Draft Final
Operable Unit Carbon Tetrachloride Plume Groundwater Remedial Investigation/ Feasibility Study
Former Fort Ord, California

Volume IV – Comments and Response

Prepared for

United States Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

MACTEC Project No. 55596 001703

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MACTEC
MACTEC Engineering and Consulting, Inc.
600 Grand Avenue, Suite 300
Oakland, CA 96510 - (510) 451-1001

Regulatory Agency Comments on the Draft Operable Unit Carbon Tetrachloride Plume Groundwater Remedial Investigation/Feasibility Study, Former Fort Ord, California: Remedial Investigation (Volume I) and Human Health Risk Assessment (Volume II), dated April 29, 2005; Feasibility Study (Volume III) dated May 31, 2005.

United States Environmental Protection Agency (US EPA) Comments on the Draft Remedial Investigation (Volume I) and Feasibility Study (Volume III), August 2, 2005

GENERAL COMMENTS

Comment 1. The Draft Operable Unit Carbon Tetrachloride Plume (OUCTP) Groundwater Remedial Investigation/Feasibility Study (RI/FS), Former Fort Ord, is well-written and organized, and is comprehensive in identifying remaining data gaps and in recognizing the uncertainties associated with the several remedial alternatives for OUCTP. While some uncertainties remain regarding the site hydrogeology and the sources and distribution of chemicals present in soils and groundwater, this additional site information can be appropriately obtained during the location- and remediation-specific characterization and design. For example, remedial efforts that utilize enhanced bioremediation or permeable reactive barriers will likely proceed through large scale pilot studies where injection and/or monitoring wells will be installed, and additional hydrogeological and chemical information will be obtained at this time. Please ensure that all new data obtained during the conduct of pilot studies are compared to expectations based on conceptual site models, and that any critical uncertainties and issues regarding the selected remediation approach are quickly brought to the attention of the Base Closure Team (BCT) for rapid resolution. This diligence is especially important for the successful implementation and performance of the preferred remedial alternative using in-situ enhanced bioremediation of carbon tetrachloride in groundwater.

Response 1: The Army appreciates US EPA's comments regarding the writing, organization, and comprehensive presentation of data in the Draft OUCTP RI/FS report. The Army agrees with US EPA's assessment that while some uncertainties remain regarding the site hydrogeology and the sources and distribution of chemicals present in soils and groundwater, this additional site information can be obtained during the remedial design phase of remedy implementation. During the remedial design phase, the Army will provide the BCT with any new data obtained during pilot studies or other field studies, compare the data to the current working conceptual site model, and identify any critical uncertainties or issues regarding the selected remediation approach.

Comment 2: Because of the Army's stated preference for aggressive remediation of the groundwater contamination, only cursory reviews were conducted of Remedial Alternative 1 (which includes monitored natural attenuation) and the Human Health Risk Assessment (Volume II.). If the Army later chooses to advocate Remedial Alternative 1, the US EPA will provide a more detailed review of these two topics.

Response 2: The Army acknowledges that in the future, US EPA and other BCT members may choose to provide a more detailed review of the Human Health Risk Assessment (Volume II) and Remedial Alternative 1 (which includes monitored natural attenuation) if this alternative is later selected for implementation by the Army.

SPECIFIC COMMENTS

Volume I, Remedial Investigation

Comment 1: Plate 15A: The CT 0.5 micrograms per liter (ug/L) concentration contours should be reevaluated in this figure. It appears that the both of the 0.5 ug/L plumes can be depicted as a single plume. Approximately 175 feet separate the two solid 0.5 ug/L plume contours shown on this figure and a groundwater well is not located between the two plume boundaries with CT concentrations less than 0.5 ug/L to support the supposition that two plumes are present. In the next version of this report please revise this figure to show that the two 0.5 ug/L CT plumes are indeed a single plume or provide an explanation why two distinct plumes are depicted, and discuss any implications for the remediation alternatives.

Response 1: The distribution of CT as illustrated on Plate 15A reflects the presence of a groundwater divide west of MW-BW-16-A that isolates CT east of this area. CT migrated to this area only as a result of a temporary westward shift of the divide toward the now-destroyed OU2 infiltration gallery, which was operated between 1995 and 1999. Groundwater elevation data measured at A-Aquifer wells in this area are sufficient to confirm the presence of this divide. Therefore, the CT plume east of the divide will continue to be illustrated as an isolated segment of the A-Aquifer plume. Clarification of this point in the text will be included in the draft final report.

Volume III, Feasibility Study

Comment 2: Section 4.2, Remedial Alternative 2, Pages 78 to 81: The discussion specifically mentions sodium lactate as the reagent that could be used to enhance bioremediation, but other reagents to stimulate anaerobic bioremediation were also discussed earlier in the RI/FS. For treatment cells of a larger scale (see Plate 5) and in the presence of relatively rapid groundwater flow rates, the very soluble form of lactate may not be effective for attainment and then maintenance of anaerobic conditions for biotransforming CT and its immediate product, chloroform. Please discuss the use of other electron donor substrates for enhancing anaerobic bioremediation of the volatile organic chemicals in OUCTP, and possibly a range of costs associated with the use of different substrates. Please also refer to the document, "Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents, August 2004," at the following website in this evaluation and in the subsequent remedial design documents: (http://www.afcee.brooks.af.mil/products/techtrans/Bioremediation/downloads/PrinciplesandPractices.pdf)

Response 2: Section 3.2.2 of the FS (Volume III) discussed the use of other electron donor substrates for enhancing and maintaining anaerobic bioremediation of chemicals of concern (COCs) within OUCTP groundwater in some detail. It also summarized data presented in Sections 3.8—3.9 and Appendix H of the RI (Volume I) that described site-specific bench-scale and pilot-scale biotreatability studies that were conducted to (1) determine the viability of enhanced biodegradation as a remedial strategy for OUCTP, and (2) evaluate the effectiveness of different electron donor substrates (sodium lactate, molasses, and soybean oil) that could potentially enhance biodegradation rates of CT.

The goals of the study were to (1) determine which electron donor substrate would be the most effective at reducing CT concentrations, (2) determine whether supplemental nutrients would be necessary to effectively enhance CT biodegradation under actual field conditions when injected in the OUCTP aquifer, (3) provide an estimate of electron donor substrate concentrations necessary to effectively induce enhanced biodegradation conditions in the field, and (4) provide an indication of the electron donor substrate residence time necessary to initiate biological activity and sustain effective CT biodegradation. Of the three carbon source amendments, sodium lactate (lactate) appeared to have the most effectiveness in reducing CT concentrations and meeting all four goals of the study, and was selected as the amendment for injection in a field phase bio-treatability pilot study at OUCTP. After the sodium lactate was injected and recirculated within the A-Aquifer, there was an immediate and lasting reduction in CT concentrations in groundwater.

