Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

Volume V - Feasibility Study

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This document was prepared by Harding Lawson Associates at the direction of the U.S. Army Corps of Engineers (COE) for the sole use of the COE and the signatories of the Federal Facilities Agreement, including the Army, the U.S. Environmental Protection Agency, the Department of Toxic Substances Control (formerly, the Toxic Substances Control Program of the Department of Health Services), and the Regional Water Quality Control Board, Central Coast Region, the only intended beneficiaries of this work. No other party should rely on the information contained herein without prior written consent of the COE and Army. This report and the interpretations, conclusions, and recommendations contained within are based in part on information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

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1.0 INTRODUCTION

The Army Corps of Engineers, Sacramento District (COE), is submitting this Feasibility Study (FS) for the National Priorities List (NPL) project at Fort Ord, California. The report was prepared by Harding Lawson Associates (HLA) as part of the basewide Remediation Investigation/Feasibility Study (RI/FS), which is being conducted in accordance with a Federal Facilities Agreement (FFA) signed in July 1990 by representatives from Fort Ord, the U.S. Army (Army), the U.S. Environmental Protection Agency, Region IX (EPA), and the California Environmental Protection Agency (Cal/EPA), including the Department of Toxic Substance Control (DTSC, formerly the Toxic Substances Control Program of the California Department of Health Services [DDS]) and the California Regional Water Quality Control Board, Central Coast Region (RWQCB).

The following sections describe the purpose and objectives of the FS report.

1.1 Objectives and Scope

Recently, Congress mandated a three-year completion schedule for RI/FS documents for Base Realignment and Closure (BRAC) sites such as Fort Ord (Public Law 102-190). Furthermore, acceleration measures suggested by the U.S. Environmental Protection Agency's draft Superfund Acceleration Cleanup Model (SACM) Guidance Manual recommend allocating and expanding resources to clean up areas that pose the greatest risk to human health and the environment while expending resources on sites that can (1) be cleaned up quickly in keeping with reuse goals and objectives and (2) be verified as clean and turned over to government agencies or sold to private entities for use and further development (*EPA, 1992k*).

The economic impact of Fort Ord's closure is another impetus to accelerate the implementation of remedial actions. Closure of Fort Ord will have significant repercussions on the local economy, and timely conversion of Fort Ord property to civilian uses is a high priority to both the local community as well as the Army.

1.2 Feasibility Study Strategy

For each of the five RI sites at Fort Ord, an FS that evaluates and recommends remedial alternatives for site cleanup is included in this report. One of the main components of an FS is to develop and analyze site-specific remedial alternatives that will lead to remedial action. The initial screening of remedial technologies, the first step of the FS, considers the universe of technologies that could apply to cleanup of a site. The *Draft Remedial Technology Screening Report* (RTS), dated February 9, 1994, describes a process to expedite the initial screening of technologies for each FS by developing a matrix of applicable, proven technologies for each Group of Compounds (GOCs) in each medium. For each FS the type of contamination and affected media were identified using the RI data. The RTS was then used to identify and screen implementable, proven technologies. These technologies were then evaluated using site specific information to select those technologies that could be developed into site-specific alternatives. By utilizing the RTS process at sites eligible for RI/FSs, a large portion of Fort Ord property impacted by chemicals could be remediated and made ready for civilian use earlier than originally projected by reducing the time required to perform each FS. If remediation of these areas were implemented prior to the final basewide Record of Decision (ROD), which is anticipated to be completed in 1995, base closure would be accelerated.

1.3 Report Organization

Sections 2.0 through 6.0 contain the FSs for Sites 2 and 12, 16 and 17, 3, 31, and 39, respectively. Each FS section contains the following subsections.

- Subsection 1 - Background. This subsection summarizes the site history and description, the nature and extent of contamination, and a summary of the Baseline Risk Assessment (BRA). Applicable or relevant and appropriate requirements (ARARs) are also discussed and target cleanup levels (TCLs) are established for the site.

- Subsection 2 - Identification and Screening of Technologies. This subsection establishes remedial action objectives, remedial units, and provides a summary of appropriate remedial technologies from the RTS that are then included in site-wide remedial alternatives.

- Subsection 3 - Development of Remedial Alternatives. This subsection provides a detailed description of each alternative retained for consideration. Equipment and services, procedures and treatment processes, and site restoration is described.

- Subsection 4 - Criteria for Detailed Analysis of Remedial Alternatives. This subsection describes the nine CERCLA-established criteria: (1) overall protection of human health and the environment, (2) compliance with ARARs, (3) long-term effectiveness, (4) reduction of toxicity, mobility, and volume, (5) short-term effectiveness, (6) implementability, (7) costs, (8) regulatory acceptance, and (9) community acceptance.

- Subsection 5 - Detailed Analysis of Remedial Alternatives. This subsection presents a detailed analysis and comparison of each remedial alternative with respect to the nine CERCLA-established criteria.

- Subsection 6 - Comparison of Remedial Alternatives. This subsection summarizes a comparison of the detailed analyses for each alternative.

- Subsection 7 - Selection of Preferred Remedial Alternative. This subsection presents the preferred remedial alternative and the rationale for its selection.

1.4 Response to Agency Comments

Responses to regulatory agency comments on the Draft FS follow the FS for Site 39 at the end of Volume V. Responses to regulatory agency comments on the Draft Final FS are included in Volume VI.

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Fort Ord, California

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Section 2.0 - Sites 2 and 12

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Basewide Remedial Investigation/Feasibility Study Fort Ord, California

Volume V - Feasibility Study

Sites 2 and 12

HLA Project No. 23366 0417351

This final version of the Sites 2 and 12 Feasibility Study addresses comments received on the Draft Final version of the report dated December 1994. Responses to agency comments on the Draft Final report are included in Volume VI of this report.

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

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2.0 FEASIBILITY STUDY FOR SITES 2 AND 12

2.1 Background

Site 2 consists of the Main Garrison Sewage Treatment Plant (MGSTP). Site 12 consists of the Lower Meadow, the DOL Automobile Yard, the Cannibalization Yard and Industrial Area, and the Southern Pacific Railroad (SPRR) Spur. Plate 2.1 contains a site vicinity map. Sites 2 and 12 were combined because they are adjacent properties and a groundwater plume was discovered within their respective site boundaries. This section summarizes the physical description, history, nature and extent of contamination; the baseline risk assessment (BRA); and the Applicable or Relevant and Appropriate Requirements (ARAR) for both sites. For greater detail, refer to the Remedial Investigation (RI) report for Sites 2 and 12 in Volume II.

2.1.1 Physical Description

- Site 2: The MGSTP is an unpaved area of approximately 28 acres west of Range Road between Trainfire Range No. 9 and Stilwell Hall. These features are shown on Plate 2.2. Plate 2.2 contains the site features referred to as well as information on groundwater contamination that will be discussed in Section 2.1.4. The facility is fenced and contains a few buildings and two large trickling filters. Outside of the fenced facility are 3 (former) unlined sewage ponding areas and 10 asphalt-lined sludge-drying beds. The site landscape consists of dune sand deposits mostly covered with vegetation.

- Site 12: This site consists of the four areas described below (Plate 2.2).

  - The Lower Meadow is a grassy area of approximately 2 acres east of Highway 1 near the Twelfth Street Gate. The site is bounded to the east by the DOL Automotive Yard and to the west by First Avenue. The Lower Meadow is approximately 5 feet lower than the DOL Automotive Yard and receives runoff from it. Several drain pipes including Outfall 31 are in the southeast corner of the site. Two additional pipes are on the eastern slope. No buildings are in the Lower Meadow.

  - The DOL Automotive Yard is east of Highway 1 and northeast of the SPRR Spur that runs east from First Avenue. The 8.5-acre fenced site is paved and bounded by Twelfth Street to the north and the Lower Meadow to the west. The site includes a paint shop (Building 2726), two wash racks, one temporary hazardous waste container storage area, an oil/water separator, an aboveground storage tank (Tank 2725), and several buildings used for automotive repair. The site is paved and slopes gently to the west.

  - The Cannibalization Yard is a small (0.5-acre) paved and fenced area located within the larger (18.5-acre) paved and fenced Industrial Area. The entire 18.5 acre area is bounded by Highway 1 to the west, a baseball field to the east, and Tenth Street to the south. The SPRR Spur separates the Industrial Area from the DOL Automotive Yard to the north. The area includes a machine shop (Building 2426), a furniture repair shop (Building 2429), the base laundry (Building 2068), a temporary hazardous waste container storage area, an oil/water separator, and an aboveground storage tank. The oil/water separator is within the Cannibalization Yard and its water discharges to the sanitary sewer.

  - The SPRR Spur, an approximately 0.8-acre area, consists of the right-of-way along a portion of a railroad spur that extends northward from the SPRR track west of Highway 1 and curves east through an industrial complex. The portion of the railroad track discussed in this report extends from the main track

east of Highway 1 across First Avenue and between the DOL Automotive Yard and the Cannibalization Yard and surrounding Industrial Area. The rest of the railroad right-of-way was investigated during the site characterization of Site 13 (*Draft Site Characterization, Site 13 - Railroad Right-of-Way, HLA, 1993j*); the Site 13 information is not repeated here. The relatively flat right-of-way is mostly unpaved except in those areas adjacent to loading docks and where the spur crosses First Avenue.

2.1.2 History

- Site 2: The MGSTP was the primary sewage treatment facility for Fort Ord, serving the majority of the housing areas and the main industrial areas from the late 1930s until May 1990 when it was decommissioned. During operation, effluent from the MGSTP was discharged under a National Pollutant Discharge Elimination System permit to a storm drain that emptied into Indianhead Beach during low tide and discharged to Monterey Bay during high tide. Sewage from Fort Ord currently flows via gravity feed to the pumping station in Marina and then is pumped to the Monterey Regional Treatment Plant (MRTP).

- Site 12: A brief history of the four areas on Site 12 is described below.

  - The Lower Meadow, reportedly, was previously used to dispose of waste material such as scrap metal, oil, and batteries generated by the Department of Logistics (DOL) (*EA Engineering, Science and Technology [EA], 1991a*). The depth of fill material is reportedly up to 30 feet (*EA, 1991a*). The area also appears to contain road construction waste. The Lower Meadow receives runoff from the DOL Automotive Yard. There are several pipes that appear to discharge runoff to the Lower Meadow. It is uncertain if these pipes were designed as drainage lines.

  - The DOL Automotive Yard includes several buildings, two wash racks (2723 and 2729), a paint shop at Building 2726, a buried container, which was originally used as a muffler for exhaust from engine testing at Wash Rack 2723 and may also have been used for liquid waste storage at Building 2719 (*EA, 1991a*). Activities potentially resulting in the release of hazardous materials at the DOL Automotive Yard included transmission repair, degreasing, engine testing, steam cleaning and washing vehicles, and petroleum/oil/lubricant (POL) storage (*EA, 1991a*).

  - The Cannibalization Yard was used from 1964 until the present to disassemble old equipment, primarily decommissioned military vehicles. Used motor oil was collected in pans, then the oil was transferred to 55-gallon drums for storage. Other activities included draining/removing gasoline (leaded and unleaded), diesel fuel, brake fluid, asbestos-containing brake shoes and linings, antifreeze/coolants, lead and acid from batteries, lubricating greases, and transmission fluids. One oil/water separator at the northeast corner of the yard, which collects surface runoff from the area, has been in use since 1988.

  - The SPRR spur, an approximately 0.8-acre area, consists of the right-of-way along a portion of a railroad spur that extends northward from the SPRR track west of Highway 1 and curves east through an industrial complex. As previously mentioned, the rest of the railroad spur was investigated during the characterization of Site 13 and is not discussed here. The SPRR spur is of concern because hydrocarbons may have been sprayed in this area for dust control.

2.1.3 Proposed Reuse

The initial proposed reuse for Site 2 includes outdoor and indoor aquaculture facilities for raising fish and shellfish, with additional research facilities to support oceanographic studies. Additional reuse plans for Site 2 include an open space area. As discussed in the BRA (Volume IV), risks associated with Site 2 were evaluated for the initial proposed reuse as an aquaculture facility. This exposure scenario is more conservative than use of Site 2 as an open space area. Therefore, either reuse plan will have conservative estimates of health risks calculated in the BRA. Reuse planned for Site 12 includes a central business district, light industrial areas, a high-tech business park, a transit center, retail businesses, medium- to high-density residential areas, and a school (*FORA, December 14, 1994*).

2.1.4 Nature and Extent of Contamination

This section summarizes the results and conclusions of the RI for Sites 2 and 12 presented in Volume II.

2.1.4.1 Sites 2 and 12 Groundwater

The hydrogeology of Sites 2 and 12 is summarized as follows:

- Both sites are located in the Salinas Basin west of the Salinas Valley Aquiclude (SVA). Two aquifer units were identified and investigated during the RI. The Upper 180-foot aquifer and the Lower 180-foot aquifer. Because the SVA is absent at Sites 2 and 12, the A-aquifer is considered part of the Upper 180-foot aquifer.

- The lithology of both aquifers is primarily sand to silty sand with up to 15 percent gravel present in some zones. A sandy silt is present at approximately 70 to 80 feet below mean sea level and acts as an aquitard between the two aquifer units. At both sites, the Upper 180-foot aquifer is unconfined, while the Lower 180-foot aquifer is confined.

- Depth to groundwater ranges from about 40 feet below ground surface (bgs) at Site 2 to about 70 to 80-feet bgs at Site 12. Groundwater flow in the Upper 180-foot aquifer is generally southwest from Site 12 towards Site 2 and Monterey Bay. Groundwater flow in the Lower 180-foot aquifer is generally from Site 2 inland towards Site 12 and the Salinas Valley.

The groundwater contamination plume is summarized as follows:

- The groundwater contamination plume at Sites 2 and 12 contains dissolved VOCs that exceed the MCLs. Table 2.1 contains a list of VOCs present above the MCL levels. The lateral extent of the affected groundwater (Plates 2.2 and 2.3) is bounded to the west by Monterey Bay. The northern boundary extends east from the ocean, passing near the north end of Trainfire Range Number 9 and crossing the railroad spur about 400 feet north of Monitoring Well, MW-12-03-180. The eastern plume boundary terminates near the baseball field east of Site 12. The southern plume boundary extends south of the Industrial Area of Site 12 to a point about 200 feet north of MW-02-06-180, near the Highway 1 overpass. The southern boundary continues west to Monterey Bay at a point near Stilwell Hall.

- The TCE plume lateral contours illustrated on Plate 2.2. The limits are based on samples obtained from the Upper 180-foot aquifer in February 1994. The distribution of 1,2-dichloroethane (1,2-DCA), DCE, and PCE is contained within these lateral limits. Plate 2.3 illustrates contours of total VOCs (the sum of the concentrations of detected compounds) based on the February 1994 data. These contours extend beyond the groundwater remedial unit (Section 2.2.1.2) along the northern boundary because of the 1,1,1-trichloroethane (1,1,1-TCA) detected in February 1994 at 71 micrograms per liter (μg/l) in MW-02-10-180. This concentration is below the MCL.

- The vertical extent of the affected groundwater ranges from the water table in the Upper 180-foot aquifer to the top of the sandy silt layer that divides the 180-foot aquifer into upper and lower zones. Depth to the water table is approximately 40 feet bgs at the western edge (Site 2) and approximately 70 to 80 feet bgs at the eastern region of the plume (Site 12). The saturated thickness is approximately 70 to 80 feet thick. The sandy silt layer dividing the Upper 180-foot aquifer appears to have limited vertical migration of dissolved VOCs, as discussed in the Draft Final Basewide Hydrological Characterization Report (*HLA, 1994f*) and the Remedial Investigation in Volume II of this RI/FS.

2.1.4.2 Site 2 Soil

Remedial investigations identified priority pollutant metals detected above maximum background concentrations in surface and near surface samples collected from the sludge drying beds at the Main Garrison Sewage Treatment Plant. All priority pollutant metals except beryllium and chromium were detected at concentrations exceeding the maximum background concentrations for shallow soils from the surface sample at Soil Boring, SB-02-09. This sample was collected from sludge remaining in the sludge beds. Total chromium was detected at concentrations of 28.6 and 30.2 milligram per kilogram (mg/kg) in the 5.5 foot samples from Borings SB-12-07 and -08, respectively. Zinc was detected at concentrations ranging from 16.7 to 31.6 mg/kg in the 5.5 foot samples from Borings SB-12-07 through -10. The chromium and zinc levels exceed the maximum background concentrations for deep soil samples (22.7 mg/kg and 13.9 mg/kg, respectively. Acetone and bis(2-ethylhexyl)-phthalate were the only organic compounds detected; both are common laboratory contaminants. Borings drilled through and samples collected from below the drying beds (approximately 5.5 ft. bgs) show that the elevated metals are confined to the near surface soils within the asphalt lined beds. No elevated TPH was found at Site 2.

The Army is in the process of sampling and evaluating the sludge bed material at Site 2 and will determine whether it is necessary to remove the material before transfer of the property in accordance with local, state, and federal regulations. The Army has determined that material in the sludge beds is not a CERCLA waste and requires no action under CERCLA. If it is determined after sampling and evaluation that the sludge should be removed from the site, it would be disposed in the OU 2 landfill.

2.1.4.3 Site 12 Soil

Remedial investigations identified soil contamination at four areas within Site 12. These include the Lower Meadow Disposal Area, Outfall 31 Area, Cannibalization Yard Area, and the SPRR Spur Area (Plates 2.4 and 2.5).

- Lower Meadow Disposal Area - The Lower Meadow Disposal Area is a grassy field of approximately 2 acres east of Highway 1 near the Twelfth Street Gate. The Lower Meadow is bounded to the east by the DOL Automotive Yard and to the west by First Avenue. The elevation of the area is approximately 5 feet lower than the DOL Automotive Yard and receives runoff from it. Several drain pipes (storm drain surface outfalls) including Outfall 31 terminate outside the disposal limits, in the southeast corner of the Lower Meadow Disposal Area.

  The principal waste materials in the disposal area appear to be construction debris and road construction waste. Soil sample results from numerous tests pits, trenches and soil borings indicated various inorganic and organic constituents were present. Lead was detected exceeding maximum background concentrations for deep soil of samples collected from Trenches TR-12-01C, -02, -03B, -04, and -06B. Lead was also detected exceeding maximum background concentrations in the Boring OF-31-02; Boring SB-12-17; Boring SB-12-18; and the Borings SB-12-19 and -20. Concentrations of lead ranged from 3.8 to 777 mg/kg. Concentrations of Zinc ranged from 14.9 to 223 mg/kg and typically were found adjacent to soil with elevated lead levels. Two trench samples (TR-12-01C) found lead at 777 and 649 mg/kg at approximately 9.5 feet bgs. The corresponding zinc levels were 214 and 223 mg/kg, respectively.

  Limited unknown extractable total petroleum hydrocarbon as diesel (TPHd) constituents are present. The detectable concentrations of TPHd ranged from 11 to 570 mg/kg (Plate 2.4). Only one soil sample obtained within the unit contained levels above 500 mg/kg. Methylene chloride, acetone, and methylethyl ketone were detected at relatively low concentrations with the highest concentration, being acetone at 0.04 mg/kg. These organic constituents include typical laboratory background contaminants and are not considered indicative of a source area. Based on these data, the extent of the disposal area appears to be approximately 220 feet by 100 feet and extends to approximately 20 feet bgs.

- Outfall 31 Area - The Outfall 31 Area is located to the east of the Lower Meadow Disposal Area and is a grass covered depression that receives surface runoff and storm drainage flow from Outfall 31 and several other pipes. It has a catch basin area that collects precipitation and rainfall runoff. The catch basin is connected to subsurface piping that runs to the west from the Outfall 31 Area to Outfall 15.

  Investigation activities found elevated inorganic and organic constituents. These activities found lead ranging from 58.3 to 394 mg/kg, copper was reported at a range of 9.4 to 81.2 mg/kg and zinc was reported at a range of 15.1 to 181 mg/kg.

  Investigation activities reported that four soil samples contained levels of TPH greater than 500 mg/kg (Plate 2.4). Two samples obtained from 0.25 and 0.35 feet bgs contained 26,000 and 4,700 mg/kg unknown TPHd. Two samples obtained from 4.25 and 10 feet bgs contained 5,100 and 1,400 mg/kg unknown TPHd. An unknown TPH as gasoline (TPHg) concentration of 160 mg/kg was reported along with the 1,400 mg/kg unknown TPHd sample obtained at 10 feet bgs. Based on these data, the extent of TPH contamination appears to be approximately 100 feet by 50 feet with a maximum depth of 15.

- Cannibalization Yard Area - This area of contamination includes the area between the eastern edge of the Cannibalization Yard and the eastern edge of the Industrial Area that abuts the baseball field. The Cannibalization Yard Area is a shallow surface drainage that has been subject to runoff from the DOL Automotive Yard and the Industrial Area to the west and south, respectively.

  Surface and shallow borings near an oil/water separator and along the eastern margin of the Cannibalization Yard Area indicated that the shallow soil contains elevated levels of metals and TPH. Shallow soil samples collected from the field east of the Cannibalization Yard Area contained arsenic, chromium, copper, lead, mercury, and zinc at concentrations exceeding their maximum background concentrations for shallow soils. Lead was detected at concentrations of 72.2 mg/kg, 466 mg/kg, 1140 mg/kg, 171 mg/kg, and 702 mg/kg in the 0.35- and 0.5-foot samples from Surface Samples (SS), locations SS-12-01, SS-12-02, SS-12-03, SS-12-04, and SB-12-32, respectively. Lead was also detected at a concentration of 441 mg/kg in the 1.5-feet sample from Boring SB-12-14. Zinc was detected at concentrations exceeding the maximum background concentration for shallow soil samples in most shallow samples collected in the field east of the Cannibalization Yard Area. Concentrations of zinc ranged from 246 to 499 mg/kg.

  TPH vertical and horizontal limits were defined by soil borings and surface samples (Plate 2.5). No TPH level greater than 500 mg/kg was found below 0.5 feet. TPH levels ranged from 220 to 3000 mg/kg in three samples at 0.35 feet bgs and the TPH level at 0.5 feet bgs is 17,000 mg/kg. Based on this data, it appears that the extent of TPH contamination is approximately 170 feet by 80 feet and extends to a maximum depth of 2 feet.

- SPRR Spur Area - This area consists of the right-of-way along a portion of the railroad spur that extends northward from the SPRR track west of Highway 1 and curves east through an industrial complex. Investigation activities in the SPRR Spur Area reported one elevated inorganic soil sample exceeding shallow soil background thresholds. This was obtained from Trench TR-12-07 at 3 feet bgs with zinc at 126 mg/kg. These activities also reported one soil boring containing two soil samples with 490 and 160 mg/kg unknown TPHd obtained at 2.0 and 5.5 feet bgs, respectively. This sample was obtained from beneath the railroad tracks.

2.1.5 Summary of Baseline Human Health Risk Assessment

Potential risks to human health and the environment associated with impacted groundwater, soil, and debris at Sites 2 and 12 are evaluated in the Baseline Human Health Risk Assessment (BRA; Volume III) and the Baseline Ecological Risk Assessment (ERA; Volume IV). These risk assessments address the excess risks to human health and the environment posed by the chemicals of potential concern (COPCs) present at the site, and were performed in accordance with EPA assessment and modeling protocols. Results of the BRA and ERA are summarized below. In addition, an evaluation of Applicable or Relevant and Appropriate Requirements (ARARs) pertaining to groundwater is discussed in Section 2.1.6 and a separate post-remediation risk assessment is described in this section as it pertains to groundwater that will be remediated to MCLs as described in Section 2.1.6.

A review of past and proposed future land use information indicates that the potential chemical sources and future land uses at these two sites differ significantly, ranging from single- to multi-use plans for Site 2 (aquaculture facility) and Site 12 (light industry, retail business, transit center, and medium-to-heavy density residential areas). Therefore, for the purposes of the BRA, Sites 2 and 12 were evaluated separately. Risks associated with Site 2 were evaluated under the most current reuse scenario (aquaculture facility). The exposure scenario used is more conservative than for the alternative reuse of Site 2 as an open space area (park); therefore either reuse scenario would have associated risks that are acceptable as discussed below. Hypothetical future receptors selected for quantitative evaluation include an onsite adult worker at Site 2 and an onsite resident at Site 12. All other potential future human receptors were considered to have significantly less potential exposure at these sites. Both receptors were assumed to be exposed via incidental ingestion of and dermal contact with soil, and inhalation of dust. The resident receptor was also assumed to be exposed to groundwater via ingestion.

The BRA evaluated risks associated with COPCs identified at Sites 2 and 12 for both noncancer health effects and excess cancer risks. Noncancer health effects were evaluated by comparing exposure estimates with EPA-developed reference doses, resulting in a hazard index (HI). Potential cancer risks were estimated by multiplying exposure estimates by EPA-or Cal/EPA-developed slope factors. The EPA has developed a threshold target HI of 1 for noncancer effects, and a target risk range of 1×10^{-6} to 1×10^{-4} for cancer. Lead was evaluated separately because of its unique toxicological properties.

2.1.5.1 Baseline Human Health Risk Assessment at Site 2

The results of the BRA at Site 2 indicate that adverse noncancer health effects associated with exposure to COPCs are not anticipated for any of the receptors evaluated. Total multipathway HIs for the onsite workers are below 1.0, the EPA threshold level of concern, at an HI of 0.01 and 0.1 for the average exposure and reasonable maximum exposure (RME) exposures, respectively. Total multipathway cancer risk estimates for the onsite worker are 2×10^{-7} average and 3×10^{-6} RME. Background concentrations of arsenic in soil account for 89 percent of the RME cancer risk. If the RME cancer risk is adjusted to account for background levels of arsenic in soil (i.e., if the risk associated with background levels of arsenic is subtracted from the total cancer risk), the residual risk is 3×10^{-7} for the RME scenario. Therefore, residual cancer risk estimates for the average or RME scenarios at Site 2 are below the EPA target risk range of 10^{-6} to 10^{-4}.

2.1.5.2 Baseline Human Health Risk Assessment at Site 12

Multipathway HI estimates for the onsite resident receptor at Site 12 ranged from 0.3 to 1.9. With two exceptions, all HIs estimated for Site 12 were below the EPA's threshold level of concern (1.0). HIs estimated for the RME 0 - 6 year old child and the 18 - 30 year old adult resident were 1.9 and 1.3, respectively. As indicated in the BRA (Section 3.6.1 in Volume III) HIs estimated at Site 12 do not account for chemical-specific "toxicological endpoints" (i.e., not all COPCs necessarily have the same toxic effect). The groundwater ingestion pathway accounts for 63 percent (HI = 1.2) and 92 percent (HI = 1.2) of the total HI for each of these receptors, respectively. The remainder of the HI (0.74 and 0.09 for the child and adult resident, respectively) results from exposure to concentrations of metals, bis-2-ethylhexyl phthalate (BEHP), and total carcinogenic polyaromatic hydrocarbons (PAHs) in soil.

Estimated lifetime cancer risks for the future onsite resident receptor at Site 12 were 5 x 10^{-6} and 6 x 10^{-5}, for the average and RME scenarios, respectively. Nearly all of the cancer risk estimated at Site 12 is from the presence of two metals in soil (arsenic and beryllium) at background concentrations and five VOCs in groundwater (1,2 DCA; 1,1 DCE; methylene chloride, PCE; and TCE). Background concentrations of arsenic and beryllium account for approximately 53 percent (3 x 10^{-6}) and 32 percent (2 x 10^{-5}) of the total average and RME cancer risk, respectively. Exposure to VOCs in groundwater account for approximately 69 percent (4 x 10^{-6}; average) and 57 percent (3 x 10^{-5}; RME) of the total risk estimated at the site.

With only one exception, cancer risks from background levels of arsenic and beryllium in soil are greater than the total cancer risk estimate associated with exposure to arsenic, beryllium and cadmium in soil at Site 12. The total and background cancer risk from RME concentrations of arsenic was 2 x 10^{-5} and 1 x 10^{-5}, respectively. These results suggest that in general, site-related concentrations of arsenic and beryllium are below naturally occurring background levels. The exceedance of RME arsenic concentrations over background levels may reflect the presence of a hotspot(s) and not extensive contamination throughout the site.

When cancer risks are adjusted to account for local background levels of arsenic and beryllium (background values for cadmium are not available), the residual risks, are 3 x 10^{-6} and 4 x 10^{-5} for the average and RME scenarios, respectively. These are within the EPA's target risk range of 10^{-6} to 10^{-4}. Of the RME risks, 3 x 10^{-5} is from VOCs in groundwater, 2 x 10^{-6} was due to background metals in soil, and 4 x 10^{-5} can be attributed to compounds potentially related to Fort Ord releases.

Lead exposure evaluation was conducted only for Site 12; lead was not selected as a COPC for Site 2. For the nearby child resident, the blood-level estimates are 3.15 and 7.29 μg/dl (micrograms per deciliter) for the average and RME scenarios, respectively. The 99th percentile blood-lead levels estimated for the 6 to 9 year old group (average) and the 6 to 18 and adult resident receptors are 4.46 and 7.64 μg/dl, respectively. These blood-lead levels are below the EPA threshold blood-lead level of 10 μg/dl.

The results of the BRA at Site 12 indicate that groundwater ingestion is the most significant contributor to both noncancer adverse health effects and lifetime cancer risk estimates.

2.1.5.3 Post Groundwater Remediation Risk Assessment

An additional risk assessment (RA) was conducted for Sites 2 and 12 to address potential risks to onsite residents ingesting groundwater remediated to MCLs for the VOCs listed in Table 2.1. MCLs were used in the RA for reasons that are discussed in Section 2.2.1.5 (ARARs). Six COPCs were evaluated in the RA: 1,2 dichloroethane (1,2 DCA); tetrachloroethene (PCE); trichloroethene (TCE); 1,2 dichloroethene (total); 1,1-dichloroethene (1,1 DCE); vinyl chloride (VC). In general, use of MCLs is conservative and when compared to PRGs, are equally protective in most cases. These chemicals were selected as COPCs because they were detected above MCLs at Sites 2 and 12. Two other chemicals: BEHP and pentachlorophenol were also detected above MCLs; however, because they were considered laboratory contaminants, they were eliminated as COPCs.

For this RA, exposure to groundwater is assumed to occur only following the completion of remediation; i.e., the COPCs for groundwater are concentrations equal to MCLs (see Sections 2.1.6 and 2.2.1.1). With one exception, the methodology used to evaluate groundwater ingestion herein is consistent with that used in the BRA for Site 12 (Section 2.0, Volume III).

Per EPA Region IX guidelines (*1990*), the carcinogenic potential of 1,1-DCE was evaluated using the methods outlines for noncarcinogens (dividing the oral Reference Dose [RfD] by a safety factor of 10, then estimating an HI; if the HI is below 1.0 then carcinogenic effects are not expected).

Average and RME HI estimates resulting from remediated groundwater ingestion ranged from 0.04 to 0.07. These values are well below the EPA's threshold level of concern (1.0) for noncancer adverse health effects. Combining the highest groundwater HI of 0.07 estimated in the RA with the highest soil HI of 0.74 estimated in the BRA (Section 3.0, Volume III) for any resident receptor at Site 12, the resultant soil and groundwater multipathway HI of 0.81 is below the EPA threshold value of concern for noncancer adverse health effects.

HIs used to estimate cancer risks for 1,1 DCE in remediated groundwater ranged from 0.09 to 0.2, well below the EPA's threshold level of concern. Lifetime cancer risk estimates for residents ingesting the remediated groundwater ranged from 3×10^{-6} and 1×10^{-5} for the average and RME scenarios, respectively. Combined with cancer risk estimates resulting solely from exposure to soil at Site 12 of 2×10^{-6} and 2×10^{-5} for the average and RME scenarios, respectively; (Table 3.17, Section 3.0, Volume III), the resultant average (5×10^{-6}) and RME (4×10^{-5}) risk estimates would still be within the EPA target risk range of 10^{-6} to 10^{-4}.

2.1.5.4 Baseline Ecological Risk Assessment

Sites 2 and 12 were evaluated separately for this baseline Ecological Risk Assessment (ERA) because the habitats present at these two sites differ. Chemical data collected from all areas of each site were used. The assessment endpoints relevant to Site 2 are as follows:

- Health of the black legless lizard, an endangered species that lives in the leaf litter layer
- Health of the food base for predators such as foxes and raptors.

The assessment endpoints relevant to Site 12 are as follows:

- Health of the silvery legless lizard, an endangered species that lives in the leaf litter layer
- Health of the food base for predators such as foxes and raptors.

To evaluate the silvery and black legless lizards, soil data were analyzed to assess potential exposures of the litter community. In addition, results of leaf litter analyses at other sites with similar habitats were extrapolated to Sites 2 and 12. To evaluate the food base for predators, deer mice, which serve as a food source for predators, were collected and analyzed at Site 2 to assess potential exposures of predators to chemicals in the deer mice. No deer mice were collected at Site 12 because of its developed nature. Exposure assumptions for predators, including home range size and ingestion rates, were used to estimate doses for direct ingestion of soil, dermal contact with soil, and ingestion of food items (e.g., deer mice), as described in the ERA (Volume IV, Section 5.0). A very conservative scenario was evaluated as recommended by the EPA. These assumptions were modified based on biota data (i.e., leaf litter and plants), as discussed in the ERA (Volume IV, Section 6.0).

Results of ERA at Site 2

The ERA used a conservative scenario based on modeled exposures to estimate potential adverse ecological effects associated with exposure to COPCs identified in soil. The COPCs are lead and selenium. The results of the ERA presented in Volume IV, Section 6.0 indicate that:

- For the black legless lizard, litter samples were not collected because the area containing the majority of elevated concentrations of metals is sparsely vegetated, primarily with hottentot fig, and does not contain sufficient litter for analysis.
- For the predator food base, the majority of identified potential hazards are from concentrations of lead and selenium in surface soils. Results of deer mice sampling at Site 2 indicate that metals present in

rodent tissues are consistent with background tissue levels.

Black legless lizards have been observed near to, and may be present at Site 2, but the habitats that are present onsite are not the preferred habitat of the lizard. This, combined with the small size of the areas marginally useable by the lizard limits the value of the habitats present. For example, the sludge beds that contain the majority of elevated concentrations of metals are sparsely vegetated and are unlikely to support lizards. Based on comparison with other sites with similar habitats (Sites 24 and 29), the leaf litter community (e.g., the food base for the black legless lizard) does not appear impacted by the concentrations of chemicals in surface soils in areas potentially habitable by the lizard. Results of deer mice sampling at Site 2 indicate that no impacts to rodent populations are expected. Similarly, no adverse effects are expected to predator populations. Even if a rodent spends all of its time in the heavily contaminated areas (which are also the areas of poorest habitat), chemicals retained in their bodies are not expected to present a hazard to predators at the site.

Results of ERA at Site 12

The ERA used a conservative scenario based on modeled exposures to estimate potential adverse ecological effects associated with exposure to COPCs identified in soil. Lead was the only soil COPC at Site 12. The results of the ERA (Volume IV, Section 6.0) indicate that:

- For the silvery legless lizard, litter samples were not collected because the area containing the majority of elevated concentrations of metals is paved and does not support vegetation.
- For the predator food base, the majority of identified potential hazards are associated with concentrations of lead in surface soils.

Silvery legless lizards may be present at Site 12, but the marginal quality of the habitats present onsite combined with the developed nature of the immediate surrounding areas limits the value of the habitats. For example, the small patches of upland ruderal habitat surrounding buildings are likely unsuitable for use by the lizard. Based on comparison with other sites with similar habitats, the leaf litter community (e.g., the food base for the silvery legless lizard) in the small areas of the site not paved does not appear impacted by the concentrations of chemicals in surface soils in areas potentially habitable by the lizard. Therefore, no adverse impacts to the silvery legless lizard are expected.

No deer mice were collected at Site 12 because of its developed nature. Results of deer mice sampling at other sites indicate tissue levels of metals are consistent with background. These results can be extrapolated to Site 12 and no impacts to rodent or predator populations are expected onsite. Additionally, the habitat quality likely limits the use of the area by small mammals. Because predators feed on rodent populations across the entire site, and in offsite areas with better habitat quality, and not only on rodents exposed to maximum soil concentrations, no adverse effects are expected to predator populations. Unless a rodent spends all of its time in the heavily contaminated areas, which is highly unlikely given the developed nature of the site, body burdens are not expected to present a substantial hazard to predators at the site.

2.1.6 Applicable or Relevant and Appropriate Requirements

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), remedial actions must be protective of human health and the environment and comply with federal or more stringent state applicable or relevant and appropriate requirements (ARARs), unless waived. Promulgated requirements are "laws imposed by state legislative bodies and regulations developed by state agencies that are of general applicability and are legally enforceable." Formally promulgated and consistently applied state or federal policies have the same weight as specific standards. Advisories and policy or guidance documents (to-be-considered requirements, or TBCs) issued by federal or state agencies that are not legally binding are not considered to be ARARs but may be included as performance standards if selected in the Record of Decision (ROD).

ARARs are identified for each remedial action proposed in an FS. ARARs are chemical-, location-, and action-specific requirements, as discussed below. Chemical-specific ARARs are identified and used to develop TCLs. However, when ARARs are not available, more stringent cleanup goals are established such that residual health risks after remediation fall within acceptable ranges.

Remedial actions implemented at a Superfund site must control further release of hazardous substances, pollutants, and contaminants to assure the protection of human health and the environment. Any hazardous substance, pollutant, or contaminant left onsite must be managed or controlled, upon completion of remedial actions, to meet ARARs.

2.1.6.1 Definition of ARARs

Guidance issued by the EPA (*EPA, 1988a*) defines ARARs as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to a particular site. The relevance and appropriateness of a requirement are judged by comparing the factors addressed to the characteristics of the remedial action, the hazardous substance(s) in question, and the physical characteristics of the site. The origin and objective of the requirements may aid in determining its relevance and appropriateness. Although relevant and appropriate requirements must be complied with to the same degree as applicable requirements, more discretion is allowed in determining which part of a requirement is relevant and appropriate.

- TBCs, the final class of requirements considered by EPA during the development of ARARs, are nonpromulgated advisories or guidance documents issued by federal or state governments. They do not have the status of ARARs but may be considered in determining the necessary cleanup levels or actions to protect human health and the environment.

The following three categories of ARARs are defined by EPA (*EPA, 1988a*):

- Ambient or chemical-specific requirements that set health- or risk-based concentration limits or ranges for particular chemicals (e.g., National Ambient Air Quality Standards)

- Location-specific requirements pertaining to restrictions placed on concentrations of hazardous substances or remedial activities (e.g., federal and state laws governing the siting of hazardous waste facilities)

- Performance-, design-, or action-specific requirements that govern particular activities with respect to remedial actions taken for hazardous wastes (e.g., hazardous wastes generated onsite must be properly managed according to federal and state law).

If ARARs are not available for a particular chemical or situation or if ARARs are not sufficient to protect human health and the environment, critical toxicity factors such as EPA-established reference doses or cancer potency factors may be used to estimate risk-based remediation goals consistent with EPA guidance, to ensure that a remedial action is protective of human health and the environment (*EPA, 1991b*).

2.1.6.2 Identification of ARARs

To identify the possible ARARs and TBCs for remedial actions at Fort Ord; federal, state, and local statutes, regulations, and guidance were considered. In the following sections, potential ARARs and TBCs are identified for soil and groundwater at Sites 2 and 12; a summary of all potential ARARs are provided on Table 2.2. This FS report considers all ARARs and TBCs in performing the detailed analysis and comparisons of the remedial alternatives in Sections 2.5 and 2.6. The chemical-specific, location-specific, and action-specific requirements are discussed below.

Chemical-Specific Requirements

- Water Quality Control Plan, Central Coast RWQCB: The Basin Plan establishes criteria for groundwater to be considered a drinking water source. The Plan (Resolution No. 89-04, dated November 17, 1989; amended February, 1994) also contains requirements for implementation plans or action plans for attaining compliance with these standards. The requirements of the Basin Plan are applicable to groundwater remediation activities. Each Regional Board promulgates and administers a Water Quality Control Plan for ground and surface water basin(s) within its region. The State Board also promulgates statewide water quality control plans that the regional boards administer. The Plans establish water quality standards (including beneficial use designations, water quality objectives to protect these uses, and implementation programs to meet the objectives) that apply statewide or to specific water basins.

  Portions of the Central Coast Region Basin Water Quality Control Plan (*RWQCB, 1989*) are ARARs. The Basin Plan classifies groundwater based on beneficial uses. This classification is based on "data collected by the local agencies and/or dischargers regarding the quality and use of waters in their vicinity." Groundwater at Sites 2 and 12 is considered a potential drinking water source.

- National Primary Drinking Water Standards: These regulations, promulgated under the Safe Drinking Water Act and found at 40 Code of Federal Regulations (CFR) Part 141, establish maximum contaminant levels (MCLs) permissible for a public water system. Drinking-water maximum contaminated level goals (MCLGs) have also been promulgated under the SDWA. MCLGs above zero are considered chemical-specific ARARs under the NCP (40 CFR 300.430[e][2][i][B]). When MCLGs are equal to zero (which is generally the case for any chemical considered to be a carcinogen), the MCL is considered to be a chemical-specific ARAR, instead of the MCLG (40 CFR 300.430[e][2][i][C]). These requirements are considered relevant and appropriate.

- State Primary Drinking Water Standards: In California Code of Regulations (CCR) Title 22, Chapter 15, California's primary drinking water standards establish enforceable limits for chemicals that may affect public health or the aesthetic qualities of drinking water. However, only those State requirements that are more stringent than federal standards are ARARs.

- Identification and Listing of Hazardous Waste: 22 CCR, Division 4.5, Chapter 11 establishes/defines procedures and criteria for identification and listing of Resource Conservation Recovery Act (RCRA) and non-RCRA hazardous wastes. Chemicals regulated as hazardous waste, and the levels at which they are hazardous, are identified in these regulations.

  If soil at Sites 2 and 12 is removed for treatment or disposal, it may become a characteristic waste under the federal hazardous waste program (RCRA), which is now regulated by the State of California. Listed and characteristic hazardous wastes are identified and defined in 22 CCR, Division 4.5, Chapter 11.

  To determine if soil is a RCRA characteristic waste based on toxicity, a Toxicity Characteristic Leaching Procedure (TCLP) must be performed. If the concentration in the waste extract is over the characteristic level for the chemical, the soil is a RCRA toxic characteristic waste. The TCLP and

Cal/EPA's modified Waste Extraction Test (WET) procedure are very similar, thus a modified WET can be considered representative of the TCLP test.

- National Primary and Secondary Ambient Air Quality Standards (NAAQS): The federal Clean Air Act, Section 109, 42 USCA 7401-7642 defines National Primary and Secondary Ambient Air Quality Standards (NAAQS), which are listed in 40 CFR 150. Under certain circumstances, these may be applicable; however, the Monterey Bay Unified Air Pollution Control District (MBUAPCD) requirements are applicable to the sites because they are more stringent.

- Monterey Bay Unified Air Pollution Control District (MBUAPCD): The MBUAPCD regulates new sources (Regulation II) and toxic air contaminants, (Regulation X, Rule 207), and restricts specific discharges of organic compounds to the atmosphere through remedial actions (such as fugitive odors from consolidation of waste and removal of organic compounds from groundwater) in accordance with Regulation X. The MBUAPCD requirements may limit emissions of total and individual organic compounds on a site-specific basis and/or may require emission controls.

  Under Rule 207, emissions of most individual organic compounds are generally restricted to 25 pounds per day using Best Available Control Technology (BACT). In addition, the MBUAPCD regulates releases of certain identified or potential air toxics at levels determined to be "appropriate for review." In some cases, a risk assessment may be required. The MBUAPCD requirements are potential ARARs for treatment of soil and groundwater by methods generating emissions and actions will be taken to ensure compliance with this ARAR. Soil and groundwater treatment system emissions are anticipated to be minimal.

Location-Specific Requirements

- Waste Management Unit Classification and Siting - Fault Zone: Under 40 CFR 264.18a, new hazardous waste treatment, storage, or disposal (TSD) units are prohibited from being located within 200 feet of a geologic fault displaced in Holocene time. Sites 2 and 12 are located within a seismically active region, but not near such a fault. Therefore, the prohibition stated above does not apply to the sites.

- Waste Management Unit Classification and Siting - Floodplain: Requirements under 40 CFR 264.18b state that a hazardous waste TSD facility should not be located within a 100-year floodplain unless it is design to prevent washout of any waste by a 100-year flood. Neither site is not located within a 100-year floodplain; therefore 40 CFR 264.18b does not apply to the site.

- Standards for the Management of Wastes Discharged to Land: This title establishes standards for the management of waste discharged to land. Title 23 CCR, Division 3, Chapter 15, Article 2 (Waste Classification and Management), Section 2511(d) provides exemptions to these requirements for cleanups taken at the direction of public agencies, as long as requirements of Article 2 are met for waste that is removed from the point of release under any remedial alternatives and disposed untreated. Contaminated soil and debris from Sites 2 and 12 would be properly disposed under Article 2 at the OU2 landfill after treatment.

  Title 23 CCR, Division 3, Chapter 15, Article 5 (Water Quality Monitoring and Response Programs for Waste Management Units) and Articles 8 and 9 (Closure and Post-Closure Maintenance) are potentially applicable to remedial alternatives at Sites 2 and 12 involving capping or onsite containment. These regulations provide detailed requirements for monitoring of water quality and, if a release occurs, for evaluation of the impact of discharges, selection of response programs, and setting of remedial objective (Article 5); performance requirements for landfill covering (Article 8); and landfill closure in an irrigated area (Article 9). The source of chemicals resulting in the groundwater contamination is not known, but Chapter 15 provisions regarding cleanup levels and monitoring do apply. The

Lower Meadow Disposal Area is not a landfill or waste management unit. However, the substantive corrective action provisions of Chapter 15 could apply. Applicable requirements of Title 23, Chapter 15 are discussed below.

- Chapter 15 Landfill Closure, Articles 1, 8, and 9: Section 2510(d). This section defines/designates existing waste management units (WMU) as "waste management units which are operating, or have received all permits necessary for construction and operation on or before the effective date."

  Section 2510(g) states that for sites that were closed, abandoned, or inactive on the effective date of the regulations (November, 1984) persons responsible for the sites may be required to develop and set up a monitoring program. If water quality impairment is found, such persons may be required to develop and carry out a corrective program.

  Section 2580(c) requires that Class III landfills be closed pursuant to Section 2581. Section 2581 provides specific closure construction details that must be implemented.

  Section 2580(d) and (e) specify closure and post-closure specifications regarding survey monuments and vegetation selection.

  Section 2581. Landfill closure requirements provides specific requirements for the final cover. Subsections (a)((1), (a)(2), (a)(3), and (a)(4) detail the multilayer cover design, including acceptable soil types, thickness, and permeability requirements. Section 2581(b) provides grading requirements.

  Section 2583, Waste Pile Closure Requirements, provides specific requirements for closure of waste materials in piles. All waste materials which are contaminated by wastes shall be either: (1) discharged to an appropriate waste management unit (WMU), or (2) compacted, covered, and closed as a landfill under Section 2581. Contaminated soil and debris from Sites 2 and 12 would either be properly disposed under (1) at the OU2 landfill, or would be contained onsite under (2).

  Section 2597. Landfill closure requirements provide specific requirements for landfill closure in irrigated areas. Subsections (b)((1) and (b)(2) require quantification of water entering, leaving, and remaining onsite and design of monitoring systems that will detect penetrations of final cover by precipitation or applied irrigation water.

- Chapter 15 - Groundwater Monitoring and Cleanup (Article 5) Article 5 includes applicable requirements for groundwater monitoring and cleanup. Article 5 was updated in 1991 to be in compliance with federal regulations regarding land waste disposal. Sections of Article 5 that are appropriate to the potential alternatives include:

  Section 2550(a) requires owners and operators of existing landfills to monitor ground and surface water and perform unsaturated zone monitoring as feasible. Section (d) specifies that monitoring requirements are applicable during the active life, closure, and post-closure periods, unless all waste residues, contaminated containment systems components, and contaminated geologic materials have been removed or decontaminated at closure.

  Section 2550.1. Required monitoring and response program. This section specifies actions including monitoring and corrective actions required if WMU operations have impacted ground or surface water.

  Section 2550.2, Water quality protection standard (Standard): The discharge must propose a Standard for inclusion in the Waste Discharge Requirements. Standards consist of five parts: ([1] List of Chemicals of Concern [see Table 2.1]); (2) Concentration Limit for each Chemical of Concern in each monitored medium (see Table 2.1); (3) List of Monitoring Points and Background Monitoring Points at which the Standard is applied (anywhere in plume); (4) Description of the Point of Compliance (anywhere in plume); and (5) the length of the Compliance Period.

- National Archeological and Historic Preservation Act: 36 CFR Part 65 states that remedial actions that may cause irreparable harm, loss, or destruction of significant artifacts are restricted under the National Historical Preservation Act (16 U.S.C. 469). The law requires action to recover and preserve such artifacts. The sites are not known to be located within a historically significant area. Historically, no significant artifacts have been uncovered during previous investigation activities at Fort Ord. Appropriate actions will be taken, however, should any artifacts be unearthed.

- Endangered Species Act of 1973: The Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.) requires action to conserve endangered species and preserve or restore a critical habitat upon which they depend. Site 2 contains areas that are a critical habitat; therefore, this act may be an ARAR for Site 2. At Site 12, there is no known critical habitat for any endangered species; therefore, this act is not an ARAR for Site 12. Each area will be screened for potential environmental impacts to any endangered species identified in the Ecological Risk Assessment (Volume IV). That report recommends measures, as necessary, to ensure compliance with this ARAR.

- California Endangered Species Act: Fish and Game Code, Section 2050 et seq. provides for the recognition and protection of rare, threatened and endangered species of plant and animals (in conjunction with state authorized or funded actions). Site 2 contains areas with endangered species but Site 12 does not contain any known ones (ARAR does not apply). Each area will be screened for potential environmental impacts to any endangered species identified in the Ecological Risk Assessment (Volume IV). That report recommends measures, as necessary, to ensure compliance with this ARAR.

- The Fish and Wildlife Coordination Act: This act, 16 U.S.C. 661 et seq., requires fish and wildlife to be protected if remedial actions modify the drainage channel or other features of the stream or river. No foreseeable remedial action at Sites 2 or 12 would modify a drainage or other stream feature. Therefore, this act is not an ARAR.

- Coastal Zone Management Act: This act (16 USC 1456 et seq.) requires activities conducted within the coastal zone to be conducted in a manner consistent with the state-approved management program. Site 2 is within the coastal zone; therefore, this ARAR applies. Site 12 is not in the coastal zone so this ARAR does not apply.

- California Coastal Act of 1976: This act, Public Resources Code Section 3000 et seq., established the state Coastal Zone Management Plan. Activities within the coastal zone are to be conducted in a manner consistent with a coastal management plan. Site 2 lies within the coastal zone. Impacts to the coastal zone will be considered to ensure compliance with this ARAR. Site 12 is not in the coastal zone so this ARAR does not apply.

- Migratory Bird Treaty Act: This act, 16 U.S.C. 703 et seq., protects certain migratory birds and their nests and eggs. Migratory birds may be present on Site 2 and on Site 12. Each area will be screened for potential environmental impacts on any species identified in the Ecological Risk Assessment (Volume IV). That Report recommends measures, as necessary, to ensure compliance with this ARAR.

Action-Specific Requirements

- Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities: Hazardous waste has not been identified at Sites 2 and 12, but if it is identified, the following regulations will be applicable:

- Title 22 CCR, Chapter 14, Use and Management of Containers; Article 9, Sections 66264.171-178. Establishes requirements for the use of containers to store hazardous waste. Applicable if excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66171; Condition of Containers. Containers for hazardous waste must be maintained in good condition. Applicable if excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66172; Compatibility of Waste in Containers. Containers for hazardous waste must be compatible with the wastes stored in them. Applicable if excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66173; Management of Containers. Containers holding hazardous waste must be closed during storage except when necessary to add or remove waste. Applicable if excavated soil or decontamination water subsequently characterized as hazardous are stored in containers onsite. Appropriate actions will be taken to comply with such requirements. Hazardous materials storage will be isolated and able to maintain control of incidental spills or leaks.

- Title 22 CCR, Section 66174; Inspections. Containers and container storage areas must be inspected weekly for leaks or deterioration. Applicable if excavated soil or decontamination water subsequently characterized as hazardous are stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66175; Containment. Container storage areas must be designed according to the requirements of this section. Applicable if excavated soil or decontamination water subsequently characterized as hazardous are stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66178; Closure. At closure, all hazardous waste and waste residues must be removed and remaining containment structures decontaminated. Applicable if excavated soil or decontamination water subsequently characterized as hazardous are stored. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Chapter 14, Article 2, Section 66264.14, Public Access Restrictions. Owners and operators of hazardous waste treatment, storage, or disposal (TSD) facilities must prevent the unknowing entry of persons or livestock onto the active portions of the facility; in addition, warning signs must be posted. Relevant and appropriate if excavated soil is hazardous and it is treated, stored, or disposed onsite; areas will be restricted from public access.

- Title 22 CCR, Chapter 14, Article 7, Section 66264.119; Post Closure Notices. Under this requirement, a restriction is placed on the deed which contains future uses of the property. Remedial measures in which hazardous levels of chemical constituents remain in place may be subject to these regulations. This may be applicable to Sites 2 and 12.

- Title 22 CCR, Chapter 14, Article 16, Section 66264.601; Miscellaneous Units. These regulations apply to facilities that treat, store, or dispose of hazardous waste in miscellaneous units. Owners and operators of TSDs at which hazardous waste is stored in miscellaneous units must locate, design, construct, operate, maintain, and close those units in a manner that is protective of human health and the environment. Carbon vessels may be used as part of the treatment activities. These carbon vessels may be considered miscellaneous treatment units while being stored, if hazardous; however, they will be regenerated offsite as part of a commercial process.

- Standards Applicable to Generators of Hazardous Waste: Establishes standards for generators of hazardous waste under Title 22, CCR, Chapter 12. Applicable if hazardous waste is generated at the sites; the substantive portions of these regulation will apply and be complied with.

- Land Disposal Restrictions: Title 22 CCR, Chapter 18 prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. It requires laboratory analysis of wastes intended for landfill disposal to establish that the waste is not restricted from landfill disposal. Applicable if listed or characteristic hazardous wastes exists; they may be subject to these regulations if they are disposed of offsite. Carbon vessels from the sites' treatment system may subsequently be found to contain hazardous or designated waste; however, they will be regenerated offsite as part of a commercial process.

- Resolution No. 88-63 (Porter Cologne Act): This resolution specifies that all ground and surface water is an existing or potential source of drinking water unless TDS are greater than 3,000 ppm, the well yield is less than 200 gallons per day from a single well, or the groundwater is unreasonable to treat using best management practices or best economically achievable treatment practices. This resolution is applicable to Sites 2 and 12. The resolution can be used to establish a general criteria for designating water use. Groundwater in the upper aquifer at the FDA site is not currently used for drinking water; however, the upper aquifer is a potential drinking source and has been identified as having beneficial uses including domestic, agricultural, and industrial water supplies.

- Resolution Number 92-49 (Porter Cologne Act): This resolution establishes policies and procedures for the investigation, cleanup, and abatement of waste. This provision states that cleanup goals attain best water quality which is reasonable if background levels cannot be restored. Groundwater at Sites 2 and 12 will be treated to attain the highest water quality which is reasonable, considering: all demands being made and to be made on those waters, and the total values involved; beneficial, detrimental, economic, social, tangible, and intangible. The groundwater treatment system will use the best control technology to treat groundwater prior to discharge.

  Under 92-49, dischargers are required to cleanup and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored, considering all the demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible. This resolution requires the application of Title 23 CCR, Division 3, Chapter 15, Section 2550.4 (Chapter 15) requirements to cleanups. In Chapter 15, cleanup levels must be set at background levels, or if background levels are not technologically or economically feasible, then at the lowest levels that are technologically or economically achievable. The Army has undertaken an economic and technical feasibility analysis pursuant to 92-49 and has determined that cleanup to the MCLs is reasonable and satisfies this requirement as discussed in Section 2.2.1.5.

- Resolution Number 68-16 (Porter Cologne Act): This resolution establishes goals for the maintenance of existing groundwater quality. Also requires best practical control technology for discharges to high quality water, excluding reinjection of water into contaminated groundwater plume, a discharge to high quality waters of the state occurs. Resolution 68-16 is not a 'zero discharge' standard but rather a statement that existing quality be maintained when it is reasonable to do so. Specifically, where any activities result in discharges to high quality waters, dischargers shall use the best practicable treatment or control of the discharge necessary to avoid pollution or nuisance and to maintain water quality consistent with maximum benefit to the people of the State. Discharges to high quality waters (outside the contaminated plume) will be treated to "nondetected" as measured by EPA Method 502.2. Discharges to water overlying the groundwater plume are not considered discharges to high quality water and will be treated to MCLs. Discharge levels (Table 2.1) were chosen for Sites 2 and 12 considering site-specific conditions, including the contaminants to be discharged and the designated beneficial uses of the receiving water, available treatment technologies, and cost.

- Federal Safe Drinking Water Act - Underground Injection Control (UIC): 40 CFR 144 prohibits injection of contaminated water into or above a drinking water formation. Exempts injection of treated groundwater into the source aquifer for the purpose of the aquifer cleanup. For Sites 2 and 12, treated groundwater may be injected to the aquifer. Injected groundwater must not contain chemical concentrations above MCLs.

- Federal Safe Drinking Water Act - National Pollutant Discharge Elimination System (NPDES): 40 CFR 122 establishes permitting standards for discharge of pollutants from any point source into waters of the United States. Treated groundwater from Sites 2 and 12 may be discharged to waters of the state. The effluent limitations and monitoring of an NPDES permit will be followed.

- Federal Safe Drinking Water Act - Publicly Owned Treatment Work (POTW): Regulation 40 CFR Part 403-5 allows municipalities to determine pretreatment standards for POTWs within its jurisdiction. These standards are ARARs only if treated or untreated groundwater from Sites 2 and 12 is discharged to a POTW. These standard will be followed if discharge to a POTW occurs.

- California Toxic Injection Well Act: CA H&S Code Section 25159.24[a] prohibits injection of contaminated water into or above a drinking water formation. Exempts injection of treated groundwater for the purpose of improving groundwater quality. Groundwater may be injected to aid/accelerate the remediation process.

Water Well Standards, California Department of Water Resources is a (Bulletin 74-81) TBC that sets standards for construction or destruction of water wells in the state. Construction of groundwater wells may be subject to these requirements. Because these standards are not promulgated, they have been identified as a TBC and are applicable for new groundwater extraction and injection wells.

2.2 Identification and Screening of Technologies

This section discusses the remedial action objectives, general response actions, technologies retained from the RTS report and the selection of technologies for remedial alternatives.

2.2.1 Remedial Action Objectives

The primary purposes for developing Remedial Action Objectives (RAOs) are to reduce risks to humans and the environment at Sites 2 and 12, and comply with applicable or relevant and appropriate requirements (ARARs). Table 2.3 presents qualitative RAOs and potential remediation requirements to reduce risk at Sites 2 and 12. The exposure routes considered include ingestion of or dermal contact with impacted soils, direct contact with debris, ingestion of contaminated groundwater, and inhalation of dust from disturbance of impacted soil.

The RAOs for soil, groundwater, and debris are to: (1) reduce risk to human health and the environment and to (2) comply with federal and State law.

Debris at Site 12 was not disposed to land in accordance with current regulations. In addition, concentrations of contaminants above background levels were detected in soil intermixed with the debris. The contamination cannot be fully defined unless the debris is removed and sampled; therefore, removal of debris is addressed under the soil remedial alternatives for Sites 2 and 12.

2.2.1.1 Chemicals of Interest

Contaminants in Groundwater

The results of the BRA for Sites 2 and 12 indicate that there is a potential cancer risk for the future onsite resident at Site 12. This risk is predominantly associated with the maximum daily ingestion of groundwater containing VOCs. The primary VOC constituents in groundwater are TCE, PCE, and 1,2-DCE. These chemicals contribute approximately 69 percent of the human health risk.

Contaminants in Soil

Based on RI data and the BRA, the chemicals in the soils at Sites 2 and 12 are within the acceptable human health risks without additional remedial measures. However, a regulatory approved cleanup level of 500 mg/kg has been established for TPH in soils at Fort Ord (*HLA, 1994a*). This level was based on conservative risks associated with constituents typically present in diesel or motor oil, conservative land use options, and site-specific geologic and hydrogeologic conditions at Fort Ord. Groundwater modelling results for site-specific conditions at Fort Ord indicate that TPH concentrations greater than 500 mg/kg may adversely affect groundwater quality. The areas with elevated TPH levels include the Lower Meadow Disposal Area, the Outfall 31 Area, and the Cannibalization Yard Area at Site 12 only.

2.2.1.2 Target Cleanup Levels

The target cleanup levels (TCLs) for Site 2 and 12 include those for soil and groundwater. The chemicals of interest in the groundwater are VOCs that exceed the maximum contaminant levels (MCLs) established by the state and federal regulatory agencies. The VOC concentrations and their respective MCLs are presented in Table 2.1. For groundwater, the TCLs are these MCLs. A further discussion of MCLs as TCLs is provided in Section 2.1.6.2, under action-specific ARARs Resolution 92-49 and Title 22 CCR, Division 3, Chapter 15, Section 2550.4. A discussion of the technical and economic feasibility of remediating groundwater below MCLs is provided in Section 2.2.1.5.

There is no human health risk from soil at Sites 2 or 12 because the BRA concluded that the chemicals there did not present an unacceptable risk. However, a remedial goal of 500 mg/kg for TPH in soil was developed by HLA in the Draft Technical Memorandum, Preliminary Remediation Goals, Fort Ord, California (HLA, 1993o), dated June 14, 1993, and was approved by all agencies including the Regional Water Quality Control Board, Central Coast Region for sites such as Sites 2 and 12. This level has been shown to be protective of human health and the environment, including groundwater quality. This level is the TCL for TPH-affected soil. It will be used to establish limits of the soil remedial units (Section 2.2.1.2) and as the treatment goal for soils that might be used as backfill in excavations. Site 2 had no elevated TPH-affected soil. For Site 12, the unknown TPHd is the only chemical of interest that will require cleanup.

2.2.1.3 Description of Remedial Units

One groundwater remedial unit and three soil remedial units were developed for Sites 2 and 12. Remedial units are developed for each site on the basis of acceptable exposure levels (TCLs), potential exposure routes and ecological considerations (BRA and ERA), and the nature and extent of contamination, i.e., the volume of soil or groundwater that contains a specific contaminant or group of similar contaminants above an established TCL. For areas containing discrete hot spots or more concentrated contamination within a homogeneous area, separate remedial units may be developed because remediation of these areas is usually addressed in a different manner by the remedial alternative. For sites where the same type of contamination occurs in both soil and groundwater and they are co-located, the remedial units may be grouped together if the soil and groundwater would be treated simultaneously.

Groundwater Remedial Unit

The groundwater remedial unit is defined as the groundwater plume at Sites 2 and 12 containing dissolved VOCs that exceed the MCLs (Table 2.1). The lateral extent of the affected groundwater is bounded to the west by Monterey Bay. The northern boundary extends east from the ocean passing near the north end of Trainfire Range Number 9 and crossing the railroad spur about 400 feet north of MW-12-03-180. The eastern plume boundary lies near the baseball field adjacent to the east of Site 12. The southern plume boundary extends south of the Industrial Area of Site 12 to a point about 200 feet north of MW-02-06-180, near the Highway 1 overpass. The southern boundary continues west to Monterey Bay at a point near Stilwell Hall. The TCE plume lateral limits are illustrated on Plate 2.2, based on groundwater samples obtained from the Upper 180-foot aquifer in February 1994. The distribution of 1,2-dichloroethane (1,2-DCA), DCE, and PCE is contained within these lateral limits. Plate 2.3 illustrates the lateral limits of the total VOCs (the sum of the concentrations of detected compounds) based on the February 1994 data. These limits extend beyond the groundwater remedial unit along the northern boundary, because of the 1,1,1-trichloroethane (1,1,1-TCA) detected in February 1994 at 71 μg/l in MW-02-10-180. This concentration is below the MCL.

The vertical extent of the groundwater plume ranges from the water table to the top of the sandy silt layer that divides the 180-foot aquifer into upper and lower zones. The affected water bearing zone beneath Sites 2 and 12 is the Upper 180-foot aquifer, which is the uppermost water-bearing zone in the vicinity and represents approximately 75 to 80 feet of saturated thickness. Depth to water is approximately 40 feet bgs at the western edge (Site 2) and 70 to 80 feet bgs at the eastern region of the plume (Site 12). The sandy silt layer dividing the Upper 180-foot aquifer appears to have limited vertical migration of dissolved VOCs as discussed in the Draft Basewide Hydrological Report (*HLA, 1993*) and the Remedial Investigation in Volume II of this RI/FS.

Soil Remedial Unit 1 (Lower Meadow Disposal Area)

The Lower Meadow Disposal Area is a grassy field of approximately 0.5 acres on Site 12, east of Highway 1 near the Twelfth Street Gate, and is Soil Remedial Unit 1 (SRU 1). The area contains concrete rubble and other construction debris intermixed with limited volumes of TPH-affected soil. The limits of the disposal area were laterally defined using a combination of geophysics and trenching and soil sampling. SRU 1 is approximately 220 feet by 100 feet and extends to approximately 20 feet bgs for a volume of about 16,000 cy. The location, aerial limits, and TPH concentrations are presented on Plate 2.4.

Soil Remedial Unit 2 (Outfall 31 Area)

Soil Remedial Unit 2 (SRU 2) is the Outfall 31 Area located east of SRU 1 and is a grass covered depression that receives surface runoff and storm drainage flow from Outfall 31 and several other pipes. It has a catch basin area that collects precipitation and rainfall runoff. The catch basin is connected to subsurface piping, which runs to the west from the Outfall 31 Area to Outfall 15. The primary contaminants are unknown TPHd in an area approximately 100 feet by 50 feet with a maximum depth of 15 feet for a volume of approximately 2,800 cy. The boundaries of SRU 2 and the TPH data are presented on Plate 2.4.

Soil Remedial Unit 3 (Cannibalization Yard Area)

Soil Remedial Unit 3 (SRU 3) is the Cannibalization Yard Area. This area is a shallow surface drainage that has been subject to runoff from the DOL Automotive Yard and the Industrial Area to the west and south, respectively. Surface and shallow borings near an oil/water separator and along the eastern margin of the Cannibalization Yard indicated that the shallow soil contains elevated levels of TPH. No TPH level greater than 500 mg/kg was found below 0.5 feet. The vertical and horizontal limits were defined by soil borings and surface samples. This area of the remedial unit is approximately 170 feet by 80 feet and extends to a maximum depth of 2 feet for a volume of about 1,000 cy. The boundaries of SRU 3 and the TPH data are presented on Plate 2.5.

2.2.1.4 Groundwater Modeling and Cleanup Time Estimates

Groundwater flow was modeled to assist in design of groundwater pumping systems and identifying feasible and conceptually sound groundwater extraction/injection plume remediation systems. Additionally, solute transport modeling results were inspected to provide data for the discussion to adopt MCLs as groundwater RAOs. This discussion, presented in Section 2.2.1, illustrates the technological and economical infeasibility of attaining background levels in groundwater. The modeling is presented in detail in Appendix 2A.

The groundwater modeling consisted of three distinct tasks. Task 1 was an initial screening evaluation using an analytical flow model to evaluate different well placement and pumping rate configurations in order to select optimal system configurations for further evaluation. Task 2 consisted of numerical modeling of selected systems using the Fort Ord finite difference numerical groundwater flow model (Volume II, Basewide Hydrogeologic Characterization (BHC), Appendix B) to evaluate the regional hydrogeologic impacts of the remediation systems. Task 3 consisted of modeling the groundwater chemical concentrations expected in the extracted groundwater during a 30 year period of system operation.

The Task 1 initial screening evaluation identified two groundwater extraction system configurations capable of capturing the groundwater plume while minimizing the potential of inducing seawater intrusion. The simpler functional groundwater pumping scenario, Pumping Scenario 1, consisted of four extraction wells operating at a combined total rate of 300 gpm. The second system Pumping Scenario 2, consisted of four extraction wells surrounded by four injection wells. For this scenario, 100 percent of the total extraction rate of 450 gpm was reinjected.

The Task 2 groundwater flow modeling estimated the steady-state water levels produced by the above two pumping scenarios. Groundwater flow paths and travel times were modeled to (1) further evaluate each system's ability to capture the groundwater plume, (2) assess seawater intrusion, and (3) estimate the effect of the systems on water levels in the area of the Operable Unit 2 (OU 2) groundwater contamination plume to the east. The estimated groundwater flow paths for Scenarios 1 and 2 are presented graphically on Plates 2.6 and 2.7, respectively.

Flow model simulation of both Pumping Scenarios 1 and 2 resulted in steady-state aquifer levels 1 to 2 feet above mean sea level at the Monterey Bay shoreline, indicating that seawater intrusion induced from the systems is unlikely. Pumping Scenario 1 appeared to have the potential of capturing groundwater from the area of the OU 2 plume. Pumping Scenario 2 did not appear to capture groundwater from the area of the OU 2 plume.

The Task 3 solute transport modeling of the total VOC plume evaluated relative and absolute aquifer restoration time periods. Solute transport modeling was conducted using the total VOCs plume geometry interpreted from the February 1994 quarterly groundwater data. Although advective flow was considered to be the principal plume transport mechanism, the solute transport model included the effects of hydrodynamic dispersion and retardation effects based on the chemical properties of TCE and the measured organic carbon content of the aquifer material.

Total VOC concentrations at the extraction wells and for the entire system (weighted-average concentrations) were estimated for a 30-year simulation period. Concentration versus time graphs were produced and compared to the TCE MCL as an estimate of a cleanup goal. The results of the solute transport modeling indicated that estimated average system concentrations for both Scenario 1 and 2 reach the TCE MCL in approximately 16 years. The estimated maximum concentrations observed in individual wells reach the TCE MCL earlier for Pumping Scenario 1 (20 years) than for Pumping Scenario 2 (27 years). The results of the solute transport modeling are very approximate and should be used for system comparison.

2.2.1.5 Evaluation of Groundwater Cleanup to Background Levels

According to Section 2550.4, Chapter 15, Title 23 of the California Code of Regulations (CCR), "for a corrective action program, the regional board shall establish a concentration limit for a constituent of concern that is greater than the background value of that constituent only if the regional board finds that it is technologically or economically infeasible to achieve the background value for that constituent and that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the concentration limit greater than background is not exceeded. In making this finding, the regional board shall consider the factors specified in subsection (d) of this section [below], the results of the engineering feasibility study submitted pursuant to subsection 2550.9(c) of this article, data submitted by the discharger pursuant to subsection 2550.9(d)(2) of this article to support the proposed concentration limit greater than background, public testimony on the proposal, and any additional data obtained during the evaluation monitoring program.

Subsection (d) In establishing a concentration limit greater than background for a constituent of concern, the regional board shall consider the following factors:

(1) Potential adverse effects on groundwater quality and beneficial uses, considering,

(A) The physical and chemical characteristics of the waste in the waste management unit;

(B) The hydrogeological characteristics of the facility and surrounding land

(C) The quantity of groundwater and the direction of groundwater flow

(D) The proximity and withdrawal rates of groundwater users

(E) The current and potential future uses of groundwater in the area

(F) The existing quality of groundwater, including other sources of contamination or pollution and their cumulative impact on the groundwater quality

(G) The potential for health risks caused by human exposure to waste constituents

(H) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents

(I) The persistence and permanence of the potential adverse effects."

RWQCB Resolution 92-49 (92-49) contains similar requirements and considerations regarding the establishment of background or other aquifer cleanup levels, and states that non-attainment [of background conditions] zones may be established for two specific situations where water quality objectives cannot be achieved:

(1) An approved cleanup program has been fully implemented and groundwater pollutant concentrations have reached asymptotic levels

(2) The site has limited water quality and environmental and human health risks, or cleanup to water quality objectives cannot be reasonably achieved.

In addition, 92-49 states that remediation technologies for reducing contamination must be fully evaluated and implemented to the extent reasonable, and residual contamination must be adequately contained and managed such that beneficial uses are not unreasonably affected outside the non-attainment zone.

Attainment of MCLs would protect beneficial uses of groundwater at Sites 2 and 12 because there would be limited human health and environmental risks. MCLs are risk-based levels and are already protective of human health and environmental receptors are not known to be in contact with groundwater in the aquifer. In addition, long term sampling and monitoring of chemical concentrations in both aquifers would be performed as part of remediation activities. Residual contamination would be addressed through post-remediation sampling: however, residual concentrations of chemicals below MCLs are not considered to pose significant detrimental effects to future beneficial uses of groundwater.

The following is a discussion of the technical and economic feasibility of achieving background levels in groundwater at the sites.

Technical Feasibility Discussion

In *Alternatives for Groundwater Cleanup, National Research Council*, June 1994, the Council states that several recent studies have raised troubling questions about whether existing technologies are capable of solving groundwater contamination problems. These studies focused on "pump-and-treat" systems that are the most common technology for groundwater cleanup in the United States. The studies indicated that pump-and-treat systems may be unable to remove enough contamination to restore the groundwater to drinking water standards, or that removal may require a very long time, in some cases centuries.

The goals of the Council study were to review the performance of existing pump-and-treat systems, to assess whether there are scientific and technological limits to restoring contaminated groundwater, to consider the public health and economic consequences of contaminated groundwater, and to provide advice on whether changes in national groundwater policy are needed to reflect the limits of current technology.

The Council found that, at the majority of contaminated sites, the complex properties of the subsurface environment, and the complex behavior of contaminants in the subsurface interfere with the ability of conventional pump-and-treat systems to achieve drinking water standards for contaminated groundwater. The Council reviewed information from 77 sites where conventional pump-and-treat systems are operating. At 69 of the sites, cleanup goals have not yet been reached, although it is possible that they will be reached at some of these sites in the future.

The Council's study concluded the following factors affect the feasibility of aquifer restoration.

- *Physical heterogeneity:* The subsurface environment is highly variable in its composition. Very often, a subsurface formation is composed of layers of materials with vastly different properties, such as sand and gravel over rock, and even within a layer the composition may vary over distances as small as a few centimeters. Because fluids move preferentially through the pore spaces between the grains of sand and gravel, or through fractures in solid rock and because these openings are distributed nonuniformly, underground contaminant migration pathways are often extremely difficult to predict.

- *Migration of contaminants to inaccessible regions*: Contaminants may migrate by molecular diffusion to regions inaccessible to the flowing groundwater. Such regions may be microscopic (for example, small pores within aggregated materials) or macroscopic (for example, clay layers). Once present within these regions, the contaminants can serve as long-term sources of pollution as they slowly diffuse back in the cleaner groundwater.

- *Sorption of contaminants to subsurface materials*: Many common contaminants have a tendency to adhere to solid materials in the subsurface. These contaminants can remain underground for long periods of time and then be released when the contaminant concentration in the groundwater decreases.

- *Difficulties in characterizing the subsurface*: The subsurface cannot be viewed in its entirety, but is usually observed only through a finite number of drilled holes. Because of the highly heterogeneous nature of subsurface properties and the spatial variability of contaminant concentrations, observations from sampling points cannot be easily extrapolated, and thus knowledge of subsurface characteristics is inevitably incomplete.

Additionally, a literature search was performed in the Final FS for the Fort Ord Landfills (OU 2), (*Dames and Moore, 1993b*) to evaluate the technological feasibility of achieving cleanup to background levels using groundwater extraction and treatment technologies. The conclusions are presented below.

- While significant mass removal of contaminants can be achieved from affected aquifers, there has been little success in reducing concentrations to low target levels, including MCLs. This limited success is a result of a variety of factors including the fact that even high solubility contaminants adhere to soil particles and that groundwater pumping causes preferential flow in high permeability areas.

- In addition, a 'rebound effect' is reported once systems are shut down. This effect is observed when low residual groundwater concentrations have been achieved during operation but tend to rise again after the system is turned off. One explanation is that saturated soils become dewatered and contaminants adhering to these soils are unaffected by continued system operation. Once the system is turned off, these soils become saturated again and residual contaminants are allowed to come into contact with the groundwater and recontaminate it.

- Research shows that what is achievable, and what is being accomplished at most sites, is a reduction in environmental degradation and heath risk to a level that is acceptable.

Research indicates that the restoration of aquifers, using pump-and-treat technologies, has little success in reducing concentrations to low target levels, including MCLs. The review of remedial performance at more than 77 sites in the United States illustrate this point. Based on this data, the Army believes adopting MCLs is an appropriate approach to setting cleanup goals and additional economic factors presented below support this.

Economical Feasibility Evaluation

The economic feasibility evaluation presented below uses numerical solute transport modeling results developed for Sites 2 and 12 (Section 2.2.1.3 and Appendix 2A). Plate 2A7 and 2A8 (Appendix 2A) illustrate the numerical solute transport modeling results on a concentration versus time curve. Inspection of these results provide estimates of the time and associated extracted mass to reduce average system concentrations to the critical point, MCLs (5.0 μg/l) and background levels (0.1 μg/l: Detection limit using EPA Test Method 502.2). These data and calculations using annual operating cost, provide the basis to conclude that costs are extremely high to achieve background level verses MCLs.

The critical point is designated as the concentration where the rate of mass removal decreases and the average total VOC concentration changes slowly and asymptotically approaches a concentration of zero. TCE was selected to represent the Total VOC groundwater plume because it constitutes the majority of the VOC mass in groundwater and is expected to be the most persistent chemical over time. The average concentration is selected because it is a reasonable representation of the groundwater treatment systems performance.

Scenario 2 results (Plate 2A8) were used to estimate cleanup times and extracted mass for this evaluation. Two site-specific groundwater pumping scenarios were developed as part of this FS. Scenario 1 consisted of four extraction wells operating at a combined total rate of 300 gallons per minute (gpm). Scenario 2 consisted of four extraction wells and four injection wells. For Scenario 2, 100 percent of the total extraction rate of 450 gpm was reinjected. To make this evaluation representative of proposed conditions, Scenario 2 was used because this is the recommended pumping scenario as described in a subsequent section (Section 2.7).

Inspection of Plate 2A8, indicate that the rate of VOC mass removal is rapid for the first 7 years of system operation. After 7 years, the rate of mass removal decreases and the average total VOC concentration changes slowly and asymptotically approaches a concentration of zero. This critical point occurs after approximately 7 years at a concentration level of 9 μg/l. Approximately 175 kilogram (kg) of mass is removed from the aquifer during the 7 years of operation.

The Scenario 2 system average total VOC concentration reaches the TCE MCL of 5 μg/l after 16 years. Approximately 65 kg of mass is removed from the aquifer from 7 years to 16 years of operation. Extrapolation of the results indicates that the system average total VOC concentration reaches 0.1 μg/l (background) after approximately 35 years. Approximately 25 kg of mass is removed in the 19 year period (year 16 to year 35) of operation required to reduce average contamination levels from MCLs to the background levels.

This evaluation process is approximate and is performed to create a relative comparison of restoration times associated with different cleanup goals. The absolute cleanup times presented and evaluated are approximate because the solute transport modeling Scenario 2 concentration results are in terms of total VOCs while the cleanup goals being compared to are to the specific compound TCE.

Given these limitations, the estimated time, various TCE cleanup goals, and the estimated cumulative operating cost are summarized below. The results are optimistic time estimates to achieve cleanup and actual cleanup times are likely to exceed these estimates.

TCE Cleanup Goal	Cleanup Time Estimate (years)	Cumulative Operating Cost
Critical Point (9 μg/l)	7	$2,625,000
MCL (5 μg/l)	16	$6,000,000
Background (<0.1 μg/l)	35	$13,125,000

The cumulative operating costs are calculated assuming an annual cost of $375,000 multiplied by the appropriate cleanup time. The annual operating cost includes approximately $115,000 for site-wide (Sites 2 and 12) groundwater monitoring, and approximately $260,000 for system related monitoring and expenses. For comparative purposes, no capital costs are included. A detailed cost breakdown for the annual operating cost is presented in Appendix 2C for the recommended remedial alternative 4B.

The incremental mass removed and cost per kilogram (kg) for the three cleanup times is summarized below.

Cleanup Time Estimate (years)	Incremental Mass Removed (kg)	Incremental Cost per Mass of TCE ($/kg)
7	175	$15,000
16	65	$52,000
35	25	$285,000

This evaluation illustrates that the cost to achieve groundwater cleanup to background levels is extremely high. The cost to reach the critical point and remove 175 kg or 66% of the contaminant mass is $2,650,000 or $15,000/kg. The cost to attain MCLs and to remove 90 percent of the plume contaminant mass is $6,000,000 or $52,000/kg. To achieve background levels, if feasible, a unit cost of $285,000/kg is required to remove the remaining 10 percent of the plume mass.

Because the MCLs are protective of human health and the environment, no significant benefit to human health or the environment is gained by remediation to levels below MCLs. Therefore, the Army believes that adopting MCLs as RAOs is an appropriate approach to cleanup standards at Sites 2 and 12. This is supported by: existing literature and performance data from a considerable number of sites, numerical model predictions of cleanup times, and risk assessment estimates which demonstrate that MCLs are protective of human health and the environment. Although the MCLs are above background, they represent the lowest Upper 180-foot aquifer groundwater concentrations that are technically and economically achievable; and MCLs comply with SWRCB Resolution 92-49 and Title 23, Chapter 15 Section 2550.4.

2.2.2 General Response Actions

General response actions (GRAs) are defined as those general classes of actions that can be taken to manage or control a particular problem at a site (*EPA, 1988b*). After review of site-specific conditions at Sites 2 and 12, several GRAs were identified for the technology screening and development of remedial action alternatives for soil and groundwater to meet the RAOs. The GRAs that are potentially applicable are:

- No Action
- Containment
- Collection
- Treatment
- Disposal/Reuse.

2.2.3 Technologies Retained from the Remedial Technology Screening Report

CERCLA guidance for RI/FSs requires that, prior to development of site-specific remedial alternatives, there is an initial screening of the universe of remedial technologies that could be used to cleanup contaminated sites (*EPA, 1988b*). The *Draft Final Remedial Technology Screening (RTS) Report, Fort Ord, California* (*HLA, 1994n*) presents a process to expedite the initial screening of remedial technologies for the FSs for Fort Ord. The objectives of the RTS were to identify and screen proven remedial technologies for typical group of compounds (GOCs) found in soil and groundwater at contaminated sites.

The RTS contains a matrix guide/checklist(s) for each media and GOCs: tables that describe and evaluate each applicable technology on the basis of effectiveness, implementability, and relative cost; and summary review forms. The matrix guide/checklist(s) and tables were used to identify and screen technologies for site specific media and GOCs, and this screening is presented on the summary review form. The matrix guide/checklists and summary review forms for this FS are presented in Appendix 2B. The summary review forms were used to prepare the site and/or remedial unit specific technology tables for this FS (Tables 2.4 to 2.7). Based on this process, the following general response actions and remedial technologies are available for selection in developing the remedial alternatives for these sites.

Groundwater Remedial Unit

- No Action
- Containment
  - Vertical Barriers
  - Capping
- Collection
  - Groundwater Extraction
- Treatment
  - Thermal
  - Chemical
  - Physical
  - Biological
- Disposal
  - Onsite
  - Offsite.

Soil Remedial Unit 1 (Lower Meadow Disposal Area)

- No Action
- Containment
  - Vertical barriers
  - Horizontal barriers
  - Capping
  - Surface water controls
- Collection

- Debris and Soil Removal

- Treatment
  - Thermal
  - Physical
  - Biological
- Disposal
  - Onsite
  - Offsite.

Soil Remedial Unit 2 (Outfall 31 Area)

- No Action
- Containment
  - Capping
  - Surface Water Controls
- Collection
  - Soil Removal
- Treatment
  - Thermal
  - Chemical
  - Physical
  - Biological
  - Offsite
- Disposal
  - Onsite
  - Offsite.

Soil Remedial Unit 3 (Cannibalization Yard Area)

- No action
- Containment
  - Capping
  - Surface Water Controls
- Collection
  - Soil Removal
- Treatment
  - Thermal
  - Chemical
  - Biological
  - Offsite
- Disposal
  - Onsite
  - Offsite.

2.2.4 Selection of Technologies for Remedial Alternative Development

This section reviews and selects the technologies that were retained from the RTS (listed in Section 2.2.3) for development of remedial alternatives. A summary of the technology screening is presented in Tables 2.4 to 2.7. Technologies are selected based on site-specific conditions and base-specific features. For example, Fort Ord is unique in that it has the regulatory agency approved Fort Ord Soil Treatment Area (FOSTA) which was specifically created to treat hydrocarbon and other chemical-contaminated soil; the FOSTA is protective of human health and the environment and provides cost effective treatment at a single location. The types of hydrocarbon treatment that are currently planned at the FOSTA, include bioventing and ex situ bioremediation. Future treatment systems that could be incorporated include portable thermal desorption and asphalt batching. Because the FOSTA provides an equivalent level of treatment, many of the technologies that pass the RTS screening no longer compare favorably. Those that are eliminated from further consideration because of the FOSTA, include offsite thermal treatment by incinerator because it could be performed onsite. The Interim Action Record of Decision (*IAROD, HLA, 1994c*) established the FOSTA for the storage and treatment of soil collected from remedial activities at Fort Ord. Several soil remedial units on RI Sites 12, 16, and 39 meet criteria established in the IAROD for treatment at the FOSTA. Soil in these remedial units will be treated at the FOSTA in accordance with the IAROD as part of the overall remedy for these sites.

Excavated soil brought to the FOSTA will be assessed for the presence of pesticides, metals, solvents, and total petroleum hydrocarbons. Soil containing only petroleum hydrocarbons, without metal concentrations above background levels or detectable pesticide concentrations (such as that from the RI sites) will be treated at the FOSTA. Soil that does not meet this criteria will be containerized and characterized to determine if onsite disposal or onsite treatment is applicable to this soil as established in the IAROD.

The FOSTA will be located at the former 519th Motorpool area, northwest of the intersection of Light Fighter Road and North-South Road, just east of the Fort Ord main entrance. The FOSTA will consist of a biotreatment cell, soil stockpile area, and an enclosed container storage building. The biotreatment cell will accept nonhazardous soil contaminated with petroleum hydrocarbons, such as that from the selected RI site remedial units described above. All soil brought to the FOSTA will be tracked according to its site of origin, cleanup levels attained, and final destination. Treated soil from the biotreatment unit at the FOSTA will be used in the OU 2 landfill closure or for backfill on base.

Another base-specific example is onsite disposal at the Fort Ord Landfill, designated as the Operable Unit 2 (OU 2) landfill for the FOSTA-treated hydrocarbon soils. This technology is more cost effective and presents a lower risk to human health and the environment. The OU 2 landfill, is approximately 170 acres, and is located in the northern portion of Fort Ord. This landfill is currently inactive and a remedial action is ongoing to install a landfill cover and groundwater extraction and treatment system. The site activities for the landfill cover include removal of the existing vegetation layer, leveling and grading of the terrain, placement and compaction of a foundation layer, and the placement and compaction of a cover layer. The cover layer will be graded, the site treatment and monitoring systems installed and cover vegetation planted. Surface water controls will be added during landfill cover construction. The surface water controls are not designed at this time, but will include a final cover with a low permeability layer, final slopes capable of handling the 100-year, 24-hour storm, perimeter drainage channels and an upgradient surface water diversion system.

The volume of soil required for construction of the foundation layer is estimated to be approximately 500,000 to 800,000 cubic yards. Soil containing levels of TPH less than 500 mg/kg can be placed as part of the landfill foundation layer. Inert fill, treated soil from the FOSTA or construction debris, such as from the SRU 1 at Sites 2 and 12, can be placed in the foundation layer.

Based upon the Section 2.2.3 screening of technologies and site- and base-specific conditions, the technologies selected for development of remedial actions at each remedial unit are presented in the following sections. Also presented are the technologies that were not selected and the reasons for their elimination.

Groundwater Remedial Unit

The No Action GRA was selected as were the technology/process options of extraction wells, reinfiltration galleries, activated carbon adsorption treatment, and reinjection, reuse/recycling, discharge to a POTW and discharge to surface water for development of remedial alternatives.

Several remedial technologies and process options were not selected as follows:

- Vertical barriers because of the unsuitable site conditions and because they are not a permanent solution
- Capping because it would not be effective or partial over the large area of the groundwater

plume and it would adversely affect reuse options

- Groundwater collection via extraction trenches/drains are not feasible because of the depth of the groundwater

- Offgas treatment (thermal, catalytic, or carbon) because it is not needed as a part of another treatment technology

- Thermal, chemical, physical, or biological treatment because they are not suitable for the low VOC concentrations in the groundwater.

Soil Remedial Unit 1 (Lower Meadow Disposal Area)

The No Action GRA was selected as were the technology/process options of soil capping; asphalt or concrete capping; grading, revegetation, and diversion and collection systems as surface water controls; excavation; debris segregation; ex situ biodegradation; onsite disposal at landfill (OU 2) or replacement after treatment; offsite disposal at a landfill or recycling facility.

Several remedial technologies and process options were not selected as follows:

- Vertical barriers because horizontal control is not required

- Horizontal barrier installation would be difficult and of questionable ability to adequately perform

- Clay, soil, and multilayered capping because an asphalt and concrete cap is more practical and provides an equal degree of performance

- Thermal sterilization because there are no known medical wastes present that would require it

- Offsite rotary kiln because the FOSTA provides an equivalent level of treatment effectiveness

- Debris washing is not a proven technology for debris treatment so it was not selected

- Offsite landfill disposal because an equivalent level of disposal is available at the OU 2 landfill.

Soil Remedial Unit 2 (Outfall 31 Area)

The No Action GRA was selected for development of remedial alternatives as were the technology/process options of asphalt, or concrete capping; grading, revegetation and diversion and collection systems surface water controls; excavation; screening; ex situ biodegradation; and onsite disposal at the OU 2 landfill and/or replacement after treatment.

Several remedial technologies and process options were not selected as follows:

- Clay and soil capping since an asphalt and concrete cap is more practical and provides an equal degree of performance

- Incineration by rotary kiln, fluidized bed, or circulating bed because an equivalent level of treatment effectiveness is provided by the FOSTA

- Offgas treatment (thermal, catalytic, or carbon) because it is not needed as part of another treatment technology

- Asphalt batching and thermal desorption because an equivalent level of treatment effectiveness is provided by the FOSTA

- Soil vapor circulation, air injection, and in situ biodegradation because they are not implementable with the shallow depth of contaminants

- Offsite thermal and biological treatment because the FOSTA provides on equivalent level of treatment effectiveness

- Offsite landfill disposal because an equivalent level of disposal is available at the OU 2 landfill.

Soil Remedial Unit 3 (Cannibalization Yard Area)

The No Action GRA was selected for development of remedial alternatives as were excavation; screening; ex situ biodegradation; and onsite disposal at the OU 2 landfill and replacement after treatment.

Several remedial technologies and process options were not selected as follows:

- Clay, asphalt, or concrete caps because they are not practical for the shallow contamination
- Grading, revegetation, and diversion and collection system surface water control because they are not practical for the shallow contamination
- Incineration by rotary kiln, fluidized bed, or circulating bed because the FOSTA provides an equivalent level of treatment effectiveness
- Offgas treatment (thermal, catalytic, or carbon) because it is not needed as part of another treatment technology
- Asphalt batching and thermal desorption because an equivalent level of treatment effectiveness is provided by the FOSTA
- Soil vapor circulation, air injection, and in situ biodegradation because they are not implementable with the shallow depth of contaminants
- Offsite thermal or biological treatment because an equivalent level of treatment effectiveness is provided by the FOSTA
- Offsite at a landfill because an equivalent level of disposal is available at the OU 2 landfill.

2.3 Development and Description of Remedial Alternatives

The technologies that were selected for the various remedial units were combined into four remedial alternatives, which are described in the following sections and summarized in Table 2.8.

To assemble remedial alternatives for each site, GRAs and process options chosen in Section 2.2.4 that represent various alternatives (*EPA, 1988b*). According to EPA guidance, taking no further action at the site should be one of the alternatives considered as a basis for comparison to other alternatives: appropriate treatment and contaminant options should also be considered. Initially, specific technologies or progress options are evaluated primarily on the basis of whether or not they can meet the RAOs discussed in Section 2.2.1. To assemble alternatives, remedial units are matched with technology types developed in Section 2.2.4 using engineering judgement and site-specific considerations. A range of alternatives developed with respect to the criteria of effectiveness, implementability, and cost. For sites at which interactions among media are not significant, media-specific remedial options can be developed rather than developing numerous comprehensive site-wide alternatives. Alternatives which meet the RAOs and evaluation criteria are retained for further consideration in the detailed analysis.

In the development and description of remedial alternatives for Sites 2 and 12 it should be emphasized that a long-term groundwater monitoring program will be implemented. This program will include the collection and analysis of groundwater samples and measurement and evaluation of groundwater levels.

2.3.1 Remedial Alternative 1

Alternative 1 consists of the following elements:

- No Action other than Groundwater and Storm Water Surface Outfall Monitoring.

This no action alternative is provided, as required under CERCLA and the NCP, as a baseline for comparison to the other proposed alternatives. This alternative recognizes that the natural attenuation of contaminants through transport, biological degradation, and dispersion can reduce levels over a period of extended time. This alternative assumes that a monitoring program for the existing groundwater wells and two surface water outfalls will continue for a period of 30 years. No institutional actions such as deed restrictions are included.

2.3.2 Remedial Alternative 2

Alternative 2 consists of the following elements:

- Groundwater Extraction and Discharge to POTW for the Groundwater Remedial Unit
- Capping, Surface Water Controls, and Deed Restrictions for SRUs 1 and 2
- Excavation and Treatment of TPH-affected Soil and Onsite Disposal for SRU 3.

This alternative presents a containment approach that includes a pumping scenario for migration control of the groundwater plume and containment of soil by capping SRUs 1 and 2 that have TPH-affected soils and/or debris at greater depths, and excavation of soil at SRU 3.

For the groundwater remedial unit, this alternative uses four extraction wells pumping at a total flow rate of 300 gpm for groundwater contaminant capture. The extracted water will be collected at a central process and control area. This alternative eliminates the requirement for chemical treatment of the extracted groundwater by proposing disposal at the publicly owned treatment works (POTW). The owner of the local POTW, Monterey Regional Water Pollution Control Agency (MRWPCA) has enacted a maximum influent total toxic organics (TTOs) concentration of 1,000 μg/l. Anticipated system concentrations from the extraction system have been estimated by groundwater modeling to be a maximum of 100 to 120 μg/l initially, diminishing to levels below 50 μg/l within 1 to 3 years (Appendix 2A). Thus, the extracted groundwater will not require treatment to meet POTW standards.

As detailed in Section 2.2.1.3, this pumping scenario was developed by achieving a balance between minimizing total extracted groundwater and overall effect on regional flow, and providing adequate capture while reducing the overall time to remove each pore volume. This extraction scenario (Pumping Scenario 1) is illustrated on Plate 2.6, which shows the well locations, groundwater contours, and particle tracking streamlines. Two extraction wells will be installed west of Highway 1, two extraction wells will be located east of Highway 1, and piping and conduit will be installed to connect them to the central process and control area west of Highway 1. The process and control system will comprise tanks, electrical distribution and supply system, and filtration and metering apparatus. The extraction well in the northwestern region may be installed in the sand dune area, which would involve installation of the well and construction of approximately 400 feet of underground piping in the dunes. Special considerations and measures will be implemented to minimize potential environmental impacts in the sand dunes

Alternative 2 soil containment includes capping, surface drainage controls, and deed restrictions for SRUs 1 and 2. This alternative would allow the Lower Meadow Disposal Area debris and elevated TPH soil at this location and at the Outfall 31 Area to remain in place but would minimize potential leaching of chemicals to groundwater. The remedial technologies include capping with asphalt and grading for surface drainage controls.

The shallow soil containing elevated TPH levels at SRU 3 is not practical to cap, so it will be excavated (approximately 1,000 cy), treated at the FOSTA, and disposed at the OU 2 landfill or elsewhere, as needed, onsite.

In addition to these remedial actions, deed restrictions for Site 2 will be required because of BRA exposure scenarios. The deed restrictions shall consider site uses consistent with onsite adult workers such as that would be found at the proposed aquaculture facility.

2.3.3 Remedial Alternative 3

Alternative 3 consists of the following elements:

- Groundwater Extraction, Treatment, and Disposal by NPDES Discharge, Reuse, Reinjection, or Reinfiltration for the Groundwater Remedial Unit
- Capping of Debris and Deed Restrictions: Selective Excavation, Treatment, and Onsite Disposal of TPH-affected Soil for SRU 1
- Excavation, Treatment, and Onsite Disposal of TPH-affected Soil for SRU 2

- Excavation, Treatment, and Onsite Disposal of TPH-affected Soil for SRU 3.

This alternative represents containment and treatment of groundwater with two subalternatives, depending upon the disposal options, selective excavation of TPH-affected soil in SRU 1, capping and deed restrictions for SRU 1, and excavation and treatment of TPH-affected soil for SRUs 2 and 3.

For the groundwater remedial unit, this alternative uses the same groundwater extraction wells as Alternative 2. However, there are two subalternatives depending upon the groundwater disposal option. Remedial Alternative 3A consists of disposal of treated groundwater by NPDES discharge or reuse. Remedial Alternative 3B uses four injection wells in addition to the four extraction wells and is Pumping Scenario 2 identified in Section 2.2.1.3 and Appendix 2A. Although reinjection wells are considered the most likely method to be used for restoring treated groundwater to the aquifer, the results of the Pilot Study at the site will be evaluated to determine whether reinfiltration galleries are a viable option. For the purposes of this FS, it is assumed reinjection wells will be used.

The extracted groundwater will require treatment to meet NPDES, reuse, or injection standards, which are anticipated to be detection limits using EPA Test Method 502.2, for the chemicals present. Discharge to areas overlying the contaminated groundwater plume need only meet aquifer cleanup levels. Treated effluent will be discharged through the storm drain under an NPDES permit, routed through piping systems for reuse, or placed back in the aquifer through the injection system. Effluent reuses include irrigation or process water.

As previously mentioned, anticipated system influent concentrations have been estimated by groundwater modeling to be a maximum of 100 to 120 μg/l initially, diminishing to levels below 50 μg/l within 1 to 3 years. Given the low anticipated influent concentrations, and the anticipated discharge requirements, granular activated carbon (GAC) is the proposed treatment method for the extracted groundwater.

The injection system (Alternative 3B) would represent a complex and capital-intensive option. It provides greater hydrologic control and minimizes regional effects. This approach uses perimeter injection wells to augment flow to the extraction wells, placed approximately along the plume axis. This alternative, has four injection wells and four extraction wells. Plate 2.7 illustrates the well locations, groundwater contours, and particle tracking streamlines. Alternative 3B has an extraction flow rate of 450 gpm and an equal injection flow rate. The minimum anticipated flow rate to provide adequate plume capture is 300 gpm (See Alternative 2) and would be appropriate if the NPDES discharge option or reuse option is implemented (Alternative 3A). However, 450 gpm is the minimum required flowrate for the injection option. A range of costs for Alternative 3 with and without injection is summarized in Section 2.6, Comparison of Alternatives.

Alternative 3 also includes capping and deed restriction for SRU 1 after selected areas of TPH-affected soil have been removed. One area with elevated TPH near SB-12-17 has 570 mg/kg unknown TPHd at 10 feet bgs and will be excavated. The assumed volume of soil to be excavated is 10 percent of the total volume of 16,000 cy i.e., 1,600 cy. The TPHd affected soil would be treated at the FOSTA and disposed of onsite at the OU 2 landfill or elsewhere, as needed. Capping, surface controls, and deed restrictions will be implemented as described in Alternative 2.

The approximately 2,800 cy of elevated TPH soil from SRU 2 will be combined with the approximately 1,000 cy of shallow soil at SRU 3. These units will be excavated, treated at the FOSTA and disposed of onsite at the OU 2 landfill or elsewhere, as needed.

In addition to these remedial actions, deed restrictions for Site 2 will be required because of BRA exposure scenarios. The deed restrictions shall consider site uses consistent with onsite adult workers such as that would be found at the proposed aquaculture facility.

2.3.4 Remedial Alternative 4

Alternative 4 consists of the following elements:

- Groundwater Extraction, Treatment, and Disposal by NPDES Discharge, Reuse, or Injection for the Groundwater Remedial Unit
- Excavation, Debris Segregation, and Treatment of TPH-Affected Soil, and Onsite Disposal for SRU 1
- Excavation, Treatment, and Onsite Disposal of TPH-Affected Soil for SRU 2
- Excavation, Treatment, and Onsite Disposal of TPH-Affected Soil for SRU 3.

This alternative includes extraction, treatment of groundwater with two subalternatives, depending upon the disposal options, excavation and segregation of debris and soil from SRU 1, and excavation and treatment of TPH-affected Soil for SRU 2 and 3. Disposal of all excavated and treated materials will be onsite. This alternative uses the identical extraction and treatment and disposal options for the groundwater remedial unit as presented in Section 2.3.3. Thus, alternative 4A represents the NPDES discharge and reuse option and Alternative 4B is injection of groundwater.

This alternative includes excavation of approximately 16,000 cy of debris and soil from SRU 1. The debris and soil will be segregated with the debris disposed of in the OU 2 landfill. The soil will be treated at the FOSTA and disposed of in the OU 2 landfill or elsewhere, as needed. Approximately 2,800 cy of elevated TPH-affected soil from SRU 2 and approximately 1,000 cy of shallow TPH-affected soil at SRU 3 will be treated at the FOSTA and disposed of at the OU 2 landfill or elsewhere, as needed.

Deed restrictions at Site 2 will also be required as part of Alternative 4.

2.4 Criteria for Detailed Analysis of Remedial Alternatives

Each of the remedial alternatives described in Section 2.3 has been assessed in accordance with the *Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA (EPA, 1988b)*. The remedial alternatives have been evaluated using the nine criteria described below.

- Overall Protection of Human Health and the Environment: Each remedial alternative has been evaluated in terms of the extent of protection of human health and the environment and the residual risk associated with implementation of the alternative. The manner in which the contaminants are managed under each alternative is considered.
- Compliance with ARARs: The ability of each alternative to meet ARARs and other guidance (TBCs) identified in Section 2.1.6 is assessed.
- Long-Term Effectiveness: Each alternative is evaluated with respect to the risk that would remain at the site after the alternative has been implemented and the response objectives have been satisfied. The magnitude of the risk is evaluated as well as the adequacy and reliability of long-term management controls required by the alternative.
- Reduction of Toxicity, Mobility, and Volume Through Treatment: In CERCLA, preference is given to remedial technologies that significantly reduce the toxicity, mobility, or volume of contaminants. This evaluation focuses on the following factors for a particular remedial alternative:
  - The treatment process the remedy will employ and the materials treated
  - The amount of hazardous materials that will be treated or destroyed
  - The degree of expected toxicity, mobility, or volume reduction as compared to conditions prior to the remedial action
  - The degree to which total destruction is achieved

- The type and quantity of treatment residuals that will remain following treatment

- The degree to which the alternative addresses the principal risk.

- Short-Term Effectiveness: The effects of each alternative during the construction, implementation, and operation phases is assessed. Factors considered included the protection of the community and workers during remedial operations, the time required to implement the alternative and to achieve the remedial goals, and the potential adverse environmental impacts that may result.

- Implementability: The three major areas of focus in assessing the implementability of a remedial action alternative are:

  - Technical feasibility - The ability to construct a treatment system, the reliability of the technology, and the ability to monitor the effectiveness of the remedy.

  - Administrative feasibility - The effort and resources required to obtain approvals from responsible agencies.

  - Availability of services and materials - The availability of contractors with the equipment and knowledge to implement the technologies under the remedial alternatives.

- Cost: Remedial alternative cost estimates are prepared using EPA guidance manuals, other technical resource documents, contractor quotes, and experience on this site and on other projects with similar scope. Both capital costs and operation and maintenance (O&M) costs were developed at a conceptual level for each remedial action alternative. These costs can be expected to have an accuracy of plus 50 to minus 30 percent. Net present value (NPV) costs over a 30 year period are calculated using a 5 percent discount rate. Assumptions used to develop costs for each alternative are listed in Appendix 2C.

  Capital costs include contractors's mobilization and demobilization, sampling and analysis, permitting, engineering, remedial equipment purchase and installation, and site restoration. O&M costs include ongoing operational site inspections, utilities, chemicals, routine maintenance and repairs, and periodic sampling and analysis.

- Regulatory Agency Acceptance: Each remedial alternative is evaluated in terms of the administrative and technical issues state or other agencies may have concerning the alternative; however, acceptance is addressed in the Proposed Plan once comments on the FS report have been received.

- Community Acceptance: Each remedial alternative is evaluated in terms of available public input and the anticipated public reaction to the alternative; however, as with regulatory acceptance discussed above, community acceptance is addressed in the Proposed Plan.

2.5 Detailed Analysis of the Alternatives

The following four remedial alternatives are evaluated in the following sections using the nine evaluation criteria. A summary of the evaluation is presented in Table 2.9.

2.5.1 Detailed Analysis of Alternative 1

Alternative 1 consists of the following elements:

- No Action other than Groundwater and Surface Water Outfall Monitoring

- No Action for Soil Remedial Units.

The detailed analysis follows.

Overall Protection of Human Health and The Environment

The no action alternative is not protective of human health or the environment. It does nothing to alleviate the contaminated groundwater which presents a potential health risk if ingested.

Compliance with ARARs

The no action alternative will not meet the chemical-specific ARARs for VOCs in groundwater. The no action alternative will not address the improper waste disposal to land for the debris at the Lower Meadow Disposal Area.

Long-Term Effectiveness

Alternative 1, the residual risk for groundwater users will remain until natural attenuation of the VOCs occurs. No reliable risk controls are included in this alternative. For these reasons, it has minimal long-term effectiveness.

Reduction of Toxicity, Mobility, and Volume Through Treatment

This alternative provides no reduction of toxicity, mobility, or volume through treatment of VOCs. Natural attenuation, including processes of dispersion, biodegradation, and adsorption to soil particles may somewhat reduce the concentration, mass and, therefore, toxicity of VOCs in groundwater over time. There would be no reduction in the toxicity, mobility or volume of TPH in soil. However, the mobility of TPH in soil appears to be low given the limited extent identified during site investigation.

Short-Term Effectiveness

This alternative does not include construction and operation of structures and equipment for remediation; thus, no associated impacts to the environment, potential risks to workers or the community will occur.

Implementability

The no action alternative is implementable. No permits are required and the monitoring wells are in-place. The monitoring of the wells and surface water outfalls employs tested and proven technologies.

Cost

Costs have been estimated for this alternative and are summarized in Table 2.9 and presented in Appendix 2C. There are no capital costs. Operation and maintenance costs include project management, collection of groundwater and surface water outfall samples and measurement of groundwater elevations on a regular basis, laboratory analysis of the samples, maintenance of the monitoring wells, and reporting of monitoring results. The annual operation and maintenance cost is $119,600 per year, with a total net present value of $1,838,500.

Regulatory Agency Acceptance

It is anticipated that the regulatory agencies will not accept this alternative and will require remedial actions.

Community Acceptance

It is anticipated that the community will not accept this alternative. However, further evaluation of community acceptance will occur after this FS is published and reviewed by interested parties.

2.5.2 Detailed Analysis of Alternative 2

Alternative 2 consists of the following elements:

- Groundwater Extraction and Discharge to a POTW
- Capping, Surface Water Controls, and Deed Restrictions for SRUs 1 and 2
- Excavation and Treatment of TPH-affected Soil and Onsite Disposal for SRU 3.

The detailed analysis follows.

Overall Protection of Human Health and The Environment

This alternative will provide additional protection for human health because containing VOCs in the groundwater with the extraction system will also accelerate their removal from the aquifer. Implementation will reduce the residual risk to an acceptable level because the groundwater will be cleaned up to the MCLs. The environment will be protected by the interception of VOCs before they reach Monterey Bay. Although one extraction well will be installed in a sensitive ecological area (the dune sands); the impact is easily mitigated. No long term ecological risk is anticipated for the well installation.

Capping of SRUs 1 and 2 will entail limited surface soil disturbance but no unacceptable risk to human health or the environment is expected. No unacceptable ecological risk is anticipated for the excavation of shallow soils in SRU 3 because no sensitive ecological areas are contained in this remedial unit.

Compliance with ARARs

This alternative is expected to meet chemical-specific ARARs for groundwater. It meets location- and action-specific ARARs for the SRUs.

Long-Term Effectiveness

The groundwater system will be designed to remove the affected groundwater in the remedial unit. Residual risks associated with chemicals will remain but decrease until the MCLs are achieved. The potential for future direct exposure to construction debris and elevated TPH-affected soil in SRU 1 and SRU 2, respectively, will be eliminated by capping, and deed restrictions, so the residual risks are very low. Capping also reduces potential leaching of chemicals to groundwater but must be inspected and maintained periodically to verify structural integrity. Excavation, treatment, and disposal of material from SRU 3 eliminates future exposures and there will be no significant residual risks.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Removal of VOCs from the groundwater remedial unit will reduce the toxicity of the plume and the mobility and volume of the contaminants. The toxicity, mobility, and volume through treatment of the VOCs will be further reduced by POTW treatment processes. A reduction in the mobility of the waste in SRU 1 and SRU 2 will be provided by capping and implementing surface controls; however, no reduction in toxicity or volume is achieved. The toxicity, mobility, and volume of the TPH-affected soil will be reduced for SRU 3 by excavation, treatment, and disposal activities.

Short-Term Effectiveness

A short-term impact to the environment is expected because of intrusive activities, but these can be mitigated. These short-term activities include the installation of wells, trenching and backfilling of subsurface piping, construction of a system enclosure, and the capping of SRU 1 and 2. The short-term impact to the ecologically sensitive dune sands area is easily mitigated. Additionally, excavation, treatment, and disposal actions will occur at SRU 3. Mitigation for intrusive activities will include dust, noise, and traffic controls to minimize environmental impacts. Personnel protection equipment (PPE) and a safety training program will be implemented for the workers.

Capping at SRUs 1 and 2 and excavation/transportation/backfilling at SRU 3 is anticipated to take 8 weeks for each activity. Actual treatment/onsite disposal of TPH affected soil will likely be 2 to 4 months depending upon biodegradation rates. Construction of the groundwater system is expected to take 12 weeks.

Estimated cleanup times have been estimated from solute transport modeling results. Section 2.2.1 identifies the cleanup times estimates for the MCLs versus background levels. Appendix 2A presents the detailed evaluation of site-specific remedial system modeling for Sites 2 and 12 and identified the limitations inherent in the cleanup time estimates.

Implementability

This alternative can be implemented. The groundwater system can be implemented either in conjunction with or separate from other basewide remedial actions. Recovery wells can be constructed using standard well installation methods. The civil, mechanical, and electrical work can be implemented using standard practices common to the construction industry. The substantive requirements for construction and POTW discharge permits are feasible. Materials and equipment are readily available. Excavation and placement of the cap activities also use common construction practices, and require protecting health and safety of workers and minimizing impacts to the local environment and disturbances to nearby residents. Treatment and disposal via the FOSTA is also implementable.

Cost

The estimated costs for this alternative are summarized in Table 2.9 and presented in Appendix 2C. The estimated total capital expenditure for the groundwater system, cap, and excavation and treatment activities is $1,278,500. The annual operation and maintenance costs is $495,800 per year, resulting in a total net present value of $8,900,200.

Regulatory Acceptance

It is anticipated that groundwater extraction will be acceptable to the agencies but may not meet the agencies' preference for onsite treatment of VOCs. The capping of the SRU 1 disposal area should be acceptable given the lack of VOCs in the debris (which could act as a source for VOCs in groundwater) and the absence of TPH in groundwater. The capping of the TPH-affected soil in SRU 2 should also be acceptable but does not meet agency preference for treatment. The excavation and treatment activities for SRU 3 are also likely to satisfy the agencies because of the reduction of chemicals at the FOSTA.

Community Acceptance

The community would likely accept this alternative as a viable solution but may prefer treatment and reuse of the water as proposed in Alternative 3 or 4. The community may also prefer minimizing regional flow effects and potential sea water intrusion through the use of injection wells. Capping may not be preferred because of the deed restrictions and uncertainty associated with the long-term maintenance required. Further evaluation of the state and community acceptance of this alternative will occur after this FS is published and reviewed by interested parties.

2.5.3 Detailed Analysis of Alternative 3

Alternative 3 consists of the following elements:

- Groundwater Extraction Treatment, and Disposal by NPDES Discharge, Reuse, or Injection
- Capping of Debris and Deed Restrictions; Selective Excavation, Treatment, and Onsite Disposal of TPH-affected soil for SRU 1
- Excavation, Treatment, and Onsite Disposal of TPH-affected Soil for SRU 2
- Excavation, Treatment, and Onsite Disposal of TPH-affected Soil for SRU 3.

Overall Protection of Human Health and The Environment

This alternative will provide protection for human health because the action of containing VOCs with the extraction system will also accelerate their removal from the aquifer. Implementation will reduce residual risks to an acceptable level because the groundwater will be cleaned up to the MCLs. The environment will be protected by the intercepting of VOCs before they reach Monterey Bay. Although one extraction well will be installed in a sensitive ecological area (the dune sands), this activity can be mitigated. The SRU remediations will provide protection of human health and the environment.

Compliance with ARARs

This alternative is expected to meet ARARs for groundwater. This alternative meets the location- and action-specific ARARs for the SUs.

Long-Term Effectiveness

The groundwater system will be designed to remove the affected groundwater in the remedial unit. Residual risks associated with chemicals decreases until the MCLs are achieved. Risks of potential future exposure to human or ecological receptors to the SRU 1 will be eliminated by capping and excavation, treatment and disposal of TPH-affected soil in all three SRUs. This also eliminates potential leaching of chemicals to groundwater.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Removal of VOCs from the groundwater remedial unit will reduce the toxicity of the plume and the mobility and volume of the contaminants. The treatment of chemicals by GAC will reduce the toxicity, mobility and volume of the VOCs. They will ultimately be destroyed during the GAC regeneration process, thus further reducing toxicity. The mobility will be reduced for the SRUs by capping and by excavation, treatment, and disposal. The toxicity, mobility, and volume will be greatly reduced because of treatment of the TPH-affected soil at the FOSTA to levels less than 500 mg/kg. No reduction of debris volume is expected through capping.

Short-Term Effectiveness

The short-term actions are the same construction activities as for Alternative 2 but include use of groundwater treatment equipment. A short-term impact to the environment is expected because of intrusive activities but this can be mitigated. For actions at SRV's there may be some risks to workers during the construction activities. Mitigation measures to minimize these will include dust, noise, and traffic controls plus the use of personal protective equipment.

Remediation time for the selective excavation activities for SRU 1 is 4 weeks. Remediation time at SRUs 2 and 3 is anticipated to be 8 weeks. Actual treatment/onsite disposal of TPH affected soil will likely be 2 to 4 months depending upon biodegradation rates. Construction of the groundwater system is expected to take 16 weeks.

Estimated cleanup times have been estimated from solute transport modeling results. Section 2.2.1 identifies the cleanup times estimates for the MCLs versus background levels. Appendix 2A presents the detailed evaluation of site-specific remedial system modeling for Sites 2 and 12 and identifies the limitations inherent in the cleanup time estimates.

Implementability

This alternative can be implemented. The groundwater system can be implemented either in conjunction with or separate from other basewide remedial actions. The extraction wells can be constructed using standard well installation methods. The civil, mechanical, and electrical work can be implemented using standard practices common to the construction industry. The permits for the groundwater and soil actions are administratively feasible. The treatment system equipment is readily available. Excavation and treatment activities requiring TPH-affected soil treatment and disposal via the FOSTA is also implementable.

Cost

Appendix 2C contains a cost range estimate for Alternative 3A (NPDES discharge or Reuse) and Alternative 3B (Injection). The estimated total range of capital expenditures for the groundwater extraction and treatment system and the soil excavation, treatment, and disposal activities is $2,160,400 to $2,713,500. The annual operation and maintenance cost range from $338,200 to $386,600. The net present value range is $7,359,400 to $8,656,500.

Regulatory Acceptance

It is anticipated that the groundwater extraction and treatment system will be acceptable to the agencies and will meet their preference for onsite cleanup of VOCs. The excavation, treatment, and disposal activities for the SRUS are also likely to satisfy the agencies because of increased protection of human health and the environment and compliance with the ARARs.

Community Acceptance

The community would likely accept this alternative as a viable solution but may prefer removal of debris at SRU 1. Excavation and treatment of SRU 2 and 3 will likely be acceptable to the community. Further evaluation of the state and community acceptance of this alternative will occur after this FS is published and reviewed by concerned parties.

2.5.4 Detailed Analysis of Alternative 4

Alternative 4 consists of the following:

- Groundwater Extraction, Treatment, and Disposal by NPDES Discharge, Reuse, or Injection
- Excavation, Debris Segregation, and Treatment of TPH-affected Soil and Onsite Disposal for SRU 1
- Excavation, Treatment, and Onsite Disposal of TPH-affected Soil for SRU 2
- Excavation, Treatment, and Onsite Disposal of TPH-affected Soil for SRU 3.

Overall Protection of Human Health and the Environment

This alternative provides the same level of protection for human health and the environment as Alternative 3.

Compliance with ARARs

This alternative is expected to meet ARARs for groundwater. This alternative meets location- and action-specific ARARs for the SRUs and the ARARs associated with debris excavation and transportation.

Long-Term Effectiveness

Alternative 4 has slightly greater long-term effectiveness than Alternative 3 because the debris from SRU 1 will be disposed of in the OU 2 landfill. Alternative 4 provides the highest degree of long-term effectiveness.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Reduction of toxicity, mobility, and volume of groundwater through treatment. Provides greatest reduction.

Short-Term Effectiveness

Alternative 4 will have the same degree of short-term effectiveness as Alternative 3.

Remediation time for the excavation/ segregation activities for SRUs 1 and 2 will be 20 weeks. Remediation time at SRU 3 is anticipated to be 8 weeks. Actual treatment/onsite disposal of TPH affected soil will likely be 2 to 4 months depending upon biodegradation rates. Construction of the groundwater system is expected to take 20 weeks.

Estimated cleanup times have been estimated from solute transport modeling results. Section 2.2.1 identifies the cleanup times estimates for the MCLs versus background levels. Appendix 2A presents the detailed evaluation of site-specific remedial system modeling for Sites 2 and 12 and identifies the limitations inherent in the cleanup time estimates.

Implementability

Alternative 4 has the same level of implementability as Alternative 3. Debris excavation, segregation, and transportation is technically and administratively feasible

Cost

Appendix 2C contains a cost range estimate for Alternative 4A (NPDES discharge or reuse) and Alternative 4B (Injection). The estimated total range of capital expenditures for the groundwater extraction, treatment, and injection systems and the soil and debris excavation, treatment, and disposal activities is $2,689,600 to $3,242,900. The annual operation and maintenance cost range from $326,700 to $375,100. The net present value range is $7,711,800 to $9,009,100.

Regulatory Acceptance

This alternative will be more acceptable to the agencies than Alternative 3 because the debris will be excavated and disposed of in the OU 2 landfill.

Community Acceptance

The community also will likely find this alternative more acceptable than Alternative 3 because the debris will be disposed of in the OU 2 landfill.

because the debris will be disposed of in the OU 2 landfill.

2.6 Comparison of Remedial Alternatives

Overall Protection of Human Health and The Environment

Alternative 1 does not provide any additional protection to human health or the environment. Alternatives 2 and 3 provide increasing levels of protection. Alternative 4 provides the greatest degree of protection for human health and the environment. However, Alternative 3 provides almost the same degree of protection.

Compliance with ARARs

Alternative 1 will not meet the chemical-specific ARARs. Alternatives 2, 3, and 4 are expected to meet chemical-, action-, and location-specific ARARs.

Long-Term Effectiveness

Alternative 1 does not provide any significant long-term effectiveness. Alternative 1 relies on natural processes to degrade the mass of VOCs dissolved in the groundwater and has minimal long-term effectiveness. Alternatives 2 and 3 provide more comprehensive long-term effectiveness with Alternative 4 providing slightly more effectiveness than Alternative 3.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternative 1 does nothing to reduce toxicity, mobility, or volume of the contaminants. Alternative 2 provides significant reductions in toxicity, mobility, and volume. Alternatives 3 and 4 provide about the same level of reduction, which is greater than Alternative 2.

Short-Term Effectiveness

Alternative 1 has no short-term effectiveness. Alternatives 2, 3 and 4 all have about the same short-term risks to the community and workers during implementation, but these are easily mitigated such that adequate protection is provided.

Implementability

Alternative 1 has no remediation to implement. Alternatives 2, 3 and 4 increase slightly in their complexity from one to the next. However, all of these alternatives are easily implementable.

Cost

The no action alternative NPV cost is the lowest at $1,838,500. Alternatives 3A and 4A have the next lowest NPV costs at $7,359,400 and $7,711,800, respectively. Alternative 2's NPV cost is the fourth lowest at $8,900,200. Alternative's 3B and 4B have the highest NPV cost at $8,656,500 and $9,009,100, respectively. Injection for Alternatives 3 and 4 increases the capital and annual O&M costs by approximately $553,000 and $48,000, respectively, thus increasing NPV costs approximately $1,297,000 or 17 percent. NPV costs for Alternative 3 is about 5 percent less than Alternative 4, but this is not significantly different given accuracy of cost estimates for FS.

Although Alternative 4B has the highest NPV cost at $9,009,100 it has the advantages of greater hydrologic control using the injection option and removes the debris from SRU 1 while site access is unrestricted.

Regulatory Acceptance

Alternative 1 will not be acceptable to the agencies. Alternatives 2, 3, and 4 all will likely have increasing acceptability with Alternative 4 being the most acceptable. Regulatory acceptance and preference will be known in more detail after agency comments are received.

Community Acceptance

Community acceptance will likely be similar to that of the agencies. Community acceptability will be known in more detail after comments are received from interested parties after review of the Proposed Plan for Sites 2 and 12.

2.7 Selection of the Preferred Remedial Alternative

On the basis of comparison of alternatives in Section 2.6, Alternative 4 which includes:

groundwater extraction, treatment, and injection, excavation of soil and debris from SRU 1 and soil from SRUs 2 and 3, and treatment of soil containing TPH at the FOSTA is selected as the preferred alternative for the following reasons:

- It is protective of human health and the environment through removal and treatment of VOCs in groundwater and TPH-affected soil

- It complies with ARARs

- It proposes removal of debris to eliminate long-term liability and avoids long-term cap maintenance

- In regards to groundwater remediation, injection of treated water provides the most conservative approach to protecting human health and the environment and meeting ARARs. The injection system can be adjusted to overcome changing regional flow conditions and variations not accounted for in the groundwater model

- Injection can create flowpaths that cause active plume reduction and may speed cleanup

- Injection reduces the affect on regional flow conditions, provides protection against local seawater intrusion, conserves water, and may prevent commingling of and possible alterations to the OU 2 groundwater plume

- The cost of Alternative 4 is 5 percent greater than Alternative 3, but this is not significantly different given the accuracy of cost estimates for a FS (+50/-30 percent).

TABLES

Table 2.1. Maximum Concentrations of Chemicals of Interest in Groundwater, Remediation Goals and Discharge Limits - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Chemical of Interest[1]	Federal MCL (μg/l)	State MCL (μg/l)	Maximum Chemical Concentration Detected[2] (μg/l)	Maximum Most Recent Chemical Concentration Detected (February 28, 1994; μg/l)	Aquifer Cleanup Levels[4]	Discharge Limits for Treated Water (μg/l)[5]
1,2-Dichloroethane	5.0	0.5	1.5	0.52	0.5	0.5
Tetrachloroethene	5.0	5.0	52.0	29.0	5.0	0.5
Trichloroethene	5.0	5.0	230.0	88.0	5.0	0.5
1,2-Dichloroethene	70.0[2]	6.0[2]	120.0[3]	44.0[3]	6.0	0.5
1,1-Dichlorothene	7.0	6.0	6.2	6.2	6.0	0.5
Vinyl Chloride	2.0	0.5	0.6	0.6	0.5	0.5

1 Chemicals listed are VOCs exceeding MCLs.
2 MCLs are appropriate for cis-1,2-DCE; MCLs for trans-1,2-DCE are 100.0 μg/l for federal and 10.0 μg/l for state.
3 Chemical reported as total 1,2-DCE.
4 The combined, or additive effect of exposure (Reasonable Maximum Exposure: RME) to chemicals at the MCL levels listed was found to be $1x10^{-5}$. This lifetime cumulative risk is within the acceptable risk range, and is health protective.
5 Discharge to areas overlying the contaminated groundwater plume need only meet aquifer cleanup levels. All limits are detection levels using EPA Test Method 502.2. Discharge limits to the POTW will meet the limits established by the Monterey Regional Water Pollution Control Agency.

Table 2.2. Potential Applicable or Relevant and Appropriate Requirements - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Chemical-Specific Requirements				
State Water Control Board	Resolution 88-63	Establishes criteria for groundwater to be considered a drinking water source.	Applicable	Groundwater at Sites 2 and 12 is considered a potential drinking water source.
Safe Drinking Water Act (40 USC 300)	40 CFR 141 and 143; National Primary Drinking Water Standards	Establishes maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) for drinking water.	Relevant and Appropriate	MCLs are currently the cleanup level at another basewide remedial action, and are proposed for the cleanup goals for chemicals in groundwater at Sites 2 and 12.
California Water Quality Standards	Title 22 CCR, Chapter 15, Section 64435	Establishes state MCLs for drinking water.	Relevant and Appropriate	Only state requirements more stringent than the National Primary Drinking Water Standards would be applicable.
Identification and Listing of Hazardous Wastes	Title 22 CCR, Chapter 11	Establishes/defines procedures and criteria for identification and listing of RCRA and non-RCRA hazardous wastes.	Applicable	Chemicals may be present at hazardous levels. Appropriate actions will be taken to ensure compliance with this ARAR.
Porter Cologne Act	Title 23 CCR, Division 3, Chapter 15, Article 2; Waste Classification and Management	This regulation establishes and defines procedures and criteria for classification and management of wastes.	Applicable	Contaminated soil or debris that is excavated and transported to the OU 2 landfill for disposal will be managed under this article.
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	40 CFR Part 150	Establishes NAAQS for criteria pollutants: particulate matter (PM10), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead.	Applicable	Emission controls from remedial actions will be implemented, as required, to ensure compliance with this ARAR.
Monterey Bay Unified Air Pollution Control District (MBUAPCD)	Regulation II (New Sources) and Regulation X (Toxic Air Contaminants)	Establishes requirements for new stationary sources of air pollution, and the appropriate level of abatement control technology for toxic air contaminants.	Relevant and Appropriate	The remedial design would need to meet the substantive requirements of these MBUAPCD regulations if screening or excavation activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal.
Location-Specific Requirements				
Waste Management Unit Classification and Siting - Fault Zone	40 CFR 26 4.18a	This regulation establishes classification and siting criteria for waste management units (WMUs). Hazardous WMUs are prohibited from being located within 200 feet of a geologic fault displaced in Holocene time.	Not Applicable	The site is located within a seismically active region, but not within 200 feet of such a fault; criteria does not apply.
Waste Management Unit Classification and Siting - Floodplain	40 CFR 264.18b	This regulation establishes classification and siting criteria for waste management units (WMUs). Hazardous WMU should not be located within a 100-year floodplain unless it is designed to prevent washout of any waste by a 100-year flood.	Not Applicable	The site is not located within a 100-year floodplain; criteria does not apply.

Table 2.2. Potential Applicable or Relevant and Appropriate Requirements - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Standards for the Management of Wastes Discharged to Land	Title 23 CCR, Division 3, Chapter 15, Articles 8 Section 2583 and 9	This regulation establishes standards for the management of waste discharged to land. Articles 8 and 9 address waste pile closure requirements.	Relevant and Appropriate	The substantive requirements for waste pile closure may apply to the Lower Meadow Disposal Area for remedial alternatives such as capping/containment.
National Archaeological and Historic Preservation Act	36 CFR Part 65	These regulations provide for the protection of any historically significant artifacts that may be unearthed during excavation activities.	Applicable	No historically significant artifacts have been uncovered during previous investigation activities at Fort Ord, and none are expected to be unearthed at these sites. Appropriate actions will be taken, however, should any such artifacts be unearthed.
Endangered Species Act of 1973	16 U.S.C. 1531 et seq.	The Endangered Species Act of 1973 requires action to conserve endangered species and preserve critical habitat upon which they depend.	Applicable to Site 2 Only	Site 2 may contain areas that are a critical habitat. Site 12 does not contain known critical habitat (ARAR does not apply). Site 2 areas will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment Report that will recommend measures, as necessary, to ensure compliance with this ARAR.
California Endangered Species Act	Fish and Game Code, Section 2050 et seq.	This act provides for the recognition and protection of rare, threatened and endangered species of plant and animals (in conjunction with state authorized or funded actions).	Applicable to Site 2 Only	Site 2 may contain areas with endangered species. There are no known endangered species at Site 12 (ARAR does not apply). Site 2 areas will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment Report that will recommend measures, as necessary, to ensure compliance with this ARAR.
Fish and Wildlife Coordination Act	16 U.S.C. 661 et seq.	This act requires fish and wildlife to be protected if remedial actions modify the drainage channel or other features of the stream or river.	Not Applicable	No foreseeable remedial action at Site 2 or 12 would modify a drainage or other stream feature; criteria does not apply.
Coastal Zone Management Act	16 U.S.C. 1456 et seq.	This act requires activities conducted within the coastal zone to be conducted in a manner consistent with the state-approved management program.	Applicable to Site 2 Only	Site 2 lies within the coastal zone; impacts to the coastal zone will be considered to ensure compliance with this ARAR. Site 12 is not in a coastal zone and this ARAR does not apply.
California Coastal Act of 1976	Public Resources Code Section 3000 et seq.	Establishes the state Coastal Zone Management Plan	Applicable to Site 2 Only	Site 2 lies within the coastal zone; impacts to the coastal zone will be considered to ensure compliance with this ARAR. Site 12 is not in the coastal zone so this ARAR does not apply.

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Migratory Bird Treaty Act	16 U.S.C. 703 et seq.	This act protects certain migratory birds and their nests and eggs.	Applicable to Site 2 Only	Migratory birds may be present on Site 2 but not on Site 12. Each area will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment Report that will recommend measures, as necessary, to ensure compliance with this ARAR.
Action-Specific Requirements				
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	Title 22 CCR, Chapter 14, Use and Management of Containers; Article 9, Sections 66264.171-178	Establishes requirements for the use of containers to store hazardous waste.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66171; Condition of Containers	Containers for hazardous waste must be maintained in good condition.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66172; Compatibility of Waste in Containers	Containers for hazardous waste must be compatible with the wastes stored in them.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66173; Management of Containers	Containers holding hazardous waste must be closed during storage except when necessary to add or remove waste.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements. Hazardous materials storage will be isolated and able to maintain control of incidental spills or leaks.
	Title 22 CCR, Section 66174; Inspections	Containers and container storage areas must be inspected weekly for leaks or deterioration.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66175; Containment	Container storage areas must be designed according to the requirements of this section.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers.

