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TREASURE ISLAND
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DEPARTMENT OF THE NAVY
BASE REALIGNMENT AND CLOSURE
PROGRAM MANAGEMENT OFFICE WEST
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5090
Ser BPMOW.SA/0523
JUN 18 2008

Mr. Ryan Miya
California Department of Toxic Substances Control
Office of Military Facilities
700 Heinz Avenue, Suite 200
Berkeley, CA 94710-2737

Dear Mr. Miya:

Subj: TRANSMITTAL OF THE RESPONSE TO COMMENTS ON THE DRAFT ADDENDUM 3 TO FINAL WORK PLAN IN-SITU ANAEROBIC BIOREMEDIATION PILOT STUDY SITE 24 AND SITE 21; TECHNICAL MEMORANDUM FOR IN-SITU ANAEROBIC BIOREMEDIATION EXPANDED TREATABILITY STUDY SITE 24; AND TECHNICAL MEMORANDUM FOR IN-SITU ANAEROBIC BIOREMEDIATION TREATABILITY STUDY SITE 21 , NAVAL STATION TREASURE ISLAND, SAN FRANCISCO, CALIFORNIA

Enclosure (1) the Response to Comments on the Draft Addendum 3 to Final Work Plan In-Situ Anaerobic Bioremediation Pilot Study, Site 24 and 21, Naval Station Treasure Island, San Francisco, California of June 18, 2008 is provided for your review. The final document and fieldwork for this work plan is scheduled for Monday, June 23, 2008.

Enclosure (2) the Technical Memorandum for In-Situ anaerobic Bioremediation Expanded Treatability Study Site 24, Naval Station Treasure Island, San Francisco, California of June 18, 2008 is provided for your files.

Enclosure (3) the Technical Memorandum for In-Situ anaerobic Bioremediation Expanded Treatability Study Site 21, Naval Station Treasure Island, San Francisco, California of June 18, 2008 is provided for your files.

Thank you for your continued support of this program. Should you have any questions or need additional information, please contact Mr. Scott Anderson, Project Manager at (619) 532-0938 or Mr. Charles Perry, Lead Project Manager, at (619) 532-0911.

Sincerely,

for JAMES B. SULLIVAN
BRAC Environmental Coordinator
By direction of Director

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Encl: (1) RTCs on Draft Addendum 3 to Final Work Plan In-Situ Anaerobic Bioremediation Pilot Study, Site 24 and 21, Naval Station Treasure Island, San Francisco, California

Encl: (2) The Technical Memorandum for In-Situ anaerobic Bioremediation Expanded Treatability Study Site 24, Naval Station Treasure Island, San Francisco, California

Encl: (3) The Technical Memorandum for In-Situ anaerobic Bioremediation Expanded Treatability Study Site 21, Naval Station Treasure Island, San Francisco, California

Distribution:
Ms. Christine Katin, U.S. Environmental Protection Agency, Region IX
Mr. Paisha Jorgensen, California Regional Water Quality Control Board
Mr. Gary Foote, Geomatrix Consultants
Ms. Mirian Saez, Treasure Island Development Authority (w/out enclosure)
Mr. Jack Sylvan, Mayor's Office of Base Reuse and Development (w/out enclosure)
Mr. Jeff Austin, Lennar Communities
Mr. Randy Brandt, LFR, Inc.
Ms. Campbell Merrifield, Tetra Tech EM Inc.
Ms. Jean Michaels, Tetra Tech EM Inc.
Mr. Pete Bourgeois, Shaw Environmental & Infrastructure

Community RAB Members:
Mr. Nathan Brennan
Ms. Dale Smith
Mr. Douglas Ryan
Ms. Alice Pilram
Mr. Saul Bloom, ARC Ecology

Comments by: Ryan Miya, Department of Toxic Substances

General Comments

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1			The Draft Addendum indicates that a conclusion reached in the Final Treatability Report for In Situ Anaerobic Bioremediation (ISB) for IR Site 24 was that increased total molar concentrations of chlorinated ethenes during post-treatment sampling in the source area indicate that a portion of the chlorinated ethenes mass balance existed in a non-dissolved phase, such as adsorbed or as dense non-aqueous phase liquid (DNAPL), and that bioremediation of this phase of the contamination had occurred. It is not clear if the Navy has concluded that the non-dissolved phase will be completely addressed by the use of ISB in the presumed source area (on the northeast side of Building 99) or whether additional measures may be necessary. Due to the possible presence of DNAPL, has the Navy considered additional investigation and/or evaluation of remedial alternatives for the presumed source area similar to those that are proposed for the source area that is addressed in the Draft Addendum (i.e., on the south side of Building 99)? It is likely that DNAPL, if allowed to remain in the aquifer will act as a long-term continuing source of groundwater contamination and may prevent remedial action objectives (RAOs) from being met within a reasonable time frame. <u>Recommendation</u> DTSC requests that the Navy discuss the extent to which the current remedial measure (ISB) is considered to be successful in completely treating non-dissolved contamination that may exist in the presumed source area (outside the area being proposed for investigation in the Draft Addendum) such that RAOs can be met within a reasonable timeframe. Additional investigation (such as Membrane Interface Probe and soil sampling) should be performed at locations within the	The FLUTe investigation on the northeast side of Building 99 conducted in 2005 did not provide any evidence of the presence of DNAPL in the area. In addition, groundwater samples collected near the northeast side of Building 99 following completion of the pilot study did not indicate contaminant concentrations were rebounding. ISB appears to have successfully addressed groundwater impacts in the area and no additional investigation and/or evaluation of remedial alternatives are being considered. To confirm the lack of rebound in the area, Shaw will collect groundwater samples from nearby wells MWW, IW1, IW3, MW2B-2, and MW1A-2. Samples will be analyzed for VOCs and dissolved gases.

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			northeast side of Building 99 to demonstrate the effectiveness of the ISB at remediating possible non-dissolved contamination.	
Specific Comments				
2	2-1	Section 2.1	Potential Source Area. A brief description of potential conditions that would warrant a Permeable Reactive Barrier (PRB) system should be provided in the text. A PRB system cannot not be installed until the DNAPL investigation is complete and design and installation specifications are reviewed and approved in a separate Treatability Work Plan.	The Navy and Shaw agree that the PRB system will not be installed until the need for it is fully evaluated following the DNAPL investigation, at which time the design will be specified in detail and finalized. The investigation will provide data to evaluate the effect DNAPL would have on the operation of the ISB system in the dissolved CVOCs area. This point has been emphasized in the revised Section 2.1.1 on the DNAPL Investigation Report.
3	2-3	Section 2.1.1.1	Membrane Interface Probe Study. A. A brief description of the deployment of the Membrane Interface Probe (MIP) is warranted (how get into ground, how long keep in ground to equilibrate and take measurements, how the data will be used to identify if DNAPLs are present). B. While the text states that "MIP locations will be determined in the field in a step-out manner, based on the real-time data from the MIP detectors", a more thorough description of how this will be implemented should be included. For example, a detection of how high will warrant how many step-outs and in what direction(s)? What level of detection will not warrant additional step-out sampling? C. A description of the method of emplacement and composition of the grout that will be used to backfill the Membrane Interface Probe borings must be presented.	The text has been clarified on the following points. A. Direct-push technology with a Geoprobe rig or equivalent will be used to deploy the MIP and FLUTe, and to collect soil cores. Valid MIP data points will be collected while the probe is advanced at a rate of 1 ft/min or less. The probe may be stopped periodically to allow for sufficient heating of the soil. To identify DNAPL, MIP, FLUTe, and soil sampling data will be used together. The purpose of MIP is to screen the area for locations with high CVOCs concentrations. These locations will be investigated with FLUTe. The purpose of FLUTe is to confirm the potential presence of DNAPL. Soil cores will also be collected at the same location as the FLUTe locations and soil samples will be analyzed to speciate and quantify the contaminants. B. Figure 3 has been revised to show more tentative initial MIP locations that are spaced 20 ft apart. The locations with the highest results will be identified and new locations 10 feet from the hot spots will be selected. These new locations will be north, south, east, and/or west of the hot spot. C. Each location will be pressure grouted with neat cement to surface elevations using a tremie after data collection to