The remedial technology screening presented in Section 3.2.2 of the FS (Volume III) also evaluated a popular ‘longer lasting’ lactate formulation (i.e., time-release Hydrogen Release Compound®) and identified several drawbacks that would preclude its consideration at this point in time, including: (1) difficulty with full-scale injection and circulation of this more viscous formulation throughout the aquifer, (2) potentially significant biofouling of the aquifer due to longer-lasting maintenance of anaerobic conditions, and (3) the cost of purchasing a proprietary, patented, longer-lasting formulation such as HRC® is approximately 8 times the cost per pound of other electron donor substrates such as sodium lactate.

For these reasons, the Army concluded that sodium lactate would be the most effective substrate to be considered further for the in situ enhanced biodegradation alternative in the FS. This conclusion will be further assessed and modified if necessary to identify alternative electron donor substrates or formulations during the remedial design phase (including a range of costs as necessary) associated with the use of different substrates. A reference to the document, “Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents, August 2004,” has been added to Section 3.2.2 of the Draft Final FS and will be referenced in the subsequent remedial design documents.

Comment 3: Section 6.0, Preliminarily Identified Preferred Remedial Alternative, Page 114: The preference for Remedial Alternative 2 is understood because of the lower cost (based on Total Net Present Value), the complete capture of the contamination, and the shorter duration of the remediation efforts for the A-aquifer, but it must also be recognized that the enhanced bioremediation technology has the greater number of operational uncertainties compared to the other alternatives. These uncertainties include the ability of the in-situ technology to attain remediation goals, possible increased costs because of the need to expand the treatment/monitoring system because of hydrogeologic and geochemical uncertainties, and the possible resistance/education of the public regarding injecting treatment chemicals into groundwater. While these uncertainties are mentioned in various sections of this RI/FS document, as part of the remedial design please include specific data objectives and criteria that would demonstrate the system is operating as expected, or otherwise signal that the remediation system requires modifications that would be discussed with the BCT.

Response 3: The uncertainties identified in the comment will be addressed during the remedial design phase of implementing the selected remedial alternative (in-situ enhanced biodegradation) using specific data objectives and criteria as suggested.

Minor Comments

Volume I, Remedial Investigation

Comment 4: Executive Summary, Cancer Risks, Page xvi: Please revise the text in this section to read that the calculated values represent the *added cancer risk* to a population of one million. It is not correct to state that the calculated number represents the number of people *who may develop cancer*.

Response 4: The Executive Summary has been revised as suggested.

Comment 5: 4.0, Nature and Extent of Contamination: Landfill Cell F is discussed numerous times throughout this section of the document but the location of the landfill is not included in any of the figures in this document. It would be useful to include the location of landfill cells and the OU-1 source area and plume in appropriate figures so that the reader can identify the location of the landfill and the OU-1 plume in relation to the OUCTP.

Response 5: The location of OU2 landfill Cell F is provided on Plates 2 and 16. The approximate location of the OU1 source area is provided on Plate 2.

Comment 6: Section 4.2.2, Upper 180-Foot Aquifer, Page 92, Last Sentence: The abbreviation CF is used in the text but it is not defined in the Acronyms and Abbreviations section of this report. In the next version of this document please include the abbreviation for CF or revise the text to clearly state what CF represents.

Response 6: CF (chloroform) was added to the Acronyms and Abbreviations list, and defined when first used in the text of the document.

Comment 7: Section 10.7, Data Gaps, Second Bullet, Page 126: It appears that the latter half of the information associated with this bullet has been inadvertently deleted as the sentence ends mid-sentence. In the next version of this document please revise this bullet so that all of its information is included in the text.

Response 7: The text will be revised appropriately.

California Regional Water Quality Control Board, Central Coast Region (RWQCB) Comments on the Draft Feasibility Study (Volume III), July 29, 2005

Comment 1: Page 80, paragraph three: This paragraph describes the Mini-Storage well as one of the two vertical conduits allowing contaminated water to migrate down from the A-Aquifer to the Upper and Lower 180-Foot Aquifers. Barring any new evidence to the contrary, we believe the option to use the Mini-Storage well as an extraction well to provide treatment influent is preferable to destroying this well. Having acted as a contaminant conduit, this well would appear uniquely capable of effective extraction of those waters recently impacted. If upon completion of its use as an extraction well, it remains a viable threat as a vertical conduit (e.g. greater contaminant concentrations remain in the A-Aquifer to threaten those aquifers below), it would appear logical to then have the Mini-Storage well destroyed.

Response 1: Comment acknowledged.

Comment 2: Page 81, Upper 180-Foot Aquifer, first bullet, second sentence: Discussion with MACTEC staff confirms that this sentence should be clarified by changing the reference from "TCE plume associated with OU2" to "CT plume".

Response 2: Text will be clarified as described.

Comment 3: Page 85, first sentence: Remedial Alternative 3 designated a "Non-Containment" zone in the A-Aquifer downgradient of the permeable reactive barrier. Although this alternative was not selected, we note that the regulatory requirements of a Non-Containment zone designation are considerable, and should be reviewed in detail should this alternative receive further consideration. Specific requirements for the non-containment zone, previously known as a non-attainment zone, are found in State Water Resources Control Board Resolution 92-49.

Response 3: Comment acknowledged.

<u>Department of Toxic Substances Control</u>
<u>(DTSC), Human & Ecological Risk Division (HERD)</u>
<u>Comments on the Draft Human Health Risk Assessment (Volume II), July 5, 2005</u>

GENERAL COMMENTS

Comment 1: The risk assessment is well written and clearly presented. However, it is not acceptable, because risks and hazards due to volatile organic chemicals in ambient air and indoor air are not assessed. These chemicals must be assessed for this operable unit (OU) and for the OU-2 landfills. The risk assessment can become acceptable upon adequate responses to the specific comments below.

Response 1: The risk assessment will be revised as requested to assess risks and hazards due to volatile organic chemicals in ambient air and indoor air.

SPECIFIC COMMENTS

Comment 1: Frequency of Detection, Sec. 2.2, p. 4: DTSC does not normally allow screening out organic chemicals as chemicals of potential concern (COPOC) on the basis of frequency of detection. Because this risk assessment deals with data from several consecutive quarters of sampling of groundwater, we agree that rare detections (1-2) among hundreds of analyses do not constitute adequate evidence that a chemical is actually present or that that chemical, if present, would contribute substantially to risk or hazard. Thus, we concur with the identification of COPC as shown in Table 5, with one exception, as described immediately below.

Response 1: Comment acknowledged.

Comment 2: Bromoform (CHBr3) in the A-Aquifer, Sec. 2.2, p. 4: We see that CHBr3 was detected in 5 of 242 analyses of water from the A Aquifer (Table 5). CHBr3 is one of the four carcinogenic trihalomethanes commonly encountered as by-products of disinfection of water by chlorination. The other three commonly found trihalomethanes are identified as COPC in the A-Aquifer, namely chloroform (CHCl3), dichlorobromomethane (CHCl2Br), and dibromochloromethane (CHClBr2). Therefore, we conclude that the detections of CHBr3 are not spurious and that this carcinogenic chemical must be included as a COPC for the A aquifer.