Table 2.2. Potential Applicable or Relevant and Appropriate Requirements - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities (continued)	Title 22 CCR, Section 66178; Closure	At closure, all hazardous waste and waste residues must be removed and remaining containment structures decontaminated.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.
	Title 22 CCR, Chapter 14, Article 2, Section 66264.14; Public Access Restrictions	Owners and operators of hazardous waste treatment, storage, or disposal (TSD) facilities must prevent the unknowing entry of persons or livestock onto the active portions of the facility; in addition, warning signs must be posted.	Relevant and Appropriate	If hazardous materials are treated, stored, or disposed onsite, areas will be restricted from public access.
	Title 22 CCR, Chapter 14, Article 7, Section 66264.119; Post Closure Notices	Under this requirement, a restriction is placed on the deed which constrains future uses of the property.	Applicable	Remedial measures in which hazardous levels of chemical constituents remain in place may be subject to these regulations.
	Title 22 CCR, Chapter 14, Article 16, Section 66264.601; Miscellaneous Units	These regulations apply to facilities that treat, store, or dispose of hazardous waste in miscellaneous units. Owners and operators of TSDs at which hazardous waste is stored in miscellaneous units must locate, design, construct, operate, maintain, and close those units in a manner that is protective of human health and the environment.	Applicable	Carbon vessels may be used as part of treatment activities. These carbon vessels may be considered miscellaneous treatment units while being stored, if hazardous; however, they will be regenerated offsite as part of a commercial process.
Standards Applicable to Generators of Hazardous Waste	Title 22 CCR, Chapter 12	Establishes standards for generators of hazardous waste.	Applicable	Hazardous waste may be generated at the site (carbon drums, soil); the substantive portions of these regulations will apply and be complied with.
Land Disposal Restrictions	Title 22 CCR, Chapter 18	Prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. Requires laboratory analysis of wastes intended for landfill disposal to establish that the waste is not restricted from landfill disposal.	Applicable	Carbon vessels from the treatment system may subsequently be found to contain hazardous or designated waste; however, they will be regenerated offsite as part of a commercial process.
Standards for Management of Wastes Discharged to Land	Title 23 CCR, Chapter 15, Water Quality Monitoring and Response Programs for Waste Management Units	Establishes standards for water quality monitoring, protection standards, and points of compliance for waste management units.	Relevant and Appropriate	Although the lower meadow disposal area is not specifically a waste management unit, the substantive corrective action provisions of Chapter 15 could apply.

Table 2.2. Potential Applicable or Relevant and Appropriate Requirements - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Porter Cologne Act	Resolution 88-63	Establishes criteria for determining if groundwater is a potential drinking water resource.	Applicable	The groundwater at Sites 2 and 12 is classified as a potential drinking water source under these guidelines and this ARAR is applicable.
State Water Resources Control Board Porter Cologne Act	Resolution 92-49, Porter Cologne Act	Establishes policies and procedures for the investigation, cleanup, and abatement of waste. This provision states that cleanup goals attain best water quality which is reasonable if background levels cannot be restored.	Applicable	Groundwater at Sites 2 and 12 will be treated to attain the highest water quality which is reasonable, considering: all demands being made and to be made on those waters, and the total values involved; beneficial, detrimental, economic, social, tangible, and intangible. The groundwater treatment system will use the best control technology to treat groundwater prior to discharge.
State Water Resources Control Board	Resolution 68-16, Porter Cologne Act	Establishes goals for the maintenance of existing groundwater quality. Also requires best practical control technology for discharges to high quality water, excluding the reinjection of water into the contaminated groundwater plume.	Applicable	Groundwater at Sites 2 and 12 will be treated to attain the highest water quality which is reasonable, considering: all demands being made and to be made on those waters, and the total values involved; beneficial, detrimental, economic, social, tangible, and intangible. The groundwater treatment system will use the best control technology to treat groundwater prior to discharge.
Federal Safe Drinking Water Act - Underground Injection Control	40 CFR 144	Prohibits injection of contaminated water into or above a drinking water formation. Exempts injections of treated groundwater into the source aquifer for the purpose of the aquifer cleanup.	Applicable	Treated groundwater may be injected to the aquifer. Injected groundwater must not contain chemical concentrations above MCLs.
Federal Safe Drinking Water Act - NPDES	40 CFR 122	Establishes permitting standards for discharge of pollutants from any point source into waters of the United States.	Applicable	Treated groundwater may be discharged to waters of the state. The effluent limitations and monitoring of an NPDES permit will be followed.
Federal Safe Drinking Water Act - POTW	40 CFR Part 403-5	Allows municipalities to determine pretreatment standards for publicly owned treatment works (POTWs) within its jurisdiction.	Applicable	Groundwater may be discharged to POTWs. The effluent limitations and monitoring of a POTW will be followed.
California Toxic Injection Well Act	California H&S Code Section 25159.24(a)	Prohibits injection of contaminated water into or above a drinking water formation. Exempts injection of treated groundwater for the purpose of improving groundwater quality.	Applicable	Groundwater may be reinjected to aid/accelerate the remediation process.

Notes:

RWQCB	California Regional Water Quality Control Board.
OU	Operable Unit.
ARAR	Applicable or Relevant and Appropriate Requirements.
EPA	U.S. Environmental Protection Agency.
CFR	Code of Federal Regulations.
U.S.C.	United States Code.
MCL	Maximum Contaminant Level.
MCLGs	Maximum Contaminant Level Goals.
RCRA	Resource Conservation and Recovery Act.
TPH	Total Petroleum Hydrocarbons.
mg/kg	Milligrams per kilogram.
IAROD	Interim Action Record of Decision.
MBUAPCD	Monterey Bay United Air Pollution Control District.
NAAQS	National Ambient Air Quality Standards.
PM10	Particulate matter with a diameter under 10 microns.
et seq.	And following.
WMUs	Waste management units.
TSD	Treatment, storage, and disposal.
CAMU	Corrective action management unit.
NEPA	National Environmental Policy Act.
FS	Feasibility study.
CEQA	California Environmental Policy Act.
Cal/EPA	California Environmental Protection Agency.

Table 2.3. Remedial Action Objectives - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Media/Exposure Pathway	Remedial Action Objectives	Potential Remediation Requirements
For Human Health Protection		
Soil - Ingestion		
Short-term	Minimize direct exposure to onsite construction workers during remediation in any area with unacceptable risk.	Personal protection and monitoring.
Long-term	Reduce potential chemical exposures to workers and residents in any areas with unacceptable risk.	Source containment, removal, and/or treatment in any area with chemicals above Target Cleanup Levels (TCLs).
Soil - Dermal Contact		
Short-term	Minimize direct exposure to onsite construction workers during remediation in any area with unacceptable risk.	Personal protection and monitoring.
Long-term	Reduce potential chemical exposures to workers and residents in any areas with unacceptable risk.	Source containment, barriers removal, and/or treatment in any area with chemicals above TCLs.
Debris - Direct Contact		
Short- and long-term	Minimize direct exposure and contact.	Source containment, barriers or removal.
Groundwater-Ingestion		
Short-term and long-term	Prevent further groundwater degradation; perform remedial action in areas with VOC contamination above TCLs (e.g., MCLs).	Containment, removal and/or treatment to MCLs.
Air - Inhalation		
Short-term	Minimize direct exposure to onsite and offsite workers; maintain background air quality levels or OSHA/NIOSH and MBUAPCD standards.	Minimize temporary releases during remediation using dust control measures; monitor air quality; personal protection and monitoring.

Table 2.3 Remedial Action Objectives - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Medium - Exposure Pathway	Remedial Action Objectives	Potential Remediation Requirements
Long-term	Prevent significant deterioration; maintain background air quality levels.	Source containment, removal, treatment, or control.
<u>For Ecological Protection</u>		
<u>Existing Habitat</u>		
Short-term	Minimize impacts to the native habitat at Site 2.	Minimize intrusive activities such as excavation and well installation. Screen areas for sensitive plant and animal species.
Long-term	Prevent significant deterioration of the native habitat at Site 2, and provide for the future prosperity of the habitat.	Native plant/animal restoration, deed restrictions, and contaminant removal.

OSHA — Occupational Safety and Health Act.
NIOSH — National Institute of Occupational Safety and Health.
MBUAPCD — Monterey Bay Unified Air Pollution Control District

Table 2.4. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Groundwater Remedial Unit
Volatile Organic Compounds in Groundwater
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
NO ACTION	None	Monitoring of site groundwater wells and storm drain surface outfalls required.	Low	Not effective; however natural attenuation of chemicals may occur over time.	Requires regulatory approval of risk to environmental and human health, and consideration of groundwater quality goals and potential uses.	Yes
CONTAINMENT	Vertical Barriers					
	Grout curtain, slurry walls, or sheet piling	Semi-permeable or impermeable barriers to horizontal migration of chemicals in groundwater.	High	Moderately effective for VOCs. Not effective based on site conditions.	Depth to groundwater limits constructability.	No
	Capping					
	Clay and soil	Semi-permeable or impermeable surface layer comprised of compacted clay over soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Not effective to meet target cleanup levels.	No defined source to groundwater is present. Future uses limit ability to implement.	No
	Asphalt or concrete	Semi-permeable or impermeable surface layer comprised of a concrete slab or a layer of asphalt to prevent surface water infiltration, chemical transport, and contact.	Low/ Moderate	Not effective to meet target cleanup levels.	No defined source to groundwater is present. Future uses limit ability to implement.	No

Table 2.4. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Groundwater Remedial Unit
Volatile Organic Compounds in Groundwater
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
COLLECTION	Groundwater Collection					
	Extraction wells	Extraction of groundwater by pumping through a series of extraction wells.	Low	Effective for site specific conditions.	Easily implementable. Equipment readily available.	Yes
	Extraction trenches and/or subsurface collection drains	Perforated pipe or gravel-lined trenches backfilled with porous media to collect contaminated water.	Low	Effective for migration control of dissolved VOCs; typically used in conjunction with treatment.	Depth to groundwater limits constructability.	No
TREATMENT	Thermal Treatment					
	Thermal oxidation (offgas)	High temperature (1400°F) destruction of organic vapors collected during treatment of groundwater.	Low	Effective; however may require supplemental process to neutralize hydrochloric acid formed by highly chlorinated VOCs.	Not required or practical because of expected low concentrations.	No
	Catalytic oxidation (offgas)	Lower temperature (600°F) destruction of organic vapors collected during treatment of groundwater using a catalyst.	Low	Effective for treatment of most VOC offgas.	Not required or practical because of expected low concentrations.	No
	Chemical Treatment					
	UV/oxidation	Application of ultraviolet light and/or oxidizing agent (e.g., hydrogen peroxide) in aqueous stream to destroy organic compounds.	Moderate/ High	Effective for VOCs. Requires controlled reaction conditions. Limited by suspended solids.	Not required or practical because of expected low concentrations.	No

Table 2.4. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Groundwater Remedial Unit
Volatile Organic Compounds in Groundwater
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Physical Treatment					
	Air sparging	Application of air into saturated zone under slight pressure to volatilize VOCs in groundwater.	Low	Highly effective for initial VOCs removed if high concentrations.	Not implementable because of low expected concentrations.	No
	Air stripping	Transfer of volatile chemicals to vapor media by rapid air/water exchange.	Low	Highly effective for most VOCs. May require pretreatment for dissolved or suspended solids.	Not required or practical because of low expected concentrations.	No
	Steam stripping	Large volumes of steam mixed with water in a packed column or similar device to promote transfer of VOCs to steam.	Moderate	Highly effective for VOCs; condensate requires treatment or disposal.	Not required or practical because of low expected concentrations.	No
	Activated carbon adsorption	Adsorption onto carbon of VOCs in groundwater by passage through trays or columns.	Low/ Moderate	Highly effective for VOCs. May require pretreatment for dissolved or suspended solids.	Implementable based on low expected concentrations.	Yes
	Activated carbon adsorption (offgas)	Adsorption onto carbon of organic vapors collected during VOC extraction.	Low	Effective for treatment of most VOC offgas.	Not required since air stripping is not applicable for the site concentration levels.	No
	Resin bed adsorption (offgas)	Adsorption of organic vapors in offgas by passage through a specialized resin bed.	Moderate	Effective for VOCs. Requires periodic regeneration of adsorbent.	Not required since air stripping is not applicable for the site concentration levels.	No

Table 2.4. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Groundwater Remedial Unit
Volatile Organic Compounds in Groundwater
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Biological Treatment					
	Biodegradation	Introduction of oxygen, nutrients, and/or bacteria to degrade contaminants through a series of extraction and reinjection wells.	Low	Not effective for TCE and PCE.	Proven technology for non-chlorinated VOCs; equipment readily available.	No
	Biodegradation (ex situ)	Introduction of oxygen, nutrients, and/or bacteria to degrade contaminants in extracted groundwater. Above-ground treatment in a slurry or packed bed reactor.	Low/ Moderate	Not effective for low expected concentrations.	Proven technology; equipment readily available.	No
DISPOSAL	Onsite Disposal					
	Reinfiltration	Reinfiltrate treated groundwater into subsurface through an infiltration gallery to replenish aquifer.	Moderate	Effective depending on hydrogeologic conditions.	Limited implementability because of high flow, desired injection location, and high maintenance.	No
	Reinjection	Reinject treated groundwater into subsurface with injection wells to replenish aquifer.	Moderate	Effective depending on hydrogeologic conditions.	Implementable depending upon achievement of treatment standards prior to reinjection.	Yes
	Reuse/recycling	Reuse/recycle treated water for process water onsite, or for irrigation or industrial processes.	Moderate	Effective depending on infrastructure and future reuse.	Implementable, depending upon achievement of treatment standards prior to end use.	Yes

Table 2.4. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Groundwater Remedial Unit
Volatile Organic Compounds in Groundwater
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
DISPOSAL (cont.)	Offsite Disposal					
	Discharge to POTW	Discharge of treated water to local sanitary sewer.	Low	Effective.	Implementable depending upon treatment standards.	Yes
	Discharge to surface waters	Discharge of treated water to surface under NPDES permit.	Low	Effective.	Implementable depending upon treatment standards.	Yes

Table 2.5. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 1 (Lower Meadow Disposal Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
NO ACTION	None	Monitoring of site groundwater wells and storm drain surface outfalls required.	Low	Not effective; however, certain land uses may allow for debris to remain in place.	Requires regulatory approval and consideration of future land use if deed restriction imposed.	Yes
CONTAINMENT	Vertical Barriers					
	Grout curtain, sheet metal, slurry walls, or sheet piling	Provides semi-permeable or impermeable barriers to horizontal migration of chemical-bearing soil and debris due to erosion or water flow.	Moderate/ High	Effective for uncontaminated debris however horizontal migration control not required.	Site constraints allows construction but barrier for erosion control not required.	No
	Horizontal Barriers					
	Grouting, sheet metal, or block displacement	Provides semi-permeable or impermeable barrier to vertical migration of soil and debris due to erosion or water flow.	High	Effective for uncontaminated debris however vertical migration control not required below debris.	Installation would be difficult because of nature of debris.	No
	Capping					
	Clay and soil	Semi-permeable or impermeable surface layer comprised of compacted clay over debris and soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Effective for minimizing contact and surface water leaching of chemicals in debris and soil to groundwater. Cap requires periodic maintenance.	Implementable depending on availability of clay or approved equivalent near the site.	No
	Multilayered	Semi-permeable or impermeable materials such as compacted clay, soil, or lime placed in layers to prevent surface water infiltration, and chemical transport.	High	Highly effective for minimizing contact and surface water leaching of chemicals in debris and soil to groundwater. Cap requires periodic maintenance.	Implementable.	No

Table 2.5. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 1 (Lower Meadow Disposal Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
CONTAINMENT (cont.)	Capping (cont.)					
	Asphalt or concrete	Semi-permeable or impermeable surface layer comprised of a concrete slab or a layer of asphalt to prevent surface water infiltration and chemical transport.	Moderate	Effective for minimizing contact and surface water leaching of source area debris and soil to groundwater.	Implementable.	Yes
	Surface Water Controls					
	Grading	Smoothing of surface to grade after completion of excavation and backfilling.	Low	Effective in controlling surface water.	Implementable.	Yes
	Revegetation	Engineered landscaping and placement of plants, shrubs, or trees to restore site after excavation.	Moderate	Effective; minimizes erosion to prevent surface water ponding and chemical transport.	Implementable.	Yes
	Diversion and collection systems	Series of pipes and basins to direct surface water away from area of concern; minimizes surface water infiltration and chemical transport.	Moderate	Effective in controlling surface water.	Implementable.	Yes
COLLECTION	Debris and Soil Removal					
	Excavation	Removal of debris and soil by digging with commonly used heavy equipment.	Moderate	Highly effective for removal of most debris and soil.	Implementable, with most equipment readily available. May require use of specialized equipment for removal of large debris.	Yes

Table 2.5. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 1 (Lower Meadow Disposal Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT	Thermal Treatment					
	Sterilization	Super heated steam-cleaning in container or vessel for sterilization purposes.	Moderate/ High	Effective for removing biological hazards associated with medical debris of unknown origin.	Technology not required for the nature of contaminants in this remedial unit.	No
	Offsite rotary kiln incinerator	Combustion in a horizontally rotating cylinder designed for uniform heat transfer and destruction of waste.	High	Effective for non-metallic, smaller-sized debris and soil.	Technology not required for the nature of contaminants in this remedial unit.	No
	Physical Treatment					
	Debris washing	High pressure spraying of debris in enclosed tank using water and chemical-specific surfactants or solvents.	Moderate/ High	Effective for removal of certain contaminants from debris surfaces. Moderately effective for heavy hydrocarbons.	Technology not proven or required for the nature of contaminants in this remedial unit.	No
	Debris segregation	Excavation and placement of debris and soil in large-scale mechanical vibrating screens to remove smaller fraction of material (e.g., soil).	Low/ Moderate	Highly effective for separation of debris from soil; reduces volume of waste.	Implementable. Sandy soil containing elevated hydrocarbons is easily separated from construction debris.	Yes
	Biological Treatment Biodegradation (ex situ)	Introduction of oxygen, nutrients, and/or bacteria to segregated soil or waste pile heaps to biodegrade organics.	Low/ Moderate	Effective for a wide variety of hydrocarbons.	Technology is implementable for hydrocarbons in soil after debris segregation. Technology not implementable for construction debris.	Yes

Table 2.5. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 1 (Lower Meadow Disposal Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
DISPOSAL	Onsite Disposal					
	Landfill	Onsite waste management unit that may be lined and capped or completely enclosed in cement or other stable, non-eroding material.	Moderate/ High	Effective for disposal of most wastes. Requires periodic maintenance, monitoring, or leachate, collection, and recovery system.	Implementable; depends on other planned basewide remedial actions.	Yes
	Replacement after treatment	Excavation and treatment, or separation of soil or debris, with replacement of material into excavated areas.	Low	Effective for debris and soil treated to TCLs. Limited by compaction requirements for future land use.	Implementable.	Yes
	Offsite Disposal					
	Landfill	Transport of chemical-bearing debris and soil to appropriate landfill by licensed waste transporter.	Low/ High	Effective; however pretreatment may be required depending upon presence of elevated hydrocarbons in soil.	Implementable; facilities are available in California.	No
	Recycling facility	Transport of recyclable or reclaimable debris to an appropriate facility such as a smelter or concrete recycler.	Low	Effective for debris such as concrete, scrap metal, glass, and oil or known substances found in containers.	Implementable; facilities are available in California.	Yes

Table 2.6. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 2 (Outfall 31 Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
NO ACTION	None	Monitoring of site groundwater wells and storm drain surface outfalls required.	Low	Not effective; however natural attenuation of chemicals may occur over time.	Requires regulatory approval and consideration of future land use if deed restriction imposed.	Yes
CONTAINMENT	Capping					
	Clay and soil	Semi-permeable or impermeable surface layer comprised of compacted clay over soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Effective for minimizing contact and surface water leaching of chemicals in soil to groundwater. Cap requires periodic maintenance; groundwater monitoring may be required.	Implementable depending on availability of clay or approved equivalent near the site.	No
	Asphalt or concrete	Semi-permeable or impermeable surface layer comprised of a concrete slab or a layer of asphalt to prevent surface water infiltration, chemical transport, and contact.	Low/ Moderate	Effective for minimizing contact and surface water leaching of chemicals in soil to groundwater.	Easily constructed and applicable.	Yes
	Surface Water Controls					
	Grading	Smoothing of surface to grade after completion of excavation and backfilling.	Low	Effective in controlling surface water.	Implementable.	Yes
	Revegetation	Engineered landscaping and placement of plants, shrubs, or trees to restore site after excavation.	Moderate	Effective; minimizes erosion to prevent surface water ponding and chemical transport.	Implementable.	Yes
	Diversion and collection systems	Series of pipes and basins to direct surface water away from area of concern; minimizes surface water infiltration and chemical transport.	Moderate	Effective in controlling surface water.	Implementable.	Yes

Table 2.6. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 2 (Outfall 31 Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
COLLECTION	Soil Removal					
	Excavation	Removal of soil by digging with commonly used heavy equipment.	Low	Highly effective for source removal.	Implementable. Equipment readily available.	Yes
TREATMENT	Thermal Treatment					
	Rotary Kiln incinerator	Combustion in a horizontally rotating cylinder designed for uniform heat transfer and waste destruction.	Moderate	Effective for removal of heavy hydrocarbons from soil.	Mobile incineration is implementable.	No
	Fluidized bed incinerator	Injection into a hot agitated bed of sand where combustion occurs.	Moderate	Effective for removal of heavy hydrocarbons from soil.	Mobile incineration is implementable.	No
	Circulating bed incinerator	Variation of fluidized bed incinerator using higher air velocity and circulating solids to create a larger and highly turbulent combustion zone.	Moderate	Effective for removal of heavy hydrocarbons from soil.	Mobile incineration is implementable.	No
	Thermal oxidation (offgas)	High temperature (1400°F) destruction of organic vapors collected during treatment.	Low	Effective; however may require supplemental process to neutralize hydrochloric acid formed by any chlorinated compounds associated with heavy hydrocarbons.	Thermal treatment of offgas may be used as part of another treatment technology.	No
	Catalytic oxidation (offgas)	Lower temperature (600°F) destruction of organic vapors collected during treatment.	Low	Effective for treatment of most hydrocarbon offgas.	Treatment of offgas may be used as part of another treatment technology.	No

Table 2.6. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 2 (Outfall 31 Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Chemical Treatment					
	Asphalt batching	Incorporation of soil into a cold or hot mix as an aggregate supplement in the manufacture of asphaltic concrete.	Moderate/ High	Effective if soil is an adequate substitute for aggregate typically used.	Equipment readily available. Requires pilot study.	No
	Physical Treatment					
	Soil vapor circulation	Application of a vacuum to extraction wells at low flow rates through unsaturated zone to biodegrade heavy hydrocarbons.	Low	Not effective for removal of hydrocarbons in permeable soil at shallow depths.	Not implementable because of shallow depth of contaminants.	No
	Thermal desorption	Low temperature thermal treatment with a heated auger which causes volatilization of heavy hydrocarbons.	Moderate	Proven Technology. Moderately effective for most hydrocarbons.	Implementable. Equipment readily available.	No
	Screening	Removal of larger sized particles from the waste stream by passage through a screen.	Low	Effective for separation and homogenization of waste.	Implementable. Equipment readily available.	Yes
	Air injection	Injection of air into unsaturated zone to biodegrade heavy hydrocarbons.	Low	Not effective for removal of hydrocarbons in permeable soil at shallow depths.	Not implementable because of shallow depth of contaminants.	No
	Activated carbon adsorption (offgas)	Adsorption onto carbon of organic vapors collected during treatment.	Low	Effective for treatment of most offgas.	Treatment of offgas may be used as part of another treatment technology.	No
	Biological Treatment					
	Biodegradation (in situ)	Introduction of oxygen, nutrients, and/or bacteria to degrade hydrocarbons in soil.	Low	Effective for a wide variety of hydrocarbons.	Not implementable because of shallow depth of contamination.	No

Table 2.6. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 2 (Outfall 31 Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Biological Treatment (cont.)					
	Biodegradation (ex situ)	Introduction of oxygen, nutrients, and/or bacteria to degrade hydrocarbons in soil.	Low	Proven technology. Effective for a wide variety of hydrocarbons in excavated soil.	Implementable; equipment readily available.	Yes
	Offsite Treatment					
	Thermal treatment	Use of high temperatures as principle means of destroying or detoxifying wastes.	High	Effective for heavy hydrocarbons.	Implementable.	No
	Biological treatment	Treatment of hydrocarbons using microorganisms at a commercial facility.	Moderate	Effective for heavy hydrocarbons.	Implementable.	No
DISPOSAL	Onsite Disposal					
	Landfill	Onsite waste management of chemical-bearing soil in an onsite waste unit.	Moderate	Effective means of disposal of hydrocarbon waste.	Implementable.	Yes
	Replacement after treatment	Excavation and treatment with replacement into excavated area.	Low	Effective for soil treated to TCLs.	Implementable; equipment readily available.	Yes
	Offsite Disposal					
	Landfill	Transport of chemical-bearing soil to an appropriate landfill by licensed waste transporter.	Low/High	Effective, however pretreatment may be required depending upon hydrocarbon concentrations.	Implementable.	No

Table 2.7. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 3 (Cannibalization Yard Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
NO ACTION	None	Monitoring of site groundwater wells and storm drain surface outfalls required.	Low	Not effective; however natural attenuation of chemicals may occur over time.	Requires regulatory approval and consideration of future land use if deed restriction imposed.	Yes
CONTAINMENT	Capping					
	Clay and soil	Semi-permeable or impermeable surface layer comprised of compacted clay over soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Effective for minimizing contact and surface water leaching of chemicals in soil to groundwater. Cap requires periodic maintenance; groundwater monitoring may be required.	Contamination too shallow for practical installation of cap.	No
	Asphalt or concrete	Semi-permeable or impermeable surface layer comprised of a concrete slab or a layer of asphalt to prevent surface water infiltration, chemical transport, and contact.	Low/ Moderate	Less effective for minimizing contact and surface water leaching of chemicals in soil to groundwater; more permeable than engineered caps.	Contamination too shallow for practical installation of cap.	No
	Surface Water Controls					
	Grading	Smoothing of surface to grade after completion of excavation and backfilling.	Low	Effective in controlling surface water.	Implementable but not practical because of shallow contamination.	No
	Revegetation	Engineered landscaping and placement of plants, shrubs, or trees to restore site after excavation.	Moderate	Effective; minimizes erosion to prevent surface water ponding and chemical transport.	Implementable but not practical because of shallow contamination.	No

Table 2.7. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 3 (Cannibalization Yard Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
CONTAINMENT (cont.)	Surface Water Controls (cont.)					
	Diversion and collection systems	Series of pipes and basins to direct surface water away from area of concern; minimizes surface water infiltration and chemical transport.	Moderate	Effective in controlling surface water.	Implementable but not practical because of shallow contamination.	No
COLLECTION	Soil Removal					
	Excavation	Removal of soil by digging with commonly used heavy equipment.	Low	Highly effective for source removal.	Implementable; equipment readily available.	Yes
TREATMENT	Thermal Treatment					
	Rotary kiln incinerator	Combustion in a horizontally rotating cylinder designed for uniform heat transfer and waste destruction.	Moderate	Effective for removal of hydrocarbons from soil.	Mobile incineration is implementable.	No
	Fluidized bed incinerator	Injection into a hot agitated bed of sand where combustion occurs.	Moderate	Effective for removal of hydrocarbons from soil.	Mobile incineration is implementable.	No
	Circulating bed incinerator	Variation of fluidized bed incinerator using higher air velocity and circulating solids to create a larger and highly turbulent combustion zone.	Moderate	Effective for removal of hydrocarbons from soil.	Mobile incineration is implementable.	No
	Thermal oxidation (offgas)	High temperature (1400°F) destruction of organic vapors collected during treatment.	Low	Effective; however may require supplemental process to neutralize hydrochloric acid formed by any chlorinated compounds associated with heavy hydrocarbons.	Thermal treatment of offgas may be used as part of another treatment technology.	No

Table 2.7. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 3 (Cannibalization Yard Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Thermal Treatment (cont.)					
	Catalytic oxidation (offgas)	Lower temperature (600°F) destruction of organic vapors collected during treatment	Low	Effective for treatment of most hydrocarbon offgas.	Treatment of offgas may be used as part of another treatment technology.	No
	Chemical Treatment					
	Asphalt batching	Incorporation of soil into a cold or hot mix as an aggregate supplement in the manufacture of asphaltic concrete.	Moderate/ High	Effective if soil is an adequate substitute for aggregate typically used.	Equipment readily available. Requires pilot study.	No
	Physical Treatment					
	Soil vapor circulation	Application of a vacuum to extraction wells at low flow rates through unsaturated zone to biodegrade heavy hydrocarbons.	Low	Not effective for removal of hydrocarbons in permeable soils at shallow depths.	Not implementable because of shallow depth of contamination.	No
	Thermal desorption	Low temperature thermal treatment with a heated auger which causes volatilization of heavy hydrocarbons.	Moderate	Proven technology. Moderately effective for most heavy hydrocarbons.	Implementable. Equipment readily available.	No
	Screening	Removal of larger sized particles from the waste stream by passage through a screen.	Low	Effective for separation and homogenization of waste.	Implementable. Equipment readily available.	Yes
	Air injection	Injection of air into unsaturated zone to biodegrade heavy hydrocarbons.	Low	Moderately effective for removal of heavy hydrocarbons in permeable soils.	Not implementable because of shallow depth of contamination.	No
	Activated carbon adsorption (offgas)	Adsorption onto carbon of organic vapors collected during treatment.	Low	Effective for treatment of most hydrocarbon offgas.	Treatment of offgas may be used as part of another treatment technology.	No

Table 2.7. Summary of Retained Technologies for Alternative Development - Sites 2 and 12
Soil Remedial Unit 3 (Cannibalization Yard Area)
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Biological Treatment					
	Biodegradation (in situ)	Introduction of oxygen, nutrients, and/or bacteria to degrade hydrocarbons in soil.	Low	Effective for a wide variety of hydrocarbons.	Not implementable because of shallow depth of contamination.	No
	Biodegradation (ex situ)	Introduction of oxygen, nutrients, and/or bacteria to degrade heavy hydrocarbons in soil.	Low	Proven technology. Effective for a wide variety of hydrocarbons in excavated soil.	Implementable. Equipment readily available.	Yes
	Offsite Treatment					
	Thermal treatment	Use of high temperatures as principle means of destroying or detoxifying wastes.	High	Effective for heavy hydrocarbons.	Implementable.	No
	Biological treatment	Treatment of hydrocarbons using microorganisms at a commercial facility.	Moderate	Effective for heavy hydrocarbons.	Implementable.	No
DISPOSAL	Onsite Disposal					
	Landfill	Onsite waste management of chemical-bearing soil in an onsite waste unit.	Moderate	Effective for disposal of hydrocarbon waste.	Implementable.	Yes
	Replacement after treatment	Excavation and treatment with replacement into excavated area.	Low	Effective for soil treated to TCLs.	Implementable. Equipment readily available.	Yes
	Offsite Disposal					
	Landfill	Transport of chemical-bearing soil to an appropriate landfill by licensed waste transporter.	Moderate/ High	Effective, however pretreatment may be required depending upon hydrocarbon concentrations.	Implementable.	No

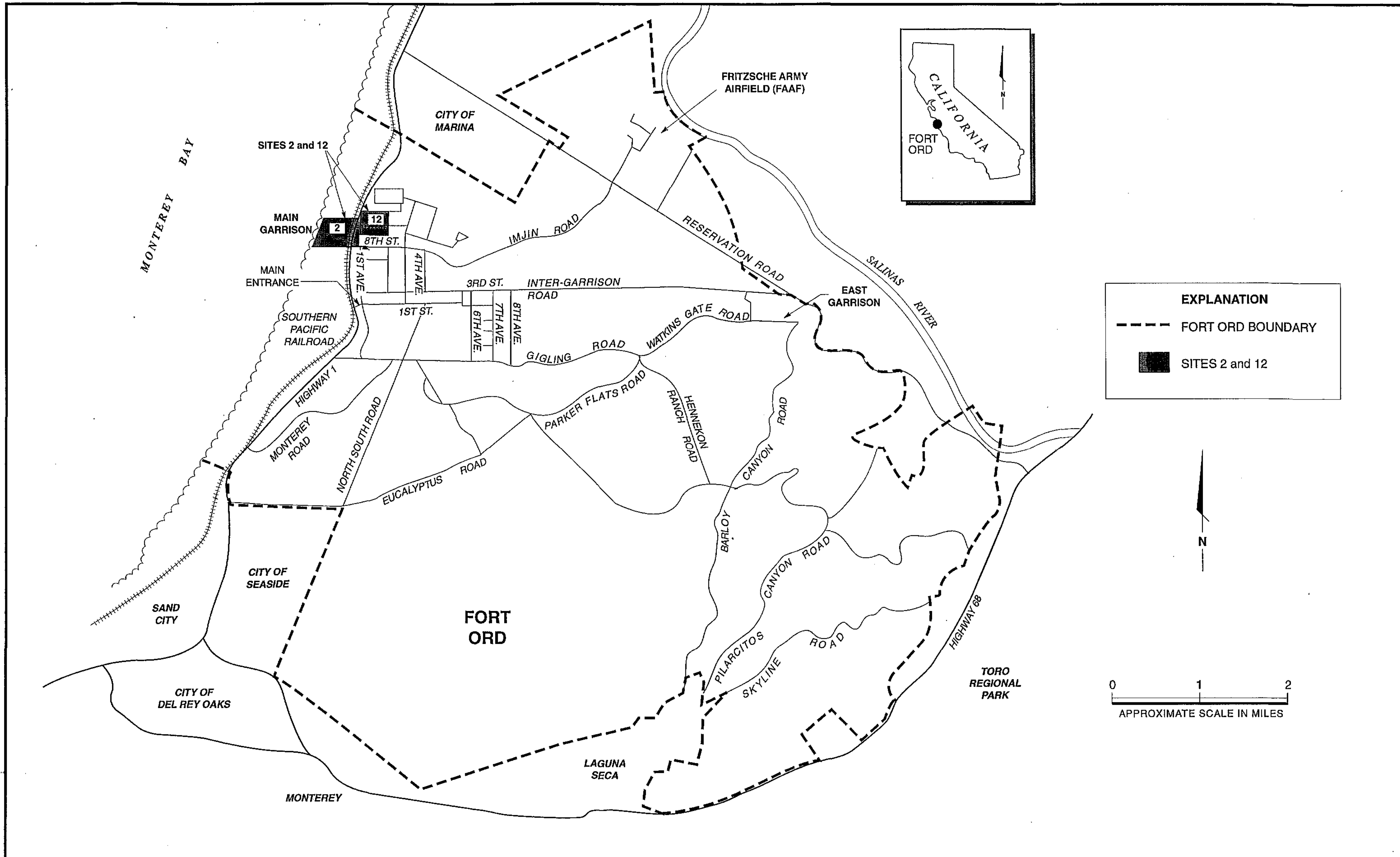
Table 2.8. Summary of Sitewide Remedial Alternatives - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternative	Groundwater Remedial Unit (VOC plume)	Soil Remedial Unit 1 (Lower Meadow Disposal Area)	Soil Remedial Unit 2 (Outfall 31 Area)	Soil Remedial Unit 3 (Cannibalization Yard Area)
1	No action	No action	No action	No action
2	Groundwater extraction, POTW discharge	Capping, surface controls and deed restriction	Capping, surface controls and deed restriction	Excavation with onsite treatment and disposal of TPH-affected soil
3	Groundwater extraction, treatment, NPDES discharge, and reuse (Alternative 3A), or injection (Alternative 3B)	Capping of debris and deed restriction; selective excavation with onsite treatment and disposal of TPH-affected soil	Excavation with onsite treatment and disposal of TPH-affected soil	Excavation with onsite treatment and disposal of TPH-affected soil
4	Groundwater extraction, treatment, NPDES discharge, and reuse (Alternative 4A), or injection (Alternative 4B)	Excavation, segregation, onsite disposal of debris; onsite treatment and disposal of TPH-affected soil	Excavation with onsite treatment and disposal of TPH-affected soil	Excavation with onsite treatment and disposal of TPH-affected soil

Table 2.9. Evaluation of Remedial Alternatives - Sites 2 and 12
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Retained for Detailed Analysis in the FS	EPA Evaluation Criteria							
	Protection of Human Health and the Environment	Compliance with ARARs	Long-term Effectiveness	Reduction of Toxicity, Mobility, and Volume Through Treatment	Short-term Effectiveness	Implementability (Technical and Administrative)	Cost ($1,000)	Regulatory Agency and Community Acceptance
Alternative 1 No action except groundwater and surface water outfall monitoring	Not protective of human health for drinking water ingestion.	Will not meet chemical-specific ARAR for groundwater. Will not meet soil remedial goal for elevated TPH levels in soil.	Residual risk remains until natural attenuation of VOCs in groundwater. Debris and TPH in soil remain in place with no reliable risk controls.	Provides no active reduction of toxicity, mobility, or volume of VOCs in groundwater or TPH in soil.	There is no short-term effectiveness.	No implementation required other than monitoring. Uses proven technologies for monitoring wells and surface water outfalls.	O&M Cost = $119/year NPV = $1,838	Likely not acceptable to agencies or community.

PLATES



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT		23366 0417151			DJP
2	12/94	DRAFT FINAL		23366 0417251			DJP
3	10/95	FINAL		23366 0417251	MLS	10/17/95	

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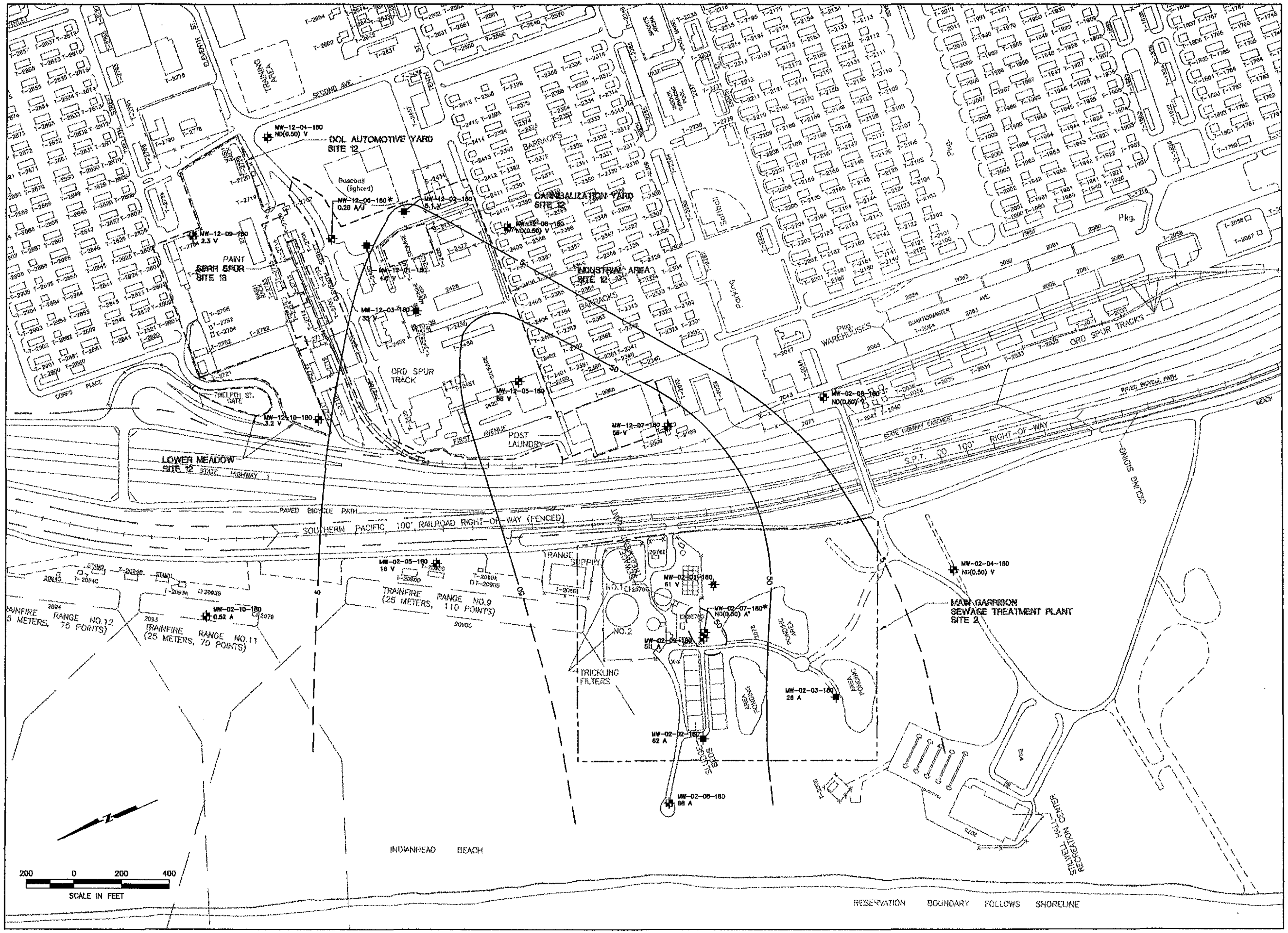
Harding Lawson Associates
Engineering and Environmental Services

Volume V - Feasibility Study
Basewide RI/FS
Fort Ord, California

Site Vicinity Map
Sites 2 and 12

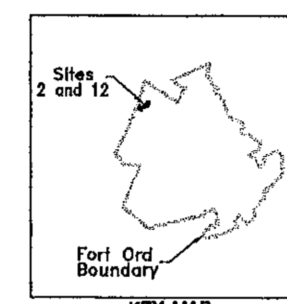
PLATE 2.1



EXPLANATION

- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- WASH RACK
- CURRENT HAZARDOUS WASTE STORAGE AREA
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- FENCE
- CONCENTRATIONS IN MICROGRAMS/LITER
- 26 A — PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLES 42a AND 42b IN VOLUME II – RI, SITES 2 AND 12.
- ND(0.50) — NOT DETECTED AT THE REPORTING LIMIT SHOWN IN PARENTHESES
- * — DATA NOT USED IN CONTOURING; WELL IS SCREENED IN A DIFFERENT INTERVAL.
- 5 — CHEMICAL CONCENTRATION CONTOUR IN µg/l DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN.

NOTE: THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.



KEY MAP

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2	12/94	DRAFT FINAL	23366347	23366 0417251			KF
3	10/95	FINAL	23366347	23366 0417251	MLC	10/17/95	KF

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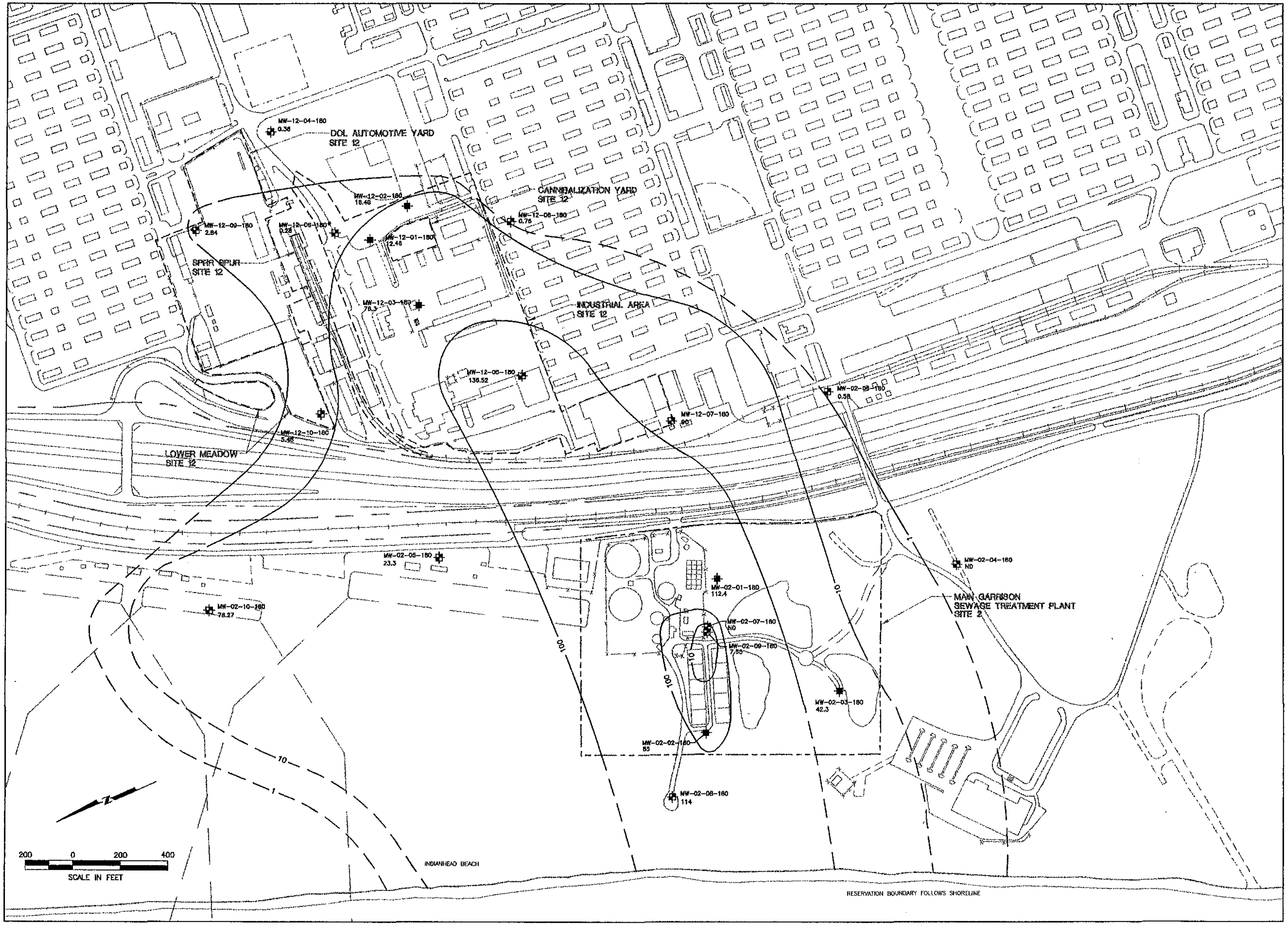
Basewide RI/FS
Fort Ord, California

Distribution of TCE in Groundwater
Upper 180-Foot Aquifer, February 1994
Sites 2 and 12

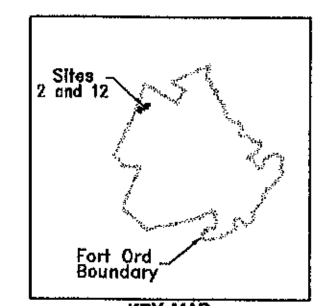
PLATE: 2.2



EXPLANATION

- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- CURRENT HAZARDOUS WASTE STORAGE AREA
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE
- 82 CONCENTRATIONS IN MICROGRAMS/LITER
- ND NOT DETECTED
- 5 CHEMICAL CONCENTRATION CONTOUR IN µg/l DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN.
- * MONITORING WELL RESULTS NOT USED DURING CONTOURING

NOTE: THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.



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2	12/94	DRAFT FINAL	23366346	23366 0417251			KF
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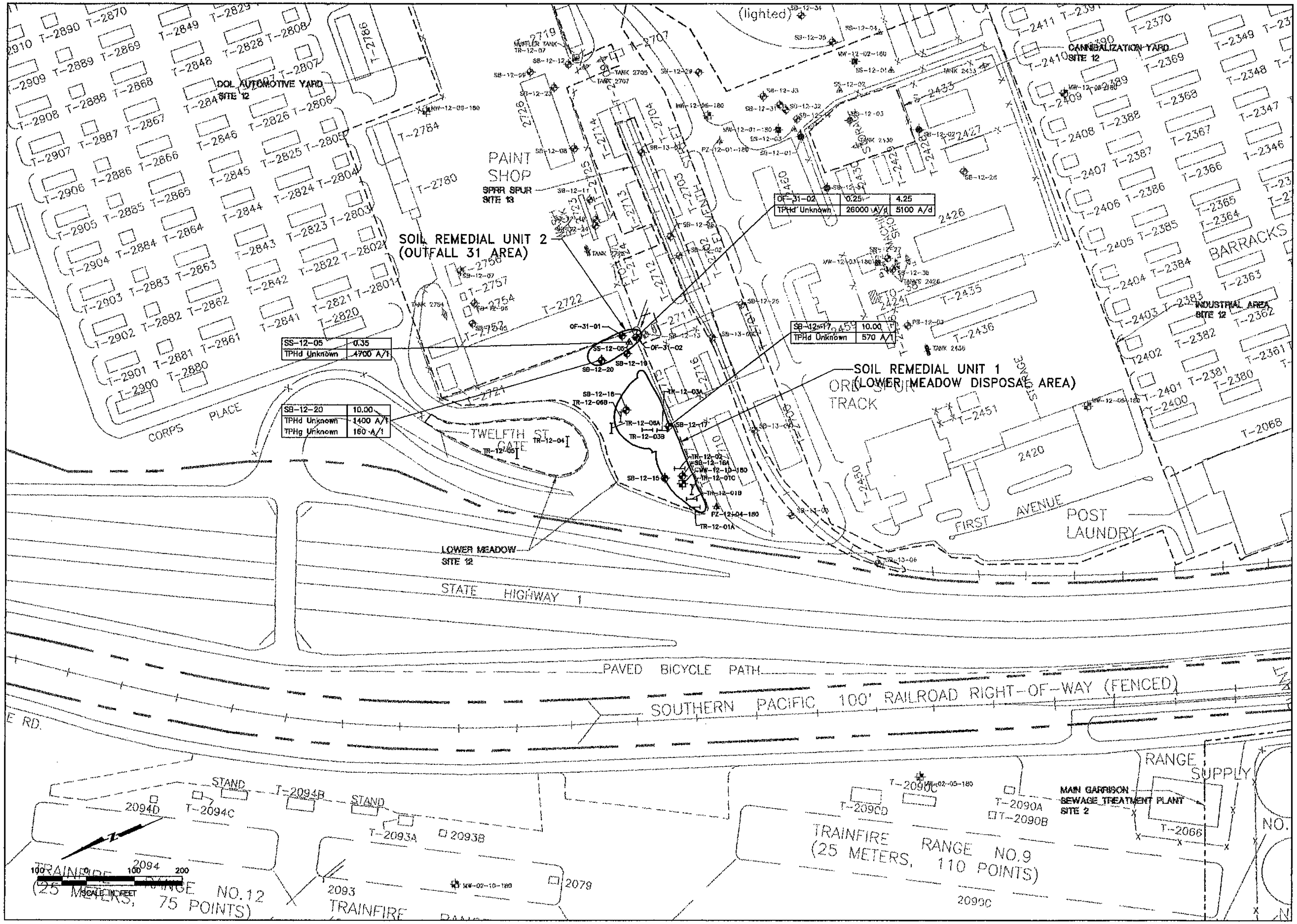
Distribution of Total VOCs in Groundwater
February 1994
Sites 2 and 12

PLATE: **2.3**



EXPLANATION

- TEST PIT
- SURFACE SOIL SAMPLE (HLA)
- SOIL BORING/PILOT BORING (HLA)
- MONITORING WELL (HLA)
- PIEZOMETER NEST (HLA)
- SOIL BORING (BY OTHERS)
- MONITORING WELL (BY OTHERS)
- FORMER UNDERGROUND STORAGE TANK
- EXISTING ABOVEGROUND STORAGE TANK
- UNDERGROUND MUFFLER
- WASH RACK
- OIL/WATER SEPARATOR
- CURRENT HAZARDOUS WASTE STORAGE AREA
- LIMITS OF REMEDIAL UNITS
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE

SAMPLE LOCATION — SAMPLE DEPTH IN FEET BELOW GROUND SURFACE

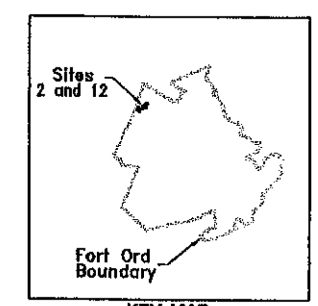
TR-12-02	8.50
TPHd Unknown	0.19 A/J

PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLES 42a AND 42b IN VOLUME II - RI, SITES 2 AND 12.

CONCENTRATIONS IN mg/kg

ANALYTES— INCLUDES ALL DETECTED ORGANICS;

NOTE:
LIMITS OF REMEDIAL UNIT 1 ARE INTERPRETED EXTENT OF DEBRIS AND DISTURBED SOIL BASED ON EM31-D AND GPR DATA



KEY MAP

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2	12/94	DRAFT FINAL	23366352	23366 0417251			KF
3	10/95	FINAL	23366352	23366 0417251	MLS	10/17/95	KF

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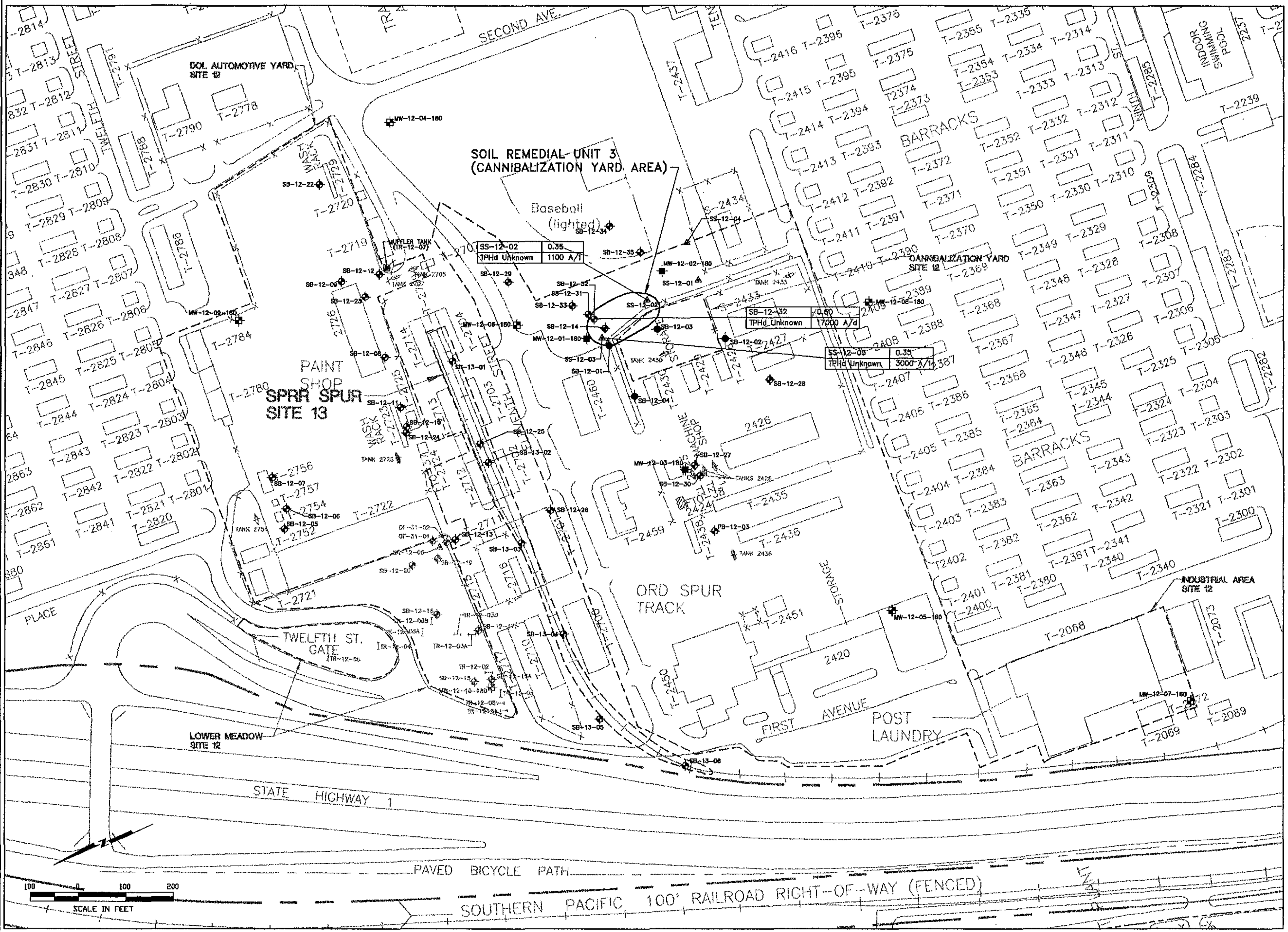
Fort Ord, California

TPH Concentrations Greater than 500 mg/kg
Soil Remedial Units 1 and 2
Lower Meadow, Site 12

PLATE: 2.4



EXPLANATION

- TEST PIT
- SURFACE SOIL SAMPLE (HLA)
- SOIL BORING/PILOT BORING (HLA)
- SOIL BORING (BY OTHERS)
- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- PIEZOMETER NEST (HLA)
- EXISTING UNDERGROUND STORAGE TANK
- FORMER UNDERGROUND STORAGE TANK
- EXISTING ABOVEGROUND STORAGE TANK
- UNDERGROUND MUFFLER
- WASH RACK
- OIL/WATER SEPARATOR
- FORMER HAZARDOUS WASTE STORAGE AREA
- LIMITS OF REMEDIAL UNITS
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE

POSTING OF CHEMICALS

SAMPLE LOCATION

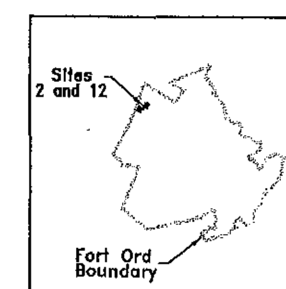
SAMPLE DEPTH IN FEET BELOW GROUND SURFACE

SS-12-03	0.35
TPHd Unknown	3000 A/f

PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLES 42a AND 42b IN VOLUME II – RI, SITES 2 AND 12.

CONCENTRATIONS IN mg/kg

ANALYTES



KEY MAP

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3	10/95	FINAL	23366590	23366 0417252	MLS	10/17/95	KF

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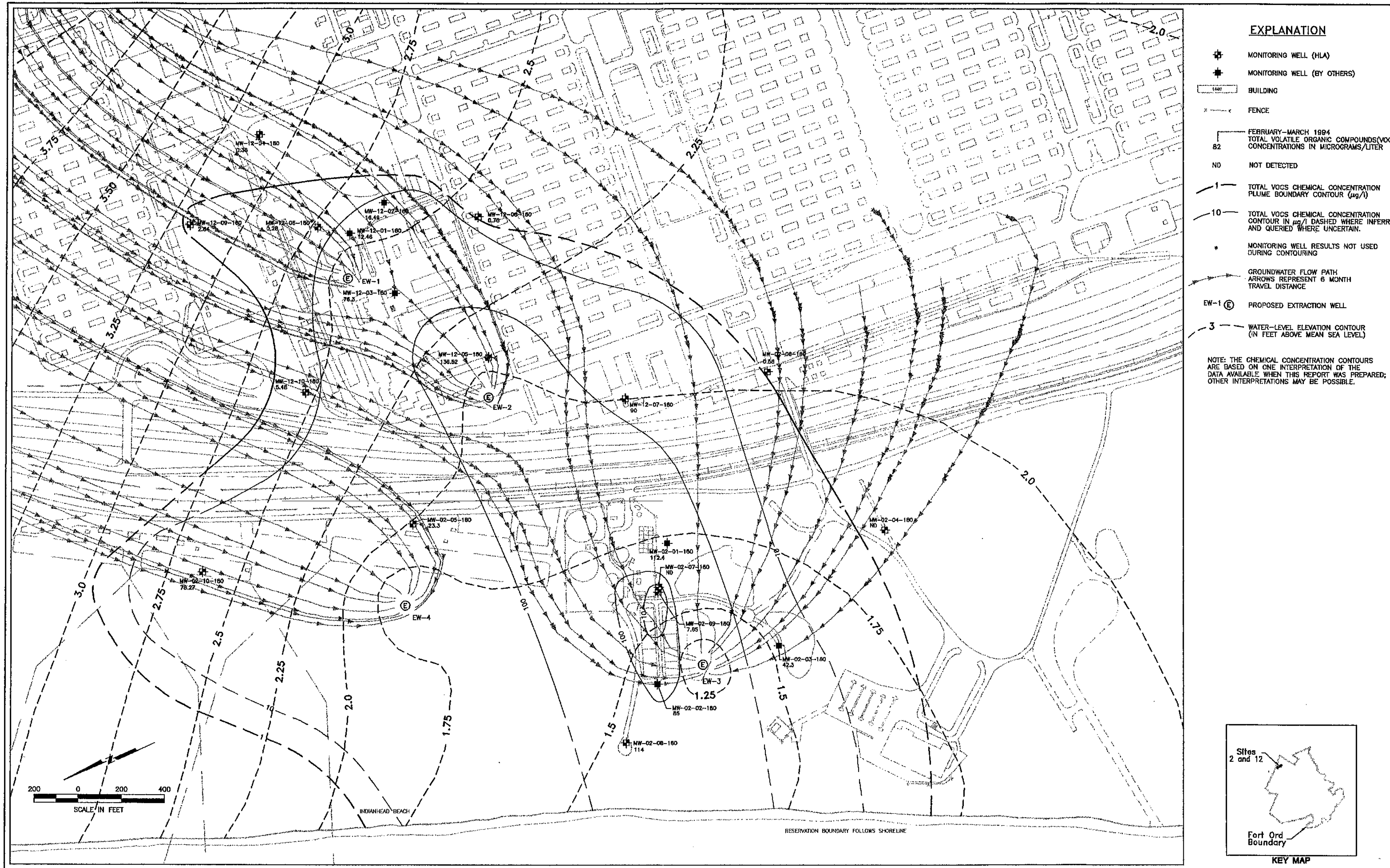
Basewide RI/FS
Fort Ord, California

TPH Concentrations Greater Than 500 mg/kg
Soil Remedial Unit 3
Site 12

PLATE: **2.5**



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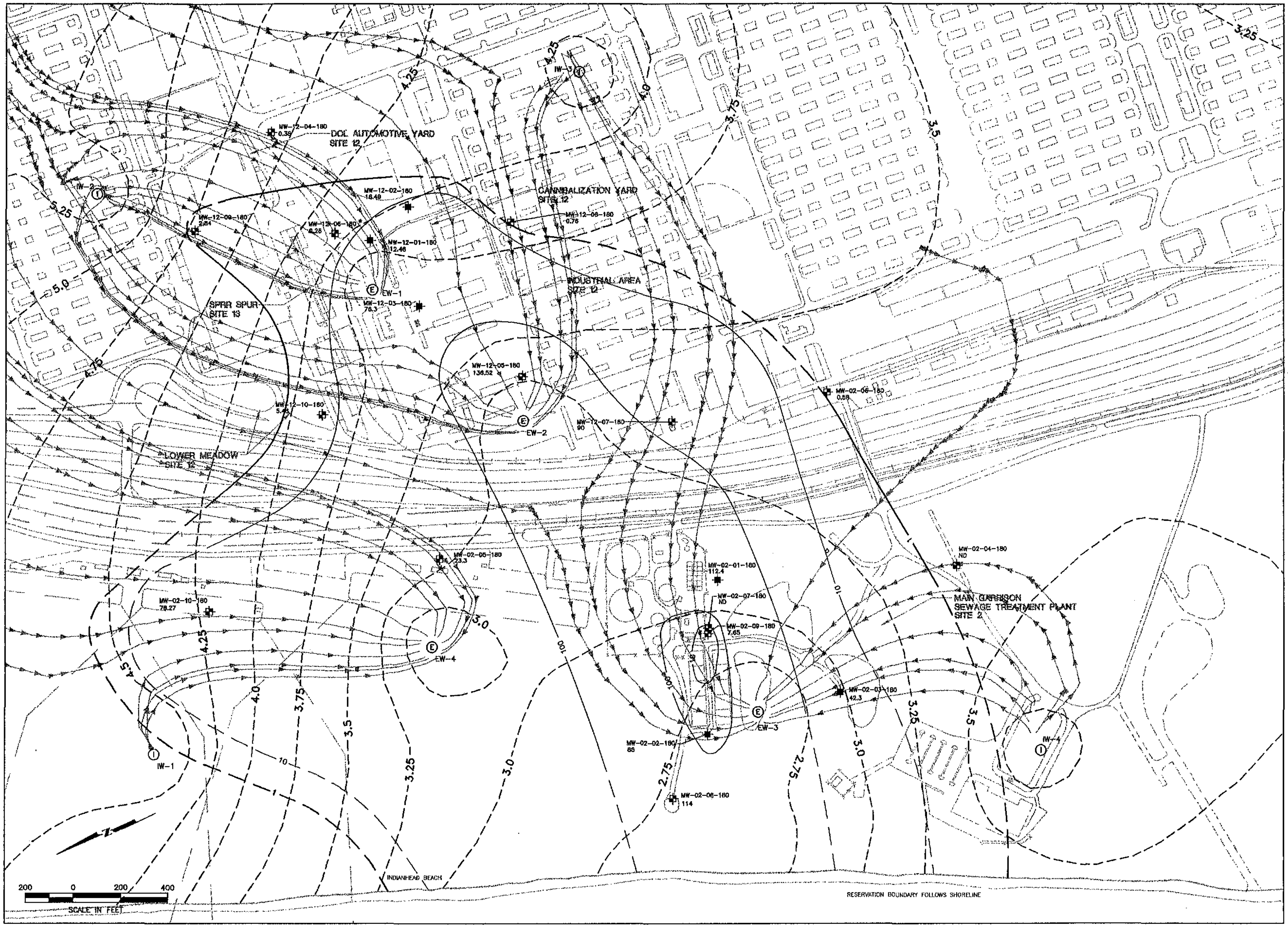
Basewide RI/FS
Fort Ord, California

Pumping Scenario 1
Estimated Groundwater Flow Paths
Sites 2 and 12

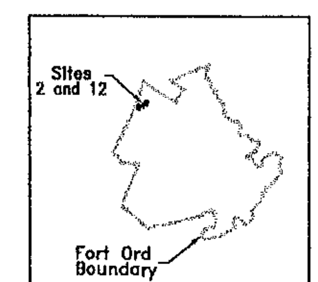
PLATE: 2.6



EXPLANATION

- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- BUILDING
- FENCE
- 82 — FEBRUARY–MARCH 1994 TOTAL VOLATILE ORGANIC COMPOUNDS(VOCS) CONCENTRATIONS IN MICROGRAMS/LITER
- ND — NOT DETECTED
- 1 — TOTAL VOCS CHEMICAL CONCENTRATION PLUME BOUNDARY CONTOUR (µg/l)
- 10 — TOTAL VOCS CHEMICAL CONCENTRATION CONTOUR IN µg/l DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN.
- * — MONITORING WELL RESULTS NOT USED DURING CONTOURING
- GROUNDWATER FLOW PATH ARROWS REPRESENT 6 MONTH TRAVEL DISTANCE
- EW-1 (E) — PROPOSED EXTRACTION WELL
- IW-1 (I) — PROPOSED INJECTION WELL
- 3 — WATER-LEVEL ELEVATION CONTOUR (IN FEET ABOVE MEAN SEA LEVEL)

NOTE: THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.



KEY MAP

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2	12/94	DRAFT FINAL	23366396	23366 0417251			KF
3	10/95	FINAL	23366396	23366 0417251	MLS	10/17/95	KF

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Basewide RI/FS
Fort Ord, California

Pumping Scenario 2
Estimated Groundwater Flow Paths
Sites 2 and 12

PLATE: 2.7

APPENDIX 2A

GROUNDWATER MODELING AND REMEDIAL SYSTEM EVALUATION

CONTENTS

TABLES

PLATES

2A1.0 INTRODUCTION

This appendix summarizes the methodologies and results of the predictive groundwater flow and solute transport modeling conducted during the preliminary groundwater extraction/injection system design and evaluation for Sites 2 and 12. The modeling investigation used the results of the Basewide Hydrogeologic Characterization (Volume II - Remedial Investigation [RI], Basewide HC), of the RI for Sites 2 and 12 (Volume II - RI, Sites 2 and 12) and the Fort Ord Groundwater Model (Volume II - RI, Basewide HC, Appendix D) to develop conceptual and numerical models of groundwater flow and groundwater plume transport in the Upper-180 foot aquifer at Sites 2 and 12. Potential groundwater pumping scenarios were simulated and evaluated using numerical groundwater flow models to determine feasible groundwater extraction/injection system designs.

The objectives of the modeling are to evaluate potential groundwater extraction/injection options including potential groundwater extraction/injection well configurations, flow rates, groundwater flow paths and hydraulic capture zones, aquifer restoration times, and chemical mass removal rates.

The scope of the evaluation consists of three modeling components:

- An initial system screening evaluation of potential groundwater extraction/injection scenarios was conducted using the two-dimensional analytical groundwater flow model QUICKFLOW of Geraghty & Miller, Incorporated (*GMI [1991]*). The analytical groundwater flow model was used to simply evaluate a variety of extraction/injection, well placement, and pumping rate scenarios. Specifically, simulated steady-state water level elevations, groundwater flow paths, and capture area geometries for the various extraction system configurations were reviewed and compared. Based on the results of the screening evaluation, two relatively efficient extraction/injection scenarios were selected for further detailed analysis using numerical groundwater flow and solute transport models.
- Detailed evaluation of two selected pumping scenarios was conducted using a four-layer MODFLOW finite-difference groundwater flow model (*USGS, 1988*) hereafter identified as the Fort Ord Groundwater Model (FOGM). The FOGM development, construction, and results are described in detail in Volume II - RI, Basewide HC, Appendix D. The results from the FOGM were used as input for the particle tracking model PATH3D (*Zheng, 1989*) to estimate the flow paths associated with the pumping scenarios. The groundwater pumping scenarios were evaluated for their capture areas, Monterey Bay boundary effects, and potential effects on the Operable Unit 2 (OU 2) groundwater plume.
- Evaluation of aquifer restoration times and chemical mass removal rates was conducted using the numerical solute transport model MT3D (*Zheng, 1990*) with the FOGM advective groundwater flow results. Solute transport modeling was used to evaluate the chemical mass removal rates of the different pumping scenarios.

2A2.0 METHODS

The following section describes the methods used for the modeling evaluation of various groundwater remediation scenarios at Sites 2 and 12. Detailed descriptions and discussion of Sites 2 and 12 geology, hydrogeology, and groundwater chemistry are presented in Volume II - RI, Sites 2 and 12.

2A2.1 Initial System Screening Evaluation

Review of the Sites 2 and 12 aquifer lithologies, pumping test results, groundwater elevations, and groundwater volatile organic compound (VOC) concentrations indicated that the aquifer properties and flow conditions in the study area are relatively homogeneous and uniform (see below); therefore, simulation of the groundwater flow system in this area using a two-dimensional analytical groundwater flow model was appropriate for an initial screening of various groundwater extraction scenarios.

2A2.1.1 QUICKFLOW Screening Model

The effects of a variety of extraction/injection scenarios were simulated using the analytical groundwater flow model QUICKFLOW. QUICKFLOW simulates steady-state or transient flow in a homogeneous, two-dimensional confined or unconfined aquifer and incorporates the effects of multiple extraction and/or injection wells. Both hydraulic heads and streamlines are computed analytically.

2A2.1.2 Screening Model Input Parameters

Results of aquifer tests performed on Wells MW-02-09-180 and MW-12-06-180 (Volume II - RI, Sites 2 and 12, Section 3.5.4.2) indicated that the system was relatively homogeneous with hydraulic conductivities ranging from 250 to 190 feet per day (ft/day) at Sites 2 and 12, respectively. Boring logs from Sites 2 and 12 indicated that the Upper-180 foot aquifer lithology in the Site 2 and 12 area is generally a homogeneous sand aquifer with an average saturated thickness of 85 feet. Groundwater flow gradients during 1993 in the Site 2 and 12 area ranged from 0.00069 to 0.00035 feet per foot (ft/ft) (Volume II - RI, Sites 2 and 12, Plates 7, 8, and 9). The direction of groundwater flow in the Site 2 and 12 area range from approximately west 10 degrees south (W10S) to west 30 degrees south (W30S). These hydrogeologic parameter values were averaged and used as input to the analytical flow model (Table 2A1). Nineteen extraction and injection scenarios were simulated during the screening evaluation. Up to 6 extraction wells and 10 injection wells were simulated at flow rates of 50 to 200 gallons per minute (gpm) per well (Table 2A2).

Average groundwater travel times to extraction wells were estimated during QUICKFLOW modeling from the travel times of particles introduced at the plume boundary and captured by the extraction wells. Particles were distributed evenly around the perimeter of the plume in the same pattern for all the evaluations. Particle travel times to extraction wells were averaged to create an average travel time for extraction scenario simulations. Average plume capture travel times are listed in Table 2A2.

During the initial screening evaluation, the following constraints were considered when developing the specific pumping scenarios. Well locations were selected to minimize or avoid areas where well construction would be impractical such as Highway 1, ecologically sensitive dune sands, and existing structures. When groundwater injection was included in a pumping scenario, the total injection rate was generally set equal to the total extraction rate.

2A2.2 Detailed Scenario Evaluation

Based on the results of the screening model, two pumping scenarios were selected for detailed evaluation using the FOGM (Table 2A3). The modeled steady-state water levels of the pumping scenarios were compared to modeled steady-state water levels under ambient flow (non-pumping conditions) to evaluate the effects of pumping. The modeled steady-state water-levels of ambient flow are developed and described in Volume II - RI, Basewide HC.

2A2.2.1 Fort Ord Groundwater Model

Detailed descriptions of the features and limitations of the FOGM are presented in Volume II - RI, Basewide HC, Appendix D. This appendix also describes the FOGM input parameter values, model construction, and model calibration. A summary of the FOGM follows.

The finite-difference numerical advective flow computer model code MODFLOW was used to create the FOGM. The FOGM domain encompassed the Main Garrison area occurring in the Salinas basin. Model boundaries generally coincided with hydrogeologic boundaries: (1) such as Monterey Bay shoreline, (2) Monterey Shale bedrock high/Salinas Basin southern boundary, (3) and the A-aquifer groundwater divide. Model boundaries that did not coincide with hydrogeologic boundaries were modeled as general head boundaries.

The four-layer numerical model was designed to represent the A-aquifer, the Fort Ord-Salinas Valley Aquiclude, the Upper-180 foot aquifer, the Intermediate 180-foot aquitard, and the Lower 180-foot/400-foot aquifers. Heterogeneous hydraulic conductivity values used in the model were derived from either in situ aquifer testing, laboratory physical testing, or literature values for similar geologic materials. Input parameters were refined during model calibration as described in Volume II, Basewide Hydrogeologic Characterization, Appendix D.

The FOGM was calibrated to simulate steady-state groundwater flow conditions at Fort Ord. Short-term transient simulations (3 days) indicated that storativity values used in the model adequately simulate observed transient trends associated with groundwater extraction. The FOGM was not calibrated under multiple-year (long-term) transient conditions.

2A2.2.2 PATH3D Model

The water-level elevations calculated from the FOGM were used as input to the computer program PATH3D (*Zheng, 1989*) to estimate steady-state groundwater flow paths and capture zones of the remediation systems. Aquifer parameters used as input to FOGM and PATH3D were identical. The simulated hydraulic head arrays from the FOGM were input to PATH3D.

In PATH3D, particles were input at the extraction wells and are traced backward in an upgradient direction from the extraction well, thus forming reverse flow paths from the extraction well. These flow paths are shown as vectors which represent the distance the water moves in a 6-month period.

2A2.3 Aquifer Restoration Time Evaluation

The aquifer restoration time for selected pumping scenarios were estimated using the solute transport model, MT3D (*Zheng, 1990*). VOC concentrations over time were calculated within the model domain to estimate the time required to attain target groundwater cleanup levels.

2A2.3.1 MT3D Solute Transport Model

The solute transport flow model, MT3D, is a numerical computer model which simulates advection, dispersion, and chemical reactions within a three-dimensional groundwater flow system. The model uses a Eulerian-Lagrangian approach to solve the advective-dispersive-reactive equation based on the method of characteristics (MOC) and the modified method of characteristics (MMOC).

The MT3D model code was developed for use with the FOGM model code (MODFLOW), a block-centered, finite-difference groundwater flow model code. The application of the MT3D modeling code in conjunction with the MODFLOW code assumes that changes in the concentration field will not affect the flow field significantly.

The MT3D transport model can be used to simulate the change in concentration of single species miscible contaminants in groundwater considering advection, dispersion, equilibrium-controlled linear or nonlinear sorption, and first-order irreversible decay or biodegradation.

2A2.3.2 Solute Transport Model Input Parameters

Input parameters for the MT3D model included the same physical aquifer properties and extraction/injection well characteristics used in the FOGM and PATH3D models, along with the hydraulic heads and volumetric fluxes across nodal cell interfaces calculated with FOGM. In addition, physiochemical properties including aquifer dispersivities, chemical retardation factors, and decay rates were required as input (Table 2A4). Initial chemical conditions were also defined throughout the model domain by superimposing the model grid over contoured total VOC concentrations and interpolating initial plume concentrations at each model node. Groundwater extraction and chemical mass removal was then simulated over time. This solute transport modeling is based on the following assumptions:

- The source of VOCs observed in groundwater is no longer present. The mass of VOCs present is limited to the dissolved fraction observed in groundwater samples.

- The dissolved VOCs are quantified as total VOCs based on the February 1994 groundwater quality data. The VOCs are assumed to be present throughout the Upper-180-foot aquifer. The quantification of the plume as total VOCs was conducted to conservatively estimate the largest contiguous plume area with the highest concentrations.

- Retardation using a retardation factor (1.54) estimated from the distribution coefficient divided by the fraction of organic carbon in water (Koc) for trichloroethene (TCE) of 125 cubic centimeters per gram (cm^3/g) and an estimated foc (0.0005). The retardation properties of TCE were selected to represent the total VOC plume because the majority of the plume is TCE. The foc value was derived from chemical analyses described in Volume II - RI, Basewide HC, Table 4.

- VOC decay is assumed too insignificant and therefore is not simulated.

- Dispersion is simulated using the assumed values of 10 feet for longitudinal, 1 foot for transverse, and 0.1 foot for vertical dispersivity. These parameters were derived from *Applied Groundwater Modeling* by *Anderson and Woesner,* Academic Press, Inc., *1992*) and are assumed to be reasonable first approximations for these analyses.

2A3.0 DEVELOPMENT OF GROUNDWATER PUMPING SCENARIOS

2A3.1 Approach

Groundwater pumping scenario development consisted of a three-phase process. The initial screening evaluation phase explored the feasibility of a variety of pumping scenarios using QUICKFLOW. Based on information developed during the initial screening evaluation, two pumping scenarios were selected for more detailed evaluation. As part of the detailed second-phase evaluation, the selected pumping scenarios were simulated using FOGM and PATH3D. During the third phase, aquifer restoration times and mass removal rates for the pumping scenarios were evaluated using the FOGM and MT3D.

2A3.2 Initial System Screening Evaluation Using QUICKFLOW

The development of groundwater extraction scenarios considered the following objectives: (1) establish hydraulic containment of the Site 2 and 12 VOC plume, (2) expedite groundwater cleanup times, and (3) minimize the potential for induced seawater intrusion.

To expedite groundwater cleanup times, the simulated extraction wells were located so that the travel distance of contaminated groundwater to the extraction well was minimized and the groundwater gradient across the plume area was maximized.

Nineteen different groundwater pumping scenarios were evaluated for hydraulic containment of the VOC plume, travel times to extraction wells, and the potential for seawater intrusion. System configurations evaluated are described in Table 2A2 with comments summarizing the results of the model run. Based on the initial screening evaluation, two pumping scenarios were selected for further evaluation.

2A3.2.1 Scenario Development and Screening Model Results

The QUICKFLOW modeling proceeded in four phases. In the first phase, the pumping rates required the complete capture of the contaminant plume while attempting to preclude seawater intrusion into the model. For this series of model simulations, a line of extraction wells aligned along the longitudinal axis of the plume was used. Five model simulations were performed in this series: FO1, FO1HR, FO1LR, FO1B, and FO10B (see Table 2A2). The maximum hydraulic containment effect was

The objective of the first two model simulations in this phase was to establish the baseline pumping rate required for hydraulic plume capture for the extraction-only scenario. In Simulation FO5A, all of the extraction wells were located west of the highway, while for Simulation FO5B, one 50 gpm extraction well was moved to the east side of the highway. Both runs had a total pumping rate of 300 gpm, and resulted in nearly identical capture zones and travel times. However, a portion of the northwest plume area was not captured. Injection wells were then simulated in Simulations FO5C, FO5D, and FO5E. The well placement on the west side of the highway is the same for each of these runs: two extraction wells and two injection wells, each pumping at 125 gpm. On the east side of the highway, Simulation FO5C had one extraction well pumping at 100 gpm and two injection wells pumping at 50 gpm, Simulation FO5D had no wells on the east side of freeway, and Simulation FO5E had two extraction wells and two injection wells, each at 100 gpm. The capture zones for these three model simulations are very similar, the main difference is in the average capture travel times predicted, ranging from an average of 7.7 years for Simulation FO5D to 4.0 years for Simulation FO5E.

2A3.2.2 Analysis of Screening Model Results

The feasibility and effectiveness of the simulated well configurations were judged in terms of hydraulic containment (i.e., plume capture) groundwater cleanup times (i.e., estimated travel times), and the potential for seawater intrusion. The well configuration selected for further evaluation consisted of modified versions of Simulations FO5B (four extraction wells pumping at 100 gpm each) and FO5E (two extraction wells pumping at 125 gpm west of the highway, two extraction wells pumping at 100 gpm east of the highway, and four injection wells pumping at rates equal to the adjacent extraction wells). Simulation FO5E was determined to be the optimum model simulation in the system screening evaluation and was selected for further evaluation using the FOGM and the MT3D model.

Two FOGM simulations were performed to evaluate those well configurations, one scenario simulated pumping wells only and one simulated both pumping and injection wells. The two selected pumping scenarios are hereafter referred to as Pumping Scenario 1 (extraction with no injection [Plate 2A1]) and Pumping Scenario 2 (extraction with perimeter injection [Plate 2A2]).

The screening evaluation process yielded the following general points to consider during groundwater extraction system design in the Sites 2 and 12 area:

- Efficient plume capture in the western portion of the plume is best accomplished with two wells located in a line parallel to Monterey Bay shoreline. This configuration maximizes the area of groundwater capture while minimizing the potential for sea water intrusion.

- Groundwater injection along the upgradient and across gradient perimeter of the plume accelerates the groundwater velocities to the extraction wells within the plume area. Groundwater injection near the southwest and northwest Monterey Bay plume boundaries decreases the ability to capture the plume in those areas.

- The total pumping system extraction rate to obtain complete capture while minimizing potential seawater intrusion is estimated to be between 300 and 450 gpm.

2A3.3 Detailed Evaluation Using FOGM, PATH3D, MT3D

The selected extraction/injection scenarios were simulated using the FOGM, PATH3D, and MT3D to further evaluate the performance of the two selected pumping configurations relative to: (1) the hydraulic effects on the Upper 180-foot aquifer, (2) the hydraulic effects on the Lower 180-foot aquifer and OU 2 Groundwater plume, (3) the effects of seawater intrusion, (4) aquifer restoration times, and (5) chemical moss removal rates.

Pumping Scenario 1 and Pumping Scenario 2 (Plates 2A1 and 2A2, respectively) are similar in that the number and location of extraction wells are identical. Pumping Scenario 2 differs from Pumping Scenario 1 in that it includes four injection wells. Table 2A3 lists the extraction and injection rates simulated for the two systems.

2A3.3.1 Hydraulic Effects on Upper 180-Foot Aquifer

The two pumping scenarios were simulated under transient conditions for a 30-year time period. Model results indicate that Scenario 1 achieves quasi-steady-state conditions in approximately 7.4 years and that Scenario 2 achieves quasi-steady-state conditions in approximately 76 days. Scenario 2 quickly obtained steady-state conditions because of the rapid coalescence of the cone of depression around the extraction wells and the boundary effects of the injection well system. Scenario 1 required significantly longer time to reach steady-state conditions and has a much larger cone of depression.

The steady-state time estimates were approximate due to the following limitations. The storativity values used in the FOGM have not been verified by multiple-year transient calibration simulations. The MT3D model results have not had transient calibration or sensitivity analysis. These limitations are due to the absence of the detailed transient water-level and chemical concentration data necessary for model calibration.

Plates 2A3 and 2A4 present the model simulated steady-state water-level elevations and local groundwater flow paths for Scenarios 1 and 2, respectively. Simulated groundwater flow paths for Scenarios 1 and 2 indicate that all groundwater approaching the extraction wells from upgradient is captured (Plates 2A3 and 2A4). However, groundwater located downgradient of the extraction wells adjacent to Monterey Bay is not captured by the extraction wells. This groundwater contains an estimated total VOC mass of approximately 81 and 77 kilograms (kgs) in Scenarios 1 and 2, respectively. A portion of this chemical mass may be captured by the extraction wells during high tides when groundwater flow in the Upper 180-foot aquifer is inland. However, the majority of this mass will most likely be discharged to Monterey Bay. This equates to a maximum mass flux rate of 7.4 grams per day assuming the mass is uniformly discharged to Monterey Bay over the 30-year simulation period. As shown by the QUICKFLOW simulations (Simulation FO3), groundwater capture can be improved adjacent to Monterey Bay without the deleterious effects of seawater intrusion by installing injection wells directly adjacent to Monterey Bay. However, this well configuration was not evaluated further in this report due to the constraints of installing injection wells on the biological sensitive sand dunes adjacent to Monterey Bay.

2A3.3.2 Hydraulic Effects on Lower 180-Foot Aquifer and OU 2 Groundwater Plume

Statistical comparison of the FOGM simulated steady-state water levels under ambient flow conditions (i.e., no groundwater pumping) to those under Scenarios 1 and 2 (Tables 2A5 and 2A6) indicate that the system has an insignificant effect on the underlying Lower 180-foot aquifer. The maximum water-level change calculated for the Lower 180-foot aquifer wells at Site 2/12 (PZ-02-01-180L, PZ-02-02-180L, PZ-12-01-180L, and PZ-12-04-180L) was 0.02 and 0.003 feet for scenarios 1 and 2, respectively.

Scenario 1 appears to lower the Upper 180-foot aquifer water levels approximately 1 foot near wells MW-OU 2-20-180, MN-OU 2-20-A and MW-OU 2-34-A in the region between Sites 2 and 12 and the OU 2 Landfill plume (Table 2A5). This change in water level will likely induce additional movement of portions of the OU 2 plume toward Sites 2 and 12. Simulated groundwater flow paths for Scenario 1 are shown relative to the OU 2 Landfill groundwater plume on Plates 2A5.

Scenario 2 does not appear to have a significant effect on the Upper 180-foot aquifer water levels in the region between Sites 2 and 12 (Table 2A5) and the OU 2 Landfill plume area. This absence of change in water level indicates that Scenario 2 will not induce movement of portions of the OU 2 Landfill groundwater plume toward Sites 2 and 12. Simulated groundwater flow paths for Scenario 2 are shown relative to the OU 2 Landfill groundwater plume on Plate 2A6.

2A3.3.3 Effects on Seawater Intrusion

The model results indicate that sea water intrusion will not be induced as a result of the implementation of Scenarios 1 and 2 Scenario 1 groundwater extraction lowers simulated Upper 180-foot aquifer water levels approximately 2 feet at the Monterey Bay boundary resulting in steady-state water-level elevations between 1 and 2 feet above mean sea level (MSL). Similarly, Scenario 2 extraction and injection lowers water levels in the Upper 180-foot aquifer approximately 1 foot at the Monterey Bay boundary resulting in a steady-state water-level elevations between 2 and 3 feet above MSL.

The main difference between the FOGM results and those predicted by QUICKFLOW was that in the pumping-only scenario (Scenario 1) the FOGM simulated heads in the area adjacent to Monterey Bay dropped several feet, causing the heads at the extraction wells to approach the point of inducing seawater intrusion. For the pumping and injection scenario (Scenario 2), FOGM gave a fairly close match of the heads predicted with QUICKFLOW. Capture zone simulations from the two models were very similar. The dissimilarity between the results of QUICKFLOW and FOGM for Scenario 1 is due to the constant head boundary effects of the QUICKFLOW model. The FOGM incorporates more accurate boundary conditions and produces more accurate results than the QUICKFLOW model.

2A3.3.4 Aquifer Restoration Time Evaluation

The results of the MT3D modeling of Scenario 1 and Scenario 2 are summarized in Plate 2A7 and Plate 2A8, respectively. These illustrations consist of plots of total VOC concentrations predicted at the extraction wells versus time. Also included on the plots are the average system concentration versus time and the maximum contaminant levels (MCL) for TCE.

Solute transport modeling of the two pumping scenarios is expected to be best suited for system to system comparison. The relative performance of one system configuration compared to the other can be interpreted from these model results. However, the absolute results such as predicted cleanup times and rates of chemical concentration decreases should be considered approximate. After final remedial system selection, implementation, and a 1- to 2 years of operation, the solute transport model should be compared to and calibrated with actual operation data to estimate more reliable cleanup times.

As illustrated on Plate 2A7 for Scenario 1, the maximum total VOC concentration for individual extraction wells reaches the TCE MCL within 20 years. For Scenario 2, the maximum total VOC concentration for individual extraction wells reaches the TCE MCL within 27 years. The total VOC effluent concentration for the combined extraction well discharge reaches the TCE MCL within 16 years for both Scenarios 1 and 2.

Scenario 2 requires a longer time to lower the maximum VOC concentration to the MCL than Scenario 1 because Scenario 2 groundwater injection decreases the localized groundwater gradient in the area of maximum total VOC concentrations (total VOC concentrations greater than 100 μg/l) and therefore increases travel times to the extraction wells. This decrease in the localized hydraulic gradient increases the amount of time required to lower the VOC concentrations in the areas of highest total VOC concentrations.

2A3.3.5 Mass Removal Evaluation

The MT3D model was used to simulate cumulative total VOC mass removal rate for Scenarios 1 and 2 (Plate 2A9).

Comparison of cumulative total VOC mass removal rates for Scenarios 1 and 2 indicates that mass removal rates are slightly greater for Scenario 2 than Scenario 1. This is probably due to the effect of the injection wells steepening hydraulic gradients and shortening travel times to the extraction wells. In addition, the cumulative total VOC mass removed over the

30-year simulation period is approximately 240 and 261 kilograms (kgs) for Scenarios 1 and 2, respectively. This equates to approximately 92 and greater than 100 percent of the total mass in the model at the start of the simulation (260 kgs). The greater mass removal (261 kg) than initial mass in the model (260 kg) is the result of mathematical errors associated with the Method of Characteristics (MOC) solution technique utilized by the MT3D. The MOC solution technique used by MT3D is not a mass balance-based solution but is concentration-based solution. As a result, the MT3D model is susceptible to increased mass balance errors associated with steep advective flow gradients along the solute transport pathway (*Zheng, 1990*). Consequently, the VOC mass removal rates shown on Plate 2A9 should be used only to compare the performance of Scenarios 1 and 2 relative to one another and should be considered only an approximation of absolute mass removal rates.

Table 2A1. QUICKFLOW Model Input Parameters*
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Parameter	Value
Hydraulic Gradient	0.000487 ft/ft (W10S)
Hydraulic Conductivity	220 ft/day
Aquifer Thickness	85 ft
Well Diameters	0.50 ft
Porosity	0.20

*See Table 2A2 for extraction and injection well numbers and flow rates.

Table 2A2. Summary of Groundwater Pumping System Initial Screening Evaluation
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Simulation No.	Description	Comments
F01	4 extraction. wells, Q = 100 gpm/well. Wells along longitudinal axis of plume. No injection.	Incomplete plume capture in SW plume area.
F01HR	4 extraction wells, Q = 150 gpm/well. Wells along longitudinal axis of plume. No injection.	Excessive groundwater capture. Potential for system induced seawater intrusion observed.
FO1LR	4 extraction wells, Q = 50 gpm/well. Wells along longitudinal axis of plume. No injection.	Incomplete plume capture in SW and NW plume areas.
FO1B	2 extraction wells, Q = 200 gpm/well. Wells along longitudinal axis of plume. No injection.	Excessive groundwater capture. Potential for system induced seawater intrusion observed.
FO1LOB	2 extraction wells, Q = 100 gpm/well. Wells in line down axis of plume. No injection.	Incomplete plume capture in SW and NW plume areas.
FQ2	4 extraction wells, Q = 100 gpm/well. Extraction wells in line down axis of plume. 8 injection wells, Q = 50 gpm/well. Injection wells located in lines on northern and southern plume boundaries.	Minor incomplete plume capture in SW and NW plume areas. Injection accelerates groundwater flow velocities.
FO2B	6 extraction wells, 4 wells down center of plume with Q = 100 gpm/well. 2 wells near SW and NW plume/Monterey Bay boundaries with Q = 50 gpm/well. 10 injection wells, Q = 50 gpm/well. Injection wells located along plume perimeter.	Minor incomplete plume capture in SW area of plume. Potential for system induced seawater intrusion observed.
FO3	4 extraction wells, Q = 100 gpm/well. Extraction wells in line down axis of plume. 4 injections wells Q = 100 gpm//well. Injection wells in line along shoreline.	Excessive groundwater capture. No potential for system induced seawater intrusion.
FO4A	4 extraction wells in line parallel to shoreline with Q = 50 gpm/well. No injection.	Incomplete plume capture. Average plume capture travel time is 3,377 days.

Table 2A2. Summary of Groundwater Pumping System Initial Screening Evaluation
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Simulation No.	Description	Comments
FO4B	4 extraction wells in line parallel to shoreline. 3 wells with Q = 50 gpm/well, 1 well with Q = 100 gpm/well near SW plume/Monterey Bay boundary. No injection.	Plume capture improved compared to Run FO4A. Average plume capture travel time is 3,167 days.
FO4C	4 extraction wells in line parallel to shoreline. 3 wells with Q = 50 gpm/well, 1 well with Q = 100 gpm/well near. 5 injection wells with Q = 50 gpm/well near SW plume/Monterey Bay boundary. 3 wells located upgradient of plume. 2 wells located near SW and NW plume/Monterey Bay boundary.	Injection near NW plume area creates incomplete plume capture in NW plume area. Average plume capture travel time is 3,051 days.
FO4D	4 extraction wells in line parallel to shoreline. 3 wells with Q = 50 gpm/well; 1 well with Q = 100 gpm/well. 4 injection wells with Q = 50 gpm/well. 3 wells located upgradient of plume. 1 well located near SW plume/Monterey Bay boundary.	Plume capture incomplete but improved over Run FO4C. System configuration necessitates disposal of 50 gpm excess groundwater flow. Average plume capture travel time is 2,778 days.
FO4E	4 extraction wells in line parallel to shoreline. 3 extraction wells with Q = 100 gpm/well. 1 extraction well with Q = 150 gpm/well. 4 injection wells with Q = 100 gpm/well. 3 wells located upgradient of plume. 1 well located near SW plume/Monterey Bay boundary.	Plume capture complete. Average plume capture travel time is 2,786 days.
FO4F	4 extraction wells, 4 wells in line parallel to shoreline with Q = 150 gpm/well for 3 wells and Q = 200 gpm/well for 1 well. 4 injection wells with Q = 150 gpm/well. 3 wells upgradient of plume. 1 well near SW corner of plume.	Plume capture complete. Average plume capture travel time is 1,404 days.
FO5A	3 extraction wells with Q = 100 gpm/well. No injection. Wells located in an approximate line parallel to shoreline in the western half of the plume (west of Highway). No injection.	Incomplete capture. Average plume capture travel time is 2,477 days.

Table 2A2. Summary of Groundwater Pumping System Initial Screening Evaluation
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Simulation No.	Description	Comments
FO5B	4 extraction wells. 2 wells near the center of the plume, but on opposite sides of Highway 101 with Q = 50 gpm/well. 2 wells located near NW and SW plume/Monterey Bay boundary with Q = 100 gpm/well. No injection.	Improved capture over Run FO5A. Minor incomplete plume capture in NW and SW plume areas. Average plume capture travel time is 2,522 days.
FO5C	2 extraction wells with Q = 125 gpm/well. 1 extraction well with Q = 100 gpm. Wells located in central plume area. 4 injection wells, 2 wells upgradient with Q = 50 gpm/well. 2 wells near SW and NW plume/Monterey Bay boundary with Q = 125 gpm/well.	Injection near SW and NW plume areas decreases plume capture in SW and NW plume areas. Average plume capture travel time is 1,961 days.
FO5D	2 extraction wells with Q = 125 gpm/well. Wells located in a line parallel to shoreline in western half of the plume. 2 injection wells with Q = 125 gpm/well. Wells located near SW and NW plume/Monterey Bay boundary.	Incomplete capture in NW and SW plume areas due to groundwater injection. Average plume capture travel time is 2,807 days.
FO5E	4 extraction wells. 2 in line parallel to shoreline in western half of plume area with Q = 125 gpm/well. 2 wells in line parallel to plume axis in center of eastern half of plume area with Q = 100 gpm/well.	Incomplete capture in NW and SW plume areas due to groundwater injection. Average plume capture travel time is 1,469 days.

Q Well pumping rate.
gpm Gallons per minute.

**Table 2A3. Groundwater Pumping System Extraction/Injection Rates
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California**

Pumping Scenario	Proposed Well Names	Extraction Rates (gpm)	Injection Rates (gpm)
Scenario 1	EW-1	50	-
	EW-2	50	-
	EW-3	100	-
	EW-4	100	-
Scenario 2	EW-1	100	-
	EW-2	100	-
	EW-3	125	-
	EW-4	125	-
	IW-1	-	100
	IW-2	-	100
	IW-3	-	125
	IW-4	-	125

gpm Gallons per minute.

Table 2A4. Solute Transport Model Input Parameters
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Parameter/Units	Value
Retardation Coefficient/unitless	.54
Biodegradation Coefficient/unitless	*
Longitudinal Dispersivity/feet	10
Transverse Dispersivity/feet	1
Vertical Dispersivity/feet	0.1

* Biodegradation is not simulated.

Table 2A5. Comparison of Simulated Water Levels, Scenario 1; Ambient Simulation Versus Scenario Simulation Volume V - Feasibility Study, Basewide RI/FS Fort Ord, California

Well ID	Column	Row	Layer	Ambient Calculated	Scenario 1 Calculated	(Scenario 1-Ambient)
BEACH	21	1	4	-4.4458	-4.4475	-0.16832E-02
MW-02-01-180	9	35	2	3.6220	1.6823	-1.9397
MW-02-02-180	7	33	2	3.4589	1.3608	-2.0981
MW-02-03-180	7	37	2	3.4516	1.4809	-1.9707
MW-02-04-180	8	42	1	3.4936	1.8677	-1.6259
MW-02-05-180	11	25	1	3.9428	1.9108	-2.0320
MW-02-06-180	12	40	1	3.6836	2.0399	-1.6437
MW-02-07-180	9	34	3	3.6316	1.6767	-1.9549
MW-02-08-180	6	30	1	3.3551	1.4641	-1.8910
MW-02-09-180	9	34	1	3.6325	1.6772	-1.9553
MW-02-10-180	12	15	1	4.2644	2.6307	-1.6337
MW-10-01-180	23	56	2	1.7425	0.89059	-0.85191
MW-10-02-180	24	56	2	1.5487	0.72254	-0.82616
MW-10-03-180	23	56	2	1.7425	0.89059	-0.85191
MW-10-04-180	24	55	2	1.7398	0.87122	-0.86858
MW-10-05-180	22	56	2	1.8624	0.99416	-0.86824
MW-10-06-180	23	56	3	1.7069	0.85937	-0.84753
MW-12-01-180	17	27	1	4.3370	2.6467	-1.6903
MW-12-02-180	17	29	1	4.2603	2.5953	-1.6650
MW-12-03-180	15	27	1	4.2080	2.3673	-1.8407
MW-12-04-180	19	24	1	4.6036	3.1361	-1.4675
MW-12-05-180	14	31	1	4.0300	2.1545	-1.8755
MW-12-06-180	17	25	3	4.4096	2.7348	-1.6748
MW-12-07-180	12	36	1	3.7968	1.9953	-1.8015
MW-12-08-180	16	33	1	4.0667	2.3923	-1.6744
MW-12-09-180	18	20	1	4.6651	3.1857	-1.4794
MW-14-01-A	49	50	1	67.841	67.829	-0.12093E-01
MW-14-02-A	42	49	1	56.958	56.951	-0.65384E-02
MW-14-03-180	41	49	3	0.87040	0.50192E-01	-0.82021
MW-14-04-A	52	50	1	70.889	70.875	-0.14206E-01
MW-17-02-180	29	49	2	2.0017	1.0450	-0.95665
MW-18-02-180	19	42	2	3.6238	2.2896	-1.3342
MW-18-03-180	26	44	3	2.9392	1.8846	-1.0546
MW-20-01-180	24	54	3	1.8505	0.94904	-0.90146
MW-20-02-180	21	54	3	2.2331	1.2811	-0.95198
MW-20-04-180	23	52	3	2.2560	1.2710	-0.98500
MW-20-06-180	18	52	3	2.7656	1.6952	-1.0704
MW-20-07-180	13	53	2	3.0135	1.9159	-1.0976
MW-22-01-A	64	53	1	102.58	102.58	-0.30518E-04
MW-22-02-A	65	52	1	91.051	91.045	-0.58670E-02
MW-22-03-A	73	53	1	107.02	107.02	0.10147E-02
MW-23-01-A	46	52	1	73.314	73.299	-0.14755E-01
MW-23-02-A	38	52	1	65.402	65.397	-0.50125E-02
MW-23-03-A	34	52	1	64.233	64.230	-0.26703E-02
MW-24-02-180	26	53	3	1.6613	0.76739	-0.89391
MW-B-13-180	89	4	3	-9.3564	-9.4444	-0.87966E-01
MW-B-14-A	89	4	1	60.463	60.455	-0.75645E-02
MW-B-22-180	15	54	1	2.7791	1.7437	-1.0354
MW-B-23-180	5	54	3	3.2864	2.1616	-1.1248
MW-B-25-180	16	56	1	2.4712	1.5136	-0.95760
MW-BW-11-A	26	20	1	6.1684	5.1301	-1.0383

Table 2A5. Comparison of Simulated Water Levels, Scenario 1; Ambient Simulation Versus Scenario Simulation Volume V - Feasibility Study, Basewide RI/FS Fort Ord, California

Well ID	Column	Row	Layer	Ambient Calculated	Scenario 1 Calculated	(Scenario 1 Ambient)
MW-BW-12-180	26	20	3	4.8176	3.7555	-1.0621
MW-BW-13-A	38	20	1	14.005	13.323	-0.68187
MW-BW-14-180	44	23	3	1.8260	1.0299	-0.79614
MW-OU1-01-A	90	1	1	56.829	56.829	-0.13351E-03
MW-OU1-06-A	89	1	1	55.348	55.348	0.22125E-03
MW-OU 2-01-A	87	49	1	90.928	90.925	-0.34409E-02
MW-OU 2-02-A	86	40	1	80.596	80.586	-0.99258E-02
MW-OU 2-03-A	77	43	1	74.062	74.043	-0.19142E-01
MW-OU 2-04-A	58	27	1	43.502	43.365	-0.13739
MW-OU 2-05(PA1)-A	68	13	1	45.097	44.986	-0.11128
MW-OU 2-05(PA2)-A	68	13	1	45.097	44.986	-0.11128
MW-OU 2-05-A	68	13	1	45.097	44.986	-0.11128
MW-OU 2-06-180	69	27	4	-8.5847	-8.6004	-0.15714E-01
MW-OU 2-06-A	69	27	1	54.269	54.195	-0.73555E-01
MW-OU 2-07-180	78	20	4	-9.6880	-9.6994	-0.11446E-01
MW-OU 2-07-A	78	20	1	58.710	58.662	-0.48363E-01
MW-OU 2-08-A	80	23	1	63.224	63.189	-0.34988E-01
MW-OU 2-09-180	64	36	4	-7.9759	-7.9949	-0.19000E-01
MW-OU 2-09-A	64	36	1	56.473	56.415	-0.57793E-01
MW-OU 2-10-180	77	38	4	-9.3191	-9.3347	-0.15586E-01
MW-OU 2-10-A	77	38	1	68.981	68.953	-0.27695E-01
MW-OU 2-11-A	65	39	1	60.872	60.830	-0.41698E-01
MW-OU 2-20-180	29	21	3	4.1428	3.1467	-0.99613
MW-OU 2-20-A	30	21	1	8.4126	7.5100	-0.90260
MW-OU 2-21-A	50	37	1	41.026	40.935	-0.91198E-01
MW-OU 2-23-180	67	46	3	-2.0400	-2.6200	-0.58003
MW-OU 2-23-A	67	46	1	73.171	73.153	-0.18196E-01
MW-OU 2-24-180	75	30	3	-4.0105	-4.4530	-0.44250
MW-OU 2-25-A	81	37	1	73.076	73.056	-0.19630E-01
MW-OU 2-26-A	90	49	1	91.973	91.970	-0.25787E-02
MW-OU 2-29-180	87	51	3	-5.5933	-5.9275	-0.33422
MW-OU 2-29-A	87	51	1	94.592	94.590	-0.23346E-02
MW-OU 2-31-180	41	10	4	-6.1494	-6.1646	-0.15174E-01
MW-OU 2-31-A	41	10	1	13.277	12.650	-0.62716
MW-OU 2-32-A	19	11	1	4.9843	3.7240	-1.2603
MW-OU 2-33-A	22	29	1	4.7659	3.4819	-1.2840
MW-OU 2-34-A	36	42	3	2.3557	1.4385	-0.91720
MW-OU 2-35-A	89	50	1	93.203	93.200	-0.26779E-02
MW-OU 2-36-180	25	9	3	5.4301	4.4453	-0.98480
MW-OU 2-36-A	25	9	1	5.4315	4.4469	-0.98457
MW-OU 2-37-180	34	6	3	5.5247	4.7603	-0.76436
MW-OU 2-37-A	34	6	1	6.1343	5.3741	-0.76019
PZ-02-01-180L	8	34	4	0.95540	0.94772	-0.76810E-02
PZ-02-01-180M	8	34	3	3.5479	1.5132	-2.0347
PZ-02-01-180U	8	34	1	3.5487	1.5102	-2.0385
PZ-02-02-180L	6	30	4	1.4488	1.4467	-0.20791E-02
PZ-02-02-180M	6	30	3	3.3542	1.4631	-1.8911
PZ-02-02-180U	6	30	1	3.3551	1.4641	-1.8910
PZ-10-01-180L	23	56	3	1.7069	0.85937	-0.84753
PZ-10-01-180M	23	56	2	1.7425	0.89059	-0.85191
PZ-10-01-180U	23	56	1	1.8284	0.96628	-0.86212

Table 2A5. Comparison of Simulated Water Levels, Scenario 1; Ambient Simulation Versus Scenario Simulation Volume V - Feasibility Study, Basewide RI/FS Fort Ord, California

Well ID	Column	Row	Layer	Ambient Calculated	Scenario 1 Calculated	(Scenario 1 Ambient)
PZ-12-01-180L	17	25	4	-2.1834	-2.2016	-0.18162E-01
PZ-12-01-180M	17	25	3	4.4096	2.7348	-1.6748
PZ-12-01-180U	17	25	1	4.4109	2.7341	-1.6768
PZ-12-02-180L	21	24	4	-3.2219	-3.2421	-0.20241E-01
PZ-12-02-180M	21	24	3	4.7947	3.4603	-1.3344
PZ-12-02-180U	21	24	1	4.7985	3.4639	-1.3346
PZ-12-04-180L	14	23	4	-1.4511	-1.4656	-0.14522E-01
PZ-12-04-180M	14	23	3	4.2459	2.4478	-1.7981
PZ-12-04-180U	14	23	1	4.2472	2.4496	-1.7976
PZ-12-04-180L						

NUMBER OF ACTIVE OBSERVATION POINTS = 111
MEAN OF RESIDUALS (M) = -0.7917399
STANDARD DEVIATION OF RESIDUALS (SDEV) = 0.7147399
MEAN OF ABSOLUTE RESIDUALS (MA) = 0.7917622
ROOT MEAN SQUARE RESIDUALS (RMS) = 1.064473
CORRELATION COEFFICIENT = 0.9998357
PROBABILITY OF UN-CORRELATION = 0.0000000

LAYER-BY-LAYER SUMMARY

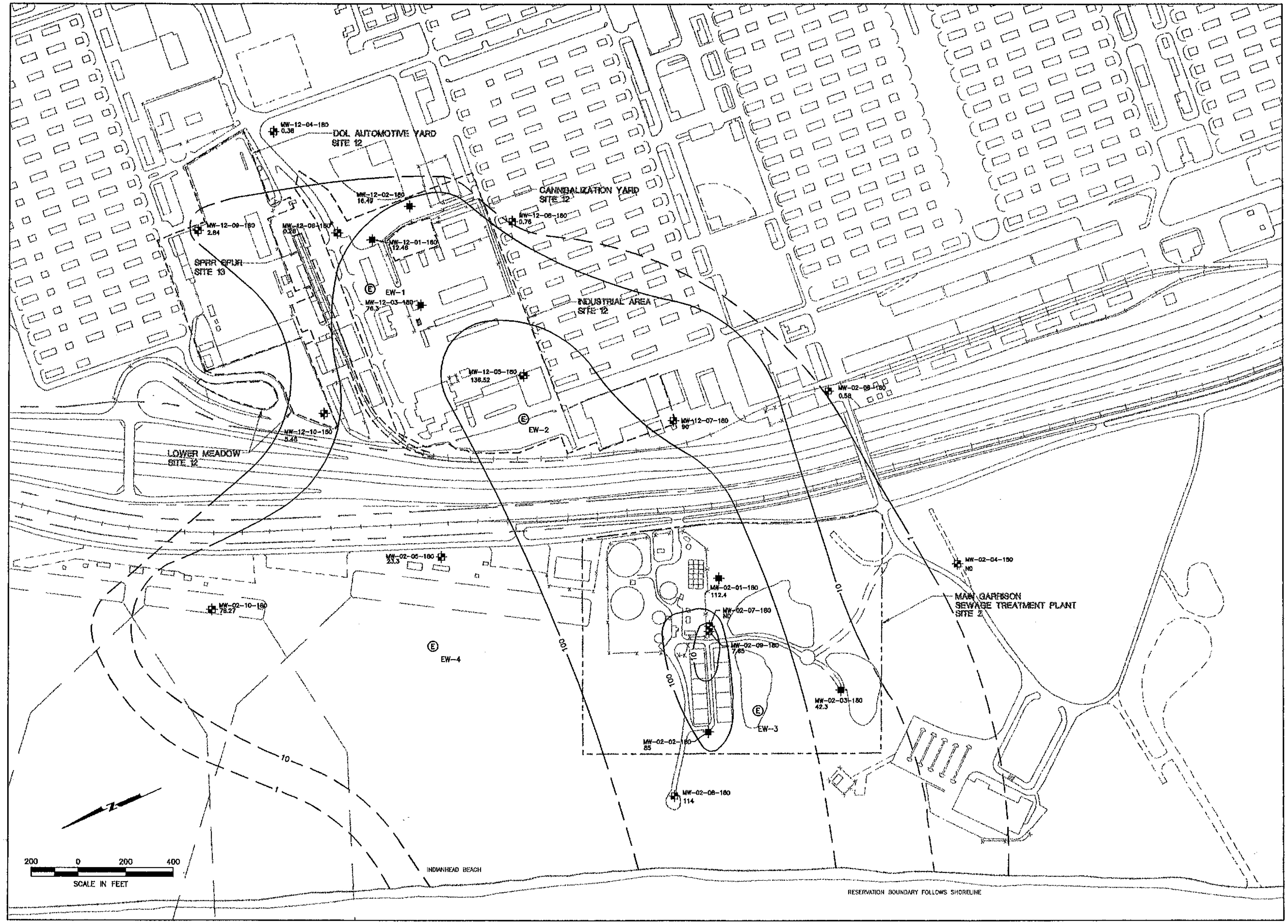
Layer	Number Obs. Points	Mean	Root Mean Square
1	61	-0.7278802	1.058713
2	12	-1.209625	1.301143
3	27	-1.067616	1.171945
4	11	-0.1284437E-01	0.1423410E-01

Table 2A6. Comparison of Simulated Water Levels, Scenario 2; Ambient Simulation Versus Scenario Simulation Volume V - Feasibility Study, Basewide RI/FS Fort Ord, California

Well ID	Column	Row	Layer	Ambient Calculated	Scenario 2 Calculated	Scenario 2- Ambient)
BEACH	21	1	4	-4.4458	-4.4457	0.76294E-04
MW-02-01-180	9	35	2	3.6220	3.0070	-0.61502
MW-02-02-180	7	33	2	3.4589	2.6295	-0.82942
MW-02-03-180	7	37	2	3.4516	2.8735	-0.57810
MW-02-04-180	8	42	1	3.4936	3.3930	-0.10059
MW-02-05-180	11	25	1	3.9428	3.1871	-0.75570
MW-02-06-180	12	40	1	3.6836	3.4284	-0.25524
MW-02-07-180	9	34	3	3.6316	2.9880	-0.64355
MW-02-08-180	6	30	1	3.3551	2.7136	-0.64154
MW-02-09-180	9	34	1	3.6325	2.9885	-0.64403
MW-02-10-180	12	15	1	4.2644	4.1618	-0.10258
MW-10-01-180	23	56	2	1.7425	1.7813	0.38842E-01
MW-10-02-180	24	56	2	1.5487	1.5872	0.38474E-01
MW-10-03-180	23	56	2	1.7425	1.7813	0.38842E-01
MW-10-04-180	24	55	2	1.7398	1.7783	0.38509E-01
MW-10-05-180	22	56	2	1.8624	1.9015	0.39095E-01
MW-10-06-180	23	56	3	1.7069	1.7457	0.38775E-01
MW-12-01-180	17	27	1	4.3370	3.9789	-0.35811
MW-12-02-180	17	29	1	4.2603	3.9616	-0.29871
MW-12-03-180	15	27	1	4.2080	3.6186	-0.58937
MW-12-04-180	19	24	1	4.6036	4.5936	-0.99645E-02
MW-12-05-180	14	31	1	4.0300	3.3975	-0.63248
MW-12-06-180	17	25	3	4.4096	4.0780	-0.33159
MW-12-07-180	12	36	1	3.7968	3.3201	-0.47675
MW-12-08-180	16	33	1	4.0667	3.7975	-0.26924
MW-12-09-180	18	20	1	4.6651	4.7224	0.57261E-01
MW-14-01-A	49	50	1	67.841	67.840	-0.83923E-03
MW-14-02-A	42	49	1	56.958	56.975	0.16933E-01
MW-14-03-180	41	49	3	0.87040	0.91038	0.39978E-01
MW-14-04-A	52	50	1	70.889	70.884	-0.49286E-02
MW-17-02-180	29	49	2	2.0017	2.0442	0.42543E-01
MW-18-02-180	19	42	2	3.6238	3.6960	0.72248E-01
MW-18-03-180	26	44	3	2.9392	2.9932	0.53973E-01
MW-20-01-180	24	54	3	1.8505	1.8886	0.38105E-01
MW-20-02-180	21	54	3	2.2331	2.2716	0.38458E-01
MW-20-04-180	23	52	3	2.2560	2.2933	0.37284E-01
MW-20-06-180	18	52	3	2.7656	2.8008	0.35186E-01
MW-20-07-180	13	53	2	3.0135	3.0552	0.41681E-01
MW-22-01-A	64	53	1	102.58	102.58	0.16174E-02
MW-22-02-A	65	52	1	91.051	91.047	-0.37842E-02
MW-22-03-A	73	53	1	107.02	107.02	0.27237E-02
MW-23-01-A	46	52	1	73.314	73.307	-0.68665E-02
MW-23-02-A	38	52	1	65.402	65.412	0.96436E-02
MW-23-03-A	34	52	1	64.233	64.246	0.13283E-01
MW-24-02-180	26	53	3	1.6613	1.6992	0.37931E-01
MW-B-13-180	89	4	3	-9.3564	-9.3518	0.46396E-02
MW-B-14-A	89	4	1	60.463	60.463	0.31281E-03
MW-B-22-180	15	54	1	2.7791	2.8204	0.41276E-01
MW-B-23-180	5	54	3	3.2864	3.3442	0.57843E-01
MW-B-25-180	16	56	1	2.4712	2.5126	0.41410E-01
MW-BW-11-A	26	20	1	6.1684	6.2722	0.10377
MW-BW-12-180	26	20	3	4.8176	4.9196	0.10201

Table 2A6. Comparison of Simulated Water Levels, Scenario 2; Ambient Simulation Versus Scenario Simulation Volume V - Feasibility Study, Basewide RI/FS Fort Ord, California

Well ID	Column	Row	Layer	Ambient Calculated	Scenario 2 Calculated	(Scenario 2-Ambient)
MW-BW-13-A	38	20	1	14.005	14.067	0.62039E-01
MW-BW-14-180	44	23	3	1.8260	1.8821	0.56150E-01
MW-OU1-01-A	90	1	1	56.829	56.829	0.38147E-04
MW-OU1-06-A	89	1	1	55.348	55.348	0.43488E-03
MW-OU 2-01-A	87	49	1	90.928	90.929	0.57220E-03
MW-OU 2-02-A	86	40	1	80.596	80.596	0.38147E-03
MW-OU 2-03-A	77	43	1	74.062	74.063	0.64850E-03
MW-OU 2-04-A	58	27	1	43.502	43.513	0.11467E-01
MW-OU 2-05(PA1)-A	68	13	1	45.097	45.103	0.58250E-02
MW-OU 2-05(PA2)-A	68	13	1	45.097	45.103	0.58250E-02
MW-OU 2-05-A	68	13	1	45.097	45.103	0.58250E-02
MW-OU 2-06-180	69	27	4	-8.5847	-8.5842	0.51785E-03
MW-OU 2-06-A	69	27	1	54.269	54.274	0.49095E-02
MW-OU 2-07-180	78	20	4	-9.6880	-9.6876	0.44346E-03
MW-OU 2-07-A	78	20	1	58.710	58.712	0.20905E-02
MW-OU 2-08-A	80	23	1	63.224	63.226	0.20561E-02
MW-OU 2-09-180	64	36	4	-7.9759	-7.9752	0.71716E-03
MW-OU 2-09-A	64	36	1	56.473	56.479	0.61531E-02
MW-OU 2-10-180	77	38	4	-9.3191	-9.3186	0.53978E-03
MW-OU 2-10-A	77	38	1	68.981	68.983	0.16785E-02
MW-OU 2-11-A	65	39	1	60.872	60.876	0.40779E-02
MW-OU 2-20-180	29	21	3	4.1428	4.2302	0.87389E-01
MW-OU 2-20-A	30	21	1	8.4126	8.4979	0.85274E-01
MW-OU 2-21-A	50	37	1	41.026	41.038	0.11612E-01
MW-OU 2-23-180	67	46	3	-2.0400	-2.0094	0.30634E-01
MW-OU 2-23-A	67	46	1	73.171	73.169	-0.20752E-02
MW-OU 2-24-180	75	30	3	-4.0105	-3.9870	0.23477E-01
MW-OU 2-25-A	81	37	1	73.076	73.077	0.11444E-02
MW-OU 2-26-A	90	49	1	91.973	91.974	0.71716E-03
MW-OU 2-29-180	87	51	3	-5.5933	-5.5720	0.21344E-01
MW-OU 2-29-A	87	51	1	94.592	94.592	0.20599E-03
MW-OU 2-31-180	41	10	4	-6.1494	-6.1488	0.63610E-03
MW-OU 2-31-A	41	10	1	13.277	13.339	0.62078E-01
MW-OU 2-32-A	19	11	1	4.9843	5.1652	0.18086
MW-OU 2-33-A	22	29	1	4.7659	4.8303	0.64449E-01
MW-OU 2-34-A	36	42	3	2.3557	2.4066	0.50884E-01
MW-OU 2-35-A	89	50	1	93.203	93.203	0.21362E-03
MW-OU 2-36-180	25	9	3	5.4301	5.5456	0.11551
MW-OU 2-36-A	25	9	1	5.4315	5.5470	0.11549
MW-OU 2-37-180	34	6	3	5.5247	5.6063	0.81555E-01
MW-OU 2-37-A	34	6	1	6.1343	6.2166	0.82253E-01
PZ-02-01-180L	8	34	4	0.95540	0.95494	-0.45538E-03
PZ-02-01-180M	8	34	3	3.5479	2.8135	-0.73443
PZ-02-01-180U	8	34	1	3.5487	2.8093	-0.73935
PZ-02-02-180L	6	30	4	1.4488	1.4486	-0.22388E-03
PZ-02-02-180M	6	30	3	3.3542	2.7126	-0.64158
PZ-02-02-180U	6	30	1	3.3551	2.7136	-0.64154
PZ-10-01-180L	23	56	3	1.7069	1.7457	0.38775E-01
PZ-10-01-180M	23	56	2	1.7425	1.7813	0.38842E-01
PZ-10-01-180U	23	56	1	1.8284	1.8678	0.39449E-01
PZ-12-01-180L	17	25	4	-2.1834	-2.1834	-0.21458E-05
PZ-12-01-180M	17	25	3	4.4096	4.0780	-0.33159

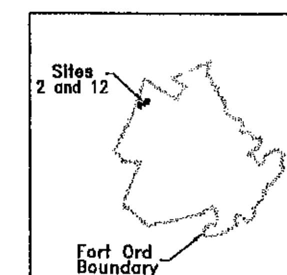


EXPLANATION

- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- CURRENT HAZARDOUS WASTE STORAGE AREA
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- FENCE
- FEBRUARY-MARCH, 1994 TOTAL VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN MICROGRAMS/LITER (62)
- ND — NOT DETECTED
- 5 — CHEMICAL CONCENTRATION CONTOUR IN µg/l DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN.

NOTE: THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.

