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**U.S. Army  
Environmental  
Center**

**FORT DEVENS  
REMEDIAL INVESTIGATIONS/FEASIBILITY STUDY  
FINAL WORK PLAN  
GROUP 2**

**FINAL  
TASK ORDER WORK PLAN  
AREA OF CONTAMINATION  
(AOC) 57, 63AX, AND 69W  
DATA ITEM A002**

**CONTRACT DAAA31-94-D-0061**

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**U.S. ARMY ENVIRONMENTAL CENTER  
ABERDEEN PROVING GROUND, MARYLAND**

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SECTION 1

AOC 57

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**FINAL WORK PLAN  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY  
AOC 57  
FORT DEVENS, MASSACHUSETTS**

**DATA ITEM A002**

**CONTRACT NO. DACA31-94-D-0061**

*Prepared for:*

**United States Army Environmental Center  
Aberdeen Proving Ground, Maryland**

*Prepared by:*

**ABB Environmental Services, Inc.  
Wakefield, Massachusetts**

**JANUARY 1996**

FINAL WORK PLAN - AOC 57  
FORT DEVENS, MASSACHUSETTS

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**GLOSSARY OF ACRONYMS AND ABBREVIATIONS**

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EXECUTIVE SUMMARY

Site Investigations (SIs) were conducted by ABB Environmental Services, Inc. (ABB-ES) at Fort Devens between May 1992 and January 1994 at twelve Study Areas (SAs) and nineteen historic gas station sites in Groups 2 and 7. As a result of the SI for SA 57 in Group 2, SA 57 was divided into two areas of concern. Area 1 was identified as the storm drain outfall (at Cold Spring Brook) which drained the Building 3713 area. Area 2 was defined as the drainage swale associated with Building 3757, and immediate surrounding area, including a portion of Cold Spring Brook downstream from Area 1. Area 1 has subsequently been included for study under the installation-wide AREES-70 storm water study. Based on the SI findings, and results of a subsequent removal action, a remedial investigation and feasibility study (RI/FS) has been recommended at SA 57/Area 2. This Draft Work Plan provides a history of investigation activities and findings at SA 57, and outlines proposed plans for the RI/FS. In this Work Plan and all subsequent plans and reports, SA 57 will be referred to as Area of Contamination (AOC) 57.

ABB-ES will conduct RI and FS activities at AOC 57 in accordance with the plans and rationale presented in the Work Plan and in conformance to the methods, procedures, and requirements set forth in the Final Project Operations Plan (POP) prepared by ABB-ES for activities conducted at Fort Devens.

As proposed in the Work Plan, activities will be performed to establish the nature and extent of contamination at the site, to evaluate potential risks to humans and the environment presented by the contaminants, and to develop and evaluate remedial alternatives to eliminate or reduce those hazards to acceptable levels. The following specific activities will be conducted at AOC 57/Area 2 as integral parts of the RI/FS:

- Background Historical Research - as a means to further understand and better characterize the contaminant release scenarios at AOC 57/Area 2;
- A Geophysical Survey - to rapidly gather AOC-wide, non-intrusive data on subsurface features. The proposed 10-acre survey will focus

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on identifying the location of potential subsurface utilities such as underground storage tanks and pipelines, as well as buried materials that may have contributed to the release of contaminants. The geophysical survey results will also provide information on subsurface geology to aid in the placement of test pits, soil borings and monitoring wells;

- Excavation of 40 Exploratory Test Pits - to define the boundaries of contaminant migration and characterize the vertical distribution of contaminants within the overburden;
- Drilling of 4 Soil Borings - to allow the collection of additional subsurface soil samples for chemical analysis;
- Installation of 4 Piezometers and 10 Groundwater Monitoring Wells - as a means to gather information on the distribution of dissolved phases of contaminants, monitoring possible free-phase product thicknesses, and characterization of aquifer hydraulic properties;
- Collection and Analysis of Soil, Groundwater, Surface Water, and Sediment Samples - including both field and laboratory analysis, to provide information necessary to evaluate contaminant distribution, assess potential risks to human health and the environment, and develop and evaluate remedial alternatives;
- An Ecological Survey and Wetlands Investigation - to identify potential ecological receptors and exposure pathways in Cold Spring Brook and its floodplain at AOC 57/Area 2;
- Human Health and Ecological Risk Assessments - to evaluate both actual and potential human health and ecological risks associated with soil, groundwater, surface water, and sediment contamination;
- Treatability Study/Pilot Testing - to provide data to allow treatment alternatives to be more accurately evaluated in the FS, to reduce uncertainties associated with the cost and performance of a

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treatment technology, and to support the design of the selected remedial alternative;

- **Determination of Applicable or Relevant and Appropriate Requirements** - to aid in establishing clean-up objectives for media of concern, to determine whether site features such as wetlands or floodplains will restrict activities on site, and to determine if the type and concentration of contaminants will trigger certain regulations, such as those which restrict land disposal or those that apply to a specific type of compound;
- **Remedial Alternatives Development/Screening** - as a key part of the FS, to develop a range of reasonable remedial alternatives which can be subjected to a detailed evaluation; and
- **Detailed Analysis of Alternatives** - performed in the FS to provide decision-makers with information that will assist them in selecting the best alternative for remediation of the site.

A comprehensive report presenting the results of these activities will be prepared upon completion.

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## 1.0 INTRODUCTION

Site Investigations (SIs) were conducted by ABB Environmental Services, Inc. (ABB-ES) at Fort Devens between May 1992 and January 1994 at the twelve Study Areas (SAs) and nineteen historic gas station sites in Groups 2 and 7. The background, investigation results, and status of those SAs are described in the Groups 2, 7, and Historic Gas Stations Site Investigation Report (ABB-ES, 1993a) and the Groups 2, 7, and Historic Gas Stations Supplemental Site Investigation Data Package (ABB-ES, 1994). As a result of the SI for SA 57 in Group 2, SA 57 was divided into two areas of concern. Area 1 was identified as the storm drain outfall (at Cold Spring Brook) which drained the Building 3713 area. Area 2 was defined as the drainage swale associated with Building 3757, and immediate surrounding area, including a portion of Cold Spring Brook downstream from Area 1. Area 1 has subsequently been included for study under the installation-wide AREES-70 storm water study. Based on the SI findings and results of a subsequent removal action, a remedial investigation and feasibility study (RI/FS) have been recommended at SA 57/Area 2. This Draft Work Plan provides a history of investigation activities and findings at SA 57, and outlines proposed plans for the RI/FS. In this Work Plan and all subsequent plans and reports, SA 57 will be referred to as Area of Contamination (AOC) 57.

ABB-ES will conduct RI activities at AOC 57 as outlined in this Work Plan in accordance with the plans and rationale presented herein and in conformance to the methods, procedures, and requirements set forth in the Final Project Operations Plan (POP) (ABB-ES, 1995b).

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## **2.0 SITE BACKGROUND AND PHYSICAL SETTING**

### **2.1 SITE BACKGROUND**

AOC 57 consists of two areas, Area 1 and Area 2, located east of Barnum Road, on the Main Post south of Building 3713 (Figures 2-1 and 2-2). A storm drain outfall which collects rainfall from the paved areas around Building 3713 has been designated Area 1. The runoff from the storm drain flows to the outfall at Area 1, and eventually into Cold Spring Brook. Area 2 is located 800 feet north of Area 1, and adjacent to a vehicle storage yard associated with Buildings 3757 and 3758. This area formally consisted of an eroded drainage ditch created by periodic rain runoff. The area has been recently regraded and a permanent drainage swale has been installed. Runoff drains into the swale and discharges east to Cold Spring Brook.

On February 13, 1977 Fort Devens personnel at Building 3713 noticed No. 4 fuel oil flowing from an overfilled UST into a nearby storm drain (Biang et al., 1992; DFAE, 1977). An estimated 50 to 100 gallons of oil entered Cold Spring Brook through Area 1 outfall. Containment dikes and absorbent booms were set up across Cold Spring Brook adjacent to Area 2, and approximately 3,000 gallons of mixed oil and water were recovered from the swamp (DFAE, 1977).

A portion of this spill reportedly flowed across Barnum Road to Area 2. However, topographic relief in the spill area and Area 2 is such that the oil could not have flowed overland to Cold Spring Brook.

ABB-ES conducted a SI at Areas 1 and 2 in September 1992. The objective of the SI was to investigate the presence or absence of environmental contaminants in the different environmental media found at AOC 57, as a result of the February, 1977 fuel oil spill. A detailed description of the results of the SI are presented in the Final Groups 2, 7, and Historic Gas Station SI Report (ABB-ES, 1993a).

Samples of surface soil, surface water, and sediment were collected from Areas 1 and 2 during the SI. Polycyclic aromatic hydrocarbons (PAHs) and total petroleum hydrocarbon compounds (TPHC) possibly associated with the fuel oil

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were detected in surface soils at Area 1 (57S-92-01X through 57S-92-03X). The human health Preliminary Risk Evaluation (PRE), which was conducted to evaluate potential exposure to the detected PAH compounds and TPHC, indicated that there was no unacceptable health risk for the presumed commercial/industrial future site use. Because Area 1 is part of the storm water drainage network which discharges into Cold Spring Brook, the Army recommended that this area be further investigated as part of the installation-wide Area Requiring Environmental Evaluation (AREE) 70 storm water study.

At Area 2, naphthalene and TPHC were detected in surface soils during the SI (57S-92-06X through 57S-92-08X). Fingerprint analysis of soil from Area 2 indicated that contaminated soil was most likely derived from lubricating oil, possibly from the release of vehicle crank case oil. Given this finding, the contaminants found at Area 2 are not likely related to the 1977 release of No. 4 fuel oil. Results of the human health and ecological PREs indicated that the chemical hazards at Area 2 were not significant. However, in considering future property value and potential purchase prospects, the Army proposed that a removal action (focused on TPHC) be conducted. Eight additional surface soil samples (57S-93-10X through 57S-93-17X) were collected from the drainage ditch area and screened for TPHC to aid in determining the extent of contamination requiring removal (Figure 2-2). A soil removal action was subsequently conducted at Area 2 in August and September, 1994.

The following subsections present a detailed summary of analytical results by medium, at Area 2. A discussion of subsequent soil removal activities at Area 2 is also presented.

### 2.1.1 Surface Soil

Three surface soil samples were collected from stained areas within the drainage ditch at Area 2 (57S-92-06X through 57S-92-08X). These samples were collected to assess the distribution of contaminants along the ditch (see Figure 2-2). Each sample was submitted for analysis of Project Analyte List (PAL) SVOCs, TPHC, Total Organic Carbon (TOC), oil fingerprinting, and grain size.

Analysis of surface soil samples detected naphthalene at a concentration of 0.3 micrograms per gram ( $\mu\text{g/g}$ ) at 57S-92-07X. TPHC were detected at each surface

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soil sample location, at concentrations ranging from 606  $\mu\text{g/g}$  at 57S-92-08X to 4,910  $\mu\text{g/g}$  in the duplicate sample at 57S-92-07X. Fingerprint analysis of soil from Area 2 indicated that contaminated soil was most likely derived from a release of vehicle crank case oil.

The human health PRE conducted to evaluate potential exposure to the detected PAH compounds, and for TPHC, indicated that there was no unacceptable health risk for commercial/industrial site use. The concentrations of naphthalene and TPHC were determined to be well below their respective ecological benchmark values. However, in consideration of the source of contaminants, the ecological PRE established that it was unknown whether or not concentrations of analytes other than SVOCs may be contributing to ecological risk at the site.

### **2.1.2 Surface Water and Sediment**

Two surface water and sediment sampling locations were sampled from Cold Spring Brook during the SI. One surface water and sediment sample location was located approximately 1,000 feet upstream (57D-92-01X), and one was located approximately 3,000 feet downstream (57D-92-02X) of AOC 57/Area 2, to assess if contaminants from AOC 57/Area 2 were impacting the surface water and sediment quality in the Brook (see Figure 2-2). In addition, surface water and sediment samples were collected from Cold Spring Brook during the Group 3 site investigations. One location (G3D-92-01X) was located immediately upstream from AOC 57/Area 2, while one (G3D-92-02X) was located just downstream of Area 2 (Figure 2-2).

Two rounds of surface water and sediment sampling were conducted during the SI. The first round of surface water samples from these two locations was analyzed for PAL SVOCs, TPHC, and PAL water quality parameters. The first round of sediment samples was analyzed for PAL SVOCs, TPHC, TOC, and grain size. The second round of sampling involved resampling surface water and sediment from 57D-92-01X, and surface water only at 57D-92-02X. The second round of surface water samples was analyzed for PAL VOCs, PAL SVOCs, PAL inorganics, and TPHC. The additional sediment sample was analyzed for PAL VOCs, PAL SVOCs, PAL inorganics, TPHC, and TOC.

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Surface water analytical results indicated the presence of chloroform at a concentration of 1.1 micrograms per liter ( $\mu\text{g/l}$ ), in the second surface water sample collected from 57D-92-01X. No other organic compounds were detected in the surface water samples collected. Cation/anion concentrations appeared to remain relatively constant in each surface water sample collected from Cold Spring Brook. Results of the Group 3 upstream surface water sample (G3D-92-01X) was consistent with 57D-92-01X, the SI upstream sample. The Group 3 downstream sample (G3D-92-02X) results were very similar to G3D-92-01X, suggesting that Area 2 is not impacting the surface water quality.

Sediment sampling results indicated the presence of PAHs and TPHC at both sampling locations. PAHs increased in number and in concentration at the downstream location (57D-92-02X), and were not detected at all at the upstream location (57D-92-01X) during the second sediment sampling event. TPHC concentrations were higher at the upstream location (57D-92-01X). The TPHC concentration of the sole sediment sample collected at 57D-92-02X was  $92.6 \mu\text{g/g}$ . The TPHC concentrations at 57D-92-01X were 497 and  $466 \mu\text{g/g}$  from Round 1 and Round 2 respectively. Several inorganic analyte concentrations appeared to be consistent in each of the sediment samples collected from Cold Spring Brook.

The Group 3 sediment results indicated the presence of VOCs, SVOCs, TPH, and various inorganics in both the upstream and downstream samples. However, the concentrations of detected analytes were similar in both the upstream and downstream samples, suggesting that AOC 57 is not impacting the sediment quality in Cold Spring Brook.

A human health and ecological risk PRE of surface water and sediment samples collected from Cold Spring Brook was not conducted during the SI. Results from sampling of this medium were evaluated during the AREE 70 study (Arthur D. Little, Inc., 1994) and current Lower Cold Spring Brook Study (ABB-ES, 1995a). The AREE 70 evaluation gathered information on 55 storm drain systems and three surface water bodies, and identified potential sources of contamination that were not identified through previous investigations. Included in the AREE 70 evaluation was Storm Drain System 6 (AOC 57 Area 1). Three sediment and two water samples were collected at three locations within the drainage ditch (SSD/SSW-93-06A, SSD/SSW-94-06B, and SSD-94-06C). Of these samples only SSD/SSW-93-06B is located within AOC 57. Analyses of the surface water and

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sediment samples indicated elevated levels of arsenic, chromium, and lead in sediment and arsenic and lead in water. Seventeen SVOCs were reported in SSD-93-06B. This sample also had the highest concentration of total SVOCs at approximately 59.8  $\mu\text{g/g}$ . Results of the sampling were incorporated into the Lower Cold Spring Brook Study PRE.

### **2.1.3 Soil Removal Activities**

Although the results of the human health and ecological PREs indicated that the chemical hazards were not significant, in considering future property value and potential purchase prospects, the Army proposed that a removal action (focused on TPHC) be conducted at Area 2.

Subsequently, ABB-ES prepared a document entitled "Final Action Memorandum, SA 57 Barnum Road Oil Spill Area 2, Fort Devens, Massachusetts" in June 1994. The Action Memorandum documented the decision to perform a removal action to address petroleum-contaminated soil in the drainage ditch at Area 2. The proposed clean-up objective outlined in the Action Memorandum was to remove surface soil within areas of petroleum staining, and historically high TPHC concentrations, to a TPHC concentration less than 500 milligrams per kilogram (mg/kg). The Action Memorandum estimated that a limited amount of soil needed to be excavated.

A removal action began on August 26, 1994 and continued until September 12, 1994. Soil was excavated using standard excavating equipment. Erosion control measures were taken during the excavation to prevent erosion and sedimentation of soil into the Cold Spring Brook wetland. Soil samples were collected for field analysis of TPHC as each area was excavated. TPHC was detected in these samples up to a maximum concentration of 74,208 mg/kg. Black, oily soil was detected at approximately 18 inches below ground surface (bgs) in an excavation, at the base of the slope. This soil was sampled for laboratory analysis for metals, SVOCs, TPHC, and VOCs. TPHC was detected at concentrations ranging from 29,300 to 50,100 mg/kg, and lead was detected at concentrations ranging from 137 to 464 mg/kg. The VOCs ethylbenzene, toluene, and xylenes were detected in the soil samples. SVOCs were not detected; however, detection limits were elevated due to dilution of the samples.

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Continued excavation efforts revealed stained soil laterally and at depths in excess of original estimates. A trench was excavated to the water table in the southernmost portion of Area 2 to define the extent of contamination. An oily sheen was observed on water in the trench. The water in this trench was analyzed for TPHC, polychlorinated biphenyls (PCBs), metals, SVOCs and VOCs. This sample contained elevated TPHC (754,000 mg/l) and PCBs (140 mg/l). GC-FID fingerprinting indicated that the oil was most likely a mixture of kerosene and lubricating oil.

The trench was not successful in determining the limits of contamination, so test pits were subsequently excavated outside the previously excavated area. Locations of the test pits are identified in Figure 2-2. Soils collected from the test pits were field screened to determine the extent of TPHC-contaminated soil. Soon after starting the test pit excavation, it became clear that contamination extended well beyond the limits originally estimated, and the removal action was suspended until Area 2 could be better characterized. A total of approximately 1,300 cubic yards of soil was ultimately excavated from Area 2, before it was lined with 6-mil polyethylene, backfilled with clean soil, and covered with an erosion control blanket. A drainage swale was constructed and lined with 6-inch riprap to channel runoff to the Cold Spring Brook wetland.

### 2.1.4 Lower Cold Spring Brook Study

In 1994, ABB-ES conducted a SI for Lower Cold Spring Brook. As part of the SI, a total of six surface water and sediment pairs (CSD-94-13X, -14X, -17X, -19X, -20X, and -35X) were collected from Lower Cold Spring Brook in the immediate vicinity of AOC 57/Area 2. The surface water samples were analyzed for PAL SVOCs, total and dissolved inorganics, and water quality parameters, TSS, chloride, sulfate, total hardness, and alkalinity. These surface water samples were also analyzed in the field for pH, dissolved oxygen, conductivity, and temperature. The sediment samples were analyzed for PAL VOCs, PAL SVOCs, PAL inorganics, TOC, TPHC, grain size distribution, and percent solids. At two of the locations, CSD-94-13X and -20X, the macroinvertebrate community was characterized, and sediment samples were subjected to toxicity testing. At these two locations, surface water and sediment samples were also analyzed for pesticides and PCBs. The data was subjected to human health and ecological preliminary risk evaluations (PREs). The findings of this SI were presented in the

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"Lower Cold Spring Brook Site Investigation Data Package", submitted in April 1995.

The results of this study indicated that the marsh located upstream of the 1977 containment dike contained sediments with elevated concentrations of VOCs, SVOCs, pesticides, PCBs, and inorganics. TPHC was detected at a maximum concentration of 2,700 mg/kg. SVOCs were detected at concentrations that marginally exceeded screening values, while pesticides, PCBs, and inorganics significantly exceeded screening values. Lead was detected in surface water at a concentration above the Ambient Water Quality Criteria (AWQC). Pesticides and the maximum concentrations of inorganics in sediment were found in the sample from location CSD-94-20X. Relative to the control, this station contained the poorest habitat. However, macroinvertebrate and aquatic toxicity results did not indicate any increased mortality relative to aquatic receptors.

## **2.2 PHYSICAL SETTING**

Limited subsurface investigation has been conducted at AOC 57. The following subsections describe the general physical setting at AOC 57 as determined from reference material on regional characteristics and site-specific information collected during the SI and removal effort.

### **2.2.1 Soil**

Unconsolidated surficial deposits of glacial and postglacial origin comprise nearly all of the exposed geologic materials at Fort Devens. The glacial units consist of till, deltaic deposits of glacial Lake Nashua, and deposits of glacial meltwater streams. The mapped surficial units in the Barnum Road area consist of sands and pebble- to boulder-gravels of glacial streams, and muck and peat swamp deposits (postglacial) near Cold Springs Brook (Jahns, 1953). Till is known to discontinuously underlie some of the water-laid deposits. The till locally ranges from unstratified gravel to silt, its consistency varies from loose to compact, and it is characteristically bouldery (Jahns, 1953). Subsection 2.2.5 of the Groups 2, 7 and Historic Gas Station Final SI Report presents a discussion of the Fort Devens soil series (ABB-ES, 1993a).

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## SECTION 2

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Grain size analyses were run on surface soil samples (57S-92-06X through 57S-92-08X), collected during the SI. These soils were determined to be fill or reworked glacial outwash. Soil types ranged from well graded sand to silty sand, with fines ranging from 1.6 to 20.2 percent and gravel from 0.7 to 37.9 percent. Water contents varied from 6.7 to 33.7 percent. Grain size analysis was also run on both sediment samples, and were indicative of sandy silt and silty sand.

### 2.2.2 Bedrock

Bedrock is not exposed at or near AOC 57. Bedrock in this portion of the installation has been mapped as the generally northeast-striking Berwick Formation (Silurian), consisting of calcareous and biotitic metasiltstone and fine-grained metasandstone, interbedded with small amounts of quartz-muscovite-garnet schist and feldspathic quartzite. West of Building 3713 the mapped bedrock unit is the Long Pond-Fort Devens facies of the Ayer Granite, which is a gneissic granite with both equigranular and porphyroblastic varieties (Zen, 1983; Robinson and Goldsmith, 1991). The "granite" may not be intrusive. Subsection 2.2.7 of the Group 2, 7 and Historic Gas Station Final SI Report presents a more detailed discussion of the bedrock geology for Fort Devens (ABB-ES, 1993a).

### 2.2.3 Hydrogeologic Conditions

No monitoring wells were installed during the SI at the site. However, monitoring wells from Group 3, which is located across Barnum Road from AOC 57, show that groundwater flows directly southeastward from the Building 3713 area to Cold Spring Brook. Water in Cold Spring Brook flows into Grove Pond, Plow Shop Pond, Nonacoicus Brook, and the Nashua River.

Groundwater in the surficial aquifer at the facility has been assigned to Class I under Commonwealth of Massachusetts regulations. Class I consists of groundwaters that are "found in the saturated zone of unconsolidated deposits or consolidated rock and bedrock, and are designated as a source of potable water supply" (314 CMR 6.03). Subsection 2.2.8 of the Group 2, 7 and Historic Gas Station Final SI Report presents a discussion of the regional hydrogeology for Fort Devens (ABB-ES, 1993a).

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### 3.0 INITIAL EVALUATION

#### 3.1 TYPES AND VOLUMES OF WASTE

Based on the results of the previous investigations, the primary site-related contaminants are TPHC and PAHs in soil and sediment. TPHC were detected at each surface soil sample location during the SI, at concentrations ranging from 606  $\mu\text{g/g}$  at 57S-92-08X to 4,910  $\mu\text{g/g}$  in the duplicate sample at 57S-92-07X. TPHC were also detected in subsurface soils during the soil removal effort, up to 40,000 mg/kg. Fingerprint analysis of soil from Area 2 during the SI indicated that contaminated soil was most likely derived from a release of vehicle crank case oil. Fingerprint analysis of the soil during the removal action indicated that the subsurface oil contamination may have resulted from lubricating oil and kerosene. PCBs and lead were also detected at elevated levels in excavated soils and in groundwater sampled during the removal action. The total volume of contaminated soil and groundwater has not been fully characterized.

The human health PRE conducted during the SI to evaluate potential exposure to the detected PAH compounds and for TPHC, indicated that there was no unacceptable health risk for commercial/industrial site use. The concentrations of naphthalene and TPHC were determined to be well below their respective ecological benchmark values. The higher concentrations of TPHC, the presence of PCBs, and the elevated lead detected during the removal effort were not evaluated in either a human health or ecological PRE.

Figure 3-1 presents a site conceptual model flow diagram showing the potential sources and transport mechanisms. The presumed source of contamination appears to be historical release(s) of vehicle crank case oil to surface soil. The primary release mechanisms are erosion and infiltration to subsurface soil. Contaminant migration pathways and transport mechanisms include wind, surface water runoff, and leaching of contaminants with storm water to lower soil horizons and groundwater.

The site's future use has been designated as "Rail, Industrial, and Trade-Related Uses" and "Open Space and Recreation". Exposure routes for the soil contamination to trespassers, on-post personnel and terrestrial ecological

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receptors appear to be via ingestion and direct contact. Exposure routes for groundwater are limited, in that it is unlikely drinking water wells will be installed at the site in the future. A potential inhalation exposure to dust by on-post personnel is also possible. Aquatic receptors in Cold Spring Brook may be exposed to contaminants in surface water and sediment via ingestion and direct contact.

### 3.2 PRELIMINARY IDENTIFICATION OF OPERABLE UNITS

The National Contingency Plan (NCP) (U.S. Environmental Protection Agency [USEPA], 1990) and the Federal Facility Agreement (Interagency Agreement [IAG], USEPA, 1991a) define an operable unit (OU) as a discrete response action that comprises an incremental step towards comprehensively addressing site contamination. The site may be divided into one or more OUs at any phase of the response action, depending on the type and complexity of contamination associated with the site. An OU approach may be appropriate for AOC 57/Area 2 depending on the RI field results.

Based on the conceptual model detailed in Subsection 3.1, the primary source of contaminants identified at AOC 57 is the historical release(s) of vehicle crank case oil to surface soil. This source has contaminated subsurface soils and may have affected groundwater and Cold Spring Brook. The Final SI PRE concluded that contaminants in the surface soil in the drainage ditch did not pose a significant risk to human health or the environment. However, during the soil removal action at AOC 57, contamination was identified over a larger area and at higher concentrations.

Based on the results of the removal action, an RI was recommended to focus on defining the distribution of soil contamination at AOC 57 and whether contaminants in soil have had an adverse impact on groundwater quality and surface water and sediment quality in Cold Spring Brook. Alternatives selected for remediation of the site are likely to entail combinations of technologies for the affected media due to the nature of the contaminants and site conditions. It is currently proposed that AOC 57 be handled as one OU. If the RI field results indicate that widespread or complex soil and groundwater contamination exists, or

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contamination in Cold Spring Brook can be directly linked to AOC 57/Area 2, multiple OUs may be appropriate.

### **3.3 PRELIMINARY IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES AND ALTERNATIVES**

As part of the project planning phase and development of the work plan, preliminary remedial action objectives and a preliminary range of remedial action technologies have been developed for AOC 57. The identification of technologies for development of potential alternatives at this stage is not intended to be a detailed investigation, but is intended to be a more general classification of potential remedial actions based upon the initially identified potential routes of exposure and associated receptors. Identification of potential technologies is made at this time in the process to help ensure that data needed to evaluate them can be collected during the RI or as early as possible from treatability studies. A detailed investigation of alternatives will be performed during the FS (see Subsections 5.10 and 5.11) based on data collected during the RI. Figure 3-2 depicts the preliminary remedial action objectives, general response actions and remedial action technologies under consideration for alternative development at AOC 57.

#### **3.3.1 Remedial Action Objectives**

Preliminary remedial action objectives were identified for each contaminated medium based on existing site information and the conceptual model. Remedial action objectives consist of medium-specific goals to protect public health and the environment based on the Applicable or Relevant and Appropriate Requirements (ARARs), the risk assessment goals, and technology-based cleanup goals. The chemical specific standards for soil and groundwater (e.g., Massachusetts Contingency Plan Method 1 soil standards, Massachusetts drinking water standards) were considered in developing the preliminary remedial action objectives identified in Figure 3-2.

Two of the four objectives identified for AOC 57 are for the contaminated groundwater. Based on a groundwater sample collected from the excavation

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during the removal action, contaminants in groundwater may exceed drinking water standards/guidelines. The identified objectives are as follows:

- to prevent the use of groundwater at AOC 57 for drinking water, and
- to prevent migration of the contaminated groundwater from the source.

The two other objectives are for the surface and subsurface soils at the site. Based on the results of the soil removal action, TPHC remaining in soil may pose a potential risk to human health and the environment. The identified remedial action objectives for the soil are to:

- prevent direct exposure to soils, and
- prevent contaminant migration via infiltration/percolation to groundwater, surface water runoff, and wind erosion.

The identified remedial action objectives for the sediments are to:

- prevent direct exposure to sediments, and
- prevent contaminant migration to surface water and groundwater.

These preliminary remedial action objectives will be reviewed and refined during the RI/FS process when RI results are obtained and as ARARs are identified.

### **3.3.2 General Response Actions**

Following identification of preliminary remedial action objectives, potential general response actions were developed. General response actions are general purpose statements describing probable remediation activities at a given site to meet remedial action objectives. The general response actions identified in this work plan have been based upon current understanding of the site and preliminary remedial action objectives. Groundwater general response actions identified for AOC 57 consist of:

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- no action
- minimal action
- containment
- collection
- treatment, and
- discharge/disposal.

