Superfund Proposed Plan

Remedial Action Is Proposed For Operable Unit Carbon Tetrachloride Plume Groundwater at Former Fort Ord, California

United States Department of the Army **May 31, 2006**

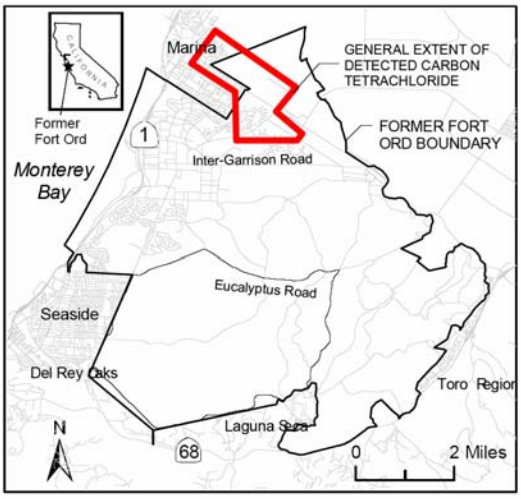

Figure 1. OUCTP Area and Fort Ord Location Map

* *The terminology used in this Proposed Plan that first appears in **bold letters** is defined in the **Glossary** found at the back of this document on **page 12**. References to **Figures, Tables**, and **page numbers** also appear in bold letters.*

Dates to remember:

MARK YOUR CALENDAR
PUBLIC COMMENT PERIOD:
June 5 to July 5, 2006

Comments on the Proposed Plan will be accepted at a

PUBLIC MEETING:
June 14, 2006

The Army will hold a public meeting to explain the Proposed Plan, hear concerns and answer questions. Oral and written comments will also be accepted at the meeting. The meeting will be held at 6:00 PM at the Stilwell Community Center.

Comments may be sent to:
Department of the Army
Fort Ord Base Realignment and Closure (BRAC) Office
Attn: Gail Youngblood
BRAC Environmental Coordinator
P.O. Box 5008, Monterey, CA 93944-5008
For more information, see the How to Make Comments section on page 11 of this Proposed Plan.

INTRODUCTION

The United States Department of the Army (Army) is presenting this **Proposed Plan*** for public review and comment regarding cleanup of **Operable Unit** Carbon Tetrachloride Plume (OUCTP) at the former Fort Ord, California. Specifically, this **Proposed Plan** identifies the **Preferred Remedial Alternative** for cleaning up the contaminated **groundwater** at OUCTP. **Groundwater** is water that is beneath the earth's surface. In addition, this **Proposed Plan** summarizes investigations and other remedial alternatives and cleanup actions. The area associated with OUCTP and location of the former Fort Ord are shown on **Figure 1**.

This **Proposed Plan** is based on information presented in the *Final Operable Unit Carbon Tetrachloride Plume **Remedial Investigation/Feasibility Study (RI/FS),** Former Fort Ord, California*, dated May 2006, (*MACTEC, 2005*) as well as other documents in the Fort Ord **Administrative Record.** After the U.S. Environmental Protection Agency (EPA) adds a site to the **National Priorities List (NPL)**, a **remedial investigation/feasibility study (RI/FS)** is performed at the site. The **remedial investigation (RI)** is the way data are collected, while the **feasibility study (FS)** is used to look at different ways to cleanup the site.

The **Administrative Record** contains documents used in making decisions for environmental cleanup projects at the former Fort Ord. The Army encourages members of the local community and other interested parties to review these documents and other relevant documents in the **Administrative Record** and comment on this **Proposed Plan.** Public comments will be considered before any action is selected and approved. Information on how to locate the **Administrative Record** and comment on this document is provided on **page 11.** Because the former Fort Ord is a Department of Defense (DOD) site, it is being

cleaned up under authority of the Army's **Installation Restoration Program (IRP)** and meets the reporting requirements for the **Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA** or "**Superfund"**).

The Army is the lead agency for investigating, reporting, and implementing remedial actions at the former Fort Ord. The support agencies are the EPA, and the California Environmental Protection Agency (Cal/EPA), including the Department of Toxic Substances Control (DTSC) and the Regional Water Quality Control Board (RWQCB). The EPA is the lead regulatory agency. The Army is issuing this **Proposed Plan** as part of its public participation responsibilities under Section 117(a) of CERCLA and Section 300.430(f)(2) of the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**.

Public comments on this **Proposed Plan** will be accepted during a public meeting and the 30-day public review and comment period and will be considered when the Army, in consultation with the EPA and the Cal/EPA, makes a final decision regarding cleanup of OUCTP at the former Fort Ord. The decision will be documented in a **Record of Decision** and responses to comments on this **Proposed Plan** will be included in the **Responsiveness Summary** attached to the **Record of Decision**. The availability of the **Record of Decision** will be announced to the public following its completion.

This Proposed Plan gives a summary of work that has been done and cleanup decisions that are being proposed for groundwater that contains dilute concentrations of **carbon tetrachloride**, a cleaning solvent, and other **volatile organic compounds (VOCs)** at the former Fort Ord. **Carbon tetrachloride** is a colorless, nonflammable liquid that was, at one time, widely used as a cleaning solvent and in fire extinguishers. High exposures to **carbon tetrachloride** (at concentrations higher than detected in former Fort Ord groundwater) can cause liver, kidney and central nervous system damage. **Carbon tetrachloride** is not a confirmed carcinogen in humans, although the National Toxicology Program (NTP) has determined that carbon tetrachloride may "reasonably be anticipated to be a carcinogen" on the basis of animal studies. **VOCs** are organic liquids that readily evaporate at temperatures normally found at ground surface. The OUCTP, located in the northwestern portion of the former Fort Ord in Monterey County, California, is shown in **Figure 2 (page 4)**.

Specifically, the purposes of this **Proposed Plan** are to:

(1) Provide background information about OUCTP

(2) Identify the **Preferred Alternative** for remedial (cleanup) action at OUCTP and explain the reasons for the preference

(3) Describe the other remedial options considered

(4) Request public review of and comment on all of the alternatives described

(5) Provide information on how the public can be involved in the remedy selection process for OUCTP.

The flow chart shown on **Figure 3** (**page 10**) summarizes the OUCTP **Record of Decision** process and the steps of the process that include public and regulatory agency involvement and approval of the proposed remedy.

SITE BACKGROUND

The former Fort Ord is located in northwestern Monterey County, California, approximately 80 miles south of San Francisco (**Figure 1**). The former Army base is made up of approximately 28,000 acres of land next to Monterey Bay and the cities of Seaside, Sand City, Monterey, and Del Rey Oaks to the south and Marina to the north. Since it was established in 1917, Fort Ord served primarily as a training and staging facility for infantry and cavalry troops. From 1947 to 1975, Fort Ord was a basic training center. After 1975, the 7th Infantry Division was based at Fort Ord. Fort Ord was selected for closure in 1991 and was placed on the Base Realignment and Closure (BRAC) List. The majority of the soldiers were reassigned to other Army posts in 1993. The DOD has retained a portion of former Fort Ord property as the Ord Military Community and U.S. Army Reserve Center. The remainder of Fort Ord was identified for transfer to federal, state, and local government agencies and other organizations.

Fort Ord was placed on the **National Priorities List (NPL)** of Superfund sites by the EPA on February 21, 1990, due to evidence of contaminated groundwater related to Operable Unit 2, the Fort Ord Landfills. A Federal Facility Agreement (FFA) was signed in July 1990 by representatives of the Army, EPA, and Cal/EPA. The FFA established schedules for conducting the investigation and cleanup process as efficiently as possible. The Basewide Remedial Investigation/Feasibility Study (Basewide RI/FS) for soil and **groundwater** contamination (hazardous and toxic waste or "HTW") began in 1991 (*HLA, 1995*).

