological settings and found that rates for sand and gravel outwash are in the range of 55%, based on studies where recharge was modeled for several Maine sites. This is significantly higher than the value accepted by MEDEP for the model, and future model use should evaluate the effect (if any) of higher recharge rates. This also is a follow-up to the RTCs Comment 12 for the Groundwater Modeling Summary Report dated March 2009, regarding the recharge values applied to the model. (Reference: Ground Water Recharge Rates For Maine Soils and Bedrock, R. G. Gerber and C. S. Hebson, Geological Society of Maine Bulletin #4: Selected Papers on the Hydrogeology of Maine; pp 23-51.)

Response: It is acknowledged that, because of the model's sensitivity to this input parameter, more confidence in the values used is desirable. However, recharge is a notoriously difficult input parameter to quantify. Different methods for calculating recharge can give widely different estimates. Also, the article cited also notes a study that estimated a recharge rate of 19% of precipitation for a sandy glacial till; a material which may be more akin to the stream deposited Upper Sand unit than glacially derived sand and gravel deposits. Since there is a high degree of

uncertainty in this parameter, and a lack of site-specific data, recharge values for the study area could be better estimated by the employment of two field methods which could then be compared to model estimated recharge rates. The two field methods that seem applicable to the study area that could be completed with relatively little effort are analysis of water-table fluctuations in observation wells, and hydrograph analysis of stream flow. Alternatively, barring collection of site specific data, future model updates could employ a more detailed sensitivity analysis for this parameter.

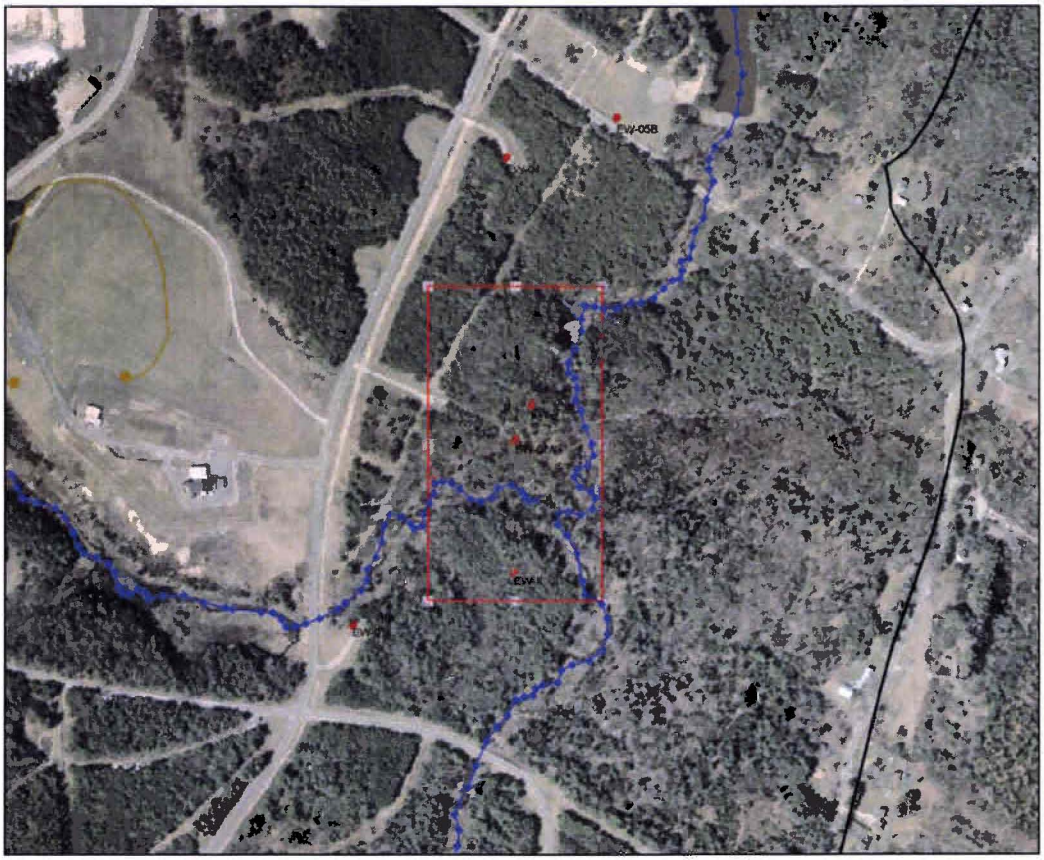
13. Page 9, Section 3.1.4 Particle Tracking for Proposed Alternative, para #3 and Figure 17:
Based on the predicted gap in recovery near EW-04, perhaps this well could be modified to screen only the lower sand and pumped at a low rate to establish complete capture in this area. The data from MW-EP-346, installed recently in the lower sand to the southwest of EW-04, will support consideration of whether the lower sand VOC concentrations warrant consideration of this as an option.