Soil and sediment general response actions consist of:

- no action
- containment
- removal
- treatment, and
- disposal

### **3.3.3 Potential Remedial Technologies and Alternatives**

The potential technologies which are most likely to satisfy the general response actions were preliminarily identified from review of documented information and data on technologies, including USEPA-published reports and vendor information. Technologies were assessed considering probable effectiveness and implementability with regard to site-specific conditions, known and suspected contaminants, and affected media. Remedial technologies identified for the contaminated groundwater at AOC 57 consist of:

- no action
- institutional controls such as zoning, implementing deed restrictions and/or performing groundwater monitoring
- installing hydraulic barriers (e.g., slurry wall, grout curtain, sheet piling) to contain the groundwater
- using interceptor trenches or extraction wells to collect contaminated groundwater

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- performing physical/chemical or biological treatment in the form of aeration, air stripping, activated carbon, UV oxidation, chemical oxidation, air sparging, oil/water separation, in-situ bioremediation, or treatment at the Fort Devens Wastewater Treatment Plant (WWTP) (currently consists only of primary treatment) or at a local publicly-owned treatment works (POTW);
- discharging treated water to Cold Spring Brook, the Fort Devens WWTP, or local POTW.

Alternatives developed from these technologies will depend upon the results of the RI (also see Subsection 3.2, Preliminary Identification of Operable Units). If possible, the alternatives developed for screening will encompass a range or combination of the technologies in which treatment is used to reduce the toxicity, mobility, or volume of the organics, but will vary in the degree to which long-term management of residuals or untreated waste is required; one or more alternatives involving containment with little or no treatment; and a no-action alternative. Alternatives that involve limited and discrete efforts to reduce potential exposures (e.g., deed restrictions) will be presented as "limited action" alternatives.

The potential remedial technologies selected for the soils and sediments at AOC 57 include no action, removal and containment by capping the site with asphalt, a soil cover, or flexible membrane liner (FML) to prevent exposure to soil and reduce potential contaminant migration. Treatment technologies identified for soil include in-situ technologies such as soil vapor extraction and bioventing, and treatment technologies for excavated soil and sediments including thermal desorption, solidification, asphalt batching, and incineration. Bioventing is included as an innovative technology for treatment of TPHC which is not as readily treated using only soil vapor extraction. The presence of non-VOC contaminants (e.g., higher molecular weight hydrocarbons) may minimize the potential effectiveness of soil vapor extraction. Asphalt batching is a proven technology and has been successfully used at Fort Devens for petroleum contaminated soils, and may be able to be used as sub-base for road or parking lot construction. Soil meeting regulatory levels (before or after treatment) may be landfilled at an on-site or off-site, lined landfill.

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Potential remedial alternatives for AOC 57 may consist of excavation and treatment technologies for sediments, surface soil and shallow soil contamination, with groundwater collection and treatment. If a subsurface contaminant source is detected in the unsaturated zone, in-situ treatment (e.g., bioventing) may be appropriate. Based on the results of the RI, a treatability test for soil vapor extraction/bioventing may be recommended to determine the permeability of the soil and treatability of the petroleum source.

#### **4.0 RI/FS OBJECTIVES**

The extent of soil, sediment, and groundwater contamination observed during the SI and suspended removal effort has necessitated the need for an RI/FS to provide more complete characterization of nature of contamination at AOC 57/Area 2. The objectives of this RI/FS focus on expanding the characterization of contaminant distribution in soil, groundwater, and surface water and sediment, along with a more detailed evaluation of past and present contamination sources and migration. Coupled with these, the RI/FS will provide a detailed assessment of human health and environmental risk, which will be used as a basis for establishing clean-up goals, and ultimately an evaluation of alternatives for site remediation.

A discussion of the individual proposed RI/FS activities and data quality objectives to be used in pursuit of these objectives is presented below.

#### **4.1 RI/FS ACTIVITIES**

The following specific activities will be conducted at AOC 57/Area 2 as integral parts of the RI/FS:

- Background Historical Research
- A Geophysical Survey
- Excavation of Exploratory Test Pits
- Drilling of Soil Borings
- Installation of Piezometers and Groundwater Monitoring Wells
- Collection and Analysis of Soil, Groundwater, Surface Water, and Sediment Samples
- An Ecological Survey and Wetlands Investigation

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- Human Health and Ecological Risk Assessments
- Treatability Study/Pilot Testing
- Determination of Applicable or Relevant and Appropriate Requirements
- Remedial Alternatives Development/Screening
- Detailed Analysis of Alternatives

### **4.1.1 Background Historical Research**

As a means to further understand and better characterize the contaminant release scenarios at AOC 57/Area 2, ABB-ES will thoroughly research historical site use, past and present waste disposal practices, nearby in-use and abandoned underground storage tanks, and other potential sources of contaminants. The results of this research effort will also guide the selection of sampling locations and laboratory analyses. Information gathered under this research activity on current and future uses of the site will be incorporated into the assessment of human health and environmental risk.

### **4.1.2 Geophysical Survey**

After conducting the historical research and prior to exploratory work, a geophysical survey will be conducted at AOC 57/Area 2 to rapidly gather AOC-wide, non-intrusive data on subsurface features. The proposed survey will focus on identifying the location of potential subsurface utilities such as underground storage tanks and pipelines, as well as buried materials that may have contributed to the release of contaminants. The geophysical survey results will also provide information on subsurface geology to aid in the placement of test pits, soil borings and monitoring wells.

### **4.1.3 Exploratory Test Pits**

Because of the inherent complexity in the distribution of contaminants as observed during the SA 57 SI and subsequent removal action, a test pitting

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program will be conducted to define the boundaries of contaminant migration and characterize the vertical distribution of contaminants within the overburden.

Using the test pits excavated during the soil removal action as a basis, test pits will be located inside and outside the presumed limits of contamination for the purpose of evaluating presumed contaminant sources and migration pathways, as well as estimating volumes of contaminated soil. Soil samples will be collected from each test pit and analyzed for various chemical parameters to characterize the concentration and distribution of individual compounds.

The results of the test pitting program will be used with other RI data to assess risk to potential receptors, to establish clean-up goals, and to evaluate remedial action alternatives.

#### **4.1.4 Soil Borings**

Soil borings will be advanced to allow the collection of additional subsurface soil samples for chemical analysis. Borings will be drilled in the area of critical interest based on the test pit excavation findings to further define the limits of contaminant migration. The results will be used to support both the contamination assessment in the RI and the remedial alternative screening in the FS.

#### **4.1.5 Groundwater Monitoring Wells and Piezometers**

Evidence collected during the suspended removal effort at AOC 57/Area 2 revealed free phase product in soil at the water table suggesting the possibility of groundwater contamination in the form of dissolved and free-phase contaminants. Little information on local groundwater flow and contamination is available.

Characterizing the nature of potential groundwater flow and contamination in the area around AOC 57/Area 2 is of critical importance to defining potential receptors. The installation of groundwater monitoring wells and piezometers at AOC 57/Area 2 will provide information on the distribution of dissolved phases of contaminants, monitoring possible free-phase product thicknesses, and characterization of aquifer hydraulic properties, all which are important to the development of remedial alternatives in the FS process.

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Wells will be installed in locations selected to provide representative samples from upgradient and downgradient groundwater. Piezometers will be located to evaluate the hydraulic dynamics between groundwater and Cold Spring Brook as part of the assessment of potential downgradient receptors. Soil samples collected during the installation of these monitoring wells and piezometers will be used to characterize soil stratigraphy, also useful in developing remedial alternatives in the FS.

### **4.1.6 Sediment and Surface Water Sampling**

In order to characterize the nature of contaminant migration to Cold Spring Brook, sediment and surface water samples will be collected from wetland areas near AOC 57/Area 2, and in Cold Spring Brook. Whole sediment samples will also be collected for toxicity testing.

The results of the sediment and surface water sampling program will be used with other RI data to assess risk to potential receptors and establish clean up goals.

### **4.1.7 Sample Analysis**

Petroleum hydrocarbons appear to be the predominant contaminants present in soil and sediment collected at AOC 57/Area 2. Elevated concentrations of VOCs, PCBs, and lead, possibly associated with the petroleum hydrocarbons, have also been detected. Soil, groundwater, surface water, and sediment samples collected from selected locations within test pits, soil borings, monitoring wells, and Cold Spring Brook will be analyzed for these analytes. Chemical analyses performed during the RI will include various field screening techniques designed to provide a preliminary evaluation of contaminant distribution. Sample analysis will also include laboratory analysis designed to provide a higher level of accuracy in evaluating contaminant distribution, as input to the human health and ecological risk assessments, and remedial alternatives development. The field and laboratory analytical program will enhance and build upon efforts begun under previous investigations at the site, including the Lower Cold Spring Brook Study.

Toxicity testing will also be conducted on selected whole sediment samples collected for the wetland adjacent to AOC 57/Area 2. The test results will be used to evaluate adverse effects associated with exposure of selected freshwater

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invertebrate species to whole sediment. These results will be used to supplement the chemical data used in the ecological risk assessment, ultimately to define clean-up goals for AOC 57/Area 2 sediment.

#### **4.1.8 Ecological Survey and Wetlands Investigation**

A qualitative ecological survey will be conducted to identify potential ecological receptors and exposure pathways in Cold Spring Brook and its floodplain at AOC 57/Area 2. Information from the qualitative survey will be incorporated into the baseline ecological risk assessment. The results of the survey will provide information necessary for evaluating and developing cost estimates for remedial alternatives.

#### **4.1.9 Baseline Risk Assessment**

A baseline risk assessment, in accordance with EPA risk assessment guidelines, will be conducted at AOC 57/Area 2 to evaluate both actual and potential human health and ecological risks associated with soil, groundwater, surface water, and sediment contamination. The components of the two risk assessments will include the following: data summarization and selection of chemicals of potential concern (COPCs); hazard assessment; ecological characterization; exposure assessments; ecological effects assessment; toxicity assessment; risk characterizations; comparison of analytical data to health standards and guidelines; and qualitative uncertainty analyses.

#### **4.1.10 Treatability Study/Pilot Testing**

Treatability studies are typically conducted to provide data to allow treatment alternatives to be more accurately evaluated in the FS, to reduce uncertainties associated with the cost and performance of a treatment technology, and to support the design of the selected remedial alternative (USEPA, 1988). Treatability studies may not be necessary for well-developed technologies that have been proven to be effective at other, similar sites or for similar contaminants.

The need for treatability studies has not been identified for soil and groundwater at AOC 57/Area 2 at this time. However, as the RI field effort proceeds, certain

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other physical and chemical data may need to be collected to aid in evaluating remedial technologies. These additional data would be used in evaluating the effectiveness of various treatment technologies; data such as soil gradation, TOC content, and moisture content may be performed on selected soil samples in order to evaluate the potential effectiveness of soil treatment technologies such as soil vapor extraction or thermal desorption. Groundwater pumping tests could, for example, be used to establish the design parameters for groundwater extraction technologies; and specific water quality parameters could be used to evaluate the effectiveness of water treatment technologies.

### 4.1.11 Applicable or Relevant and Appropriate Requirements

CERCLA requires that Superfund remedial actions meet any federal and state standards, criteria, or requirements that are determined to be Applicable or Relevant and Appropriate Requirements (ARARs). Chemical-specific and location-specific ARARs can be identified during the RI as the chemical and physical site conditions are characterized. Action-specific ARARs are typically identified during the FS based on the remedial actions being evaluated. ARARs are considered during the RI/FS process to aid in establishing clean-up objectives for media of concern, to determine whether site features such as wetlands or floodplains will restrict activities on site, and to determine if the type and concentration of contaminants will trigger certain regulations, such as those which restrict land disposal or those that apply to a specific type of compound (e.g., PCBs). Compliance with ARARs is a criterion which must be met for an alternative to be selected as the remedial action.

### 4.1.12 Remedial Alternatives Development/Screening

A range of remedial alternatives are developed in the FS by assembling combinations of technologies to address the response objectives (see Section 3.0). The range of alternatives should include no action, actions that reduce contaminant migration or minimize exposure, and treatment alternatives that address the principal threats and eliminate or minimize the need for long-term management. These alternatives will then be screened using effectiveness, implementability, and cost criteria to limit the number of alternatives to be evaluated in detail, while still preserving the range of options.

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#### **4.1.13 Detailed Analysis of Alternatives**

A limited number of alternatives remaining after the screening process will be evaluated based on seven of the nine CERCLA criteria in the FS. The criteria of state and community acceptance will be evaluated upon receipt of state and public comments. Each alternative is evaluated individually, and then the alternatives are compared against each other to provide decision-makers with information that will assist them in selecting the best alternative for remediation of the site.

#### **4.2 DATA QUALITY OBJECTIVES**

The procedures of the Quality Assurance (QA) Objectives presented in Section 3.0 of Volume I of the Fort Devens POP will be followed during the RI/FS field program at AOC 57/Area 2 (ABB-ES, 1995b). This subsection describes a general scope of work, data quality objectives (DQOs) and the QA/QC approach.

Analyses will be conducted on samples collected from AOC 57/Area 2 to evaluate the nature and distribution of the contaminants detected during previous investigations. On-site field analysis will conform with the guidelines presented in Subsection 4.6 of Volume I of the Fort Devens POP. Off-site laboratory analytical procedures are presented in Section 7.0 of Volume I of the POP, and the Laboratory QA Plan and the USAEC Performance Demonstrated Analytical Methods procedures are presented in Appendices B and C, respectively, in Volume II of the Fort Devens POP (ABB-ES, 1995b).

The USEPA has recently identified two general levels of analytical data quality, which replace the former five general levels. One of the levels, Screening with Definitive Confirmation, generally comprises field screening and analysis, and encompasses former USEPA 1987 DQO Levels I and II. Activities conducted under the AOC 57 RI which fall into this category include basic field measurements for pH, conductivity, temperature, dissolved oxygen, turbidity, and photoionization detector (PID) measurements, as well as any on-site analyses. The other general level of data quality, Definitive Data, generally comprises laboratory analysis using CLP RAS or other published USEPA methods, and includes former USEPA 1987 DQO Levels III, IV, and V. Laboratory methods

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which have been performance-demonstrated under procedures outlined in the USATHAMA QA Plan (USATHAMA, 1990) fall into this level. This level includes off-site water quality parameter and other parameters where USAEC guidelines are not applicable, and off-site laboratory analyses for PAL organics and inorganics. The specific data requirements and analytical parameters for proposed samples at AOC 57/Area 2 are outlined in Section 5.0 of this Draft Work Plan.

All data collected during the RI/FS process (both chemical and geotechnical data) will be entered and stored in USAEC's Installation Restoration Data Management Information System (IRDMIS). The subcontract analytical laboratory will be responsible for entering all laboratory chemical data as USAEC Level II data, and ABB-ES will be responsible for all geotechnical data. The USAEC will be responsible for reviewing and qualifying the USAEC Level II data submitted by the subcontract laboratory, and elevating the chemical data to USAEC Level III data. At that point the chemical data will be at it's highest data quality and will be available for use in the IRDMIS. USAEC Level III and appropriate data will be used in the RI/FS Report.

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## **5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS**

### **5.1 PROJECT PLANNING**

The planning and scoping of the RI/FS program at AOC 57 was conducted in accordance with the USEPA guidance document "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", (USEPA, 1988).

### **5.2 COMMUNITY RELATIONS**

For this task ABB-ES will assist the U.S. Army in conducting communication activities relating to the site as outlined in the IAG (USEPA, 1991) and existing Community Relations Plan (CRP) (E&E, 1992, as revised) for Fort Devens.

The IAG stipulates that community relations be compliant with all USEPA public participation requirements specified by CERCLA and the NCP; a Community Relations Plan be developed; a public repository be established; an Administrative Record be established at two locations and the Administrative Record be updated and supplied to the USEPA.

The activities proposed in the CRP are designed to inform interested citizens and local officials about the progress of remedial activities and to provide opportunities for the public to be involved in planning remedial actions at the site. Specific community relation activities ABB-ES will participate in will include:

- attending Restoration Advisory Board (RAB) meetings pertaining to the site;
- preparing fact sheets to inform the public of the use of USEPA presumptive remedies (if applicable) as potential remedial alternatives, and of the proposed plan and public comment period;
- updating the Administrative Record;

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- attending a public informational meeting at the onset of the public comment period that provides an informal question and answer session about the proposed plan for remediating the site; and
- attending a formal public hearing during the public comment period that provides opportunity for the public to submit oral or written comments on the proposed plan for remediating the site. All comments received will be transcribed and responded to in the Responsiveness Summary.

### **5.3 FIELD INVESTIGATION ACTIVITIES**

All field activities will be conducted in accordance with the Fort Devens POP and USAEC's Geotechnical Guidelines (USAEC, 1987). The following subsections describe the proposed activities to be conducted during the RI/FS at AOC 57/Area 2, based on the objectives and rationale outlined in Section 4.0.

#### **5.3.1 Background Research**

Background research at AOC 57/Area 2 will involve an extensive search of historical records and other sources of information to include interviews with pertinent individuals knowledgeable in the past use and history of AOC 57/Area 2, photograph interpretation and literature searches. Coordination shall be made through USAEC and the Fort Devens BRAC Environmental Coordinator (BEC) Office. The objective of the research will be to discover and define contaminant release mechanisms, dates and locations of releases, and nature and volume of contaminants released.

#### **5.3.2 Surficial Geophysical Survey**

A surficial geophysical survey will be conducted in an attempt to locate subsurface source(s) of the TPHC contamination detected in soils at Area 2. Magnetometer and terrain conductivity surveys will be conducted on a 20-foot grid in an area approximately ten acres in size. Figure 5-1 shows the proposed location of the geophysical survey grid. The proposed area has been selected because it encompasses areas 1) in which contamination has been detected, and 2) presumed

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upgradient of detected contamination and therefore in a potential source area. Geophysical anomalies will be investigated with ground penetrating radar (GPR). Information obtained during the geophysical survey will be used to direct subsequent field activities (i.e., test pitting, borings, monitoring well placement, etc.). The geophysical survey will be conducted in accordance with Subsection 4.4.3 of Volume I of the POP (ABB-ES, 1995b).

### 5.3.3 Test Pitting

A total of 40 test pits will be excavated in and around the northern area drainage ditch at Area 2 (see Figure 5-1). Proposed locations have been selected based on visual observation, and the results of previous investigations at Area 2, and will be modified based on the results of the surficial geophysical survey if applicable.

The test pits will be excavated with a backhoe in accordance with the requirements specified in Subsection 4.4.4 of Volume I of the POP (ABB-ES, 1995b). Excavated soil will be placed on plastic sheeting adjacent to each test pit during excavation. Once a test pit has been completed, the soil will be placed back into the test pit and leveled. A total of three soil samples will be collected from each test pit. Samples will be collected from areas presumed to be contaminated based on visual, olfactory, and PID screening evidence. The 120 samples collected will be field analyzed for TPHC and BTEX (see Table 5-1).

A total of 20 samples will be submitted for laboratory analyses of TPHC, selected PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, petroleum fingerprinting, grain-size, and PAL inorganics. Samples will be selected from both future re-use areas ("Rail, Industrial, and Trade-Related Uses" and "Open Space and Recreation") present at the site, and from both surface (0-1 foot) and sub-surface (1-15 feet) depths. The following table presents the proposed soil sampling plan:

|                      | INDUSTRIAL | OPEN SPACE |
|----------------------|------------|------------|
| SURFACE (1 FT)       | 5          | 5          |
| SUBSURFACE (1-15 FT) | 5          | 5          |

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The test pit soil sample with the highest field screening concentration from each of the three area/depth locations will be submitted for laboratory analysis. The remaining samples from each area/depth location will be chosen randomly, in order that sample results used in the risk assessment are representative of site conditions. In conjunction with existing data and RI screening results, the laboratory analytical results to be developed from this program will be adequate to perform a meaningful human health risk assessment for foreseeable reuse scenarios, characterize distribution, identify areas requiring potential remediation, and develop remedial cost estimates during the feasibility study.

### **5.3.4 Soil Borings**

Four soil borings will be advanced to a total depth of approximately 20 feet bgs, using hollow stem augers. Proposed boring locations (shown in Figure 5-1) will be modified as appropriate after the excavation of test pits, to further define the limits of contaminant migration. Subsurface soil samples will be collected at depth intervals of 4 to 6 feet, 10 to 12 feet (or as determined by test pitting results), and 16-18 feet (or to the depth of groundwater) from each boring location. Soil borings will not be advanced through filled test pit excavations. The twelve subsurface soil samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, TPHC and PAL Inorganics. Table 5-4 provides a summary of soil boring location and sample rationale. Soil borings and sampling will be completed in accordance with Subsections 4.4.6.1 and 4.5.1.3 of Volume I of the POP (ABB-ES, 1995b).

### **5.3.5 Monitoring Well Installation and Sampling**

Two upgradient and eight downgradient monitoring wells will be installed at AOC 57/Area 2. Table 5-2 provides rationales for each new monitoring well to be installed during the RI. Monitoring well locations at AOC 57 will be based upon contaminant distributions and subsurface conditions as determined by the test pitting program. Monitoring well locations depicted on Figure 5-1 are intended to help show the proposed scope of the investigation, not final well locations. The two upgradient wells will be constructed as water table wells. Six shallow downgradient wells will also be constructed as water table wells. Provisions for installing two deeper wells downgradient have been made to assess vertical gradients and associated contamination migration. These two other downgradient

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wells will be constructed adjacent to two selected water table wells to establish two downgradient well couplets.

Soil samples will be collected at 5-foot intervals for geologic characterization during the installation of new wells as specified in POP Section 4.4.6. Continuous soil sampling will be conducted while installing one of the downgradient monitoring wells to establish a continuous stratigraphic record for AOC 57/Area 2. One soil sample per well boring will be collected from within the planned monitoring well screen interval, for laboratory analysis of TOC only. The monitoring wells will be constructed in accordance with Subsection 4.4.6 of Volume I of the POP (ABB-ES, 1995b).

Each of the newly installed monitoring wells will be developed using the procedures for well development presented in Subsection 4.4.6.5 of Volume I of the POP (ABB-ES, 1995b).

Two rounds of groundwater samples will be collected from the ten new and two existing monitoring wells (G3M-92-02X and G3M-92-07X) at AOC 57 (see Figure 5-1). The rounds will be separated by at least 90 days to evaluate seasonal variations in contaminant concentrations. Groundwater sampling procedures are presented in Subsection 4.5.2.2 of Volume I of the POP (ABB-ES, 1995b). Prior to pre-sample purging of monitoring wells, the depth of water will be measured with an oil-water interface probe to check for the presence of a free product layer. The twenty four groundwater samples will be submitted for laboratory analysis of selected PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Water Quality Parameters (including alkalinity, hardness, pH, temperature, conductivity and dissolved oxygen), and anions and cations (see Table 5-3).

After the completion of the first round of groundwater sampling, hydraulic conductivity tests will be performed on each of the newly installed monitoring wells to further define aquifer characteristics and groundwater flow at AOC 57. The procedures for conducting the hydraulic conductivity tests are presented in Subsection 4.8.2 of Volume I of the POP (ABB-ES, 1995b). Hydraulic conductivity test data will be analyzed by the methods of Hvorslev (1951) and Bouwer and Rice (1976). When appropriate the KGS model (Hyder and Butler,

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1995) will be used in conjunction with the Bouwer and Rice method. The Bouwer and Rice method will also be used with respect to the limitations outlined by Brown, Narasimhan, and Demir (1995).

### 5.3.6 Piezometer and Surface Water Measurement Stations

Two piezometer pairs will be installed at AOC 57/Area 2, near Cold Spring Brook, to assess hydraulic gradients in and around the adjacent wetland areas (see Figure 5-1). Piezometers will be installed as outlined in Subsection 4.4.6.6 of Volume I of the POP (ABB-ES, 1995b). The only variations are that piezometers will be constructed of 1-inch inside diameter (ID) polyvinyl chloride (PVC) with a 2-foot long screened interval. Table 5-2 and Figure 5-1 provide the rationale and proposed location for each new piezometer installed during the RI.

Three surface water elevation measurement stations will also be established in Cold Spring Brook adjacent to AOC 57/Area 2. The surface water measurement stations will be used in conjunction with four piezometer locations to evaluate both vertical and horizontal groundwater flow gradients near the brook.

### 5.3.7 Sediment and Surface Water Sampling

In order to characterize the nature of contaminant migration to Cold Spring Brook, sediment and surface water samples will be collected from wetland areas near AOC 57/Area 2, and in Cold Spring Brook (see Figure 5-1). Sediment samples will be collected from areas of deposition at five locations along the brook. One surface water sample and two sediment samples (0 to 1 and 2 to 4 feet bgs) will be collected at each of the five sampling locations. An additional five sediment and surface water sample pairs will be collected from separate locations. The procedures for conducting the surface water and sediment sampling are presented in Subsection 4.5.2 of Volume I of the POP (ABB-ES, 1995b).

The fifteen sediment samples will be analyzed for selected PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics, TPHC, TOC, petroleum fingerprinting and grain size. The ten surface water samples will be analyzed for selected PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics, TPHC, and water quality parameters (see Table 5-5).

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In order to determine effects of contaminated sediments from AOC 57/Area 2 on aquatic organisms, controlled whole sediment laboratory toxicity tests will also be conducted. Although the results of the proposed sediment toxicity tests will be used to predict the effects that might occur to aquatic ecological receptors *in situ*, it is important to recognize that: (1) exposure to contaminated sediments might be avoided by motile organisms; and, (2) toxicity to organisms *in situ* may be dependent upon sediment physical characteristics and equilibrium partitioning that are not replicable under laboratory conditions (ASTM, 1993).

The objective of the proposed toxicity testing is to obtain laboratory data to evaluate adverse effects associated with exposure of the freshwater invertebrate species *Hyallela azteca* (the amphipod) and *Chironomus tentans* (the chironomid midge) to whole sediment from AOC 57/Area 2.

Six short-term chronic toxicity tests for *Chironomus tentans* and *Hyallela azteca* will be conducted (with whole sediment samples and no dilutions) to provide a screening-level spatial distribution of sediment toxicity at AOC 57. The ASTM *Standard Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates* (E 1383; ASTM, 1993) and the draft USEPA *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* (USEPA, 1994) will be used as the laboratory standard. Specific test protocols outlined in USEPA (1994) for the amphipod (10-day growth and survival) and the midge (10-day growth and survival) will be followed. Sediment samples for toxicity testing will be stored according to protocols established in the ASTM *Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing* (E 1391-90; ASTM, 1993). Sediment samples for analytical chemistry analysis and toxicity testing will be conducted concurrently, allowing for evaluation of chemical and physical stressors in the baseline ecological risk assessment. The six toxicity testing sampling locations (5 plus one reference station) are shown in Figure 5-1.

Statistical analyses to assess the significance of any differences in survival and growth between the Cold Spring Brook reference sample, and/or negative control sediment sample and AOC 57/Area 2 whole sediment samples, will be performed.

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### 5.3.8 Ecological Survey & Wetlands Investigation

A qualitative ecological survey will be conducted to identify potential ecological receptors and exposure pathways in Cold Spring Brook and its floodplain at AOC 57/Area 2. Information from the qualitative survey will be incorporated into the baseline ecological risk assessment.

Ecological receptors in the vicinity of the AOC which potentially could be exposed to contaminated environmental media will be identified during the qualitative ecological survey. Possible site-specific exposure pathways through which ecological receptors could be exposed to contaminated media will be evaluated, and any observed gross signs and symptoms of stress on biological receptors at the site will be recorded. The qualitative ecological survey will help further define the proposed surface water and sediment sampling locations, and define sampling requirements for the toxicity testing at AOC 57/Area 2. This survey includes a literature review and a field reconnaissance program as described below.

A limited literature review will be conducted to evaluate the major floral and faunal receptors and ecological community types likely to be encountered in the Cold Spring Brook floodplain in the vicinity of AOC 57/Area 2. Existing information sources related to flora, fauna, and ecological communities in the area will be reviewed, and standard taxonomic sources and references will be identified. Trustee agencies such as the U.S. Fish and Wildlife Service, the Massachusetts Division of Fish and Wildlife, Fort Devens Forestry Department, and the Massachusetts Natural Heritage Program will be contacted for information regarding state or federally listed endangered or threatened species. Historic information on the biota (e.g., fish) of Cold Spring Brook will be retrieved from the Fort Devens Environmental Management Office. Relevant information obtained during the Lower Cold Spring Brook SI (ABB-ES, 1995a) will be reviewed.

Following the information review, a limited field reconnaissance program will be initiated to characterize the aquatic, wetland, and terrestrial habitats at and in the vicinity of the Cold Spring Brook floodplain at AOC 57/Area 2. The field program will identify and verify major vegetative cover types and dominant taxa at the site. This field program will involve a site walk-over by a wetland-aquatic

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specialist and an ecologist. Qualitative belt and/or line transect surveys of vegetative community types will be conducted; each identified cover type will be characterized through the use of a minimum of 2 transects. Observations of wildlife use of the site will be collected during the qualitative vegetative survey.

Ten minnow traps will be set for a 24-hour period in the brook channel and palustrine wetland to obtain baseline information on the forage fish community. In addition, the fish community will be qualitatively sampled with a small man-powered haul seine. No fishing shall occur without a valid Scientific Collection Permit from the Massachusetts Division of Fisheries and Wildlife.