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				minimize the potential for vertical distribution of the contaminants.
4	2-4	Section 2.1.1.3	Soil Sampling. A description of the method of emplacement and composition of the grout that will be used to backfill the Geoprobe borings must be presented.	Each location will be pressure grouted with neat cement to surface elevations using a tremie after data collection to minimize the potential for vertical distribution of the contaminants.
5	2-4	Section 2.1.1.4	Monitoring Well Installation. Monitoring well screens must not exceed 10 feet in length to minimize the potential for dilution. If necessary, installation of a cluster of two or more short-screened (5 to 10 feet) monitoring wells at each location should occur rather than installing one well with a long screen-length.	The section has been renamed "Well Installation" because three of the four wells are not being built exclusively as monitoring wells, but as injection and extraction wells. Injection and extraction wells require larger screen intervals (20 ft long) to serve their purposes. Data from injection and extraction wells will be confirmed with data from monitoring wells within the plume.
6	2-5	Section 2.1.1.5	DNAPL Investigation Report. As a part of the characterization of the potential DNAPL CVOC plume, a description of how the proposed characterization methods will be able to differentiate between a DNAPL plume which occurs in small residual globules disseminated throughout the aquifer and one with a low surface area to mass of larger pools of DNAPL is essential. Describe how the data obtained will be used to differentiate between these two general types of DNAPL plumes, which is a key aspect with regards to potential DNAPL plume characterization.	The form of the DNAPL may be as small residual globules disseminated throughout the aquifer, as pools of DNAPL, or a mixture. If there is a mixture, treatment will focus on the pools, as that is the more recalcitrant form, and the successful treatment of pools will also effectively treat globules. When investigating with the FLUTe, globules would appear as small distributed stains, while a pool would appear as an extended stain. Futhermore, a pool would need to be supported by a less permeable layer, which can be verified by the soil cores.
7	2-5	Section 2.1.3	Potential Treatment Pilot Test Alternatives. The Draft Addendum discusses potential alternatives for addressing a DNAPL plume that has yet to be identified and/or adequately characterized. Remediation alternatives cannot be effectively evaluated before characterization of any DNAPL plume is complete.	Comment noted.
8	2-9	Section 2.2.1.1	Delineation using Temporary Wells. It is stated that the sample depth within the well screen intervals will be selected based on depths of high concentration results from nearby biobarrier well locations, but the screen-length and total depth of the temporary wells is not specified. Long screen-lengths (greater than 10-feet long) will provide a flow-weighted average of the contaminant concentrations within the screened interval and therefore, are not appropriate for plume	The temporary wells will have a depth of 40 or 45 ft bgs, and the screen interval will be from 10 ft bgs to 35 or 40 ft bgs. Shaw will sample the temporary wells using a screen interval boundary sampling tool which allows collection of depth-discrete samples. Installation of wells with extended screens allows for effective use of the tool at multiple depths. Data generated by the sampling will allow for vertical characterization of aquifer impacts for the purposes of remedial

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			delineation. In other words, samples should be collected from short screen-lengths at multiple depth-intervals, as needed, to evaluate the configuration of the dissolved plume in three dimensions for the purposes of site characterization and remedial design. The construction details of the proposed temporary wells must be revised to include the use of multi-depth sampling intervals for plume delineation.	design.
9	2-10	Section 2.2.1.2	Reconfigure Injection and Extraction Wells. The text states that extraction wells will be designed with screen intervals between 10 and 30 feet below ground surface (bgs) or possibly deeper depending on the groundwater sampling at new temporary well locations. The basis for determining the screen lengths for the design of the proposed new extractions wells must be provided. As stated previously, the Navy should perform multi-depth sampling so that extraction well screen-intervals can be designed to target the intervals of highest groundwater contamination.	Multi-depth sampling will be conducted in the temporary wells as discussed in the response to Comment No. 8. The extraction wells will have a screen length of at least 20 ft so that the well will provide enough water for extraction. The screen interval will be selected for optimized operation.
10	2-12	Section 2.2.2.1	Substrate Media Evaluation. The text provides a brief description of some alternative media that may be evaluated as a part of this work, but the experimental design of the media evaluation is not presented. Additional details describing the procedures that will be implemented and exactly how the various substrates will be compared and evaluated must be included.	The evaluation will focus on the cost and practicality of using lactose as a substrate, with consideration of the added cost and process steps involved with solids handling and dissolution of large quantities of lactose powder.
11	3-1	Section 3.0	Site 21. Design details such as performance monitoring specifications, methods that will be used to monitor the groundwater to ensure that the plume is not being pushed into other areas, and the analytical suite of groundwater contaminants that will be monitored over time (as well as the frequency) must be presented in the Draft addendum.	Section 3.4 outlines the sampling and analysis for Site 21. The details are available in Appendix B, Sampling and Analysis Plan Addendum 1.
12	3-2	Section 3.1	Injection of Substrate and SDC-9. A. Please define what "site anisotropy" is and describe how the addition of five times the lactic acid concentration required will safely account for its occurrence.	A. Site anisotropy means that the soil and hydrology characteristics are not uniform throughout the site. For example, clay balls in the subsurface may impede the distribution of substrate because they are less permeable.

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			B. It is unclear how injection of contaminated site water at locations in the interior of the plume will help distribute the substrate and microbes any more than injection of clean water with substrate and SDC-9 culture amendments. C. The text proposes to inject the substrate and microbes one injection interval below the depth of the 100 µg/L plume to prevent the plume from being pushed deeper. However, given the lack of groundwater characterization between approximately 10 and 23 feet bgs directly south of the dip tank at 21-MW08A and B (Figure 9), as well as the dense and unpredictable nature of the contaminants, deeper groundwater contamination may in fact be present at this location. In addition, the highest soil contamination was found southwest of the dip tank, and west of monitoring wells 21-MW08A and B, but no groundwater data are available from this location. Therefore, the Navy should conduct additional soil and groundwater investigation and/or deeper injections in the areas south and southwest of the dip tank to account for uncertainties associated with site characterization. D. A groundwater extraction/injection schedule with approximate time frames should be included in the Draft addendum in order for the reviewers to evaluate the phased "perimeter" and plume "interior" injections to help prevent the lateral spread of the plume due to the injection process.	The substrate quantity is designed to balance electron donor demand. For Site 21, this quantity is multiplied by a safety factor of 5, which is a relatively large safety factor. An abundance of substrate will improve the distribution by providing a large concentration gradient to drive molecular diffusion, and there will be plenty to spread around by advective transport. B. In the context of this comment, clean water may refer to water from wells located outside the plume boundaries or hydrant water. First, it makes sense to add the amendments directly into the contaminated water to treat it. The water would provide electron acceptors (chlorinated ethenes) necessary for the growth of the DHC microbes. Second, extracting only from wells located outside of the plume boundaries may not provide sufficient water in the one month planned for water extraction activities. Therefore, some wells inside of the plume will be used. Third, it is favorable to use site groundwater opposed to hydrant water because the latter does not initially have the same geochemistry of the site groundwater. Hydrant water is oxygenated and amended with a bactericide which is unfavorable for anaerobic reductive dechlorination. The explanation in Addendum 3 for the use of contaminated water has been modified to emphasize the points above. C. CE concentrations in shallow and deep groundwater immediately southwest of the dip tank, in the vicinity of sample 21-GB03 which contained 2.4 mg/kg TCE, do not appear to exceed the TS limit of 100 ug/L. Grab groundwater samples from location 21-HP013, completed approximately ten feet south of 21-GB03, contained 30 ug/L TCE and 12 ug/L PCE at 7 to 9 feet bgs and less than 0.05 ug/L PCE and TCE at 18 to 20 feet. However, an additional deep injection location in the vicinity of 21-GB03 will be added to the program to alleviate concerns regarding