- * MONITORING WELL RESULTS NOT USED DURING CONTOURING
- EW-1 (E) PROPOSED EXTRACTION WELL



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366381	23366 0417151			AED
2	12/94	DRAFT FINAL	23366381	23366 0417251			PH
3	10/95	FINAL	23366381	23366 0417251	MLS	10/17/95	PH

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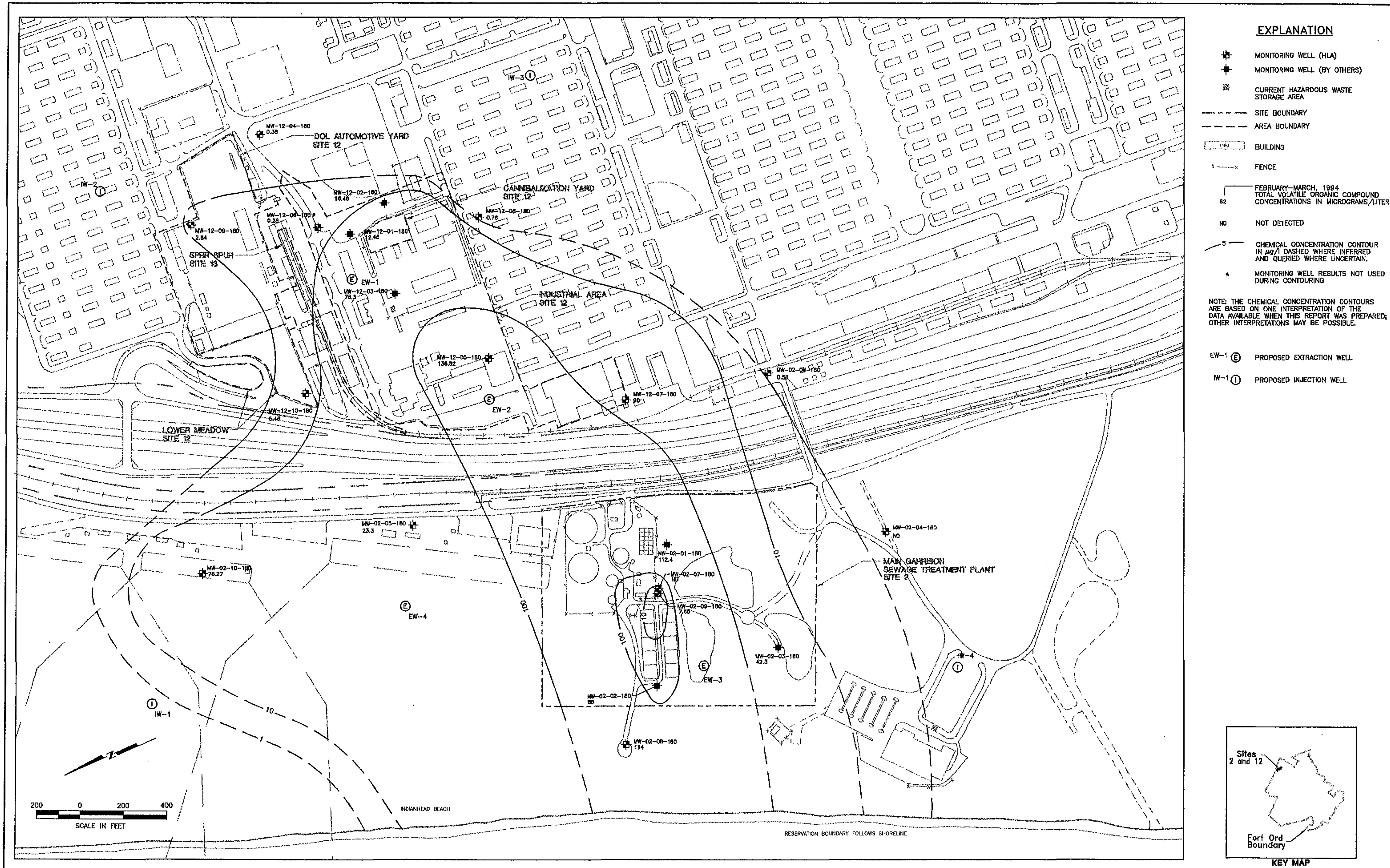
Volume V – Feasibility Study
Basewide RI/FS
Fort Ord, California

Pumping Scenario 1
Well Configuration Map
Sites 2 and 12

PLATE: **2A1**



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2	12/94	DRAFT FINAL	23366382	23366 0417251			PH
3	10/95	FINAL	23366382	23366 0417251	MLS	10/18/95	PH

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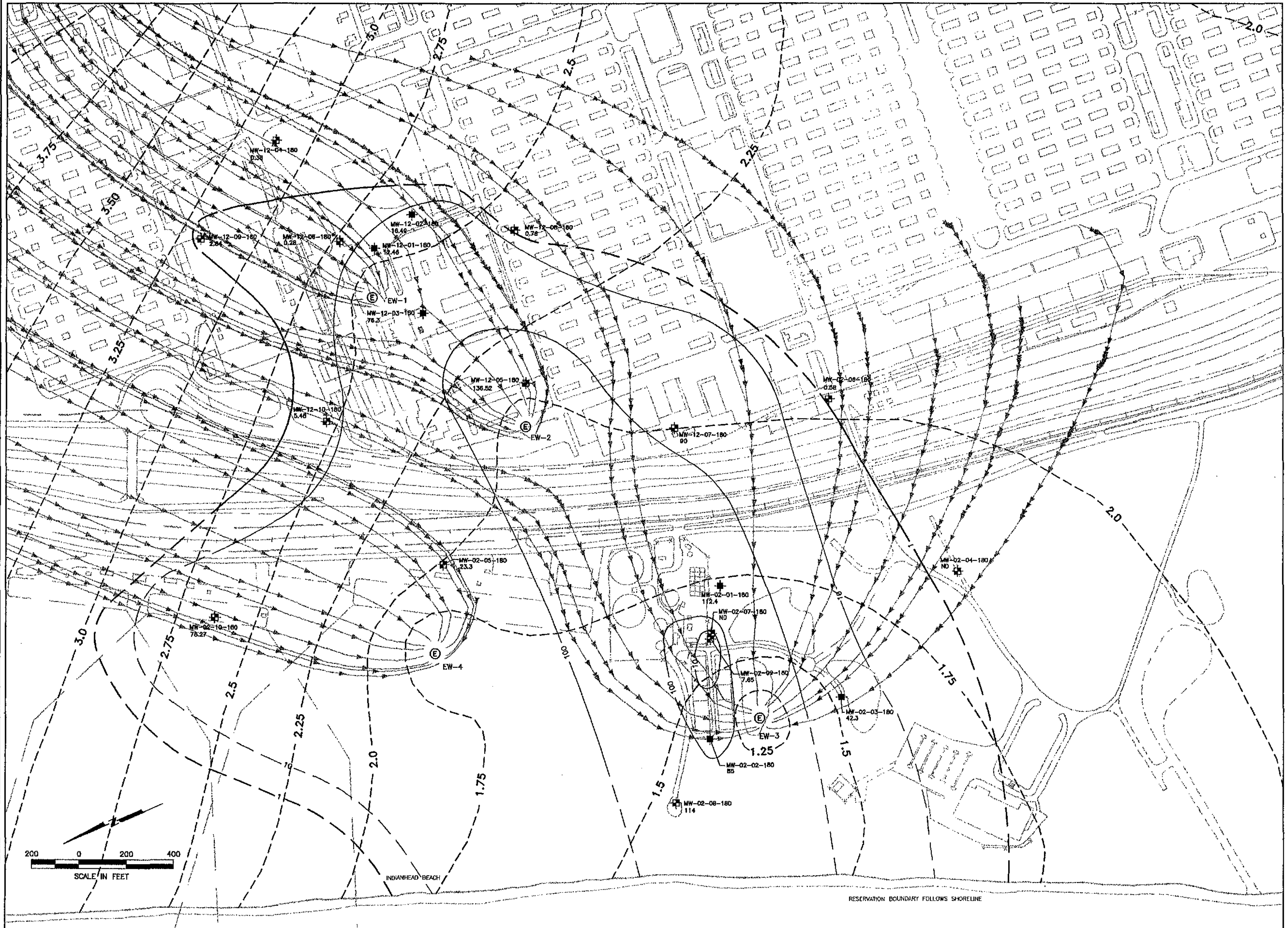
Basewide RI/FS
Fort Ord, California

Pumping Scenario 2
Well Configuration Map
Sites 2 and 12

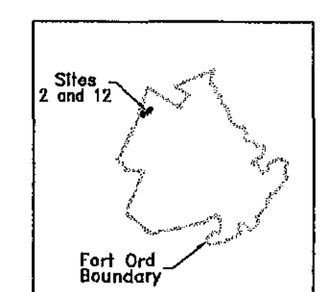
PLATE: **2A2**



EXPLANATION

- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- BUILDING
- FENCE
- 82 — FEBRUARY–MARCH 1994 TOTAL VOLATILE ORGANIC COMPOUNDS(VOCS) CONCENTRATIONS IN MICROGRAMS/LITER
- ND — NOT DETECTED
- —1— TOTAL VOC CHEMICAL CONCENTRATION PLUME BOUNDARY CONTOUR (μg/l)
- —10— TOTAL VOC CHEMICAL CONCENTRATION CONTOUR IN μg/l DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN.
- • MONITORING WELL RESULTS NOT USED DURING CONTOURING
- GROUNDWATER FLOW PATH ARROWS REPRESENT 6 MONTH TRAVEL DISTANCE
- EW-1 Ⓔ PROPOSED EXTRACTION WELL
- —3— WATER-LEVEL ELEVATION CONTOUR (IN FEET ABOVE MEAN SEA LEVEL)

NOTE: THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366370	23366 0417151			AED
2	12/94	DRAFT FINAL	23366370	23366 0417251			PH
3	10/95	FINAL	23366370	23366 0417251	MLS	10/17/95	PH

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Basewide RI/FS
Fort Ord, California

Pumping Scenario 1, Simulated Local Groundwater Flow Paths and Water-Level Elevations Sites 2 and 12

PLATE: **2A3**

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23386369	23386 0417151			AED
2	12/94	DRAFT FINAL	23386369	23386 0417251			PH
3	10/95	FINAL	23386369	23386 0417251	MLS	10/17/95	PH

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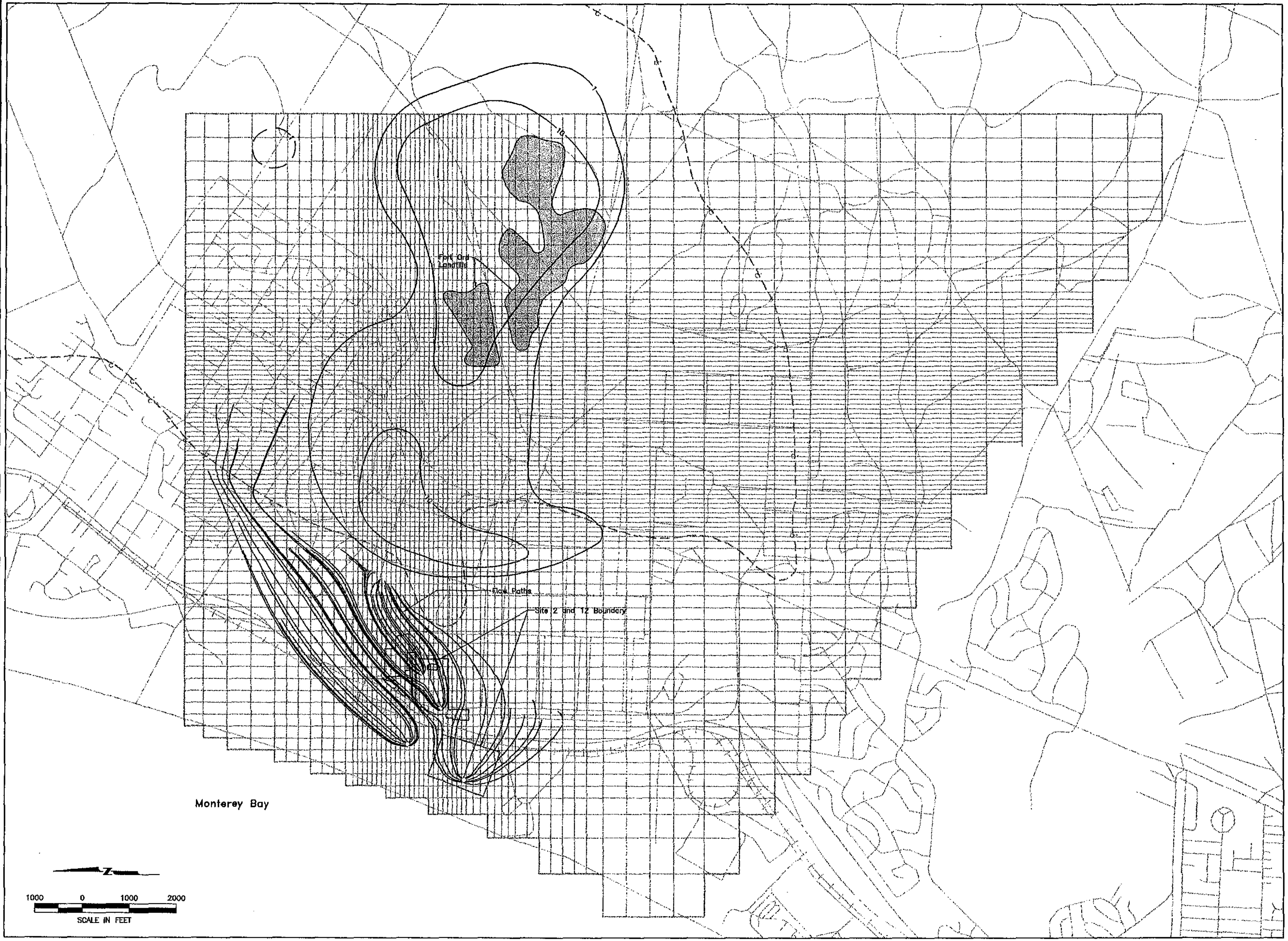
Basewide RI/FS
Fort Ord, California

Pumping Scenario 2, Simulated Local Groundwater Flow Paths and Water–Level Elevations Sites 2 and 12

PLATE: **2A4**



EXPLANATION

APPROXIMATE EDGE OF FORT ORD–SALINAS VALLEY AQUICLUDE BOUNDARY, QUERIED WHERE UNCERTAIN

ACTIVE MODEL AREA

GROUNDWATER FLOW PATH (DISTANCE TRAVELED OVER 30 YEARS)

—10— OU2 TOTAL VOC CHEMICAL CONCENTRATION CONTOUR IN ug/l DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN

APPROXIMATE EXTENT OF FORT ORD LANDFILLS. DAMES AND MOORE, APRIL 8, 1994

NOTE: THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366374	23366 0417151			KF
2	12/94	DRAFT FINAL	23366374	23366 0417251			KF
3	10/95	FINAL	23366374	23366 0417251	MLS	10/17/95	KF

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Volume V – Feasibility Study
Basewide RI/FS
Fort Ord, California

Pumping Scenario 1, Simulated Groundwater Flow Paths Relative to OU 2 Groundwater Plume Sites 2 and 12

PLATE: **2A5**

EXPLANATION

APPROXIMATE EDGE OF FORT ORD–SALINAS VALLEY AQUICLUDE BOUNDARY, QUERIED WHERE UNCERTAIN

ACTIVE MODEL AREA

APPROXIMATE EXTENT OF FORT ORD LANDFILLS. DAMES AND MOORE, APRIL 8, 1994

GROUNDWATER FLOW PATH (DISTANCE TRAVELED OVER 30 YEARS)

—10— OU2 TOTAL VOC CHEMICAL CONCENTRATION CONTOUR IN ug/l DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN

NOTE: THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
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2	12/94	DRAFT FINAL	23366373	23366 0417251			KF
3	10/95	FINAL	23366373	23366 0417251	MLC	10/17/95	KF

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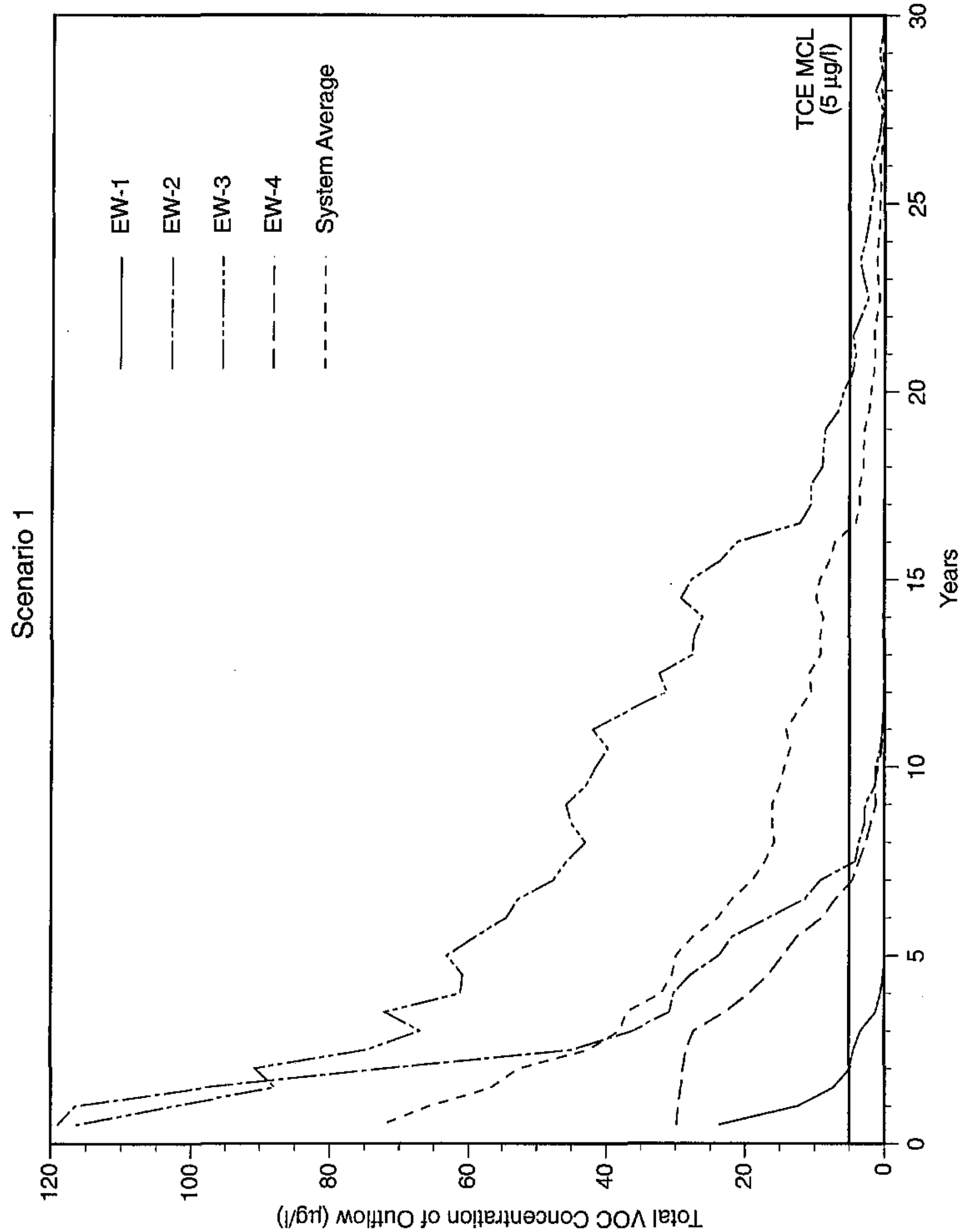
Volume V – Feasibility Study
Basewide RI/FS
Fort Ord, California

Pumping Scenario 2, Simulated Groundwater Flow Paths Relative to OU 2 Groundwater Plume
Sites 2 and 12

PLATE: **2A6**

41975



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HLA

Scenario 1: Estimated Total VOC Concentration Versus Time
Sites 2 and 12
Volume V - FS, Basewide RI/FS
Fort Ord, California

PLATE
2A7

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
DLFc	23366 0417151	BK	6/94	11/94

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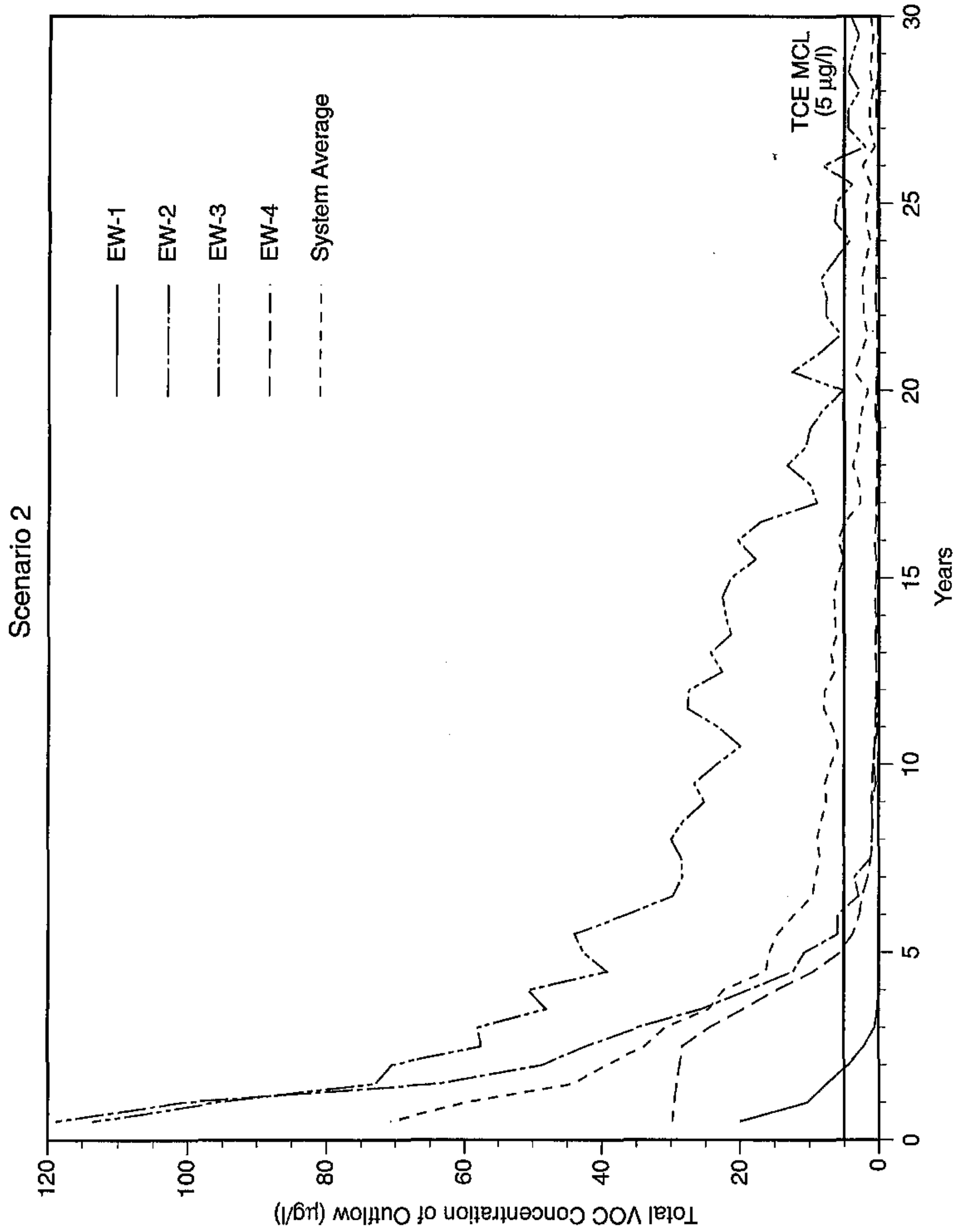

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Scenario 2: Estimated Total VOC Concentration Versus Time
Sites 2 and 12
Volume V - FS, Basewide RI/FS
Fort Ord, California

PLATE
2A8

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
DLFc	23366 0417151	BK	6/94	11/94

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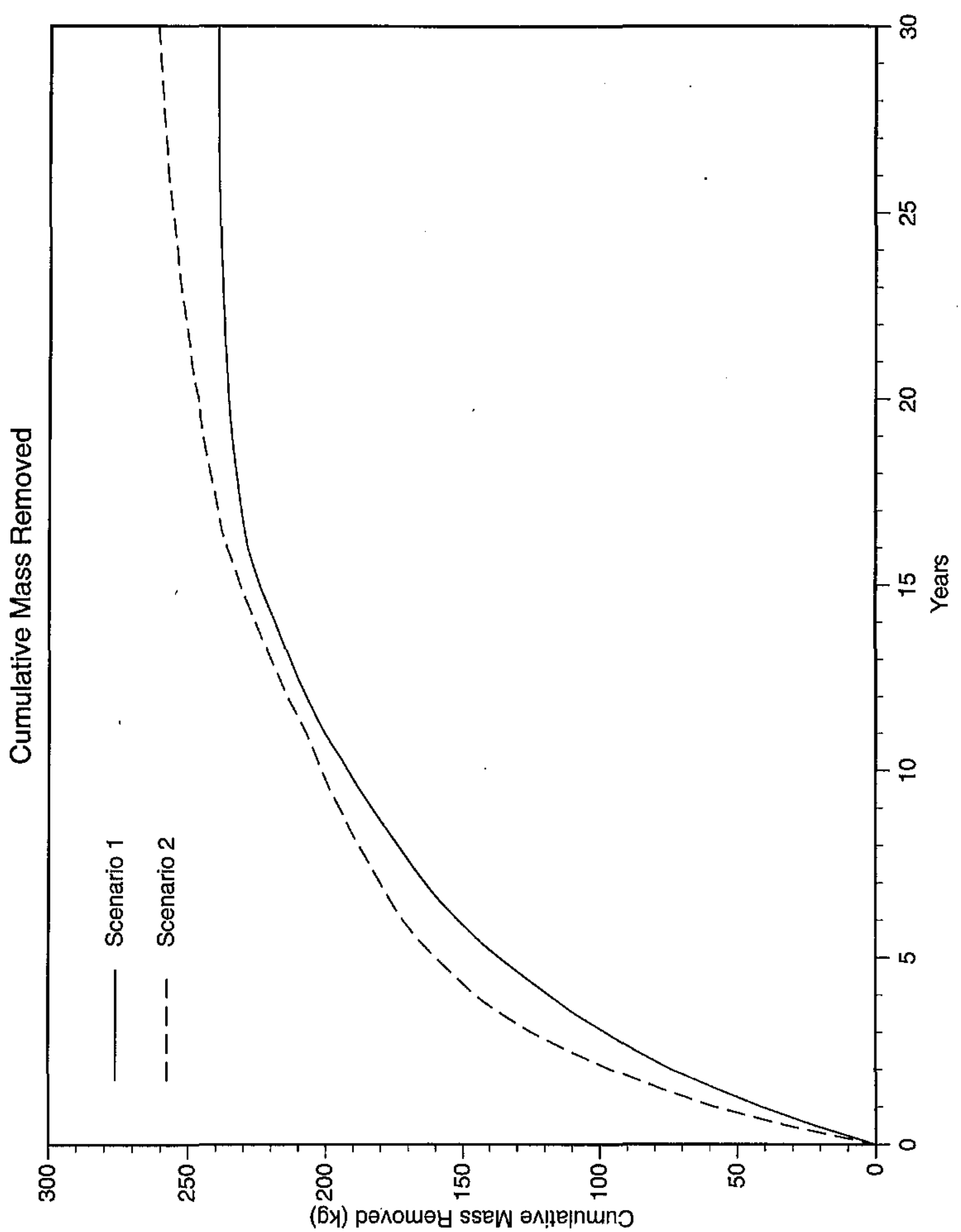

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Cumulative Mass of VOCs Removed
Scenarios 1 and 2
Sites 2 and 12
Volume V - FS, Basewide RI/FS
Fort Ord, California

PLATE
2A9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
DLFc	23366 0417151	BK	6/94	11/94

APPENDIX 2B

TECHNOLOGY SCREENING CHECKLIST AND SUMMARY REVIEW FORMS

The attached checklists in this Appendix are taken from the *Draft Final Remedial Technology Screening (RTS) Report, Fort Ord, California,* dated February 9, 1994. These forms were completed for the wastes present at Sites 2 and 12. These checklists refer to remedial technology screening tables (Tables 1 to 22) that can be found in the RTS report. These RTS tables were developed specifically for Fort Ord on a basewide level to aid in the preparation of Fort Ord Feasibility Studies. As described in the main text of this Feasibility Study (FS), all technologies identified as applicable from the selected RTS tables were incorporated. Section 2.2.4 of this report describes how these standard RTS technologies were then screened and selected for conditions at Sites 2 and 12.

- Form B-1 identifies the appropriate RTS table based on site chemicals and the media affected. Separate in-situ and ex-situ categories are presented for soil, and only one category for debris. Based on this form, RTS Tables 5, 6, 12, 13, and 14 were identified as applicable for Sites 2 and 12.

- Forms B-2 and B-3 list the retained technologies identified from the RTS tables, for soil and debris, respectively.

APPENDIX 2B

FORM B-1

MATRIX GUIDE/CHECKLIST
IDENTIFICATION OF TECHNOLOGY SCREENING TABLES
Remedial Technology Screening Report
Fort Ord, California

Locate Group of Compounds below in rows (A) through (F): Check One.	A ■ B ■ C ■ D ☐ E ☐ F ☐
In what media are the compounds? Locate the appropriate column (#) for either soil, groundwater, or debris.	Soil (1&2) ■ Groundwater (3&4) ■ Debris (5) ■
Are both in situ and ex situ treatment potentially applicable for soil or groundwater at this site? Locate in situ, ex situ, or both types of treatment in Columns (1) through (4).	Soil: In Situ 1 ■ Ex Situ 2 ■ Groundwater: In Situ 3 ■ Ex Situ 4 ■
Where compound, media, and type of treatment intersect, refer to the technology screening table number indicated. Use Forms B-2, B-3, or B-4 to record applicable technologies as tables are reviewed.	Table(s) 5 6 12 13 14

Media	Soil		Groundwater		Debris
Classes of Compounds	(1) In Situ	(2) Ex Situ	(3) In Situ	(4) Ex Situ	(5) *
(A) VOCs	Table 1	Table 2	**Table 13**	**Table 14**	**Table 12**
(B) TPH-light	Table 3	Table 4	Table 15	Table 16	
(C) TPH-heavy	**Table 5**	**Table 6**	Table 17	Table 18	
(D) Metals	Table 7	Table 8	Table 19	Table 20	
(E) Pesticides	Table 9	Table 10	Table 21	Table 22	
(F) Mixed Waste +	Table 11		Table 23		

* Debris is not specific to a Group of Compounds

\+ Mixed waste is two or more dissimilar Groups of Compounds combined in soil or groundwater, such as metals and VOCs.

APPENDIX 2B

FORM B-2

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

INSTRUCTIONS: For Debris or Mixed Waste, see Forms A-3 or A-4. Complete several forms if necessary for each separate Group of Compounds and Media, and attach to Feasibility Study file for each site (e.g., one form for VOCs in groundwater, and a separate form for metals in soil).

- Name of Site: Sites 2 and 12 - VOCs in Groundwater
- Brief Description: Dissolved VOCs in groundwater, (groundwater remedial unit)
- Group of Compounds (select one)
  VOCs _X_ TPH-light ___
  TPH-heavy ___ Metals ___
  Pesticides ___
- Media (select one)
  Soil ___ Groundwater _X_
- Potentially Applicable Treatment (select one or both)
  In Situ _X_ Ex Situ _X_
- Referenced Table(s) Number 13 14
- Technologies Retained

In Situ	Ex Situ
See Attached	See Attached

- Form Completed by: Dan Fitzgerald
- Description of Technology(s) (Appendix C) Reviewed by: Dan Fitzgerald
- Date Completed: July 8, 1994

FORM B-2 (attachment)

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

- **Sites 2 and 12 - VOCs in Groundwater**
  Technologies Retained

In Situ	Ex Situ
No Action	No Action
Vertical Barriers	Thermal Oxidation (offgas)
Clay and Soil Capping	Catalytic Oxidation (offgas)
Asphalt or Concrete Capping	UV/Oxidation
Extraction Wells	Air Stripping
Extraction Trenches	Steam Stripping
Air Sparging	Activated Carbon Adsorption
Biodegradation (in situ)	Activated Carbon Adsorption (offgas)
	Resin Bed Adsorption (offgas)
	Biodegradation
	Reinfiltration
	Reuse/Recycling
	Discharge to POTW
	Discharge to Surface Waters

APPENDIX 2B

FORM B-3

TECHNOLOGY SCREENING SUMMARY FORM
DEBRIS
Remedial Technology Screening Report
Fort Ord, California

INSTRUCTIONS: For single Groups of Compounds in soil or groundwater, or for mixed waste, see Forms A-2 and A-4, respectively. Complete separate forms if necessary for different types of debris (e.g., one form for live ammunition and unexploded ordnance, and a separate form for household refuse and appliances).

- Name of Site: Site 12 - Lower Meadow Disposal Area

- Brief Description: Concrete and construction debris (Soil RU #1)

- Type of Debris (select one category, one or more type of debris)

Household refuse	____
Appliances	____
Scrap metal	X
Scrap lumber	X
Glass	____
Medical	____
Incinerator ash	____
Spent ammunition	X
Live ammunition	____
Unexploded ordinance	____

- Group of Compounds (if detected within debris): VOCs ____ TPH-light ____ TPH-heavy X ; Metals ____ Pesticides ____

- Referenced Table(s): Number 12

- Technologies Retained

  See Attached

- Form Completed by: Dan Fitzgerald

- Description of Technology(s) (Appendix C) Reviewed by: Dan Fitzgerald

- Date Completed: June 25, 1994

APPENDIX 2B

FORM B-3 (attachment)

TECHNOLOGY SCREENING SUMMARY FORM
DEBRIS
Remedial Technology Screening Report
Fort Ord, California

- **Site 12 - Lower Meadow Disposal Area**
  Technologies Retained

No Action
Vertical Barriers
Horizontal Barriers
Clay and Soil Capping
Multilayered Capping
Asphalt or Concrete Capping
Grading
Revegetation
Diversion and Collection Systems
Excavation
Sterilization
Offsite Rotary Kiln Incinerator
Debris Washing
Debris Segregation
Biodegradation
Landfill Disposal Onsite
Replacement After Treatment
Landfill Disposal Offsite
Recycling Facility Offsite

APPENDIX 2B

FORM B-2

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

INSTRUCTIONS: For Debris or Mixed Waste, see Forms A-3 or A-4. Complete several forms if necessary for each separate Group of Compounds and Media, and attach to Feasibility Study file for each site (e.g., one form for VOCs in groundwater, and a separate form for metals in soil).

- Name of Site: Site 12 - Lower Meadow - Outfall 31
- Brief Description: Elevated heavy TPH-affected soil (Soil RU #2)
- Group of Compounds (select one)
  - VOCs ____ TPH-light ____
  - TPH-heavy X Metals ____
  - Pesticides ____
- Media (select one)
  - Soil X Groundwater ____
- Potentially Applicable Treatment (select one or both)
  - In Situ X Ex Situ X
- Referenced Table(s) Number 5 6
- Technologies Retained

In Situ	Ex Situ
See Attached	See Attached

- Form Completed by: Dan Fitzgerald
- Description of Technology(s) (Appendix C) Reviewed by: Dan Fitzgerald
- Date Completed: June 25, 1994

APPENDIX 2B

FORM B-2 (attachment)

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

- **Site 12 - Lower Meadow - Outfall 31**
  Technologies Retained

In Situ	Ex Situ
No Action	No Action
Clay and Soil Capping	Rotary Kiln Incineration
Asphalt or Concrete Capping	Fluidized Bed Incineration
Grading	Circulating Bed Incineration
Revegetation	Thermal Oxidation (offgas)
Diversion and Collection Systems	Catalytic Oxidation (offgas)
Excavation	Asphalt Batching
Soil Vapor Circulation	Thermal Desorption
Air Injection	Screening
Biodegradation (in situ)	Activated Carbon Adsorption (offgas)
	Biodegradation
	Thermal Treatment Offsite
	Biological Treatment Offsite
	Landfill Disposal Onsite
	Replacement After Treatment
	Landfill Disposal Offsite

APPENDIX 2B

FORM B-2

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

INSTRUCTIONS: For Debris or Mixed Waste, see Forms A-3 or A-4. Complete several forms if necessary for each separate Group of Compounds and Media, and attach to Feasibility Study file for each site (e.g., one form for VOCs in groundwater, and a separate form for metals in soil).

- Name of Site: Site 12 - SPRR Area and Cannibalization Yard
- Brief Description: Elevated heavy TPH-affected soil (Soil RU #3)
- Group of Compounds (select one)
  - VOCs ____ TPH-light ____
  - TPH-heavy X Metals ____
  - Pesticides ____
- Media (select one)
  - Soil X Groundwater ____
- Potentially Applicable Treatment (select one or both)
  - In Situ X Ex Situ X
- Referenced Table(s) Number 5 6
- Technologies Retained

In Situ	Ex Situ
See Attached	See Attached

- Form Completed by: Dan Fitzgerald
- Description of Technology(s) (Appendix C) Reviewed by: Dan Fitzgerald
- Date Completed: June 25, 1994

APPENDIX 2B

FORM B-2 (attachment)

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

- **Site 12 - SPRR Area and Cannibalization Yard Area**
  Technologies Retained

In Situ	Ex Situ
No Action	No Action
Clay and Soil Capping	Rotary Kiln Incineration
Asphalt or Concrete Capping	Fluidized Bed Incineration
Grading	Circulating Bed Incineration
Revegetation	Thermal Oxidation (offgas)
Diversion and Collection Systems	Catalytic Oxidation (offgas)
Excavation	Asphalt Batching
Soil Vapor Circulation	Thermal Desorption
Air Injection	Screening
Biodegradation (in situ)	Activated Carbon Adsorption (offgas)
	Biodegradation
	Thermal Treatment Offsite
	Biological Treatment Offsite
	Landfill Disposal Onsite
	Replacement After Treatment
	Landfill Disposal Offsite

APPENDIX 2C

COST ESTIMATES AND ASSUMPTIONS

APPENDIX 2C

Assumptions for Cost Estimates
Fort Ord Sites 2 and 12 Feasibility Study

General Assumptions

- Mobilization for each alternative includes the following: mobilization of equipment, trailer rental, temporary fencing (as necessary), generator or temporary power hookup, preparation of a health and safety plan, and acquiring of other incidental equipment/materials including personnel protective equipment (PPE).

- Clearances for activities in the Lower Meadow (SRU1) and the Sand Dunes (Groundwater Remedial Unit) will be a biological survey and utility clearances.

- Clearing and grubbing includes removal of brush as well as cutting, chipping and tree stump removal.

- Field testing during surface restoration comprises labor (geotechnical engineer), materials and laboratory compaction tests. Activities include supervision of backfilling, grading, surveying and preparation of as-built drawings.

- Dust suppression and air monitoring will be conducted for all intrusive activities.

- Onsite treatment of TPH-affected soil will be performed at the existing FOSTA. Transportation, treatment at FOSTA, and disposal at OU 2 or placement at an appropriate location is estimated to cost $60 per cubic yard.

- Excavation sampling costs include labor, materials and analytical fees for sidewall sampling to verify excavation limits and initial stockpile sampling.

- Pre-Field activities include preparation of a site-specific work plan, documentation of substantive requirements, preparation of an addendum to the quality assurance project plan (QAPP), and sample and analysis plan (SAP); implementing deed restrictions (where applicable) and interaction with regulatory agencies.

- A contingency cost of 15 percent for estimated capital costs and O&M costs has been included.

Alternative 1

- The No Action alternative includes quarterly sampling and analysis of 20 wells and 2 surface water outfalls on Sites 2 and 12. The analytical methods for the wells are EPA Method 8010 and 8020. Several wells require priority pollutant metals, fecal coliform, nitrate/nitrite, and orthophosphate analytes.

- Professional fees include labor to perform well purging and sampling, project management and report preparation.

Alternative 2

- Capping at SRU 1 and 2 and excavation/transportation/backfilling at SRU 3 is anticipated to take 8 weeks for each activity. Actual treatment/onsite disposal of TPH affected soil will likely be 2 to 4 months depending upon biodegradation rates. Construction of the groundwater system is expected to take 12 weeks.

- In-place capping will entail preparation/compaction of existing sand material at the site, importing 12 inches of Class II AB, installation of a 6-inch-thick asphalt surface, and 2 percent grading of the asphalt surface for surface water controls. All runoff will be routed to newly constructed catch basins, as required, and include the connection of Outfall 31 and other surface drain pipes.

- The existing wells will be protected in-place and resealed, if required, with the wellhead modified to meet future site reuse.

- SRU 1 has a surface area of approximately 22,000 square feet, and SRU 2 has a surface area of approximately 5,000 square feet . Capping of soil having dimensions of 400 feet by 100 feet within and outside the remedial unit boundaries will be required. SRU 3 has an area of 13,500 square feet, with an estimated depth of 2 feet, and requires excavation and FOSTA treatment of 1,000 cubic yards.

- The groundwater system will contain extraction wells, a conveyance system, and a central process area. The conveyance system will include underground piping and conduit connecting the extraction wells to the central process area. It is anticipated the conveyance system will cross Highway 1 because of its proximity to the plume and the proposed extraction system. One extraction well is located approximately 400 feet into the dune sand area near Trainfire Area 9. This alignment will require special consideration during design, permitting, and construction.

- The process area will be constructed near the Main Garrison Sewage Treatment Plant. The process area will be enclosed and secure with a concrete foundation supporting process equipment and containing utilities including sewer, water, phone, and electrical. The process equipment will consist of surge vessels, metering apparatus, electrical distribution, electrical controls, and a discharge pumping system as required. No GAC treatment is anticipated for disposal to the publicly owned treatment works (POTW). This system will be designed to process a total of 300 gpm from four wells.

- Design and specification costs are between 5 and 20 percent of system capital cost depending upon construction costs for specific remedial units. This task includes detailed drawings acceptable to the Corps of Engineers, Sacramento District (Sacramento COE) for obtaining competitive bids. The groundwater conveyance system design includes a survey of intersected utilities along the pipeline alignment and determining the most efficient alignment.

- Pre-Field fees are assumed to be between 5 and 15 percent of construction costs or excavation/treatment costs. Construction management is assumed to be between 5 and 10 percent of construction costs or excavation/treatment costs.

- Cap maintenance will comprise annual inspections onsite by qualified personnel and brief reports.

- The POTW fee is based on the annual fee of $475,000 per million gallons per day (MGD) for a continuous stream of 300 gpm. Fees are specified by the Monterey Regional Water Pollution Control Agency.

Alternative 3

- Remediation time for the selective excavation activities for SRU 1 is 4 weeks. Remediation time at SRUs 2 and 3 is anticipated to be 8 weeks. Actual treatment/onsite disposal of TPH affected soil will likely be 2 to 4 months depending upon biodegradation rates. Construction of the groundwater system is expected to take 16 weeks.

- The existing wells will be protected in-place and resealed, if required, with the wellhead modified to meet future site reuse.

- SRU 1 has a surface area of approximately 22,000 square feet and SRU 2 has a surface area of approximately 5,000 square feet . This corresponds to 16,000 cy and 2,800 cy for SRU 1 and 2 assuming a total depth of 20 feet and 15 feet, respectively. Capping of SRU 1 will cover 22,000 square feet. SRU 3 has an area of 13,500 square foot and with an estimated depth of 2 feet is 1,000 cubic yards.

- It is assumed that 10 percent (1,600 cy) of the soil contained in SRU 1 is affected by elevated TPH and will require selected excavation and treatment. Excavation sidewall and bottom samples will be obtained in those limited areas where elevated TPH was found in SRU 1.

- The groundwater and treatment system will contain extraction wells, a conveyance system, and a central treatment area. The conveyance system will include underground piping and conduit connecting the extraction wells to the central compound. It is anticipated the conveyance system will cross Highway 1 because of its proximity to the plume and the proposed extraction system. One extraction well is approximately 400 feet into the dune sand area near Trainfire Area 9. One injection well (if used) is located approximately 800 feet into the dune sand area near Trainfire Area 11. These alignments will require special considerations during design, permitting, and construction.

- One treatment compound will be constructed near the Main Garrison Sewage Treatment Plant. The compound is an enclosed, secure area with a concrete foundation supporting process equipment and containing utilities including sewer, water, phone, and electrical. The process equipment will consist of surge vessels, metering apparatus, electrical distribution, electrical controls, and a discharge pumping system as required. Chemical treatment using granulated activated carbon (GAC) is anticipated for disposal to either the storm drain, local reuse, or injection. This system will be designed to process a total of 300 gpm from four wells for the NPDES discharge or reuse approach. The system will process 450 gpm for the injection approach.

- Remediation system costs are calculated for the NPDES discharge or reuse approach (Alternative 3A) and the injection approach (Alternative 3B) to provide a range of NPV costs.

- The injection system (if used) will comprise four injection wells, a conveyance system, and injection pumps and controls. Common trenches will be used, where feasible, to combine with the extraction conveyance system. Total injection flowrate is assumed to be 450 gpm.

- Average annual granular activated carbon (GAC) usage costs are estimated from the average system influent concentrations based on the groundwater modeling. An average annual cost of $60,000 for GAC assumes a worst-case adsorption rate of 0.2 percent based on the average system influent concentrations. Initial yearly costs may be greater but will soon decrease.

- Design and specification fees are between 3 and 12 percent of system capital cost depending upon construction costs for specific remedial units. This task includes detailed drawings acceptable to the COE for obtaining competitive bids. The groundwater conveyance system design includes a survey of intersected utilities along the pipeline alignment and determining the most efficient alignment.

- Pre-Field fees are assumed to be between 5 and 12 percent of construction costs or excavation/treatment costs. Construction management is assumed to be between 3 and 5 percent of construction costs or excavation/treatment costs.

- Cap maintenance will comprise annual inspections onsite by qualified personnel and brief reports.

Alternative 4

- Remediation time for the excavation/segregation activities for SRU 1 and 2 will be 20 weeks. Remediation time at SRU 3 is anticipated to be 8 weeks. Actual treatment/onsite disposal of TPH affected soil will likely be 2 to 4 months depending upon biodegradation rates. Construction of the groundwater system is expected to take 20 weeks.

- The existing wells will be protected in-place and resealed, if required, with the wellhead modified to meet future site reuse.

- All three soil remedial units will be excavated. SRU 1 has a surface area of approximately 22,000 square feet and SRU 2 has a surface area of approximately 5,000 square feet. This corresponds to 16,000 cy and 2,800 cy for SRU 1 and 2 assuming a total depth of 20 feet and 15 feet, respectively. SRU 3 has an area of 13,500 square feet and an estimated depth of 2 feet for 1,000 cubic yards.

- It is assumed that 10 percent (1,600 cy) of the soil contained in SRU 1 is affected by elevated TPH and will require segregation and treatment. Excavation sidewall samples will be obtained in those limited areas where elevated TPH was found in SRU 1 but the debris area sidewalls will not be sampled elsewhere.

- The remaining 90 percent of soil and debris in SRU 1 will be excavated, consolidated, and transported to OU 2 landfill.

- The groundwater system will contain extraction wells, a conveyance system, a treatment system, and an injection system. The conveyance system will be the same as assumed in Alternative 3. One extraction well is approximately 400 feet into the dune sand area near Trainfire Area 9. One injection well (if used) is approximately 800 feet into the dune area near Trainfire Area 11. These alignments will require special considerations during design, permitting, and construction.

- One treatment and injection compound will be constructed near the Main Garrison Sewage Treatment Plant and cost assumptions are the same as for Alternative 3.

- Remediation system costs are calculated for the NPDES discharge or reuse approach (Alternative 4A) and the injection approach (Alternative 4B) to provide a range of NPV costs.

- The injection system cost assumptions are the same as for Alternative 3.

- GAC usage costs are based on the same assumptions as for Alternative 3.

- Design and specification fees are between 3 and 12 percent of system capital cost depending upon the construction costs for specific remedial units. This task includes detailed drawings acceptable to the COE for obtaining competitive bids. The groundwater conveyance system design includes a survey of intersected utilities along the pipeline alignment and determining the most efficient alignment.

- Pre-Field fees are assumed to be between 5 and 8 percent of construction costs or excavation/treatment costs. Construction management is assumed to be between 3 and 5 percent of construction costs or excavation/treatment costs.

TABLE 2C1

Estimated Costs for Alternative 1

Note: These costs are for comparison purposes only, and are intended to have an estimated accuracy of only +50% to -30%. Many design variables and permitting requirements have not been established. Construction cost estimates will be refined after system design is complete.

Item	Units		Cost per Unit	Total
Annual O&M				
Groundwater Monitoring (20 Wells and 2 Outfalls 4 times per year)				
Analytical (with 10% QA/QC Samples)	96	samples	$625	$60,000
HLA Field Labor and Equipment	16	days	$1,500	$24,000
Reporting	4	quarters	$2,500	$10,000
Project Management	4	quarters	$2,500	$10,000
Yearly O&M				$104,000
O&M cost contingency	15%			$15,600
Total Annual O&M costs				$119,600

Total O&M NPV:	i= 5%	n= 30 years	**$1,838,500**

TABLE 2C2

Estimated Costs for Alternative 2

Note: These costs are for comparison purposes only, and are intended to have an estimated accuracy of only +50% to -30%. Many design variables and permitting requirements have not been established. Construction cost estimates will be refined after system design is complete.

Item	Units		Cost per Unit	Total
Capital and Installation Costs				
CAPPING OF SOIL RU 1 AND 2				
Mobilization	1	each	$5,000	$5,000
Clearing and Grubbing	1	each	$8,000	$8,000
Subbase Preparation and Compaction	40,000	ft2	$0.50	$20,000
Drainage System	1	each	$15,000	$15,000
Asphalt Surface	40,000	ft2	$1.50	$60,000
Field Testing	1	each	$15,500	$15,500
			Subtotal	$123,500
EXCAVATION/TREATMENT OF RU 3				
Mobilization	1	each	$5,000	$5,000
Excavation of Shallow Soils	1,000	cy	$10	$10,000
FOSTA Treatment/Transportation/Disposal	1,000	cy	$60	$60,000
Excavation Sampling	1,000	cy	$40	$40,000
Field Testing	1	each	$5,000	$5,000
Backfill Clean Import	1,000	cy	$20	$20,000
Drainage/Surface Replacement	1	each	$5,000	$5,000
			Subtotal	$145,000
GROUNDWATER SYSTEM				
Extraction System				
Extraction Wells	4	each	$20,000	$80,000
Extraction Wellheads/Pumps/Vault Boxes	4	each	$7,000	$28,000
Conveyance System				
Trenching/Piping with Surface Replacement	6,000	lf	$30.00	$180,000
Trenching/Piping/Conduit in Dunes	400	lf	$40.00	$16,000
Highway 1 Crossing	1	each	$25,000	$25,000
Process System				
Compound Construction/Utilities/Security	1	system	$100,000	$100,000
Process Equipment (300 gpm: No GAC)	1	system	$125,000	$125,000
Pumping System to POTW	1	each	$15,000	$15,000
			Subtotal	$569,000
DESIGN AND PREFIELD ACTIVITIES				
Engineering				
Capping Design for Soil RU 1 and 2	10%	of construction		$12,350
Capping Construction Oversight	10%	of construction		$12,350
Excavation Design for Soil RU 3	5%	of construction		$7,250
Excavation/Construction Oversight	5%	of construction		$7,250
GW System and Appurtenances Design/Specs	10%	of construction		$56,900
Conveyance System Design	6,400	ft	$3.50	$22,400
Highway 1 Crossing/Dune Alignment	1	each	$20,000	$20,000
Groundwater Construction Oversight	5%	of construction		$28,450

TABLE 2C2

Estimated Costs for Alternative 2

GW System Startup	1	each	$20,000	$20,000
Prefield Activities				
Capping for Soil RU 1 and 2	10%	of construction		$12,350
Excavation/Treatment Prefield for Soil RU 3	5%	of construction		$7,250
GW System Prefield	5%	of construction		$28,450
Conveyance System Prefield	6,400	ft	$3.00	$19,200
Highway 1 Crossing/Dune Alignment Prefield	1	each	$20,000	$20,000
			Subtotal	$274,200
Subtotal Capital Costs				$1,111,700
Capital Cost Contingency	15%			$166,800
Total Capital Cost				$1,278,500
Annual O&M				
Cap Maintenance	1	each	$10,000	$10,000
Electricity (30 HP)	370,000	kWh	$0.13	$48,100
Process System Maintenance	4	quarters	$5,000	$20,000
Process System Sampling and Analysis	4	quarters	$10,000	$40,000
POTW Disposal Fee at 300 gpm	1	each	$205,000	$205,000
Extraction Wellhead Maintenance	4	wells	$2,000	$8,000
Groundwater Monitoring (sampling and analysis)	4	quarters	$20,000	$80,000
Reporting	4	quarters	$2,500	$10,000
Project Management	4	quarters	$2,500	$10,000
Yearly O&M				$431,100
O&M Cost Contingency	15%			$64,700
Total Annual O&M costs				$495,800

Total Capital + O&M NPV: i= 5% n= 30 years **$8,900,200**

TABLE 2C4

Estimated Costs for Alternative 3B
Groundwater Injection

Note: These costs are for comparison purposes only, and are intended to have an estimated accuracy of only +50% to -30%. Many design variables and permitting requirements have not been established. Construction cost estimates will be refined after system design is complete.

Item	Units		Cost per Unit	Total
Capital and Installation Costs				
CAPPING; LIMITED EXCAVATION OF SOIL RU 1				
Mobilization	1	each	$5,000	$5,000
Clearing and Grubbing	1	each	$5,000	$5,000
Soil Excavation/FOSTA Treatment/Disposal	1,600	cy	$70	$112,000
Excavation Sampling	1,600	cy	$40	$64,000
Field Testing	1	each	$10,000	$10,000
Backfill Excavation	1,600	cy	$20	$32,000
Subbase Preparation and Compaction	40,000	ft2	$0.50	$20,000
Drainage System	1	each	$10,000	$10,000
Asphalt Surface	40,000	ft2	$1.50	$60,000
			Subtotal	$318,000
EXCAVATION/TREATMENT OF RU 2 AND 3				
Mobilization	1	each	$5,000	$5,000
Excavation of Soil	3,800	cy	$10	$38,000
FOSTA Treatment/Transportation/Disposal	3,800	cy	$60	$228,000
Excavation Sampling	3,800	cy	$40	$152,000
Field Testing	1	each	$10,000	$10,000
Backfill Clean Import	3,800	cy	$20	$76,000
Drainage/Surface Replacement	1	each	$5,000	$5,000
			Subtotal	$514,000
GROUNDWATER SYSTEM				
Extraction/Injection System				
Extraction Wells	4	each	$20,000	$80,000
Extraction Wellheads/Pumps/Vault Boxes	4	each	$7,000	$28,000
Injection Wells	4	each	$20,000	$80,000
Injection Wellheads/Vault Boxes	4	each	$7,000	$28,000
Conveyance System				
Trenching/Piping with Surface Replacement	12,000	lf	$30.00	$360,000
Trenching/Piping/Conduit in Dunes	1,200	lf	$40.00	$48,000
Highway 1 Crossing	1	each	$25,000	$25,000
Treatment/Injection System				
Compound Construction/Utilities/Security	1	system	$130,000	$130,000
Treatment Equipment (450 gpm: GAC)	1	system	$300,000	$300,000
Injection Pumps and Process Equipment	1	each	$75,000	$75,000
			Subtotal	$1,154,000
DESIGN AND PREFIELD ACTIVITIES				
Engineering				
Capping/Excavation Design for Soil RU 1	5%	of construction		$15,900
Capping/Excavation Oversight for Soil RU 1	5%	of construction		$15,900

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

Volume V - Feasibility Study
Section 3.0 - Sites 16 and 17

Draft: July 25, 1994
Draft Final: November 29, 1994
Final: October 24, 1995

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Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

Volume V - Feasibility Study

Sites 16 and 17

HLA Project No. 23366 0417251

This final version of the Sites 2 and 12 Feasibility Study addresses comments received on the Draft Final version of the report dated December 1994. Responses to agency comments on the Draft Final report are included in Volume VI of this report.

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

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TABLES

PLATES

APPENDIXES

3.0 FEASIBILITY STUDY FOR SITES 16 AND 17

3.1 Background

Sites 16 and 17 (Plate 3.1) comprise one RI site that includes:

- Site 16
  - Directorate of Logistics (DOL) Maintenance Yard
  - Pete's Pond
  - Pete's Pond Extension
- Site 17
  - 1400 Block Motor Pool Complex
  - a baseball field
  - storage buildings

Site 16 was combined with Site 17 because they are contiguous, they contain similar types of contaminants, and they both contain waste disposal areas with similar types of waste. The sites have been combined since the initial site characterization activities were completed when their similarities became apparent.

This section briefly describes the physical description, history, nature and extent of contamination, summaries of the Baseline Human Health Risk Assessment (BRA) and Ecological Risk Assessment (ERA), and Applicable or Relevant and Appropriate Requirements (ARARs). Except for the ARARs, these items are described in greater detail in Volumes II, III and IV.

Responses to agency comments on the Feasibility Studies, including Sites 16 and 17 appears in an Appendix at the end of Volume V - Feasibility Studies.

3.1.1 Physical Description

Sites 16 and 17 are in the Main Garrison in the northwest portion of Fort Ord (Plate 3.1).

3.1.1.1 Site 16

Within Site 16 are four discrete areas: an open field, the DOL Maintenance Yard, Pete's Pond, and Pete's Pond Extension (Plate 3.1). Pete's Pond and Pete's Pond Extension are common names for two open areas within Site 16; except during heavy rainfall when Pete's Pond temporarily contains surface runoff from the storm drains that discharge into it, neither is a surface water body. The open field is southwest of the DOL Maintenance Yard and was not investigated because no known site activities or sources occurred in this area.

DOL Maintenance Yard

The DOL Maintenance Yard is an approximate area of about 4.5 acres on Eighth Street near the Fifth Avenue Cut-Off in the Main Garrison. The northern half of this area is paved. Surface runoff from the unpaved southern portion drains into Pete's Pond Extension, which is northwest of the DOL Maintenance Yard. The area is fenced with access through gates on Eighth Street.

Pete's Pond and Pete's Pond Extension

Pete's Pond and Pete's Pond Extension are northwest of the DOL Maintenance Yard. Pete's Pond is a 3.3-acre triangular depression between Eighth Street, Fifth Avenue, and the Fifth Avenue Cut-off. The area is bordered by roadways on all sides and is covered with low-lying brush and grasses. At its deepest point, the ground surface at Pete's Pond is approximately 10 feet below Fifth Avenue. Six storm drains discharge into Pete's Pond from Sites 15, 16, and 17 as well as from areas to the south and east (including Site 23 and housing areas in the Main Garrison). Although dry most of the year, Pete's Pond fills to depths of up to 5 feet during heavy rainfall.

Pete's Pond Extension is between Pete's Pond and the DOL Maintenance Yard. The approximately 3.5-acre area consists of a vegetated hillside on the northeast and a flat vegetated area on the southwest. Vegetation consists of low-lying brush, trees, and grasses; there are no buildings onsite.

3.1.1.2 Site 17

Site 17 consists of approximately 56 acres and is west of Site 16 in the Main Garrison. Site 17 consists of three major areas: the 1400 Block Motor Pool Complex, a nearby baseball field, and 34 storage buildings along Fourth Avenue.

1400 Block Motor Pool Complex

The 1400 Block Motor Pool complex (35 acres) consists of paved areas, buildings used for motor vehicle maintenance, and several wash racks. A paved, 8-acre area in the northeastern portion of the 1400 Block Motor Pool Complex is referred to as the Site 17 Disposal Area.

Baseball Field

The baseball field is an unpaved area (7 acres) west of the 1400 Block Motor Pool Complex.

Storage Buildings

Thirty-six storage buildings exist on Site 17 along a 14-acre strip on Fourth Avenue.

3.1.2 Site History

3.1.2.1 Site 16

DOL Maintenance Yard

The DOL Maintenance Yard has been used as a heavy equipment maintenance facility since the 1950s when the site was originally developed. Its six buildings and structures are enclosed within a fenced area, and are identified by number and current or previous use as follows:

- Building 4900, the main maintenance yard building, is used primarily for vehicle repairs; small arms weapons were also repaired in its northern wing. Operations in Building 4900 included a weapons blueing process, spray painting, and general vehicle repairs. A former 1,500-gallon diesel underground storage tank (UST) near Building 4900 was removed in March 1992.

- Building 4901 is used for storage of unused motor oil

- Building 4902 is a wash rack. An oil/water separator is adjacent to the wash rack.

- Building 4903 contains a diesel-powered steam cleaner. A 200-gallon aboveground diesel fuel tank adjacent to the building provided fuel to the steam cleaner by gravity feed.

- Building 4904 was the former paint shop.

- Building 4905 is used for a storage of nonhazardous materials.

Pete's Pond and Pete's Pond Extension

Pete's Pond and Pete's Pond Extension have remained open space areas since development of the surrounding areas. Based on an aerial photograph review (see Section 4.0 of Volume II RI - Sites 16 and 17) these areas were apparently used for refuse dumping sometime during the late 1940s and early 1950s.

3.1.2.2 Site 17

1400 Block Motor Pool Complex

The 1400 Block Motor Pool Complex (which includes Buildings 1476 through 1495) was undeveloped until about 1977 when building construction began. Since then, the motor pool has operated until the troop reallocation in 1993. The facility was used for service of motor vehicles including light and heavy trucks and other army vehicles. Materials that were or are currently stored at the 1400 Block Motor Pool Complex include lubricating oils, brake fluid, coolants, cleaning solvents, diesel, and gasoline. These materials are stored in fourteen USTs which remain in the 1400 Block Motor Pool Complex and are being evaluated as part of the UST program at Fort Ord. Eight other USTs have been removed from Site 17. The Site 17 Disposal Area has been used as a parking area and contains a washrack and grease rack. Based on aerial photographs it appears that material was buried in this area between the late 1940s and early 1950s.

Baseball Field

Based on aerial photographs, it appears that the baseball field was constructed during the mid 1970s, or about the same time as the 1400 Motor Pool Block Complex was developed. The field was originally suspected to contain debris; however, based on geophysical surveys of the area, debris appears to have been buried east of, and not at, the baseball field in what is now referred to as the Site 17 Disposal Area.

Storage Buildings

The storage buildings along Fourth Avenue were built in the 1940s and were used for storage of various materials. For example, corrosive chemicals were stored in Buildings 1431 and 1435. Building 1442 previously housed an incinerator for waste generated from the first Fort Ord Hospital constructed in the 1940s; this building now houses an autoclave used to sterilize medical debris from the onbase Hays Hospital which was constructed in 1969.

Disposal Area

There are no known sources of information on site history related to the Disposal Area at Site 17.

3.1.3 Proposed Reuse

This section discusses proposed future land uses for Sites 16 and 17.

3.1.3.1 Site 16

For future land use planning, parts of Site 16 have been designated as part of Polygon 2e (*FORA, December 14, 1994*), which comprises approximately 40 acres. No other sites are in Polygon 2e. This area is proposed for public agency corporation yards for the City of Marina, the County of Monterey, and the Monterey-Salinas Transit District.

3.1.3.2 Site 17

For future land use planning, Site 17 has been designated as part of Polygon 16, an area of approximately 500 acres that includes Sites 14, 15, part of 16, 17, 18, 23, 24, and 38 (*FORA, December 14, 1994*). This area, proposed by the California State University (CSU) as the site for its new Monterey Bay campus, includes most of the developed areas at the Main Garrison. Existing structures are to be used for student/faculty artists, lecture/laboratory spaces, and university administrative offices. In addition, the parcel will provide sites for new facilities, including additional residence halls, a permanent library building, and a science center. The precise locations of future structures within this area are unknown.

3.1.3.3 Nearby Populations

U.S. Army personnel are present at Sites 16 and 17, but neither these sites nor adjacent areas are heavily used. The nearest resident populations currently are in the city of Marina, approximately 1 mile north of the site. There are no onsite residences on the sites, although many former army housing units are approximately 0.5 miles southeast. In the future, people who may be present at or near Sites 16 and 17 include those expected to be associated with CSU and nearby commercial workers.

3.1.4 Nature and Extent of Contamination

The nature and extent of contamination is described in greater detail in the RI for Sites 16 and 17 (Volume II). In the RI program, data from soil borings, test pits, and monitoring wells were used to evaluate the nature and extent of contamination and debris within Sites 16 and 17. Table 3.1 summarizes the tasks included in the RI program, and Table 3.2 presents a summary of the results. Plates 3.2 through 3.5 present the distribution of contaminants and debris at Sites 16 and 17.

3.1.4.1 DOL Maintenance Yard

Potential contaminants at the DOL Maintenance Yard were petroleum hydrocarbons, metals, and semivolatile organic compounds (SOCs). RI efforts focused on potential source areas, which were in the unpaved areas of the DOL Maintenance Yard. Thirty-five soil samples were collected from 12 test pits and 15 soil borings to define the nature and extent of contamination. Analytical results from these soil samples indicated that total chromium was the only metal detected above maximum background levels. Hexavalent chromium was not detected. Total petroleum hydrocarbons (TPH) as diesel and an unknown petroleum hydrocarbon heavier than diesel were detected in 10 of the 35 samples from depths of 2 to 9 feet. Detected TPH concentrations ranged rom 11 to 4,300 mg/kg. SOCs were analyzed based on areas with elevated TPH concentrations and were detected in four of the soil samples. Plate 3.2 shows the distribution of TPH at the DOL Maintenance Yard.

3.1.4.2 Pete's Pond

Potential contaminants at Pete's Pond were debris, and contaminants associated with debris including metals, dioxins, and oil and grease. Fifty-three samples were collected from seven test pits, eight borings, and one monitoring well and five outfall surface locations to delineate the nature and extent of contamination. Cadmium, copper, lead, mercury, and zinc were detected in soil samples above background levels but below Cal/EPA Total Threshold Limit Concentration (TTLC) levels. Most of the metals were generally either associated with debris or with a storm drain outfall. Oil and grease were detected in four samples, pesticides were detected in three samples, and dioxins were detected in one sample. Debris at Pete's Pond appears to be rather scattered, but is primarily located in two areas. In general, approximately 30 percent of the materials in this area are debris in a matrix of sand. Debris consists of general household debris, UXO/OEW, and medical debris. Plate 3.4 shows the distribution of debris and concentrations of selected compounds greater than background levels at Pete's Pond.

3.1.4.3 Pete's Pond Extension

Potential contaminants at Pete's Pond Extension were debris and contaminants associated with debris such as petroleum hydrocarbons, metals, dioxins, SOCs and volatile organic compounds (VOCs). Forty samples were collected from 22 test pits and 5 soil borings to delineate the nature and extent of contamination at Pete's Pond Extension. Analytical results from soil samples collected during the RI indicated that arsenic, chromium, copper, lead, nickel, mercury, and zinc were detected above their background concentrations, but below Cal/EPA total TTLC levels. Most of the metals above background levels are associated with the presence of debris. An unknown petroleum hydrocarbon, SOCs, and VOCs were also identified in a sample from Test Pit TR-16-28 in the debris; TPH was reported at 1,300 mg/kg in this sample. Trace levels of SOCs and VOCs were also identified in three other soil samples, from other test pits at Pete's Pond Extension. Dioxins were identified in two soil samples at 5 and 7 feet below ground surface (bgs). Debris at Pete's Pond Extension was identified in test pits at depths of 1 to 7 feet bgs beneath about 1 foot of sandy soil. In general, approximately 30 percent of the material in this area is debris in a matrix of sand. Debris consisted of general household debris, UXO/OEW, and medical debris. Plate 3.3 shows the distribution of debris at Pete's Pond Extension, and locations where selected chemical compounds were detected above background levels.

3.1.4.4 Site 17 Disposal Area

Potential contaminants at the Site 17 Disposal Area were debris and contaminants associated with debris including petroleum hydrocarbons, and metals. Fifty-six samples from 22 test pits and 12 soil borings were used to delineate the nature and extent of contamination. Analytical results from the soil samples indicated that arsenic, cadmium, chromium, copper, lead, nickel, mercury, silver, and zinc were detected above their respective maximum background levels; however, concentrations were below Cal/EPA TTLCs and most were associated with debris. The maximum lead concentration in the debris was 442 mg/kg.

Elevated levels of TPH were identified in three test pits (TR-17-11, TR-17-14, and TR-17-12) at 5.5 feet, 7.0 feet, and 8.5 feet bgs, respectively. In general, up to 60 percent of the material in this area is debris in a matrix of sand. The type of debris includes medical debris and general household waste. Plate 3.5 shows the distribution of debris at the disposal area, and locations where selected chemical compounds were detected above background.

3.1.4.5 Groundwater

At least four separate aquifer zones of the Salinas Basin have been identified in the northern portion of Fort Ord: the upper, 180-foot, 400-foot, and the 900-foot aquifers. In general, the upper aquifer is too thin and continuous to serve as a significant source of potable water; the deeper aquifers, however, comprise major water-supply sources. Regional groundwater flow in these aquifers is to the northwest, generally toward Monterey Bay; however, local variations to this flow direction are common, often resulting from local pumping centers. Over most of this area, the Salinas Valley Aquiclude separates the upper and 180-foot aquifer; in the western portion of Fort Ord (west of Sites 16 and 17), however, this unit is absent and the upper and 180-foot aquifers are commingled. Groundwater conditions at Fort Ord are described in detail in Volume II, Basewide Hydrogeologic Characterization.

In this area of Fort Ord, VOCs, primarily trichloroethene (TCE), tetrachloroethene (PCE), and, to a lesser extent, carbon tetrachloride, have been detected in the upper and 180-foot aquifers. The primary source of these VOCs appears to be the Fort Ord Landfill (Operable Unit 2 [OU 2]). As shown on Plate 3.6, OU 2 is approximately 2,500 feet east of Sites 16 and 17, and the OU 2 plume of VOCs in groundwater appears to extend to these two sites. Additional details regarding the OU 2 groundwater remedial unit are provided in Volume I.

Three monitoring wells are used to monitor groundwater conditions at Sites 16 and 17. Since August 1993, chemicals consistently detected, or above background concentrations in the groundwater at Sites 16 and 17 include PCE, TCE, and carbon tetrachloride. PCE and TCE concentrations are below their Maximum Contaminant Levels (MCLs) of 5.0 μg/l, at concentrations up to 1.9 and 2.2 μg/l, respectively. Carbon tetrachloride has been detected at 1.1 μg/l, which is roughly twice the California MCL of 0.5 μg/l. Because these compounds are similar in concentration to those in the OU 2 groundwater and because no onsite source for these compounds has been identified at Sites 16 or 17, the groundwater contamination at Sites 16 and 17 appears to be associated with the OU 2 plume.

3.1.5 Summary of Risk Assessments

Potential risks to human health and the environment associated with potentially impacted groundwater and soil at Sites 16 and 17 are evaluated in the Baseline Human Health Risk Assessment (BRA; Volume III) and the Ecological Risk Assessment (ERA; Volume IV). These risk assessments address the risks to human health and the environment posed by the chemicals of potential concern (COPCs) present at the site, and were performed in accordance with EPA assessment and modeling protocols. Results of the BRA and ERA are summarized below.

3.1.5.1 Baseline Human Health Risk Assessment

For the purposes of the BRA, Sites 16 and 17 were subdivided into four areas: the DOL Maintenance Yard, Pete's Pond, Pete's Pond Extension, and the Site 17 Disposal Area. Based on proposed future land use (Section 3.1.3) and site characteristics such as topography, location, and total area, four hypothetical future receptors were selected for quantitative evaluation: student/faculty artists, utility workers, construction workers, and commercial workers. Other potential future human receptors were considered to have insignificant exposures at this site. The hypothetical student receptor was assumed to be exposed to soil at the Site 17 Disposal Area, Pete's Pond, and Pete's Pond Extension, as described in Section 4.4.3.1 of Volume III. This receptor was also assumed to be exposed to groundwater via ingestion and inhalation of vapors during domestic use (e.g., showering) of groundwater.

The construction worker receptors were assumed to be exposed to soil at the DOL Maintenance Yard or the Site 17 Disposal Area. Utility worker receptors were assumed to be exposed to soil at Pete's Pond or Pete's Pond Extension. All receptors were assumed to be exposed to soil via incidental ingestion of and dermal contact with soil, and inhalation of dust.

Exposure assumptions, such as soil and groundwater ingestion rates, inhalation rates, and exposure frequency, were used to estimate a dose via each pathway evaluated, as described in the BRA, Volume III, Section 2.2.4. As recommended by EPA, two separate exposure scenarios were evaluated: (1) a reasonable maximum exposure (RME), and (2) an average exposure scenario.

The BRA included estimates of adverse noncancer health effects and potential cancer risks associated with exposure to COPCs identified at Sites 16 and 17. The COPCs identified at Sites 16 and 17 included arsenic, antimony, beryllium, cadmium, copper, lead, mercury, nickel, bis(2-ethylhexyl)phthalate, chlordane, 4,4'-DDT, and TCDD. COPCs were selected separately for each of the four areas evaluated, and are presented in Volume III, Section 4.0. Noncancer health effects were evaluated by comparing exposure estimates with EPA-developed reference doses, resulting in a hazard index (HI). Potential cancer risks were estimated by multiplying exposure estimates by EPA- or Cal/EPA-developed slope factors. The EPA has developed a threshold target HI of 1 for noncancer effects, and a target risk range of 1×10^{-6} to 1×10^{-4} for cancer effects. For commercial/worker scenarios (including construction and utility workers), a more reasonable lower end target risk of 1×10^{-5} may be applied for cancer effects. Lead was evaluated separately because of its unique toxicological properties.

The results of the BRA indicate that estimated multipathway HIs for noncancer health effects are at or below the EPA threshold level of concern of 1 for all receptors evaluated. Estimated multipathway HIs range from 0.0001 to 1. EPA guidance states that "when the hazard index exceeds unity (i.e., 1) there may be a concern for potential health effects" (*EPA, 1989b*). The HIs for Sites 16 and 17 do not exceed 1; therefore, noncancer health effects are not expected for any of the receptors evaluated.

Estimated cancer risks for the utility worker receptors are below the EPA target risk range for both the average and RME scenarios. Estimated cancer risks for the student/facility artists receptor are within the EPA target risk range of 1×10^{-6} to 1×10^{-4} for both the average and RME scenarios. Estimated cancer risks for the student/facility artist are 2×10^{-7} and 5×10^{-6} for the average and RME scenarios, respectively. Estimated cancer risks for the utility worker range from 1×10^{-9} to 7×10^{-8}. Estimated cancer risks for the construction worker receptor at the Site 17 Disposal Area are 2×10^{-9} and 1×10^{-6} for the average and RME scenarios, respectively. Estimated cancer risks to the construction worker receptor at the DOL Maintenance Yard are 3×10^{-9} and 2×10^{-6} for the average and RME scenarios, respectively. These RME cancer risks are at the low end of the target risk range of 1×10^{-6} to 1×10^{-4}, and are below the target risk of 1×10^{-5} for worker scenarios. Estimated cancer risks for the commercial/worker receptor at the DOL Maintenance Yard are 7×10^{-7} and 1×10^{-5} for the average and RME scenarios, respectively. The RME cancer risk is within the EPA target risk range of 1×10^{-6} to 1×10^{-4}, and is at the target risk level of 1×10^{-5} for worker scenarios.

All exposures to lead evaluated at Sites 16 and 17 are below the EPA threshold blood-lead level of 10 μg/dl (micrograms per deciliter).

3.1.5.2 Ecological Risk Assessment

For the Ecological Risk Assessment (ERA; Volume IV), chemical data for shallow soil samples collected from Site 16 (Pete's Pond, Pete's Pond Extension, and the DOL Maintenance Yard) were used. At the Site 17 Disposal Area, contaminants are beneath paved areas; therefore this area was not evaluated in the ERA because of the lack of complete exposure pathways for ecological receptors. Assessment endpoints evaluated at Site 16 include the following:

- Health of the silvery legless lizard, an endangered species that lives in the leaf litter layer
- Health of the food base for predators such as foxes and raptors
- Health of the central maritime chaparral habitat, a rare and declining habitat.

To evaluate the silvery legless lizard, soil and leaf litter data were evaluated to assess potential exposures to the litter community. To evaluate the food base for predators, an attempt was made to collect and analyze small mammals, which serve as a food source for predators; no small mammals were collected from Site 16, as discussed in Volume IV, Section 6.0. To evaluate the central maritime chaparral habitat, the chemical concentrations in soil, areal extent of contamination, and potential impacts to ecological receptors were considered to provide a weight-of-evidence analysis. Exposure assumptions, including home range size and ingestion rates, were used to estimate doses for direct ingestion of soil, dermal contact with soil, and ingestion of food items (e.g., deer mice), as described in Volume IV, Section 5.0. These assumptions were modified based on site-specific biota data (i.e., leaf litter and plants), as discussed in Volume IV, Section 6.0. A very conservative scenario was evaluated as recommended by EPA.

The ERA used a conservative scenario based on modeled exposures to estimate potential adverse ecological effects associated with exposure to COPCs identified in soil at Site 16. COPCs for soil at Site 16 include chlorinated dibenzodioxin (CDD) and chlorinated dibenzofuran (CDF) congeners and lead. The results of the ERA indicate that:

- For the silvery legless lizard, results of leaf litter analyses indicate metals are present in soil at colocated litter samples at concentrations consistent with background. No significant differences were found in litter species composition relative to reference transects in similar habitats.
- For the predator food base, results of deer mice sampling at Site 31, which has similar chemicals in soil at similar concentrations, suggest that metals would likely be present at tissue levels consistent with background in rodent tissues at Site 16.
- For the central maritime chaparral habitat, lack of success trapping deer mice indicates that the habitat does not support a large population of small mammals.

Although lizards were not captured at Site 16, silvery legless lizards may be present in all evaluated areas. However, the small size of the areas, combined with the developed nature of the immediate surrounding areas, limits the value of the habitats. For example, Pete's Pond is a small (3.3 acres) triangular depression surrounded by three roads and provides at best only marginal habitat for the lizard. The leaf litter community (e.g., the food base for the silvery legless lizard) does not appear impacted by the concentrations of chemicals detected in surface soil.

Site 16 consists of two upland ruderal, developed areas (Pete's Pond and the DOL Maintenance Yard), and a mixture of upland ruderal and central maritime chaparral habitat in Pete's Pond Extension. Suitable habitat for small mammals was not identified in the two upland ruderal, developed areas. Because of the limited area and its disturbed nature, mammals were not captured at Pete's Pond Extension, which was considered potential small mammal habitat. On the basis of this information, the habitats present at Site 16 do not appear to support small mammals. Therefore, predators would not likely be present in these areas because no food is available, and exposure of predators to COPCs is not expected at Site 16.

Areas containing debris (including UXO/OEW and medical debris) have been identified at Site 16. The selected remedial alternative should address the ecological effects of these areas containing UXO/OEW, which were not included in the ERA. These debris areas contain the central maritime chaparral habitat identified in the ecological assessment endpoints presented above. The central maritime chaparral habitat is characterized as a rare and declining habitat. However, the size of the habitat is small, and it is surrounded by roads on three sides and the DOL Maintenance Yard on the fourth side. This habitat is in effect a small island in a sea of development. The vast majority of central maritime chaparral habitat located on Fort Ord is associated with the inland ranges (i.e., Site 39) and areas near Fritzsche Area Air Field (e.g., Site 35). Nevertheless, the selected remedial alternative should attempt to minimize disturbance to this habitat, if possible. A biologist should be present during remediation to ensure minimal impacts to the habitat, and a revegetation plan should be prepared to replace areas altered during remediation.

3.1.6 Applicable or Relevant and Appropriate Requirements

Under CERCLA, a remedial action must be protective of human health and the environment, and comply with federal or more stringent State ARARs, unless waived, such as laws imposed by state legislative bodies and regulations developed by state agencies that are of general applicability and are legally enforceable. Formally promulgated and consistently applied state or federal policies have the same weight as specific standards. Advisories and policy or guidance documents (to-be-considered requirements [TBCs]) issued by federal or state agencies that are not legally binding are not considered to be ARARs but may be included as TBCs.

ARARs are identified for each remedial action proposed in an FS. ARARs are chemical-, location-, and action-specific requirements as discussed in subsequent sections. Chemical-specific ARARs are identified and used in the development of TCLs.

Remedial actions recommended in an FS for a Superfund site must control further release of hazardous substances, pollutants, and contaminants to assure the protection of human health and the environment. Any hazardous substance, pollutant, or contaminant left onsite must be managed or controlled to meet ARARs upon completion of remedial actions.

3.1.6.1 Definition of ARARs

Guidance issued by the EPA (*1988b*) defines ARARs as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to a particular site.

The relevance and appropriateness of a requirement is judged by comparing the factors addressed to the characteristics of the remedial action, the hazardous substance(s) in question, and the physical characteristics of the site. The origin and objective of the requirement may aid in determining its relevance and appropriateness. Although relevant and appropriate requirements must be complied with to the same degree as applicable requirements, more discretion is allowed in determining which part of a requirement is relevant and appropriate.

TBCs, the final class of requirements considered by EPA during the development of ARARs, are nonpromulgated advisories or guidance documents issued by federal or state governments. They do not have the status of ARARs but may be considered in determining the necessary cleanup levels or actions to protect human health and the environment.

The following three categories of ARARs were defined by EPA (*1988a, b*):

- Ambient or chemical-specific requirements that set health- or risk-based concentration limits or ranges for particular chemicals (e.g., National Ambient Air Quality Standards)

- Location-specific requirements pertaining to restrictions placed on concentrations of hazardous substances or remedial activities (e.g., federal and state laws governing the siting of hazardous waste facilities)

- Performance-, design-, or action-specific requirements that govern particular activities with respect to remedial actions taken for hazardous wastes (e.g., hazardous wastes generated onsite must be properly managed according to federal and state law).

If ARARs are not available for a particular chemical or situation or if ARARs are not sufficient to protect human health and the environment, critical toxicity factors such as EPA-established reference doses or cancer potency factors may be used to estimate risk-based remediation goals consistent with EPA guidance, to ensure that a remedial action is protective of human health and the environment (*EPA, 1991a*).

3.1.6.2 Identification of ARARs

To identify the possible ARARs and TBCs for remedial actions at Fort Ord federal, state, and local statutes, regulations, and guidance were considered.

In the following sections, potential ARARs and TBCs are identified for the affected media at Sites 16 and 17. This FS considers all ARARs and TBCs in evaluating the various remedial alternatives in the detailed analysis (Section 3.5). Table 3.3 presents all potential ARARs applicable for remedial alternatives for the site.

Chemical-Specific Requirements

No concentration-based ARAR for soil cleanup levels has been established by the EPA or by Cal/EPA; however, guidelines have been established to evaluate soil cleanup levels on a site-specific basis. In addition, levels which define hazardous waste have been established by the EPA and Cal/EPA. All of these guidelines should be considered TBCs for soil remedial units. Potential chemical-specific ARARs and TBCs for Sites 16 and 17 are as follows:

- Monterey Bay Unified Air Pollution Control District (MBUAPCD): New Sources and Toxic Air Contaminants regulations are relevant and appropriate. Regulations II and X establish requirements for new stationary sources of air pollution and appropriate levels of abatement control technology for toxic air contaminants. Remedial design would need to meet the substantive requirements of these MBUAPCD regulations, if screening or excavating activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal.

- National Primary and Secondary Ambient Air Quality Standards: The Federal Primary and Secondary Ambient Air Quality Standards (NAAQS) is an ARAR. 40 CFR Part 150 establishes NAAQS for criteria pollutants including: particulate matter (PM-10), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. Although none of these pollutants have been identified in the air at Sites 16 and 17, particulate matter containing airborne lead dust could be generated during remedial construction activities.

- Soil Cleanup Levels: Soil Cleanup Levels are not ARARs but are TBCs, therefore they are not included in Table 3.3. These levels are based on guidelines developed in the Leaking Underground Storage Tank (LUFT) Manual prepared by the RWQCB by the Task Force on LUFTs. LUFT guidance establishes cleanup levels based on geologic and hydrogeologic conditions of the site. A value of 500 mg/kg for soil containing petroleum hydrocarbons has been approved by the EPA and RWQCB (see the IAROD) for protection of groundwater at Fort Ord based on geology, hydrogeology, and the type of TPH commonly identified at Fort Ord.

Location-Specific Requirements

There are generally two types of location-specific ARARs: (1) those regulations which establish location-specific criteria for placement of a remedial action, such as placement of a treatment system, and (2) those regulations which are based on the current status of the location of the remedial unit, such as a coastal area or endangered species habitat. Sites 16 and 17 are currently developed sites, and do not contain special resources such as coastal areas or endangered species habitat or other sensitive environmental or historical locations. Certain special-status species have been identified at Sites 16 and 17; in particular, the loggerhead shrike, the California gull, Kellogg's horkelia, Monterey ceanothus, and sandmat manzanita have been identified. However, these areas are not considered a critical habitat. The following describe location-specific regulations for Sites 16 and 17 and evaluates whether these regulations are ARARs.

- The Endangered Species Act of 1973: Code of Federal Regulations (CFR) 16 USC 1531 requires action to conserve endangered species and preserve or restore a critical habitat. The Central Maritime Chaparral habitat is located on Site 16. Therefore, this act is an ARAR.

Action-Specific Requirements

- Land Disposal Restrictions: Title 22 CCR, Division 4.5, Chapter 18. Prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. Requires laboratory analysis of wastes intended for landfill disposal to establish that the waste is not restricted from landfill disposal. Listed or characteristic hazardous wastes may be subject to these regulations if they are land disposed.

- Standards for the Management of Wastes Discharged to Land: This title establishes standards for the management of waste discharged to land. Title 23 CCR, Division 3, Chapter 15, Article 2 (Waste Classification and Management), Section 2511(d) provides for exemptions to these requirements for cleanups taken at the direction of public agencies as long as requirements of Article 2 are met for waste that is removed from the point of release under any remedial alternatives and disposed untreated. Contaminated soil and debris from Sites 16 and 17 would be properly disposed pursuant to Article 8 at the OU 2 landfill; soil would be treated. Articles 8 and 9 (Closure and Post-Closure Maintenance) may be relevant and appropriate to capping alternatives at Sites 16 and 17. These regulations provide detailed performance requirements for landfill covering (Article 8); and landfill closure (Article 9). The Site 17 Disposal Area is not a landfill or waste management unit. However, the substantive corrective action provisions of Chapter 15 could apply. Applicable requirements of Title 23, Chapter 15 are discussed below.

Section 2583, Waste Pile Closure Requirements, provides specific requirements for closure of waste materials in piles. All waste materials which are contaminated by wastes shall be either: (1) discharged to an appropriate waste management unit (WMU), or (2) compacted, covered, and closed as a landfill under Section 2581. Contaminated soil and debris from Sites 16 and 17 would either be properly disposed under (1) at the OU 2 landfill, or would be contained onsite under (2).

- Chapter 15 Landfill Closure, Articles 1, 8, and 9: Section 2510(d). This section defines/designates existing waste management units (WMU) as "waste management units which are operating, or have received all permits necessary for construction and operation on or before the effective date."

  Section 2510(g) states that for sites that were closed, abandoned, or inactive on the effective date of the regulations (November, 1984) persons responsible for the sites may be required to develop and set up a monitoring program. If water quality impairment is found, such persons may be required to develop and carry out a corrective program.

Section 2580(c) requires that Class III landfills be closed pursuant to Section 2581. Section 2581 provides specific closure construction details that must be implemented.

Section 2580(d) and (e) specify closure and post-closure specifications regarding survey monuments and vegetation selection.

Section 2581. Landfill closure requirements provides specific requirements for the final cover. Subsections (a)((1), (a)(2), (a)(3), and (a)(4) detail the multilayer cover design, including acceptable soil types, thickness, and permeability requirements. Section 2581(b) provides grading requirements.

- Medical Waste Management Act: California Health and Safety Code, Div. 4, Chapter 6.1-6.5 covers the handling, treatment and disposal of medical wastes. Applicable if wastes as defined in this act; wastes determined to be medical wastes will be handled appropriately.

- Infectious Waste: Title 22, Article 13, Sections 66835-66865 covers the handling, treatment, and disposal of infectious wastes. Applicable if waste is determined to be infectious; if so, or potentially infectious it will be handled appropriately.

3.2 Identification and Screening of Technologies

This section presents the remedial action objectives, chemicals of interest, descriptions of remedial units, and the screening and selection of remedial technologies for alternative development.

3.2.1 Remedial Action Objectives

The remedial action objectives (RAOs) for Sites 16 and 17 are: (1) the protection of human health and the environment, and (2) compliance with ARARs. Table 3.4 presents RAOs for the protection of human health from exposure to chemicals, debris, and UXO/OEW in impacted soil at Sites 16 and 17. The exposure routes considered in Table 3.4 include ingestion or dermal contact with impacted soil, inhalation of dust created from impacted soil, and disturbance of impacted soil containing UXO/OEW or medical debris. Based on the results of the ERA (Volume IV), risks to ecological receptors at Sites 16 and 17 are not significant; however, impacts to the existing habitat should be mitigated where possible through revegetation of remediated areas with native species.

The proposed RAOs for Sites 16 and 17 are the achievement of acceptable human health risks based on future usage of the sites and compliance with ARARs or TBCs. Human health risks should be: (1) 1×10^{-6} or lower excess cancer risk (one-in-one million probability of an exposed individual developing cancer) for student/faculty artists, and 1×10^{-5} for commercial workers, and (2) a hazard index of one or less for possible noncancer health effects. The BRA indicates that the soil at Sites 16 and 17 is currently (i.e., without additional remedial measures) slightly above the range of acceptable human health risks.

In addition to consideration of chemical-related risks, ARARs and TBCs are also evaluated at Sites 16 and 17 as they pertain to RAOs. TBC- and ARAR-related RAOs are: (1) to remediate soil containing TPH to the cleanup level of 500 mg/kg as discussed in Section 3.2.1.2, and (2) to remediate debris at the sites which was not previously disposed in accordance with Title 23 CCR, Chapter 15, as discussed in Section 3.1.6.2. Potential exposures to UXO/OEW and medical debris will be evaluated under the remedial alternatives for mitigation of any associated physical or biological hazards.

3.2.1.1 Chemicals of Interest and Debris

The following sections discuss the chemicals of interest and debris at Sites 16 and 17.

TPH in Soil

TPH as diesel or unknown TPH has been identified above 500 mg/kg at the following locations:

- DOL Maintenance Yard
  - At 3.0 to 6.5 feet bgs with concentrations from 660 to 4,300 mg/kg in five test pits or borings
- Pete's Pond Extension
  - Test Pit TR-16-28 at 5.5 feet bgs at a concentration of 1,300 mg/kg
- Site 17, Disposal Area
  - Test Pit TR-17-12 at 8.5 feet bgs at a concentration of 880 mg/kg
  - Test Pit TR-17-14 at 7.0 feet bgs at a concentration of 740 mg/kg
  - Test Pit TR-17-11 at 5.5 feet bgs at a concentration of 1,000 mg/kg.

Potential Impacts to Groundwater

Potential impact to groundwater from contaminants present in soil were also evaluated. For organic compounds, potential impacts to groundwater were evaluated using EPA's mass transport model combined with data specific to Fort Ord (*Draft Technical Memorandum: Approach to Evaluating Potential Groundwater Quality Impact*, dated July 29, 1993) (*PRG Technical Memorandum*). This model uses groundwater depth and soil characteristics to estimate future maximum chemical concentrations in groundwater. These calculated potential concentrations in groundwater are then compared to MCLs. For soil containing metals or pesticides, potential impacts to groundwater were assessed qualitatively. This approach focused on concentrations of pesticides and metals in soil outside the fill areas. If pesticides were not detected or metals were below background, no further evaluation was performed. At Sites 16 and 17, concentrations of metals and pesticides in soil surrounding and below the fill areas were below maximum background levels.

Vertical-leaching (VLEACH) modeling was performed in the PRG Technical Memorandum which showed that a concentration of 500 mg/kg or less of TPH would not impact groundwater. Concentrations greater than 500 mg/kg may impact groundwater.

Debris

One RAO is to reduce risk from physical or biological hazards resulting from past operations. At Sites 16 and 17, these hazards include risks from buried UXO/OEW and medical debris.

UXO/OEW has been identified in the following areas, at the following depths:

- Pete's Pond (by Army Corp of Engineers), near the surface
- Pete's Pond Extension, at up to 5 feet.

UXO/OEW were not specifically identified at the Site 17 Disposal Area. However, because this area contains debris similar in nature and age to debris found in Pete's Pond and Pete's Pond Extension, it also has the potential to contain UXO/OEW.

Medical debris, in the form of medical jars containing cotton, syringes, vials with cotton balls, and gauze, were identified in test pits at Pete's Pond Extension and the Site 17 Disposal Area. Risks from medical debris include contact with potentially infectious materials and the physical risks from contact with sharps (sharp needles, scalpels, or glassware). The risks from medical debris can be reduced by avoiding direct contact with these items and making them less accessible to future potential populations. Approximately 50 percent of the material within all three areas is debris in a sand matrix.

3.2.1.2 Target Cleanup Levels

Soil

There is a slight human health risk from soil at Sites 16 or 17 calculated in the BRA. However, the risk is slight, therefore a target cleanup level was not developed for soil based on risk (Volume III, BRA). A remedial goal of 500 mg/kg for TPH in soil was developed by HLA in the *Draft Technical Memorandum, Preliminary Remediation Goals, Fort Ord, California* (*HLA, 1993o*), dated June 14, 1993, and was approved by all agencies including the Regional Water Quality Control Board, Central Coast Region for sites such as Sites 16 and 17. This level has been shown to be protective of human health and the environment, including groundwater. This level is the TCL for TPH-affected soil. It will be used to establish limits of the soil remedial units, and as the treatment goal for soils that might be used as backfill in excavations.

Debris

Debris itself at Sites 16 and 17 was not evaluated in the BRA because it is not associated with chemical risks; however, contaminants associated with soil intermixed with debris were evaluated. For the most part, the cleanup of debris is driven by Applicable or Relevant and Appropriate Requirements (ARARs) as discussed in (Section 3.1.6).

Groundwater

No TCLs were developed for groundwater at Sites 16 and 17 because contamination appears to be associated with OU 2. Groundwater cleanup will be addressed under the remedial program at OU 2.

3.2.1.3 Description of Remedial Units

Remedial units are developed for each site on the basis of acceptable exposure levels (TCLs), potential exposure routes and ecological considerations (BRA and ERA), and the nature and extent of contamination at each site (*EPA, 1988b*). In areas where contamination is homogeneous within a given media, the most rational basis for defining a remedial unit is by the type and extent of contamination, i.e., the volume of soil or groundwater that contains a specific contaminant or group of similar contaminants above an established TCL. For areas containing discrete hot spots or more concentrated contamination within a homogeneous area, separate remedial units may be developed because remediation of these areas is usually addressed in a different manner by the remedial alternative. For sites where the same type of contamination occurs in both soil and groundwater and they are co-located, the remedial units may be grouped together if the soil and groundwater would be treated simultaneously.

Soil remedial units are defined by the contaminants or debris they contain: areas with TPH are in Soil Remedial Unit 1; areas with debris are in Soil Remedial Unit 2. Thus, Sites 16 and 17 contain the two remedial units shown on Plate 3.7.

Groundwater

The groundwater at Sites 16 and 17 contains the same types of chemical contaminants at similar concentrations and appears to be continuous with groundwater within the OU 2 groundwater plume (Plate 3.6). Because the compounds in the groundwater at Sites 16 and 17 appear to be associated with the OU 2 plume, remediation of the groundwater at Sites 16 and 17 would be most effective in conjunction with the OU 2 groundwater remediation program. Therefore, the impacted groundwater at Sites 16 and 17 has been incorporated into the OU 2 groundwater remedial unit and will not be considered as a separate remedial unit for Sites 16 and 17. The OU 2 groundwater remediation program consists of pumping and treating groundwater to MCLs and is described in OU 2 Record of Decision (OU 2 ROD).

Soil Remedial Unit 1

This remedial unit consists of the TPH-impacted soil at the DOL Maintenance Yard. This unit contains approximately 1,100 cubic yards of soil containing over 500 mg/kg of TPH. Soil above the TCL is estimated to be up to 6 feet in thickness and to extend over an area of 4,700 square feet. Plate 3.7 shows the extent of the remedial unit. Because this soil does not contain debris or other chemical contaminants, it has been defined as a separate remedial unit.

Soil Remedial Unit 2

This remedial unit consists of debris and associated soil containing TPH above the TCL at Pete's Pond, Pete's Pond Extension, and the Site 17 Disposal Area, and contains approximately 67,000 cy. Approximately 3,600 cy is from Pete's Pond and Pete's Pond Extension and the rest of the debris is from the Site 17 Disposal Area. Debris was identified in test pits up to 20 feet deep with thickness of up to 15 feet and extending over an area of 14 acres. Plates 3.7 shows the lateral extent of this remedial unit. Observations made during the RI exploration indicate that this unit contains UXO/OEW, medical debris, and household debris, as well as three isolated areas containing TPH-impacted debris (two at the Site 17 Disposal Area and one at Pete's Pond Extension).

3.2.2 General Response Actions

In accordance with EPA Interim Final *Guidance for Conducting Remedial Investigations/Feasibility Studies Under CERCLA*, general response actions (GRAs) are defined as those general classes of actions that can be taken to manage or control a particular problem at a site (*EPA, 1988b*). After review of site-specific conditions at Sites 16 and 17, several GRAs were identified for the technology screening and development of remedial action alternatives for soil. The GRAs that are potentially applicable are:

- No Action
- Containment
- Collection
- Treatment
- Disposal.

In the following sections, the screening of technologies is described and specific remedial alternatives are developed for Sites 16 and 17. Each GRA has a number of remedial technology types and each technology has a variety of process options that can be part of the remedial alternative. For example, one GRA for soil remediation is containment; one of the remedial technologies for containing soil is capping; various process options are available to accomplish capping (e.g., an asphalt cap, a concrete cap, or a cap composed of low-permeability clay or soil). The technology types and associated process options are evaluated using the criteria of effectiveness, implementability, and order-of-magnitude cost to develop remedial action alternatives.

3.2.2.1 No Action

Evaluation of a no action alternative is required under CERCLA and the National Contingency Plan [NCP]. The no action alternative provides for a comparison for costs and benefits of other remedial actions evaluated.

3.2.2.2 Containment

Containment reduces the potential for exposure to a contaminated site and also reduces the mobility of chemicals of interest. Containment can include covering the affected area with a cap, a vegetative cover, stabilizing the impacted materials, or placing some type of vertical or horizonal barrier to prevent further migration. Surface water controls minimize surface water infiltration to prevent further migration. Such actions greatly reduce exposure pathways and the migration of chemicals to other areas.

3.2.2.3 Collection

Collection comprises the physical removal of contaminated material. Collection may be followed by disposal, treatment, reuse, or replacement. Debris or soil may be removed by standard excavation techniques.

3.2.2.4 Treatment

Reducing the volume, toxicity, or mobility of contaminants in soil is considered a treatment action. Treatment may occur after removal or in situ. A variety of treatment processes are available but they generally fall into one or a combination of four different treatment types: physical, chemical, biological, and thermal. Some treated materials may contain residual chemical contamination after treatment and may require some form of disposal. Other materials may be reused or recycled after treatment and others may be left in place after treatment. These actions treat the contaminant within the soil to reduce the contaminant's volume, toxicity, or mobility and reduce the overall risk of the impacted material.

3.2.2.5 Disposal

The disposal options for soil and debris after removal and/or treatment are considered disposal/reuse actions. Disposal options can include transferring soil and debris to an onsite repository, waste management unit, or offsite landfill. Reuse options include asphalt batching of soil, brick or aggregate manufacturing, and use as soil conditioner/fertilizer. Each disposal/reuse option has specific treatment standards which must be met. These actions provide an appropriate method of handling impacted materials after removal and/or treatment to reduce the overall risk from the impacted material.

3.2.3 Technologies Retained from the Remedial Technology Screening Report

CERCLA guidance for RI/FSs requires that, prior to development of site-specific remedial alternatives, there is an initial screening of the universe of remedial technologies that could be used to cleanup contaminated sites (*EPA, 1988b*). The *Draft Remedial Technology Screening Report (RTS), Fort Ord, California*, presents a process to expedite the initial screening of remedial technologies for the FSs for Fort Ord (*HLA, 1994n*). The objectives of the RTS were to identify and screen proven remedial technologies for typical groups of compounds (GOCs) found in soil and groundwater at contaminated sites.

The RTS contains a matrix guide/checklist(s) for each of the media and GOCs, tables that describe and evaluate each applicable technology (on the basis of effectiveness, implementability, and relative cost), and summary review forms. The matrix guide/checklist(s) and tables were used to identify and screen technologies for site-specific media and GOCs and this screening is presented on the summary review forms. The matrix guide/checklist and summary review forms for this FS are presented in Appendix 3A. These summary review forms were used to prepare the site- and/or Remedial Unit-specific technology tables for this FS (Tables 3.5 and 3.6). Based on this process, the following general response actions and remedial technologies are available for selection in developing the remedial alternatives for this site:

No Action

Containment

- Vertical and Horizontal Barriers
- Capping
- Surface Water Controls

Collection

- Debris and Soil Removal
- Source Soil Removal

Treatment

- Thermal
- Chemical
- Physical
- Biological
- Offsite

Disposal

- Onsite
- Offsite.

3.2.4 Selection of Technologies for Remedial Alternative Development

This section reviews and selects the technologies that were retained from the RTS (listed in Section 3.2.3) for development of remedial alternatives. Technologies are selected the basis of on site-specific conditions and base-specific features. For example, Fort Ord is unique in that it has the regulatory agency-approved Fort Ord Soil Treatment Area (FOSTA) that was specifically created to treat hydrocarbon and other chemical-contaminated soil; the FOSTA is protective of human health and the environment and provides cost-effective treatment at a single location. The types of hydrocarbon treatment that are currently planned at the FOSTA, include bioventing and ex situ bioremediation. Future treatment systems that could be incorporated include portable thermal desorption and asphalt batching.

Several technologies and process options are potentially effective and technically feasible, but were eliminated from further evaluation because treatment of the TPH-impacted soils at the FOSTA will provide equivalent treatment. These technologies include: thermal treatment (rotary kiln incineration, fluidized bed incineration, circulation bed incineration), asphalt batching, thermal desorption (low temperature), in situ biodegradation, offsite treatment (thermal, biological), onsite and offsite disposal. Each of these technologies would require pilot studies, and the overall effectiveness would not be known until completion of the pilot studies. The FOSTA utilizes a presumptive technology (i.e., technologies which have been proven to work for TPH-contaminated soil at Fort Ord), and therefore reduces the risk of selecting a technology that may not be effective or feasible.

The Interim Action Record of Decision (IAROD, *HLA, 1994c*) established the Fort Ord Soil Treatment Area (FOSTA) for the storage and treatment of soil collected from remedial activities at Fort Ord. Several soil remedial units on RI Sites 39, 16, and 12 meet criteria established in the IAROD for treatment at the FOSTA. Soil in these remedial units will be treated at the FOSTA in accordance with the IAROD as part of the overall remedy for these sites.

Excavated soil brought to the FOSTA will be assessed for the presence of pesticides, metals, solvents, and total petroleum hydrocarbons. Soil containing only petroleum hydrocarbons, without metal concentrations above background levels or detectable pesticide concentrations (such as that from the RI sites), will be treated at the FOSTA. Soil that does not meet this criteria will be containerized and characterized to evaluate if onsite disposal or onsite treatment is applicable to this soil as established in the IAROD.

The FOSTA will be located at the former 519th Motorpool area, northwest of the intersection of Light Fighter Road and North-South Road, just east of the Fort Ord main entrance. The FOSTA will consist of a biotreatment cell, soil stockpile area, and an enclosed container storage building. The biotreatment cell will accept nonhazardous soil contaminated with petroleum hydrocarbons, such as that from the selected RI site remedial units described above. All soil brought to the FOSTA will be tracked according to its site of origin, cleanup levels attained, and final destination. Treated soil from the biotreatment unit at the FOSTA will be used in the OU 2 landfill closure or for backfill on base.

Another base-specific example of a presumptive remedy is onsite disposal at the OU 2 landfill for the FOSTA-treated hydrocarbon soils and debris. The Fort Ord Landfill, designated as the Operable Unit 2 (OU 2) Landfill, is approximately 170 acres and is located in the northern portion of Fort Ord. This landfill is currently inactive, and a remedial action is ongoing to install a landfill cover and groundwater extraction and treatment system. The site activities for the landfill cover include removal of the existing vegetation layer, leveling and grading of the terrain, placement and compaction of a foundation layer, and the placement and compaction of a cover layer. The cover layer will be graded, the site groundwater treatment and monitoring systems installed, and cover vegetation planted. Surface water controls will be added during landfill cover construction. The surface water controls are not designed at this time, but will include a final cover with a low permeability layer, final slopes capable of handling the 100-year, 24-hour storm, perimeter drainage channels, and an upgradient surface water diversion system.

The volume of soil required for construction of the foundation layer is estimated to be approximately 500,000 to 800,000 cubic yards. Soil containing levels of TPH less than 500 mg/kg can be placed as part of the landfill foundation layer. Inert fill, treated soil from the FOSTA, or construction debris, such as from the SRU 1 at Sites 2 and 12 or debris from Sites 16 or 17, can be placed in the foundation layer.

Based upon the Section 3.2.3 screening of technologies and the Fort Ord-specific conditions, the technologies retained for development of remedial alternatives for each remedial unit are presented in the following sections. Also presented are the technologies that were not selected and the reasons for their elimination.

Soil Remedial Unit 1 - DOL Maintenance Yard

The following RTS-identified technologies passed site-specific screening and were selected for use in the development of remedial alternatives: no action; capping using asphalt; surface water controls; standard excavation; and ex situ bioremediation at the FOSTA.

Several remedial technologies/process options were not selected as follows:

- Capping using clay, soil or concrete. The area containing TPH-contaminated soil is paved with asphalt. Therefore, capping using materials other than asphalt were not selected.

- Deep soil excavation. This technique is effective but is not needed at Sites 16 and 17 because the contaminated soil and debris can be excavated using standard methods.

- Soil vapor circulation, air injection, and various offgas treatment processes. Thermal oxidation, catalytic oxidation, and activated carbon adsorption are not considered effective for heavy-fraction TPH contamination in shallow (less than 10 feet) soils. Because the TPH contamination identified at the DOL Maintenance Yard is heavier than diesel and less than 10 feet deep, these technologies were not retained for further evaluation.

- Screening. Separation of TPH-contaminated soil using common screening equipment is not considered effective and feasible for the TPH-impacted soils, because screening is only effective when the contaminant is present in a specific fraction of soil (e.g., trapped within a clay matrix). Screening is not effective in separating homogeneous soil such as is found at Sites 16 and 17.

Soil Remedial Unit 2 - Debris

The following RTS-identified technologies passed the site-specific screening and were selected for use in the development of remedial alternatives: no action, capping using asphalt or synthetic materials, surface water controls, debris and soil excavation, sterilization, debris separation, onsite disposal in a repository before or after treatment, and offsite disposal at a demolition or standard landfill.

The following technologies were not selected:

- Capping using soil or concrete. These methods of capping were eliminated from further evaluation because other capping materials are more consistent with current and proposed future uses.

- Vertical and horizonal barriers. These barriers were eliminated from further evaluation because of the low effectiveness of these types of barriers and the irregular deposition of debris. These options would be very difficult to implement because of the presence of identified, but not fully delineated, buried UXO/OEW.

- Offsite rotary kiln incineration. Incineration was eliminated from further evaluation because it is not effective for metallic waste present in the medical debris.

- Debris washing and biodegradation. These treatment options were eliminated from further evaluation because they are not effective for medical debris.

- Recycling. Recycling was eliminated from further evaluation because recycling is not effective for medical debris and UXO/OEW.

3.3 Development and Description of Remedial Alternatives

To assemble remedial alternatives for each site, general response actions (GRAs) and process options chosen in Section 3.2.4 that represent various technology types for each medium are combined to form site-wide alternatives (*EPA, 1988b*). According to EPA guidance, taking no further action at the site should be one of the alternatives considered as a basis for comparison to other alternatives: appropriate treatment and containment options should also be considered. Initially, specific technologies or process options are evaluated primarily on the basis of whether or not they can meet the Remedial Action Objectives (RAOs) discussed in Section 3.2.1. To assemble alternatives, remedial units are matched with technology types developed in Section 3.2.4 using engineering judgement and site-specific considerations. A range of alternatives ar developed with respect to the criteria of effectiveness, implementability, and cost. For sites at which interactions among media are not significant, media-specific remedial options can be developed rather than developing numerous comprehensive site-wide alternatives. Alternatives which meet the RAOs and evaluation criteria are retained for further consideration in the detailed analysis.

The technologies that were selected were assembled into the four remedial alternatives that are described in the following sections.

3.3.1 Remedial Alternative 1

In this alternative, current site conditions remain unchanged except for continuation of an existing groundwater monitoring program. CERCLA guidance requires this evaluation of this No Action alternative to provide a baseline for comparison.

3.3.2 Remedial Alternative 2

Alternative 2 involves capping the debris and the TPH-impacted soil in place at Sites 16 and 17.

An asphalt cap would be consistent with the future land use of the DOL Maintenance Yard and the Site 17 Disposal Area. For these paved areas existing asphalt will be inspected, cracks will be patched and repaired, and an additional 2 inches of asphalt will be placed over the existing asphalt and covered with a sealant.

A clay cap is the easiest to install and would be more consistent where future land use is open space areas such as Pete's Pond and Pete's Pond Extension; however, to achieve required permeability, a clay cap would need to be thicker than the other materials that could be used, and would thus increase the volume of imported soil and raise the elevation of the area several feet. Because of the existing storm drainage system that discharges into Pete's Pond, this would be more of a problem at Pete's Pond than at Pete's Pond Extension. To reduce the elevation change, a synthetic liner or Claymax™ (bentonite clay sandwiched between layers of geotextile) could be installed as part of the cap.

For the purposes of this FS, the proposed cap design for Pete's Pond and Pete's Pond Extension involves the placement of a clean soil buffer over the debris then placement of a low-permeability layer of Claymax™ over the graded area. Overliner material (specified fill) would be placed and then covered with native topsoil to facilitate the growth of indigenous plant life placed during revegetation activities after completion of the cap.

Because the wastes will remain onsite, deed restrictions will be required for this alternative. The activities anticipated for the construction of the containment cap at Pete's Pond and Pete's Pond Extension are as follows:

- Clearing UXO/OEW within the top 2 feet of soil; this will be accomplished by having the specialized Army team detonate and dispose the cleared UXO/OEW
- Identifying and transplanting special status plant species
- Abandoning existing monitoring wells in the grading areas
- Relocating and rerouting existing storm drain outfalls that discharge into Pete's Pond
- Regrading to provide positive drainage and relocating the storm drains in Fifth Avenue and Fifth Avenue Cut-off

- Placing and compacting an approximately 6-inch thick layer of clean specified fill over the regraded surfaces, and rolling it smooth
- Installing a 1/4-inch thick layer of Claymax over the clean soil
- Placing 3 inches of clean specified fill over the Claymax, then placing 2 feet of clean native soil over the overliner material
- Revegetation with native species of plants similar to those removed at the beginning of construction
- Installing new monitoring wells to replace abandoned wells to continue monitoring groundwater at the site.

3.3.3 Remedial Alternative 3

Alternative 3 involves treating the TPH-impacted soils at the FOSTA and consolidating the debris from Pete's Pond and Pete's Pond Extension into the Site 17 Disposal Area.

At the DOL Maintenance Yard, TPH-impacted soil above the TCL would be excavated, with confirmation samples being collected from the walls and bottom of the excavation. The excavation area would then be backfilled with clean material. Soil would be excavated using a backhoe and either stockpiled onsite or hauled directly to the FOSTA for treatment. The treated soil would either be used as part of the OU 2 Landfill cap, as roadbase material, or as clean fill on Fort Ord.

For the debris, this alternative involves excavating the debris from Pete's Pond, Pete's Pond Extension, and areas of the Site 17 Disposal Area. The excavated soil would then be consolidated and contained within the paved portion of the Site 17 Disposal Area. The consolidated debris would be contained using an asphalt cap. Because the wastes would remain onsite, deed restrictions would be required for the Site 17 Disposal Area.

The anticipated construction activities for debris consolidation include:

- Removing existing structures at the Site 17 Disposal Area
- Removing the existing pavement and clean overburden at the Site 17 Disposal Area
- Clearing UXO/OEW at Pete's Pond and Pete's Pond Extension, and having the specialized Army team detonate and dispose the cleared UXO/OEW to the depth of debris, or 10 feet below ground surface (bgs), whichever is deeper
- Identifying and transplanting any special status plant species to another area of Site 16 that will not be disturbed by remedial activities
- Excavating debris at Pete's Pond and Pete's Pond Extension, placing the debris in the Site 17 Disposal Area, covering it with one layer of Claymax and 1 foot of clean soil, and restoring the asphalt pavement using the old pavement with an additional 2 inches of asphalt and a sealant to provide additional containment
- Backfilling the excavations at Pete's Pond and Pete's Pond Extension with clean soil using clean overburden soils from the Site 17 Disposal Area
- Revegetation of Pete's Pond and Pete's Pond Extension with native species of plants similar to those removed at the beginning of construction
- Installing a monitoring well to monitor groundwater downgradient of the Site 17 Disposal Area.

3.3.4 Remedial Alternative 4

Alternative 4 involves treating the TPH-impacted soil at the FOSTA; screening and treating the debris from Pete's Pond, Pete's Pond Extension, and the Site 17 Disposal Area prior to disposal.

At the DOL Maintenance Yard, TPH-impacted soil above the TCL will be remediated in the same manner as Alternative 3.

For the debris, this alternative involves clearing UXO/OEW, removing the debris from Pete's Pond, Pete's Pond Extension, and the Site 17 Disposal Area and screening and sterilizing the screened debris. The screened and sterilized debris that does not contain decomposable material would be transported to the OU 2 landfill to be used in the cap foundation layer. Any decomposable material such as wood and household debris would be disposed at a sanitary (Class III) landfill.

The anticipated construction activities for the debris include:

- Removing the pavement and clean overburden at the Site 17 Disposal Area
- Clearing UXO/OEW within the debris at Pete's Pond and Pete's Pond Extension and, having the specialized Army team detonate and dispose the UXO/OEW to the depth of debris, or 10 feet below ground surface (bgs), whichever is deeper
- Identifying and transplanting special status plant species into areas within Pete's Pond and Pete's Pond Extension which will not be impacted by remedial activities
- Excavating debris at Pete's Pond, Pete's Pond Extension, and the Site 17 Disposal Area
- Screening and segregating the debris, and sterilizing the screened debris, and stockpiling decomposable material
- Transporting decomposable material to a sanitary landfill for disposal
- Transporting the screened and sterilized debris to the OU 2 landfill for incorporation into the foundation layer
- Sampling and analysis of screened soil and reuse as backfill if within acceptable criteria for backfilling
- Backfilling the excavations with clean soil (including overburden soil from the Site 17 Disposal Area)
- Revegetation of Pete's Pond and Pete's Pond Extension with native species of plants similar to those removed at the beginning of construction, and replacing the pavement at the Site 17 Disposal Area.

3.4 Criteria for Detailed Analysis of Remedial Alternatives

Each of the remedial alternatives described in Section 3.3 was evaluated in accordance with the *Guidance for Conducting Remedial Investigations/Feasibility Studies Under CERCLA* (*EPA, 1988b*) using the nine criteria described below:

- <u>Overall Protection of Human Health and the Environment</u>. Each remedial alternative is evaluated in terms of the extent of protection of human health and the environment and the risks at the site after implementation of the alternative. The manner in which the contaminants are managed under each alternative is considered.
- <u>Compliance with ARARs</u>. The ability of each alternative to meet ARARs and other guidance identified in Section 3.1.6 is assessed.
- <u>Long-Term Effectiveness</u>. Each alternative is evaluated with respect to the risk that would remain at the site after the alternative has been implemented and the RAOs have been satisfied.
- <u>Reduction of Toxicity, Mobility, and Volume Through Treatment</u>. In CERCLA, preference is given to remedial technologies that significantly reduce the toxicity, mobility, or volume of contaminants. The degree of reduction is assessed for each alternative. Considerations include the extent of irreversibility of the treatment and the disposition of treatment residuals.
- <u>Short-Term Effectiveness</u>. The effects of each alternative during the construction, implementation, and operation phases are assessed. Factors considered included protection of the community and workers

during remedial operations, the time required to implement the alternative and to achieve the remedial goals, and potential adverse environmental effects that may result.

- Implementability. The three major areas of focus in assessing the implementability of a remedial alternative are:

  - Technical feasibility: The ability to construct a treatment system, the reliability of the technology, and the ability to monitor the effectiveness of the remedy

  - Administrative feasibility: The efforts and resources required to obtain approvals from other agencies

  - Availability of services and materials: The availability of contractors with the equipment and knowledge to implement the technologies of the remedial alternatives.

- Cost. Cost estimates for the remedial alternatives are prepared using EPA guidance manuals, other technical resource documents, contractor quotes, site-specific experience, and experience on other projects with similar scope. Both capital costs and operation and maintenance (O&M) costs are developed at a conceptual level for each remedial action alternative. These cost estimates can be expected to range from plus 50 percent to minus 30 percent. Net present value (NPV) costs are calculated using a 5 percent discount rate for 30 years of operation and maintenance.

  Capital costs can include contractor's mobilization and demobilization, sampling and analysis, engineering, purchase and installation of remedial equipment, and site restoration. O&M costs can include ongoing operational site inspections, utilities, chemicals, routine maintenance and repairs, and periodic sampling and analysis.

- Regulatory Agency Acceptance. Each remedial alternative is evaluated in terms of the administrative and technical issues that the state or other agencies may have concerning the alternative.

- Community Acceptance. Each remedial alternative is evaluated in terms of available public input and the anticipated public reaction to the alternative.

3.5 Detailed Analysis of Remedial Alternatives

The remedial alternatives are evaluated in the following sections using the nine evaluation criteria. A summary of this evaluation is presented in Table 3.8.

3.5.1 Detailed Analysis of Remedial Alternative 1

Alternative 1 is the No Action alternative. It is anticipated that continued monitoring of groundwater may be required to detect threats to human health and the environment.

Overall Protection of Human Health and the Environment

The no action alternative provides no additional protection to human health and the environment; nevertheless, based on the results of the BRA, no human health risk exists for the future potential users, and no significant risks to ecological receptors exist. The potential for human exposure would continue to exist through direct exposure to surface soil containing TPH, and debris containing UXO/OEW and medical debris and through inhalation, ingestion, and contact with contaminated airborne dust particles.

This alternative would not impact special status habitat, however, it could allow degradation of the groundwater from TPH contaminated soil.

Compliance with ARARs

The no action alternative would not comply with TBCs or ARARs for the site and would violate Discharge of Waste to Land ARARs. TPH levels up to 4,300 mg/kg, as well as UXO/OEW and medical debris, would be left unremediated. This alternative does not evoke location-specific or action-specific ARARs.

Long-Term Effectiveness

In the long term, this alternative does not change or reduce human exposure or reduce the transport of contaminants through the soil matrix except through natural attenuation. Debris would remain at the sites.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Under the No Action alternative, no reduction of toxicity, mobility, or volume occurs. This alternative does not mitigate risks from TPH-impacted soil, UXO/OEW, or medical debris.

Short-Term Effectiveness

The short-term conditions would remain unchanged. Risks and threats to the health of the community and onsite workers from contact with TPH in soil and debris remain unchanged. This alternative does not change the potential for surface contaminants in the soil to be dispersed into the environment.

Implementability

There are no technical concerns for the implementability of the No Action alternative. Technical aspects of ongoing monitoring do not pose obstacles to implementing this alternative. No specialized services or materials are required to implement it, however, administrative concerns may be an obstacle since cleanup of the sites are required for base closure and transfer of the property.

Cost

Cost estimates are provided in Appendix 3B. The only capital costs for this alternative are the costs of establishing a monitoring program; these costs are estimated to be $20,600. Annual costs would be incurred for O&M of the existing monitoring system and may vary considerably depending on regulatory requirements imposed by various agencies. Assuming that three additional wells would be installed to augment the three existing monitoring wells and that quarterly monitoring and reporting would be required, estimated annual O&M costs are $49,200. The net present value (NPV) using a 5 percent discount rate for 30 years of monitoring is $774,000 (Table 3.7).

Regulatory Agency Acceptance

It is anticipated that regulatory agencies may require remedial actions more extensive than those proposed in this alternative; however, acceptance will be addressed in the Proposed Plan after comments on the FS have been received.

Community Acceptance

Because the remedial alternatives applicable to the site have not been presented to the community, the community's acceptance of the no action alternative cannot be determined at this time. However, it is anticipated that the community may request some type of removal action to reduce risks associated with the debris and soil. Community acceptance will be addressed in the Proposed Plan.

3.5.2 Detailed Analysis of Remedial Alternative 2

This alternative consists of construction of a cap over the areas containing debris and TPH-impacted soil to mitigate future migration of TPH and reduce exposure potential. The cap type will be selected based on future land use of the areas. For the purposes of this FS, it is assumed that: (1) an asphalt cap would be constructed over the Site 17 Disposal Area and the DOL Maintenance Yard, and (2) the cap at Pete's Pond and Pete's Pond Extension would consist of a more natural type of cap such as clay or Claymax™ to be consistent with future land use.

Overall Protection of Human Health and the Environment

By installing a cap over the consolidated soil, risks to the environment that might exist at the site would be mitigated in several ways. Capping the contaminated soil and debris would reduce contact by humans and animals and potential leaching of contaminants to the groundwater through surface water infiltration, thereby protecting groundwater quality. In addition, the site would be revegetated to mitigate disturbance of the ecological environment.

Compliance with ARARs

Because this alternative would reduce or eliminate the exposure pathways of concern and minimize migration of contaminants to groundwater, it would comply with action-specific ARARs.

Action-specific ARARs are imposed on caps containing wastes and debris (23 CCR, Chapter 15). Although the waste material will not be underlain by a multilayer liner, this alternative complies with the intent of 23 CCR, Chapter 15, Section 2511(d) and allows the Army to comply with these requirements to the extent possible. The debris is not anticipated to be a RCRA or non-RCRA restricted waste and thus will not be regulated under the land disposal restrictions (LDRs).

Monterey Bay Unified Air Pollution Control District (MBUAPCD) regulates activities such as excavation and grading of the impacted soil and debris. Fugitive dust emissions will be minimized and kept below the allowable limit through dust control measures.

This alternative could potentially evoke several location-specific ARARs because it would alter the soil and surface elevations within the area. Therefore, the cap must be designed to provide adequate drainage capacity equivalent to that originally present.

Special status plant species have been identified at Pete's Pond and Pete's Pond Extension; therefore, measures will be taken to comply with the Endangered Species Act through revegetation with native species after remedial activities are completed.

Long-Term Effectiveness

A properly designed, constructed, and maintained cap provides adequate long-term effectiveness. To verify that the cap remains intact and that risks the environment are mitigated, ongoing monitoring and maintenance is required. In addition, it is anticipated that deed restrictions will be imposed. Because the different capping alternatives are of equal long-term effectiveness, the final choice of the cap types would be based on engineering considerations, cost, and future land use.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Because this alternative is a containment measure, the toxicity and volume of contaminated materials would not be destroyed or reduced, but mobility would be reduced. Given implementation of this alternative, contaminants could not be transported by wind, or other mechanisms that came in contact with the contaminated soil or debris. In addition, possible future migration of contaminants to the groundwater would also be reduced by minimizing potential surface-water infiltration through the contaminated soil.

Short-Term Effectiveness

This alternative involves earthwork such as grading which could result in minimal transport of contaminated soil and debris. These operations could have a short-term impact on human health and safety through handling UXO/OEW, and grading; however, these potentially adverse impacts would be minimized through the use of trained personnel and dust control measures such as spraying the soil with water. Worker's exposure to the contaminants would be further minimized through the use of proper health and safety procedures.

Air monitoring stations would be established up and downwind of the site during soil movement to permit evaluation of potential health risks from dust exposure. Air samples will be collected and analyzed for total particulates when wind velocities exceed a threshold level that could transport dust offsite.

There would also be some risk of adverse environmental impacts from this alternative because of the dust and particulates from soil excavation and transportation. These impacts would be minimized, however, by the dust control measures. It is anticipated that the contaminated soil and debris can be capped within three months.

Implementability

Cap installation is well established through the use of conventional construction techniques. There are few, if any, technical considerations that would prohibit the installation of a cap. Because caps have been installed at other sites with similar contamination, it is anticipated that this plan would be administratively feasible with a minimal effort.

Excavation is a simple remedial action that is easily implemented at Sites 16 and 17, but special precautions will need to be taken when removing UXO/OEW and when excavating in areas that could contain either UXO/OEW or medical debris. Services for UXO/OEW removal, although available, would have be to scheduled in advance because they require specially trained teams from the Army or specialized UXO/OEW removal subcontractors. Services and materials for other portions of the work are readily available.

Cost

Cost estimates are provided in Appendix 3B. Capital costs and O&M costs are presented in Table 3.7. The capital cost estimate includes site preparation, cap installation, and monitoring well installation. Capital costs are estimated at $1,175,200. O&M costs associated with cap maintenance and semiannual groundwater monitoring are estimated at $53,400 per year. The total net present value (NPV) cost using a 5 percent discount rate for this alternative for 30 years of operation is estimated at $1,804,000.

Regulatory Agency Acceptance

Although the acceptability of this plan to the regulatory agencies has not yet been determined, it is anticipated that they may accept this alternative. Acceptance will be addressed in the Proposed Plan.

Community Acceptance

Because this alternative clears near-surface UXO/OEW, and contains debris and TPH-impacted soil beneath a cap, it is anticipated that this alternative will be acceptable to a majority of the community members. Acceptance will be addressed in the Proposed Plan.

3.5.3 Detailed Analysis of Remedial Alternative 3

This alternative includes: (1) excavation of soil containing over 500 mg/kg of TPH and treatment of the soil at the FOSTA, and (2) excavation and consolidation (at the Site 17 Disposal Area) of debris from Pete's Pond and Pete's Pond Extension.

Overall Protection of Human Health and the Environment

Consolidation and installation of the cap over the debris mitigates risks to human health and the environment in the following ways: (1) it mitigates direct exposure to the soil, (2) it mitigates exposure to contaminated airborne dust, and (3) it reduces the possibility of future migration of contaminants to the groundwater through surface water infiltration, and (4) revegetation over the cap with native species would mitigate impacts to the ecological environment.

Deed restrictions may be imposed on future land use at the Site 17 Disposal Area, but consolidation of the debris would make the size of the area subject to deed restrictions smaller than under Alternative 2.

Compliance with ARARs

It is anticipated that Alternative 3 will meet both location-specific and action-specific ARARs. Potential ARARs for this alternative include those discussed in Section 3.1.5. This alternative complies with ARARs for the excavation, treatment, and disposal and/or reuse of the TPH-impacted soil and for the excavation and handling of medical debris. Action-specific ARARs are imposed on caps containing wastes and debris (23 CCR, Chapter 15). Although the waste material will not be underlain by a multilayer liner, this alternative complies with the intent of 23 CCR, Chapter 15, Section 2511(d) and allows the Army to comply with these requirements to the extent possible. The debris is not anticipated to be a RCRA or non-RCRA restricted waste and thus will not be regulated under LDRs.

Excavation of TPH-impacted soil will meet the TBC of 500 mg/kg. Medical debris excavated will be handled in accordance with the Health and Safety Code, Division 4, Chapters 6.1 through 6.5.

Special status plant species have been identified at Pete's Pond and Pete's Pond Extension; therefore, measures will be taken to comply with the Endangered Species Act through revegetation with native species after remedial activities are completed.

Long-Term Effectiveness

This alternative reduces risks to the environment by removing and treating TPH-impacted soil at the DOL Maintenance Yard and by containing debris at the Site 17 Disposal Area. Consolidation and containment of debris would be effective in the long-term through appropriate maintenance and monitoring procedures and deed restrictions.

Deed restrictions may be imposed on future land use at the Site 17 Disposal Area, but consolidation of the debris would make the size of the area subject to deed restrictions smaller than in Alternative 2.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternative 3 reduces the chemical toxicity, mobility, and volume through biological degradation treatment of soil from the DOL Maintenance Yard at the FOSTA. The mobility of the contaminants in the debris is reduced by containment, but this alternative would not reduce the toxicity or volume of the contaminants associated with the debris.

Short-Term Effectiveness

This alternative involves excavation and transportation of TPH-impacted soil and debris (including medical debris) to onsite treatment or containment areas. The excavation and loading operations would have a potential adverse short-term impact on human health and the environment because of the contaminated and potentially infectious dust generated during excavation and because of the hazards of UXO/OEW clearance. These potentially adverse impacts would be minimized through the use of dust control measures, such as spraying the soil with water, and by the use of proper health and safety procedures and specially trained personnel.

Air monitoring stations would be established upwind and downwind of the site to permit evaluation of the potential health risk from dust exposure during excavation. Air samples would be collected and analyzed for total particulates when wind velocities exceed a threshold level that could transport dust offsite. Excavation and transportation of the TPH-impacted soil to the FOSTA is estimated to take two to four weeks and excavation and consolidation of debris is estimated to take six to eight weeks.

Implementability

Excavation is a simple remedial action that is easily implemented at Sites 16 and 17, but special precautions will need to be taken when removing UXO/OEW and when excavating in areas that could contain either UXO/OEW or medical debris. Services and materials for other portions of the work are readily available. Treatment of TPH-contaminated soil at the

FOSTA is a presumptive remedy that has been proven for soil at Fort Ord.

Cost

Cost estimates are provided in Appendix 3B. Table 3.7 presents the capital and O&M costs for this alternative. The cost estimate includes: (1) site preparation, UXO/OEW clearance, excavation, consolidation, cap installation, and monitoring well installation for the debris and (2) excavation, transportation, and treatment at the FOSTA for TPH-impacted soils. Capital costs are estimated at $1,211,100. O&M costs for cap maintenance and quarterly surface and groundwater monitoring are estimated at $38,200 per year. The total net present value (NPV) cost for this alternative for 30 years of operation using a 5 percent discount rate is estimated at $1,604,000.

Regulatory Agency Acceptance

It is anticipated that this alternative may not be acceptable to all the regulatory agencies. Acceptance will be addressed in the Proposed Plan when comments on the FS have been received.

Community Acceptance

Because this alternative removes and treats TPH-impacted soils and consolidates the debris to one location under a paved parking lot, it is anticipated that it would be acceptable to a majority of community members. Community concern over dust that may be generated from operations and over increased traffic noise may be offset by the prospect of cleaning three of the four areas to levels with no future land use restrictions. Acceptance will be addressed in the Proposed Plan.

3.5.4 Detailed Analysis of Remedial Alternative 4

This alternative includes excavation of soil containing over 500 mg/kg of TPH from the DOL Maintenance Yard and treatment of the soil at the FOSTA. The excavation would be backfilled with clean fill and the asphalt pavement would be patched.

Debris from Sites 16 and 17 would be excavated, treated (screened and sterilized), and disposed as part of the Fort Ord OU 2 Landfill foundation layer. Screened soil would be sampled and reused as backfill material, if at acceptable concentrations. Clean soil would be brought in for backfill and the sites would be restored and revegetated, or repaved.

Overall Protection of Human Health and the Environment

Excavation, treatment of soil at the FOSTA, and disposal of debris at the OU 2 landfill reduces long-term risks by elimination of the inhalation, incidental ingestion, and dermal exposure routes. Thus, this alternative would provide increased protection compared to the no action alternative, and would allow unrestricted use of the sites for the future reuse exposure scenario. Impact to the ecological environment would be mitigated through revegetation with native species of plants.

Compliance with ARARs

Alternative 4 is anticipated to meet all action-specific and location-specific ARARs.

Removing the TPH-impacted soil and debris from the site would result in a clean site that no longer presents a potential threat to human health or the environment. Because excavation, loading, screening, and transportation of contaminated fill would be conducted using proper dust control, engineering, and health and safety procedures, this alternative would reduce the exposure pathways of concern and be in compliance with ARARs.

Action-specific ARARs are imposed on landfills containing municipal wastes under 23 CCR Chapter 15. The excavated debris will be sterilized thereby meeting Health and Safety Code Chapter 6.1 for treatment of medical debris.