All fish captured in the minnow traps and seines will be keyed to species. A subsample of fish collected will be weighed and measured; sample collection forms will be completed for these samples. Sample collection forms will include: the client; site name; Sample Identification Number; sampling location; species; number of animals per subsample; physical characteristics of the sampling station; length and weight of fish sampled; date and time; names of field personnel; and a checklist to record any observed gross physical abnormalities. Any grossly deformed specimens will be photographed, preserved, and retained in a voucher collection. In addition, voucher specimens of each species collected will be obtained, labeled, preserved, and archived. If necessary, duplicates of the voucher specimens will be sent to recognized experts in the field for taxonomic confirmation.

Based on the Cold Spring Brook SI (ABB-ES, 1995a), limited Aroclor-1260 contamination may be encountered in AOC 57/Area 2 sediments. PCBs bioaccumulate and bioconcentrate in fish tissue; therefore, 5 whole body forage fish samples from AOC 57/Area 2 will be analyzed for pesticides and PCBs. An additional sample will be collected upstream of AOC 57/Area 2 to quantify pesticide and PCB contamination at an upgradient reference station.

The following target species for fish tissue sample collection have been tentatively selected: golden shiner (*Notemigonus crysoleucas*) or bluegill (*Lepomis macrochirus*). It is unlikely that the SA 57/Study Area 2 study area provides habitat for higher level consumers such as the largemouth bass (*Micropterus salmoides*) or chain pickerel (*Esox niger*). However, if either of these species is

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encountered during the field effort, they will be preferentially selected for tissue analysis.

Tissue for residue analysis will consist of whole fish samples only. The number of individual fish per sample will be dependent upon the species and sizes of target fish encountered; the volume of tissue required by the laboratory; and, the distribution and relative abundance of the fish within AOC 57/Area 2.

Limited habitat mapping will be completed at AOC 57/Area 2. Observed evidence of ecological stress in plant species, such as yellowing, wilting, or insect infestations, and animal species (disease, parasitism, death, and reduced diversity or abundance) will be noted. Any state or federally listed rare or endangered species identified during the survey will be documented.

The wetlands will be functionally assessed through the use of the Nashua-Hudson Circumferential Highway Method (Nashua-Hudson Circumferential Highway, 1992). This technique has been recommended for use in New England by the New England Division Corps of Engineers (NEDCOE) as a rapid method to assess wetland functions and values. The Nashua-Hudson Circumferential Highway Method is designed to provide a descriptive wetland functional evaluation that includes hydrologic, cultural, and biological information regarding the wetland and its functions. Wetlands at AOC 57/Area 2 were previously delineated for the NEDCOE. If required for the FS, the wetland delineation at this study area will be reviewed; any required delineation updates will be made, in accordance with state and federal guidance. Wetlands will be identified and delineated pursuant to federal (Section 404 of the Clean Water Act) and state regulations (Massachusetts Wetlands Protection Act (M.G.L. c. 131, s.40) and Regulations (310 CMR 10.00)).

### 5.4 SAMPLE ANALYSIS AND DATA MANAGEMENT

The analytical program for the RI/FS at AOC 57/Area 2 is designed to identify the contaminants that are expected to be encountered. Based on the results of the SI and subsequent removal effort, a suite of contaminant types were identified at AOC 57/Area 2. The field screening and laboratory analyses selected for the RI are designed to provide useable data on the concentrations and distributions of

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the contaminants for use in both the risk assessments and feasibility study. The specific analyses proposed for each sample are itemized in the Sampling and Laboratory Analysis Schedule (Table 5-5). The procedures to be followed during the RI/FS for both field screening and laboratory analysis are presented in Section 7.0 of Volume I of the POP. The Laboratory QA Plan and the USAEC Performance Demonstrated Analytical Methods are presented in Appendices B and C of Volume III of the POP (ABB-ES, 1995b).

With the volume of data being collected, a critical aspect to developing USAEC chemical and geotechnical data for this RI/FS will be to maintain strict compliance with the data management procedures set forth in Section 8.0 of Volume I of the POP.

## **5.5 DATA EVALUATION**

The data collected during the RI will be evaluated to determine whether it meets the RI DQOs. The evaluations for AOC 57/Area 2 will be completed on the basis of verifying the nature and distribution of environmental contamination. The procedures for the data assessment are presented in Section 12.0 of Volume I of the POP.

ABB-ES will assess the presence, sources, and spacial distribution of contamination, as well as potential pathways of contaminant migration in the environment using data collected from the RI and SI.

## **5.6 RISK ASSESSMENT**

A baseline risk assessment will be conducted at AOC 57/Area 2 to evaluate the potential human health and ecological risks associated with soil, surface water, sediment and groundwater contamination.

### **5.6.1 Human Health Risk Assessment**

The risk assessment will be performed to conform with the following USEPA guidance manuals and directives:

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- *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A)*, (RAGs) 1989b, Interim Final, December 1989.
- *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part B), Development of Risk-based Preliminary Remediation Goals*, 1991b, Interim, December 1991.
- *Dermal Exposure Assessment Principles and Applications*, Interim, January 1992.
- *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, 1991c, OSWER Directive 9355.0-30, April 22, 1991.
- *Standard Default Exposure Factors: Human Health Evaluation Manual, Supplemental Guidance*, 1991d, OSWER Directive 9285.6-03, March 25, 1991.
- *Supplemental Risk Assessment Guidance for the Superfund Program*, 1989a Draft Final, USEPA Region I Risk Assessment Work Group, June 1989.
- *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons*, July 1993.

The components of the risk assessment will include the following: Data Summarization and Selection of Chemicals of Potential Concern (COPCs); Exposure Assessment; Toxicity Assessment; Risk Characterization; Comparison of Analytical Data to Health Standards and Guidelines; and Qualitative Uncertainty Analysis. A more detailed discussion of these components follows.

COPCs will be selected for inclusion in the risk assessment based on frequency of detection and, for inorganic analytes, comparison to Fort Devens background concentrations. If the maximum detected concentration is below the basewide background concentration, then it will be eliminated as a COPC. Essential nutrients (i.e., potassium, sodium, magnesium, calcium, and iron) will be considered for elimination if it can be documented that they are present at

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concentrations not associated with adverse effects. Any analytes attributable to laboratory contamination will not be included as COPCs. The reasons for eliminating any analytes will be documented in the risk assessment report.

In the Exposure Assessment, potential exposures under current and future land use conditions will be evaluated. AOC 57/Area 2 contains an eroded drainage ditch which empties into Cold Spring Brook and it is adjacent to Building 3713 and a vehicle storage yard. In the Devens Reuse Plan (Vanasse Hangen Brustlin, Inc., 1994), the future use of the site is designated as "Rail, Industrial, and Trade-Related Uses" and "Open Space and Recreation". Example uses include industry, research and development with rail or distribution links, or academic and institutional uses. Examples of future uses of AOC 57 that could be expected under its "Open Space and Recreation" land use designation include passive recreation such as walking or bird watching.

Based on the findings in the SI and SSI, exposure scenarios will be developed for the following human exposure pathways at a minimum:

- Contact with subsurface soil during excavation. Soil at AOC 57/Area 2 could be excavated in the future either for utility repair/installation or building construction. Because the site is within the buffer zone of a wetland, major construction is unlikely. Receptors would be the individuals doing the construction or excavation. Exposure routes could include incidental ingestion of soil, inhalation of VOCs, and dermal contact with soil. Following USEPA Region I guidance, dermal contact will not be evaluated quantitatively. The need to consider shallow groundwater as a potential exposure medium (to which a worker could come in contact) will be determined based on the results of the groundwater sampling program.
- Contact with surface soil during site maintenance activities. Potential receptors of surface soil contamination would be site workers involved in grounds maintenance. Exposure could occur through the incidental ingestion of soil particles and dermal contact. As above, dermal contact will be identified in the risk assessment as an exposure route but it will not be modeled.

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While dust could be generated during soil excavation, it would be considered a potentially important exposure medium only if a major construction project were expected. Therefore, the inhalation of soil dust will be identified as a potential exposure pathway but will not be modeled in the risk assessment.

Although the migration of site contaminants to Cold Spring Brook will be investigated in the RI, the potential for human exposure to contaminants in the stretch of the Brook downgradient of the site is low. Wading in the Brook in this area is unlikely due to the heavily wooded nature of the area. The risk assessment will identify the Brook as a possible exposure medium but will eliminate it due to limited accessibility. While fishing in Cold Spring Brook is possible, possible risks from consumption of Cold Spring Brook fish will not be evaluated in the risk assessment.

Under assumed future industrial use of the site, extraction of groundwater beneath the AOC appears unlikely. For the risk assessment, however we will assume that any future users of the AOC may install a drinking water well to supply potable water for on-site workers. The baseline risk assessment will identify this water supply well and discuss future reliance on it for drinking water.

Following USEPA Region I guidance, the 95% upper confidence limit (UCL) on the arithmetic mean concentration will be coupled with central tendency and reasonable maximum exposure (RME) exposure parameter values to model the central tendency and RME soil exposure scenarios.

To minimize comments a Risk Assessment Approach Plan (RAAP) will be developed and a meeting will be held with representatives from the U.S. Army, USEPA, and Massachusetts Department of Environmental Protection (MADEP) to discuss these exposure pathways. The RAAP will be published and the meeting will be scheduled when work on the risk assessment begins.

In the Toxicity Assessment, brief toxicity profiles will be developed for the COPCs. These profiles will identify the toxic effects associated with exposure. Summary tables containing the dose/response data for the COPCs will also be included in the Toxicity Assessment. Dose/response data will be obtained from the USEPA Integrated Risk Information System (IRIS) database, Healths Effects Assessment Summary Tables (HEAST), and readily available toxicity values

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developed by the USEPA Environmental Criteria and Assessment Office (ECAO).

The Risk Characterization will combine the exposure intakes from the Exposure Assessment with the toxicity values identified in the Toxicity Assessment to develop quantitative risk estimates (i.e., cancer risks and noncancer hazard indices) for the COPCs. Risk estimates will be developed for individual COPCs, for exposure pathways, and for receptors potentially exposed through more than one medium. If quantitative risk estimates cannot be generated for particular COPCs, their risks will be discussed in the Risk Characterization.

In addition to the quantitative risk evaluation, exposure point concentrations will be compared to federal and state health-based standards and guidelines. For example, a comparison of soil concentrations to MCP Method 1 soil standards (used only as guidelines) will be included. An uncertainty analysis will follow the risk characterization discussion to identify important issues that affect the interpretation of the risk assessment findings. Uncertainties and limitations in the Toxicity and Exposure Assessments as well as in current risk assessment methodologies will be discussed.

#### **5.6.2 Baseline Ecological Risk Assessment**

The purpose of the baseline ecological risk assessment at AOC 57/Area 2 is to provide an evaluation of the actual and potential risks to ecological receptors posed by chemicals in environmental media at the site. The results of the SA 57 (AOC 57) preliminary risk evaluation (PRE) presented in the Lower Cold Spring Brook Site Inspection Report (ABB-ES, 1995a) have been used in the development of the approach for the baseline ecological risk assessment. This PRE suggested that several inorganic analytes, pesticides, TPHC, and PCBs in AOC 57 sediment may pose a risk to ecological receptors.

The approach used in this ecological evaluation will be consistent with the following guidance:

- Risk Assessment Guidance for Superfund Environmental Evaluation Manual (USEPA, 1989c);

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- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference (USEPA, 1989a);
- Ecological Assessment of Superfund Sites: An Overview (USEPA, 1991a); and,
- Framework for Ecological Risk Assessment (USEPA, 1992).

Recent risk assessment guidance including the USEPA "Eco Update" bulletins and recent publications (e.g., Maughan 1993; Suter, 1993) will also be consulted.

The baseline ecological risk assessment will consist of the following elements: hazard assessment, ecological characterization, ecological exposure assessment, ecological effects assessment, ecological risk characterization, and an uncertainty analysis.

The assessment approach will integrate a variety of methodologies to assess risks. The decisions regarding overall risk to ecological receptors will be based on the weight-of-evidence from the results of all components of the assessment methodology (i.e., an approach that integrates results of physical, biological, toxicological, and modeling studies to draw risk-based conclusions). The weight-of-evidence components were designed to provide measures of risks for different ecological receptors, exposure pathways, and potential adverse effects.

A Risk Assessment Approach Plan will be completed prior to commencement of the ecological risk assessment. This plan shall be presented to state and federal regulators, as well as natural resource trustees. Comments from regulators and trustees shall be incorporated into the RI ecological risk assessment for AOC 57/Area 2.

The hazard assessments will present an overview of the type and extent of contamination present at AOC 57/Area 2 and will identify ecological chemicals of potential concern (COPCs). COPCs will be selected from available site data based on factors such as the applicability of the data for ecological assessment, the data quality objectives, the classification of chemicals (e.g., inorganic, volatile organic, pesticides), comparison of chemical concentrations with naturally occurring basewide background concentrations for inorganics in surface soils, and

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upstream concentrations for surface water and sediment in Cold Spring Brook, the physical and chemical properties of chemicals, the frequency of detection, and the inherent toxicity of the chemicals and their potential to bioaccumulate.

The ecological characterization will serve as the basis for identifying potential ecological receptors at AOC 57/Area 2. Flora and fauna located at or potentially affected by the site will be qualitatively characterized. Information gathered in the qualitative ecological survey (see Section 5.3.8 of this Work Plan) will be incorporated into a receptor analysis in the ecological characterization section of the risk assessment. The results of the receptor analysis will be used to further develop exposure scenarios for the ecological exposure assessment.

The ecological exposure assessment will evaluate the potential for receptor exposure to COPCs at AOC 57/Area 2. This evaluation will involve the identification of potential exposure routes and an evaluation of the magnitude of exposure of identified ecological receptors. Exposure concentrations and/or doses will be estimated for each exposure pathway. If appropriate, indicator species will be selected for ecological exposure modeling.

Exposure pathways describe how ecological receptors can come into contact with contaminated media and are based on identifying (1) the contaminant source, (2) the environmental transport medium, (3) the point of receptor contact, and (4) the exposure route (e.g., incidental soil ingestion, drinking of contaminated surface water, or ingestion of contaminated prey items).

A conceptual site model identifying exposure pathways will be developed for AOC 57/Area 2. The ecological exposure pathways most likely to be complete include:

- dermal contact and incidental ingestion by wildlife of contaminated sediments, surface soil, and/or surface water,
- wildlife ingestion of food items that are contaminated as a result of accumulation of contamination from the soils and sediments,
- direct contact with and ingestion of surface water and sediment by aquatic life,

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- direct contact with and ingestion of surface soils by plants and invertebrates.

Based on COPC concentration data, exposure point concentrations within each medium will be estimated for the selected ecological exposure pathways and receptors. For evaluating exposure to wildlife receptors, these concentrations will be assumed to be equivalent to: (1) the lower of the 95 percent upper confidence limit on the arithmetic mean or the maximum detected concentration; and (2) the arithmetic mean concentration. For evaluating exposure to aquatic receptors, surface water and sediment concentrations will be evaluated on a sampling station by sampling station basis (e.g., summary statistics will not be used).

The process of assessing exposure for wildlife receptors will involve estimating the likely dosage for each relevant exposure route, and summing these estimates to derive an expected total body dosage for each receptor type. The extent of exposure will depend upon various factors such as the type of food consumed, feeding rates, habitat preference, and home range. Pesticide and PCB tissue data from forage fish will be incorporated into the exposure assessment for AOC 57/Area 2.

In order to evaluate exposure of aquatic organisms to contaminated sediment, two species of benthic macroinvertebrates will be exposed to AOC 57/ Area 2 sediment in controlled laboratory toxicity tests, as outlined in Section 5.3.9 of this Work Plan.

The ecological effects assessment will contain a description of the ecotoxicological effects associated with the COPCs, and a discussion of the relationship between the exposure concentration and the potential for adverse effects in ecological receptors. Measurements of actual toxicity and adverse effects will be completed when possible to decrease uncertainties associated with evaluating the actual mixture of contamination present in sediments at AOC 57.

Toxicological effects will be evaluated using concentration- or dose-response data regarding acute and chronic toxicity to the identified potential ecological receptors. Benchmark concentrations or doses will be identified for use in the ecological risk characterization section. Sources which will be considered in identifying benchmark values for aquatic receptors include USEPA ambient water

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quality criteria, State water quality standards, and sediment quality guidelines. Criteria or standards for protection of terrestrial receptors have not yet been established; therefore terrestrial benchmark values will be obtained from published toxicological studies.

Effects from exposure of aquatic organisms to contaminated sediment will be evaluated using controlled laboratory toxicity tests, as outlined in Section 5.3.9 of this Work Plan.

The purpose of the ecological risk characterization will be to combine the results of the exposure and effects assessments to characterize the ecological risks at AOC 57/Area 2. This section will identify ecological receptors that might be at risk from site-related contamination. Risks will be characterized for aquatic and wildlife receptors.

Potential risks to wildlife will be described using the following hazard index approach. The estimated doses or exposure concentrations will be compared to benchmark values identified in the toxicity assessment. Hazard Quotients (HQs) will be calculated for each chemical by dividing the exposure concentration by the benchmark value. These HQs will be summed into a cumulative hazard index (HI). As the HI increases in magnitude, the likelihood for adverse ecological effects increases. When the estimated HQ is less than 1, the contaminant exposure will be assumed to fall below the range considered to be associated with adverse effects for growth, reproduction and survival (of the individual organism) and no risks to the wildlife populations will be assumed. When the HQ or HI is greater than 1, a discussion of the ecological significance will be included. When HIs are greater than 1, an evaluation of the HQs comprising the HI will be completed.

This hazard ranking scheme evaluates potential ecological effects to individual organisms and does not evaluate potential population-wide effects. Contaminants may cause population reductions by affecting birth and mortality rates, immigration, and emigration (USEPA, 1989b). In many circumstances, lethal or sub-lethal effects may occur to individual organisms with little population or community level impacts; however, as the number of individual organisms experiencing toxic effects increases, the probability that population effects will occur also increases. The number of affected individuals in a population

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presumably increase with increasing HQ or HI values; therefore, the likelihood of population level effects occurring is generally expected to increase with higher HQ or HI values.

Risks for aquatic receptors will be characterized for AOC 57/Area 2 based on a weight-of-evidence evaluation of the following factors:

- presence or absence of analytes in surface water and sediment samples,
- concentrations of analytes measured in surface water and sediment samples,
- responses of *H. azteca* and *C. tentans* in the sediment laboratory toxicity tests,
- concentrations of COPCs in surface water relative to reported toxicity of the COPC in laboratory tests (AQUIRE information), Federal AWQC and State Water Quality Standards, and
- concentrations of COPCs in sediment relative to available sediment quality guidelines

The samples for sediment toxicity testing and chemical analysis will be collected concurrently and split for the two separate analyses; therefore, the chemical analyses results for the sediment samples can be used to help interpret the contaminant exposures for the test species (*H. azteca* and *C. tentans*). If toxicity is observed in any of the sediment toxicity tests, simple linear regressions will be completed to determine if a correlation exists between the concentration of an analyte in sediment samples and the adverse response in the toxicity test.

The ecological risk characterization section will also contain a discussion of visual observations of any ecosystem degradation or other symptoms of environmental stress observed during the qualitative ecological survey.

The estimation of ecological risks involves a number of assumptions. In this section, the uncertainties associated with these risk assessment assumptions will be

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identified and their potential effects upon the results of the risk assessment will be discussed.

The results of the risk assessment will be discussed in a summary section that will include summary data tables containing quantitative risk estimates.

### **5.7 REMEDIAL INVESTIGATION REPORT**

Upon completion of the of field activities, laboratory analysis, and the ecological and human health and ecological risk assessments, ABB-ES will prepare an RI Report following appropriate USEPA Region I and USACE guidelines. The report will address the specific contaminant issues that prompted the RI, and will conclude with findings and recommendations concerning site conditions.

Recommendations will constitute one of the following:

- Take no further action or initiate long-term monitoring (Record of Decision [ROD] required).
- Conduct a Feasibility Study.

### **5.8 TREATABILITY STUDY/PILOT TESTING**

SI and removal action data indicate that soil and groundwater at AOC 57/Area 2 are contaminated with TPHC, PCBs, lead, and VOCs. The RI will further evaluate the nature and distribution of soil and groundwater contamination, as well as quantitatively evaluate risks. Treatability studies are not recommended for soil and groundwater at AOC 57/Area 2 at this time. However, data can be collected at this phase which will aid in evaluating remedial technologies.

#### **5.8.1 Data Requirements for Evaluating Soil Remedial Technologies**

If, during geophysical surveys or test pit excavation, a potential source of petroleum contamination is located, data in addition to chemical analyses will be collected. Potential treatment technologies for soil include soil vapor extraction,

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thermal desorption, and incineration technologies. To aid in evaluating the effectiveness of these technologies, samples will be collected from the source area for grain size analysis, TOC content, and moisture content.

### **5.8.2 Data Requirements for Evaluating Groundwater Remedial Technologies**

Evaluation of the potential effectiveness of groundwater remedial technologies is dependent upon information which will be collected during RI field activities, including contaminant source, direction of groundwater flow, and additional chemical data. Hydraulic conductivity tests will be performed on each of the newly installed wells (Subsection 5.3.8) to further define the hydraulic conductivity of the soils at AOC 57/Area 2. Although beneficial for evaluating hydraulic conductivity, these tests are limited for evaluating aquifer characteristics under a pumping scenario. A pumping test may be warranted at a later time depending upon the findings from the RI. Pumping tests would be used to establish well efficiency, specific capacity and short-term yields and to calculate transmissivity, storage coefficients, and long-term pumping rates.

Groundwater samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, TSS, TDS, anions and cations and Water Quality Parameters, including alkalinity, hardness, pH (measured in the field), temperature (measured in the field), and dissolved oxygen (measured in the field). The data collected during the RI will be used to evaluate the potential effectiveness of groundwater treatment technologies.

### **5.9 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

ARARs are human health and environmental regulatory requirements used to determine the appropriate extent of site cleanup, develop site-specific remedial response objectives, develop remedial action alternatives, and direct site cleanup. Superfund Amendments and Reauthorization Act (SARA) (Section 121) and the NCP (USEPA, 1990) require that CERCLA remedial actions comply with federal and state ARARs. To be an ARAR, state requirements must be identified in a timely manner and applied consistently statewide. Additional procedures for ARAR identification are specified in Section VII (7.5) of the IAG (USEPA, 1991a) between the USEPA and the U.S. Department of the Army.

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Applicable requirements are federal and state requirements that specifically address substances or contaminants and actions at CERCLA sites. Relevant and appropriate requirements are federal and state requirements that, while not legally applicable, are appropriate if the site circumstances are sufficiently similar to those covered by the jurisdiction of the requirement. Applicable requirements and relevant and appropriate requirements are considered to have the same weight with respect to requiring compliance at CERCLA site cleanups. SARA also identifies a "To Be Considered" (TBC) category, which includes federal and state nonregulatory requirements such as criteria, advisories, and guidance documents. TBCs do not have the same status as ARARs; however, if no ARAR exists for a chemical or particular situation, TBCs can be used to ensure that a remedy is protective.

CERCLA remedial actions must be protective of human health and the environment and comply with ARARs. ARARs can be divided into three categories: chemical-, location-, and action-specific. Chemical-specific ARARs for AOC 57 will be identified using RI site characterization data. Potential location- and action-specific ARARs will be identified during the development of alternatives. The potential location- and chemical-specific ARARs for the site will be presented in the draft RI Report. The identification of ARARs is an iterative process, and the list of potential ARARs will be refined as alternatives are developed. ABB-ES will also present a synopsis of location-, action- and chemical-specific ARARs in the draft and final FS Reports.

#### **5.10 REMEDIAL ALTERNATIVES DEVELOPMENT/SCREENING**

For this task of the FS process, ABB-ES will develop a range of distinct, hazardous waste management alternatives that will reduce the potential human health and ecological risks associated with exposure to contaminated soil and groundwater at AOC 57, as deemed necessary from the results of the RI. This process consists of six general steps:

- Develop remedial action objectives and preliminary remediation goals based on data review, and compilation of ARARs.

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- Develop general response actions for each medium of interest defining containment, treatment, excavation, pumping, or other actions, singly or in combination, that may be taken to satisfy the remedial action objectives for the site.
- Determine target cleanup levels and identify volumes or areas of media to which general response actions might be applied.
- Identify and screen the technologies applicable to each general response action to eliminate those that cannot be implemented technically at the site.
- Identify and evaluate technology process options to select a representative process for each technology type retained for consideration.
- Assemble the selected representative technologies into alternatives representing a range of treatment and containment combinations as appropriate, and screen these alternatives with respect to the criteria of effectiveness, implementability, and cost.

The first two steps and potential technology identification in the fourth step have been preliminarily performed as described in Section 3.0, Initial Evaluation, for the benefit of identifying field data and treatability/pilot testing needs early for the RI. The potential remedial action objectives, response actions, and technologies identified in this work plan will be reviewed and refined as the RI/FS process progresses.

The sixth step entails the final assembly and screening of remedial alternatives. As appropriate, a range of remedial alternatives will be developed by combining retained technologies in which treatment is used to reduce the toxicity, mobility, or volume of wastes, but vary in the degree to which long-term management of residuals or untreated waste is required; one or more alternatives involving containment with little or no treatment; and a no-action alternative. Alternatives that involve minimal efforts to reduce potential exposures (e.g., site fencing, deed restrictions) will be presented as "limited action" alternatives.

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During screening, alternatives are quantitatively defined to allow differentiation with respect to the criteria of effectiveness, implementability, and cost. Quantitative definition of alternatives with respect to spatial requirements, time frames, rates of treatment, and refinement of volumes/areas of contaminated material, as well as transportation distances for disposal technologies, required permits for off-site actions, and imposed limitations will enable differentiation among alternatives with respect to the screening criteria. Innovative technologies may be carried through the screening process if there is reason to believe they offer significant advantages in the form of better treatment performance or implementability, fewer adverse impacts, or lower costs. The three screening criteria conform with remedy selection requirements of CERCLA and the NCP. The screening step eliminates impractical alternatives or higher cost alternatives (i.e., order of magnitude) that provide little or no increase in effectiveness or implementability over their lower-cost counterparts. By eliminating these alternatives early, more time and effort can be devoted to detailed analysis of the more promising alternatives. The no-action alternative will not be evaluated according to screening criteria; it will pass through screening to be evaluated during detailed analysis as a baseline for the other retained alternatives (USEPA, 1988).

#### **5.11 DETAILED ANALYSIS OF ALTERNATIVES**

For this task of the FS process, ABB-ES will conduct a detailed analysis of alternatives which will consist of an individual analysis of each alternative against a set of evaluation criteria and a comparative analysis of all options against the evaluation criteria with respect to one another.

The detailed analysis presents the relevant information that allows a site remedy selection. The detailed analysis of each remedial alternative includes the following:

- detailed descriptions of each remedial alternative, with emphasis on application of the various technologies as components in the alternative

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- detailed analysis of each remedial alternative relative to the evaluation criteria established to address CERCLA requirements

The detailed description of each remedial alternative will emphasize the technologies used and the components of each alternative. Where appropriate, the description will present preliminary design calculations, process flow diagrams, sizing of key components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative.

As part of the criteria analysis, remedial alternatives will be examined with respect to requirements stipulated in CERCLA (Section 121), as amended by SARA. CERCLA emphasizes the evaluation of long-term effectiveness and related considerations for each remedial alternative. USEPA guidance for conducting RI/FSs under CERCLA (USEPA, 1988) and the NCP outline the following nine criteria for evaluating remedial alternatives:

1. overall protection of human health and environment;
2. compliance with ARARs;
3. long-term effectiveness and performance;
4. reductions in toxicity, mobility, and volume through treatment;
5. short-term effectiveness;
6. implementability;
7. cost;
8. state/support agency acceptance; and
9. community acceptance.

The first seven criteria (threshold and balancing criteria) will be used for detailed analysis of alternatives in the FS Report. The eighth and ninth CERCLA evaluation criteria, state acceptance and community acceptance, are modifying criteria and are addressed following the public information meeting, public hearing and public comment period.

The detailed analysis of alternatives will be presented in the FS Report discussed in Subsection 5.12.

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### 5.12 FEASIBILITY STUDY REPORT

At the conclusion of the FS process, ABB-ES will produce an FS Report to compile the development/screening of alternatives and detailed analysis of alternatives. Additionally, the FS Report will include a comparative analysis of alternatives. The comparative analysis will identify the advantages and disadvantages of each alternative relative to one another in relation to the evaluation criteria.

The criteria of state and community acceptance will be addressed in the Responsiveness Summary and the Draft ROD, once formal Commonwealth and community comments on the Draft FS Report and the Proposed Plan have been received. Following public comment, the Army, in consultation with USEPA, will modify the FS or Proposed Plan based on the comments received.

The FS Report will be issued in draft and final versions according to the IAG reporting requirements for primary documents. Draft versions for regulatory review and comments will include one issued upon initial screening of alternatives and one upon detailed analysis of alternatives.

### 5.13 POST RI/FS SUPPORT

For this task ABB-ES will prepare the Proposed Plan, the Fact Sheet, the responsiveness summary, and the ROD. This task also includes attending public informational meetings and formal meetings regarding the cleanup of this site.