Response 2: Bromoform will be included as a COPC for the A-aquifer.

Comment 3: Vinyl Chloride (VC) in the Lower 180-400 ft Aquifer, Sec. 2.2, p. 4: After conferring with Mr. Stewart Black of the Geological Support Unit, we accept the Army's argument that the 37 detections of VC among 183 analyses from the 180-400 ft aquifer (Tab le 5) are probably artifacts, caused by migration of VC monomer from well casings made of polyvinyl chloride. This explanation is more likely than either a release of VC outright or formation of VC as a breakdown product of other chlorinated hydrocarbons. VC need not be included as a COPC for this risk assessment. However, we strongly urge that the Army continue sampling and analyzing for vinyl chloride in the future.

Response 3: Comment acknowledged.

Comment 4: Domestic Use of Groundwater, Sec. 3.1.1, p. 6: Unless the Basin Plan of the Central Coast Regional Water Quality Control Board excludes domestic use of groundwater at this site, we will consider the pathway for drinking water to be potentially complete. Therefore, strike the sentences on the "prohibition zone", because they are irrelevant to the risk assessment (i.e. "Groundwater within the OUCTP . . . adult residents in the area.").

Response 4: This paragraph will be changed to read as follows:

"Groundwater within the OUCTP currently is not used by residents within the Fort Ord area for domestic household purposes. Drinking water in the Fort Ord area is provided by the Marina Coast Water District (MCWD) and is pumped from wells that are located east of the OUCTP area screened in the Lower 180-Foot Aquifer. Groundwater from these drinking water wells is then blended together and treated with chlorine before it reaches housing and facilities on former Fort Ord (*MCWD, 2003*). Based on groundwater monitoring data and data provided by the MCWD, these drinking water wells have not been impacted by contaminants related to the OUCTP (*MCWD, 2003; MACTEC, 2005*). Groundwater within the OUCTP is located in a "prohibition zone," within which the installation of new supply wells is restricted by the County. According to Section 3, Subsection D of Section 15.08.140 of Chapter 15.08 of Title 15, of the Monterey County Code, a prohibition zone is an area overlying or adjacent to a contaminant plume where water well construction is prohibited and applications for water supply wells will not be accepted. Therefore, direct contact groundwater exposure pathways for residents potentially exposed to groundwater within the OUCTP are currently incomplete and are expected to remain so in the future. For the evaluation of potential future conditions, it is assumed in this HHRA that the OUCTP groundwater is used by child and adult residents in the area; therefore, all exposure pathways associated with the groundwater are considered complete for evaluation purposes only.

Comment 5: Incomplete Evaluation of Air Pathway, Sec. 3.1.2, p. 7: The Army did not evaluate exposures either to ambient air or to indoor air affected by intrusion of subsurface vapors. The Army based this decision on two lines of evidence:

a. Ambient air sampling at the nearby Operable Unit 2 (OU-2) landfills found CCl4 and other VOCs in approximately the same concentrations both upwind and downwind from the landfills (Shaw 2004a). Because types and concentrations of contaminants were similar in ambient air both upwind and downwind of the landfills, ambient air was not evaluated in the risk assessment in the current document.

b. Direct air sampling found no important differences between concentrations of CCl4 and other VOCs in indoor and outdoor air at Lexington Court, which lies directly above the highest concentrations of carbon tetrachloride in the plume (Shaw 2004b). Because indoor air and outdoor air were similar, indoor air was not evaluated in the risk assessment in the current document.

In our memoranda reviewing these earlier reports, we agreed with these conclusions, within their limited contexts. Note well, however, that the OU-2 landfills are upwind from Lexington Court and hydrologically upgradient from the CCl4 plume in groundwater. Thus, it seems entirely possible that the OU-2 landfills are the ultimate source of CCl4 in groundwater, outdoor air, subsurface vapor, and indoor air. This is a case where risks and hazard might overlap between two operable units. We had noted this possibility in our memorandum of 17 November 2004 presenting comments on Shaw (2004a). Unless Army activities can be ruled out as sources of the CCl4 and other VOCs in ambient air, we strongly recommend that health risks and hazards due to VOCs in ambient air must be assessed for both the CCl4 plume and the OU-2 landfills. The current risk assessment is therefore deficient, due incomplete assessment of the inhalation pathway. Evaluation of ambient air and vapor intrusion will require exposures of 24 hr/day and 350 day/yr, values different from those shown in Table 8.

Response 5: The risk assessment will be revised as requested to assess risks and hazards due to volatile organic chemicals in ambient air and indoor air. However, groundwater beneath OU2 primarily flows to the west, meaning that the OUCTP source area at Lexington Court is cross-gradient in the A-Aquifer, minor radial flow associated from the proximal groundwater divide notwithstanding. The non-detection of CT at MW-BW-50-A immediately upgradient of the OUCTP source area, the distinct soil gas signature confined to the OUCTP source area, and the consistent lack of a CT signature at OU2 monitoring wells conclusively excludes OU2 as a potential source of CT in groundwater associated with the OUCTP. Because of the evidence ruling out the OU2 landfill as a source of groundwater contamination in the Lexington Court area, and the lack of any data indicating that the OU2 landfill represents a source of VOC contamination to ambient, outdoor air, the revisions to risk assessment focused on the potential for vapor intrusion into indoor air using subsurface soil gas data to estimate indoor air contaminant concentrations.

Comment 6: Treatment of Non-Detects, Sec. 3.2.1, p. 9: In addition to USEPA's recommendation to substitute one-half the quantitation limit for non-detects (USEPA, 1989), recent guidance (USEPA, December 2002, http://www.epa.gov/oswer/riskassessment/pdf/ucl.pdf) recommends exploring other techniques, such as the bounding method and statistical techniques described by Dr. Dennis Helsel of the U.S. Geological Survey. We strongly urge the Army to explore these newer techniques and adopt them for future risk assessments. This comment requires neither a response from the Army nor any change in the current document.

Response 6: Comment acknowledged.

Comment 7: Distributional Testing, Sec. 3.2.1, p. 9: The bullets here do not describe the condition of a data set passing goodness-of-fit tests for both normality and lognormality, a condition which occurs with great regularity. Defaulting to the normal in such a circumstance is not logical if p-values are available for both goodness-of-fit tests. For future risk assessments, we recommend that data sets which pass goodness-of-fit tests for both normal and lognormal distributions should be assigned to the distribution which yielded the better fit. This comment requires neither a response from the Army nor any change in the current document.

Response 7: Comment acknowledged.

Comment 8: Inhalation of Air in the Shower, Sec. 3.2.2, p. 10: We have examined these calculations and we find them acceptable. We are pleased that the Army found the documentation for CalTOX to be useful.

