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

Volume V – Comments and Response on Draft Final

Prepared for

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1.0 INTRODUCTION

The potential for soil vapor intrusion from groundwater in the Operable Unit Carbon Tetrachloride Plume (OUCTP) at Fort Ord was evaluated in response to comments received from the Department of Toxic Substance Control (DTSC) on the draft Proposed Plan for the OUTCTP. DTSC requested that health risks associated with off-gassing of volatile contaminants from the OUCTP plume located downgradient of the suspected source area into indoor air be evaluated and raised concerns about the adequacy of the existing data to evaluate the indoor air pathway. The attached conceptual model (Figure 1) shows the location of monitoring wells and soil vapor samples, and the results of carbon tetrachloride (CT) analyses in groundwater and soil vapor, as described below.

1. **Soil Vapor Sampling-** A soil vapor sample was collected in September 2004 at 85 feet below ground surface (bgs) at sample location CTP-SGP-66, which is located over a portion of the groundwater plume with a relatively high concentration of CT. These results are presented in Appendix G of the final RI/FS. No analytes were detected by EPA Method TO-15 at a reporting limit of 0.079 parts per billion by volume (ppbv). The closest groundwater monitoring well, MW-BW-53-A, is a distance of approximately 125 feet cross gradient from CTP-SGP-66. The depth to groundwater at MW-BW-53-A is 96 feet bgs. Groundwater concentrations at MW-BW-53-A in samples collected when the soil vapor sample was collected were 13 micrograms per liter (µg/L) CT, 1.8 µg/L chloroform, and 6.4 µg/L TCE. The concentration of CT in groundwater at this location decreased to 7.6 µg /L in September 2005 (*MACTEC, in press*). The proximity of the two sampling locations and the fact that no contaminants were detected at concentrations greater than reporting limits in soil gas suggests that off gassing from groundwater is not significant.

2. **Indoor Air Sampling -** In March 2004, prior to the implementation of the soil vapor extraction (SVE) system, the air in Building 6277 in Lexington Court was sampled to evaluate the potential for VOCs in subsurface vapors to serve as a source of VOC contamination to indoor air (*Shaw, 2004*). The DTSC version of the Johnson and Ettinger (J&E) model was used to estimate indoor air concentrations using soil vapor data collected immediately below the slab of the Building 6277 foundation and at 6 feet bgs below the building (*Shaw, 2004*). Indoor air concentrations were calculated for CT, 1,3-butadiene, benzene, chloroform, PCE, and TCE, which were the only contaminants detected in either the sub-slab or 6-foot bgs soil vapor samples. The estimated concentration of CT in indoor air samples estimated using the J&E model were between 1 and 3

orders of magnitude less than the concentration of CT measured in indoor air samples. The concentrations of CT in indoor air samples were 0.092 parts per billion by volume (ppbv) and 0.099 ppbv in the two samples collected (Table 1). The concentrations of CT in outdoor samples collected at Lexington Court were 0.09 ppbv and 0.098 ppbv in the two samples collected. Both the indoor and outdoor samples collected at Lexington Court were within the range of background concentrations measured in outdoor air during the Fort Ord ambient air monitoring program (CT ranged from 0.067 ppbv and 0.13 ppbv). Specific to Fort Ord these results provide additional information that groundwater contamination is not a significant source of contamination to indoor air.

3. **Estimated Indoor Air Concentration (J&E Modeling)** - The DTSC version of the J&E model was used to estimate indoor air concentrations of carbon tetrachloride and estimate risks using groundwater data collected from the center and downgradient portion of the carbon tetrachloride plume that lies beneath the City of Marina where there is existing residential housing (near MW-BW-49A). The "hot spot" in the center of the plume is located beneath the existing habitat reserve and, due to land use controls, is not available for future residential housing. The model assumed a 30-year exposure period.

    a. Analytical results from samples collected from monitoring well MW-BW-53A, sampled at a depth of 96 feet below ground surface, were used to estimate indoor air concentrations at the center of the plume. CT, TCE, and chloroform were the only VOCs detected in September 2004 at concentrations of 13 µg/L, 4.9 µg/L and 1.6 µg/L, respectively. The cumulative human health cancer risk to indoor air using the September 2004 data is 2 E-5 and the noncancer hazard estimate is 0.031 (Table 1). The input concentration of 7.6 µg/L CT collected in September 2005 was also modeled. The estimated cancer risk is 1E-5 and the noncancer hazard estimate is 0.02.

    b. Analytical results from samples collected from monitoring well MW-BW-49A, sampled at a depth of 35 feet bgs, were used to estimate indoor air concentrations at the downgradient portion of the plume. CT and chloroform were the only VOCs detected in September 2004 at concentrations of 4 µg/L and of 0.27 µg/L, respectively. The cumulative human health cancer risk due to exposure to indoor air is 2 E-5 and the noncancer hazard estimate is 0.02 (Table 1). The input concentration of 2.5 µg/L CT collected in September 2005

collected in September 2005 was also modeled. No other VOCs were detected in this sample. The estimated cancer risk is 9 E-6 and the noncancer hazard estimate is 0.01.

4. **Cumulative Risk**: The cumulative RME cancer risk estimates associated with exposure to contaminants in the A-aquifer is 3E-5. The estimated RME cancer risks are 2E-5 for the Upper 180 foot aquifer, and 2E-5 for the 180-400 foot aquifer. The estimated cancer risks associated with the vapor intrusion pathway are approximately twice the estimated risk associated with household water use when groundwater data were used to estimate the indoor air concentrations (at MW-BW-49A and MW-BW-53A). Conversely, the estimated cancer risk associated with the vapor intrusion pathway were negligible compared to direct contact pathways associated with household uses of groundwater when soil gas data was used to estimate indoor air concentrations at CTP-SGP-35.