The Proposed Plan will explain the opportunities for the public to comment on the remedial alternatives evaluated in the FS Report. It will provide a brief history of AOC 57, the principal findings of site investigations, and will provide brief descriptions of the Preferred Alternative and other alternatives evaluated in the FS. It will outline the criteria used by the Army to propose an alternative and present the Army's rationale for its preliminary selection of the Preferred Alternative.

The Fact Sheet will be written to provide the public with a brief explanation of the Army's selected remedy for cleanup of the site. A report describing the initial

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screening of alternatives and detailed analysis of alternatives will be prepared according to the IAG reporting requirements for secondary documents. The Fact Sheet briefly summarizes the information detailed in the Proposed Plan including details regarding the public comment period and public meetings to be held.

The Responsiveness Summary will contain all the comments received during the public comment period and the responses. The Responsiveness Summary will be issued with the ROD document and both will be made available for public review in the Administrative Record located at Fort Devens and the Ayer Town Hall.

The ROD will be issued to document the Army's final choice of a remedy for cleanup of the site, considering all comments received during the public comment period. Once the ROD is signed by the appropriate Army and USEPA personnel, it will become part of the Administrative Record.

Format for the above documents will follow USEPA Region I established models and will be issued in draft and final versions according to the IAG reporting requirements for primary documents.

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## **6.0 PROJECT MANAGEMENT AND SCHEDULE**

### **6.1 TASK ORDER STAFFING**

The project organization structure is illustrated in Figure 6-1. Solid lines on the figure depict direct lines of control while dotted lines indicate channels of communication. Rationale for project organization and resource allocation are discussed in the Fort Devens POP. QA/QC procedures and responsibilities for ABB-ES, USAEC, and Environmental Science & Engineering (ESE) Laboratory personnel are also described in the Fort Devens POP (ABB-ES, 1993b, revised 1995).

The duties, functions, and responsibilities associated with each task are detailed in the following paragraphs.

**Program Manager.** The Program Manager for ABB-ES' USAEC efforts is Mr. Joseph T. Cuccaro. He is responsible for providing direction, coordination, and continuous monitoring and review of the program. His responsibilities include initiating program activities; participating in work plan preparation; coordinating staff assignments; assisting in the identification and fulfillment of equipment and special resource needs; monitoring all task activities to confirm compliance with schedule, fiscal, and technical objectives; maintaining communications both internally and with the USAEC Contracting Officer's Representative (COR) through continuous interaction, thereby allowing quick resolution of potential problems; providing final review and approval of work plans, task deliverables, schedules, contract changes, and manpower allocations; and developing coordination among management, field teams, and support personnel to maintain consistency of performance.

**Project Manager.** The Project Manager for ABB-ES' Fort Devens efforts, Mr. Paul Exner, P.E., has the day-to-day responsibility for conducting the Fort Devens project. The Project Manager is responsible for confirming the appropriateness and adequacy of the technical or engineering services provided for a specific task; developing the technical approach and level of effort required to address each element of a task; supervising day-to-day conduct of the work, including integrating the efforts of all supporting disciplines and subcontractors for all tasks;

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overseeing the preparation of all reports and plans; providing for QC and quality review during performance of the work; confirming technical integrity, clarity, and usefulness of task work products; forming a task group with expertise in disciplines appropriate to accomplish the work; reviewing and approving sampling tests and QA plans, which include monitoring site locations, analysis methods to be used, and hydrologic and geophysical techniques to be used; developing and monitoring task schedules; supervising task fiscal requirements (e.g., funds management for labor and materials), and reviewing and approving all invoicing actions; and providing day-to-day communication, both within the ABB-ES team and with the USAEC COR, on all task matters including task status reporting.

**Corporate Officer.** ABB-ES' Corporate Officer, William R. Fisher, P.E., is responsible for ensuring that a contract for the services to be provided has been executed; necessary corporate resources are committed to conduct the program activities; corporate level input and response is readily available to both the ABB-ES team and the USAEC COR; and assistance is provided to the Program and Project Managers for project implementation.

**Technical Director and Project Review Committee.** The members of the Project Review Committee for this Task Order are Mr. James Buss, P.G., Mr. Jeffrey Pickett, and Mr. Willard Murray, Ph.D., P.E. Mr. Buss will serve as Technical Director and will be responsible for the overall technical quality of the work performed; he also will serve as chairman of the Project Review Committee. The function of this group of senior technical and/or management personnel is to provide guidance and oversight on the technical aspects of the project. This is accomplished through periodic reviews of the services provided to confirm they represent the accumulated experience of the firm, are being produced in accordance with corporate policy, and live up to the objectives of the program as established by ABB-ES and USAEC.

**Quality Assurance Supervisor.** Mr. Christian Ricardi is the QA Supervisor for ABB-ES' USAEC program and this project. The QA function has been established so that appropriate protocols from USAEC, Commonwealth of Massachusetts, and USEPA Region 1 are followed. In addition, the QA Supervisor must confirm that QC plans are in place and implemented for each element of the task. The QA Supervisor reports directly to the Program Manager but is responsible to the Project Manager in matters related to management of

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the QA/QC work element. The QA Supervisor is independent of the Project Manager relative to corrective action. The QA Supervisor has authority to stop work that is not in compliance with the POP, provided he has the concurrence of the USAEC Chemistry Branch, the Program Manager, the COR, and the Contracting Officer.

**Health and Safety Supervisor.** Ms. Cynthia E. Sundquist is the Health and Safety Supervisor for the Fort Devens project, reporting directly to the Project Manager. She has stop-work authority to prevent or mitigate any unacceptable health and safety risks to project personnel, the general public, or the environment. Responsibilities of this position include confirming that the project team and, in particular, field personnel, comply with the ABB-ES Health and Safety Plan (HASP); helping the Program Manager and Project Manager develop the site-specific HASP; making certain that the HASP is distributed to appropriate personnel; and informing the Program Manager and the appropriate USAEC personnel in the specified manner when any health- or safety-related incident occurs.

**Contract Manager.** Ms. Elaine H. Findlay is the Contract Manager for the Fort Devens effort. The Contract Manager supports the Program Manager and Project Manager in all contractual matters, providing a liaison between contract representatives for USAEC and all subcontracted services.

**Project Administrator.** Ms. Dana Porter is the Project Administrator for the Fort Devens effort. The Project Administrator supports the Program Manager and Project Manager in the day-to-day monitoring of fiscal, schedule, and documentation requirements. She is responsible for maintaining the necessary systems to support budget monitoring and controls, and schedule monitoring and maintenance; and for controlling the flow and processing of documentation.

**RI/FS Task Manager.** Mr. Herb Colby will serve as Task Manager for the remedial investigation and feasibility study for the AOC. As a Task Leader, he is responsible for planning all ABB-ES' geologic and hydrogeologic investigations at the AOCs. He also is responsible for effecting the interpretation of all chemical and hydrogeologic information and data, performance of the FSs, and preparation of the required reports for the AOC.

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**Field Operations Leader.** Mr. Rod Rustad will serve as the Field Operations Leader for the Fort Devens Field Program. As Field Operations Leader he is responsible for conducting the field program in accordance with procedures outlined in the Work Plan and POP.

**Laboratory/Data Management Leader.** Ms. Elizabeth Dawes, as the coordinator of laboratory services, is responsible for implementing and maintaining the Fort Devens analytical program. Her responsibilities as the Laboratory Management Leader will include coordination with the Project Manager, QA Supervisor, and the analytical subcontractors on overall project and individual site analytical efforts. As the Data Management Leader, Ms. Dawes is responsible for operating and maintaining the database management systems committed to USAEC projects.

### 6.2 SUBCONTRACTORS

The following services and/or activities will be performed by subcontractors during the RI/FS field investigation activities at the AOC: field drilling and monitoring well installation, test pit excavation, surveying, investigation derived waste disposal, and laboratory chemical analysis.

**Drilling Services.** Maher Environmental has been chosen through a competitive bidding process to provide drilling services for the RI. The drilling subcontractor will be responsible for mobilizing the proper drilling equipment to complete the soil boring and monitoring well installation. The Field Operations Leader will be responsible for coordinating and overseeing the activities of the drilling subcontractor.

**Surveying Services.** Martinage Engineering Associates, a professional land surveying company registered in the Commonwealth of Massachusetts, has been subcontracted to establish map coordinates and elevations for new monitoring wells and sampling locations. Surveying activities will be coordinated and monitored by the Field Operations Leader, who will keep the Task and Project Managers informed on a day-to-day basis.

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**Test Pit Excavation.** Enpro has been chosen through a competitive bidding process to provide excavation services during the exploratory test pitting portion of the RI.

**Investigation-derived Waste Disposal.** Jetline has been chosen through a competitive bidding process. They will be responsible for removing and disposing of soil and/or water generated during the RI/FS program. Jetline will be responsible for disposing of the waste in accordance with all state and federal regulations.

**Laboratory Chemical Analysis.** Analytical services for the AOC field investigation will be subcontracted to ESE of Gainesville, Florida. ESE's analytical program is USAEC-approved.

**Laboratory Toxicity and Bioaccumulation Testing.** Whole sediment and bioaccumulation testing for the field investigation will be subcontracted to Springborn Laboratories, Inc. (SLI) located in Wareham, Massachusetts.

### 6.3 PROJECT SCHEDULE

A projection of the schedule for the RI/FS is presented in this subsection. This schedule has been designed to allow for the regulatory review and approval period specified in the Federal Facility Agreement for all deliverables.

The field tasks are scheduled to be completed in five-day work shifts within eight months of receiving authorization to proceed. The fieldwork is anticipated to commence in August 1995.

## **GLOSSARY OF ACRONYMS AND ABBREVIATIONS**

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|        |                                                                     |
|--------|---------------------------------------------------------------------|
| ABB-ES | ABB Environmental Services, Inc.                                    |
| AOC    | Area of Contamination                                               |
| ARARs  | Applicable or Relevant and Appropriate Requirements                 |
| AWQC   | Ambient Water Quality Criteria                                      |
| cm/sec | centimeter per second                                               |
| CRL    | certified reporting limit                                           |
| CERCLA | Comprehensive Environmental Response Compensation and Liability Act |
| COPC   | chemicals of potential concern                                      |
| COR    | Contracting Officer's Representative                                |
| CRP    | Community Relations Plan                                            |
| DCA    | Dichloroethane                                                      |
| DQO    | Data Quality Objective                                              |
| E&E    | Ecology and Environment, Inc.                                       |
| ECAO   | Environmental Criteria and Assessment Office                        |
| ESE    | Environmental Science & Engineering                                 |
| FS     | feasibility study                                                   |
| GC     | gas chromatograph                                                   |
| GPR    | ground-penetrating radar                                            |
| HASP   | Health and Safety Plan                                              |
| HEAST  | Health Effects Assessment Summary Tables                            |
| IAG    | interagency agreement                                               |
| IRDMIS | Installation Restoration Data Management Information System         |
| IRIS   | Integrated Risk Information System                                  |
| MADEP  | Massachusetts Department of Environmental Protection                |
| MCL    | Maximum Contaminant Level                                           |
| NCP    | National Contingency Plan                                           |

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## **GLOSSARY OF ACRONYMS AND ABBREVIATIONS**

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|       |                                              |
|-------|----------------------------------------------|
| OU    | operable unit                                |
| PAHs  | polynuclear aromatic hydrocarbons            |
| PAL   | Project Analyte List                         |
| PCB   | polychlorinated biphenyl                     |
| PID   | photoionization detector                     |
| POP   | Project Operations Plan                      |
| POTW  | publicly-owned treatment works               |
| PRE   | preliminary risk evaluation                  |
| QA    | Quality Assurance                            |
| QC    | Quality Control                              |
| RAAP  | Risk Assessment Approach Plan                |
| RAGS  | Risk Assessment Guidance for Superfund       |
| RI    | remedial investigation                       |
| ROD   | Record of Decision                           |
| SA    | Study Area                                   |
| SARA  | Superfund Amendments and Reauthorization Act |
| SI    | site investigation                           |
| SSI   | supplemental site investigation              |
| SVOC  | semivolatile organic compound                |
| TBC   | to be considered                             |
| TCLP  | Toxicity Characteristics Leaching Procedure  |
| TOC   | total organic carbon                         |
| TPHC  | total petroleum hydrocarbon compounds        |
| TRC   | Technical Review Committee                   |
| TSS   | total suspended solids                       |
| USAEC | U.S. Army Environmental Center               |
| USEPA | U.S. Environmental Protection Agency         |
| UV    | ultraviolet                                  |
| UXO   | unexploded ordnance                          |
| VOC   | volatile organic compound                    |

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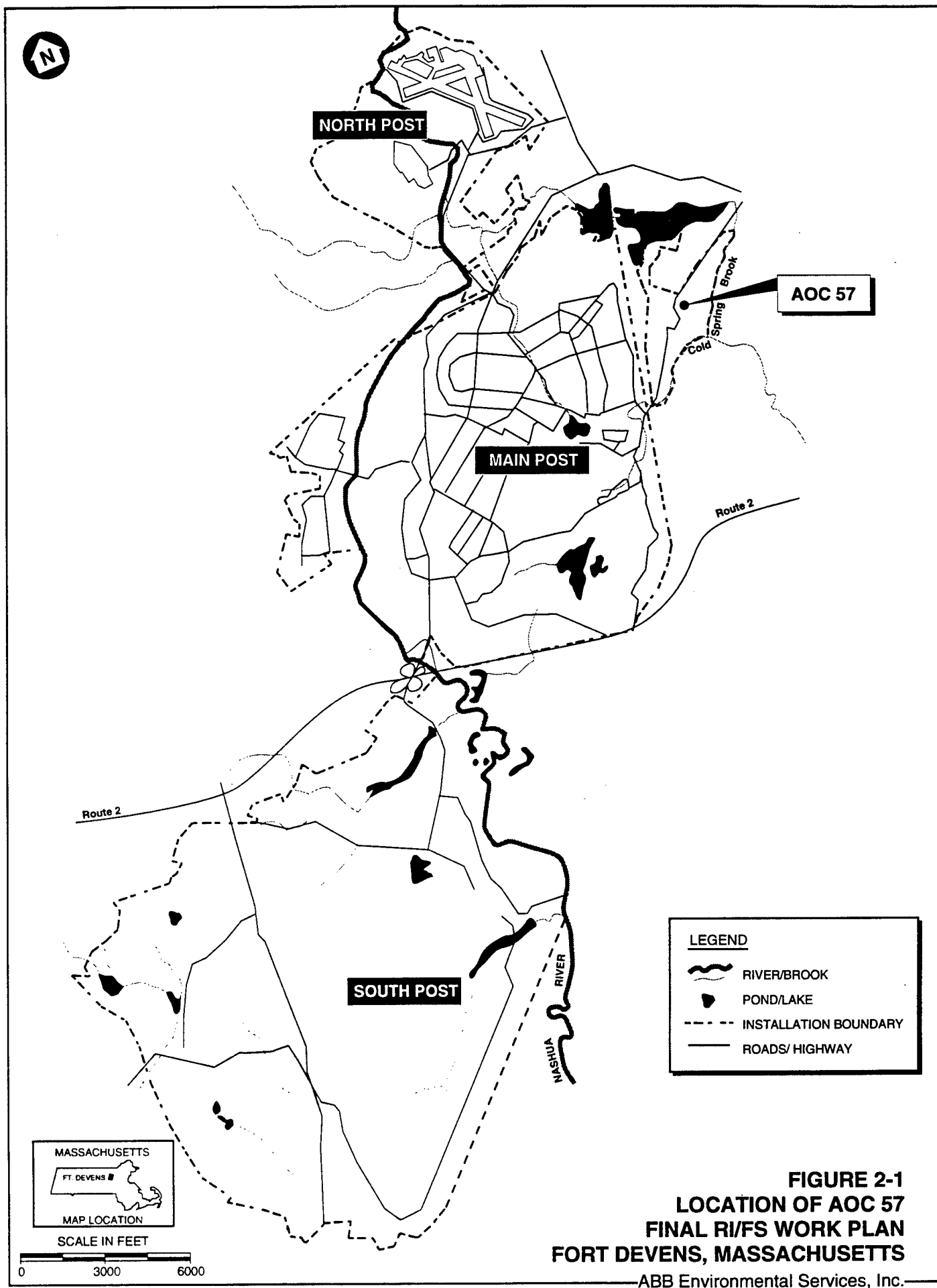
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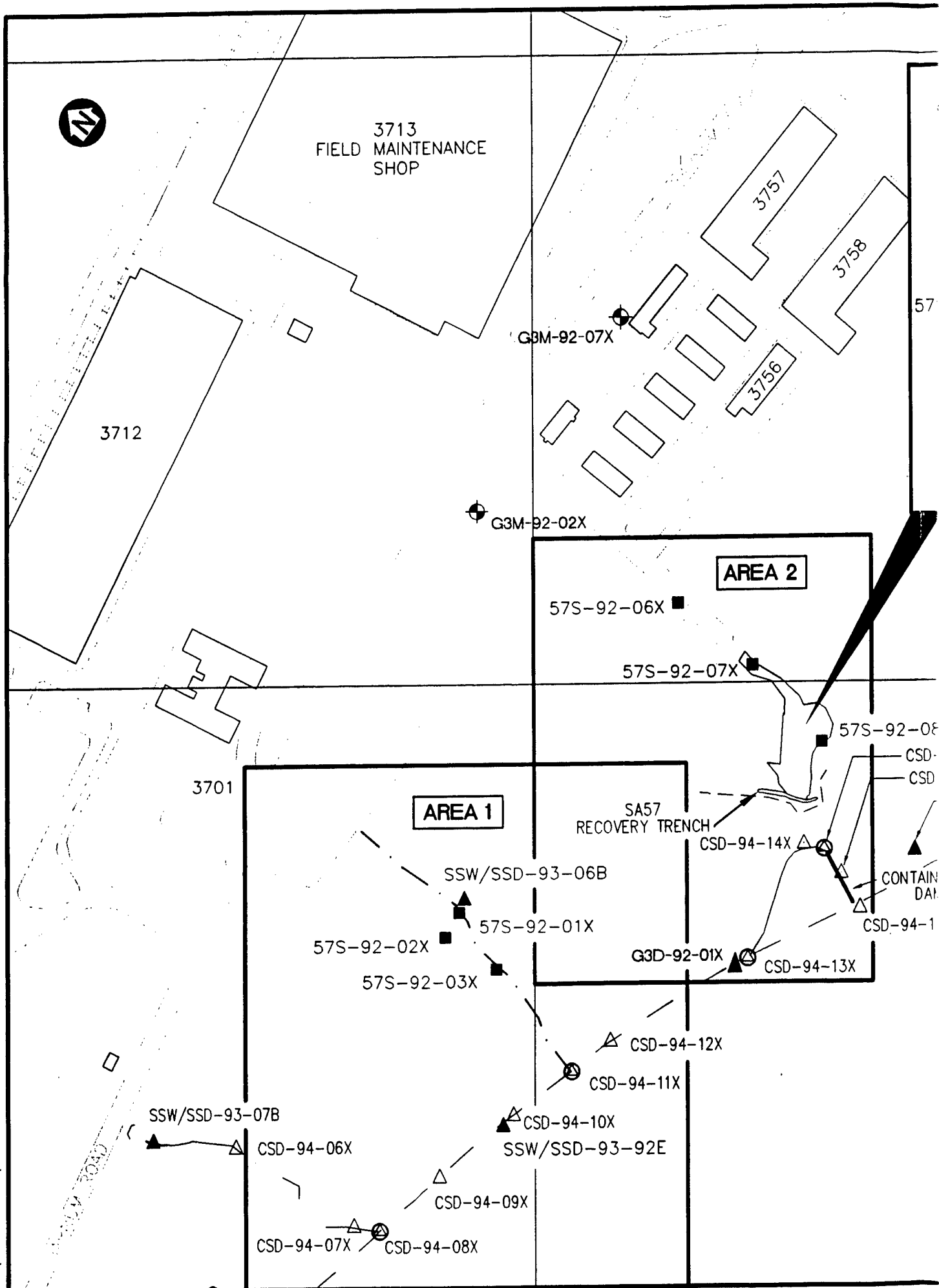
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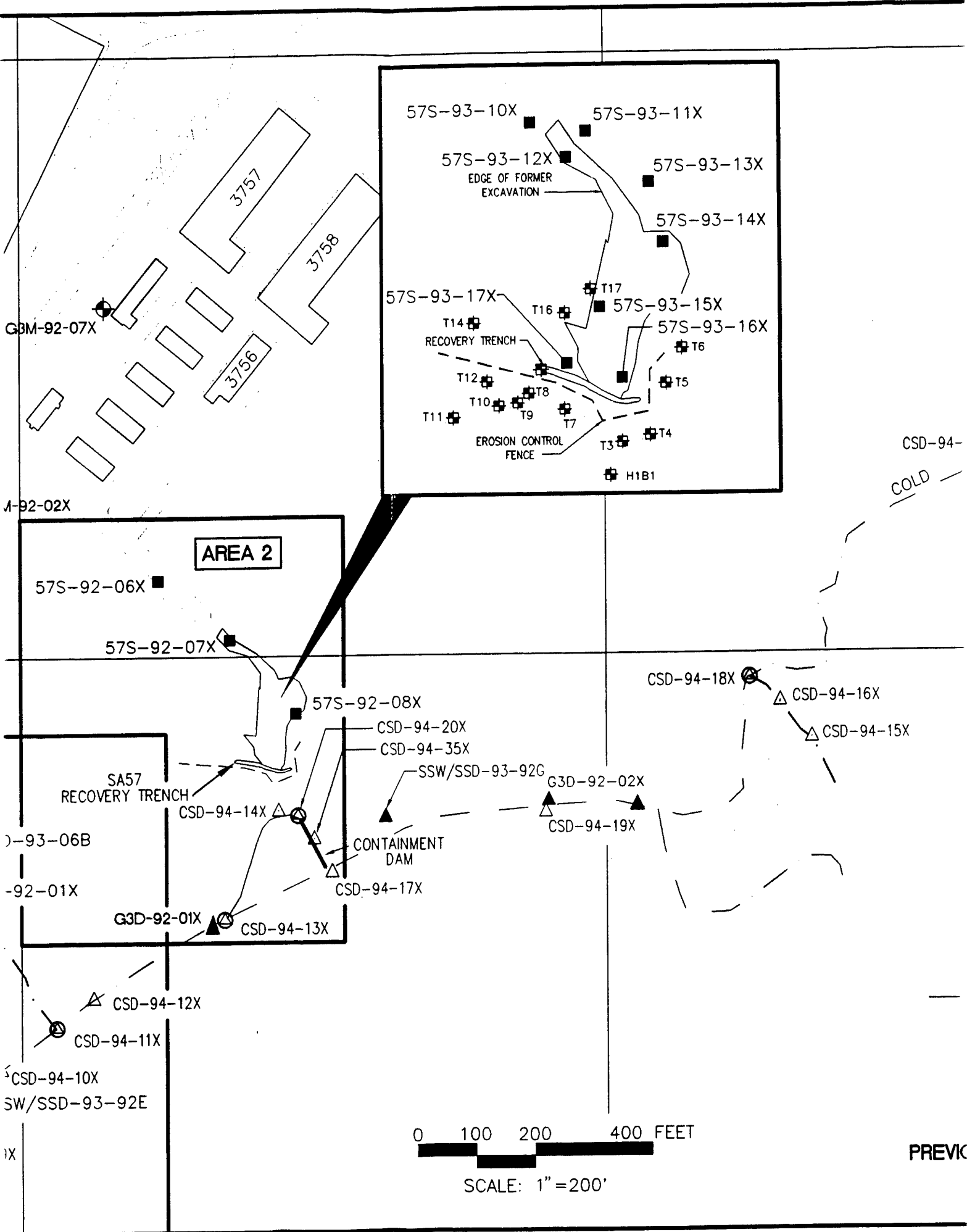
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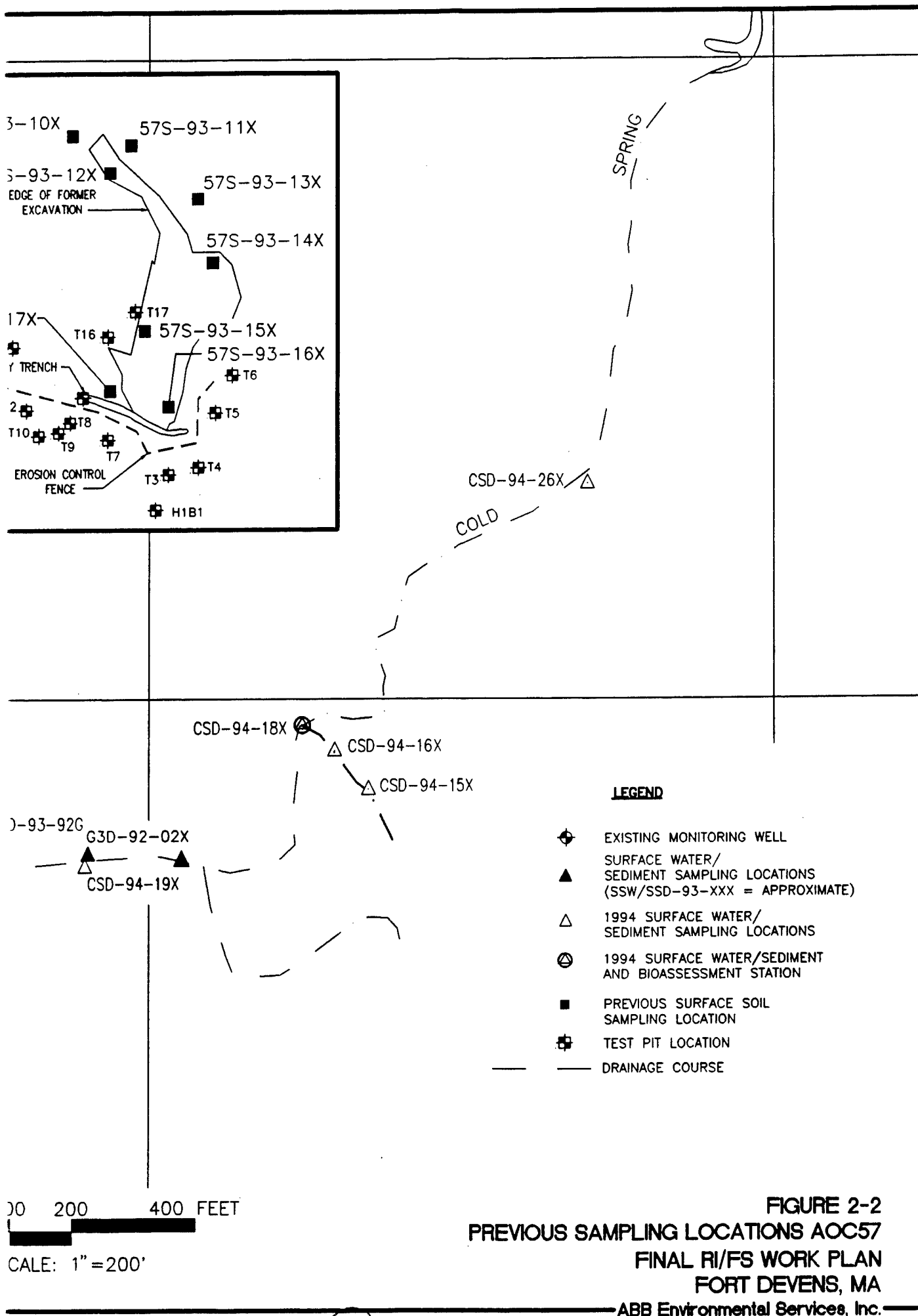
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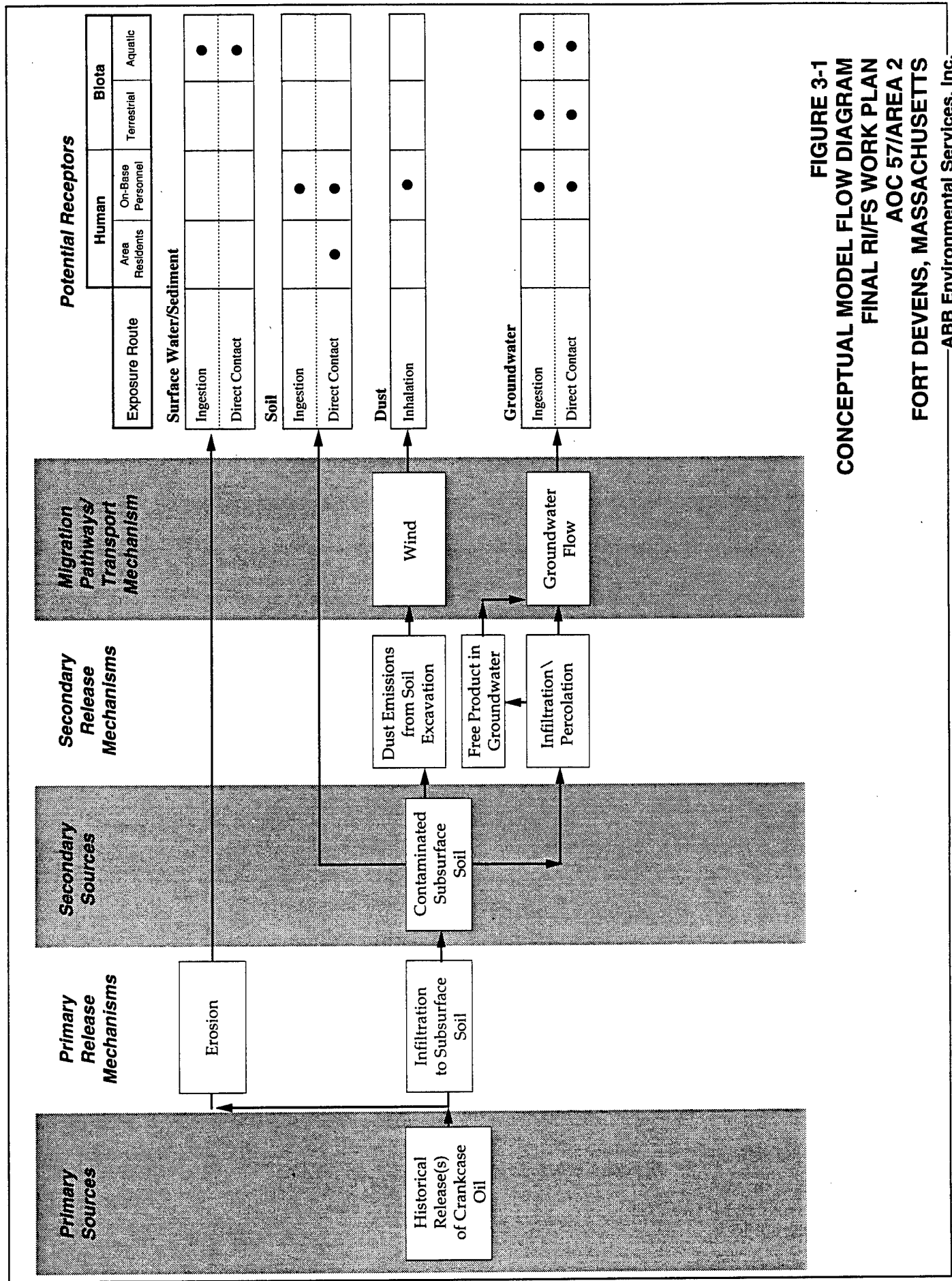


**FIGURE 3-1**  
**CONCEPTUAL MODEL FLOW DIAGRAM**  
**FINAL RI/FS WORK PLAN**  
**AOC 57/AREA 2**  
**FORT DEVENS, MASSACHUSETTS**  
 ABB Environmental Services, Inc.