Several Superfund or CERCLA investigations have been conducted at the former Fort Ord that included the area now referred to as OUCTP. The initial identification of **carbon tetrachloride** in **groundwater** occurred in 1992 during sampling of monitoring wells installed in 1975 for reasons unrelated to the CERCLA investigations. The presence of **carbon tetrachloride** in groundwater at what is now OUCTP was first documented in the Fort Ord Landfills Preliminary Hydrogeologic Investigation *(HLA, 1990*), and **monitoring** and investigations continued under the Basewide Hydrogeologic Characterization program (*HLA, 1994*). Since the source of or use of **carbon tetrachloride** at the former Fort Ord was not documented as part of previous investigations, including the Basewide RI/FS (*HLA, 1995*), a separate **site characterization** or investigation of **carbon tetrachloride** in **groundwater** was initiated, and the results of this initial investigation were presented in the Draft Final Carbon Tetrachloride Investigation Report *(HLA, 1999*). Subsequent investigation activities and studies of OUCTP were then conducted as part of the OUCTP Remedial Investigation (OUCTP RI/FS, Volume I; *MACTEC, 2006*) and are summarized in this **Proposed Plan**.

SITE CHARACTERISTICS

By finding the areas of highest concentration of **carbon tetrachloride** in the **groundwater** and in the **soil gas**, the Army has identified the apparent **carbon tetrachloride** disposal location. **Soil gas** (soil vapor) is air existing in empty spaces in the soil between the groundwater and the ground surface. Knowledge of historical practices (cleaning electronic equipment and radios) and that **carbon tetrachloride** was a very commonly-used solvent from the 1940s through the 1960s, led to the conclusion that used **carbon tetrachloride** was likely disposed of to the ground over a period of years at a former training facility in the vicinity of what is now Lexington Court, which is within the Abrams Park subdivision in the City of Marina.

Carbon tetrachloride in the **soil gas** is the suspected source of **carbon tetrachloride** in the **groundwater** and could have resulted in the possible intrusion of **soil gas** into indoor air. To assess a potential method for removing **carbon tetrachloride** from **soil gas**, a pilot study was conducted using a **soil vapor extraction (SVE)** system. The SVE uses a process in which chemical vapors are extracted from the soil by applying a vacuum to wells. The system was operated for a total of four months in two phases and resulted in the removal of 0.78 pounds of **carbon tetrachloride** from the **vadose zone**. The **vadose zone** is the unsaturated zone in the soil between the ground surface and the water table.

After completion of the SVE pilot study, monitoring indicated **carbon tetrachloride** and other **volatile organic compounds (VOCs)** present in **soil gas** in the **vadose zone** had been reduced to very low levels (near the detection limit). This indicated that the **carbon tetrachloride** source has been removed; therefore, no additional cleanup activity is required or recommended for **soil gas** in the vicinity of Lexington Court. However, since the exact source of the **carbon tetrachloride** was not identified, the Army will evaluate the data collected during the **groundwater** cleanup for evidence of any potential additional sources of **carbon tetrachloride**.

There are four distinct **aquifers,** (underground beds or layers of porous soils (e.g., sand) that contain **groundwater**) beneath the former Fort Ord. These **aquifers** are layered above one another and are separated by **aquitards (**underground bed or layer of non-porous soils (e.g., clay) that retards the flow of **groundwater**). The top three **aquifers** at the former Fort Ord have been found to contain detectable concentrations of **carbon tetrachloride** and other **VOCs** within OUCTP. **Groundwater** from within OUCTP is not currently used as a source of drinking water.

Three **groundwater remedial units,** or areas of contamination that make up OUCTP, are defined based on the presence of **carbon tetrachloride** or other **VOCs** at concentrations above **Maximum Contaminant Levels (MCLs)** in each of three **aquifers** as shown on **Figure 2**: (1) the shallow or uppermost A-Aquifer, (2) the Upper 180-Foot Aquifer, and (3) the Lower 180-Foot Aquifer. **Carbon tetrachloride** contamination has not been observed in the fourth and deepest underlying **aquifer** (400-Foot Aquifer or Deep Aquifer) at the former Fort Ord. The current nature and extent of **groundwater** contamination within OUCTP is defined as follows:

A-Aquifer Groundwater Remedial Unit: The **carbon tetrachloride** plume in the A-Aquifer is approximately 1.6 miles long and ranges from 500 to 750 feet wide (**Figure 2**). The top of the A-Aquifer varies from 20 to 120 feet below ground surface (bgs). The maximum historic detected concentration of **carbon tetrachloride** in the A-Aquifer since groundwater monitoring was initiated in 1992 was 19 micrograms per liter (µg/L) or **parts per billion (ppb)**. The most recent maximum concentration of **carbon tetrachloride** detected in the A-Aquifer was 15 ppb, which is above the **maximum contaminant level** of 0.5 ppb. Isolated detections of the **VOCs perchloroethylene** (PCE) and **trichloroethylene** (TCE) have historically occurred at maximum concentrations (1.63 ppb and 6.4 ppb, respectively) below or slightly above the **maximum contaminant level** (5.0 ppb for both PCE and TCE) within this **aquifer**, but are currently below those levels. PCE was used primarily as a dry-cleaning agent and for metal degreasing. TCE is a volatile organic compound that is often used an industrial degreasing solvent. TCE is not a confirmed carcinogen in humans, although the National Toxicology Program (NTP) and the Department of Health and Human Services (DHHS) has determined that TCE may "reasonably be anticipated to be a carcinogen" on the

basis of animal studies. **Groundwater** in this aquifer flows northwest. Because of the presence of the Fort Ord – Salinas Valley Aquitard (FO-SVA), there is no flow of **groundwater** between the A-Aquifer and the underlying aquifers in the OUCTP area except where the FO-SVA was penetrated by poorly constructed wells drilled into the lower aquifers. Two such **vertical conduits** have been identified and have resulted in the migration of **carbon tetrachloride** from the A-Aquifer into the underlying Upper and Lower 180-Foot Aquifers. One of these **vertical conduits** (Fort Ord groundwater monitoring well MW-B-13-180) was recently properly abandoned and sealed to prevent it from acting as a **vertical conduit**.

Upper 180-Foot Aquifer Groundwater Remedial Unit: There are two narrow, parallel plumes in this **aquifer** resulting from **vertical conduits** (**Figure 2**). The maximum historic detected concentration of **carbon tetrachloride** in the Upper 180-Foot Aquifer since groundwater monitoring was initiated was 9.8 ppb. The most recent maximum concentration of **carbon tetrachloride** detected in the Upper 180-Foot Aquifer was 3.5 ppb, which is above the **maximum contaminant level** of 0.5 ppb. There have been no detections of other **VOCs** at concentrations near **maximum contaminant levels** within this **aquifer**. The Upper 180-foot Aquifer is separated from the Lower 180-Foot Aquifer by the Intermediate 180-Foot Aquitard, where present. Where this **aquitard** is not present, **groundwater** from the Upper 180-Foot Aquifer may flow into the Lower 180-Foot Aquifer. The Upper 180-Foot Aquifer plumes are migrating southeast toward a natural "hole" in the underlying Intermediate 180-Foot Aquitard, where the eastern plume then enters the Lower 180-Foot Aquifer. The **carbon tetrachloride** plume commingles (mixes) with the Operable Unit 2 (OU2) TCE plume at this location.