Monterey County regulates emissions from activities such as excavation, loading, and transportation of soil. Fugitive dust emissions will be minimized and kept below the allowable limit through dust control measures. A Health and Safety Plan would also be required; it is

TABLES

Table 3.1. Summary of Remedial Investigation Program - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Field Program	Analytical Program and Dates for Each Site				
	Site 16 DOL Maintenance Yard	Site 16 Pete's Pond Extension	Site 16 Pete's Pond	Site 17 Disposal Area	Site 17 Other Areas
Phase I					
Geophysics Survey	None	None	Completed	Completed	None
Soil Borings	SB-16-01 to SB-16-07 (TPHg, TPHd, VOCs, BTEX, metals, pH) 1/17/92 - 1/18/92	None	SB-16-08 to SB-16-12 (TPHg, TPHd, TOG, VOCs, metals, pH) 2/1/92 - 2/2/92	None	SB-17-01 to SB-17-02 (TPHd, TPHg, BTEX, metals, pH) MSB-17-02 (VOCs)
Monitoring Wells	None	None	MW-16-01-A (TPHg, TPHd, TOG, VOC, metals, pH) 2/3/92	None	MW-17-01-A, MW-17-02-180 (TPHg, TPHd, BTEX, metals, pH) 2/1/92 - 2/10/92
Monitoring Wells Sampled	None	None	MW-16-01-A	None	MW-17-01-A, MW-17-02-180
Soil Gas Survey	None	None	SG-16-01 to SG-16-21 (VOCs) 1/29/92 - 1/30/92	SG-17-01 to SG-17-16 (VOCs) 2/12/92 - 2/13/92	SG-17-17 to SG-17-22 (VOCs) 1/16/92 - 1/17/92
Test Pits	None	None	TR-16-01 to TR-16-07 (TPHd, VOCs, metals, pH) 1/30/92 - 2/1/92	TR-17-01 to TR-17-07 (TPHd, VOCs, metals, pH) TR-17-06 was not excavated 2/6/92	None

Table 3.1. Summary of Remedial Investigation Program - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Field Program	Analytical Program and Dates for Each Site				
	Site 16 DOL Maintenance Yard	Site 16 Pete's Pond Extension	Site 16 Pete's Pond	Site 17 Disposal Area	Site 17 Other Areas
Phase II					
Geophysics Survey	None	Completed	None	Completed	None
Soil Borings	SB-16-13 to SB-16-20 (Ensys, TPHd, TPHmo) SB-16-13, SB-16-15, SB-16-17 to SB-16-20 (SOCs) 10/20/93 - 10/22/93	SB-16-24 to SB-16-28 (TPHd, TPHmo, VOCs, SOCs, metals, CR VI, CDDs/CDFs) SB-16-25 (sulfur mustard, VOCs) 3/3/94 - 3/15/94	SB-16-21 to SB-16-23 (TPHd, TPHmo, metals, CR VI, VOCs, SOCs, PCBs, TRPH) SB-16-23 (CDDs/CDFs) 2/25/94 - 2/28/94	SB-17-03 to SB-17-12 (TPHd, TPHmo, VOCs, SOCs, metals, CR VI, CDDs/CDFs [no dioxin in SB-17-03]) SB-17-06 to SB-17-11 (PCBs) 3/4/94 - 3/11/94	None
Test Pits	TR-16-08 to TR-16-19 (TPHd, TPHmo) TR-16-09 to TR-16-17 (Ensys) TR-16-09, TR-16-11, TR-16-13, and TR-16-17 (SOCs) 8/16/93 - 8/18/93	TR-16-20 to TR-16-40 (TPHd, TPHmo, VOCs, metals, CR VI) TR-16-20, TR-16-21, TR-16-28, TR-16-33, TR-16-37 (SOCs) 8/16/93 - 8/27/93 TR-16-41 (sulfur mustard, VOCs) 3/14/94 TR-16-25 (no sample)	None	TR-17-08 to TR-17-17 (TPHd, TPHmo, VOCs, metals, CR VI) TR-17-11 to TR-17-14 (SOCs) TR-17-13 (no sample) 8/24/93 - 8/26/93 TR-17-18 to TR-17-21 (TPHd, TPHmo, VOCs, SOCs, metals, CR VI) TR-17-19, TR-17-20 (PCBs, CDDs/CDFs) 2/22/94 - 2/24/94	None

Table 3.2 Summary of Results of the Remedial Investigation Analytical Program - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Chemical Parameter	DOL Maintentance Yard				
		Shallow (2 to 10 ft bgs)		Deep (greater than 10 feet)	
	Number of Occurances	Maximum Concentration	Location and Depth of Maximum	Maxium Concentration	Location and Depth of Maximum
VOCs (in ug/kg)					
Acetone	1 of 8	77 ug/kg	SB-16-02 at 5.5	-	-
Methyl ethyl ketone	1 of 8	27 ug/kg	SB-16-02 at 5.5	-	-
Methylene chloride	ND	-	-	-	-
Trichloroethene	ND	-	-	-	-
Tetrachloroethene	ND	-	-	-	-
Toluene	ND	-	-	-	-
SOCs (in ug/kg)					
Di-n-butylphthalate	1 of 9	95 ug/kg	SB-16-18 at 3.0	-	-
Dibenzofuran	1 of 9	410 ug/kg	SB-16-09 at 3.0	-	-
Bis(2-ethylhexyl)phthalate	1 of 9	3900 ug/kg	SB-16-18 at 3.0	-	-
Fluorene	2 of 9	670 ug/kg	SB-16-09 at 3.0	-	-
2-Methylnaphthalene	4 of 9	1700 ug/kg	SB-16-09 at 3.0	-	-
Naphthalene	4 of 9	700 ug/kg	SB-16-13 at 6.0	-	-
Phenanthrene	3 of 9	190 ug/kg	SB-16-18 at 3.0	-	-
Pentachlorophenol	ND			-	-
PESTICIDES (in ug/kg)					
4,4'-DDT	ND	-	-	-	-
DIOXINS/FURANS (in pg/g)					
TCDD-TE	NA	-	-	-	-
TPH (in mg/kg)					
TPH-Diesel	1 of 35	2,000 mg/kg	TR-16-09 at 3.0	-	-
TPH-Extractable Unknown	9 of 27	4,300 mg/kg	TR-16-13 at 6.0	-	-
METALS (in mg/kg)					
Antimony	ND			-	-
Arsenic	16 of 21	1.7 mg/kg	SB-16-06 at 5.5	2.0 mg/kg	SB-16-01 at 20.5
Beryllium	8 of 21	0.21 mg/kg	SB-16-05 at 9.0	0.43 mg/kg	SB-16-04 at 15.5
Cadmium	ND	-	-		
Chromium	21 of 21	21.30 mg/kg	SB-16-07 at 5.5	24.3 mg/kg	SB-16-04 at 15.5
Copper	14 of 21	3.4 mg/kg	SB-16-02 at 5.5	4.3 mg/kg	SB-16-04 at 15.5
Lead	17 of 21	3.8 mg/kg	SB-16-05 at 5.5	2.6 mg/kg	SB-16-02 at 15.5
Mercury	ND	-	-	-	
Nickel	21 of 21	14.0 mg/kg	SB-16-07 at 5.5	15.3 mg/kg	SB-16-04 at 15.5
Zinc	21 of 21	9.6 mg/kg	SB-16-02 at 5.5	10.5 mg/kg	SB-16-04 at 15.5
Thallium	ND	-	-	-	-
Silver	ND	-	-	-	-
Selenium	ND	-	-	-	-

Table 3.2 Summary of Results of the Remedial Investigation Analytical Program - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Chemical Parameter	Pete's Pond						
		Surface (0-2 feet)		Shallow (2 to 10 ft bgs)		Deep (greater than 10 feet)	
	Number of Occurences	Maximum Concentration	Location and Depth in ft of Maximum	Maximum Concentration	Location and Depth in ft of Maximum	Maxium Concentration	Location and Depth in ft of Maximum
VOCs (in ug/kg)							
Acetone	22 of 53	28 ug/kg	TR-16-06 at 1.5	34 ug/kg	SB-16-10 at 5.5	12 ug/kg	SB-16-09 at 10.5
Methyl ethyl ketone	1 of 53	-	-	9.1 ug/kg	TR-16-02 at 9.5	-	-
Methylene chloride	3 of 53	3 ug/kg	OF-16-03-02	9.1 ug/kg	SB-16-11 at 5.5	-	-
Trichloroethene	ND	-	-	-	-	-	-
Tetrachloroethene	ND	-	-	-	-	-	-
Toluene	ND	-	-	-	-	-	-
SOCs (in ug/kg)							
Di-n-butylphthalate	NA /1/	-	-	-	-	-	-
Dibenzofuran	NA /1/	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	NA /1/	-	-	-	-	-	-
Fluorene	NA /1/	-	-	-	-	-	-
2-Methylnaphthalene	NA /1/	-	-	-	-	-	-
Naphthalene	NA /1/	-	-	-	-	-	-
Phenanthrene	NA /1/	-	-	-	-	-	-
Pentachlorophenol	NA /1/	-	-	-	-	-	-
PESTICIDES (in ug/kg)							
4,4'-DDT	3 of 8	22 ug/kg	OF-16-02-01	-	-	-	-
DIOXINS/FURANS (in pg/g)							
TCDD-TE	1 of 1	1.87 pg/g	SB-16-23 at 2.0	-	-	-	-
TPH (in mg/kg)							
TPH-Diesel	ND	-	-	-	-	-	-
TPH-Extractable Unknown	ND	-	-	-	-	-	-
METALS (in mg/kg)							
Antimony	1 of 53	-	-	-	-	6.0 mg/kg	SB-16-12 at 21.0
Arsenic	37 of 53	1.8 mg/kg	TR-16-01 at 1.5	2.1 mg/kg	TR-16-05 at 5.0	1.9 mg/kg	SB-16-12 at 10.5
Beryllium	21 of 53	0.42 mg/kg	TR-16-01 at 1.5	0.45 mg/kg	TR-16-05 at 5.0	0.29 mg/kg	SB-16-21 at 10.7
Cadmium	5 of 53	4.5 mg/kg	OF-16-02-01	1.5 mg/kg	TR-16-05 at 5.0	-	-
Chromium	36 of 53	18.1 mg/kg	TR-16-01 at 1.5	17.4 mg/kg	TR-16-05 at 5.0	17.8 mg/kg	SB-16-09 at 21.0
Copper	17 of 53	40.3 mg/kg	OF-16-05-01	36.3 mg/kg	TR-16-05 at 5.0	7.7 mg/kg	SB-16-12 at 21.0
Lead	52 of 53	80.1 mg/kg	OF-16-05-02	23.6 mg/kg	TR-16-05 at 5.0	4.1 mg/kg	SB-16-08 at 10.5
Mercury	3 of 53	0.63 mg/kg	TR-16-06 at 1.5	-	-	0.26 mg/kg	MW-16-01-A at 30.5
Nickel	45 of 53	16.1 mg/kg	TR-16-01 at 1.5	14.2 mg/kg	TR-16-09 at 5.5	17.0 mg/kg	MW-16-01-A at 70.5
Zinc	50 of 53	1730 mg/kg	TR-16-06 at 1.5	85 mg/kg	TR-16-05 at 5.0	16.1 mg/kg	SB-16-08 at 16.0
Thallium	ND	-	-	-	-	-	-
Silver	ND	-	-	-	-	-	-
Selenium	ND	-	-	-	-	-	-

Table 3.2 Summary of Results of the Remedial Investigation Analytical Program - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Chemical Parameter	Pete's Pond Extension						
		Surface (0-2 feet)		Shallow (2 to 10 ft bgs)		Deep (greater than 10 feet)	
	Number of Occurences	Maximum Concentration	Location and Depth in ft of Maximum	Maximum Concentration	Location and Depth in ft of Maximum	Maxium Concentration	Location and Depth in ft of Maximum
VOCs (in ug/kg)							
Acetone	1 of 40	-	-	-	-	12 ug/kg	SB-16-09 at 10.5
Methyl ethyl ketone	ND	-	-	-	-	-	-
Methylene chloride	ND	-	-	1.8 in P.	-	-	-
Trichloroethene	6 of 40	68 ug/kg	TR-16-21 at 1.0	1.2 ug/kg	TR-16-29 at 4.5	-	-
Tetrachloroethene	2 of 40	-	-	6.4 ug/kg	TR-16-30 at 5.0	-	-
Toluene	1 of 40	-	-	1.2 ug/kg	TR-16-38 at 3.0	-	-
SOCs (in ug/kg)							
Di-n-butylphthalate	ND	-	-	-	-	-	-
Dibenzofuran	ND	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	4 of 17	96 ug/kg	SB-16-28 at 1.2	77 ug/kg	SB-16-24 at 7.0	-	-
Fluorene	ND	-	-	-	-	-	-
2-Methylnaphthalene	ND	-	-	-	-	-	-
Naphthalene	ND	-	-	-	-	-	-
Phenanthrene	ND	-	-	-	-	-	-
Pentachlorophenol	1 of 17	-	-	88 ug/kg	SB-16-27 at 6.2	-	-
PESTICIDES (in ug/kg)							
4,4'-DDT	NA(?)	-	-	-	-	-	-
DIOXINS/FURANS (in pg/g)							
TCDD-TE	2 of 2	-	-	21.84 pg/g	SB-16-24 at 7.0	-	-
TPH (in mg/kg)							
TPH-Diesel	ND	-	-	TPH-D in P.	-	-	-
TPH-Extractable Unknown	1 of 40	-	-	1,300 mg/kg	TR-16-28 at 5.5	-	-
METALS (in mg/kg)							
Antimony	10 of 40	6.9 mg/kg	TR-16-20 at 2.0	3.4 mg/kg	TR-16-27 at 2.5	6.0 mg/kg	SB-16-12 at 21.0
Arsenic	29 of 40	6.4 mg/kg	TR-16-20 at 2.0	3.3 mg/kg	TR-16-24 at 7.0	1.9 mg/kg	SB-16-12 at 10.5
Beryllium	12 of 40	0.19 mg/kg	TR-16-21 at 1.5	0.25 mg/kg	TR-16-26 at 5.7	0.29 mg/kg	SB-16-21 at 10.7
Cadmium	5 of 40	1.7 mg/kg	TR-16-20 at 2.0	1.1 mg/kg	TR-16-24 at 7.0	-	-
Chromium	40 of 40	25.1 mg/kg	TR-16-20 at 2.0	24.7 mg/kg	TR-16-24 at 7.0	17.8 mg/kg	SB-16-09 at 21.0
Copper	16 of 40	443 mg/kg	TR-16-20 at 2.0	185 mg/kg	TR-16-27 at 2.5	7.7 mg/kg	SB-16-12 at 21.0
Lead	40 of 40	741 mg/kg	TR-16-20 at 2.0	475 mg/kg	TR-16-24 at 7.0	4.1 mg/kg	SB-16-08 at 10.5
Mercury	3 of 40	0.25 mg/kg	TR-16-20 at 0.5	-	-	0.26 mg/kg	MW-16-01A at 30.5
Nickel	40 of 40	20.2 mg/kg	TR-16-20 at 2.0	25.1 mg/kg	TR-16-24 at 7.0	17.0 mg/kg	MW-16-01A at 70.5
Zinc	29 of 40	1030 mg/kg	TR-16-20 at 2.0	678 mg/kg	TR-16-24 at 7.0	16.1 mg/kg	SB-16-08 at 16.0
Thallium	1 of 40	-	-	-	-	-	-
Silver	3 of 40	1.2 mg/kg	TR-16-20 at 2.0	-	-	-	-
Selenium	ND	-	-	-	-	-	-

Table 3.2 Summary of Results of the Remedial Investigation Analytical Program - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Chemical Parameter	Site 17 Disposal Area						
		Surface (0-2 feet)		Shallow (2 to 10 ft bgs)		Deep (greater than 10 feet)	
	Number of Occurences	Maximum Concentration	Location and Depth in ft of Maximum	Maximum Concentration	Location and Depth in ft of Maximum	Maxium Concentration	Location and Depth in ft of Maximum
VOCs (in ug/kg)							
Acetone	8 of 56	8.8 ug/kg	TR-17-04 at 2.0	31 ug/kg	TR-17-04 at 5.0	5.0 ug/kg	SB-17-03 at 20.7
Methyl ethyl ketone	ND	-	-	-	-	-	-
Methylene chloride	1 of 56	-	-	3.5	TR-17-03 at 2.5	-	-
Trichloroethene	ND	-	-	-	-	-	-
Tetrachloroethene	ND	-	-	-	-	-	-
Toluene	ND	-	-	-	-	-	-
SOCs (in ug/kg)							
Di-n-butylphthalate	ND	-	-	-	-	-	-
Dibenzofuran	ND	-	-	-	-	-	-
Bis(2-ethylhexyl)phthalate	2 of 32	-	-	130 ug/kg	TR-17-12 at 8.5	360 ug/kg	SB-17-08 at 11.7
Fluorene	ND	-	-	-	-	-	-
2-Methylnaphthalene	ND	-	-	-	-	-	-
Naphthalene	ND	-	-	-	-	-	-
Phenanthrene	ND	-	-	-	-	-	-
Pentachlorophenol	1 of 17	-	-	-	-	-	-
PESTICIDES (in ug/kg)							
4,4'-DDT	NA(?)	-	-	-	-	-	-
DIOXINS/FURANS (in pg/g)							
TCDD-TE	5 of 5	4.06 pg/g	TR-17-20 at 1.0	30.19 pg/g	SB-17-07 at 6.7	7.87 pg/g	SB-17-08 at 11.7
TPH (in mg/kg)							
TPH-Diesel	ND	-	-	-	-	-	-
TPH-Extractable Unknown	10 of 56	38 mg/kg	TR-17-17 at 0.5'	1,000 mg/kg	TR 17-11 at 5.5	37 mg/kg	SB-17-08 at 11.7
METALS (in mg/kg)							
Antimony	20 of 56	0.72 mg/kg	SB-17-04 at 1.7	5.5 mg/kg	TR-17-12 at 8.5	1.2 mg/kg	SB-17-08 at 11.7
Arsenic	42 of 56	1.4 mg/kg	TR-17-15 at 0.5	13.1 mg/kg	TR-17-20 at 5.0	2.1 mg/kg	SB-17-04 at 11.2
Beryllium	11 of 56	0.24 mg/kg	SB-17-04 at 1.7	0.25 mg/kg	TR-17-03 at 6.7	0.44 mg/kg	SB-17-04 at 11.2
Cadmium	3 of 56	-	-	3.2 mg/kg	TR-17-12 at 8.5	-	-
Chromium	56 of 56	15.2 mg/kg	SB-17-06 at 1.7	52.7 mg/kg	TR-17-11 at 5.5	16.8 mg/kg	SB-17-11 at 16.2
Copper	12 of 56	10.5 mg/kg	SB-17-04 at 1.7	257 mg/kg	TR-17-07 at 6.7	70.5 mg/kg	SB-17-08 at 11.7
Lead	55 of 56	29 mg/kg	TR-17-02 at 1.5	442 mg/kg	TR-17-20 at 5.0	96.5 mg/kg	TR-17-15 at 11.0
Mercury	14 of 56	0.13 mg/kg	TR-17-02 at 1.5	7.5 mg/kg	TR-17-11 at 5.5	0.2 mg/kg	SB-17-08 at 11.7
Nickel	51 of 56	11.6 mg/kg	SB-17-14 at 0.5	470 mg/kg	TR-17-12 at 8.5	14.9 mg/kg	SB-17-08 at 11.7
Zinc	37 of 56	39.8 mg/kg	SB-17-04 at 1.7	673 mg/kg	TR-17-09 at 9.5	124 mg/kg	TR-17-15 at 11.0
Thallium	ND	-	-	-	-	-	-
Silver	1 of 56	-	-	4.8 mg/kg	TR-17-20 at 5.0	-	-
Selenium	1 of 56	-	-	1.2 mg/kg	TR-17-04 at 5.0	-	-

NOTES:

ND	Not dected in any of the samples analyzed
NA	Not analyzed
NA /1/	Not analyzed. SOCs were generally analyzed only when TPH was detected.
mg/kg	Miligrams per kilogram
ug/kg	Micrograms per kilogram
pg/g	Picograms per gram
DOL	Directorate of Logistics.
ft	Feet.
VOCs	Volatile organic compounds.
ug/kg	Micrograms per kilogram.
ND	Not detected in ay of the samples analyzed.
SOCs	Semivolatile organic compounds.
TCDD-TE	2,3,7,8-tetrachlorodibenzo-p-dioxin toxic equivalents.
TPH	Total petroleum hydrocarbons.

Table 3.3. Potential Applicable or Relevant and Appropriate Requirements - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Chemical-Specific Requirements				
Monterey Bay Unified Air Pollution Control District (MBUAPCD)	Regulation II (New Sources) and Regulation X (Toxic Air Contaminants)	Establishes requirements for new stationary sources of air pollution, and the appropriate level of abatement control technology for toxic air contaminants.	Relevant and Appropriate	The remedial design would need to meet the substantive requirements of these MBUAPCD regulations if screening or excavating activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal.
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	40 CFR Part 150	Establishes NAAQS for criteria pollutants: particulate matter (PM10), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead.	Applicable	Although none of these pollutants have been identified in the air at Sites 16 and 17, particulate matter containing lead could be generated during remedial construction activities.
Location-Specific Requirements				
Endangered Species Act of 1973	16 U.S.C. 1531 et seq.	The Endangered Species Act of 1973 requires action to conserve endangered species and preserve critical habitat upon which they depend.	Applicable	Endangered species of plants and animals have been observed at Sites 16 and 17. Each area will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment Report that will recommend measures, as necessary, to comply with this ARAR.
Action-Specific Requirements				
Land Disposal Restrictions	Title 22 CCR, Chapter 18	Prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. Requires laboratory analysis of wastes intended for landfill disposal to establish that the waste is not restricted from landfill disposal.	Applicable	Listed or characteristic hazardous wastes may be subject to these regulations if they are land disposed.
Standards for Discharges of Waste to Land	Title 23 CCR, Division 3, Chapter 15, Article 1, Section 2511(d) and Article 2	Exempts from Chapter 15 any actions taken by a public agency to cleanup waste, provided that waste removed from the place of release shall be discharged according to Article 2.	Applicable	If soil or debris from Sites 16 and 17 is excavated, then the provisions in Article 2 dealing with waste classification and management will be complied with. Placement of the soil in the OU 2 landfill as part of the cap is allowed under Article 2.
Standards for Discharges of Waste to Land	Title 23 CCR, Division 3, Chapter 15, Articles 8 and 9		Relevant and Appropriate	If soil and debris from Sites 16 and 17 is contained onsite, it would be subject to these requirements. The containment unit would be designed, monitored, and closed in compliance with Chapter 15.
Medical Waste Management Act	California Health and Safety Code, Div. 4, Chapter 6.1 - 6.5	These regulations cover the handling, transportation, treatment, and disposal of medical wastes.	Applicable	If any waste is determined to be medical waste as defined in this act, it will be handled appropriately.

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Infectious Waste	Title 22, Article 13, Sections 66835 - 66865	These regulations cover the handling, treatment, and disposal of medical wastes.	Applicable	If any waste is determined to be infectious or potentially infectious, it will be handled appropriately.

RWQCB California Regional Water Quality Control Board.
OU Operable unit.
ARAR Applicable or relevant and appropriate requirements.
EPA U.S. Environmental Protection Agency.
CFR Code of Federal Regulations.
U.S.C. United States Code.
MCL Maximum Contaminant Level.
MCLGs Maximum Contaminant Level Goals.
RCRA Resource Conservation and Recovery Act.
TPH Total petroleum hydrocarbons.
mg/kg Milligrams per kilogram.
IAROD Interim Action Record of Decision.
MBUAPCD Monterey Bay Unified Air Pollution Control District.
NAAQS National Ambient Air Quality Standards.
PM10 Particulate matter with a diameter under 10 microns.
et seq. And following.
WMUs Waste management units.
TSD Treatment, storage, and disposal.
CAMU Corrective action management unit.
NEPA National Environmental Policy Act.
FS Feasibility study.
CEQA California Environmental Quality Act.
Cal/EPA California Environmental Protection Agency.

Table 3.4. Remedial Action Objectives - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

For Human Health Protection

Media/Exposure Pathway	Remedial Action Objective	Potential Remediation Requirement
Soil - Ingestion or Dermal Contact		
Short-term	Minimize direct exposure of onsite construction workers during remedial action in any area with unacceptable acute risks.	Personnel protection and monitoring.
Long-term	Reduce potential chronic chemical exposure of potential future onsite uses in any area to acceptable levels (10^{-6} excess cancer risk; Hazard Index <1).	Source containment, deed restriction, fencing; removal and/or treatment.
Air - Inhalation of Dust		
Short-term	Minimize direct exposure of onsite construction workers during remedial action and maintain background air quality levels or OSHA/NIOSH standards.	Minimize temporary releases during remediation; employ dust control measures, personal protection, and monitoring.
Long-term	Minimize soil erosion, maintain background air quality levels.	Air quality monitoring, source containment, deed restriction, fencing; removal and/or treatment.

Table 3.4. Remedial Action Objectives - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

For Human Health Protection

Media/Exposure Pathway	Remedial Action Objective	Potential Remediation Requirement
Safety Hazards Associated with UXO/OEW		
Short-term	Minimize contact with UXO/OEW of onsite construction workers during remediation activities.	Use personnel trained to handle UXO/OEW; use remote operation equipment.
Long-term	Reduce potential exposure to UXO/OEW of potential future onsite users in any area compatible with future use.	Source control, deed restrictions, fencing; removal and/or treatment.
Safety Hazards Associated with Medical Debris		
Short-term	Minimize contact with medical debris of onsite construction workers during remedial activities.	Use personnel trained to handle medical debris, personal protection, and monitoring. Avoid direct contact.
Long-term	Reduce potential exposure of medical debris for potential future onsite users in any area compatible with future use.	Source control, deed restrictions, removal and/or treatment.

MCLs Maximum Contaminant Levels.
OSHA Occupational Safety and Health Act.
NIOSH National Institute of Occupational Safety and Health.
UXO/OEW Unexploded ordnance/explosive and ordnance waste.

Table 3.5. Summary of Retained Remedial Technology Options
Soil Impacted by Heavy Total Petroleum Hydrocarbons - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
NO ACTION	None	Monitoring, deed restrictions, access restrictions may be required.	Low	Not effective; however natural attenuation of chemicals may occur over time.	Requires regulatory approval of risk to environmental and human health and consideration of future land use if deed restriction imposed.	Yes
CONTAINMENT	Capping					
	Clay and soil	Semipermeable or impermeable surface layer composed of compacted clay over soil to minimize surface water infiltration, chemical transport, and contact	Moderate	Effective for minimizing contact and surface water leaching of chemicals in soil to groundwater. Cap requires continuous maintenance; groundwater monitoring may be required.	Implementable depending on topography; presence of cap limits site development.	No
	Asphalt or concrete	Semipermeable or impermeable surface layer composed of a concrete slab or a layer of asphalt to minimize surface water infiltration, chemical transport, and contact.	Low/Moderate	Less effective for minimizing contact and surface water leaching of chemicals in soil to groundwater; more permeable than engineered caps.	Implementable depending on topography, planned site development, and concentration of chemicals	Yes

Table 3.5. Summary of Retained Remedial Technology Options
Soil Impacted by Heavy Total Petroleum Hydrocarbons - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
	Surface Water Control					
	Grading	Smoothing of surface to grade after completion of excavation and backfilling.	Low	Could be effective in conjunction with other measures such as consolidation in an onsite repository and monitoring.	Implementable at close of site work.	Yes
	Revegetation	Engineered landscaping and placement of plants, shrubs, or trees to restore site after excavation.	Moderate	Minimizes erosion to prevent surface water ponding and chemical transport; effective in conjunction with other measures.	Implementable at close of site work; depends on planned site development and ecological considerations.	Yes
	Diversion and collection systems	Series of pipes and basins to direct surface water away from area of concern; minimizes surface water infiltration and chemical transport.	Moderate	Could be effective in conjunction with other measures.	Implementable at close of site work; depends on long-term planned site development.	Yes
COLLECTION	Source Soil Removal					
	Standard excavation	Removal of soil by digging with commonly used heavy equipment.	Low	Highly effective for source removal.	Implementable; equipment readily available.	Yes

Table 3.5. Summary of Retained Remedial Technology Options
Soil Impacted by Heavy Total Petroleum Hydrocarbons - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
COLLECTION (cont.)	Source Soil Removal (cont.)					
	Deep soil excavation	Removal of soil with deep augers and other nonstandard excavation techniques.	High	Effective for source removal; but not necessary for soils at Sites 16 and 17.	May be difficult to implement in sandy soil; equipment readily available.	No
TREATMENT	Thermal Treatment					
	Rotary kiln incinerator ex situ	Combustion in a horizontally rotating cylinder designed for uniform heat transfer.	Moderate	Effective for removal of TPH-h in sandy soil; however, would require pilot studies.	Equipment available, including some mobile units.	No
	Fluidized bed incinerator ex situ	Injection into a hot agitated bed of sand where combustion occurs.	Moderate	Effective for removal of TPH-h in sandy soil; however, would require pilot study.	Equipment available, including some mobile units.	No
	Circulating bed incinerator	Variation of fluidized bed incinerator using higher air velocity and circulating solids to create a larger and highly turbulent combustion zone.	Moderate	Effective for removal of TPH-h in sandy soil; however, would require pilot study.	Equipment available including some mobile units.	No
	Thermal oxidation (offgas)	High-temperature (1400° F) destruction of organic vapors collected during treatment.	Low	Effective for destruction of organic vapors, but extraction of organic vapors from TPH-h is very difficult.	Proven technology; equipment readily available.	No

Table 3.5. Summary of Retained Remedial Technology Options
Soil Impacted by Heavy Total Petroleum Hydrocarbons - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Thermal Treatment (cont.)					
	Catalytic oxidation (offgas)	Lower- temperature (600° F) destruction of organic vapors collected during treatment.	Low	Effective for treatment of most offgas, but only moderately effective for removal of TPH-h in soils.	Proven technology; equipment readily available.	No
	Chemical Treatment					
	Asphalt batching	Incorporation of soil into a cold or hot mix as an aggregate supplement in the manufacture of asphaltic concrete.	Low	Soil must be an adequate substitute for aggregate typically used; volatilization of chemicals in hot mix process may require emissions controls; however, would require pilot study.	Equipment readily available. Requires pilot study.	No
	Physical Treatment					
	Soil vapor circulation (Biotreat)	Application of a vacuum to extraction wells at low flow rates through unsaturated zone to biodegrade TPH-h.	Low	Only moderately effective for removal of TPH-h in permeable soils.	Implementable for permeable soils such as sands. Equipment readily available. Requires pilot study.	No

Table 3.5. Summary of Retained Remedial Technology Options
Soil Impacted by Heavy Total Petroleum Hydrocarbons - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Physical Treatment (cont.)					
	Air injection/Biotreat	Injection of air into unsaturated zone to biodegrade TPH-h.	Low	Only moderately effective for removal of TPH-h in permeable soils.	Implementable for permeable soils such as sands. Equipment readily available. Requires pilot study.	No
	Activated carbon adsorption (offgas)	Adsorption onto carbon of organic vapors collected during treatment.	Low	Effective treatment of most offgas; however, only moderately effective for removal of TPH-h in permeable soils.	Proven technology; equipment readily available.	No
	Thermal desorption	Low temperature thermal treatment with a heated auger which causes volatilization of TPH-h.	Low/Moderate	Only moderately effective for most TPH-h, and would require pilot study.	Proven technology; equipment readily available. Required rehydration for backfill and dust control.	No
	Screening	Removal of larger sized particles from the waste stream by passage through a screen.	Low	Not effective, because TPH-h would have to be present in specific fraction to reduce volume of contamination.	Applicable for primary processing prior to soil treatment if soil is nonhomogeneous.	No

Table 3.5. Summary of Retained Remedial Technology Options
Soil Impacted by Heavy Total Petroleum Hydrocarbons - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Biological Treatment					
	Biodegradation in situ	Introduction of oxygen, nutrients, and/or bacteria to degrade contaminants in soil.	Low	Effective for a wide variety of organic compounds, but not as effective for shallow soils with depth to groundwater greater than 80'.	Proven technology; equipment readily available. Sandy soils may require amendment of nutrients and bacteria. Requires pre-design study.	No
	Biodegradation	Introduction of oxygen, nutrients, and/or bacteria to degrade TPH-h in soil in an aboveground facility such as a slurry reactor or treatment pad.	Low	Effective for a wide variety of organic compounds.	Proven technology; equipment readily available. Sandy soils may require amendment of nutrients and bacteria. Requires pre-design study.	Yes
	Offsite Treatment					
	Thermal treatment	Use of high temperatures as principal means of destroying or detoxifying wastes.	High	FOSTA provides equivalent treatment.	Implementability limited by offsite facility location, availability, and concentrations of chemicals.	No
	Biological treatment	Degradation of organics using microorganisms.	Moderate	FOSTA provides equivalent treatment.	Implementability limited by offsite facility location, availability, and concentrations of chemicals.	No

Table 3.5. Summary of Retained Remedial Technology Options
Soil Impacted by Heavy Total Petroleum Hydrocarbons - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
DISPOSAL	Onsite Disposal	Onsite waste management of chemical-bearing soil in an onsite waste unit or replacement into the excavated area after treatment.	Moderate	Effective means of disposal; however, may require continuous maintenance and monitoring depending on concentrations.	Implementable depending on effectiveness of treatment and achievement of cleanup levels prior to disposal.	Yes
	Offsite Disposal					
	Landfill	Transport of chemical-bearing soil to an appropriate landfill by licensed waste transporter.	Low to High	Effective, however, pretreatment may be required depending upon concentrations.	Implementable and readily available. Class of landfill depends upon concentrations.	No

TPH-h Total petroleum hydrocarbons.

Table 3.6. Summary of Retained Remedial Technology Options
Debris - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
NO ACTION	None	Monitoring, deed restrictions, access restrictions may be required, depending on the presence of contamination.	Low	Not effective; however, certain land uses may allow for debris to remain in place.	Requires regulatory approval of: any risk to environmental and human health, impact of chemicals on groundwater, consideration of future land use if deed restriction imposed, and current landfilling requirements.	Yes
CONTAINMENT	<u>Vertical Barriers</u>					
	Grout curtain, sheet metal, slurry walls, or sheet piling	Provides semipermeable or impermeable barriers to horizontal migration of chemical-bearing soil and debris due to erosion or water flow.	Moderate/ High	Barriers are only moderately effective and would be less effective for debris which is irregularly deposited.	Installation would be highly susceptible to failure because of site geology and presence of UXO.	No
	<u>Horizontal Barriers</u>					
	Grouting, sheet metal, or block displacement	Provides semipermeable or impermeable barrier to vertical migration of soil and debris due to erosion or water flow.	High	Barriers are only moderately effective and would be less effective for debris which is irregularly deposited.	Installation would be highly susceptible to failure because of site geology and presence of UXO.	No
	<u>Capping</u>					
	Clay and soil	Semipermeable or impermeable surface layer comprised of compacted clay over debris and soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Effective for minimizing contact and surface water leaching of chemicals in debris and soil to groundwater. Cap requires continuous maintenance.	Implementable depending on planned site development and current regulatory requirements regarding landfilling. Compaction of waste prior to capping may prove difficult depending on waste profile.	No

Table 3.6. Summary of Retainе⌄ Remedial Technology Options
Debris - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
COLLECTION	Debris and Soil Removal					
	Excavation	Removal of debris and soil by digging with commonly used heavy equipment.	Moderate	Highly effective for removal of most debris and soil.	Implementable, with most equipment readily available; may require use of specialized equipment for removal of large debris or ammunition. Footing of equipment in sandy dune areas may prove difficult.	Yes
TREATMENT	Thermal Treatment					
	Sterilization	Super heated steam cleaning in container or vessel for sterilization purposes.	Moderate/ High	Effective for removing biological hazards associated with medical debris of unknown origin.	Equipment available. Energy intensive; favorable for smaller-sized debris.	Yes
	Offsite rotary kiln incinerator	Combustion in a horizontally rotating cylinder designed for uniform heat transfer and destruction of waste.	High	Effective for nonmetallic, smaller-sized debris and soil.	Implementable; however, acceptance at a licensed incinerator depends on presence of contamination.	No
	Physical Treatment					
	Debris washing	High-pressure spraying of debris in enclosed tank using water and chemical-specific surfactants or solvents.	Moderate/ High	Effective for removal of certain contaminants from debris surfaces.	Implementable; however, large scale equipment not readily available.	No
	Debris separation	Excavation and placement of debris and soil in large-scale mechanical vibrating screens to remove smaller fraction of material (e.g., soil).	Low/ Moderate	Highly effective for separation of debris from soil; reduces volume of waste.	Implementable; screening equipment readily available. Sandy soil is easily separated from other material. Requires pre-design study	Yes

Table 3.6. Summary of Retained Remedial Technology Options
Debris - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Biological Treatment					
	Ex situ Biodegradation	Introduction of oxygen, nutrients, and/or bacteria to waste pile heaps to biodegrade organics and chemical residues associated with explosives.	Low/ Moderate	Effective for a wide variety of organic chemicals and residues.	Implementable; equipment readily available. Sandy soil may require amendment of nutrients and bacteria. Requires pre-design study.	No
DISPOSAL	Onsite Disposal					
	Repository	Onsite waste management unit that may be lined and capped or completely enclosed in cement or other stable, non-eroding material.	High	Effective for containment of most wastes. Requires continuous maintenance and monitoring or leachate, collection and recovery system (LCRS).	Implementable depending on planned site development; area would have to be designated as a permanent landfill facility.	Yes
	Replacement after treatment	Excavation and treatment, or separation of soil or debris, with replacement of material into excavated areas.	Low	Effective for any debris or soil treated to agreed upon levels; may require liner, cap, or monitoring depending on waste.	Easily implemented; equipment readily available to backfill debris or soil.	Yes
	Offsite Disposal					Yes
	Demolition landfill	Transport of live ammunition or explosives to offsite facility for detonation and/or disposal.	Low/ Moderate	Effective for live ammunition detonation and disposal of fragments or exploded ordnance.	Implementable; unexploded ordnance would be detonated and disposed by Army team.	

Table 3.6. Summary of Retained Remedial Technology Options
Debris - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
DISPOSAL (cont.)	Landfill	Transport of chemical-bearing debris and soil to appropriate landfill by licensed waste transporter.	Low/ High	Effective; however pretreatment may be required depending upon presence of: contamination, biological hazards, or live ammunition.	Implementable and readily available. Class of landfill depends upon type of debris; some landfills offer pretreatment.	No
	Recycling facility	Transport of recyclable or reclaimable debris to an appropriate facility such as a smelter.	Low	Effective for debris such as scrap metal, glass, and oil or known substances found in containers.	Implementable; facilities are available in California.	No

UXO Unexploded ordnance.

Table 3.7. Summary of Remedial Alternative Cost Estimates[a]
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

	Alternative	Capital	Annual	NPV[c] Cost
1)	No Action	$20,600	$49,200	$774,000
2)	In situ containment of soil and debris	$1,175,200	$53,400	$1,804,000
3)	Excavation and onsite treatment of TPH-impacted soil at the FOSTA Consolidation and containment of debris at Site 17 Disposal Area	$1,211,100	$38,200	$1,604,000
4)	Excavation and onsite treatment of TPH-impacted soil at the FOSTA Excavation, screening, sterilization, and offsite disposal of debris	$5,158,000	$0	$5,158,000

TPH Total petroleum hydrocarbons.

FOSTA Fort Ord Soil Treatment Area.

a These cost estimates are for comparison purposes only and are intended to have an estimated range of about +50 percent to -30 percent. Many design variable and pérmitting requirements have not been established. Construction cost estimates for the selected alternative will be refined when an alternative has been selected and approved in the remedial design phase.

b Assumes 5 percent interest rate.

c Net Present Value

Table 3.8. Evaluation of Remedial Alternatives - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Retained for Detailed Analysis in the FS	EPA Evaluation Criteria							
	Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness	Reduction of Toxicity, Mobility, and Volume or Mass Through Treatment	Short-Term Effectiveness	Implementability (Technical and Administrative)	NPV Cost	Regulatory Agency and Community Acceptance
Alternative 1 No Action	This alternative will not effectively protect the environment.	ARARs would not be complied with.	Risk will remain as long as UXO exists near surface and debris is present. Risk to groundwater associated with TPH-impacted soil will remain.	No active reduction of toxicity, mobility, volume, or mass of contaminants.	No short-term effects on humans or the environment.	Easily implementable	$774,000	Not likely acceptable to agencies or the public.
Alternative 2 Containment	Groundwater protected by capping TPH-soil. Human health protected by removing UXO and capping debris. Capping areas disturbs ecological environment.	ARARs would be complied with.	Containment reduces risk from debris and TPH-impacted soil.	Does not reduce toxicity or volume, but containment reduces mobility.	Short-term, mitigable impacts to environment during construction. Workers will require protective measures.	Implementable	$1,804,000	Generally acceptable.

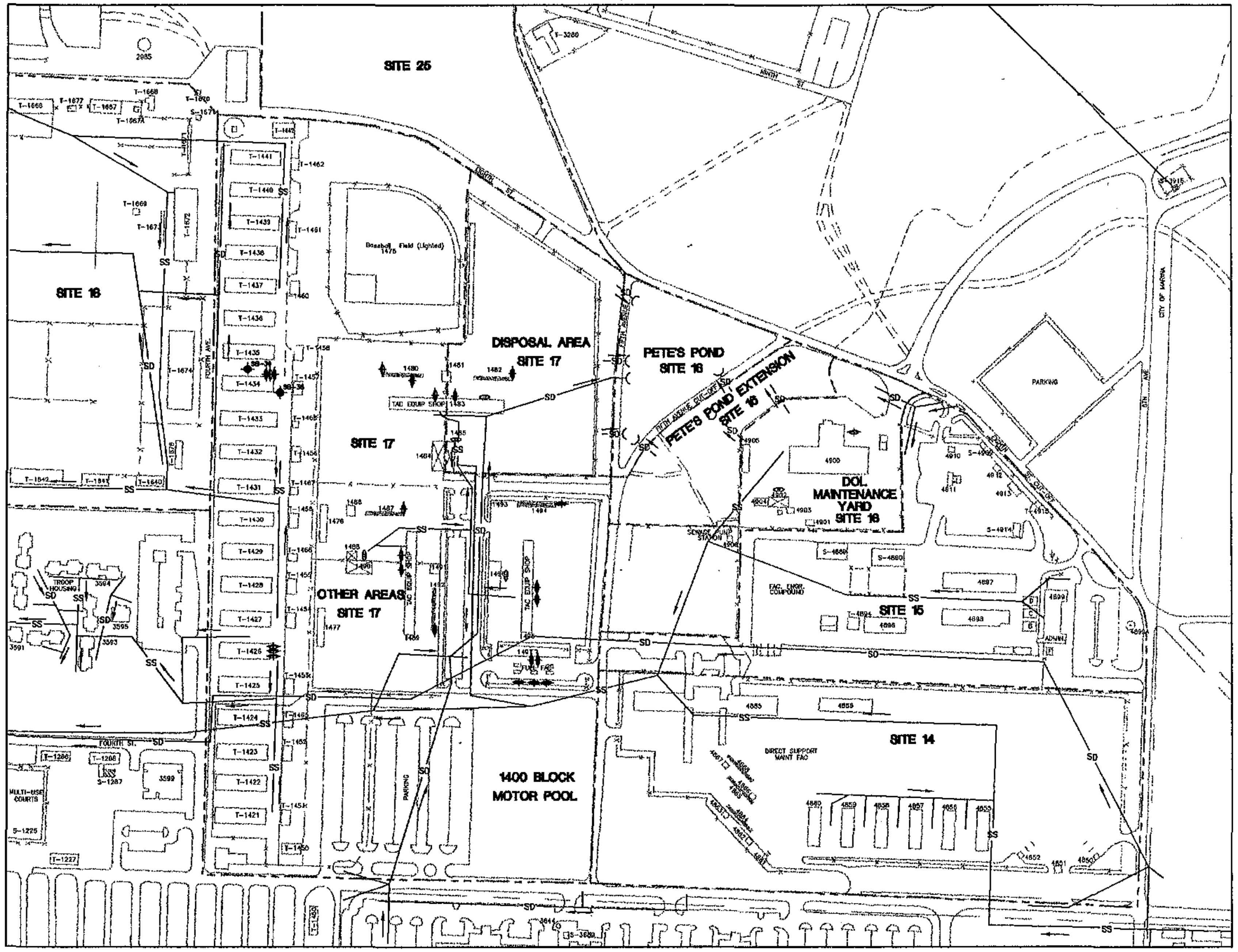
Table 3.8. Evaluation of Remedial Alternatives - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Retained for Detailed Analysis in the FS	EPA Evaluation Criteria							
	Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness	Reduction of Toxicity, Mobility, and Volume or Mass Through Treatment	Short-Term Effectiveness	Implementability (Technical and Administrative)	NPV Cost	Regulatory Agency and Community Acceptance
<u>Alternative 3</u> - Consolidation/ containment of debris - Excavation/ onsite treatment of TPH-impacted soil at FOSTA	Groundwater protected by removing TPH-soil. Human health protected by removing UXO, and capping debris. Excavation temporarily disturbs ecological environment.	ARARs would be complied with.	Containment reduces risk. Removal/treatment of TPH-impacted soil reduces risk.	Reduces volume, toxicity, and mobility of TPH-impacted soil. Reduces mobility, but not toxicity or volume, of debris.	Short term, mitigable impacts to environment during construction. Workers will require protective measures.	Implementable	$1,604,000	May not be acceptable to some agencies.

Remedial Alternatives Retained for Detailed Analysis in the FS	EPA Evaluation Criteria							
	Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness	Reduction of Toxicity, Mobility, and Volume or Mass Through Treatment	Short-Term Effectiveness	Implementability (Technical and Administrative)	NPV Cost	Regulatory Agency and Community Acceptance
Alternative 4 - Excavation/ onsite treatment of TPH-impacted soil at FOSTA - Excavation, screening/sterilization and onsite disposal of debris	Groundwater protected by removing TPH-soil. Human health is protected by removing contamination from site. Excavation disturbs ecological environment.	ARARs would be complied with.	Removing the contaminants from the site removes the risk from the site.	Reduces volume, toxicity, and mobility of TPH-impacted soil. Treating the debris reduces volume and toxicity.	Short term, mitigable impacts to environment during construction. Workers will require protective measures.	Implementable	$5,158,000	Generally acceptable

FS Feasibility study.
ARARs Applicable or relevant and appropriate requirements.
TPH Total petroleum hydrocarbons.
UXO Unexploded ordnance.
FOSTA Fort Ord Soil Treatment Area.
TCL Target cleanup level.
TPH-h Total petroleum hydrocarbons - heavy.
NPV Net present value.

PLATES



EXPLANATION

- SOIL BORING (BY OTHERS)
- EXISTING UNDERGROUND STORAGE TANK
- FORMER UNDERGROUND STORAGE TANK
- WASH RACK
- GREASE RACK
- OIL/WATER SEPARATOR
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE
- SD — STORM DRAIN LINE
- SS — SANITARY SEWER LINE

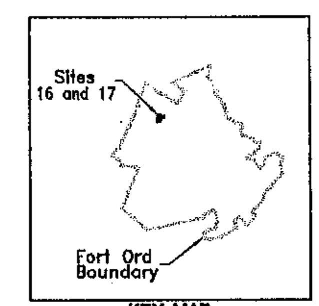
TYPE DESIGNATION: MW = MONITORING WELL, SS = SURFACE SAMPLE, HP = HYDROPUNCH SAMPLE, OF = OUTFALL SAMPLE, PZ = PIEZOMETER, SB = SOIL BORING, SG = SOIL GAS, PB = PILOT BORING, TR = TEST PIT

SITE NUMBER

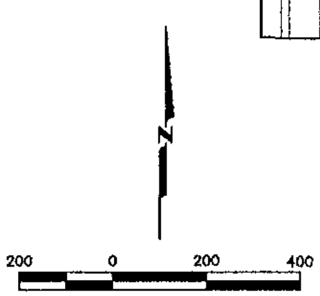
MW-02-01-180

AQUIFER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUIFER)

WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TEST PIT NUMBER



KEY MAP



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366337	23366 0174152			PH
2	12/94	DRAFT FINAL	23366337	23366 0417252			PH
3	10/95	FINAL	23366337	23366 0417251	MLS	10/17/95	PH

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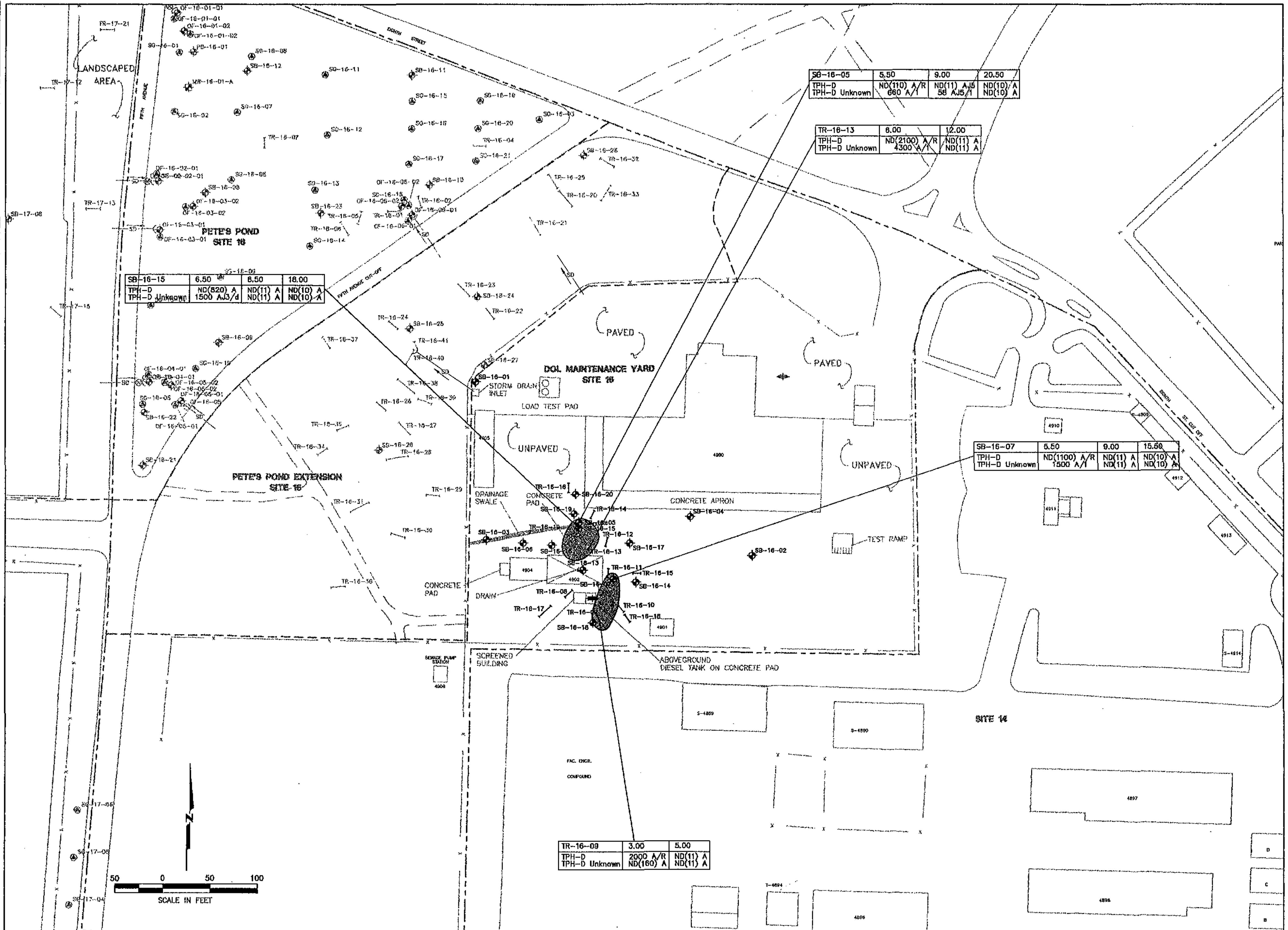
Fort Ord, California

Site Map
Sites 16 and 17

PLATE: 3.1



EXPLANATION

- TEST PIT
- SOIL GAS SAMPLING POINT (HLA)
- SOIL BORING (BY OTHERS)
- MONITORING WELL (HLA)
- SEDIMENT SAMPLE FROM STORM DRAIN OUTFALL PIPE
- FORMER UNDERGROUND STORAGE TANK
- EXISTING ABOVEGROUND STORAGE TANK
- WASH RACK
- OIL/WATER SEPARATOR
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE
- STORM DRAIN LINE
- APPROXIMATE EXTENT OF TPH CONCENTRATIONS (TPH AS DIESEL AND AS UNKNOWN TPH AS DIESEL) GREATER THAN 500 mg/kg

SAMPLE LOCATION — SAMPLE DEPTH IN FEET BELOW GROUND SURFACE

SS-12-03	0.5
TPH-D	26.7 A
TPH -UNKNOWN	16.3 NJ

PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLES 41a AND 41b IN VOL. II-RI, SITES 16 AND 17.

CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM

ANALYTES–ABBREVIATIONS ARE DEFINED IN THE LIST OF ACRONYMS AND ABBREVIATIONS. SEE NOTE.

ND(1.0) NOT DETECTED AT THE REPORTING LIMIT SHOWN IN PARENTHESES

NA NOT ANALYZED

NOTE:

1. THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366363	23366 0417152			PH
2	12/94	DRAFT FINAL	23366363	23366 0417252			PH
3	10/95	FINAL	23366363	23366 0417251	MLS	10/17/95	PH

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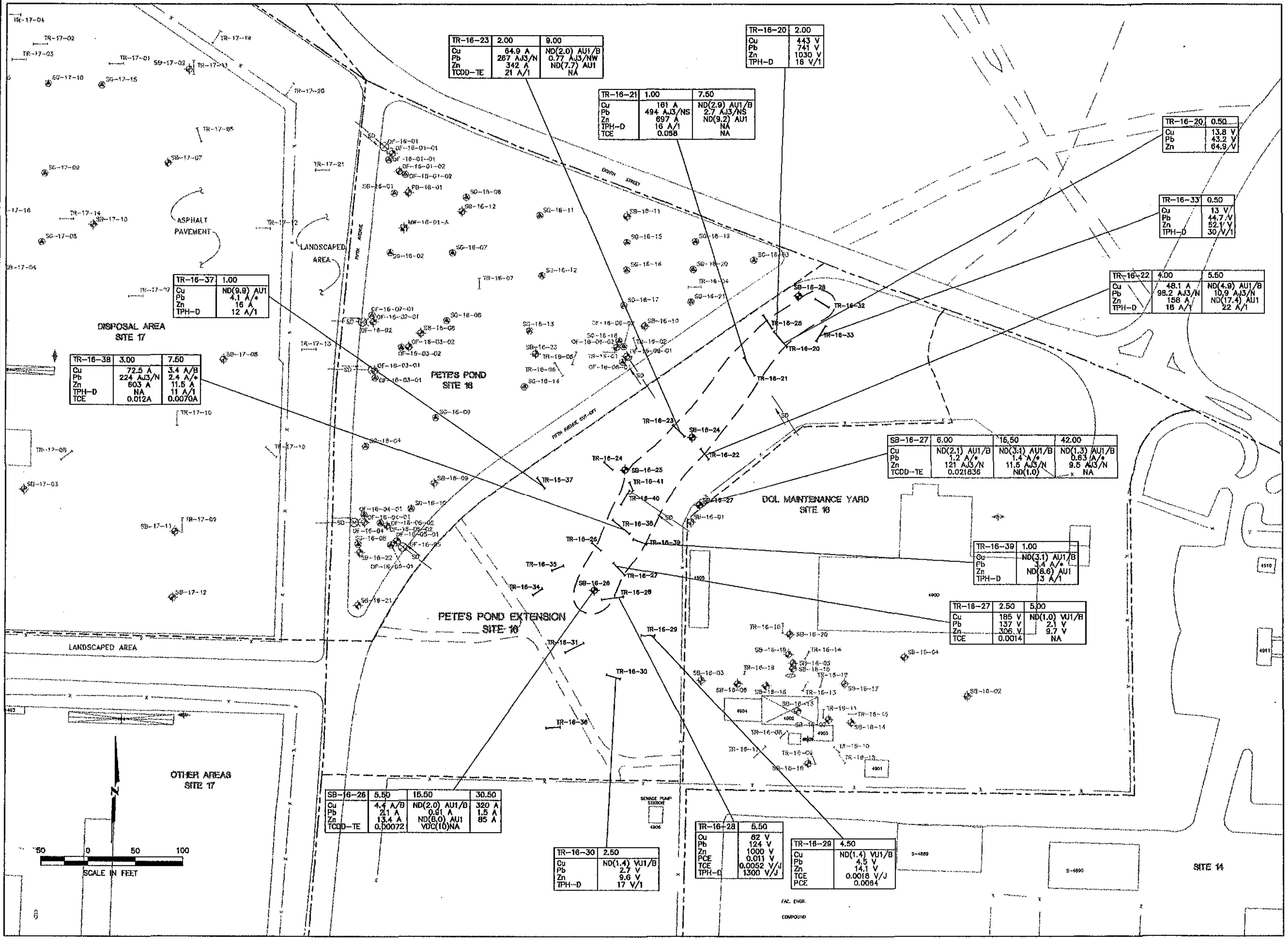
Fort Ord, California

Summary of Remedial Investigation
Distribution of TPH-D and Unknown TPH-D
Concentrations Above 500 ppm
Site 16 – DOL Maintenance Yard

PLATE: **3.2**



EXPLANATION

- TEST PIT
- SOIL GAS SAMPLING POINT (HLA)
- SOIL BORING/PILOT BORING (HLA)
- MONITORING WELL (HLA)
- SEDIMENT SAMPLE FROM STORM DRAIN OUTFALL PIPE
- FORMER UNDERGROUND STORAGE TANK
- EXISTING ABOVEGROUND STORAGE TANK
- WASH RACK
- GREASE RACK
- OIL/WATER SEPARATOR
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE
- STORM DRAIN LINE
- EXTENT OF SUBSURFACE DEBRIS

SAMPLE LOCATION — SAMPLE DEPTH IN FEET BELOW GROUND SURFACE

SS-12-03	0.5
Pb	28.Z A
Zn	16.3 NJ

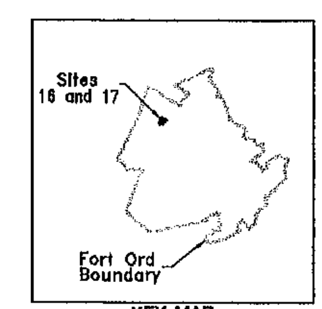
- PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLES 41a AND 41b IN VOL. II-RI, SITES 16 AND 17.
- CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM
- ANALYTES-- ABBREVIATIONS ARE DEFINED IN THE LIST OF ACRONYMS AND ABBREVIATIONS. SEE NOTE.

ND(1.0) NOT DETECTED AT THE REPORTING LIMIT SHOWN IN PARENTHESES

NA NOT ANALYZED

NOTE:

1. THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
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2	12/94	DRAFT FINAL	23366364	23366 0417252			PH
3	10/95	FINAL	23366364	23366 0417251	MLS	10/17/95	PH

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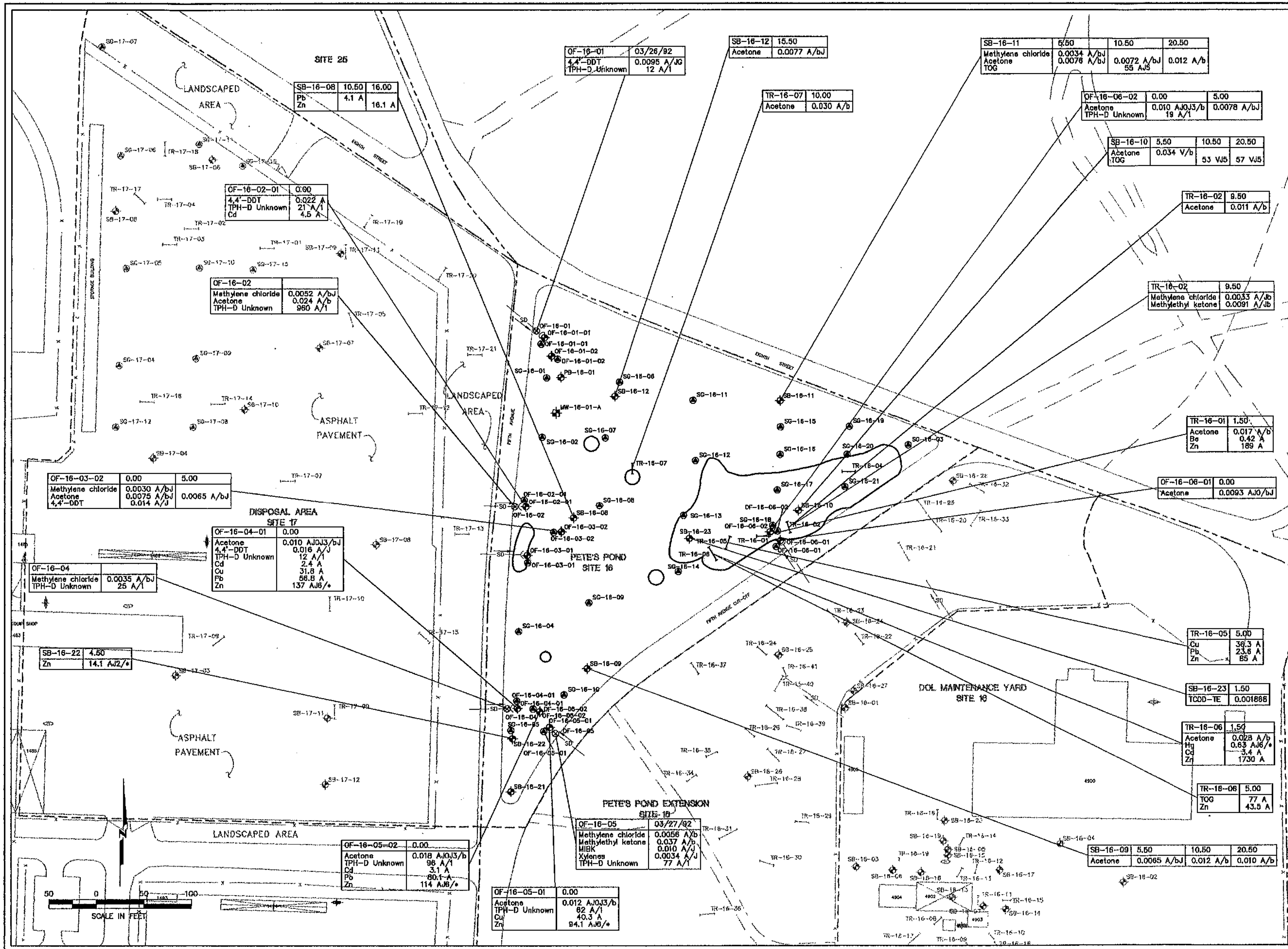
Fort Ord, California

Summary of Remedial Investigation
Distribution of Selected Compounds
Detected In Soil Above Background
Site – 16 Pete's Pond Extension

PLATE: 3.3



EXPLANATION

- TEST PIT
- SOIL GAS SAMPLING POINT (HLA)
- SOIL BORING/PILOT BORING (HLA)
- MONITORING WELL (HLA)
- SEDIMENT SAMPLE FROM STORM DRAIN OUTFALL PIPE
- FORMER UNDERGROUND STORAGE TANK
- EXISTING ABOVEGROUND STORAGE TANK
- WASH RACK
- GREASE RACK
- OIL/WATER SEPARATOR
- SITE BOUNDARY
- AREA BOUNDARY
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE
- STORM DRAIN LINE
- EXTENT OF SUBSURFACE DEBRIS AS DEFINED WITH TRENCH LOGS AND GEOPHYSICAL ANOMALIES

SAMPLE LOCATION — SAMPLE DEPTH IN FEET BELOW GROUND SURFACE

SS-12-03	0.5
Pb	28.2 A
Zn	16.3 NJ

PROJECT AND LABORATORY QUALIFIERS ARE DEFINED IN TABLES 41a AND 41b IN VOL. II-RI, SITES 16 AND 17.

CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM EXCEPT FOR TCDD-TE (IN MICROGRAMS PER KILOGRAM)

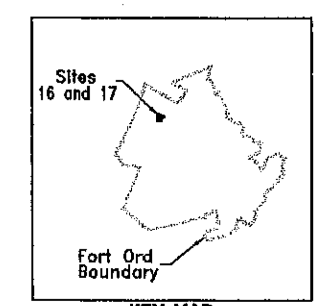
ANALYTES—ABBREVIATIONS ARE DEFINED IN THE LIST OF ACRONYMS AND ABBREVIATIONS. SEE NOTES.

ND(1.0) NOT DETECTED AT THE REPORTING LIMIT SHOWN IN PARENTHESES

NA NOT ANALYZED

NOTES:

1. INCLUDES ALL INORGANICS EXCEEDING MAXIMUM BACKGROUND CONCENTRATIONS, DETECTED CONCENTRATIONS OF INORGANICS FOR WHICH BACKGROUND CONCENTRATIONS ARE NOT AVAILABLE, AND ALL DETECTED ORGANICS.
2. NONCARCINOGENIC PAHS ARE PRESENTED AS A SUMMED TOTAL, DIOXINS AND FURANS AS A TCDD TOXIC EQUIVALENT (TCDD-TE), AND CARCINOGENIC PAHS AS A BENZO(A)PYRENE TOXIC EQUIVALENT (B(a)P-TE).



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
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2	12/94	DRAFT FINAL	23366322	23366 0417252			PH
3	10/95	FINAL	23366322	23366 0417251	MLS	10/17/95	PH

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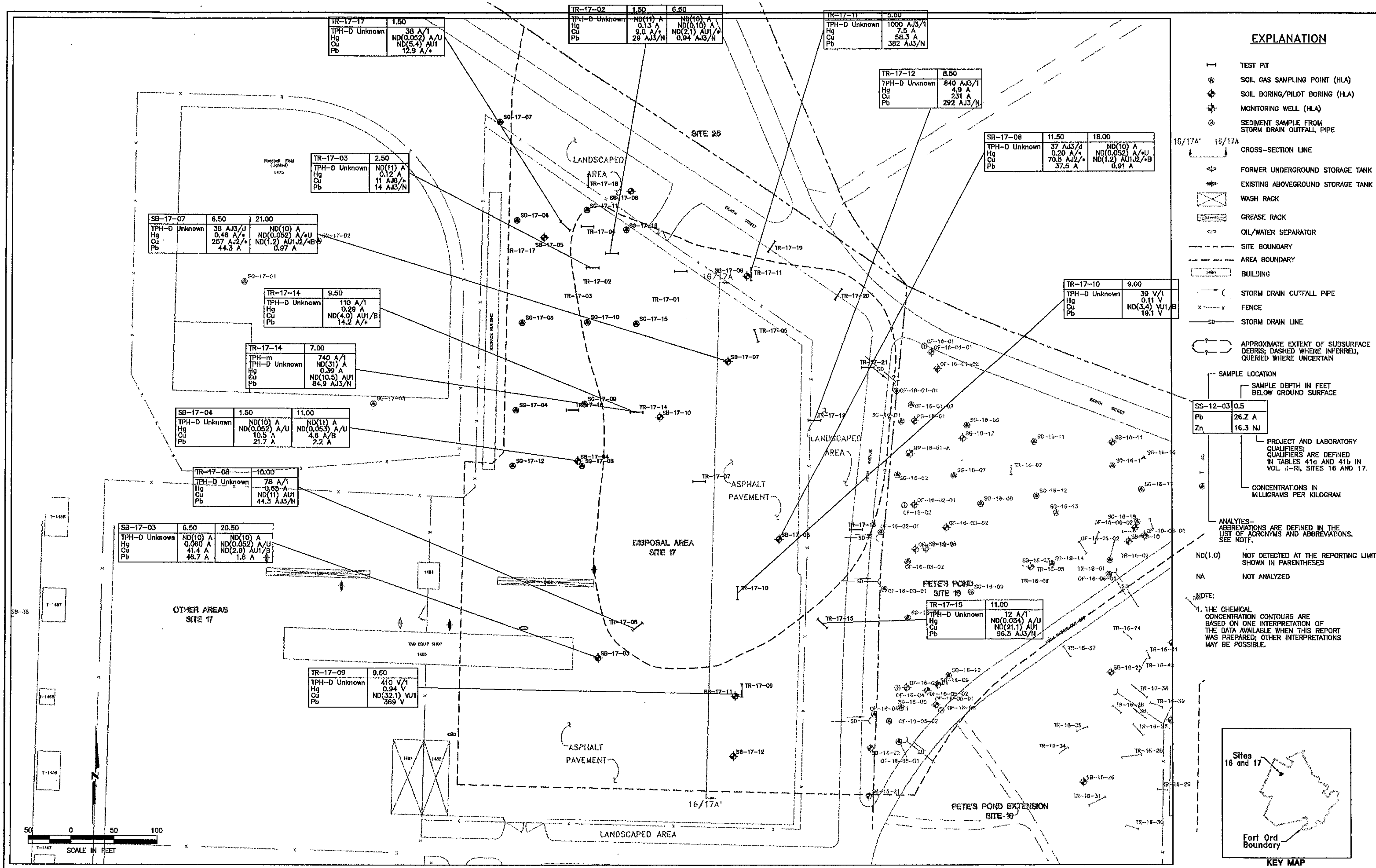
Fort Ord, California

Summary of Remedial Investigation
Distribution of Selected Organic and Inorganic Compounds Detected in Soil and Sediment Above Background, Site 16 – Pete's Pond

PLATE: **3.4**



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
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2	12/94	DRAFT FINAL	23366365	23366 0417252			PH
3	10/95	FINAL	23366365	23366 0417251	MCS	10/17/95	PH

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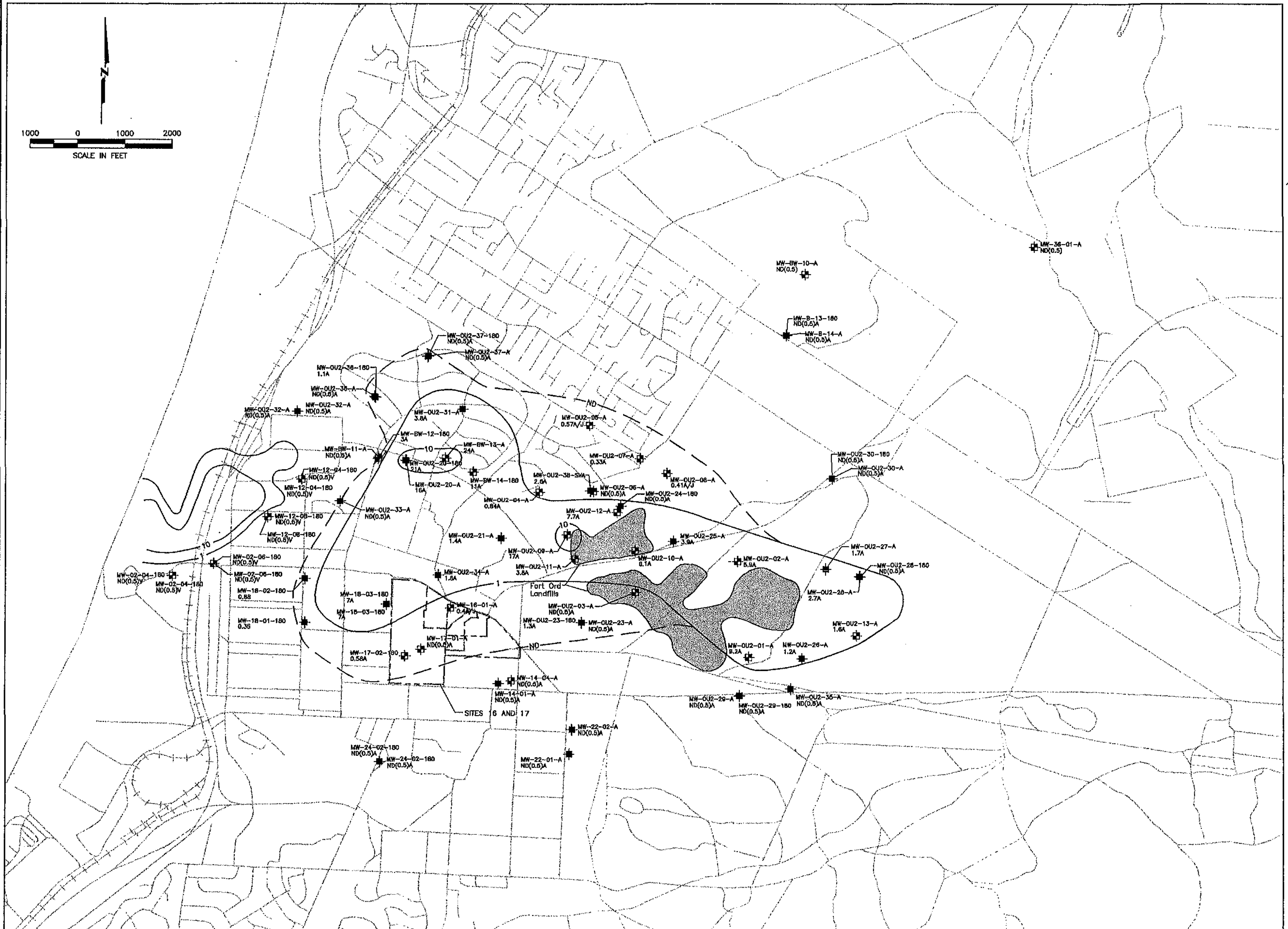
Summary of Remedial Investigation
Distribution of Selected Organic and Inorganic Compounds Detected in Soil Above Background, Site - 17 Disposal Area

PLATE: 3.5



EXPLANATION

- HLA MONITORING WELL
- NON-HLA MONITORING WELL
- INACTIVE WATER-SUPPLY WELL
- ACTIVE WATER-SUPPLY WELL
- APPROXIMATE EDGE OF FORT ORD-SALINAS VALLEY AQUICLUDE BOUNDARY, QUERIED WHERE UNCERTAIN
- —10— CHEMICAL CONCENTRATION CONTOUR IN µg/l DASHED WHERE INFERRED
- —ND— APPROXIMATE LIMITS OF OU-2 GROUNDWATER PLUME FOR BOTH THE A AND THE 180 FOOT AQUIFER
- ND(0.5) NOT DETECTED AT THE REPORTING LIMIT SHOWN IN PARENTHESES
- 24 A CONCENTRATION OF TCE IN µg/l WITH HLA QUALIFIER
- APPROXIMATE EXTENT OF FORT ORD LANDFILLS. DAMES AND MOORE, APRIL 8, 1994

NOTE: THE CHEMICAL CONCENTRATION CONTOURS ARE BASED ON ONE INTERPRETATION OF THE DATA AVAILABLE WHEN THIS REPORT WAS PREPARED; OTHER INTERPRETATIONS MAY BE POSSIBLE.

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	12/94	DRAFT	23366671	23366 0417252			PH
2	12/94	DRAFT FINAL	23366671	23366 0417252			PH
3	10/95	FINAL	23366671	23366 0417251	NLS	10/17/95	PH

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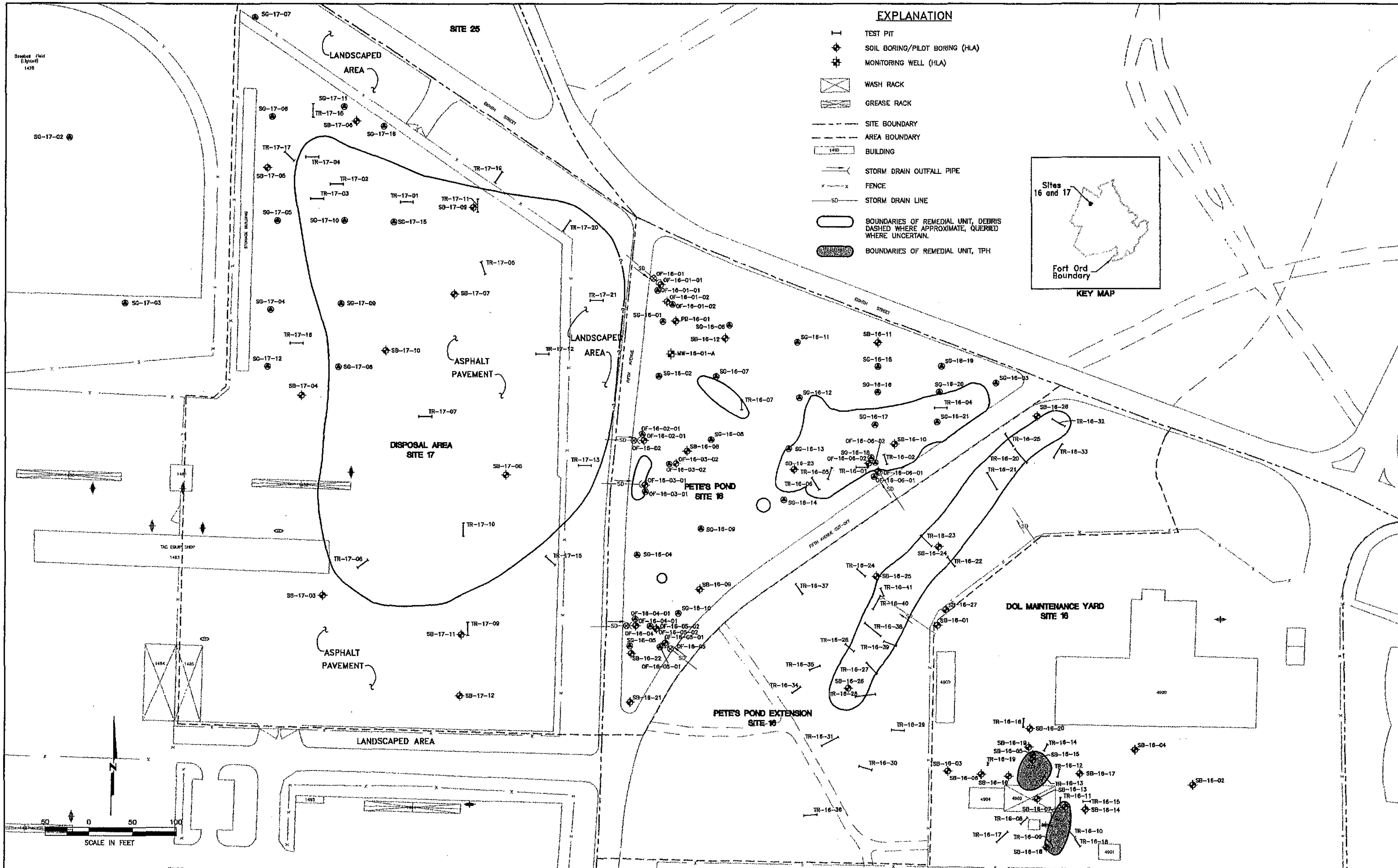
Basewide FI/FS
Fort Ord, California

A-Aquifer and Upper 180-Foot Aquifer
OU-2 Groundwater Plume
February - March 1994

PLATE: **3.6**



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366348	23366 0417152			PH
2	12/94	DRAFT FINAL	23366348	23366 0417252			PH
3	10/95	FINAL	23366348	23366 0417251	MLS	10/17/95	PH

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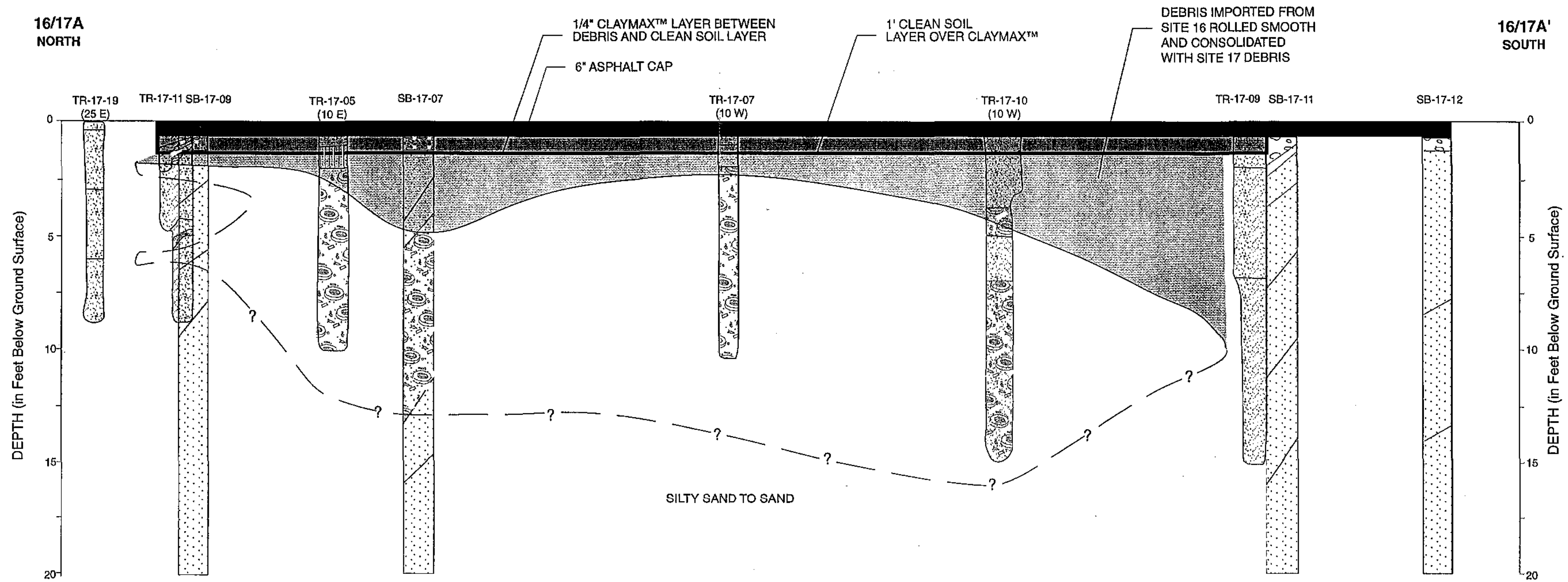
Basewide RI/FS
Fort Ord, California

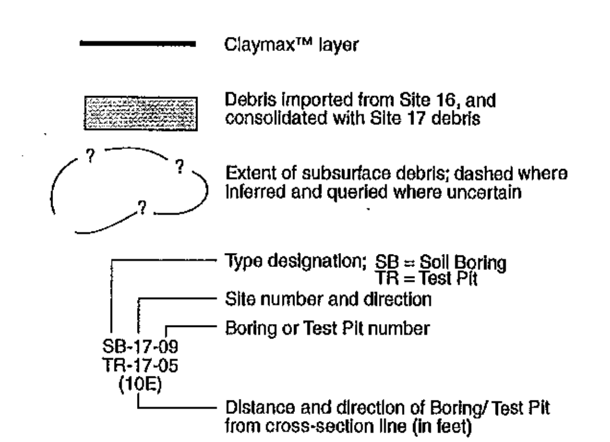
Remedial Units
Sites 16 and 17

PLATE: 3.7



Vertical Scale 1" = 5'
Horizontal Scale 1" = 50'
Vertical exaggeration =10

NOTE: Topographic surface presented on this plate



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	6/94	DRAFT	340 050394DJP	23366 0417152			AG
	12/94	DRAFT FINAL		23366 0417252			
	10/95	FINAL		23366 0417252	MLS	10/17/95	

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Fort Ord, California

CROSS SECTION 16/17A - 16/17A' FOR ALTERNATIVE 3
CONSOLIDATION AND CONTAINMENT OF DEBRIS
SITE 17 - DESPOSAL AREA

DRAWING
3.8

APPENDIX 3A

REMEDIAL TECHNOLOGY SCREENING (RTS) CHECKLIST AND SUMMARY REVIEWS

APPENDIX 3A

The attached matrix guide/checklists in this Appendix are taken from the *Draft Remedial Technology Screening (RTS) Report, Fort Ord, California*, dated February 9, 1994. These forms were annotated for the wastes present at Sites 16 and 17. These checklists refer to remedial technology screening tables (Tables 1 to 22), which can be found in the RTS report. These RTS tables were developed specifically for Fort Ord on a basewide level to accelerate the preparation of Fort Ord Feasibility Studies. As described in the main text of this Sites 16 and 17 Feasibility Study (FS), all technologies identified as applicable from the appropriate RTS tables were incorporated into Tables 3.5 and 3.6 of this FS. Section 3.2 of this report describes how these standard RTS technologies were then screened for specific conditions at Sites 16 and 17.

- Form A-1 identifies the appropriate RTS tables based on site-specific chemicals and the media affected. Separate in situ and ex situ categories are presented for soil, and only one category for debris. Based on this form, RTS Tables 5, 6, and 12 were identified as applicable for Sites 16 and 17.

- Forms A-2 and A-3 list the retained technologies identified from RTS Tables 5, 6, and 12 identified on Form A-1, for soil and debris, respectively. These technologies were incorporated into Table 3.5 and 3.6 of this FS for further site-specific screening and evaluation.

Appendix 3A

Form A-1

Matrix Guide/Checklist - Sites 16 and 17
Identification of Technology Screening Tables
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Locate Group of Compounds below in rows (A) through (F): Check One.	A ☐ B ☐ C ☒ D ☐ E ☐ F ☐
In what media are the compounds? Locate the appropriate column (#) for either soil, groundwater, or debris.	Soil (1&2) ☒ Groundwater (3&4) ☐ Debris (5) ☒
Are both in situ and ex situ treatment potentially applicable for soil or groundwater at this site? Locate in situ, ex situ, or both types of treatment in columns (1) through (4).	1 ☒ 2 ☒ 3 ☐ 4 ☐
Where compound, media, and type of treatment intersect, refer to the technology screening table number indicated. Use Forms B-2, B-3, or B-4 to record applicable technologies as tables are reviewed.	Table(s) 5 6 12** ___ ___

Media	Soil		Groundwater		Debris
Classes of Compounds	(1) In Situ	(2) Ex Situ	(3) In Situ	(4) Ex Situ	(5) *
(A) VOCs	Table 1	Table 2	Table 13	Table 14	Table 12
(B) TPH-light	Table 3	Table 4	Table 15	Table 16	
(C) TPH-heavy	Table 5	Table 6	Table 17	Table 18	
(D) Metals	Table 7	Table 8	Table 19	Table 20	
(E) Pesticides	Table 9	Table 10	Table 21	Table 22	
(F) Mixed Waste +	Table 11		Table 23		

* Debris is not specific to a Group of Compounds

\+ Mixed waste is two or more dissimilar Groups of Compounds combined in soil or groundwater, such as metals and VOCs.

** Tables 5 and 6 are from RTS and have been combined into Table 3.5 in this F.S. Table 12 from the RTS is Table 3.6 in this F.S.

Appendix 3A

Form A-3

Debris Technology Screening Summary Form - Sites 16 and 17
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

INSTRUCTIONS: For single Groups of Compounds in soil or groundwater, or for mixed waste, see Forms B-2 and B-4, respectively. Complete separate forms if necessary for different types of debris (e.g., one form for live ammunition and unexploded ordnance, and a separate form for household refuse and appliances).

- Name of Site: Site 17 Disposal Area, Pete's Pond, Pete's Pond Extension
- Brief Description: Buried waste to 15 feet
- Type of Debris (select one category, one or more type of debris)

Household refuse	____
Appliances	____
Scrap metal	____
Scrap lumber	____
Glass	
Medical debris	X
Incinerator ash	____
Spent ammunition	____
Live ammunition	____
Unexploded ordinance	X

- Group of Compounds (if detected within debris) VOCs ____ TPH-light ____ TPH-heavy X
  Metals X Pesticides X
- Referenced Table(s) Number 12
- Technologies Retained

  Excavation

Sterilization	Containment - Multilayered
Debris Separation	Asphalt or Concrete
Offsite Disposal	Excavation
Onsite Disposal	Surface Water Control

- Form Completed by: Peggy Llewellyn
- Description of Technology(s) (Appendix C) Reviewed by: ____________
- Date Completed: June 10, 1994

APPENDIX 3B

REMEDIAL ALTERNATIVE COST ESTIMATES

Appendix 3B

Assumptions for Cost Estimates

Ford Ord Sites 16 and 17 Feasibility Study

GENERAL ASSUMPTIONS

- Mobilization includes mobilization of equipment, materials, temporary construction facilities, and PPE for workers.

- Dust control and air monitoring includes one water truck with operator, and three samples for dust particulates per day for Alternatives 3 and 4.

- Existing well on Pete's Pond (Site 16) will remain for monitoring groundwater for Alternatives 1, 2, and 3.

- Demolition includes wash racks, storage building, and Tac. Equipment Shop for Alternatives 3 and 4.

- UXO/OEW clearance is required for Alternatives 2, 3, and 4. Item may require surface and sub-surface investigation. Excavation of debris will be performed by UXO/OEW contractor at a rate of $20.00 per cubic yard.

- Monitoring wells will be constructed to monitor groundwater up and downgradient of impacted soil or debris that is left onsite. Monitoring will be conducted quarterly for 3 years for Alternatives 1, 2, and 3.

- Clearing & Grubbing includes removal, cut, chip, grub stumps, remove and reset of small trees.

- It is estimated that approximately 100 individual sensitive or endangered plants currently exist at Pete's Pond and Pete's Pond Extension; an actual survey will be conducted prior to construction activities.

- Asphalt removal and replacement is considered for Alternatives 3 and 4 on Site 17. It assumes that existing asphalt and subbase can be reused for replacement of the new pavement.

- Contingency is assumed to be 15 percent of the capital cost, excluding disposal costs.

- Design Engineering is assumed to be 10 percent of construction costs for Alternatives 1, 2, and 3. Because of the higher cost and simpler design of Alternative 4, design engineering is assumed to be 5 percent for Alternative 4.

- Permitting is assumed to be 2 percent of construction costs.

- Construction management is assumed to be 10 percent of construction costs. Because of the higher cost and simpler design of Alternative 4, construction management is assumed to be 5 percent for Alternative 4.

ALTERNATIVE 1:

- Groundwater would be monitored from six proposed wells.

ALTERNATIVE 2:

- A double layer Claymax™ cover, with 2 feet of clean soil cover to allow vegetation growth will be used for Pete's Pond and Pete's Pond Extension so that these areas can remain open space areas.

- The existing asphalt pavement at the DOL Maintenance Yard and Site 17 Disposal Area will be enhanced with 2 inches of additional asphalt concrete and a seal coat. Areas currently not paved at the DOL Maintenance Yard will be paved with 4 inches of asphalt base and 6 inches of asphalt concrete.

- Drainage is considered a lump sum item which includes removal and resetting of existing manholes, and storm drain and sanitary sewer inlets and lines. V-gutter is proposed along the northern boundary of Sites 16 and 17 for storm drain collection and diversion. Cost also includes materials.

ALTERNATIVE 3:

- Debris in Pete's Pond, Pete's Pond Extension, and the landscaped areas of Site 17 Disposal Area will be placed under asphalt paved area at Site 17 Disposal Area.

- Excavation includes removal and stockpiling of clean soil above the debris at Site 17 Disposal Area and excavation and placement of debris from Site 16 into Site 17 Disposal Area, and backfilling the Site 16 excavations with clean soil overburden from Site 17 Disposal Area. This results in a completely balanced site with no import or soil disposal items.

- Excavation near building on DOL Maintenance Yard on Site 16 may require shoring to protect the building; shoring costs are not included.

- Excavations deeper than 6 feet will have sloped sides.

- Cost used for soil treatment at the FOSTA were estimated at $60/cubic yard.

- The haul distance from the DOL Maintenance Yard to the FOSTA is estimated to be 5 miles round trip.

ALTERNATIVE 4:

- This alternative assumes that the debris from Sites 16 and 17 will be excavated and screened onsite.

- It is estimated that 50 percent of the material screened will be actual debris with the remaining portion clean sand. This is based on a weighted average of 30 percent debris from Pete's Pond and Pete's Pond Extension and 60 percent from the Site 17 Disposal Area.

- Screened and sterilized debris will be taken to the OU 2 Landfill in Fort Ord, California. The distance between Site 17 and the OU 2 Landfill is estimated at 20 miles round trip.

- One sample per 100 cubic yards of the screened sand will be collected and analyzed to verify that the sand is clean and can be used as clean backfill in the excavations.

- Soil excavated from the DOL Maintenance Yard will be treated at the FOSTA. Assumptions are the same as those for the TPH-contaminated soil for Alternative 3.

Table 3B-1. Alternative 1 - Cost Estimate- Sites 16 and 17
Volume V - Feasibility Study - Basewide RI/FS
Fort Ord, California

ITEM DESCRIPTION	QUANITY	UNIT	UNIT PRICE	TOTAL
CAPITAL COSTS				
Install Monitoring Wells	3	wells	$5,000	$15,000
Total Construction Costs				$15,000
Design Engineering	10%	of construction		$1,500
Prefield activities	2%	of construction		$300
Construction Management	10%	of construction		$1,500
Subtotal Capital Costs				$18,300
Contingency - 15%				$2,300
Total Capital Costs				$20,600
OPERATION & MAINTENTANCE				
Quarterly Monitoring (6 wells 4 times a year)				
Analytical	24	wells	$1,250	$30,000
HLA Field Labor & Equip	8	days	$1,150	$9,200
Reporting	4	report	$2,500	$10,000
Quarterly Cost				$49,200
Total Annual O & M Costs				$49,200
Net Present Value of O&M and Capital Cost for 30 years at 5% per year				$774,000

Note: These costs are for comparision purposes only, and are intended to have an estimated accuracy of only +50% to -30%. Many design variables and prefield activities have not been established. Construction cost estimates will be refined after system design is complete.

Table 3B-2. Alternative 2 - Cost Estimate- Sites 16 and 17
Volume V - Feasibility Study - Basewide RI/FS
Fort Ord, California

ITEM DESCRIPTION	QUANITY	UNIT	UNIT PRICE	TOTAL
CAPITAL COSTS				
Setup				
Mobilization/Demobilization	1	lump sum	$30,000	$30,000
Abandoning Monitoring Wells	1	lump sum	$5,000	$5,000
Transplanting Sensitive Plants	100	each	$5	$500
UXO Clearance	6.7	acre	$5,000	$33,500
Demolition	17000	sf	$2	$34,000
Clearing & Grubbing	6.7	acre	$4,000	$26,800
				$0
Capping				$0
Drainage Deversion (Pete's Pond)	1	lump sum	$36,000	$36,000
Grading	4000	cy	$10	$40,000
Import (claymax cover & positive drainage)	4000	cy	$17	$68,000
Claymax Cover	300000	sf	$1	$300,000
6" Subbase & 4" Asphalt Cover (Unpaved DOL)	2500	sy	$17	$42,500
2" Additional Asphalt- Currently paved areas	15180	sy	$5	$75,900
				$0
Site Restoration				$0
Install Monitoring Wells	3	wells	$5,000	$15,000
Landscaping	150000	sf	$1	$150,000
Plant restoration	100	each	$5	$500
Total Construction Costs				$857,700
				$774,000
Design Engineering	10%	of construction		$85,800
Prefield activities	2%	of construction		$17,200
Construction Management	10%	of construction		$85,800
Subtotal Capital Costs				$1,046,500
				$1,923,500
Contingency - 15%				$128,700
Total Capital Costs				$1,175,200
OPERATION & MAINTENTANCE				
Quarterly Monitoring (6 wells 4 times a year)				
Analytical	24	wells	$1,250	$30,000
HLA Field Labor & Equip	8	days	$1,150	$9,200
Reporting	4	report	$2,500	$10,000
Quarterly Cost				$49,200
Annual Cap Inspection Cost & Report	1	lump sum	$4,000	$4,000
Total Annual O & M Costs				$53,200
Net Present Value of O&M and Capital Cost for 30 years at 5% per year				$1,804,000

Note: These costs are for comparision purposes only, and are intended to have an estimated accuracy of only +50% to -30%. Many design variables and prefield activities have not been established. Construction cost estimates will be refined after system design is complete.

Table 3B-3. Alternative 3 - Cost Estimate- Sites 16 and 17
Volume V - Feasibility Study - Basewide RI/FS
Fort Ord, California

ITEM DESCRIPTION	QUANITY	UNITS	UNIT PRICE	TOTAL
CAPITAL COSTS				
Setup				
Mobilization	1	lump sum	$30,000	$30,000
Abandoning Monitoring Wells	1	lump sum	$5,000	$5,000
Transplanting Sensitive Plants	100	each	$5	$500
UXO Clearance	6.7	acre	$5,000	$33,500
Demolition	17000	sf	$2	$34,000
Clearing & Grubbing	6.7	acre	$4,000	$26,800
Asphalt Remvoal	30150	sy	$4	$120,600
Excavation & Treatment - DOL Maintenance Yard				
Excavation	1100	cy	$7	$7,700
Dust Control	5	days	$500	$2,500
Soil Testing - Confirmation/Characterization	20	each	$500	$10,000
Treating Soil at the FOSTA	1100	cy	$60	$66,000
Import & Compact Backfill	1100	cy	$20	$22,000
Restore Asphalt Pavement	2400	sy	$7	$16,800
Excavation & Consolidation - Debris to Site 17 Disposal Area				
Excavation/Hauling/ Both ways	5200	cy	$20	$104,000
Excavation /Hauling - Clean overburden	5200	cy	$5	$26,000
Dust Control and Air Monitoring	25	days	$500	$12,500
Compaction	10500	cy	$2	$21,000
Single layer of Claymax	160000	sf	$1	$160,000
Restore Asphalt Pavement	2800	sy	$7	$19,600
Site Restoration				
Install Monitoring Wells	3	wells	$5,000	$15,000
Landscaping	150000	sf	$1	$150,000
Plant restoration	100	each	$5	$500
Total Construction Costs				$884,000
Design Engineering	10%	of construction		$88,400
Prefield activities	2%	of construction		$17,700
Construction Management	10%	of construction		$88,400
Subtotal Capital Costs				$1,078,500
Contingency - 15%				$132,600
Total Capital Costs				$1,211,100
OPERATION & MAINTENTANCE				
Quarterly Monitoring (3 wells 4 times a year)				
Analytical	12	well	$1,250	$15,000
HLA Field Labor & Equip	8	days	$1,150	$9,200
Reporting	4	report	$2,500	$10,000
Quarterly Cost				$34,200
Annual Cap Inspection Cost & Report	1	lump sum	$4,000	$4,000
Total Annual O & M Costs				$38,200
Net Present Value of O&M and Capital Cost for 30 years at 5% per year				$1,604,000

Note: These costs are for comparision purposes only, and are intended to have an estimated accruacy of only +50% to -30%. Many design variables and prefield activities have not been established. Construction cost estimates will be refined after system design is complete.

Table 3B-4. Alternative 4 - Cost Estimate- Sites 16 and 17
Volume V - Feasibility Study - Basewide RI/FS
Fort Ord, California

ITEM DESCRIPTION	QUANITY	UNITS	UNIT PRICE	TOTAL
CAPITAL COSTS				
Setup				
Mobilization	1	lump sum	$30,000	$30,000
Abandoning Monitoring Wells	1	lump sum	$5,000	$5,000
Transplanting Sensitive Plants	100	each	$5	$500
UXO Clearance	6.7	acre	$5,000	$33,500
Demolition	17000	sf	$2	$34,000
Clearing & Grubbing	6.7	acre	$4,000	$26,800
Asphalt Remvoal	30150	sy	$4	$120,600
Excavation & Treatment - DOL Maintenance Yard				
Excavation	1100	cy	$5	$5,500
Dust Control and Air Monitoring	5	days	$500	$2,500
Soil Testing - Confirmation/Characterization	20	each	$500	$10,000
Import & Compact Backfill	1100	cy	$20	$22,000
Transporation & Treatment at the FOSTA	1100	cy	$60	$66,000
Restore Asphalt Pavement	2400	sy	$7	$16,800
Excavation/Screening/Sterilizing/Onsite Disposal - Debris				
Excavation	67500	cy	$20	$1,350,000
Dust Control and Air Monitoring	50	days	$500	$25,000
Screening	67500	cy	$12	$810,000
Sterilizing	36500	cy	$10	$365,000
Soil Testing of Screened Soil for backfill	365	each	$500	$182,500
Transportation & Disposal of Debris	36500	cy	$6	$219,000
Import	36500	cy	$6	$219,000
Spread/Compact Fill	67500	cy	$2	$135,000
Restore Asphalt Pavement	28000	sy	$7	$196,000
Site Restoration				
Install Monitoring Wells	1	wells	$5,000	$5,000
Landscaping	150000	sf	$1	$150,000
Plant restoration	100	each	$5	$500
Total Construction Costs				$4,030,200
Design Engineering	5%	of construction		$201,500
Prefield activities	2%	of construction		$80,600
Construction Management	5%	of construction		$201,500
Subtotal Capital Costs				$4,513,800
Contingency - 15%				$644,200
Total Capital Costs				$5,158,000
Net Present Value of O&M and Capital Cost for 30 years at 5% per year				$5,158,000

Note: These costs are for comparision purposes only, and are intended to have an estimated accuracy of only +50% to -30%. Many design variables and prefield activities have not been established. Construction cost estimates will be refined after system design is complete.

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

Volume V - Feasibility Study

Section 4.0 - Site 3

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Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

Volume V - Feasibility Study

Sites 3

HLA Project No. 23366 0417353

This final version of the Site 3 Feasibility Study addresses comments received on the Draft Final version of the report dated December 1994. Responses to agency comments on the Draft Final report are included in Volume VI of this report.

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

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4.0 FEASIBILITY STUDY FOR SITE 3

4.1 Background

4.1.1 Physical Description

Site 3 extends approximately 3.2 miles (780 acres) along the coastline of Monterey Bay and forms a portion of the western boundary of Fort Ord. The site is bordered to the south by Sand City, to the north by the city of Marina, to the west by Monterey Bay, and to the east by the trainfire range access road and Highway 1 (Plate 4.1). Small arms firing ranges, numbered 1 through 17, are scattered along the eastern half of the site (Plate 4.2). No firing ranges are numbered 10 or 13. In general, trainees fired from firing lines in the eastern portion of the site toward targets spaced at varying intervals to the west. Spent bullets accumulated on the east-facing (leeward) sides of the sand dunes that formed "backstops" for the targets. A former ammunition storage area is between Ranges 3 and 4. The area west of the dunes is an undeveloped beach.

Most of the surface area of Site 3 is unpaved and vegetated, with dune sand present at the surface. The predominant topography (i.e., numerous, intersecting rolling hills) of Site 3 reflects a morphology typical of the dune sand deposits that underlie the site. The bases of the dunes begin at an elevation of approximately 40 feet above mean sea level (MSL); the maximum elevation of the dunes is approximately 150 feet MSL. The dunes are truncated to the west by steep cliffs formed as a result of waves and winter storms. The cliffs are up to 40 feet high above the beach.

Stilwell Hall and two sewage treatment plants are the main structures onsite. Stilwell Hall, in the central part of Site 3 and formerly used as a recreation center, was 200 to 300 feet from the shoreline when it was built in the 1940s. However, natural forces have eroded the shoreline cliffs so that Stilwell Hall is now adjacent to the shoreline. A seawall was constructed to protect the structure from the encroaching surf. The Ord Village Sewage Treatment Plant (STP) and the Main Garrison STP are within Site 3 but are not considered part of this site (Plate 4.1). Instead, these STPs are being investigated separately as Sites 1 and 2, respectively. Sewage is no longer treated at these plants, but instead is pumped from Site 1 and gravity fed from Site 2 to the Monterey Regional Treatment Plant (MRTP) in the city of Marina.

Seven storm drain outfalls, which collect stormwater from the Main Garrison area of Fort Ord, discharge to either the dune area or the intertidal zone of the site. Three of the storm drains discharge to the dunes near Ranges 8 and 11 and Site 1. The other four storm drain outfalls discharge to Monterey Bay in the surf zone along Site 3 (Plate 4.4). The storm drain outfalls are being investigated as part of the Basewide Surface Water Outfall Investigation (BWSWOI). Storm drain outfalls at Site 3 require no action under CERCLA; however, monitoring of future discharges is required and will be performed under the Basewide Storm Water Outfall Monitoring Program. The Army and future users of the site will determine whether removal of the outfalls or diversion of stormwater will be undertaken.

4.1.2 History

Site 3 was used for small arms trainfire beginning in the 1940s. Trainees fired small-caliber hand-held weapons at targets near the leeward dune faces. According to Mr. Roy Durham, the director of Fort Ord Range Control, all of the target ranges were used before 1975, Ranges 1 through 8 have been used since 1975, with Range 8 receiving the heaviest and most recent use. During training activities, cartridges were routinely collected for reuse. No routine efforts were made to collect the spent ammunition. However, in 1976 and 1977, several hundred pounds of spent ammunition were recovered at Ranges 15 and 16 by a Fort Ord contractor, with little disturbance to the dunes (*EA, 1991a*). This is the only known remedial activity at Site 3.

4.1.3 Proposed Reuse

Site 3 is proposed for reuse as a state park consisting mostly of open space (*FORA, December 14, 1994*). Preliminary proposed land uses will be reviewed during the state's General Plan process. The sandy beach area is proposed to be used by the public for activities such as wading, surfing, and sunbathing. The coastal dune zone is proposed to be restored and preserved as coastal dune habitat; public access will be limited to boardwalks or hiking trails that provide access to the beach. The disturbed dune zone will also be restored and preserved as coastal dune habitat and will also be the site of visitor service facilities (e.g., trailheads, scenic overlooks, displays). Family campgrounds and day-use facilities are also proposed. Stilwell Hall is proposed for use as a multi-agency visitor center. The former ammunition storage area is proposed to be used for equipment parking and storage. The Site 1 STP is proposed for reuse as a desalination plant. An area encompassing the Site 2 STP is proposed for development as an aquaculture and marine research center or open space area.

4.1.4 Nature and Extent of Contamination

Lead, zinc, antimony, copper, and iron are the primary components of spent ammunition at the site. Lead is the main chemical of potential concern because its concentrations are among the highest and it has a high toxicity relative to the other metals. Where other metals were detected at higher concentrations (e.g., copper and antimony in Test Pit O-9 in Study Area 1 at 0.13 foot), their distribution patterns were similar to that of lead in other test pits (Plates 4.2 and 4.3). Although iron was generally detected most often and at the highest concentrations, it was not considered to be a chemical of concern because it was detected at elevated concentrations in all soil samples (including those collected from the Control Area), it is an essential nutrient, and has a much lower toxicity than does lead.

The highest concentrations of lead were detected where surface coverage of spent ammunition was greater than 10 percent based on visual observations (shown in red on Plate 4.4); in these areas, the lead concentrations in sieved surface soil samples ranged from 457 mg/kg at Test Pit O-9 in Study Area 1 to 46,300 mg/kg at Test Pit I-35 in Study Area 2 (Table 4.1). An encrusted bullet layer was present beneath the surface (0 to 0.25 foot deep) and extended to depths of approximately 1 to 2 feet bgs in most areas when the surface coverage was greater than 10 percent and in some areas where surface coverage was 1 to 10 percent. Lead concentrations in soil samples generally followed the vertical distribution of spent ammunition. Lead concentrations greater than 51.8 mg/kg (maximum background for lead) were generally limited to depths above 2 feet, except where the encrusted bullet layer extended deeper than 2 feet (e.g., Test Pit M-02 in Study Area 1). Concentrations of lead generally decrease by orders of magnitude with depth.

Because the results for both study areas were similar (i.e., no relation to age or usage of the ranges) and because visual mapping was the most effective way to estimate spent ammunition distribution across the site, results of the quantitative sampling in the study areas are applied sitewide.

The occurrence of elevated concentrations of lead only in shallow soil and groundwater data from nearby wells indicate that there is little potential for contamination of the groundwater by lead. The individual investigation tasks are summarized below.

- <u>Spent ammunition distribution</u>: The concentration of spent ammunition is generally highest (10 percent or greater) in a band along the sand dunes, immediately behind the targets. Between the firing lines and the targets and flanking the heavy concentrations of bullets, extending to the tops of the dunes, the concentration of spent ammunition is moderate (1 to 10 percent). Between ranges and from the tops of the dunes to the shoreline (with the exception of blowout areas) the concentrations of spent ammunition decrease to less than 1 percent. Where surface coverage of spent ammunition exceeds 10 percent, an encrusted bullet layer is found at an approximate depth of 0.5 foot and extends to depths between 1.0 to 2.0 feet. In general, no bullets are found beneath the encrusted layer. Where surface concentrations of spent ammunition are low, no bullets were encountered beneath the surface. In each blowout, the amount of spent ammunition is highest in the western portion of the blowout, directly above the shoreline cliff that rises above the beach; the concentrations of lead in the blowouts decrease both landward (eastward) and down the cliff face. No bullets were detected in test pits at the base of the blowouts or in the surf zone.

- Spent ammunition characteristics: The results of analyses of the bullet samples indicate that spent ammunition at the site is composed primarily of copper, lead, iron, zinc, and antimony.

- Extent of contamination in soil: Analytical results for soil samples collected during the RI indicated that concentrations of antimony, copper, chromium, lead, and zinc are above their respective background concentrations. Iron and tin were also detected in the soil samples; background data are not available for these two metals. However, iron was present at similar concentrations in samples from the Control Area, and is thought to be present at site-specific background levels. Hexavalent chromium was not detected in any of the soil samples. Of the detected metals, lead is considered to be the primary chemical of concern on the basis of its concentration, frequency of detection, and toxicity. High concentrations of lead were detected where surface coverage exceeds 10 percent (mostly the dune faces behind the targets), and in two test pits where surface coverage was 1 to 10 percent. Lead concentrations above maximum background (51.8 mg/kg) were generally limited to depths of 2 feet or less, except where the encrusted layer extended deeper than 2 feet; this distribution corresponds to the vertical distribution of spent ammunition. As described in the RI for Site 3 (Volume II), the lateral extent of contamination corresponds, in general, to the distribution of spent ammunition in areas of heavy deposition (approximately 850,000 square feet). Lead concentrations generally decrease by an order of magnitude within a depth of 2 feet and range from 11 to 46,300 mg/kg (Table 4.1).

- Leaching analyses: The results of leaching analyses performed using both rainwater and saltwater applied to soil samples indicate that the highest concentrations of metals may be leached by rainwater (rainwater has a lower pH than saltwater). The leaching procedure is described in the RI (Volume II). For the samples analyzed, lead concentrations in leachate ranged from ND to 76.60 mg/L and decreased with depth corresponding to spent ammunition.

- Air results: Because of highly variable wind conditions, assessment of airborne contaminants that may originate solely from Site 3 was not possible. For the entire area surveyed, which included Site 3, metals detected in air include lead, antimony, and copper.

- Potential groundwater contamination: A groundwater investigation was not conducted as part of the RI. Evaluation of soil sampling data, leaching analysis, and data collected as part of other site investigations (such as groundwater data from Site 2 which falls within the overall boundaries of Site 3) indicates that the potential for groundwater contamination is low. As discussed in the RI for Site 3, a groundwater investigation is not warranted (Volume II).

4.1.5 Summary of Risk Assessments

Potential risks to human health and the environment associated with potentially impacted soil at Site 3 are evaluated in the Baseline Human Health Risk Assessment (BRA) (Volume III) and the Baseline Ecological Risk Assessment (ERA) (Volume IV). These risk assessments numerically quantify the excess risks to human health and evaluate potential effects to the environment posed by the chemicals of potential concern (COPCs) present at the site, in accordance with EPA-approved procedures and modeling protocols. Results of the BRA and ERA are summarized below.

4.1.5.1 Baseline Human Health Risk Assessment

For the BRA, chemical data from Study Areas 1 and 2 were used. It was assumed that the extent and degree of contamination characterized within these two study areas reflect conditions across the entire site. Based on preliminary site investigations conducted by HLA, only a small portion of the surface of Site 3 is heavily or moderately contaminated with spent ammunition (4 and 5 percent, respectively). Approximately 91 percent of the surface at Site 3 is considered only lightly or not at all contaminated. For the purposes of the BRA it was assumed that any human receptor at Site 3 would be exposed to contaminants through either (1) a random walk anywhere throughout any portion of the site, or (2) exclusive visitation of only one of the three bullet distribution areas. To evaluate the random walk exposure scenario, chemical detection data were "transformed" to reflect weighted surface area concentrations (Section 5.2.1, Volume III).

Hypothetical nearby child and adult resident receptors and an onsite park ranger receptor were evaluated in the BRA. All receptors were assumed to be exposed to COPCs via incidental ingestion of soil, dermal contact with soil, and inhalation of dust. Exposure assumptions such as ingestion rate, inhalation rate, and exposure frequency were used to estimate dose via each pathway evaluated, as described in Volume IV, Section 2.2.4. As recommended by EPA, two separate exposure scenarios were evaluated: (1) a reasonable maximum exposure (RME), and (2) an average exposure.

The BRA estimated adverse noncancer health effects associated with exposure to the COPCs identified at Site 3 (i.e., antimony, copper, and lead). Because neither EPA nor Cal/EPA has developed slope factors for any of these COPCs, cancer risks were not estimated. Lead was evaluated separately because of its unique toxicological properties. The results of the BRA based on the two potential site visitation scenarios described above are discussed below.

4.1.5.1.1 Weighted Surface Area

Estimated multipathway hazard indices (HIs) for the nearby resident or the onsite park ranger receptor based on a random walk at Site 3 ranged from 0.000009 to 0.7, below the EPA's threshold level of concern for noncancer adverse health effects. Blood-lead levels estimated for the resident and park ranger receptors ranged from 2.76 to 7.15 μg/dl. All blood-lead levels were below the EPA's 10 μg/dl threshold level of concern (*EPA, 1990e*).

4.1.5.1.2 Bullet Distribution Areas

For the 1 to 10 percent areas, the multipathway HIs for the nearby resident and the onsite park ranger ranged from 0.00003 to 2. Only the RME HIs for the child resident (0 to 6 years) and the park ranger, with HIs of 2 and 1, respectively, exceeded the agency threshold level of concern (1.0) for noncancer adverse health effects. The estimated blood-lead levels for the resident and the park ranger at the 1 to 10 percent area ranged from 2.77 to 89.36 μg/dl. RME residents with estimated 99th percentile blood-lead levels of 89.36 μg/dl (0 to 6 years) and 34.46 μg/dl (6 to 18 years and 18 to 30 years) and the park ranger with a blood-lead level of 34.36 μg/dl exceeded the EPA's 10 μg/dl threshold level of concern (*EPA, 1990e*). Blood-lead levels estimated for all average exposure scenarios in the 1 to 10 percent area were below 10 μg/dl.

For the ≥10 percent area, multipathway HIs for the nearby resident and the onsite park ranger ranged from 0.0004 to 30. Only the HIs for the RME resident receptors, with estimated HIs of 30 (0 to 6 years), 5 (6 to 18 years), and 3 (18 to 30 years), and the park ranger (HI of 16) exceeded agency threshold levels of concern (1.0) for noncancer effects. Estimated blood-lead levels at the ≥10 percent area for the resident or park ranger ranged from 2.79 μg/dl to 177.42 μg/dl. Blood-lead levels estimated for the average resident exposure scenario were all below 10 μg/dl. All evaluated RME residents with estimated 99th percentile blood-lead levels of 177.42 μg/dl (0 to 6 years), and 61.32 (6 to 18 and 18 to 30 years) exceeded the EPA's 10 μg/dl threshold level of concern (*EPA, 1991e)*. For the park ranger, estimated 99th percentile average and RME blood-lead levels of 20.5 μg/dl and 61.32 μg/dl, respectively also exceeded the 10 μg/dl threshold.

4.1.5.1.3 Summary and Conclusions

For the random site walk exposure scenario, HIs estimated for both the nearby resident and the park ranger were all below 1 for antimony and copper. In addition, the results of the lead exposure modeling indicate that exposure to lead would result in estimated blood-lead levels below EPA's 10 μg/dl threshold level of concern (*EPA, 1990e*). Therefore potential adverse health effects are not expected for a random walk at Site 3. If, however, receptors were to limit his or her visits solely to either the 1 to 10 percent or the ≥10 percent bullet distribution areas, estimated HIs and blood-lead levels would exceed agency threshold levels of concern.

It is important to note that the estimation of adverse health effects for those receptors limiting their exposure to both the 1 to 10 percent and the ≥10 percent areas is based on very conservative exposure assumptions. Only 4 and 5 percent of Study Areas 1 and 2 are composed of bullet fragments in the 1 to 10 and the ≥10 percent areas, respectively; therefore the likelihood that human receptors will limit his or her visitation only to that single area is highly improbable. In addition, unlike the ≥10 percent area, HIs and blood-lead levels estimated at the 1 to 10 percent area exceeded agency levels of concern by less than an order of magnitude. HIs and blood-lead levels estimated for the ≥10 percent areas exceeded agency levels of concern by over one order of magnitude, suggesting a greater health concern in this area.

4.1.5.2 Ecological Risk Assessment

For the ERA, chemical data collected in the two study areas and the control area (three areas) were used. Additional surface soil, plant, and mammal data were collected to address potential risks to ecological receptors. Assessment endpoints evaluated at Site 3 include the following:

- Health of the Smith's blue butterfly, an endangered species that lives on buckwheat plants
- Health of the black legless lizard, an endangered species that lives in the leaf litter layer
- Health of mourning doves and their young
- Health of the food base for predators such as foxes and raptors.

In addition, dilution modeling was performed on sediments in stormwater from the four ocean outfalls that lead into the Monterey Bay. The results of the modeling are presented in the ERA (Volume IV) and indicate that no impacts from chemicals of potential concern in stormwater or sediment are anticipated for Monterey Bay.

To evaluate the Smith's blue butterfly, seeds from buckwheat plants and soil were collected and root elongation bioassays were conducted to assess potential impacts to the butterfly's habitat and food source. To evaluate the black legless lizard, soil data were analyzed and leachate tests were conducted on bullets to assess potential bioavailability of chemicals in the near-surface soil layer. To evaluate mourning doves, leachate results were used to assess potential bioavailability of metals in bullet fragments that may be ingested and be incorporated into "crop milk." To evaluate the predator food base, deer mice, which serve as a food source for predators, were collected from each of the three areas and analyzed to assess potential exposures of predators to chemicals in the deer mice. Exposure assumptions such as home range size and ingestion rates were used to estimate doses for direct ingestion of soil, dermal contact with soil, and ingestion of food items (e.g., deer mice), as described in Volume IV, Section 5.0. A very conservative scenario was evaluated as recommended by EPA. These assumptions were modified based on biota data, as discussed in Volume IV, Section 6.0.

The ERA estimated potential adverse ecological effects associated with exposure to soil lead concentrations in high bullet density cover areas. The results of the ERA indicate that:

- For the Smith's blue butterfly, bullet densities of less than 10 percent by volume did not impact the germination or growth of buckwheat plants. Bullet densities greater than 10 percent resulted in decreased growth for some, but not all, buckwheat plants.

- For the black legless lizard and dove, results of leaching tests using synthetic rainwater indicate that less than 0.1 percent of the chemicals in bullets are readily leachable, and thus bioavailable to the lizard or dove.

- Because doves are not expected to nest in the area, and any foraging in impacted areas is considered minimal, chemical exposure from lead at Site 3 for a dove and its brood is not considered to be a significant exposure pathway.

- For the predator food base, results of deer mice analyses indicate that lead is present in tissues above background tissue levels.

Buckwheat plants grow in all three areas of Site 3, including the greater than 10 percent areas. The buckwheat plants growing in these areas of high density bullet distribution may be stressed, leading to decreased growth. Because the Smith's blue butterfly moves from plant to plant during its lifetime, it is unlikely that this decreased rate of plant growth seen in some plants is posing a threat to the continued survival of the species at the site.

Black legless lizards are also present in all three areas of Site 3. Due to low leachability of metals from the bullets, the most likely hazards to the legless lizard at the site are the physical presence of an encrusted layer of bullets, such as is found in the areas of heavy deposition. This would likely restrict the occurrence of the lizard to areas outside of the encrusted layer, because the lizard often moves beneath the top of the soil layer. Because only 4 percent of the surface of Site 3 is heavily contaminated with spent ammunition, it is not expected that this poses a substantial hazard to the survival of the species at the site.

Deer mice were captured in all three areas of the site. A rodent's home range likely extends beyond the sampling location of the maximum soil concentrations of metals. No impacts to rodent populations onsite are expected because the contamination is limited to a small percentage of the site. Because predators feed on rodent populations across the entire site and not only on rodents exposed to maximum soil concentrations, no adverse effects are expected to predator populations. Unless a rodent spends all of its time in the areas of heavy deposition, body burdens are not expected to present a substantial hazard to predators at the site.

Remediation at Site 3 should take place only in heavily impacted areas. Care should be taken to not disturb buckwheat plants in areas not heavily impacted, i.e., areas of less than 10 percent bullet cover. Excavation and remediation in these less impacted areas may lead to unnecessary habitat destruction that may adversely impact species such as the Smith's blue butterfly and black legless lizard. A biologist should be present during remediation activities to ensure protection of the Smith's blue butterfly, buckwheat plants, and black legless lizard and to comply with the Endangered Species Act. Buckwheat plants removed from highly contaminated areas should be replaced following remediation. Revegetation with native plants should increase the habitat quality of the area following remediation.

4.1.6 Applicable or Relevant and Appropriate Requirements

Under CERCLA, remedial actions must be protective of human health and the environment and comply with federal or more stringent State applicable or relevant and appropriate requirements (ARARs), unless waived. Promulgated requirements are "laws imposed by state legislative bodies and regulations developed by state agencies that are of general applicability and are legally enforceable." Formally promulgated and consistently applied state or federal policies have the same weight as specific standards. Advisories and policy or guidance documents (to-be-considered requirements, or TBCs) issued by federal or state agencies that are not legally binding are not considered to be ARARs but may be included as requirements to be considered.

ARARs are identified for each remedial action proposed in an FS. ARARs are chemical-, location-, and action-specific requirements as discussed below. If ARARs are not available for a particular chemical or situation, critical toxicity factors such as EPA-established reference doses or cancer potency factors may be used to estimate risk-based remediation goals such as HBLC to be consistent with EPA guidance and to ensure that a remedial action is protective of human health and the environment (*EPA, 1991b*). Each remedial alternative is then evaluated for its ability to meet ARARs. This approach was used to establish soil HBLC in Volume III (BRA) and Volume V (ERA) because no ARARs are available for soil cleanup at Site 3.

Remedial actions recommended in an FS to be undertaken at a Superfund site must control further release of hazardous substances, pollutants, and contaminants to assure the protection of human health and the environment. Any hazardous substance, pollutant, or contaminant left onsite must be managed or controlled, upon completion of remedial actions, to meet ARARs.

4.1.6.1 Definition of ARARs

Guidance issued by the EPA (*EPA, 1988a*) defines applicable or relevant and appropriate requirements (ARARs) as follows:

- Applicable requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, although not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, are well suited to a particular site because they address problems or situations sufficiently similar to those encountered at a CERCLA site.

The relevance and appropriateness of a requirement is judged by comparing the factors addressed to the characteristics of the remedial action, the hazardous substance(s) in question, and the physical characteristics of the site. The origin and objective of a requirement may aid in determining its relevance and appropriateness. Although relevant and appropriate requirements must be complied with to the same degree as applicable requirements, more discretion is allowed in determining which part of a requirement is relevant and appropriate.

TBCs, the final class of requirements considered by EPA during the development of ARARs, are nonpromulgated advisories or guidance documents issued by federal or state governments. They do not have the status of ARARs but may be considered in determining the necessary cleanup levels or actions to protect human health and the environment.

The following three categories of ARARs are defined by EPA (*EPA, 1988a*):

- Ambient or chemical-specific requirements that set health- or risk-based concentration limits or ranges for particular chemicals (e.g., National Ambient Air Quality Standards)

- Location-specific requirements pertaining to restrictions placed on concentrations of hazardous substances or remedial activities (e.g., federal and state laws governing the siting of hazardous waste facilities)

- Performance-, design-, or action-specific requirements that govern particular activities with respect to remedial actions taken for hazardous wastes (e.g., hazardous wastes generated onsite must be properly managed according to federal and state law).

If ARARs are not available for a particular chemical or situation or if ARARs are not sufficient to protect human health and the environment, critical toxicity factors such as

EPA-established reference doses or cancer potency factors may be used to estimate risk-based remediation goals such as HBLCs to be consistent with EPA guidance, and to ensure that a remedial action is protective of human health and the environment (*EPA, 1991b*).

4.1.6.2 Identification of ARARs

To identify the possible ARARs and TBCs for remedial actions at Fort Ord, federal, state, and local statutes, regulations, and guidance were considered.

In the following sections, potential ARARs and TBCs are identified for the affected medium at Site 3 (i.e., soil); a summary of all potential ARARs is provided in Table 4.2. This FS report considers ARARs and TBCs in evaluating the various remedial alternatives in the detailed analysis (Section 4.5).

Chemical-Specific Requirements

- Identification and Listing of Hazardous Waste: Once lead-containing soil at Site 3 is removed for treatment or disposal, it may become a characteristic hazardous waste under the Resource Conservation Recovery Act (RCRA). RCRA-hazardous wastes are defined generally and are not site-specific. RCRA is now regulated by the state of California. RCRA-listed and characteristic hazardous wastes are identified and defined in Title 22 CCR, Division 4.5, Chapter 11.

  To determine if the lead-containing soil at Site 3 is a RCRA-characteristic hazardous waste, a toxicity characteristic leaching procedure (TCLP) must be performed. If the lead concentration in the waste extract is over 5.0 mg/l (the characteristic level for lead), the soil is a RCRA-characteristic hazardous waste.

  In addition to the RCRA requirements, California also has additional identification and disposal procedures for California (non-RCRA) hazardous wastes.

  To determine if soil is a California hazardous waste, a Waste Extraction Test (WET) is required to determine the soluble threshold limit concentration (STLC) of lead in the soil. The TCLP and Cal/EPA modified WET procedure are very similar; thus, a modified WET can be considered representative of or equivalent to a TCLP test. In California, the total lead concentration (irrespective of leachability) can also classify a soil as California hazardous waste, known as the total threshold limit concentration (TTLC). Lead-bearing material is defined as California hazardous waste if its TTLC is above 1,000 mg/kg or its STLC is above 5.0 mg/l. A California designated waste is a waste that, although not classified as hazardous, could impact water quality at its final area of disposition.

  Both the RCRA (22 CCR) and California (23 CCR) waste classification requirements discussed above would be applicable to the transport or disposal of lead-containing soil. Soil left in place, however, would not be transported or disposed and, therefore, would not require classification under these regulations. The above classification requirements are not site-specific standards, but are conservative levels established for use, general transport, and disposal of hazardous materials throughout California and the United States.

- Waste Classification and Management: Title 23 CCR, Division 3, Chapter 15, Article 2, Waste Classification and Management, Section 2522 is a chemical-specific ARAR. These regulations refer to the requirements of Title 22 CCR, Chapter 11 for the identification and listing of hazardous wastes described above, but also include another waste classification for "designated" waste. Generally, a designated waste is a nonhazardous waste that could potentially degrade waters of the state. This classification depends on site-specific conditions upon final placement of this waste. The Volume III - Site 3 Baseline Risk Assessment established that the site contaminants are not a threat to groundwater; thus, soil remaining in place at Site 3 would not be classified as a designated waste. Should this soil be excavated and disposed of elsewhere, however, it would need to be placed at an appropriate landfill facility. This article also establishes proper management requirements for waste treatment, storage, or disposal in landfills, surface impoundments, waste piles, and land treatment facilities.

- Monterey Bay Unified Air Pollution Control District (MBUAPCD): Regulation II (New Sources) and Regulation X (Toxic Air Contaminants) establish requirements for new stationary sources of air pollution, and the appropriate level of abatement control technology for toxic air contaminants. The remedial design would need to meet the substantive requirements of these MBUAPCD regulations if screening, treatment, or excavation activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal. The MBUAPCD has established emission limits for lead to the atmosphere to protect communities surrounding remediation sites. This rule sets a limiting lead concentration of 1 $\mu g/m^3$ at ground level, at the boundary of the site, averaged over a 24-hour period.

- National Primary and Secondary Ambient Air Quality Standards (NAAQS): 40 CFR Part 150 establishes NAAQS for criteria pollutants: particulate matter (PM10), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. Potential ARARs for air include NAAQS, State Ambient Air Quality Standards (SAAQS), and National Emissions Standards for Hazardous Air Pollutants (NESHAPs) promulgated under the Clean Air Act.

  EPA established primary and secondary emissions standards for air pollutants (NAAQS) under the Clean Air Act of 1970. Primary NAAQS consider sources that contribute to exposure and consider all pathways of exposure to the air pollutant. Primary NAAQS are set based only on air quality considerations and not on the costs or technical feasibility of achieving these standards. Secondary NAAQS are set to protect the public from known or anticipated effects of air pollutants. SAAQS are similar to the NAAQS; however, only one standard, rather than primary and secondary standards, is set. NAAQS have been set for lead and thus apply at Site 3. NESHAPs are set for specific sources of emissions, none of which are applicable to Site 3.

Other criteria to be considered are the California Applied Action Levels for air developed by the California Department of Health Services. These have not been developed for the chemicals of potential concern (COPCs) at Site 3.

Potential air concentration limits are available for worker populations. Permissible exposure limits (PELs) are enforceable standards promulgated by the Occupational Safety and Health Administration (*OSHA, 1989*). The PEL for a particular chemical is the 8-hour time-weighted average or ceiling concentration above which workers may not be exposed. PELs are only applicable to occupational exposure and cannot be used to evaluate adverse health effects to nonworker populations. Dust containing lead may be encountered or generated during remedial construction activities. Dust suppression measures will be implemented to prevent such emissions.

Location-Specific Requirements

- Endangered Species Act of 1973: 16 U.S.C. 1531 et seq., regulated in 50 CFR Parts 200 and 402, requires action to conserve endangered species and preserve or restore a critical habitat essential to their survival. Site 3 is a critical habitat for endangered species identified in Volume II, therefore this act is an ARAR.

  These regulations provide for the protection of endangered or threatened plant and animal species through an evaluation of affected habitats in the site area, as well as consultation with the appropriate government agencies. Each area will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment that will recommend measures, as necessary, to ensure compliance with this ARAR.

- California Endangered Species Act: California Fish and Game Code, Sections 2050 et seq., provides for the recognition and protection of rare, threatened and endangered species of plant and animals (in conjunction with state authorized or funded actions). Site 3 contains endangered species of plants and animals; therefore, each area will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment that will recommend measures, as necessary, to ensure compliance with this ARAR.

- Migratory Bird Treaty Act: 16 U.S.C. 703 et seq. protects certain migratory birds and their nests or eggs. Migratory birds are present on Site 3. Each area will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment that will recommend measures, as necessary, to ensure compliance with this ARAR.

- National Archaeological and Historic Preservation Act: 16 U.S.C. Section 469 et seq., promulgated in 36 CFR Part 65, provides for the protection of any historically significant artifacts that may be unearthed during excavation activities. The law requires action to recover and preserve such artifacts. Remedial actions that may cause irreparable harm, loss, or destruction of significant artifacts are restricted. Site 3 is not known to be located within a historically significant area. No historically significant artifacts have been uncovered during previous investigation activities at Fort Ord, and none are expected to be unearthed at these areas. Appropriate actions will be taken, however, should any such artifacts be unearthed.

- Coastal Zone Management Act: 16 U.S.C. 1456 et seq., requires activities conducted in the coastal zone (the area west of Highway 101) to be completed in a manner that is consistent with the state's coastal zone management program. Site 3 lies within the coastal zone; therefore, impacts to the coastal zone will be considered in the FS.

- California Coastal Act of 1976: Public Resources Code Section 3000 et seq. establishes the State Coastal Zone Management Plan. Site 3 lies within the coastal zone; therefore, impacts to the coastal zone will be considered.

Action-Specific Requirements

- Corrective Action Management Units (CAMUs): 40 Code of Federal Regulations (CFR), Section 264.552, Decision Criteria for CAMU Designation. This section lists seven criteria considered when designating a CAMU for management of remediation wastes. Spent ammunition and soil at Site 3 may be excavated and treated onsite prior to disposal at the OU 2 landfill; therefore, a CAMU for treatment or management and storage of soil at Site 3 would be allowed without triggering RCRA TSD permitting or land disposal restriction requirements. The OU 2 landfill would also be designated a CAMU for placement of soil from Site 3.

  A CAMU at Site 3 would facilitate implementation of a reliable, effective, protective, and cost effective remedy because treatment, screening, or management of soil could take place immediately after excavation onsite with (1) a minimal amount of dust generation, handling, and transportation of soil, (2) fewer costs associated with mobilization of equipment and transportation because these activities would take place at the point of excavation. Creation of a CAMU at Site 3 would not create unacceptable risks to humans because of its remote location and mitigative measures that would be implemented such as air monitoring and dust control measures. The environment would not be impacted significantly by the creation of a CAMU because staging would take place in areas below sensitive dune areas and would be preceded by assessment of biological concerns under the Habitat Management Plan (HMP), (*COE, 1994*). The CAMU would meet all design criteria as specified in this section.

- Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and

Disposal Facilities: Title 22 CCR, Chapter 14, Article 9, Use and Management of Containers; Sections 66264.171-178 establish requirements for the use of containers to store hazardous waste. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

Title 22 CCR, Section 66264.171; Condition of Containers requires that containers used to store and transport hazardous waste must be maintained in good condition. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

Title 22 CCR, Section 66264.172, Compatibility of Waste in Containers, requires that containers for hazardous waste must be compatible with the wastes stored in them. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

Title 22 CCR, Section 66264.173, Management of Containers requires that containers holding hazardous waste must be closed during storage except when necessary to add or remove waste. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

Title 22 CCR, Section 66264.174, Inspections, requires that containers and container storage areas must be inspected weekly for leaks or deterioration. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

Title 22 CCR, Section 66264.175, Containment, requires that container storage areas be designed according to the requirements of this section. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66264.176, Special Requirements for Ignitable or Reactive Waste: Containers of ignitable or reactive wastes must be stored at least 15 meters from a facility's property line. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66264.177, Special Requirements for Incompatible Wastes: Incompatible wastes are not to be placed in the same container or in unwashed containers that previously held incompatible wastes. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

Title 22 CCR, Section 66264.178, Closure, requires that all hazardous waste and waste residues must be removed and remaining containment structures decontaminated at closure. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

Title 22 CCR, Chapter 14, Article 2, Section 66264.14, requires that owners and operators of hazardous waste treatment, storage, or disposal (TSD) facilities prevent the unknowing entry of persons or livestock onto the active portions of the facility; in addition, warning signs must be posted. If excavated soil is hazardous and it is treated, stored, or disposed onsite, areas will be restricted from public access.

Title 22 CCR, Chapter 14, Article 7, Section 66264.119, Post Closure Notices, requires a restriction on the deed which constrains future uses of the property. Remedial measures in which hazardous levels of chemical constituents remain in place may be subject to these regulations.

Title 22 CCR, Chapter 14, Article 16, Section 66264.600-603, Miscellaneous Units; applies to facilities that treat, store, or dispose of hazardous waste in miscellaneous units. Owners and operators of TSDs at which hazardous waste is stored in miscellaneous units must locate, design, construct, operate, maintain, and close those units in a manner that is protective of human health and the environment. Remedial measures in which hazardous levels of chemical constituents are treated in miscellaneous units may be subject to these regulations.

Land Disposal Restrictions: Title 22 CCR, Division 4.5, Chapter 18 contains the Land Disposal Restrictions (LDR) for wastes that are to be disposed in waste management units such as a landfill facility. These requirements would not apply to hazardous waste managed within a Corrective Action Management Unit (CAMU) as planned for Site 3 and the OU 2 landfill. The LDRs would cover both RCRA and non-RCRA wastes handled outside of the CAMU. Certain RCRA wastes and restricted non-RCRA wastes may be land disposed without further treatment only if an extract of the waste does not exceed the specified values. The specified extract concentrations for lead are 5 mg/l for RCRA wastes from a TCLP or EP Toxicity analysis, and 67 mg/l for non-RCRA wastes from a WET analysis. As discussed in the RI, Volume II, a maximum of 76.6 mg/l lead was detected in the leachable extract using rainwater during the RI, therefore, some Site 3 soil may require pretreatment to meet LDRs if disposed offsite at a landfill without treatment at the Site 3 CAMU or management at OU 2. If hazardous waste is removed from Site 3 or the Site 3 CAMU and taken offsite, it will be manifested appropriately, and will be transported by registered hazardous waste transporters.

Monterey Bay Unified Air Pollution Control District (MBUAPCD): Regulation II (New Sources) and Regulation X (Toxic Air Contaminants) establish requirements for new stationary sources of air pollution, and the appropriate level of abatement control technology for toxic air contaminants. The remedial design would need to meet the substantive requirements of these MBUAPCD regulations if activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal. The local requirement that applies to possible remedial actions to be taken at Site 3 is the MBUAPCD Regulation which establishes standards for air emissions of lead. This requirement applies to any remedial actions implemented at Site 3 which must comply with air standards. A Data Form G describing remedial activities and air monitoring must be submitted to the MBUAPCD 30 days before commencing operations. Air monitoring and dust suppression will be implemented during remedial activities at Site 3.

4.2 Identification and Screening of Technologies

This section discusses remedial action objectives, chemicals of interest, definition of remedial units, and tho screening and selection of remedial technologies for alternative development.