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				uncertainties associated with site characterization. D. A schedule has been added to Section 3.3.
13	3-3	Section 3.2	Makeup Water Extraction. The approximate volume of groundwater as well as the volume of lactic acid and SDC-9 added to groundwater that will be required for the proposed injections (per location as well as total) should be presented.	The specifics provided in this response will be added to the text. The following estimates are provided for the substrate lactic acid, but the Navy and Shaw will have the option of using equivalent amounts of a lactic acid/lactose mixture. The target average in situ concentration of lactic acid is 3,250 mg/L, so the injections will need to deliver approximately 7,100 kg of substrate. The target volume to be injected will be 40,000 gallons, which is about 7% of the aquifer volume of the treatment area, assuming an effective porosity of 0.30. Given these design parameters, the injection concentration of lactic acid will be approximately 47 g/L. The volume of SDC-9 to be injected is 60 L. There are 32 injection locations, so about 1,250 gal will be injected into each location.
14		Figure 5	Site 24 Total Chlorinated Ethenes. The contour map shows a small area exceeding 500 micrograms per liter (pg/L) total chlorinated ethenes at the toe of the plume (within 100 feet of the Bay). However, the data upon which this interpretation is based in not shown on the map. Please specify the data that was used to derive this interpretation at the toe of the plume.	The *Technical Memorandum, In Situ Anaerobic Bioremediation Expanded Treatability Study, Site 24, Naval Station Treasure Island, San Francisco, California* (Site 24 Tech Memo) and the *Technical Memorandum, In Situ Anaerobic Bioremediation Treatability Study, Site 21, Naval Station Treasure Island, San Francisco, California* (Site 21 Tech Memo) present the data on the results to date. The Tech Memos are enclosed.

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Specific Comments				
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1	1-3		The document assesses the practicality of treating the total chlorinated ethenes down to concentrations as low as 100 µg/L because attenuation of contaminants below this concentration occurs at a rate that is not well understood, although previous studies have shown that biological reduction can continue to a lower concentration. It also states that conclusions to date are preliminary. Assuming that concentrations reach 100 µg/L successfully, will the feasibility of continuing the study be evaluated?	In situ bioremediation is capable of reaching concentrations below 100 µg/L. The feasibility of continuing similar in situ bioremediation treatment is being evaluated in Tetra Tech's Remediation Investigation / Focused Feasibility Study. At the end of the current treatability studies at Sites 24 and 21, Shaw anticipates that the Navy will assess the need for further treatment considering the clean up goals that have been established. For Site 24, the remedial goals as of May 2008 are: 86.2 µg/L for PCE, 56 µg/L for TCE, 712 µg/L for cis-1,2-DCE, and 165 µg/L for VC. For Site 21, the remedial goals as of June 2008 are: 190 µg/L for PCE, 2000 µg/L for TCE, none for cis-1,2-DCE, and 240 µg/L for VC.
2	2-2	Section 2.1.1	The DNAPL investigation will include the former UST area at the southeast corner of Building 99. There is limited information about the USTs and whether they have been removed. Although this area is being investigated, the Navy does not believe the USTs to be the DNAPL source. Will action be taken to characterize/remove the tanks if they are found to exist?	It is Shaw's opinion that the tanks do not currently exist based on previous work in the former UST area. However, if the tanks are encountered during the investigation, Shaw will discuss with the Navy about removing them. This activity would not be covered under the current scope of Addendum 3.
3	2-12	Section 2.2.3	Groundwater will be sampled in four milestone events before the conclusion of the ISB treatment: baseline conditions, during recirculation and injection with DHC microbes, four months into Stage 2, and eight months into Stage 2. In the event that vinyl chloride accumulates in the process, would it be detected inside the building apart from any of the four sampling events? Is the building currently vacant?	Building 99 is currently vacant. Building 96 is mostly vacant, but one part is used for storage by Toys for Tots. No indoor air sampling is proposed as part of the Addendum 3 work and accumulations of VC in between groundwater sampling events would not be detected. The building is well ventilated and potential indoor air breathing hazards to sampling technicians are not expected. Also, VC is created only for a short time and is generally quickly degraded. In any case, a photoionization detector or Draeger tubes for VC detection will be utilized for air sampling during indoor work in accordance with the Health and Safety Plan.
General Comments				
4			What is the current use of Building 3?	The majority of Building 3 consists of warehouse space which is leased to movie production groups. The San Francisco Public Utilities Commission stores transformers and other electrical devices within a

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				room adjoining the south side of the building. Building 3 is characterized as a low occupancy building.

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1			***The Presentation of Data Collected to Date.*** The document does not provide a sufficient evaluation of the data collected to date to allow a reader to asses whether the proposed additional activities are appropriate. Although some information has been presented at BRAC Closure Team (BCT) meetings in PowerPoint presentations, a technical document containing a thorough presentation of results to date has not been prepared for BCT review. As such, we are not able to assess whether the proposed additional activities are appropriate.	The *Final Treatability Report, In Situ Anaerobic Bioremediation Pilot Study, Site 24, Building 99, Naval Station Treasure Island, San Francisco, California* (Shaw, 2005) presents the results of the pilot study that established the technical basis for the current proposed work related to bioaugmentation and groundwater recirculation. As requested in the comment, Shaw has prepared documents that present the results to date of work completed following the pilot study, which includes the bioremediation of the extended plume at Site 24 and of the plume at Site 21. The *Technical Memorandum, In Situ Anaerobic Bioremediation Expanded Treatability Study, Site 24, Naval Station Treasure Island, San Francisco, California* (Site 24 Tech Memo) and the *Technical Memorandum, In Situ Anaerobic Bioremediation Treatability Study, Site 21, Naval Station Treasure Island, San Francisco, California* (Site 21 Tech Memo) are enclosed.
2			***The Description of Many Proposed Activities is Vague.*** Details on data interpretation (i.e., how DNAPL is identified) and remediation design (e.g., injection volumes) are not discussed. Additionally, the analytical suite for performance monitoring is not defined adequately. Please see the Specific Comments below for many other .examples where additional information is needed for clarification. In general, the Work Plan does not provide sufficient details and supporting information about the work that is to be implemented to allow us to evaluate adequacy of the proposed work.	It should be emphasized that the proposed work is a study, so the Navy and Shaw would like to leave some flexibility in Addendum 3 such that the design can be improved as more field data becomes available. For example, the appropriateness or adequacy of the PRB and DNAPL treatment system will be contingent upon the results of the DNAPL investigation. The design of these systems is outlined in Addendum 3, and will be refined and documented in the DNAPL Treatability Work Plan, as stated in Section 2.1.3. Certain proposed activities including injection volumes and how DNAPL is identified are clarified in the responses that follow.
3			***Evaluation of Underground Storage Tank Area and Subsurface Utilities as Potential Source Areas.*** The document proposes to conduct a source area investigation in the vicinity of EW-4, including the location of a former underground storage tank (UST) area. This UST area was not previously identified in the October 2003 Final Facility-wide UST Summary Report or the August 2004 Final UST Summary Update. Please explain how the Navy came to know about the presence of these USTs and why they had not been identified in	The Navy RPM alerted Shaw regarding the UST area in mid-2007. There is uncertainty about the history of the tanks, described as "three 1000-gallon solvent USTs shown in 1948 Navy PWC map" on Figure 1-4 of the *Draft Remedial Investigation and Focused Feasibility Study Report for Installation Restoration Site 24 Former Dry Cleaning Facility, Naval Station Treasure Island, San Francisco, California* (Sultech, 2007). The report does not discuss these USTs any further. It is Shaw's opinion that the tanks do not currently exist based on