Lower 180-Foot Aquifer Groundwater Remedial Unit: There are two separate plumes in this aquifer (**Figure 2**). The maximum historic detected concentration of **carbon tetrachloride** in the Lower 180-Foot Aquifer since **groundwater** monitoring was initiated was 6.95 ppb. The most recent maximum concentration of **carbon tetrachloride** detected in the Upper 180-Foot Aquifer was 3.6 ppb, which is above the **Maximum Contaminant Level** of 0.5 ppb. Isolated detections of the VOC **1,2-dichloroethane (1,2-DCA**) have also historically (1.7 ppb) and currently (1.2 ppb) occurred at concentrations above the **maximum contaminant level** (0.5 ppb) within this **aquifer**. The most common use of **1,2-dichloroethane** is in the production of vinyl chloride which is used to make a variety of plastic and vinyl products. It is also used as a solvent. The northern plume in the Lower 180-Foot Aquifer is the result of **carbon tetrachloride** migrating downward through one of the same vertical conduits that resulted in a plume in the Upper 180-Foot Aquifer. The southern plume in the Lower 180-Foot Aquifer is the result of **carbon tetrachloride** in the Upper 180-Foot Aquifer migrating through the hole in the Intermediate 180-Foot Aquitard. The southern **carbon tetrachloride** plume commingles with the OU2 TCE plume at this location.

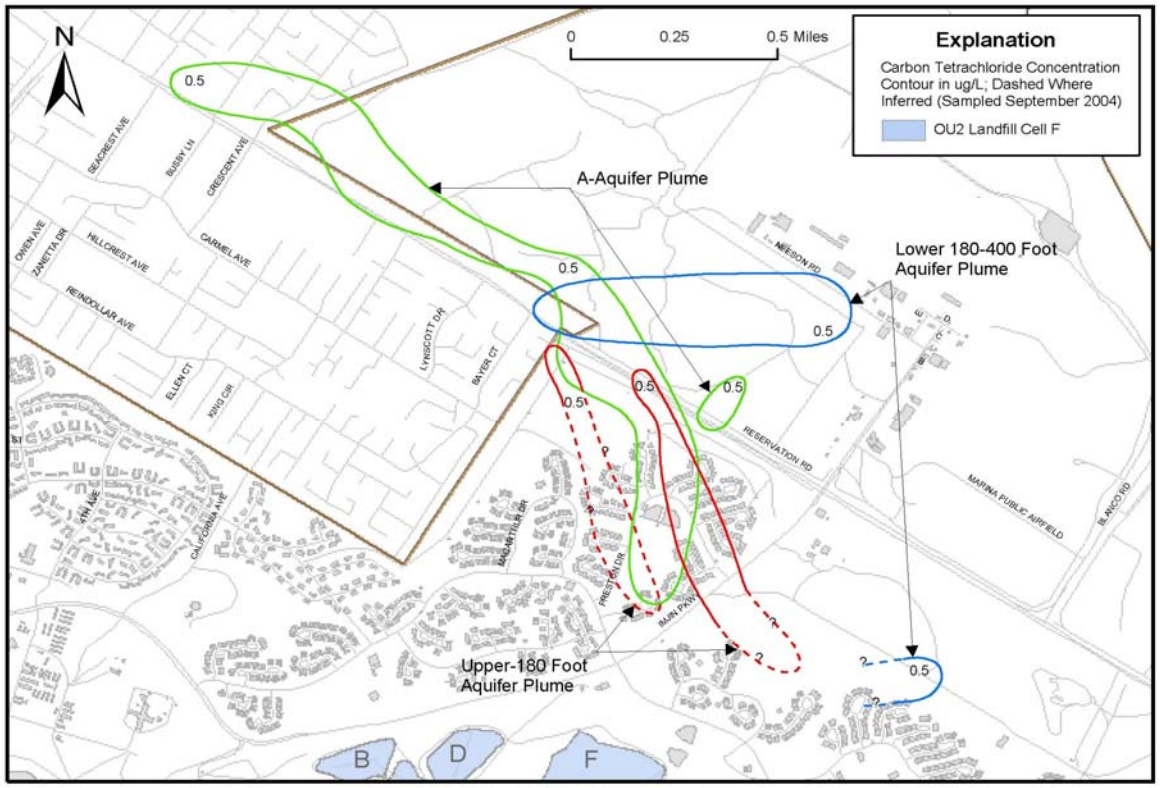

Figure 2. OUCTP Plume Map

SCOPE AND ROLE OF OPERABLE UNIT CARBON TETRACHLORIDE PLUME

The Army's strategy for OUCTP is to (1) investigate and define the nature and extent of **carbon tetrachloride** and other VOC contamination within the study area, and (2) address the contamination via implementation of a selected response action (cleanup) or preferred remedy that will meet the **remedial action objectives** identified for OUCTP.

VOC contamination is present in groundwater in the low parts per billion (ppb) range. Compared to the **maximum contaminant level** of 0.5 ppb for **carbon tetrachloride**, the current maximum concentration of **carbon tetrachloride** in each of the three aquifers is 15 ppb (A-Aquifer); 3.5 ppb (Upper 180-Foot Aquifer); and 3.6 ppb (Lower 180-Foot Aquifer). The maximum concentration of **1,2-DCA**—the only other VOC that currently exceeds the **maximum contaminant level** of 0.5 ppb in one of the three aquifers—is 1.2 ppb (Lower 180-Foot Aquifer).

Further refinement of the selected remedy for each of the **aquifers** recommended in this **Proposed Plan** will take place during the next steps in the **CERCLA** process. After the remedy for OUCTP has been selected and approved, remedial action designs and work plans will be initiated. Upon approval of the designs and plans, the remedy will be constructed, implemented and operated. Monitoring will ensure the success of the remedy and the potential need for modification. The entire operation of the remedy will be presented to the regulatory agencies for their review and comment. When established clean-up criteria are met, the operable unit will be closed and all equipment will be dismantled and removed.

The Army conducts a five-year review at the former Fort Ord every five years to gather updated information, evaluate the condition of the site, and determine whether human health and the environment remain protected from any contamination that might be left at the site. After the remedy is approved and implemented for OUCTP, it will be reevaluated during the five-year reviews to make sure it remains protective of human health and the environment.

SUMMARY OF SITE RISKS

Potential human health risks from exposure to VOCs detected in **groundwater** and **soil gas** within OUCTP were evaluated in the **Human Health Risk Assessment (Risk Assessment**; OUCTP RI/FS, Volume II) using **groundwater** and **soil gas** data collected at the site (*MACTEC, 2005*). The **Risk Assessment** addressed the potential excess cancer and noncancer risks to future onsite child and adult residents posed by detected chemicals present in groundwater and soil gas (irrespective of cleanup levels) in accordance with regulatory agency guidance. For the indoor air evaluation, all chemicals detected in soil gas were quantitatively (statistically) evaluated in the **Risk Assessment**. For the groundwater evaluation, only chemicals selected as chemicals of potential concern were evaluated in the **Risk Assessment**. Potential risks to children and adult residents were evaluated assuming that they could potentially be exposed to contamination in soil gas and groundwater due to vapor intrusion to the indoor air, and from use of contaminated groundwater for household purposes such as showering and bathing, and as a source drinking water. It should be noted that groundwater from OUCTP is not currently supplied for domestic use, and the installation of new drinking water wells at the former Fort Ord is restricted under Monterey County Ordinance No. 04011, dated April 1999. Therefore, the estimated risks from groundwater contaminants are based on a hypothetical scenario under which an individual installs a private drinking water well without authority, permit, or approval, and uses it exclusively for their drinking and household water purposes.