Response 8: Comment acknowledged.

Comment 9: Risk Characterization, Sec. 5.3, p. 20: We agree with the Army's estimates of risk and hazard, at least for the pathways they evaluated. Estimated cancer risks for these pathways are 2 E-6 to 1 E-5 for the several aquifers, values which fall in the "risk management range" of 1 E-6 to 1 E-4. Summed hazard for the pathways assessed is less than the benchmark of 1.0. When ambient air and vapor intrusion are evaluated, these values will all increase, almost certainly to >1 E-4 and >1.0.

Response 9: Estimated cancer risks and noncancer hazards will be modified to reflect the assessment of ambient air and indoor air.

CONCLUSION AND RECOMMENDATIONS

Comment 1: The risk assessment is not acceptable in its current form, because risks and hazards via inhalation are underestimated.

Response 1: The risk assessment will be revised as requested to assess risks and hazards due to volatile organic chemicals in ambient air and indoor air.

Comment 2: The source of the CCl4 and other VOCs might very well be the OU-2 landfills. If Army activities are the source of VOCs in ambient air and groundwater, then they must evaluate potential health effects of VOCs in ambient air and intrusion of subsurface vapors.

Response 2: The risk assessment will assess risks and hazards due to volatile organic chemicals in ambient air and indoor air. Existing data conclusively exclude the OU2 as a potential source of CT to groundwater associated with the OUCTP.

Comment 3: Include CHBr3 as a COPC in the A-Aquifer.

Response 3: Bromoform will be included as a COPC in the A-aquifer.

Department of Toxic Substances Control (DTSC),
Engineering Services Unit (ESU)
Comments on the Draft Feasibility Study (Volume III), August 3, 2005

Comment 1: In section 3.2 (In-Situ Remediation), in-situ chemical oxidation (ISCO) should be included as a potential alternative.

Response 1: As stated in Section 3.2 (Remedial Technology Screening), potentially applicable remedial technologies for OUCTP groundwater were identified based on previous bench-scale and pilot treatability studies conducted during the RI (Volume I; Sections 3.8 and 3.9); experience in treating groundwater at the former Fort Ord; professional judgment; EPA and other remediation technology databases; and input from regulatory agencies. In situ chemical oxidation (ISCO) was not considered further in the FS for the following reasons:
(1) it increases oxygen levels in the aquifer, which has already been demonstrated to be oxygenated (aerobic);
(2) site-specific studies indicated the opposite condition (non-oxygenated or anaerobic) is desired within the aquifer to enhance biodegradation of chemicals of concern such as carbon tetrachloride (CT);
(3) it has not been fully demonstrated as effective in treating low concentrations of CT below aquifer cleanup levels;
(4) it would be technically and economically difficult to implement throughout such a large plume; and
(5) it significantly alters the geochemistry of the subsurface aquifer environment to a much greater degree than enhanced biodegradation formulations as follows: (a) there is a potential for uncontrolled exothermic reactions (explosions) via the generation of ozone gas that could potentially migrate into and through underground utilities, where high-voltage-equipment may ignite the gas; (b) the volume of chemical oxidant that is injected into the saturated zone displaces the same volume of groundwater from the immediate vicinity, which can cause significant ‘mounding’ or increases in groundwater elevations; and (c) the chemical oxidant can significantly lower the pH (acidify) of the subsurface environment, which can mobilize metals from soils into groundwater and can precipitate in the soil and reduce subsurface permeability

Comment 2: For the cost estimates, there are a few issues that need to be clarified. For alternative A4 (pump and treat with aqueous GAC), the total O&M cost is not supported by the line items of O&M costs. The total listed O&M cost is $17.5 million while the line items only support about a $2.8 million total O&M cost.

Response 2: The total O&M cost listed for Alternative A4 is the net present value (based on a 2.0% real interest rate) of the sum of: (1) Treatment System Annual O&M costs for 30 years, plus (2) Plume Monitoring Annual O&M costs for 30 years as follows:

<u>Treatment System Annual O&M Cost</u>
$920,000 per year for Years 1-10 = $8.264 million
$552,000 per year for Years 11-20 = $4.959 million
$368,000 per year for Years 21-30 = $3.306 million
<u>Total = $16.529 million</u>

<u>Plume Monitoring Annual O&M Cost</u>
$42,000 per year for 30 years = $0.941 million

<u>Total 30-Year Annual O&M Cost</u>
$16.529 + $0.941 million = $17.47 million

Comment 3: Alternatives A4 and A5 also count the GAC system (for year 1) and air stripper (for year 1) monitoring twice – once in the capital cost section and once in the operating cost section. The reason for this should be clearly identified, or the capital costs for these activities should be removed. Typically, a one time operating cost could be put in the capital cost section, but only if it is a one time cost.

Response 3: The treatment system construction, startup, and monitoring costs that occur during the first year of system startup and shakedown (Year 0) were included as capital costs, and are assumed to be higher than in subsequent years. After the system has been installed and in operation for one year, these costs were then assumed to be annualized and to decrease over time for a period of 30 years.

Comment 4: Alternative A2 has a high capital cost, in part due to high injection well costs and also due to lactate solution. Lactate solution could be considered a capital cost if it is only used in year 1. But, if lactate solution will be injected periodically, the costs of lactate would be better included in O&M costs.

Response 4: Injection well and lactate solution costs were included in the capital costs because an aggressive lactate injection program is assumed to occur during the first year of implementation (Year 0). Costs for subsequent injection events (occurring after the first year of implementation) were included as O&M costs.

<u>Department of Toxic Substances Control (DTSC),</u>
<u>Northern California Geologic Services Unit (GSU)</u>
<u>Comments on the Draft Remedial Investigation (Volume I) and</u>
<u>Human Health Risk Assessment (Volume II),</u>
<u>July 5, 2005</u>

GENERAL COMMENTS

Comment A: The conceptual site model (CSM) developed for the RI/FS at OUCTP is not consistent with the CSM that the Army has developed for groundwater flow at Operable Unit 1 (OU-1). OU-1 is located just east/northeast of OUCTP and much of the data used to generate maps, cross-sections and groundwater flow models for OU-1 are the same data used to generate maps, cross-sections and groundwater flow models in the RI/FS.

A comparison of the geologic and hydrogeologic interpretations contained in the RI/FS with similar geologic and hydrogeologic interpretations provided to DTSC by the Army for OU-1 found that the Army has provided DTSC with two separate interpretations for the same data.

It is the opinion of GSU that the CSM which is currently being developed for OU-1 may better reflect the environmental conditions at both OU-1 and at OUCTP. GSU recommends revising the CSM discussed in the RI/FS for OUCTP to reflect the recent findings at OU-1. Once the CSM has been revised the GSU (and the Army) will be able to better evaluate whether additional monitoring points, geophysical investigations, pump testing or other investigation techniques will be needed to evaluate and monitor the narrow contaminant flow paths which appear to be present at the top of the FO-SVA and at the base of the A-aquifer.