4.2.1 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the protection of human health and the environment at Site 3 are: (1) to reduce the aggregate risks associated with site-related chemicals, (2) to reduce potential adverse health effects for noncarcinogenic site-related chemicals in the long-term and short-term by remediation to meet Health-Based Levels of Concern (HBLCs), (3) to protect sensitive habitats and restore those that are heavily disturbed and (4) to protect future onsite users from UXO/OEW hazards. These objectives are in accordance with CERCLA guidance and intended reuse of Site 3 (Section 4.1.3). The RAOs are listed in Table 4.3.

4.2.1.1 Chemicals of Interest

The following metals were detected in soil at Site 3: antimony, chromium, copper, iron, lead, tin, and zinc. However, according to the BRA (Volume III), only lead warranted a HBLC calculation, and therefore is the only chemical of interest for remedial alternative analysis.

4.2.1.2 Health Based Levels of Concern

Blood-lead levels and HIs associated with some nearby resident and onsite park ranger receptors exposed solely to the 1 to 10 percent or ≥10 percent bullet distribution areas exceed regulatory threshold levels of concern. Because lead is present in the highest concentrations of the three COPCs throughout Study Areas 1 and 2, it may represent the greatest concern for human health.

Therefore, a health-based level of concern (HBLC) for lead concentrations in soil was estimated so that the EPA threshold level of blood lead for children and adults would not be exceeded. EPA's Uptake Biokinetic (UBK) model and Cal/EPA's LEADSPREAD lead exposure model described in Volume III, Section 2.3.3, were used to estimate the cleanup lead concentration for children and adults, respectively (*EPA, 1990e, Cal/EPA, 1992*). Although antimony and copper are present (in some areas) at high concentrations, they appear to be collocated with the high levels of lead. It is therefore expected that if lead in soil is remediated to the HBLC, this will result in a reduction in the concentrations of antimony and copper to below levels that might result in adverse health effects to humans. Exposure to lead below its HBLC is not expected to result in an exceedance of agency levels of concern (10 μg/dl blood-lead level). For lead, HBLC of 1,860 and 4,192 mg/kg were estimated for children and adults, respectively, using the lead exposure models described in Section 2.4.3 of the BRA (Volume III). Because it is more conservative (i.e., protective of both children and adults), 1,860 mg/kg is recommended as the HBLC for lead in soil at Site 3.

4.2.1.3 Description of Remedial Unit

Groundwater

Chemicals in soil at Site 3 do not pose a threat to groundwater, therefore no groundwater remedial unit was warranted or developed for Site 3.

Surface Water Outfalls

Based on the results of the data collected in the Basewide Surface Water Outfall Investigation (Volume II) and the dilution modeling performed in the ERA (Volume IV), chemicals in stormwater and sediment are not adversely impacting Monterey Bay. Therefore, a remedial unit was not developed for the outfalls.

Storm drain outfalls at Site 3 require no action under CERCLA; however, monitoring of future discharges is required and will be performed under the Basewide Storm Water Outfall Monitoring Program. The Army and future users of the site will determine whether removal of the outfalls or diversion of stormwater will be undertaken.

Soil Remedial Unit

Remedial units are developed for each site on the basis of acceptable exposure levels (HBLCs), potential exposure routes and ecological considerations (BRA and ERA), and the nature and extent of contamination, i.e., the volume of soil or groundwater that contains a specific contaminant or group of similar contaminants above an established HBLC. For areas containing discrete hot spots or more concentrated contamination within a homogeneous area, separate remedial units may be developed because remediation of these areas is usually addressed in a different manner by the remedial alternative. For sites where the same type of contamination occurs in both soil and groundwater and they are co-located, the remedial units may be grouped together if the soil and groundwater would be treated simultaneously.

A HBLC of 1,860 mg/kg for lead was developed as being protective of human health under the intended reuse scenarios at Site 3. The study areas sampled during the RI contain lead above the HBLC mainly in areas of heavy deposition (HD) with greater than 10 percent visual surface coverage of spent ammunition (Plates 4.2 and 4.3). As discussed in the ERA for Site 3 (Volume IV), a significant number of endangered species and existing sensitive habitats would be destroyed if bullets and soil were removed outside the areas of heavy distribution (i.e., the 1 to 10 percent coverage areas). The draft final BRA calculated a noncancer risk HI of 2.0 from the lead associated with the areas of moderate (1 to 10 percent surface coverage of bullets) distribution for an individual who spends all of their time at the site in these areas. This level is slightly above the EPA's threshold of concern (1.0). The probability for an individual to spend all of their time is this area is low because access would be limited to areas of moderate distribution by future park design features such as roped-off boardwalks. For these reasons, the soil remedial unit does not include spent ammunition and soil associated with areas of moderate distribution. The remedial unit is thus defined by the areas of heavy deposition shown in red on Plate 4.4, and extends to approximately 2 feet below ground surface (bgs).

The total surface area encompassing visual observation of HD made during the RI is approximately 850,000 square feet. The remedial unit consists of approximately 63,000 cubic yards (cy) of spent ammunition and soil to a depth of approximately 2 feet bgs, of which approximately 55,000 cy is soil, and 8,000 cy is spent ammunition. Concentrations of lead detected in soil in RI study areas range from 11 to 46,300 mg/kg.

4.2.2 General Response Actions

In accordance with EPA Interim Final *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, general response actions (GRAs) are defined as those general classes of actions that can be taken to manage or control a particular problem at a site (*EPA, 1988b*). After review of site-specific conditions at Site 3, several GRAs were identified for the technology screening and development of remedial action alternatives for soil. The general response actions that are potentially applicable are:

- No Action
- Containment
- Collection
- Treatment
- Disposal.

In the following sections, technologies for the general response actions are screened as described in Section 4.2.4, and specific remedial action alternatives are developed for Site 3. Each general response action has associated with it a number of remedial technology types and process options that can be part of the remedial action. For example, one general response action for soil remediation is containment; one of the remedial technologies for containing soil is capping; various process options are available to effect capping, e.g., an asphalt cap, a concrete cap, or a cap composed of low-permeability clay or soil. The technology types and associated process options are evaluated using the criteria of effectiveness, implementability, and the order of magnitude of the cost to identify remedial actions and develop remedial action alternatives.

4.2.3 Technologies Retained from the Remedial Technology Screening Report

CERCLA guidance for RI/FSs requires an initial screening of the universe of remedial technologies that could be used to cleanup contaminated sites, prior to development of site-specific remedial alternatives (*EPA, 1988b*). The *Draft Final Remedial Technology Screening Report* (RTS), presented a process to expedite the initial screening of remedial technologies for the FSs for Fort Ord (*HLA, 1994n*). The objectives of the RTS were to identify and screen proven remedial technologies for typical groups of compounds (GOCs) found in soil and groundwater at contaminated sites.

The RTS contains a matrix guide/checklist(s) and summary review forms for each medium and

GOCs, and tables that describe and evaluate each applicable technology on the basis of effectiveness, implementability, and relative cost. The matrix guide/checklist(s) and tables were used to identify and screen technologies for site specific media and GOCs, and this screening is presented on the summary review form. The matrix guide/checklist and summary review forms for this FS are presented in Appendix 4A. The summary review forms were used to prepare the site and/or remedial unit specific technology tables for this FS (Table 4.4). Based on this process, the following general response actions and remedial technologies are available for selection in developing the remedial alternatives for this site:

- No Action
- Containment
  - Barriers
  - Capping
  - Surface Water Controls
- Collection
  - Excavation
- Treatment
  - Physical/Chemical Treatment
  - Stabilization/Fixation
  - Offsite Treatment
- Disposal
  - Onsite Disposal
  - Offsite Disposal

4.2.4 Selection of Technologies for Remedial Alternative Development

This section reviews and selects the technologies that were retained from the RTS screening listed in Section 4.2.3 for development of remedial action alternatives. Technologies are selected based on site-specific conditions and base-specific features. For example, Fort Ord is unique in that it has the regulatory agency-approved Fort Ord Soil Treatment Area (FOSTA), which was specifically created to treat hydrocarbon- and other chemical-contaminated soil at one location, and which is protective of human health and the environment and cost effective. The types of hydrocarbon treatment planned to take place at the FOSTA include bioventing and ex situ bioremediation. Future treatment systems that could be incorporated include thermal desorption and asphalt batching mobile units. Because the FOSTA provides an equivalent level of treatment, many of the technologies that pass the RTS screening no longer compare favorably. Those that are eliminated from further consideration because of the FOSTA, include offsite thermal treatment by incineration because it could be performed onsite.

Based on the Section 4.2.3 screening of technologies and the Fort Ord specific conditions, the technologies retained for development of remedial actions for the soil remedial unit are presented in Section 4.3. The technologies that were not selected and the reasons for their elimination are presented below.

- <u>Containment</u>: Although several containment technologies for metals in soil were retained in the RTS report, only surface water controls were selected for use in the development of remedial alternatives. The other technologies are not appropriate for Site 3 as described below.

  Horizontal barriers consist of a bottom seal placed beneath contaminated soil to prevent downward migration of contaminants; however, lead in soil is not a threat to groundwater at Site 3. This options is relatively unproven, and would be difficult to implement in sand dunes. Also, ensuring the integrity of horizontal barriers would be difficult. Therefore, horizontal barriers were eliminated from further consideration. Vertical barriers were eliminated from further consideration because the lead and in soil does not appear to be migrating laterally.

Capping with clay, asphalt, concrete, synthetic material, or a combination of these materials is not considered effective or feasible for the onsite surface soil because of the variable topography, dune migration and the presence of sensitive species. Furthermore, there is no evidence that lead is a threat to groundwater at Site 3. Capping was, therefore, eliminated from further consideration.

- Collection: The collection action that was selected for development of remedial alternatives was excavation for spent ammunition and soil removal, including hand and mechanical excavation of spent ammunition and associated surface and near-surface soil.

  Deep soil excavation was not selected because lead in soil at Site 3 is generally confined to the upper 2 feet bgs.

- Disposal: Onsite disposal in a repository or waste management unit was not selected for development of remedial alternatives because it would require construction of a repository which meets RCRA hazardous requirements. This repository would not be compatible with future recreational land use and construction may adversely impact sensitive wildlife habitat. Disposal of soil and spent ammunition at a demolition landfill was not selected because neither live ammunition nor unexploded ordnance has been identified at Site 3.

4.3 Development and Description of Remedial Alternatives

To assemble remedial alternatives for each site, GRAs and process options were chosen from Section 4.2.4 that, when combined, represent various alternatives for soil from Site 3 (*EPA, 1988b*). According to EPA guidance, taking no further action at the site should be one of the alternatives considered as a basis for comparison to other alternatives: appropriate treatment and containment options should also be considered. Initially, specific technologies or progress options are evaluated primarily on the basis of whether or not they can meet the RAOs discussed in Section 4.2.1. To assemble alternatives, remedial units are matched with technology types developed in Section 4.2.4 using engineering judgement and site-specific considerations. A range of alternatives was developed with respect to the criteria of effectiveness, implementability, and cost. For sites at which interactions among media are not significant, media-specific remedial options can be developed rather than developing numerous comprehensive site-wide alternatives. Alternatives which meet the RAOs and evaluation criteria are retained for further consideration in the detailed analysis.

The technologies that were selected for the soil remedial unit include: no action, shallow excavation, separation, soil washing, stabilization, asphalt batching, and on- and off-site disposal, and were combined into three site-wide remedial alternatives described in the following sections.

4.3.1 Remedial Alternative 1

This alternative consists of taking no further action to treat, contain or remove spent ammunition or impacted soil. This alternative is required for consideration under CERCLA as a basis for comparison to other alternatives. The only activity to continue under no action is periodic groundwater monitoring under the basewide program to detect any threat to human health or the environment and continuation of deed and access restrictions already in place. Monitoring wells within Site 3 (at Site 2) are sampled as part of basewide activities; therefore, there are no costs associated with this alternative.

Storm drain outfalls at Site 3 require no action under CERCLA; however, monitoring of future discharges is required and will be performed under the Basewide Storm Water Outfall Monitoring Program. The Army and future users of the site will determine whether removal of the outfalls or diversion of storm water will be undertaken.

4.3.2 Remedial Alternative 2

This alternative consists of mechanical and hand excavation of approximately 63,000 cy of spent ammunition and soil, mechanical separation using screening techniques (sieving and density separation equipment), and subsequent placement of soil as a foundation layer for the OU 2 landfill cover. Based on RI test pit sieve analyses from areas of HD, the total volume of 63,000 cy consists of approximately 55,000 cy of soil and 8,000 cy of spent ammunition. Soil outside areas of HD will be remediated based on RI data, visual observation and soil confirmation results. The determination will be based on (1) the goal of minimizing intrusive activities into adjacent sensitive habitats that have moderate to little deposition, and (2) engineering constraints and field evaluations, such as the ability to reach an isolated area that would require significant excavation without disturbing sensitive habitat.

Storm drain outfalls at Site 3 require no action under CERCLA; however, monitoring of future discharges is required and will be performed under the Basewide Storm Water Outfall Monitoring Program. The Army and future users of the site will determine whether removal of the outfalls or diversion of storm water will be undertaken.

Because the potential for live ammunition exists in areas near firing ranges, a UXO Team will supervise all excavation activities and will be responsible for mitigation of any hazards to workers. Although there is no record of deposition of UXO/OEW at Site 3, the UXO Team will clear all areas prior to excavation. After excavation and separation by screening, the spent ammunition and any fragments will be transported and cleaned by a scrap metal dealer for subsequent recycling and recovery of metals at a refinery.

The excavated soil would be treated onsite in a designated CAMU (Section 4.1.6.2) by one of the following three methods, depending on residual concentrations of lead after separation: (1) stabilization, (2) soil washing, or (3) asphalt batching, and transported to a designated CAMU at the OU 2 landfill where it will be used as foundation layer material for the landfill cover.

For treatment of soil, a pre-remedial design study would be required under this alternative that would consist of applying separation techniques and one or more of the above treatment technologies to a limited area of the remedial unit to further define design and operating parameters (Plate 4.5). A work plan for bench-scale and pilot study treatment is being prepared for submittal to the regulatory agencies. The work plan will outline the approach for implementing the pre-remedial design study. Bench-scale and pilot studies are anticipated to be completed in the spring and summer of 1995.

Successful separation of larger metal fragments was achieved during the RI; however, residual lead levels in soil remains high. Separation and lead analyses of various soil fractions would first be conducted to evaluate the most effective manner of separating the fractions containing the highest concentrations of lead and metal fragments from the soil. On the basis of the results of the sieving and lead analyses, the three methods of soil treatment would be implemented as part of the pre-remedial design bench-scale studies. The most feasible method of sieving and/or treatment would be recommended in a Conceptual Plan Report and submitted to the regulatory agencies for approval and subsequent implementation as full-scale remediation for the entire soil remedial unit (Plate 4.5).

Under the pre-remedial design study, the top 2 feet of soil would be excavated using: (1) hand crews in areas inaccessible to heavy equipment, (2) common heavy equipment such as front-end loaders and scrapers in areas with stable and accessible dune slopes, and (3) specialized equipment necessary for access or moving soil and spent ammunition in and out of the dunes such as conveyor belts and special tires on equipment.

The soil and spent ammunition would be moved to a level staging area on the east side of the dunes, stockpiled on plastic, covered, and transferred in loads to a nearby mechanical vibrating screen or gravity-feed separator to remove the spent ammunition. Air monitoring would be performed at stations surrounding the pre-remedial design area and air sampling would be performed for lead and particulate matter. If emission levels exceed MBUAPCD limits, dust control measures would be implemented such as spraying with water or postponing movement of soil during periods of high wind that could transport fugitive dust emissions offsite. After spent ammunition is separated from soil, it would be stockpiled separately, loaded onto trucks or railroad cars, and transported to a scrap metal recycling facility. These facilities accept spent ammunition encrusted or mixed with sand without prior cleaning because sand (silica) is used as a flux material in the refinery process. The metals present in the spent ammunition, such as copper, lead, zinc, and iron, would be reused in manufacturing processes after smelting.

After separation of the spent ammunition, soil would be collected from stockpiles and sieve analyses would be performed at a laboratory to separate the soil into different sized fractions. Each fraction would then be analyzed for total lead to determine the distribution of lead, i.e., whether the majority of lead is present in a certain fraction of the soil. For example, if concentrations of lead are much higher in the finest-grain fractions, the soil could be shaken through a screen that will retain the larger fractions of sand, but allow the finer fractions to pass through for separate handling. If lead concentrations are greatest in the larger fractions, any larger-sized lead fragments could be separated using a density separation method. The pre-remedial design study would further define the characteristics of the lead in soil so that separation could occur in the most efficient manner. If the results of the study indicate that lead is present equally in all fractions of the soil, further separation using screening equipment would not be pursued. Also, treatment of soil by asphalt batching would not be evaluated because the DTSC's Draft *Use Constituting Disposal* policy requires lead concentrations in soil to be below RCRA levels for recycling of the soil into asphalt. Without significant reduction of lead concentrations, the soil may not meet the requirements. Concentrations of lead in sieved soil samples analyzed during the RI were above the TTLC and some rainwater leachate analyzed exceeded the STLC; therefore, asphalt batching may not be pursued for soil that cannot be separated effectively. However, stabilization or soil washing could be implemented for remediation of soil with concentrations of lead (above the STLC) that would trigger LDRs (Plate 4.5).

If sieve and lead analyses indicate concentrations of lead in soil leachate using the TCLP test could be reduced to below the STLC, asphalt batching would be pursued (Plate 4.5). The soil would be used as a sand fraction aggregate in the manufacture of asphalt for reuse as pavement or patching material, depending on whether a hot or cold mix process is used. As with stabilization, a bench scale study would be necessary to determine the appropriate mix design, and TCLP analyses on the final product, as well as physical testing for strength and stability under American Society for Testing and Materials (ASTM) protocols would be performed.

Stabilization of soil would require a bench scale study performed on a limited amount of soil to develop an appropriate mix design, and would be performed offsite by a subcontractor. The type of binder used to stabilize the soil could be one of many, such as cement or silica-based agents, and would be determined in the bench scale study. If a mix design is developed that reduces the leachability of the final stabilized product to below the STLC for lead, a unit could be brought onsite to stabilize the remainder of the soil. A TCLP or WET analysis would be performed on the stabilized product (friable stabilized material or blocks), and if lead concentrations in the leachate are below the STLC, the material could be reused as structural backfill or for construction purposes. The same criteria promulgated by the DTSC for asphalt would also apply to the stabilized product, i.e., that the aggregate is of equal or better quality than commercially available material, which would be determined in the bench scale study.

Soil washing would also require a bench scale study to determine the type of washing solution that would be most effective for removing the lead from soil into solution. In addition, pre-crushing the soil to achieve a uniform grain size may be necessary for efficient extraction of the metals from soil particle surfaces. The bench-scale study would be performed by a subcontractor offsite; however, if soil washing is implemented in the pre-remedial design study, a mobile unit would be set up onsite. For the purposes of this evaluation, soil washing refers to any process that uses water or other solutions mixed with soil to reduce the volume and concentration of lead-containing soil and could include the following: innovative technologies and acid-extraction or soil leaching forms of soil washing such as Cognis' Terra Met™ process, Earth Treatment Technologies' metals Recovery and Recycling System™, and Tallon Metal Technologies' Vitrokele™ process. Each of the processes use a liquid medium to wash the lead from the soil; the most viable option would be chosen based on an engineering evaluation of analytical and bench scale results. Soil would be fed into the mobile unit, treated, and returned to the dunes assuming concentrations would be reduced below the HBLC. The wash water containing the concentrated lead would be recycled at a refinery by the subcontractor.

With each of the potential soil remediation methods, a step-by-step process would be used to evaluate the approach as the study progresses to assess the efficiency of the method and to communicate with the regulatory agencies and public regarding the outcome of each stage of testing. After successful application and completion of treatment by the method chosen for the pre-remedial design study, full-scale implementation would follow, and would most likely be performed onsite in flat areas east of the dunes and west of the Southern Pacific Railroad Right-of-Way and State Highway 1 (Plates 4.3 and 4.4).

During remediation activities the protection of sensitive biological resources will be addressed to mitigate associated impacts, and implement resource conservation and management requirements of the *Installation-Wide Multi-Species Habitat Management Plan [HMP]* (*COE, 1994*). It is intended that the quality and extent of sensitive biological resources on the beach ranges be restored after remediation to levels that approximate preexisting natural conditions. The HMP outlines procedures, mitigation, and success criteria for the ongoing protection of biological resources on the beach firing ranges during remediation. The approach is to document initial resources, avoid impacts to these resources if possible, relocate HMP species if necessary and restore habitat. Prior to remediation each site would be characterized and surveyed to establish baseline population information on HMP species. Smith's blue butterfly larvae, black legless lizards, and seed of HMP plants species would be collected and relocated. Restoration plans would be developed to restore HMP species and habitat disturbed during remediation to preexisting levels of density, composition, and diversity. Restoration sites would be monitored and adjustments made, if necessary, to meet success criteria specified in the HMP within a five year monitoring period.

HMP species of concern on the beach ranges are Smith's blue butterfly, western snowy plover, Monterey spineflower, sand gilia, coast wallflower, and the black legless lizard. Activities to minimize or mitigate impacts to these species during remediation are summarized as follows:

- Documenting the presence or absence of sensitive taxa during preremediation surveys conducted by qualified biologists to determine baseline information on HMP species

- Protection of HMP plant species during the period of active growth and flowering between January and June by establishing exclusion fences or flagging

- Seed collection of spineflower, coast wallflower, and sand gilia during June and July and incorporation of collected seed into restoration areas

- Implementation of general avoidance measures such as: (1) informing workers prior to remedial activities verbally and in writing as to the locations of known sensitive resources in the area and specific measures to be taken to avoid those resources during remediation, and (2) establishing fenced or flagged exclusion zones where appropriate and necessary to prevent accidental intrusion into areas that may support sensitive resources

- May surveys for snowy plover and avoidance of habitat during the breeding and nesting season, including conducting work in areas that can be seen or heard from snowy plover nesting sites

- Develop baseline population data on Smith's blue butterfly by conducting capture/recapture population surveys, relocate larvae on buckwheat plants in excavation areas to known Smith's blue butterfly population locations in August and September

- Relocate black legless lizards occurring in excavation areas to offsite locations in similar habitat during the month of April when lizards are the most active, and, perform construction under the supervision of qualified biologists to capture and relocate any lizards uncovered during remedial activities

- Develop restoration plans that incorporate onsite seed and/or plants or plant species from the Monterey Bay region appropriate to the site on a community level, encourage HMP species at densities reflecting preexisting levels, include dune recontouring recommendations, iceplant removal and, promote soil stabilization.

Remedial activities will be confined to observed or quantitatively determined areas of high bullet density, unless intrusion into adjacent natural areas is cleared in advance by the Fort Ord Directorate of Environmental and Natural Resources (DENR) environmental specialist or his designee. If field surveys or additional data collection determine that areas beyond high density zones require remediation, procedures to minimize impacts to HMP species will follow guidelines outlined in the HMP and developed in consultation with the DENR specialist and the United States Department of Fish and Wildlife. The HMP indicates that no more than 10 percent of the coastal occurrence of HMP species and habitat may be disturbed at one time. Restored areas may be combined with natural areas contributing to HMP species habitat, if they meet specified success criteria. Remediation and habitat restoration may be accomplished in stages to prevent impacts to HMP species and habitat in excess of 10 percent disturbance.

After excavation, separation, treatment, and recycling, the excavated areas would be revegetated to restore the natural flora and fauna of the dunes as suggested in the Summary of the ERA (Section 4.1.5.2) and described in the HMP. In addition, if the current planned reuse is implemented at Site 3, existing use restrictions would need to be amended to mitigate intrusive activities into areas of sensitive ecological habitat where spent ammunition is left in place.

The primary advantages of this alternative are that spent ammunition and soil within areas of disturbed sensitive habitat with concentrations above the HBLC would be removed from these areas of HD, and treated and recycled. Risks to human health and the environment would be reduced, and the site could be reused as planned.

4.3.3 Remedial Alternative 3

This alternative consists of excavation and separation at the onsite CAMU at Site 3 as described above for Alternative 2. However, instead of recycling and treatment, the separated soil would be disposed at a landfill and the spent ammunition would be recycled as described under Alternative 2. Soil would be placed at an onsite CAMU at the OU 2 landfill as a foundation layer for the landfill cover or disposed at a Class I landfill.

Storm drain outfalls at Site 3 require no action under CERCLA; however, monitoring of future discharges is required and will be performed under the Basewide Storm Water Outfall Monitoring Program. The Army and future users of the site will determine whether removal of the outfalls or diversion of storm water will be undertaken.

This remedial alternative provides flexibility in planning and management of the large volume of soil to be excavated from Site 3. Depending on the volume of soil to be excavated, either disposal option or a combination of both could be used. The volume of soil estimated to be excavated in this FS could vary depending on field characterization of each of the ranges during full-scale remediation. In addition, even though the BRA indicated areas of moderate deposition pose no risks under the reuse scenario, ongoing discussions with the regulatory agencies and the public regarding removal of areas of moderate deposition of spent ammunition (areas of 1 to 10 percent surface coverage) have not concluded.

Thus, there is uncertainty in the total volume of soil to be excavated and managed under full-scale remediation. The flexible disposal options provided under this alternative will allow for ongoing strategizing and management of the soil in the most efficient and cost effective manner during finalization of the Proposed Plan and ROD.

Disposal Option 1

Management of excavated soil in a CAMU at the OU 2 landfill would be a reliable, effective, protective, and cost-effective remedy for the following reasons:

- A large volume of soil is needed at Fort Ord for the OU 2 landfill foundation layer, and soil from Site 3 could be used for the foundation. Significant cost savings would be realized in both eliminating the need to purchase or acquire backfill material, and not having to dispose of soil from Site 3 at an offsite landfill.
- The excavated soil would be removed from potential contact with human and environmental receptors and enclosed in the existing landfill at OU 2, thus eliminating associated risks.
- Management of the soil at the base would eliminate risks involved in transporting a large volume of soil offsite over public roadways to another location. The closest Class I landfill facility to Fort Ord at the present time is the Kettleman Hills facility, over 150 miles from Monterey.

Disposal Option 2

As discussed under Alternative 2, a pre-remedial design study would be performed to assess the most effective manner for reducing lead concentrations in soil using separation equipment. Based on residual lead concentrations, acceptance of the soil at an appropriate landfill would be determined on the basis of comparison of maximum concentrations to total and/or soluble threshold limit concentrations (TTLC/STLC). If lead concentrations exceeded the STLC, pretreatment would be required prior to disposal at a Class I landfill, and would be performed at the landfill facility. Pretreatment for soil would likely consist of stabilization. If lead levels did not exceed the STLC in soil, it would be disposed at a Class I or II landfill, depending on whether total concentrations exceeded the TTLC. For purposes of this evaluation, it was assumed that the materials would be manifested and transported to Chem Waste Management's (CWM's) Kettleman Hills facility, the closest operating Class I landfill. Ecological concerns during remediation would be handled as described under Alternative 2.

After the contaminated materials were removed from the site, the excavated areas would be revegetated to restore the natural flora and fauna of the dunes as suggested in the Summary of the ERA (Section 4.1.5.2). In addition, if the current planned reuse is implemented at Site 3, existing deed restrictions would need to be amended to mitigate intrusive activities into areas of sensitive ecological habitat where spent ammunition is left in place outside excavated areas.

The primary advantages of this alternative are that spent ammunition and soil within areas of disturbed sensitive habitat with concentrations above the HBLC would be removed from these areas of HD, and properly disposed and recycled. Risks to human health and the environment would be reduced, and the site could be reused as planned.

4.4 Criteria for Detailed Analysis of Remedial Alternatives

Each of the remedial alternatives described in Section 4.3 has been assessed in accordance with the *Guidance for Conducting Remedial Investigations/Feasibility Studies Under CERCLA (EPA, 1988b)*. The remedial alternatives have been evaluated using the nine criteria described below:

Overall Protection of Human Health and the Environment

Each remedial alternative is evaluated in terms of the extent of protection of human health and the environment and the residual risk associated with implementation of the alternative. The manner in which the contaminants are managed under each alternative is considered.

Compliance with ARARs

The ability of each alternative to meet ARARs and other guidance identified in Section 4.1.6 and Table 4.2 is assessed.

Long-term Effectiveness

Each alternative is evaluated with respect to the risk that would remain at the site after the alternative is implemented and the response objectives are satisfied. Calculated residual concentrations of chemicals at the site that will not pose a threat to human health and the environment are the HBLCs. The magnitude of the risk is established as well as the adequacy and reliability of long-term management controls planned under the alternative.

Reduction of Toxicity, Mobility, and Volume Through Treatment

In CERCLA, preference is given to remedial technologies that significantly reduce the toxicity, mobility, or volume of contaminants. The degree of reduction is assessed for each alternative. Considerations include the extent of irreversibility of the treatment and the disposition of treatment residuals.

Short-term Effectiveness

The effects of each alternative during the construction, implementation, and operation phases are assessed. Factors considered include protection of the community and workers during remedial operations, the time required to implement the alternative and to achieve the remedial goals, and potentially adverse environmental impacts that may result.

Implementability

The three major areas of focus in assessing the implementability of a remedial action alternative are:

- Technical feasibility - The ability to construct a treatment system, the reliability of the technology, and the ability to monitor the effectiveness of the remedy.
- Administrative feasibility - The effort and resources required to obtain approvals from regulatory agencies.
- Availability of services and materials - The availability of contractors with the equipment and knowledge to implement the technologies under the remedial alternatives.

Costs

Remedial alternative cost estimates are prepared using EPA guidance manuals, other technical resource documents, contractor quotes, and experience on this site and on other projects with similar scope. Both capital costs and operation and maintenance (O&M) costs are developed at a conceptual level for each applicable remedial action alternative. These costs can be expected to have an accuracy of +50/-30 percent. Net present value (NPV) costs are calculated using a 5 percent discount rate for up to 30 years, which CERCLA guidance requires as the maximum length of time for costing purposes.

Capital costs include costs for such items as contractor's mobilization and demobilization, sampling and analysis, permitting, engineering, remedial equipment purchase and installation, and site restoration. O&M costs include items such as ongoing operational site inspections, utilities, chemicals, routine maintenance and repairs, and periodic sampling and analysis.

Regulatory Acceptance

Each remedial alternative is evaluated in terms of the administrative and technical issues state or other agencies may have concerning the alternative; however, acceptance will be addressed in the Proposed Plan once comments on the FS are received.

Community Acceptance

Each remedial alternative is evaluated in terms of available public input and the anticipated public reaction to the alternative; however, as with regulatory acceptance discussed above, community acceptance will be addressed in the Proposed Plan.

4.5 Detailed Analysis of Remedial Alternatives

This section presents a detailed analysis of Alternatives 1 through 3 using the nine criteria defined above. The analysis is summarized in Table 4.5.

4.5.1 Detailed Analysis of Remedial Alternative 1

Alternative 1 is the no action alternative. Groundwater monitoring would be performed as part of basewide activities.

Overall Protection of Human Health and the Environment

The no action alternative provides no additional protection to human health and the environment and would not meet HBLCs; however, for recreational uses identified, the results of the BRA indicate that human health risks do not exceed regulatory agency levels of concern (Volume III). The potential would continue for direct human exposure to surface soil contaminants, and through inhalation, ingestion, and contact with contaminated airborne dust particles.

Compliance with ARARs

The no action alternative would not meet chemical-specific ARARs HBLCs for the site. Lead, detected at levels up to 46,300 mg/kg (above the TCL), would be left uncontained onsite. This alternative does not invoke action-specific ARARs. Location-specific ARARs such as the Endangered Species Act would not be met because endangered species would be allowed to continue to come in contact with the contaminated soil.

Long-term Effectiveness

In the long term, this alternative does not change or reduce human exposure or reduce the transport of contaminants through the soil.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Under the no action alternative, no reduction of toxicity, mobility, or volume would occur. This alternative does not mitigate any risks associated with the existing concentrations of lead in soil.

Short-term Effectiveness

Short-term conditions would remain unchanged. Any risks and threats to the health of the community and onsite workers from possible ingestion, inhalation, and dermal contact would remain unchanged. In addressing adverse environmental impacts, this alternative would not change the potential for surface contaminants in the soil to be dispersed to the environment. Degradation of the environment could occur with this alternative.

Implementability

There are no technical concerns regarding the implementability of a no action alternative. No specialized services or materials are required. However, the administrative feasibility or implementability of the no action alternative may be an obstacle, i.e., parties involved in reuse determination may not be satisfied with no action at Site 3.

Costs

No capital costs are associated with this alternative. Groundwater monitoring would be performed under basewide activities, and therefore, its cost would not be borne under this alternative. Any costs incurred through administrative implementation would vary considerably depending on regulatory requirements imposed by the various agencies.

Regulatory Acceptance

It is anticipated that the regulatory agencies may require remedial actions that are more extensive than proposed in this alternative; however, acceptance will be addressed in the proposed plan once comments on the FS have been received. It is also anticipated that regulatory agencies would impose deed and access restrictions on near-future uses of the site if no action is implemented.

Community Acceptance

Because the remedial alternatives applicable to the site have not been presented to the community, its acceptance of the no action alternative cannot be determined at this time. Community acceptance will be addressed in the proposed plan; however, it is anticipated that this alternative would not meet with public approval because of the intended recreational reuse.

4.5.2 Detailed Analysis of Remedial Alternative 2

Alternative 2 is the excavation, separation, and recycling of spent ammunition and treatment of soil.

Overall Protection of Human Health and the Environment

Removal of spent ammunition and soil from HD areas reduces long-term risks by eliminating the inhalation, incidental ingestion, and dermal exposure routes. Thus, Alternative 2 would provide increased protection to human health and the environment over the long term. In addition, heavily disturbed areas would be restored and revegetated, which would improve the status of the sensitive habitat areas within the dunes. There may be residual risks associated with implementation of this alternative because not all spent ammunition and lead in soil would be remedied; however, sensitive habitat areas would be restored that were heavily disturbed. Removal in HD areas only would limit impacts to the existing sensitive habitats from intrusive activities associated with the remedy. There are some increased short-term risks associated with the dust that would be generated during excavation, separation, treatment, and loading. In addition, there is a potential for spills on public roads from trucks transporting spent ammunition offsite.

Compliance with ARARs

Removing spent ammunition from HD areas of the site would reduce potential threats to human health or the environment. Because excavation, separation, treatment, loading, and transportation would be conducted using proper dust control, engineering, and health and safety methods, this alternative would eliminate the exposure pathways of concern identified in the risk assessment and be in compliance with ARARs (Volume III).

Action-specific ARARs would be met for the onsite CAMU, which would be designed and managed under appropriate requirements. Hazardous waste transported during remediation would be transported by registered hazardous waste transporters. Soil containing hazardous levels of lead that is treated onsite would be subject to standards applicable to generators of hazardous waste such as waste analysis and emergency response and preparedness plans for hazardous waste stored onsite (Title 22 CCR). The remedy would be performed in accordance with these offsite regulations.

Location-specific ARARs such as the Endangered Species Act would be met for HD areas through implementation of the remedy.

MBUAPCD Regulation 11, Rule 1, regulates emissions from activities such as excavation, treatment, loading, and transportation of the metal-bearing soil. Fugitive dust emissions would be minimized and kept below the allowable limit through dust control measures. A health and safety plan (under OSHA) and consideration of the Coastal Zone Management Plan would also be required; it is anticipated that all of these ARARs would be met during the remedy.

Long-term Effectiveness

Because this alternative removes spent ammunition and soil from areas of HD, the current risks and potential risks to the community and ecological receptors posed by the site in its present condition would be reduced. It is also anticipated that no long-term monitoring would be required. Access restrictions would be implemented as part of the recreational reuse scenario; it is anticipated that fenced boardwalks and warning signs regarding restrictions on use of sensitive habitat areas would also serve to restrict access to areas containing spent ammunition and affected soil outside areas of HD. This alternative recycles the lead and treats the soil; therefore, long-term liability and other long-term risks would be eliminated.

Reduction of Toxicity, Mobility, and Volume Through Treatment

This alternative reduces the toxicity, mobility, and volume of treated soil if lead is removed from the soil by separation or soil washing. If the soil is stabilized or asphalt batched, mobility would be reduced; and separation may reduce the volume prior to treatment. The overall toxicity and volume of spent ammunition would not be reduced through recycling; however, it would no longer exist as scrap metal and would be remanufactured into a product with an intended use. The mobility of the lead would be reduced in the long term because it could not be transported by wind or by any materials or living organisms. Mobility would be increased in the short term because of dust generation; however, dust control measures would be employed during site operations.

Short-term Effectiveness

This alternative involves excavation, separation of spent ammunition, recycling, and treatment of soil. The excavation, separation, treatment, and loading operations would have a potential adverse short-term impact on community human health because of the lead-containing dust and particulates generated during excavation and removal. These potentially adverse impacts would be minimized through the use of dust control measures such as spraying the soil with water or postponing operations during times of high wind. In addition, the exposure of workers to the lead would be minimized by using proper health and safety procedures. As with worker and community health, there would be a potential risk of adverse environmental impacts to sensitive ecological habitats associated with this alternative because of the dust and particulates generated during excavation, separation, treatment, and loading and disturbance to vegetation; these activities would, however, be minimized by using dust control measures and revegetation of impacted areas.

Air monitoring stations would be established up- and downwind of the site to allow evaluation of potential risks as a result of dust exposure during excavation. Air samples would be collected and analyzed for total particulates and lead when wind velocities exceeded a threshold level capable of transporting dust offsite. It is anticipated that remedial activities could be completed within 8 to 12 months.

Implementability

Soil excavation, separation, loading, and transportation have been used widely and can be performed using well-established, conventional techniques. There are few or no technical considerations that would prohibit excavation, separation, and transportation of spent ammunition. Treatment units are available as described in the description of this alternative, and although some types of treatment are less well-established, the equipment and materials are available. Because the technologies that may be included in this alternative have been used at other sites with similar contamination problems, it is anticipated that this plan would be administratively feasible with minimal effort. The services and materials required to implement this plan are available on relatively short notice.

Costs

Costs developed for this alternative are presented in Appendix 4B, Table 4B-1, and are summarized in Tables 4.5 and 4.6. There are no O&M costs associated with this alternative because the remedy results in closure of the site. The capital costs associated with this alternative for excavation, separation, recycling, and treatment are: $11,482,000 for stabilization; $13,759,000 for soil washing; and $16,036,000 for asphalt batching. These estimates include site work, treatment, transportation, recycling, and site restoration costs.

Regulatory Acceptance

The regulatory agencies have approved similar remedies at numerous sites under similar conditions, and it is anticipated that the alternative will be acceptable to the agencies. Acceptance will be addressed in the proposed plan once comments on the FS are received.

Community Acceptance

Because this alternative removes the potential long-term risks at the site, and treats or recycles contaminated soil, it is anticipated that it would be acceptable to a majority of the community members. Community concern over increased traffic, noise, or dust generated from operations would be offset by reducing risks and restoring sensitive habitat for intended reuse. Acceptance will be addressed in the proposed plan.

4.5.3 Detailed Analysis of Remedial Alternative 3

Alternative 3 consists of excavation, separation and recycling of spent ammunition, and disposal of soil at the OU 2 landfill CAMU or a Class I landfill. This alternative will provide additional flexibility for management of the large volume of soil to be excavated from Site 3.

Overall Protection of Human Health and the Environment

Removal of spent ammunition and soil from HD areas reduces long-term risks by eliminating the inhalation, incidental ingestion, and dermal exposure routes. Thus, Alternative 3 would provide increased protection to human health and the environment over the long term. In addition, heavily disturbed areas would be restored and revegetated, which would improve the status of the sensitive habitat areas within the dunes. There may be residual risks associated with implementation of this alternative because not all spent ammunition and soil would be removed; however, sensitive habitat areas that were heavily disturbed would be restored. Removal in HD areas only would limit impacts to the existing sensitive habitat from intrusive activities associated with the remedy. There are some increased short-term risks associated with dust that would be generated during excavation, separation, and loading, and a potential for spills on roadways from trucks transporting the spent ammunition and/or soil offsite; however, these risks would be mitigated through implementation of health and safety and emergency response plans, and engineering and administrative controls.

Compliance with ARARs

Removal of spent ammunition and soil from areas of HD would result in a reduction of potential threats to human health or the environment. Because excavation, separation, loading, and transportation of spent ammunition and soil would be conducted using proper dust control, engineering, and health and safety techniques, this alternative would mitigate the exposure pathways of concern identified in the risk assessment and be in compliance with ARARs (Volume III). Action-specific ARARs would be met for the onsite CAMUs, which would be designated under appropriate requirements. As discussed in Section 4.1.6.2, CAMUs are exempt from LDRs for hazardous or RCRA wastes. However, an appropriate landfill cover will be designed and implemented at the OU 2 landfill for the CAMU.

Action-specific ARARs are imposed on landfills containing hazardous wastes under 22 CCR, Division 4.5, Chapters 12, 14, and 20, and 23 CCR Chapter 15; the Kettleman Hills facility is currently in full compliance. The spent ammunition and soil would be manifested and transported to the landfill by licensed hazardous waste haulers, thereby meeting 22 CCR, Division 4.5, Chapter 14, Article 5, and Chapter 13. The separated soil is expected to meet land disposal restrictions for disposal of lead at a Class I land disposal facility. A TCLP test or Cal-WET test would be required before disposal.

MBUAPCD Regulation 11, Rule 1, regulates emissions from activities such as excavation, loading, and transportation of the metal-bearing soil. Fugitive dust emissions would be minimized and kept below the allowable limit through dust control measures. A health and safety plan (under OSHA) and consideration of the Coastal Zone Management Plan would also be required; it is anticipated that all of these ARARs would be met during implementation of the remedy.

Location-specific ARARs such as the Endangered Species Act would be met for the HD areas through removal and disposal of contaminated soil and spent ammunition and application of the HMP.

Long-term Effectiveness

Because this alternative removes all spent ammunition and soil from HD areas, the current and potential risks to the community and ecological receptors posed by the site in its present condition would be reduced. It is also anticipated that no long-term monitoring would be required. Access restrictions would be implemented as part of the recreational reuse scenario; it is anticipated that fenced boardwalks and warning signs regarding restrictions on use of sensitive habitat areas would also serve to restrict access to areas containing spent ammunition and affected soil outside areas of HD. Because this alternative would transfer the lead-containing soil from one location to another without treatment, long-term liability and other long-term risks would not be eliminated. However, either landfill would be maintained, operated, and closed in accordance with current regulations to protect human health and the environment over the long term.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Because this alternative consists of separation of spent ammunition and soil and further separation techniques to attempt reduction of lead concentrations in soil, there could be reduction in the volume; however, the toxicity would not be reduced. The lead-containing soil would be transported to the OU 2 CAMU or a permitted landfill; thus, the mobility of the contaminants would be reduced in the long term because they could not be transported by wind or by any materials or living organisms, and may be pretreated prior to disposal at a Class I landfill (depending on concentrations) with a concomitant reduction in mobility. Their mobility would be increased in the short term because of dust generation; however, dust control measures would be employed during site operations.

Spent ammunition would be recycled and revised in the manufacture of other products thus reducing the toxicity, mobility, and volume of spent ammunition as a waste through the smelting and reuse processes.

Short-term Effectiveness

This alternative involves excavation, separation, and transportation of spent ammunition to a recycling facility and soil to a landfill. The excavation, separation, and loading operations could have a potentially adverse short-term impact on community human health because of the lead-containing dust and particulates generated during remedial activities. These potentially adverse impacts would be minimized through the use of dust control measures such as spraying the soil with water or postponing operations during times of high wind. In addition, the exposure of workers to the contaminants would be minimized by the use of proper health and safety procedures. As with worker and community health, there would be a potential risk of adverse environmental impacts associated with this alternative because of the dust and particulates generated during excavation and loading. These impacts would be minimized by using dust control measures. Spent ammunition would be transported in enclosed containers posted with appropriate signs thereby limiting short-term impacts of transportation offsite.

Air monitoring stations would be established up- and downwind of the site to allow for evaluation of potential risks as a result of dust exposure during excavation. Air samples would be collected and analyzed for total particulates and lead when wind velocities exceeded a threshold level capable of transporting dust offsite. It is anticipated that the spent ammunition and soil could be excavated and transported to the offsite landfill within 6 to 8 months.

Implementability

Excavation, separation, loading, and transportation have been used widely and can be performed using well-established, conventional techniques. There are few or no technical considerations that would prohibit excavating and transporting the spent ammunition to a recycling facility or the soil to a landfill. Because Option 1 has been discussed and approved by the regulatory agencies, it anticipated that it could be implemented. Option 2 has been used at numerous sites with similar contamination problems, it is anticipated it could be administratively feasible with a minimal amount of effort. The services and materials required to implement this plan are available on relatively short notice.

Costs

Costs developed for this alternative are presented in Appendix 4B, Table 4B-2, and are summarized in Tables 4.5 and 4.6. There are no O&M costs associated with this alternative because the remedy results in closure of the site. The total capital costs associated with this alternative are estimated to range from: $7,115,000 for placement of untreated soil at the OU 2 CAMU, to $15,390,000 for offsite disposal at a Class I landfill. This estimate includes site work, transportation and disposal, and site restoration costs.

Regulatory Acceptance

The regulatory agencies have approved the approach for Option 1 for this site and have approved similar remedies at numerous sites under similar conditions for Option 2. For these reasons, it is anticipated that the alternative would be acceptable to the agencies. Acceptance will be addressed in the proposed plan after comments on the FS are received.

Community Acceptance

Because this alternative would remove the potential long-term risks at the site and remove contamination from the site, it is anticipated that it would be acceptable to a majority of the community members. Community concern over increased traffic, noise, or dust that could be generated from operations, would be offset by reducing risks and restoring sensitive habitat for intended reuse and proper health and safety and emergency response plans. Acceptance will be addressed in the proposed plan.

4.6 Comparison of Remedial Alternatives

Each potential remedial alternative for Site 3 was evaluated and compared on the basis of the nine EPA evaluation criteria described in Section 4.4. The comparison of alternatives is discussed below and summarized in Table 4.5.

Overall Protection of Human Health and the Environment

Alternative 1, no action, would not provide good overall protection of human health and the environment because it would not be expected to meet chemical-specific ARARs for lead in soil. Alternative 2 (excavation, separation, recycling of spent ammunition, and treatment of soil) and Alternative 3 (excavation, separation, and recycling of spent ammunition and disposal of soil at a CAMU or landfill) would significantly increase overall protection in HD areas, eliminating the potential risks associated with human contact and reducing the site-weighted lead concentration to below the HBLC. There would be some increased short-term risks associated with the generation of dust during excavation, separation, and some risks associated with loading and offsite transport; however, these risks would be mitigated through implementation of dust control measures and health and safety protocols.

Compliance with ARARs

Alternative 1 would not meet chemical-specific ARARs because all lead-containing soil would remain in place. Alternatives 2 and 3 would meet all chemical-specific, action-, and location-specific ARARs.

Long- and Short-term Effectiveness

Alternative 1 potentially would allow direct contact with spent ammunition and lead-containing soil and, therefore, would not be effective in the long term. Alternatives 2 and 3 would provide remedies effective in the short and long terms and would take 6 to 8 months, and 8 to 12 months to implement, respectively. Alternatives 2 and 3 would remove spent ammunition and soil from areas of HD from the site, thereby reducing the site risks; however, under Alternative 3, the long-term risks associated with the lead-containing soil would remain with the generator at the CAMU or landfill. Both of these alternatives would also require possible access and deed restrictions to protect sensitive habitat and inform potential future users of the site of any residual risks in unexcavated areas.

Reduction of Toxicity, Mobility, and Volume Through Treatment

The no action alternative, Alternative 1, would not reduce the toxicity, mobility, or volume of the chemicals in the soil. Alternative 2 would reduce toxicity, mobility, and volume, depending on the type of treatment implemented. Alternative 3 would reduce the mobility, but not the toxicity or volume of lead-containing soil. However, the CAMU at OU 2 and other offsite permitted landfills would be designed to be able to closely monitor potential migration of contaminants. If stabilization of soil were required before disposal at a Class I landfill, the mobility of chemicals would be reduced.

Implementability

All of the alternatives considered for remediation are implementable subject to the ability to secure the appropriate permits and approvals. Alternatives 2 and 3 would have to be implemented in accordance with ARARs, and would require equipment that is readily available.

Costs

Total estimated NPV costs would vary considerably for the three alternatives. There are no costs associated with Alternative 1 at this time. Alternatives 2 and 3, which would achieve the HBLC, are:

- Alternative 2: $11,482,000 (stabilization); $13,759,000 (soil washing); $16,036,000 (asphalt batching) depending on the method of soil treatment
- Alternative 3: $7,115,000 (OU 2 CAMU); $15,390,000 (Class I landfill).

Placement of soil at the OU 2 CAMU is the most cost effective option under Alternative 3. Option 2 under Alternative 3 and Alternative 2 have a range of cost much higher than Option 1.

Regulatory Agency and Community Acceptance

It is expected that the regulatory agencies and the community would accept each of the two action alternatives; however, the status of their acceptance cannot be determined at this time.

4.7 Selection of the Preferred Remedial Alternative

On the basis of the comparison of remedial alternatives in Section 4.6, Alternative 3 is selected as the preferred alternative for the following reasons.

- It would be protective of human health and the environment through removal and recycling of spent ammunition and disposal of contaminated soil at a CAMU onsite or an offsite landfill
- It would comply with ARARs
- It would be the most effective in the short and long terms, because the contamination would be managed onsite at Fort Ord and would have a beneficial reuse as foundation layer material.
- It would reduce the mobility and volume of contaminated soil through placement in the CAMU or landfill and recycling of the volume of waste associated with spent ammunition
- It is easily implemented through use of readily available equipment

- The cost is the lowest of the two alternatives that involve remediation of the site.

TABLES

Table 4.1 Summary of Analytical Results for Inorganic Soil Samples - Site 3
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method Analyte	Number of Samples Analyzed	Number of Samples With Detected Analyte	Number of Samples With Nondetected Analyte	Number of Samples With Results Rejected	Totals	Units	Minimum Detected Value	Maximum Detected Value
METALS BY ICP								
Antimony	69	18	42	9	69	mg/kg	9.30	3360.00
Chromium	69	69	0	0	69	mg/kg	3.20	53.80
Copper	30	30	0	0	30	mg/kg	5.50	19900.00
Iron	69	69	0	0	69	mg/kg	1810.00	31200.00
Lead	69	40	29	0	69	mg/kg	11.00	46300.00
Zinc	69	66	3	0	69	mg/kg	6.30	2160.00
EPA-282.2								
Tin	68	13	55	0	68	mg/kg	1.00	67.40
EPA-7211								
Copper	39	39	0	0	39	mg/kg	0.47	12.30
EPA-7196								
Chromium VI	72	0	67	5	72			
EPA-9045								
pH	69	69	0	0	69	ph	5.10	8.30
EPA-9081								
Cation Exchange Capacity as Na	69	69	0	0	69	meq/100g	2.00	40.30

ICP Inductively coupled plasma
mg/kg Milligrams per kilogram
meq/100q Milliequivalents per 100 grams

Table 4.2. Potential Applicable or Relevant and Appropriate Requirements - Site 3
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Chemical-Specific Requirements				
Identification and Listing of Hazardous Wastes	Title 22 CCR, Chapter 11	Establishes/defines procedures and criteria for identification and listing of RCRA and non-RCRA hazardous wastes.	Applicable	Chemicals may be present at hazardous levels.
Standards for the Management of Hazardous Waste	Title 23 CCR, Chapter 15, Article 2; Waste Classification and Management	Establishes and defines procedures and criteria for identification and listing of designated and hazardous wastes.	Applicable	If any soil is determined to be designated or hazardous waste, it will be handled appropriately.
Monterey Bay Unified Air Pollution Control District (MBUAPCD)	Regulation II (New Sources) and Regulation X (Toxic Air Contaminants)	Establishes requirements for new stationary sources of air pollution, and the appropriate level of abatement control technology for toxic air contaminants.	Relevant and Appropriate	The remedial design would need to meet the substantive requirements of these MBUAPCD regulations if screening or excavation activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal.
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	40 CFR Part 150	Establishes NAAQS for criteria pollutants: particulate matter (PM10), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead.	Applicable	Dust containing lead may be encountered or generated during remedial construction activities. Dust suppression measures will be implemented to prevent such emissions.
Location-Specific Requirements				
Endangered Species Act of 1973	16 U.S.C. 1531 et seq. 50 CFR Parts 200 and 402	Provides for the protection of endangered or threatened plant and animal species through an evaluation of affected habitats in the site area, as well as consultation with the appropriate government agencies.	Applicable	Site 3 does contain endangered species of plants and animals. Each area will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment that will recommend measures, as necessary, to ensure compliance with this ARAR.
California Endangered Species Act	California Fish and Game Code, Sections 2050 et seq.	Provides for the recognition and protection of rare, threatened and endangered species of plant and animals (in conjunction with state authorized or funded actions).	Applicable	Site 3 does contain endangered species of plants and animals. Each area will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment that will recommend measures, as necessary, to ensure compliance with this ARAR.
Migratory Bird Treaty Act	16 U.S.C. 703 et seq.	Protects certain migratory birds or their nests or eggs.	Applicable	Migratory birds are present on Site 3. Each area will be screened for potential environmental impacts to such species and results will be included in the Ecological Risk Assessment that will recommend measures, as necessary, to ensure compliance with this ARAR.

Table 4.2. Potential Applicable or Relevant and Appropriate Requirements - Site 3
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Location-Specific Requirements				
National Archaeological and Historic Preservation Act	16 USC 469 et seq. 36 CFR Part 65	Provides for the protection of any historically significant artifacts that may be unearthed during excavation activities.	Applicable	No historically significant artifacts have been uncovered during previous investigation activities at Ford Ord, and none are expected to be unearthed at these areas. Actions will be taken, as necessary, however, should any such artifacts be unearthed.
Coastal Zone Management Act	16 U.S.C. 1456	Requires activities conducted in the coastal zone (the area west of Highway 101) to be completed in a manner that is consistent with the state's coastal zone management program.	Applicable	Site 3 lies within the coastal zone; impacts to the coastal zone will be considered in the FS.
California Coastal Act of 1976	Public Resources Code Section 3000 et seq.	Establishes the State Coastal Zone Management Plan.	Applicable	Site 3 lies within the coastal zone; impacts to the coastal zone will be considered in the FS.
Action-Specific Requirements				
Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities	Title 22 CCR, Chapter 14, Use and Management of Containers; Article 9, Sections 66264.171-178	Establishes requirements for the use of containers to store hazardous waste.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Actions will be taken, as necessary, to comply with such requirements.
	Title 22 CCR, Section 66171; Condition of Containers	Containers for hazardous waste must be maintained in good condition.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Actions will be taken, as necessary, to comply with such requirements.
	Title 22 CCR, Section 66172; Compatibility of Waste in Containers	Containers for hazardous waste must be compatible with the wastes stored in them.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Actions will be taken, as necessary, to comply with such requirements.
Standards for owners and operators of hazardous waste treatment, storage, and disposal facilities (continued)	Title 22 CCR, Section 66173; Management of Containers	Containers holding hazardous waste must be closed during storage except when necessary to add or remove waste.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Actions will be taken, as necessary, to comply with such requirements.

Table 4.2. Potential Applicable or Relevant and Appropriate Requirements - Site 3
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
	Title 22 CCR, Section 66174; Inspections	Containers and container storage areas must be inspected weekly for leaks or deterioration.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Actions will be taken, as necessary, to comply with such requirements.
	Title 22 CCR, Section 66175; Containment	Container storage areas must be designed according to the requirements of this section.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Actions will be taken, as necessary, to comply with such requirements.
	Title 22 CCR, Section 66178; Closure	At closure, all hazardous waste and waste residues must be removed and remaining containment structures decontaminated.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in container.
	Title 22 CCR, Chapter 14, Article 2, Section 66264.14	Owners and operators of hazardous waste treatment, storage, or disposal (TSD) facilities must prevent the unknowing entry of persons or livestock onto the active portions of the facility; in addition, warning signs must be posted.	Relevant and Appropriate	If excavated soil is hazardous and it is treated, stored, or disposed onsite, areas will be restricted from public access.
	Title 22 CCR, Chapter 14, Article 7, Section 66264.119; Post Closure Notices	Under this requirement, a restriction is placed on the deed which constrains future uses of the property.	Applicable	Remedial measures in which hazardous levels of chemical constituents remain in place may be subject to these regulations.
	Title 22 CCR, Chapter 14, Article 16, Section 66264.600-603, Miscellaneous Units	These regulations apply to facilities that treat, store, or dispose of hazardous waste in miscellaneous units. Owners and operators of TSDs at which hazardous waste is stored in miscellaneous units must locate, design, construct, operate, maintain, and close those units in a manner that is protective of human health and the environment.	Applicable	Remedial measures in which hazardous levels of chemical constituents are treated in miscellaneous units may be subject to these regulations.
Standards Applicable to Generators of Hazardous Waste	Title 22 CCR, Chapter 12	Establishes standards for generators of hazardous waste.	Applicable	If hazardous waste is generated at the site, the substantive portions of these regulation will apply.

Table 4.2. Potential Applicable or Relevant and Appropriate Requirements - Site 3
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Land Disposal Restrictions	Title 22 CCR, Chapter 18	Prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. Requires laboratory analysis of wastes intended for landfill disposal to establish that the waste is not restricted from landfill disposal.	Applicable	Listed or characteristic hazardous wastes may be subject to these regulations if they are land disposed.
Standards for discharges of waste to land	Title 23 CCR, Chapter 15	Sets standards for waste and site classifications and waste management requirements for waste treatment, storage, or disposal in landfills, surface impoundments, waste piles, and land treatment facilities in order to protect water quality.	Applicable	Chapter 15 does not apply because spent ammunition was not disposed at Site 3, but was deposited as part of the firing of small arms.
Monterey Bay Unified Air Pollution Control District (MBUAPCD)	Regulation II (New Sources) and Regulation X (Toxic Air Contaminants)	Establishes requirements for new stationary sources of air pollution, and the appropriate level of abatement control technology for toxic air contaminants.	Relevant and Appropriate	The remedial design would need to meet the substantive requirements of these MBUAPCD regulations if activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal.

Table 4.3. Remedial Action Objectives - Site 3
Volume V - Feasibility Study RI/FS
Fort Ord, California

Media/Exposure Pathway	Objective	Remediation Requirements
For Human Health Protection		
Air/Soil Inhalation/Ingestion		
Short-term	Minimize direct exposure to onsite and offsite workers; maintain background air quality levels or OSHA/NIOSH and MBUAPCD standards.	Minimize temporary releases during remediation; monitor air quality; personal protection and monitoring.
Long-term	Prevent significant deterioration; maintain background air quality levels	Source containment, removal, or control.
For Ecological Protection		
Existing Habitat		
Short-term	Minimize intrusive activities into existing habitat.	Utilize remediation equipment that protects existing habitat.
Long-term	Restore heavily disturbed sensitive habitat.	Habitat restoration.
Safety Hazards Associated with Live Ammunition and UXO/OEW		
Short-term	Minimize contact with live ammunition and UXO/OEW by onsite construction workers during remedial activities.	Use personnel trained to handle live ammunition and UXO/OEW; use remote operation equipment.
Long-term	Reduce potential exposure to live ammunition and UXO/OEW to potential future onsite users in any area compatible with future use.	Source control, deed restrictions, fencing; removal and/or treatment.

MBUAPCD	Monterey Bay Unified Air Pollution Control District.
OSHA	Occupational Safety and Health Administration.
NIOSH	National Institute of Occupational Safety and Health.
UXO	Unexploded Ordnance.
OEW	Ordnance and Explosive Waste.

Table 4.3. Remedial Action Objectives - Site 3
Volume V - Feasibility Study RI/FS
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Media/Exposure Pathway	Objective	Remediation Requirements
For Human Health Protection		
Air/Soil Inhalation/Ingestion		
Short-term	Minimize direct exposure to onsite and offsite workers; maintain background air quality levels or OSHA/NIOSH and MBUAPCD standards.	Minimize temporary releases during remediation; monitor air quality; personal protection and monitoring.
Long-term	Prevent significant deterioration; maintain background air quality levels	Source containment, removal, or control.
For Ecological Protection		
Existing Habitat		
Short-term	Minimize intrusive activities into existing habitat.	Utilize remediation equipment that protects existing habitat.
Long-term	Restore heavily disturbed sensitive habitat.	Habitat restoration.
Safety Hazards Associated with Live Ammunition and UXO/OEW		
Short-term	Minimize contact with live ammunition and UXO/OEW by onsite construction workers during remedial activities.	Use personnel trained to handle live ammunition and UXO/OEW; use remote operation equipment.
Long-term	Reduce potential exposure to live ammunition and UXO/OEW to potential future onsite users in any area compatible with future use.	Source control, deed restrictions, fencing; removal and/or treatment.

MBUAPCD Monterey Bay Unified Air Pollution Control District.
OSHA Occupational Safety and Health Administration.
NIOSH National Institute of Occupational Safety and Health.
UXO Unexploded Ordnance.
OEW Ordnance and Explosive Waste.

Table 4.4 Retained Remedial Technologies - Site 3
Spent Ammunition and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Development of Alternative
NO ACTION	None	Monitoring, deed restrictions, access restrictions may be required, depending on the presence of contamination.	Low	Not effective; however, certain land uses may allow for debris to remain in place.	Requires regulatory approval of: any risk to environmental and human health, impact of chemicals on groundwater, consideration of future land use if deed restrictions imposed, and current landfilling requirements.	Yes
CONTAINMENT	Vertical Barriers					
	Grout curtain, sheet metal, slurry walls, or sheet piling	Provides semipermeable or impermeable barriers to horizontal migration of chemical-bearing soil and debris due to erosion or water flow.	Moderate/ High	Barriers are only moderately effective for containment of certain types of contamination; but could be more effective for uncontaminated debris.	Installation could prove difficult depending on site geology. Typically used as an interim measure; however, may be useful for erosion control and further spread of debris in sands.	No
	Horizontal Barriers					
	Grouting, sheet metal, or block displacement	Provides semipermeable or impermeable barrier to vertical migration of soil and debris due to erosion or water flow.	High	Barriers are only moderately effective for containment of certain types of contamination; but could be more effective for uncontaminated debris.	Installation often difficult depending on site geology and distribution of debris. Typically used as an interim measure; however, could be used in conjunction with excavation and replacement, or erosion control.	No

Table 4.4 Retained Remedial Technologies - Site 3
Spent Ammunition and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Development of Alternative
CONTAINMENT	Capping					
	Clay and soil	Semipermeable or impermeable surface layer comprised of compacted clay over debris and soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Effective for minimizing contact and surface water leaching of chemicals in debris and soil to groundwater. Cap requires continuous maintenance; groundwater monitoring may be required.	Implementable depending on planned site development and current regulatory requirements regarding landfilling. Compaction of waste prior to capping may prove difficult depending on waste profile.	No
	Multilayered	Semipermeable or impermeable materials such as compacted clay, soil, or lime placed in layers to prevent surface water infiltration, chemical transport, and contact.	High	Highly effective for minimizing contact and surface water leaching of chemicals in debris and soil to groundwater. Cap requires continuous maintenance.	Implementable depending on planned site development and current regulatory requirements regarding landfilling. Compaction of waste prior to capping may prove difficult depending on waste profile.	No
	Asphalt or concrete	Semipermeable or impermeable surface layer comprised of a concrete slab or a layer of asphalt to prevent surface water infiltration, chemical transport, and contact.	Low/ Moderate	Less effective for minimizing contact and surface water leaching of source area debris and soil to groundwater; more permeable than engineered caps.	Implementable for uncontaminated debris depending on planned site development and current regulatory requirements regarding landfilling. Compaction of waste prior to capping may prove difficult depending on waste profile.	No

Table 4.4 Retained Remedial Technologies - Site 3
Spent Ammunition and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Development of Alternative
CONTAINMENT (cont.)	Surface Water Controls					
	Grading	Smoothing of surface to grade after completion of excavation and backfilling.	Low	Could be effective in conjunction with other measures such as consolidation in an onsite repository and monitoring.	Implementable at close of site work.	Yes
	Revegetation	Engineered landscaping and placement of plants, shrubs, or trees to restore site after excavation.	Moderate	Minimizes erosion to prevent surface water ponding and chemical transport; effective in conjunction with other measures.	Implementable at close of site work; depends on planned site development and ecological considerations.	Yes
	Diversion and collection systems	Series of pipes and basins to direct surface water away from area of concern; minimizes surface water infiltration and chemical transport.	Moderate	Could be effective in conjunction with other measures.	Implementable at close of site work; depends on long-term planned site development.	Yes
COLLECTION	Excavation					
	Standard Excavation	Removal of debris and soil by digging with commonly used heavy equipment.	Moderate	Highly effective for removal of most debris and soil.	Implementable, with most equipment readily available; may require use of specialized equipment for removal of large debris or ammunition. Footing of equipment in sandy dune areas may prove difficult.	Yes

Table 4.4 Retained Remedial Technologies - Site 3
Spent Ammunition and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Development of Alternative
COLLECTION (cont.)	Deep soil excavation	Removal of soil with deep augers and other nonstandard excavation techniques.	High	Effective for metals in soil.	Not applicable to shallow contamination at Site 3.	No
TREATMENT	Physical Treatment					
	Screening	Removal of larger sized particles from the waste stream by passage through a screen.	Low	Effective for separation and homogenization of waste.	Applicable for primary processing prior to soil treatment.	Yes
	Soil washing	Extraction of contaminants using solvents or surfactants as washing solution ex situ.	Moderate/ High	Effective for metals in soil; depends on solvent affinity for metals. May be used as primary treatment process for reduction of volume requiring treatment.	Equipment available; however, technology is innovative for lead in soil and not proven on large scale; requires subsequent treatment of waste stream.	Yes
	Stabilization/Fixation					
	Cement-based stabilization	Cement- or pozzolanic-based agents are added to bind contaminants and soil into a solid mass.	Moderate	Effective for metals in soil.	Difficult to implement for soil with cobbles or boulders; limits land use if left onsite. Requires pilot study.	Yes
	Asphalt batching (thermoplastic stabilization)	Soil is incorporated into asphalt emulsion for use as an aggregate in the manufacture of asphalt.	Low/ Moderate	Effective depending on concentrations of metals in soil.	Not implementable if concentrations of metals above RCRA-regulated levels.	Yes

Table 4.4 Retained Remedial Technologies - Site 3
Spent Ammunition and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Development of Alternative
TREATMENT (cont.)	<u>Offsite Treatment</u>					
	Stabilization	Reduces chemical mobility through binding contaminants and soil into a solid mass.	High	Effective for metals in soil.	Not implementable for reuse if concentrations of metals above RCRA-regulated levels. Implementability depends on offsite facility location and availability.	Yes
	Asphalt batching (thermoplastic stabilization)	Soil is incorporated into asphalt emulsion for use as an aggregate in the manufacture of asphalt.	Low/ Moderate	Effective depending on concentrations of metals in soil.	Implementability limited if concentrations of metals above RCRA-regulated levels.	Yes
DISPOSAL	<u>Onsite Disposal</u>					
	Replacement after treatment	Excavation and treatment, or separation of soil or debris, with replacement of material into excavated areas.	Low	Effective for any debris or soil treated to agreed upon levels; may require liner, cap, or monitoring depending on waste.	Easily implemented; equipment readily available to backfill debris or soil.	Yes
	Repository	Onsite waste management unit that may be lined and capped or completely enclosed in cement or other stable, non-eroding material.	High	Effective for containment of most wastes. Requires continuous maintenance, monitoring, or leachate, collection, and recovery system (LCRS).	Implementable depending on planned site development; area would have to be designated as a permanent landfill facility.	No
	Onsite disposal	Onsite with replacement of or treated soil.	Moderate	Effective if approved by regulatory agencies.	Implementable, depending on planned site development.	Yes
	<u>Offsite Disposal</u>					
	Demolition landfill	Transport of live ammunition or explosives to offsite facility for detonation and/or disposal.	Low/ Moderate	Effective for live ammunition detonation and disposal of fragments or exploded ordnance.	Implementable; unexploded ordnance would be detonated and disposed by Army team.	No

Table 4.4 Retained Remedial Technologies - Site 3
Spent Ammunition and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Development of Alternative
DISPOSAL (cont.)	Landfill	Transport of chemical-bearing debris and soil to appropriate landfill by licensed waste transporter.	Low/ High	Effective; however pretreatment may be required depending upon presence of: contamination, biological hazards, or live ammunition.	Implementable and readily available. Class of landfill depends upon type of debris; some landfills offer pretreatment.	Yes
	Recycling facility	Transport of recyclable or reclaimable debris to an appropriate facility such as a smelter.	Low	Effective for debris such as scrap metal, glass, and oil or known substances found in containers.	Implementable; facilities are available in California.	Yes

Table 4.5. Evaluation of Remedial Alternatives - Site 3
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

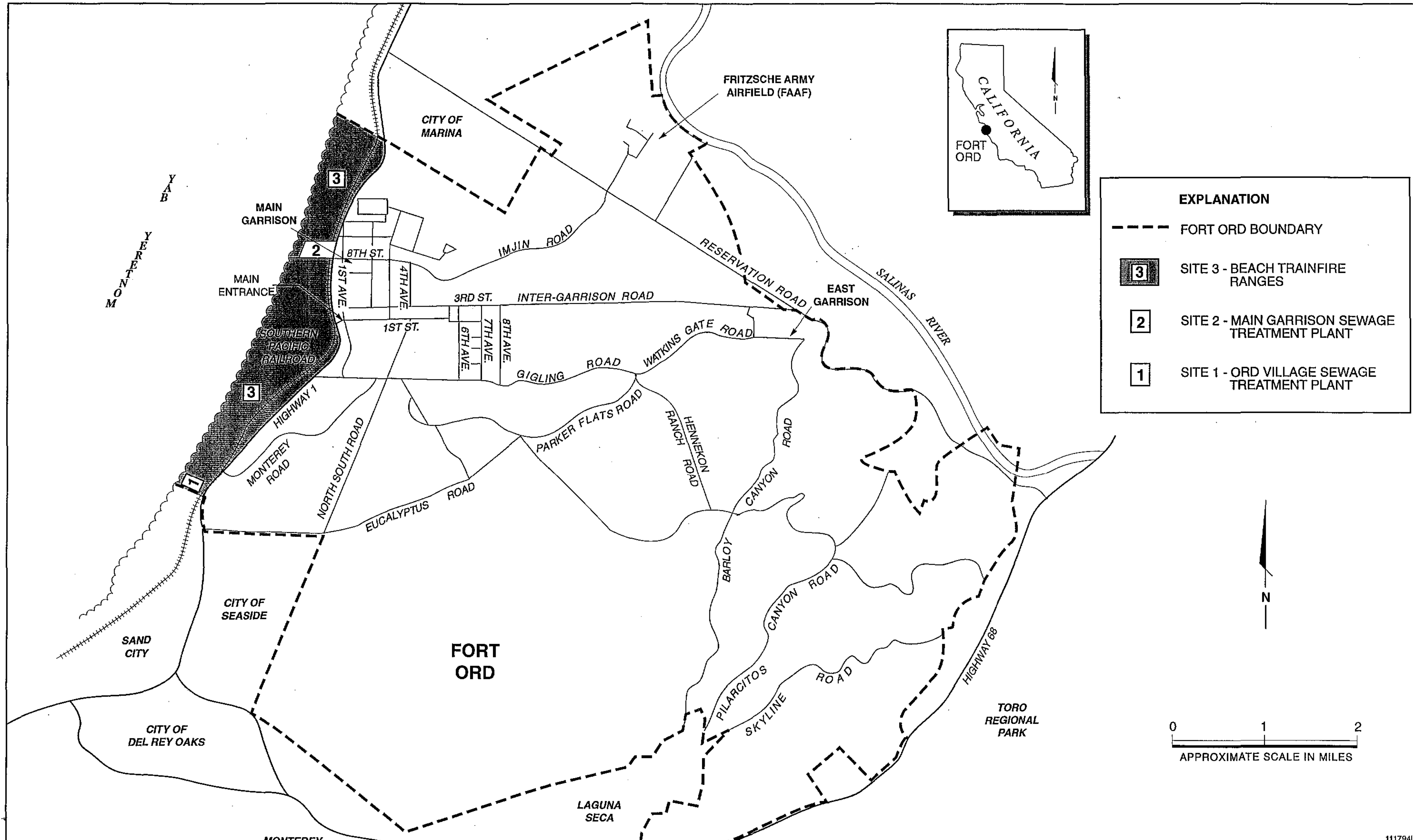
Alternative	Short-Term Effectiveness[1]	Long-Term Effectiveness	Reduction of Toxicity, Mobility, and Volume Through Treatment	Implementability	Compliance with ARARs	Overall Protection of Human Health and the Environment	Regulatory Agency and Community Acceptance	NPV Cost
Alternative 1: No Action	Not effective	Not effective	No reduction of T, M, or V	Easy to Implement	No	Not protective	To be determined	$0
Alternative 2: Excavation, Separation, Recycling, and Treatment	Effective SCT = 8-12 mo.	Effective Moderately complex, will achieve TCLs	Soil: Reduction of T, M, and V Spent Ammunition: Reduction of T and M, no reduction of V	Implementable; some equipment specialized	Yes	Protective	To be determined	$11,897,000/ $11,695,000/ $13,972,000*
Alternative 3: Excavation, Separation, and Disposal at Landfills	Effective SCT = 6-8 mo.	Effective Will achieve TCLs	Soil: Reduction of M, no reduction of T or V Spent Ammunition: Reduction of M, no reduction of T or V	Easy to implement	Yes	Protective	To be determined	$15,806,000

SCT Soil Cleanup Time
TCL Target Cleanup Level.
* Range of cost for soil treatment as follows: stabilization/soil washing/asphalt batching.
NPV Net Present Value

Table 4.6. Summary of Remedial Alternative Cost Estimates - Site 3
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Alternative	Capital (Total) Cost
Alternative 1	$0
Alternative 2	
Stabilization	$11,482,000
Soil Washing	$13,759,000
Asphalt Batching	$16,036,000
Alternative 3	
OU 2 CAMU	$7,115,000
Class I Landfill	$15,390,000

PLATES



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Site Location Map - Site 3
Volume V - Feasibility Study
Basewide RI/FS
Fort Ord, California

PLATE **4.1**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
RHCc	23366 0417253	MLS	6/94	11/94

EXPLANATION

- HAND-DUG TEST PIT
- CONFIRMATION SAMPLE
- MONITORING WELL (HLA)
- SITE BOUNDARY
- STUDY AREA BOUNDARY
- PATTERN/COLOR OUTLINE
- BLOWOUT
- 160 GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 10 FEET)
- 1460 BUILDING

POSTING OF CHEMICALS

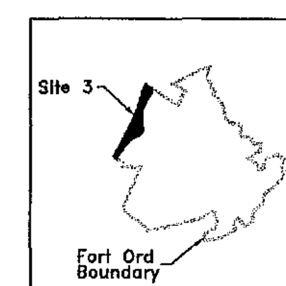
- SAMPLE LOCATION
- SAMPLE DEPTH IN FEET BELOW GROUND SURFACE
- SAMPLE COLLECTION DATE

SS-12-03	(0.5)( )
Pb	28.2 A
Zn	18.3 NJ

- PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLE 13 IN VOLUME II -- RI, SITE 3.
- CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (mg/kg)
- ANALYTES- INCLUDES ALL INORGANICS EXCEEDING MAXIMUM BACKGROUND CONCENTRATIONS AND DETECTED CONCENTRATIONS OF INORGANICS FOR WHICH BACKGROUND CONCENTRATIONS ARE NOT AVAILABLE ABBREVIATIONS ARE DEFINED IN TABLE 13 OF RI.

- HEAVY, 10% OR GREATER SURFACE AREA COVERED BY SPENT AMMUNITION
- MODERATE, 1 TO 10% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- LIGHT, LESS THAN 1% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- NO SPENT AMMUNITION PRESENT AT SURFACE

TARGET CLEANUP LEVEL FOR LEAD IN SOIL IS 1,925 MG/KG



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366350	23366 0417153			AED
2	12/94	DRAFT FINAL	23366350	23366 0417253			AED
3	10/95	FINAL	23366350	23366 0417251	MLS	10/17/95	AED

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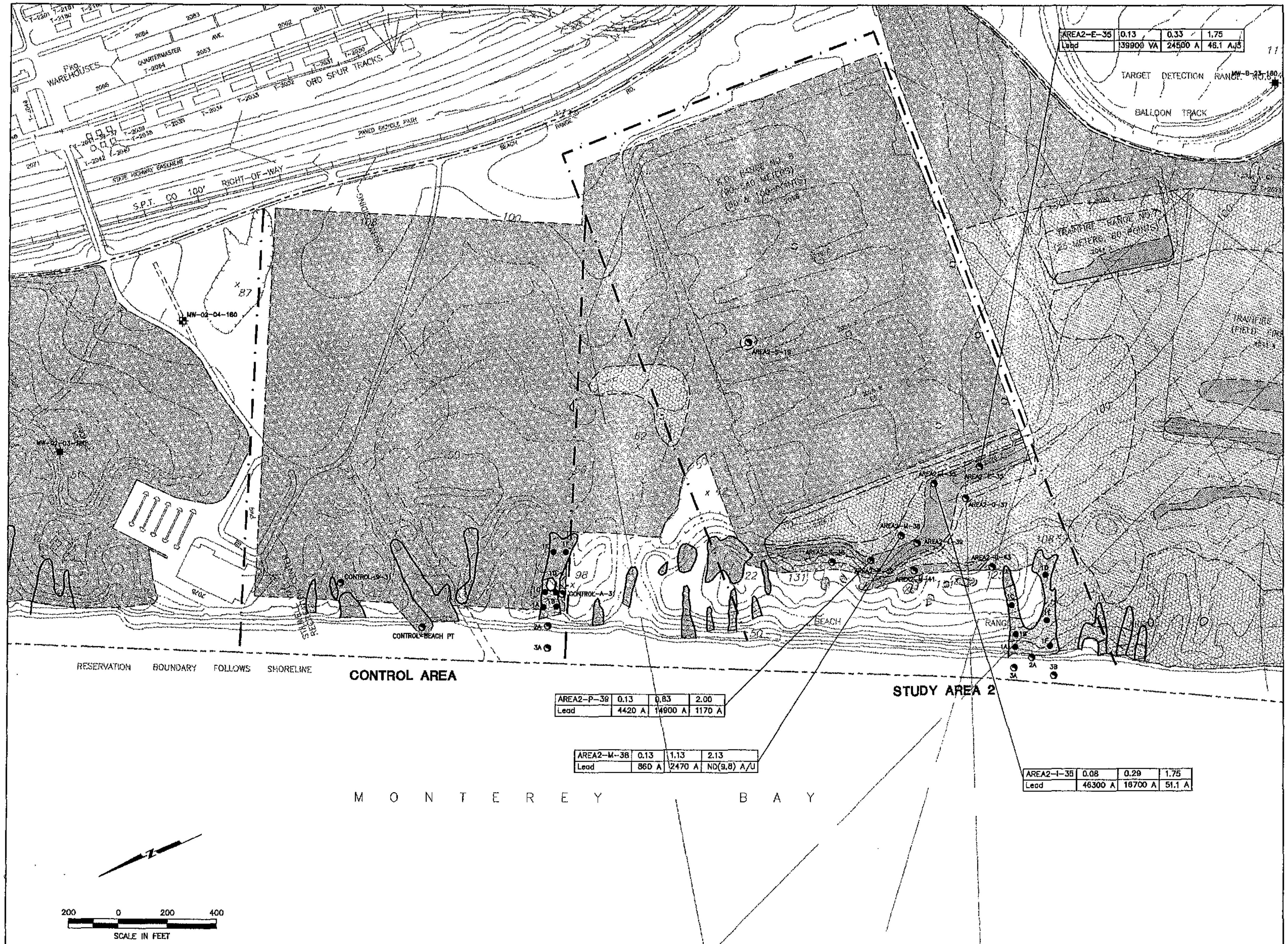
Volume V - Feasibility Study
Basewide RI/FS
Fort Ord, California

Lead Concentrations In Soil Above TCL
Study Area 1 - Site 3

PLATE: 4.2



EXPLANATION

- HAND-DUG TEST PIT
- CONFIRMATION SAMPLE
- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- SITE BOUNDARY
- STUDY AREA BOUNDARY
- PATTERN/COLOR OUTLINE
- BLOWOUT
- GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 10 FEET)
- BUILDING

POSTING OF CHEMICALS

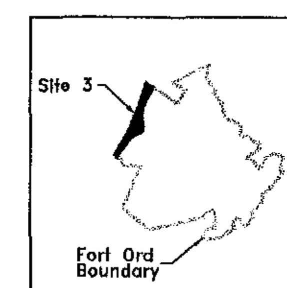
- SAMPLE LOCATION
- SAMPLE DEPTH IN FEET BELOW GROUND SURFACE
- SAMPLE COLLECTION DATE

SS-12-03	(0.5)( )
Pb	26.2 A
Zn	16.3 NJ

- PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLE 13 IN VOLUME II – RI, SITE 3.
- CONCENTRATIONS IN MILLIGRAMS PER KILOGRAM (mg/kg)
- ANALYTES– INCLUDES ALL INORGANICS EXCEEDING MAXIMUM BACKGROUND CONCENTRATIONS AND DETECTED CONCENTRATIONS OF INORGANICS FOR WHICH BACKGROUND CONCENTRATIONS ARE NOT AVAILABLE. ABBREVIATIONS ARE DEFINED IN TABLE 13 of RI.

- HEAVY, 10% OR GREATER SURFACE AREA COVERED BY SPENT AMMUNITION
- MODERATE, 1 TO 10% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- LIGHT, LESS THAN 1% OF SURFACE AREA COVERED BY SPENT AMMUNITION
- NO SPENT AMMUNITION PRESENT AT SURFACE

TARGET CLEANUP LEVEL FOR LEAD IN SOIL IS 1,925 MG/KG



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366351	23366 0417153			AED
2	12/94	DRAFT FINAL	23366351	23366 0417253			AED
3	10/95	FINAL	23366351	23366 041737	MLS	10/17/95	AED

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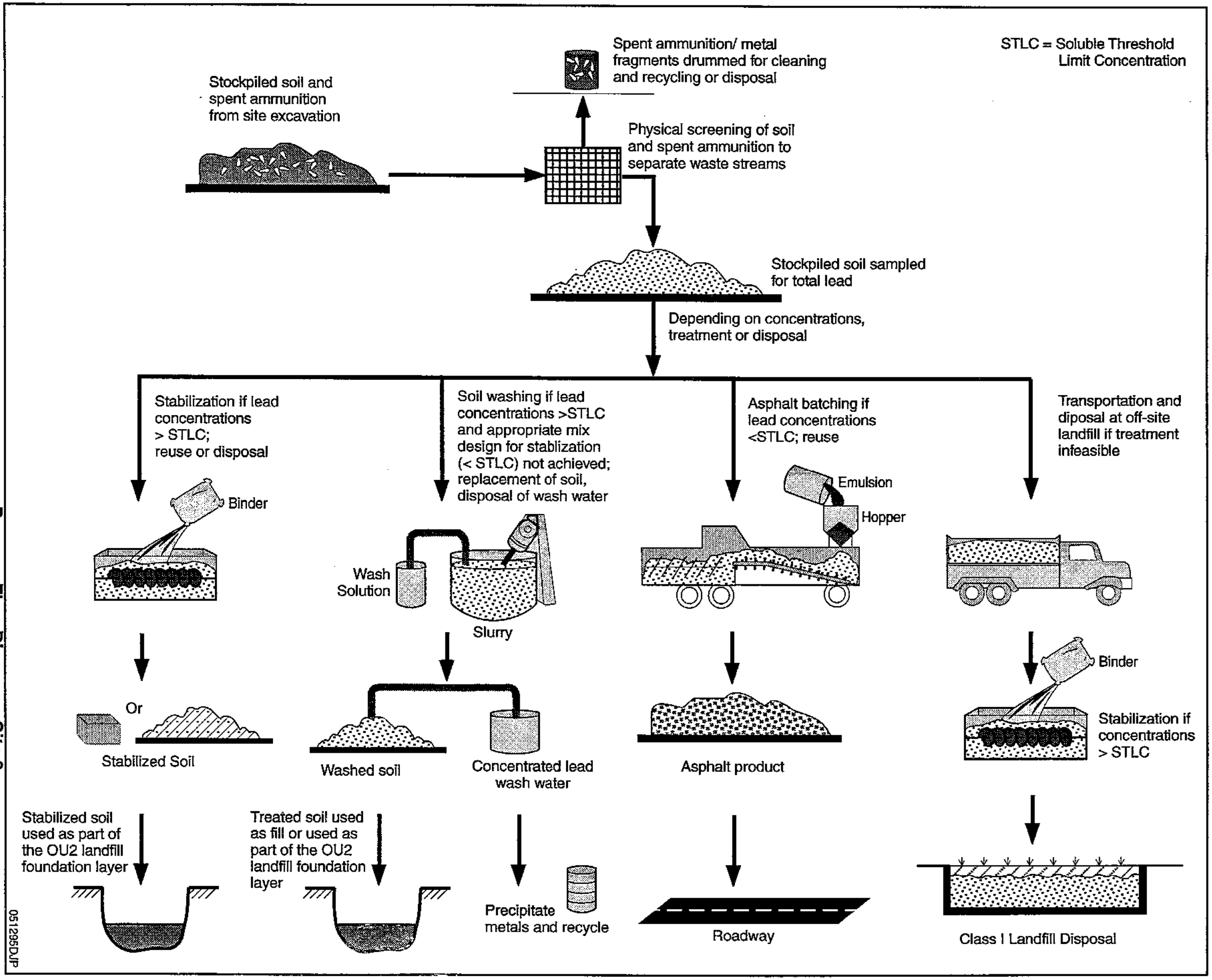
Volume V – Feasibility Study
Basewide RI/FS
Fort Ord, California

Lead Concentrations in Soil Above TCL
Control Area and Study Area 2 – Site 3

PLATE: 4.3



HLA

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Process Flow Diagram - Site 3
Pre-Remedial Design Study
Volume V - Feasibility Study
Basewide RI/FS
Fort Ord, California

PLATE **4.5**

051295DJP

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
DJP	23366 0417253	MLS	6/94	11/94

APPENDIX 4A

REMEDIAL TECHNOLOGY SCREENING SUMMARY CHECKLIST FORMS

APPENDIX 4A

The attached checklists in this Appendix are taken from the *Draft Remedial Technology Screening (RTS) Report, Fort Ord, California,* dated February 9, 1994. These forms were completed for the wastes present at Site 3. These checklists refer to remedial technology screening tables (Tables 1 to 23), which can be found in the RTS report. These RTS tables were developed specifically for Fort Ord on a basewide level to accelerate in the preparation of Fort Ord Feasibility Studies. As described in the main text of this Site 3 Feasibility Study (FS), all technologies identified as applicable from the selected RTS tables were incorporated into Table 4.4 of this FS. Section 4.4 of this report describes how these standard RTS technologies were then screened for specific conditions at Site 3.

- Form 4A-1 identifies the appropriate RTS table based on site chemicals and the media affected. Separate in situ and ex situ categories are presented for soil, and only one category for debris. Based on this form, RTS Tables 8 and 12 were identified as applicable for Site 3.
- Form 4A-2 lists the retained technologies identified from the RTS Tables 8 and 12 identified on Form 4A-1, for soil and debris, respectively. These technologies were incorporated into Table 4.4 of this FS for further site-specific screening and evaluation.

APPENDIX 4A

FORM 4A-1

MATRIX GUIDE/CHECKLIST
IDENTIFICATION OF TECHNOLOGY SCREENING TABLES
Remedial Technology Screening Report
Fort Ord, California

Locate Group of Compounds below in rows (A) through (F): Check One.	A ☐ B ☐ C ☐ D ■ E ☐ F ☐
In what media are the compounds? Locate the appropriate column (#) for either soil, groundwater, or debris.	Soil (1&2) ■ Groundwater (3&4) ☐ Debris (5) ■
Are both in situ and ex situ treatment potentially applicable for soil or groundwater at this site? Locate in situ, ex situ, or both types of treatment in Columns (1) through (4).	Soil: In Situ 1 ☐ Ex Situ 2 ■ Groundwater: In Situ 3 ☐ Ex Situ 4 ☐
Where compound, media, and type of treatment intersect, refer to the technology screening table number indicated. Use Forms B-2, B-3, or B-4 to record applicable technologies as tables are reviewed.	Table(s) 8 12 ___ ___ ___

Media	Soil		Groundwater		Debris
Classes of Compounds	(1) In Situ	(2) Ex Situ	(3) In Situ	(4) Ex Situ	(5) *
(A) VOCs	Table 1	Table 2	Table 13	Table 14	**Table 12**
(B) TPH-light	Table 3	Table 4	Table 15	Table 16	
(C) TPH-heavy	Table 5	Table 6	Table 17	Table 18	
(D) Metals	Table 7	**Table 8**	Table 19	Table 20	
(E) Pesticides	Table 9	Table 10	Table 21	Table 22	
(F) Mixed Waste +	Table 11		Table 23		

* Debris is not specific to a Group of Compounds

\+ Mixed waste is two or more dissimilar Groups of Compounds combined in soil or groundwater, such as metals and VOCs.

APPENDIX 4A

FORM 4A-2

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

INSTRUCTIONS: For Debris or Mixed Waste, see Forms A-3 or A-4. Complete several forms if necessary for each separate Group of Compounds and Media, and attach to Feasibility Study file for each site (e.g., one form for VOCs in groundwater, and a separate form for metals in soil).

- Name of Site: Site 3
- Brief Description: Beach trainfire ranges with spent ammunition
- Group of Compounds (select one)
  - VOCs ____ TPH-light ____
  - TPH-heavy ____ Metals X
  - Pesticides ____
- Media (select one)
  - Soil X Groundwater ____
- Potentially Applicable Treatment (select one or both)
  - In Situ ____ Ex Situ X
- Referenced Table(s) Number 8 12
- Technologies Retained

In Situ	Ex Situ
	Stabilization
	Soil Washing
	Asphalt Batching

- Form Completed by: Margaret L. Stemper
- Description of Technology(s) (Appendix C) Reviewed by: Margaret L. Stemper
- Date Completed: June 1, 1994

APPENDIX 4B

COST ESTIMATES
AND ASSUMPTIONS

COST ESTIMATES AND ASSUMPTIONS

General Assumptions

- Air monitoring during excavation would include three continuous air monitoring stations, daily samples analyzed for lead and particulates, and 2 man hours of operation per day. Air monitoring would be performed as needed during handling and movement of contaminated material; for the purposes of this FS, it is assumed that air monitoring would be performed for 130 days (duration of remedial activities) to identify airborne concentrations associated with various soil handling operations.

- Dust suppression includes one water truck with operator. Dust suppression would be performed as needed during handling and movement of contaminated material, assumed to be 130 days.

- Excavated soil would not increase in volume due to the geologic nature of sand.

- Verification samples would be taken on approximate 50-foot centers from excavation bottoms. Samples would be analyzed for lead. Soil treatment verification samples are included in the cost per cubic yard for treatment.

- Mobilization includes equipment, materials, temporary construction facilities, and fencing for all phases of remedial activity.

- Handling and movement of contaminated material would occur through approximately two thirds of remedial construction activities.

Assumptions: Remedial Alternative 2

- Excavated soil would be screened, of which 8,000 cubic yards (cy) is spent ammunition and 55,000 cy is soil.

- Excavation, separation, recycling, and treatment would take approximately 8-12 months.

- Waste characterization at the recycling (refinery) facility would be based on analytical data collected during the RI.

- Recycling and transportation of spent ammunition assumes the current rate paid for recycled metals such as copper and lead would offset the transportation cost, with an additional cost of $1 per cy for handling.

Assumptions: Remedial Alternative 3

- Excavated soil would be screened, of which 8,000 cubic yards (cy) is spent ammunition and 55,000 cy is soil.

- Excavation, screening, and onsite disposal at the OU 2 CAMU or offsite disposal would take approximately 6-8 months.

- For Option 1, transportation, stockpiling, backfilling, compacting, and regrading of soil placed at the OU 2 landfill CAMU is included in cost.

- Air monitoring under Option 1 would be more than for Option 2 because the soil would be handled onsite in two locations (CAMUs at Site 3 and OU 2) instead of one.

- For Option 2, offsite Class I disposal is assumed to be at CWM - Kettleman Hills Facility, California.

- For Option 2, waste characterization would be performed at the Class I disposal facility on one composite sample shipped to the facility and from analytical data collected from stockpile samples targeted for disposal during remediation.

- For Option 2, transportation and stabilization of RCRA soil to a Class I landfill is included in cost.

- Waste characterization at the recycling (refinery) facility would be based on analytical data collected during the RI.

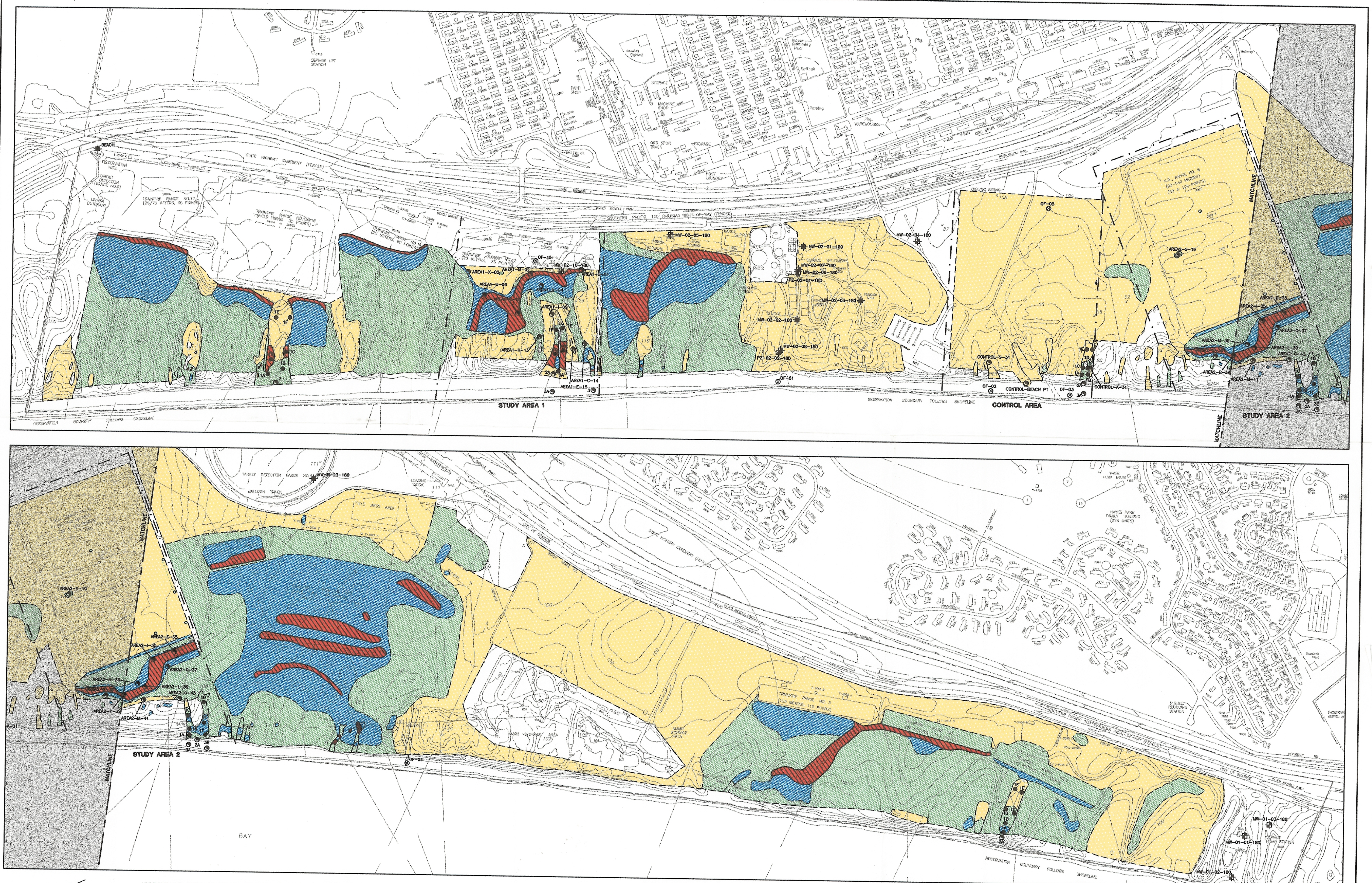
- Recycling and transportation of spent ammunition assumes the current rate paid for recycled metals such as copper and lead would offset the transportation cost, with an additional cost of $1 per cy for handling.

Table 4B-1. Cost Estimate - Site 3
Alternative 2 - Excavation, Separation, Recycling, and Treatment
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Item	Quantity/Units	Unit Cost	Total
CAPITAL COST			
Setup			
- Mobilization (excavate, screen)	2 each	$10,000	$20,000
Excavation of Soil			
- Surveying	1 allowance	$30,000	$30,000
- Excavation	63,000 cy	$10	$630,000
- Dust Control	130 day	$500	$66,000
- Screening	63,000 cy	$12	$756,000
- Stockpile Sampling	630 each	$100	$63,000
- Sidewall and Bottom Verification Sampling	340 each	$100	$34,000
Recycling/Treatment			
- Recycle, Transport Spent Ammunition	8,000 cy	$1	$8,000
Treatment			
- Stabilization/Soil Washing/Asphalt Batching	55,000 cy	$120/ $150/ $180	$6,600,000/ $8,250,000/ $9,900,000
Site Restoration			
- Site Grading	1 allowance	$30,000	$30,000
- Revegetation	1 allowance	$70,000	$70,000
Sampling			
- Air Monitoring	130 day	$100	$13,000
Construction Cost Subtotal			
- Construction Management (15%)	1 allowance	$1,248,000/ $1,496,000/ $1,743,000	$1,248,000/ $1,496,000/ $1,743,000
		Capital Cost Subtotal	$9,568,000/ $11,466,000/ $13,363,000
		Contingency (20%)	$1,914,000/ $2,293,000/ $2,673,000
TOTAL CAPITAL COST (costs are rounded to the nearest $1,000)			**$11,482,000/ $13,759,000/ $16,036,000**

Table 4B-2. Cost Estimate - Site 3
Alternative 3 - Excavation, Separation and Recycling, and Placement at OU 2 CAMU or Offsite Disposal at Landfills
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Item	Quantity/Units	Cost per Unit	Total
CAPITAL COST			
Setup			
- Mobilization (excavate)	1 each	$10,000	$10,000
Excavation and Screening of Soil			
- Surveying	1 allowance	$30,000	$30,000
- Excavation	63,000 cy	$10	$630,000
- Dust Control	130 day	$500	$65,000
- Screening	63,000 cy	$12	$756,000
- Stockpile Sampling	630 each	$100	$63,000
- Verification Sampling	340 each	$100	$34,000
Recycling/Treatment			
-Recyle, Transport Spent Ammunition	8,000 cy	$1	$8,000
Option 1 (Placement at OU 2 CAMU)/Option 2 (Offsite Disposal at Class I Landfill)			
- Transport/Place/Dispose Soil	55,000 cy	$60/$190	$3,330,000/ $10,725,000
Site Restoration			
- Site Grading	1 allowance	$30,000	$30,000
- Revegetation	1 allowance	$70,000	$70,000
Sampling			
- Air Monitoring	130 day	$1,000	$130,000
Construction Cost Subtotal			
- Construction Management (15%, excluding disposal fees)	1 lump sum		$773,000/ $274,000
		Capital Cost Subtotal	$5,929,000/ $12,825,000
		Contingency (20%)	$1,186,000/ $2,565,000
		TOTAL CAPITAL COST (costs are rounded to the nearest $1,000)	**$7,115,000/ $15,390,000**



APPROXIMATE SURFACE CONCENTRATION OF SPENT AMMUNITION

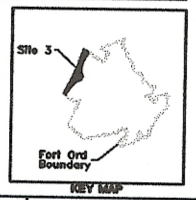
SCALE IN FEET (300 0 300 600)

- HEAVY, 10% OR GREATER SURFACE AREA COVERED
- MODERATE, 1 TO 10% OF SURFACE AREA COVERED
- LIGHT, LESS THAN 1% OF SURFACE AREA COVERED
- NO SPENT AMMUNITION PRESENT AT SURFACE
- APPROXIMATE BOUNDARY OF SOIL REMEDIAL UNIT WITH LEAD CONCENTRATIONS >1860 MG/KG

EXPLANATION

- HAND-DUG TEST PIT
- CONFIRMATION SAMPLE
- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- PIEZOMETER NEST (HLA)
- SEDIMENT SAMPLE FROM STORM DRAIN OUTFALL PIPE
- SITE BOUNDARY
- STUDY AREA BOUNDARY
- 160 GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 10 FEET)
- 1480 BUILDING
- DUNE BLOWOUT LOCATION WITH SURFACE CONCENTRATION OF SPENT AMMUNITION

MW-02-01-180
- TYPE DESIGNATION; MW = MONITORING WELL, SS = SURFACE SAMPLE, HP = HYDROPUNCH SAMPLE, OF = OUTFALL SAMPLE, PZ = PIEZOMETER, SB = SOIL BORING, SG = SOIL GAS, PB = PILOT BORING, TR = TRENCH
- SITE NUMBER
- AQUIFER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUIFER)
- WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TRENCH NUMBER



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366349	23366 0417153	MLS	7/94	AED
2	12/94	DRAFT FINAL	23366349	23366 0417253	MLS	11/94	AED

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Volume V – Feasibility Study
Basewide RI/FS
Fort Ord, California

Soil Remedial Unit
Site 3

PLATE: 4.4

SCALE IN FEET (300 0 300 600)

EXPLANATION

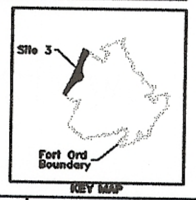
APPROXIMATE SURFACE CONCENTRATION OF SPENT AMMUNITION

- HEAVY, 10% OR GREATER SURFACE AREA COVERED
- MODERATE, 1 TO 10% OF SURFACE AREA COVERED
- LIGHT, LESS THAN 1% OF SURFACE AREA COVERED
- NO SPENT AMMUNITION PRESENT AT SURFACE
- APPROXIMATE BOUNDARY OF SOIL REMEDIAL UNIT WITH LEAD CONCENTRATIONS >1860 MG/KG

- HAND-DUG TEST PIT
- CONFIRMATION SAMPLE
- MONITORING WELL (HLA)
- MONITORING WELL (BY OTHERS)
- PIEZOMETER NEST (HLA)
- SEDIMENT SAMPLE FROM STORM DRAIN OUTFALL PIPE
- SITE BOUNDARY
- STUDY AREA BOUNDARY
- 160 GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 10 FEET)
- 1480 BUILDING
- DUNE BLOWOUT LOCATION WITH SURFACE CONCENTRATION OF SPENT AMMUNITION

MW-02-01-180

- TYPE DESIGNATION; MW = MONITORING WELL, SS = SURFACE SAMPLE, HP = HYDROPUNCH SAMPLE, OF = OUTFALL SAMPLE, PZ = PIEZOMETER, SB = SOIL BORING, SG = SOIL GAS, PB = PILOT BORING, TR = TRENCH
- SITE NUMBER
- AQUIFER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUIFER)
- WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TRENCH NUMBER



KEY MAP

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366349	23366 0417153	MLS	7/94	AED
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Volume V – Feasibility Study
Basewide RI/FS
Fort Ord, California

Soil Remedial Unit
Site 3

PLATE: 4.4

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

Volume V - Feasibility Study

Section 5.0 - Site 31

Draft: July 26, 1994
Draft Final: November 28, 1994
Final: October 25, 1995

Harding Lawson Associates
Engineering and Environmental Services
105 Digital Drive, P.O. Box 6107
Novato, California 94948 - (415) 883-0112

Basewide Remedial Investigation/Feasibility Study Fort Ord, California

Volume V - Feasibility Study

Site 31

HLA Project No. 23366 0417354

This final version of the Site 31 Feasibility Study addresses comments received on the Draft Final version of the report dated December 1994. Responses to agency comments on the Draft Final report are included in Volume VI of this report.

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

CONTENTS

CONTENTS

TABLES

PLATES

APPENDIXES

5.0 FEASIBILITY STUDY FOR SITE 31

5.1 Background

The following background sections are brief summaries of detailed information provided in the Remedial Investigation, Site 31 (Vol. II); the Baseline Human Health Risk Assessment, Site 31 (Vol. II); and the Ecological Risk Assessment, Site 31 (Vol. IV), of this Basewide Remedial Investigation/Feasibility Study (RI/FS) for Fort Ord, California. A background review of applicable environmental protection requirements and legislation for Site 31 is also presented.

5.1.1 Physical Description

Site 31, the Former Dump Site, is in the southern part of the East Garrison, in and adjacent to a ravine approximately 0.2 mile southeast of the intersection of Watkins Gate Road and Barloy Canyon Road (Plate 5.1). The dump site is at the boundary of the Leadership Reaction Training Compound (LRTC) on the northern side of the ravine south of Watkins Gate Road (Plate 5.2). The ravine is bounded to the west by Barloy Canyon Road and to the south by Crescent Bluff Road. To the east, the ravine widens, turns north and opens on to Watkins Gate Road. The ravine is approximately 60 feet deep (approximately 180 feet above mean sea level [MSL] at the top to 120 feet above MSL at the bottom) and is heavily vegetated with oak trees and low brush, including poison oak. The ravine's steep slope (1 foot horizontal distance for every 1 foot vertical distance) and loose surficial soil make walking difficult. High-voltage power lines cross over the site. The visible extent of disposal encompasses an approximately 500-foot-long section of the northern slope of the ravine. Visible debris includes, among other things, whole, broken, and melted cans, glass bottles, burnt wood pieces, concrete fragments, scrap metal, and empty, crushed 55-gallon drums.

5.1.2 History

The dump site was apparently used in the 1940s and 1950s. In the 1940s, the East Garrison, which is the oldest of the developed sections of Fort Ord, was a tent city for troops in training or being staged for transport (*EA, 1991a*). Based on a review of a 1941 map by the Office of Constructing Quartermaster, Fort Ord, the tent city was located approximately 2,000 feet north of Site 31. According to the map, a 500-ton incinerator (labeled T-400) was located at the top of the Site 31 ravine described above, within the area now occupied by the Leadership Reaction Training Compound. Although the East Garrison reportedly had been used as a training ground for cavalry and artillery since World War I, no records regarding the use of Site 31 were found. On the basis of interviews with Fort Ord personnel and of field observations obtained during this investigation, refuse observed on and within the ravine slope appears to date predominantly from the 1940s and 1950s (*EA, 1991a*). Apparently, during this time, refuse was wholly or partially incinerated in the incinerator described above and dumped over the northern slope of the adjacent ravine. Remnant coal debris, observed west of the existing site building structures, probably represents the location of former coal stockpiling, which probably served as a source of fuel for the incinerator. Also, Site 31 may be the landfill discussed in the Chemical Systems Laboratory (CSL) report, which described a general refuse landfill dating from the 1930s (*CSL, 1983*). At some later time, the incinerator was removed and dumping ceased, and the Leadership Reaction Training Compound was constructed and used. The site is currently not in use.

5.1.3 Proposed Reuse

The preliminary plan for reuse of land at Site 31 has been included as part of a 734-acre parcel that includes the East Garrison and Sites 29, 30, and 32 (FORA, December, 1994). Precise future plans for Site 31 are unknown. Site 31 has been included within a 200-acre parcel slated to become the Monterey Agricultural Center, which will include facilities for agricultural production, storage, cooling, packaging, and distribution and approximately 250 housing units for families and farm workers. Development of the Agricultural

Center is expected in existing developed areas of the parcel, particularly the East Garrison and the Ammo Supply Point. The remainder of the parcel is to be set aside as open space/habitat, with a priority on preserving areas that are natural habitats (*FORG, 1994; COE, 1994*). The steep nature of Site 31 and its natural habitats suggest that part will be set aside as open space and not developed as part of the Agricultural Center.

5.1.4 Nature and Extent of Contamination

The main potential source of contamination identified at Site 31 is incinerated debris and ash likely associated with the onsite incineration of refuse generated at the East Garrison during the 1940s and 1950s. Debris encountered along the northern slope of the ravine was probably dumped into the ravine after being wholly or partially incinerated. Areas of the slope where debris-free sand overlies debris-containing sands may have resulted from sand being pushed into the ravine during regrading activities associated with construction of the Leadership Reaction Training Compound (LRTC). The emanation of ash from the incinerator and the settling of ash on the ground surface in the vicinity of Site 31 represent an additional possible former migration pathway for the deposition of existing site contaminants.

Nonpoint sources of contamination considered during the remedial investigation of Site 31 include:

- Asphalt paving operations (as well as stockpiling of coal) at the Leadership Reaction Training Compound that may have released petroleum hydrocarbons and associated constituents

- The application of pesticides in the vicinity of Site 31. Such pesticides may include dichlorodiphenyltrichloroethane (DDT) or dichlorodiphenylethene (DDE).

5.1.4.1 Surface Debris

Surface debris is present at Site 31. This debris was differentiated into four different groups (Plate 5.2), and generally includes debris that is encountered within the first 2 feet below the ground surface. The four groups are described below:

- Sporadic surface debris (e.g., wood, metal pieces, whole and broken glass, and coal pieces) overlying silty sand to sandy silt, extending approximately 500 feet along the northern slope of the ravine and covering approximately one-half to three-fourths of the slope (from top to bottom)

- Extensive debris present at the surface and extending deeper than 2 feet bgs containing 25 to 75 percent debris (containing bottlecaps, pieces of pottery and metal, melted and unmelted glass pieces and bottles) and 25 to 75 percent silty sand to sandy silt, in an area approximately 60 feet by 60 feet on the northern slope of the ravine

- Moderately extensive to sporadic debris generally shallower than 8 inches bgs containing trace to 10 percent debris (e.g., metal fragments, whole and broken bottles, rusted cans, wood, coal pieces, and nylon netting) and 90 to 100 percent silty sand to sandy silt, in three areas along the northern slope of the ravine

- Coal debris shallower than 8 inches bgs, containing 10 to 100 percent coal debris in sand matrix, overlying silty sand to sandy silt, and existing in two areas north of the ravine.

5.1.4.2 Subsurface Debris

Subsurface debris at Site 31 is generally defined as that encountered between 2 and 15 feet below the ground surface. Incinerated and unincinerated subsurface debris was encountered in soil borings on the northern slope and on the bottom of the ravine and generally represented 10 to 20 percent of the material in a sand to silty sand matrix. The subsurface debris exists in an area approximately 320 feet by 110 feet (horizontal distance) along the northern slope of the ravine extending between the top and bottom of the slope (Plate 5.3). Subsurface debris included melted and unmelted glass fragments, concrete and asphalt chunks, burnt and unburnt wood, melted and unmelted fragments, brick and clay tile fragments, coal pieces, plastic netting, and ash.

5.1.4.3 Chemical Data

Chemical data collected during the Site 31 RI indicate the following:

- Relatively low concentrations of volatile organic compounds (VOCs) were detected in soil gas throughout the site. Because concentrations were low and VOCs were not detected in soil samples collected adjacent to soil gas sampling points, and because detected concentrations do not appear to be associated with the presence of debris, VOCs in soil gas were not investigated further as part of the RI.

- Acetone and methylene chloride were the only VOCs detected in soil samples analyzed; these VOCs are considered laboratory contaminants.

- Total petroleum hydrocarbons as diesel (TPHd), polycyclic aromatic hydrocarbons (PAHs), and dibenzofuran were detected in surface and subsurface soil samples; these chemicals appear to be related to the presence of incinerated and unincinerated debris.

- Pesticides, including 4,4'-DDE, 4,4'-DDT, gamma-BHC (lindane), heptachlor, aldrin, dieldrin, and endrin, were detected in surface and subsurface soil samples; these chemicals either may be related to the presence of incinerated and unincinerated debris or may be related to the former applications of pesticides along the ravine slope.

- Chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs) were detected throughout the site in surface and subsurface soil samples, both inside and outside areas with debris; concentrations appear to decrease away from the dump site. The presence of CDDs and CDFs may be related either to the dumping of incinerated refuse or to the settling of ash emanating from the chimney of the former onsite incinerator.

- Priority pollutant metals were detected above maximum background concentrations in surface and subsurface soil samples; generally, elevated metal concentrations were associated with the presence of incinerated or unincinerated debris at or above the sampling location.

- The lateral and vertical extent of several organic and inorganic compounds was not delineated to nondetect or established maximum background concentrations, respectively; however, because concentrations are low and/or are near maximum background conditions, no further investigation was warranted. The nature and extent of contamination from onsite sources at Site 31 have been adequately characterized to perform the Baseline Human Health Risk Assessment, Ecological Risk Assessment, and the Feasibility Study at this site.

Because chemicals detected within the soil at the site are relatively immobile and because groundwater is deep (i.e., approximately 135 feet below the bottom of the ravine), groundwater quality was not investigated at the site. However, the potential impact to groundwater by detected organic chemicals was evaluated in the Site 31 RI (Volume II) using VLEACH modeling on selected organic chemicals or groups of chemicals. With the exception of the TPHd surrogate dodecane, the results of the modeling indicated that these chemicals would not leach to groundwater over a 100-year period if left in place at maximum detected site concentrations. The modeling indicated that dodecane might leach to groundwater in 49 years and estimated the maximum concentration of less than 0.01 μg/l in 100 years; this is not considered to represent a significant impact to groundwater.

Potential impacts from metals, including lead, detected in soil were evaluated qualitatively in the Site 31 RI and are not anticipated to pose a threat to groundwater quality. The lack of a threat to groundwater quality is further substantiated by the following evidence:

- The mobility of the metals is generally a function of compound solubility, soil type, cation exchange capacity (CEC), salinity, and pH. Mobility is generally favored by low pH (less than 5). Soil pH is the primary factor in determining leachability in soil because this property is related to the ability of metals to move into solution. The other properties mentioned above (e.g., CEC) become significant after a metal has moved into solution. Because the pH of soil at the site ranges from 5.1 to 8.0, it is unlikely that metals at the site would migrate in solution or have the potential to leach into groundwater.

- Precipitation at Site 31 is not expected to alter soil pH or cause leaching of lead due to "acid rain." Normal pH of rainfall is approximately 5.6. Rainfall pH at Fort Ord is not expected to be below normal pH levels because the base is near the coast and provides little opportunity for rainfall to react with air pollutants and become unusually acidic.

- The occurrence of metals was also reviewed to evaluate the distribution of metals with depth. In most cases, the highest concentrations of metals were detected at the surface and within the debris. Concentrations of metals were generally within background levels below the debris fill, with a few exceptions. Where metals were detected above background beneath the fill, the concentrations dropped over an order of magnitude from concentrations detected in samples from the fill material. These results indicate that metals, including lead, have not leached into underlying soil.

The Site 31 RI also considered chemical migration via air and surface water pathways. This evaluation indicated that:

- Because no VOCs were detected in the soil (except for probable laboratory contaminants such as acetone and methylene chloride), volatilization is not considered a mechanism for the migration of contaminants into the air. The chemicals detected at Site 31 have relatively low vapor pressures and would not be readily volatilized to the air at ambient temperature conditions. However, there is a possibility that a few semivolatile organic compounds (SOCs) could volatilize, as discussed in Section 5.2 of the Site 31 RI.

- For Site 31, surface water is not considered a significant migration pathway for the following reasons: 1) surface water infrequently occurs at Site 31, 2) site conditions are not conducive to the dissolution of most of the detected chemicals, and 3) considering that the contaminants have been in place for over 40 years, concentrations of chemicals detected in the soil along the ravine bottom are generally low compared to concentrations in upslope debris-containing soils that indicate surface water transport, if any, is limited even over short distances.

Although several potential migration pathways have been evaluated for chemicals found at Site 31, no significant migration pathways in air, surface water, or groundwater currently exist. Chemicals at Site 31, although persistent, are generally immobile. In addition, an evaluation of analytical results of Site 31 soil samples and the results of modeling indicate that chemicals have not significantly migrated through soil (i.e., greater than a few feet) and do not pose a significant threat to groundwater in the future.

5.1.5 Summary of Risk Assessments

Potential risks to human health and the environment associated with impacted soil and debris material at Site 31 are evaluated in the Baseline Human Health Risk Assessment (BRA) in Volume III, and the Ecological Risk Assessment (ERA) in Volume IV. These risk assessments address the excess risks to human health and the environment posed by the chemicals of potential concern (COPCs) present at the site and were performed in accordance with EPA-approved assessment and modeling protocols. Results of the BRA and ERA, as well as target cleanup levels (TCLs), are summarized in the following sections.

5.1.5.1 Baseline Human Health Risk Assessment

Site 31 was subdivided for the Baseline Human Health Risk Assessment (BRA) into three topographical areas: the North Slope, the South Slope, and the LRTC Area. The North Slope encompasses the northern slope of the ravine and most of the surface and subsurface debris; the South Slope encompasses the ravine floor and lower part of the southern ravine slope; and the LRTC Area includes the relatively level area above the north slope (Plate 5.2). North Slope data were divided into surface soil data (0 to 2 feet bgs), subsurface data (between 2 to 10 feet bgs), and deep soil data (greater than 10 feet bgs). Both the South Slope and the LRTC Area soil data were divided into as follows: surface (0 feet bgs), subsurface (between 0 to 10 feet bgs), and deep (greater than 10 feet bgs).

Surface soil data for the North Slope included data from to 0-2 feet bgs, whereas the surface soil data for the LRTC and South Slope areas includes only data from samples taken directly on the ground surface (0 feet bgs). These different surface soil delineations reflect the differing exposure pathways used in the BRA. As described in Volume III the Baseline Human Health Risk Assessment for Site 31, a nearby resident trespasser scenario was used to establish risk levels for the soil and debris at Site 31. The nearby resident trespasser receptor was assumed to be exposed only to chemicals detected at the soil surface at the South Slope and LRTC Area because this receptor was assumed not to engage in activities (e.g., digging) that would expose him or her to soil at a greater depth in these areas. Surface soil at the North Slope, where the historical dumping of refuse and incinerator ash were predominantly dumped, is looser than at the other two areas due to the presence of sandy fill and surface and near-surface debris. Moreover, the vegetative cover (predominantly grasses) is less dense at the North Slope than at the South Slope and LRTC Area. For these reasons, the soil is more friable at the North Slope. Thus, when climbing on this steep slope, it is assumed that the receptor could potentially be exposed to soil up to 2 feet below the ground surface.

The chemicals detected in soil at each of the three areas are as follows:

- North Slope
  - Surface soil (0 to 2 feet bgs): SOCs, PAHs, dibenzofuran, fluoranthene, 2-methylnaphthalene, naphthalene, phenanthrene, and pyrene), pesticides (4,4'-DDE and 4,4'-DDT), CDDs and CDFs expressed as tetrachlorodibenzo-p-dioxin total equivalent (TCDD-TE), and metals (antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, silver, and zinc)
  - Subsurface soil (2 to 10 feet bgs): VOCs (acetone and methylene chloride), pesticides (4,4'-DDE and 4,4'-DDT), CDDs and CDFs expressed as TCDD-TE, TPH as diesel, and metals (antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, silver, thallium, and zinc)
  - Deep soil (greater than 10 feet bgs): Pesticides (aldrin, lindane, 4,4'-DDE, 4,4'-DDT, dieldrin, endrin, and heptachlor), and metals (antimony, arsenic, beryllium, total chromium, copper, lead, nickel, and zinc).
- South Slope
  - Surface soil (0 feet bgs): TCDD-TE and metals (antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, and zinc)
  - Subsurface soil (between 0 to 10 feet bgs): VOCs (acetone), TCDD-TE, and metals (antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, and zinc)
  - Deep soil (greater than 10 feet bgs): No analytes were detected above method detection limits.

- LRTC Area
  - Surface soil (0 feet bgs): TCDD-TE and metals (antimony, arsenic, beryllium, total chromium, copper, lead, mercury, nickel, and zinc)
  - Subsurface soil (0 to 10 feet bgs): TCDD-TE and metals (antimony, arsenic, beryllium, total chromium, copper, lead, mercury, nickel, and zinc)
  - Deep soil (greater than 10 feet bgs): metals (arsenic, beryllium, total chromium, lead, nickel, and zinc).

For the purposes of the BRA, one receptor and three exposure pathways were selected for quantitative evaluation for the COPCs identified. These receptors are henceforth referred to as "nearby resident trespassers." All other potential future human receptors were considered to have significantly less exposure to this site. The nearby resident trespasser receptor was assumed to be exposed to soil through incidental ingestion, dermal contact, and inhalation of dusts at each of these three areas. The potential for chemical transport offsite in fugitive dusts was also evaluated. The BRA for Site 31 is very conservative; it assumes that the nearby resident trespasser receptor plays at Site 31 every weekend day every week of the year, whatever the weather, and does this for all of the 12 years from 6 to 18 years of age. The BRA evaluated the risks associated with COPCs identified at Site 31 for both non-cancer health effects as well as excess cancer risks. Lead was evaluated separately because of its unique toxicological effects. Results of the BRA indicate that:

- No unacceptable noncarcinogenic adverse health effects from chemicals other than lead are anticipated at Site 31. Total Hazard Indexes (HIs) for Site 31, which are the sums of the multipathway noncarcinogenic HIs for the North Slope, South Slope, and LRTC Area, were estimated to be 0.02 for the reasonably maximally exposed receptor. This is below the target EPA HI of 1.0.

- The estimated total human health cancer risks for Site 31, which are the sum of the multipathway cancer risks estimated for the North Slope, South Slope, and LRTC Area, are calculated in the BRA. The average and reasonable maximum exposure (RME) total cancer risks are 2×10^{-8} and 8×10^{-7}, respectively. These risks are below the EPA target risk range of 1×10^{-6} to 1×10^{-4}.

- Because lead has unique toxicological properties, it was evaluated using a different methodology than the hazard index or excess cancer risks described above. Numerical modeling was performed to evaluate possible lead exposure for the nearby resident trespasser receptor at Site 31 and estimate the associated blood concentration using EPA approved methodology. The EPA target blood-lead level used for receptors at Site 31 in the BRA was 10 micrograms of lead per deciliter of blood (μg/dl). This 10 μg/dl is an EPA-recommended level provided in guidance documentation for conducting lead studies and risk assessments (*EPA, 1992d*). This target blood-lead level is not a legal requirement, but is the basis for the Baseline Human Health Risk Assessment used as part of the CERCLA process. Possible lead exposure was evaluated for only one area at Site 31, the North Slope, because it is the only area where lead is a COPC. The results of this lead exposure evaluation indicate that a remedy for lead, based on possible human health effects, is recommended for Site 31. The calculated blood-lead level for existing soil concentrations at Site 31 for the assumed RME receptor and pathway is 16.1 μg/dl. Furthermore, this evaluation indicates that a target cleanup level (TCL) of 1,860 mg/kg for lead in surface soil yields an acceptable blood-lead level and is protective of human health at Site 31.

5.1.5.2 Ecological Risk Assessment

For the ERA, chemical data collected from all areas identified in the Site 31 RI were used; data were not subdivided by area. Assessment endpoints evaluated at Site 31 include the following:

- Health of the silvery legless lizard, an endangered species that lives in the leaf litter layer

- Health of the food base for predators such as foxes and raptors.

To evaluate the silvery legless lizard, soil and leaf litter data were analyzed to assess potential litter community exposures. To evaluate the food base for predators, deer mice, which serve as a food source for predators, were collected and analyzed to assess potential exposures of predators to chemicals in the dear mice. Exposure assumptions for predators, including home range size and ingestion rates, were used to estimate doses for direct ingestion of soil, dermal contact with soil, and ingestion of food items (e.g., deer mice), as described in Volume IV, Section 5.0. A very conservative scenario was evaluated as recommended by EPA. These assumptions were modified based on biota data, as discussed in Volume IV, Section 6.0.

The ERA used a conservative scenario based on modeled exposure to estimate potential adverse noncancer health effects associated with exposure to COPCs identified in soil at Site 31. Soil COPCs at Site 31 include CDD and CDF congeners, lead, and thallium. The results of the ERA indicate that:

- For the silvery legless lizard, no differences were found in litter species composition relative to reference transects in similar habitats but organism abundance was lower. However, thallium concentrations in soil are consistent with background, and no decreasing organism abundance trends were associated with increasing lead or CDD and CDF concentrations. Chemical hazards are therefore probably not associated with maximum concentrations of chemicals in surface soil.

- For the predator food base, the majority of predicted potential hazards are due to concentrations of lead in surface soils. Results of deer mice sampling at Site 31 indicate that metals are present in rodent tissues consistent with background tissue levels.

Silvery legless lizards are likely present at Site 31. The leaf litter community (e.g., the food base for the silvery legless lizard) does not appear impacted by the concentrations of chemicals in surface soils.

Results of deer mice sampling at Site 31 indicate tissue levels of metals are consistent with background. Soil contamination in vegetated areas onsite is limited to a small percentage of the site. Additionally, predators feed on rodent populations across the entire site and not only on rodents exposed to maximum soil concentrations. Therefore, no adverse effects are expected to predator populations.

No remedial action was recommended for Site 31 based solely on the ERA because intrusive remedial activities, such as excavation or capping, would likely cause more ecological damage to the sensitive native habitat at Site 31 than leaving such material in place.

5.1.6 Applicable or Relevant and Appropriate Requirements

Under CERCLA), remedial actions must be protective of human health and the environment and comply with federal or more stringent state applicable or relevant and appropriate requirements (ARARs), unless waived. Promulgated requirements are "laws imposed by state legislative bodies and regulations developed by state agencies that are of general applicability and are legally enforceable." Formally promulgated and consistently applied state or federal policies have the same weight as specific standards. Advisories and policy or guidance documents issued by federal or state agencies that are not legally binding are not considered to be ARARs but may be included as to-be-considered requirements (TBCs).

ARARs are identified for each remedial action proposed in this FS. ARARs are chemical-, location-, and action-specific requirements as discussed below.

Remedial actions recommended in this FS are intended to control further release of hazardous substances, pollutants, and contaminants to assure the protection of human health and the environment. Any hazardous substance, pollutant, or contaminant left onsite must be managed or controlled, upon completion of remedial actions, to meet ARARs, unless a waiver of such requirements is obtained.

5.1.6.1 Definition of ARARs

Guidance issued by the EPA (*1988a*) defines ARARs as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to a particular site.

The relevance and appropriateness of a requirement is judged by comparing the factors addressed to the characteristics of the remedial action, the hazardous substance(s) in question, and the physical characteristics of the site. The origin and objective of the requirements may aid in determining its relevance and appropriateness. Although relevant and appropriate requirements must be complied with to the same degree as applicable requirements, more discretion is allowed in determining which part of a requirement is relevant and appropriate.

TBCs, the final class of requirements considered by EPA during the development of ARARs, are nonpromulgated advisories or guidance documents issued by federal or state governments. TBCs do not have the status of ARARs but may be considered in determining the necessary cleanup levels or actions to protect human health and the environment.

The following three categories of ARARs were defined by EPA (*1988a*):

- Ambient or chemical-specific requirements that set health- or risk-based concentration limits or ranges for particular chemicals (e.g., federal and state laws regarding air quality)

- Location-specific requirements pertaining to restrictions placed on concentrations of hazardous substances or remedial activities (e.g., federal and state laws governing the siting of hazardous waste facilities)

- Performance-, design-, or action-specific requirements that govern particular activities with respect to remedial actions taken for hazardous wastes (e.g., hazardous wastes generated onsite must be properly managed according to federal and state law).

5.1.6.2 Identification of ARARs

Federal, state, and local statutes, regulations, and guidance were considered to identify the possible ARARs and TBCs for remedial actions at Site 31. Requirements identified as potentially applicable or relevant and appropriate are summarized in Table 5.3. This FS report considers the identified ARARs and TBCs in evaluating the various remedial alternatives in the Detailed Analysis (Section 5.5).

Chemical-Specific Requirements

In the following sections, potentially chemical-specific ARARs and TBCs are identified for the affected media at the site.

No chemical-specific ARARs for groundwater or surface water were identified because these media are not contaminated or threatened by the soil contamination present at Site 31. As discussed in Section 5.1.4.3, the chemicals present at Site 31 are not likely to leach to groundwater because they are immobile. Furthermore, surface water is not expected to be impacted by the contaminants at Site 31 because rainfall is infrequent and intermittent. Stormwater quickly runs off the steep slopes, is absorbed into the porous sandy soil, or is evapotranspired. No standing water, wetland areas, or continuously running streams are present on Site 31.

There are no numerical, chemical-specific cleanup levels (ARARs) for metals in soil, so risk assessments were performed (Volumes III and IV) to develop target cleanup levels (TCLs) that are protective of human health and the environment. These risk assessments are presented in Section 5.1.5. TCLs are presented in Section 5.2.1.2 Other environmental standards for chemicals in soil include:

- Identification and Listing of Hazardous Waste: Title 22 of the California Code of Regulations (CCR), Division 4.5, Chapter 11 identifies and defines RCRA-listed, characteristic, and non-RCRA hazardous wastes. Once lead-containing soil at Site 31 is removed for treatment or disposal, it may be classified as a characteristic hazardous waste under the Resource Conservation Recovery Act (RCRA). RCRA-hazardous wastes are defined generally and are not site-specific. RCRA is now regulated by the state of California.

  Lead containing soil at Site 31 may be classified as a RCRA-characteristic hazardous waste. To determine if the lead-containing soil at Site 31 is a RCRA-characteristic hazardous waste, a toxicity characteristic leaching procedure (TCLP) must be performed. If the lead concentration in the waste extract is over 5.0 mg/l (the characteristic level for lead), the soil is a RCRA-characteristic hazardous waste.

To determine whether soil is a California hazardous, a Waste Extraction Test (WET) is required to determine the Soluble Threshold Limit Concentration (STLC) of lead in the soil. The TCLP and Cal/EPA modified WET procedure are very similar; thus, a modified WET can be considered representative of or equivalent to a TCLP test. In California, the total lead or DDE/DDT concentration (irrespective of leachability) known as the total threshold limit concentration or TTLC, can also classify a soil as California hazardous waste.

Lead-bearing material is defined as California hazardous waste if its total threshold limit concentration (TTLC) is above 1,000 mg/kg or its STLC is above 5.0 mg/l. Similarly, DDE/DDT-bearing material is defined as a California hazardous waste if its TTLC is above 1.0 mg/kg or its STLC is above 0.1 mg/l.

The waste classification requirements discussed above would be applicable to the classification of soil for transport or disposal excavated from Site 31. Soil left in place, however, would not be transported or disposed and, therefore, would not require classification under these regulations. The above classification requirements are not site-specific standards, but are conservative levels established for use, general transport, and disposal of hazardous materials throughout California and the United States.

The maximum detected lead concentration in soil samples from Site 31 was 22,100 mg/kg. Soil excavated or removed from Site 31 might be classified as a hazardous waste if it exceeds the TTLC or STLC for lead. The maximum 4-4'-DDE/DDT concentration detected in soil samples from Site 31 was 1.7 mg/kg. Excavated or removed soil might be classified as a hazardous waste if it exceeds the TTLC or STLC for DDE/DDT. The TTLC for DDE/DDT of 1.0 mg/kg was exceeded at only one single sample location on Site 31.