No plants and animals were identified as potentially being directly exposed to **VOC**s in **groundwater** present below the ground surface in the aquifers associated with OUCTP. Potential inhalation exposure to VOCs from volatilization of groundwater was not evaluated for burrowing animals. Risks to the environment were not specifically assessed except for the extent to which implementation of the alternatives may have impacts on potential ecological receptors (e.g., if a groundwater extraction and treatment system were to be located in an ecologically sensitive area).

Cancer risks were estimated for two different scenarios and were compared to regulatory risk management values as follows:

- *Reasonable Maximum Exposure (RME):* For the RME scenario, it was assumed that an onsite resident would be exposed to VOCs through domestic use of **groundwater** and from vapor intrusion to indoor air from **soil gas** and groundwater 350 days per year for a total duration of 30 years (both during childhood and as an adult). Contamination in the A-Aquifer was associated with the highest estimated cumulative excess cancer risk from all pathways (3 in 100,000); followed by the Upper 180 Foot-Aquifer (2 in 100,000); and then the Lower 180-Foot Aquifer (2 in 100,000). The estimated excess cancer risk from direct contact with groundwater was 1 in 100,000 in the A-aquifer; 3 in 1,000,000 in the Upper 180 Foot-Aquifer and 2 in 1,000,000 in the Lower 180-Foot Aquifer. Can we state anything that relates cancer risks to daily cancer risks
- *Comparison to Regulatory Risk Management Values*: These cumulative excess cancer risk estimates are within the EPA and Cal/EPA-DTSC cancer risk management range of "1 in 10,000" to "1 in 1,000,000", and are above Cal/EPA-DTSC's

point of departure for risk management of "1 in 1,000,000". An excess cancer risk of "1 in 10,000" means that an exposed individual may have an added 1 in 10,000 chance of developing cancer over a lifetime than would an unexposed individual. An excess cancer risk of "1 in 1,000,000" means that an exposed individual may have an added 1 in 1,000,000 chance of developing cancer over a lifetime than would an unexposed individual.

Noncancer risks were estimated for two different scenarios and were compared to regulatory risk management values as follows:

- *Reasonable Maximum Exposure (RME)*: For the RME scenario, it was assumed that an onsite resident would be exposed to VOCs through domestic use of groundwater and from vapor intrusion to indoor air from soil gas and groundwater 350 days per year for a total duration of 30 years (both during childhood and as an adult). The total RME hazards estimated for the three aquifers for the adult resident, and child resident did not exceed 1.0 **Hazard Index (HI)**.
- *Comparison to Regulatory Risk Management Values*: These cumulative noncancer hazard estimates are below the acceptable noncancer regulatory **Hazard Index (HI)** of one (1.0) for both exposure scenarios and all three groundwater remedial units (aquifers).

REMEDIAL ACTION OBJECTIVES

The primary **Remedial Action Objectives (RAOs)** for OUCTP **groundwat**er impacted by **VOCs** are to (1) reduce risks to human health and the environment, and (2) comply with **Applicable or Relevant and Appropriate Requirements (ARARs)** such as federal, State, and local laws and regulations.

Cleanup levels are acceptable contaminant levels that, when achieved within a site, would reduce potential risks and comply with **Applicable or Relevant and Appropriate Requirements**. Proposed **aquifer cleanup levels (ACLs)** were developed for OUCTP based on (1) an assessment of **Applicable or Relevant and Appropriate Requirements** including federal and State **maximum contaminant levels** for **groundwater**; and (2) the results of the **Risk Assessment** (OUCTP RI/FS, Volume II; *MACTEC, 2006*).

The chemicals of concern and proposed **aquifer cleanup levels** for each of the three **aquifers** in OUCTP shown in **Table 1** found at the back of this Proposed Plan (**page 16)** were developed as follows:

- Chemicals of concern were identified based on their concentration, frequency of detection, and toxicity, and an assessment of their contribution to cumulative risks assessed in the **Risk Assessment**;
- Federal and State drinking water levels (**Maximum Contaminant Levels; MCLs**) were reviewed for each chemical of concern detected in **groundwater** within OUCTP. The more conservative or lower of the federal or State **maximum contaminant levels** for each chemical of concern within the OUCTP plume were selected as **aquifer cleanup levels** because total risks estimated in the **Risk Assessment** (OUCTP RI/FS, Volume II) are within regulatory risk management ranges, and **maximum contaminant levels** are enforceable standards for chemicals in drinking water that may affect public health.

SUMMARY OF ALTERNATIVES

The **Preferred Remedial Alternative** proposed for implementation at OUCTP is:

- A-Aquifer—**In Situ Enhanced Biodegradation.** This is a groundwater treatment technology that uses the injection of a liquid formula into subsurface wells within a contaminated aquifer to stimulate the growth of naturally occurring microorganisms that consume chemical contaminants (such as VOCs) through naturally occurring biodegradation processes.
- Upper 180-Foot Aquifer—Groundwater Extraction and Treatment Within Operable Unit 2 (OU2) Groundwater Extraction and Treatment System;
- Lower 180-Foot Aquifer—Monitored Natural Attenuation (reduction of contaminants over time through natural processes without treatment) with Wellhead Treatment Contingency (the treatment of groundwater at the point where it is extracted for use as drinking water).

Remedial alternatives were assembled in the OUCTP **Feasibility Study** (FS; OUCTP RI/FS, Volume III) to provide a logical and comprehensive approach for cleanup of all three aquifers based on the results of the remedial technology screening (*MACTEC, 2005*). For the purposes of the **Feasibility Study** evaluation, the most effective remedial technologies were assembled into stand-alone full-scale remedial alternatives for each of the three **groundwater remedial units (aquifers)** based

on their ability to achieve aquifer cleanup levels throughout the entire plume, with consideration of access limitations to portions of the plume (e.g., portions of the plume are located in developed or ecologically sensitive areas where it would be difficult to install and operate equipment). The remedial alternatives considered for OUCTP include:

- Remedial Alternative 1—No Action With Monitored Natural Attenuation (All Aquifers).
- Remedial Alternative 2—In Situ Enhanced Biodegradation (A-Aquifer); Groundwater Extraction and Treatment Within OU2 Groundwater Treatment and Extraction System (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer).
- Remedial Alternative 3—In Situ Permeable Reactive Barrier (A-Aquifer) (In situ permeable reactive barriers are composed of a material that passively removes contaminants from. flowing ground water); Groundwater Extraction and Treatment Within OU2 Groundwater Extraction and Treatment System (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer).
- Remedial Alternative 4—Groundwater Extraction and Treatment (A-Aquifer); Groundwater Extraction and Treatment Within OU 2 Groundwater Extraction and Treatment System (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer).

All of the alternatives include common components summarized as follows:

- Elimination of a **vertical conduit** that is allowing contaminated groundwater to migrate from the A-Aquifer into the Upper 180-Foot and Lower 180-Foot Aquifers.
- Monitoring of up to 30 additional wells for 30 years.
- Monitored natural attenuation of the Lower 180-foot Aquifer with a contingency plan for well-head treatment of **groundwater** being extracted from potable water supply wells if chemicals of concern associated with OUCTP are detected in these wells.
- Institutional controls (e.g., deed restrictions, land use controls, etc.) to ensure groundwater within the OUCTP area is not accessed or used for any purpose by future property owners.