Response: At this time, there are no plans to re-construct the well screen. With the proposed pumping regime and addition of EW-05B to the extraction well network, EW-04 becomes largely redundant. The Navy believes that EW-01 should be shut off entirely at this time. However, as the type of evaluation described in the Technical Memorandum will be completed on a regular basis, the resumption of pumping at EW-04 may be warranted in the future if there are significant concentration rebound effects, and as new data becomes available that will help to better define the target capture zones.

14. Page 10, Section 3.1.4 Particle Tracking for Proposed Alternative, para #2 and Figures 17 and 19:

a.) The reversal of the vertical gradient is significant if it is able to slow continued migration of the plume to surface water. Does the reverse gradient also increase the potential for an influx of shallow groundwater or surface water to the extraction well? This seems particularly important at EW-Y, and would need to be considered when evaluating the pumping regime if the new wells are installed.

Response: Yes, the reverse gradient increases the potential for an influx of shallow groundwater or surface water to the extraction well. Model computed flow for stream sections within the red rectangle (see graphic below) is 4,018 ft^3/day with EW-X and EW-Y, and 5,981 ft^3/day without EW-X and EW-Y. It is assumed that the difference in stream flow is due to the infiltration of surface water to the aquifer as a result of pumping EW-X and EW-Y.



b.) It is also notable that with the proposed shutdown of EW-5A a portion of the plume > 100 ug/L TVOC continues to move to Picnic Pond, where the vertical gradients remain upward. This will not meet the objective of reducing discharge to surface waters.

Response: It is noted that the portion of the plume referred to above is not captured by either EW-05A or by the proposed pumping regime. It is hoped that, with the inclusion of new data acquired from the 1,4-dioxane remedial investigation, this area can be further addressed in the next model update.

15. Figures 14 and 15: The labels for the extraction wells are obscured in some cases. Please correct.

Response: The labels will be corrected.

16. Figures 14, 15, 16, and 17: There are too many particle lines to clearly show flow paths. Please trim the number of particles so that flow paths are clearly seen.

Response: The number of particles will be trimmed so that flow paths are clearly seen.

17. Page 12, Section 3.2.2, Particle Tracking Results, para 2, first sentence: The sentence refers to forward particle tracking, but the figure cited shows backwards particle tracking. Please reference the correct figure.

Response: The text incorrectly to referred to Figure 20. The correct reference was Figure 21. The text will be revised accordingly.

18. Page 14, Section 4.1.1, Conclusions: MEDEP agrees that EW-1, EW-4, and EW-5A are ineffective and that EW-5B will help prevent further movement of contaminants toward the surface water.

Response: **Noted.**

19. Pages 14 - 15, Section 4.1.2 Recommendations:

a.) #1 – If EW-04 was modified to pump only the lower sand more complete capture will be established for the plume, the relative value of this addition should be considered when the pumping regime is optimized, along with consideration of the plume discharge originating north of EW-5A.

Response: Please see response to Specific Comment 13.

b.) #2 and #3 – MEDEP agrees with the approach proposed, but will reserve acceptance of final locations until data are available this year from the new wells installed as part of the 1,4 dioxane investigation.

Response: As recommended in the Technical Memorandum, there are numerous monitoring wells in the vicinity of the identified hot spots that could be employed as temporary extraction wells at least during frost-free seasons prior to installing more permanent extraction wells. Even if sustainable yields are below the target yield, they would aid in preventing future impacts to surface water.

c.) #5 – MEDEP supports continued and more frequent evaluation of the pump and treat system. Based on other wells installed in the Lower Sand, pumping rates are likely to decline due to hydrologic or mechanical issues and stakeholders need to more rapidly approve responses to future changes in the plume or the system.

Response: The Navy strongly agrees with this comment.

d.) MEDEP suggests adding a recommendation to developing a transport model. (See comments 2 and 3 above.)

Response: Please see response to General Comment 2.

e.) MEDEP suggests a recommendation to add that pore water should be sampled regularly to determine if contamination is still reaching the surface water after the new remedy is in place.

Response: Four pore water samplings points, PW-01 through PW-04, have been added to the Long Term Monitoring Plan since Monitoring Event 32.

20. Page 15, Section 4.2, Sites 1 and 3 Remedy: MEDEP agrees with the assessment of this remedy. However, the reduction in concentrations will not be immediate – the currently-contaminated groundwater will take some time to pass through and will continue to discharge to the stream for a while.

Response: Noted. An assessment of the naturally occurring phyto- and bio-remediation properties associated with the riparian wetlands and floodplain has not been completed. The presence of vinyl chloride in pore water samples suggests that some natural degradation of impacted groundwater is occurring prior to discharge to surface water.

21. Section 4.2, Sites 1 and e Remedy, last sentence. The model could easily estimate the difference in the amount of groundwater discharge to the stream between the current conditions and the proposed conditions. This would be useful information for an ecological assessment.

Response: It is agreed that the model could easily estimate the difference in the amount of groundwater discharge to the stream between the current conditions and the proposed conditions. However, it remains to be determined how much less discharge is acceptable to maintain the health of riparian and aquatic habitats along the stream corridor.

22. Figure 4: Please add the Lower Sand outline to the legend block.

Response: The Lower Sand outline will be added to the legend block.