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DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND, MID-ATLANTIC
9742 MARYLAND AVENUE
NORFOLK, VA 23511-3095

IN REPLY REFER TO:

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OPHE3/08/003

JAN 5 2010

Ms. Sun Yi (Code 3HS11)
NPL/BRAC Federal Facilities Branch
U.S. Environmental Protection Agency, Region III
1650 Arch Street
Philadelphia, PA 19103-2029

Dear Ms. Yi:

SUBJECT: RESPONSE TO COMMENTS; DRAFT FINAL FEASIBILITY STUDY - SITES 11 AND 12, ALLEGANY BALLISTICS LABORATORY, ROCKET CENTER, WEST VIRGINIA

This letter is provided in response to your comments dated September 14, 2009 on the *Draft Final Feasibility Study - Sites 11 and 12, Allegany Ballistics Laboratory, Rocket Center, West Virginia*. The enclosed responses were provided in electronic form on December 12, 2009, and incorporate the focused injection response at selected wells as agreed to at the December 8 - 9, 2009 partnering meeting.

If you have any questions or comments regarding this matter, please contact Mr. Bill Fraser at (757) 445-6549, or E-Mail at william.g.fraser@navy.mil.

Sincerely,

TIMOTHY A. REISCH
Head, Restoration Branch
By direction of the
Commanding Officer

Enclosure

Copy to: CH2MHill (Mr. Steve Glennie) (provided electronically)
WVDEQ (Mr. Thomas Bass) (provided electronically)

USEPA Comments and Navy Responses to the

Draft Final Feasibility Study for Groundwater at Sites 11 and 12

Allegany Ballistics Laboratory, Rocket Center, West Virginia

USEPA'S COMMENTS DATED September 14, 2009 on the *Draft Final Feasibility Study for Groundwater at Sites 11 and 12, Allegany Ballistics Laboratory, Rocket Center, West Virginia, July 2009*

EDITORIAL COMMENTS

The Navy will incorporate the editorial comments provided on CD by USEPA.

GENERAL COMMENTS

1. Alternative 2 (Source Zone Removal, Monitored Natural Attenuation [MNA], and Institutional Controls [ICs]) is the preferred remedial alternative for Sites 11 and 12, but the Feasibility Study (FS) has not provided a robust and defensible evaluation to show that MNA is truly a viable option for groundwater at these sites. Section 4.2.3.1, MNA, presents the three lines of evidence that are used to demonstrate that NA is occurring at a site, which are described in more detail in the U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-17P *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites* (April 1999) (OSWER Directive). However, the FS does not provide a thorough evaluation of the site-specific data in consideration of these lines of evidence.

   The first line of evidence, as described in the OSWER Directive, is historical groundwater/soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points. The FS has stated that, in general, contaminant concentrations are decreasing over time. However, this is not necessarily the case for trichloroethylene (TCE) in the alluvial aquifer at Site 11. The time-concentration plot for Site 11 alluvial well 11GW06 shows TCE concentrations are generally increasing over time. Two other Site 11 wells reported elevated concentrations of TCE (11GW17 and 11GW15), as shown on Figure 3-1, Sampling Results for COCs Retained for Direct Remediation. Since these wells were only sampled once, trends cannot be evaluated. Additionally, data from a shallow bedrock well at Site 11 (11GW12S) also shows a consistent increase of TCE concentrations after about April 2000 (Appendix H). An increasing trend of TCE concentrations is also shown for alluvial aquifer well 12MW01 at Site 12. Additionally, several Site 12 wells do not show a clear decreasing trend. The lack of data showing a "clear and meaningful trend of decreasing contaminant mass" is a concern for Sites 11 and 12 alluvial and shallow bedrock groundwater that requires further consideration when evaluating the efficacy of MNA.