Alternatives 2 – 4 were developed based on the following considerations for the A-Aquifer and Upper 180-Foot Aquifer, respectively:

- A-Aquifer: Portions of the plume are located under roadways, heavily developed commercial areas, and ecologically sensitive areas where it would be difficult to install and operate permanent wells, piping, and treatment system equipment. In addition, there is variability in groundwater conditions and in the applicability of certain remedial technologies evaluated in portions of the plume. Therefore, for the purposes of the **Feasibility Study** evaluation, the location of the treatment systems included in Alternatives 2 – 4 were selected based on accessibility and other logistical considerations (*MACTEC, 2005*). As stated above, these assumptions will be revisited and refined during the remedial design phase of remedy implementation.
- Upper 180-Foot Aquifer: Cleanup of this aquifer under Alternatives 2 – 4 would be the same. Cleanup would be accomplished by adapting the OU2 Groundwater Extraction and Treatment System, which is already in place and treating groundwater from OU2, to also cleanup the VOC plume associated with OUCTP. These alternatives assume a newly installed groundwater extraction well and potential future extraction wells would be pumped for capture of the majority of the Upper 180-Foot Aquifer plume. The unique components of the A-Aquifer remedial alternatives are summarized as follows:

Remedial Alternative 1—No Action With Monitored Natural Attenuation (All Aquifers). The no action alternative is required as a baseline for comparison to other alternatives (EPA, 1989), and assumes the common components listed above plus the following:

- The plume(s) would naturally attenuate over a period of approximately 30 years to meet cleanup goals (RAOs), and chemical concentrations in groundwater and offsite plume migration would not increase in a statistically significant manner.
- Costs associated with planning and installing up to 30 additional monitoring wells to 'bound' the plumes are estimated at approximately $558,000. Operations and maintenance costs for 30 years of monitoring and reporting are estimated at $2.19 million, for a total estimated cost for this alternative of $2.75 million. Costs associated with contingent wellhead treatment of water supply wells in the Lower 180-Foot Aquifer if chemicals of concern are detected in these wells would be estimated during the remedial design phase for implementation of the selected alternative.

Remedial Alternative 2—In Situ Enhanced Biodegradation (A-Aquifer); Groundwater Extraction and Treatment Within OU2 Groundwater Extraction and Treatment System (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer).

This alternative includes the common components listed above and presents an in situ remediation scenario for treatment and migration control of the A-Aquifer groundwater plume using a large network of in situ enhanced biodegradation injection points throughout the entire plume. In order to address accessibility and other logistical considerations described above, it was assumed injection equipment would be used that requires only temporary access to the ground surface, and no permanent equipment would be installed. The components of this alternative for the A-Aquifer are described below.

- A sodium lactate solution would be injected until concentrations of chemicals of concern in the A-Aquifer are at or below **aquifer cleanup levels**. Sodium lactate is natural salt that is derived from a natural fermentation product, lactic acid, which is produced naturally in foods such as cheese and yogurt. The groundwater would be monitored for the chemicals of concern and their breakdown products during the cleanup.
- Costs associated with installing the lactate injection and recirculation treatment system and additional monitoring wells, and conducting the first lactate injection event are estimated at approximately $4.63 million. Treatment system operations and maintenance costs for 20 years of monitoring and reporting are estimated at approximately $4.91 million, for a total estimated cost for this alternative of $9.54 million.

Remedial Alternative 3—In Situ Permeable Reactive Barrier (A-Aquifer); Groundwater Extraction and Treatment Within OU2 Groundwater Extraction and Treatment System (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer).

This alternative includes the common components listed above and presents an in situ remediation and containment approach that includes installation of an in situ permeable reactive barrier (PRB) near the downgradient plume boundary for offsite migration control of the A-Aquifer plume. In order to address accessibility and other logistical considerations described above, it was assumed the PRB would be located at the downgradient end of the plume on former Fort Ord property. The components of this alternative for the A-Aquifer are described below.

- If the results of a pilot study indicate a PRB would be effective, a full-scale PRB would be installed.
- The full-scale in situ PRB would be installed near the downgradient plume boundary for offsite migration control of the A-Aquifer plume.
- Groundwater modeling indicated the PRB would cleanup the majority of the **carbon tetrachloride** plume upgradient of the PRB within 50 years, with only a small portion of the plume remaining at concentrations ranging from 0.5 to 1.5 parts per billion (ppb). However, **groundwater** downgradient of the PRB would remain contaminated at concentrations ranging between 0.5 and 5 ppb due either to the continued migration of **carbon tetrachloride** already present downgradient of the PRB or from residual **carbon tetrachloride** emanating from the PRB. Therefore, it is anticipated that designation of a **non-containment zone** may be required for this area since it would contain chemicals of concern above aquifer cleanup levels for an undetermined period of time. A **non-containment zone** is an area of limited groundwater contamination where **aquifer cleanup levels** cannot be met in a reasonable period of time.
- Costs associated with installing the PRB and additional monitoring wells are estimated at approximately $8.73 million. Operations and maintenance and monitoring and reporting costs for 30 years are estimated at approximately $4.42 million, for a total estimated cost for this alternative of $13.15 million.

Remedial Alternative 4—Groundwater Extraction and Treatment (A-Aquifer); Groundwater Extraction and Treatment Within OU2 Groundwater Extraction and Treatment System (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer).

This alternative includes the common components listed above and presents an approach that includes pumping groundwater from the A-Aquifer plume with aboveground treatment and reinjection of treated water back into the aquifer. In order to address accessibility and other logistical considerations described above, it was assumed permanent extraction wells and treatment system piping and equipment would be located on former Fort Ord property in easily accessible areas. The components of this alternative for the A-Aquifer are described below.

- Five groundwater extraction wells would be installed for capture of the majority of the A-Aquifer plume. The extracted water would be collected at an aboveground groundwater treatment plant, and would be treated and reinjected back into the aquifer.
- A portion of the downgradient plume would not be technically feasible to capture because, based on the groundwater

modeling simulation, any increase in the estimated pumping rate above 50 gallons per minute (gpm) would dry up the well. Current development in the vicinity of the proposed well will not allow relocation to a more suitable area. Concentrations of **carbon tetrachloride** in the downgradient (uncaptured) portion of the plume are estimated to range from between 0.5 to 5 ppb based on current plume conditions (the aquifer cleanup level for **carbon tetrachloride** is 0.5 ppb). It is assumed the contaminants in this part of the plume would be cleaned up naturally over time (natural attenuation).

- Although concentrations of chemicals of concern in the downgradient portion of the plume are expected to decline over time through natural attenuation processes, it is anticipated that designation of a **non-containment zone** may be required for this area since the contaminants would be above the cleanup levels for an undetermined period of time.
- The extracted **groundwater** would be treated to meet the cleanup goals and would be reinjected back into the **aquifer** through wells located within the plume to increase the flow toward the extraction wells.
- Costs associated with installing the extraction, treatment, and reinjection system and additional monitoring wells are estimated from $2.38 to $2.46 million, depending on whether activated carbon or air stripping treatment is selected for implementation during the remedial design phase. Treatment system operations and maintenance costs for 30 years of monitoring and reporting are estimated from $11.07 to $17.47 million, depending on the treatment method, for a total estimated cost for this alternative of $13.45 to $19.93 million.

EVALUATION OF ALTERNATIVES

The evaluation and comparison of remedial alternatives based on EPA's nine evaluation criteria specified in EPA's *Guidance for Conducting Remedial Investigations/Feasibility Studies Under CERCLA* (*EPA, 1989*) is summarized in **Table 2** found at the back of this Proposed Plan (**page 17**).