Location	Estimated Risk from Exposure through Direct Contact (1)	Estimated Risk from Exposure through Inhalation of Indoor Air (2)	Cumulative Risk (3)
A-Aquifer			
Near Source Area (MW-BW-53A)	1 E-5	2 E-5	3 E-5
Downgradient (MW-BW-49A)	1 E-5	2 E-5	3 E-5
Upper 180-foot Aquifer	3 E-6	2 E-5	2 E-5
180-400 foot Aquifer	2 E-6	2 E-5	2 E-5

Notes:

(1) Estimated risk from exposure through direct contact with groundwater is reported in Table 21 of the Human Health Risk Assessment, Volume III, Final RI/FS

(2) Estimated risk from exposure through inhalation of indoor air is reported in Table 1 of this Response to Comments, Volume V, Final RI/FS

(3) Cumulative risk is the sum of the risk from direct contact and inhalation of indoor air.

As described in the RI/FS, the Army is committed to remediate the OUCTP groundwater plume, which will greatly reduce any long-term potential risk associated with the plume. In addition, the results from the soil gas and indoor air samples indicate that volatilization of carbon tetrachloride is not occurring above the OUCTP groundwater plume and the current level of characterization is adequate. In addition, the J&E model indicates that if CT is volatizing from the plume, the total estimated risks, while greater than point of departure for risk management of 1E-6, are within the risk management range of 1E-6 to 1E-4. The Army has determined contamination in the downgradient area is relatively recent and the Army is committed to initiating the groundwater remediation in the first remediation phase in the portion of the plume within the city of Marina. This will greatly reduce the actual exposure duration.

2.0 Response to Comments on Draft Final Operable Unit Carbon Tetrachloride Plume, Groundwater Remedial Investigation/Feasibility Study, Dated October 25, 2005

2.1 California Regional Water Quality Control Board, Central Coast Region Comments dated December 22, 2005:

Comment 1: Site Conceptual Models:
There has been ongoing discussion regarding the differences in site conceptual models employed by Army contractors for the Operable Unit Carbon Tetrachloride Plume (OUCTP), and the neighboring Operable Unit 1 (OU1) plume. We believe that Ft. Ord plume flows are primarily gradient-driven or controlled, with one exception being OU1, where stratigraphy has arguably exerted some influence, causing the plume to narrow and pass through the previous down-gradient monitoring network. We believe that as long as the OUCTP down-gradient monitoring network is on sufficiently tight spacing to protect against the plume passing without detection, which we believe it is, the public's interests are protected, and we will not push for resolution of which conceptual model best predicts plume behavior.

Response 1: The Army appreciates the Water Board's perspective on the site conceptual model for the OUTCP and will continue to conduct routine groundwater monitoring to evaluate the downgradient portion of the plume.

2.2 California Department of Toxic Substances Control Comments Letter dated January 11, 2006:

Specific comments on Volume III – Feasibility Study

Comment 1: Appendix A, Table A2: 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 1: Table A2 of the FS includes the breakdown of capital costs and annual O&M costs as indicated in the comment. The costs indicated are not one-time costs, and therefore appear as both capital and O&M costs. Capital costs associated with installation, lactate injection, observation, and system monitoring that would occur during the first year of implementation are shown in Table A2 for Year 1. Subsequent lactate injection events (assumed every 2.5 years after the first event

in Year 1) are included as O&M costs.

Comment 2: Appendix A, Table A4: 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. The estimate may be better clarified if the costs are broken out by segments (i.e., 1-10 year; 11-20 years; 21-30 years) to match the O&M monitoring estimates.

Response 2: Table A2 of the FS includes the breakdown of annual O&M costs as indicated in the comment that support the total listed O&M costs of approximately $17.5 million that combines the two types of O&M costs over 30 years. Annual Treatment System O&M costs were assumed to differ for each 10-year period and are therefore broken out by Years 1-10, Years 11-20, and Years 21-30. Annual Plume Monitoring O&M costs were assumed to be the same for Years 1-30, and therefore were not broken out by 10-year period.

Comment 3: Appendix A, tables A4 and A5: 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: Tables A4 and A5 of the FS include the breakdown of capital costs and annual O&M costs as indicated in the comment. The costs indicated are not one-time costs, and therefore appear as both capital and O&M costs. Capital costs associated with system monitoring that would occur during the first year of implementation are shown in Tables A4 and A5 for Year 1. Subsequent system monitoring events are included as O&M costs for the subsequent years indicated.

2.3 California Department of Toxic Substances Control, Human and Ecological Risk Division (HERD) Comments, Memorandum dated December 13, 2005:

General comments

Comment 1: The responses to Specific Comments 1, 2, 3, 6, 7, and 8 and Comment 3 of HERD's Conclusions/recommendations are acceptable and require no further comment

Response 1: Comment acknowledged.

Comment 2: Response to Specific Comment 4: The discussion of the prohibition zone in Section 3.1.1 was not deleted in the revised test. However, the edited text indicates that all exposure pathways associated with the groundwater are considered complete for evaluation purposes. Importantly, because this exposure pathway was quantitatively evaluated in the document, HERD finds the revised text to be acceptable.

Response 2: Comment acknowledged.

Comment 3: Volatile Organic Compounds (VOCs) in Ambient and Indoor Air (Responses to General Comment 1, Specific comments 5 and 9, and Comments 1 and 2 of HERD's Conclusion and Recommendation).

3.1. Ambient Air Evaluation. HERD notes that the document was revised to qualitatively, but not quantitatively, evaluate exposure to outdoor ambient air. Because ambient air is not expected to be significantly impacted by OU CCl_4 plume (OUCTP), HERD finds the qualitative evaluation of outdoor air acceptable. However, because exposure to VOCs in ambient air has been shown to pose a significant risk at nearby OU-2, HERD recommends that the Army continue to monitor ambient air at OU-2 and assess risks for nearby receptors.