**AOC 57 Groundwater**

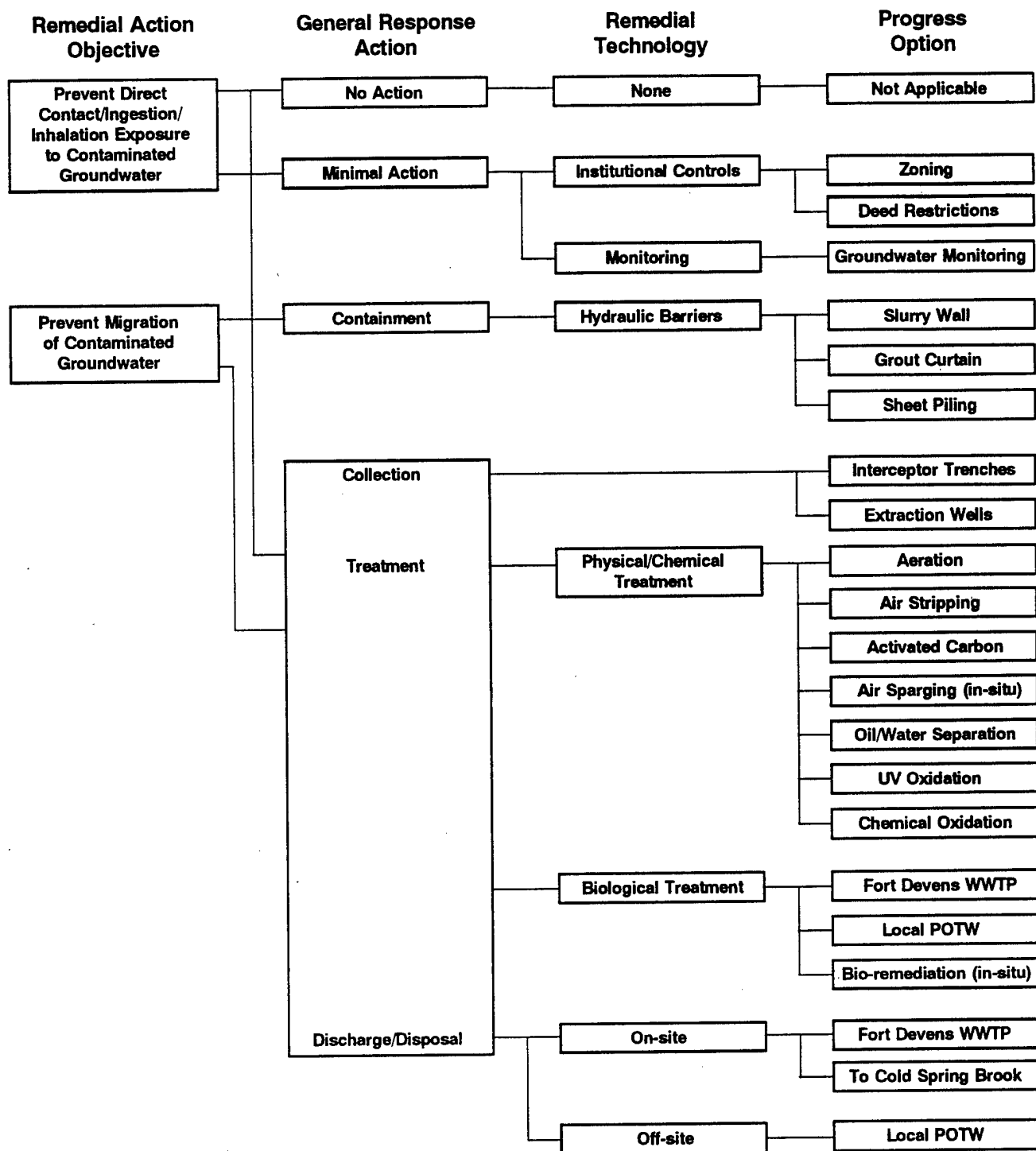


**FIGURE 3-2**  
**IDENTIFICATION OF POTENTIAL REMEDIAL TECHNOLOGIES**  
**FINAL RI/FS WORK PLAN**  
**AOC 57/AREA 2**  
**FORT DEVENS, MA**

- ABB Environmental Services, Inc.

## AOC 57 Soil

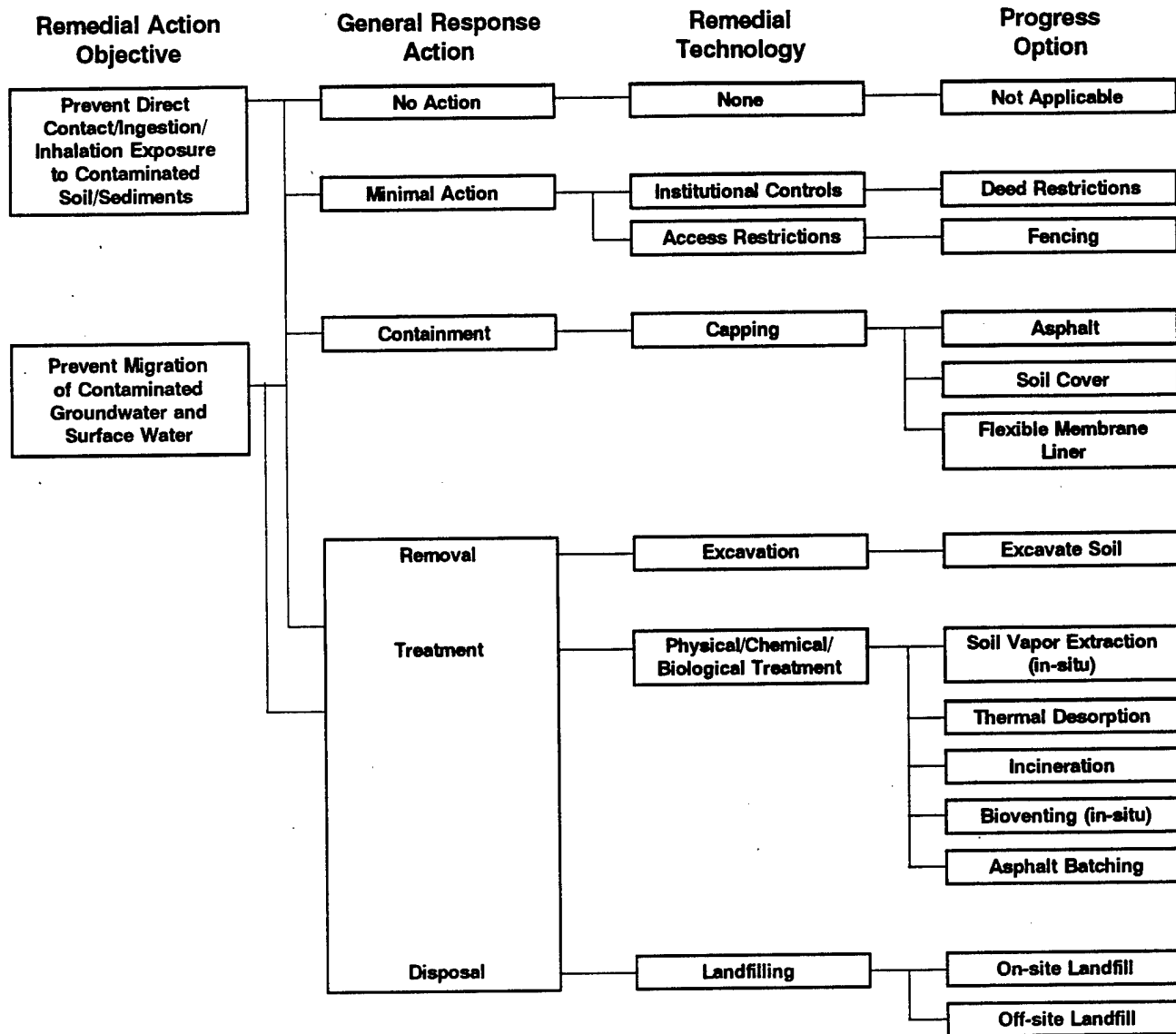


FIGURE 3-2 (Cont.)  
 IDENTIFICATION OF POTENTIAL REMEDIAL TECHNOLOGIES  
 FINAL RI/FS WORK PLAN  
 AOC 57/AREA 2  
 FORT DEVENS, MA

ABB Environmental Services, Inc.



3713  
FIELD MAINTENANCE  
SHOP

3712

G3M-92-07X

3757

3758

3756

G3M-92-02X

57S-92-06X

57S-92-07X

RAIL, IN  
AND TR  
OP

3701

57S-92-08X

SA57  
RECOVERY TRENCH

SSW/SSD-93-06B

CSD-94-14X

CSD-94-17

57S-92-01X

57S-92-02X

CSD-94-13X

G3D-92-01X

57S-92-03X

CSD-94-12X

CSD-94-11X

SSW/SSD-93-07B

CSD-94-06X

SSW/SSD-93-92E

CSD-94-10X

CSD-94-09X

CSD-94-07X

CSD-94-08X

J:\7466-00\FIG-6A.DWG



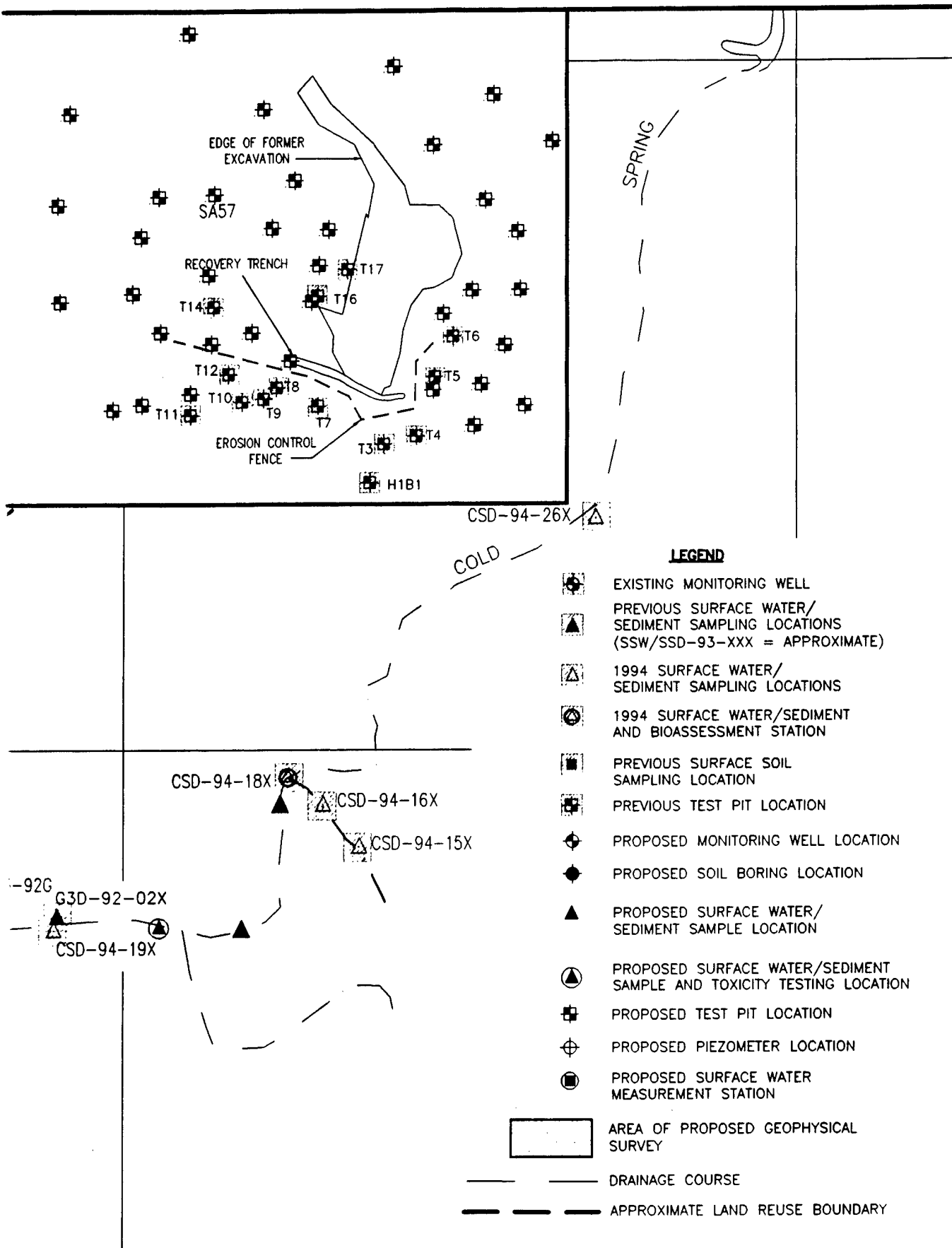


**FIGURE 5-1**  
**PREVIOUS AND PROPOSED EXPLORATION LOCATIONS AOC57**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

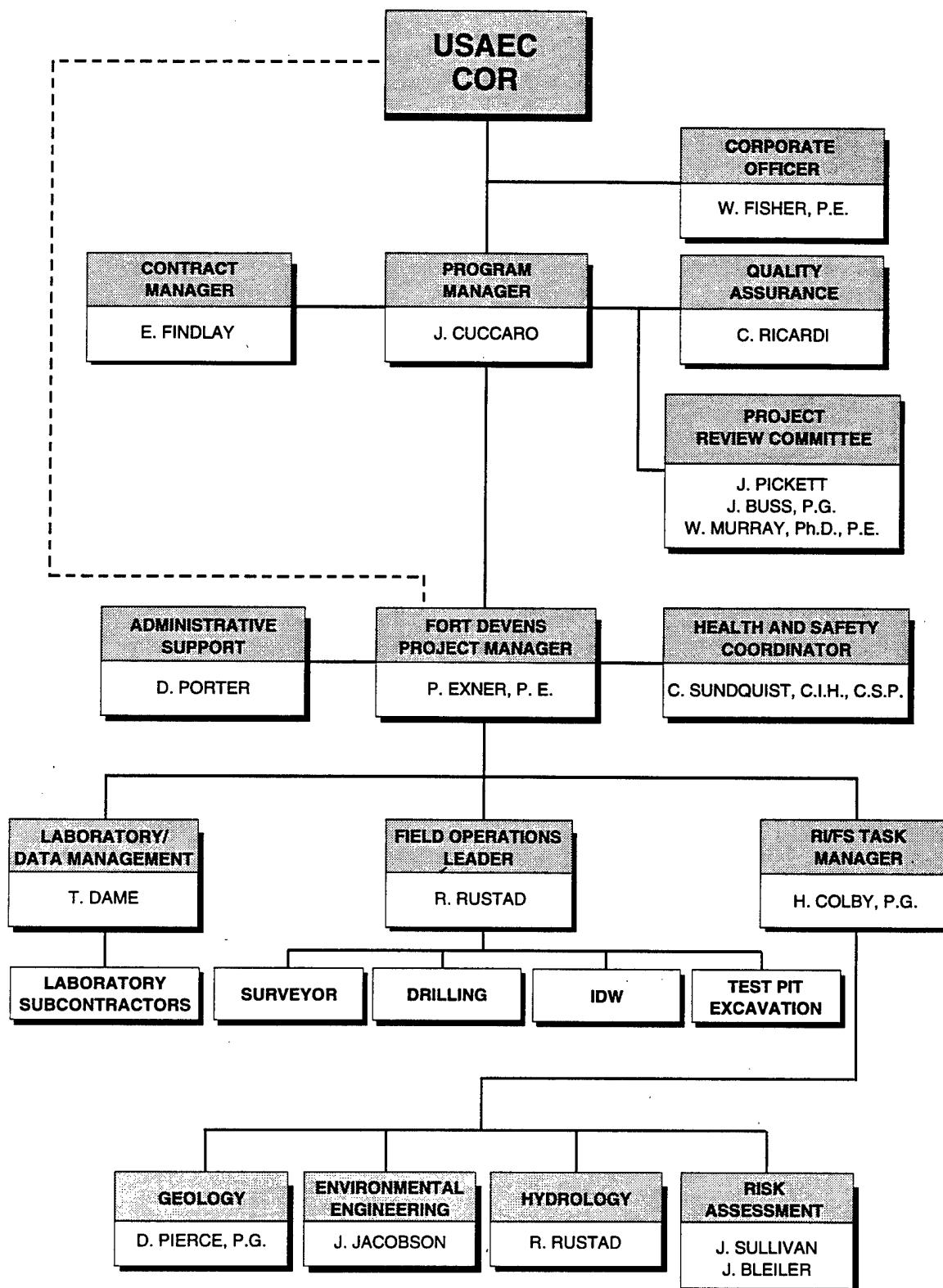


**FIGURE 6-1**  
**PROJECT ORGANIZATION**  
**AOC 57/AREA 2 BUILDING 3713 FUEL OIL SPILL SITE**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MASSACHUSETTS**

ABB Environmental Services, Inc.

TABLE 5-1  
FIELD ANALYTICAL SAMPLE RATIONALE  
AOC 57  
FINAL RI/FS WORK PLAN  
FORT DEVENS, MA

| SAMPLE<br>TYPE | DEPTH    | MEDIA | NO. OF<br>SAMPLES | LOCATION AND RATIONALE                                                                                                                                    |
|----------------|----------|-------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Test Pit       | variable | Soil  | 120               | To assess the distribution of contamination in soil. Three samples will be collected from 40 test pits, for field analysis of selected PAL VOCs and TPHC. |

**TABLE 5-2**  
**MONITORING WELL/PIEZOMETER INSTALLATION SUMMARY AND RATIONALE**  
**AOC 57**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID    | DRILLING METHOD | EXPECTED WATER TABLE DEPTH (FT) | ESTIMATED BOTTOM DEPTH OF SCREEN (FT) | ESTIMATED LENGTH OF SCREEN (FT) | PURPOSE AND RATIONALE                                                       |
|------------|-----------------|---------------------------------|---------------------------------------|---------------------------------|-----------------------------------------------------------------------------|
| 57M-95-01X | 6.25 HSAs       | 25                              | 30                                    | 10                              | To evaluate shallow groundwater quality upgradient of Area 2.               |
| 57M-95-02X | 6.25 HSAs       | 25                              | 30                                    | 10                              | To evaluate shallow groundwater quality upgradient of Area 2.               |
| 57M-95-03X | 6.25 HSAs       | 25                              | 30                                    | 10                              | To evaluate shallow groundwater quality downgradient of Area 2.             |
| 57M-95-04X | 6.25 HSAs       | 25                              | 30                                    | 10                              | To evaluate shallow groundwater quality downgradient of Area 2.             |
| 57M-95-05X | 6.25 HSAs       | 25                              | 30                                    | 10                              | To evaluate shallow groundwater quality downgradient of Area 2.             |
| 57M-95-06X | 6.25 HSAs       | 25                              | 30                                    | 10                              | To evaluate shallow groundwater quality downgradient of Area 2.             |
| 57M-95-07X | 6.25 HSAs       | 25                              | 30                                    | 10                              | To evaluate shallow groundwater quality downgradient of Area 2.             |
| 57M-95-08X | 6.25 HSAs       | 25                              | 30                                    | 10                              | To evaluate shallow groundwater quality downgradient of Area 2.             |
| 57M-95-09X | 6.25 HSAs       | 25                              | 50                                    | 10                              | To further evaluate deep groundwater quality downgradient of Area 2.        |
| 57M-95-10X | 6.25 HSAs       | 25                              | 50                                    | 10                              | To further evaluate deep groundwater quality downgradient of Area 2.        |
| 57P-95-01X | 4.25 HSAs       | 10                              | 15                                    | 2                               | To further evaluate hydrologic conditions in the area of Cold Spring Brook. |
| 57P-95-02X | 4.25 HSAs       | 10                              | 15                                    | 2                               | To further evaluate hydrologic conditions in the area of Cold Spring Brook. |
| 57P-95-03X | 4.25 HSAs       | 10                              | 15                                    | 2                               | To further evaluate hydrologic conditions in the area of Cold Spring Brook. |
| 57P-95-04X | 4.25 HSAs       | 10                              | 15                                    | 2                               | To further evaluate hydrologic conditions in the area of Cold Spring Brook. |

**TABLE 5-3**  
**MONITORING WELL/GROUNDWATER SAMPLE RATIONALE**  
**AOC 57**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| <b>SITE ID</b> | <b>LOCATION</b>                       | <b>RATIONALE AND PURPOSE</b>                                                                                                                                                                                                     |
|----------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| G3M-92-02X     | Existing well upgradient of Area 2.   | Monitor groundwater quality upgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters.   |
| G3M-92-07X     | Existing well upgradient of Area 2.   | Monitor groundwater quality upgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters.   |
| 57M-95-01X     | Proposed well upgradient of Area 2.   | Monitor groundwater quality upgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters.   |
| 57M-95-02X     | Proposed well upgradient of Area 2.   | Monitor groundwater quality upgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters.   |
| 57M-95-03X     | Proposed well downgradient of Area 2. | Monitor groundwater quality downgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 57M-95-04X     | Proposed well downgradient of Area 2. | Monitor groundwater quality downgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 57M-95-05X     | Proposed well downgradient of Area 2. | Monitor groundwater quality downgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 57M-95-06X     | Proposed well downgradient of Area 2. | Monitor groundwater quality downgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 57M-95-07X     | Proposed well downgradient of Area 2. | Monitor groundwater quality downgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |

**TABLE 5-3**  
**MONITORING WELL/GROUNDWATER SAMPLE RATIONALE**  
**AOC 57**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID    | LOCATION                              | RATIONALE AND PURPOSE                                                                                                                                                                                                            |
|------------|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 57M-95-08X | Proposed well downgradient of Area 2. | Monitor groundwater quality downgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 57M-95-09X | Proposed well downgradient of Area 2. | Monitor groundwater quality downgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 57M-95-10X | Proposed well downgradient of Area 2. | Monitor groundwater quality downgradient of Area 2. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |

**TABLE 5-4**  
**SOIL BORING LOCATION AND SAMPLE RATIONALE**  
**AOC 57**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID    | DEPTH<br>(FT BGS) | DRILLING<br>METHOD | SAMPLE<br>ID                     | LOCATION AND RATIONALE                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------|-------------------|--------------------|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 57B-95-01X | 20                | 4.25 - inch HSAs   | BX570104<br>BX570110<br>BX570116 | Located in the northern area drainage ditch, at locations chosen to support both the contamination assessment in the RI, and the remedial alternative screening in the FS. Samples will be collected at 4 to 6 feet, 10 to 12 feet (or as dictated by test pit results), and 16 to 18 feet (or depth of groundwater) from each location. Each sample will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics and TPHC. |
| 57B-95-02X | 20                | 4.25 - inch HSAs   | BX570204<br>BX570210<br>BX570216 | Located in the northern area drainage ditch, at locations chosen to support both the contamination assessment in the RI, and the remedial alternative screening in the FS. Samples will be collected at 4 to 6 feet, 10 to 12 feet (or as dictated by test pit results), and 16 to 18 feet (or depth of groundwater) from each location. Each sample will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics and TPHC. |
| 57B-95-03X | 20                | 4.25 - inch HSAs   | BX570304<br>BX570310<br>BX570316 | Located in the northern area drainage ditch, at locations chosen to support both the contamination assessment in the RI, and the remedial alternative screening in the FS. Samples will be collected at 4 to 6 feet, 10 to 12 feet (or as dictated by test pit results), and 16 to 18 feet (or depth of groundwater) from each location. Each sample will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics and TPHC. |
| 57B-95-04X | 20                | 4.25 - inch HSAs   | BX570404<br>BX570410<br>BX570416 | Located in the northern area drainage ditch, at locations chosen to support both the contamination assessment in the RI, and the remedial alternative screening in the FS. Samples will be collected at 4 to 6 feet, 10 to 12 feet (or as dictated by test pit results), and 16 to 18 feet (or depth of groundwater) from each location. Each sample will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics and TPHC. |

**TABLE 5-5**  
**SEDIMENT/SURFACE WATER LOCATION AND SAMPLE RATIONALE**  
**AOC 57**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID    | SAMPLE ID |                  | SEDIMENT<br>SAMPLE<br>DEPTH | LOCATION AND RATIONALE                                                                                                                                                                                                                                                                                                                                    |
|------------|-----------|------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | SEDIMENT  | SURFACE<br>WATER |                             |                                                                                                                                                                                                                                                                                                                                                           |
| 57D-95-03X | DX570301  | --               | 0'-1'                       | Located immediately upstream of site in Cold Spring Brook. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAI Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters.                              |
|            | DX570302  | --               | 2'-4'                       |                                                                                                                                                                                                                                                                                                                                                           |
|            | WX5703XX  |                  | --                          |                                                                                                                                                                                                                                                                                                                                                           |
| 57D-95-04X | DX570401  | --               | 0'-1'                       | Located in wetlands adjacent to site. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAI Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters.                                                   |
|            | DX570402  | --               | 2'-4'                       |                                                                                                                                                                                                                                                                                                                                                           |
|            | WX5704XX  |                  | --                          |                                                                                                                                                                                                                                                                                                                                                           |
| 57D-95-05X | DX570501  | --               | 0'-1'                       | Located in wetlands adjacent to site. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAI Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters.                                                   |
|            | DX570502  | --               | 2'-4'                       |                                                                                                                                                                                                                                                                                                                                                           |
|            | WX5705X1  |                  | --                          |                                                                                                                                                                                                                                                                                                                                                           |
| 57D-95-06X | DX570601  | --               | 0'-1'                       | Located in Cold Spring Brook, at the downstream margin of site. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAI Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters.                         |
|            | DX570602  | --               | 2'-4'                       |                                                                                                                                                                                                                                                                                                                                                           |
|            | WX5706X1  |                  | --                          |                                                                                                                                                                                                                                                                                                                                                           |
| 57D-95-07X | DX570701  | --               | 0'-1'                       | Located downstream of the site in Cold Spring Brook. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAI Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters.                                    |
|            | DX570702  | --               | 2'-4'                       |                                                                                                                                                                                                                                                                                                                                                           |
|            | WX5707X1  |                  | --                          |                                                                                                                                                                                                                                                                                                                                                           |
| 57D-95-08X | DX570801  | --               | 0'-1'                       | Located upstream of site in Cold Spring Brook. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAI Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters.                                          |
|            | DX570802  | --               | 2'-4'                       |                                                                                                                                                                                                                                                                                                                                                           |
|            | WX5708XX  |                  | --                          |                                                                                                                                                                                                                                                                                                                                                           |
| 57D-95-09X | DX570901  | --               | 0'-1'                       | Located in wetland adjacent to site. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAI Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters.                                                    |
|            | DX570902  | --               | 2'-4'                       |                                                                                                                                                                                                                                                                                                                                                           |
|            | WX5709XX  |                  | --                          |                                                                                                                                                                                                                                                                                                                                                           |
| 57D-95-10X | DX571001  | --               | 0'-1'                       | Located in or adjacent to Cold Spring Brook, immediately downstream of containment dam. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAI Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters. |
|            | DX571002  | --               | 2'-4'                       |                                                                                                                                                                                                                                                                                                                                                           |
|            | WX5710XX  |                  | --                          |                                                                                                                                                                                                                                                                                                                                                           |