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			the earlier UST Summary Reports. In addition, information presented in the Draft Remedial Investigation (RI) Report for Site 24 suggests that chemicals may have been discharged to the to the sanitary sewer inside Building 99 and exiting Building 99 to the southeast. Additionally, samples collected from wells near sanitary sewers generally show higher chlorinated ethane concentrations (wells EW-6 and EW-10, Figure 5) than other wells. Consistent with our comments on the Draft Site 24 RI Report, we believe that subsurface utilities should be evaluated to asses whether they have affected the distribution of contaminants in the subsurface, either as a direct source (resulting from past chemical discharge) or by creating pathways.	previous work in the former UST area. The Navy believes that sufficient sampling has been conducted to conclude that subsurface utilities are not acting as preferential pathways beyond the Site 24 boundary. The November 17, 2005 Site 24 Boundary Change letter cites several boundary change justifications, including: (1) "The IR Site 24 southern boundary was adjusted to remove portions of former Fuel Line Sites F2A and F2B because the sites have undergone extensive investigation and cleanup under the petroleum program. In addition, data indicate that the IR Site 24 volatile organic compound (VOC) plume does not extend into these sites" and (2) "Overall, the IR Site 24 boundary was modified with the primary goal of investigating the source area at Building 99 and the surrounding VOC plume. The proposed boundary is designed to encompass the entire VOC plume." The figure attached to the 2005 letter shows that PCE was not detected in groundwater outside of the revised Site 24 boundary, including north and south of Site 24 along the subsurface utility lines, indicating that the utility lines have not acted as a preferential pathway beyond the Site 24 boundary.
4			***Evaluation of Individual Volatile Organic Compounds (VOCs).*** Data presented in the report only show total VOC concentrations. When the pilot treatability studies were initiated in 2003, the BCT agreed to use 100 micrograms per liter (µg/L) total VOCs for purposes of assessing the effectiveness of the studies. However, the BCT has not yet established cleanup goals for individual VOCS in groundwater. As we have suggested at previous BCT meetings, we believe it is prudent to present and evaluate data for individual VOCs (e.g., vinyl chloride) to better assess whether the treatment technologies could be a final remedy for these sites.	The Site 24 Tech Memo shows distribution of individual chlorinated ethenes.

Specific Comments				
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5	1-3	Section 1.1	The first bullet of text on page 1-3 states, "The use of direct-push injection points (Site 24 BioBarrier Wells and Site 21 Injection Points) is a viable and cost-effective method of distributing small to moderate amounts of substrate and DHC microbes within a zone of influence with a radius of approximately 10 to 15 feet." Our calculations indicate that the volume required to achieve a radius of influence (equidistant from the injection location) of 10 feet assuming effective porosity of 0.25, is approximately 580 gallons per foot of targeted depth interval. Although we do agree that direct-push injections are inexpensive, large volumes of fluid injection (about 5,800 gallons for 10 feet of thickness and 10 feet radius of influence) would be required for effective distribution. If small volumes of fluid are to be injected, how will the injected amendments be evenly distributed throughout the targeted area of depth?	At Site 21, the volume to be injected will be about 7% of the aquifer volume, which is 40,000 gal for the entire plume or 91 gal per foot of targeted depth interval, assuming an effective porosity of 0.30. The direct-injection will use high pressure to jet out the water. Injected amendments will be sufficiently distributed by mechanical dispersion and molecular diffusion. Please refer to the response to Comment No. 23 regarding assessment of the distribution for the direct push injections at Site 21.
6	1-3	Section 1.1	The third bullet under the conclusions from the Expanded Treatability Study at Site 24 and direct injections at Site 21 states, "A PRB using EHC® is effective at reducing concentrations of chlorinated ethenes to below 100 micrograms per liter (µg/L)." Please provide the data from these studies that supports this statement. The effectiveness of a PRB relies not only on the media emplaced, but also on the hydraulic performance of the system, the contaminant discharge across the alignment, and careful construction (emplacement) methods (to ensure the emplaced media is more permeable than the aquifer sediments). Residence time influent concentration (based on groundwater flow velocity and maximum plume concentration) are key in the design of the PRB, in conjunction with the compound specific degradation rate for the emplaced treatment media. These site specific factors should be considered as part of the PRB design.	The Site 21 Tech Memo discusses the application of the PRB at Site 21, and the results. Note that Comment No. 14 is also related to the design of the PRB.
7	2-2	Section 2.1	The text states, "ESB is considered most applicable if DNAPL is distributed throughout the aquifer as small residual globules distributed through the aquifer matrix. ERH is considered most applicable if the DNAPL occurs in the aquifer as pools or as large residual bodies distributed through the aquifer matrix." The document should provide references to support these statements unless they are	The statement that ESB is considered most applicable if DNAPL is distributed throughout the aquifer as small residual globules and that ERH is considered most applicable if DNAPL occurs in aquifer as pools or as large residual bodies is based upon opinion, literature and experience. For ESB to be effective, the surface area of the DNAPL must be activated and/or increased so that it can become bioavailable.

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			simply opinions provided by the authors of the report, in which case, a basis for the opinion should be provided. Also, it may be difficult to establish whether pools of DNAPL or widespread globules exist in the subsurface. This information appears to be an important decision criterion for choosing one of these two technologies. What if both globules and pools exist?	DNAPL that is distributed through the aquifer as small residual globules is an effective starting point for ESB, because the surface area of the DNAPL is already large and distributed. The addition of excess substrate will act as a surfactant, coating the surface of the DNAPL, enhancing the dissolution of the DNAPL at the interface of the globules. If the DNAPL exists as a pool or as a large residual body in the aquifer, the addition of excess substrate will have the effect of activating the surface of the DNAPL but little to no effect on increasing the surface area. Dissolution of the DNAPL at the interface will occur, but the degradation will be negligible because the bacteria cannot get to the DNAPL mass. A literature reference in support of the above statements includes: Carr, C.S., S. Garg, and J.B. Hughes, 2000. "Effect of Dechlorinating Bacteria on the Longevity and Composition of PCE-Containing Nonaqueous Phase Liquids under Equilibrium Dissolution Conditions," Environmental Science & Technology, 34, 1088-1094. ERH is equally applicable technically whether the DNAPL is present in pools or as distributed globules. The resistance of the soil and water between electrode pairs will result in the heating of the area, volatilizing free phase contaminants and generating steam which can easily be captured by a vapor extraction system. However, ERH is more expensive than ESB, on the order of \$250/cubic yard (yd^3) based upon full-scale removal actions performed at Alameda Point, compared to an estimated \$85/yd^3 for ESB. Therefore if the DNAPL is present as distributed globules, then the application of ESB will be cost effective. If there is a mixture of pools and globules, treatment will focus on the pools, as that is the more recalcitrant form, and the successful treatment of pools will also effectively treat globules. When investigating with the FLUTe, globules would appear as small distributed stains, while a pool would appear as an extended stain. Furthermore, a pool would need to be supported by a less permeable layer, which can be verified by the soil cores.
8	2-2	Section 2.1.1	The text states, "Data from nearby wells IEW5 (former EW5), IEW6 (former EW6), and EIW5 (former IW5) do not strongly suggest that	The data are presented in the enclosed Site 24 Tech Memo in Appendix A, "Site 24, Extraction Wells Data," and Appendix B, "Site