Response 3. 1: The Army appreciates HERD's acknowledgement that a qualitative evaluation of outdoor air is acceptable. As described in the introduction to these responses, the results from the soil gas and indoor air samples indicate that volatilization of carbon tetrachloride is not occurring above the OUCTP groundwater plume and the current level of characterization is adequate. In addition, the J&E model indicates that if CT is volatizing over the plume, the estimated risk are within the acceptable risk management range, even assuming a 30 year exposure (Table 1 and Appendix A).

3.2. Indoor Air. In the human health risk assessment, soil gas data from the Lexington Court area (which is in the vicinity of the suspected source area) were used to evaluate vapor intrusion to indoor air using the DTSC Johnson and Ettinger (J&E) soil gas model. HERD has the following comments on the J&E inputs used in the document.

- **While the text states that the soil type was assumed to be sand, the printouts indicate that a soil type was not actually selected. The document should be updated in this regard.**

- **Unless appropriate justification can be provided to support the use of 18°C as the average soil temperature, use 24°C as recommended in DTSC guidance (*DTSC, 2005*).**

- **In the document, the J&E model was used to estimate risk and hazard for both children and adults, assuming an exposure duration of 6 and 24 year for children and adults, respectively. HERD recommends that the DTSC J&E model be run as developed (i.e., assuming an exposure duration of 30 years, and evaluating risk and hazard from indoor air exposure for adults only). Alternatively, the infinite source indoor air concentration shown on the "Intercalcs" sheet of the J&E model can be used as the source term using standard risk equations to calculate hazard for the child and risk for child + adult weighted exposures.**

Response 3.2: The J&E model was rerun with the corrected soil parameters for sand, at 18 degrees Celsius, and for 30-year adult exposure duration (Appendix A). These changes to the input parameters result in cancer and noncancer risk that are not significantly different from the original model results presented in the Risk Assessment.

The temperature of 18 degrees Celsius was used as input to the model because it is representative of typical groundwater temperatures in the A-aquifer observed during monitor well purging and well development. For example, 18 degrees Celsius is consistent with temperatures reported in well development records for monitoring well MW-BW-43A through MW-BW-54A that were provided in the letter report summarizing drilling activities for these wells installed in 2001 (*Harding ESE, 2002*).

Comment 4: Feasibility Study (FS). While HERD previously did not comment on the FS, HERD conducted a cursory review of the FS in conjunction with our review of the Response to Comments. HERD noted the following:

4.1. Chemicals of Concern. Table 2 of the FS lists chemicals of concern (COCs) and proposed aquifer cleanup levels (ACLs). HERD notes that only CCl_4, tetrachloroethene, trichloroethene, and 1,2-dichloroethane were listed as chemicals of concern and California maximum contaminant levels (MCLs) were chosen as the ACLs. It appears that the selection of this subset of the COPCs which were quantitatively evaluated in the risk assessment was based in part on their contribution to the cumulative risks. HERD recommends that all of the COPCs quantitatively evaluated in the risk assessment be included in Table 2 of the FS.

Response 4.1: As noted in EPA's A Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Documents (*EPA, 1999*), the summary of the baseline risk assessment in the Proposed Plan should present the "major chemical(s) of concern." Chemicals of concern are defined as those contaminants identified in the RI/FS needing to be addressed by the response action proposed in

the ROD. Accordingly, the summary of site risks presented in the proposed plan is not intended to act as a comprehensive summary of the baseline risk assessment. In fact, EPA guidance recommends that the risk assessment be summarized using a narrative, rather than a tabular format, which would indicate that the use of large, comprehensive tables should be avoided here.

4.2. Chloroform. The DTSC geologist for the site previously commented that the Army should address the potential for chloroform to increase to levels of concern. The Army responded (Response 25) that there is no MCL for chloroform other than that associated with total trihalomethanes (100 ug/L). The Army further concluded that CCl_4 degradation from concentrations less than 20 ug/L will not result in chloroform concentrations exceeding 100 ug/L.

HERD notes that the total trihalomethane MCL is not a risk-based concentration for chloroform. In addition, the risk-based Cal-modified tap water Preliminary Remediation Goal (PRG) for chloroform is 0.53 ug/L (*USEPA, 2004*). HERD therefore recommends that chloroform concentrations continue to be monitored with any future remedial efforts associated with OUCTP. It is noted that the Army's response indicated that this is already planned.

Response 4.2: Comment acknowledged.

4.3. Rather than providing only qualitative discussion of the reduction of toxicity, it is recommended that quantitative risk reduction associated with each remedial alternative relative to the baseline risk assessment be included in the document. HERD also recommends that risk associated with exposure to potential increasing concentrations of chloroform produced from CCl4 degradation be discussed.

Response 4.3: Risk evaluations are not typically performed to assess the effectiveness of various remedial alternatives in the FS. CERCLA requires that each proposed remedy meet the threshold of being protective of human health and the environment. It is assumed that remediation will continue until the remedial action objectives are achieved, making it likely that each alternative would achieve identical scores regardless of the actual or relative reduction of risk. Further, estimating actual residual contaminant concentrations other than the RAOs would be subject to a high degree of uncertainty, rendering the value of any subsequent risk estimates questionable.

<u>Specific Comment</u>

Comment 1: Risk Estimates. HERD notes that the risk estimates and discussion contained in the Executive Summary for the document (page xviii) do not correspond to

correspond to the risk estimates contained in "Volume II: Human Health Risk Assessment." Specifically, the risk estimates associated with the vapor intrusion to indoor air pathway discussed in the Executive Summary are higher than those included in the risk assessment portion of the document. The document needs to be updated so that the risk estimates are consistent and accurate throughout the document.

Response 1: The Executive Summary in the final RI/FS has been updated to summarize both the Risk Assessment and the estimated risk associated with vapor intrusion to indoor air from groundwater in the center and down gradient portions of the plume, as described in the introduction to these responses.