   The second line of evidence outlined in the OSWER directive calls for hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the site, and the rate at which such processes will reduce contaminant concentrations to required levels. The FS has not presented a thorough discussion of the geochemical data that may have been collected at the site and the attenuation processes active at the site. Some geochemical data were collected and are summarized in Appendix F, but these data are limited (oxidation-reduction potential,

dissolved oxygen, pH, etc.) and do not include many of the electron acceptors or donors (such as sulfate, nitrate, iron, total organic carbon) or other chemical parameters (such as methane, carbon dioxide) that should be monitored to determine natural attenuation (NA) processes. The last bulleted item of Section 2.2.2.9, RI, on Page 2-14, indicates that ferrous iron and sulfide tests were conducted, but the results are not presented in the FS or evaluated with respect to NA processes. This is a concern because the FS is citing references in the third paragraph on Page 4-5 that aerobic co-metabolism is a viable degradation pathway for TCE in the aerobic zones of the Site 11 alluvial aquifer (since it has occurred at another site), but the FS has not presented any evidence to show that this process is occurring or can occur at Site 11.

The third line of evidence typically used to demonstrate that NA is occurring at a site is data from field or microcosm studies (conducted in or with actual contaminated site media) which directly demonstrate the occurrence of a particular NA process at the site and its ability to degrade the contaminants of concern. This line of evidence has not been considered at Sites 11 or 12; however, it should be noted that the OSWER Directive indicates that this line of evidence is typically only required when the first and second lines of evidence prove inadequate.

Based on the discussion above, a more in-depth evaluation of the site data with respect to the efficacy of MNA as a remedial option at this site appears warranted. The line of evidence approach, as outlined in the OSWER Directive and summarized in the FS, should be utilized to direct the evaluation of the site data to demonstrate MNA is a viable alternative. A discussion of the NA processes active at the site, based on actual site data, should be presented.

Response: The U.S. EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9200.4-17P *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites* (April 1999) (OSWER Directive) indicates that: "MNA is appropriate as a remedial approach only when it can be demonstrated capable of achieving a site's remedial objectives within a time frame that is reasonable compared to that offered by other methods... . EPA, therefore, expects that MNA typically be used in conjunction with active remediation measures (e.g., source control) or as a follow-up to active remediation measures that have already been implemented." As it is currently written in the FS, MNA serves as a follow-up to an active remediation measure that has been completed (i.e., source removal). After the removal action, the maximum historical concentrations of TCE and MC at Sites 11 and 12 were observed at 190 and 540 µg/L. These maximum concentrations represent a moderate to low level of contamination, which are typically amenable to natural attenuation processes.

The Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater (EPA/600/R-98/128, September 1998), which was prepared as a technical guidance to supplement the OSWER Directive, recommended that as part of the natural attenuation evaluation, an initial screening based on the available site data be conducted to determine if natural attenuation is capable of attaining the site-specific RAOs in a time period that is reasonable compared to other alternatives, before investing in a detailed study. The protocol recommended the use of a screening

model, such as BIOSCREEN. The FS used the SourceDK model, which is an improved screening model compared to BIOSCREEN. The projected remediation time frame for the sole reliance on NA processes based on the SourceDK model ranges from 4 to 24 years. Because of the absence of direct receptors, this time frame range is considered reasonable based on the current and future groundwater use.

As described in Section 4.2.3.1 of the FS report, the first line of evidence to demonstrate that natural attenuation is occurring is documented loss of contaminants over time. The figures and tables shown in Appendix H will be revised to show the complete data sets. Appendix H figures will be revised to (1) remove groundwater data obtained from temporary piezometers, (2) show all monitoring well groundwater data, (3) show trend lines, and (4) show non-detect results at half the detection limit. Tables will be added to summarize the Site 11 TCE trends in the alluvial and shallow bedrock aquifers. As stated in the FS report, in general, contaminant concentrations are decreasing over time. More specifically:

- Groundwater samples were collected and analyzed from monitoring well 11GW06 in May 2000, August 2000, November 2000, February 2001, May 2004, and December 2006. Although there have been historical fluctuations in TCE concentrations, there is an overall flat to generally decreasing concentration in TCE over time.
- Groundwater samples were collected and analyzed from monitoring well 11GW12S in August 1999, May 2000, August 2000, November 2000, February 2001, May 2004, and December 2006. Although there have been historical fluctuations in TCE concentrations (within in the same order of magnitude), there is an overall flat to generally decreasing concentration in TCE over time.
- Because TCE concentrations in monitoring well 11GW06 and 11GW12S are relatively low, the fluctuations in TCE concentrations may be attributed to expected variations in the laboratory analysis and/or seasonal variations.
- TCE was detected in monitoring wells 11GW15 and 11GW17 during the December 2006 sampling event at concentrations 60 µg/L and 34 µg/L, respectively. Because these wells were only sampled once, trends cannot yet be evaluated. However, Alternative 2 proposes long-term groundwater monitoring to obtain additional TCE concentration data, examine concentrations trends over time and seasons, and evaluate the remedy effectiveness.
- The data presented in Appendix H for monitoring well 12MW01 is incomplete. Groundwater samples were collected and analyzed from monitoring well 12MW01 in September 2003, June 2005, and December 2006. Results indicated that TCE was non-detect in the June 2005 and December 2006 sampling events. Therefore, there has been a decreasing trend in TCE concentrations at 12MW01 over time.
- Alternative 2 requires monitoring to ensure that COC concentrations decline and ultimately achieve MCLs or approach background levels. Five year reviews have been included as part of this remedy to support the evaluation of remedy efficacy.