Response A: As discussed at the August 25, 2005 meeting with DTSC, RWQCB, and EPA, MACTEC continues to assert that the OUCTP conceptual model accounts for lateral and vertical groundwater flow conditions and the fate and transport of carbon tetrachloride in the A-Aquifer, the Upper 180-Foot Aquifer, and the Lower 180-Foot Aquifer. Inconsistencies between the OU1 and OUCTP conceptual models reflect differences in opinion between professional hydrogeologists and do not necessarily affect recommendations for remedial action. Additional information collected as part of initiating the Remedial Action Plan will be used to revise the OUCTP conceptual model and preferred alternatives, if necessary.

Comment B: There is currently not enough data available to completely define the lateral and vertical impact of CT (or any other contaminant of concern) on the Upper 180-Foot Aquifer. Additional data may be required to fully characterize contamination in this aquifer.

Response B: Please refer to our response to Comment 13.

Comment C: There is currently not enough data available to completely define the lateral and vertical impact of CT (or any other contaminant of concern) on the Lower 180-Foot/400-Foot Aquifer. Additional data may be required to fully characterize contamination in this Aquifer.

Response C: Please refer to our response to Comment 13.

SPECIFIC COMMENTS AND RECOMMENDATIONS

Comment 1: Executive Summary, Page xi, Paragraph 2: States "the main objective of the cleanup will be to reduce the health risk caused by the presence of carbon tetrachloride contamination in groundwater." This paragraph should be revised to include protection of the environment and to protect the waters of the state from further degradation caused by migration of the CT plume.

Response 1: The text has been revised as suggested.

Comment 2: Executive Summary, Page xii, Paragraph 2: States "No further search for soil contamination is recommended." It is the opinion of GSU that the potential for CT migration in soil gas above the groundwater has not been fully characterized and additional investigation may be necessary. Please revise this paragraph to address this issue.

Response 2: As discussed on the August 25, 2005 meeting, this comment refers primarily to the vadose zone overlying the downgradient area of the plume, away from the source area. Additional risk assessment modeling, using new DTSC regulations (based on a Johnson-Ettinger type model, have been incorporated into Volume II and results are consistent with the current degree of characterization and additional characterization is not necessary.

Comment 3: Chapter 1.1 Purpose and Objective of RI/FS Report: The paragraph contained in this chapter refers only to the impact of CT on groundwater. The text makes no mention of characterization of CT impact on soil or soil gas. Please revise this chapter to include characterization of soil and soil gas.

Response 3: Additional text will be inserted to address the historical impact to soil and soil gas beneath the source area and subsequent characterization.

Comment 4: Chapter 1.2.2 Site History, Paragraph 2: The text in this paragraph discusses maps and aerial photographs dating from 1941 to the present that were reviewed. GSU was only able to find one small aerial photograph that was

provided as an insert on Plate 2.

Since the Army seems to be having difficulty finding any record of CT use at the base it is the opinion of GSU that a thorough aerial photo investigation is a very important tool for identification of the activities that took place in the proposed source area.

Recommendation: A comprehensive aerial photo study should be completed and added to the RI/FS. Actual aerial photos or high quality copies of all aerial photos that were reviewed should be included in the RI/FS report so that the reader can verify the Army's findings. These photos should include labeling of the key structures and activities present in the photo and text should be added to this chapter clearly describing each of the key observations on each photo.

Response 4: A comprehensive aerial photo study was performed as part of the historical research to determine potential carbon tetrachloride source areas. A new appendix containing aerial photographs from 1941, 1949, 1956, 1966, 1978, and 2003 has been added to the report (Appendix J).

Comment 5: Chapter 1.2.3.5 Conceptual Site Model: Please see General Comment A above.

Response 5: Please refer to response to General Comment A.

Comment 6: Chapter 2.1 Water Supply System: This chapter discusses the Fort Ord drinking water supply system, Marina Coast Water District drinking water supply system and private wells. Each of these systems may have an impact on the CT plume in groundwater and could be considered a potential pathway for CT to impact area drinking water. It appears that the Army has evaluated this possibility. However, GSU was not able to find a map or a cross-section in the RI/FS which shows the proximity of the CT plume in groundwater to any of the wells (supply systems) discussed in this chapter.

Recommendation: GSU recommends that the Army add select maps and cross-sections to the RI/FS to allow the reader to see the CT plumes proximity to each of the systems and wells discussed and to support any conclusions contained in the RI/FS.

Response 6: References to previous reports that have detailed lithology on cross-sections from the OUCTP area to the Fort Ord supply wells area will be included in the Draft Final OUCTP RI report.

Comment 7: **Chapter 2.3 OU2 Groundwater Treatment System Conveyance: This chapter makes reference to the "infiltration gallery" and the "OU2 GWTS" but does not provide a reference map, design drawing and cross-section to support the discussion contained in the chapter.**

Recommendation: Please include a map showing the location of all systems and structures discussed in this chapter. GSU also recommends that a design drawing and cross-section be included to help the reader understand what each of the items discussed looks like and how they relate to the CT plume in soil and groundwater.

Response 7: The former location of the infiltration gallery has been added to Plate 2. A reference to schematic drawings of the infiltration gallery will be included in the Draft Final RI Report.

Comment 8: **Chapter 3.5 Geophysical Investigation, Conclusions: The text states "More information may be obtained after data processing…" It is not clear if this information has been obtained or not. Please clarify why this data processing was not completed prior to completion of the RI/FS and if the data will be included in the Final RI/FS.**

Response 8: Additional processing has occurred but results remained inconclusive regarding the surface of the FO-SVA. This statement will be removed from the Draft Final RI report.

Comment 9: **Chapter 3.5 Geophysical Investigation, Conclusions: GSU review of the data provided found that the selected method of geophysical evaluation (GPR) was not completely successful at delineating the top of the SVA. A recent geophysical evaluation completed by the Army at OU-1 used a surface resistivity technique to help delineate the top of the SVA and appears to have had some success. GSU recommends that the Army consider using surface resistivity or any other appropriate geophysical method to assist with identification of channels which may be present in the top of the FO-SVA.**

Response 9: MACTEC has conducted several resistivity surveys in the OU1 area and have become aware of the limitations of this approach, particularly given the high resistivity of the dry dune sands. We have concluded that interpretations made using this technique alone in this environment are unreliable. Further, as discussed at the August 25, 2005 meeting, we do not agree that channels within the surface of the FO-SVA are needed to explain the distribution of TCE in the OU1 area, nor carbon tetrachloride in the OUCTP area.

Comment 10: **Chapter 4.1 Soil Gas: The RI/FS does not adequately address soil contamination which may be present in the vadose zone above the**

groundwater plume. GSU is aware that the Army has put fourth an effort to evaluate the potential for soil contamination and has completed studies to identify a soil gas plume in the potential source area of the CT plume. However, the RI/FS has not adequately evaluated the potential migration pathways for CT through the vadose zone above the CT plume in the down gradient portion of the A-Aquifer.