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			DNAPL will be found in the UST area." It is unclear which data support this statement. Please provide more detail and discussion.	24, Injection Wells Data."
9	2-2	Section 2.1.1	The text states, "The Tetra Tech Remedial Investigation of the site shows cross sections in which the Bay Mud occurs at a depth of 35 feet. Tetra Tech considered this to be a laterally continuous confining unit. Shaw's data did not confirm this. Although clayey lenses were observed, they appear to be discontinuous, and therefore do not constitute a lower confining layer at least down to 35 feet." It is not clear whether Shaw has concluded (1) that no continuous layer of Bay Mud exists or (2) that a continuous confining layer might occur at a depth greater then 35 feet. Given the likely importance of Bay Mud as a low permeability, continuous layer for preventing downward contaminant migration, Shaw should consider extending their DNAPL investigation to depths where Bay Mud is expected to encountered, to confirm the absence or presence of this important hydrogeologic unit.	Shaw collected the data while tracking the plume, and was not conducting a geological study. The statement is intended just to note what was observed, and more data would be required to reach a conclusion. No work was done to confirm or deny the presence of a laterally continuous confining unit at 35 ft bgs.
10	2-4	Section 2.1.1.1	The text states, " ....the depth will be ***up to*** 35 feet bgs, which is slightly deeper then the depth of the Bay Mud." Geomatrix recommends that the depth of the MIP investigation should be ***at least*** 35 feet, especially since Shaw indicates in Section 2.1.1 that Bay Mud was not encountered at this depth. Shaw should be prepared to extend the investigation below 35 feet based on real-time chemical and lithological information as it is available in the field. For example, it would not be helpful to terminate a MIP boring at 35 feet if the detector response(s) indicate that high VOCs were present at 35 feet bgs (and likely deeper). Additionally, the document should discuss procedures for preventing vertical mobilization of DNAPL if it is encountered at a shallow depth. Finally, the document should indicate a description of the method used for identifying Bay Mud with the MIP technology.	The text will be changed to say "at least 35 feet bgs." Vertical drawdown of DNAPL is not anticipated during the use of direct-push. The boring will be grouted immediately after the direct-push tool is removed, tremied in from the bottom upward. Since the geology at the site does not involve multiple aquifers and continuous confining layers between the ground surface and the Bay Mud, the major risks associated with vertical mobilization (e.g. contaminating a lower clean aquifer) do not apply here. If cases arise where MIP sampling is required below zones of potential DNAPL, the driller would take additional measures to prevent vertical mobilization by using conductor casing in the DNAPL-affected region that serves as a clean path for the MIP to reach the non-DNAPL-affected depth. The Bay Mud will be identified using soil cores, opposed to using the MIP, whose purpose is to determine the extent of contamination. During MIP logging, electrical conductivity data is also collected which gives clues about the relative lithology, but it may not be enough to differentiate the Bay Mud from the overburden.
11	2-4	Section 2.1.1.1	Figure three shows only two initial locations for using the MIP technology and the text indicates that, "the total number of MIP	Figure 3 has been clarified with the addition of more starting MIP locations.

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			locations is anticipated to be up to 30 locations." While we understand that the need for flexibility for expanding the study based on real-time data, we believe that additional initial locations should be identified in this work plan. Additionally, the text states, "If a possible DNAPL source is detected using MIP technology.....". The document should include a discussion of criteria that will be used to identify DNAPL using MIP and how many confirmation soil and groundwater samples will be collected for comparison with the MIP results.	The criteria for identifying DNAPL will be staining on the FLUTe fabric. In the investigation, first MIP will be used as a screening tool to identify the areas with high CVOC concentrations. In the quoted text, "possible DNAPL source" means an area with high CVOC concentrations. Second, FLUTe will be used to confirm the presence of DNAPL at 8 locations. Third, soil core samples will be analyzed to speciate and quantify the DNAPL. Soil cores will be taken from the borings used for the FLUTe sampling. Up to five soil samples from each core will be analyzed. Baseline groundwater samples will be collected from the 4 new wells in the DNAPL investigation area. This data will supplement the baseline groundwater sampling data taken in the January 2007 event and allow the plume contour to be refined.
12	2-4	Section 2.1.1.2	The text indicates that borings will be drilled to conduct FLUTe® and soil sampling, however, no information is provided about the number of borings to be drilled, their location, or the depth to which borings will be drilled. Please provide this information or explain how decisions will be made to identify locations and depths during the DNAPL investigation.	FLUTe samples and soil cores will be taken from the eight locations with the highest MIP results. The depth will be to 35 feet bgs. The length of the FLUTe liners is specified at the time they are ordered.
13	2-4	Section 21.1.4	A discussion of the drilling methods for monitoring well installation and methods for minimizing vertical mobilization of DNAPL (if present) should be included in this section. On page 2-5 of the same section, text states, "Analysis of samples may include: VOCs, dissolved gases, sulfate, alkalinity and ferrous iron." Since this document is a Work Plan Addendum, we request that it specify the analyte list for the baseline monitoring. Stating that samples <u>may</u> be analyzed for various constituents provides no meaningful information.	Monitoring/extraction/injection wells will be installed by hollow stem auger. Shaw will aim to place them close to DNAPL, but not right where the DNAPL is. Since the geology at the site does not involve multiple aquifers and continuous confining layers between the ground surface and the Bay Mud, the major risks associated with vertical mobilization (e.g. contaminating a lower clean aquifer) do not apply here. Sampling will be in accordance with the Sampling and Analysis Plan (Shaw 2007) and the Sampling and Analysis Plan Addendum 1.
14	2-5	2.1.2	The conceptual design involves 10 injection locations to a depth of 35 feet bgs where 36,300 pounds of a granular compound (EHC) is injected over five-foot depth intervals at 15-foot spacing "to create a PRB that stretches a linear distance of 150 feet...." It seems very unlikely that a continuous PRB can be installed by injecting a granular	Comment noted. An outline of the PRB system is provided in Addendum 3. If the application of the PRB is found to be appropriate based on the findings of the DNAPL investigation, then the detailed design will be provided in the DNAPL Treatability Work Plan, as stated in Section 2.1.3.

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			substance into the subsurface at discrete locations. There are many other PRB installation methods that would provide a much higher likelihood of success, in terms of passive treatment and mass discharge reduction, compared to the proposed approach. Figure 4 shows the "PRB System" in plan view as a series of EHC injection locations where cylinders of EHC material appear to be adjoining to form a continuous wall of reactive material across the dissolved plume. We calculate the soil mass for these cylinders to be approximately 9,420,000 lbs, based on the volume of ten cylinders with a height of 30 feet and a radius of 10 feet, and a dry density for sand of 100 pounds per cubic foot. The design EHC weight of 36, 300 pounds represents less then 0.5% by weight of the soil contained within the boundaries of the circles shown in Figure 4, which is approximately four times less then the vendor recommended mass of EHC for constructing a "PRB System" by injection at a chlorinated solvent site. (http://www.adventusgroup.com/pdfs/EHC/EHC%20mechanisms%20requirements.pdf). Although additional information and justification for the design of the PRB system would be useful for the Addendum, the available limited information suggests that the PRB system would not be effective at limiting dissolved chlorinated ethene migration. In addition, a discussion of the detailed performance monitoring network for the demonstration of the effectiveness of the "PRB System" would be useful in this section.	The preliminary design was provided by Adventus, and is attached.
15		Section 2.1.3.1	The text states that the ERH "array will give a radius of influence of approximately 25 to 30 feet....." Please provide the supporting documentation for the statement. The text indicates that this system has been used by the Navy at Alameda Point. Was the technology successful at this site?	A single ERH cell of six electrodes with a neutral at the center has been used to treat an area of greater than 3,000 square feet down to a depth of 25 feet below ground surface (ft bgs). This performance was documented at several locations at Alameda Point, where electrodes were laid out in a hexagonal pattern with regular spacing of 25 feet. Thermal treatment occurred throughout the hexagonal area and extended roughly eight feet outside the hexagonal array. The application of ERH at Alameda has been very successful. Non-time critical removal actions have been performed at three separate DNAPL plumes, covering areas nearly an acre in size with treatment depths up to 45 ft bgs. Total CVOC concentrations as great as 400,000 µg/L at a singe monitoring well have been reduced to less