Conclusions

Comment 1: HERD has reviewed the Response to Comments and revised risk assessment, and notes that the majority of HERD's previous comments have been adequately addressed. While HERD finds it acceptable to evaluate exposure to ambient air for OUCTP in a qualitative manner only, HERD recommends that ambient air continue to be monitored at nearby OU-2. For the indoor air evaluation, HERD recommends that the document be updated to reflect our comments noted above. With respect to the FS, HERD recommends that all of the COPCs quantitatively evaluated in the risk assessment be discussed, and that an evaluation of quantitative risk reduction be included.

Response 1: Comment acknowledged. Please see response to (HERD) Comments No. 3 and 4.

2.4 California Department of Toxic Substances Control (Stewart W. Black, Northern California Geologic Services Unit [GSU]), Memorandum dated December 15, 2005:

General Comments

Comment A: The Draft Final RI/FS is well written and organized. It appears that MACTEC has addressed GSU comments on the Draft RI/FS and has remained true to the data points that are currently available. While some uncertainty remains, it appears that there is enough data available to select a remediation approach and to support the conclusions and recommendations contained in the document.

Response A: Comment acknowledged.

Comment B: The Draft Final RI/FS contains an evaluation of existing data gaps and outlines some of the uncertainties associated with select remedial alternatives.

GSU continues to be concerned with the inconsistencies which remain between the OU1 and the OUCTP conceptual site models (CSM). A comparison of the most recent geologic and hydrogeologic interpretations contained in this Draft Final RI/FS with the most recent geologic and hydrogeologic interpretations provided to DTSC by the Army for OU-1 found that the Army continues to provide DTSC with two separate interpretations for the same data.

It is the opinion of GSU that the additional data required to resolve this issue can be obtained during the remedial design and remedial action phase of OUCTP clean up operations. Pilot studies which include extraction wells, injection wells and monitoring wells should be designed and strategically located to confirm the CSM for OUCTP and OU-1 as well as test a selected remedy.

GSU recommends that all existing and future data collected at OU-1 and at OUCTP be integrated into one comprehensive CSM for both OU-1 and OUCTP. It is the opinion of GSU that the depositional environment and groundwater flow patterns at OUCTP and OU-1 may be similar. If this is true one would expect that the contaminant plume migration patterns may also be similar. It is therefore imperative that additional data is collected during the remedial action phase to assure that a very narrow plume of contamination in groundwater (like the one seen at OU-1) is not allowed to slip through the existing monitoring network and migrating off-site or to a deeper drinking water aquifer.

Prior to implementation of a final remedy all data gaps should be addressed and a final, comprehensive CSM for both OU1 and OUCTP should be completed.

GSU recommends that the Army work closely with the Base Closure Team (BCT) during the design and implementation of pilot testing, preparation of the Remedial Action Plan, system design, system operation and system monitoring to insure that all data gaps are addressed and that the final remedy is operating properly and successfully.

Response B: The Army is committed to working closely with the BRAC Cleanup Team (BCT) during the design and implementation of pilot testing, preparation of the Remedial Action Plan, system design, system operation and system monitoring to insure that all data gaps are addressed and that the final remedy is operating properly and successfully.

Comment C: The additional text that has been added to Plates 16 and 17 help with the explanation of the complex vertical flow of groundwater. Even with these

revisions uncertainty remains with respect to the extent of the carbon tetrachloride plume and the TCE plume in the 180-Foot and 400-Foot Aquifers.

The Army is currently collecting additional data near the easterly portion of the OU-2 plume and near the southeasterly portion of the OUCTP plume by installing additional groundwater extraction wells. The wells are designed to enhance the OU-2 groundwater treatment system and to stop the migration of TCE to the southeast. The data collected from this activity may help define the carbon tetrachloride plume in the area. It is also likely that the groundwater extraction currently planned for OU-2 in this area will capture the southerly portion of the carbon tetrachloride plume.

It is the opinion of GSU that operations which are currently underway to expand the OU-2 groundwater treatment system and to better define the extent of the TCE plume may provide the information needed to close data gaps associated with the carbon tetrachloride plume. It is also likely that expansion of the OU-2 groundwater extraction and treatment system which is currently planned for this area may also capture the carbon tetrachloride plume shown on Plates 16 and 17.

GSU recommends that the Army continue to work closely with the BCT during the design and installation of the OU-2 extraction and treatment system. Data collected from operations at OU-2 should be used to refine the OU-2 and the OUCTP CSM. This information should then be incorporated into the design and implementation of a final remedy for clean up of groundwater at OUCTP.

Response C: As stated above, the Army is committed to working closely with the BCT during the design and implementation of pilot testing, preparation of the Remedial Action Plan, system design, system operation and system monitoring to insure that all data gaps are addressed and that the final remedy is operating properly and successfully.

2.5 Comments of The Fort Ord Environmental Justice Network, Dated December 20, 2005

Comment 1: Recommendations

- **The report should include more information about secondary contaminants such as chloroform and tetrachloroethene (PCE).**
- **The Army should continue monitoring soil gas levels after the soil vapor extraction unit is shut down to verify its success.**

- **The human health risk assessment should be expanded and acknowledge the greater risks posed to children.**
- **The Army needs to include in the report and Army response FOEJN comments.**

Response 1: The Army will consider these recommendations during the development and implementation of the remedial design.

General Comments

Comment 1: Overall, the report is very good, and is a significant improvement over the previous draft. Most of the report is easy to read and contains a large amount of valuable and informative data. We agree with the vast majority of the report's conclusions, and are pleased to see the Army embracing new technologies such as the bioremediation technique recommended in the report.