As described in Section 4.2.3.1 of the FS report, the second line of evidence to demonstrate that natural attenuation is occurring is favorable chemical and geochemical data. Natural attenuation data have been collected at Site 11 as follows:

- Alkalinity: August 1999, August 2000, November 2000, February 2001

- **Hardness: August 1999, August 2000, November 2000, February 2001, June 2007 (bedrock only)**
- **Chloride and total organic carbon (TOC): May 2004, June 2007 (bedrock only)**
- **Nitrate and Sulfate: June 2007 (bedrock only)**

Natural attenuation data have been collected at Site 12 as follows:

- **Alkalinity: December 2006**
- **TOC: December 2006 and June 2007**
- **Chloride, hardness, nitrate, nitrogen (alluvial only), and sulfate: June 2007**
- **Methane/ethane/ethene: June 2007**
- **Ferrous iron and sulfide test kits: June 2007**

The evaluation of natural attenuation at Sites 11 and 12 can be found in the *Preliminary Natural Attenuation Screening at Sites 11 and 12 Technical Memorandum*, dated December 16, 2008. The third paragraph on page 4-5 states, "In the aerobic zones of Site 11, aerobic cometabolism is a viable pathway for TCE degradation to carbon dioxide." This paragraph does not state that aerobic cometabolism is occurring at Site 11; however, site conditions support that this method of degradation is viable. The long-term monitoring approach for Alternative 2 includes analyzing groundwater on a seasonal rotation for VOCs, metals, TOC, chloride, nitrate/nitrite, sulfate/sulfide, methane/ethane/ethene, and alkalinity. Appendix I Raw Groundwater Data will be added to the FS report. Appendix F will be updated to include all available geochemical field parameters and field text results. The *Preliminary Natural Attenuation Screening at Sites 11 and 12 Technical Memorandum* will be provided on a reference CD.

As described in Section 4.2.3.1 of the FS report, <u>the third line of evidence</u> to demonstrate that natural attenuation is occurring is microbial data that support the occurrence of degradation and provide for the development of estimated biodegradation rates. As stated in the OSWER Directive, this line of evidence is typically only required when the first and second lines of evidence prove inadequate. If the first and second lines of evidence were to prove inadequate, a contingency plan will enable the long-term monitoring plan to be reviewed and revised as necessary. A contingency plan will be included in a technical memorandum of sample data interpretation, after each sampling event.

As stated above, evaluation of natural attenuation at Sites 11 and 12 can be found in the *Preliminary Natural Attenuation Screening at Sites 11 and 12 Technical Memorandum* (CH2M HILL, 2008). The long-term monitoring plan for Alternative 2 includes sampling, analysis, and evaluation in support of the lines of evidence approach outlined in the OSWER Directive.

2. Section 4.2.3.1 MNA discusses the predominant NA processes occurring at Sites 11 and 12 are likely advection and dispersion. As expressed in our letter dated February 13, 2009 and in prior discussions during partnering meetings, when relying on NA processes for site remediation, EPA prefers those processes that degrade or destroy contaminants (OSWER Directive 9200.4-17P, 1999).

We recommend evaluating the feasibility of an additional remedial alternative that includes using enhanced reductive dechlorination (ERD) technology to actively treat the areas where the highest concentrations are observed in the groundwater plumes for contaminants of concern (COCs) retained for direct remediation (i.e., TCE, VC and MC). The treatment would focus on the plume source areas, rather than across the entire plume, as proposed in the draft FS. This alternative would reduce the number of injection points needed and allow MNA to be a finishing step for the downgradient portion of the plumes.