**TABLE 5-5**  
**SEDIMENT/SURFACE WATER LOCATION AND SAMPLE RATIONALE**  
**AOC 57**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID    | SAMPLE ID |                  | SEDIMENT<br>SAMPLE<br>DEPTH | LOCATION AND RATIONALE                                                                                                                                                                                                                                                                                              |
|------------|-----------|------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | SEDIMENT  | SURFACE<br>WATER |                             |                                                                                                                                                                                                                                                                                                                     |
| 57D-95-11X | DX571101  | --<br>WX5711XX   | 0'-1'<br>--                 | Located in Cold Spring Brook, downstream of site. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters. |
| 57D-95-12X | DX571201  | --<br>WX5712XX   | 0'-1'<br>--                 | Located in Cold Spring Brook, downstream of site. Sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, TOC and petro. fingerprinting. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pest/PCBs, PAL inorganics, TPHC, and water quality parameters. |

TABLE 5-6  
 SAMPLING AND LABORATORY ANALYSIS SCHEDULE  
 AOC 57  
 DRAFT RI/FS WORK PLAN  
 FORT DEVENS, MA

| SITE<br>TYPE | MEDIA | SITE<br>ID | SAMPLE<br>ID | LAB<br>SAMPLE<br>NO. | MS/1<br>MSD | DUP | RINS | FINGER | PET<br>GRAIN<br>SIZE | PAL2<br>VOCs | PAL2<br>SVOCs | PAL2<br>INORG. | PAL2<br>PEST/<br>PCBs | PAL2<br>PRMTRS | WTR QUA | TPHC | TDS | TOC |
|--------------|-------|------------|--------------|----------------------|-------------|-----|------|--------|----------------------|--------------|---------------|----------------|-----------------------|----------------|---------|------|-----|-----|
|              |       |            |              |                      |             |     |      |        |                      |              |               |                |                       |                |         |      |     |     |
| EXCV         | SOIL  | 57E-95-01X | EX5701-      | DV4S* 101            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-02X | EX5702-      | DV4S* 102            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-03X | EX5703-      | DV4S* 103            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-04X | EX5704-      | DV4S* 104            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-05X | EX5705-      | DV4S* 105            | 1           | 1   |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-06X | EX5706-      | DV4S* 106            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-07X | EX5707-      | DV4S* 107            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-08X | EX5708-      | DV4S* 108            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-09X | EX5709-      | DV4S* 109            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-10X | EX5710-      | DV4S* 110            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-11X | EX5711-      | DV4S* 111            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-12X | EX5712-      | DV4S* 112            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-13X | EX5713-      | DV4S* 113            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-14X | EX5714-      | DV4S* 114            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-15X | EX5715-      | DV4S* 115            | 1           | 1   |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-16X | EX5716-      | DV4S* 116            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-17X | EX5717-      | DV4S* 117            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-18X | EX5718-      | DV4S* 118            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-19X | EX5719-      | DV4S* 119            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-20X | EX5720-      | DV4S* 120            |             |     |      |        | 1                    | 1            | 1             | 1              | 1                     |                |         | 1    |     |     |
| EXCV         | SOIL  | 57E-95-21X | EX5721-      | DV4S* 121            |             |     |      |        | **                   | **           | **            | **             | **                    |                |         | **   |     |     |
| EXCV         | SOIL  | 57E-95-22X | EX5722-      | DV4S* 122            |             |     |      |        | **                   | **           | **            | **             | **                    |                |         | **   |     |     |
| EXCV         | SOIL  | 57E-95-23X | EX5723-      | DV4S* 123            |             |     |      |        | **                   | **           | **            | **             | **                    |                |         | **   |     |     |
| EXCV         | SOIL  | 57E-95-24X | EX5724-      | DV4S* 124            |             |     |      |        | **                   | **           | **            | **             | **                    |                |         | **   |     |     |
| EXCV         | SOIL  | 57E-95-25X | EX5725-      | DV4S* 125            |             |     |      |        | **                   | **           | **            | **             | **                    |                |         | **   |     |     |
| EXCV         | SOIL  | 57E-95-26X | EX5726-      | DV4S* 126            |             |     |      |        | **                   | **           | **            | **             | **                    |                |         | **   |     |     |

TABLE 5-6  
 SAMPLING AND LABORATORY ANALYSIS SCHEDULE  
 AOC 57  
 DRAFT RI/FS WORK PLAN  
 FORT DEVENS, MA

| SITE TYPE | MEDIA | SITE ID    | SAMPLE ID | LAB SAMPLE NO. | MS/1 | DUP | RINS | FINGER | PET | GRAIN SIZE | PAL2 VOCS | PAL2 SVOCs | PAL3 INORG. | PAL3 PEST/PCBs | PAL2 PRMTRS | WTR QUA | TPHC | TDS | TOC |
|-----------|-------|------------|-----------|----------------|------|-----|------|--------|-----|------------|-----------|------------|-------------|----------------|-------------|---------|------|-----|-----|
|           |       |            |           |                |      |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-27X | EX5727-   | DV4S*          | 127  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-28X | EX5728-   | DV4S*          | 128  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-29X | EX5729-   | DV4S*          | 129  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-30X | EX5730-   | DV4S*          | 130  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-31X | EX5731-   | DV4S*          | 131  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-32X | EX5732-   | DV4S*          | 132  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-33X | EX5733-   | DV4S*          | 133  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-34X | EX5734-   | DV4S*          | 134  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-35X | EX5735-   | DV4S*          | 135  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-36X | EX5736-   | DV4S*          | 136  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-37X | EX5737-   | DV4S*          | 137  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-38X | EX5738-   | DV4S*          | 138  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-39X | EX5739-   | DV4S*          | 139  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| EXCV      | SOIL  | 57E-95-40X | EX5740-   | DV4S*          | 140  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-01X | BX570104  | DV4S*          | 141  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-01X | BX570110  | DV4S*          | 142  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-01X | BX570116  | DV4S*          | 143  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-02X | BX570204  | DV4S*          | 144  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-02X | BX570210  | DV4S*          | 145  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-02X | BX570216  | DV4S*          | 146  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-03X | BX570304  | DV4S*          | 147  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-03X | BX570310  | DV4S*          | 148  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-03X | BX570316  | DV4S*          | 149  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-04X | BX570404  | DV4S*          | 150  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-04X | BX570410  | DV4S*          | 151  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |
| BORE      | SOIL  | 57B-95-04X | BX570416  | DV4S*          | 152  |     |      |        |     |            |           |            |             |                |             |         |      |     |     |

TABLE S-6  
 SAMPLING AND LABORATORY ANALYSIS SCHEDULE  
 AOC 57  
 DRAFT RI/FS WORK PLAN  
 FORT DEVENS, MA

| SITE<br>TYPE | MEDIA       | SITE<br>ID | SAMPLE<br>ID | LAB<br>SAMPLE<br>NO. | MS/1 | MSD | DUP | RINS | PET<br>FINGER | GRAIN<br>SIZE | PAL2<br>VOCS | PAL2<br>SVOCs | PAL2<br>INORG. | PAL2<br>PEST/PCBs | PAL2<br>PRMTRS | PAL2<br>WTR QUA | TPHC | TDS | TOC |
|--------------|-------------|------------|--------------|----------------------|------|-----|-----|------|---------------|---------------|--------------|---------------|----------------|-------------------|----------------|-----------------|------|-----|-----|
|              |             |            |              |                      |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-01X | BX5701--     | DV4S* 153            |      |     |     | 1    |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-02X | BX5702--     | DV4S* 154            |      |     |     | 1    |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-03X | BX5703--     | DV4S* 155            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-04X | BX5704--     | DV4S* 156            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-05X | BX5705--     | DV4S* 157            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-06X | BX5706--     | DV4S* 158            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-07X | BX5707--     | DV4S* 159            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-08X | BX5708--     | DV4S* 160            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-09X | BX5709--     | DV4S* 161            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| BORE         | SOIL        | 57M-95-10X | BX5710--     | DV4S* 162            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | G3M-92-02X | MXG302X1     | DV4W* 163            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | G3M-92-02X | MXG302X1     | DV4F* 163            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | G3M-92-02X | MXG302X2     | DV4W* 164            | 1    |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | G3M-92-02X | MXG302X2     | DV4F* 164            | 1    |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | G3M-92-07X | MXG307X1     | DV4W* 165            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | G3M-92-07X | MXG307X1     | DV4F* 165            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | G3M-92-07X | MXG307X2     | DV4W* 166            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | G3M-92-07X | MXG307X2     | DV4F* 166            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | 57M-95-01X | MX5701X1     | DV4W* 167            | 1    |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | 57M-95-01X | MX5701X1     | DV4F* 167            | 1    |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | 57M-95-01X | MX5701X2     | DV4W* 168            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | 57M-95-01X | MX5701X2     | DV4F* 168            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | 57M-95-02X | MX5702X1     | DV4W* 169            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | 57M-95-02X | MX5702X1     | DV4F* 169            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | 57M-95-02X | MX5702X2     | DV4W* 170            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |
| WELL         | GROUNDWATER | 57M-95-02X | MX5702X2     | DV4F* 170            |      |     |     |      |               |               |              |               |                |                   |                |                 |      |     |     |

**TABLE 5-6**  
**SAMPLING AND LABORATORY ANALYSIS SCHEDULE**  
**AOC 57**  
**DRAFT RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE TYPE | MEDIA       | SITE ID    | LAB       |            | MS/I | DUP | RINS | FINGER | PET | GRAIN SIZE | PAL2 VOCs | PAL2 SVOCs | PAL3 INORG. | PAL2 |      | WTR QUA | PAL3 | PEST/PCBs | TPHC | TDS | TOC |
|-----------|-------------|------------|-----------|------------|------|-----|------|--------|-----|------------|-----------|------------|-------------|------|------|---------|------|-----------|------|-----|-----|
|           |             |            | SAMPLE ID | SAMPLE NO. |      |     |      |        |     |            |           |            |             | PAL2 | PAL3 |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-03X | MX3703X1  | DV4W* 171  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-03X | MX3703X1  | DV4F* 171  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-03X | MX3703X2  | DV4W* 172  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-03X | MX3703X2  | DV4F* 172  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-04X | MX3704X1  | DV4W* 173  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-04X | MX3704X1  | DV4F* 173  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-04X | MX3704X2  | DV4W* 174  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-04X | MX3704X2  | DV4F* 174  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-05X | MX3705X1  | DV4W* 175  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-05X | MX3705X1  | DV4F* 175  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-05X | MX3705X2  | DV4W* 176  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-05X | MX3705X2  | DV4F* 176  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-06X | MX3706X1  | DV4W* 177  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-06X | MX3706X1  | DV4F* 177  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-06X | MX3706X2  | DV4W* 178  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-06X | MX3706X2  | DV4F* 178  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-07X | MX3707X1  | DV4W* 179  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-07X | MX3707X1  | DV4F* 179  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-07X | MX3707X2  | DV4W* 180  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-07X | MX3707X2  | DV4F* 180  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-08X | MX3708X1  | DV4W* 181  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-08X | MX3708X1  | DV4F* 181  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-08X | MX3708X2  | DV4W* 182  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-08X | MX3708X2  | DV4F* 182  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |
| WELL      | GROUNDWATER | 57M-95-09X | MX3709X1  | DV4W* 183  |      |     |      |        |     |            |           |            |             | 1    | 1    | 1       | 1    | 1         | 1    | 1   | 1   |
| WELL      | GROUNDWATER | 57M-95-09X | MX3709X1  | DV4F* 183  |      |     |      |        |     |            |           |            |             |      |      |         |      |           |      |     |     |

TABLE 5-6  
 SAMPLING AND LABORATORY ANALYSIS SCHEDULE  
 AOC 57  
 DRAFT RI/FS WORK PLAN  
 FORT DEVENS, MA

| SITE<br>TYPE | MEDIA         | SITE<br>ID | SAMPLE<br>ID | LAB<br>SAMPLE<br>NO. | MS/1 | DUP | RINS | FINGER | PET<br>GRAIN<br>SIZE | PAL2<br>VOCS | PAL2<br>SVOCs | PAL2<br>INORG. | PAL2<br>PEST/<br>PCBs | PAL2<br>PRMTRS | WTR QUA | TPHC | TDS | TOC |
|--------------|---------------|------------|--------------|----------------------|------|-----|------|--------|----------------------|--------------|---------------|----------------|-----------------------|----------------|---------|------|-----|-----|
|              |               |            |              |                      |      |     |      |        |                      |              |               |                |                       |                |         |      |     |     |
| WELL         | GROUNDWATER   | 57M-95-09X | MX5709X2     | DV4W* 184            |      |     |      |        | -                    | -            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| WELL         | GROUNDWATER   | 57M-95-09X | MX5709X2     | DV4F* 184            |      |     |      |        | -                    | -            |               | 1              |                       |                |         | -    | -   |     |
| WELL         | GROUNDWATER   | 57M-95-10X | MX5710X1     | DV4W* 185            |      |     |      |        | -                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| WELL         | GROUNDWATER   | 57M-95-10X | MX5710X1     | DV4F* 185            |      |     |      |        | -                    | -            |               | 1              |                       |                |         | -    | -   |     |
| WELL         | GROUNDWATER   | 57M-95-10X | MX5710X2     | DV4W* 186            |      |     |      |        | -                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| WELL         | GROUNDWATER   | 57M-95-10X | MX5710X2     | DV4F* 186            |      |     |      |        | -                    | -            |               | 1              |                       |                |         | -    | -   |     |
| STRM         | SEDIMENT      | 57D-95-03X | DX570301     | DV4S* 187            |      | 1   |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-03X | DX570302     | DV4S* 188            |      |     | 1    |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-04X | DX570401     | DV4S* 189            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-04X | DX570402     | DV4S* 190            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-05X | DX570501     | DV4S* 191            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-05X | DX570502     | DV4S* 192            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-06X | DX570601     | DV4S* 193            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-06X | DX570602     | DV4S* 194            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-07X | DX570701     | DV4S* 195            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-07X | DX570702     | DV4S* 196            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-08X | DX570801     | DV4S* 197            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-09X | DX570901     | DV4S* 198            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-10X | DX571001     | DV4S* 199            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-11X | DX571101     | DV4S* 200            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SEDIMENT      | 57D-95-12X | DX571201     | DV4S* 201            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SURFACE WATER | 57D-95-03X | WX5703XX     | DV4W* 202            |      | 1   |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SURFACE WATER | 57D-95-04X | WX5704XX     | DV4W* 203            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SURFACE WATER | 57D-95-05X | WX5705XX     | DV4W* 204            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SURFACE WATER | 57D-95-06X | WX5706XX     | DV4W* 205            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |
| STRM         | SURFACE WATER | 57D-95-07X | WX5707XX     | DV4W* 206            |      |     |      |        | 1                    | 1            | 1             | 1              | 1                     | 1              |         | 1    | 1   |     |

**TABLE 5-6**  
**SAMPLING AND LABORATORY ANALYSIS SCHEDULE**  
**AOC 57**  
**DRAFT RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE TYPE                        | MEDIA         | SITE ID    | LAB SAMPLE ID | LAB SAMPLE NO. | MS/1 MSD | DUP | RINS | FINGER | PET SIZE | GRAIN | PAL2 VOCS | PAL2 SVOCs | PAL2 INORG. | PAL2 PEST/PCBs | PAL3 PRMTRS | WTR QUA | TDS | TOC |
|----------------------------------|---------------|------------|---------------|----------------|----------|-----|------|--------|----------|-------|-----------|------------|-------------|----------------|-------------|---------|-----|-----|
|                                  |               |            |               |                |          |     |      |        |          |       |           |            |             |                |             |         |     |     |
| STRM                             | SURFACE WATER | 57D-95-08X | WX5708XX      | DV4W* 207      |          |     |      |        | -        | -     | -         | 1          | 1           | 1              | 1           | 1       | 1   | -   |
| STRM                             | SURFACE WATER | 57D-95-09X | WX5709XX      | DV4W* 208      |          |     |      |        | -        | -     | -         | 1          | 1           | 1              | 1           | 1       | 1   | -   |
| STRM                             | SURFACE WATER | 57D-95-10X | WX5710XX      | DV4W* 209      |          |     |      |        | -        | -     | -         | 1          | 1           | 1              | 1           | 1       | 1   | -   |
| STRM                             | SURFACE WATER | 57D-95-11X | WX5711XX      | DV4W* 210      |          |     |      |        | -        | -     | -         | 1          | 1           | 1              | 1           | 1       | 1   | -   |
| STRM                             | SURFACE WATER | 57D-95-12X | WX5712XX      | DV4W* 211      |          |     |      |        | -        | -     | -         | 1          | 1           | 1              | 1           | 1       | 1   | -   |
| SOIL SAMPLE SUBTOTAL             |               |            |               |                | 35       | 35  | 47   | 47     | 47       | 47    | 47        | 47         | 47          | 47             | 0           | 47      | 0   | 25  |
| WATER SAMPLE SUBTOTAL            |               |            |               |                | 0        | 0   | 34   | 34     | 58       | 34    | 34        | 34         | 34          | 34             | 34          | 34      | 24  | 0   |
| MS/MSD SAMPLES (5%)              |               |            |               |                | NA       | NA  | NA   | NA     | NA       | NA    | NA        | NA         | NA          | NA             | 0           | NA      | 0   | NA  |
| (5% PER EPISODE FOR GROUNDWATER) |               |            |               |                | 0        | 0   | NA   | NA     | NA       | NA    | NA        | NA         | NA          | NA             | NA          | NA      | NA  | 0   |
| DUPLICATES (5%)                  |               |            |               |                | 2        | NA  | 3    | 3      | 3        | 3     | 3         | 3          | 3           | 3              | 0           | 3       | 0   | 2   |
| (5% PER EPISODE FOR GROUNDWATER) |               |            |               |                | 0        | 0   | 3    | 3      | 3        | 3     | 3         | 3          | 3           | 3              | 3           | 3       | 3   | 0   |
| RINSATE BLANKS (5%)              |               |            |               |                | NA       | NA  | 3    | 3      | 3        | 3     | 3         | 3          | 3           | 3              | 0           | 3       | 0   | 2   |
| TRIP BLANKS                      |               |            |               |                | NA       | NA  | 3    | 3      | 3        | 3     | 3         | 3          | 3           | 3              | 0           | 3       | 0   | 2   |
| FOR SOIL (AQUEOUS SAMPLE)        |               |            |               |                | NA       | NA  | 3    | 3      | 3        | 3     | 3         | 3          | 3           | 3              | 0           | 3       | 0   | 2   |
| (AQUEOUS SAMPLE)                 |               |            |               |                |          |     | 9    |        |          |       |           |            |             |                |             |         |     |     |
| SOIL SAMPLE TOTAL                |               |            |               |                | 37       | 37  | 35   | 50     | 53       | 50    | 50        | 50         | 53          | 53             | 0           | 50      | 0   | 27  |
| WATER SAMPLE TOTAL               |               |            |               |                | 0        | 0   | 0    | 49     | 67       | 40    | 40        | 40         | 67          | 43             | 37          | 40      | 27  | 2   |

NOTE: 1 MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SAMPLES WILL BE COLLECTED FOR INORGANICS AND PESTICIDE/PCBS ONLY AS INDICATED IN THE PROJECT OPERATIONS PLAN.

\*\* - TWENTY (20) OF THE FORTY (40) TEST PITS EXCAVATED WILL BE SAMPLED FOR OFF-SITE ANALYSIS BASED ON FIELD SCREENING RESULTS. TEST PITS SITES IDENTIFIED FOR ANALYSIS IN THIS TABLE ARE FOR REPRESENTATIVE PURPOSES ONLY.

\*PAL = PROJECT ANALYTE LIST.

[ ] = INDICATES QA/QC PARAMETERS TO BE COLLECTED

MS/MSD = MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLE

DUP = DUPLICATE SAMPLE

RINS = RINSATE SAMPLE

NA = NOT APPLICABLE

SECTION 2

AOC 63AX

**FINAL WORK PLAN  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY  
AOC 63AX  
FORT DEVENS, MASSACHUSETTS**

**DATA ITEM A002**

**CONTRACT NO. DACA31-94-D-0061**

*Prepared for:*

**United States Army Environmental Center  
Aberdeen Proving Ground, Maryland**

*Prepared by:*

**ABB Environmental Services, Inc.  
Wakefield, Massachusetts**

**JANUARY 1996**

FINAL WORK PLAN - AOC 63AX  
FORT DEVENS, MASSACHUSETTS

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**GLOSSARY OF ACRONYMS AND ABBREVIATIONS**

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### EXECUTIVE SUMMARY

Base Realignment and Closure Environmental Evaluation Reports and Supplemental Site Evaluations were conducted in 1993 and 1994 at five Fort Devens areas requiring environmental evaluation (AREEs). These AREEs included collective, site-wide evaluations of facilities within the installation that currently, or historically, were known or suspected of being the source of the release of contaminants that may pose a threat to human health or the environment.

In a November 1993 report entitled "Draft Previously Removed Underground Storage Tanks", ten AREE 63 (Previously Removed Underground Storage Tanks) sites were identified for supplemental investigation. A work plan entitled "Previously Removed Underground Storage Tanks (AREE 63)" issued in February 1994, discussed the objectives and the recommended approach of the supplemental site evaluations. After transferring four of the ten sites out of the investigation process to either no further action status or removal action status, and adding one site to the "to be investigated" list, field investigations were ultimately conducted at seven AREE 63 sites during the spring and summer of 1994.

One of the seven, AREE 63AX, is the site of an underground storage tank (UST) formerly located on the southwest side of Building 2517, located on the Main Post (Figure 2-1). The 1,000-gallon waste oil UST was removed in 1989. Approximately 100 cubic yards of oil-contaminated soil were removed with the UST. The soil contamination was determined to be attributed to a tank seam separation.

The supplemental investigation at AREE 63AX was designed to establish whether residual waste oil contamination of soil and groundwater existed there. Three soil borings were advanced to bedrock refusal around the former UST location for the purpose of collecting subsurface soil samples for chemical analysis, and for the installation of groundwater monitoring wells. Field screening and laboratory analysis of soils collected during the investigation indicated no significant concentrations of residual contamination at any of the boring locations. Analysis

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of groundwater collected from the three wells, however, revealed elevated concentrations of VOCs, some in excess of MCP Method 1 GW-1 standards.

Based on these investigation findings, it was recommended that further investigation of groundwater contamination at AREE 63AX be conducted. In compliance with the Interagency Agreement (IAG), the AREE was transferred into the Remedial Investigation/Feasibility Study (RI/FS) process and redesignated AOC 63AX.

ABB-ES will conduct RI and FS activities at AOC 63AX in accordance with the plans and rationale presented in the Work Plan and in conformance to the methods, procedures, and requirements set forth in the Final Project Operations Plan (POP) prepared by ABB-ES for activities conducted at Fort Devens.

As proposed in the Work Plan, activities will be performed to establish the nature and extent of contamination at the site, to evaluate potential risks to humans and the environment presented by the contaminants, and to develop and evaluate remedial alternatives to eliminate or reduce those hazards to acceptable levels. The following specific activities will be conducted at AOC 63AX as integral parts of the RI/FS:

- Background Historical Research - as a means to further understand and better characterize the contaminant release scenarios at AOC 63AX;
- A Geophysical Survey - to rapidly gather AOC-wide, non-intrusive data on subsurface features. The proposed survey will focus on determining the depth to bedrock and the presence of subsurface utilities. The geophysical survey results will also provide information on subsurface geology to aid in the placement of soil borings and monitoring wells;
- TerraProbe Survey - to rapidly obtain data on the lateral and vertical distribution of subsurface soil contaminants and groundwater quality;

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- **Drilling of 5 Soil Borings** - to allow the collection of additional subsurface soil samples for chemical analysis;
- **Installation of 4 Groundwater Monitoring Wells** - as a means to gather information on the distribution of dissolved phases of contaminants, monitoring possible free-phase product thicknesses, and characterization of aquifer hydraulic properties;
- **Collection and Analysis of Soil and Groundwater Samples** - including both field and laboratory analysis, to provide information necessary to evaluate contaminant distribution, assess potential risks to human health and the environment, and develop and evaluate remedial alternatives;
- **Human Health and Ecological Risk Assessments** - to evaluate both actual and potential human health and ecological risks associated with soil and groundwater contamination;
- **Treatability Study/Pilot Testing** - to provide data to allow treatment alternatives to be more accurately evaluated in the FS, to reduce uncertainties associated with the cost and performance of a treatment technology, and to support the design of the selected remedial alternative;
- **Determination of Applicable or Relevant and Appropriate Requirements** - to aid in establishing clean-up objectives for media of concern, to determine whether site features will restrict activities on site, and to determine if the type and concentration of contaminants will trigger certain regulations, such as those which restrict land disposal or those that apply to a specific type of compound;
- **Remedial Alternatives Development/Screening** - as a key part of the FS, to develop a range of reasonable remedial alternatives which can be subjected to a detailed evaluation; and

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- Detailed Analysis of Alternatives - performed in the FS to provide decision-makers with information that will assist them in selecting the best alternative for remediation of the site.

A comprehensive report presenting the results of these activities will be prepared upon completion.

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**ABB Environmental Services, Inc.**

## 1.0 INTRODUCTION

Base Realignment and Closure Environmental Evaluation Reports and Supplemental Site Evaluations were conducted in 1993 and 1994 at five Fort Devens areas requiring environmental evaluation (AREEs). These AREEs included collective, site-wide evaluations of facilities within the installation that currently, or historically, were known or suspected of being the source of the release of contaminants that may pose a threat to human health or the environment.

In a November 1993 report entitled "Draft Previously Removed Underground Storage Tanks", ten AREE 63 (Previously Removed Underground Storage Tanks) sites were identified for supplemental investigation. A work plan entitled "Previously Removed Underground Storage Tanks (AREE 63)" issued in February 1994, discussed the objectives and the recommended approach of the supplemental site evaluations. After transferring four of the ten sites out of the investigation process to either no further action status or removal action status, and adding one site to the "to be investigated" list, field investigations were ultimately conducted at seven AREE 63 sites during the spring and summer of 1994.

One of the seven, AREE 63AX, is the site of an underground storage tank (UST) formerly located on the southwest side of Building 2517, located on the Main Post (Figure 2-1). The 1,000-gallon waste oil UST was removed in 1989. Approximately 100 cubic yards of oil-contaminated soil were removed with the UST. The soil contamination was determined to be attributed to a tank seam separation.

The supplemental investigation at AREE 63AX was designed to establish whether residual waste oil contamination of soil and groundwater existed there. Three soil borings were advanced to bedrock refusal around the former UST location for the purpose of collecting subsurface soil samples for chemical analysis, and for the installation of groundwater monitoring wells. Field screening and laboratory analysis of soils collected during the investigation indicated no significant concentrations of residual contamination at any of the boring locations. Analysis of groundwater collected from the three wells, however, revealed elevated concentrations of VOCs, some in excess of MCP Method 1 GW-1 standards.

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Based on these investigation findings, it was recommended that further investigation of groundwater contamination at AREE 63AX be conducted. In compliance with the Interagency Agreement (IAG), the AREE was transferred into the Remedial Investigation/Feasibility Study (RI/FS) process and redesignated AOC 63AX.

ABB Environmental Services, Inc. (ABB-ES) has been tasked to conduct the RI/FS at AOC 63AX in accordance with the plans and rationale presented herein, and in conformance with the methods, procedures, and requirements set forth in the Fort Devens Project Operations Plan (POP) (ABB-ES, 1995) and all applicable U.S. Army Environmental Center (USAEC) guidelines.

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## **2.0 SITE BACKGROUND AND PHYSICAL SETTING**

### **2.1 SITE BACKGROUND**

Building 2517, constructed in 1966, is an abandoned motor repair facility and dispatch office operated by the Army Motor Vehicle Pool. The facility originally served as a tactical equipment repair shop, containing several vehicle bays and a hydraulic lift. The facility was investigated in 1993 under AREE 61 (Maintenance and Waste Accumulation Areas) to determine if potential releases of contaminants to the environment had occurred there. The building was designated AREE 61O.

Of the pertinent AREE 61O findings, a historic gas station (located east of the building within the parking area) and the Building 2517 waste oil UST were identified as potential sources of contamination. An earlier investigation of the historic gas station (Study Area [SA] 43K) was conducted in 1992, during which, a 5000-gallon gasoline UST was discovered and removed. In the absence of significant contamination in soil and groundwater in the area around the former gas station, the SA 43K study recommended no further action.

Further investigation of the former waste oil UST was conducted under AREE 63 (Previously Removed Underground Storage Tanks). The area immediately around a former 1,000 gallon waste oil UST at Building 2517 was identified as 63AX. The UST was situated near the southwest corner of Building 2517 beneath a large, asphalt-paved lot (Figure 2-2). The lot has most recently served as a parking area for recreational vehicles and the Fort Devens Taxi Service. The UST, which was installed in 1980, was removed along with approximately 100 cubic yards of waste oil-contaminated soil in February 1989. Supplemental investigations under AREE 63 included the installation of soil borings and groundwater monitoring wells to establish whether residual soil and groundwater contamination associated with the former UST exists.

The supplemental investigation conducted in 1994 identified only minor residual soil contamination. Analytical results on groundwater identified several volatile organic compounds (VOCs) in excess of MCP Method 1 standards for GW-1 groundwater which is being used as guidance for the CERCLA actions.