It is understood that the scope of this document was very large and complex, forcing the Army to breeze over or exclude some information as a result. Unfortunately, in this instance it has resulted in the absence of important information regarding other contaminants besides carbon tetrachloride. Neither of the pilot studies discusses the effect of the remediation technologies on compounds such as chloroform or PCE in any great length, despite the conclusion of the risk assessment that those compounds are significant risk drivers behind carbon tetrachloride. More information regarding these compounds, particularly their behavior during the pilot studies needs to be included in the report.

Response 1: The Army will consider these recommendations during the development and implementation of the remedial design.

Comment 2: The results of the soil vapor extraction (SVE) system are very encouraging. However, the recommendation to cease monitoring when the system is shut down causes some concern. While current monitoring indicates that concentrations of carbon tetrachloride vapor in the soils have been minimized, it is by no means assured that concentrations will not rise again in the absence of the SVE unit's operation. It is therefore recommended that the Army continue limited monitoring of the soil vadose zone to verify the success of this particular project.

Response 2: The Army will consider these recommendations during the development and implementation of the remedial design.

Comment 3: The most flawed section of the document is the human health risk assessment. While the groundwater evaluated is not currently in use and presumable will

presumable will not be until it has been fully remediated, it is vital that initial risk assessment be accurate for comparative purposes in the future. The assessment has underestimated risks, particularly in children. The most obvious way that this has occurred is the average exposure duration for children being set at six years for children instead of the nine used for adults. No explanation is provided as justification of the six year value. This assumption has no basis (individuals may continue to grow and develop until the age of 18 and frequently much longer), and results in a gross underestimation of risks to children. Therefore the Army should evaluate risks to children over 9 years if they wish for their risk estimates to have any sort of value. The report also notes that the effect of lower body weight in children on risk was not accounted for during evaluations pertaining to indoor soil vapor intrusion. While the effect of this on calculations of overall risk may be negligible, it is another example of the Army underestimating risks to children. The report assumes that all areas of contaminated groundwater would be blended together, and while the methodology is sound, this approach does not consider the possibility of private wells that are not connected with a larger system The Army should note that risks from such private wells have the potential to be greater than those calculated in the report.

Response 3: The methodology used in the risk assessment is consistent with both U.S. EPA and Cal/EPA guidance, and is specifically intended to avoid underestimating risks, particularly in children. Children are often evaluated separately from adults in Superfund risk assessments because children have a lower overall body weight relative to the predicted intake. This is particularly evident when assessing exposure to soil-bound contaminants. A number of studies have shown that inadvertent ingestion of soil is common among children 6 years old and younger (*Calabrese et al., 1989; Davis et al., 1990; Van Wijnen et al., 1990*). Consequently, children are typically evaluated separately up to the age of 6 years, after which the disparities between intake rates and body weight become less apparent, and also for purposes of combining exposures across different pathways. However, there appears to be some confusion in the comment with regard to exposure durations. As noted above, children are typically evaluated separately from adults for an exposure duration of 6 years, but overall residential exposures are assumed to be 30 years for the reasonable maximum exposure (RME) assessment; for the remaining 24 years the receptor is assumed to be an adult. Central tendency estimates (CTE), or average exposure, assume an exposure duration of 9 years. These exposure durations of 30 and 9 years represent, respectively, the approximate 90^{th} and 50^{th} percentiles of the length of time the typical person remains at one residence without moving. It is important to note that, regardless of the exposure duration evaluated, the chronic RfD was used to estimate noncarcinogenic hazard. The RfD is defined as the an estimate of a daily exposure that is likely to be without an appreciable risk of adverse effects during a lifetime, and EPA's Scientific Advisory Board has determined that for most

that for most chemicals, the approach of combining the higher 6-year exposure for children with chronic toxicity criteria is overly protective (*EPA, 1993*). Note that, because cancer risk is averaged over a lifetime, it is directly proportional to the exposure duration as well as the dose and the potency of the chemical.

The Army acknowledges that childhood-specific exposure factors were not used in the indoor air evaluation. This is an artifact of the DTSC model used for the indoor air evaluation. As noted in the comment, the overall effect is negligible and well within the degree of accuracy that can be achieved in the overall risk assessment process.

The Army acknowledges that contaminant concentrations in individual wells may exceed the average concentration for groundwater contamination used in the risk assessment. However, EPA defines the exposure point concentration as the average concentration contacted at the exposure point(s) over the duration of the exposure period. Contaminant concentrations in groundwater at specific wells would be expected to be variable over time due simply to the natural movement of the groundwater. For this reason, concentrations at individual wells cannot reliably predict the average concentration over the assumed 30-year exposure duration, and use of the average concentration is appropriate. It is important to note that Monterey County prohibits installation of water supply wells in the area of the OUCTP, and all known existing water supply wells have either been abandoned or are currently monitored to assure that any detected contamination is within acceptable limits.

Comment 4: It should also be noted that comments submitted by FOEJN regarding the previous draft of this document were not included in Volume IV, "Comments and Response." These comments were submitted well before several of the other agency comments included (July 3, 2005). While many of FOEJN's comments were addressed by other agencies and responded to, the Army is still required to include and respond to the concerns of the community. The absence of such a response breeds mistrust among citizens, regardless of any other actions taken by the Army. Over the course of such large and complex cleanup projects such as Fort Ord, the Army needs to make every effort possible to engage and involve members of the community in the process. When they do not, they invite more resistance to the Army's actions and all parties suffer as a result.

Response 4: The Army apologizes for this oversight. Please see the response to these comments below in Section 3.1. The Army makes every effort to track and respond to all comments received from the community, including comments from FOEJN. In fact, the Army follows up all comments received via e-mail to ensure that appropriate signed comment letters are placed in the Administrative Record. The Army's Fort Ord BRAC office examined e-mailed message files and checked all available records and was unable to locate the referenced comment letter.