PREFERRED ALTERNATIVE

The alternative that best meets the nine EPA evaluation criteria and is proposed for implementation as the Preferred Alternative for OUCTP is Remedial Alternative 2—In Situ Enhanced Biodegradation (A-Aquifer); Groundwater Extraction and Treatment Within OU2 Groundwater Extraction and Treatment System (Upper 180-Foot Aquifer); Monitored Natural Attenuation with Wellhead Treatment Contingency (Lower 180-Foot Aquifer).

This alternative was selected as most likely to be acceptable to the support agencies and public because it is the only alternative that would (1) cleanup the entire A-Aquifer and Upper 180-Foot Aquifer plumes to below **aquifer cleanup levels** within the shortest timeframe for the lowest associated cost while (2) protecting human health and the environment and complying with **Applicable or Relevant and Appropriate Requirements,** such as federal, State and local laws and regulations. It also provides long term Monitored Natural Attenuation and contingent wellhead treatment at water supply wells in the Lower 180-Foot Aquifer if chemicals of concern are detected in these wells.

The Preferred Alternative identified in this **Proposed Plan** may be modified in response to public or regulatory agency comments, or new information that is identified after the OUCTP RI/FS report is finalized (e.g., during the remedial design phase of remedy implementation).

Based on the evaluation and comparison of remedial alternatives using EPA's nine evaluation criteria summarized in **Table 2**, Alternative 2 was identified as the preferred alternative for implementation within OUCTP plume for the following reasons:

Threshold Criteria

1) Overall Protection of Human Health and the Environment: This alternative would provide the greatest degree of protection of human health and the environment within the shortest timeframe compared to the other alternatives because it is the only alternative expected to cleanup to below aquifer cleanup levels.
2) Compliance with **Applicable or Relevant and Appropriate Requirements**: This alternative is the only alternative evaluated that would comply with all **Applicable or Relevant and Appropriate Requirements**.

Balancing and Modifying Criteria

3) Short-Term Effectiveness: This alternative would be effective in the short term because it would only take approximately six months to install the lactate injection/recirculation wells and implement the first injection within the A-Aquifer; install a new extraction well and connect it to the existing OU2 Groundwater Extraction and Treatment System in the Upper 180-Foot Aquifer; and install new monitoring wells and establish the Monitored Natural Attenuation program throughout OUCTP.

4) Long-Term Effectiveness and Permanence: This alternative would have the greatest long-term effectiveness and permanence because it would actively cleanup and contain the two upper plumes that are acting as a source of contamination to the Lower 180-Foot Aquifer, which is used for drinking water. There are no drinking water wells in the vicinity of the groundwater contamination.

5) Reduction of Toxicity, Mobility, and Volume Through Treatment: This alternative would actively reduce the toxicity, mobility, and volume of contaminants better than the other alternatives evaluated. It is the only alternative that would cleanup the entire A-Aquifer and Upper 180-Foot Aquifer plumes to below **aquifer cleanup levels** in less than 30 years.

6) Implementability: This alternative would require a moderate level of effort to implement from a technical perspective. It involves installation of several hundred injection points/recirculation wells within the A-Aquifer; installation of an extraction well, piping conveyance, and treatment capacity to tie in **groundwater** from the Upper 180-Foot Aquifer to the existing OU2 Groundwater Extraction and Treatment System; and long-term Monitored Natural Attenuation and reporting for these and the Lower 180-Foot Aquifer.

7) Cost: Aside from the No Action with Monitored Natural Attenuation Alternative, which would not actively cleanup or contain the plume in the foreseeable future, this alternative has the lowest total cost of all the alternatives evaluated. The total cost for this alternative is estimated at $9.54 million.

8) Support Agency Acceptance: The EPA, DTSC and RWQCB support the Preferred Alternative.

9) Community Acceptance: Community acceptance will be evaluated during the public comment period and reported in the OUCTP ROD.

The Preferred Alternative Is:

A-AQUIFER
In Situ Enhanced Biodegradation

UPPER 180-FOOT AQUIFER
Groundwater Extraction and Treatment Within Operable Unit 2

LOWER 180-FOOT AQUIFER
Monitored Natural Attenuation With Wellhead Treatment Contingency

Based on information currently available, the lead agency believes the Preferred Alternative meets the threshold criteria and provides the best approach among the remedial alternatives with respect to the balancing and modifying criteria. The lead agency expects the Preferred Alternative to satisfy the following statutory requirements of CERCLA §121(b): 1) be protective of human health and the environment; 2) comply with ARARs (or justify a waiver); 3) be cost-effective; 4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and 5) satisfy the preference for treatment as a principal element (or justify not meeting the preference).

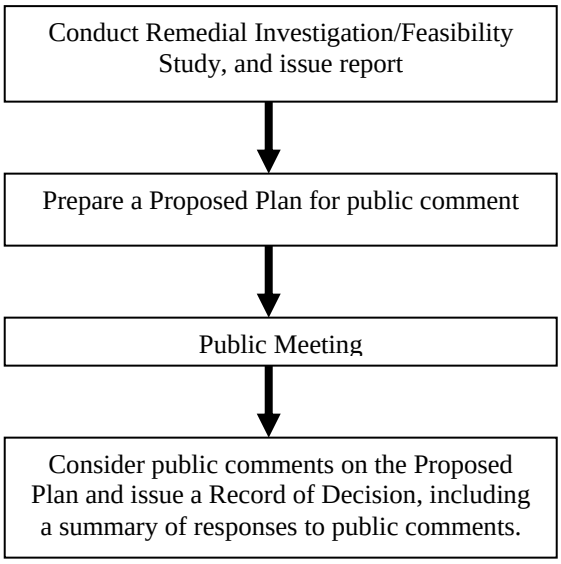

Figure 3. OUTCP Record of Decision Process

COMMUNITY PARTICIPATION

Public comments on this **Proposed Plan** will be accepted during a public meeting and during the 30-day public review and comment period described below. These comments will be considered when the Army and the EPA, in consultation with the state regulatory agencies (DTSC and RWQCB, both part of Cal/EPA), make a final decision regarding the remedial action to be implemented to address the presence of groundwater contaminants within OUCTP. The decision will be documented in a **Record of Decision** and Army responses to public comments on this **Proposed Plan** will appear in the **Responsiveness Summary** section of the **Record of Decision**.

The flow chart shown on **Figure 3** summarizes the development and public input for the OUCTP **Record of Decision** process.

The remedy for OUCTP will be evaluated every five years to ensure it protects human health and the environment.

HOW TO MAKE COMMENTS

The local community and interested parties are encouraged to comment on the investigation and remedial action decision process described in this OUCTP **Proposed Plan**. A public meeting regarding the OUCTP Proposed Plan will be held on June 14, 2006 at 6:00 p.m. at the Stilwell Community Center. Representatives from the Army, EPA, DTSC, and RWQCB will be present at this meeting to explain the OUCTP Proposed Plan, hear concerns, and answer questions. The OUCTP RI/FS provides a detailed report that describes the information presented in the Remedial Investigation (RI: Volume I), Human Health Risk Assessment (Volume II), and Feasibility Study (FS; Volume III) for OUCTP (*MACTEC, 2006)*. This and other relevant or referenced reports are available for review at the Information Repositories and the **Administrative Record** listed below.