- Waste Classification and Management: Title 23 CCR, Chapter 15, Division 3, Article 2 Section 2522, "Waste Classification and Management" is a chemical-specific ARAR. These regulations refer to the requirements of Title 22 CCR, Chapter 11 for the identification and listing of hazardous wastes described above, but also include another waste classification for designated waste. A California-designated waste is a waste that, although not classified as hazardous, could impact water quality at its final area of disposition.

- National Primary and Secondary Ambient Air Quality Standards: The EPA established primary and secondary emissions standards for air pollutants (NAAQS) under the Clean Air Act of 1970 (40 CFR 150). Primary NAAQS consider sources that contribute to exposure and consider all pathways of exposure to the air pollutant. Primary NAAQS are set only on the basis of air quality considerations, not on the costs or technical feasibility of achieving these standards. Secondary NAAQS (known as SAAQS) are set to protect the public from known or anticipated effects of air pollutants. SAAQS are similar to the NAAQS; no SAAQS are set for lead. NAAQS have been set for lead and particulates and thus apply at Site 31. No other site contaminants are expected to be subject to NAAQS or SAAQS. The NAAQS particulate standard is based on an annual arithmetic mean of 50 $\mu g/m^3$ for dust particles smaller than 10 microns in diameter. The NAAQS for lead is based on a maximum quarterly average of 1.5 $\mu g/m^3$.

- Monterey Bay Unified Air Pollution Control District: The Monterey Bay Unified Air Pollution Control District has established emission requirements for new sources (Regulation II) and for toxic air contaminants including lead (Regulation X, Rule 1000). Toxic Air Contaminants are regulated by the state of California under the California Health and Safety Code, Chapter 6.5, Sections 39002 et seq. The MBUAPCD regulations for toxic air contaminants include chemicals (such as lead) and requirements beyond those included in this state regulation. The MBUAPCD has the authority to implement these district regulations under the California Health and Safety Code, Division 26, Section 39002, which grants local and regional air districts the primary responsibility for control of air pollution from all sources other than vehicle sources.

  Although CERCLA exempts administrative requirements, such as air permits, the substantive provisions for such requirements must be met if remedial activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal. These requirements include:

  - Best control technology (BCT) shall be installed and operational on all sources of carcinogenic toxic air contaminants (CTACs).

  - Estimated emissions from the remedial actions at Site 31 shall not be anticipated to cause a net risk in excess of one cancer incidence per 1 x 10^5 population as estimated in a risk assessment. When more than one potential carcinogenic toxic air contaminant (CTAC) is emitted, the risk assessment shall be performed on the basis of additive impact of the CTACs. For new or modified sources of toxic air contaminants, the appropriate Environmental Protection Agency approved Users Network for Applied Modeling of Air Pollutants series model shall be used.

  - Additionally, in no event shall the emissions impact of any carcinogenic toxic air contaminant (CTAC) exceed in any 1-hour period 1/420th of the current permissible exposure limit (PEL), calculated on a worst-case basis beyond the site boundary. This factor may be revised on a pollutant-specific basis by the MBUAPCD in accordance with reliable scientific data. Site 31 is part of Fort Ord, which currently has no internal property lines.

Related MBUAPCD guidance that was identified as TBCs included "public nuisance" regulations of the MBUAPCD. The MBUAPCD has not established requirements strictly regarding dust emissions from excavation activities; however, the closest regulation is the Public Nuisance regulation, which can be invoked in the interest of protecting public health.

Location-Specific Requirements

Location-specific ARARs are based on site-specific considerations. Requirements that may be applicable to Site 31 are discussed below, and summarized on Table 5.3.

- Endangered Species Act of 1973: The Endangered Species Act of 1973 (16 USC 1531 et seq.), regulated in 50 CFR Parts 200 and 402, requires action to conserve endangered species and preserve or restore a critical habitat essential to their survival. The ERA indicates that the silvery legless lizard, an endangered species, may be present in the leaf litter layer at Site 31. Site 31 also contains species identified as a Category 2 candidate for listing as an Endangered Species, such as the Monterey dusky-footed woodrat, the Monterey ornate shrew, loggerhead shrike, and toro manzanita.

- California Endangered Species Act: The California Endangered Species Act (California Fish and Game Code Sections 2050, et seq.) also protects species identified as rare, threatened, or endangered in California. Site 31 contains species categorized as a California Species of Special Concern, or as rare in California and elsewhere by the California Native Plant Society, such as the golden eagle and sharp-shinned hawk. Site 31 will be screened for potential environmental impacts of remedial activities to such species. Results of the screening are included in the Ecological Risk Assessment (Volume IV). Both of these regulations are applicable to these species' habitats at Site 31.

- Migratory Bird Treaty Act: Several migratory birds are present at Site 31, including the golden eagle, sharp-skinned hawk, and loggerhead shrike. The Migratory Bird Treaty Act (16 United States Code [USC] 703 et seq.) protects these birds and their habitats. The Migratory Bird Treaty Act protects certain migratory birds, eggs, or nests. Any remedial actions conducted at Site 31 must consider protecting these birds and their nesting areas.

- National Archaeological and Historic Preservation Act: Remedial actions that may cause irreparable harm, loss, or destruction of significant historical artifacts are restricted under the National Historical Preservation Act (Title 36 of the Code of Federal Regulations [CFR] Part 65). This law requires action to recover and preserve such artifacts and is applicable to remedial actions at Site 31. Site 31 is not known to be located within a historically significant area; however, should such artifacts be unearthed, appropriate actions would be taken to comply with this requirement.

- The Fish and Wildlife Coordination Act: This act (40 CFR Section 6.302) requires fish or wildlife to be protected if remedial actions modify the drainage channel or other features of a stream or river. The statute requires federal agencies to take into consideration the effect that water-related projects would have upon fish and wildlife and then take action to prevent loss or damage to these resources. Such action should be viewed in the context of obtaining maximum overall project benefits, i.e., cleaning up the site. These acts require a determination of whether an action will result in the control or structural modification of a body of water. The types of actions that would fall under the jurisdiction of the act include: projects involving construction of dams, levees, impoundments, stream relocation, and water diversion structures. Thus, an erosion control wall or onsite repository constructed as part of a remedial alternative for Site 31 would need to comply with the substantive provisions of this act.

- California Fish and Game Code: Chapter 6, (Section 1601) of this Code governs the alteration of streambeds and the placement of fill material in a water of the United States. These requirements apply to streambeds. A streambed is broadly defined to include any earthen geologic structure that carries intermittent or continuous water flow and supports specific types of vegetation. This streambed definition includes any area below the 2-year maximum water level for that streambed. Thus, the bottom of the ravine at Site 31 may be considered a streambed, whereas debris and soil located on the North Slope (a significant distance from the bottom of the ravine) would not be considered part of this streambed. ARARs regarding streams would only be applicable to remedial actions that specifically impact this streambed.

- Monterey County Oak Tree Preservation Ordinance: This county ordinance protects oak trees that are larger than 6 inches in diameter or greater than 2 feet tall. Because ARARs do not include local and county ordinances, this ordinance is a to-be-considered requirement, but not directly applicable to remedial actions at Site 31.

Action-Specific Requirements

Action-specific ARARs are triggered by the type of remedial action under consideration. These ARARs are summarized in Table 5.3. These requirements and how they apply to Site 31 are discussed below.

- Corrective Action Management Units (CAMUs): 40 Code of Federal Regulations (CFR), Section 264.552, Decision Criteria for CAMU Designation. This section lists seven criteria considered when designating a CAMU for management of remediation wastes. Spent ammunition and soil at Site 3 may be excavated and treated onsite prior to offsite disposal at the OU 2 Landfill; therefore, a CAMU for treatment and storage of soil at Site 3 and a CAMU for disposal of soil at the OU2 landfill would allow for treatment, disposal, and management of the soil from Site 31 as well without triggering RCRA TSD permitting or land disposal restriction requirements.

  CAMUs at Site 3 and the OU2 landfill would facilitate implementation of a reliable, effective, protective, and cost effective remedy for Site 31 soil because treatment and disposal of the small amount of soil could take place at Site 3 and the OU2 landfill with fewer costs associated with mobilization of equipment and transportation. Creation of CAMU(s) at Site 3 and the OU2 landfill would not create unacceptable risks to humans because of its remote location and mitigative measures that would be implemented such as air monitoring and dust control measures. The environment would not be impacted significantly by the creation of CAMU(s) because staging would take place in the parking areas below the sensitive dune areas. Design of the CAMUs would be implemented according to necessary requirements.

- Standards for Owners and Operators of Hazardous Waste Storage, Treatment and Disposal Facilities: The requirements for Treatment, Storage, and Disposal (TSD) facilities under RCRA, now regulated by the state of California, as well as state requirements for non-RCRA hazardous wastes, are in Title 22 Chapter 14. CERCLA legislation allows administrative or procedural requirements, such as facility permits, to be waived as long as the substantive requirements of such regulations are attained.

  - Under Title 22 CCR Chapter 14, Article 2, remedial actions must be secured from public egress and warning signs posted. The substantive provisions of these requirement would be applicable to remedial actions at Site 31.

  - Under Title 22 CCR Chapter 14, Article 7, deed restrictions are placed on property regarding the future uses of land. These provisions may be applicable to Site 31 depending on the chemicals remaining in place at Site 31.

- Under Title 22 CCR, Chapter 14, Article 9, requirements are established for the use and management of containers, such as for routine container inspections and compatibility of the container with the wastes stored in them. Lead-containing soil classified as hazardous may be stored in containers at Site 31, and the substantive provisions of these container requirements would be applicable to remedial action at Site 31.

- Under Title 22 CCR, Chapter 14, Article 15.5, Section 66264.553 design, operating, or closure standards normally applicable to temporary tanks and container storage areas used for the treatment or storage of hazardous remediation wastes used during remedial actions may be replaced by alternative requirements that provide equivalent protection of human health and the environment. These regulations may be applicable to remedial actions at Site 31, such as for temporary tanks used to collect rinsate from debris screening. Regulatory approval would be required for such alternative requirements.

- Under Title 22 CCR, Chapter 14, Article 16, remedial actions at Site 31, such as for debris screening, may be viewed as a miscellaneous treatment unit The substantive provisions of these requirements may be applicable to remedial actions at Site 31. Any such miscellaneous units would be located, designed, operated and maintained, and closed in a manner that is protective of human health and the environment.

• Standards Applicable to Generators of Hazardous Waste: Title 22 CCR, Chapter 12 Division 4.5, contains the standards applicable to generators of hazardous waste and interim status standards for hazardous waste treatment, storage, and disposal facilities. Generators who accumulate hazardous waste onsite for less than 90 days must comply with waste analysis, emergency response and preparedness, and prevention requirements of this part. Because hazardous wastes may be stored at Site 31 as part of remedial actions, the requirements would be applicable.

• Land Disposal Restrictions: Title 22 CCR, Division 4.5, Chapter 18, prohibits land disposal of specified, untreated hazardous wastes and provides special requirements for handling such wastes under land disposal restrictions (LDRs). LDRs apply to wastes discharged after 1986. Waste materials were placed at Site 31 in the 1940s and 1950s and as such are not directly subject to LDRs. For Site 31, LDRs will not apply because soil containing hazardous levels of contaminants will not be disposed onsite or offsite except at a CAMU at Site 3 where soil will be treated prior to disposal at the OU 2 landfill.

  LDRs also prescribe treatment standards for specific hazardous debris. For debris and soil at Site 31, these standards could be triggered for any debris larger than 60 millimeters (2.36 inches) in size. Such debris would need to be screened or otherwise separated from the soil in accordance with these regulations, prior to landfill disposal. Pressure washing or stream cleaning would be an acceptable treatment technology to remove potentially hazardous chemicals (lead or DDE/DDT) from debris present in soil at Site 31. Separated debris that is not classified as hazardous is not subject to LDRs, and may be disposed of at an appropriate nonhazardous landfill.

• California Hazardous Waste Control Law: The California Hazardous Waste Control Laws (Health and Safety Code, Division 20, Chapter 6.5, Section 25113 et seq.) regulate the recycling of hazardous wastes. The California law incorporates stringent federal regulations for RCRA wastes. Under this statute, RCRA hazardous recyclable wastes must generally still be managed as a hazardous waste and reused at a permitted waste facility. Non-RCRA hazardous waste is a waste that is not regulated by the U.S. EPA, but is regulated by the state of California. Under California law, non-RCRA hazardous wastes may be recycled, but such material must be handled as a hazardous waste if the waste is to be used "in a manner constituting disposal or applied to the land." However, if non-RCRA recycled materials are used or reused as an ingredient in an industrial process to make a product (and not used in a manner consistent with a disposal), they may be conditionally exempt from California hazardous waste regulations.

For the lead-containing soil at Site 31, the most likely soil recycling option is asphalt batching. Because some of the soil may be classified as a RCRA hazardous waste and cannot be recycled, this fraction of soil cannot be incorporated into asphalt product. For this reason, the RCRA hazardous fraction of the waste may be kept separate from non-RCRA hazardous waste fraction by selective excavation activities, which would allow the latter soil fraction to be incorporated into an asphalt product. Placement of this asphalt is not interpreted as use in a manner constituting disposal or applied to land, and is exempt from the California hazardous waste regulations because the asphalt produced is not considered a waste but a commercial product.

5.2 Identification and Screening of Technologies

This section discussed remedial action objectives, chemicals of interest, definition of remedial units, and the screening and selection of remedial technologies for alternative development.

5.2.1 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the protection of human health and the environment at Site 31 are: (1) to reduce the aggregate risks associated with site-related chemicals, (2) to reduce potential adverse health effects for carcinogenic and noncarcinogenic site-related chemicals in the long-term and short-term by remediation to meet TCLs, and (3) to restore heavily disturbed sensitive habitats. These objectives are in accordance with CERCLA guidance and intended reuse of Site 31 (Section 5.1.3).

Table 5.1 presents RAOs related to remedial actions at Site 31. Potential exposure routes considered in Table 5.1 are based on the BRA, and include ingestion of, or dermal contact with, lead-containing soil, and the inhalation of dust created from lead-containing soil. EPA guidance was used in selecting long-term human health RAOs of (1) between 10^{-4} to 10^{-6} excess cancer risk, (2) a hazard index less than 1.0 for non-cancer health risk, and (3) an acceptable blood-lead level of less than 10 μg/dl for 99 percent of the exposed target population. These RAOs for human health are similar to those used in the Site 31 BRA. Target cleanup levels for chemicals established in the BRA define how the RAOs for the reduction in long-term human exposure to the impacted soil through ingestion, dermal contact, and dust inhalation are achieved. Soil left in place with concentrations at or below TCLs does not pose unacceptable risks to future residents or users of the area.

Qualitative RAOs are also presented for protecting Site 31's environment, including its sensitive ecological habitats. No RAOs are necessary for groundwater because groundwater is not threatened by the impacted soil/debris present at Site 31.

5.2.1.1 Chemicals of Interest

On the basis of results of the Baseline Human Health Risk Assessment (BRA) and Ecological Risk Assessment (ERA), lead is the only chemical at Site 31 that warrants remedial action. Table 5.2 presents a summary of lead concentrations detected in soil at Site 31. Other chemicals identified at the site were not health risks or were not present above their respective target cleanup levels (TCLs). Debris present at the site does not require remediation, but debris is considered in the evaluation of remedial technologies and development of site remedial alternatives because it is collocated with the lead-containing soil at Site 31.

5.2.1.2 Target Cleanup Levels

The BRA indicated that lead was the only contaminant to warrant remedial action. The target cleanup level (TCL) developed in the BRA is 1,860 mg/kg for lead in surface soil. This TCL is based on a sitewide average exposure scenario. No subsurface soil TCL was developed because the BRA established that no significant exposure pathways to humans and the environment exist for the COPCs identified in the subsurface soil at Site 31. As discussed in Section 5.1.4, this TCL meets the RAOs for Site 31 in that the excess cancer risk at 8.0×10^{-7} is below the RAO of 1.0×10^{-6} to 10^{-4}, the hazard index for noncarcinogenic health effects of 0.02 is below the RAO of 1.0, and the estimated blood levels are within the RAO of a 10-μg/dl estimated blood-lead level for 99 percent of the exposed target population.

5.2.1.3 Description of Remedial Units

Remedial units are developed for each site on the basis of acceptable exposure levels (TCLs), potential exposure routes, and ecological considerations (BRA and ERA), and the nature and extent of contamination at each site (*EPA, 1988b*). In areas where contamination is homogeneous within a given media, the most rational basis for defining a remedial unit is by the type and extent of contamination, i.e., the volume of soil or groundwater that contains a specific contaminant or group of similar contaminants above an established TCL. For areas containing discrete hot spots or more concentrated contamination within a homogeneous area, separate remedial units may be developed because remediation of those areas is usually addressed in a different manner by the remedial alternative. For sites where the same type of contamination occurs in both soil and groundwater and they are collocated, the remedial units may be grouped together if the soil and groundwater would be treated simultaneously.

Groundwater Remedial Unit

As discussed previously, chemicals in soil at Site 31 do not pose a threat to groundwater. No groundwater remedial units were warranted or developed for Site 31.

Soil Remedial Unit

Development of the soil remedial unit at Site 31 was based on target cleanup levels (TCLs) established in the BRA. Of the COPCs identified at Site 31 in the BRA, only lead is present at concentrations that could pose a risk to human health. The TCL for lead in soil established in the BRA is 1,860 mg/kg. At Site 31, lead concentrations above this cleanup level were all located in soils on the North Slope, so the soil remedial unit was located in this area. The five surface soil sample datapoints above the TCL are within the soil remedial unit. The maximum lead concentration measured within the unit is 22,100 mg/kg.

The steep slopes of the soil remedial unit are the angle of repose for the sandy soil, with almost a 45-degree slope (1 foot horizontal run for every vertical foot rise). Although heavily vegetated, the steep slope and sandy noncohesive soil make the area unstable. The defined unit covers approximately 3,200 square feet, extends to a depth of 3 feet, and includes about 350 cubic yards of soil and debris. The horizontal extent of the soil remedial unit is shown on Plates 5.2, 5.3, and 5.4; a geologic cross section is presented on Plate 5.5

Plate 5.3 shows subsurface soil data for lead above the surface soil TCLs. Of the subsurface samples taken at Site 31, two isolated samples contained lead above the surface soil TCL of 1,860 mg/kg. One sample location at 3,620 mg/kg is located at a depth of 5 feet bgs directly under the soil remedial unit. The other isolated datapoint has a concentration of 2,410 mg/kg at a depth of 9 feet bgs, approximately 100 feet west of the soil remedial unit. Based on the available data, remedial action is not anticipated for subsurface soil (below 5 feet bgs) because no TCLs have been established for subsurface soil and this source was not identified as posing a potential health risk or as a realistic exposure pathway. Use of a surface TCL for subsurface soil is highly conservative, yet only one subsurface soil sample outside the soil remedial unit has lead concentrations above this surface TCL. Furthermore, this single subsurface sample result of 2,410 mg/kg is not significantly greater than the surface TCL of 1,860 mg/kg.

The rationale for establishing the soil remedial unit based on the results of the BRA for Site 31 described above, is based on a compromise between two approaches considered:

(1) Remove none of the waste in order to minimize impacts to Site 31's sensitive habitat.

(2) Remove all of the waste material on Site 31.

The first approach is based on the findings of the ERA, which indicate that no unacceptable detrimental impacts to the local habitat were observed at Site 31 even after 40 years of exposure to the waste materials, and because remedial actions would likely disrupt Site 31's sensitive habitat. This approach, although based on the ERA, was rejected because it would leave lead in place at concentrations that may pose an unacceptable risk to human health, as described in the BRA.

The second approach is based on the idea that all waste should be removed from Site 31 because this waste should be contained in an engineered landfill. This approach was rejected because it would cause unnecessary destruction to Site 31's sensitive habitat in order to remove material that does not pose an unacceptable risk to human health and the environment, including ground and surface water. This approach would require removal of soil and debris in excess of 7,000 cubic yards, covering almost 1 acre (40,000 square feet) of hillside, and extending to a depth of 15 feet below the ground surface. Removal of this waste would disrupt a large area of the site. Given the loose, unstable geology of the ravine side slopes, large quantities of surrounding soil would also have to be removed while excavating the deeper debris, unless costly shoring systems were used. It also would require removal of the live oak woodland habitat and other sensitive habitat areas that would take several years to reestablish, even with mitigation efforts. These efforts would create much more severe impacts to the environment than leaving lead-bearing soil in place with concentrations less than 1,860 mg/kg.

For these reasons, one remedial unit based on the BRA was developed consisting of surface soil on the North Slope where lead concentrations exceed 1,860 mg/kg. Excavation and soil removal at this remedial unit mitigates potential risks to human health and reduces detrimental impacts to ecological receptors evaluated in the ERA. The unit is located on the North Slope in upland ruderal habitat (see Plate 5.4). Excavation of this unit would leave undisturbed a coast live oak woodland area just west of the soil remedial unit. This is consistent with the Monterey County Oak Tree Preservation Ordinance, which protects oak trees greater than 6 inches in diameter or more than 2 feet tall. The woodland area, which has been less impacted by chemicals, provides habitat for the species evaluated in the ERA.

5.2.2 General Response Actions

In accordance with EPA Interim Final *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*, general response actions (GRAs) are defined as those general classes of actions that can be taken to manage or control a particular problem at a site (*EPA, 1988b*). After review of site-specific conditions at Site 31, several GRAs were identified for the technology screening and development of remedial action alternatives for soil. The general response actions identified as potentially applicable are:

- No Action
- Containment
- Collection
- Treatment
- Disposal.

In the following section, technologies for each general response actions are screened, and specific remedial action alternatives are developed for Site 31. Each general response action has associated with it a number of remedial technology types and process options that can be part of the remedial action. For example, one general response action for soil remediation is containment; one of the remedial technologies for containing soil is capping; various process options are available to effect capping, e.g., use of a cap composed of asphalt, concrete, or low-permeability clay or soil. The technology types and associated process options are evaluated on a site-specific basis using the criteria of effectiveness, implementability, and the order of magnitude of the cost to identify remedial actions and develop remedial action alternatives.

5.2.3 Technologies Retained from the Remedial Technology Screening Report

CERCLA guidance for RI/FSs requires that, prior to development of site-specific remedial alternatives, there is an initial screening of the universe of remedial technologies that could be used to cleanup contaminated sites (*EPA, 1988b*). The *Remedial Technology Screening Report (RTS; HLA, 1994n)* presents a process to expedite the initial screening of remedial technologies for the FSs for Fort Ord. The objectives of the RTS were to identify and screen proven remedial technologies for typical groups of compounds (GOCs) found in soil and groundwater at contaminated sites.

The RTS contains a matrix guide/checklist(s) for each media and GOCs, tables that describe and evaluate each applicable technology (on the basis of effectiveness, implementability, and relative cost) and summary review forms. The matrix guide/check list(s) and tables were used to identify and screen technologies for site specific media and GOCs, and this screening is presented on the summary review forms. The matrix guide/checklists and summary review forms for this FS are presented in Appendix 5A. These summary review forms were used to prepare the Soil Remedial Unit specific technology table for Site 31 (Table 5.4). Based on this process, the following general response actions and remedial technologies are available for selection in developing the remedial alternatives for this site:

- No Action
- Containment
  - Vertical and horizontal barriers
  - Capping
  - Surface water controls
- Collection
  - Debris soil removal
  - Source soil removal
- Treatment
  - Thermal
  - Chemical
  - Physical
  - Biological
  - Stabilization/fixation
  - Offsite
- Disposal
  - Onsite
  - Offsite.

5.2.4 Selection of Technologies for Remedial Alternative Development

This section reviews and selects the technologies that were retained from the RTS screening listed in Section 5.2.3 for development of remedial action alternatives. Technologies are selected or eliminated based on site-specific conditions, as summarized on Table 5.4. For Site 31, the unstable geology, limited quantity of lead-containing material within the soil remedial unit, and sensitive ecological habitat were the major site-specific conditions that eliminated several RTS-identified treatment technologies. Remedial activities proposed for Site 3, the Beach Trainfire Ranges, allowed the retention of specific RTS identified treatment technologies (soil washing, asphalt batching, and soil stabilization) that would otherwise have been eliminated due to the limited quantities of soil at Site 31.

The following RTS-identified technologies, passed site-specific screening and were selected for use in developing of remedial alternatives:

- No action
- Collection/excavation
- Chemical and physical treatment methods, including asphalt batching, soil screening, soil washing, debris separation, debris washing, and offsite stabilization
- Disposal in an onsite repository or offsite; either of these disposal areas might involve various containment technologies that were eliminated for in place containment.

General descriptions of these technologies can be found in the RTS. These selected technologies are also discussed in the detailed description of remedial alternatives in Section 5.3.

Technologies that were not applicable for the Soil Remedial Unit are listed below. General descriptions of these eliminated technologies can be found in the RTS. Because the RTS screening initially established these technologies as applicable (on a base-wide level), a rationale for the elimination of these technologies is provided.

- <u>Containment</u>
  - <u>Vertical and horizontal barrier installation</u>. Horizontal barriers consist of a bottom seal placed beneath lead-containing soil to prevent downward migration of contaminants. Possible barrier techniques include grout injection and block displacement with grout sealing. These options are relatively unproven, and it is difficult to ensure the integrity of the barrier or to determine if a complete seal has been created. In addition, they would provide no significant additional protection from chemical migration because site investigations have shown that the chemicals in the soil have not migrated significantly; therefore, horizontal barriers were eliminated from further consideration. Vertical barriers were eliminated from further consideration because the lead in soil does not appear to be migrating laterally.
  - <u>Capping</u>. Capping using clay/soil, asphalt, concrete, synthetic material, or a combination of these materials is not considered feasible for the in-place surface soil at Site 31. The steep slope and unstable geology would make capping contaminants in place difficult to implement, and would also disrupt Site 31's sensitive wildlife habitat
  - <u>Surface water controls</u>. Surface water controls such as installation of a runoff diversion and collection system are feasible but were not retained for further consideration. Revegetation is still considered as a possible mitigation measure after remedial actions, but not as an engineered solution to provide storm water control as part of a containment system. The extent to which chemicals are transported in stormwater runoff depends on the physical and chemical characteristics of the chemicals, the soil type, and the magnitude of the rain event. No erosion control of sediment and debris/ash left in place at Site 31 was included in the development of alternatives. It was considered unnecessary for the following reasons:

    (1) Contaminants have been present at the site for over 40 years without appreciable migration downgradient in the ravine, as discussed in the fate and transport section of the RI (Volume II, Section 3.0).

    (2) The ravine flattens out into a relatively level area that is heavily vegetated. This area effectively serves as a sedimentation basin that stops sediment from migrating offsite.

    (3) No appreciable runoff was detected by attempted stormwater sample collection activities

during remedial investigation and ecological assessment activities.

(4) The BRA evaluated air migration of dust and erosion in its exposure assessment. Air emission of dust was more significant than sediment/erosion for development of TCLs.

- Collection
  - Deep soil excavation. This option was not considered for further evaluation because contamination or debris (greater than 15 feet) because the soil remedial unit at Site 31 only includes surface soil. In addition, the sensitive habitat and unstable geologic conditions would make this technology difficult to implement.
- Treatment
  - Thermal treatments. Thermal treatments (including sterilization and offsite rotary kiln incinerator) were eliminated from further consideration because these treatment technologies do not effectively remove lead from soil.
  - Biological treatment. Biodegradation was eliminated from further consideration because this technology is not effective for lead in soil.
  - Onsite stabilization/fixation. In situ stabilization is difficult to implement because of the sensitive wildlife habitat and unstable geological conditions at Site 31. This process would also be inefficient because of the varying depth of lead containing soil, which would result in additional soil being needlessly immobilized. Debris collocated with the lead-containing soil may also make this technology difficult to implement. For these reasons this technology was eliminated from further consideration.
- Disposal
  - Replacement of soil after treatment. This technology was not retained for further evaluation because of its potential impacts on sensitive wildlife habitat at Site 31. Placing stabilized soil back in the excavation would not allow for the proper revegetation of the native habitat at Site 31.
  - Onsite disposal. Replacement of chemical-laden soil back in place was not retained for further evaluation. This technology is generally performed in conjunction with onsite treatment. Because the limited quantity of impacted soil makes onsite treatment prohibitively expensive, onsite disposal is also impractical. Backfilling would be best accomplished directly after excavation activities, providing little time for treatment. Furthermore, sensitive ecological habitat may not allow for the replacement of treated or chemical-laden soil back in place.
  - Offsite demolition landfills. This option was not necessary because no UXO is anticipated at Site 31.
  - Offsite recycling. Recycling was eliminated from further consideration because the heterogeneous nature of the debris present at Site 31 makes it difficult to separate recyclable material, such as glass or metal, from the soil/debris mixture. Furthermore, the limited volume of lead-containing soil at Site 31 makes recycling, such as at a smelting facility, impractical.

5.3 Development and Description of Remedial Alternatives

To assemble remedial alternatives for each site, general response actions (GRAs) and process options chosen in Section 5.2.4 that represent various technology types for each medium are combined to form site-wide alternatives (*EPA, 1988b*). According to EPA guidance, taking no further action at the site should be one of the alternatives considered as a basis for comparison to other alternatives: appropriate treatment and containment options should also be considered. Initially, specific technologies or process options are evaluated primarily on the basis of whether or not they can meet the Remedial Action Objectives (RAOs) discussed in Section 5.2.1. To assemble alternatives, remedial units are matched with technology types developed in Section 5.2.4 using engineering judgment and site-specific considerations. A range of alternatives are developed with respect to the criteria of effectiveness, implementability, and cost. For sites at which interactions among media are not significant, media-specific remedial options can be developed rather than developing numerous comprehensive site-wide alternatives. Alternatives which meet the RAOs and evaluation criteria are retained for further consideration in the detailed analysis described in Section 5.2.4 above and summarized on Table 5.4. The selected technologies were included in the development of alternatives for Site 31 as described below:

- No Action. No action is provided as Alternative 1 in accordance with CERCLA guidance.

- Collection. This technology was not considered alone because collection/excavation, by itself, does not meet remedial action objectives. However, collection is necessary for all the action alternatives because in situ treatments were not feasible for lead in soil at Site 31. Therefore, collection/excavation was incorporated into Alternatives 2, 3, and 4 at Site 31.

- Treatment (Physical, Chemical, and Stabilization). The excavated soils at Site 31 may be treated by such methods as asphalt batching, soil washing, and soil stabilization. Since remedial activities at Site 3 will involve several treatment technologies for similar lead-containing sandy soils, treatment of Site 31 soils at Site 3 represents a cost-effective method. The limited volume of soil at Site 31 would make other onsite treatment alternatives prohibitively expensive.

- Disposal (Onsite Repository and Offsite). This technology involves placement of excavated soil and debris in an onsite repository or disposal of the material at an offsite location. At either disposal area, various containment technologies might be used, including lining and capping.

These four remedial alternatives, are described in detail in the following sections and summarized on Table 5.5.

5.3.1 Remedial Alternative 1

This alternative consists of taking no further action to treat or control soil or debris at the site. This alternative is required for consideration under CERCLA as a basis for comparison with other alternatives. Institutional actions are not imposed under this alternative.

5.3.2 Remedial Alternative 2

This alternative consists of excavating a limited amount of debris and associated soil with lead concentrations above TCLs from the soil remedial unit on the north slope of Site 31. These soil excavation activities would impact local flora and fauna. Restoration of the original habitat, such as through revegetation with native plant species, would be conducted to mitigate these impacts.

Excavated material from the soil remedial unit may be classified as a hazardous waste based on its lead concentrations. For this reason, excavated material would be screened to remove non-hazardous debris material from the soil in order to reduce the total volume of hazardous waste, as well as make the soil amenable for treatment as described below. Separated debris material would be rinsed or steam cleaned for onsite disposal during closure of the Corrective Action Management Unit (CAMU) at the OU 2 landfill, if feasible, or offsite disposal at a Class II or III landfill facility, where appropriate. Mechanical separation using screens (sieving equipment) would be used to separate debris from the sandy soil. Rinsate could be recycled and dehydrated, with the residual solids incorporated back into the separated sand for treatment as described above.

Screened soil from Site 31 will be used as part of the onsite pre-remedial treatment study or final remedial action for Site 3, the Beach Trainfire Ranges. Because of the large volume of soil at Site 3, various treatment technologies (soil washing, soil stabilization, and asphalt batching) are being evaluated that are otherwise not practical for the small quantity of material at Site 31. The Army intends to rely upon a CAMU designation for remedial actions at Site 3 and for placement of soil at the OU 2 landfill. This designation would allow consolidation of excavated soil from Site 31 at Site 3 without triggering land disposal restrictions.

The remedial unit excavation area would be backfilled to original grade. Because compaction of this backfill would be difficult given the steep slope and unstable geological conditions, an open-web geotextile or taxifier would be applied to the backfilled area to provide stability until vegetation is re-established. The selected geotextile/taxifier would be specified in the remedial design and would allow for the growth of native vegetation. These areas would be watered periodically as necessary using an irrigation system or water truck with spray hose until vegetation is established. Selected native plants would be removed during excavation activities, maintained, and transplanted into the backfilled area as appropriate.

Because this alternative does not consider unrestricted reuse of the site, deed restrictions for Site 31 would be required.

If the excavated soil from Site 31 cannot be treated as part of the Site 3 pilot study or final remedial action, it will be sent for offsite disposal at an appropriate landfill.

5.3.3 Remedial Alternative 3

This alternative consists of excavating a limited amount of debris and associated soil with lead concentrations above TCLs from the soil remedial unit on the North Slope of Site 31. Excavated material would be placed within a corrective action management unit (CAMU) that would prevent potential direct human exposure to the waste materials, water infiltration and the migration of debris and lead-containing soil offsite. A relatively flat area near the bottom of the ravine or on top of the ravine near the LRTC Area would be the location of this repository. The final location of this unit would be a function of engineering design and ecological considerations.

Installation of the CAMU would involve stripping the surface of existing vegetation, placing and consolidating soil and debris, and covering over with several layers of soil and impermeable material, as well as installing the necessary equipment needed for proper drainage control and irrigation, if necessary. A concrete retaining wall or earthen berm would be used to direct stormwater runoff and prevent erosion of the cap. A methane gas collection system is not anticipated to be required for this cap because the waste materials are inorganic and not biodegradable. Excavation of soil and construction of this cap would impact local flora and fauna. However, impacts would be mitigated by restoration of the original habitat, such as through revegetation with native plant species.

Several different types of caps could be installed over the area, the choice of capping method and materials being dependent upon future land use plans. The types of caps considered are a clay cap, a cap with a synthetic liner, an asphalt cap, or a combination of caps. A clay cap is the easiest type to install; however, it would be thicker than the others and would add a considerable volume of material to the site, raising the elevation of the site several feet. Furthermore, obtaining clay material in the area could be difficult and expensive. To alleviate some of the problems inherent in raising the height of the cover, a synthetic liner or Claymax™ (bentonite clay sandwiched between layers of geotextile) could be installed as part of the cap. Another possibility is an asphalt cap. This type of cap would add the least elevation to the site but would not be consistent with the sensitive habitat area.

Although the FS is not a design document, a conceptual design of the CAMU was prepared to estimate costs. For the purposes of the FS, a Claymax™ or equivalent type cap system is assumed. The activities anticipated for the construction of the CAMU are as follows:

- Selection of an area near the lower end of Site 31 in a relatively flat, stable area. This area would be sub-excavated to provide soil for the vegetative cover of the unit and to reduce the overall height of the CAMU. The excavated area would be compacted to serve as a foundation for the double-liner system serving as the bottom of the CAMU.

- Placement of a double liner-system. This liner would consist of two 1/4-inch-thick layers of Claymax™ separated by a 6-inch layer of sand. Claymax™ would provide a flexible, impermeable layer to seal the consolidated material from the surrounding environment. Another 6-inch protective layer of sand would be placed over the top of the double-liner system to prevent debris from puncturing the liner.

- Excavation, placement, and compaction of lead-containing soil (350 cy) from the side slopes to the CAMU

- Placement of a double liner similar to that described above as a cap over the placed soil

- Placement of a geotextile membrane/liner system over the double-liner cap and underneath the vegetative cover to provide drainage

- Placement of approximately 2 feet of clean, native soil over the top Claymax™ layer to protect it and allow growth of native vegetation

- Grading of the area to collect and divert stormwater runoff and maintain natural drainage patterns to the extent practical

- Backfilling of excavations with clean soil and restoration to the original grade.

Site restoration and backfill activities would be similar to those described for Alternative 2. No vadose zone or groundwater monitoring would be required. The CAMU's vegetative cover would also be revegetated with native plant species.

Because this alternative does not consider unrestricted reuse of the site, deed restrictions for Site 31 would be required.

5.3.4 Remedial Alternative 4

This alternative is similar to Alternative 2 described above and involves the same excavation, backfill, and site restoration activities. However, instead of screening the debris and shipping the separated soil to Site 3 for incorporation with remedial activities on that site, excavated soil that could be classified as hazardous waste based on its lead concentrations would be sent directly for offsite disposal at a Class I hazardous waste landfill; non-hazardous debris would be sent for disposal at a Class II or III landfill.

Because this alternative does not consider unrestricted reuse of the site, deed restrictions for Site 31 would be required.

5.4 Criteria for Detailed Analysis of Remedial Alternatives

Each of the remedial alternatives described in Section 5.3 has been assessed in accordance with the *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA, 1988b)*. The remedial alternatives have been evaluated using nine criteria described below:

- <u>Overall Protection of Human Health and the Environment</u>: Each remedial alternative is evaluated in terms of the extent of protection of human health and the environment and the residual risk associated with implementation of the alternative. The manner in which the contaminants are managed under each alternative is considered.

- <u>Compliance with ARARs</u>: The ability of each alternative to meet ARARs and other guidance identified in Section 5.1.6 and Table 5.3 is assessed.

- <u>Long-Term Effectiveness</u>: Each alternative is evaluated with respect to the risk that would remain at the site after the alternative has been implemented and the response objectives have been satisfied. Residual concentrations of chemicals that will not pose a threat to human health and the environment at the site are calculated. These are the TCLs. The magnitude of the risk is established as well as the adequacy and reliability of long-term management controls required by each alternative.

- Reduction of Toxicity, Mobility, and Volume through Treatment: In CERCLA, preference is given to remedial technologies that significantly reduce the toxicity, mobility, or volume of contaminants. The degree of reduction is assessed for each alternative. Considerations included the extent of irreversibility of the treatment and the disposition of treatment residuals.

- Short-Term Effectiveness: The effects of each alternative during the construction, implementation, and operation phases are assessed. Factors considered include protection of the community and workers during remedial operations, the time required to implement the alternative and to achieve the remedial goals, and potential adverse environmental impacts that may result.

- Implementability: The three major areas of focus in assessing the implementability of a remedial action alternative are:

  - Technical feasibility: The ability to construct a treatment system, the reliability of the technology, and the ability to monitor the effectiveness of the remedy.

  - Administrative feasibility: The effort and resources required to obtain approvals from other agencies.

  - Availability of services and materials: The availability of contractors with the equipment and knowledge to implement the technologies under the remedial alternatives.

- Costs: Remedial alternative cost estimates are prepared using EPA guidance manuals, other technical resource documents, contractor quotes, and experience on this site and on other projects with similar scope. Both capital costs and operation and maintenance (O&M) costs are developed at a conceptual level for each remedial action alternative. These costs can be expected to range from 50 percent high to 30 percent low. Net present value (NPV) costs are calculated using a 5 percent discount rate, and a 30 year maximum timeframe.

  Capital costs include contractor's mobilization and demobilization, sampling and analysis, permitting, engineering, remedial equipment purchase and installation, and site restoration. O&M costs include ongoing operational site inspections, utilities, chemicals, routine maintenance and repairs, and periodic sampling and analysis.

- Regulatory Agency Acceptance: Each remedial alternative is evaluated in terms of potential agency administrative and technical issues, but regulatory acceptance will be directly attained in the Basewide Record of Decision.

- Community Acceptance: Each remedial alternative is evaluated in terms of available public input and anticipated public reaction; however, as with regulatory acceptance, community acceptance will be addressed in the Proposed Plan.

5.5 Detailed Analysis of Remedial Alternatives

The four remedial alternatives are evaluated in the following sections using the nine evaluation criteria. A summary of this evaluation is presented in Table 5.5.

5.5.1 Detailed Analysis of Remedial Alternative 1

Remedial Alternative 1 is the No Action alternative. This alternative consists of taking no further action to treat or control soil or debris at the site. This alternative is required for consideration under CERCLA as a basis for comparison with other alternatives.

Overall Protection of Human Health and the Environment

The no action alternative would provide no additional protection to human health and the environment. The potential for human exposure would continue to be through direct exposure to surface soil contaminants and through inhalation, ingestion, and contact with contaminated airborne dust particles.

Compliance with ARARs

This alternative would not comply with ARARs.

Long-Term Effectiveness

In the long term, this alternative would not change or reduce human exposure or the transport of contaminants through the soil matrix.

Reduction of Toxicity, Mobility, and Volume through Treatment

In the no action alternative, no reduction of toxicity, mobility, or volume would occur. This alternative would not mitigate any risks associated with the onsite lead concentrations in the fill materials.

Short-Term Effectiveness

The short-term conditions would remain unchanged. Any risks and threats to the health of the community and onsite workers from possible ingestion, inhalation, and dermal contact would remain unchanged. In addressing adverse environmental impacts, this alternative would not change the potential for surface contaminants in the soil to be dispersed into the environment.

Implementability

There are no technical concerns regarding the implementability of a no action alternative. No specialized services or materials are required. However, the government agency and public acceptance required to implement the no action alternative may be an obstacle.

Costs

No capital costs are associated with this alternative. Furthermore, no annual costs would be incurred for O&M or monitoring activities because groundwater is not impacted and these actions are not anticipated for this alternative. Thus, the net present value (NPV) for 30 years of monitoring is $0 (Table 5.6).

Regulatory Agency Acceptance

It is anticipated that the regulatory agencies may require remedial actions that are more extensive than proposed in this alternative; however, acceptance will be attained in the Basewide Record of Decision.

Community Acceptance

Because the remedial alternatives applicable to the site have not been presented to the community, acceptance of the no action alternative cannot be determined at this time. Community acceptance will be addressed in the Proposed Plan.

5.5.2 Detailed Analysis of Remedial Alternative 2

This alternative involves the excavation and treatment of soil and disposal of debris from the soil remedial unit.

Overall Protection of Human Health and the Environment

Removal of lead-containing soil from the site would reduce the long-term risks associated with this material by elimination of the inhalation, incidental ingestion, and dermal exposure routes. Thus, this alternative would provide increased protection to human health and the environment over the long term.

Removing lead-containing soil would result in a site that no longer presents an unacceptable risk to human health or the environment. Because excavation, loading, and transportation of lead-containing soil would be conducted using proper dust control, engineering, and health and safety techniques, this alternative would eliminate the exposure pathways of concern identified in the risk assessment and be in compliance with the BRA. This alternative would meet the TCL for lead because soil with lead above these levels would be removed from the site. There are some increased short-term human health risks associated with dust that would be generated during remedial excavation and loading activities. These risks would be minimized through the use of dust control measures and implementation of a health and safety plan to protect workers during remediation.

Impacts to the native wildlife habitat would be associated with this alternative's remedial excavation activities. Native plant and animal restoration activities would be implemented to reduce these impacts. A biologist would be present during remediation to ensure minimal impacts to this habitat. Natural revegetation would be used to allow the coast live oak woodland to expand itself into the excavated area.

Compliance with ARARs

This alternative would comply with all applicable or relevant and appropriate requirements as discussed in Section 5.1.6.

MBUAPCD Rule 1000 regulates air emissions of toxic contaminants like lead from activities such as excavation, loading, and transportation of the metal-bearing soil. Fugitive dust emissions would be minimized and kept below the allowable limit through dust control measures.

Location-specific ARARs applicable to these activities include those pertaining to migratory birds as well as the California and Federal Endangered Species Acts. Consideration of these ecological concerns would be addressed through screening the area for potential environmental impacts to such endangered species, implementing mitigation measures as necessary, and performing site restoration activities after completion of remedial activities.

Action-specific ARARs would be met for treatment and disposal of soil from Site 31 at the Site 3 and OU2 landfill CAMUs.

Long-Term Effectiveness

Because this alternative removes lead-containing soil from the site, the current risks and potential exposures to the community and ecological receptors posed by the site in its present condition would be eliminated. It is also anticipated that no long-term monitoring would be required.

Reduction of Toxicity, Mobility, and Volume through Treatment

Soil stabilization, soil washing, or asphalt stabilization (at Site 3, the Beach Trainfire Ranges) of lead-containing soil from Site 31 would reduce the toxicity and mobility of the lead contamination. Furthermore, screening the debris from the soil could reduce the volume of lead-containing material. Chemical mobility would be increased in the short term because of dust generation during excavation/treatment activities; however, dust control measures will be employed during site operations.

Short-Term Effectiveness

Remedial soil excavation and loading operations would have a potentially adverse short-term impact on human health and the environment because of the contaminated dust and particulates generated during excavation and removal. These potentially adverse impacts would be minimized through the use of dust control measures such as spraying the soil with water. Additionally, the exposure of workers to the contaminants would be minimized by the use of proper health and safety procedures.

Air monitoring stations would be established up- and downwind of the site to permit evaluation of potential health risks as a result of dust exposure during excavation. Air samples would be collected and analyzed at a minimum for total particulates and total lead when wind velocities exceed a threshold level capable of transporting dust offsite.

It is anticipated that the contaminated soil and debris could be excavated and transported to Site 3 or to an offsite landfill as appropriate and the site restored in 4 to 6 months. Short-term impacts to the native wildlife habitat would be associated with this alternative's remedial excavation activities. A biologist would be present during remediation to ensure minimal impacts to this habitat. Native plant and animal restoration activities would be implemented to reduce these impacts. Natural revegetation would be used to allow the coast live oak woodland to expand into the excavated area. Native vegetation is expected to be reestablished within 6 months after completion of remedial activities.

Implementability

Soil excavation, loading, and transportation have been widely used and can be performed using well-established, conventional techniques. Because this alternative has been used at numerous sites with similar contamination problems, it is anticipated that this plan would be administratively feasible with a minimal amount of effort. The services and materials required to implement this plan are available on relatively short notice.

Costs

Costs developed for Alternative 2 are presented in Table 5.6. No annual O&M costs are associated with this alternative. The total associated capital costs are estimated to be $315,000. This estimate includes costs of site work, transportation and disposal, and site restoration.

If soil from Site 31 cannot be treated at Site 3, it will be sent for offsite disposal. Because Site 3 will have large volumes of similar soil for disposal, the unit costs are significantly lower than the costs for separate disposal of Site 31's soil, as assumed in Alternative 4. The estimated costs for this disposal contingency is approximately $320,000. Disposal will be used for Site 31's excavated soil only if it cannot be treated as part of Site 3 remedial activities.

Regulatory Acceptance

Regulatory agencies have approved similar remediation plans at numerous sites under similar conditions, and it is anticipated that they would accept this alternative. Acceptance will be attained in the Basewide Record of Decision.

Community Acceptance

Because this alternative would remove the potential long-term risks at the site, it is anticipated that it would be acceptable to a majority of the community members. Acceptance will be addressed in the Proposed Plan.

5.5.3 Detailed Analysis of Remedial Alternative 3

This alternative involves excavation and placement of soil and debris from the soil remedial unit in a corrective action management unit (CAMU) in a flat area elsewhere onsite.

Overall Protection of Human Health and the Environment

By installing a cap over the consolidated soil in a designated CAMU, risks to human health and the environment that might exist at the site would be mitigated. These risks, which are small, would be further reduced in several ways. First, the contaminated surface soil would not be exposed; so airborne dust would not be generated. The possibility of direct contact would be further reduced by having the protective cap over the lead-containing soil.

Thus, this remediation plan would increase the overall protection of human health and the environment. In the short term, some dust might be generated from the excavation, transportation, and replacement of contaminated fill; however, these increased risks would be controlled through the use of dust control measures and implementation of a health and safety plan to protect workers during remediation.

Impacts to the native wildlife habitat would be associated with this alternative's remedial excavation activities. Placement of a CAMU onsite would cause further significant impacts to Site 31's sensitive habitat, than just those from excavation. A level, stable area would be required to be cleared of existing vegetation to construct the CAMU. Native plant and animal restoration activities would be implemented to reduce these impacts. A biologist would be present during remediation to ensure minimal impacts to this habitat. Natural revegetation would be used to allow the coast live oak woodland to expand into the excavated area and native vegetation used as part of the vegetative cover for the CAMU.

This alternative would meet the TCLs for lead except soils within the CAMU; however, the possibility for exposure to this soil that contains lead above TCLs would be eliminated. Installing a cap over the contaminated fill that has been consolidated into one location would prevent dust from becoming airborne, would prevent people from directly contacting the lead-containing soil, and would further reduce the remote possibility of future migration of contaminants to the groundwater.

Compliance with ARARs

This alternative would comply with all applicable or relevant and appropriate requirements as discussed in Section 5.1.6.

Regulations regarding CAMUs (22 CCR, Article 19) would apply to this alternative because excavated material classified as hazardous would be placed at Site 31. The design of this unit would follow the provisions of these regulations.

MBUAPCD Rule 1000 regulates air emissions of toxic contaminants like lead from activities such as excavation, loading, and transportation of the metal-bearing soil. Fugitive dust emissions from remedial activities such as excavation, loading, and transportation of the metal-bearing soil would be minimized through dust control measures.

This alternative invokes several location-specific ARARs. The ravine at Site 31 contains a streambed and would need to comply with the substantive provisions of the California Fish and Game Code. Furthermore, this alternative could alter drainage within the drainage plan, so it would also need to comply with the Fish and Wildlife Coordination Act (16 U.S.C. 662 et seq.).

Long-Term Effectiveness

Installing a cap over the consolidated debris and soil would effectively reduce any risks associated with soil contaminants by eliminating the inhalation, incidental ingestion, and dermal exposure routes for both human and ecological receptors. A properly designed, constructed, and maintained cap would provide adequate long-term effectiveness. To ensure that the cap would remain intact and that risks to human health and the environment would be mitigated, ongoing monitoring and maintenance would be required. In addition, it is anticipated that a deed restriction would be imposed by the regulatory agencies to reduce the risk that future users would be exposed to lead-containing soil. Because the different capping alternatives are of equal long-term effectiveness in protecting human health and the environment, the final choice of the cap type would be based on engineering considerations.

Reduction of Toxicity, Mobility, and Volume through Treatment

Because this alternative is a containment measure, the toxicity and volume of contaminated materials would not be destroyed or reduced, but the contaminants would be effectively immobilized. After implementation of this alternative, contaminants could not be transported by wind, surface water, or living organisms because they could not come into contact with lead-containing soil. In addition, the remote possibility of future migration of contaminants to the groundwater would be further reduced by eliminating potential infiltration through the lead-containing soil.

Short-Term Effectiveness

This alternative would involve excavation and minimal transportation of the lead-containing soil. These operations could have a short-term impact on human health, because of contaminated dust and particulates generated during the excavation and transportation processes; however, these potentially adverse impacts would be minimized through the use of dust control measures such as spraying the soil with water. Worker exposure to the contaminants would be further minimized through the use of proper health and safety procedures.

Air monitoring stations would be established up- and downwind of the site during soil movement to permit evaluation of potential health risks as a result of dust exposure. Air samples would be collected and analyzed at a minimum for total particulates and total lead when wind velocities exceed a threshold level capable of transporting dust offsite.

It is anticipated that the lead-containing soil could be excavated, relocated, and capped within 6 to 12 months. Short term impacts to the native wildlife habitat would be associated with this alternative's remedial excavation activities. Native plant and animal restoration activities would be implemented to minimize these impacts. Native vegetation is expected to be reestablished within 6 months after completion of remedial activities. A biologist would be present during remediation to ensure minimal impacts to this habitat. Natural revegetation would be used to allow the coast live oak woodland to expand into the excavated area.

Implementability

Excavation and cap installation are well-established technologies that use conventional construction techniques. The services and materials required for this alternative would be readily available on relatively short notice. However, several technical conditions would make implementation of this alternative difficult, namely the unstable geologic conduction afforded by the geography at the site.

Costs

Capital costs and annual O&M costs of Alternative 3 are presented in Table 5.6. The capital cost estimate includes excavation, subbase preparation, cover system installation, and monitoring well installation. Capital costs are estimated at $410,000. O&M costs associated with cover system inspection/maintenance are estimated at $2100 per year. The total net present value (NPV) cost for this alternative for 30 years of operation is estimated at $445,000.

Regulatory Agency Acceptance

Acceptance of this alternative by the regulatory agencies will be attained in the Basewide Record of Decision.

Community Acceptance

It is anticipated that this alternative would not be readily acceptable to a majority of the community members because contaminants would remain onsite above TCLs, and it would cause significant disruption to a sensitive wildlife habitat. Acceptance will be addressed in the Proposed Plan.

5.5.4 Detailed Analysis of Remedial Alternative 4

This alternative involves excavation of the soil remedial unit and disposal of soil and debris at an appropriate landfill. Site restoration activities would be the same as Alternative 2.

Overall Protection of Human Health and the Environment

This alternative would meet the TCL for lead because a soil that contains lead above these levels would be removed from the site. Removal of lead-containing soil from the site would also reduce the long-term risks associated with this material by elimination of the inhalation, incidental ingestion, and dermal exposure routes. Thus, this alternative would provide protection to human health and the environment over the long term. There are some increased short-term risks associated with dust that would be generated during remedial excavation and loading activities. These risks would be reduced through the use of dust control measures and implementation of a health and safety plan to protect workers during remediation.

Impacts to the native wildlife habitat would be associated with this alternative's remedial excavation activities. Native plant and animal restoration activities would be implemented to minimize these impacts. A biologist would be present during remediation to ensure minimal impacts to this habitat. Natural revegetation would be used to allow the coast live oak woodland to expand into the excavated area.

Compliance with ARARs

This alternative would comply with all applicable or relevant and appropriate requirements as discussed in Section 5.1.6.

Action-specific ARARs are imposed on landfills containing hazardous wastes (23 CCR Chapter 15). Lead-containing soil would be sent to an approved facility currently in full compliance. Such soil would be manifested and transported to the landfill by licensed hazardous waste haulers. The lead containing soil is expected to meet land disposal restrictions for disposal of lead at a Class I land disposal facility. However, an EP Toxicity test would be required before such disposal.

MBUAPCD Rule 1000 regulates air emissions of toxic contaminants, including lead from activities such as excavation, loading, and transportation of the metal-bearing soil. Fugitive dust emissions would be minimized and kept below the allowable limit through dust control measures.

Location-specific ARARs applicable to these activities include those pertaining to migratory birds as well as the California and Federal Endangered Species acts. Consideration of these ecological concerns would be addressed through screening the area for potential environmental impacts, implementing mitigation measures as necessary, and performing site restoration activities after completion of remedial activities.

Long-Term Effectiveness

Because this alternative would remove lead-containing soil from the site, the current and potential risks to the community and ecological receptors posed by the site in its present condition would be eliminated. It is also anticipated that no long-term monitoring would be required. However, there would be potential long-term liability associated with placing the lead-containing soil in a landfill.

Reduction of Toxicity, Mobility, and Volume through Treatment

Lead-containing soil or debris would be transported to a permitted hazardous waste landfill; thus, the mobility of the contaminants would be reduced in the long term because they could not be transported by wind or living organisms. Their mobility may be increased in the short term because of dust generation during excavation/treatment activities; however, dust control measures would be employed during site operations.

Short-Term Effectiveness

This alternative would involve excavation and transportation of the lead-containing soil/debris to a hazardous waste landfill. The excavation and loading operations would have a potential for short-term adverse impact on human health and the environment because of the contaminated dust and particulates generated during excavation and removal. These potentially adverse impacts would be reduced through the use of dust control measures such as spraying the soil with water. The exposure of workers to the contaminants would be controlled by the use of proper health and safety procedures.

Air monitoring stations would be established up- and downwind of the site to permit evaluation of potential health risks as a result of dust exposure during excavation. Air samples would be collected and analyzed at a minimum for total particulates and total lead when wind velocities exceeded a threshold level capable of transporting dust offsite.

It is anticipated that the contaminated fill could be excavated and transported to an offsite landfill, and the site restored in 4 to 6 months. Short term impacts to the native wildlife habitat would be associated with this alternative's remedial excavation activities. A biologist would be present during remediation to ensure minimal impacts to this habitat. Native plant and animal restoration activities would be implemented to minimize these impacts. Natural revegetation would be used to allow the coast live oak woodland to expand into the excavated area.

Native vegetation is expected to be reestablished within 6 months after completion of field activities.

Implementability

Soil excavation, loading, and transportation have been used widely and can be performed using well-established, conventional techniques. Because this alternative has been used at numerous sites with similar contamination problems, it is anticipated that this plan would be administratively feasible with a minimal amount of effort. The services and materials required to implement this plan are available on relatively short notice.

Costs

Costs developed of Alternative 4 are presented in Table 5.6. No annual O&M costs are associated with this alternative. The total associated capital and costs are estimated to be $335,000. This estimate includes costs of site work, transportation and disposal, and site restoration.

Regulatory Agency Acceptance

Regulatory agencies have approved similar remediation plans at numerous sites under similar conditions, and it is anticipated that the state would accept this alternative. Acceptance will be attained in the Basewide Record of Decision.

Community Acceptance

Because this alternative would remove the potential long-term risks at the site, it is anticipated that it would be acceptable to a majority of the community members. Acceptance will be addressed in the Proposed Plan.

5.6 Comparison of Remedial Alternatives

The four potential remedial alternatives for Site 31 were compared to each other with respect to the nine EPA evaluation criteria presented in Section 5.4. The results of this evaluation are presented in Table 5.5.

Overall Protection of Human Health and the Environment

Alternative 1 would not provide overall protection of human health and the environment because it would not be expected to meet chemical-specific TCLs proposed for soil. Alternatives 2, 3, and 4 would significantly increase overall protection by removing, containing, or disposing of the chemical-bearing soil, thereby eliminating the potential risks associated with human or animal contact. There would be some increased short-term risks associated with the generation of dust during excavation, loading, and construction activities, as well as limited offsite transportation and disposal risks. Native plant and animal restoration activities would be implemented under Alternatives 2, 3, and 4 to minimize impacts to the local habitat.

Compliance with ARARs

Alternative 1 might not trigger action-specific ARARs if lead-containing soil and debris remain in place. Alternatives 2, 3, and 4 would be designed and implemented in accordance with all applicable ARARs; no waiver is anticipated for any of these three alternatives.

Long- and Short-Term Effectiveness

In terms of long-term and short-term effectiveness, Alternative 1 would allow potential direct contact with chemical-bearing soil and therefore would not be effective in the short or long term. Alternative 3 would provide short- and long-term effectiveness for the remediation of the chemical-bearing soil. Both Alternatives 1 and 3 would also require long-term monitoring and maintenance of the site. Deed restrictions to inform potential future users of the risks associated with onsite contamination would be required under all the alternatives. Alternatives 2 and 4 would provide short-term effectiveness and would take only approximately 4 to 6 months to remove and treat soil at Site 3 or dispose of the excavated material at a Class I landfill. Both Alternatives 2 and 4 would also provide long-term effectiveness at the site, because chemical-bearing soil would be removed from the site. Alternative 4, however, would have long-term liability associated with placing the lead-containing soil at a landfill. Alternative 2 would have fewer long-term risks than Alternative 4 because the soil would be effectively treated or recycled to reduce its hazardous characteristics.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 would not reduce the toxicity, mobility, and volume of the chemicals in the soil. Under Alternative 2, the mobility, toxicity, and volume of the lead-containing material would be reduced through screening the debris from soil and by possible treatment of the soil in conjunction with Site 3 remedial activities. Alternative 3 and 4 would reduce the mobility of chemicals in onsite soil but would not reduce the toxicity or volume of chemical-bearing soil.

Implementability

All of the alternatives considered for remediation are implementable subject to the ability to secure the appropriate approvals. Alternative 1 would be the technically easiest to implement. Alternatives 2, 3, and 4 would have to be designed according to ARARs, and each of the action alternatives would require specialized construction or treatment equipment; however, these are readily available. Alternative 4 is less complicated and would be easier to implement than either Alternatives 2 or 3. Alternative 3, because of its complexity, would be the most difficult to implement.

Costs

The NPV of the estimated cost of the no action alternative for 30 years is negligible. Total estimated net present (NPV) costs vary by $130,000 for the other three alternatives (Table 5.6). The total NPVs of the estimated costs of Alternatives 2, 3 and 4, are $315,000 ($320,000 for contingency disposal), $445,000, and $335,000, respectively.

Regulatory Agency and Community Acceptance

It is expected that the regulatory agencies and the community would accept each of the three action alternatives. Regulatory acceptance will be established in the Basewide Record of Decision. Community acceptance will be solicited by the Proposed Plan and addressed in the Responsiveness Summary of the Basewide Record of Decision.

5.7 Selection of the Preferred Alternative

In accordance with CERCLA guidance, the preferred alternative must meet the first two of the nine criteria: protection of human health and the environment as well as compliance with ARARs. The next five criteria are balancing criteria used for comparing alternatives. The final two criteria, state and community acceptance, are used to address the concerns of state agencies.

Based on the above comparison of alternatives, Alternative 2 is the preferred alternative. A graphical summary of this alternative is presented on Plate 5.6. This alternative was selected because it was the most practical and effective solution. It obtains an equivalent level of protection of human health and the environment as the other action alternatives and it meets ARARs. It also reduces the toxicity, mobility, and volume of waste, is the least expensive action alternative, and has the least liability associated with remaining onsite chemicals or landfilled waste.

Furthermore, Section 121 of CERCLA mandates that the selected remedial action must:
(1) protect human health and the environment;
(2) comply with ARARs unless a waiver is justified; (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. Alternative 2 meets the above CERCLA mandates in that:

- It would be protective of human health and the environment because it removes lead-containing soil that poses a potential human health risk from the site (as identified in the BRA). Mitigation measures would also be taken to reduce ecological impacts of remedial excavation activities.

- It requires no waivers and would comply with all applicable or relevant and appropriate requirements

- It is the least costly of the action alternatives.

- It provides a permanent remedial solution through the removal of lead-containing soil from the site that poses an unacceptable risk to human health.

- It follows the preference for treatment as a principal element by including excavated soil from Site 31 into remedial actions proposed for Site 3, the Beach Trainfire Ranges. These treatment activities may involve soil washing, soil stabilization, and/or asphalt batching of the lead-containing soil from Site 31 during remedial actions at Site 3, the Beach Trainfire Ranges.

TABLES

Table 5.1. Remedial Action Objectives - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Media/Exposure Pathway	Remedial Action Objective	Potential Remediation Requirements
For Human Health Protection from Air/Soil Inhalation/Ingestion/Dermal Contact		
Short-term	Minimize direct exposure through ingestion of, or dermal contact with, site soil by onsite construction workers during interim remedial action in any area with unacceptable acute risks.	Personal protection and monitoring, dust control, warning signs, decontamination, and exclusion zones.
	Minimize direct exposure of onsite construction workers to dusts generated during remedial action and maintain acceptable air quality levels per MBUAPCD or OSHA/NIOSH standards.	Control of temporary dust releases during remediation, personal protection and monitoring, warning signs.
Long-term	Reduce to acceptable levels potential chronic chemical exposures through ingestion of, or dermal contact with, soil by potential future onsite receptors (excess cancer risk no greater than 10^{-4} to 10^{-6}, hazard index less than 1, and target blood-lead level less than 10 μg/dl).	Source containment, deed restrictions, fencing of site, containment, removal, and/or treatment of soil impacted with chemicals above TCLs.
	Prevent migration of soil offsite (such as by dust), maintain background air quality levels, and reduce future onsite chemical exposures in any areas with unacceptable risk.	Air quality monitoring, deed restrictions, fencing of site, containment, removal, and/or treatment of soil with chemicals above TCLs.
For Ecological Protection of Existing Habitat		
Short-term	Minimize impacts to the existing native habitat at Site 31.	Restricting intrusive activities such as excavation, screening of areas for sensitive plant and animal species, and native plant/animal restoration.
Long-term	Prevent significant deterioration of the native habitat at Site 31.	Native plant/animal restoration, deed restrictions and containment, removal and/or treatment of soil containing chemicals above TCLs.

μg/dl Micrograms per deciliter.
MBUAPCD Monterey Bay Unified Air Pollution Control District.
OSHA Occupational Safety and Health Act.
NIOSH National Institute of Occupational Safety and Health.
TCLs Target Cleanup Levels.

Table 5.2. Lead Concentrations Detected in Soil[1] - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

	Shallow Soils	Deep Soils
Maximum Background Concentration in NQTP Soil	51.8 (mg/kg)[2]	3.7 (mg/kg)[3]
Maximum Detected Concentration in Soil	22,100 (mg/kg)	3,620 (mg/kg)
Locations with Samples Above Maximum Background	23	13

1 Ninety-nine soil samples from Site 31 were analyzed for lead. The minimum detected value was 0.59 mg/kg.

2 Soil samples collected from less than 2 feet bgs and derived from the following geologic units: Qal, Qoal, Qar, Qod, Tsm (see Volume II, Background Soil Investigation for explanations).

3 Soil samples collected from greater than 2 feet bgs and derived from the following geologic units: Qal, Qoal, Qar, Qod, Tsm.

Table 5.3. Potentially Applicable or Relevant and Appropriate Requirements - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Chemical-Specific Requirements				
Identification and Listing of Hazardous Wastes	Title 22 CCR, Chapter 11	Establishes and defines procedures and criteria for identification and listing of RCRA and non-RCRA (California) hazardous wastes.	Applicable	Lead or 4,4'-DDE/DDT present in excavated soil at Site 31 may be present above concentrations established for classification as hazardous waste
Standards for the Management of Hazardous Waste	Title 23 CCR, Chapter 15, Article 2	Establishes and defines procedures and criteria for identification and listing of designated wastes.	Applicable	Excavated soil from Site 31 may potentially be classified as a designated waste.
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	40 CFR Part 150	Establishes NAAQS for criteria pollutants: particulate matter (PM10), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead.	Applicable	Dust containing lead may be encountered or generated during remedial construction activities. Dust suppression measures will be implemented to prevent such emissions.
Monterey Bay Unified Air Pollution Control District (MBUAPCD)	California Health and Safety Code, Division 26, Section 39002; MBUAPCD Regulation II (New Sources), and Regulation X (Toxic Air Contaminants)	Requirements for new stationary sources of air pollution and the appropriate level of abatement control technology for toxic air contaminants are established by regional air boards.	Applicable	The remedial design would need to meet the substantive requirements of these MBUAPCD regulations if remedial activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal.
Location-Specific Requirements				
Endangered Species Act of 1973	16 USC. 1531 et seq.	Provide for the protection of endangered or threatened plant and animal species through an evaluation of affected habitats in the site area, as well as consultation with the appropriate government agencies.	Applicable	Results of the Ecological Risk Assessment indicate that the silvery legless lizard, an endangered species, may be present in the leaf litter layer at Site 31. Site 31 also contains species identified as Category 2 candidates for listing under the Endangered Species Act, as California Species of Special Concern, or as rare in California and elsewhere by the California Native Plant Society.
California Endangered Species Act	California Fish and Game Code, Sections 2050, et seq.	Provides for the recognition and protection of rare, threatened, and endangered species of plant and animals (in conjunction with state authorized or funded actions).	Applicable	Site 31 does not contain any species of plants or animals listed as California endangered species. The site does contain species that are identified as Category 2 candidates for listing under the Federal Endangered Species Act, as California Species of Special Concern, or as rare in California and elsewhere by the California Native Plant Society.
Migratory Bird Treaty Act	16 U.S.C. 703 et seq.	Protects certain migratory birds or their nests or eggs.	Applicable	Migratory birds are present on Site 31.

Table 5.3. Potentially Applicable or Relevant and Appropriate Requirements - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
National Archaeological and Historic Preservation Act	36 CFR Part 65	Provide for the protection of any historically significant artifacts that may be unearthed during excavation activities.	Applicable	No historically significant artifacts have been uncovered during previous investigation activities at Fort Ord, and none are expected to be unearthed at these areas. Appropriate actions will be taken, however, should any such artifacts be unearthed.
Fish and Wildlife Protection	California Fish and Game Code, Chapter 6, Section 1601	Governs the alteration of streambeds	Applicable	Placement of an erosion control wall could constitute streambed alteration. Excavation on areas will be backfilled to original grade and stabilized with taxifier or geotextile membrane.
Fish and Wildlife Coordination Act	40 CFR 6.302	Diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife. Requires consultation with the Department of Fish and Wildlife prior to any action that would alter a body of water of the U.S.	Applicable	Remedial actions may modify the ravine streambed at Site 31.
Action-Specific Requirements				
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	Title 22 CCR, Chapter 14, Article 2, Section 66264.14	Owners and operators of hazardous waste treatment, storage, or disposal (TSD) facilities must prevent the unknowing entry of persons or livestock onto the active portions of the facility; in addition, warning signs must be posted.	Relevant and Appropriate	If excavated soil is hazardous and it is treated, stored, or disposed onsite, areas will be restricted from public access.
	Title 22 CCR, Chapter 14, Article 7, Section 66264.119; Post Closure Notices	Under this requirement, a restriction is placed on the deed, which constrains future uses of the property.	Applicable	Remedial measures in which hazardous levels of chemical constituents remain in place may be subject to these regulations.
	Title 22 CCR, Chapter 14, Use and Management of Containers; Article 9, Sections 66264.171-178	Establishes requirements for the use of containers to store hazardous waste. Sets standards for container condition, compatibility with wastes, management, inspections. Also regulates secondary containment, and facility closure.	Applicable	Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers at Site 31. Appropriate actions will be taken to comply with such requirements.

Table 5.3. Potentially Applicable or Relevant and Appropriate Requirements - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	Title 22 CCR, Chapter 14, Article 15.5, Section 66254.552	Provides definitions and general standards applicable to Correction Action Management Unit (CAMU) for the management of remediation waste of RCRA corrective action sites.	Applicable	Although not a RCRA site, onsite waste management units at Site 31 could be considered CAMU's for hazardous waste placed or consolidated onsite.
	Title 22 CCR, Chapter 14, Article 15.5, Section 66264.553	These regulations apply to temporary tanks and container storage areas used for the treatment or storage of hazardous remediation wastes of hazardous waste in temporary units. Owners and operators of TSDs at which hazardous waste is stored in temporary units. Owners and operators of TSDs at which hazardous waste is stored in temporary units subject to other TSD requirements may request approval of alternative requirements which are protective of human health and the environment.	Applicable	Temporary tanks or containers may be used at Site 31 to store rinsate from remedial soil/debris screening activities. This rinsate could potentially be classified as hazardous waste.
	Title 22 CCR, Chapter 14, Article 16, Section 66264	These regulations apply to facilities that treat, store, or dispose of hazardous waste in miscellaneous units. Owners and operators of TSDs at which hazardous waste is stored in miscellaneous units must locate, design, construct, operate, maintain, and close those units in a manner that is protective of human health and the environment.	Applicable	Remedial measures in which hazardous levels of chemical constituents are treated in miscellaneous units may be subject to these regulations.
Standards Applicable to Generators of Hazardous Waste	Title 22 CCR, Chapter 12	Establishes standards for generators of hazardous waste.	Applicable	If hazardous waste is generated at the site, the substantive portions of these regulations would apply.
Land Disposal Restrictions	Title 22 CCR, Chapter 18	Prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. Requires laboratory analysis of wastes intended for landfill disposal to establish that the waste is not restricted from landfill disposal.	Applicable for excavated soil subsequently characterized as hazardous waste.	Listed or characteristic hazardous wastes land disposed after 1986 are subject to these regulations. Pretreatment such as stabilization and/or debris screening of excavated soil may be required prior to landfill disposal.

Table 5.3. Potentially Applicable or Relevant and Appropriate Requirements - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Standards for Discharges of Waste to Land	Title 23 CCR, Chapter 15; Article 2	Sets standards for waste and site classifications and waste management requirements for waste treatment, storage, or disposal in landfills, surface impoundments, waste piles and land treatment facilities in order to protect water quality.	Applicable for excavated soil	"Actions taken at the direction of public agencies to cleanup or abate waste conditions of pollution or nuisance resulting from unintentional or unauthorized releases of waste or pollutants to the environment;" . . . are exempt from the provisions of Chapter 15 . . . " provided that wastes, pollutants, or contaminated materials removed from the immediate place of release shall be discharged according to Article 2 of this subchapter. (See Text)
California Hazardous Waste Control Law	Health and Safety Code, Division 20, Chapter 6.5 Sections 25113 et seq.	Establishes guidance for the recycling of hazardous wastes.	Applicable	Soil from Site 31 may be recycled. California (Non-RCRA) hazardous and RCRA hazardous waste have different recycling requirements. Only soil that is non-RCRA hazardous may be recycled by asphalt batching for subsequent placement on land.

ARAR Applicable or relevant and appropriate requirements.
EPA U.S. Environmental Protection Agency.
CCR California Code of Regulations.
CFR Code of Federal Regulations.
USC. United States Code.
RCRA Resource Conservation and Recovery Act.
MBUAPCD Monterey Bay Unified Air Pollution Control District.
NAAQS National Ambient Air Quality Standards.
PM10 Particulate matter with a diameter under 10 microns.
et seq. And following.
TSD Treatment, storage, and disposal.
NEPA National Environmental Policy Act.
FS Feasibility study.
CEQA California Environmental Quality Act.
Cal/EPA California Environmental Protection Agency.

Table 5.4. Retained Remedial Technologies - Site 31
Debris and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Retained for Alternative Development
NO ACTION	None	Required according to CERCLA guidance.	Low	Not effective; however, certain land uses may allow for waste material and debris to remain in place.	Requires regulatory approval of any risk to environmental and human health or impact of chemicals on groundwater; also requires consideration of future land use.	Yes
CONTAINMENT	Vertical Barriers					
	Grout curtain, sheet metal, slurry walls, or sheet piling	Provides semi-permeable or impermeable barriers to horizontal migration of chemical-bearing soil and debris due to erosion or water flow.	Moderate/ High	Barriers are only moderately effective for containment of certain types of contamination.	Not implementable due to Site 31's steep slope and unstable geology.	No
	Horizontal Barriers					
	Grouting, sheet metal, or block displacement	Provides semi-permeable or impermeable barrier to vertical migration of soil and debris due to erosion or water flow.	High	Barriers are only moderately effective for containment of certain types of contamination.	Not implementable due to Site 31's steep slope and unstable geology.	No

Table 5.4. Retained Remedial Technologies - Site 31
Debris and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Retained for Alternative Development
CONTAINMENT (cont.)	Capping					
	Clay and soil	Semi-permeable or impermeable surface layer comprised of compacted clay over debris and soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Effective for minimizing contact and surface water leaching of chemicals in debris and soil to groundwater. Cap requires continuous maintenance; groundwater monitoring may be required.	Not implementable due to Site 31's steep slope and unstable geology. Compaction of waste prior to capping may prove difficult depending on waste profile.	No
	Multilayered	Semi-permeable or impermeable materials such as compacted clay, soil, or lime placed in layers to prevent surface water infiltration, chemical transport, and contact.	High	Highly effective for minimizing contact and surface water leaching of chemicals in debris and soil to groundwater. Cap requires continuous maintenance.	Not implementable due to Site 31's steep slope and unstable geology. Compaction of waste prior to capping may prove difficult depending on waste profile.	No
	Asphalt or concrete	Semi-permeable or impermeable surface layer comprised of a concrete slab or a layer of asphalt to prevent surface water infiltration, chemical transport, and contact.	Low/ Moderate	Less effective for minimizing contact and surface water leaching of source area debris and soil to groundwater; more permeable than engineered caps.	Not implementable because an asphalt or concrete cap would be disruptive to the sensitive ecological habitat at Site 31.	No

Table 5.4. Retained Remedial Technologies - Site 31
Debris and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Retained for Alternative Development
CONTAINMENT (cont.)	Surface Water Controls					
	Grading	Smoothing of surface to grade after completion of excavation and backfilling.	Low	Would need to be consistent with existing drainage patterns in Site 31's sensitive ecological habitat.	Highly dependent on ecological considerations. May be used as a mitigation measure for collection activities, but generally not as an engineered containment solution.	No
	Revegetation	Engineered landscaping and placement of plants, shrubs, or trees to restore site after excavation.	Moderate	Would need to be consistent with existing drainage patterns in Site 31's sensitive ecological habitat.	Highly dependent on ecological considerations. May be used as a mitigation measure for collection activities, but generally not as an engineered containment solution.	No
	Diversion and collection systems	Series of pipes and basins to direct surface water away from area of concern; minimizes surface water infiltration and chemical transport.	Moderate	Not necessary. Also would alter existing drainage patterns in Site 31's sensitive ecological habitat.	Depends on long-term planned site development and ecological considerations.	No
COLLECTION	Debris and Soil Removal					
	Excavation	Removal of debris and soil by digging with commonly used heavy equipment.	Moderate	Highly effective for removal of most debris and soil.	Implementable, with most equipment readily available; footing of equipment in sandy dune and steep areas may prove difficult. Hand excavation may be preferable at Site 31.	Yes

Table 5.4. Retained Remedial Technologies - Site 31
Debris and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Retained for Alternative Development
	Deep soil excavation	Removal of soil with deep augers and other nonstandard excavation techniques.	High	Effective for metals in soil.	Not necessary and would be difficult to implement due to unstable geologic conditions and sensitive ecological habitat.	No
TREATMENT	Thermal Treatment					
	Sterilization	Super heated steam-cleaning in container or vessel for sterilization purposes.	Moderate/ High	Not effective for metals.	Equipment available. Energy intensive; favorable for smaller-sized debris.	No
	Offsite rotary kiln incinerator	Combustion in a horizontally rotating cylinder designed for uniform heat transfer and destruction of waste.	High	Not effective for metals in soil.	Implementable; however, acceptance at a licensed incinerator depends on presence of contamination.	No
	Chemical Treatment					
	Asphalt batching	Incorporation of soil into a cold or hot mix as an aggregate supplement in the manufacture of asphaltic concrete.	Low	Soil must be an adequate substitute for aggregate typically used, volatilization of chemicals in hot mix process may require emissions controls.	Equipment readily available. Requires pilot study. Soil may be incorporated into remedial activities at Site 3.	Yes

Table 5.4. Retained Remedial Technologies - Site 31
Debris and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Retained for Alternative Development
TREATMENT (cont.)	Physical Treatment					
	Screening	Removal of larger sized particles from the waste stream by passage through a screen.	Low	Effective for separation and homogenization of waste.	Applicable for primary processing prior to soil treatment.	Yes
	Soil washing	Extraction of contaminants using solvents or surfactants as washing solution ex situ	Moderate/ High	Effective for metals in soil; depends on solvent affinity for metals. May be used as primary treatment process for reduction of volume requiring treatment	Equipment available; however, technology is innovative for lead in soil and not proven on large scale; requires subsequent treatment of waste stream. Soil may be incorporated into remedial activities at Site 3.	Yes
	Debris washing	High pressure spraying of debris in enclosed tank using water and chemical-specific surfactants or solvents, if necessary	Moderate/ High	Effective for removal of certain contaminants from debris surfaces	Implementable; chemical-specific surfactants would not be necessary for contaminants on debris from Site 31.	Yes
	Debris separation	Excavation and placement of debris and soil in large-scale mechanical vibrating screens to remove smaller fraction of material (e.g., soil).	Low/ Moderate	Highly effective for separation of debris from soil; reduces volume of waste.	Implementable; screening equipment readily available. Sandy soil is easily separated from other material.	Yes

Table 5.4. Retained Remedial Technologies - Site 31
Debris and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Retained for Alternative Development
TREATMENT (cont.)	Biological Treatment					
	Biodegradation	Introduction of oxygen, nutrients, and/or bacteria to waste pile heaps to biodegrade organics and chemical residues associated with explosives.	Low/ Moderate	Not effective for lead in soil.	Implementable; equipment readily available. Sandy soil may require amendment of nutrients and bacteria. Requires pre-design study.	No
	Onsite Stabilization/Fixation					
	In situ Cement- or Pozzolonic-based stabilization	Fixation agents are added to bind contaminants and soil into a solid mass.	Moderate	Effective for metals in soil.	Difficult to implement for soil with debris; limits land use if left onsite. Required pilot study.	No
	Offsite Treatment					
	Stabilization/fixation	Reduces chemical mobility through binding contaminants and soil into a solid mass.	High	Effective for metals in soil.	Implementability affected by offsite facility location and availability. Soil may be incorporated into remedial activities at Site 3.	Yes
DISPOSAL	Onsite Disposal					
	Replacement after treatment	Excavation and treatment, or separation of soil or debris, with replacement of material into excavated areas.	Low	Effective for any debris or soil treated to agreed-upon levels; cap, or monitoring depending on waste.	Not implementable due to sensitive habitat at Site 31 which requires timely backfilling and revegetation activities.	No

Table 5.4. Retained Remedial Technologies - Site 31
Debris and Metals in Soil
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Retained for Alternative Development
DISPOSAL (cont.)	Onsite Disposal					
	Onsite repository	Onsite corrective action management unit that may be lined and capped or completely enclosed in cement or other stable, non-eroding material.	High	Effective for containment of most wastes. Requires continuous maintenance, monitoring, or leachate, collection, and recovery system (LCRS).	Implementable depending on planned site development; area would have to be designated as a permanent landfill facility.	Yes
	Onsite disposal	Onsite replacement of chemical-bearing soil or treated soil to the excavation area. Assumes treatment of contaminated soil to acceptable levels before replacement, and no additional containment controls are required.	Moderate	Effective if approved by regulatory agencies. Requires continuous maintenance and monitoring.	Replacement of treated soil would not be practical given the limited quantity and sensitive ecological habitat at Site 31 which requires timely backfilling and revegetation activities.	No
	Offsite Disposal					
	Demolition landfill	Transport of live ammunition or explosives to offsite facility for detonation and/or disposal.	Low/ Moderate	Effective for live ammunition detonation and disposal of fragments or exploded ordnance.	Not implementable; unexploded ordnance is not anticipated to be encountered at Site 31.	No
	Landfill	Transport of chemical-bearing debris and soil to appropriate landfill by licensed waste transporter.	Low/ High	Effective; however pretreatment may be required depending upon presence of: contamination, biological hazards, or live ammunition.	Implementable and readily available. Class of landfill depends upon type of debris and soil contaminants; some landfills offer pretreatment.	Yes
	Recycling facility	Transport of recyclable or reclaimable debris to an appropriate facility such as a smelter.	Low	Effective for debris such as scrap metal, glass, and oil or known substances found in containers.	Not implementable because of heterogenous nature and limited quantity of debris material.	No

Table 5.5. Evaluation of Remedial Alternatives - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Retained for Detailed Analysis in the FS	EPA Evaluation Criteria							
	Protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction of toxicity, mobility, and volume through treatment	Short-term effectiveness	Implementability (technical and administrative)	NPV Cost	Regulatory Agency and community acceptance
Alternative 1: No Action	This alternative will not be protective of human health and the environment.	May not trigger ARARs if contamination left in place.	Would not meet remedial goals for an inordinately long period of time, if ever. Although some compounds may degrade with time, lead contamination would not.	Would not reduce toxicity, mobility, volume of waste.	Would not reduce risks to human health and the environment either at present or in the future.	Could be easily implemented.	None.	Regulatory and community acceptance will be addressed in the Proposed Plan and Basewide Record of Decision for Site 31.

Table 5.5. Evaluation of Remedial Alternatives - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Retained for Detailed Analysis in the FS	EPA Evaluation Criteria							
	Protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction of toxicity, mobility, and volume through treatment	Short-term effectiveness	Implementability (technical and administrative)	NPV Cost	Regulatory Agency and community acceptance
Alternative 2: Excavation and Treatment of Soil and Disposal of Debris	Protective of human health and the environment.	Complies with all applicable or relevant and appropriate requirements.	Provides long-term protection of human health and the environment by removing/ stabilizing waste.	Reduces the toxicity and mobility of lead in soil through stabilization/ fixation. Reduces the volume of waste through screening debris.	Effective in the short term. This alternative can be readily implemented once approved. Possible short-term adverse effects to human health from dust and to the native habitat due to construction activities.	Implementable, but would require special consideration during construction activities for the unstable geologic conditions and sensitive wildlife habitat.	$315,000 (320,000 for contingency disposal)	Regulatory and community acceptance will be addressed in the Proposed Plan and Basewide Record of Decision for Site 31.

Table 5.5. Evaluation of Remedial Alternatives - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Retained for Detailed Analysis in the FS	EPA Evaluation Criteria							
	Protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction of toxicity, mobility, and volume through treatment	Short-term effectiveness	Implementability (technical and administrative)	NPV Cost	Regulatory Agency and community acceptance
Alternative 3: Excavation and Placement of Soil and Debris in an Onsite Waste Management Unit	Protective of human health and the environment.	Requires designation of onsite waste management unit as a corrective action management unit or waiver of LDRs.	Effective in the long term. Contaminants above TCLs would remain onsite, however. Periodic inspection/ maintenance of the cap would be required to ensure containment of the waste.	Reduces the mobility of contaminants through containment, but would not reduce its volume or toxicity.	Effective in the short term. This alternative can be readily implemented once approved. Possible short-term adverse effects to human health from dust and to the native habitat due to construction activities.	Implementable. Construction of the cap would be difficult due to unstable geological conditions and sensitive wildlife habitat.	$445,000	Regulatory and community acceptance will be addressed in the Proposed Plan and Basewide Record of Decision for Site 31.

Table 5.5. Evaluation of Remedial Alternatives - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Retained for Detailed Analysis in the FS	EPA Evaluation Criteria							
	Protection of human health and the environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction of toxicity, mobility, and volume through treatment	Short-term effectiveness	Implementability (technical and administrative)	NPV Cost	Regulatory Agency and community acceptance
Alternative 4: Excavation and Offsite Disposal of Soil and Debris	Protective of human health and the environment.	Complies with all applicable or relevant and appropriate requirements.	Provides long-term protection of human health and the environment by removing waste. Some liability may be associated with the final landfill accepting the soil.	Reduces the toxicity and mobility of lead in soil through stabilization/ fixation at the landfill accepting the waste.	Effective in the short term. This alternative can be readily implemented once approved. Possible short-term adverse effects from dust generated due to construction activities.	Implementable, but would require special consideration during excavation activities for the unstable geologic conditions and sensitive wildlife habitat.	$335,000	Regulatory and community acceptance will be addressed in the Proposed Plan and Basewide Record of Decision for Site 31.

ARARs = Applicable or relevant and appropriate requirements
EPA = Environmental Protection Agency
FS = Feasibility Study
CDRs = Land Disposal Restrictions
NPV = Net Present Value
TCL = Target Cleanup Levels

Table 5.6. Summary of Remedial Alternative Cost Estimates[1] - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

	Alternative	Capital Cost	Annual O&M Costs	Total Net Present Value[1]
(1)	No Action	$0	$0	$0
(2)	Excavation and Treatment of Soil and Disposal of Debris	$315,000	$0	$315,000
	(Disposal contingency)	($320,000)[2]		($320,000)[2]
(3)	Excavation and Placement of Soil and Debris in a Corrective Action Management Unit	$410,000	$2,100	$445,000
(4)	Excavation and Offsite Disposal of Soil and Debris	$335,000	$0	$335,000

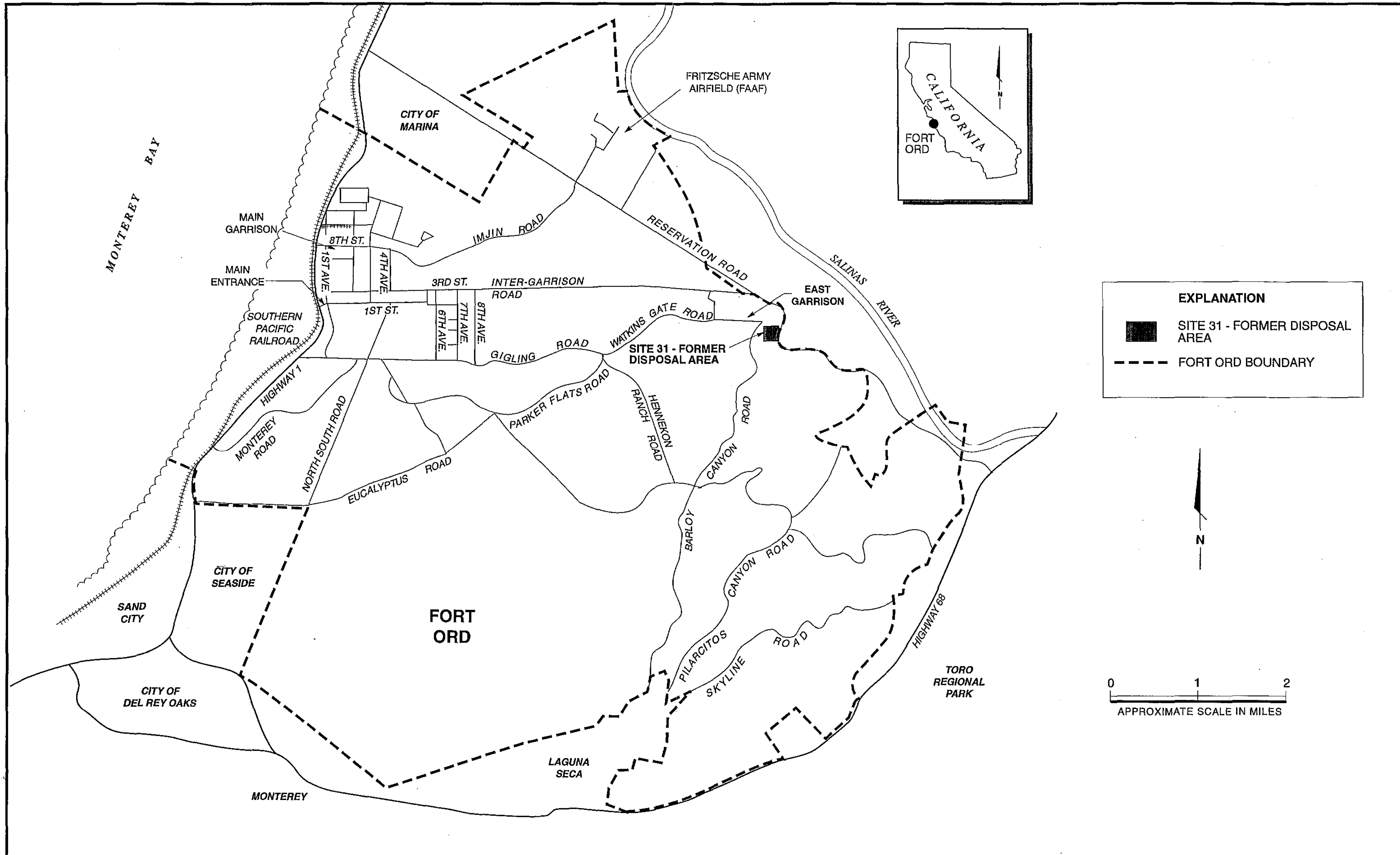
Note:

These costs are for comparison purposes only and can be expected to range from 50 percent high to 30 percent low. Many design variables and permitting requirements have not been established. Construction cost estimates for the preferred alternative will be refined after an alternative has been selected and approved in the remedial design phase.

1 Assumes 5 percent interest rate, and 30-year timeframe.

2 This is the cost of disposal if soil cannot be treated at Site 3. These disposal costs are significantly less than those used in Alternative 4 because of the larger soil volumes involved with remedial activities at Site 3.

PLATES



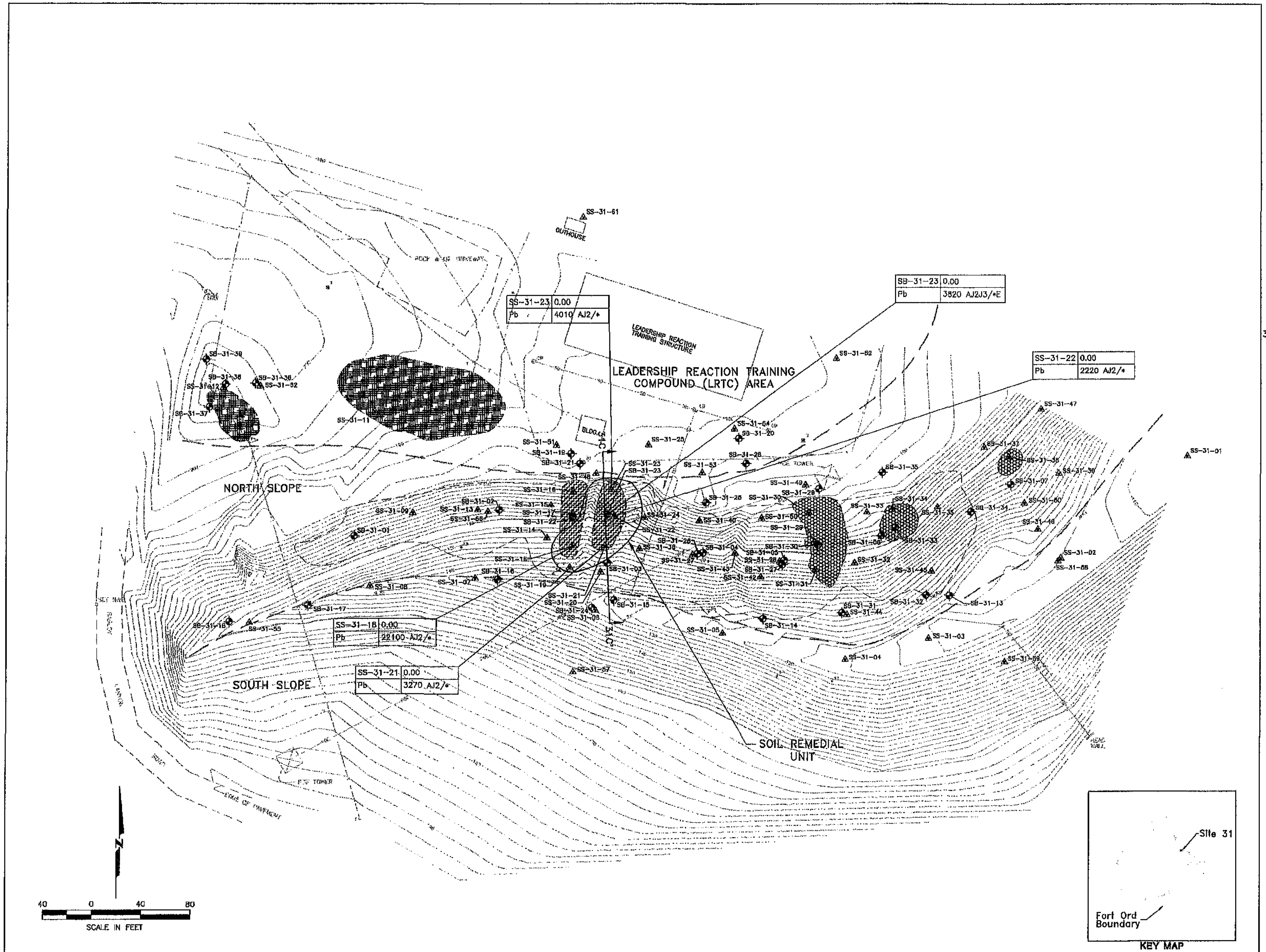
NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
	7/94	DRAFT		23366 0417154			DJP
	11/94	DRAFT FINAL		23366 0417254			
	10/95	FINAL		23366 0417254	MLS	10/17/95	

Harding Lawson Associates
Engineering and Environmental Services

Volume V - Feasibility Study
Basewide RI/FS
Fort Ord, California

Fort Ord Location Map
Site 31 - Former Disposal Area

PLATE: 5.1



EXPLANATION

- SURFACE SOIL SAMPLE (HLA)
- SOIL BORING/PILOT BORING (HLA)
- SOIL REMEDIAL UNIT 1
- AREA OF SPORADIC SURFACE DEBRIS (WOOD, METAL PIECES, WHOLE AND BROKEN GLASS AND COAL); OVERLIES YELLOWISH BROWN TO LIGHT YELLOWISH BROWN SILTY SAND TO SANDY SILT, LOCALLY BECOMES DARK YELLOWISH BROWN.
- AREA OF COAL DEBRIS SHALLOWER THAN 8 INCHES BELOW GROUND SURFACE (BGS).
- AREA OF EXTENSIVE DEBRIS DEEPER THAN 2 FEET BGS; 25%–75% IS GRAYISH BROWN SILTY SAND TO SANDY SILT, 25%–75% IS DEBRIS (BOTTLECAPS, PIECES OF POTTERY AND METAL, MELTED AND UNMELTED GLASS PIECES AND BOTTLES, FORK, GLASS STOPPER)
- AREA OF MODERATELY EXTENSIVE TO SPORADIC DEBRIS GENERALLY SHALLOWER THAN 8 INCHES BGS; DEBRIS EXTENDS BELOW 2 FEET BGS IN LOCALIZED AREAS; 90–100% IS DARK YELLOWISH BROWN SILTY SAND SANDY SILT. 0–10% IS DEBRIS (METAL FRAGMENTS, WHOLE AND BROKEN BOTTLES, RUSTED CANS, WOOD, COAL, AND NYLON NETTING).
- 31C 31C' CROSS-SECTION LINE, SEE PLATES 5.4 AND 5.5
- APPROXIMATE AREA BOUNDARY LINE
- GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 2 FEET)
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE
- GLOBAL POSITIONING SYSTEM (GPS) POINT
- WATER CATCH BASIN
- FENCE POST REFERENCE POINT
- TELEPHONE POLE
- TELEPHONE LINE
- PACIFIC GAS & ELECTRIC POWER LINE
- STORM DRAIN LINE

SAMPLE LOCATION

SS-31-05	9.00
Pb	2410 A

- SAMPLE DEPTH IN FEET BELOW GROUND SURFACE
- PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLE 9 OF VOLUME II, SITE 31 REMEDIAL INVESTIGATION
- CONCENTRATIONS IN MILLIGRAMS PER KG
- ANALYTES– ABBREVIATIONS ARE DEFINED IN THE ACRONYM LIST

MW-02-01-180

- TYPE DESIGNATION; MW = MONITORING WELL, SS = SURFACE SAMPLE, SB = SOIL BORING
- SITE NUMBER
- AQUIFER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUIFER)
- WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TRENCH NUMBER

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	8/94	DRAFT	23366345	23368 0417154			KF
2	12/94	DRAFT FINAL	23366345	23368 0417254			KF
3	10/95	FINAL	23366345	23368 0417254	MLS	10/18/95	KF

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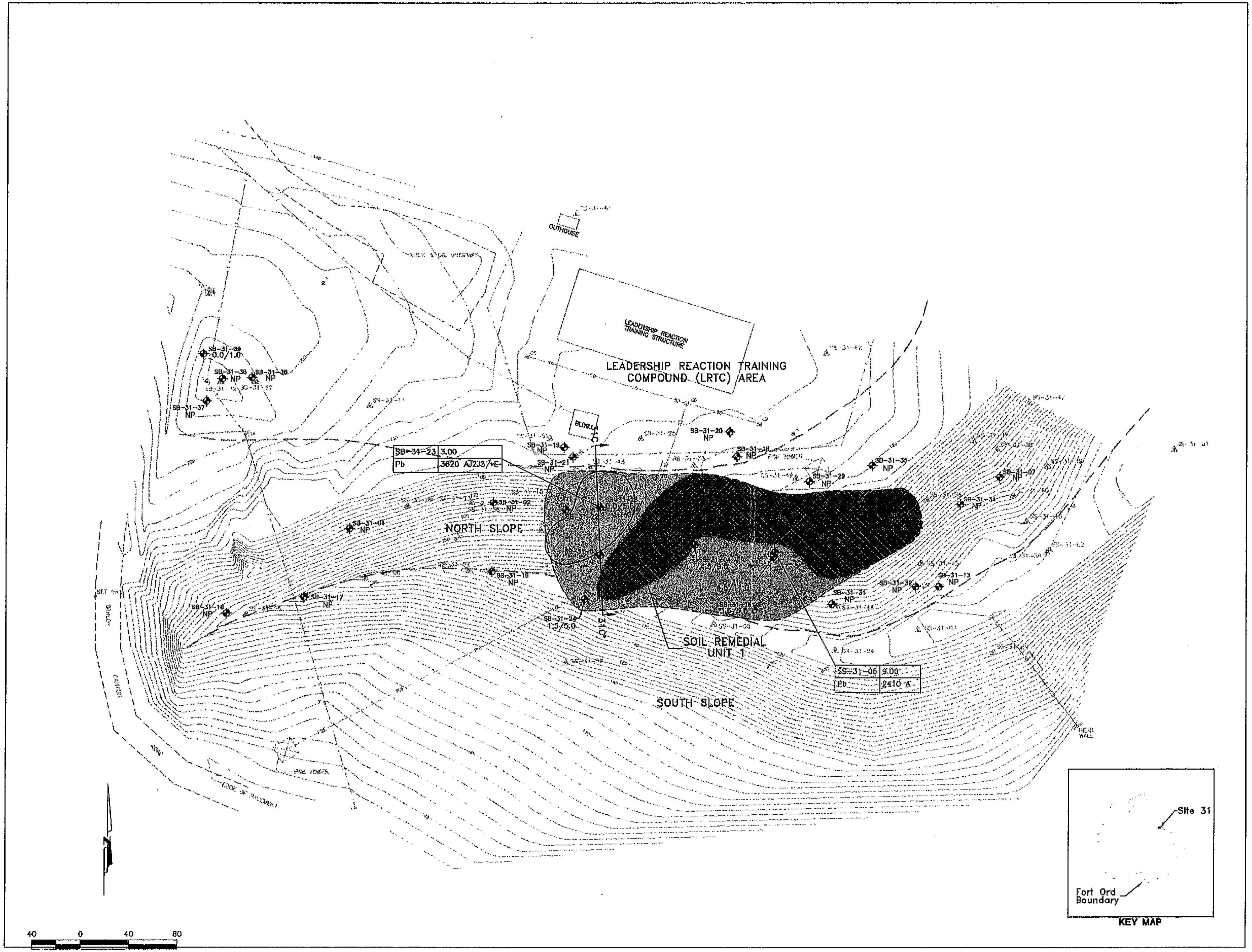
Volume V – Feasibility Study
Basewide RI/FS
Fort Ord, California

Site Plan and Surface Debris Map Showing Soil Remedial Unit and Lead Above TCLs
Site 31 – Former Dump Site

PLATE: 5.2



EXPLANATION

- SOIL GAS SAMPLING POINT (HLA)
- SURFACE SOIL SAMPLE (HLA)
- SOIL BORING/PILOT BORING (HLA)
- SOIL REMEDIAL UNIT 1
- EXTENT OF SUBSURFACE DEBRIS-CONTAINING SAND; 80%-90% IS DARK YELLOWISH BROWN TO DARK GRAYISH BROWN SAND TO SILTY SAND, 10%-20% IS DEBRIS (MELTED AND UNMELTED GLASS FRAGMENTS, CONCRETE AND ASPHALT CHUNKS, BURNT AND UNBURNT WOOD, METAL FRAGMENTS, BRICK AND CLAY TILE FRAGMENTS, COAL, PLASTIC NETTING, ASH).
- THICKNESS OF DEBRIS-CONTAINING SAND GENERALLY FROM 2 TO 5.5 FEET BGS.
- THICKNESS OF DEBRIS CONTAINING SAND GENERALLY FROM 5.5 TO 13 FEET. BELOW GROUND SURFACE (BGS).
- 2.0/6.0 — DEPTH TO TOP OF DEBRIS /DEPTH TO BOTTOM OF DEBRIS
- NP — NO SUBSURFACE DEBRIS PRESENT
- 31C — 31C' CROSS-SECTION LINE, SEE PLATES 5.4 AND 5.5
- APPROXIMATE AREA BOUNDARY LINE
- GROUND SURFACE CONTOUR (FEET ABOVE MEAN SEA LEVEL, CONTOUR INTERVAL 2 FEET)
- BUILDING
- STORM DRAIN OUTFALL PIPE
- FENCE
- GLOBAL POSITIONING SYSTEM (GPS) POINT
- WATER CATCH BASIN
- FENCE POST REFERENCE POINT
- TELEPHONE POLE
- TELEPHONE LINE
- PACIFIC GAS & ELECTRIC POWER LINE
- STORM DRAIN LINE

SAMPLE LOCATION — SS-31-06; SAMPLE DEPTH IN FEET BELOW GROUND SURFACE — 9.00

SS-31-06	9.00
Pb	2410 A

- Pb — ANALYTES— ABBREVIATIONS ARE DEFINED IN THE ACRONYM LIST
- 2410 — CONCENTRATIONS IN MILLIGRAMS PER KG
- A — PROJECT AND LABORATORY QUALIFIERS; QUALIFIERS ARE DEFINED IN TABLE 9 OF VOLUME II, SITE 31 REMEDIAL INVESTIGATION

- ND(1.0) — NOT DETECTED AT THE REPORTING LIMIT SHOWN IN PARENTHESES
- NA — NOT ANALYZED

MW-02-01-180
- TYPE DESIGNATION; MW = MONITORING WELL, SS = SURFACE SAMPLE, SB = SOIL BORING
- SITE NUMBER
- AQUIFER DESIGNATION, WHERE APPLICABLE (180-FOOT AQUIFER)
- WELL, PIEZOMETER, SOIL BORING, SOIL GAS POINT, PILOT BORING, TRENCH NUMBER

NOTE:

1. THE EXTENT OF SUBSURFACE DEBRIS PRESENTED ON THIS PLATE IS BASED ON ONE INTERPETATION OF THE DATA; OTHER INTERPRETATIONS MAY BE POSSIBLE.
2. TRACE DEBRIS WAS ENCOUNTERED IN SOME BORINGS (e.g., SB-31-34) THAT ARE NOT WITHIN THE AREA OF SUBSURFACE DEBRIS SHOWN ON THIS PLATE.
3. DEBRIS WAS NOT ENCOUNTERED IN TWO BORINGS (SB-31-03 & SB-31-22) THAT ARE WITHIN THE INTERPRETED AREA OF SUBSURFACE DEBRIS.

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
	6/94	DRAFT	23366344	23366 0417154			KF
2	12/94	DRAFT FINAL	23366344	23366 0417254			KF
3	10/95	FINAL	23366344	23366 041737	MLS	10/17/95	KF

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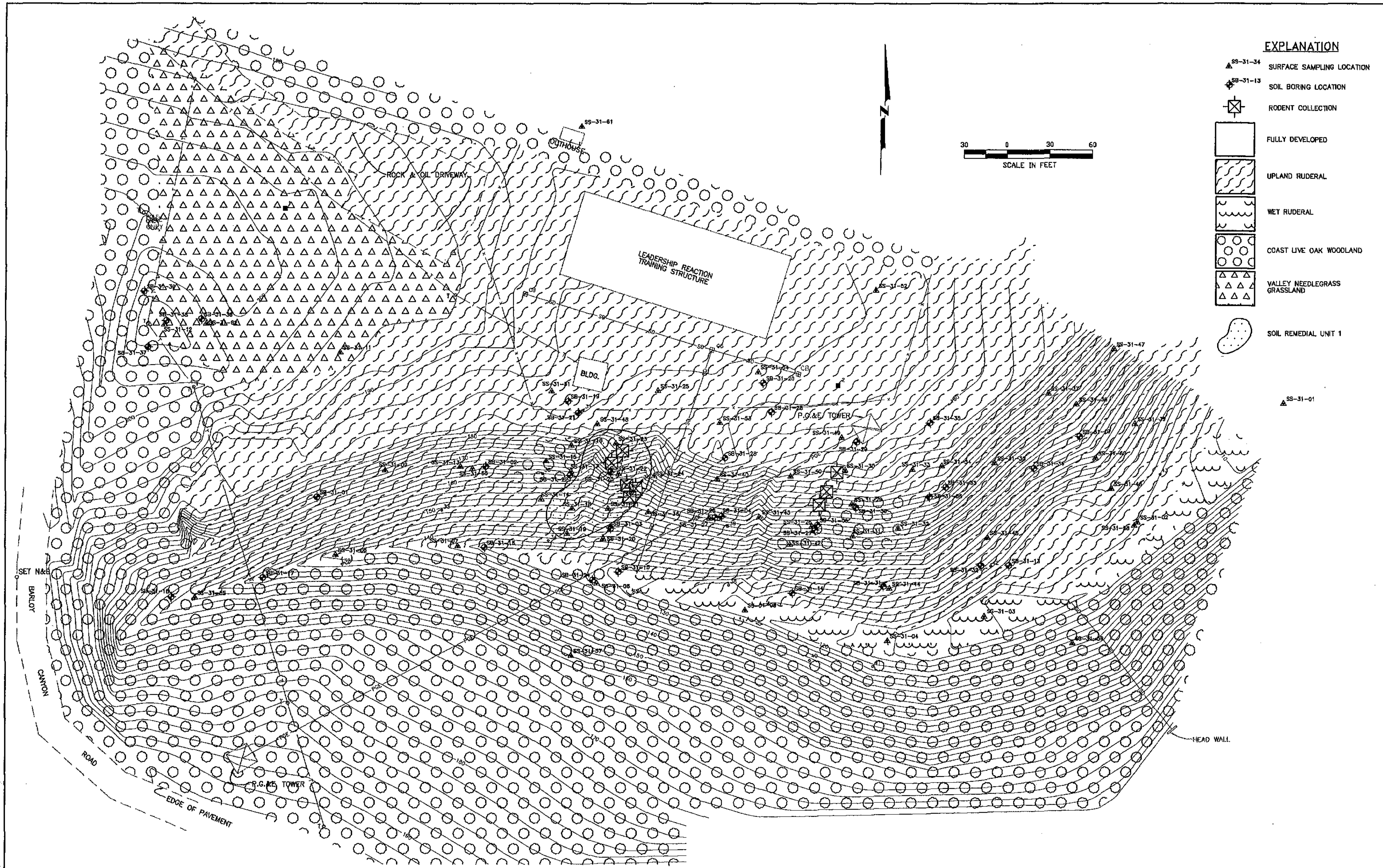
Basewide RI/FS
Fort Ord, California

Subsurface Debris Thickness Map Showing Soil Remedial Unit and Lead Above TCLs
Site 31 – Former Dump Site

PLATE: **5.3**



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	12/94	DRAFT FINAL	23366670	23366 0417254			AED
2	10/95	FINAL	23366670	23366 0417254	MLS	10/18/95	AED

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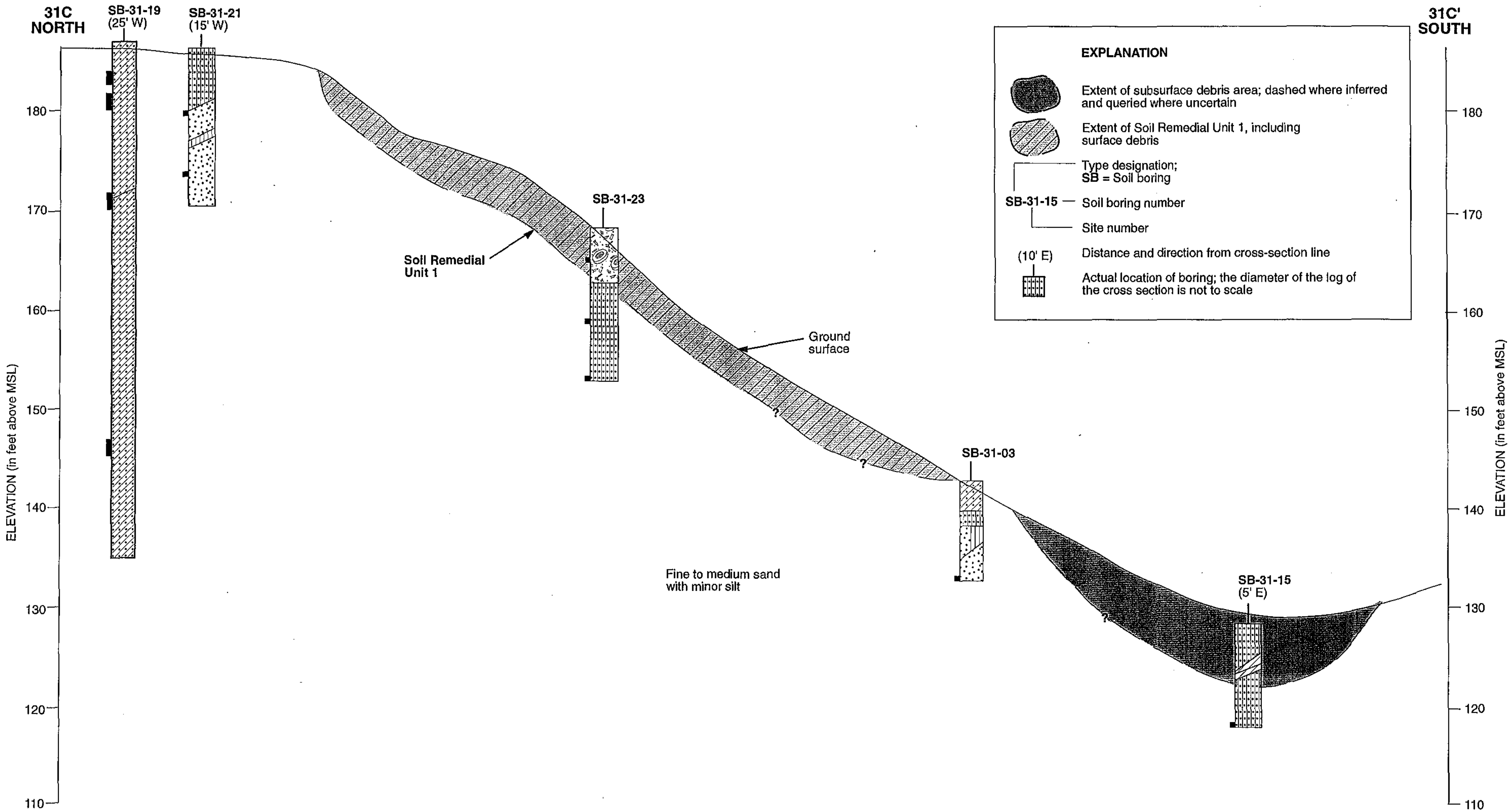
Basewide RI/FS
Fort Ord, California

Soil Remedial Unit and Associated Plant Communities
Site 31 – Former Dump Site

PLATE: 5.4

23366670 60.0
19951017.1714



Notes:
1. The extent of debris shown on this plate represents one interpretation based on available data; other interpretations may be possible.

2. Soil classification and sample locations symbols/patterns are described on Plate A1 of Appendix A of Volume II - Site 31 Remedial Investigation

Horizontal Scale: 1"=10'
Vertical Scale: 1"=10"
Vertical Exaggeration 1:1

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
	7/94	DRAFT		23366 0417154			AG
	11/94	DRAFT FINAL		23366 0417254			
	10/95	FINAL		23366 0417254	MLS	10/17/95	

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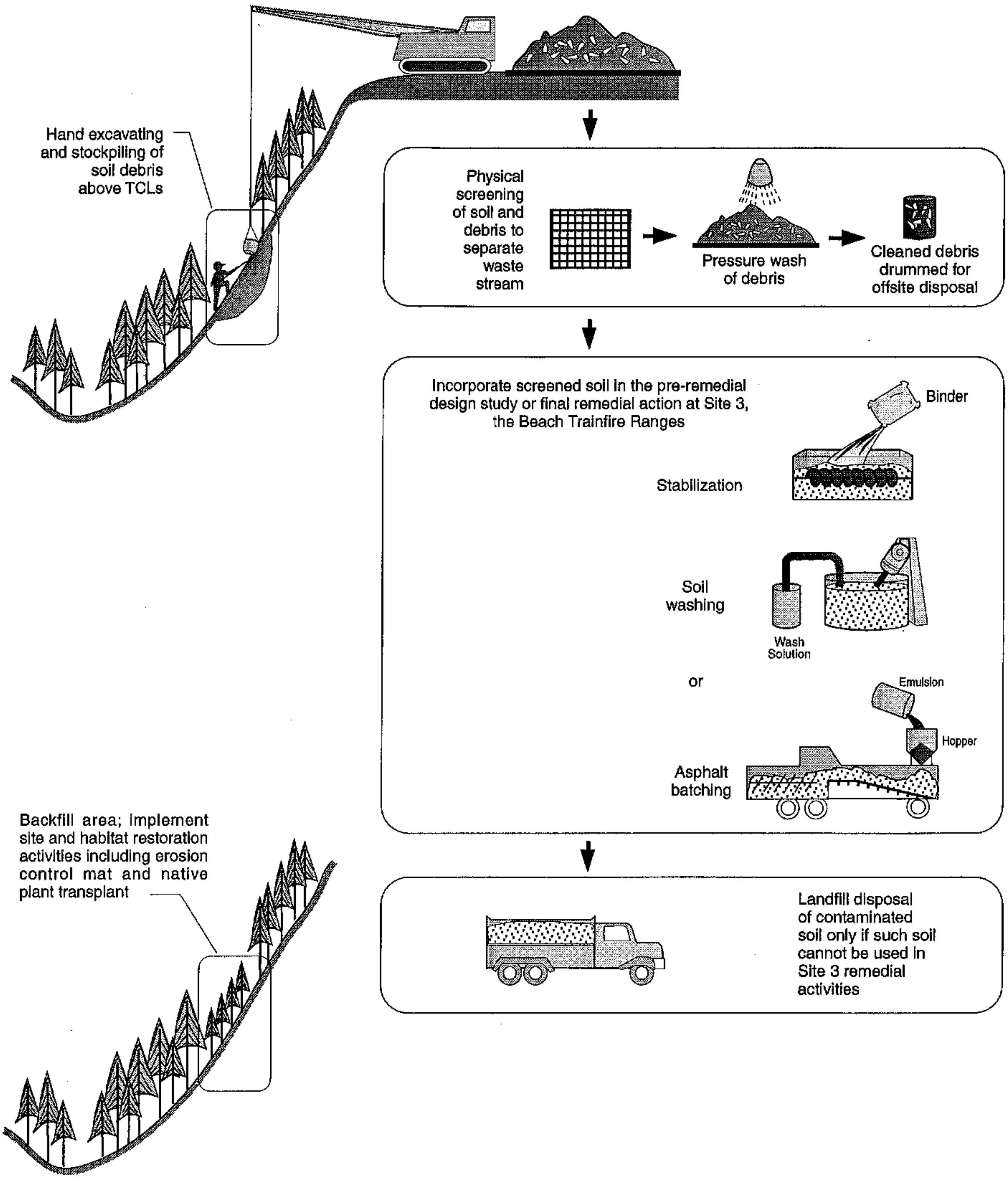
Volume V- Feasibility Study
Fort Ord, California

Geologic Cross Section 31C - 31C'
Site 31 - Former Dump Site

PLATE: 5.5

mc112894LZ



112294SE

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The Preferred Alternative for Site 31
Soil Excavation/Treatment and Debris Disposal
Volume V - FS, Basewide RI/FS
Fort Ord, California

PLATE **5.6**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
DJP	23366 0417254	MLS	11/94	11/94

APPENDIX 5A

REMEDIAL TECHNOLOGY SCREENING CHECKLISTS AND SUMMARY REVIEW FORMS

The attached checklists in this Appendix are taken from the *Draft Remedial Technology Screening (RTS) Report, Fort Ord, California*, dated February 9, 1994. These forms were completed for the wastes present at Site 31. These checklists refer to remedial technology screening tables (Tables 1 to 22), which can be found in the RTS report. These RTS tables were developed specifically for Fort Ord on a basewide level to accelerate in the preparation of Fort Ord Feasibility Studies. As described in the main text of this Site 31 Feasibility Study (FS), all technologies identified as applicable from the selected RTS tables were incorporated into Table 5.4 of this FS. Section 5.2.3 of this report describes how these standard RTS technologies were then screened for specific conditions at Site 31.

- Form 5A-1 identifies the appropriate RTS table based on site chemicals and the media affected. Separate in situ and ex situ categories are presented for soil, and only one category for debris. Based on this form, RTS Tables 7, 8, and 12 were identified as applicable for Site 31.

- Forms 5A-2 and 5A-3 list the retained technologies identified from the RTS Tables 7, 8, and 12 identified on Form A-1, for soil and debris, respectively. These technologies were incorporated into Table 5.4 of this FS for further site-specific screening and evaluation.

FORM 5A-1

Matrix Guide/Checklist - Site 31
Identification of Technology Screening Tables
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Locate Classes of Compounds below in Rows (A) through (F): Check One.	A ☐ B ☐ C ☐ D ■ E ☐ F ☐
In what media are the compounds? Locate the appropriate column (#) for either soil, groundwater, or debris.	Soil (1&2) ■ Groundwater (3&4) ☐ Debris (5) ■
Are both in situ and ex situ treatment potentially applicable for soil or groundwater at this site? Locate in situ, ex situ, or both types of treatment in Columns (1) through (4).	1 ■ 2 ■ 3 ☐ 4 ☐
Where compound, media, and type of treatment intersect, refer to the technology screening table number indicated. Use Forms B-2, B-3, or B-4 to record applicable technologies as tables are reviewed.	Table(s) 7 8 12 ___ ___

Media	**Soil**		Groundwater		**Debris**
Classes of Compounds	(1) In Situ	(2) Ex Situ	(3) In Situ	(4) Ex Situ	(5) *
(A) VOCs	Table 1	Table 2	Table 13	Table 14	**Table 12**
(B) TPH-light	Table 3	Table 4	Table 15	Table 16	
(C) TPH-heavy	Table 5	Table 6	Table 17	Table 18	
(D) Metals	**Table 7**	**Table 8**	Table 19	Table 20	
(E) Pesticides	Table 9	Table 10	Table 21	Table 22	
(F) Mixed Waste +	Table 11		Table 23		

Tables referenced in this checklist can be found in the *Draft Remedial Technology Screening Report*, dated February 9, 1994.

* Debris is not specific to a Class of Compounds

\+ Mixed waste is two or more dissimilar Classes of Compounds combined in soil or groundwater, such as metals and VOCs.

FORM 5A-2

Soil Technology Screening Summary Form - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

INSTRUCTIONS: Complete several forms if necessary for each separate Class of Compounds and Media, and attach to Feasibility Study file for each site (e.g., one form for VOCs in groundwater, and a separate form for metals in soil).

- Name of Site: Site 31 - Former Dump Site
- Brief Description: Ravine area containing incinerator ash/debris
- Group of Compounds (select one)
  - VOCs ____ TPH-light ____
  - TPH-heavy ____ Metals (lead) X
  - Pesticides ____
- Media (select one)
  - Soil X Groundwater ____
- Potentially Applicable Treatment (select one or both)
  - In Situ X Ex Situ X
- Referenced Table(s)[1] Number 7 8
- Technologies Retained

In Situ	Ex Situ
No Action	Soil Removal
Vertical/Horizontal Barriers	Physical Treatment
Capping, Surface Water Controls	Stabilization/Fixation
Source Soil Removal	Onsite/Offsite Disposal
Physical Treatment	
Stabilization/Fixation	
Onsite/Offsite Disposal	

- Form Completed by: Mark Goralka
- Description of Technology(s) (Appendix C) Reviewed by: Mark Goralka
- Date Completed: June 18, 1994

1 Tables/forms referenced in this checklist can be found in the *Draft Remedial Technology Screening Report*, February 8, 1994.

FORM 5A-3

Debris Technology Screening Summary Form - Site 31
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

INSTRUCTIONS: Complete separate forms if necessary for different types of debris (e.g., one form for live ammunition and unexploded ordnance, and a separate form for household refuse and appliances).

- Name of Site: Site 31 - Former Dump Site
- Brief Description: Ravine area containing incinerator ash/debris
- Type of Debris (select one category, one or more type of debris)

Type of Debris	
Household refuse	X
Appliances	
Scrap metal	X
Scrap lumber	
Glass	X
Medical	
Incinerator ash	X
Spent ammunition	
Live ammunition	
Unexploded ordinance	

- Group of Compounds (if detected within debris)

VOCs		TPH-light		TPH-heavy	
Metals	X	Pesticides			

- Referenced Table(s)[1] Number 12
- Technologies Retained

No Action	Surface Water Controls
Vertical/Horizontal Barriers	Debris and Soil Removal
Biological Treatment	Source Soil Removal
Capping	Thermal/Physical Treatment
Stabilization/Fixation	
Onsite/Offsite Disposal	

- Form Completed by: Mark Goralka
- Description of Technology(s) (Appendix C) Reviewed by: Mark Goralka
- Date Completed: June 18, 1994

1 Tables/forms referenced in this checklist can be found in the *Draft Remedial Technology Screening Report* (February 8, 1994).

APPENDIX 5B

REMEDIAL ALTERNATIVE COST ESTIMATES AND ASSUMPTIONS

CONTENTS

TABLES

General Assumptions

- Mobilization for each alternative is assumed to be include the following: Mobilization of equipment, trailer rental, temporary fencing (as necessary), generator rental or temporary power hookup, preparation of a health and safety plan, and acquisition of other incidental equipment/materials, including personnel protective equipment (PPE).

- Although UXO is not expected to be at the site, it is assumed that a total of 1 day of UXO clearance would be required to clear the remedial unit and the proposed waste management unit.

- An ecological clearance of the area would be performed, and a biologist would be present onsite during initial excavation and site restoration activities (4 days total).

- Hand excavation is proposed for the removal of lead-containing soil from the Soil Remedial Unit. Backfill of the excavated remedial unit would use borrowed material obtained on Fort Ord. Excavation of the Soil Remedial Unit would not require shoring.

- A crane would be used to aid in the excavation of the remedial unit. This crane would be placed at the Leadership Reaction Training Center (LRTC) area, with an attached bucket capable of being lowered and filled by site workers excavating the remedial unit.

- An estimated 50 individual native, sensitive, or endangered plants would be removed and transplanted for habitat restoration activities of disturbed areas in Alternative 2. An additional 75 plants are assumed to be transplanted in construction of the waste management unit in Alternative 3. Furthermore, the revegetated area is assumed to require watering for 6 months (180 days) after transplanting until vegetation has properly re-developed.

- Imported borrow assumes that fill material is available at Fort Ord free of charge, but would be loaded and transported by others. Placement of the material includes dumping of material using a dump truck, and spreading and compaction by hand. An erosion control geotextile fabric would be placed over the fill material to stabilize the side slopes until habitat restoration is completed at the site.

- Dust suppression includes one water truck, with spray hose and operator for $500/day.

- Air monitoring includes one continuous air monitoring station rental, daily samples for lead and particulates, and 2 man hours of operation per day (about $500/day). Air monitoring would be conducted during all remedial excavation/backfilling operations involving lead-containing soil.

- Soil testing of excavated lead-containing soil is assumed to be 50 cy for excavated soil from the Soil Remedial Unit. These samples would be analyzed for STLC and TTLC lead.

- Clearing and grubbing includes removal of brush, as well as cutting, chipping, and tree stump grubbing.

- Prefield activities is assumed to be 20 percent of construction costs, excluding waste disposal costs. These activities include the substantive provisions of permits, typical documents such as a Quality Assurance and Procedures Plan, and deed restrictions. (Because it is more complex, Alternative 3 is assumed to be 30 percent.)

- Construction management is assumed to be 20 percent of construction costs, excluding waste disposal costs. (Because it is more complex, Alternative 3 is assumed to be 30 percent.)

- Design engineering is assumed to be 20 percent of construction costs, excluding waste disposal costs. (Because it is more complex, Alternative 3 is assumed to be 30 percent.)

- Capital cost and annual cost contingencies are assumed to be 15 percent of total costs.

Alternative 1 Assumptions

- Estimated cleanup time is indefinite, and greater than 30 years.
- This action includes no institutional or other actions on the site. This action was included in accordance with CERCLA guidance as a basis for comparison with other alternatives. However, because of the sensitive habitat at Site 31, this option is a feasible alternative.

Alternative 2 Assumptions

- Estimated time to implement these remedial construction activities is 4 to 6 months.
- Excavated soil would be treated at Site 3 as part of its pre-remedial design study, or as part of the ongoing treatment activities. The final treatment has not been established (soil washing, soil stabilization, or asphalt batching). The treatment cost used was for the most expensive option, soil stabilization.
- Segregation/screening of debris from the excavated material is estimated to take 4 days, 25 cy/day (because of the heterogeneous nature of the debris mixture), utilizing two laborers at $30/hour for 10-hour days. This amounts to $9,600 or approximately $25/cy. Screened debris is assumed to constitute 15 percent of the excavated material (50 cy of the 350 cy total). Furthermore, it is assumed that the screened material would be suitable for Class II or III landfill disposal.
- Steam cleaning/pressure washing of segregated debris (50 cy) is estimated to take 1.5 days, utilizing two laborers at $40/hour for 10-hour days. This amounts to $1,200 or approximately $24/cy (pressure washer and decontamination area assumed as part of mobilization costs).
- As a contingency, Alternative 2B shows the cost of disposition of the excavated soil after placement at Site 3 if treatment is not practical. The disposal cost of $190/cy is assumed based on Site 3 cost estimates and larger soil volumes.

Alternative 3 Assumptions

- Estimated time to implement these remedial construction activities is 6 to 12 months.
- Excavation, backfill, and site restoration activities would be the same as those described in Alternative 2.
- Additional earthmoving activities would be required under this alternative for the construction of the cap. Furthermore, it is estimated that habitat restoration activities would also require additional transplanting (50 extra plants) and watering activities for the capped area.
- The repository area would be excavated to a depth of 4 feet. The removed soil would be reused as cover after placement of the excavated material to allow vegetative growth. Excavated contaminated material from the soil remedial unit would be placed over a double liner system (described below) in this unit. The top 6 inches of this material would be treated with lime and another double liner added over the placed contaminated material similar in construction to the bottom liner. The original clean soil subexcavated from the repository would be used to provide a 2 foot vegetative cover.
- A geotextile membrane would be placed underneath the vegetative cover to provide drainage.
- The WMU double liner system would consist of a composite section of materials. This system would consist of a ¼-inch layer of Claymax™, covered by 6 inches of sand, and then another ¼-inch layer of Claymax™ material. Because of the relatively small quantities involved, the cost for the Claymax™ liner ($0.75/sf) was slightly higher than that for a larger project. A 6-inch protective layer of sand would be provided over the top liner to prevent debris from puncturing the liner.

- The top 6 inches of the excavated soil placed in the CAMU would be lime-treated to reduce permeability and increase stability.
- A double liner as described above would be constructed over the placed waste material.
- A geotextile membrane/liner system would be placed over the double liner cap for drainage.
- A 2 foot vegetative cover layer would be placed over the geotextile membrane and double liner cap.
- Additional habitat restoration activities would be undertaken for the vegetative cap, as described under the general assumptions.
- A geotechnical engineer would be onsite full-time during construction of the waste management unit for observation and field testing of materials and relative compaction.
- Annual cap maintenance would require a two person field crew, approximately 40 person-hours a year.
- No groundwater monitoring or monitoring well installation would be required.