Unfortunately, the comments referenced were not received by the Army until delivered as part of FOEJN's subsequent comment letter on the Draft Final version of this document.

Specific Comments

Volume I

Comment 5: Section 1.2.3.1, pages 5-9: The inclusion of report summaries is a welcome change and greatly improves the reader's ability to understand the context of the report's complex material.

Response 5: Comment acknowledged.

Comment 6: Section 1.2.3.1, page 8, last bullet: The site mentioned in this bullet contained very high levels of PCE in groundwater, and while monitoring results were included in this report it is disturbing that the Central Coast RWQCB has determined that no remediation or additional sampling is required at the site. Because this contamination could potentially influence conditions at the OUCTP, the Army should aggressively fight the RWQCB and push for remediation at the site.

Response 6: Comment acknowledged.

Comment 7: Section 1.3, page 16-17: This section should be more specific in detailing the types of notification used to inform citizens of actions taken at the OUCTP. This section also notes that "information regarding contamination and ongoing investigative activities were presented to specific neighborhood organizations…." FOEJN asserts that whenever possible, the Army should provide this information directly to citizens.

Response 7: The Army will consider these recommendations as the Army prepares and develops the Proposed Plan.

Comment 8: Section 3.2.3, pages 49-50: The tables in this section are very helpful, but could use table numbers for ease of reference.

Response 8: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS. However, the Army will consider this request during the preparation of future documents or for public meetings.

Comment 9: Section 3.5, page 54, paragraph 3: "GPR-2 exhibits a series of short shallow

dipping reflectors, similar to those on GPR-1, and a short horizontal reflection on the south end of the line that may also represent the top of the A-Aquifer." This line is extremely technical and difficult to understand. It should be rephrased to be more understandable to people who do not have expertise in this field.

Response 9: To clarify, ground penetrating radar (GPR) was used to obtain images of subsurface geologic structure. The resulting GPR profile along survey line GPR-2 shows images of inclined geologic layers that are similar to images on profile GPR-1. These inclined layers are interpreted to represent buried layers of sand. Additionally, GPR-2 shows a horizontal (i.e., flat) pattern at the south end of the line that is interpreted to represent the top of the water table.

Comment 10: Section 3.9.6, page 79, last paragraph: The inclusion of a plate or plates in Volume I illustrating this and other aspects of the bio-treatability study would be most useful, and better explain the results of the study.

Response 10: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS.

Comment 11: Appendix F, Section 6.0: It is understood that groundwater modeling is a complex and time-intensive endeavor, but it would be incredibly useful to use the created model to attempt to recreate the original conditions in an effort to verify the entire conceptual model if at all possible. Doing so could potentially alert investigators to the existence of other sources, or confirm other important assumptions regarding the OUCTP.

Response 11: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS.

Comment 12: Appendix F, Section 9.3, page 51, last sentence: While the effects of the pilot study on aquifer levels was negligible, it is possible that a full scale treatment injecting 65,750 gallons of dense (at least more so than water) lactate may influence water levels in the aquifer. This should be evaluated.

Response 12: Groundwater elevations will continue to be evaluated as part of the quarterly monitoring program as well as during a full-scale phase of remediation. Should groundwater elevations be adversely changed to jeopardize remedial actions, alternative actions will be considered and implemented as necessary.

Comment 13: Appendix F, Plate F12: This plate is very informative and should be included

included in the plates of the main body of Volume I.

Response 13: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS.

Comment 14: Appendix F, Plates 14-A through G: The view of these plates should be shifted to the northwest to allow for the entire plume to be seen in all of the plates.

Response 14: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS.

Comment 15: Appendix F, Plates F17-A through G: These plates should also be shifted to the northwest to allow the entirety of the carbon tetrachloride to be seen.

Response 15: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS.

Volume II

Comment 16: Sections 3.2-3.3: While values used in these equations are included in later tables, it would be useful if those tables were included within the text for ease of reference, particularly for equations where the majority of the variable will remain static in all calculations.

Response 16: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS.

Comment 17: Section 5.1, page 21: Please refer to the General Comments regarding average exposure lengths for children.

Response 17: Please refer to the response to Comment 3.

Comment 18: Section 7.0, pages 34: the conclusions in this section need to be more fully explained. The terms "2E-06" or "cumulative noncancer hazards did not exceed one" mean little to the average citizen, and this section that citizens

are most concerned with. The Army should explain these risks in the most clear terms possible.

Response 18: As already noted in the text in Section 5.1, cancer risks are expressed as statistical probabilities. A one in one million excess cancer risk (1 E-6 or 1 x 10^{-6}) can be interpreted as an expected one additional cancer per one million exposed individuals, or an additional one in one million chance of an exposed individual developing cancer. It is important to note here that this does not mean the total cancer risks are one in one million. Overall risks of cancer in the United States are such that 1 out of every 3 or 4 individuals would be expected to develop cancer over a lifetime. The cancer slope factor converts estimated daily intakes, averaged over a lifetime, directly to the risk of an individual developing cancer. Because the slope factor is often an upper 95th percentile confidence limit, the carcinogenic risk estimate will generally be an upper-bound estimate. This means that EPA is reasonably confident that the "true risk" will not exceed the risk estimate derived through use of this method, and is likely to be less than that predicted.

Noncarcinogenic hazards are assessed by evaluating the ratio of the estimated dose to the appropriate reference dose. This value is known as the hazard quotient (HQ). If the HQ is less than 1 (i.e., the estimated intake is less than the reference intake associated with no adverse health effects), the exposure is considered unlikely to be associated with any adverse effects, even for sensitive populations. Conversely, chemicals with a hazard quotient greater than 1 may pose risk of adverse, noncarcinogenic health effects. The hazard index (HI) is the sum of all of the chemical and route-specific HQs. HIs are summed for all chemicals for each exposure pathway, resulting in an estimate of total noncarcinogenic hazard. If the HI is less than 1, the combined intakes of chemicals by the exposure routes under consideration are not likely to pose a health risk. If the HI exceeds 1, the chemicals should be subdivided according to their toxic endpoint, and the hazard associated with for each chemical and its should be considered separately. However, unlike cancer risks, the HQ and HI are not a description of the probability of an adverse effect, and cannot be expressed as a linear relationship with respect to the reference dose. That is, a HI of 0.01 is not necessarily 10 times more protective than a HI of 0.1.