Response: The recommended additional remedial alternative (i.e. which focuses on ERD injection in existing monitoring wells in the plume near former source areas, rather than across the entire plume) was evaluated following the recommendation of the Tier I Partnering Team during the October 2009, ABL Partnering Meeting. The Team's consensus was to evaluate an additional alternative in the FS, consisting of the use of localized treatment in existing wells.

Taking the ABL Partnering Team's recommendations in to consideration, the Navy will include an additional alternative to the FS. This new alternative consists of passive enhanced bioremediation using gravity-fed 3-D Microemulsion (3DMe)™ (formerly known as HRC Advanced) or a similar anaerobic degradation stimulant to degrade TCE and methylene chloride. This would be conducted in existing wells near the former source areas, where practical. This should promote anaerobic biodegradation. This will be followed by long term monitoring to evaluate the remedy effectiveness. Wells that will be considered for this type of injection comprise 11GW06, 11GW15, 12MW18, and 11GW12S. Other wells with TCE or methylene chloride exceedances (i.e. 12MW09S, 12MW21S/D) will not be considered for this treatment, due to the artesian conditions where they are located, limiting the ability of chemical delivery via gravity feeding.

3. The groundwater data used in the FS for Site 11 are more than eight years old, while data used for Site 12 are more recent. The FS does not explain the data gap for Site 11 and whether the concentration trends discussed are reflective of current conditions. Please revise the FS to discuss this data gap and its impact on the evaluation of site conditions at Site 11.

   Response: As summarized in Figure 3-1, groundwater at Site 11 was sampled in August 1999, May 2000, August 2000, November 2000, February 2001, July 2003, May 2004, Mat 2005, December 2006, and June 2007. Groundwater at Site 12 was sampled in July 2003, September 2003, May and June 2005, December 2006, and June 2007. Concentration trends discussed in the FS are based on the assumptions that the current conditions at Sites 11 and 12 are represented by the most recent sampling data available. Appendix H will be revised to include all available data from Sites 11 and 12.

4. EPA still recommends the remedy for the site groundwater be evaluated such that after ARARs (i.e., MCLs) are achieved, and just prior to remedy completion (i.e., when the aquifer achieves dynamic equilibrium), a risk assessment be performed on the residual contaminants remaining in the groundwater to ascertain that the contaminant risk levels are within the acceptable cancer risk range of 1E-06 to 1E-04 and HI=1 based on target

organs. As requested in the Navy's Draft Response to EPA's Comments, dated November 12, 2008, two examples of where this approach has been implemented at other NPL sites in Region 3 are discussed below.

The approach described above has been implemented at operable unit (OU) 10 of the Letterkenny Army Depot NPL site. The remedy approach is documented in the Record of Decision (ROD) for Conococheague Drainage System, dated March 2006. The Watson and Johnson Superfund Site has also implemented this approach, described in the September 2009 ROD. Both RODs are available to be viewed in the respective sites' Administrative Records. Please note that Region 3 has developed recommended language (in **BOLD** below) to be included in describing this approach in RODs. The section documenting the use of this approach in the Watson and Johnson ROD is provided below:

Remedial action objectives for human health risks associated with the groundwater include:

- Prevention of exposure to contaminated groundwater in the future.
- Prevention of further migration of the contaminant plume.
- Restoration of groundwater quality throughout the plume to primary drinking water standards.

The primary objective for the groundwater is to restore the aquifer to beneficial use. The remedial cleanup levels for groundwater contaminants of concern are as follows:

TABLE example: preliminary Remedial CLEANUP LEVELS for groundwater

Groundwater COCs	MCL (ug/L)
TCE	5
PCE	5
Cis-1,2-DCE	70
Vinyl Chloride	2
BEHP	6

Because groundwater which meets the MCLs for individual contaminants may not meet the risk-based standards (1.0E-04) and HI less than or equal to 1 cumulatively, if multiple contaminants are present, determination of meeting the "protection of human health and the environment" RAO will be performance-based. When preliminary cleanup standards have been attained (MCLs), EPA [or Navy, in this case] will evaluate post-Record of Decision (ROD) data from the periodic groundwater monitoring and develop a trend analysis and risk assessment. The risk assessment will be based on an assessment of the cumulative risk across all

applicable exposure routes for all COCs remaining in groundwater following achievement of the MCLs. The remediation of groundwater at the Site will continue until the risk-based cleanup standards (1.0E-04 and HI less than or equal to 1) are achieved.