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**ABB Environmental Services, Inc.**

## SECTION 2

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The results of these investigative activities were reported in a September 1994 document entitled "Underground Storage Tank (AREE 63) Supplemental Site Evaluation Data Package/Base Realignment and Closure Environmental Evaluation (BRAC EE) Fort Devens, Massachusetts", prepared by Arthur D. Little, Inc. (ADL). This investigation involved the drilling of three soil borings, and the installation of three monitoring wells in and around the former UST (Figure 2-2).

Monitoring well 63AX-94-01 is located on the south side of Building 2517, outside the northwest corner of the former UST excavation; well 63AX-94-02 is located on the south side of Building 2517, outside the southern corner of the former UST excavation; and 63AX-94-03 is located on the east side of Building 2517 in the former recreational vehicle parking lot. Subsurface soil and groundwater samples were collected from each monitoring well location. Field screening and laboratory analysis results are discussed in the following subsections.

### 2.1.1 Subsurface Soil

Subsurface soil samples were collected from the borings for lithologic characterization and VOC screening by PID. At boring location 63AX-94-01, soil samples were collected continuously from the ground surface to the bottom of the boring to obtain continuous stratigraphic information, and to determine the depth to groundwater. Refusal was encountered at depths ranging from 12.5 to 15 feet bgs. Soil encountered consisted of dark yellowish-brown sand and gravel from 0 to 5 feet bgs, underlain by an olive-brown silty till, which becomes increasingly dense with depth. No rock core samples were collected during the field program.

Soil samples were collected from the depth intervals 4 to 6 and 6 to 8 feet bgs at each boring (just below the observed water table), and were analyzed for benzene, toluene, ethylbenzene and xylenes (BTEX), and total petroleum hydrocarbons (TPHC) in a field laboratory, using non dispersive infrared (NDIR) and Gas Chromatography (GC) techniques. Generally, the samples with the highest observed TPHC concentration from each boring were submitted to a USAEC performance-demonstrated laboratory for analysis of PAL VOCs, PAL SVOCs, TPHC, PAL inorganics and total organic carbon (TOC) analysis.

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Field analysis indicated the presence of TPHC, but not BTEX. TPHC concentrations ranged from 8 parts per million (ppm) to a high of 495 ppm (observed at the 4 to 6 foot depth at 63AX-94-03). Laboratory analysis of subsurface soils indicated no compounds at concentrations exceeding Massachusetts Contingency Plan (MCP) Method 1 S-2/GW-1 Standards.

### **2.1.2 Groundwater**

Groundwater was encountered at approximately 3 feet bgs. Monitoring wells were constructed in each soil boring with well screening spanning the water table. Rounds of groundwater samples were collected from the three wells in April and July of 1994. Samples were submitted to the USAEC laboratory for analysis of PAL VOCs, PAL SVOCs, TPHC, PAL inorganics and water quality parameters.

Analysis of the groundwater sample from well 63AX-94-01 indicated the presence of benzene (33  $\mu\text{g/L}$ ), trichloroethene (51  $\mu\text{g/L}$ ), and 1,1-dichloroethene (54  $\mu\text{g/L}$ ) at concentrations in excess of their respective MCP Method 1 GW-1 Standards. No other compounds were detected in exceedance of MCP Method 1 GW-1 standards.

## **2.2 PHYSICAL SETTING**

The following subsections describe the physical setting of AOC 63AX.

### **2.2.1 Soil**

Unconsolidated surficial deposits of glacial and postglacial origin comprise nearly all of the exposed geologic materials at Fort Devens. The glacial units consist of till, deltaic deposits of glacial Lake Nashua, and deposits of glacial meltwater streams. Based on the regional soils map for Fort Devens, the soils at AOC 63AX were mapped by the Soil Conservation Service and have been classified as the Hinckley-Merrimack (Freetown)- Windsor (HMW) soil association. Subsection 2.2.5 of the Groups 2, 7 and Historic Gas Station Final SI Report presents a detailed discussion of the Fort Devens soil series (ABB-ES, 1993).

## **SECTION 2**

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### **2.2.2 Bedrock**

Based on regional bedrock maps, it appears that the bedrock in this portion of the installation is part of the Oakdale Formation, which consists of metasiltstone and phyllite. Subsection 2.2.7 of the Group 2, 7 and Historic Gas Station Final SI Report presents a detailed discussion of the bedrock geology for Fort Devens (ABB-ES, 1993).

### **2.2.3 Hydrogeologic Conditions**

Locally, the site is drained by a stormwater drainage ditch that runs along the eastern and southern borders of the site (Figure 2-1). Groundwater flow directions are not known because the existing monitoring well locations were not surveyed; however, surface topography and drainage suggest a southerly flow is likely.

Fort Devens is in the Nashua River drainage basin, and the Nashua River is the eventual discharge locus for all surface water and groundwater flow at the installation. The water of the Nashua River has been assigned to Class B. Class B surface water is "designated for the uses of protection and propagation of fish, other aquatic life and wildlife, and for primary and secondary contact recreation" (314 CMR 4.03).

Groundwater in the surficial aquifer at Fort Devens is Class I. Class I consists of groundwaters which are "found in the saturated zone of unconsolidated deposits or consolidated rock and bedrock, and are designated as a source of potable water supply" (314 CMR 6.03). Subsection 2.2.8 of the Group 2, 7 and Historic Gas Station Final SI Report presents a detailed discussion of the regional hydrogeology for Fort Devens (ABB-ES, 1993).

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**ABB Environmental Services, Inc.**

### **3.0 INITIAL EVALUATION**

#### **3.1 TYPES AND VOLUMES OF WASTE**

Based on the results of the previous investigations, the primary site-related contaminants at AOC 63AX are VOCs in groundwater. Benzene, 1,1-dichloroethene, and trichloroethene were detected at levels exceeding MCP Method 1 GW-1 standards which are being used to help guide the scoping of the remedial investigation.

Figure 3-1 presents a site conceptual model flow chart showing the potential source and transport mechanisms for the contaminants detected at AOC 63AX. Based on the results of the supplemental investigation, it appears that the former waste oil UST was the primary source of groundwater contamination.

The primary release mechanism appears to be leaks from the former UST and associated piping to soil and groundwater. Residual contaminated soil in the area around the former UST represents a potential secondary source of groundwater contamination. The migration pathways/transport mechanisms appear to be dissolution and migration through groundwater flow, and advective transport by wind as fugitive dust. During any soil removal effort, contaminants could be released into the air in the form of dust.

AOC 63AX is currently a fenced parking lot covered with asphalt. In the Devens Reuse Plan (Vanasse Hangen Brustlin, Inc., 1994), the future use of the site is designated as "Innovation and Technology Business". Example uses include office buildings, light industry, and academic and institutional uses. Because of this, a possible human health exposure scenario is that people working at the site could be affected by the fuel-related contaminants through ingestion, direct contact and inhalation of volatilized contaminants from groundwater derived from the site. On-post personnel could be exposed to contaminated subsurface soil through accidental ingestion and direct contact. Both area residents and on-post personnel could be exposed to contaminated subsurface soil dust via inhalation during potential excavation and construction activities.

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## **SECTION 3**

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### **3.2 PRELIMINARY IDENTIFICATION OF OPERABLE UNITS**

The National Contingency Plan (NCP) (U.S. Environmental Protection Agency [USEPA], 1990) and the Federal Facility Agreement (Interagency Agreement [IAG]), (USEPA, 1991a) define an operable unit (OU) as a discrete response action that comprises an incremental step towards comprehensively addressing site contamination. The site may be divided into one or more OUs at any phase of the response action, depending on the type and complexity of contamination associated with the site. Because the residual oil contamination is probably limited to the saturated zone, and in consideration of the complex associations of soil and groundwater contaminants in the saturated zone, differentiation of soil contamination and groundwater contamination is impractical. Therefore, it is currently recommended that AOC 63AX be remediated as one OU.

### **3.3 PRELIMINARY IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES AND ALTERNATIVES**

As part of the project planning phase and development of the work plan, preliminary remedial action objectives and a preliminary range of remedial action technologies have been developed for AOC 63AX. The identification of technologies for development of potential alternatives at this stage is not intended to be a detailed investigation, but is intended to be a more general classification of potential remedial actions based upon the initially identified potential routes of exposure and associated receptors. Identification of potential technologies is made at this time in the process to help ensure that data needed to evaluate them can be collected during the RI or as early as possible from treatability studies. A detailed investigation of alternatives will be performed during the FS (see Subsections 5.10 and 5.11) based on data collected during the RI. Figure 3-2 depicts the preliminary remedial action objectives, general response actions and remedial action technologies under consideration for alternative development at AOC 63AX.

#### **3.3.1 Remedial Action Objectives**

Preliminary remedial action objectives were identified for each contaminated medium based on existing site information and the conceptual model. Remedial action objectives consist of medium-specific goals to protect public health and the

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environment based on the Applicable or Relevant and Appropriate Requirements (ARARs), the risk assessment goals, and technology-based cleanup goals. The chemical specific standards/guidelines (e.g., Massachusetts Contingency Plan Method 1 soil and groundwater standards) identified for screening purposes in the Supplemental Site Evaluation were used in developing the preliminary remedial action objectives. Two of the three objectives identified for AOC 63AX are for the contaminated groundwater. In the Supplemental Site Evaluation, benzene, trichloroethene, and 1,1-dichloroethene were found to exceed drinking water standards/guidelines. The identified objectives are to prevent direct exposure to the groundwater and to prevent migration of the contaminated groundwater from the source. The other objective is for the subsurface soils at the site. From the Supplemental Site Evaluation, detected analytes in subsurface soil did not exceed MCP standards/guidelines, and are not expected to pose a potential risk to human health. Sampling revealed that VOCs were not detected in the subsurface soils investigated. However, subsurface soils warrant further investigation as a potential source of VOC contaminants in the groundwater. The identified remedial action objective for the subsurface soil is to prevent contaminant release to groundwater. These preliminary remedial action objectives will be reviewed and refined during the RI/FS process when RI results are obtained and as ARARs are identified.

### **3.3.2 General Response Actions**

Following identification of preliminary remedial action objectives, potential general response actions were developed. General response actions are general purpose statements describing probable remediation activities at a given site to meet remedial action objectives. The general response actions identified in this work plan have been based upon current understanding of the site and preliminary remedial action objectives.

Groundwater general response actions identified for AOC 63AX consist of:

- no action
- limited action
- containment
- collection

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- treatment, and
- discharge/disposal

Soil general response actions consist of:

- no action
- removal
- treatment, and
- disposal

### **3.3.3 Potential Remedial Technologies and Alternatives**

The potential technologies which are most likely to satisfy the general response actions were preliminarily identified from review of documented information and data on technologies, including USEPA-published reports and vendor information. Technologies were assessed considering probable effectiveness and implementability with regard to site-specific conditions, known and suspected contaminants, and affected media. Remedial technologies identified for the contaminated groundwater at AOC 63AX consist of:

- no action;
- institutional controls such as zoning and implementing deed restrictions, and/or performing groundwater monitoring;
- installing hydraulic barriers (e.g., slurry wall, grout curtain, sheet piling) to contain the groundwater; and
- using interceptor trenches or extraction wells to collect contaminated groundwater

Treatment technologies include physical/chemical or biological treatment in the form of:

- aeration
- air stripping

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- activated carbon
- UV oxidation
- chemical oxidation
- air sparging
- in-situ bioremediation
- treatment at the Fort Devens Wastewater Treatment Plant (WWTP) (currently consists only of primary treatment) or treatment at a local publicly-owned treatment works (POTW).

Disposal technologies consist of discharging treated water to groundwater, the Fort Devens WWTP, or local POTW.

Alternatives developed from these technologies will depend upon the results of the RI (also see Subsection 3.2, Preliminary Identification of Operable Units). If possible, the alternatives developed for screening will encompass a range or combination of the technologies in which treatment is used to reduce the toxicity, mobility, or volume of the organics, but will vary in the degree to which long-term management of residuals or untreated waste is required; one or more alternatives involving containment with little or no treatment; and a no-action alternative. Alternatives that involve minimal efforts to reduce potential exposures (e.g., deed restrictions) will be presented as "limited action" alternatives.

The potential remedial technologies selected for the soils at AOC 63AX include no action and various treatment technologies. Treatment technologies identified for soil include in-situ technologies such as soil vapor extraction and bioventing, and treatment technologies for excavated soil including thermal desorption, asphalt batching, and incineration. Bioventing is included as an innovative technology for treatment of TPHC which is not as readily treated using only soil vapor extraction. The presence of non-VOC contaminants (e.g., higher molecular weight hydrocarbons) may minimize the potential effectiveness of soil vapor extraction. Asphalt batching is a proven technology and has been successfully used at Fort Devens for petroleum contaminated soils, and may be able to be

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used as sub-base for road or parking lot construction. Soil meeting regulatory levels (before or after treatment) may be landfilled at an on-site or off-site, lined landfill.

Potential remedial alternatives for AOC 63AX may consist of excavation and treatment technologies for subsurface soil contamination, with groundwater extraction and treatment. If an in-situ treatment technology (e.g., bioventing) is considered, the groundwater table may need to be lowered by pumping to allow for air flow through the source area. Based on the results of the RI, a treatability test for soil vapor extraction/bioventing may be recommended to determine the permeability of the soil and treatability of the petroleum source.

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## **4.0 RI/FS OBJECTIVES**

The groundwater contamination observed during the supplemental investigation has necessitated the need for an RI/FS to provide more complete characterization of nature of contamination at AOC 63AX. The objectives of this RI/FS focus on further characterization of contaminant in soil and groundwater, along with a detailed evaluation of contaminant migration. Coupled with these, the RI/FS will provide a detailed assessment of human health and environmental risk, which will be used as a basis for establishing clean-up goals, and ultimately an evaluation of alternatives for site remediation.

A discussion of the individual proposed RI/FS activities and data quality objectives to be used in pursuit of these objectives is presented below.

### **4.1 RI/FS ACTIVITIES**

The following specific activities will be conducted at AOC 63AX as integral parts of the RI/FS:

- Background Research
- Geophysics Survey
- TerraProbe Survey (Thin Diameter Tube Sampler)
- Drilling of Soil Borings
- Installation of Groundwater Monitoring Wells
- Laboratory Analysis of Soil and Groundwater Samples
- Human Health and Ecological Risk Assessments
- Treatability Study/Pilot Testing

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- Determination of Applicable or Relevant and Appropriate Requirements
- Remedial Alternatives Development/Screening
- Detailed Analysis of Alternatives

### **4.1.1 Background Historical Research**

As a means to further understand and characterize the current distribution of contaminants at AOC 63AX, ABB-ES will thoroughly research historical site use, past and present waste oil disposal practices, nearby in-use and abandoned maintenance facilities, and other potential sources of contaminants. The results of this research effort will guide the selection of sampling locations and laboratory analyses. Information gathered under this research activity on current and future uses of the site will be incorporated into the assessment of human health and environmental risk.

### **4.1.2 Geophysical Survey**

A ground-penetrating radar (GPR) survey will be conducted at AOC 63AX to map the depth and configuration of the bedrock/overburden interface beneath the area of investigation. The bedrock surface map will aid in the interpretation of groundwater flow and contaminant migration characteristics. GPR will also be used to identify the location of any subsurface utility lines or structures prior to invasive exploration activities.

### **4.1.3 TerraProbe Survey**

As a schedule and cost cutting measure, a TerraProbe (same technology as the Geoprobe) investigation will be conducted to rapidly obtain data on:

- the lateral and vertical distribution of subsurface soil contamination, and
- groundwater quality in the area of the former UST.

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Subsurface soil and groundwater samples collected during the survey will be field screened to allow investigation of many locations around the former tank location in a minimally intrusive manner. The results will be used to further guide the selection of soil borings and groundwater monitoring well installations.

#### **4.1.4 Soil Borings**

Soil borings will be advanced to allow the collection of additional subsurface soil samples for chemical analysis. Borings will be drilled in the area of critical interest based on the GPR and TerraProbe survey findings to define the limits of contaminant migration. The results will be used to support both the contaminant assessment in the RI and the remedial alternative screening in the FS.

#### **4.1.5 Monitoring Wells**

The newly installed monitoring wells will allow further characterization of overburden and bedrock groundwater quality up- and downgradient, through the collection of groundwater samples for laboratory chemical analysis. The results of the groundwater sampling will be used to further assess the distribution of groundwater contamination and aid in the development of remedial alternatives in the FS process.

The new monitoring wells will also provide additional monitoring points up- and downgradient of the former tank site, to further define the site-specific groundwater flow directions and in-situ hydraulic conductivities.

#### **4.1.6 Sample Analysis**

VOCs in groundwater appear to be the predominant contaminants in groundwater at AOC 63AX. These VOCs are probably derived from the waste oil released from the former UST. It is likely that other petroleum hydrocarbon related compounds such as semivolatile organic compounds (SVOCs) and waste oil related contaminants such as inorganics and PCBs could also exist in groundwater at this AOC. Because oil contaminated soil was observed and removed during the UST removal, it is possible that residual waste oil contamination such as VOCs, SVOCs, and inorganics remain in soil. Soil and groundwater collected from the

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newly-installed soil borings and monitoring wells will be analyzed for these analytes.

Chemical analyses performed during the RI will include field screening techniques designed to provide a preliminary evaluation of contaminant distribution. Sample analysis will also include laboratory analysis designed to provide a higher level of accuracy in evaluating contaminant distribution, as input to the human health and ecological risk assessments, and remedial alternatives development. The field and laboratory analytical program will enhance and build upon efforts begun under previous investigations at the site.

### **4.1.7 Baseline Risk Assessment**

A baseline risk assessment, in accordance with EPA risk assessment guidelines, will be conducted at AOC 63AX to evaluate both actual and potential human health and ecological risks associated with soil and groundwater contamination. The components of the two risk assessments will include the following: data summarization and selection of chemicals of potential concern (COPCs); hazard assessment; ecological characterization; exposure assessments; ecological effects assessment; toxicity assessment; risk characterizations; comparison of analytical data to health standards and guidelines; and qualitative uncertainty analyses.

### **4.1.8 Treatability Study/Pilot Testing**

Treatability studies are typically conducted to provide data to allow treatment alternatives to be more accurately evaluated in the FS, to reduce uncertainties associated with the cost and performance of a treatment technology, and to support the design of the selected remedial alternative (USEPA, 1988). Treatability studies may not be necessary for well-developed technologies that have proven effective at other similar sites or for similar contaminants.

The need for treatability studies has not been identified for soil and groundwater at AOC 63AX at this time. However, as the RI field effort proceeds, certain other physical and chemical data may need to be collected to aid in evaluating remedial technologies. These additional data would be used in evaluating the effectiveness of various treatment technologies; data such as soil gradation, TOC content, and moisture content may be performed on selected soil samples in order

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to evaluate the potential effectiveness of soil treatment technologies such as soil vapor extraction or thermal desorption. Groundwater pumping tests could, for example, be used to establish the design parameters for groundwater extraction technologies; and specific water quality parameters could be used to evaluate the effectiveness of water treatment technologies.

#### **4.1.9 Applicable or Relevant and Appropriate Requirements**

CERCLA requires that Superfund remedial actions meet any federal and state standards, criteria, or requirements that are determined to be Applicable or Relevant and Appropriate Requirements (ARARs). Chemical-specific and location-specific ARARs can be identified during the RI as the chemical and physical site conditions are characterized. Action-specific ARARs are typically identified during the FS based on the remedial actions being evaluated. ARARs are considered during the RI/FS process to aid in establishing clean-up objectives for media of concern, to determine whether site features such as wetlands or floodplains will restrict activities on site, and to determine if the type and concentration of contaminants will trigger certain regulations, such as those which restrict land disposal or those that apply to a specific type of compound (e.g., PCBs). Compliance with ARARs is a criterion which must be met for an alternative to be selected as the remedial action.

#### **4.1.10 Remedial Alternatives Development/Screening**

A range of remedial alternatives are developed in the FS by assembling combinations of technologies to address the response objectives (see Section 3.0). The range of alternatives should include no action, actions that reduce contaminant migration or minimize exposure, and treatment alternatives that address the principal threats and eliminate or minimize the need for long-term management. These alternatives will then be screened using effectiveness, implementability, and cost criteria to limit the number of alternatives to be evaluated in detail, while still preserving the range of options.

#### **4.1.11 Detailed Analysis of Alternatives**

A limited number of alternatives remaining after the screening process will be evaluated based on seven of the nine CERCLA criteria in the FS. The criteria of

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state and community acceptance will be evaluated upon receipt of state and public comments. Each alternative is evaluated individually, and then the alternatives are compared against each other to provide decision-makers with information that will assist them in selecting the best alternative for remediation of the site.

### **4.2 DATA QUALITY OBJECTIVES**

The procedures of the Quality Assurance (QA) Objectives presented in Section 3.0 of Volume I of the Fort Devens POP will be followed during the RI/FS field program at AOC 63AX (ABB-ES, 1995). This subsection describes a general scope of work, data quality objectives (DQOs) and the QA/QC approach.

Analyses will be conducted on samples collected from AOC 63AX to evaluate the nature and distribution of the contaminants detected during previous investigations. On-site field analysis will conform with the guidelines presented in Subsection 4.6 of Volume I of the Fort Devens POP. Off-site laboratory analytical procedures are presented Section 7.0 of Volume I of the POP, and the Laboratory QA Plan and the USAEC Certified Analytical Methods procedures are presented in Appendices B and C, respectively, in Volume II of the Fort Devens POP (ABB-ES, 1995).

The USEPA has recently identified two general levels of analytical data quality, which replace the former five general levels. One of the levels, Screening with Definitive Confirmation, generally comprises field screening and analysis, and encompasses former USEPA 1987 DQO Levels I and II. Activities conducted under the AOC 63AX RI which fall into this category include basic field measurements for pH, conductivity, temperature, dissolved oxygen, turbidity, and photoionization detector (PID) measurements, as well as any on-site analyses. The other general level of data quality, Definitive Data, generally comprises laboratory analysis using CLP RAS or other published USEPA methods, and includes former USEPA 1987 DQO Levels III, IV, and V. Laboratory methods which have been performance-demonstrated under procedures outlined in the USATHAMA QA Plan (USATHAMA, 1990) fall into this level. This level includes off-site water quality parameter and other parameters where USAEC guidelines are not applicable, and off-site laboratory analyses for PAL organics and inorganics. The specific data requirements and analytical parameters for

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proposed samples at AOC 63AX are outlined in Section 5.0 of this Draft Work Plan.

All data collected during the RI/FS process (both chemical and geotechnical data) will be entered and stored in USAEC's Installation Restoration Data Management Information System (IRDMIS). The analytical laboratory will be responsible for entering all laboratory chemical data as USAEC Level II data, and ABB-ES will be responsible for all geotechnical data. The USAEC will be responsible for reviewing and qualifying the USAEC Level II data submitted by the subcontract laboratory, and elevating the chemical data to USAEC Level III data quality. At that point the chemical data will be at its highest data quality and will be available for use in the IRDMIS. Only USAEC Level III chemical data and other appropriate field analytical data will be used in the RI/FS Report.

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## **5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS**

### **5.1 PROJECT PLANNING**

The planning and scoping of the RI/FS program at AOC 63AX was conducted in accordance with the USEPA guidance document "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", (USEPA, 1988).

### **5.2 COMMUNITY RELATIONS**

For this task ABB-ES will assist the U.S. Army in conducting communication activities relating to AOC 63AX as outlined in the IAG (USEPA, 1991) and existing Community Relations Plan (CRP) (E&E, 1992, as revised) for Fort Devens.

The IAG stipulates that community relations be compliant with all USEPA public participation requirements specified by CERCLA and NCP; a Community Relations Plan be developed; a public repository be established; an Administrative Record be established at two locations and the Administrative Record be updated and supplied to the USEPA.

The activities proposed in the CRP are designed to inform interested citizens and local officials about the progress of remedial activities, and to provide opportunities for the public to be involved in planning remedial actions at the site. Specific community relation activities ABB-ES will participate in will include:

- attending Restoration Advisory Board (RAB) meetings pertaining to AOC 63AX;
- preparing fact sheets to inform the public of the use of USEPA presumptive remedies (if applicable) as potential remedial alternatives, and of the proposed plan and public comment period;
- updating the Administrative Record;

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- attending a public informational meeting at the onset of the public comment period that provides an informal question and answer session about the proposed plan for remediating AOC 63AX; and
- attending a formal public hearing during the public comment period that provides opportunity for the public to submit oral or written comments on the proposed plan for remediating AOC 63AX. All comments received will be transcribed and responded to in the Responsiveness Summary.

### **5.3 FIELD INVESTIGATION ACTIVITIES**

All field activities will be conducted in accordance with the Fort Devens POP (ABB-ES, 1995) and USAEC's Geotechnical Guidelines (USATHAMA, 1987). The following subsections describe the proposed activities to be conducted during the RI/FS at AOC 63AX, based on the objectives and rationale outlined in Section 4.0.

#### **5.3.1 Background Research**

Background research at AOC 63AX will involve an extensive search of historical records and other sources of information to include interviews with pertinent individuals knowledgeable in the past use and history of AOC 63 AX, photograph interpretation, and literature searches. Coordination shall be made through the USAEC and the Fort Devens BRAC Environmental Coordinator (BEC) office. The objective of the research will be to discover and define contaminant release mechanism, dates and locations of releases, and nature and volume of contaminant release.

#### **5.3.2 Geophysical Survey**

The GPR survey will be the first field investigation activity conducted during the AOC 63AX RI. Data will be collected from survey lines established within a 20-foot grid in the two acre area surrounding the former UST location (see Figure 5-1). Information on subsurface utilities, variations in overburden characteristics, and configuration of the overburden-bedrock interface gathered during the survey

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will be used to guide subsequent field activities (i.e., locating soil borings, selecting drilling methods, and the placement and construction of monitoring wells). The GPR survey will be conducted in accordance with Subsection 4.4.3.2 of Volume I of the POP (ABB-ES, 1995).

### **5.3.3 TerraProbe Investigation**

The TerraProbe investigation will be conducted to further define the lateral and vertical distribution of contamination in soil and groundwater in the area around the former UST excavation. Up to 20 TerraProbe exploration locations will be sampled down to a depth of 15 feet bgs. Proposed locations are shown in Figure 5-1. Subsurface soil samples will be collected from each location at the presumed water table depth (3 feet bgs), roughly the midpoint of the saturated aquifer (between 8 and 9 feet bgs), and at the base of the overburden (between 12.5 and 15 feet bgs). A total of 60 soil samples will be collected. Groundwater samples will be collected from the vicinity of the water table at each TerraProbe location, for a total of 20 groundwater samples. TerraProbe soil and groundwater samples will be collected using the methods described in Section 4.5.1.3 of Volume I of the POP (ABB-ES, 1995). All samples will be field screened for total petroleum hydrocarbons (TPHC) and VOCs in ABB-ES' field laboratory (Table 5-1). The field analytical procedures TPHC and VOC analysis are presented in Section 4.6 of Volume I of the POP (ABB-ES, 1995).

### **5.3.4 Soil Borings**

Based on the results of the TerraProbe and GPR surveys, five soil boring locations will be selected at AOC 63AX for the purpose of collecting soil samples for laboratory analysis. The borings will be advanced using hollow stem augers to bedrock refusal. Proposed boring locations are shown in Figure 5-1.

Soil samples will be collected continuously in each boring to characterize subsurface stratigraphy using the procedures outlined in Section 4.4.6.1 of Volume I of the POP. Samples will be collected at the approximate depth of the water table (3 feet bgs), roughly the midpoint of the saturated aquifer (between 8 and 9 feet bgs), and at the base of the overburden (between 12.5 and 15 feet bgs). Each sample will be submitted for laboratory analysis of TPHC, Project Analyte List (PAL) VOCs, PAL SVOCs and PAL inorganics. Ten percent of the soil samples

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collected with be analyzed for grain size using the methods described in Section 4.5.1.4 of Volume I of the POP. Soil samples will be collected using the methods prescribed in Section 4.5.1.3 of Volume I of the POP. Table 5-2 provides a summary of the soil boring location and sampling rationale.

### **5.3.5 Monitoring Well Installation**

Four groundwater monitoring wells will be installed at AOC 63AX during the RI to characterize groundwater quality and groundwater flow in overburden and bedrock around the former UST location. Well locations will be determined in consideration of the results of the TerraProbe and GPR surveys, and will, at a minimum, include one well positioned upgradient, and three wells will be positioned downgradient of the former UST excavation. The upgradient well and one downgradient well will be shallow wells, constructed with screened intervals intersecting the water table. The other two downgradient wells will be constructed with screened intervals installed in bedrock up to a depth of 40 feet bgs. Table 5-3 provide the well installation rationale and proposed locations, respectively.

Overburden soil samples will be collected at five-foot intervals from each monitoring well boring for soil characterization and field screening by PID only. One soil sample collected from the planned monitoring well screened interval will be submitted for laboratory analysis of total organic carbon (TOC). Installation of the wells will be in accordance with the procedures specified in Section 4.4.6 of Volume I of the POP. Bedrock core samples will be collected and logged during the installation of both bedrock wells. Rock coring procedures are provided in Section 4.4.6.4 of Volume I of the POP (ABB-ES, 1995).

Each of the newly installed monitoring wells will be developed using the procedures for well development presented in Section 4.4.6.5 of Volume I of the POP (ABB-ES, 1995).