2.6 Comments from the Community:

Comment 1: Residents living on and in close proximity to Fort Ord are at greatest risk of exposures. We don't feel that the threats have been finally and completely alleviated, and would like to know what the other methods of elimination would have been. We are concerned about length of exposures to Carbon Tetrachloride and other contaminants of concern prior to clean-up efforts.

The Human Health Risk Assessment continues to be of grave concern due to the fact that the conclusions are reached after evaluating a report, not humans. We don't believe that the contamination vapors have disappeared. What assurances do we have?

Response 1: One of the basic tenants of risk assessment is that there is no health risks if there are no complete pathways of exposure. The estimated risks presented in the risk assessment should be considered hypothetical, as it was assumed that contaminated groundwater is used for drinking water and other household purposes. Monterey County currently enforces a prohibition on well drilling and using contaminated water from the OUCTP, so there is no potential for exposure through drinking or other household uses. The information currently available suggest that volatilization from the groundwater is not occurring and does not represent a source of contamination in either outdoor or indoor air.

3.0 Response to Comments on Draft Operable Unit Carbon Tetrachloride Plume, Groundwater Remedial Investigation/Feasibility Study, Dated April 29 and May 31, 2005

3.1 Comments of Peter L. deFur of Environmental Stewardship Concepts, On Behalf of The Fort Ord Environmental Justice Network, Dated June 3, 2005

Comment 1: Recommendations

- **The Army should reassess the section of the conceptual model detailing the scenario for the initial disposal of carbon tetrachloride.**
- **The Army needs to perform a detailed feasibility study that compares remediation technologies and costs rather than focusing just on lactate injection, despite its promise.**
- **The Army's modeling for exposures during showering needs to be revised to take into account conditions such as an enclosed, unventilated environments and the potential for oral exposure during showering.**

Response 1: Please see the specific responses to the comments below.

General Comments

Comment 2: Overall the report is very detailed and provides the best description to date of the hydrology at the Fort Ord site. The depth of background information provided in the document should serve as a standard for all future reports from the Army. Including entire documents relevant to the report as appendices rather than merely citing them in the text is a welcome trend that we hope continues. The assertions made in the document are generally made on sound evidence, and help to better characterize the carbon tetrachloride plume.

Response 2: Comment acknowledged.

Comment 3: One area of the report that still causes some concern is the Army's conceptual model regarding the initial disposal of carbon tetrachloride. The current model asserts that the contamination stems from approximately five gallons a month of carbon tetrachloride being poured onto the soil over six years, for a total of 360 gallons. This does not seem to be a high enough quantity of carbon tetrachloride to cause the current plume. Under the proposed scenario, the highly volatile nature of carbon tetrachloride combined with the slow rate of discharge would significantly reduce the amount that would reach the aquifer. It is more likely that a large quantity of carbon

of carbon tetrachloride was disposed of in a single event. As noted in section 10.7, mass transport simulations put the volume of carbon tetrachloride disposed of at 2,500 gallons. Until the Army can effectively account for the discrepancy between these values, the Army should be open to the possibility of additional sources. This is a distinct possibility given the complex hydrogeology at the site that may make finding these sources more difficult than under normal circumstances.

Response 3: The draft RI/FS was revised to include a possible range of 360 gallons to perhaps 1,000 gallons of carbon tetrachloride released.

Comment 4: The bench scale tests using lactate to speed the dechlorination of carbon tetrachloride shows great promise. We appreciate these kinds of innovative solutions and would like to encourage the use of more in the future. However, the feasibility study component of the document is sparse at best. No cost analysis was performed, and remedial technologies were not compared to one another. The title of the document implied that these would be included in here and not in a separate volume. The Army should have been more clear about this schedule.

Response 4: Comment acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS. The Army will consider these recommendations during the development and implementation of the remedial design.

Comment 5: Though the human health risk assessment in Volume II has determined that the OUCTP groundwater contamination poses unacceptable cancer risks, even these risks may have been underestimated. Estimates of risks from showering with contaminated water appear to be underestimated by ignoring the potential for the ingestion of water and the higher concentrations of contaminants that would be encountered in a confined space such as a shower stall or bathroom.

Response 5: Incidental ingestion of water during showering is accounted for in the overall water ingestion rate. The amount of water ingested during a shower is typically negligible compared to the overall ingestion rate. As noted in Section 3.2.2, the equations used to estimate contaminant concentrations in air while showering account for the average bathroom ventilation rate, and thus account for air concentrations expected in a confined space such as a bathroom.

Specific Comments

Volume I

Comment 6: Section 1.3. Pg 14: The report indicates that private wells were sampled, but does not indicate when. If any wells were sampled before reporting standards changed from 5.0 µg/L to a more restrictive 0.5 µg/L, they should be tested again given the increased sensitivity of newer methods.

Response 6: Samples collected from private wells were analyzed for CT with a reporting level of 0.5 µg/L.

Comment 7: Section 3.4. Pg 51: Second Paragraph:
Is the use of bottled water acceptable as a water source to mix with the potassium bromide? Some brands of bottled water contain as many or more compounds as municipal tap water. FDA screens bottled water for far fewer compounds than the EPA requires for municipal sources. Could any of these compounds played a role in the failure of the tests and would deionized water have been more appropriate?