Written comments on this OUCTP **Proposed Plan** will be accepted at the public meeting scheduled on June 14, 2006, and throughout the 30-day public comment period from June 5 to July 5, 2006. Correspondence should be postmarked no later than July 5, 2006 and sent to the attention of the U.S. Army representative at the following address:

Department of the Army
Fort Ord Base Realignment and Closure (BRAC) Office
ATTN: Gail Youngblood
BRAC Environmental Coordinator
P.O. Box 5008
Monterey, California 93944-5008

Please reference the OUCTP Proposed Plan in your correspondence.

INFORMATION ACCESS

U.S. Army Representative

Department of the Army
Fort Ord Base Realignment and Closure (BRAC) Office
P.O. Box 5008
Monterey, California 93944-5008

Contact: Gail Youngblood, BRAC Environmental Coordinator
(831) 242-7918 gail.youngblood@monterey.army.mil
FAX: (831) 393-9188
Hours: 8:00 a.m. to 5:00 p.m.

Regulatory Representatives

U.S. Environmental Protection Agency, Region IX

Superfund Federal Facilities Cleanup Branch
75 Hawthorne Street, Mail Code SFD-8-3
San Francisco, California 94105

Contact: Martin Hausladen, Remedial Project Manager
(415) 972-3007 Hausladen.Martin@epamail.epa.gov
Hours: 8:00 a.m. to 5:00 p.m.

Cal/EPA Department of Toxic Substances Control, Region 2

Site Mitigation/Office of Military Facilities
8800 Cal Center Drive
Sacramento, California 95826

Contact: Susan Goss, Remedial Project Manager
(916) 255-6403 SGoss@dtsc.ca.gov
Hours: 8:00 a.m. to 5:00 p.m.

Cal/EPA Regional Water Quality Control Board,
Region 3

895 Aerovista Place, Suite 101
San Luis Obispo, California 93401-7906

Contact: Grant Himebaugh, Remedial Project Manager
(805) 542-4636 Ghimebaugh@waterboards.ca.gov
Hours: 8:00 a.m. to 5:00 p.m.

INFORMATION REPOSITORIES

California State University Monterey Bay (CSUMB)
Library Learning Complex
100 Campus Center, Bldg. 12
Seaside, CA 93955

(831) 582-3733

Hours:

Monday—Thursday, 9:00 a.m.—9:00 p.m.
Friday, 9:00 a.m.—5:00 p.m.
Closed Saturday
Sunday, 2:00 p.m.—9:00 p.m.

Seaside Branch Library
550 Harcourt Avenue
Seaside, CA 93955

(831) 899-2537

Hours:

Monday—Thursday, 10:00 a.m.—8:00 p.m.
Friday and Saturday, 10:00 a.m.—5:00 p.m. -- Closed Sunday.

Administrative Record Location

Fort Ord Administrative Record
Building 4463 Gigling Road
Room 101
Ord Military Community, CA 93944-5004

(831) 393-9186

Hours:

Monday—Friday, 9:00 a.m.—4:00 p.m.
Other hours by appointment. Closed daily, 12:00 p.m.—1:30 p.m. for lunch. Closed on Federal Holidays.

REFERENCES

Harding Lawson Associates (HLA; Now MACTEC, Inc.), 1990. *Fort Ord Landfills, Final Preliminary Hydrogeologic Investigation, Fort Ord, California*. Prepared for the U.S. Army Corps of Engineers, Sacramento District. April.

_____, 1994. *Draft Final Basewide Hydrogeologic Characterization, Fort Ord, California.* Prepared for the U.S. Army Corps of Engineers, Sacramento District. June 10.

_____, 1995. *Final Basewide Remedial Investigation/Feasibility Study, Fort Ord, California, Volumes I – VI.* Prepared for the U.S. Army Corps of Engineers, Sacramento District. October 1.

_____, 1999. *Draft Final Carbon Tetrachloride Investigation Report, Fort Ord, California.* Prepared for the U.S. Army Corps of Engineers, Sacramento District. November 10.

MACTEC Engineering & Consulting, Inc. (MACTEC; formerly HLA and Harding ESE), 2006. *Final Operable Unit Carbon Tetrachloride Plume Groundwater Remedial Investigation / Feasibility Study, Former Fort Ord, California: Volume I—Remedial Investigation; Volume II—Human Health Risk Assessment; Volume III—Feasibility Study.* Prepared for the U.S. Army Corps of Engineers, Sacramento District. May.

U.S. Environmental Protection Agency (EPA), 1989. *Guidance for Conducting Remedial Investigation/Feasibility Studies Under CERCLA. Interim Final*. EPA 540/G-89/001. October.

GLOSSARY

1,2-Dichloroethane (1,2-DCA) - a colorless, oily, organic liquid with a sweet, chloroform-like odor used as a solvent for resins and fats, photography, photocopying, cosmetics, drugs; and as a fumigant for grains and orchards.

Administrative Record – A collection of all documents relied upon to select a remedial action pertaining to the investigation and cleanup of the former Fort Ord.

Applicable or Relevant and Appropriate Requirements (ARARs) – Federal, State, and local laws and regulations pertaining to environmental cleanups that can be specific to the chemicals found at a site, the potential actions proposed to address contamination at a site, or the location of the site.

Aquifer – An underground bed or layer of porous soils (e.g., sand) that contains groundwater.

Aquifer Cleanup Levels (ACLs) – The concentrations of chemicals in groundwater to be achieved in the cleanup of a site that are protective of human health and comply with relevant State and local laws and regulations.

Aquitard – An underground bed or layer of non-porous soils (e.g., clay) that retards the flow of groundwater.

Carbon tetrachloride – A colorless, nonflammable toxic liquid that was widely used as a cleaning solvent and in fire extinguishers.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, otherwise known as Superfund) – A federal law that addresses the funding for and cleanup of abandoned or uncontrolled hazardous waste sites. This law also establishes criteria for the creation of decision documents such as the Remedial Investigation, Feasibility Study, Proposed Plan, and Record of Decision.

Feasibility Study (FS) – An evaluation of potential technologies and treatment options that can be used to clean up a site.

Groundwater – Water that is beneath the earth's surface, flows through soil and rock, and is often used as a source of drinking water.

Groundwater remedial unit – The horizontal and vertical extent or volume of groundwater that is contaminated at concentrations above aquifer cleanup levels.

Hazard Index (HI) –The potential noncancer hazard posed by hypothetical exposure to contaminants at a site that is estimated in the Risk Assessment. Typically if the total HI is greater than 1, a potential for adverse noncancer health effects may exist. If the HI is equal to or less than 1, exposures are not expected to result in adverse noncancer health effects.

Human Health Risk Assessment – An assessment of potential cancer and noncancer risks posed by hypothetical exposure to contaminants at a site that can be used in the development of cleanup levels that are protective of human health.

In Situ Enhanced Biodegradation – A groundwater treatment technology that uses injection of a liquid formula into subsurface wells within a contaminated aquifer to stimulate the growth of microorganisms that consume chemical contaminants (such as VOCs) through naturally occurring biodegradation processes. Many different formulas are available and proven to enhance biodegradation and reduce concentrations of contaminants in groundwater depending on site-specific conditions, including natural substances such as lactic acid (lactate), oil emulsions, molasses, and hydrogen release compounds (HRC®), which are lactic acid formulations.

Installation Restoration Program (IRP) – The Department of Defense (DoD) established the Defense Environmental Restoration Program (DERP) to address hazardous substances, pollutants, contaminants, and military munitions remaining from past activities at military installations and formerly used defense sites (FUDS). Within the DERP, the Installation Restoration Program (IRP) focuses on releases of hazardous substances, pollutants, or contaminants that pose environmental health and safety risks.