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				than 1,500 µg/L during ERH application over 6 months. Average concentrations based upon as many as 17 monitoring wells have been reduced from 50,000 µg/L to less than 100 µg/L and average plume area temperatures have been increased from less than 18 degrees Celsius (°C) to greater than 100°C with 3 to 6 months of treatment. The removal of hundreds to thousands of pounds of CVOCs has been estimated based upon vapor recovery rates and gas phase concentrations.
16	2-7, 2-8	Section 2.1.3.3	The operation of the injection and circulation program (i.e. the amendment delivery method) is unclear. There is no explanation for the volume of lactic acid and SDC-9 to be added to the groundwater, and how many pore volumes of the treatment zone are to be circulated through the system, and at which wells. We recognize that it is important to have flexibility in operation of the bioremediation system such that performance enhancing modification can be implemented as data become available. However, this document should clearly describe the starting conditions and present the supporting design calculations. In addition, the text says, "During Stage 1, groundwater samples will be collected monthly from five wells and may be analyzed for alkalinity, sulfate, and dissolved arsenic." This statement could be interpreted to be suggesting that, at a minimum, one groundwater sample will be collected per month but the sample may not be analyzed for anything. The same language is used in Section 2.1.3.4 and 2.2.1.1.	The starting operational parameters are listed below and will be optimized in the field: target concentration of lactic acid within the Site 24 treatment area is 2,000 mg/L; each injection well will receive 2 to 3 pounds of SDC-9; the rate of injection will be about 7 gpm as it was in Addendum 1; well locations for extraction and injection are shown on Figure 6, "Site 24 Phase 2 of the Expanded Treatability Study Well Layout." The quantity of substrate is determined by balancing the electron donors supplied by the substrate with the electron donor demand. The electron donor demand is the sum of the demands for reductive dechlorination of dissolved and sorbed phases of CVOCs and for competing electron accepting reactions. The required quantity of substrate is multiplied by a safety factor. The quantity of SDC-9 is based on the treatment volume and the target average number of cells per liter of aquifer volume, which is typically between $1x10^6$ and $1x10^7$. Shaw anticipates that about one pore volume of the treatment zone will be recirculated, as was observed during Phase 1. The actual amount of water recirculated depends on when substrate reaches the extraction wells. In Phase 1, the total volume of recirculated water was 13.7 million gallons.
17		Section 2.1.3.1	The text indicates that there will be "*up to* four consecutive quarters of post-treatment groundwater sampling of *up to* five wells in the source area." As written, this requirement could be satisfied if one well is sampled once. We recommend that in both cases the words "up to" be replaced with "a minimum of." We believe that it is essential for	Comment noted. The wording in the Work Plan is intended to suggest the need for flexibility. However, the Sampling and Analysis Plan provides the specifics about the location, frequency, and analytes.

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			monitoring to be conducted for a sufficient period of time to confirm that rebound does not occur.	
18		Section 2.2, and Figure 5	The text in this section states that the downgradient plume "contains relatively higher concentrations of more reduced compounds including TCE, DCE, and VC. It would be helpful to present figures that show individual VOC concentrations to support this statement (see general comments above). On a related note, Figure 5 shows plume contours for total VOCs but it does not present any of the data that were used to develop the contours. On [the] figure showing iso-concentration contours, please present the data that were used to develop the contours. Additionally, note 1 of Figure 5 indicates that the "100 µg/L chlorinated ethenes plume is conservative because it includes areas around the injection wells even thought their total chlorinated ethenes concentration is less then 100 µg/L." Chemical concentrations for post-injection samples from the injection wells will be biased low because these wells were flooded with amendment-containing water, and therefore, it is misleading to suggest the plume contour is conservative based on results of the injection wells. The injection wells should not be used for monitoring the dissolved plume.	The Site 24 Tech Memo presents figures that show the concentrations of individual VOCs. The analytical data is also available in that document. Shaw recognizes that injection wells may experience higher rates of bioremediation, but believes that the information from these wells is an important part of the picture. The data from both injection and extraction wells will be used to measure results.
19		Section 2.2.1.1	Please provide the rationale for why temporary wells are not required west of location TW-23	New temporary wells are not necessary west of the TW-23 because there are existing wells there such as TW-13 and TW-22 (see Figure 5), and furthermore, previous data from that areas shows no plume movement toward the west and the south.
20	2-10	Section 2.2.1.2	The text in the first paragraph states, "Phase 1 of the expanded TS demonstrated that the radial distribution well layout provided better substrate distribution than the two-well loop system used in the pilot study (source area). The reconfiguration of the injection and extraction wells is based on the results of the Phase 1 system operation." Please provide the analysis of the Phase 1 data that is cited to support the reconfiguration. Also, the text in this paragraph indicates that "degradation decreased away from the injection wells." How far away was the effective degradation observed? Please provide the supporting data. Additionally, this section indicates that wells formerly used as injection wells will be used as extraction wells in the Phase 2 dissolve plume in situ bioremediation program.	Effective degradation was observed at injection and extraction wells, and the data is provided in the Tech Memo. Therefore, the distance from injection well to the limit of effective degradation was not observed. The distance between injection and extraction wells was based on the distance a pulse of substrate can travel before being completely consumed. Given that substrate can last for 4 to 6 months, the extraction well locations were selected using Visual Modflow model results for the site. The model also showed that a radial distribution system can achieve excellent results, which was confirmed in the field. The four new wells are shown in Figure 6 as EW28, EW29, EW30,

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			Geomatrix would like to point out that, under this scenario, all post-startup samples collected from the extraction and injection wells will be from wells that have received injected substrate and therefore these samples will likely indicates "best case" reduction of chlorinated ethenes. To better monitor the effectiveness of the in situ bioremediation program, additional monitoring wells should be installed in areas where direct injection of substrate did not occur, to ensure adequate effectiveness throughout the entire plume. Finally, please identify the locations of the four additional extraction wells discussed in the last paragraph of this section.	and EW31. There will not be wells dedicated only for monitoring purposes for the dissolved CVOCs plume.
21	2-12	Section 2.2.2	The text states that "upon adequate distribution of the substrate, the recirculation systems will be stopped and the microbes will be allowed to degrade the VOCs." How will it be determined that "adequate distribution" has occurred?	Adequate distribution will be determined using field analysis for alkalinity. Alkalinity is directly proportional to the concentration of volatile organic acid ions like acetate and propionate, which are the breakdown products of the substrate.
22	2-12	Section 2.2.3	In general, the monitoring program discusses what "may" be monitored, which is not appropriate for a Work Plan (as discussed previously). The minimum frequency, locations and analytes that will be part of the monitoring program should be listed, as more sampling locations, analytes, and increase the frequency can be added as needed. In addition, the proposed frequency of the monitoring appears insufficient (four and eight months into Stage 2). The performance of the in situ bioremediation program will be difficult to assess in terms of concentration versus time with only two data points at the end of Stage 2.	Refer to Appendix B "Sampling and Analysis Plan" for complete information about frequency, locations, and analytes. Two rounds of progress groundwater sampling with analysis for VOCs were determined to be adequate because intermediate VOC results are not key to the treatability study. More data would illustrate how ISB progresses, but this was already established in detail in the Final Treatability Report for the pilot study at Building 99, in which VOCs were frequently sampled, about once every two weeks. Only the final data is needed to gauge the effectiveness.
23	3-1	Section 3.0	The data presented on Figure 9 do not support the conclusion (paragraph 2) that the plume is the deepest in the middle and shallower away from the middle. Additionally, the text states "the recirculation system involves upfront engineering, fabrication, and installation, costs, that make it cost-prohibitive for use in smaller treatment areas such as Site 21." We disagree with that statement, especially since the work done previously at Site 24 does not appear to have involved much upfront engineering and fabrication (i.e. the injection system is portable). It appears that Shaw intends to simply inject substrate into the subsurface without assessing how effective the distribution will be.	Refer to the cross section in Figure 8, which may provide a clearer visual of the conclusion about the shape of the plume. Evaluation of the distribution of the injections has been added to Addendum 3: The distribution of the injections will be evaluated in two ways. For the first evaluation, a bromide tracer will be used to determine the radius of influence of a direct-push injection. The substrate and bromide tracer will be injected together at an injection location that is approximately 10 feet from one or more monitoring wells. The monitoring wells will be sampled for the bromide concentration before and after the injection. The injection location is