Recommendation: Prior to completion of the remedial investigation data should be collected to show that CT currently found in groundwater is not volatilizing and migrating through the vadose zone to the surface. The potential impact of CT (and other VOC's) on soil gas above the CT plume in groundwater should also fully characterized and documented in a clear and concise manor.

Response 10: As discussed at the August 25, 2005 meeting and described in Appendix G, depth-discrete vadose zone samples were collected downgradient from the source area and carbon tetrachloride was not detected, despite fact that these samples overlie relatively high carbon tetrachloride concentrations in groundwater. Additional modeling, using the DTSC technique, was conducted and is now described in Volume II of the Draft Final RA report. Results indicate that volatilization of carbon tetrachloride should not be occurring in the OUCTP area (downgradient of the source area) and the current level of characterization is adequate.

Comment 11: Chapter 4.2.1 A-Aquifer: A comparison of the geologic and hydrogeologic interpretations contained in this Chapter with similar geologic and hydrogeologic interpretations provided to DTSC by the Army for OU-1 found that the Army has provided DTSC with two separate interpretations for the same data.

It is the opinion of GSU that the CSM which is currently being developed for OU-1 may better reflect the environmental conditions at both OU-1 and at OUCTP. If the OU-1 CSM is correct, significant data gaps may exist in the existing monitoring network for the OUCTP A-Aquifer.

The contaminant plume found in the A-Aquifer at OU-1 has been found to be very narrow (600 feet or less) in places and the higher concentration portion of the plume appears to be associated with low areas or channels in the top of the SVA. If this CSM is correct the current monitoring network may have data gaps in the following locations:

- **The western boundary of the plume between MW-BW-45A and MW-BW-38A.**
- **The northeast portion of the plume between MW-BW-67A and MW-BW-75A.**

- **The eastern portion of the plume between MW-BW-36A and MW-BW-28A.**
- **The eastern portion of the plume between MW-BW-58A and MW-BW-28A.**
- **The southwestern portion of the plume between MW-BW-55A and MW-BW-61A.**
- **The southeastern portion of the plume between MW-BW-51A and MW-BW-50A.**

Recommendation: GSU recommends revising the CSM discussed in the RI/FS for OUCTP to reflect the recent findings at OU-1. Once the CSM has been revised DTSC (and the Army) will be able to better evaluate whether additional monitoring points, geophysical investigations, pump testing or other investigation techniques will be needed to evaluate and monitor the narrow contaminant flow paths which appear to be present. Once the new data is acquired this chapter may be revised.

Response 11: As discussed at the August 25, 2005 meeting, the OUCTP monitoring well network has been designed with an orientation consistent with the direction of groundwater flow in each aquifer such that complete coverage of each plume can be defined. That a spacing of 600 feet is exceeded between several well pairs is irrelevant. The direction or potential direction of groundwater flow, and therefore dissolve carbon tetrachloride, has been addressed and is adequately monitored by the current network. However, additional data collected as part of the Remedial Action Plan may require that new monitoring wells be installed to address particular geographic areas requiring further refinement to adequately monitor the progress of proposed remedial processes.

Comment 12: Chapter 4.2.1, Figure 3 TCE Concentrations, A-Aquifer Near Source: It appears that there is enough data to prepare a contour map (plume map) of TCE contamination in the A-Aquifer at OUCTP but such a map has not been prepared. To completely characterize the OUCTP site, plume maps should be prepared for all contaminants of concern and included in the RI/FS. These maps should be prepared for each aquifer at the site.

Response 12: The Draft Final OUCTP RI report will include appropriate references to the Annual Reports of Quarterly Groundwater Monitoring, which include TCE concentration contour maps of the OUCTP area.

Comment 13: Chapter 4.2.2 Upper 180-foot Aquifer: The text in this Chapter appears to be consistent with the geologic, hydrogeologic, and water quality data currently available for the Upper180-Foot Aquifer. However, it is the opinion of GSU that there is currently not enough data available to completely define the lateral and vertical impact of CT (or any other contaminant of concern) on

the Upper 180-Foot Aquifer. Additional data may be required to fully characterize this Aquifer.

Response 13: As discussed at the August 25, 2005 meeting, interaction between the Upper and Lower 180-Foot Aquifers in this area is complex and involves vertical flow through a breach in the Intermediate 180-Foot Aquitard. Graphical presentation is difficult but sufficient data exist to confirm this interaction. Additional explanatory text will be included on Figures 16 and 17.

Comment 14: Chapter 4.2.3 Lower 180-foot Aquifer: The text in this Chapter appears to be consistent with the geologic, hydrogeologic, and water quality data currently available for the Lower180-Foot Aquifer. However, it is the opinion of GSU that there is currently not enough data available to completely define the lateral and vertical impact of CT (or any other contaminant of concern) on the Upper 180-Foot Aquifer. Additional data may be required to fully characterize this Aquifer.

Response 14: See response to comment 13.

Comment 15: Chapter 4.0 Nature and Extent of Contamination: There is no information provided in this Chapter about the nature and extent of contamination in the 400-Foot Aquifer. Please add text to provide this information.

Response 15: A statement noting the absence of carbon tetrachloride in the 400-Foot Aquifer and the Deep Aquifer was made in Section 4.2 of the Draft OUCTP RI/FS. A statement reiterating that carbon tetrachloride has not been detected in the 400-Foot Aquifer was added to Section 4.0.

Comment 16: Chapter 8.1.1 A-Aquifer, Paragraph 2: The text refers to a "wave-cut terrace" near Crescent Avenue. GSU has attempted to recontour the top of the SVA using the information provide on Plate 15B. We also reviewed the contour map provided to DTSC for OU-1 and the GPS data provided. It is not clear how MACTEC has determined that a wave-cut terrace is present in the area of MW-BW-66A.

With a few minor changes in the contouring technique the wave-cut terrace can be contoured out of the top of the SVA. GSU also finds it interesting that a relatively deep channel can be contoured into the top of the SVA in the same area (see Figure 1.2 Salinas Valley Aquitard Elevation Contour Map prepared by HydroGeoLogic, Inc for OU-1) and that this channel seems to parallel the CT plume shown in the A-Aquifer on Plates 15A and 15B.

To confirm the contour of the top of the FO-SVA at OU-1 the Army has completed a surface resistivity study which seems to provide relatively good

geophysical data on the top of the FO-SVA.

Recommendation: GSU recommends that the Army provide additional data to support the interpretation currently shown in the FO-SVA Top Elevation Contour map presented in Plates 15A and 15B. This supporting data may include additional well information not shown on the map or appropriate geophysical data which clearly shows the contour of the top of the FO-SVA.