Maximum Contaminant Levels (MCLs) – The highest concentrations of chemicals allowed in drinking water that are Federal and/or State enforceable standards permissible for a public water system.

Monitoring – Ongoing collection of information about the environment that helps gauge the effectiveness of a cleanup action.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP) – The federal government's plan for responding to oil spills and hazardous substance releases. Developed to provide a national response capability and promote overall coordination among the hierarchy of responders and contingency plans.

National Priorities List (NPL) – A list of sites that are national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. Intended primarily to guide the United States Environmental Protection Agency in determining which sites warrant further investigation.

Non-containment zone – A limited groundwater pollution zone that may be established where water quality objectives (e.g., aquifer cleanup levels) are exceeded if full restoration of beneficial uses of groundwater are not technologically or economically achievable within a reasonable period of time.

Operable Unit (OU) – An area of contamination under study as part of the environmental cleanup process.

Parts per billion (ppb) – A unit of measure used to describe levels or concentrations of contamination. A measure of concentration, equaling 0.0000001 percent. For example, One part per billion is the equivalent of one drop of impurity in 500 barrels of water. Most drinking water standards are ppb concentrations.

Perchloroethylene (PCE) - A volatile organic compound used primarily as a dry-cleaning agent. It is often referred to as "perc."

Point of departure – A Cal/EPA-DTSC regulatory risk management term that refers to a potential excess cancer risk to humans of 1 in 1,000,000 for the assumed chemical exposures estimated in a **Risk Assessment**. In general, further action is not warranted if the excess cancer risk is below 1 in 1,000,000. If the risk exceeds this level, Cal/EPA-DTSC generally requires further evaluation or discussion of the risk so that management decisions can be made, but also considers risks within the risk management range of 1 in 1,000,000 to 1 in 10,000 on a site-specific basis.

Preferred Remedial Alternative – The remedial alternative that compared to other potential alternatives, was determined to best meet the nine CERCLA evaluation criteria in the Feasibility Study, and is proposed for implementation at a site.

Proposed Plan – A plan that identifies the preferred alternative for a site cleanup, and is made available to the public for comment.

Record of Decision (ROD) – A report documenting the final action, approved by the regulatory agencies, that is required at Superfund sites.

Remedial Action Objectives (RAOs) – The main cleanup objectives for a contaminated site, which are to reduce risks to human health and the environment and comply with relevant State and local laws and regulations. Specifically for contaminated groundwater, these objectives include:

- Exposure Control—Prevent the potential exposure of child and adult residents to groundwater contaminants above aquifer cleanup levels;
- And to the extent practicable based on technical and economic feasibility, achieve:
- Source Control—Prevent or minimize further degradation of groundwater at the site;
- Plume Containment—Mitigate the potential for contaminants to continue to migrate offsite;
- Plume Remediation—Reduce contaminant concentrations in groundwater to below aquifer cleanup levels.

Remedial Investigation (RI) – A series of investigations and studies to identify the types and extent of chemicals of concern at the site and to determine cleanup criteria

Responsiveness Summary – Serves the dual purposes of: (1) presenting stakeholder concerns about the site and preferences regarding the remedial alternatives; and (2) explaining how those concerns were addressed and the preferences were factored into the remedy selection process.

Site characterization – An investigation of the nature and extent of contamination associated with the known or potential release of hazardous substances.

Soil gas – Soil gas or (soil vapor) is air existing in void spaces in the soil between the groundwater and the ground surface. These gases may include vapor of hazardous chemicals as well as air and water vapor.

Soil vapor extraction (SVE) - A process in which chemical vapors are extracted from the soil by applying a vacuum to wells.

Superfund – See Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) above.

Trichloroethylene (TCE) – A volatile organic compound that is commonly used as an industrial degreasing solvent.

Vadose Zone - Also termed the **unsaturated zone**, is the soil between the ground surface and the water table.

Vertical conduit – A well, drilled through an aquitard, that is not adequately sealed to prevent groundwater from the upper aquifer from leaking into the aquifer(s) below.

Volatile organic compounds (VOCs) – Organic liquids, including many common solvents, that readily evaporate at temperatures normally found at ground surface and at shallow depths.

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Table 1. Chemicals of Concern & Aquifer Cleanup Levels					
Aquifer / Chemical of Concern/ Chemicals of Potential Concern	**Maximum Contaminant Level (MCL)**		**Aquifer Cleanup Level (ACL) (ppb)**	**Maximum Chemical Concentration Detected**	
	State (ppb)	**Federal (ppb)**		**September 2004 (ppb)**	**Historic (ppb)**
A-Aquifer					
Chemicals of Concern					
Carbon Tetrachloride	0.5	5	0.5	15	19
Perchloroethylene (PCE)	5	5	5	0.87	1.63
Trichloroethylene (TCE)	5	5	5	4.9	6.4
Upper 180-Foot Aquifer					
Chemicals of Concern					
Carbon Tetrachloride	0.5	5	0.5	3.5	9.8
Lower 180-Foot Aquifer					
Chemicals of Concern					
Carbon Tetrachloride	0.5	5	0.5	3.66	6.95
1,2-Dichloroethane	0.5	5	0.5	1.2	1.7

Note: ppb equals parts per billion.

Table 2. Summary of Evaluation of Remedial Alternatives

Remedial Alternative	EPA CERCLA Evaluation Criteria\								
	Overall Protection of Human Health and the Environment	**Compliance with Applicable or Relevant and Appropriate Requirements**	**Short-Term Effectiveness**	**Long-Term Effectiveness and Permanence**	**Reduction of Toxicity, Mobility, or Volume Through Treatment**	**Implementability**	**Total 30-Year Cost (millions)**	Regulatory Acceptance	**Community Acceptance**
Remedial Alternative 1 All Aquifers: No Action With Monitored Natural Attenuation (MNA)	Not protective except by continuing to prohibit groundwater uses	Does not comply unless treatment is unachievable and non-attainment waiver is granted	Not effective	Unknown	No reduction or treatment	Easy to construct; difficult to gain approval	$2.75	No	Determined in Record of Decision
Remedial Alternative 2 A-Aquifer: In Situ Enhanced Biodegradation Upper 180-Foot Aquifer: Groundwater Extraction and Treatment Within Operable Unit 2 Lower 180-Foot Aquifer: Monitored Natural Attenuation with Wellhead Treatment Contingency	Protective; treats contamination using methods already proven effective in site studies	Complies	Effective	Effective; estimated to permanently achieve cleanup within 15 years	Reduces through treatment	Moderate level of effort to construct; approval likely. Short-term impacts on aquifer	$9.54	Yes	Determined in Record of Decision
Remedial Alternative 3 A-Aquifer: In Situ Permeable Reactive Barrier (PRB) Upper & Lower 180-Foot Aquifers: Same as Remedial Alternative 2	Less protective; would not treat entire plume and requires studies to determine if effective	Does not comply throughout entire plume	Effective at treating portions of plume	Unknown; estimated to achieve cleanup within 20 - 50 years	Reduces through treatment in portions of plume	High level of effort to construct; approval unknown	$13.15	No	Determined in Record of Decision
Remedial Alternative 4 A-Aquifer: Groundwater Extraction and Treatment Upper & Lower 180-Foot Aquifers: Same as Remedial Alternative 2	Protective; treats contamination using methods already proven effective at former Ft. Ord	Complies	Effective	Effective; estimated to permanently achieve cleanup within 30 years	Reduces through treatment	Moderate level of effort to construct; approval likely	$13.45—$19.93	No	Determined in Record of Decision