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				tentatively going to be 21D1-2, and the monitoring wells will be 21-MW08A and 21-MW08B. Refer to Figure 9. For the second evaluation, a selection of wells in the plume area will be sampled for alkalinity using a HACH kit before and after all the injections. The wells will be selected from among the following: 21-MW02A, 21-MW02B, 21-MW03A, 21-MW03B, 21-MW09A, 21-MW09B, and injection point wells.
24		Section 3.0, and Figure 7	A note on Figure 7 states, "VOC Cleanup Level: 100 µg/L". We do not believe cleanup levels have been established by the BCT.	The wording has been changed to "Treatability study treatment goal: 100 µg/L".
25		Section 3.0, and Figure 9	Figure 9 shows the proximity of existing monitoring wells to proposed direct injection points. Many of the existing monitoring wells are within less than 10 feet of planned injection points (21-MW-03A, 21-MW08A&B, 21-MW-9A&B, 21-MW10A&B, 21-MW-14). During direct injection programs at many sites, injected fluid has often been observed to emanate from nearby monitoring wells suggesting that the wells act as a preferential pathway for the pressurized fluid to migrate through the subsurface. Once this happens, the affected monitoring well cannot provide reliable performance monitoring data because the injected fluid may persist in the filter pack and vicinity of the well for a substantial time period. We expect that this could happen at Site 21, and the data from the monitoring program will not be representative of average groundwater conditions within the treatment zone, and will falsely provide the impression of a successful remediation program. Therefore, we recommend that the Work Plan include monitoring well data from new wells to be installed in a transect at the downgradient edge of the injection area after the injection program is completed. The new wells should be constructed with short, depth-discreet well screens to assess both vertical and lateral distribution of amendment and chlorinated ethenes, and the effects of treatment on the discharge of chlorinated ethenes to the Bay.	Shaw believes that the problem described by Geomatrix is not a concern for the monitoring wells at Site 21. The sand pack used for the monitoring wells is equivalent to the aquifer matrix. There is no mechanism for the persistence of the amendments, and there is no reason to expect amendments to bind more tightly to the sand pack than to the aquifer matrix. Hypothetically, if additional monitoring wells were installed following the completion of direct-injections, results from these new wells would be equivalent to results from existing monitoring wells. Existing wells have short, depth-discreet well screens. These are specified in Appendix B "Sampling and Analysis Plan," Table 3 "Site 21 Sampling Locations."
26	3-1	Section 3.0	The text states, "DHC microbes are present in the aquifer but have difficulty dechlorinating beyond the cis-1,2-DCE stage, possibly because of substrate limitations. Bioaugmentation with cultured SDC-9 might help jump start the process..." Please provide the data to support the statement that dechlorination beyond cis-1,2-DCE is not	The statement about a possible substrate limitation was not a good explanation of the current scenario. Given the same amount of substrate as would be used for ISB with bioaugmentation of SDC-9, the indigenous DHC population would be completely capable of dechlorinating to ethene, just at a slower rate than SDC-9. This was

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			occurring. If the substrate limitation is the reason for incomplete dechlorination, why not just add more substrate?	demonstrated in the bench tests and the field tests at Building 99 as documented in the Final Report (Shaw, 2005). So, the purpose of adding the SDC-9 is to provide a microbial culture that is more effective at dechlorination than the indigenous culture.
27	3-2	Section 3.1	The text states, "Work performed under Addendum 2 demonstrated EHC®, a proprietary remediation product of Adventus Group, can be injected using direct-push technology and, and with dispersion over time, had a radius of influence of 10 feet." This statement seems to suggest that Shaw believes that each injection will evenly distribute the remediation compound throughout the entire target depth interval to a radial distance of 10 feet from the point of injection, and that their remediation program has been designed (at least conceptually) based on this belief. Please discuss the Addendum 2 data that supports this belief. Will any confirmatory soil borings or other activities (other than monitoring long screened wells) be completed to readily and inexpensively assess the distribution of amendment after or during the injection program? The document also indicates that dispersion, a time dependant process, will result in distribution of the substrate. Has this process been modeled? Lateral dispersion is generally very small at most sites, and the timeframe required for diffusion to distribute biologically active compounds is likely too long to allow for several feet of migration (the substrate may be consumed before it diffuses far enough). The document should provide a technical basis that includes calculations and assumptions with respect to groundwater flow rates, hydrodynamic dispersion, and injection volumes, before finalizing the injection program.	Refer to the response to Comment No. 23 regarding the assessment of the distribution for the direct push injections at Site 21. The expected radius of influence for the direct-push injections of substrate at Site 21 is based on previous studies: Johnson, C.D., M.J. Truex, D.P. Leigh, B.L. Porter, and S. Granade, 2004, Implementation of In Situ Anaerobic Bioremediation in a Thin, Shallow Unconfined Aquifer, Battelle Press Papers from the Proceedings of the Fourth International Conference on Remediation of Chlorinated and Recalcitrant Compounds, Monterey, CA, May 24-27, 2004. Shaw Environmental, Inc., 2003, Final Evaluation, In Situ Bioremediation of a Chlorinated Ethene Groundwater Plume at Naval Base Ventura County, Point Mugu, California, July 31. Also, direct-push injection of molasses at Shaw's bioremediation project in Selma, CA resulted in radial distribution of more than 15 feet.
28	3-2	Section 3.1	The text say, "Based on results from the Site 24 TS about 650 milligrams per liter of lactic acid will be required to reduce the concentrations of chlorinated ethenes as well as other electron acceptors." We interpret this statement to mean that sufficient lactic acid will be added such that the final treatment zone pore volume has an in situ concentration of at least 650 mg/L (as opposed to an injection fluid concentration). If the plan is to rely on dispersion to distribute amendment, what injection concentration is required to achieve an in situ concentration of 650 mg/L throughout the entire	The number 650 mg/L is based on a calculation of the electron demand, and is the minimum concentration for any part of the treatment zone. However, to account for site anisotropy, the target average in situ concentration is 3,250 mg/L, which is 650 multiplied by a safety factor of 5. See the response to Comment No. 29 regarding the injection fluid concentration.