Alternative 4 Assumptions

This alternative uses the same assumptions as Alternative 2, except that soil transport/treatment costs (at Site 3) are substituted by landfill disposal costs.

- Estimated time to implement these remedial construction activities is 4 to 6 months.
- Disposal at a Class I Landfill assumes that the lead-containing soil would be sent to Kettleman Hills, California, for disposal. The unit cost ($360/cy) given includes costs for a one-time profile fee ($500), disposal ($185/ton), Kings County tax (10 percent, California state tax ($42/ton), roll-off bin rental (20 cy capacity, $10/day), and transport of soil in the roll-off bins ($650/bin). (Note: This disposal cost is higher than that for lead-containing soil at Site 3, the Beach Trainfire Ranges, because of the small quantity of soil.)

Table 5B1: Remedial Action Cost Estimate - Site 31*
Alternative 1 - No action
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
CAPITAL COSTS				
No action Required	0	each	$0	$0
Total construction costs				$0
Design engineering	20%	of construction costs		$0
Prefield activities	5%	of construction costs		$0
Construction management	20%	of construction costs		$0
Subtotal capital costs				$0
Capital cost contingency	15%	of capital costs		$0
Total capital costs				**$0**
ANNUAL REPORTING, OPERATIONS, AND MAINTENANCE				
None	0	each		$0
Total annual costs				$0
O&M PV for 30 years at 5% ROR				$0
Annual cost contingency	15%	of annual costs		$0
Total NPV O&M costs				**$0**
TOTAL ALTERNATIVE COST**				**$0**

* These costs are for comparison purposes only, and can range from 50 percent high to 30 percent low. Many design variables and necessary prefield activities have not been established. Construction cost estimates will be refined after remedial design is complete.

** This cost reflects only the direct, quantifiable costs of inaction. Indirect, unquantifiable costs, such as the risk and increased liability associated with leaving contaminants uncontained onsite, are not included in this amount.

Page 1 of 1

Table 5B2: Remedial Action Cost Estimate - Site 31*
Alternative 2A - Excavation and Treatment of Soil with Disposal of Debris
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
SYSTEM MATERIAL COSTS				
Rental / setup				
Mobilization	1	each	$20,000	$20,000
12 ton crane rental, inc. operator & oiler	4	wks	$4,000	$16,000
Pressure washer rental	30	day	$30	$900
Remove/maintain native plants for transplant	50	each	$100	$5,000
UXO clearance	1	each	$2,000	$2,000
Excavation / Treatment				
Hand Excavation	350	cy	$30	$10,500
Sampling of material/excavation walls (1 per 50 cy)	14	each	$250	$3,500
Import soil loading and trasport	350	cy	$10	$3,500
Backfill and compaction by hand	350	cy	$30	$10,500
Soil screening	350	cy	$25	$8,800
Pressure wash of debris	50	cy	$24	$1,200
Dust control	10	day	$500	$5,000
Air Monitoring (eqpmt & sampling)	10	day	$500	$5,000
Onsite biologist	2	day	$750	$1,500
Site Restoration				
Erosion control mat (100' x 100')	1,500	sy	$2.00	$3,000
Water revegetated area	180	days	$30	$5,400
Transplant native species / revegetation	50	each	$100	$5,000
Onsite biologist	2	day	$750	$1,500
Soil Treatment at Site 3				
Load soil and transport to Site 3 (12 mile roundtrip)	315	cy	$5	$1,600
Soil treatment (soil wash, stabilize, or asphalt batch)	315	cy	$180	$56,700
Placement of treated soil at site 3	315	cy	$5	$1,600
Disposal Costs				
Debris transport/disposal at nonhazardous landfill	70	ton	$40	$2,800
Total construction costs				$171,000
Design engineering	20%	of construction costs		$33,640
Prefield activities	20%	of construction costs		$33,640
Construction management	20%	of construction costs		$33,640
Subtotal capital costs				$271,920
Capital cost contingency	15%	of capital costs		$40,788
Total capital cost				**$312,700**
ANNUAL REPORTING, OPERATIONS, AND MAINTENANCE				
Monitoring/Inspection	0	each	$0	$0
Project management	0	each	$0	$0
Total annual costs				$0
O&M PV for 30 years at 5% ROR (Org.)				$0
Annual cost contingency	15%	of annual costs		$0
Total NPV costs				**$0**
TOTAL ALTERNATIVE COST				$312,700

* These costs are for comparison purposes only, and can range from 50 percent high to 30 percent low.
Many design variables and necessary prefield activities have not been established.
Construction cost estimates will be refined after remedial design is complete.

Table 5B2: Remedial Action Cost Estimate - Site 31*
Alternative 2B - Excavation of Soil with Disposal of Debris as a Contingency**
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
SYSTEM MATERIAL COSTS				
Rental / setup				
Mobilization	1	each	$20,000	$20,000
12 ton crane rental, inc. operator & oiler	4	wks	$4,000	$16,000
Pressure washer rental	30	day	$30	$900
Remove/maintain native plants for transplant	50	each	$100	$5,000
UXO clearance	1	each	$2,000	$2,000
Excavation / Treatment				
Hand Excavation	350	cy	$30	$10,500
Sampling of material/excavation walls (1 per 50 cy)	14	each	$250	$3,500
Import soil loading and trasport	350	cy	$10	$3,500
Backfill and compaction by hand	350	cy	$30	$10,500
Soil screening	350	cy	$25	$8,800
Pressure wash of debris	50	cy	$24	$1,200
Dust control	10	day	$500	$5,000
Air Monitoring (eqpmt & sampling)	10	day	$500	$5,000
Onsite biologist	2	day	$750	$1,500
Site Restoration				
Erosion control mat (100' x 100')	1,500	sy	$2.00	$3,000
Water revegetated area	180	days	$30	$5,400
Transplant native species / revegetation	50	each	$100	$5,000
Onsite biologist	2	day	$750	$1,500
Soil Treatment at Site 3				
Load soil and transport to Site 3 (12 mile roundtrip)	300	cy	$5	$1,500
Soil treatment (soil wash, stabilize, or asphalt batch)	0	cy	$180	$0
Disposal Costs				
Load soil/deris into trucks	365	cy	$5	$1,800
Transport, and disposal of soil (inc. taxes, etc.)	315	cy	$190	$59,900
Debris transport/disposal at nonhazardous landfill	70	ton	$40	$2,800
Total construction costs				$174,300
Design engineering	20%	of construction costs		$34,300
Prefield activities	20%	of construction costs		$34,300
Construction management	20%	of construction costs		$34,300
Subtotal capital costs				$277,200
Capital cost contingency	15%	of capital costs		$41,580
Total capital cost				**$318,800**
ANNUAL REPORTING, OPERATIONS, AND MAINTENANCE				
Monitoring/inspection	0	each	$0	$0
Project management	0	each	$0	$0
Total annual costs				$0
O&M PV for 30 years at 5% ROR (Org.)				$0
Annual cost contingency	15%	of annual costs		$0
Total NPV costs				**$0**
TOTAL ALTERNATIVE COST				$318,800

* These costs are for comparison purposes only, and can range from 50 percent high to 30 percent low. Many design variables and necessary prefield activities have not been established. Construction cost estimates will be refined after remedial design is complete.

** Disposal would occur only if soil from Site 31 cannot be treated as part of Site 3 remedial activites. It is assumed that soil could be disposed of a cheaper rate than for that at site 3 alone (as in Alternative 4) because of the larger soil quantities for disposal.

Table 5B3: Remedial Action Cost Estimate - Site 31*
Alternative 3 - Excavation and Onsite Placement of Soil and Debris
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

ITEM DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
CAPITAL COSTS				
Setup				
Mobilization	1	each	$20,000	$20,000
12 ton crane rental, inc. operator & oiler	4	wks	$4,000	$16,000
Steam cleaner rental	30	day	$30	$900
Remove/maintain native plants for transplant	50	each	$100	$5,000
UXO utility clearance	1	each	$3,500	$3,500
Excavation / Treatment				
Hand excavation	350	cy	$30	$10,500
Sampling of material/excavation walls (1 per 50 cy)	14	each	$250	$3,500
Import soil loading and trasport	350	cy	$10	$3,500
Backfill and compaction by hand	350	cy	$30	$10,500
Dust control	20	day	$500	$10,000
Air monitoring (eqpmt & sampling)	20	day	$500	$10,000
Onsite biologist	2	day	$750	$1,500
Site Restoration				
Erosion control mat (100' x 100')	1,500	sy	$2.00	$3,000
Transplant native species / revegetation	50	each	$100	$5,000
Water revegetated area	180	days	$30	$5,400
Onsite biologist	2	day	$750	$1,500
Onsite Respository Construction				
Clearing and grubbing	5,500	sf	$0.10	$600
Subexcavation 4 ' deep (reuse on top)	800	cy	$12.00	$9,600
Transport/placement of contaminated material (3' lift)	350	cy	$10.00	$3,500
Compaction of excavated material (4" lifts)	350	cy	$6.00	$2,100
Lime treatment of placed material (top layer)	100	sy	$9.00	$900
Claymax (Four 1/4" layers of 5,500 sf each)	22,000	sf	$0.75	$16,500
6" sand layer betwen claymax layers	400	cy	$3.00	$1,200
6" sand foundation layer for debris protection	400	cy	$3.00	$1,200
Load transport cap material (1 hr r/t)	800	cy	$10.00	$8,000
Geotextile/membrane for drainage under cover	5,500	sf	$0.75	$4,100
Placement/compaction of vegetative cover	800	cy	$10	$8,000
Geotech. engineer oversight / compaction tests	120	hrs	$75	$9,000
Drainage swales	350	lf	$0.50	$200
Remove/maintain native plants for transplant	50	each	$50	$2,500
Transplant native species / revegetation	75	each	$50	$3,800
Onsite biologist	2	day	$750	$1,500
Water revegetated cap area	180	days	$30	$5,400
Total construction costs				$187,900
Design engineering	30%	of construction costs		$56,370
Prefield activities	30%	of construction costs		$56,370
Construction management	30%	of construction costs		$56,370
Total capital costs				$357,010
Capital cost contingency	15%	of capital costs		$53,552
Total capital cost				**$410,600**
ANNUAL REPORTING, OPERATIONS, AND MAINTENANCE				
Reporting, inspection, landscape prunning	1	each	$1,600	$1,600
Project management	1	each	$500	$500
Total annual costs				$2,100
O&M PV for 30 years at 5% ROR				$32,300
Annual Cost Contingency	15%	of annual costs		$4,845
Total NPV costs				**$37,100**
TOTAL ALTERNATIVE COST				$447,700

* These costs are for comparison purposes only, and can range from 50 percent high to 30 percent low. Many design variables and necessary prefield activities have not been established. Construction cost estimates will be refined after remedial design is complete.

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

Volume V - Feasibility Study

Section 6.0 - Site 39

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Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

Volume V - Feasibility Study

Site 39

HLA Project No. 23366 07179

This final version of the Site 39 Feasibility Study addresses comments received on the Draft Final version of the report dated December 1994. Responses to agency comments on the Draft Final report are included in Volume VI of this report.

Basewide Remedial Investigation/Feasibility Study
Fort Ord, California

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6.0 FEASIBILITY STUDY FOR SITE 39

6.1 Background

Site 39 consists of the Inland Ranges and the 2.36-inch Rocket Range (Plate 6.1). This draft final FS is based on the information presented in the Remedial Investigation (Volume II), the Baseline Human Health Risk Assessment (BRA) (Volume III), the Baseline Ecological Risk Assessment (ERA) (Volume IV), proposed target cleanup levels (TCLs), and applicable or relevant and appropriate requirements (ARARs) discussed in this report.

Section 6.1 summarizes background information and includes information from the Remedial Investigation (RI) of Site 39, including its physical description, history, proposed reuse, and the nature and extent of its chemical contamination and Ordnance and Explosive Waste (OEW), including unexploded ordnance (UXO). In addition, this section summarizes the risk assessments, discusses TCLs, and presents the ARARs, remedial action objectives and the general response actions. It also presents the technologies retained from the *Draft Final Remedial Technologies Screening Report* (*HLA, 1994n*).

6.1.1 Physical Description

Site 39 is in the southwestern portion of Fort Ord and includes the Inland Ranges (approximately 8,000 acres) and the 2.36-inch Rocket Range (approximately 50 acres) (Plate 6.1). The Inland Ranges are bounded by Eucalyptus Road to the north, Barloy Canyon Road to the east, South Boundary Road to the south, and North-South Road to the west. The 2.36-inch Rocket Range is immediately north of Eucalyptus Road, near the north-central portion of the Inland Ranges. Within the boundaries of Site 39, access is limited and is constrained by the limited availability of roads, the generally rough terrain, and the potential presence of UXO/OEW.

Within the Inland Ranges, most ordnance-related activities were associated with trainfire ranges that are situated just inside the perimeter; weapons firing was generally directed toward the center of the Inland Ranges. The main trainfire ranges are numbered 18 through 48. Other trainfire ranges have been added over the years or have other functional areas or firing lines; these other ranges are identified by the range number and a letter suffix (e.g., 23M, 40A). The High Impact Area (HIA), about 1,100 acres in the center of the Inland Ranges, is defined as the area whose boundaries are based on maximum ordnance trajectory, overlapping range fans, and the extent of restricted air space for Monterey Airport. The main target areas for the high explosive ordnance used at some ranges are within the HIA. Other high explosive target areas are within the Inland Ranges but outside of the HIA. The locations and limits of the individual trainfire ranges have not changed appreciably over the years, although several had been decommissioned.

The 2.36-inch Rocket Range is north of the Inland Ranges near the intersection of Eucalyptus Road and Watkins Gate Road. The range is relatively flat with low shrubs and is bounded on the east side by a man-made berm. No physical boundary defines the west side of the range. A low, broad ridge provides a natural backstop for the target area at the northern extent of the range. The firing line is near the south boundary. Two sections of narrow gauge track for moving targets and disturbed ground, possibly from a third track, extend across the range from east to west. Except for these tracks, no evidence of target remnants is present.

The western and central portions of Site 39 consist of low rolling hills and closed depressions; the ground surface generally slopes to the west and northwest throughout most of the area. In the eastern portions of the site, the terrain is more rugged and consists of ridges rising up to 600 feet above the canyon bottoms. Elevations range from approximately 900 feet above mean sea level (MSL) in the southeast to approximately 200 feet above MSL in the southwest. At individual ranges within the Inland Ranges, the ground surface between the firing line and the targets is generally flat and may slope slightly up or down to the targets. These flat areas appear to have been selected to provide a clear line of fire to the targets. At many of the ranges, the ground surface behind the targets (i.e., downrange) consists of one or more hills; these natural features serve as backstops and were most likely a factor in the selection of the location and configuration of the range.

6.1.2 History

The Inland Ranges were reportedly used since the early 1900s for ordnance training exercises, including onshore naval gunfire. Over the years, various types of ordnance have been used or found in the Inland Ranges, including hand grenades, mortars, rockets, mines, artillery rounds, and small arms rounds. Some training activities using petroleum hydrocarbons were also conducted. The 2.36-inch Rocket Range was used as an antitank rocket (bazooka) range during and shortly after World War II. Both range areas are inactive because of the Fort Ord closure.

6.1.3 Proposed Reuse

The proposed future use of most of the Inland Ranges will be as a Natural Resource Management Area (NRMA) (*FORA, December 14, 1994*). This NRMA will be managed by the U.S. Department of the Interior, Bureau of Land Management, and public access will be restricted. Several areas just inside the perimeter of the Inland Ranges have a proposed future land use other than the NRMA. The Range 35 Military Operations on Urbanized Terrain (MOUT) area, near the northeastern edge of the Inland Ranges, will be used as a peace officer training area. Areas along the south boundary of the Inland Ranges (and Fort Ord) are proposed for several uses, including city and county parks, a school expansion, and relocation of Highway 68.

6.1.4 Nature and Extent of Contamination

The delineation of Site 39 is based on previous investigations, including field work at several ranges within the Inland Ranges and research of potential ordnance-related training areas within and outside the Inland Ranges. The nature and extent of contamination at specific areas within the site are described in the Site 39 RI (Volume II) and are summarized below. Specifically, the RI focused on the following areas:

- Range 36A - Explosive Ordnance Disposal (EOD) Range (formerly Site 5)
- Range 40A - Flame Field Expedient (FFE) Training Range (formerly Site 9)
- Range 33 - Demolition Training Range
- Explosive ordnance target areas (including the 2.36-inch Rocket Range)
- Small arms ranges (Ranges 18, 19, 21, 22, 23, 24, 25, 26, 27, 27A, 28, 29, 30, 35A, 38, 39, and 46)
- Groundwater chemistry
- Occurrence of UXO/OEW.

6.1.4.1 Range 36A - EOD Range

Range 36A was used for disposal of various types of commercial explosives and military ordnance and ammunition. Disposal occurred by open burning and open detonation (OB/OD). The range was used sporadically until October 1992. The site has recently been activated and used for disposal of UXO/OEW removed from areas outside the Inland Ranges.

The site usage indicates that the potential contaminants at the site are explosive compounds (Table 6.1) and metals (Table 6.2). The combined results of the Range 36A investigations (*JMM, 1990* and the Volume II RI) are summarized as follows:

- Cyclotrimethylenetrinitramine (RDX) and cyclotetramethylenetetranitramine (HMX) were detected at concentrations up to 16.5 milligrams per kilogram (mg/kg) and 1.84 mg/kg, respectively. These explosive compounds were only detected in surface samples (except for one detection of RDX at 15 feet bgs), indicating that such contamination was limited to surface soils. The explosive compounds appear to occur predominantly in the western, central, and northern portions of Range 36A.

- With the exception of lead and beryllium in surface soil, the other metals detected above their maximum shallow or deep background concentrations no not appear to be related to site activities.

6.1.4.2 Range 40A - FFE Training Range

Range 40A was used for training military personnel in the construction and use of improvised weapons using flammable substances. Training exercises included (1) ejecting burning material from TNT-charged drums a distance of 75 to 100 yards from a given firing point and (2) conducting fire and smoke demonstrations by filling trenches with fuel and then igniting the fuel and allowing it to burn.

On the basis of the range usage, potential contaminants included (in order of significance) petroleum hydrocarbons and associated organic compounds (Table 6.3), priority pollutant metals (Table 6.4), and explosive compounds. The following summarizes the results of the soil investigation:

- An approximately 8-foot-thick, relatively horizontal clay layer appears to underlie most of the range; the clay is exposed at the surface in a portion of the central depression at the range and is likely to be at depths greater than 10 feet at topographically higher areas along the perimeter. This clay layer may retard vertical migration of contaminants.

- Unknown TPH as diesel and unknown TPH as gasoline have been detected, primarily in surface soil samples. Concentrations range up to 1,400 mg/kg (Table 6.3); the concentrations that exceed 100 mg/kg are limited to surface soils within or adjacent to the three trenches used for fire and smoke demonstrations. A small area of surface soil in the target area contains unknown TPH (calibrated as diesel) at levels just above the reporting limit. Other organic compounds, including noncarcinogenic polyaromatic hydrocarbons (PAHs) and tentatively identified compounds (TICs), were also detected; these occurred at relatively low concentrations, only in surface and near-surface (2.5 feet bgs) samples, and appear, in some cases, to be related to petroleum hydrocarbons. The highest concentrations of PAHs and TICs are associated with the high concentrations of unknown TPH as diesel and are usually detected below the reporting limit elsewhere.

- The following metals were detected at least once above maximum background concentrations in surface and/or subsurface soil samples: arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc. However, with the exception of cadmium, lead, and zinc in surface soil samples collected from borings within the trenches or a small portion of the target area, other metals detected significantly above maximum background concentrations do not appear to be related to site activities (Table 6.4).

- No explosive compounds were detected in the soil samples.

6.1.4.3 Range 33 - Demolition Training Range

Range 33 was used as a standard demolition and field expedient demolition training range from 1984 to 1989. Materials used in the range included trinitrotoluene (TNT), C-4 (plastic explosive), and a field expedient explosive, which consisted of a sack of ammonium nitrate soaked in diesel fuel. Recent ordnance disposal activities reportedly resulted in explosion craters within the range.

On the basis of range usage, potential contaminants include (in order of significance) petroleum hydrocarbons and related constituents, metals, and explosive compounds.

The results of the Range 33 investigation are summarized as follows:

- Unknown TPH as diesel was detected in only one surface sample at a concentration of 230 mg/kg (Table 6.5). This indicates that hydrocarbon contamination related to site activities, where present, is likely to be at a low concentration and limited to surface soil in a small localized area.
- Low levels of a few identifiable semivolatile organic compounds (SOCs) and TICs are present, primiarily in surface soil.
- Beryllium, cadmium, chromium, copper, lead and zinc were above depth- and soil-specific maximum background concentrations (Table 6.6). However, with the exception of cadmium, copper, and zinc in localized surface soil, the other metals do not appear to be related to site activities. Most of these elevated metal concentrations occur in subsurface soil and do not appear to be related to the source areas for the unknown petroleum hydrocarbons and explosive compounds.
- Several explosive compounds, including RDX and HMX, were detected in soil samples from borings adjacent to explosion craters that resulted from recent ordnance disposal activities. Explosive compounds were not detected elsewhere at Range 33.

6.1.4.4 Explosive Ordnance Target Areas

Portions of the Inland Ranges, and the 2.36-inch Rocket Range, have been used in the past for training troops in the use of explosive ordnance. Training activities utilized a variety of conventional explosive ordnance, including mortars, rockets, artillery, and grenades. Explosive ordnance were fired at targets within specific ranges or within the High Impact Area. Potential contaminants anticipated at these explosive ordnance target areas included explosive compounds and metals. A biased soil sampling approach, conducted at most of the identified explosive ordnance target areas, was performed to evaluate the presence of these potential contaminants in areas expected to contain the highest levels (worst cases) of contamination. These areas were selected based on past usage (i.e., areas that were heavily used) and physical evidence (e.g., large accumulations of ordnance-related debris). Therefore, the intent of the investigation was not to define the lateral and vertical extent of contamination across Site 39, but to identify the types and potential maximum concentrations of contaminants and to investigate the vertical extent of contamination in a large number of localized areas. These results would then be used to provide a general characterization of the extent of contamination by explosive compounds and metals.

The results are summarized as follows:

- Several explosive compounds were detected, predominantly in surface soil samples. Except for HMX, which was detected at a maximum concentration of 1,100 mg/kg, the explosive compounds were present at relatively low concentrations (Table 6.7). The concentrations of explosive compounds, when present in the subsurface, decreased significantly (usually an order of magnitude or greater) from the surface to 2.0 or 2.5 feet bgs.
- Based on the results of the soil sampling, ordnance-related chemical contamination appears to be primarily in Ranges 44 and 48. These two ranges show evidence of heavy use, such as demolished targets and abundant UXO/OEW at the bases of the targets. Elsewhere, the occurrences of explosive compounds were sporadic and concentrations were usually close to, at, or below reporting limits.
- Antimony, arsenic, beryllium, cadmium, total chromium, copper, lead, mercury, nickel, selenium, silver, and zinc were detected in surface and/or subsurface samples at concentrations above maximum background concentrations (Table 6.8). The elevated concentrations of these metals, except mercury and selenium, are attributed to some extent to site-related activities. The highest levels of metals were primarily in surface samples, predominantly near targets at

Ranges 37, 44, and 48. In general, except for Range 37, the samples with high metals concentrations correspond to the samples with detectable explosive compounds at the site. At Range 37, the lack of explosive compounds may be a result of the degradation of the explosive compounds at the target areas, which appear to be relatively old in comparison to the target areas at Ranges 44 and 48.

- Total organic carbon values at the explosive ordnance target areas ranged from 375 to 16,200 mg/kg (Table 6.7).

6.1.4.5 Small Arms Ranges

There are 17 small arms ranges at Site 39 that were used for pistol, rifle, and machine gun practice using various caliber ammunition. Targets at the small arms ranges consisted of fixed and pop-up targets with and without backstops. A visual survey similar to that conducted at Site 3 (Volume II) was conducted to evaluate the surface distribution of spent ammunition, and these results were used to qualitatively evaluate the distribution of potential contamination.

The results of the bullet distribution evaluation at the small arms ranges are as follows:

- Spent ammunition consisted primarily of various caliber bullets and lesser amounts of black powder rifle balls and lead shot.

- The potential contaminant at the small arms ranges is expected to be lead; this conclusion is drawn from observations at Site 3, where similar types and compositions of ammunition were used.

- In general, most of the areas within the small arms ranges contain less than 1 percent surface distribution of bullets.

- A few, small localized areas contained 1 to 10 percent or greater than 10 percent surface distribution of bullets; these higher distributions were generally found in the immediate vicinity of the targets, in small depressions created from ammunition fired in front of the targets, in roads and washes adjacent to targets, and in sand and backstops behind targets.

- Based on a similar, more extensive study at Site 3, lead concentrations in soil are anticipated to exceed 1,000 mg/kg in areas where the bullet surface concentrations are 10 percent or greater, and possibly in areas where the coverage is 1 to 10 percent (Site 3 RI/FS, Volumes II/V).

- Soil and groundwater sample analyses performed for the Site 3 investigation indicated that there is little potential for contamination of groundwater by lead. Depths to groundwater in the small arms ranges at Site 39 (based on available water-level data) vary from approximately 60 to 180 feet bgs, which are generally greater depths than groundwater at Site 3. Therefore, it appears that there is little potential for contamination of groundwater by lead in the small arms ranges. In addition, lead was only detected once in one groundwater sample from Monitoring Well MW-BW-08-A in the small arms ranges in the western part of the Inland Ranges; lead was detected during the 1992 sampling round at a concentration of 1.8 micrograms per liter (μg/l), which is well below the Maximum Contaminant Level (MCL) of 50 μg/l for lead.

6.1.4.6 Groundwater Chemistry

Sampling and analysis of groundwater was performed at seven wells in the Inland Ranges to evaluate the presence of explosive compounds, metals, and nitrate resulting from past activities. One well in Range 36A and six wells in the western part of the Inland Ranges constituted the sampling program. Inorganic analytical results are presented in the Site 39 RI, Volume II. The results of the groundwater sampling are summarized as follows:

- Explosive compounds were not detected in any of the samples analyzed.

- Antimony was detected at concentrations ranging from 8.8 to 13.6 μg/l. The MCL for antimony is 6.0 μg/l.

- Arsenic, beryllium, chromium (total), copper, lead, mercury, and zinc were detected at least once during the investigation and/or the 1992 basewide sampling rounds at concentrations below their respective MCLs.

- Nitrate was detected twice in one well at concentrations of 14.8 mg/l and 22 mg/l, which are above the MCL of 10 mg/l.

Groundwater containing nitrate and antimony above their MCLs will be further evaluated under the basewide groundwater monitoring program.

6.1.4.7 Occurrence of UXO/OEW

Because Site 39 was used since the early 1900s for ordnance-related training activities, OEW, including UXO, is present at the site. Several research activities were conducted to provide qualitative information concerning the distribution of UXO/OEW at the site. These activities included: site visits and interviews with Fort Ord personnel, record and historical map reviews, and field observations of ordnance-related training areas. Soil chemical analyses from the various field activities were also reviewed.

The following summarizes the results of the research:

- Sixteen high-explosive/anti-armor ranges are located in the Inland Ranges. Seventeen small arms ranges and three specialty training ranges were also identified as potentially containing UXO/OEW.

- In general, ordnance used or found are conventional types that include small arms ammunition, grenades, rockets, mortars, artillery rounds, mines, and bombs.

- The distribution of UXO/OEW in a given range appears to have been primarily influenced by the locations of targets which were either within the ranges at dedicated locations, or outside the ranges in the High Impact Areas. However, several of the ranges where high-explosive ordnance use was not anticipated (i.e., where UXO/OEW would not normally be expected) were found to contain UXO/OEW as well.

- High densities of UXO/OEW at Site 39 appear to be associated with targets in the high-explosive/anti-armor ranges in the northwest part of the Inland Ranges and in the 2.36-Inch Rocket Range. These areas commonly contain targets that are closely spaced and have had high usage as indicated by demolished targets and abundant ordnance debris on the ground surface. Several small, localized areas containing high densities were identified as piles of debris that appear to have been consolidated during range clearance or dumped during disposal.

- In general, the central portion of the Inland Ranges contains medium accumulations of UXO/OEW, characterized by a relatively clear ground surface with one to a few observable UXO/OEW items within the range of vision.

- Areas containing low densities of UXO/OEW are predominantly around the perimeter of the Inland Ranges and are characterized by random occurrences of UXO/OEW.

6.1.5 Summary of Risk Assessments

Possible risks to human health and the environment associated with potentially impacted soil and groundwater at Site 39 were evaluated in the Baseline Human Health Risk Assessment (BRA; Basewide RI/FS Volume III, Section 7.0) and the Baseline Ecological Risk Assessment (ERA; Basewide RI/FS Volume IV). These risk assessments numerically quantify the excess risks to human health and evaluate potential effects to the environment posed by chemicals of potential concern (COPCs) present at the site, in accordance with U.S. Environmental Protection Agency (EPA)-approved assessment procedures and modeling protocols. Results of the BRA and ERA are summarized below.

6.1.5.1 Baseline Human Health Risk Assessment

As previously mentioned, the Site 39 RI focused on the following areas: Range 36A, Range 40A, Range 33, explosive ordnance target areas, and the small arms ranges. Soil sampling was conducted in areas that were most likely to be impacted by ordnance. For the BRA, it was conservatively assumed that the extent and degree of soil contamination within these study areas reflect soil conditions across the entire site. Therefore, chemical data for Site 39 soil samples were evaluated as one data set.

As discussed in the RI (Volume II), comprehensive groundwater study was not warranted at Site 39 because shallow contamination in soil and the results of groundwater sampling from seven existing monitoring wells at the site indicated that groundwater quality had not been impacted by site activities. The wells were screened in either the Uppermost or Paso Robles aquifer beneath Site 39. Data for samples collected from these two aquifers were evaluated separately in the BRA.

Two hypothetical future receptors were evaluated in the BRA. The hypothetical onsite habitat management worker receptor was assumed to be exposed to COPCs via incidental ingestion of soil, dermal contact with soil, inhalation of dust, and ingestion of groundwater. The offsite resident was assumed to be exposed to soil via inhalation of dust. Because current offsite residents in the vicinity of Site 39 receive their domestic water supply from municipal wells, exposure to groundwater beneath Site 39 was not evaluated for the offsite resident receptor. Potential exposure to COPCs in soil was based on surface soil (i.e., 0 to 2 feet bgs) data. Intrusive activities (such as digging) and consequent potential exposure to subsurface soil are not expected to occur at the site because of the presence of unexploded ordnance.

Exposure assumptions, such as soil and groundwater ingestion rates, inhalation rate, and exposure frequency, were used to estimate dose via each pathway evaluated, as described in Volume III BRA, Section 2.2.4. As recommended by EPA, two separate exposure scenarios were evaluated: (1) a reasonable maximum exposure (RME) and (2) an average exposure.

The BRA included estimates of adverse noncancer health effects and potential cancer risks associated with exposure to COPCs identified at Site 39. The COPCs in soil are five SOCs (2-amino-dinitrotoluene, 4-amino-dinitrotoluene, HMX, RDX, and 2,4,6-trinitrotoluene) and seven metals (antimony, arsenic, beryllium, cadmium, copper, lead, and nickel). Because of its unique toxicological properties, lead was evaluated separately using EPA- and Cal/EPA-provided models. The COPCs in groundwater in the uppermost aquifer are four metals (antimony, arsenic, beryllium, and mercury) and one inorganic compound (nitrate).

The results of the BRA indicate that the estimated multipathway hazard indices (HIs) for the onsite habitat management worker are 0.1 and 1 for the average and RME scenarios, respectively. For the offsite resident receptors, the estimated average HIs for noncancer health effects range from 0.0003 to 0.0004. The estimated RME HIs range from 0.0008 to 0.002. For all receptors evaluated, the HIs are below or equal to the EPA threshold level of concern of 1. EPA guidance states that "when the hazard index exceeds unity (i.e., 1) there may be a concern for potential health effects" (*EPA, 1989b*). The HIs for Site 39 do not exceed 1. Therefore, the results of the BRA indicate that no noncancer health effects are expected for any of the receptors evaluated.

The estimated multipathway cancer risks for the onsite habitat management worker are 2×10^{-6} and 8×10^{-5} for the average and RME scenarios, respectively. The average risk is at the low end of EPA's target risk range of 1×10^{-6} to 1×10^{-4}, and the RME risk is within this target risk range. Approximately 98 percent of the total RME risk is a result of multipathway exposures to arsenic, beryllium, and RDX in soil, and possible ingestion of arsenic and beryllium in groundwater. The contribution of each of these chemicals to the total RME risk is:

- Arsenic in soil: 7 percent (RME risk of 5.4×10^{-6}; RME concentration of 3.68 mg/kg)
- Arsenic in groundwater: 24 percent (RME risk of 1.9×10^{-5}; RME concentration of 0.00148 mg/l)
- Beryllium in soil: 43 percent (RME risk of 3.4×10^{-5}; RME concentration of 9.34 mg/kg)
- Beryllium in groundwater: 15 percent (RME risk of 1.2×10^{-5}; RME concentration of 0.0003 mg/l)
- RDX in soil: 9 percent (RME risk of 7.1×10^{-6}; RME concentration of 3.83 mg/kg).

Much of the total RME risk may be attributed to naturally occurring concentrations of arsenic and beryllium in groundwater, and arsenic in soil. The RME concentration of arsenic in soil (3.68 mg/kg) barely exceeds the background concentration (3.4 mg/kg); the residual cancer risk associated with the arsenic soil concentration above background is 4×10^{-7}. Available data suggests that the detected concentrations of arsenic and beryllium in groundwater at Site 39 are naturally occurring. Moreover, direct exposure of the habitat management worker receptor to groundwater at Site 39 is unlikely. As discussed in the RI (Volume II), additional groundwater monitoring will be performed to assess potential site-related impacts to groundwater.

Estimated risks associated with exposure to beryllium and RDX in soil account for approximately 52 percent of the total RME risk. The RME concentrations of these chemicals appear to be associated with site activities as discussed in the RI (Volume II).

For the offsite resident, the estimated average cancer risk is 2×10^{-7} and the RME risk is 3×10^{-6}. The RME risk is at the low end of EPA's target risk range and was estimated under RME conditions that are likely to overestimate actual exposures (Volume III BRA, Site 39, Section 7.6).

In addition to estimates of noncancer health effects and potential cancer risks, the BRA included an evaluation of potential exposure to lead in soil. The results of this evaluation indicated that blood lead levels estimated for the habitat management worker and offsite resident receptors are below the EPA-approved target blood lead levels. Lead exposure is not, therefore, expected to result in adverse health effects for the receptors evaluated. However, because no chemical concentration data were available for the small arms ranges, these ranges were not included in this estimate of potential lead exposure. These areas were assessed in a manner similar to that performed at Site 3. Because of the similarities in the surface distribution of bullets, site usage, and site conditions, the occurrence of lead at Site 39 is assumed to be similar to that at Site 3. Therefore, although no chemical data are available to estimate risks associated with lead at the small arms ranges, cleanup of these areas will proceed in a manner similar to that at Site 3.

6.1.5.2 Baseline Ecological Risk Assessment

For the ERA, chemical data collected in the areas identified in the Site 39 RI were used. Within each area, samples were divided into vegetated and unvegetated locations. The ERA was restricted to an evaluation of potential hazards to ecological receptors associated with chemicals in vegetated locations. Assessment endpoints evaluated at Site 39 include the health of:

- The silvery legless lizard, an endangered species that lives in the leaf litter layer
- The food base for predators such as foxes and raptors
- The central maritime chaparral habitat, a rare and declining habitat.

To evaluate the silvery legless lizard, soil data were analyzed to assess potential exposures to the leaf litter community. Results of leachate tests conducted on bullets from Site 3 were used to assess potential bioavailability of chemicals associated with small arms ranges in the near-surface soil layer. To evaluate the food base for predators, the results of chemical analyses of deer mice, which serve as a food source for predators, collected from Site 3 were used to assess exposures to predators. Because Sites 3 and 39 have similar historical land uses and were both used as trainfire ranges, data collected from biota at Site 3 were considered appropriate for evaluation of Site 39, as described in Volume IV, Section 6.0. To evaluate the central maritime chaparral habitat, the chemical concentrations in soil, areal extent of contamination, and potential impacts to ecological receptors were considered to provide a weight of evidence analysis. Exposure assumptions including home range size and ingestion rates were used to estimate doses for direct ingestion of soil, dermal contact with soil, and ingestion of food items (e.g., deer mice), as described in Volume IV, Section 5.0. A very conservative scenario was evaluated as recommended by EPA. These assumptions were modified based on biota data, as discussed in Volume IV, Section 6.0.

The ERA used a conservative scenario based on modeled exposure to estimate potential adverse noncancer health effects associated with exposure to COPCs identified in soil. Soil COPCs include eight SOCs (bis[2-ethylhexyl]phthalate, 2-amino dinitrotoluene, 4-amino dinitrotoluene, HMX, PETN, pentachlorophenol, RDX, and tetryl) and twelve metals (antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, and zinc). The results of the ERA indicate that:

- For the silvery legless lizard, results of leachate tests using synthetic rainwater indicate that less than 0.1 percent of the chemicals in bullets (e.g., lead and zinc) are readily leachable, and thus bioavailable to the lizard.

- For the predator food base, the majority of predicted potential hazards are a result of concentrations of HMX and lead in surface soils. The hazard posed by HMX was a result of concentrations detected only at one location in the explosive ordnance target area. Results of deer mice sampling at Site 3 also indicate that lead is likely present in rodent tissues at Site 39 above background tissue levels.

Silvery legless lizards are probably present in all evaluated areas of Site 39. Because of the low leachability of metals from the bullets, the most likely hazard to the legless lizard at the site is the physical presence of bullets found in the high density bullet areas. This layer would likely restrict the occurrence of the lizard to other areas because the lizard often moves beneath the top of the soil layer. Because only a small percent of the 8,000 acres of Site 39 is heavily contaminated with spent ammunition, this is not expected to pose a substantial hazard to the survival of the species at the site. Chemical hazards to the silvery legless lizard, other than those posed by bullets, are likely restricted to the one identified hotspot of HMX.

Results of deer mice sampling at Site 3 indicate elevated tissue levels of lead associated with high density bullet areas. These results can be extrapolated to Site 39. A rodent's home range likely extends beyond the sampling location of the maximum soil concentrations of lead. No impacts to rodent populations are expected onsite because the chemical contamination from bullets is limited to a small percentage of the site. Because predators feed on rodent populations across the entire site and not only on rodents exposed to maximum soil concentrations, no adverse effects are expected to predator populations. Rodent body burdens are not expected to present a hazard to predators at the site. Potential hazards from exposure to the hotspot of HMX can be eliminated by removal of this topsoil.

On the basis of the data collected and evaluated for Site 39, the central maritime chaparral habitat does not appear to be substantially affected beyond the impact areas and areas containing high bullet cover. Necessary soil excavation and removal should be limited to areas currently devoid of vegetation. A biologist should be present during remediation to ensure minimal impacts to the habitat.

The Habitat Management Plan for this area includes controlled burning over several years to address UXO (*COE, 1994*). This future use is planned to consist of multiple patch burnings, totalling up to 800 acres per year. The burning of small patches of the central maritime chaparral habitat over time, which will probably result in detonation of ordnance, is expected to result only in short-term adverse impacts to small patches of the habitat. Following burning, any remaining UXO should be removed by hand to decrease impacts to the habitat. Natural revegetation is preferred to allow the area to recover following remediation.

6.1.6 Applicable or Relevant and Appropriate Requirements

Under CERCLA, remedial actions must be protective of human health and the environment and comply with federal or more stringent state ARARs, unless waived. Promulgated requirements are "laws imposed by state legislative bodies and regulations developed by state agencies that are of general applicability and are legally enforceable." Formally promulgated and consistently applied state or federal policies have the same weight as specific standards. Advisories and policy or guidance documents (referred to as to-be-considered requirements, or TBCs) issued by federal or state agencies that are not legally binding are not considered to be ARARs but may be included as requirements to be considered.

ARARs are identified for each remedial action proposed in an FS. ARARs are chemical-, location-, and action-specific requirements, as discussed below and summarized in Table 6.9. If ARARs are not available for a particular chemical or situation, critical toxicity factors such as EPA-established reference doses or cancer potency factors may be used to estimate risk-based remediation goals consistent with EPA guidance, and to ensure that a remedial action is protective of human health and the environment (*EPA, 1991b*).

This approach was used to establish soil TCLs in Volume III (BRA) and Volume V (ERA) because no ARARs are available for soil cleanup at Site 39.

Remedial actions recommended in an FS to be taken at a Superfund site must control further release of hazardous substances, pollutants, and contaminants to assure the protection of human health and the environment. Any hazardous substance, pollutant, or contaminant left onsite must be managed or controlled, upon completion of remedial actions, to meet ARARs.

6.1.6.1 Definition of ARARs

Guidance issued by the EPA (*EPA, 1988a*) define ARARs as follows:

- Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Superfund site.

- Relevant and appropriate requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, although not applicable to a specific hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Superfund site, are well suited to a particular site because they address problems or situations sufficiently similar to those encountered at a Superfund site. The relevance and appropriateness of a requirement are judged by comparison of the requirement to the characteristics of the remedial action, the hazardous substance(s) in question, and the physical characteristics of the site. The origin and objective of the requirement may aid in determining its relevance and appropriateness. Although relevant and appropriate requirements must be complied with to the same degree as applicable requirements, more discretion is allowed in determining which part of a requirement is relevant and appropriate.

TBCs, the final class of requirements considered by EPA during the identification of ARARs, are nonpromulgated advisories or guidance documents issued by federal or state governments. They do not have the status of ARARs but may be considered in determining the necessary cleanup levels or actions to protect human health and the environment.

The following three categories of ARARs are defined by EPA (*EPA, 1988a*):

- Ambient or chemical-specific requirements that set health- or risk-based concentration limits or ranges for particular chemicals (e.g., National Ambient Air Quality Standards).
- Location-specific requirements pertaining to restrictions placed on concentrations of hazardous substances or remedial activities (e.g., federal and state laws governing the siting of hazardous waste facilities).
- Performance-, design-, or action-specific requirements that govern particular activities with respect to remedial actions taken for hazardous wastes (e.g., hazardous wastes generated onsite must be properly managed according to federal and state law).

6.1.6.2 Identification of ARARs

Federal, state, and local statutes, regulations, and guidance were considered to identify the possible ARARs and TBCs for remedial action at Site 39. Requirements identified as applicable or relevant and appropriate are summarized in Table 6.9. The chemical-specific, location-specific, and action-specific requirements are discussed below.

Chemical-Specific Requirements

No concentration-based ARAR for soil cleanup levels has been established by EPA or California Environmental Protection Agency (Cal/EPA); however, guidelines have been established to evaluate soil cleanup levels on a site-specific basis. In addition, levels that define hazardous waste have been established by the EPA and Cal/EPA and some recommended soil cleanup levels (RSCLs) have been established by state and county agencies.

- Identification and Listing of Hazardous Wastes: Title 22 of the California Code of Regulations (CCR), Chapter 11, establishes and defines procedures and criteria for identification and listing of Resource Conservation and Recovery Act (RCRA) and non-RCRA hazardous waste. Chemicals currently identified at Site 39 are at concentrations less than the hazardous waste levels; however, if compounds are identified at hazardous levels during remedial activities, this ARAR becomes applicable.
- Standards for Management of Hazardous Wastes: Title 23 CCR, Chapter 15, Division 3, Article 2, Section 2522, establishes and defines procedures and criteria for identification and listing of designated waste.
- Monterey Bay Unified Air Pollution Control District (MBUAPCD): New source and toxic air contaminant regulations are relevant and appropriate. MBUAPCD's Regulations II and X establish requirements for new stationary sources of air pollution, and appropriate levels of abatement control technology for toxic air contaminants, respectively. The remedial design must meet the substantive requirements of these regulations if screening or excavating activities generate toxic air emissions. Levels of these emissions, however, are anticipated to be minimal.
- National Primary and Secondary Ambient Air Quality Standards (NAAQS): Title 40 Code of Federal Regulations (CFR), Part 150 (40 CFR 150) establishes NAAQS for criteria pollutants: particulate matter (PM_{10}), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead. Lead is present in soil at Site 39; airborne emissions of lead and other particulate matter could be generated during remediation activities. The airborne emissions are easily mitigated by using standard dust control measures.

Location-Specific Requirements

- Endangered Species Act of 1973: Title 16 of the United States Code (U.S.C.), Paragraphs 1531 and following (16 U.S.C. 1531 et seq.), regulated in 50 CFR 200 and 402, requires action to conserve endangered species and preserve or restore a critical habitat essential to their survival. Site 39 is a critical habitat for endangered species, some of which are identified in the RI in Volume II; therefore, this act is an ARAR. The regulations provide for the protection of endangered or threatened plant and animal species through an evaluation of affected habitats in and near the site, as well as by consultation with the appropriate government agencies. Site 39 contains endangered plant and animal species; therefore, the remedial alternative chosen for Site 39 will mitigate disturbance to ecological receptors as recommended in the ERA.

- California Endangered Species Act: California Fish and Game Code, Sections 2050 et seq., provides for the recognition and protection of rare, threatened, and endangered species of plant and animals (in conjunction with state authorized or funded actions). Site 39 contains endangered species of plants and animals; therefore, the remedial alternative chosen for Site 39 will mitigate disturbance to ecological receptors as recommended in the ERA.

- Migratory Bird Treaty Act: 16 U.S.C. 703 et seq. protects certain migratory birds and their nests or eggs. Migratory birds are present at Site 39; therefore, the remedial alternative chosen for Site 39 will mitigate disturbance to ecological receptors as recommended in the ERA.

- National Historic Preservation Act: 16 U.S.C. Section 469 and 36 CFR Part 65 provide for the protection of significant cultural resources on federal lands. Remedial actions that may cause irreparable harm, loss, or destruction of significant artifacts are restricted under the National Historic Preservation Act (16 USC Section 469) and 36 CFR Part 65. No significant cultural resources are known to have been unearthed during previous intrusive activities at Fort Ord. Appropriate actions will be taken should any such artifacts be unearthed during remediation.

Action-Specific Requirements

- Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities:

  - Title 22 CCR, Chapter 14, Use and Management of Containers, Article 9, Sections 66264.171-178, establishes requirements for the use of containers to store hazardous waste. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

  - Title 22 CCR, Section 66264.171, Condition of Containers: Containers used to store and transport hazardous waste must be maintained in good condition. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

  - Title 22 CCR, Section 66264.172, Compatibility of Waste in Containers: Containers for hazardous waste must be compatible with the wastes stored in them. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

  - Title 22 CCR, Section 66264.173, Management of Containers: Containers holding hazardous waste must be closed during storage except when necessary to add or remove waste. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66264.174, Inspections: Containers and container storage areas must be inspected weekly for leaks or deterioration. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66264.175, Containment: Container storage areas must be designed according to the requirements of this section. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66264.176, Special Requirements for Ignitable or Reactive Waste: Containers of ignitable or reactive wastes must be stored at least 15 meters from a facility's property line. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66264.177, Special Requirements for Incompatible Wastes: Incompatible wastes are not to be placed in the same container or in unwashed containers that previously held incompatible wastes. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Section 66264.178, Closure: At closure, all hazardous waste and waste residues must be removed and remaining containment structures decontaminated. Excavated soil or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Appropriate actions will be taken to comply with such requirements.

- Title 22 CCR, Chapter 14, Article 2, Section 66264.14: Owners and operators of hazardous waste treatment, storage, or disposal (TSD) facilities must prevent the unknowing entry of persons or livestock onto the active portions of the facility; in addition, warning signs must be posted. If excavated soil is hazardous and it is treated, stored, or disposed onsite, access will be restricted.

- Title 22 CCR, Chapter 14, Article 7, Section 66264.119, Post-Closure Notices: Under this requirement, a restriction is placed on the deed that constrains future uses of the property. Remedial measures in which hazardous levels of chemical constituents remain in place may be subject to these regulations.

- Title 22 CCR, Chapter 14, Article 16, Section 66264.600-603 Miscellaneous Units: These regulations apply to facilities that treat, store, or dispose of hazardous waste in miscellaneous units. Owners and operators of TSDs at which hazardous waste is stored in miscellaneous units must locate, design, construct, operate, maintain, and close those units in a manner that is protective of human health and the environment. Remedial measures in which hazardous levels of chemical constituents are treated in miscellaneous units may be subject to these regulations.

• Land Disposal Restrictions: Title 22 CCR, Division 4.5, Chapter 18, prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. This regulation requires laboratory analysis of wastes intended for landfill disposal to establish that the waste is not restricted from landfill disposal. Listed or characteristic hazardous wastes may be subject to these regulations if they are land disposed. However, hazardous waste from Site 39 will be treated at a designated CAMU at Site 3 prior to disposal at the OU2 landfill. Therefore, LDRs would only apply to hazardous waste disposed offsite at a landfill if treatment at the CAMU is not implemented.

- California Hazardous Waste Control Law: Health and Safety Code, Division 20, Chapter 6.5, Section 25113 et seq., regulates the recycling of hazardous wastes. The California law incorporates stringent federal regulations for RCRA wastes. Under this statute, RCRA hazardous recyclable wastes must generally be managed as a hazardous waste and reused at a permitted waste facility. Non-RCRA hazardous waste is a waste that is not regulated by the U.S. EPA, but is regulated by the state of California (a California-designated waste). Under California law, non-RCRA hazardous wastes may potentially be recycled, but such material must be handled as a hazardous waste if the waste is to be used "in a manner constituting disposal or applied to the land." However, if such non-RCRA recycled materials are used or reused as ingredients in an industrial process to make a product (and not used in a manner consistent with a disposal), they may potentially be conditionally exempt from California hazardous waste regulations. For the metals in spent ammunition at Site 39, the most likely recycling option is at a smelting facility.

6.2 Identification and Screening of Technologies

This section discusses remedial action objectives, chemicals of interest, definition of remedial units, and the screening and selection of remedial technologies for alternative development.

6.2.1 Remedial Action Objectives

The Remedial Action Objectives (RAOs) for the protection of human health and the environment at Site 39 are to: (1) reduce the aggregate risks associated with site-related chemicals, (2) reduce potential adverse health effects for carcinogenic and noncarcinogenic site-related chemicals in the long-term and short to meet TCLs, and (3) restore heavily disturbed habitats. These objectives are in accordance with CERCLA guidance and intended reuse of Site 39 (Section 6.1.3).

Table 6.10 presents RAOs for Site 39. Potential exposure routes considered in Table 6.10 are based on the BRA, and include ingestion of, or dermal contact with contaminated soil, and the inhalation of dust created from contaminated soil. Although there is a potential risk associated with ingestion of groundwater, minimizing contact with groundwater was not included as an RAO because the intended reuse would not include using groundwater as a drinking water source. EPA guidance was used in selecting long-term human health RAOs of between 1×10^{-4} to 1×10^{-6} excess cancer risk, a hazard index less than 1.0 for non-cancer health risk, and an acceptable blood lead level of less than 10 μg/dl for 99 percent of the exposed target population. These RAOs for human health are similar to those used in the Site 39 BRA and include protection against UXO/OEW hazards. Application of TCLs established in the BRA can achieve RAOs for reduction in long-term human exposure to the impacted soil through ingestion, dermal contact, and dust inhalation. Soil left in place with concentrations at or below TCLs does not pose unacceptable risks to future residents or users of the area. Potential risks related to UXO/OEW will be evaluated under a non-time-critical removal action.

6.2.1.1 Chemicals of Interest

Chemicals of interest at Site 39 are those chemicals that pose a potential risk to human health or the environment because of their toxicity at their present concentrations or are regulated at certain levels by ARARs or TBCs.

The areas at Site 39 and the respective chemicals of interest include:

- Range 40A - Unknown TPH
- Range 33 - The explosive compound RDX
- Explosive Ordnance Target Areas - The explosive compound RDX, lead, and beryllium

- Small Arms Ranges - Lead.

6.2.1.2 Target Cleanup Levels

The results of the BRA indicate that the estimated risks for all receptors evaluated at Site 39 are within or below the EPA's target risk range of 1×10^{-6} to 1×10^{-4} and all HIs are at or below the EPA's target HI of 1. For commercial/worker scenarios, a more reasonable target risk of 1×10^{-5} may be applied. The estimated RME cancer risk for the hypothetical onsite habitat management worker exceeds the EPA target risk criteria of 1×10^{-5} for a commercial/worker scenario. Because arsenic and beryllium concentrations in groundwater and arsenic concentrations in soil appear to be associated with background conditions, it was assumed that RDX and beryllium in soil are the only chemicals for which remedial action may be warranted.

TCLs were developed for beryllium and RDX in surface soil. No subsurface TCLs were developed because no complete subsurface soil exposure pathways for potential human receptors were identified at the site. A TCL of 2.8 mg/kg was developed for beryllium in soil, based on a target risk of 1×10^{-5} and the RME habitat management worker risk estimates for multipathway exposures. A TCL of 0.5 mg/kg was developed for RDX in soil, and was based on a target risk of 1×10^{-6} and the RME habitat management worker risk estimates for multipathway exposures. A target risk of 1×10^{-6} was used for RDX in surface soil to maintain a total risk (from beryllium and RDX in soil) of 1×10^{-5}. As discussed in Section 6.2.1, these TCLs meet the remedial action objectives (RAOs) for Site 39 because the potential cancer risks associated with a RDX concentration in soil of 0.5 mg/kg and a beryllium concentration in soil of 2.8 mg/kg will result in a total risk within the EPA's target risk range.

As discussed in Section 6.1.5.1, cleanup of lead contamination at the small arms ranges will be conducted in a manner similar to cleanup of Site 3. A TCL was developed on a basewide basis for Site 3 and other Fort Ord sites where lead contamination was found to pose possible human health risks. Because anticipated future land uses and possible exposure pathways at the small arms ranges are similar to conditions assumed in the calculation of the TCL for Site 3, the recommended soil TCL of 1,860 mg/kg for Site 3 is applicable to Site 39 (Volume V, Site 3 FS).

A remedial goal of 500 mg/kg for TPH in soil was developed by HLA in the *Draft Technical Memorandum, Preliminary Remediation Goals, Fort Ord, California (HLA, 1993o)*, dated June 14, 1993, and was approved by all agencies for sites such as Site 39. This level has been shown to be protective of human health and the environment, including groundwater. This level is the TCL for TPH-affected soil. It will be used to establish limits of the soil remedial units and as the treatment goal for soils that might be used as backfill in excavations.

6.2.1.3 Description of Remedial Units

Remedial units are developed for each site on the basis of acceptable exposure levels (TCLs), potential exposure routes and ecological considerations (BRA and ERA), and the nature and extent of contamination at each site (*EPA, 1988b*). In areas where contamination is homogeneous within a given media, the most rational basis for defining a remedial unit is by the type and extent of contamination, i.e., the volume of soil or groundwater that contains a specific contaminant or group of similar contaminants above an established TCL. For areas containing discrete hot spots or more concentrated contamination within a homogeneous area, separate remedial units may be developed because remediation of these areas is usually addressed in a different manner by the remedial alternative. For sites where the same type of contamination occurs in both soil and groundwater and they are collocated, the remedial units may be grouped together if the soil and groundwater would be treated simultaneously.

Groundwater

As discussed previously, although background concentrations of metals in groundwater would pose a risk if the groundwater were used, chemicals in groundwater do not pose a threat based on planned reuse and deed restrictions would warn future users of the site to identify a separate drinking water source. The only chemicals detected above their MCL (antimony and nitrate) will be evaluated under the basewide groundwater monitoring program; therefore, no groundwater remedial unit was warranted or developed for Site 39.

Soil Remedial Units

Two soil remedial units were defined by the types and concentrations of contaminants present and their distribution horizontally and vertically (Plate 6.2). Although RDX was detected at Range 36A at concentrations above the TCL, the soil was not included in a remedial unit for the purposes of this draft final FS because the range was reactivated for detonation of UXO/OEW from basewide activities and will likely continue to be used throughout remedial and clearance activities. RDX in soil at Range 36A will be addressed as part of the closure of the detonation area after detonation activities are completed.

Soil Remedial Unit 1

This remedial unit consists of the soil containing concentrations of RDX and TPH at the following areas: Range 40A (Plate 6.3), Range 33 (Plate 6.4), and the explosive ordnance target areas (Ranges 30, 30A, 35, 36, 37, 43, 44, 45, 48, and the 2.36-Inch Rocket Range) (Plate 6.5). The boundaries of the remedial unit are based on concentrations of RDX or TPH at or above the TCLs of 0.5 and 500 mg/kg, respectively. The Soil Remedial Unit (SRU) consists of the following areas:

- Range 40A: One area where there are two detected concentrations of TPH above the TCL. Because TPH was not detected at 4.5 ft bgs or deeper, this area extends to about 4.5 ft bgs and contains approximately 180 cy of soil (Plate 6.3).
- Range 33: Two locations at isolated target areas where concentrations of RDX are above the TCL. The remedial unit area extends to 2 feet bgs and contains a total of approximately 60 cy of soil (Plate 6.4).
- Explosive ordnance target areas: Three general areas where concentrations of RDX are above the TCL. The first area is in the vicinity of Ranges 35, 36, and 37 and the 2.6-Inch Rocket Range and contains approximately 30 cy. The second area is in the vicinity of Ranges 43 to 45 and 48, and contains approximately 120 cy. The third area is in the vicinity of Ranges 30 and 30A and contains approximately 30 cy. The remedial unit areas extend to about 2 feet bgs and contain a total of approximately 180 cy (Plate 6.5).

SRU 1 consists of these three areas (some with subareas), which contain a total of approximately 420 cy of soil containing mainly RDX and a small volume of TPH.

Soil Remedial Unit 2

This remedial unit consists of the soil containing concentrations of lead above the TCL from: the explosive ordnance target areas and the small arms ranges.

For the explosive ordnance target areas, the distribution of lead with concentrations at or above the TCL of 1,860 mg/kg defines the remedial unit. For the small arms ranges, chemical data for lead in soil are not available and the distribution of lead is believed to correspond to the distribution of spent ammunition. The validity of this correlation was evaluated in the Site 3 RI (Volume II) and similar conditions are present at the Site 39 small arms ranges. SRU 2 consists of the following:

- Explosive ordnance target areas: An area in Range 37 and another in Range 48 where lead concentrations are above the TCL, and an area in Range 44 where one detected concentration of beryllium is above the TCL (Plate 6.5). The soil remedial unit extends to 2 ft bgs and contains approximately 60 cy.
- Small arms ranges: Because of similar soil types and historical usage, the data interpretations for Site 3 were used to evaluate the distribution of lead in soil at the small arms ranges. The Site 3 RI found that in areas where 10 percent or greater of the

surface is covered with spent ammunition, the soil from the surface to about 2 feet bgs typically contains lead above the TCL of 1,860 mg/kg. This same relationship of bullet coverage to lead concentrations is assumed to exist at the small arms ranges. Therefore, the soil (and spent ammunition) remedial unit where lead concentrations are anticipated to be above the TCL (i.e., areas of greater than 10 percent surface coverage) consists of the following areas that extend to 2 ft bgs. Because these areas were not investigated or mapped except by visual observation, they are not shown on the remedial unit plates.

- Range 19 - Backstop: approximately 275 cy. Behind backstop: approximately 275 cy

- Range 21 - Backstop: approximately 1,100 cy. Behind backstop: approximately 490 cy

- Range 22 - Isolated area: approximately 25 cy

- Range 23 - Bunkers and target area: approximately 50 cy

- Range 25 - Backstop: approximately 900 cy

- Range 26 - Firing lines: approximately 150 cy

- Range 39 - Backstop: approximately 550 cy. Firing lines: approximately 225 cy

The two explosive ordnance target areas and seven areas at the small arms ranges of SRU 2 contain a total of approximately 4,100 cy of spent ammunition and soil containing lead.

6.2.2 General Response Actions

In accordance with EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final*, general response actions (GRAs) are defined as those general classes of actions that can be taken to manage or control a particular problem at a site (*EPA, 1988b*). After review of site-specific conditions at Site 39, several GRAs were identified for the technology screening and development of remedial action alternatives for soil to meet the RAOs. The general response actions that are potentially applicable are:

- No Action
- Containment
- Collection
- Treatment
- Disposal.

6.2.3 Technologies Retained from the Remedial Technology Screening Report

CERCLA guidance for RI/FSs requires that, prior to development of site-specific remedial alternatives, there is an initial screening of the universe of remedial technologies that could be used to clean up contaminated sites (*EPA, 1988b*). The *Draft Final Remedial Technology Screening Report* (RTS) (*HLA, 1994n*), presents a process to expedite the initial screening of remedial technologies for the Fort Ord FSs. The objectives of the RTS were to identify and screen proven remedial technologies for typical groups of compounds (GOCs) found in soil and groundwater at contaminated sites.

The RTS contains: (1) a matrix guide/checklist(s) for each media and GOC; (2) tables that describe and evaluate each applicable technology on the basis of effectiveness, implementability, and relative cost; and (3) summary review forms. The matrix guide/checklist(s) and tables are to be used to identify and screen technologies for site-specific media and GOCs and this screening is then presented on the summary review forms. The matrix guide/checklist(s) and summary review forms for this FS are presented in Appendix 6A. The summary review forms were used to prepare remedial unit-specific technology tables (Tables 6.11 and 6.12). Based on this process, the following general response actions and remedial technologies are available for selection in developing the remedial alternatives for this site:

Soil Remedial Unit 1

- No Action
- Collection
  - Excavation
- Containment
  - Barriers
  - Capping
  - Surface Water Controls
- Treatment
  - Thermal
  - Chemical
  - Physical
  - Biological
  - Offsite
- Disposal
  - Onsite
  - Offsite

Soil Remedial Unit 2

- No Action
- Collection
  - Excavation
- Containment
  - Barriers
  - Capping
  - Surface Water Controls
- Treatment
  - Physical
  - Stabilization
  - Offsite
- Disposal
  - Onsite
  - Offsite.

6.2.4 Selection of Technologies for Remedial Alternative Development

This section reviews and selects the technologies that were retained from the RTS (listed in Section 6.2.3) for development of remedial alternatives. Technologies are selected on the basis of site-specific conditions and base-specific features. For example, Fort Ord is unique in that it has the regulatory agency-approved Fort Ord Soil Treatment Area (FOSTA) that was specifically created to treat hydrocarbon and other chemical-contaminated soil; the FOSTA is protective of human health and the environment and provides cost-effective treatment at a single location. The types of hydrocarbon treatment that are currently planned at the FOSTA include bioventing and ex situ bioremediation. Future treatment systems that could be incorporated include portable thermal desorption and asphalt batching. Because the FOSTA provides an equivalent level of treatment, many of the technologies that pass the RTS screening no longer compare favorably. Those that are eliminated from further consideration because of the FOSTA, include offsite thermal treatment by incinerator because it could be performed onsite. The Interim Action Record of Decision (IAROD, *HLA, 1994c*) established the Fort Ord Soil Treatment Area (FOSTA) for the storage and treatment of soil collected from remedial activities at Fort Ord. Several soil remedial units on RI Sites 39, 16, and 12 meet criteria established in the IAROD for treatment at the FOSTA. Soil in these remedial units will be treated at the FOSTA in accordance with the

IAROD as part of the overall remedy for these sites.

Excavated soil brought to the FOSTA will be assessed for the presence of pesticides, metals, solvents, and total petroleum hydrocarbons. Soil containing only petroleum hydrocarbons, without metal concentrations above background levels or detectable pesticide concentrations (such as that from the RI sites), will be treated at the FOSTA. Soil that does not meet this criteria will be containerized and characterized to evaluate if onsite disposal or onsite treatment is applicable to this soil as established in the IAROD.

The FOSTA will be located at the former 519th Motorpool area, northwest of the intersection of Light Fighter Road and North-South Road, just east of the Fort Ord main entrance. The FOSTA will consist of a biotreatment cell, soil stockpile area, and an enclosed container storage building. The biotreatment cell will accept nonhazardous soil contaminated with petroleum hydrocarbons, such as that from the selected RI site remedial units described above. All soil brought to the FOSTA will be tracked according to its site of origin, cleanup levels attained, and final destination. Treated soil from the biotreatment unit at the FOSTA will be used in the OU 2 landfill closure or for backfill on base.

Another base-specific example is onsite disposal at the OU 2 landfill for the FOSTA-treated hydrocarbon soils. This technology is more cost effective and presents a lower risk to human health and the environment. The Fort Ord Landfill, designated as the Operable Unit 2 (OU 2) Landfill, is approximately 170 acres and is located in the northern portion of Fort Ord. This landfill is currently inactive, and a remedial action is ongoing to install a landfill cover and groundwater extraction and treatment system. The site activities for the landfill cover include removal of the existing vegetation layer, leveling and grading of the terrain, placement and compaction of a foundation layer, and the placement and compaction of a cover layer. The cover layer will be graded, the site groundwater treatment and monitoring systems installed, and cover vegetation planted. Surface water controls will be added during landfill cover construction. The surface water controls are not designed at this time, but will include a final cover with a low permeability layer, final slopes capable of handling the 100-year, 24-hour storm, perimeter drainage channels, and an upgradient surface water diversion system.

The volume of soil required for construction of the foundation layer is estimated to be approximately 500,000 to 800,000 cubic yards. Soil containing levels of TPH less than 500 mg/kg can be placed as part of the landfill foundation layer. Inert fill, treated soil from the FOSTA, or construction debris, such as from Soil Remedial Unit (SRU) 1 at Sites 2 and 12, can be placed in the foundation layer.

Based upon the Section 6.2.3 screening of technologies and the Fort Ord-specific conditions, the technologies retained for development of remedial alternatives for each remedial unit are presented in the following sections. Also presented are the technologies that were not selected and the reasons for their elimination.

Soil Remedial Unit 1 (Total Petroleum Hydrocarbons and RDX)

The following RTS-identified technologies passed site-specific screening and were selected for use in the development of remedial alternatives for SRU 1 (Table 6.11):

- No Action
- Surface Water Controls (Grading, Revegetation, Diversion and Collection Systems)
- Excavation
- Ex Situ Biodegradation
- Onsite and Offsite Disposal.

Several remedial technologies/process options were not selected for the following reasons:

- Vertical and horizontal barriers: They would not be effective for the shallow contamination

- Capping with clay, asphalt, concrete, or multilayered materials: It would be disruptive to sensitive ecological habitat and not consistent with planned site reuse

- Thermal treatment by rotary kiln, fluidized bed, or circulating bed incinerator: An equivalent level of treatment is available at the FOSTA

- Offgas treatment: It is not needed as part of other treatment technologies that were selected

- Asphalt batching and thermal desorption: An equivalent level of treatment is available at the FOSTA

- Soil vapor circulation and air injection: They are only moderately effective for removal of TPH in permeable soil and not effective on the shallow contamination

- Screening: It is not effective

- In situ biodegradation: It is not implementable for the shallow contamination

- Offsite thermal and biological treatment: An equivalent level of treatment is available at the FOSTA.

Soil Remedial Unit 2 (Metals and Spent Ammunition)

The following RTS-identified technologies passed site-specific screening and were selected for use in the development of remedial alternatives for SRU 2 (Plate 6.12):

- No Action

- Excavation

- Surface Water Controls (Grading, Revegetation, and Diversion and Collection Systems)

- Screening

- Soil Washing

- Asphalt Batching

- Onsite and Offsite Stabilization

- Onsite Disposal at the Corrective Action Management Unit (CAMU) at the OU 2 Landfill, or in Excavated Areas as Backfill,

- Offsite Disposal at a Landfill or Recycling Facility.

Several remedial technologies/process options were not selected for the following reasons:

- Vertical and horizontal barriers: They would not be effective for shallow contamination

- Capping with clay, asphalt, concrete, or multilayered materials: It would be disruptive to sensitive ecological habitat and not consistent with planned site reuse

- Onsite Repository: it would not be consistent with planned site reuse; OU 2 CAMU provides equivalent onsite disposal.

6.3 Development and Description of Remedial Alternatives

To assemble remedial alternatives for each site, general response actions (GRAs) and process options chosen in Section 6.2.4 that represent various technology types for each medium are combined to form site-wide alternatives (*EPA, 1988b*). According to EPA guidance, taking no further action at the site should be one of the alternatives considered as a basis for comparison to other alternatives: appropriate treatment and containment options should also be considered. Initially, specific technologies or process options are evaluated primarily on the basis of whether or not they can meet the Remedial Action Objectives (RAOs) discussed in Section 6.2.1. To assemble alternatives, remedial units are matched with technology types developed in Section 6.2.4 using engineering judgement and site-specific considerations. A range of alternatives are developed with respect to the criteria of effectiveness, implementability, and cost. For sites at which interactions among media are not significant, media-specific remedial options can be developed rather than developing numerous comprehensive site-side alternatives. Alternatives which meet the RAOs and evaluation criteria are retained for further consideration in the detailed analysis.

The technologies/process options that were selected were combined into four site-wide remedial alternatives that address both soil remedial units. These are described in Sections 6.3.1 through 6.3.4 and summarized in Table 6.13.

6.3.1 Remedial Alternative 1

This alternative would take no further action to treat, contain, or remove contaminated soil or spent ammunition. This alternative is required for consideration under CERCLA as a baseline against which the other alternatives are compared. The no action alternative would rely on natural degradation and dispersion over many years to eventually eliminate potential risks. The only activity to continue under no action would be periodic groundwater monitoring, performed as part of the basewide program to detect any threat to human health or the environment. Costs associated with basewide monitoring are not included in the cost estimate for this alternative. It is likely that deed and/or access restrictions over much of Site 39 would be necessary.

6.3.2 Remedial Alternative 2

Alternative 2 would consist of the following institutional controls: (1) construction of perimeter fences around each of the areas or subareas described in Section 6.2.1.2 to restrict access and completely enclose the contaminated soil at Site 39, (2) posting of warning placards at appropriate intervals along the fences, and (3) deed and land use restrictions for future development. Access restrictions would consist of permanent chainlink fences for a total of approximately 8,400 linear feet (lf) around the boundaries of the remedial unit areas. The fences would be installed with concrete footings and would be 8 feet high and mounted with barbed wire as a deterrent to trespassers. In addition, placards would be displayed at intervals of 100 lf, warning of the potential chemical hazards. The integrity of the fences and placards would be checked on a yearly basis by a maintenance crew, and repairs would be made, as needed. Deed restrictions would be recorded to limit development of the property (i.e., future land use would be restricted because the impacted soil would remain in place).

6.3.3 Remedial Alternative 3

This alternative consists of soil excavation from both remedial units (approximately 4,520 cy) and transportation and treatment at Fort Ord. Surface and subsurface clearance for UXO/OEW would be performed prior to excavation activities by a UXO team; any UXO would be detonated/disposed at Fort Ord. Soil containing TPH and RDX from Soil Remedial Unit 1 (approximately 420 cy) would be transported to and treated at the FOSTA. Soil containing lead, spent ammunition, and beryllium (approximately 4,100 cy) from Soil Remedial Unit 2 would either be transported to and treated at the Site 3 CAMU, or transported to the CAMU at the OU 2 Landfill for placement as foundation layer material.

Treatment of soil impacted with TPH would consist of ex situ biodegradation at the FOSTA because the FOSTA is designed for bioremediation of soil, and is the preferred method of treatment for explosive compounds such as RDX. Soil containing RDX would be treated separately by ex situ biodegradation at the FOSTA but may require additional aeration and amendment with carbon-rich nutrients to achieve effective degradation. After verification sampling of the treated soil indicated that TCLs had been achieved, it would be reused at Fort Ord for backfilling, as top soil for revegetation, or for placement in the OU 2 Landfill.

Treatment of soil impacted with lead and spent ammunition at Site 39 would consist of separation (i.e., screening) and recycling of spent ammunition and soil treatment by one of three methods: stabilization, soil washing, or asphalt batching, depending on the outcome of the preremedial design study at the Site 3 CAMU (Section 4.3 of the Site 3 FS). Soil may also be placed at the CAMU at the OU 2 Landfill.

Limited amounts of soil containing beryllium would also be treated by the same methods as lead-containing soil. Based on communications with various bench-scale vendors, beryllium is similar to lead and other heavy metals and could be treated using the same processes. Confirmation sampling of batches of soil suspected to contain beryllium would be performed to verify treatment.

Excavated areas would be backfilled with clean or treated soil, compacted, graded, and revegetated with native species of plants that would enhance the naturally occurring habitat. Diversion and collection systems for surface water control would be utilized as needed.

6.3.4 Remedial Alternative 4

This alternative would consist of excavation of soil from the remedial units (approximately 4,520 cy) with prior UXO/OEW clearance being performed as described for Alternative 3. Soil containing only TPH (approximately 180 cy) would be treated at the FOSTA. Soil containing RDX (approximately 240 cy) would be manifested and transported to Chemical Waste Management's (CWM's) Kettleman Hills facility, the closest operating Class I landfill facility. Based on chemical analyses performed during the RI, the soil does not contain concentrations of chemicals that would require pretreatment (e.g., stabilization) prior to disposal in the landfill to comply with the Land Disposal Restrictions (LDRs). Soil containing spent ammunition, lead and beryllium (approximately 4,100 cy) would be transported to and disposed at CWM's Class I landfill if not placed at the OU 2 CAMU under Alternative 3. If pretreatment under LDRs is required for the lead-containing soil and spent ammunition, stabilization would be performed at the landfill facility prior to disposal. The site would be restored as described under Alternative 3.

6.4 Criteria for Detailed Analysis of Remedial Alternatives

Each of the remedial alternatives described in Section 6.3 has been assessed in accordance with EPA's *Guidance for Conducting Remedial Investigations/Feasibility Studies Under CERCLA, Interim Final* (*EPA, 1988b*). The remedial alternatives have been evaluated using the nine criteria described below.

Overall Protection of Human Health and the Environment

Each remedial alternative is evaluated in terms of the extent of protection of human health and the environment and any risk that would remain at the site after implementation of the alternative. The manner in which the contaminants are managed under each alternative is considered.

Compliance with ARARs

The ability of each alternative to meet ARARs and other guidance identified in Section 6.1.6 is assessed.

Long-Term Effectiveness

Each alternative is evaluated with respect to the risk that would remain at the site after the alternative has been implemented and the extent to which the remedial action objectives (RAOs) have been satisfied. Residual concentrations of chemicals remaining at the site are assessed as they relate to potential threats to human health and the environment.

Reduction of Toxicity, Mobility, and Volume Through Treatment

In CERCLA, preference is given to remedial technologies that significantly reduce the toxicity, mobility, or volume of contaminants. This evaluation focuses on the following factors for a particular remedial alternative:

- The treatment process and the materials treated
- The amount of hazardous materials that will be treated or destroyed
- The degree of expected toxicity, mobility, or volume reduction when compared with conditions prior to implementation

- The degree to which total destruction of contaminants is achieved

- The type and quantity of treatment residuals that will remain following treatment

- The degree to which the alternative addresses the principal risks (e.g., RDX and lead).

Short-Term Effectiveness

The effects of each alternative are assessed during the construction, implementation, and operation phases. Factors considered include protection of the community and workers during remedial operations, the time required to implement the alternative and to achieve the remedial goals, and potential adverse environmental effects that may result.

Implementability

The three major areas of focus in assessing the implementability of a remedial alternative are:

- Technical feasibility: For example, the ability to construct a treatment system, the reliability of the technology, and the ability to monitor the effectiveness of the remedy

- Administrative feasibility: The effort and resources required to obtain approvals from other agencies

- Availability of services and materials: The availability of contractors with the equipment and knowledge to implement the technologies.

Cost

Cost estimates for the remedial alternatives are prepared using EPA guidance manuals, other technical resource documents, contractor quotes, and experience on this site and on other projects with similar scope. Both capital costs and operation and maintenance (O&M) costs, if applicable, are developed at a conceptual level for each remedial alternative. These cost estimates can be expected to have an accuracy of +50 percent to -30 percent. Net present value (NPV) costs are calculated using a 5 percent interest rate for up to 30 years of O&M.

Capital costs include items such as contractor's mobilization and demobilization, sampling and analysis, permitting, engineering, purchase and installation of remediation equipment, and site restoration. O&M costs include items such as ongoing operational site inspections, utilities, chemicals, routine maintenance and repairs, and periodic sampling and analysis.

Regulatory Agency Acceptance

Each remedial alternative is evaluated in terms of its potential concern to the administrative and technical issues regulatory agencies. Acceptance will be addressed in the Proposed Plan once comments on the FS have been received.

Community Acceptance

Each remedial alternative is evaluated in terms of available public input and the anticipated public reaction to the alternative; however, as with regulatory acceptance, community acceptance will be addressed in the Proposed Plan.

6.5 Detailed Analysis of Remedial Alternatives

The remedial alternatives are evaluated in the following sections based on the nine evaluation criteria. A summary of this evaluation is presented in Table 6.13.

6.5.1 Detailed Analysis of Remedial Alternative 1

Alternative 1 consists of no action and does not treat, contain, or remove spent ammunition or contaminated soil.

Overall Protection of Human Health and the Environment

The no action alternative would provide no additional protection to human health and the environment. The potential for exposure to humans and the environment would continue to exist through direct exposure to chemical contaminants in soil, and through inhalation, ingestion, and contact with contaminated airborne dust particles.

Compliance with ARARs

The no action alternative would not meet chemical-specific ARARs for the site. Neither would this alternative meet action-specific or location-specific ARARs. Deed restrictions may be required.

Long-Term Effectiveness

In the long term, this alternative would not change or reduce human or ecological risks or reduce the potential transfer of chemical contaminants through the soil matrix.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Although some natural attenuation of organic chemicals may occur over time, the no action alternative would not reduce the toxicity, mobility, or volume of contaminated soil. This alternative would not mitigate any risks.

Short-Term Effectiveness

Short-term conditions would remain unchanged, because this alternative would not reduce potential risks to the community or onsite workers from possible ingestion, inhalation, or dermal contact with contaminated soil. Also, this alternative would not change the potential for surface contaminants to be dispersed throughout the environment; the potential for degradation of the environment would continue.

Implementability

The no action alternative would be easy to implement. No specialized services or materials would be required. However, the administrative feasibility of implementing the no action alternative may be difficult.

Cost

No capital or O&M costs would be associated with this alternative.

Regulatory Agency Acceptance

It is anticipated that the regulatory agencies would not accept this alternative; they would require more extensive actions. Acceptance will be addressed in the Proposed Plan once comments on the FS have been received.

Community Acceptance

It is anticipated that the community would not accept this alternative. Because the remedial action alternatives applicable to the site have not been presented to the community, acceptance of this alternative cannot be determined at this time, but will be addressed in the Proposed Plan.

6.5.2 Detailed Analysis of Remedial Alternative 2

Alternative 2 consists of constructing an 8-foot-high chainlink fence around each of the remedial unit areas described in Section 6.2.1.2 to enclose the areas and restrict access. The fences would be posted at 100-foot intervals with warning placards.

Protection of Human Health and the Environment

This alternative would provide increased protection of human health by limiting access to contaminated soil. However, minimal protection would be afforded to the environment because endangered plants and animals within fenced areas would still be exposed to chemicals left onsite.

Compliance with ARARs

This alternative would not meet chemical-specific ARARs or TCLs for the site. However, access to soil containing TPH, RDX, and lead left onsite would be restricted; deed restrictions may be required. This alternative would not comply with location-specific ARARs such as the Endangered Species Act, because no action would be taken to conserve the species or preserve critical habitat. Action-specific ARARs that are invoked, such as MBUAPCD's air emission standards, would be complied with for construction activities through air monitoring and use of personal protective equipment (PPE).

Long-Term Effectiveness

In the long term, this alternative would provide some mitigation of risk to human health by limiting access. Minimal protection to the environment would be afforded except by limiting access of some fauna.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Although some natural attenuation of organic chemicals may occur over time, this alternative would not reduce the toxicity, mobility, or volume of contaminated soil and does not mitigate risks associated with existing onsite chemical concentrations in soil.

Short-Term Effectiveness

There would be minimal exposure to workers and the community during implementation of this alternative. Potential impacts would be mitigated through proper and easily implementable health and safety measures. Implementation of this alternative would likely be completed in 3 to 6 months.

Implementability

The fence could be installed using well-established procedures and conventional construction techniques. There are few technical considerations that would affect the ability to install the fence. However, special precautions would be taken to clear and remove UXO/OEW along the fence line prior to its construction; UXO/OEW clearance would also be performed in areas where construction crews enter and exit the site. Services for UXO/OEW clearance and removal are readily available.

Cost

Capital and O&M costs associated with Alternative 2 are presented in Appendix 6B in Table 6B-1 and are summarized in Table 6.14. The cost estimate includes site preparation, UXO/OEW clearance, and fence and warning placard installation and maintenance. Capital costs are estimated at $92,000. O&M costs are estimated at $2,000 per year. The total net present value (NPV) cost for this alternative for 30 years is estimated to be $122,000.

Regulatory Agency Acceptance

It is anticipated that the regulatory agencies may require remedial actions more extensive than those proposed in this alternative. Acceptance will be addressed after comments have been received on the FS.

Community Acceptance

It is anticipated that the community may not accept this alternative. Because the remedial alternatives applicable to the site have not been presented to the community, acceptance of this alternative cannot be determined at this time, but will be addressed in the Proposed Plan.

6.5.3 Detailed Analysis of Remedial Alternative 3

This alternative includes excavation and onsite treatment of soil from the remedial units (approximately 4,520 cy). Areas to be excavated and entrance and exit roads would be cleared of UXO/OEW. Following UXO/OEW clearance, the soil containing TPH and RDX (approximately 420 cy) would be excavated and treated at the FOSTA. Soil containing lead and spent ammunition (approximately 4,100 cy) would either be: (1) treated, along with soil from Site 3 at the CAMU, by separating and recycling the spent ammunition and then treating the remaining soil by stabilization, soil washing, or asphalt batching, or (2) placed as foundation layer material at the OU 2 Landfill CAMU.

Treated soil from the FOSTA and lead-containing soil would be reused onsite for backfilling, top soil, or placed in the OU 2 Landfill. The excavated areas would be revegetated with native plant species to restore the natural habitat. A remediation flow diagram is shown on Plate 6.6.

Overall Protection of Human Health and the Environment

This alternative would provide protection of human health by removing and treating impacted soil from within the remedial units. Protection would be afforded to the environment through removal of impacted soil and revegetation with native plant species.

Compliance with ARARs

Location-specific ARARs such as the Endangered Species Act would be complied with because the critical habitat in remediated areas would be enhanced through removal of chemical-bearing soil and revegetation. Action-specific ARARs such as the MBUAPCD's air emission standards would be complied with through use of air monitoring and PPE during construction activities.

Long-Term Effectiveness

This alternative would reduce human and ecological residual risks to an acceptable level by cleanup to TCLs. In addition, it would reduce the potential transfer of chemical constituents through the soil matrix by treating the soil.

Reduction of Toxicity, Mobility, and Volume Through Treatment

This alternative would reduce the toxicity, mobility, and volume of soil containing TPH and RDX through treatment to TCLs. Treatment of lead-bearing soil by soil washing (as part of remediation at Site 3) would effect a reduction in all three parameters, but treatment by stabilization or asphalt batching would effect only a reduction in mobility.

Short-Term Effectiveness

There could be a short-term increase in risks to onsite construction workers associated with implementation of the alternative; however, these risks would be easily mitigated by proper health and safety procedures and standard construction mitigation measures. Implementation of this alternative would likely be completed within 8 to 12 months.

Implementability

There are only minor technical considerations that would affect implementation of this alternative. UXO/OEW clearance, excavation, transportation, and treatment at the FOSTA and at Site 3 are well-established procedures that involve use of conventional construction techniques. The technologies are reliable and it is easy to monitor their effectiveness. Equipment and specialty services (e.g. UXO/OEW clearance) are readily available.

Cost

Capital costs for Alternative 3 are presented in Table 6B-2 in Appendix 6B, and are summarized in Table 6.14. The cost estimate includes site preparation, UXO/OEW clearance, excavation, transportation, and treatment at the FOSTA, treatment at Site 3, onsite disposal, and site restoration. Total capital costs are estimated at $1,184,000. No O&M costs are associated with this alternative.

Regulatory Agency Acceptance

It is anticipated that the regulatory agencies would approve of this alternative because it removes, treats, and disposes of soil from the remedial units; however, acceptance will be addressed in the Proposed Plan after comments have been received on the FS.

Community Acceptance

It is anticipated that the community will accept this alternative for the same reasons as the regulators. Because the remedial alternatives applicable to the site have not been presented to the community, acceptance of this alternative cannot be determined at this time, but will be addressed in the Proposed Plan.

6.5.4 Detailed Analysis of Remedial Alternative 4

This alternative would consist of excavation of soil from the remedial units (approximately 4,520 cy); treatment of approximately 180 cy of TPH-contaminated soil at the FOSTA; and offsite disposal of approximately 240 cy of soil containing RDX at a Class I landfill. The remaining 4,100 cy of soil containing lead and spent ammunition would also be disposed offsite at a Class I landfill.

Overall Protection of Human Health and the Environment

This alternative would protect human health by removing and disposing of contaminated soil from the site. Protection would be afforded to the environment through removal of soil and revegetation as described previously. Therefore, the residual risks would be at an acceptable level.

Compliance with ARARs

Location-specific ARARs such as the Endangered Species Act would be complied with because the critical habitat in remediated areas would be enhanced through removal of chemical-bearing soil and revegetation. Action-specific ARARs such as the MBUAPCD's air emission standards would be complied with through use of air monitoring and PPE during construction activities.

Long-Term Effectiveness

Because this alternative removes contaminated soil from the site, the residual risks to human health and the environment would be at an acceptable level. Some long-term liability remains for the soil and spent ammunition disposed of in the Class I landfill.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Because this alternative merely transfers most of the contaminated soil to another location without treatment, no reduction would occur in the overall toxicity and volume of contaminated soil except for the TPH soil treated at the FOSTA. However, the other soil would be removed from the site and transported to a permitted landfill; thus, the mobility of the contaminants would be reduced in the long term because they could not be transported by wind or other mechanisms. Their mobility could increase in the short term because of dust generation; however, dust control measures would be employed during site operations.

Short-Term Effectiveness

The excavation and loading operations for this alternative would have a potentially adverse short-term impact to construction workers because contaminated dust and particulates would be generated during excavation and removal. However, this impact would be easily mitigated through the use of dust control measures such as spraying the soil with water, and use of proper health and safety procedures. Implementation of this alternative would likely be completed within 6 to 8 months.

Implementability

Soil excavation, loading, transportation, and disposal have been used widely and can be performed using well-established, conventional techniques and equipment. There are only minor technical considerations that would affect implementation. Because this alternative has been used at numerous sites with similar contamination problems, it is anticipated that this plan would be administratively feasible. The services and materials required to implement this plan are readily available.

Cost

Capital costs associated with Alternative 4 are presented in Table 6B-3 in Appendix 6B and are summarized on Table 6.14. The cost estimate includes site preparation, UXO/OEW clearance, excavation, transportation, disposal, and site restoration. Total capital costs are estimated at $1,293,000. No O&M costs are associated with this alternative; therefore, the total cost includes capital costs only.

Regulatory Agency Acceptance

It is anticipated that the regulatory agencies would approve of this alternative; however, acceptance will be addressed in the Proposed Plan after comments are received on the FS.

Community Acceptance

It is anticipated the community would accept this alternative. However, because the remedial alternatives applicable to the site have not been presented to the community, acceptance of this alternative cannot be determined at this time, but will be addressed in the Proposed Plan.

6.6 Comparison of Remedial Alternatives

Each potential remedial alternative for Site 39 was evaluated and compared on the basis of the nine CERCLA criteria described in Section 6.4. The comparison of alternatives is discussed below and summarized in Table 6.13.

Overall Protection of Human Health and the Environment

Alternative 1, no action, would not provide adequate protection of human health and the environment because it does nothing to reduce risks from exposure to the contaminated soil. Alternative 2 (institutional controls) would increase overall protection because it prevents access, but it does not treat or remove the contaminated soil. Alternatives 3 (excavation, treatment and disposal) and 4 (excavation and disposal) would significantly increase overall protection to an acceptable level.

Compliance with ARARs

Alternatives 1 and 2 would not comply with action-specific ARARs; chemical-specific TCLs would not be met because contaminated soil would remain at the site. Alternatives 3 and 4 would meet chemical-, location-, and action-specific ARARs.

Long- and Short-Term Effectiveness

Alternative 1 would potentially allow direct contact with contaminated soil, and, therefore, would not be effective in the short or long term. Alternatives 2, 3 and 4 would pose short-term exposures to workers during construction but such exposures are easily mitigated. In the long term, Alternative 2 does not significantly reduce the long-term risks but it does limit access to contaminated areas. Alternatives 3 and 4 would be effective in the long term because the contaminants would be removed, treated, or disposed and the risks would be reduced to an acceptable level. Alternative 4 would be less effective than Alternative 3 in the long term because the liability associated with the disposal of contaminated soil and spent ammunition at a Class I landfill would remain.

Reduction of Toxicity, Mobility, and Volume Through Treatment

Alternatives 1 and 2 would not reduce the toxicity, mobility, or volume of the chemicals in soil except for natural attenuation of organic contaminants over time. Alternative 3 would reduce the toxicity, mobility, and volume of the soil that is treated; if soil is stabilized or incorporated into asphalt as part of remediation at Site 3, only the mobility would be reduced. Alternative 4 would not reduce the toxicity and volume of contaminated soil, but would reduce the mobility through placement of the contaminated soil and spent ammunition in a Class I landfill.

Implementability

Each of the alternatives is implementable, subject to the ability to secure the appropriate permits and approvals. Alternatives 1 and 2 could be more difficult to implement from an administrative perspective because these alternatives may not be amenable to the regulatory agencies and the community. Alternatives 3 and 4 are more complex than Alternatives 1 and 2, but the necessary equipment and services are readily available.

Cost

Total estimated NPV costs vary considerably for the four alternatives. No costs are associated with Alternative 1. Alternative 2, which would not comply with ARARs but would limit access, is estimated to cost approximately $122,000 over a period of 30 years and is the least expensive. Estimated costs for Alternatives 3 and 4, both of which would comply with ARARs, are $1,184,000 and $1,293,000, respectively. Alternative 3 has a slightly lower cost than

Alternative 4; however, because the difference is within the accuracy range of the cost estimates, this factor is not weighted heavily in the selection of the preferred alternative.

Regulatory Agency and Community Acceptance

The regulatory agencies and community are not expected to accept Alternatives 1 and 2 but are likely to accept either Alternative 3 or 4. The status of their acceptance will be determined in the Proposed Plan.

6.7 Selection of the Preferred Remedial Alternative

On the basis of the comparison of alternatives in Section 6.6, Alternative 3 is selected as the preferred alternative for the following reasons:

- It would be protective of human health and the environment through removal and treatment of contaminated soil
- It would comply with ARARs
- It would be the most effective in the short and long term
- It provides significant reduction in toxicity, mobility, and volume
- It would be implemented through use of the existing FOSTA and treatment processes at Site 3
- It has a slightly lower cost than the other remedial alternative that meets the ARARs.

TABLES

Table 6.1. Summary of Explosive Compounds Detected in Soil Samples - Site 39, Range 36A
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
LW23								
HMX	69	5	64	0	69	ug/g	0.41	1.84
RDX	69	9	60	0	69	ug/g	0.31	16.50
1,3,5-Trinitrobenzene	69	0	69	0	69			
1,3-Dinitrobenzene	69	0	69	0	69			
Tetryl	69	0	69	0	69			
Nitrobenzene	69	0	69	0	69			
2,4,6-Trinitrotoluene	69	0	69	0	69			
2,4-Dinitrotoluene	69	0	69	0	69			
2,6-Dinitrotoluene	69	0	69	0	69			
Moisture Content	47	47	0	0	47	%	0.80	18.40

ug/g Micrograms per gram.

Table 6.2. Summary of Inorganic Constituents Detected in Soil Samples - Site 39, Range 36A
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
COLD VAPOR AA								
Mercury	70	2	59	9	70	mg/kg	0.11	0.11
FUAA-EPA7060								
Arsenic	70	69	1	0	70	mg/kg	0.40	3.90
FUAA-EPA7421								
Lead	70	68	2	0	70	mg/kg	1.00	176.00
FUAA-EPA7740								
Selenium	70	2	68	0	70	mg/kg	0.55	0.66
FUAA-EPA7841								
Thallium	70	0	70	0	70			
METALS BY ICP								
Antimony	70	0	61	9	70			
Beryllium	70	40	30	0	70	mg/kg	0.19	0.81
Cadmium	70	1	69	0	70	mg/kg	0.65	0.65
Chromium	70	63	7	0	70	mg/kg	5.40	38.90
Copper	70	41	29	0	70	mg/kg	1.60	15.10
Nickel	70	36	34	0	70	mg/kg	6.10	25.60
Silver	70	4	66	0	70	mg/kg	0.38	0.73
Zinc	70	53	17	0	70	mg/kg	2.80	53.10

mg/kg Milligrams per kilogram.

Table 6.3. Summary of Organic Compounds Detected In Soil Samples
Site 39, Range 40A, Phases 1 and 2
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
BTEX								
Benzene	14	0	14	0	14			
Ethylbenzene	14	0	14	0	14			
Toluene	14	0	14	0	14			
Xylenes	14	0	14	0	14			
EPA-8270								
Phenol	24	0	24	0	24			
Bis(2-chloroethyl)ether	24	0	24	0	24			
2-Chlorophenol	24	0	24	0	24			
1,3-Dichlorobenzene	24	0	24	0	24			
1,4-Dichlorobenzene	24	0	24	0	24			
Benzyl alcohol	24	0	24	0	24			
1,2-Dichlorobenzene	24	0	24	0	24			
2-Methylphenol	24	0	24	0	24			
4-Methylphenol	24	0	24	0	24			
n-Nitrosodipropylamine	24	0	24	0	24			
Hexachloroethane	24	0	24	0	24			
Nitrobenzene	24	0	24	0	24			
Isophorone	24	0	24	0	24			
2-Nitrophenol	24	0	24	0	24			
2,4-Dimethylphenol	24	0	24	0	24			
Benzoic acid	24	0	24	0	24			
Bis(2-chloroethoxy)methane	24	0	24	0	24			
2,4-Dichlorophenol	24	0	24	0	24			
1,2,4-Trichlorobenzene	24	0	24	0	24			
Naphthalene	24	0	24	0	24			
4-Chloroaniline	24	0	24	0	24			
Hexachlorobutadiene	24	0	24	0	24			
4-Chloro-3-methylphenol	24	0	24	0	24			
2-Methylnaphthalene	24	1	23	0	24	ug/kg	2600.00	2600.00
Hexachlorocyclopentadiene	24	0	24	0	24			
2,4,6-Trichlorophenol	24	0	24	0	24			
2,4,5-Trichlorophenol	24	0	24	0	24			
2-Chloronaphthalene	24	0	24	0	24			
2-Nitroaniline	24	0	24	0	24			
Dimethyl phthalate	24	0	24	0	24			
Acenaphthylene	24	0	24	0	24			
2,6-Dinitrotoluene	24	0	24	0	24			
3-Nitroaniline	24	0	24	0	24			
Acenaphthene	24	0	24	0	24			
2,4-Dinitrophenol	24	0	24	0	24			
4-Nitrophenol	24	0	24	0	24			

Table 6.3. Summary of Organic Compounds Detected in Soil Samples
Site 39, Range 40A, Phases 1 and 2
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method (Number of Analyses)/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
Dibenzofuran	24	0	24	0	24			
2,4-Dinitrotoluene	24	0	24	0	24			
Diethyl phthalate	24	0	24	0	24			
4-Chlorophenyl phenylether	24	0	24	0	24			
Fluorene	24	0	24	0	24			
4-Nitroaniline	24	0	24	0	24			
4,6-Dinitro-2-methylphenol	24	0	24	0	24			
n-Nitrosodiphenylamine	24	0	24	0	24			
4-Bromophenylphenylether	24	0	24	0	24			
Hexachlorobenzene	24	0	24	0	24			
Pentachlorophenol	24	2	22	0	24	ug/kg	58.00	75.00
Phenanthrene	24	1	23	0	24	ug/kg	210.00	210.00
Anthracene	24	0	24	0	24			
Di-n-butylphthalate	24	0	24	0	24			
Fluoranthene	24	0	24	0	24			
Pyrene	24	1	23	0	24	ug/kg	190.00	190.00
Butylbenzylphthalate	24	0	24	0	24			
3,3-Dichlorobenzidine	24	0	24	0	24			
Benzo(a)anthracene	24	0	24	0	24			
Chrysene	24	0	24	0	24			
Bis(2-ethylhexyl)phthalate	24	7	17	0	24	ug/kg	62.00	420.00
Di-n-octylphthalate	24	0	24	0	24			
Benzo(b)fluoranthene	24	0	24	0	24			
Benzo(k)fluoranthene	24	0	24	0	24			
Benzo(a)pyrene	24	0	24	0	24			
Indeno(1,2,3-cd)pyrene	24	0	24	0	24			
Dibenzo(a,h)anthracene	24	0	24	0	24			
Benzo(ghi)perylene	24	0	24	0	24			
Bis(2-chloroisopropyl)ether	24	0	24	0	24			
TPH DIESEL								
TPH-Diesel	74	0	74	0	74			
TPH-Extractable Unknown Hydrocarbon	60	4	56	0	60	mg/kg	13.00	1400.00
TPH GAS								
TPH-Gasoline	14	0	14	0	14			
EPA8015G/8020								
TPH-Gasoline	60	0	60	0	60			
TPH-Purgeable Unknown Hydrocarbon	60	1	59	0	60	ug/kg	10000.00	10000.00
Benzene	60	0	60	0	60			
Ethylbenzene	60	0	60	0	60			
Toluene	60	0	60	0	60			
Xylenes	60	0	60	0	60			

Table 6.3. Summary of Organic Compounds Detected In Soil Samples
Site 39, Range 40A, Phases 1 and 2
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method (Number of Analyses)/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
EPA-8330								
HMX	14	0	14	0	14			
RDX	14	0	14	0	14			
1,3,5-Trinitrobenzene	14	0	14	0	14			
1,3-Dinitrobenzene	14	0	14	0	14			
Tetryl	14	0	14	0	14			
Nitrobenzene	14	0	14	0	14			
2,4,6-Trinitrotoluene	14	0	14	0	14			
2,4-Dinitrotoluene	14	0	14	0	14			
2,6-Dinitrotoluene	14	0	14	0	14			
o-Nitrotoluene	14	0	14	0	14			
m-Nitrotoluene	14	0	14	0	14			
p-Nitrotoluene	14	0	14	0	14			
2-Amino-dinitrotoluene	14	0	14	0	14			
4-Amino-dinitrotoluene	14	0	14	0	14			
EPA-8330M								
Nitroglycerin	14	0	14	0	14			
Picric Acid	14	0	14	0	14			
Nitroguanidine	14	0	14	0	14			
PETN	14	0	14	0	14			

ug/kg Micrograms per kilogram.
mg/kg Milligrams per kilogram.

Table 6.4. Summary of Inorganic Constituents Detected In Soil Samples
Site 39, Range 40A, Phases 1 and 2
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
COLD VAPOR AA								
Mercury	60	12	48	0	60	mg/kg	0.07	0.19
FUAA-EPA7060								
Arsenic	60	23	37	0	60	mg/kg	0.67	4.80
FUAA-EPA7421								
Lead	74	74	0	0	74	mg/kg	1.00	168.00
FUAA-EPA7740								
Selenium	60	1	59	0	60	mg/kg	1.10	1.10
FUAA-EPA7841								
Thallium	60	0	60	0	60			
METALS BY ICP								
Beryllium	60	50	10	0	60	mg/kg	0.13	1.30
Cadmium	60	6	54	0	60	mg/kg	0.99	5.40
Chromium	60	52	8	0	60	mg/kg	6.60	51.60
Copper	60	52	8	0	60	mg/kg	1.80	28.90
Nickel	60	47	13	0	60	mg/kg	5.20	43.10
Silver	60	2	58	0	60	mg/kg	0.68	0.91
Zinc	60	44	16	0	60	mg/kg	7.30	130.00
EPA-9045								
pH	14	14	0	0	14	ph	4.70	7.70
EPA-7041								
Antimony	60	1	59	0	60	mg/kg	0.56	0.56

mg/kg Milligrams per kilogram.

Table 6.5. Summary of Organic Compounds Detected in Soil Samples - Site 39, Range 33
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
EPA-8270								
Phenol	6	0	6	0	6			
Bis(2-chloroethyl)ether	6	0	6	0	6			
2-Chlorophenol	6	0	6	0	6			
1,3-Dichlorobenzene	6	0	6	0	6			
1,4-Dichlorobenzene	6	0	6	0	6			
Benzyl alcohol	6	0	6	0	6			
1,2-Dichlorobenzene	6	0	6	0	6			
2-Methylphenol	6	0	6	0	6			
4-Methylphenol	6	0	6	0	6			
n-Nitrosodipropylamine	6	0	6	0	6			
Hexachloroethane	6	0	6	0	6			
Nitrobenzene	6	0	6	0	6			
Isophorone	6	0	6	0	6			
2-Nitrophenol	6	0	6	0	6			
2,4-Dimethylphenol	6	0	6	0	6			
Benzoic acid	6	0	6	0	6			
Bis(2-chloroethoxy)methane	6	0	6	0	6			
2,4-Dichlorophenol	6	0	6	0	6			
1,2,4-Trichlorobenzene	6	0	6	0	6			
Naphthalene	6	0	6	0	6			
4-Chloroaniline	6	0	6	0	6			
Hexachlorobutadiene	6	0	6	0	6			
4-Chloro-3-methylphenol	6	0	6	0	6			
2-Methylnaphthalene	6	0	6	0	6			
Hexachlorocyclopentadiene	6	0	6	0	6			
2,4,6-Trichlorophenol	6	0	6	0	6			
2,4,5-Trichlorophenol	6	0	6	0	6			
2-Chloronaphthalene	6	0	6	0	6			
2-Nitroaniline	6	0	6	0	6			
Dimethyl phthalate	6	0	6	0	6			
Acenaphthylene	6	0	6	0	6			
2,6-Dinitrotoluene	6	0	6	0	6			
3-Nitroaniline	6	0	6	0	6			
Acenaphthene	6	0	6	0	6			
2,4-Dinitrophenol	6	0	6	0	6			
4-Nitrophenol	6	2	4	0	6	ug/kg	68.00	98.00
Dibenzofuran	6	0	6	0	6			
2,4-Dinitrotoluene	6	0	6	0	6			
Diethyl phthalate	6	0	6	0	6			
4-Chlorophenyl phenylether	6	0	6	0	6			
Fluorene	6	0	6	0	6			
4-Nitroaniline	6	0	6	0	6			
4,6-Dinitro-2-methylphenol	6	0	6	0	6			

Table 6.5. Summary of Organic Compounds Detected in Soil Samples - Site 39, Range 33
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
n-Nitrosodiphenylamine	6	0	6	0	6			
4-Bromophenylphenylether	6	0	6	0	6			
Hexachlorobenzene	6	0	6	0	6			
Pentachlorophenol	6	2	4	0	6	ug/kg	49.00	67.00
Phenanthrene	6	0	6	0	6			
Anthracene	6	0	6	0	6			
Di-n-butylphthalate	6	0	6	0	6			
Fluoranthene	6	0	6	0	6			
Pyrene	6	0	6	0	6			
Butylbenzylphthalate	6	0	6	0	6			
3,3-Dichlorobenzidine	6	0	6	0	6			
Benzo(a)anthracene	6	0	6	0	6			
Chrysene	6	0	6	0	6			
Bis(2-ethylhexyl)phthalate	6	4	2	0	6	ug/kg	50.00	250.00
Di-n-octylphthalate	6	1	5	0	6	ug/kg	55.00	55.00
Benzo(b)fluoranthene	6	0	6	0	6			
Benzo(k)fluoranthene	6	0	6	0	6			
Benzo(a)pyrene	6	0	6	0	6			
Indeno(1,2,3-cd)pyrene	6	0	6	0	6			
Dibenzo(a,h)anthracene	6	0	6	0	6			
Benzo(ghi)perylene	6	0	6	0	6			
Bis(2-chloroisopropyl)ether	6	0	6	0	6			
TPH DIESEL								
TPH-Diesel	64	0	64	0	64			
TPH-Extractable Unknown Hydrocarbon	64	1	63	0	64	mg/kg	230.00	230.00
EPA8015G/8020								
TPH-Gasoline	64	0	64	0	64			
TPH-Purgeable Unknown Hydrocarbon	64	0	64	0	64			
Benzene	64	0	64	0	64			
Ethylbenzene	64	0	64	0	64			
Toluene	64	0	64	0	64			
Xylenes	64	0	64	0	64			
EPA-8330								
HMX	7	3	4	0	7	mg/kg	0.14	5.30
RDX	7	5	2	0	7	mg/kg	0.12	12.00
1,3,5-Trinitrobenzene	7	0	7	0	7			
1,3-Dinitrobenzene	7	0	7	0	7			
Tetryl	7	0	7	0	7			
Nitrobenzene	7	0	7	0	7			
2,4,6-Trinitrotoluene	7	0	7	0	7			
2,4-Dinitrotoluene	7	0	7	0	7			
2,6-Dinitrotoluene	7	0	7	0	7			

Table 6.6. Summary of Inorganic Constituents Detected in Soil Samples - Site 39, Range 33
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
COLD VAPOR AA								
Mercury	64	0	64	0	64			
FUAA-EPA7060								
Arsenic	64	50	14	0	64	mg/kg	0.53	3.90
FUAA-EPA7421								
Lead	64	64	0	0	64	mg/kg	0.62	17.70
FUAA-EPA7740								
Selenium	64	0	64	0	64			
FUAA-EPA7841								
Thallium	64	0	64	0	64			
METALS BY ICP								
Beryllium	64	20	44	0	64	mg/kg	0.20	0.60
Cadmium	64	1	63	0	64	mg/kg	17.50	17.50
Chromium	64	63	1	0	64	mg/kg	6.80	31.40
Copper	64	13	51	0	64	mg/kg	3.70	38.80
Nickel	64	56	8	0	64	mg/kg	5.10	18.70
Silver	64	0	64	0	64			
Zinc	64	36	28	0	64	mg/kg	7.30	105.00
EPA-7041								
Antimony	64	4	60	0	64	mg/kg	0.52	0.64

mg/kg Milligrams per kilogram.

Table 6.7. Summary of Organic Compounds Detected in Soil Samples - Site 39, Explosive Ordnance Target Areas
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Test Method/ Analyte Name	Number of Samples Tested for Chemical	Number of Samples With Chemical Detects	Number of Samples With Chemical Non-Detects	Number of Samples With Chemical Rejects	Totals	Units	Minimum Detected Value	Maximum Detected Value
EPA-9060								
Total Organic Carbon	20	20	0	0	20	mg/kg	375.00	16200.00
EPA-8330								
HMX	285	38	247	0	285	mg/kg	0.10	1100.00
RDX	285	21	264	0	285	mg/kg	0.11	11.00
1,3,5-Trinitrobenzene	285	1	284	0	285	mg/kg	0.14	0.14
1,3-Dinitrobenzene	285	0	285	0	285			
Tetryl	285	1	284	0	285	mg/kg	0.39	0.39
Nitrobenzene	285	0	285	0	285			
2,4,6-Trinitrotoluene	285	2	283	0	285	mg/kg	0.16	4.00
2,4-Dinitrotoluene	285	0	285	0	285			
2,6-Dinitrotoluene	285	0	285	0	285			
o-Nitrotoluene	285	0	285	0	285			
m-Nitrotoluene	285	0	285	0	285			
p-Nitrotoluene	285	0	285	0	285			
2-Amino-dinitrotoluene	285	11	274	0	285	mg/kg	0.10	1.20
4-Amino-dinitrotoluene	285	11	274	0	285	mg/kg	0.10	1.50
EPA-8330M								
Nitroglycerin	285	3	282	0	285	mg/kg	0.28	8.10
Picric Acid	285	0	285	0	285			
Nitroguanidine	285	0	285	0	285			
PETN	285	1	284	0	285	mg/kg	1.50	1.50

mg/kg Milligrams per kilogram.

Table 6.9. Potential Applicable or Relevant and Appropriate Requirements - Site 39
Volume II - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Chemical-Specific Requirements				
Identification and Listing of Hazardous Wastes	Title 22 CCR, Division 4.5, Chapter 11	Establishes/defines procedures and criteria for identification and listing of RCRA and non-RCRA hazardous wastes.	Applicable	If chemicals are present at hazardous levels, actions will be taken as necessary to comply with these procedures.
Porter-Cologne Act	Title 23 CCR, Division 3, Chapter 15, Article 2; Waste Classification and Management	Establishes and defines procedures and criteria for identification and listing of designated waste.	Applicable	If chemicals are present at designated levels, actions will be taken as necessary to comply with these procedures.
Monterey Bay Unified Air Pollution Control District (MBUAPCD)	Regulation II (New Sources) and Regulation X (Toxic Air Contaminants)	Establishes requirements for new stationary sources of air pollution, and the appropriate level of abatement control technology for toxic air contaminants.	Relevant and Appropriate	The remedial design would need to meet the substantive requirements of these MBUAPCD regulations if screening or excavating activities generate toxic air emissions. Levels of these emissions are anticipated to be minimal.
National Primary and Secondary Ambient Air Quality Standards (NAAQS)	40 CFR Part 150	Establishes NAAQS for criteria pollutants: particulate matter (PM10), sulfur dioxide, carbon monoxide, nitrogen dioxide, ozone, and lead.	Applicable	Lead and particulate matter are present at Site 39 and could be generated during remedial construction activities. However, this is easily mitigated.
Location-Specific Requirements				
Endangered Species Act of 1973	16 U.S.C. 1531 et seq.	Provides for the protection of endangered or threatened plant and animal species through an evaluation of affected habitats in the site area, as well as consultation with the appropriate government agencies.	Applicable	Site 39 does contain endangered species of plants and animals. Each area will be screened for potential environmental impacts to such species based on the results of the ERA.
California Endangered Species Act	California Fish and Game Code, Sections 2050, et seq.	Provides for the recognition and protection of rare, threatened and endangered species of plant and animals (in conjunction with state authorized or funded actions).	Applicable	Site 39 does contain endangered species of plants and animals. Each area will be screened for potential environmental impacts to such species based on the results of the ERA.
Migratory Bird Treaty Act	16 U.S.C. 703 et seq.	Protects certain migratory birds or their nests or eggs.	Applicable	Migratory birds are present on Site 39. Each area will be screened for potential environmental impacts to such species and results based on the results of the ERA.

Table 6.9. Potential Applicable or Relevant and Appropriate Requirements - Site 39
Volume II - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
National Historic Preservation Act	36 CFR Part 65	Provides for the protection of any historically significant artifacts that may be unearthed during excavation activities.	Applicable	No historically significant artifacts have been uncovered during previous investigation activities at Fort Ord. Necessary actions will be taken should any such artifacts be unearthed during remediation.
Action-Specific Requirements				
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities	Title 22 CCR, Chapter 14, Use and Management of Containers; Article 9, Sections 66264.171-178	Establishes requirements for the use of containers to store hazardous waste.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66264.171; Condition of Containers	Containers for hazardous waste must be maintained in good condition.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66264.172; Compatibility of Waste in Containers	Containers for hazardous waste must be compatible with the wastes stored in them.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66264.173; Management of Containers	Containers holding hazardous waste must be closed during storage except when necessary to add or remove waste.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66264.174; Inspections	Containers and container storage areas must be inspected weekly for leaks or deterioration.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66264.175; Containment	Container storage areas must be designed according to the requirements of this section.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.

Table 6.9. Potential Applicable or Relevant and Appropriate Requirements - Site 39
Volume II - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (continued)	Title 22 CCR, Section 66264.176; Special Requirements for Ignitable or Reactive Waste	Container of ignitable or reactive wastes must be stored at least 15 meters from a facility's property line.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66264.177; Special Requirements for Incompatible Waste	Incompatible wastes must not be placed in the same container, or in unwashed containers which previously held incompatible wastes.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.
	Title 22 CCR, Section 66264.178; Closure	At closure, all hazardous waste and waste residues must be removed and remaining containment structures decontaminated.	Applicable	Excavated soil, or decontamination water subsequently characterized as hazardous may be stored in containers onsite. Necessary actions will be taken to comply with such requirements.
	Title 22 CCR, Chapter 14, Article 2, Section 66264.14	Owners and operators of hazardous waste treatment, storage, or disposal (TSD) facilities must prevent the unknowing entry of persons or livestock onto the active portions of the facility; in addition, warning signs must be posted.	Relevant and Appropriate	If hazardous material is treated, stored, or disposed onsite, areas will be restricted from public access.
	Title 22 CCR, Chapter 14, Article 7, Section 66264.119; Post Closure Notices	Restrictions can be placed on the deed which constrains future uses of the property.	Applicable	Remedial measures in which hazardous levels of chemical constituents remain in place may be subject to these regulations.
	Title 22 CCR, Chapter 14, Article 16, Section 66264.600-603; Miscellaneous Units	Applies to facilities that treat, store, or dispose of hazardous waste in miscellaneous units. Owners and operators must locate, design, construct, operate, maintain, and close the units in a manner that is protective of human health and the environment.	Applicable	If hazardous material is treated, stored, or disposed in miscellaneous units, the units will be managed as required by these regulations.
Land Disposal Restrictions	Title 22 CCR, Division 4.5, Chapter 18	Prohibits land disposal of specified untreated hazardous wastes and provides special requirements for handling such wastes. However, soil excavated from Site 39 will subsequently be treated at the Site 3 CAMU and disposed after treatment at the OU2 landfill.	Applicable	Listed or characteristic hazardous wastes may be subject to these regulations if they are land disposed offsite at a landfill rather than the intended CAMU treatment unit at Site 3.

Table 6.9. Potential Applicable or Relevant and Appropriate Requirements - Site 39
Volume II - Feasibility Study, Basewide RI/FS
Fort Ord, California

Source	Regulation, Standard, or Level of Control	Description	Applicable or Relevant and Appropriate	Comments
California Hazardous Waste Control Law	Health and Safety Code, Division 20, Chapter 6.5 Sections 25113 et seq.	Regulates the recycling of hazardous wastes.	Applicable	Spent ammunition from Site 39 may be recycled. Non-RCRA hazardous (California designated waste) and RCRA hazardous waste have slightly different recycling requirements. Spent ammunition that is hazardous may be recycled for reuse at a smelting facility.

ARAR Applicable or relevant and appropriate requirements.
EPA U.S. Environmental Protection Agency.
ERA Ecological Risk Assessment.
CAMU Corrective Action Management Unit.
CFR Code of Federal Regulations.
U.S.C. United States Code.
RCRA Resource Conservation and Recovery Act.
TPH Total petroleum hydrocarbons.
MBUAPCD Monterey Bay Unified Air Pollution Control District.
NAAQS National Ambient Air Quality Standards.
PM10 Particulate matter with a diameter under 10 microns.
et seq. And following.
WMUs Waste management units.
TSD Treatment, storage, and disposal.
FS Feasibility study.
Cal/EPA California Environmental Protection Agency.

Table 6.10. Remedial Action Objectives - Site 39
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Media	Exposure Pathway	Remedial Action Objective	Potential Remediation Requirements
For Human Health Protection			
<u>Air/Soil Ingestion/Inhalation/Dermal Contact</u>			
	Short-term	Minimize direct exposure of onsite construction workers during remedial action in any area with unacceptable risks.	Personal protection and monitoring, and dust control.
	Long-term	Reduce potential chemical exposures to potential future onsite users in any area to acceptable levels (excess cancer risk of 10^{-4} to 10^{-6}, hazard index <1, and target blood lead level < 10 μg/dl).	Source containment, deed restrictions, fencing, removal and/or treatment of soil containing chemicals above TCLs.
<u>Safety Hazards Associated with UXO/OEW</u>			
	Short-term	Minimize contact with UXO/OEW by onsite construction workers during remedial activities.	Use personnel trained to handle UXO/OEW; use remote operation equipment.
	Long-term	Reduce exposure to UXO/OEW to potential future onsite users in any area compatible with future use.	Source control, deed restrictions, fencing; removal and/or treatment.

μg/dl	Micrograms per deciliter
MBUAPCD	Monterey Bay Unified Air Pollution Control District
OSHA	Occupational Safety and Health Act
NIOSH	National Institute of Occupational Safety and Health
TCL	Target Cleanup Level
UXO	Unexploded Ordnance
OEW	Ordnance and Explosive Waste

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
NO ACTION	None	Deed and access restrictions may be required.	Low	Not effective; however natural attenuation of some chemicals may occur over time.	Requires regulatory approval and consideration of future land use if deed restriction imposed.	Yes
COLLECTION	Excavation	Removal of soil by digging with common heavy equipment such as backhoes and loaders.	Low	Effective for shallow contamination at Site 39.	Easily implemented; equipment readily available.	Yes
CONTAINMENT						
	Vertical Barriers					
	Grout curtain, sheet metal, slurry walls, or sheet piling	Provides semi-permeable or impermeable barriers to horizontal migration of chemical-bearing soil due to erosion or water flow.	Moderate/High	Not effective for shallow contamination at Site 39.	Implementable.	No

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
CONTAINMENT (cont.)	Horizontal Barriers					
	Grouting, sheet metal, or block displacement	Semi-permeable or impermeable surface layer comprised of compacted clay over debris and soil to prevent surface water infiltration, chemical transport, and contact.	High	Not effective for shallow contamination at Site 39.	Difficult to implement.	No
	Capping Clay and soil	Semi-permeable or impermeable surface layer comprised of compacted clay over debris and soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Effective for minimizing contact and surface water leaching of chemicals in soil to groundwater. Cap requires periodic maintenance; groundwater monitoring may be required.	Not implementable because cap would be disruptive to the sensitive ecological habitat at Site 39.	Yes
	Multilayered	Semi-permeable or impermeable materials such as compacted clay, soil, or line placed in layers to prevent surface water infiltration, chemical transport, and contact	High	Highly effective for minimizing contact and surface water leaching of chemicals in debris and soil to groundwater. Cap requires periodic maintenance.	Not implementable because cap would be disruptive to the sensitive ecological habitat at Site 39.	Yes

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
CONTAINMENT (cont.)	Asphalt or concrete	Semi-permeable or impermeable surface layer comprised of a concrete slab or a layer of asphalt to prevent surface water infiltration, chemical transport, and contact.	Low/ Moderate	Less effective for minimizing contact and surface water leaching of contaminants in soil to groundwater; more permeable than engineered caps.	Not implementable because cap would be disruptive to the sensitive ecological habitat at Site 39.	No
	<u>Surface Water Controls</u>					
	Grading	Smoothing of surface to grade after completion of excavation and backfilling.	Low	Effective in conjunction with other measures such as excavation.	Easily implementable; highly dependent on ecological considerations.	Yes
	Revegetation	Engineered landscaping and placement of plants, shrubs, or trees to restore site after remediation.	Low/Moderate	Minimizes erosion to prevent surface water ponding and chemical transport; effective in conjunction with other measures.	Easily implementable; highly dependent on ecological considerations.	Yes
	Diversion and collection systems	Series of pipes and basins to direct surface water away from area of concern; minimizes surface water infiltration and chemical transport.	Moderate	Effective for surface water runon/runoff control.	Easily implementable; depends on long-term planned site development and ecological considerations.	Yes

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT	Thermal Treatment Rotary kiln incinerator ex situ	Combustion in a horizontally rotating cylinder designed for uniform heat transfer.	Moderate	Highly effective for removal of TPH in homogeneous and sandy soil.	Volume of soil with concentrations of TPH not adequate to warrant treatment. An equivalent level of treatment is available at the FOSTA	No
	Fluidized bed incinerator ex situ	Injection into a hot agitated bed of sand where combustion occurs.	Moderate	Highly effective for removal of TPH in homogeneous and sandy soil.	Volume of soil with concentrations of TPH not adequate to warrant treatment. An equivalent level of treatment is available at the FOSTA	No

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Circulating bed incinerator	Variation of fluidized bed incinerator using higher air velocity and circulating solids to create a larger and highly turbulent combustion zone.	Moderate	Highly effective for removal of TPH in homogeneous and sandy soil; less effective for removal of RDX.	Volume of soil with concentrations of TPH not adequate to warrant treatment. An equivalent level of treatment is available at the FOSTA	No
	Thermal oxidation (offgas)	High-temperature (1400° F) destruction of organic vapors collected during treatment.	Low	Effective for destruction of organic vapors, but extraction of organic vapors from TPH is very difficult.	Proven technology; equipment readily available. Volume of soil with concentrations of TPH not adequate to warrant treatment by this method.	No
	Catalytic oxidation (offgas)	Lower-temperature (600° F) destruction of organic vapors collected during treatment.	Low	Effective for treatment of most offgas, but only moderately effective for removal of TPH in soil.	Proven technology; equipment readily available. Volume of soil with concentrations of TPH not adequate to warrant treatment by this method	No

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Chemical Treatment					
	Asphalt batching	Incorporation of soil into a cold or hot mix as an aggregate supplement in the manufacture of asphaltic concrete.	Low	Soil must be an adequate substitute for aggregate typically used; volatilization of chemicals in hot mix process may require emissions controls.	Equipment readily available. Requires pilot study. An equivalent level of treatment is available at the FOSTA	No
	Physical Treatment Soil vapor circulation (Biotreat)	Application of a vacuum to extraction wells at low flow rates through unsaturated zone to biodegrade TPH.	Low	Only moderately effective for removal of TPH in permeable soils; not effective for RDX in soil.	Not implementable for shallow contamination in soil at Site 39. Requires pilot study.	No
	Air injection/Biotreat	Injection of air into unsaturated zone to biodegrade TPH.	Low	Only moderately effective for removal of TPH in permeable soils; not effective for RDX in soil.	Not implementable for shallow contamination in soil at Site 39. Requires pilot study.	No

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Physical Treatment (cont.)					
	Activated carbon adsorption (offgas)	Adsorption onto carbon of organic vapors collected during treatment.	Low	Effective for adsorption of organic vapors, but extraction of TPH from soil is very difficult. RDX cannot be extracted.	Proven technology; equipment readily available. Volume of soil with concentrations of TPH not adequate to warrant treatment by this method.	No
	Thermal desorption	Low temperature thermal treatment with a heated auger which causes volatilization of TPH.	Low/Moderate	Effective for volatile compounds. Not effective for RDX.	Proven technology; equipment readily available. Volume of soil with concentrations of TPH not adequate to warrant treatment by this method. An equivalent level of treatment is available at the FOSTA.	No
	Screening	Removal of larger sized particles from the waste stream by passage through a screen.	Low	Not effective unless TPH and RDX are present in specific fraction to reduce volume of contamination.	Not applicable to soil at Site 39 containing TPH and RDX.	No

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	<u>Biological Treatment</u>					
	Biodegradation in situ	Introduction of oxygen, nutrients, and/or bacteria to degrade contaminants in soil in conjunction with groundwater treatment and reinfiltration.	Low	Effective for a wide variety of organic compounds.	Not implementable for shallow contamination at Site 39.	No
	Biodegradation	Introduction of oxygen, nutrients, and/or bacteria to degrade TPH in soil in an aboveground facility such as a slurry reactor or treatment pad.	Low	Effective for a wide variety of organic compounds.	Proven technology; equipment readily available. Treatment of RDX may require amendment of nutrients and bacteria. Requires pre-design study.	Yes
	<u>Offsite Treatment</u> Thermal treatment	Use of high temperatures as principal means of destroying or detoxifying wastes.	High	Effective for TPH; less effective for RDX.	Implementability limited by offsite facility location, availability, and concentrations of chemicals. An equivalent level of treatment is available at the FOSTA.	No

Table 6.11. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 1 - TPH and RDX
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Remedial Alternative Development
TREATMENT (cont.)	Offsite Treatment (cont.) Biological treatment	Degradation of organics using microorganisms.	Moderate	Effective for TPH; less effective for RDX.	Volume of soil is not adequate to warrant offsite treatment. An equivalent level of treatment is available at the FOSTA.	No
DISPOSAL	Onsite Disposal	Onsite waste management of chemical-bearing soil in an onsite waste unit or replacement into the excavated area after treatment.	Moderate	Effective means of disposal after treatment.	Implementable depending on effectiveness of treatment and achievement of cleanup levels.	Yes
	Offsite Disposal Landfill	Transport of chemical-bearing soil to an appropriate landfill by licensed waste transporter.	Low to High	Effective, however, pretreatment may be required depending upon concentrations.	Implementable and readily available. Landfills are available in California to accept soil from Site 39.	Yes

TPH Total petroleum hydrocarbons.

Table 6.12. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 2 - Metals
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Alternative Development
NO ACTION	None	Deed and access restrictions may be required.	Low	Not effective; however, certain land uses may allow for soil to remain in place.	Requires regulatory approval and consideration of future land use if deed restriction imposed.	Yes
COLLECTION	Excavation	Removal of soil by digging with commonly used heavy equipment, or by hand.	Low	Effective for metals in soil.	Easily implemented for shallow soil at Site 39.	Yes
CONTAINMENT	Vertical Barriers					
	Grout curtain, sheet metal, slurry walls, or sheet piling	Provides semi-permeable or impermeable barriers to horizontal migration of chemical-bearing soil due to erosion or water flow.	Moderate/ High	Not effective for shallow contamination at Site 39.	Implementable.	No
	Horizontal Barriers					
	Grouting, sheet metal, or block displacement	Provides semi-permeable or impermeable barrier to vertical migration of soil due to erosion or water flow.	High	Not effective for shallow contamination at Site 39.	Difficult to implement.	No

Table 6.12. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 2 - Metals
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Alternative Development
CONTAINMENT (cont.)	Capping					
	Clay and soil	Semi-permeable or impermeable surface layer composed of compacted clay over debris and soil to prevent surface water infiltration, chemical transport, and contact.	Moderate	Effective for minimizing contact and surface water leaching of chemicals in soil to groundwater. Cap requires periodic maintenance; groundwater monitoring may be required.	Not implementable because cap would be disruptive to the sensitive ecological habitat.	No
	Multilayered	Semi-permeable or impermeable materials such as compacted clay, soil, or lime placed in layers to prevent surface water infiltration, chemical transport, and contact.	High	Highly effective for minimizing contact and surface water leaching of chemicals in soil to groundwater. Cap requires periodic maintenance.	Not implementable because cap would be disruptive to the sensitive ecological habitat.	No
	Asphalt or concrete	Semi-permeable or impermeable surface layer composed of a concrete slab or a layer of asphalt to prevent surface water infiltration, chemical transport, and contact.	Low/ Moderate	Less effective for minimizing contact and surface water leaching of source area soil to groundwater; more permeable than engineered caps.	Not implementable because cap would be disruptive to the sensitive ecological habitat.	No

Table 6.12. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 2 - Metals
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Alternative Development
CONTAINMENT (cont.)	Surface Water Controls					
	Grading	Smoothing of surface to grade after completion of excavation and backfilling.	Low	Could be effective in conjunction with other measures such as excavation.	Implementable at close of site work; highly dependent on ecological considerations.	Yes
	Revegetation	Engineered landscaping and placement of plants, shrubs, or trees to restore site after excavation.	Low/ Moderate	Minimizes erosion to prevent surface water ponding and chemical transport; effective in conjunction with other measures.	Easily implementable; highly dependent on ecological considerations.	Yes
	Diversion and collection systems	Series of pipes and basins to direct surface water away from area of concern; minimizes surface water infiltration and chemical transport.	Moderate	Effective for surface water runoff/runoff control.	Easily implementable; depends on long-term planned site development and ecological considerations.	Yes

Table 6.12. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 2 - Metals
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Alternative Development
TREATMENT	Physical Treatment					
	Screening	Removal of larger sized particles from the waste stream by passage through a screen.	Low	Effective for separation and homogenization of waste.	Applicable for primary processing prior to soil treatment.	Yes
	Soil washing	Extraction of contaminants using leachate washing solution ex situ.	Moderate/ High	Effective for metals in soil; depends on leachate affinity for metals. May be used as primary treatment process for reduction of volume requiring treatment.	Equipment available; however, technology is innovative for lead in soil. Requires subsequent treatment of waste stream.	Yes
	Asphalt batching	Incorporation of soil into a cold or hot mix as an aggregate supplement in the manufacture of asphaltic concrete.	Low/ Moderate	Soil must be an adequate substitute for aggregate typically used and may not contain RCRA waste.	Equipment readily available. Requires pilot study.	Yes

Table 6.12. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 2 - Metals
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Alternative Development
TREATMENT (cont.)	Stabilization					
	Cement- or Pozzolonic-based stabilization	Fixation agents are added to bind contaminants and soil into a solid mass.	Moderate	Effective for metals in soil.	Implementable; however, requires predesign study to determine appropriate mix design.	Yes
	Offsite Treatment					
	Stabilization/fixation	Reduces chemical mobility through binding contaminants and soil into a solid mass.	High	Effective for metals in soil.	Implementable if offsite facility location is available.	Yes
DISPOSAL	Onsite Disposal					
	Replacement after treatment	Excavation and treatment, or separation of different-sized soil fractions, with replacement of material into excavated areas.	Low	Effective for soil treated to agreed-upon levels.	Easily implemented; equipment readily available to backfill soil.	Yes
	Repository/Onsite disposal	Onsite waste management unit that may be lined and capped or completely enclosed in cement or other stable, non-eroding material.	High	Effective for containment of most wastes. However, equivalent onsite disposal provided at the OU 2 Landfill.	Not implementable for planned site usage.	No

Table 6.12. Summary of Retained Remedial Technologies - Site 39
Soil Remedial Unit 2 - Metals
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

General Response Action	Remedial Technology Type/Process Option	Description	Cost	Effectiveness	Implementability	Selected for Alternative Development
DISPOSAL (cont.)						
	Offsite Disposal					
	Landfill	Transport of chemical-bearing soil to appropriate landfill by licensed waste transporter.	Low/ High	Effective; however pretreatment may be required depending upon concentrations.	Implementable and readily available. Class of landfill depends upon type of soil; some landfills offer pretreatment.	Yes
	Recycling facility	Transport of recyclable or reclaimable material to an appropriate facility such as a smelter.	Low	Effective for recyclable materials such as metal from separated spent ammunition.	Implementable for spent ammunition separated from soil.	Yes

Table 6.13. Evaluation of Remedial Alternatives - Site 39
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Selected for Detailed Analysis	EPA Evaluation Criteria							
	Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness	Reduction of Toxicity, Mobility, and Volume Through Treatment	Short-Term Effectiveness	Implementability	NPV Cost	Regulatory Agencies and Community Acceptance
Alternative 1 No Action	Would not provide any protection to human health or the environment.	Would not meet ARARs. Deed restrictions may be required.	Risk associated with metals in soil will remain. Risk associated with TPH and RDX in soil will remain until natural degradation occurs.	No active reduction of toxicity, mobility, or volume of contaminants.	No change in short-term risks to human the health and environment.	Easy to implement technically; may not be able to gain necessary regulatory agency approvals.	No costs are associated with this alternative.	Likely not acceptable to agencies or the public.
Alternative 2 Institutional Controls	Mitigation of risk human health by limiting access; minimal protection of the environment except for limited access to some fauna.	Would not meet most ARARs. Deed restrictions may be required.	Does not significantly reduce residual risks.	Does not reduce toxicity, mobility, or volume.	Effective in short term because protective measures are easy to implement.	Easy to implement technically; may not be able to gain necessary regulatory approvals.	$122,000	Likely not acceptable to agencies or the public.