Response 16: The presence of the wave-cut terrace in the surface of the FO-SVA west of MW-BW-43-A and MW-BW-66-A is based on (1) the presence of clean, coarse gravel with abundant shell fragments west of MW-BW-43-A, consistent with a coarse beach-type sand unit, (2) the abrupt drop in FO-SVA elevation between MW-BW-43-A and MW-BW-44-A, coincident with the thickness of the beach sand unit, (3) the sharp drop in groundwater elevation west of MW-BW-43-A and MW-BW-66-A, (4) the dramatically lower hydraulic gradient of the water table west of MW-BW-43-A relative to the water table east of this well, and (5) the dramatically higher hydraulic conductivity (>500 feet/day) measured at MW-BW-44-A relative to values at monitoring wells further east of this area (typically 20 feet/day). Combined, it is clear that a significant facies change occurs west of MW-BW-43-A and MW-BW-66-A and that a wave-cut terrace, as reported in previous investigations to exist at other locations in Monterey County, is the most likely explanation for all lithologic and hydraulic observations made in this area. Additional data collected as part of the Remedial Action Plan will be used to revise the conceptual model, if necessary.

Comment 17: Chapter 8.1.2 Upper 180-Foot Aquifer: The text states "Groundwater in this aquifer is confined by the overlying aquitard (FO-SVA) and flows east-southeastward toward a natural pinch-out in the underlying aquitard (intermediate 180-Foot Aquitard) where the flow merges with the underlying Lower 180-Foot Aquifer."

Recommendation: Please add an isopach map of the Intermediate 180-Foot Aquitard so that the reader may confirm that the pinch-out exists and that it is shown in the correct location on Figure 16.

Response 17: Structural maps of the aquitards beneath the northern portion of Fort Ord have been constructed as part of the OU2 investigation. References to the OU2 Plume Delineation Investigation Report will be included in the OUCTP RI Report. Furthermore, isopach maps are included in Appendix F, as part of the model construction, to more fully illustrate the structure of the aquifers and aquitards in the study area.

Comment 18: Figure 16: To be consistent with the rest of the "Plates" in the Please revise the title of "Figure 16" to be "Plate 16".

Response 18: The plate has been revised as suggested.

Comment 19: Chapter 9.3 Particle Analysis, Paragraph 3: The text states "As shown on Plate_," Please insert the proper plate number into this sentence.

Response 19: The plate number will be inserted into this sentence.

Comment 20: Chapter 10.1 Summary and Conclusions, Paragraph 2: The text states "Hydraulic communication between the A-Aquifer and underlying aquifers is limited to those areas west of OUCTP where the FO-SVA clay unit pinches out…"

Recommendation: To confirm this conclusion please provide an isopach map of the FO-SVA in the RI/FS. GSU recommends that this isopach map include all FO-SVA thickness data which is currently available in the Fort Ord data base. By using this regional approach GSU will be able to confirm that the Army has placed the location of the FO-SVA pinch-out in the correct location, that the FO-SVA impact on groundwater flow has been properly addressed in the groundwater flow model and that the FO-SVA is in fact a continuous clay layer which stretches across Fort Ord and the surrounding area.

Response 20: Please refer to our response to Comment 17.

Comment 21: Chapter 10.1 Summary and Conclusions, Paragraph 2: The text states "To such vertical conduits…" Please change "To" to "Two" on this sentence.

Response 21: The typographical error has been corrected.

Comment 22: Chapter 10.1 Summary and Conclusions, Paragraph 5: The text states "The Intermediate 180-Foot Aquitard consists of approximately 50 feet of interbedded clay and…" To confirm the location of the 180-Foot aquitard and its impact on groundwater flow please include an isopach map in the RI/FS. GSU recommends that this isopach map include all 180-Foot Aquitard thickness data which is currently available in the Fort Ord data base. By using this regional approach GSU will be able to confirm that the Army has placed the location of the 180-Foot Aquitard pinch-out in the correct location and that the impact on groundwater flow has been properly addressed in groundwater flow modeling.

Response 22: Please see our response to Comment 17.

Comment 23: Chapter 10.8 Conclusions, Bullet 1: The text states "The SVE pilot study has effectively removed All CT mass from within the vadose zone and future contribution to the A-Aquifer is not likely or anticipated." GSU is not able to concur with this conclusion at this time. The data gaps described in comment number 10 above (bullets 5 and 6) leave open the possibility that a source for CT may be present to the south of the Army's proposed source area.

Response 23: Comment 10 bullets 5 and 6 refer to alleged data gaps in the groundwater monitoring program and do not apply to the soil gas monitoring network described in Section 3.2. Results from the SVE pilot study, as discussed in Section 3.10 and Appendix G consistently indicate the removal of carbon tetrachloride from the vadose zone beneath the source area. Results from the soil gas surveys, operation and results of the two phases of SVE pilot study confirm that the source area of OUCTP has been identified and remediated. Additional sources of carbon tetrachloride speculated by the DTSC are unfounded and inconsistent with data collected as part of the OUCTP or previous OU2 investigations. As discussed at the August 25, 2005 meeting, CT is an unlikely component of the OU2 plume because CT had been phased out at or just before the time the Fort Ord landfills had been constructed. Furthermore, analytical results from extraction wells in the A-Aquifer that have operated for the past decade have not detected elevated concentrations of carbon tetrachloride consistent with a source.

Comment 24: Chapter 10.8 Conclusions, Bullet 2: The text states "Continued migration of CT in the A-Aquifer has resulted in a two mile long plume at low concentrations." GSU is not able to concur with this conclusion at this time. This was the same conclusion which was made at OU-1 until recent drilling and sampling found higher concentrations of TCE associated with narrow channels which are present in the top of the SVA (base of the A-Aquifer). These new findings have resulted in a revised CSM for OU-1. It is the opinion of GSU that this revised CSM may apply to OUCTP.

Recommendation: GSU recommends revising the CSM for OUCTP to reflect the recent findings at OU-1. Once the CSM has been revised DTSC (and the Army) will be able to better evaluate whether the statement made in Bullet 2 is accurate or if additional monitoring points, geophysical investigations, pump testing or other investigation techniques will be needed to evaluate and monitor the narrow contaminant flow paths which may be present.

Response 24: The length of the OU1 plume did not increase with the addition of new monitoring wells; it increased with the detection of TCE at elevated concentrations at an existing monitoring well. A significant distinction between the OU1 and OUCTP area is that four monitoring wells are present downgradient of the leading edge of the CT plume in the A-Aquifer that have remained non-detect for CT since their installation. Groundwater elevation data from these four locations illustrate a consistent gradient as with other monitoring wells located west of the wave-cut terrace and indicate that the four monitoring wells are properly located to monitor the advancement of the A-Aquifer CT plume.

Comment 25: Appendix F, Groundwater Modeling Report: The modeling report indicated that, of the remedial alternatives assessed; only enhanced natural attenuation using a Lactate Recirculation and Injection System (Scenario 3) was observed to be effective in containing and mitigating the A-Aquifer Carbon Tetrachloride plume within a time period of 15 years. It appeared from the review of the Lactate Recirculation pilot test that chloroform was produced while carbon tetrachloride was degraded. It may be possible that chloroform will not further breakdown to the next daughter product.