Response: The Navy does not agree with these recommended statements being added to the FS. An FS is intended to evaluate appropriate remedial alternatives and not state remedy complete determinations.

5. Note that regardless of whether there are receptors drinking the water, the goal is to remediate the aquifer to beneficial future use. This goal should be stated in the Report.

Response: A third site-specific remedial action objective, to remediate the aquifer to beneficial future use, will be added to Section 3.2.2. Section 3.2.2 will be revised to state,

"...The site-specific RAOs for groundwater at Site 11 and 12 are to:

- **Prevent human exposure to groundwater containing COCs above SRGs**
- **Reduce concentrations of COCs to meet SRGs in groundwater**
- **Remediate the targeted aquifer(s) to beneficial future use as defined by drinking water standards (i.e., MCLs) or approaching background values"**

SPECIFIC COMMENTS

6. **Section 3.4, Evaluation of COCs, Page 3-4:** The second paragraph states that monitoring wells 12MW15 and 11GW10S/D were selected as the site-specific background wells for Sites 11 and 12; however, the data from these wells have not been provided in the FS for comparison purposes. Additionally, site groundwater data, in general, have not been provided in the FS with the exception of the detections shown on site figures and in the Appendix H tables. This lack of a comprehensive presentation of data does not allow review of all the chemical data without referring back to the individual Remedial Investigation reports for Sites 11 and 12. Since the data relate to the selection of remedial alternatives, groundwater data summary tables should be provided in the FS. Please revise the FS to include groundwater data summary tables, which include data from all site monitoring wells including the background wells.

   Response: The raw data will be provided in electronic format (CD) with the Revised Draft-Final Feasibility Study for groundwater at Sites 11 and 12.

7. **Table 3-1, Summary of COCs for Site 11, and Table 3-2, Summary of COCs for Site 12:** Background concentrations are shown on these tables, but the tables do not document the source(s) for these concentrations. For clarity and completeness, please revise Table 3-1 and Table 3-2 to reference the source of the background concentration data.

   Response: Tables 3-1 and 3-2 will be revised to reference the monitoring well location and date of the background concentration.

8. **Table 3-7, Summary of Site 11 COCs Retained for Direct Remediation:** For TCE in the alluvial aquifer at Site 11, it is noted that there is a "trend of decreasing concentrations and downgradient movement." As previously stated, there are limited data showing

decreasing concentrations in TCE in Site 11 alluvial groundwater. Only concentrations in wells 11GW02 and 11GW03 appear to show a declining trend in TCE concentrations. All other alluvial aquifer wells show either increasing concentrations, or lack sufficient data to evaluate trends. Please revise Table 3-7 to provide a more accurate picture of Site 11 conditions.

Response: Only three alluvial monitoring wells had at least one TCE detection greater than the MCL: 11GW06, 11GW15, and 11GW17. Graphing available data, alluvial well 11GW06 shows a flat to negative sloping trendline (i.e., general decreasing concentration trend) over time. Alluvial wells 11GW15 and 11GW17 were only sampled once, and could not be evaluated. The second bullet within the TCE row in Table 3.7 will be revised to state, "Trend of decreasing concentration within the hotspot (i.e., 11GW06) and downgradient observed."

9. **Table 3-7, Summary of Site 11 COCs Retained for Direct Remediation:** For several of the inorganics in Site 11 groundwater, Table 3-7 notes that there are generally decreasing trends for these contaminants (i.e., total antimony, total barium, total chromium, dissolved iron, total manganese, and total thallium). Groundwater summary tables have not been provided in the FS nor does Appendix H include time concentration plots for these contaminants. Therefore, statements regarding trends for inorganic constituents cannot be evaluated. Please revise the FS to include supporting data that show trends for the inorganic constituents in groundwater.