Response 7: The use of bottled water for mixing with potassium bromide is appropriate for this study because the concentration of bromide ion prior to injection was significantly higher than any level of bromide impurities present in tap or bottled water.

Comment 8: The document is not clear if tracer tests have been suspended indefinitely or of there are plans to continue them. The Army needs to better clarify discussions regarding the current state of tracer tests at these wells.

Response 8: No tracer tests are currently being conducted nor have future tracer tests been planned to be conducted

Comment 9: Section 3.6.3. Pg 57-58. The table "Lower 180 Foot Aquifer Pump Tests" should all be on one page to make it easier to read.

Response 9: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS.

Comment 10: Section 3.6.5. Pg 60-61: The table ""Permeameter Testing Results" should be on one page to make it easier to read.

Response 10: Comments acknowledged. This would be a helpful change in making the document easier to understand. Unfortunately, the comments were not received in

in time for the Army to incorporate this change due to schedule constraints in producing the Final RI/FS.

Comment 11: Section 3.7.6. Pg 65: This section needs to note that the slow rate of attenuation is unacceptable and will not meet remediation goals. The report notes that there are numerous reducing environments in the aquifer that are not producing the predicted dechlorination of the carbon tetrachloride. This may be an indication of a continuing source that has yet to be considered. The causes of the ineffectiveness of these reducing environments should be investigated to determine if there is a continuing source and to enhance the understanding factors contributing to the dechlorination of carbon tetrachloride for future remediation efforts.

Response 11: The draft final report concludes at the end of Section 3.7.2.1 that "any locally induced reducing environment appears insufficient to halt the migration of CT as the plume is present at least 1,000 feet further downgradient from this area". The oxidizing environment typical of the Fort Ord aquifers is sufficient explanation as to why microbial activity is not adequately attenuating CT.

Comment 12: Section 4.2.1. Pg 88, last paragraph, second to last line: This section predicts that as the TCE plume migrates, natural attenuation processes will further reduce concentrations. This assertion is undermined by prior statements in the document referring to areas within the A-Aquifer where reducing environments exist but CT attenuation is only occurring at a very slow rate. Is this slow rate of natural attenuation also affecting TCE? The Army should clarify this.

Response 12: Natural attenuation is not limited to dechlorination within reducing environments, rather, as defined in Section 3.7 of the draft final report, includes dilution and dispersion mechanisms. As such, without a continuing source, concentrations are anticipated to decline over time.

Comment 13: Section 4.2.2. Pg 89, second bullet: The assertion that the benzene concentrations detected at well MP-BW-41-202 are related to the well's installation does not appear to make sense. How could a well's installation create a local environment of benzene contamination? Benzene contamination at this well should be investigated or more thoroughly explained.

Response 13: That benzene has not been consistently detected at MP-BW-41-202 indicates that the initial detection was anomalous and more likely not representative of true groundwater conditions.

Comment 14: Section 9.4. Pg 121, top paragraph: The value of 360 gallons of CT released in the area may be too low. Because of CT's highly volatile nature and the

amount of soil the liquid would have had to filter though, the actual amount disposed of may in fact be far greater. The 360 gallon value better represents the amount of CT that actually penetrated to the aquifer.

Response 14: The focus of the RI is to determine the nature and extent of CT impacting groundwater and vadose zone. The mass of CT in those two environments has been accounted for.

Comment 15: Section 10.7. Pg 125, first bullet: Values regarding the amount of CT disposed of at Lexington Court vary throughout the document. Section 9.4 gives the amount of 360 gallons, but section 10.7 estimates a value of 2,500 gallons. This is a very large discrepancy, and needs to be rectified somehow. The amount of CT disposed of is a vital part of the site's conceptual model and will be considered in many aspects of the groundwater cleanup.

Response 15: The draft RI/FS was revised to include a possible range of 360 gallons to perhaps 1,000 gallons of carbon tetrachloride released.

Volume II

Comment 16: Section 3.3.3, Pg 13: The intake estimates for showering seem to ignore several factors that may increase risk. The first is that some water may be swallowed during the course of the shower, and this is not accounted for in these estimates. The second is that airborne concentrations of COPCs may be much higher than estimated. Showers and bathrooms are small confined spaces that are generally not well ventilated. Compounds not taken into the body of an individual taking a shower will remain in the room until it is aired out after the shower. This would force the concentrations of compounds upwards over time and increase risks. If the HHRA accounted for increased concentrations during showering it is not apparent and should be stated more clearly.

Response 16: Please see the response to Comment 5.

4.0 References:

Calabrese, E.J., H. Pastides, R. Barnes, et al. 1989. *How much soil do young children ingest: an epidemiologic study. In: Petroleum Contaminated Soils, Vol. 2*. E.J. Calabrese and P.T. Kostecki, eds. pp. 363-417. Chelsea, MI, Lewis Publishers.

Davis, S., P. Waller, R. Buschom, J. Ballou, and P. White, 1990. *Quantitative estimates of soil ingestion in normal children between the ages of 2 and 7 years: population-based estimates using Al, Si, and Ti as soil tracer elements.* Archives of Environmental Health 45:112-122.

Environmental Protection Agency (EPA), 1993. *Science Advisory Board Review of the Office of Solid Waste and Emergency Response draft Risk Assessment Guidance for Superfund (RAGS), Human Health Evaluation Manual (HHEM)*. EPA-SAB-EHC-93-007. Science Advisory Board, Washington, DC.

EPA, 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and other Remedy Selection Decision Documents*. Office of Solid Waste and Emergency Response. EPA 540-R-98-031. July.

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MACTEC Engineering and Consulting, Inc. (MACTEC), in press. *Annual Report of Quarterly Monitoring, October 2004 through September 2005, Former Fort Ord, California.*

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Van Wijnen, J.H., P. Clausing, and B. Brunekreef, 1990. *Estimated soil ingestion by children*. Environmental Research, 51:147-162.