Table 6.13. Evaluation of the Remedial Alternatives - Site 39
Volume II - Feasibility Study, Basewide RI/FS
Fort Ord, California

Remedial Alternatives Selected for Detailed Analysis	EPA Evaluation Criteria							
	Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness	Reduction of Toxicity, Mobility, and Volume Through Treatment	Short-Term Effectiveness	Implementability	NPV Cost	Regulatory Agencies and Community Acceptance
Alternative 3 Excavation and Onsite Treatment and Disposal	Human health and environment are protected by removing and treating soil.	ARARs would be met.	Reduces risks to an acceptable level.	Reduces toxicity, mobility, and volume of soil; extent of reduction depends on specific treatment selected.	Mitigable impacts to workers and the environment during construction. Protective measures necessary for workers.	Easy to implement; treatment readily available.	$1,184,000	Would likely be acceptable to agencies and the community.
Alternative 4 Excavation and Offsite Disposal	Human health and environment are protected by removing and disposing soil offsite.	ARARs would be met.	Reduces risks to an acceptable level. Some long-term liability associated with offsite landfill disposal remains.	Reduces mobility only if stabilized prior to disposal.	Mitigable impacts to workers and the environment during construction. Protective measures necessary for workers.	Easy to implement; disposal at permitted landfill facilities readily available.	$1,293,000	Would likely be acceptable to agencies and the community.

ARARs Applicable or relevant and appropriate requirements.
NPV Net Present Value.

Table 6.14. Summary of Remedial Alternative Cost Estimates* - Site 39
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

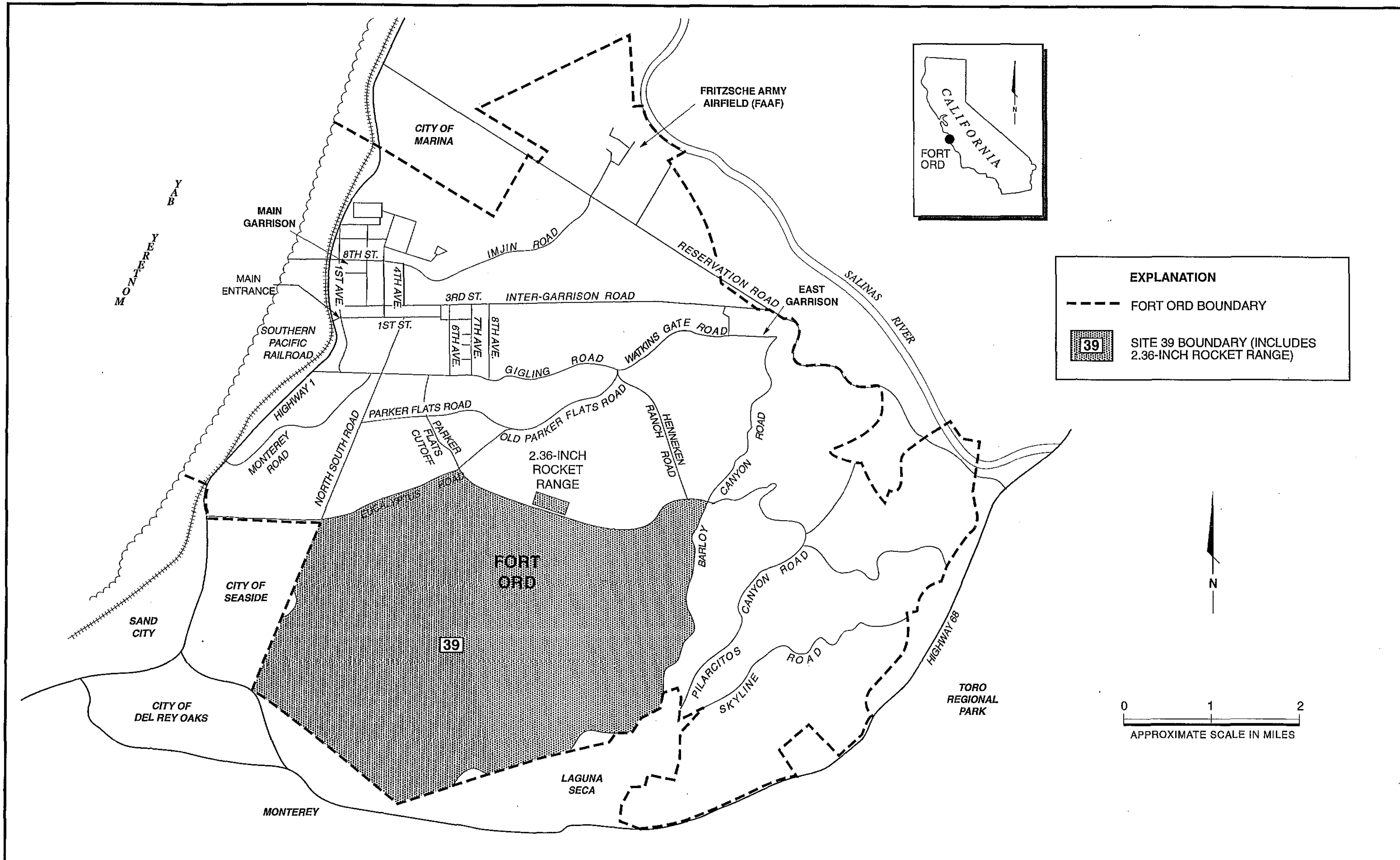
Alternative	Capital Cost	Annual O&M Costs	Total Net Present Value**
1 - No Action	--	--	--
2 - Institutional Controls	$92,000	$2,000	$122,000
3 - Excavation and Onsite Treatment and Disposal	$1,184,000	--	$1,184,000
4 - Excavation and Offsite Disposal	$1,293,000	--	$1,293,000

* These cost estimates are for comparison only and are intended to have an accuracy of +50 percent to -30 percent. Many design and permitting requirements have not been established. Construction cost estimates for the preferred alternative will be refined in the remedial design phase after an alternative has been selected and approved.

** Assumes 5 percent interest rate.

-- There are no costs for this category associated with this alternative.

PLATES



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
	7/94	DRAFT FINAL		23366 0417153			DJP
	10/95	FINAL		23366 0417153	MLS	10/17/95	

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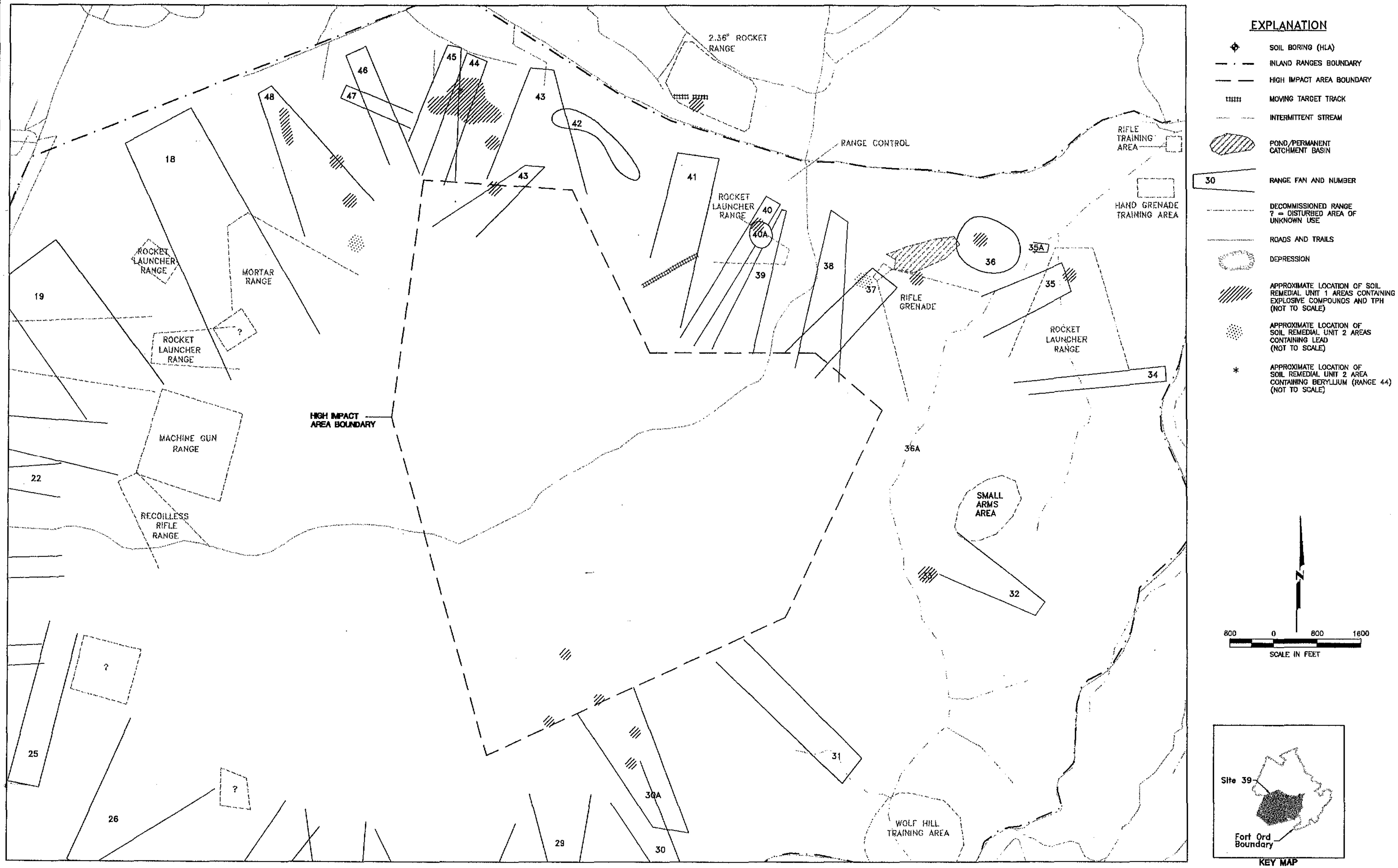
Volume V - Feasibility Study
Basewide RI/FS
Fort Ord, California

SITE LOCATION MAP - SITE 39

PLATE
6.1



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	12/94	DRAFT FINAL	23366827	23366 07178			JK
2	10/95	FINAL	23366827	23366 04137	MLS	10/17/95	JK

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Basewide RI/FS
Fort Ord, California

Locations of Soil Remedial Units 1 and 2 – Site 39

PLATE: **6.2**

NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366462	23366 07172			AED
2	12/94	DRAFT FINAL	23366462	23366 07178			AED
3	10/95	FINAL	23366462	23366 041737	MLS	10/17/95	AED

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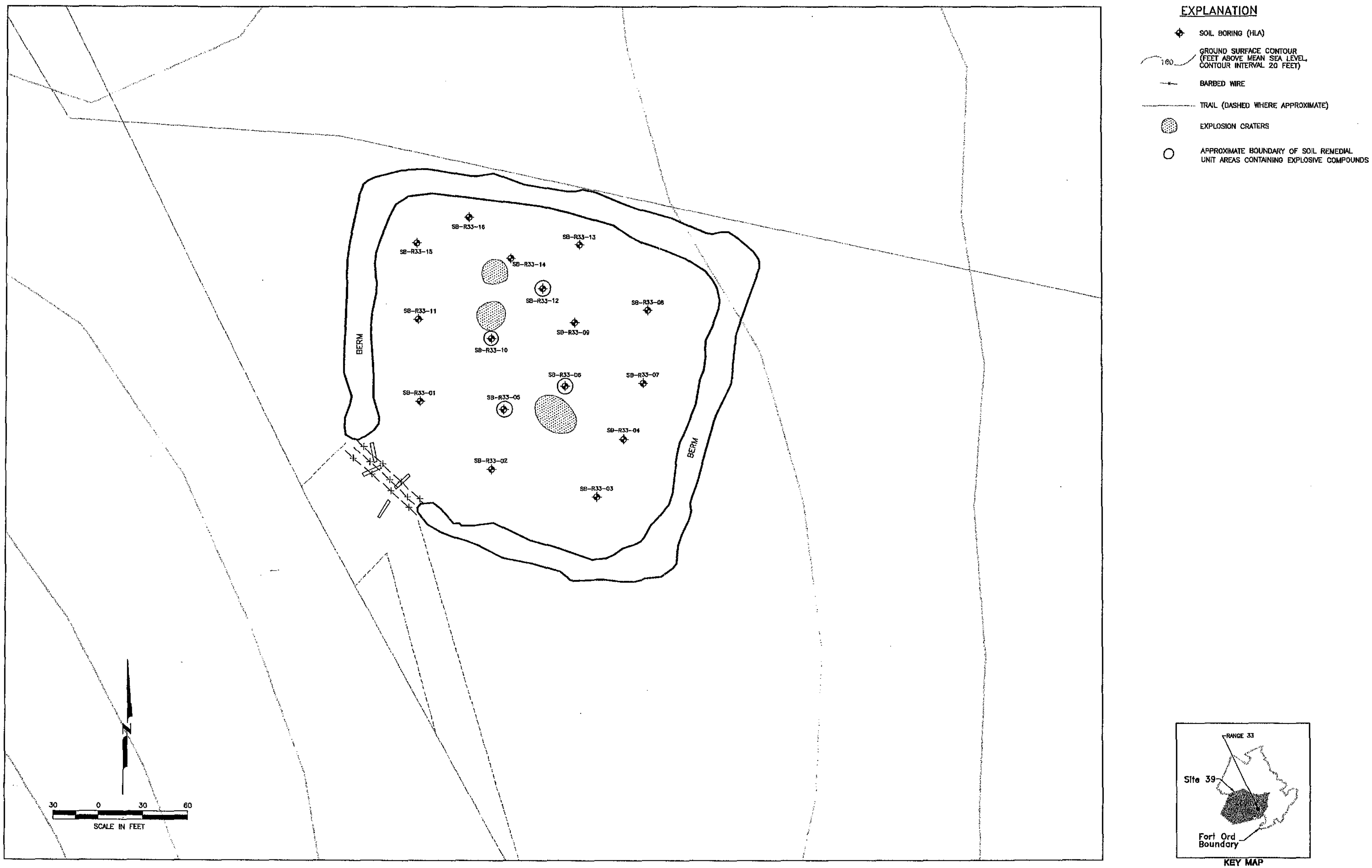
Soil Remedial Unit 1 – TPH
Range 40A – Site 39

PLATE: 6.3



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366463	23366 07172			AED
2	12/94	DRAFT FINAL	23366463	23366 07176			AED
3	10/95	FINAL	23366463	23366 041737	MLS	10/17/95	AED

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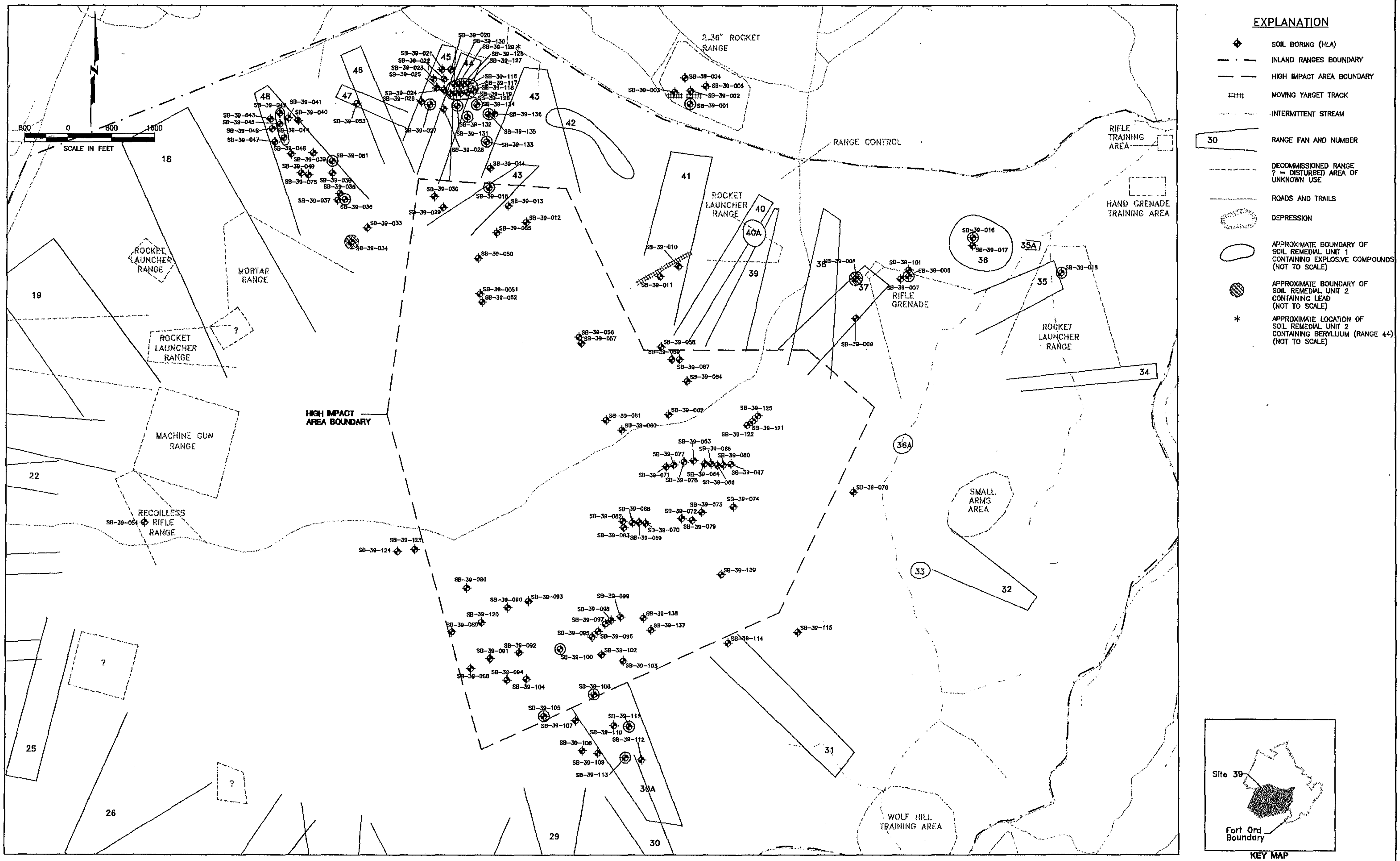
Soil Remedial Unit 1 – Explosive Compounds
Range 33 – Site 39

PLATE: 6.4



NO.	DATE	REVISIONS	HLA FILE NO.	PROJECT NO.	APPROVED	APPROVAL DATE	DRAWN BY
1	7/94	DRAFT	23366473	23366 07172			AED
2	12/94	DRAFT FINAL	23366473	23366 07178			AED
3	10/95	FINAL	23366473	23366 041737	MLS	10/17/95	AED

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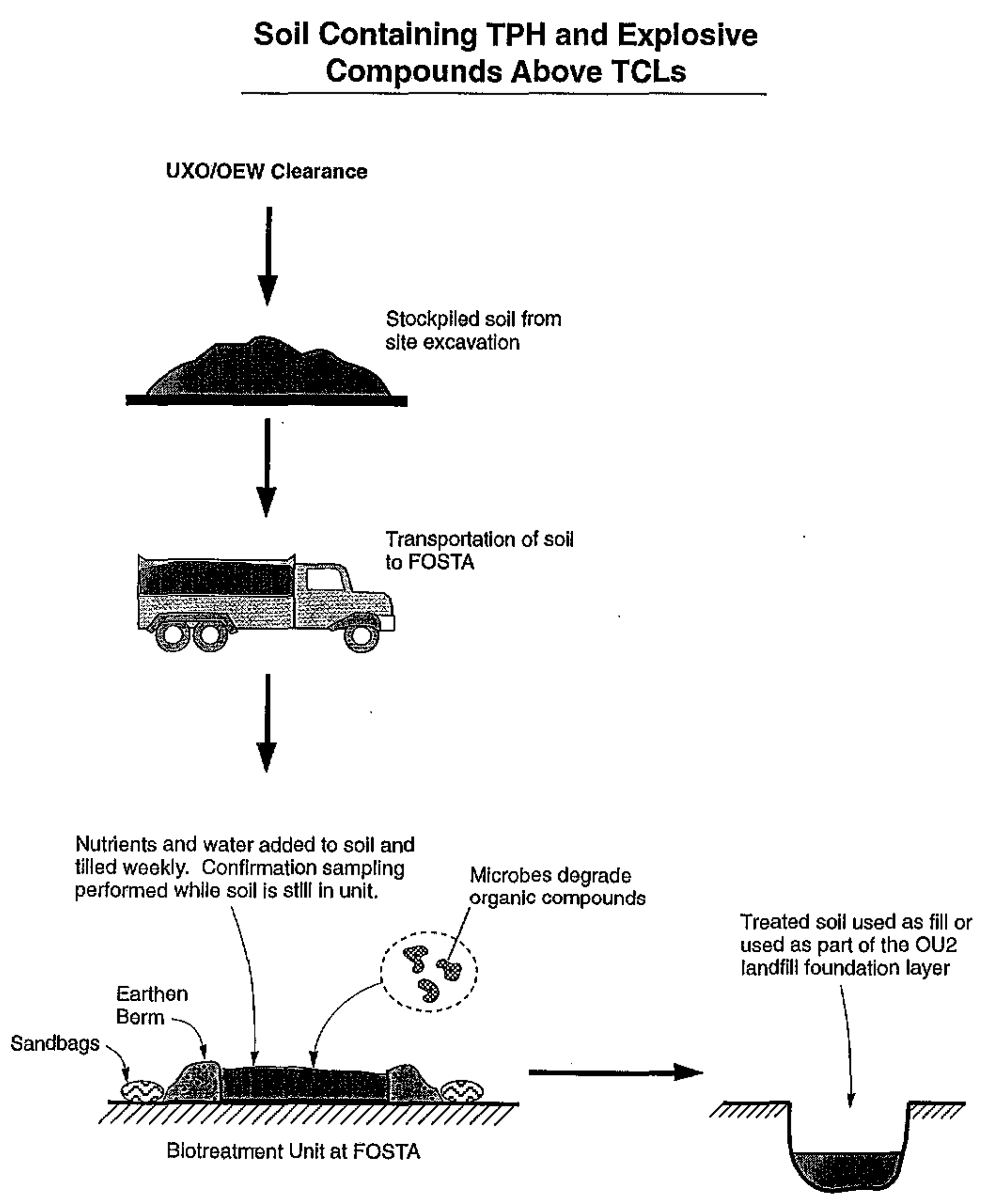
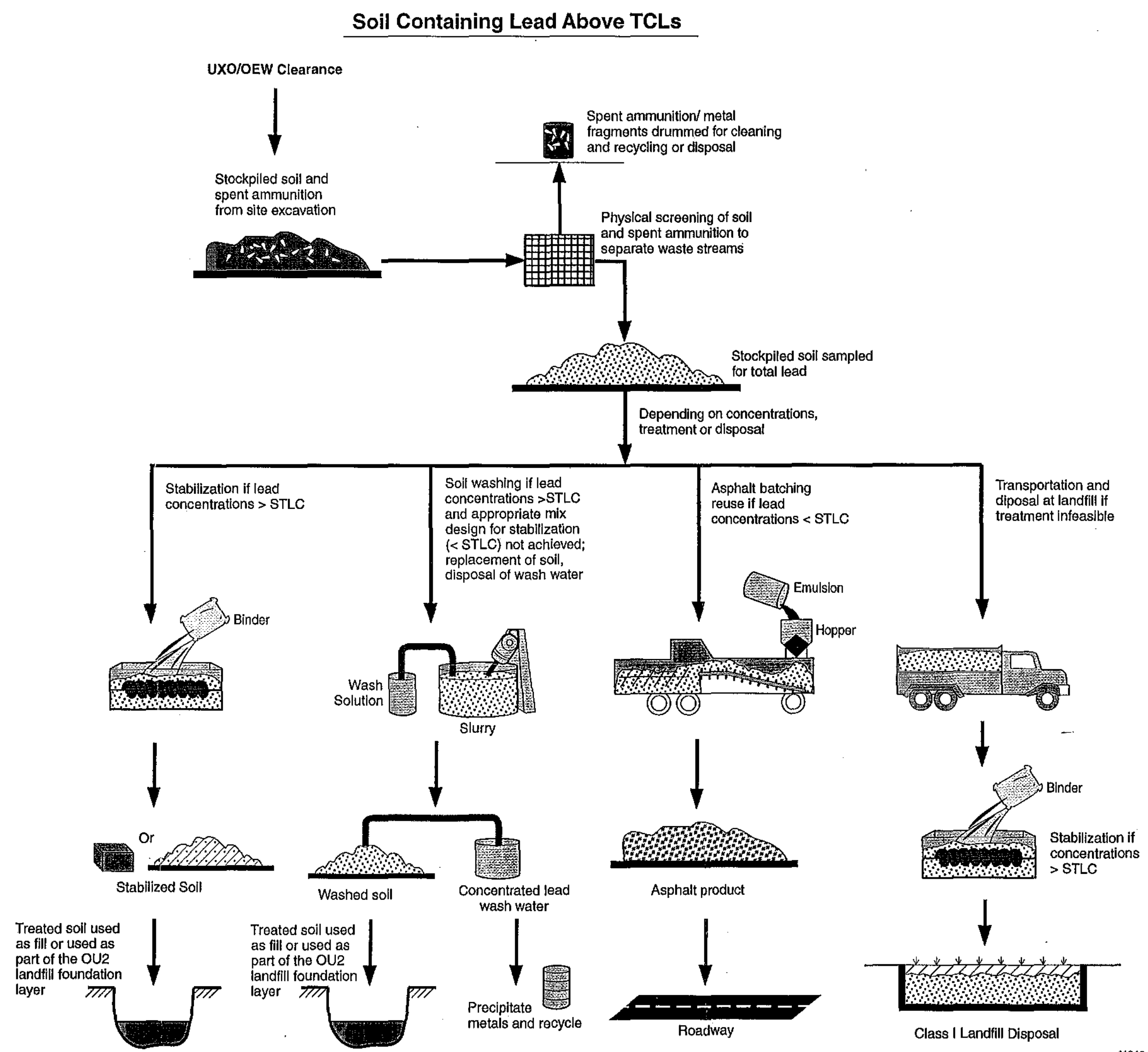
Basewide RI/FS
Fort Ord, California

Soil Remedial Units 1 and 2
Lead, Beryllium, and Explosive Compounds
Explosive Ordnance Target Areas – Site 39

PLATE: 6.5





Abbreviations

STLC = Soluble Threshold Limit Concentration
TCL = Target Cleanup Level
TPH = Total Petroleum Hydrocarbons
FOSTA = Fort Ord Soil Treatment Area

HLA Harding Lawson Associates Engineering and Environmental Services	Remediation Flow Diagram, Remedial Alternative 3 - Site 39 Volume V - Feasibility Study Basewide RI/FS Fort Ord, California		PLATE 6.6
DRAWN LZc	JOB NUMBER 23366 07178	APPROVED MLS	DATE 11/94 — REVISED DATE 10/95

APPENDIX 6A

REMEDIAL TECHNOLOGY SCREENING SUMMARY CHECKLIST FORMS

APPENDIX 6A

The checklist forms in this Appendix are from the *Draft Final Remedial Technology Screening (RTS) Report, Fort Ord, California (HLA, 1994n)*. These forms were completed for contamination present at Site 39. These checklists refer to remedial technology screening tables (Tables 1 to 23), which can be found in the RTS report. These RTS tables were developed specifically for Fort Ord on a basewide level to accelerate the preparation of Fort Ord Feasibility Studies. As described in the main text of the FS, the technologies identified as applicable using the appropriable RTS tables were incorporated into Tables 6.11 and 6.12 of this FS. Section 6.2.3 of this report describes the technologies retained (i.e., identified as applicable) from the RTS and Section 6.2.4 describes those selected for development of remedial alternatives.

Form 6A-1 identifies the appropriate RTS table, based on contaminants present and the media affected. Separate in situ and ex situ categories are presented for soil, and only one category is presented for debris. Based on this form, RTS Tables 4 and 8 were identified as applicable for Site 39.

Forms 6A-2 and 6A-3 list the retained technologies identified on RTS Tables 4 and 8 (from Form 6A-1), for TPH and metals in soil, respectively. These technologies were incorporated into Tables 6.11 and 6.12 of this FS for further site-specific screening and evaluation.

FORM 6A-1

MATRIX GUIDE/CHECKLIST
IDENTIFICATION OF TECHNOLOGY SCREENING TABLES
Remedial Technology Screening Report
Fort Ord, California

Locate Group of Compounds below in rows (A) through (F): Check One.	A ☐ B ■ C ☐ D ■ E ☐ F ☐
In what media are the compounds? Locate the appropriate column (#) for either soil, groundwater, or debris.	Soil (1&2) ■ Groundwater (3&4) ☐ Debris (5) ☐
Are both in situ and ex situ treatment potentially applicable for soil or groundwater at this site? Locate in situ, ex situ, or both types of treatment in Columns (1) through (4).	Soil: In Situ 1 ☐ Ex Situ 2 ■ Groundwater: In Situ 3 ☐ Ex Situ 4 ☐
Where compound, media, and type of treatment intersect, refer to the technology screening table number indicated. Use Forms B-2, B-3, or B-4 to record applicable technologies as tables are reviewed.	Table(s) 4 8 ___ ___ ___

Media	Soil		Groundwater		Debris
Classes of Compounds	(1) In Situ	(2) Ex Situ	(3) In Situ	(4) Ex Situ	(5) *
(A) VOCs	Table 1	Table 2	Table 13	Table 14	Table 12
(B) TPH-light	Table 3	**Table 4**	Table 15	Table 16	
(C) TPH-heavy	Table 5	Table 6	Table 17	Table 18	
(D) Metals	Table 7	**Table 8**	Table 19	Table 20	
(E) Pesticides	Table 9	Table 10	Table 21	Table 22	
(F) Mixed Waste +	Table 11		Table 23		

* Debris is not specific to a Group of Compounds
\+ Mixed waste is two or more dissimilar Groups of Compounds combined in soil or groundwater, such as metals and VOCs.

FORM 6A-2

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

INSTRUCTIONS: For Debris or Mixed Waste, see Forms 6A-3 or 6A-4. Complete several forms if necessary for each separate Group of Compounds and Media, and attach to Feasibility Study file for each site (e.g., one form for VOCs in groundwater, and a separate form for metals in soil).

- Name of Site: Site 39
- Brief Description: Inland Ranges; RDX,TPH
- Group of Compounds (select one)

VOCs	___	TPH-light	X
TPH-heavy	___	Metals	___
Pesticides	___		

- Media (select one) Soil X Groundwater ___
- Potentially Applicable Treatment (select one or both) In Situ ___ Ex Situ X
- Referenced Table(s) Number 4 ___
- Technologies Retained

No Action	Biodegradation
Barriers	Onsite Disposal
Capping	Offsite Disposal
Institutional Controls	
Surface Water Controls	
Excavation	

- Form Completed by: Margaret L. Stemper
- Description of Technology(s) (Appendix C) Reviewed by: Margaret L. Stemper
- Date Completed: July 1, 1994

FORM 6A-3

TECHNOLOGY SCREENING SUMMARY FORM
SOIL AND GROUNDWATER
Remedial Technology Screening Report
Fort Ord, California

INSTRUCTIONS: For Debris or Mixed Waste, see Forms 6A-3 or 6A-4. Complete several forms if necessary for each separate Group of Compounds and Media, and attach to Feasibility Study file for each site (e.g., one form for VOCs in groundwater, and a separate form for metals in soil).

- Name of Site: Site 39
- Brief Description: Inland Ranges; metals (lead, spent ammunition)
- Group of Compounds (select one)

VOCs	___	TPH-light	___
TPH-heavy	___	Metals	X
Pesticides	___		

- Media (select one): Soil X Groundwater ___
- Potentially Applicable Treatment (select one or both): In Situ ___ Ex Situ X
- Referenced Table(s) Number ___ 8
- Technologies Retained

No Action	Stabilization
Institutional Controls	Asphalt Batching
Surface Water Controls	Onsite Disposal
Excavation	Offsite Disposal
Soil Washing	

- Form Completed by: Margaret L. Stemper
- Description of Technology(s) (Appendix C) Reviewed by: Margaret L. Stemper
- Date Completed: July 1, 1994

APPENDIX 6B

COST ESTIMATES AND ASSUMPTIONS

APPENDIX 6B
COST ESTIMATES AND ASSUMPTIONS

The following assumptions were used to estimate costs:

Assumptions: Remedial Alternative 2

- Installation of the fence would take approximately 1 to 3 months.
- Annual site inspection will be performed by a technician in 4 days.
- O&M costs also include minor repairs to damaged fencing or placards.

General Assumptions: Remedial Alternatives 3 and 4

- Handling and movement of contaminated material would occur through approximately two thirds of remedial construction activities.
- UXO clearance would be performed prior to all intrusive activities by a special team from the Army.
- Air monitoring during excavation would include three continuous air monitoring stations, daily samples analyzed for lead and particulates, and 2 man hours of operation per day. Air monitoring would be performed as needed during handling and movement of contaminated material. It is assumed that air monitoring would be performed for 20 days, the duration of remedial activities, to identify airborne concentrations associated with various soil handling operations.
- Dust suppression includes one water truck with operator. Dust suppression would be performed as needed during handling and movement of contaminated material, assumed to be 20 days.
- Excavated soil would not increase in volume because of the geologic nature of sand.
- Verification samples would be taken on approximate 50-foot centers from excavation bottoms. Samples would be analyzed for lead, TPH, or RDX. Soil treatment verification samples are included in the cost per cubic yard for treatment.
- Mobilization includes equipment, materials, temporary construction facilities, and fencing for all phases of remedial activity.

Assumptions: Remedial Alternative 3

- Excavation, transportation, treatment, and site remediation would take approximately 8 to 12 months.
- Soil containing TPH and RDX would be transported and treated at the Fort Ord Soil Treatment Area (FOSTA) at an average cost of $60 per cubic yard (cy).
- Soil containing spent ammunition and lead would be transported and treated at Site 3 at an average cost of $150 per cy (the average cost for the three potential types of treatment).

Assumptions: Remedial Alternative 4

- Excavation, transportation, and offsite disposal and site restoration would take approximately 6-8 months.
- Soil containing TPH would be transported to the FOSTA, treated, and transported to a backfilling location at Fort Ord at an average cost of $60 per cubic yard.
- Offsite Class I disposal is assumed to be at CWM - Kettleman Hills Facility, California.
- Waste characterization would be performed by the disposal facility on one composite sample shipped to the facility and from analytical data collected from stockpile samples targeted for disposal during remediation.

Table 6B-1. Cost Estimate - Site 39
Alternative 2 - Institutional Controls
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Item	Quantity/Units	Cost per Unit	Total
Capital Costs			
Setup			
- Mobilization	1	$3,000	$3,000
- UXO Clearance	0.1 acre-ft	$10,000	$1,000
Installation			
- Surveying	1 allowance	$5,000	$5,000
- Concrete Footings	84	$100	$8,400
- Fence/Placards	8400 linear feet	$5	$42,000
Administration			
- Deed Restriction	1	$10,000	$10,000
Construction Cost Subtotal			
- Construction management, pre-field activities, design (15%)	1 allowance	$10,400	$10,400
		Capital Cost Subtotal	$79,800
		Contingency (15%)	$12,000
CAPITAL COST SUBTOTAL (rounded to nearest $1,000)			$92,000
Annual Operations and Maintenance Costs			
- Technician	4 days	$440	$1,760
- Materials	1 allowance	$500	$500
ANNUAL O&M COSTS SUBTOTAL (rounded to nearest $1,000)			$2,000
Total NPV O&M (30 years, 5% interest)			$30,000
TOTAL ESTIMATED COSTS			$122,000

Table 6B-2. Cost Estimate - Site 39
Alternative 3 - Excavation and Treatment
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Item	Quantity/Units	Unit Cost	Total
CAPITAL COSTS			
Setup			
- Mobilization	1	$10,000	$10,000
Excavation of Soil			
- UXO Clearance	0.1 acre-ft	$10,000	$1,000
- Surveying	1 allowance	$10,000	$10,000
- Excavation	4,520 cy	$15	$67,800
- Dust Control	20 days	$500	$10,000
- Stockpile/Verification Sampling	135 samples	$100	$13,500
Transport/Treatment			
- Transport/Treat at FOSTA	420 cy	$60	$25,200
- Transport/Treat at Site 3	4,100 cy	$150	$615,000
Site Restoration			
- Import Backfill (Lead-containing Soil)	4,100 cy	$10	$41,000
- Site Grading	1 allowance	$30,000	$30,000
- Revegetation	1 allowance	$70,000	$70,000
Sampling			
- Air Monitoring	20 days	$100	$2,000
Construction Cost Subtotal			
- Construction management, pre-field activities, design (15%)	1 allowance	134,300	$134,300
		Capital Cost Subtotal	$1,029,800
		Contingency (15%)	$154,500
TOTAL ESTIMATED CAPITAL COST (costs are rounded to the nearest $1,000)			$1,184,000

Table 6B-3. Cost Estimate - Site 39
Alternative 4 - Excavation and Disposal at Landfills
Volume V - Feasibility Study, Basewide RI/FS
Fort Ord, California

Item	Quantity/Units	Cost per Unit	Total
CAPITAL COST			
Setup			
- Mobilization	1	$10,000	$10,000
Excavation and Screening of Soil			
- UXO Clearance	0.1 acre-ft	$10,000	$1,000
- Surveying	1 allowance	$10,000	$10,000
- Excavation	4,520 cy	$15	$67,800
- Dust Control	20 days	$500	$10,000
- Stockpile/Verification Sampling	135 samples	$100	$13,500
Transport/Treatment FOSTA	420 cy	$60	$25,200
Offsite Disposal			
- Transport/Dispose Soil (Class I)	4,100 cy	$170	$697,000
Site Restoration			
- Import Backfill (Lead-containing soil)	4,100 cy	$10	$41,000
- Site Grading	1 allowance	$30,000	$30,000
- Revegetation	1 allowance	$70,000	$70,000
Sampling			
- Air Monitoring	20 days	$100	$2,000
Construction Cost Subtotal			
- Construction management, pre-field activities, design (15%)	1 lump sum	$146,600	$146,600
		Capital Cost Subtotal	$1,124,100
		Contingency (15%)	$168,600
TOTAL ESTIMATED CAPITAL COST (costs are rounded to the nearest $1,000)			$1,293,000

APPENDIX

RESPONSE TO AGENCY COMMENTS

VOLUME V APPENDIX
RESPONSE TO AGENCY COMMENTS
DRAFT BASEWIDE REMEDIAL INVESTIGATION/FEASIBILITY STUDY
VOLUME V - FEASIBILITY STUDY
FORT ORD, CALIFORNIA

The following are the Army's responses to the comments of the regulatory agencies on the Draft Basewide Remedial Investigation/Feasibility Study. All comments and the associated responses pertaining to this volume of the Basewide Remedial Investigation/Feasibility Study are provided below.

I. U.S. ENVIRONMENTAL PROTECTION AGENCY GENERAL REVIEW COMMENTS

General Comments

Comment 23: **Section 1.2, FS Strategy, last sentence, page 1. What is meant by: "If remediation of these areas were implemented prior to the final basewide Record of Decision (ROD), ..."?**

Response: The statement was meant to indicate the possibility of acceleration of cleanup at Fort Ord if remedial work could be initiated prior to issuance of the ROD.

Comment 24: **Applicable or Relevant and Appropriate Requirements (ARARs). Attached please find Attachment E, which includes EPA comments dated October 19, 1994, on ARARs, provided by Lisa Castañon, EPA Assistant Regional Counsel.**

Response: Comments have been addressed.

Comment 25: **The No Action alternative cannot include institutional controls such as deed restrictions. Institutional controls constitute an action. Thus, it would be appropriate at sites which have acceptable risk and no ARARs to drive cleanup, to include another alternative for institutional controls only.**

Response: Additional institutional controls that do not currently exist have been removed from the no action alternatives. Institutional controls have been added to other alternatives where appropriate.

Comment 26: **Please break the "Summary of Risk Assessment" section in each FS into the following two parts in order to more clearly summarize risk: 1) Baseline human health risk assessment summary, which may need to include a sub-section which qualitatively addresses any threats to human health from physical or biological hazards -- medical and other debris, UXO, etc., and 2) Ecological risk assessment summary.**

Response: The Basewide Human Health Risk Assessment (BRA) only deals with chemical hazards; physical hazards are addressed in the Remedial Action Objectives where applicable. Otherwise, the text has been revised as suggested.

Comment 27: **Selection of Preferred Remedial Alternative Section. Where cleanup of a site is necessary for the protection of public health and/or the environment (ie, cancer risk exceeds 10^{-6}, HI >1), it is necessary to show how protective the remedy will be when cleanup standards are achieved by presenting what risk level the remedy will achieve (ie, Sites 2 and 12).**

Additionally, there may be sites where the future use of the site is non-residential and the site is in a protective state for that reuse, but a cleanup is necessary to comply with ARARs. In that case, if the cleanup further reduces the risk, then a post-remediation risk assessment based on residential standards could indicate that the site was protective for that purpose and institutional controls would not be necessary.

Response: The cumulative lifetime cancer risk from multiple VOCs in groundwater (at MCLs) for Sites 2 and 12 was found to be 2×10^{-6} and 1×10^{-5} for the average and reasonable maximum exposure (RME), respectively. These results indicate that MCLs are within the EPA target risk range of 10^{-6} to 10^{-4} and are protective of human health and the environment. These methodologies and results are summarized in a new section in the BRA summary, Section 2.1.5 for Sites 2 and 12.

Comment acknowledged. The Army recognizes that ARAR-driven cleanups may lead to site conditions that would not require institutional controls.

Comment 28: Lead. It is confusing how the lead information is dealt with in the" Summary of Baseline Risk Assessment" and "Target Cleanup Levels" sections. At all sites, but site 31, the blood-lead levels are not exceeded but at some of these same sites a TCL for lead is identified. Please explain. Also clarify for the reader the relationship between the blood-lead levels and the TCL of 1925 mg/kg?

In addition, as many Summary of Baseline Risk Assessment sections describe, cancer and non-cancer levels are within the EPA range. Many of these same sections go on to say that lead, also a non-carcinogen, presents levels that would be "prudent" to remediate. It is a bit confusing as to whether or not "prudent" is "required" by Superfund standards.

Response: Target cleanup levels (TCLs) for lead were developed for Sites 3 and 31 only. The BRA indicated that no adverse health effects are associated with possible exposure to lead at the other RI sites evaluated. The TCL of 1,860 mg/kg will result in an estimated blood-lead level below the target blood-lead level. See response to Comment 73 regarding "prudent."

Comment 29: The "Target Cleanup Levels" section might best follow, or be a part of, the Remedial Action Objectives section, since TCLs are based on the BRA, ARARs and RAOs. In some cases, like Sites 16 and 17, the TCL section is a subsection of the BRA section and when no TCLs are supposedly necessary for risk, TCLs are prematurely introduced based on TBCs, which are not discussed fully until the ARARs section.

Also, break the TCL section into discussions on TCLs for human health, ecological, and chemical specific ARAR levels, then identify the most stringent value(s). A table with multiple columns covering these same areas would also be useful.

Response: The texts have been revised as suggested.

Comment 30: Total Petroleum Hydrocarbons (TPH). The previously approved 500mg/kg Preliminary Remediation Goal for TPH in soil was primarily based on health protectiveness (the carcinogenic components of used motor oil), and was to be used only at sites where SOC data was not available. It happened that this level was also shown to be protective of groundwater quality. Where SOC analyses were done in areas of TPH-contaminated soil and the overall risk to human health and the

Specific Comments

SITES 2 AND 12

Comment 33: **Section 2.1.5.3 Target Cleanup Levels, Section 2.1.4.3 Site 12 Soil, Section 2.2.1.1 Contaminants in Soil, and Section 2.2.1.2 Description of Remedial Units. What is the basis for the 100 mg/kg cleanup level or "regulatory standard" for TPH at this site, when such a standard is not mentioned in the ARARs section and the risk level is acceptable. Also, please clarify what the difference between this 100 mg/kg TPH level for residential sites and the 500 mg/kg TPH level which was shown to be protective of groundwater everywhere on Fort Ord?**

Response: The basis for the original 100 mg/kg cleanup level for TPH was the MCDH maximum contaminant level for soil at UST sites. The cleanup level to be implemented at Fort Ord is 500 mg/kg, the remedial goal developed by HLA (*1994o*) and approved by all agencies and is selected as a performance standard that will be proposed in the Basewide ROD.

Comment 34: **Section 2.1.5.2 Results of BRA at Site 12, Table 2.1, Section 2.2.1.1 Contaminants in Soil, and Section 2.1.5.3 Target Cleanup Levels, second paragraph. "For soil, there are no TCLs for Site 12... because the BRA concluded that the chemicals there did not present an unacceptable risk." The multipathway HI for Site 12 is 3.1 (groundwater 2.2 and soil 0.9). A post-remediation risk assessment should be calculated to insure that it is indeed protective, as stated in the nine criteria analysis. If the contaminants in soil are not being addressed (including through the cleanup of TPH-contaminated soils), then the proposed groundwater cleanup goals must be low enough such that the post-remediation HI from exposure to groundwater, when added to the 0.9 HI for soil, does not push the multipathway HI over 1.0.**

In addition, given that the soil HI is near one and that lead exists at over half the acceptable level, was an analysis done to determine if similar health effects from HI-related non-carcinogens and from lead warrant soils remediation to reduce a potential threat.

Response: Minor changes to the BRA have been implemented based on agency comments. New risk numbers are summarized in Section 2.1.5 of the BRA. A post-remediation risk assessment was performed for MCLs in groundwater and is summarized in Section 2.1.5.3. The lifetime cancer risk estimates for residents ingesting groundwater remediated to MCLs are 2×10^{-6} and 1×10^{-5} for the average and RME scenarios, respectively. Average and RME HI estimates resulting from remediated groundwater are 0.04 to 0.07, respectively. Combining the highest HI of 0.07 for groundwater with the highest soil HI of 0.74 (current state; unremediated soils) estimated in the BRA, the resultant soil and groundwater multipathway HI is 0.81. This is below the EPA threshold value of concern.

An analysis was performed to determine the risk from HI-related non-carcinogens and from lead. The results indicate that remediation is not warranted based on metals in soil.

Comment 35: **If remediation of the soil units is indeed warranted, then the treatment and disposal of the other constituents present in the soils (i.e., metals) that exceed background levels or that may contribute to risk need to be considered.**

Response: The soil containing other constituents (i.e., metals) will be properly disposed of in the OU 2 landfill after treatment of TPH.

Comment 36: Section 2.2.4, page 20. Clarify what is meant by the FOSTA being "regulatory agency permitted"? In addition, a permit is not needed for CERCLA actions conducted entirely onsite. Similar comment applies to Section 3.2.4 of Sites 16/17 FS, Section 4.2.4 of Site 3 FS, and Section 6.2.4 of Site 39 FS.

Response: The FOSTA has been approved by the regulatory agencies; therefore, the text has been revised to state this. The Army understands that only the substantive portions of permits will be implemented for CERCLA actions conducted entirely onsite.

Comment 37: Section 2.2.4 Selection of Technologies for Remedial Alternative Development, Groundwater Remedial Unit. Please provide rationale for not including Air stripping further in the analysis, particularly given its effectiveness and relatively low cost.

Response: Air stripping as a treatment technology was not included because of its high capital cost and limited added benefit because of the low influent concentrations (10 to 230 $\mu g/l$) and high maintenance requirements. Use of an air stripper requires a secondary GAC polishing system to treat VOCs in water to nondetectable levels or MCLs prior to injection.

Comment 38: Sections 2.3.2, 2.3.3, and 2.3.4. Alternatives 2, 3, and 4 should include deed restrictions for Site 2, since the BRA did not consider unrestricted future use of this site.

Response: The text has been revised as suggested.

Comment 39: Section 2.3.2 Remedial Alternative 2. For the sake of the lay reader, it would be useful to express the maximum allowable influent of 1.0 mg/l of total toxic organics into the local POTW as $\mu g/l$, since the following statement compares it in such a way.

Response: The text has been revised as suggested.

Comment 40: Section 2.4 Criteria for Detailed Analysis of Remedial Alternatives. For the "Reduction of Toxicity, Mobility, and Volume" criteria, please add "Through Treatment". Please correct for all sites.

Response: The text and tables have been revised as suggested.

Comment 41: Section 2.3.3 Remedial Alternative 3, and Section 2.5.3 Detailed Analysis of RA 3, and Table 2.1. Section 2.3.3 states that groundwater will be treated to MCLs to meet NPDES, reuse, or reinjection standards, and that this alternative meets ARARs (Section 2.5.3). This level may not comply with State Water Board Resolution 68-16. Please provide additional columns in Table 2.1 indicating the discharge levels for NPDES, reuse, or reinjection (inside and outside plume). This comment also applies to Alternative 4.

Response: MCLs are the cleanup levels for VOCs in the Sites 2 and 12 groundwater plume. A discussion of the technical and economical infeasibility of attaining background aquifer levels is included in Section 2.2.1. SWRCB Resolution 68-16 (Anti-Degradation Policy), Resolution 92-49, and Title 23, Chapter 15, are considered potential ARARs for the groundwater remedial action. The discussion regarding the infeasibility of achieving background levels is provided to meet requirements set forth in Title 23, Chapter 15, Section 2550.4 (Concentration Limits).

A new column has been added to Table 2.1 as per EPA and RWQCB requests. This column identifies discharge levels for NPDES, reuse, and reinjection (inside and outside the plume).

Comment 42: **Section 2.6 Comparison of Remedial Alternatives. Cost. Please introduce or define subalternatives 3A, 3B, 4A, and 4B when the alternatives are first discussed in Sections 2.3.3 and 2.3.4, as they are also mentioned in Appendix C and not defined.**

Response: The text has been revised to introduce subalternatives 3A, 3B, 4A, and 4B in Sections 2.3.3 and 2.3.4.

Comment 43: **Appendix 2C, General Assumptions. Please change the bullet starting with "Permitting... " to indicate that while a permit is not required, the following activities will be completed.**

Response: Appendix 2C references to "Permitting" have been changed to "Pre-Field Activities." The Army understands that only the substantive portions of permits will be implemented for CERCLA actions conducted entirely onsite.

SITES 16 AND 17

Comment 44: **Section 3.1.5 Summary of Risk Assessments. The future use of this site is non-residential and the site is in a protective state for that reuse, but a cleanup may be necessary to comply with ARARs. If an ARARs driven cleanup further reduces the risk, then a post-remediation risk assessment based on residential standards could indicate that the site was protective for that purpose and institutional controls would not be necessary. See general FS comment.**

Response: Post-remediation risks associated with chemicals left in soil after implementation of Alternative 4 at Site 17, Pete's Pond, and Pete's Pond Extension are such that unrestricted use of those sites could occur. The other alternative would reduce risk. The text of Sections 3.3.3 and 3.3.4 has been modified where appropriate.

Comment 45: **Section 3.1.5.1 Target Cleanup Levels, page 5, Section 3.2.1.1 TPH in Soil, page 11, and Section 3.1.6.2 Identification of ARARs. If SOCs were analyzed at this site and considered in the risk assessment, then no action is warranted for TPH based on risk. See general comment. Depending on the resolution of this issue, the alternatives could change considerably.**

Also, Section 3.1.5.1 identifies a TPH cleanup level of 500 mg/kg, whereas Section 3.1.6.2 mentions a 100 mg/kg TBC and the 500 mg/kg level. Please clarify what level, if any, is necessary.

Response: TPH in soil requires no action based on risk to human health. The TPH cleanup level of 500 mg/kg is a TCL that is protective of groundwater. The 100 mg/kg concentration (the MCDH soil cleanup goal) has been eliminated from consideration as a TBC because the 500 mg/kg is an approved and appropriate cleanup level.

Comment 46: **Section 3.1.5 Summary of Risk Assessments. Include a qualitative discussion regarding the baseline risks or hazards (chemical, biological, or physical), if any, associated with exposure to medical and other debris or UXO/OEW, to help establish a need, if any, to remediate based on risk. The RAOs discussed in Section 3.2.1 and in Table 3.4 seem to be pointing in that direction. See general FS comment.**

Response: The BRA addresses only chemical-related risks, so it is not appropriate to include a discussion of these risks in Section 3.1.5. Non-chemical-related risks such as medical waste and UXO/OEW were discussed in Section 3.2.1.

Comment 47: **Section 3.2.2.1 No Action. Institutional controls are considered an action. See general FS comment.**

Response: Institutional controls have been deleted from the no action alternative.

Comment 48: **Section 3.2.2 General Response Actions. As a minor note, this section has much more detail than the similar section (Section 2.2.2) for Sites 2 and 12.**

Response: Comment acknowledged.

Comment 49: **Sections 3.3.2, 3.3.3, and 3.3.4. Alternatives 2, 3, and 4 should include deed restrictions since the BRA did not consider unrestricted future use of this site. While these may be discussed in the detailed analysis section, it should be included in these sections as well.**

Response: Alternatives 2 and 3 may require deed restrictions; a discussion has been added to Sections 3.3.2 and 3.3.3. Alternative 4 removes wastes and TPH-contaminated soil above 500 mg/kg, so use of the site would be unrestricted and no deed restriction would be required. Section 3.3.4 has been revised accordingly.

Comment 50: **Sections 3.3.3 and 3.3.4 Remedial Alternatives 3 and 4. Please provide the depth, with rationale, to which the UXO will be cleared.**

Response: For Alternatives 3 and 4, UXO will be cleared to the depth of the debris. This discussion has been incorporated into Sections 3.3.3 and 3.3.4.

Comment 51: **Section 3.3.4 Remedial Alternative 4. Was consolidating Sites 16/17 debris (with and without treatment) at the OU2 Landfill for use as base material for the cap considered? If not, please do so; if so, why did it not become part of this or another alternative?**

Response: Initially, the Site 16 and 17 debris did not appear to meet the engineering requirements for the OU 2 landfill foundation layer. However, analysis subsequent to submittal of the Draft RI/FS identified significant quantities of debris that could be used as part of the foundation layer for the landfill cap. Therefore, Alternative 4 has been modified to include use of debris at the Fort Ord OU 2 Landfill rather than disposal at an offsite landfill.

Comment 52: **Section 3.5.2 Detailed Analysis of Remedial Alt 2, Compliance with ARARs. Permits for monitoring well construction and destruction and for grading the site would not be required if these activities were conducted as part of the Superfund remedy. But, the substantive requirements of such a permit must be met.**

Response: The text in Section 3.5.2 has been revised to address meeting substantive requirements.

Comment 53: Section 3.5.3 Detailed Analysis of Remedial Alt 3, Overall Protection of Human Health and the Environment, first sentence. Based on BRA results for DOL Maintenance Yard chemicals, no mitigation is necessary for the protection of human health.

Response: This sentence has been modified. However, remediation is required for the protection of groundwater.

Comment 54: Section 3.5.3 Detailed Analysis of Remedial Alt 3, Compliance with ARARs, and Table 3.8. Are the deed restrictions discussed here related to an ARAR? They should also be discussed under the "Overall Protection of Human Health and the Environment" and "Long-Term Effectiveness"criteria.

Response: Section 3.5.3 and Table 3.8 have been revised as suggested.

Comment 55: Section 3.5.4 Detailed Analysis of Remedial Alt 4, Overall Protection of Human Health and the Environment, last sentence. Relative to the protection of human health and the environment, what is the significance of noting that spills of debris may take place when transporting debris offsite. Since the debris will be sterilized, please be more specific about any hazard associated with debris spills.

Response: This alternative has been modified. The debris will be transported to an onsite landfill; therefore, the above-mentioned sentence has been deleted.

Comment 56: Section 3.6 Comparison of Remedial Alternatives, Long- and Short-Term Effectiveness, last sentence. Please further explain in what way this alternative will result in long-term liability/responsibility.

Response: The text has been modified to address long-term liability and responsibility.

Comment 57: Section 3.6 Comparison of Remedial Alternatives, Implementability, first sentence. Again, no permits are required for Superfund activities conducted entirely onsite.

Response: The text has been revised.

Comment 58: Table 3.4. Soil - Ingestion or Dermal Contact, Long-term. Given the results of the BRA, the potential chronic chemical exposure does not exceed acceptable levels so does not need to be reduced. Thus, a potential remediation requirement for chronic chemical exposure could be no action.

Response: The no action alternative would not meet the TCC for protection of groundwater or meet the remedial action goals for the UXO/OEW and medical debris; therefore, remedial units were developed on the basis of these considerations.

SITE 3 - BEACH TRAINFIRE RANGES

Comment 59: Summary of BRA and ERA Section 4.1.5 and Target Cleanup Levels Section 4.1.5.1. See general FS comment regarding lead.

Response: These sections have been revised as suggested.

Conversely, Alternative 3 could be left as is and Alternative 2 could include a subalternative for the disposal of separated soils in the event that the predesign technologies prove ineffective.

Response: The alternatives were developed to provide one option consisting of treatment and recycling and another consisting of disposal.

Comment 65: **Sections 4.3.2 and 4.3.3. Regarding alternatives 2 and 3, even though the ecological assessment at Site 3 is not complete, these alternatives should more clearly identify the need for possible dune restoration activities and mitigation to flora and fauna caused by excavation activities. While this is mentioned in the detailed analysis sections, it should also be discussed here.**

Response: The text has been revised.

Comment 66: **Sections 4.3.2 and 4.3.3. Alternatives 2 and 3 should include deed restrictions since the BRA did not consider unrestricted future use of this site. While this may be mentioned in the detailed analysis sections, it should also be discussed here.**

Response: The text has been revised.

Comment 67:. **Section 4.5 Detailed Analysis of Remedial Alternatives, Compliance with ARARs. For each alternative, what is the rationale for discussing the TCL for lead under this criteria when it appears that it is not associated with an ARAR. The TCL for lead, if one is needed, relates to the Overall protection of human health and the environment criteria.**

Response: The text has been revised.

Comment 68: **Section 4.5.1 Detailed Analysis of Alternative 1, Regulatory Acceptance criteria. Deed and access restrictions are considered "action", and cannot be considered part of a "no action" alternative.**

Response: The deed and access restrictions under this alternative refer to those already in place at Site 3. The text has been revised to clarify this point.

Comment 69: **Section 4.5.2 Detailed Analysis of Remedial Alt 2, Overall Protection of Human Health and the Environment, last sentence. Relative to the protection of human health and the environment, what is the significance of noting the potential for spills of spent ammunition on public roads. Please be more specific about any threat or hazard associated with such spills.**

Response: Although it is unlikely for a spill to occur, it was mentioned as one pathway (non-site-related) for exposure and relates to overall protection of human health and the environment; transport of potentially hazardous waste over roadways may not be as protective as treating and backfilling the soil onsite.

Comment 70: **Sections 4.5.2 and 4.5.3 Detailed Analysis of Remedial Alts 2 and 3, Short-term effectiveness. These sections should discuss the potential for impacts to the dunes and the flora and fauna during remediation, and how mitigative measures will be employed.**

Response: A discussion of impacts to the dunes during remediation is provided in the description of the alternative.

Comment 71: **Section 4.5.3 Detailed Analysis of Remedial Alt 3, Compliance with ARARs. Regarding the grading permit from the City of Seaside, permits are not required for such Superfund actions conducted entirely onsite.**

Response: The reference to a permit has been deleted.

SITE 31 - FORMER DUMP SITE

Comment 72: **Section 5.1.5 Summary of Risk Assessments. The future use of this site is non-residential and the site is in a protective state for that reuse, but a cleanup may be necessary to comply with ARARs. If an ARARs driven cleanup further reduces the risk, then a post-remediation risk assessment based on residential standards could indicate that the site was protective for that purpose and institutional controls would not be necessary. See general FS comment.**

As is, Alternatives 2 and 4 should include deed restrictions since such a calculation is not presented. Sections 5.5.2 and 5.5.4 (Detailed Analysis of Remedial Alts 2 and 4, Long-Term Effectiveness) does not provide such a justification or calculation to support the statement that no deed or access restrictions would be required.

Response: Cleanup at Site 31 is based on Human Health Risk Assessment TCLs and is not required by ARARs. Because ARARs are not driving remedial actions at Site 31, a post-remediation risk assessment is not presented.

Text has been revised to include a deed restriction for each of the action alternatives.

Comment 73: **Section 5.1.5 Summary of Risk Assessments, page 6. This section states that it would be "prudent" to remediate the lead at this site. It is a bit confusing as to whether or not "prudent" is "required" by Superfund standards. Please indicate the blood-lead level calculated and the EPA standard.**

Response: For the average scenario, modeled blood-lead levels are below the target blood-lead level of 10 $\mu g/dl$, indicating remedial action is unnecessary. For the RME scenario, the modelled blood-lead levels for the 95th and 99th percentile are 12.6 and 16.10 $\mu g/dl$, respectively. These levels exceed the target blood-lead level that, in this case, indicates remedial action is necessary. Remediation of lead was deemed prudent to address the more conservative RME scenario rather than rely on the average exposure scenario. The text has been revised.

Comment 74: **Section 5.3.2 Alternative 2 should include deed restrictions since the BRA did not consider unrestricted future use of this site. While this may be mentioned in the detailed analysis sections, it should also be discussed here.**

Response: Text has been revised to include deed restrictions.

Comment 75: **Sections 5.3.2 Remedial Alternative 2. While the concept of treating Site 31 soils with those at Site 3 makes general sense, the fact that no treatability studies have been conducted makes this alternative full of contingencies. However, since the volume of soil is low, it is of less consequence since this small volume could be landfilled as a last resort, or final contingency, if treatment proves to be ineffective. With that in mind, please add an offsite disposal contingency to the alternative, or simply combine this alternative with Alternative 4.**

Response: Text has been revised to add offsite disposal contingency to Remedial Alternative 2.

Comment 76: Section 5.5 Detailed Analysis of Remedial Alternatives, Compliance with ARARs. For each alternative, what is the rationale for discussing the TCL for lead under this criteria when it appears that it is not associated with an ARAR. Does not the TCL for lead relate to the Overall protection of human health and the environment criteria?

Response: The TCL for lead is not associated with ARARs. Text has been revised to include the TCL discussion in the overall protection of human health and the environment criteria.

Comment 77: Sections 5.5.2, 5.5.3, and 5.5.4 Detailed Analysis of Remedial Alts 2, 3, and 4, Overall Protection of Human Health and the Environment. The information contained in the last two sentences of each of these sections regarding short-term impacts to the environment with subsequent mitigative efforts should also be discussed under the Short-term Effectiveness criteria.

Response: Text has been revised as suggested.

SITE 39 - INLAND RANGES AND 2.36-INCH ROCKET RANGE

Comment 78: While the general approach to addressing chemical related risks at Site 39 seems appropriate, the remedial alternatives do not address UXO. EPA considers UXO in general at Fort Ord to be a CERCLA hazardous substance and requests that it be evaluated and included in the Draft Final RI/FS. We may dispute the document if it is not included. Our rationale for requiring the inclusion of UXO in the RI/FS was presented to the Army in a letter dated September 7, 1994, which is included here as Attachment F. Please consider this letter as a formal comment on the Draft RI/FS, respond to it in your written response to comments, and update the document as requested.

Response: In accordance with the National Contingency Plan (NCP), DOD (the Army) will be the removal response authority with respect to remediation involving military weapons and munitions. The Army is preparing as companion documents to the Basewide RI/FS a hazard assessment and an explosive safety submission for the Inland Ranges. These documents present the Army's strategies for removal and remediation of UXO at Fort Ord. In addition, the UXO relationship to the CERCLA process is under consideration by the Army.

Comment 79: As discussed in a general comment on the RI/FS, the above comment on UXO extends to the time-critical removal action addressing UXO outside of the Inland Ranges. The results of this removal action should be presented in the RI for Site 39 and summarized in the FS such that any final actions deemed necessary can be presented as alternatives in the FS. For instance, the depths to which UXO were located and cleared need to be evaluated relative to future land uses and the need for the FS to develop alternatives which may include additional clearances, institutional controls and/or contingencies for UXO clearance activities in the future.

Response: Please see response to EPA General Comment 78, above. Companion documents have been prepared for areas outside the Inland Ranges containing UXO, such as the Time-Critical Removal Action (TCRA) memo. In addition, a Land Disposal Site Plan (LDSP) has been prepared and submitted to the agencies. UXO clearance activities were considered for each of the intrusive activities associated with each alternative in the FSs.

Comment 80: **Section 6.1.4.1 Range 36A - EOD Range. Assuming the UXO time-critical removal action is complete and can be included in this RI/FS report, disposal activities at Range 36A should also be complete and corrective action plans or alternatives for the range should also be presented here. While some investigations at this site have been done, additional sampling may be required to insure that removal activities have not caused further contamination. How and when will this occur?**

Response: The Army intends to continue using Range 36A as a disposal area for UXO. At the time the disposal area is closed, closure plans will be prepared in accordance with applicable regulations.

Comment 81: **Section 6.1.5 Summary of BRA. Given that the multipathway HI for the onsite habitat management worker under the RME is 1 (equal to the EPA threshold level), please provide further rationale as to why action is not warranted to address this potential risk.**

Response: EPA guidance states that "when the hazard index <u>exceeds</u> unity (i.e., 1), there may be a concern for potential health effects" (*EPA, 1989b*). Because the HI for the habitat management worker receptor does not exceed 1, no further action is warranted. The variables used to calculate the HI are conservative as discussed in Section 8 of Volume 3.

Comment 82: **Section 6.1.5.1, Target Cleanup Levels, page 8, Section 6.1.6.2 Identification of ARARs, page 10, and Section 6.2.1.2 Soil Remedial Unit 1, page 15. The BRA indicates that the only chemical warranting cleanup from a risk perspective is RDX. The discussion in the Soil Cleanup Levels section of Section 6.1.6.2 regarding the 500 mg/kg TPH level is not correct. The 500 mg/kg level was derived from the carcinogenic components of used motor oil and is not too be used when SOC data is available, as is the case here. An independent value would need to be developed based on an ARAR or, if necessary, a TBC. See general FS comment on this issue.**

In addition, why are the unknown TPH values listed in the second bullet in section 6.1.4.2 compared to a 100mg/kg level?

Response: The BRA evaluated risks associated with all detected chemicals at the site, including SOCs. No risks were found to be associated with SOCs at Site 39. However, a regulatory approved remedial goal of 500 mg/kg was developed for TPH by HLA in the *Draft Final Technical Memorandum, Preliminary Remedial Goals, Fort Ord, California (HLA, 1994o)*. This is the value that the Army wishes to select as a performance standard in the ROD. This value is protective of human health and the environment. Additionally, it was shown to be protective of groundwater quality.

The MCDH soil cleanup goal of 100 mg/kg is not an applicable TBC for this remedial action and has been deleted from the ARARs discussion.

Comment 83: **Section 6.2.1 RAOs and Table 6.10. Table 6.10 includes an RAO for the protection of humans from UXO/OEW hazards. Include this discussion in Section 4.2.1.**

Response: Section 6.2.1 (not 4.2.1) has been revised as suggested.

Comment 84: **Section 6.2.1 RAOs, last sentence. What is meant by the sentence, "Potential risks related to UXO/OEW will be evaluated under a non-time critical removal action"? The RI suggests that, qualitatively, Site 39 contains UXO which pose a serious threat to the future users of this site if left unremediated. This <u>evaluation</u> is straight-forward. It's the remedial, not removal, alternatives which need further evaluation.**

Response: Please see response to EPA General Review, Comments 79 and 80, above, regarding the companion documents related to UXO.

Comment 85: Section 6.2.1.1 Chemicals of Interest. First of all, this section, and all similar sections in each FS, should be renamed "Chemicals (or Contaminants) of Concern". Secondly, under the conditions of the UXO time-critical removal action, Range 36A was only to be used for the removal action and must undergo closure upon completion of the removal unless another removal or remedial action specifies that it remain open.

Response: The title was used because "contaminants of concern" is typically associated with risk assessment terminology; for example, TPH is a chemical (compound) of interest because it may be regulated by ARARs. Therefore, the chemicals of interest for which remedial units are developed consist of both ARAR- and risk-based cleanup levels. Regarding Site 36A, please see response to EPA General Comment 80, above.

Comment 86: Section 6.3.1 and Table 6.13 No Action. Deed or access restrictions are considered an action. See general FS comment.

Response: Access and deed restrictions already in place at Site 39 would continue under the no action alternative. Further institutional actions are considered under Alternative 2.

Comment 87: Section 6.3.3 Remedial Alternative 3. The treatment alternatives for the lead-contaminated soils are too vague, particularly since treatability studies have not been conducted. For instance, stabilization, soil washing, or asphalt batching will be used, or the soils may simply be landfilled if they cannot be treated with these Site 3 technologies. It's one thing to have a contingency, but this approach is too loose. Initiate treatability studies as soon as possible. Will the technology be selected by the Proposed Plan or ROD? Similar comment made for Sites 3 and 31.

Response: A work plan for bench-scale and pilot study treatment of soil at Site 3 is currently under preparation for submission to the regulatory agencies. It is anticipated that evaluation of the studies and preparation of a Draft Conceptual Plan for implementation of chosen treatment methods will be completed in the spring or summer of 1995, which will precede the proposed plan.

Comment 88: Sections 6.3.3 and 6.3.4, Remedial Alts 3 and 4. Please provide the depth of UXO/OEW clearance activities and the rationale for the depth. Also, since this area is not covered by the time-critical removal, discuss the clearance procedures and technologies and how the UXO will be disposed of.

Response: Clearance will be performed by the DOD (the Army) to depths deemed adequate for safe excavation of shallow soil. Clearance and disposal procedures will be performed by the Army's UXO Team under current policies for Fort Ord.

Comment 89: Sections 6.3.3 and 6.3.4. Alternatives 3 and 4 should include deed restrictions since the BRA did not consider unrestricted future use of this site. This should also be added to the Detailed Analysis discussions.

Response: For the reuse scenario evaluated in the BRA, remediation to TCLs would be protective of future receptors in accordance with the planned reuse.

Comment 90: **Table 6B-1 Cost Estimate for Alt 2. What is involved with the costs associated with deed restriction administration? Should similar costs be added to estimates for other RI/FS site alternatives, since nearly all sites will have deed restrictions?**

Response: The costs reflect contingencies for drafting, submission, and implementation of the deed restriction. Each site will not necessarily have a deed restriction; this will be considered on a site-specific basis depending on intended reuse, current restrictions in place, and whether, for instance, the chosen alternative involves placement of a cap that would require a deed restriction.

II. U.S. ENVIRONMENTAL PROTECTION AGENCY TECHNICAL REVIEW COMMENTS

General Comments (No revision required)

Comment 1: **Format follows "Guidance for Conducting RI and FS under CERCLA" including:**

a) Report structured in suggested outline format.

b) Remedial Alternatives cover broad range of technologies.

c) Remedial Alternatives are evaluated using nine criteria items.

d) Screening of technologies are presented in acceptable brief formats and are substantiated in the appendices.

Response: Comment acknowledged.

Comment 2: **The FS was reviewed as a stand alone document and the findings and conclusions associated with the RI were not addressed.**

Response: Comment acknowledged.

Comment 3: **The listed regulations were not reviewed.**

Response: Comment acknowledged.

General Comments (For All Sites)

Comment 1: **A brief discussion is needed on the basis for combining Site 2 with Site 12 and Site 16 with Site 17.**

Response: At the beginning of the RI/FS process, areas at Fort Ord were broken up into investigation sites for characterization in order to include or eliminate sites for future investigation in the Remedial Investigation program. At the beginning of the Remedial Investigation phase, adjoining sites with similar types of contamination were combined for the RI, RA, and FS.

Sites 2 and 12 were combined, as were Sites 16 and 17, because the contaminants were contiguous and/or similar in nature. The specific rationale for combining sites has been added to Section 2.1 (Site 2 and 12) and Section 3.1 (Sites 16 and 17).

Comment 2: **A detailed discussion is needed to describe the Fort Ord Soil Treatment Area (FOSTA). The discussion should include location of the FOSTA, acceptable wastes, additional details of the technologies used, period during which the FOSTA will be operational, duration of the treatment, surface water controls, accessibility, site preparation, and permitting.**

Response: The texts have been revised to provide further discussion of the FOSTA in Section 2.4 of applicable sites.

Comment 3: **A more definitive discussion should be provided on how separate remediation units were developed, combined, or separated. In addition, these sections should discuss only technologies and process options, not remedial alternatives.**

Response: The texts have been revised to include a discussion of how remedial units are developed. Remedial alternatives were not discussed in these sections.

Comment 4: **A detailed discussion is needed to describe the OU-2 landfill. The discussion should include location of the OU-2 landfill, wastes that can be accepted at the landfill, period during which the landfill will be operational, surface water controls, accessibility, site preparation, and permitting.**

Response: Text has been revised to include a discussion of the OU 2 landfill in Section 2.4 of applicable sites.

Comment 5: **Sensitive environments are not discussed as potential targets in the Baseline Risk Assessments (BRAs) or in the context of the sites. Specifically, remediation areas that include sensitive habitats and those that contain endangered species are not discussed. It should be clearly stated if there are no sensitive environments associated with a particular site.**

Response: Sensitive environments are addressed in the Ecological Risk Assessment (ERA) Volume IV of the RI/FS. The FSs address sensitive environments at applicable sites in the ARAR section and under the Remedial Action Objectives (RAOs). For sites where no known sensitive environments exist, the text has been revised to address this point.

Comment 6: **Development and screening of remedial alternatives is not presented. The text in Sections 2.3, 3.3, 4.3, 5.3, and 6.3 does not explain how the remedial alternatives are selected. A clear rationale or explanation for their selection should be provided. A new section should be added between, prior to each of these subsections, that describes how remedial alternatives were selected based on the various combinations of technologies and process options available. This new section should explain why the selection of alternatives represents a logical spectrum of possible remediation options.**

Response: The texts have been revised to include a discussion of how remedial alternatives are developed.

SITES 2 AND 12

General Comments

Comment 1: **An introduction of a long-term monitoring program should be emphasized since the selected remedial alternative may involve groundwater injection.**

Response: Chapter 15, Section 2510(g), is applicable to the groundwater remediation action at Sites 2 and 12 and requires a monitoring program. A long-term monitoring program will be implemented at Sites 2 and 12. An introductory paragraph has been added to Section 2.3 to emphasize the long-term monitoring program.

Comment 2: **The capacity of the onsite landfill should be addressed. Would the landfill capacity be sufficient to contain a volume of soil greater than the quantity of soil estimated to be excavated?**

Response: The OU 2 landfill has sufficient capacity to contain volumes of soil greater than the proposed volumes of soil in the recommended alternative for Sites 2 and 12. A detailed description of the OU 2 landfill is contained in Section 2.2.4.

Specific Comments

Comment 1: **Section 2.1.3, Page 2: Who is proposing the development? Are there any Environmental Impact Reports proposed for Sites 2 and 12.**

Response: The word "development" has been replaced with "reuse." The referenced document (*FORG, 1994*) contains the detailed description of the community reuse plan. The basewide EIS is ongoing and is anticipated to be approved in early 1995. This EIS includes future reuse at Sites 2 and 12.

Comment 2: **Section 2.1.4.2, Page 4: What are the maximum background concentrations? Describe the basis used to determine the maximum background concentrations.**

Response: The background concentrations for deep soils for total chromium and zinc are 22.7 mg/kg and 13.9 mg/kg, respectively. The basis for determining the maximum background concentrations for the site is described in the *Draft Final Basewide Background Soil Investigation, Fort Ord, California*, March 15, 1993 (*HLA, 1993e*). The reader should also refer to the RI for Sites 2 and 12, Volume II, Section 4.3, and Responses to Comments from the EPA Technical Review of Sites 2 and 12, presented as an appendix to Volume II; responses to General Comment 2 and Specific Comments 11 and 12 address maximum background concentrations.

Comment 3: **Plate 2.5: Map should be enlarged so that details of sampling locations can be determined.**

Response: Plate 2.5 has been enlarged to better illustrate the details of sampling locations.

Comment 4: **Section 2.1.5.1., Page 6: Describe the basis used to establish the background concentrations for arsenic in the soil.**

Response: The basis for determining the maximum background concentrations for arsenic as well as other metals for the site were developed in the *Draft Final Basewide Background Soil Investigation, Fort Ord, California*, March 15, 1993 (*HLA, 1993e*). The reader should also refer to the RI for Sites 2 and 12, Volume II, Section 4.3, and Responses to Comments from the EPA Technical Review of Sites 2 and 12, presented as an appendix to Volume II; responses to General Comment 2 and Specific Comments 11 and 12 address maximum background concentrations.

Comment 5: **Section 2.1.5.1, Page 6, and Section 2.2.1.1, Page 16: The proposed use for Site 2 includes outdoor and indoor aquaculture facilities. Does the BRA at Site 2 account for this?**

Response: The BRA accounts for onsite workers at Site 2 who would be employed at the aquaculture facility.

Comment 6: **Section 2.1.5.2, Page 6: Describe the reason for exempting lead as a chemical of potential concern (COPC).**

Response: Lead was not selected as a COPC for Site 2 because levels were below the health-based screening level. The lead exposure evaluation is in Section 2.1.5 in this report. Refer to the BRA, Volume III, Section 3.3, for further description of the COPC selection process.

Comment 7: **Section 2.1.5.3., Page 6: Has the regional Water Quality Control Board (RWQCB) accepted that the Target Cleanup Levels (TCLs) for groundwater are the MCLs? Non-degradation criteria may require lower TCLs.**

Response: MCLs as aquifer cleanup goals are protective of human health and the environment and have been accepted by the RWQCB at other sites at Fort Ord, specifically OU 1 and OU 2. A discussion of the technical and economical infeasibility of attaining background aquifer levels is included in Section 2.2.1. Table 2.1 has a new column added as per RWQCB request.

Comment 8: **Section 2.2.1.2, Page 16: Describe the basis for grouping the remedial units into three units.**

Response: Grouping of the three SRU units is based on the nature and extent of TPH and debris and applicability of technology and process options. Section 2.2.1.2 has been revised to include this information.

Comment 9: **Section 2.2.4, Page 20, first paragraph:**

a: After the first sentence, insert "A summary of technology screening is presented in Tables 2.5 through 2.7."

Response: This text has been inserted as requested.

b: The discussion of the FOSTA needs further elaboration. Specifically, explain if the FOSTA is being considered (for the purposes of this feasibility study) as a treatability study or demonstration plant. Based on data obtained from the FOSTA, explain in the if the elimination of certain technologies is based on cost, effectiveness, or implementation.

Response: The FOSTA is not a treatability study or a demonstration plant. The purpose of the FOSTA for the FSs is to provide a soil treatment process for TPH-affected soil. It provides cost-effective treatment at a single location. It is protective of human health and the environment and provides an equivalent level of treatment for several screened process options and technologies. The text has been revised to explain that elimination of certain technologies because of the FOSTA is based on an equivalent level of treatment effectiveness. Further discussion of the FOSTA is presented in the response to EPA Technical Review, General Comment 2.

Comment 10: **Section 2.2.4, Page 21, SRU1: Are there any contingency plans for unplanned discoveries?**

Response: Contingency plans for unplanned discoveries of UXO in the SRU1 currently exist as an addendum to the Health and Safety Plan. Additional detailed plans will be developed as part of the final remedial action.

Comment 11: **Section 2.3, Pages 22-24: A general basis for selecting the combination of remedial technologies is not apparent and should be explained, at least briefly, in each Remedial Alternative.**

Response: A general basis for selecting the combinations of retained remedial technologies has been clarified in the text in the introduction to Section 2.3. Combinations of technologies and process options are grouped to represent a variety of GRAs, to provide increasing levels of protection and acceptance to the regulatory agencies and the public. Sections 2.3, 3.3, 4.3, 5.3, and 6.3 were revised, as stated in the response to EPA Technical Review, General Comment 6.

Comment 12: **Section 2.3.2, Page 23: Where will surface water drain to? Describe where the connection to the POTW would be and what site permits would be needed.**

Response: Surface water, diverted from the cap of SRU1, will not be exposed to affected soil and so will not contain contaminants. This water will be routed to surface water Outfall 31. The surface water outfall and storm drain piping all flow, eventually, to the Monterey Bay. The connection to the POTW will be at the location of a sanitary sewer line nearest the extraction and treatment area. This exact area has not been determined at this time but the Fort Ord sewer piping will provide the conveyance system to the POTW. NPDES and POTW permitting will meet substantive requirements, but a CERCLA action is exempt from administrative requirements.

Comment 13: **Section 2.5.4, Page 30: A discussion of the NPDES discharge location should be provided.**

Response: The NPDES discharge location would be close to the extraction and treatment system. This area has not been determined at this time but Fort Ord has an extensive surface water outfall system that can be used.

Comment 14: **Table 2.1, Maximum Concentrations of Chemicals of Concern: The last column identifies aquifer clean-up levels. They are identical to the MCLs presented in the third column. Please explain if the RWQCB's Non-Degradation Policy applies to aquifer clean-up levels at these sites. If so, the aquifer clean-up levels may be lower than the MCLs.**

Response: A discussion of the technical and economical infeasibility of attaining background aquifer levels is included in Section 2.2.1. Table 2.1 has a new column added as per the CRWQCB request. Further discussion is contained in the response to EPA General Review, Specific Comment 41.

SITES 16 AND 17

General Comments

Comment 1: **A reference for OU-2 groundwater contaminant plume should be included and a brief basis for how remediation of OU-2 will alleviate any groundwater remediation needed for Sites 16 and 17.**

Response: Sections 3.1.4.5 and 3.2.1.2 have been expanded to provide additional information. In addition, Plate 3.6, which shows the OU 2 groundwater plume and its proximity to Sites 16 and 17, has been added to the report.

Comment 2: **More detail in the treatment processes should be addressed for each Soil Remediation Unit. For example, in Remedial Alternative 4, the debris under SRU2 will be treated and then transported to an offsite landfill. However, the debris may contain medical wastes, TPH, metals, VOCs, and SOCs. Sterilization is the only treatment process indicated on Page 16 under SRU2.**

Response: In general, treatment processes used are limited to treatment of TPH soil at the FOSTA and sterilization of the debris. Additional treatment for metals, SOCs, and VOCs is not required because the levels detected are significantly below listed hazardous waste levels and can be used as part of the foundation layer for the OU 2 landfill cap.

Specific Comments

Comment 1: **Section 3.1.1, Page 1: What is the existing depth of Pete's Pond and Pete's Pond Extension?**

Response: At its deepest point, the ground surface is approximately 10 feet below Fifth Avenue. The text has been revised for clarification.

Comment 2: **Section 3.1.3, Page 3: Are there sensitive environments associated with Pete's Pond when there is standing water? Are there sensitive environments for Sites 16 and 17?**

Response: Pete's Pond is not a sensitive environment when standing water is present. The area is a manmade drainage area surrounded by roads. Due to the infrequent inundation of Pete's Pond and the developed nature of the surrounding area, this area is not a wetland habitat. The central maritime chaparral habitat that forms a portion of Pete's Pond Extension is a rare and declining habitat, but is a small area surrounded by developed land; this habitat is discussed briefly in a new Section 3.1.5.2 of this report and in the Ecological Risk Assessment, Volume IV. No sensitive environments exist at Site 17; the areas of contamination are paved.

Comment 3: **Section 3.1.4.1, Page 3: Are there any contamination concerns regarding the paved areas in the DOL Maintenance Yard?**

Response: Based on existing and former site use, no probable source areas were identified in the paved areas of the DOL Maintenance Yard.

Comment 4: **Section 3.1.4.5, Page 4:**

a) **Provide a brief description of the boundaries and chemical concentrations associated with the OU-2 groundwater plume. Explain how Sites 16 and 17 are associated with the OU-2 plume, rather than with separate plumes.**

b) **A plate showing the OU-2 plume should be presented.**

Response: The text has been revised regarding the association of Sites 16 and 17 with the OU 2 plume, and a plate (Plate 3.6) has been added.

Comment 5: **Section 3.1.4.5, Page 4: Are there any current uses or proposed uses of the groundwater?**

Response: The text has been revised regarding current or proposed uses of the local groundwater.

Comment 6: **Section 3.2.4, Page 15: It should be explained why a Groundwater Remedial Unit is not required, or it should be indicated that it is part the OU-2 remedial efforts.**

Response: Section 3.2.1.2 provides a discussion of why a groundwater remedial unit is not required and that the groundwater remediation at Sites 16 and 17 will occur as part of the OU 2 remedial efforts.

Comment 7: **Section 3.3.2, Section 3.3.3, Section 3.3.4, Pages 16,17,18: Where will the Army dispose of UXO/OEW in the soil?**

Response: Clearance, detonation (as needed), and disposal of UXO/OEW will be performed consistent with Army protocol. Details such as identification of detonation and disposal locations are dependent on the specific circumstances of the UXO/OEW hazards and will be provided in companion documents prepared by the Army. See the response to U.S. EPA General Review Comment 2b for further UXO/OEW handling procedures.

Comment 8: **Section 3.3.3, Page 17, first Paragraph: This section should mention that the debris consolidated in the Site 17 Disposal Area will be capped with asphalt.**

Response: Text has been revised.

SITE 3 - BEACH TRAINFIRE RANGES

General Comments

Comment 1: **There is no mention of the potential for live ammunition being on the site. This may pose additional problems for worker and community safety that should be addressed.**

Response: The potential for contact with live ammunition does exist at the site. Remedial activities implemented in areas of heavy deposition (greater than 10 percent surface coverage) will be conducted under the supervision of the Army's UXO Team, which will be responsible for mitigation of any hazards to workers associated with any live ammunition that may be found. The text has been revised to reflect this.

Comment 2: **Would there be any reason for non-metal contaminants to be present at the Site 3? Have any non-metal contaminants been detected in the soil?**

Response: The chemical characteristics of the different types of ammunition found at Site 3 were determined through analyses performed during the RI (Volume II). Organic compounds were not expected to be present at the site because the components of the bullets were metallic.

Comment 3: **Are there any long-term monitoring programs that should be considered?**

Response: Based on the results of the RI for Site 3 (Volume II), groundwater quality has not been affected by the presence of the spent ammunition; however, groundwater at the site will continue to be monitored under the Basewide Monitoring Program.

SITE 31

Specific Comments

Comment 1: **Section 5.1.4.3, Page 3: Due to the sloped terrain of the site, there should be some discussion on the impact of surface water outfall from this site and its potential targets.**

Response: The text has been revised to address surface water. The potential is very low for offsite migration of chemicals present at Site 31 via this mechanism, as described in Section 5.0 of the Site 31 RI, Volume II (Fate and Transport). Additional discussion regarding the elimination of surface water controls from the development of remedial alternatives is presented in Section 5.2.4 of the Feasibility Study.

Comment 2: **Section 5.6, Section 5.7, Pages 29-30, Implementability: Due to the estimated low volume to be excavated, this section should include the possibility that a similar technology for soil washing may be used at the site and that capital costs may be incorporated at another site.**

Response: Treating soil from Site 31 at Site 3 would be simpler, less costly, and quicker than moving treatment equipment to Site 31. Because the preferred alternative for Site 3 includes stockpiling and physical screening or treatment of RCRA waste (lead-containing soil) at Site 3, the Army intends to rely upon a CAMU designation for remediation activities at Site 3. Soil from Site 31 can be consolidated at Site 3 under this CAMU designation, and movement of equipment between Sites 3 and 31 would be unnecessary.

SITE 39

Specific Comments

Comment 1: **Section 6.1.4.6, Page 5: Groundwater sampling appears to have taken place over a small portion of the site. It is unlikely that the limited sampling data collected to date is representative of groundwater quality beneath Site 39.**

Response: In general, contaminants in soil at Site 39 are limited to shallow soil, so full characterization of the groundwater beneath the site is not warranted. It was not the intent of the groundwater sampling performed during the RI to define groundwater quality; the samples were taken as requested by the regulatory agencies.

Comment 2: **Section 6.1.5, Page 7: A discussion is needed of the aquifers beneath the site, whether or not groundwater quality is impacted, and whether there are receptors for contaminants in groundwater.**

Response: This information is provided in the Site 31, RI Volume II, Sections 1.6 and 3.6, and Volume III, Section 2.2.4.

Comment 3: **Section 6.2.1.2, Page 13: Although it appears that soil contamination is not present at greater depths, a brief discussion on justifying the exclusion of a groundwater remedial unit should be included.**

Response: The text has been revised for clarification.

Comment 4: **Section 6.3.1, Page 17: Remedial Alternative 3 should be represented on a plate.**

Response: Plate 6.6 has been added as suggested to illustrate Remedial Alternative 3.

Comment 5: **Section 6.3.3, Section 6.3.4, Page 18: A plate showing the areas for SRU1 and SRU2 within Site 39 should be provided.**

Response: Plate 6.2 has been added as suggested to illustrate the approximate locations of Soil Remedial Units 1 and 2.

Comment 6: **Section 6.5.3, Section 6.5.4, Pages 23 and 24: The physical terrain of Site 39 is rough and access to roads is limited (described in Section 6.1.1), but there is no mention of this and its potential impact to the implementability of Remedial Alternatives 3 and 4 and the need for special equipment.**

Response: The rough terrain of Site 39 was mentioned in Section 6.1. As to its effect on the implementability of the alternatives, discussion with excavation contractors indicated that access to areas requiring excavation that are previously cleared by the UXO Team would not require special equipment or cause unnecessary delays. These areas are regularly accessed for reconnaissance, RI, biological, and other activities.

III. U.S. ENVIRONMENTAL PROTECTION AGENCY TECHNICAL REVIEW COMMENTS, VOLUME V - ARARS

General Comments

SITES 2 AND 12

Comment 1: **Do we need to discuss ARARs for soil?**

Because the risk assessment concludes that soils do not present an unacceptable risk, are ARARs triggered at these sites? If the groundwater contamination and resulting remedial action have sufficient nexus to soils contamination, then ARARs may need to be analyzed for soils. However, do site conditions warrant a no action determination for soils such that ARARs are not considered?

Response: The groundwater contamination (VOCs) and the soil remedial units (TPH) are not related. However, potential soil ARARs for discharge of waste to land are summarized in Table 2.2 and analyzed in Section 2.1.6. Although soil does not represent a risk, a regulatory agency approved level of 500 mg/kg TPH will be selected by the Army as the performance standard in the ROD.

Comment 2: **If ARARs are triggered for soil, which ARARs apply?**

Because the preferred alternative includes excavation of soil, the exemption under Chapter 15 would be triggered such that Article 1 Section 2511 (d) and Article 2 are the only applicable provisions.

If the Army wishes to rely upon a narrative standard contained in guidance related to underground storage tanks (or does the guidance set specific numbers?), then the Army may identify the guidance as TBC (see pg 10). As lead agency, the Army may select the TBC as a performance standard in the ROD, and based upon the narrative standard, select a number.

Response: Potential ARARs are listed in Section 2.1.6 and include the applicable sections of Chapter 15 for the excavation alternatives as well as the capping alternatives. The Army wishes to use the regulatory agency approved level of 500 mg/kg as a performance standard in the ROD.

Comment 3: **Chapter 15**

With respect to Chapter 15 as an ARAR for soils, everything other than Article 1 section 2511 (d) and Article 2 should be deleted with respect to soil cleanup.

Response: Chapter 15, Article 1 [Section 2511(d)] and Article 2, are relevant and appropriate for the capping remedial actions and, although it is not the preferred alternative, they are included in Section 2.1.6 for completeness.

Comment 4: **Resolution 92-49**

EPA would agree that 92-49 may apply to groundwater cleanup.

Response: Comment acknowledged.

Comment 5: **Resolution 68-16**

Description of 68-16 on pg 15 should note that the applicability to high quality waters excludes reinjection into the contaminated groundwater plume.

Response: Text has been revised as suggested.

Comment 6: **[This comment number was not used in the numbering sequence.]**

Comment 7: **Remedial Alternatives**

Many of the remedial alternatives, including the preferred alternative, include multiple options within each alternative, eg, groundwater extraction, treatment, and disposal by NPDES discharge <u>or</u> reuse <u>or</u> injection. EPA generally prefers more specificity for a particular alternative. Do we know at this time which is the likely option to be implemented?

Response: The most likely option to be implemented is disposal by injection. This is consistent with the recommended alternative. It is not known with complete certainty that other disposal options will not be used, so other applicable ARARs are presented for completeness.

Comment 8: ARARs Table

Delete the first ARAR listed in the Table. The correct cite is Resolution 88-63 and it is already included in the Table at pg 5. The source should be cited as the Porter-Cologne Act.

Title 23, Chapter 15, Article 1 Section 2511 (d) and Article 2 should be included in the Table.

Whenever a potential ARAR is listed and described, but found to be inapplicable, the Table states "Relevant and Appropriate", eg, Fault Zone, Floodplain. The Table should state "Not Applicable" or, if a requirement is clearly irrelevant, it may simply be deleted.

Title 22 Article 16 on pg 5. Miscellaneous "Units," not Standards.

Title 22 "Standards Applicable to Transporters of Hazardous Wastes" should be deleted because ARARs apply on-site only. The Army may be nonetheless required to comply with this provision, but it is not an ARAR. Delete from ARARs Table, pg 5 and text pg 14.

Resolutions 88-63 and 92-49 should cite the Porter-Cologne Act as their source.

Water Well Standards, Bulletin 74-81 sounds like a TBC, not an ARAR. pg 6

Resolution 68-16 on pg 6 should cite the source as Porter Cologne Act. Include comment noted above re high quality waters.

The Migratory Bird Conservation Act should be deleted from the Table at 3.

Response: The text has been revised as suggested except for the following items. The first citation has been corrected to Resolution 89-04 per the RWQCB comment. Sections of Chapter 15 are discussed in the text but not specifically listed in Table 2.2 because the table is intended as a summary.

Water Well Standards, Bulletin 74-81 is a TBC and is included in the text and deleted from the table. Table 2.2 is intended as a summary of potential ARARs and does not list TBCs.

Comment 9: Specific revisions.

Pg 7. Under 2.1.6, "CERCLA" is the proper citation, not SARA. Revise last sentence in this paragraph to read: "...TBCs issued by federal or state agencies that are not legally binding are not ARARs but may be included as performance standards if selected in the ROD." Revise first full paragraph in second column to read: "Remedial actions implemented at a Superfund site..."

Pg 8. Under the Basin Plan description, the first paragraph should be deleted because it is too general and not substantive. Begin with the second paragraph and revise the first sentence as follows: "Certain substantive portions of the Central Coast Region Water Quality Control Plan are ARARs."

Pg 9. The Basin Plan need not go into detail regarding Resolution 88-63 because it is already found on pg 15. 88-63 should be a stand alone ARAR because it has gone through an ARARs analysis. (See mark-up)

Pg 16. Under 2.2.1, the third paragraph states that the RAO for groundwater includes cleaning the aquifer to MCLs to the extent practicable. What does this mean? If the MCLs are the ARAR, then they must be complied with, without any qualifiers.

Pg 25. Under Compliance with ARARs, delete reference to other guidance.

Pg 29. The Proposed Plan is referenced under both Agency and Community Acceptance as the document in which acceptance will be addressed. Did the Army intend to refer to the Responsiveness Summary in the ROD? Community acceptance is not generally known until after the proposed plan has been issued and a public meeting held.

Response: The text has been revised as suggested except for the following items.

The phrase "to the extent practicable" has been deleted from this FS. The Army understands that MCLs will be selected as performance standards in the ROD. Chapter 15, Section 2550.4: Concentration Limits states that when a cleanup goal is established at levels greater than background, each limit shall be re-evaluated at least every 5 years. It is at this time that the performance of the system will be evaluated as to whether MCLs are practical and achievable in a reasonable period. Thus, even though a performance standard is selected in a ROD, evaluation of actual system performance can be used to renegotiate groundwater performance standards.

On page 25, Section 2.4 (compliance with ARARs), the reference to other guidance has been clarified to include TBCs.

The Army's intent is to gain further understanding of the community's acceptance for a specific alternative after the Proposed Plan is issued and a public meeting is held.

SITE 3

Comment 1: CAMU Designation

If RCRA waste will be "placed" at Site 3 from Site 39, then Site 3 may need to be formally designated as a CAMU in the FS.

Response: Because there is a potential for stockpiling and physical screening or treatment of RCRA waste (lead-containing soil) at Site 3, the Army intends to rely upon a CAMU designation for remediation activities at the site.

Comment 2: Specific Revisions

Pg 6. Separate discussion of Titles 22 and 23 with respect to Identification and Listing of Hazardous Wastes.

Pg 7. Delete duplicative discussion of Title 22. Note distinction between stating that a requirement is waived vs. not an ARAR.

Pg 10. Cite and discuss Article 1 section 2511(d) and Article 2 of Chapter 15 as ARARs. General description of Title 23 is confusing given that remedial alternative and site conditions exempt most of Chapter 15's provisions.

Response: The text has been revised on Pages 6, 7, and 10 as suggested.

Comment 3: ARARs Table

The RCRA Title 22 Identification and Listing of Hazardous Waste on pg 1 of the Table should cite only Chapter 11.

The term "appropriate" used in the Comments column is somewhat confusing given that "relevant and appropriate" is a term of art under ARARs analysis.

Give a complete citation for Title 22, Chapter 14, Article 16 at pg 3 of the Table, eg, sections, name of provision.

Delete the following

Migratory Bird Conservation Act at pg 2 of the Table and pg 8 of the text.

RCRA Standards Applicable to Transporters and CA Vehicle Code at pp 3-4 of the Table and pg 10 of the text.

CEQA at pg 4 of the Table and pg 11 of the text.

NEPA at pg 4 of the Table and pg 11 of the text.

OSHA at pg 4 of the Table and pp 8, 11 of the text.

Response: The text and table have been revised as suggested.

SITES 16 AND 17

Comment 1: What is driving the soils cleanup?

The BRA indicates that contaminants do not present an unacceptable risk. But, 500 mg/kg will be used to establish limits for soil remediation. It is not clear that the Army may rely upon the 1993 Draft Technical Memo cited at pp 5-6 for a cleanup standard without a site-specific rationale.

Response: The cleanup level of 500 mg/kg for TPH in soil has been approved by all agencies for protection of groundwater quality at sites such as 16 and 17 and will be selected as the performance standard in the Basewide ROD.

Comment 2: LDRs/CAMUs

Is there RCRA waste at Site 16 or 17? If not, then Land Disposal Requirements ("LDRs") and the Minimum Technology Requirements ("MTRs") will not be triggered. The CAMU rule allows RCRA waste to be consolidated in certain circumstances

without triggering LDRs. But, if there is no RCRA waste, no LDRs come into play, and the need for CAMU provisions is mute. If we know definitively that RCRA waste is not present, delete the RCRA regulations. If non-RCRA waste is being consolidated, other ARARs may need to be considered, eg, Chapter 15, Article 2.

If there is a strong likelihood that RCRA waste may be present, then we need to revamp the ARARs section, eg, the cites need to be corrected, the descriptions need to correlate to the cites, a CAMU designation needs to be made formally.

Response: To date, no RCRA wastes have been identified at Sites 16 and 17. The RCRA regulations were included in the event that RCRA wastes were identified during the remediation. These citations have been deleted.

Comment 3: ARARs for Capping Alternative

Which ARAR is driving the capping requirements. Are RCRA regulations relevant and appropriate?

Response: RCRA regulations are not relevant; however, Title 23, Chapter 15, Section 2511(d), may be applicable.

Comment 4: ARARS Table

Delete the following:
Title 23, Chapter 15 re fault zone at pg 2 of the Table

Title 23, Chapter 15 re floodplain at pg 2 of the Table

Title 22, Chapter 13 re transporters at pg 4 of the Table

Title 13 re CA Vehicle Code at pg 4 of the Table

Title 23, Chapter 15 general reference at pg 5 of the Table

NEPA at pg 5 of the Table

CEQA at pg 5 of the Table

Response: The above-mentioned citations have been deleted.

Comment 5: Specific Revisions

Pg 6. The situation to SARA under 3.1.6 should be changed to CERCLA.

Response: The text has been revised as suggested.

SITE 31

Comment 1: Soils Consolidation

If soil from Site 31 will be consolidated for treatment at Site 3, then the text should explain and discuss this in more definitive terms. Currently, the text is ambiguous ("The opportunity exists..."). Consolidation affects certain ARARs, which will need to

be discussed in the event it takes place.

Response: The text has been revised to be more specific. Because the preferred alternative for Site 3 includes potential for stockpiling and physical screening or treatment of RCRA waste (lead-containing soil) at Site 3, the Army intends to rely upon a CAMU designation for remediation activities at the site. This designation would allow consolidation of soil from Site 31 at Site 3 for treatment.

Comment 2: ARARs Table

The following are not ARARs and should be deleted:

Migratory Bird Conservation Act at pg 10 of the text and pg 2 of the Table.

Clean Water Act at pg 2 of the Table. (Substantive portions of the regulations may need to be complied with, but a permit need not be obtained.)

RCRA Standards Applicable to Transporters of Hazardous Waste at pg 12 of the text and pg 4 of the Table.

California Vehicle Code at pg 4 of the Table.

Title 23, Chapter 15 general reference at pg 4 of the Table.

CEQA and NEPA at pg 14 of the text and pp 4-5 of the Table.

Construction Safety Orders at pg 5 of the Table and pg 14 of the text.

OSHA at pp 9, 14, 23, of the text and pg 5 of the Table.

Prop 65 at pg 14 of the text.

Response: The indicated ARARs have been deleted, and the table and text have been revised accordingly.

Comment 3: Specific Revisions

Pg 6. Revise first sentence of 5.1.6 as follows: "Under section 121(e) of CERCLA, remedial actions must be protective of human health and the environment and comply with promulgated..." Do not cite SARA and do not confuse protectiveness with "implying" ARARs.

Pg 8. Discuss Title 22 RCRA and Title 23 separately in the text. See mark-up.

Pg 11. Delete discussion regarding permits under the Fish and Game Code and the Clean Water Act. Under the Monterey County Oak Tree Preservation bullet, revise as follows: "Because ARARs do not include local and county ordinances, this ordinance is a to-be-considered requirement.

Pg 13. The discussion regarding Title 23, Chapter 15 should be deleted, except for Article 1 section 2511(d) and Article 2 given that this is an excavation action.

Pg 15. "Chemicals of Interest" are generally referred to as "Contaminants of Concern."

Pg 19. Remedial alternative 2 states that "The opportunity exists to use the screened soil from Site 31 as part of the onsite pre-remedial treatment study scheduled for Site 3..." Can we be more definitive here? Will we or won't we consolidate soil treatment.

Pg 23. The TCL for lead should be discussed under "Overall Protection of Human Health and the Environment" section because it is risk-derived, not "Compliance with ARARs" section, second paragraph.

Pg 25. The first sentence under 5.5.3 uses the term "waste management unit" which may be inappropriate. Why not state "cap?" The second column references CAMUs in one sentence and then follows up with a discussion of capping requirements. This transition is confusing. May want to delete; CAMUs are discussed at pg 13.

Response: The indicated revisions have been incorporated into the text and tables, except for the comment on page 15 regarding "Chemicals of Interest." This terminology was used because this section typically includes both chemicals subject to ARARs as well as chemicals identified in the BRA and ERA as potential risks to human health and the environment. "Contaminants of Concern" is a term typically used in risk assessments for chemicals that pose potential risks and does not consider chemicals because of ARARs.

SITE 39

Comment 1: ARARs Table

Delete the following:

Migratory Bird Conservation Act on pg 11 of the text and pg 2 of the Table.

Standards Applicable to Transporters on pg 13 of the text and pg 4 of the Table.

California Vehicle Code on pg 13 of the text and pg 4 of the Table.

NEPA on pg 13 of the text and pg 5 of the Table.

CEQA on pg 13 of the text and pg 5 of the Table.

OSHA on pg 14 of the text.

Health and Safety Standards on pg 5 of the Table.

General reference to Chapter 15 on pg 4 of the Table.

Be more specific in the citation for Title 22, Identification and Listing of Hazardous Wastes at pg 1 of the Table.

The term "appropriate" used in the comments column of the Table may be somewhat confusing given that "relevant and appropriate" is a term of art for ARARs analysis.

Hazardous Waste Control Law and guidance regarding recycling: Is this applicable to the remedial action as an on-site ARAR?

Response: The indicated ARARs have been deleted, and the text and table have been revised as suggested. Lead-containing soil at Site 39 will be treated by one of the methods determined during bench-scale studies for similar conditions at Site 3. Regarding the Hazardous Waste Control Law, one of the treatment methods that may be applied is asphalt batching, for which this law may apply for soil that is recycled into asphalt as an aggregate substitute.

Comment 2: **Specific Revisions**

Pg 3. Under 6.1.4.2, the second paragraph states that explosive compounds are a potential contaminant of concern. The last sentence in this section states that no explosive compounds were detected in soil samples. Is this inconsistent?

Pg 8. Under 6.1.6, the reference to SARA should be changed to CERCLA.

Pg 9. Revise as follows: "... remedial actions must be protective of human health and the environment and comply with promulgated ARARs."

Pg 13. Under Title 22, the ARAR is entitled Miscellaneous "Units" rather than "Standards." Revise also pg 4 of the ARARs Table.

Pg 15. Under 6.2.1.1, The heading is generally referred to as "Contaminants of Concern" rather than "Chemicals of Interest."

Response: Under 6.1.4.2, the second paragraph states that "On the basis of the range usage, potential contaminants included . . . several compounds . . .," which is a reference to contaminants that may have been present at the site. The RI then focused the sampling program on investigation of those compounds suspected to be present. This was not a reference to "potential contaminants of concern" as used in risk assessment terminology. Therefore, the text was not inconsistent, as it correctly summarized the results of the RI at Site 39.

The text and table have been revised as suggested for pages 8, 19, and 13.

On page 15, the title was used because "contaminants of concern" is typically associated with risk assessment terminology, and TPH is a chemical (compound) of interest because it may be regulated by ARARs. Therefore, the chemicals of interest for which remedial units are developed consist of both ARAR- and risk-based cleanup levels.

IV. REGIONAL WATER QUALITY CONTROL BOARD COMMENTS

I. SITES 2 AND 12

Specific Comments

Comment 1: **<u>Section 2.1.4.3 page 5</u> - The number of soils samples reported in the Cannibalization Yard area and the number of results shown in the text do not correlate. There are more sample locations than sample results. Correct the discrepancy.**

Response: All soil sample locations are presented on Plate 2.5. TPH concentrations and depths were posted only to those sample locations where TPH values exceeded 500 mg/kg. All locations, depths, and concentrations of lead detected in the vicinity of the

Cannibalization Yard Area are discussed in Section 2.1.4.3. Concentrations of lead and all other metals detected in soil in the vicinity of the Cannibalization Yard are presented in the Sites 2 and 12 RI, Volume II, on Plate 30. No revisions to the FS text are appropriate.

Comment 2: **<u>Section 2.1.5.3 page 6</u> - The use of MCLs as the target cleanup level (TCLs) is incorrect.**

For ground water TCLs, the Army must evaluate remediation to background water quality or best water quality if background cannot be restored as required under State Water Resources Control Board (SWRCB) Resolution No. 92-49 and California Code of Regulations, Title 23, Chapter 15 (Chapter 15).

The RI/FS Report identifies that the 100 ppm TCL for total petroleum hydrocarbons in soil was established for residential reuses. While this statement may be accurate, the 100 ppm concentration developed by the Regional Water Board is based on a threat to water quality and not reuse or land use considerations. The text should be modified to correct the basis for the 100 ppm concentration.

Response: MCLs as aquifer cleanup goals are protective of human health and the environment and have been accepted at other sites at Fort Ord, specifically OU 1 and OU 2. A discussion of the technical and economic infeasibility of attaining background aquifer levels following Chapter 15 guidelines is included in Section 2.2.1. Table 2.1 has a new column added as per RWQCB request.

The TCL for TPH at Sites 2 and 12 has been changed from 100 mg/kg to the regulatory-approved level of 500 mg/kg. The Army recognizes that the 500 mg/kg value for TPH is protective of human health and water quality, as established in *Draft Technical Memorandum, Preliminary Remediation Goals, Fort Ord, California (HLA, 1994o)*. The text in Section 2.1.5.4 (TCLs) has been revised.

Comment 3: **<u>Section 2.1.6.2 page 8</u> - The citation to "Resolution 89-39" for the Water Quality Control Plan, Central Coast Region (Basin Plan) is incorrect. The existing Basin Plan does not include a Resolution 89-39 that establishes a "Basin plan (sic) to set numerical and narrative water quality standards." The latest update to the Central Coast Region Basin Plan is dated November 17, 1989, under Resolution No. 89-04 and was amended in February, 1994.**

Response: The text has been revised to correct this reference.

Comment 4: **<u>Page 11</u> - Chapter 15 Section 2510 (g) says that for sites that were closed, abandoned, or inactive on the effective date of the regulations (November 1984) persons responsible for the sites may be required to develop and set up a monitoring program. If water quality impairment is found, such persons may be required to develop and carry out a corrective program. Section 2510 (g) applies to the site and needs to be added to the potential ARARs listing and included in Table 2.2. Corrective action includes, but is not limited to, landfill closure requirements and ground water remediation.**

Response: The text in the FS Section 2.1.6.2 has been revised to include Chapter 15, Section 2510(g), as a potential ARAR. Specific sections of Chapter 15 are discussed in the text but not listed in the summary Table 2.2.

Comment 5: **Page 12 - Chapter 15 Section 2550.4, Concentration Limits, provides methodologies for setting cleanup levels greater than background. The proposed aquifer cleanup levels in Table 2.1 do not meet Chapter 15, which requires cleanup to background unless the Regional Water Board finds that cleanup to background is technologically or economically infeasible. Furthermore, SWRCB Resolution No. 92-49 (part of the Basin Plan) is also an action-specific ARAR requiring the establishment of cleanup levels as developed in Chapter 15, Section 2550.4. SWRCB Resolution No. 92-49 also requires that dischargers must cleanup and abate the effect of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored. Refer to Chapter 15 Section 2550.4 for specific information that must be addressed in establishing cleanup levels greater than background.**

Discharge limits for treated water must be based on the best practicable treatment technologies as required under SWRCB Resolution No. 68-16 and Resolution No. 92-49. As has been identified at OU2, the discharge limits for all volatile organic compounds in treated ground water are to be no greater than the method detection limit (0.5 ppb). If treated water is discharged to areas over the existing plume and will not migrate or further contaminate other waters, discharge at the aquifer cleanup levels is acceptable.

Response: Section 2.2.1 (RAOs) has been revised to include a discussion of the technical and economic infeasibility of attaining background aquifer levels based on methodologies of Section 2550.4. Further discussion of this issue is provided in the responses to EPA General Review, Specific Comment 41, and the EPA Technical Review of Volume V, ARARs, Comment 9.

The discharge limits for the treated water will be 0.5 $\mu g/l$ for individual VOCs listed in Table 2.1. However, discharge of treated water to areas overlying the contaminated groundwater plume need only meet aquifer cleanup goal levels. A column has been added to Table 2.1 as requested.

Comment 6: **Page 15 - SWRCB Resolution No. 92-49 is applicable to both the establishment of cleanup levels in ground water and the level of treatment for discharge.**

Response: The Army acknowledges that Resolution 92-49 is applicable to both the establishment of cleanup levels in groundwater and the level of treatment for discharge.

Comment 7: **Section 2.2.1 page 16 - The ground water remedial action objectives that are based on MCLs do not meet the requirements of Chapter 15 or SWRCB Resolution No. 92-49. Since cleanup levels are not typically modified after establishment in the Record of Decision, evaluation during the ground water extraction and treatment system operation is not considered acceptable to decide if attaining MCLs is practical and technologically feasible. The risk and interactions from multiple chemicals in ground water must be evaluated in establishing aquifer cleanup standards. At other sites within Fort Ord cleanup levels have been below MCLs due to the combined risk provided by multiple contaminants in ground water.**

Response: A discussion of the technical and economical infeasibility of attaining background aquifer levels is included in Section 2.2.1. Further discussion is referred to in the response to RWQCB Comment 5 above.

The cumulative risk from multiple chemicals in groundwater (at MCLs) has been evaluated and is summarized in Section 2.1.5. The results indicate that MCLs for the VOCs listed in Table 2.1 are protective of human health and the environment.

Comment 8: **Section 2.2.4 page 20 - The Fort Ord Soil Treatment Area (FOSTA) is not a regulatory agency-permitted unit, as stated in this section. However, the Underground Storage Tank Remediation Area (USRA) was permitted by the Regional Water Board for treatment of petroleum contaminated soils. Correct the language in the text.**

Response: The text in Section 2.2.4 has been corrected to state that the FOSTA is a regulatory agency approved unit.

Comment 9: **Ground Water Remedial Unit, Page 21, Fifth Bullet - The text indicates that the re-infiltration technology/process option was not selected due to high maintenance cost. However, ground water modeling presented in Section 2.2.13 contains an option for treated water injection. Why was the infiltration option eliminated so soon in the evaluation process if this option is being evaluated in the ground water model? Treated water recharge/infiltration is necessary to prevent potential salt water intrusion and create hydraulic barriers to contaminant flow.**

Response: Groundwater injection was considered for remedial alternative development and is contained in the recommended remedial alternative. Groundwater injection is considered discharge to the subsurface, whereas groundwater infiltration is considered discharge to the surface. Groundwater infiltration (surface infiltration) is not considered compatible with site conditions because of the existence of asphalt surfaces at Site 12 and the existence of sensitive habitat on Site 2; it was not selected for this reason. The Army agrees that treated water injection may be necessary to prevent saltwater intrusion and create hydraulic barriers to contaminant flow.

Comment 10: **Section 2.5.2 page 28 - The Regional Water Board is concerned with the alternative of capping both debris and contaminated soils and trying to enforce land use restrictions once land is transferred or sold to public and private parties. We encourage the Army to remove all contaminated soils now while access is unrestricted. In addition, total contaminated soil removal now will eliminate the need for future remediation activities. Most, if not all wastes at this site could be used as part of the foundation layer for the OU2 landfill cap. Please note, however, that any waste other than inert fill must be properly disposed of in permitted landfill.**

Response: The Army acknowledges the RWQCB preference to remove all contaminated soils now while access to these sites is unrestricted. Alternative 4, the preferred alternative, includes removal of all soil and debris.

Comment 11: **Tables 2.1 and 2.2 - These tables should be corrected in accordance with our preceding comments, where appropriate.**

Response: Table 2.1 has been changed to incorporate a column for discharge limits for treated water. Table 2.2 has been changed to correct an ARAR citation but all sections of Chapter 15 are not listed because Table 2.2 is intended as a summary table.

Comment 12: **Table 2.1 - This table must include a column identifying discharge limits for extracted and treated ground water. As stated above, discharge limits for treated water discharged to contaminated waters within the same plume can be equivalent to the aquifer cleanup limits; however, water discharge outside the plume must meet the**

requirements of SWRCB Resolution No. 68-16. Based on present information, discharged limits for water discharge outside the plume will be method detection levels for EPA Method 502.

Response: See response to RWQCB Comment 11 above.

APPENDIX 2A, SITES 2 AND 12

General Comments

Ground water modeling should include a sensitivity analysis to evaluate input parameters used and output generated. The sensitivity analysis conducted to decide the optimum extraction and injection well location is adequate. However, we are concerned in that lack of sensitivity analysis of the input parameters could compromise the modeling efforts to locate extraction and injection wells.

We are also concerned in that the modeling conducted for Sites 2/12 did not evaluate the hydrologeologic impacts after the ground water mound between OU2 and Sites 2/12 is removed. In previous discussions with the Army your consultant has said that the mound has been caused by irrigation at the Parade Grounds. If this is the case, with base closure we would assume this irrigation will cease and the entire ground water flow system will change. This information should be addressed and modeled to estimate the impacts.

Basewide ground water monitoring identifies that variable vertical ground water flow within the Upper 180 foot aquifer exists, will influence contaminant transport, and will ultimately affect the ability of the ground water pump and treat system to remediate contamination as identified by the modeling efforts. How has the variable vertical flow component been factored into the model? The use of a fixed vertical flow value is questionable at best.

Response: The sensitivity analysis of model input parameters for the finite-difference numerical groundwater flow model input parameters is described in Appendix D of the Basewide Hydrogeologic Characterization in Volume II of the RI/FS.

During the modeling of the Sites 2 and 12 groundwater treatment systems, the recharge associated with the groundwater mound was eliminated, and the pumping scenarios were evaluated for their ability to operate in the resultant groundwater flow conditions. The modeling indicated that the pumping scenarios were not significantly affected. The results of this modeling were not included in the RI. However, this type of predictive groundwater modeling and evaluation will be conducted and presented during the OU 2 pre-design investigation and the Sites 2 and 12 pilot study.

The variable vertical flow components of the groundwater flow at Fort Ord occur in response to either aquifer discharge or recharge. The model simulates the effects of recharge and discharge and also simulates vertical flow conditions. Transient vertical flow conditions created and documented during the Sites 2 and 12 pilot study will be evaluated and used for additional model calibration.

Specific Comment

Comment 1: Section 2A2.2.1 Page 2A2 - **The ground water model should be run and calibrated for long-term transient conditions. By only evaluating short-term conditions, potential boundary conditions that may affect the long term cleanup viability will not be evident. Additional modeling and calibration should be undertaken to further refine**

the ground water model to insure the proposed extraction system will not be compromised in the future.

Response: The model was not calibrated for long-term transient conditions because the field dataset necessary for calibration did not exist at the time of modeling. Additional modeling will be conducted during the OU 2 pre-design activities and during the Sites 2 and 12 pilot study activities. Long-term transient model calibration will be conducted using data generated from the field tests. Transient conditions expected to be simulated will include the 3- to 6-month operation of an extraction and injection system in the vicinity of Monterey Bay at Site 2.

SITES 16 AND 17

General Comments

The Regional Water Board is concerned with the alternative of capping both debris and contaminated soils and trying to enforce land use restrictions once land is transferred or sold to public and private parties. We encourage the Army to remove all contaminated soils now while access is unrestricted. In addition, total contaminated soil removal now will eliminate the need for future remediation activities. Most, if not all wastes at this site could be used as part of the foundation layer for the OU2 landfill cap. Please note, however, that any waste other than inert fill must be properly disposed of in permitted landfill.

Response: Comment acknowledged.

Specific Comments

Comment 1: **Section 3.1.3.3, Page 3: The closest residents to these two areas are within one mile, not three miles as stated in the text. This needs to be corrected.**

Response: The text has been revised.

Comment 2: **Section 3.1.5.1, Page 6: The text should state that all agencies, including the Regional Water Board, have approved the *Draft Technical Memorandum, Preliminary Remediation Goals, Fort Ord, California*, dated June 14, 1993. Furthermore, the Regional Water Board approved the total petroleum hydrocarbon (TPH) concentration level as a preliminary goal with qualifiers that site specific information and a risk assessment must be used to further refine the final target cleanup level.**

Response: Section 3.1.5.3 has been revised to note that the other signatories of the FFA have also approved the *Draft Technical Memorandum*.

Comment 3: **Section 3.1.6.2, Page 7: SWRCB Resolution No. 92-49 also applies to establishing soil cleanup levels where contamination may or will cause a threat to water quality. As such, SWRCB Resolution No. 92-49 should be included in the listing of potential ARARs.**

Response: The text has been revised regarding SWRCB Resolution No. 92-94 as a potential ARAR.

Comment 4: **Section 3.3.3, Page 17: Alternative 3 is not an acceptable alternative for waste disposal from Pete's Pond or Pete's Pond Extension because Site 17 does not satisfy Chapter 15 requirements for waste management units. Furthermore, the proposed**

alternative does not include plans to install bottom liners, conduct water quality water monitoring, and conduct final closure activities pursuant to Chapter 15.

Response: Alternative 3 has been modified to address this comment. The Army intends to comply with Chapter 15 requirements to the extent feasible.

Comment 5: **Section 3.3.4, Page 18: The "Monterey County Sanitary Landfill" does not exist in Marina. The landfill is the Marina Landfill operated by the Monterey Peninsula Waste Management District. Correct the text.**

Response: Comment acknowledged. The offsite landfill has been eliminated as the method for debris disposal. If this alternative is chosen, debris would be incorporated in the Fort Ord Landfill as part of the foundation layer.

Comment 6: **Section 3.5.2, Page 21: The section on compliance with ARARs is incorrect with respect to Chapter 15. Chapter 15, Section 2511(d), requires the Army to comply with the requirements of Chapter 15 to the extent feasible. As such, Section 2511(d) does allow the Army to construct a cap over the in-place waste without constructing a multi-layered liner system beneath the waste.**

Response: The text has been revised to state that the Army will comply with the requirements of Chapter 15 to the extent feasible.

Comment 7: **Section 3.5.3, Page 23: The section on compliance with ARARs is incorrect with respect to Chapter 15. Specifically, Chapter 15 requires that excavated waste from Pete's Pond and Pete's Pond Extension must be discharged to a permitted waste management unit. Furthermore, the waste disposal from Pete's Pond and Pete's Pond Extension into Site 17 is not acceptable, as the Site 17 waste disposal area does not meet Chapter 15 landfill construction standards for waste management units. In addition, water quality monitoring and landfill closure requirements pursuant to Chapter 15 must also be followed. The text must be corrected.**

Response: The text has been revised. Placement of excavated waste at Site 17 or at the OU 2 landfill will be in compliance with Chapter 15 to the extent feasible.

Comment 8: **Section 3.5.3, Page 24, Regulatory Agency Acceptance: The statement "The regulatory agencies have approved similar remediation plans [waste removal and placement at permitted sites] at numerous sites under similar conditions, and it is anticipated that they would accept this alternative" is presumptive by the Army and is not correct. Each alternative applicable to individual sites should stand on its own merits. In addition, we are not aware of any other unpermitted sites that have the range of contaminants (e.g., medical waste, explosive waste and unknown debris) existing at this site. Furthermore, as we have stated, Alternative 3 does not meet Chapter 15 requirements and as such would not be approved by the Regional Water Board.**

Response: The text has been revised. Please see response to Comment 4.

Comment 9: **Section 3.6, Page 27, Compliance with ARARs: The text is incorrect in stating that Alternative 3 would meet action-specific ARARs. As stated above, Chapter 15 requires that waste placement at Site 17 would require construction of a waste management unit in compliance with all construction and water quality monitoring requirements of Chapter 15. The proposed alternative does not include construction**

of a Chapter 15 compliant waste management unit. As such, Alternative 3 is not in compliance with ARARs.

Response: The text has been revised. Please see response to Comment 4.

SITE 31

General Comments

The remedial actions should be expanded to include removal of all contaminated soils and debris in addition to soils contaminated by lead above the TCL. The soils and debris could be used as part of the foundation layer for the OU2 landfill closure. Contaminated soils left on-site may pose a long term environmental problem for the Army and require long term monitoring water quality and site closure for the proposed remedial actions. Complete removal will eliminate any long term monitoring requirements or potential future actions in the event that land use options change. The availability of the OU2 landfill for disposal of excavated materials provides the Army with a cost effective alternative to off-site disposal in addition to providing the additional soil needed for the OU2 landfill closure.

Response: The approach of establishing one soil remedial unit at Site 31, based on the BRA and consisting of surface soil with lead concentrations that exceed 1,860 mg/kg, represents a compromise between two other approaches considered:

(1) Removing none of the waste to minimize impacts to Site 31's sensitive habitat (recommended in the ERA)

(2) Removing all of the waste on Site 31 to protect human health, environmental receptors, or groundwater from possible future contamination from this waste.

The first approach, although recommended in the ERA, was rejected because it would leave lead in place at concentrations that pose an unacceptable risk to human health. The second approach would require removal of soil and debris in excess of 7,000 cubic yards, covering almost 1 acre (40,000 square feet) of hillside, and extending to a depth of 15 feet below the ground surface. Removing this waste would necessitate disruption of a large area of the site. Given the loose, unstable geology of the ravine side slopes, large quantities of surrounding soil would also have to be removed while excavating the deeper debris, unless costly shoring systems were used. It also would require removal of the live oak woodland habitat and other sensitive habitat areas that would take several years to reestablish even with mitigation efforts. These efforts would create much more severe impacts to the environment than leaving lead at concentrations less than 1,860 mg/kg. Biota samples taken from the site did not show any unacceptable detrimental impacts to the local habitat, even after 40 years of exposure to the waste materials.

For these reasons, the decision was made to establish one remedial unit in surface soil on the North Slope where lead concentrations exceed 1,860 mg/kg.

Section 5.2.1.2 of the Site 31 FS has been revised to provide a more detailed discussion on the rationale for development of the soil remedial unit.

Specific Comments

Comment 1: **Section 5.1.4.3, Page 3: Chemical data collected during Remedial Investigation (RI) activities were evaluated for impacts to ground water; however, the contaminated soils can also be transported downslope into the intermittent stream channel at the bottom of the ravine and ultimately into surface water. The Army must evaluate the potential for surface water contamination from contaminated soils at the site. In particular, identified pesticides and inorganic substances are environmentally persistent and can cause ecological damage at low concentration levels. The Army must evaluate the site specific contamination potential, the potential for off-site migration and whether ecological damage will result.**

Response: Text has been revised to address surface water. The potential is very low for offsite migration of chemicals present at Site 31 via this mechanism, as described in Section 5.0, Fate and Transport, Site 31 Remedial Investigation, Volume II. Additional discussion regarding the elimination of surface water controls from the development of remedial alternatives is presented in Section 5.2.4 of the Feasibility Study.

Comment 2: **Section 5.1.5, Page 6: We disagree with the statement "Additional intrusive remedial actions needed to achieve ecological based TCL . . . would likely cause more ecological damage . . . than leaving such material in place." We believe that while ecological damage will occur in the short run during removal activities, the remedial actions for total removal is prudent for the long term ecological and water quality protection.**

Response: No text has been changed. Long-term ecological protection is addressed in the response to the RWQCB General Comment for Site 31, as well as in Section 5.2.1.2. Long-term water quality protection is addressed in the Site 31 RI, Fate and Transport section, as summarized in FS Section 5.1.4.3.

Comment 3: **Section 5.1.6.2, Page 13, Action Specific Requirements: The identification of Chapter 15 for the site is correct; however, the conclusion on the applicability of Chapter 15 to the site and proposed actions are incorrect. In particular, this section states "Because remedial actions at Site 31 will be taken at the direction of public agencies to clean up or abate the waste discharge to land at the point of release, these remedial actions are exempt from the provisions of Chapter 15." While this statement is correct, the subsequent statements regarding Chapter 15 is incorrect because the exemption is not an all-inclusive exemption. Section 2511(g) [sic] states " . . . that wastes, pollutants, or contaminated materials removed from the immediate place of discharge shall be discharged according to Article 2 of Chapter 15, and further provided that remedial actions intended to contain such wastes at the place of release shall implement applicable provisions of Chapter 15 to the extent feasible." Thus, the remedial alternatives proposed must meet the requirements of Chapter 15 to the extent feasible. Alternatives include, but are not limited to, construction standards for new waste management areas, water quality monitoring, closure and post closure maintenance.**

Response: The applicability of Chapter 15 to the remedial action at Site 31 is a matter of interpretation. It is important to note that Chapter 15, 2510(a) states that "the regulations in this subchapter (Chapter 15) pertain to water quality aspects of waste discharge to land." The waste materials present at Site 31 do not pose a threat to ground or surface waste quality either currently or in the future.

Nevertheless, remedial actions are recommended for Site 31 to reduce human health risks. Removal of the waste materials will be subject to the first provision of Section 2511(d), which states "that wastes, pollutants, or contaminated materials removed from the immediate place of release shall be discharged according to Article 2 of this subchapter." Article 2 specifies waste classification, management, treatment, storage, and disposal requirements. However, the second provision, which states "that remedial actions intended to contain such wastes at the place of release shall implement the provisions of this subchapter to the extent feasible," is not applicable. Based on the results of the Remedial Investigation, no remedial actions at Site 31 are required to contain wastes at the place of release because waste materials pose no significant threat to ground and surface waters.

Section 5.1.6.2 has been revised to provide more detail regarding the applicability of Chapter 15 requirements.

Comment 4: **<u>Section 5.1.6.2, Page 13</u>: Chapter 15 requirements apply to all waters, including surface and ground water. Section 5.1.6.2 states "Thus, chemicals remaining in place do not pose a current or future threat to groundwater . . ." The Army must evaluate the threat to surface water related to soil contamination.**

Response: See response to RWQCB Comment 1 on Site 31, above, for discussion regarding impacts to surface water.

Comment 5: **<u>Section 5.2.1.1, Page 15</u>: The chemical of interest should include the pesticides 4,4'-DDE and 4,4'-DDT. Soil contamination caused by DDT compounds are above California hazardous waste levels and are long-lasting persistent chemicals that have been shown to contaminate surface water supplies and cause ecological damage.**

Response: Text has been revised to include discussion on DDE and DDT. Section 5.1.5 of the Summary of Risk Assessments lists chemicals detected at the site and that were considered in developing the Human Health and Ecological Risk Assessments for Site 31. This listing of chemicals includes the pesticides 4,4'-DDE and 4,4'-DDT. Because neither the BRA nor the ERA found 4,4'-DDE and 4,4'-DDT to be a risk to human health or the environment, these chemicals are not listed as chemicals of interest for development of soil remedial units in Section 5.2.1.1.

The maximum detected concentration for 4,4'-DDE and 4,4'-DDT at Site 31 was found in the same sample location at concentrations of 1.2 and 1.7 mg/kg, respectively. Only one single surface soil datapoint exceeded the Total Threshold Limit Concentration of 1.0 mg/kg for these compounds. A small amount of soil containing DDE/DDT might be classified as a hazardous waste per 22 CCR Chapter 11. With composite sampling, it is quite possible that the soil would not be classified as hazardous.

A hazardous waste classification is not a cleanup standard but a general classification established regarding waste transport, handling, and landfill acceptance. The classification standards are general and not based on site-specific conditions. The BRA and ERA do account for actual conditions, and 4,4'-DDE and 4,4'-DDT concentrations do not pose a risk to human health or the environment.

Comment 6: **<u>Section 5.2.1.2, Page 15</u>: The last paragraph on this page states "The Soil Remedial Unit is located on steep (1 to 1) slopes." The (1 to 1) notation should include text stating these refer to the ratio between the vertical to horizontal slope distance.**