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			treatment zone. Clarification on whether the 650 mg/L is an average in situ concentration, or injection fluid concentration, is needed.	
29	3-3	Section 3.1	A discussion of the injection strategy is present, but no discussion on the injection volume per location and total mass of substrate and SDC-9 is provided. These important details need to be added so the reader can asses the relative impact that this program may have on groundwater quality. Figure 9 show overlapping circles that imply complete and even radial distribution of injection fluid form each injection point, where Figure 10 shows even vertical distribution from each injection point. The document should provide a plan to confirm that this even lateral and vertical distribution is occurring at several injection locations.	The specifics provided in this response will be added to the text in Section 3.1. The following estimates are provided for the substrate lactic acid, but the Navy and Shaw will have the option of using equivalent amounts of a lactic acid/lactose mixture. The target average in situ concentration of lactic acid is 3,250 mg/L, so the injections will need to deliver approximately 7,100 kg of substrate. The target volume to be injected will be 40,000 gallons, which is about 7% of the aquifer volume of the treatment area, assuming an effective porosity of 0.30. Given these design parameters, the injection concentration of lactic acid will be approximately 47 g/L. The volume of SDC-9 to be injected is 60 L. There are 32 injection locations, so about 1,250 gal will be injected into each location. To evaluate the effectiveness of substrate distribution, all wells in the plume area will be sampled for alkalinity using a HACH kit before and after all the injections.
30	3-3	Section 3.1	A discussion of the injection sequence is presented, where the sequence of injection from below the plume upwards, and from the perimeter towards the center is being proposed to prevent lateral and vertical spreading of plume. The document indicates that using water extracted from nearby monitoring wells will create a "re-circulation effect." However, a conclusion from Site 24 was that re-circulation did not provide plume containment. Also, if the makeup water is extracted and placed in a tank, and water levels recover somewhat within the treatment area, then injection of the temporarily stored and amended makeup water will result in a hydraulic mound which could cause vertical and lateral migration, regardless of the sequence of injection.	As stated in response to Comment No. 5, the volume of water to be injected is 7% of the aquifer volume, which is much less than what Geomatrix calculated (91 gal per foot of targeted depth interval opposed to 580 gal/ft). So, first, any hydraulic mound would not have the magnitude of effect that Geomatrix predicts. Second, Shaw believes that the sequence of injections will influence the migration of the contaminated groundwater such that it is laterally inward, and vertically upward. There is not an injection sequence strategy for Site 24 that parallels the strategy for Site 21 because the systems at the two sites are so different. Therefore the conclusion for Site 24 Phase 1 about the recirculation system not providing complete plume containment is not necessarily applicable to Site 21.

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31	3-3	Section 3.2	The document proposes to extract "Makeup Water" from nearby extraction wells for amendment prior to re-injection at the direct injection locations. This scenario will artificially increase the likelihood that injection fluid is preferentially pulled towards each monitoring well, giving the appearance of effective delivery because each well could show the beneficial effects of the injection even if substantial portions of the treatment zone are not affected by the injection program. For this reason, additional monitoring wells or depth-discreet confirmatory groundwater sampling is required, in place of monitoring wells that are used to extract water for nearby injection locations.	Shaw believes that the groundwater will recover following the extraction activity, and that the mounds of groundwater being pushed back and forth will have the beneficial effect of mixing the water around for better substrate distribution.

Specific Comments on Sampling and Analysis Plan (Appendix B)				
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32		Section 2.1	The City of San Francisco is included in the list of agencies that provide regulatory support and oversight. Please remove the city from your list	The city has been removed from the list as requested.
33	2-2	Section 2.3	The first bullet states "Observation of presence or absence of DNAPL by Membrane Interface Probe....." It is unclear in this statement how the MIP will be used to determine whether or not DNAPL exists.	The first two bullets will be replaced with the three bulleted items below. The change is intended to clarify the different purposes of the MIP, FLUTe, and soil samples. • Membrane Interface Probe (MIP) will serve as a real-time semi-quantitative screening tool for identifying locations of high concentrations of chlorinated ethenes. • FLUTe will be used to give an indication of the presence of DNAPL at the high concentration locations identified by the MIP. • Soil core sampling will speciate and quantify the DNAPL.
34	2-3	Section 2.5	The last bullet on this page states "If MIP and FLUTe™ system indicate pools or large ganglia of DNAPL..." It is unclear in this statement how the MIP or FLUTe™ system will be used to determine whether or not DNAPL exists or ganglia or pools. Upon encountering DNAPL, it is very likely that the MIP components would be saturated and required some recovery time before proceeding. Furthermore, if the presence of DNAPL is indicated with MIP in real time, it may be prudent to terminate the MIP boring to prevent vertical mobilization of DNAPL.	When investigating with the FLUTe, globules would appear as small distributed stains, while a pool would appear as an extended stain. Furthermore, a pool would need to be supported by a less permeable layer, which can be verified by the soil cores. MIP will be used as a screening tool for CVOCs, and FLUTe will be used to confirm the presence of DNAPL. Encounters with high concentrations of CVOCs may saturate the electron capture detector, but at such concentrations the less sensitive PID and FID will provide useful data. Improvements in MIP technology have made recovery times on the order of minutes. One such improvement is the use of PEEK tubing instead of Teflon tubing for the return line, because the PEEK tubing has greater resistance to absorption of organics.
35	2-4	Section 2.5	The first bullet of this page states "If concentration of chlorinated ethenes in soil samples are in the high (>1000 mg/kg) range, then presence of DNAPL will be confirmed." For PCE and TCE, concentrations <1,000 mg/kg also indicate DNAPL, depending on the soil organic carbon conditions and porosity. We recommend the document provide a basis for the 1000 mg/kg criterion and recalculate the value for each chlorinated ethene based on soil and organic	The SAP has been corrected to be consistent with the Work Plan in its description of the purpose of the soil sampling. The purpose of the soil samples is not to confirm the presence of DNAPL, which is the purpose of the FLUTe. Rather, the sampling will be used to speciate and quantify the DNAPL. The 1,000 mg/kg criterion has been removed from the text.

Specific Comments on Sampling and Analysis Plan (Appendix B)				
Comment No.	Page No.	Section, Figure, Table	Comments	Response
			content and porosity.	
36	3-1	Section 3.1.1	We recommend that the document include confirmation soil sampling at several locations over the full range of MIP responses to provide a qualitative comparison of MIP response and chemical concentration.	Four soil samples in the low to medium MIP response range will be added to the sampling plan so that a qualitative comparison of MIP response and chemical concentration can be observed.

Client Name: SHAW
Project Location: Treasure Island, Site 24
Proposal Number: AAI7-406

	Value	Unit
Calculations		
Length of Treatment Zone	150	ft
Width of Treatment Zone	10	ft
Depth to top of plume	6	ft bgs
Depth to bottom of plume	50	ft bgs
Thickness of Treatment Zone	44	ft
Volume of Treatment Zone	66,000	ft3
Mass of Soil in Treatment Zone	3,630	U.S. tons
Volume pore space	21,780	ft3
EHC mass calculations:		
Contact Time * Application Rate Multiplier	5	days*%EHC
Linear Groundwater Velocity	1.04	ft/day
Contact Time	10	days
Percentage EHC by soil mass	0.50%	
Mass of EHC Required	36,300	lbs
Injection details:		
Percent solids in slurry	30%	
Volume Water Required	10,164	U.S. gallons
Slurry volume	11,748	U.S. gallons
Number of injection points	15	points
Mass EHC per point	2420	lbs
Slurry volume per point	783	U.S. gallons
Application rates for reference:		
Slurry volume to pore space volume	7.2%	
EHC concentration in groundwater	1.7	lbs/ft3
EHC Cost		
EHC, 36,300 lb at $ 2.00/lb	$72,600	USD
Shipping (estimated)	$3,000	USD
TOTAL	**$75,600**	**USD**

N60028_001577
TREASURE ISLAND
SSIC NO. 5090.3

ENCLOSURE 1

TECHNICAL MEMORANDUM
IN SITU ANAEROBIC BIOREMEDIATION TREATABILITY STUDY
SITE 24

DATED 18 JUNE 2008

THIS RECORD IS ENTERED IN THE DATABASE AND FILED AS

RECORD NO. N60028_001569

ENCLOSURE 2

TECHNICAL MEMORANDUM
IN SITU ANAEROBIC BIOREMEDIATION TREATABILITY STUDY
SITE 21

DATED 18 JUNE 2008

THIS RECORD IS ENTERED IN THE DATABASE AND FILED AS

RECORD NO. N60028_001570