   Response: See response to Comment 6

10. **Table 3-7, Summary of Site 11 COCs Retained for Direct Remediation, and Table 3-8, Summary of Site 12 COCs Retained for Direct Remediation:** Since MCLs are not-to-exceed levels (meaning not even one exceedance is allowed), the following metals that were noted in the risk assessment as risk drivers and assumed to be present due to the volatile organics present should be reconsidered in the FS:

    Site 11: Arsenic – MCL = 10 ppb, current concentration is 10.8 ppb
    Thallium – MCL = 2 ppb, current concentration is 7.4 ppb

    Site 12: Arsenic – MCL = 10 ppb, current concentration is 10.6 ppb
    Chromium – MCL = 100 ppb, current concentration is 250 ppb
    Lead – Action Level = 15 ppb, current concentration is 18.5 ppb
    Thallium – MCL = 2 ppb, current concentration is 6.2 ppb

    Please include a general statement in Table 3-7 and 3-8 and the text, where applicable, that states that regardless of whether a COC is considered in the FS for costing purposes, all COCs will be monitored and data analyzed for trend in contaminant levels over time, especially as part of the Five-Year Review Process.

    In Section 2.3.1.3, it is noted that PCE is no longer in the vicinity of the F-Well, and will not be considered further in the FS. Please note that continued monitoring is necessary.

    Response: The Navy concurs and will revise the Draft-Final FS as requested.

11. **Figure 3-2, Sites 11 and 12 Alluvial Aquifer COCs Retained for Direct Remediation:** Solid isoconcentration lines are used to show the northern extent of the Site 11 TCE plume, but use of a solid line instead of a dashed line for inferred concentrations is not supported by the data. There are no wells north of 11GW15 and 11GW17 that can be used to show that TCE concentrations are 5 micrograms per liter (ug/l). A similar approach is used for the Site 12 TCE plume. A solid line is used to show the northern extent of the plume in an area (within the building) where no data have been collected. In areas where groundwater concentrations are estimated, a dashed isoconcentration line should be used to show inferred groundwater concentrations or data supporting the solid lines should be provided. Revise Figure 3-2 to address this concern.

    Response: The Navy concurs and will revise the Draft-Final FS as requested.

12. **Section 4.1, General Response Actions, and Section 4.2.4, Removal and Offsite Disposal, Pages 4-1 and 4-11:** Since source zone removal is a (completed) component of the remedial alternative, a table that shows the range of concentrations and the average concentration for soil confirmation samples at Sites 11 and 12 should be provided. A figure that shows the extent of soil contamination and subsequent excavated areas should also be provided.

    Response: Section 2.2.1.2 Advanced Site Inspection [Site 11], and Section 2.2.2.8 Site 12 CERCLA Soil Removal Action refers the reader to additional information located in the RI Reports for Sites 11 and 12, respectively. The following information will be provided on a reference CD: (1) raw soil data for both sites: and, (2) a figure showing the extent of soil contamination and subsequent excavated areas.

13. **Section 4.2.3.1, MNA, Page 4-7:** The first full paragraph states that the rates of biodegradation at Sites 11 and 12 cannot yet be verified; therefore, a literature default value was used for modeling. The FS does not address why site-specific biodegradation rates cannot yet be verified and when the site-specific values will be used for the model. Please revise the FS to provide this information.

    Response: The most recent groundwater sampling event at Site 12 (June 2007) included a robust analysis of natural attenuation parameters (i.e., chloride, nitrate, nitrogen, sulfate, TOC, and hardness). Alkalinity and TOC at Site 12 were analyzed in December 2006. Alkalinity and hardness at Site 11 were analyzed in August 2000 and February 2001. Chloride and TOC at Site 11 were analyzed in May 2004.

    SourceDK is a planning tool for developing order-of-magnitude estimates of remediation timeframe and identifying information needed to reduce the uncertainty in remediation timeframe estimates. As a planning and screening tool, SourceDK only approximates more complicated processes that occur in the field and, therefore, simplifies actual site conditions. SourceDK modeling will not be used during the long-term monitoring associated with MNA; instead, actual data and trends will be used in the evaluation of MNA rates over time. This will ensure MNA remains an appropriate component of the remedial actions at Sites 11 and 12.

14. **Table 4-1, Primary Screening of Remedial Technologies:** Under the effectiveness column, the effectiveness of the remedial technology is described in relation to the site

COCs selected for remediation. Although volatile organic compounds (VOCs) are the primary COCs, the effectiveness of the technologies at remediating the inorganic COCs should also be described as this may be a determining factor in selecting one alternative over another, particularly if two alternatives have similar effectiveness for VOCs. Revise Table 4-1 to also address the inorganic COCs.