Recommendation: Prior to full scale implementation of this remediation approach the Army should assess the potential for chloroform to increase to levels of concern.

Response 25: Chloroform will be monitored as part of the VOC suite with any future remedial efforts associated with OUCTP. However, given that an MCL for chloroform does not exist other than that associated with total trihalomethanes (100 μg/L), it can be concluded that CT degradation from concentrations less than 20 μg/L will not result in chloroform concentrations exceeding 100 μg/L. The unit molar ratio of CT to CF is 1.29, reflecting the lower molecular weight of CF relative to CT. This means that the complete degradation of CT to CF would result in CF concentrations about 29 percent lower than those of CT. Thus, there is no mechanism for CF concentrations to increase above the already documented concentrations of CT.

Comment 26: Appendix F, Groundwater Modeling Report: The enhanced natural attenuation scenario will require an adequate supply or flux of electron acceptors to allow for degradation of carbon tetrachloride to acceptable levels.

Recommendation: Please provide an evaluation or explanation of the availability of electron acceptors to remediate the carbon tetrachloride plume to acceptable levels.

Response 26: An evaluation of the availability of electron receptors will be included in the Remedial Action Work Plan.

Comment 27: Appendix F, Groundwater Modeling Report: Scenario 1 included groundwater extraction to remove contaminant mass from the A-Aquifer. The simulation showed capture of most of the carbon tetrachloride plume and the captured portion of the plume would be remediated in 30 years. The downgradient portion of the plume was not completely captured. The addition of extraction wells to this scenario may allow for faster cleanup and capture of the downgradient portion that was not captured in the initial simulation.

Recommendation: Please consider running the simulation with additional hypothetical extraction wells to try to achieve complete capture and faster cleanup.

Response 27: The proposed remedial alternatives presented in the OUCTP RI/FS report were discussed and agreed upon between the Army and the DTSC, RWQCB, and EPA based on presentations of existing groundwater and pilot study results. As discussed in these meetings and reiterated in the report, the installation and operation of extraction wells west of the Former Fort Ord boundary within the commercial/residential district of the City of Marina is not practicable given significantly restricted access. For this reason, *insitu* remediation techniques were presented to the regulatory agencies and agreed upon for evaluation as part of the downgradient terminus area of the A-Aquifer CT plume.

Comment 28: Appendix F, Groundwater Modeling Report, Page 32, first paragraph, second sentence: It is indicated that the discussion of predictive simulations are presented in Section 6.0. The predictive simulations are actually presented in Section 9.0. Section 6.0 discusses Model Verification. Please correct the text as appropriate.

Response 28: The discrepancy has been corrected.

Comment 29: Appendix F, Groundwater Modeling Report, Page 41, last paragraph, first sentence: It is indicated that Plate F13 depicts the observed and simulated Carbon Tetrachloride plume in the A-Aquifer. A review of the plates indicated that Plate F12 depicts the plume. Please correct the text as appropriate.

Response 29: The text has been modified to reference the correct plate number.

Comment 30: Appendix F, Groundwater Modeling Report, Page 44, second to last paragraph: It is indicated that two suspected vertical conduits are present within the carbon tetrachloride plume.

Recommendation: Please provide an explanation of current monitoring wells

located at the areas of potential vertical conduits and assess if monitoring is adequate to assess the potential for vertical conduits.

Response 30: The current monitoring well network was sufficient to identify these vertical conduits and is therefore adequate to monitor the effect of plugging them. The presence of two conduits is substantiated by the two CT plumes emanating from these conduits in the Upper 180-Foot Aquifer. Destruction of the eastern conduit (MW-B-13-180) should result in the eventual decay of the eastern Upper 180-Foot Aquifer plume. It cannot yet be determined if the destruction of MCWD Well No. 8 has resulted in the decay of the western plume, as historical data prior to this well destruction activity does not exist. A very high density of residential land use in this vicinity presents significant challenges to the installation of additional monitoring wells. Results from continued monitoring from the existing network will be used to determine whether additional data are necessary.

Comment 31: Appendix F, Groundwater Modeling Report, Scenario 4, remediation of carbon tetrachloride with the use of a permeable reactive barrier (PRB): The area of contamination that is present downgradient of the simulated PRB does not cleanup during the simulation. Augmenting the simulation with downgradient extraction may be useful to make this a viable alternative. Please consider running the PRB scenario with downgradient extraction.

Response 31: Please refer to our response to Comment 27.

Comment 32: Appendix F, Draft Groundwater Modeling Report, Page 54, second sentence, It is indicated that the PRB half life was similar to the half life used for Scenario 4. This possibly should be referring to Scenario 3 (Lactate injection scenario). Please correct the text as appropriate.

Response 32: The text will be clarified as necessary.

Comment 33: Appendix F, Draft Groundwater Modeling Report, Page 46, first paragraph: It is indicated that simulation of eastward movement of the A-Aquifer plume as a result of injection of treated water west of the plume was not done. It is concluded that it is a low probability that this mass will continue to migrate eastward. It is concluded that the results of the steady state simulation reasonably represent the observed conditions and plausible conditions not observed. It may be possible that simulation of eastward movement of the plume as a result of injection of treated water could become necessary if it is later decided that active remediation at this part of the plume is warranted.

Recommendation: Please provide further explanation as to why it is a low probability that a portion of the A-Aquifer carbon tetrachloride plume is unlikely to migrate to the east.

Response 33: The A-Aquifer CT plume is not likely to migrate further east from the MW-BW-16-A vicinity because CT in this area represents an 'abandoned' portion of the A-Aquifer plume. Flow to this area was induced by the temporary injection of treated wastewater from the OU2 GWTP at the infiltration gallery, which used to be located west of the OUCTP source area. Now that groundwater flow directions have equilibrated to those prior to OU2 injection activities, the OUCTP plume will continue to migrate to the west of the MW-BW-16-A location. Proximity to the groundwater divide at MW-BW-16-A will result in very slow migration and essentially represents a stagnation point. The continued non-detection of CT at the monitoring well MW-BW-58-A downgradient of MW-BW-16-A will confirm that CT in this area is not actively migrating to the northeast.

Comment 34: Appendix F, Draft Groundwater Modeling Report, Page 33, second to last paragraph: It is indicated that analysis of the sensitivity of the model indicated variations in the overall calibration of groundwater flow in Layer 1 with respect to horizontal anisotropy. On page 6 it is indicated that Layer 1 was deactivated during the calibration process. Please provide clarification regarding this apparent discrepancy.

Response 34: Text on Page 33 will be revised to refer to Layer 2; Layer 1 was initially constructed as part of a two-layer representation of the A-Aquifer and was subsequently deactivated when it was determined that this level of vertical discretization was not necessary.