Response: The effectiveness column in Table 4-1 will be revised to include text regarding the effectiveness of the technologies at remediating the inorganic COCs.

15. **Section 5.1.2.2, Monitored Natural Attenuation, Page 5-2:** The first paragraph states, "The design of an effective MNA program involves utilization of an appropriate monitoring well network, implementation of a site-specific groundwater sampling and analysis strategy, and a contingency plan." A contingency plan for MNA has not been presented in the description of the MNA remedial alternative nor have costs associated with such a contingency plan been included in the cost estimates. Please revise the FS to describe a contingency plan for the MNA alternative that will be carried forward through the remedial selection process, including the cost estimates.

    Response: The cost estimate for Alternative 2 (Appendix E, Table E-1) includes a line item for data interpretation. A contingency plan will be included in the data interpretation technical memorandum after each sampling event.

    The first paragraph of Section 5.1.2.2 will be revised to state, "...contingency plan (Wiedemeier, 2000). A contingency plan will be included in the data interpretation technical memorandum after each sampling event."

16. **Section 5.1.2.2, Monitored Natural Attenuation, Page 5-2:** For the MNA alternative as well as the MNA components of Alternatives 3 and 4 (Sections 5.1.3.3, 5.1.4.3), only one new deep monitoring well is proposed, which will serve as a sentinel monitoring well. Based on the current configuration of the plumes, it appears that additional performance monitoring wells (PMWs) will also be warranted. As stated on Page 5-2, PMWs located "upgradient of, within, and immediately downgradient of the area of contamination, are used to monitor the attenuation process." Figure 3-5, Sites 11 and 12 FS COCs Requiring Remediation, shows that the downgradient extent of the TCE plumes in Site 11 alluvial groundwater and shallow bedrock groundwater are not currently defined as no monitoring wells screened at appropriate intervals are located north of the existing areas of contamination. Figure 3-5 also shows that the downgradient extent of TCE in the Site 12 alluvial groundwater is not defined. PMWs that monitor the downgradient extent of this contamination will be required. Please revise the FS to propose a sufficient number of downgradient PMWs to monitor the TCE plumes at Site 11 and 12. If wells associated with other ABL sites will be used for this purpose, these wells should be clearly identified on site figures and included in any future sampling events.

    Response: The cost estimate for Alternative 2 (Appendix E, Table E-1) includes the installation of two alluvial wells and one bedrock well. The ABL Partnering Team will evaluate the need to install additional alluvial wells downgradient of the TCE plumes at Sites 11 and 12, and shallow bedrock plume at Site 12 as part of the Monitoring Plan.

17. **Section 5.1.2.2, Monitored Natural Attenuation, Page 5-2:** The second paragraph states that existing onsite wells will serve as sentinel wells; however, these wells have not been identified. Additionally, sampling of these wells does not appear to have been included in the cost estimates (Table E-2 of Appendix E). Please revise the FS to identify potential existing sentinel wells, and include sampling of these wells in the cost estimates.

    Response: The text will be modified to identify the potential existing sentinel wells and to state that it is assumed two additional alluvial wells and one additional bedrock well will be installed to serve as sentinel wells.

    The cost estimate for Alternative 2 (Appendix E, Table E-1) includes the sampling and analysis for 30 samples per monitoring event. Table 5-1 presents the conceptual monitoring plan for MNA, comprised of 14 alluvial wells, 8 shallow bedrock wells, and 5 deep bedrock wells. It is unlikely that all twenty-seven wells will be sampled during every monitoring event. It is a more common approach to sample a percentage of site monitoring wells on a rotational basis to obtain a viable data set in a cost efficient manner. Based on this assumption, the cost estimate will not require revisions to include sampling of any additional sentinel wells.

18. **Section 5.1.3.1, Active Treatment Areas, Page 5-3:** The injection zone for enhanced reductive dechlorination (ERD) is within the shallow bedrock aquifer at Site 12. The last sentence of the second paragraph states, "Because of the aquifer interaction, actively treating the [methylene chloride] MC in the shallow bedrock will likely indirectly treat any residual contaminants in the alluvial aquifer as well." The FS does not address the effectiveness of ERD for treating MC in the deeper bedrock aquifer, in which MC was detected above the federal maximum contaminant level (MCL) in 2006 at two deeper wells (12MW21D and 12MW22D), as shown on Figure 3-1. Please revise the FS to address the effectiveness of ERD for treating MC in the deeper bedrock aquifer. Additionally, discuss whether it is feasible to inject the substrate into the deeper bedrock aquifer and whether this may have the potential to remediate shallow bedrock and alluvial aquifer contamination, in consideration of the upward gradient in this area.

    Response: As stated in Section 3.7, "MC detections in the Site 12 deep bedrock aquifer, encompassing the area around deep bedrock well 12MW21D, may be an extension of the shallow bedrock MC area of contamination. The shallow and bedrock aquifer screen intervals are separated by a vertical depth of 3 to 6 feet in the southeast portion of Site 12, supporting the likely connection of the MC area of contamination in the bedrock aquifer." Due to the placement of the Site 12 bedrock monitoring well screen intervals, the bedrock was subdivided into shallow and deep aquifers. However, it is likely that the deep bedrock MC contamination (Figure 3-4) is an extension of the shallow bedrock contamination (Figure 3-3). In addition, the MC value at well 12MW22D in December 2006 was 10 ug/L. In June 2007, MC was not detected. Similarly, the MC value at well 12MW21D in December 2006 was 300 µg/L. In June 2007, MC was not detected. Based on the information above, treating the "shallow" bedrock MC plume will likely treat any remaining MC in the "deep" bedrock; however, it is likely there is no MC remaining in the deep bedrock, which is consistent with the site conceptual model.

The last sentence of section 5.1.3.1 will be revised to state, "Because of the alluvial-bedrock aquifer interconnection, and that any deep bedrock MC contamination is likely an extension of the shallow bedrock MC contamination, treating the MC in the shallow bedrock is expected to indirectly treat any residual contaminants in the alluvial and deep bedrock aquifers as well. However, based on the most recent data (i.e., 2007) and trend data, it is unlikely that there is MC contamination remaining in the deep bedrock. This is consistent with the site's conceptual model of contaminant release and transport."

19. **Section 5.1.3.2, Conceptual ERD Design, Page 5-4:** The FS states that for cost-estimating purposes, emulsified vegetable oil (EVO) was selected as the substrate for injection. However, the FS does not provide an estimate of the quantity of EVO that may be required for injection. Please revise the FS to provide an estimated quantity of EVO required for this alternative, and describe how this estimate was derived.

    Response: The following text will be added to the end of Section 5.1.3.2, "Refer to Table E-3 in Appendix E for the conceptual design of the ERD via injection."

20. **Figure 5-1a, Alternatives 3 and 4 – Site 11 Injection Design:** Please include wells 11GW12S and 11GW12D on the figure.

    Response: Figure 5-1a presents the proposed Site 11 alluvial injection design. To be complete, bedrock wells (11GW10S/D, 11GW11D, 11GW12S/D, 11GW13, and F-WELLS/D) will be included on the figure.

21. **Appendix H, Concentration Trend Graphs for Sites 11 and 12:** The concentration trend graphs should be created using only real data points. If concentration data is not available for a well because it was not sampled during a sampling event, then it should be indicated on the table and on the trend graph (no data point); the previous or most recent sampling result should not be regenerated and used for the plot. The purpose of including monthly average concentrations and the trend line is unclear and the information they provide is misleading. Please also indicate non-detects on the tables and graphs.

    Response: As discussed in the response to General Comment 1, Appendix H will be revised. The tables and figures will be revised to indicate non-detects. As noted in the tables, (1) trend graphs will be created only using monitoring wells with detections, (2) if the result for any particular event in these wells was a non-detect value, half of the reporting limit will be used, (3) if a particular group of constituents was not analyzed during all rounds of sampling at a particular well, the trend line will be based upon the previous results and marked to indicate as such.

    Monthly average concentrations and trend lines have been included to provide an overall summary of the site as a whole. Because the hydrogeologic and biological conditions vary within each site, evaluating the groundwater concentration trend at each well individually may be misleading. The average trend line supports the ability of the site as a whole to naturally attenuate over time.