Two rounds of groundwater samples will be collected from the four new and three existing monitoring wells at AOC 63AX. The groundwater sampling rounds will be separated by at least 90 days to evaluate seasonal variations in contaminant concentrations. Groundwater sampling procedures are presented in Subsection 4.5.2.2 of Volume I of the POP using dedicated teflon bailers (ABB-

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ES, 1995). Each of the fourteen groundwater samples will be submitted for laboratory analysis of PAL VOCs, PAL SVOCs, PAL Pesticides/polychlorinated biphenyls (PCBs), PAL inorganics (filtered and unfiltered), TPHC, total suspended solids (TSS), total dissolved solids (TDS), Water Quality Parameters (including alkalinity, hardness, pH, temperature, conductivity and dissolved oxygen) and anions & cations. Table 5-4 provides a summary of the groundwater sampling rationale.

After completion of the first round of groundwater sampling, hydraulic conductivity tests will be performed on each of the newly installed monitoring wells to further define the hydraulic conductivity of the geologic units at AOC 63AX. The procedures for conducting the hydraulic conductivity tests in soil and bedrock are presented in Subsection 4.8.2 of Volume I of the POP (ABB-ES, 1995). Hydraulic conductivity test data will be analyzed by the methods of Hvorslev (1951) and Bouwer and Rice (1976). When appropriate, the KGS model (Hyder and Butler, 1995) will be used in conjunction with the Bouwer and Rice method. The Bouwer and Rice method will also be used with respect to limitations outlined by Brown, Narasimhan, and Demir (1995).

All new and existing monitoring wells at AOC 63AX will be included in the quarterly basewide synoptic water level measurement rounds as outlined in Section 4.8.1 of the Fort Devens POP (ABB-ES, 1995). The water level data will be used to construct groundwater potentiometric contour maps, determine groundwater flow direction, and calculate vertical and horizontal gradients.

#### **5.4 SAMPLE ANALYSIS AND DATA MANAGEMENT**

The analytical program for the RI/FS at AOC 63AX is designed to identify the contaminants that are expected to be encountered. Based on historical site use and the analytical results of previous investigations, a suite of contaminant types have been identified for AOC 63AX. The field screening and laboratory analyses selected for the AOC 63AX RI are designed to provide detailed information on the concentrations and distributions of site contaminants for use in both the risk assessment and feasibility study. The specific analyses proposed for each proposed sample are itemized in the Sampling and Laboratory Analysis Schedule (Table 5-5). The procedures to be followed during the RI/FS for both screening

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and laboratory analysis are presented in Section 7.0 of Volume I of the POP. The Laboratory Quality Assurance Plan and the USAEC Performance Demonstrated Analytical Methods are presented in Appendix B and C of Volume III of the POP.

### 5.5 DATA EVALUATION

The data collected during the RI will be evaluated to determine whether it meets the RI DQOs. The evaluations for AOC 63AX will be completed on the basis of verifying the nature and distribution of environmental contamination. The procedures for the data assessment are presented in Section 12.0 of Volume I of the POP.

ABB-ES will assess the presence, sources, and spacial distribution of contamination, as well as potential pathways of contaminant migration in the environment using data collected from previous investigations and this RI.

### 5.6 RISK ASSESSMENT

A baseline risk assessment will be conducted at AOC 63AX to evaluate the potential human health and ecological risks associated with subsurface soil and groundwater contamination.

#### 5.6.1 Human Health Risk Assessment

The human health risk assessment will be performed to conform with the following USEPA guidance manuals and directives:

- *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A)*, (RAGs) 1989b, Interim Final, December 1989.
- *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part B), Development of Risk-based Preliminary Remediation Goals*, Interim, December 1991b.

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- *Dermal Exposure Assessment Principles and Applications*, Interim, January 1992.
- *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, 1991c, OSWER Directive 9355.0-30, April 22, 1991.
- *Standard Default Exposure Factors: Human Health Evaluation Manual, Supplemental Guidance*, 1991d, OSWER Directive 9285.6-03, March 25, 1991.
- *Supplemental Risk Assessment Guidance for the Superfund Program*, 1989a Draft Final, USEPA Region I Risk Assessment Work Group, June 1989.
- *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons*, July 1993.

The components of the risk assessment will include the following: Data Summarization and Selection of Chemicals of Potential Concern (COPCs); Exposure Assessment; Toxicity Assessment; Risk Characterization; Comparison of Analytical Data to Health Standards and Guidelines; and Qualitative Uncertainty Analysis. A more detailed discussion of these components follows.

COPCs will be selected for inclusion in the risk assessment based on frequency of detection and, for inorganic analytes, comparison to Fort Devens background concentrations. If the maximum detected concentration is below the basewide background concentration, then it will be eliminated as a COPC. Essential nutrients (i.e., potassium, sodium, magnesium, calcium, and iron) will be considered for elimination if it can be documented that they are present at concentrations not associated with adverse effects. Any analytes attributable to laboratory contamination will not be included as COPCs. The reasons for eliminating any analytes will be documented in the risk assessment report.

In the Exposure Assessment, potential exposures under current land use conditions as well as possible future land use conditions will be evaluated. AOC 63AX is the site of a former waste oil UST and is currently a parking lot covered with asphalt. In the Devens Reuse Plan (Vanasse Hangen Brustlin, Inc., 1994), the

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future use of the site is designated as "Innovation and Technology Business". Example uses include office buildings, light industry, and academic and institutional uses.

Based on the findings of previous investigations, exposure scenarios will be developed for the following exposure pathways:

- Contact with subsurface soil during excavation. The soil at this AOC could be excavated in the future either for utility repair/installation or building construction. The receptor would be the individual involved in soil excavation. Exposure routes during excavation could include incidental ingestion of soil and inhalation of VOCs. Dermal contact with soil would also occur but, in the risk assessment, this route will not be evaluated quantitatively (following USEPA Region I policy). The need to consider shallow groundwater as a potential exposure medium (to which a worker could come in contact) will be determined based on the results of the groundwater sampling program.
- Depending on the direction of groundwater flow and depth to groundwater, another possible exposure pathway could be migration of VOCs in the shallow groundwater and soil gas into a downgradient building foundation. Whether this pathway should be evaluated will depend on the findings of the RI's hydrologic investigation and contamination assessment. Because of the shallow water table, it is unlikely that a building basement or foundation would be constructed on the site itself; rather a slab foundation would be laid. However, depending on the lateral and vertical extent of groundwater contamination, it is possible that a future downgradient receptor might be identified.

Under an assumed future industrial/commercial land use scenario, extraction of groundwater beneath the AOC appears unlikely. However, for the risk assessment, we will assume that a well could be installed at the site to serve onsite workers. The baseline risk assessment will identify this potential water supply well and discuss future reliance on it for drinking water.

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While dust could be generated during soil excavation, it is not considered to be as important as the release of VOCs in the subsurface soil. Therefore, the inhalation of soil dust that becomes airborne will be identified as a potential exposure pathway but will not be modeled in the risk assessment.

Following USEPA Region I guidance, the 95% upper confidence limit (UCL) on the mean soil concentration will be coupled with central tendency and reasonable maximum exposure (RME) exposure parameter values to model the central tendency and RME exposure scenarios (USEPA, 1994). For groundwater, if evaluated for vapor migration, the average and maximum concentrations will be used to model the two exposure scenarios. (USEPA Region I guidance states that the use of the 95% UCL is not appropriate for evaluating groundwater exposures.)

To minimize comments, a Risk Assessment Approach Plan (RAAP) will be developed and a meeting will be held with representatives from the U.S. Army, USEPA, and MADEP to discuss these exposure pathways. The RAAP will be published and the meeting will be scheduled when work on the risk assessment begins.

In the Toxicity Assessment, brief toxicity profiles will be developed for the COPCs. These profiles will identify the toxic effects associated with exposure. Summary tables containing the dose/response data for the COPCs will also be included in the Toxicity Assessment. Dose/response data will be obtained from the USEPA Integrated Risk Information System (IRIS) database, Health Effects Assessment Summary Tables (HEAST), and readily available toxicity values developed by the USEPA Environmental Criteria and Assessment Office (ECAO).

The Risk Characterization will combine the exposure intakes from the Exposure Assessment with the toxicity values identified in the Toxicity Assessment to develop quantitative risk estimates (i.e., cancer risks and noncancer hazard indices) for the COPCs. Risk estimates will be developed for individual COPCs, for exposure pathways, and for receptors potentially exposed through more one medium. If quantitative risk estimates cannot be generated for particular COPCs, their risks will be discussed in the Risk Characterization.

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In addition to the quantitative risk evaluation, exposure point concentrations will be compared to federal and state health-based standards and guidelines. For example, a comparison of soil concentrations to MCP Method 1 soil standards (used only as guidelines) will be included. An uncertainty analysis will follow the risk characterization discussed to identify important issues that affect the interpretation of the risk assessment findings. Uncertainties and limitations in the Toxicity and Exposure Assessments as well as in current risk assessment methodologies will be discussed.

### **5.6.2 Ecological Risk Assessment**

Based on the results of the Supplemental Site Evaluation, AOC 63AX contains no significant ecological habitat. The site is located in an urbanized, paved area and is surrounded by buildings. The site is being evaluated in an RI due to the presence of subsurface soil and groundwater contamination from a leaking UST. Because no ecological exposure to subsurface soil is anticipated, a quantitative ecological risk assessment is not proposed at AOC 63AX.

The results of the risk assessment will be discussed in a summary section that will include summary data tables containing quantitative risk estimates.

### **5.7 REMEDIAL INVESTIGATION REPORT**

Upon completion of the of the field investigation and laboratory analyses, elevation of the Level III chemical data and completion of the ecological and human health risk assessments, ABB-ES will prepare an RI Report. The RI Report will address the specific issues that resulted in the RI and will present conclusions and recommendations concerning site conditions and status. The RI Report will include the human health risk assessment as one of its sections. A separate FS report will be completed for this AOC.

The data interpretation will conclude with the nature and distribution of site-related contamination, with one of the following recommendations:

- Take no further action or initiate long-term monitoring (Record of Decision [ROD] required).

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- Conduct a Feasibility Study.

The RI Report will follow appropriate USEPA Region I and USAEC guidelines.

## **5.8 TREATABILITY STUDY/PILOT TESTING**

The Supplemental Site Evaluation data indicate that groundwater at AOC 63AX is contaminated with VOCs (benzene, trichloroethene, and 1,1-dichloroethene). The RI will further evaluate the nature and distribution of soil and groundwater contamination, as well as quantitatively evaluate risks. Treatability studies are not recommended for soil and groundwater at AOC 63AX at this time. However, data can be collected at this phase which will aid in evaluating remedial technologies.

### **5.8.1 Data Requirements for Evaluating Soil Remedial Technologies**

If a significant source of petroleum contamination is located during the subsurface soil investigation, data in addition to chemical analyses will be collected. Potential treatment technologies for soil include soil vapor extraction, thermal desorption, and incineration technologies. To aid in evaluating the effectiveness of these technologies, samples will be collected from the source area for soil gradation, TOC content, and moisture content.

### **5.8.2 Data Requirements for Evaluating Groundwater Remedial Technologies**

Evaluation of the potential effectiveness of groundwater remedial technologies is dependent upon information which will be collected during RI field activities, including contaminant source, direction of groundwater flow, and additional chemical data. Hydraulic conductivity tests will be performed on each of the newly installed wells (Subsection 5.3.6) to further define the hydraulic conductivity of the soils at AOC 63AX. Although beneficial for evaluating hydraulic conductivity, these tests are limited for evaluating aquifer characteristics under a pumping scenario. A pumping test may be warranted at a later time depending upon the findings from the RI. Pumping tests would be used to establish well efficiency, specific capacity and short-term yields and to calculate transmissivity, storage coefficients, and long-term pumping rates.

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Groundwater samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (filtered and unfiltered), TPHC, TSS, TDS, anions & cations, and water quality parameters, including alkalinity, hardness, pH (measured in the field), temperature (measured in the field), and dissolved oxygen (measured in the field). The data collected during the RI will be used to evaluate the potential effectiveness of groundwater treatment technologies.

### 5.9 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

ARARs are human health and environmental regulatory requirements used to determine the appropriate extent of site cleanup, develop site-specific remedial response objectives, develop remedial action alternatives, and direct site cleanup. Superfund Amendments and Reauthorization Act (SARA) (Section 121) and the NCP (USEPA, 1990) require that CERCLA remedial actions comply with federal and state ARARs. To be an ARAR, state requirements must be identified in a timely manner and applied consistently statewide. Additional procedures for ARAR identification are specified in Section VII (7.5) of the IAG (USEPA, 1991a) between the USEPA and the U.S. Department of the Army.

Applicable requirements are federal and state requirements that specifically address substances or contaminants and actions at CERCLA sites. Relevant and appropriate requirements are federal and state requirements that, while not legally applicable, are appropriate if the site circumstances are sufficiently similar to those covered by the jurisdiction of the requirement. Applicable requirements and relevant and appropriate requirements are considered to have the same weight with respect to requiring compliance at CERCLA site cleanups. SARA also identifies a "To Be Considered" (TBC) category, which includes federal and state nonregulatory requirements such as criteria, advisories, and guidance documents. TBCs do not have the same status as ARARs; however, if no ARAR exists for a chemical or particular situation, TBCs can be used to ensure that a remedy is protective.

CERCLA remedial actions must be protective of human health and the environment and comply with ARARs. ARARs can be divided into three categories: chemical-, location-, and action-specific. Chemical-specific ARARs for AOC 63AX will be identified using RI site characterization data. Potential

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location- and action-specific ARARs will be identified during the development of alternatives. The potential location- and chemical-specific ARARs for the site will be presented in the draft RI Report. The identification of ARARs is an iterative process, and the list of potential ARARs will be refined as alternatives are developed. ABB-ES will also present a synopsis of location-, action- and chemical-specific ARARs in the draft and final FS Reports.

### **5.10 REMEDIAL ALTERNATIVES DEVELOPMENT/SCREENING**

For this task of the FS process, ABB-ES will develop a range of distinct, hazardous waste management alternatives that will reduce the potential human health risks associated with exposure to contaminated soil and groundwater at AOC 63AX, as deemed necessary from the results of the RI. This process consists of six general steps:

- Develop remedial action objectives and preliminary remediation goals based on data review, and compilation of ARARs.
- Develop general response actions for each medium of interest defining containment, treatment, excavation, pumping, or other actions, singly or in combination, that may be taken to satisfy the remedial action objectives for the site.
- Determine target cleanup levels and identify volumes or areas of media to which general response actions might be applied.
- Identify and screen the technologies applicable to each general response action to eliminate those that cannot be implemented technically at the site.
- Identify and evaluate technology process options to select a representative process for each technology type retained for consideration.
- Assemble the selected representative technologies into alternatives representing a range of treatment and containment combinations as

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appropriate, and screen these alternatives with respect to the criteria of effectiveness, implementability, and cost.

The first two steps and the potential technology identification in the fourth step have been preliminarily performed as described in Section 3.0, Initial Evaluation, for the benefit of identifying field data and treatability/pilot testing needs early for the RI. The potential remedial action objectives, response actions, and technologies identified in this work plan will be reviewed and refined as the RI/FS process progresses.

The sixth step entails the final assembly and screening of remedial alternatives. As appropriate, a range of remedial alternatives will be developed by combining retained technologies in which treatment is used to reduce the toxicity, mobility, or volume of wastes, but which vary in the degree to which long-term management of residuals or untreated waste is required; one or more alternatives involving containment with little or no treatment; and a no-action alternative. Alternatives that involve minimal efforts to reduce potential exposures (e.g., fencing) will be presented as "limited action" alternatives.

During screening, alternatives are quantitatively defined to allow differentiation with respect to the criteria of effectiveness, implementability, and cost. Quantitative definition of alternatives with respect to spatial requirements, time frames, rates of treatment, and refinement of volumes/areas of contaminated material, as well as transportation distances for disposal technologies, required permits for off-site actions, and imposed limitations will enable differentiation among alternatives with respect to the screening criteria. Innovative technologies may be carried through the screening process if there is reason to believe they offer significant advantages in the form of better treatment performance or implementability, fewer adverse impacts, or lower costs. The three screening criteria conform with remedy selection requirements of CERCLA and the NCP. The screening step eliminates impractical alternatives or higher cost alternatives (i.e., order of magnitude) that provide little or no increase in effectiveness or implementability over their lower-cost counterparts. By eliminating these alternatives early, more time and effort can be devoted to detailed analysis of the more promising alternatives. The no-action alternative will not be evaluated according to screening criteria; it will pass through screening to be evaluated

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during detailed analysis as a baseline for the other retained alternatives (USEPA, 1988).

#### **5.11 DETAILED ANALYSIS OF ALTERNATIVES**

For this task of the FS process, ABB-ES will conduct a detailed analysis of alternatives which will consist of an individual analysis of each alternative against a set of evaluation criteria, and a comparative analysis of all options against the evaluation criteria with respect to one another.

The detailed analysis presents the relevant information that allows a site remedy selection. The detailed analysis of each remedial alternative includes the following:

- detailed descriptions of each remedial alternative, with emphasis on application of the various technologies as components in the alternative
- detailed analysis of each remedial alternative relative to the evaluation criteria established to address CERCLA requirements

The detailed description of each remedial alternative will emphasize the technologies used and the components of each alternative. Where appropriate, the description will present preliminary design calculations, process flow diagrams, sizing of key components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative.

As part of the criteria analysis, remedial alternatives will be examined with respect to requirements stipulated in CERCLA (Section 121), as amended by SARA. CERCLA emphasizes the evaluation of long-term effectiveness and related considerations for each remedial alternative. USEPA guidance for conducting RI/FSs under CERCLA (USEPA, 1988) and the NCP outline the following nine criteria for evaluating remedial alternatives:

1. overall protection of human health and environment;
2. compliance with ARARs;
3. long-term effectiveness and performance;

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4. reductions in toxicity, mobility, and volume through treatment;
5. short-term effectiveness;
6. implementability;
7. cost;
8. state/support agency acceptance; and
9. community acceptance.

The first seven criteria (threshold and balancing criteria) will be used for detailed analysis of alternatives in the FS Report. The eighth and ninth CERCLA evaluation criteria, state acceptance and community acceptance, are modifying criteria and are addressed following the public information meeting, public hearing and public comment period.

The detailed analysis of alternatives will be presented in the FS Report discussed in Subsection 5.12.

### 5.12 FEASIBILITY STUDY REPORT

At the conclusion of the FS process, ABB-ES will produce an FS Report to compile the development/screening of alternatives and detailed analysis of alternatives. Additionally, the FS Report will include a comparative analysis of alternatives. The comparative analysis will identify the advantages and disadvantages of each alternative relative to one another in relation to the evaluation criteria.

The criteria of state and community acceptance will be addressed in the Responsiveness Summary and the Draft ROD, once formal Commonwealth and community comments on the Draft FS Report and the Proposed Plan have been received. Following public comment, the Army, in consultation with USEPA, will modify the FS or Proposed Plan based on the comments received.

The FS Report will be issued in draft and final versions according to the IAG reporting requirements for primary documents. Draft versions for regulatory review and comments will include one issued upon initial screening of alternatives and one upon detailed analysis of alternatives.

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### 5.13 POST RI/FS SUPPORT

For this task ABB-ES will prepare the Proposed Plan, the Fact Sheet, the responsiveness summary, and the ROD for the OU. This task also includes attending public informational meetings and formal meetings regarding the cleanup of this site.

The Proposed Plan will explain the opportunities for the public to comment on the remedial alternatives evaluated in the FS Report. It will provide a brief history of AOC 63AX, the principal findings of site investigations, and will provide brief descriptions of the Preferred Alternative and other alternatives evaluated in the FS. It will outline the criteria used by the Army to propose an alternative and present the Army's rationale for its preliminary selection of the Preferred Alternative.

The Fact Sheet will be written to provide the public with a brief explanation of the Army's selected remedy for cleanup of the site. It will contain the information the public needs to understand and participate in the Army's plans for the remediation activities. The Fact Sheet briefly summarizes the information detailed in the Proposed Plan including details regarding the public comment period and public meetings to be held.

The Responsiveness Summary will contain all the comments received during the public comment period and the responses. The Responsiveness Summary will be issued with the ROD document and both will be made available for public review in the Administrative Record located at Fort Devens and the Ayer Town Hall.

The ROD will be issued to document the Army's final choice of a remedy for cleanup of the site, considering all comments received during the public comment period. Once the ROD is signed by the appropriate Army and USEPA personnel, it will become part of the Administrative Record.

Format for the above documents will follow USEPA Region I established models and will be issued in draft and final versions according to the IAG reporting requirements for primary documents.

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## **6.0 PROJECT MANAGEMENT AND SCHEDULE**

### **6.1 TASK ORDER STAFFING**

The project organization structure is illustrated in Figure 6-1. Solid lines on the figure depict direct lines of control while dotted lines indicate channels of communication. Rationale for project organization and resource allocation are discussed in the Fort Devens POP. QA/QC procedures and responsibilities for ABB-ES, USAEC, and Environmental Science & Engineering (ESE) Laboratory personnel are also described in the Fort Devens POP (ABB-ES, 1995).

The duties, functions, and responsibilities associated with each task are detailed in the following paragraphs.

**Program Manager.** The Program Manager for ABB-ES' USAEC efforts is Mr. Joseph T. Cuccaro. He is responsible for providing direction, coordination, and continuous monitoring and review of the program. His responsibilities include initiating program activities; participating in work plan preparation; coordinating staff assignments; assisting in the identification and fulfillment of equipment and special resource needs; monitoring all task activities to confirm compliance with schedule, fiscal, and technical objectives; maintaining communications both internally and with the USAEC Contracting Officer's Representative (COR) through continuous interaction, thereby allowing quick resolution of potential problems; providing final review and approval of work plans, task deliverables, schedules, contract changes, and manpower allocations; and developing coordination among management, field teams, and support personnel to maintain consistency of performance.

**Project Manager.** The Project Manager for ABB-ES' Fort Devens efforts, Mr. Alan Fillip P.E., has the day-to-day responsibility for conducting the Fort Devens project. The Project Manager is responsible for confirming the appropriateness and adequacy of the technical or engineering services provided for a specific task; developing the technical approach and level of effort required to address each element of a task; supervising day-to-day conduct of the work, including integrating the efforts of all supporting disciplines and subcontractors for all tasks; overseeing the preparation of all reports and plans; providing for QC and quality

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review during performance of the work; confirming technical integrity, clarity, and usefulness of task work products; forming a task group with expertise in disciplines appropriate to accomplish the work; reviewing and approving sampling tests and QA plans, which include monitoring site locations, analysis methods to be used, and hydrologic and geophysical techniques to be used; developing and monitoring task schedules; supervising task fiscal requirements (e.g., funds management for labor and materials), and reviewing and approving all invoicing actions; and providing day-to-day communication, both within the ABB-ES team and with the USAEC COR, on all task matters including task status reporting.

**Corporate Officer.** ABB-ES' Corporate Officer, William R. Fisher, P.E., is responsible for ensuring that a contract for the services to be provided has been executed; necessary corporate resources are committed to conduct the program activities; corporate level input and response is readily available to both the ABB-ES team and the USAEC COR; and assistance is provided to the Program and Project Managers for project implementation.

**Technical Director and Project Review Committee.** The members of the Project Review Committee for this Task Order are Mr. James Buss, P.G., Mr. Jeffrey Pickett, and Mr. Willard Murray, PhD., P.E. Mr. Buss will serve as Technical Director and will be responsible for the overall technical quality of the work performed; he also will serve as chairman of the Project Review Committee. The function of this group of senior technical and/or management personnel is to provide guidance and oversight on the technical aspects of the project. This is accomplished through periodic reviews of the services provided to confirm they represent the accumulated experience of the firm, are being produced in accordance with corporate policy, and live up to the objectives of the program as established by ABB-ES and USAEC.

**Quality Assurance Supervisor.** Mr. Christian Ricardi is the QA Supervisor for ABB-ES' USAEC program and this project. The QA function has been established so that appropriate protocols from USAEC, Commonwealth of Massachusetts, and USEPA Region 1 are followed. In addition, the QA Supervisor must confirm that QC plans are in place and implemented for each element of the task. The QA Supervisor reports directly to the Program Manager but is responsible to the Project Manager in matters related to management of the QA/QC work element. The QA Supervisor is independent of the Project

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Manager relative to corrective action. The QA Supervisor has authority to stop work that is not in compliance with the POP, provided he has the concurrence of the USAEC Chemistry Branch, the Program Manager, the COR, and the Contracting Officer.

**Health and Safety Supervisor.** Ms. Cynthia E. Sundquist is the Health and Safety Supervisor for the Fort Devens project, reporting directly to the Project Manager. She has stop work authority to prevent or mitigate any unacceptable health and safety risks to project personnel, the general public, or the environment. Responsibilities of this position include confirming that the project team and, in particular, field personnel, comply with the ABB-ES Health and Safety Plan (HASP); helping the Program Manager and Project Manager develop the site-specific HASP; making certain that the HASP is distributed to appropriate personnel; and informing the Program Manager and the appropriate USAEC personnel in the specified manner when any health- or safety-related incident occurs.

**Contract Manager.** Ms. Elaine H. Findlay is the Contract Manager for the Fort Devens effort. The Contract Manager supports the Program Manager and Project Manager in all contractual matters, providing a liaison between contract representatives for USAEC and all subcontracted services.

**Project Administrator.** Ms. Dana Porter is the Project Administrator for the Fort Devens effort. The Project Administrator supports the Program Manager and Project Manager in the day-to-day monitoring of fiscal, schedule, and documentation requirements. She is responsible for maintaining the necessary systems to support budget monitoring and controls, and schedule monitoring and maintenance; and for controlling the flow and processing of documentation.

**RI/FS Task Manager.** Mr. Herb Colby will serve as Task Manager for the Fort Devens AOC 63AX RI/FS field investigation. As a Task Manager, he is responsible for planning all ABB-ES' geologic and hydrogeologic investigations at Fort Devens. He also is responsible for the interpretation of all chemical and hydrogeologic information and data for the preparation of the AOC 63AX RI/FS Report.

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**Field Operations Leader.** Mr. Rod Rustad will serve as the Field Operations Leader for the Fort Devens Field Program. As Field Operations Leader he is responsible for conducting the field program in accordance with procedures outlined in the Work Plan and POP.

**Laboratory/Data Management Leader.** Ms. Elizabeth Dawes, as the coordinator of laboratory services, is responsible for implementing and maintaining the Fort Devens analytical program. Her responsibilities as the Laboratory Management Leader will include coordination with the Project Manager, QA Supervisor, and the analytical subcontractor on overall project and individual site analytical efforts. As the Data Management Leader, Ms. Dawes is responsible for operating and maintaining the database management systems committed to USAEC projects.

### 6.2 SUBCONTRACTORS

The following services and/or activities will be performed by subcontractors during the RI/FS field investigation activities at AOC 63AX: field drilling and monitoring well installation, surveying, investigation derived waste disposal, and laboratory chemical analysis.

**Drilling Services.** Maher Environmental has been chosen through a competitive bidding process to provide drilling services for the RI. The drilling subcontractor will be responsible for mobilizing the proper drilling equipment to complete the soil boring and monitoring well installation. The Field Operations Leader will be responsible for coordinating and overseeing the activities of the drilling subcontractor.

**Surveying Services.** Martinage Engineering Associates, a professional land surveying company registered in the Commonwealth of Massachusetts, has been subcontracted to establish map coordinates and elevations for new monitoring wells and sediment sampling locations. Surveying activities will be coordinated and monitored by the Field Operations Leader, who will keep the Project Manager informed on a day-to-day basis.

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**Investigation-derived Waste Disposal.** A subcontractor will be chosen through a competitive bidding process. The subcontractor will be responsible for removing and disposing of soil and/or water generated during the RI/FS program. The subcontractor will be responsible for disposing of the waste in accordance with all state and federal regulations.

**Laboratory Chemical Analysis.** Analytical services for the AOC 63AX RI/FS field investigations will be subcontracted to ESE of Gainesville, Florida. ESE's analytical program is USAEC-approved.

### **6.3 PROJECT SCHEDULE**

ABB-ES' projection of the schedule for the AOC 63AX RI/FS at Fort Devens allows for the regulatory review and approval period specified in the Federal Facility Agreement for all deliverables.

The field tasks are scheduled to be completed in five-day work shifts during the 10 weeks following authorization to proceed. The fieldwork is anticipated to commence in August 1995.

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## GLOSSARY OF ABBREVIATIONS AND ACRONYMS

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|        |                                                                       |
|--------|-----------------------------------------------------------------------|
| AAFES  | Army Air Force Exchange Service                                       |
| ABB-ES | ABB Environmental Services, Inc.                                      |
| AOC    | Area of Contamination                                                 |
| ARARs  | Applicable or Relevant and Appropriate Requirements                   |
| ATEC   | ATEC Environmental Consultants                                        |
| BTEX   | benzene, toluene, ethylbenzene, and xylenes                           |
| bgs    | below ground surface                                                  |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFU    | colony forming units                                                  |
| cm/sec | centimeters per second                                                |
| COPC   | chemical of potential concern                                         |
| COR    | Contracting Officer's Representative                                  |
| CRP    | Community Relations Plan                                              |
| DQO    | Data Quality Objective                                                |
| EA     | Environmental Applications, Inc.                                      |
| ECAO   | Environmental Criteria and Assessment Office                          |
| EMO    | Environmental Management Office                                       |
| ESE    | Environmental Science & Engineering                                   |
| FID    | flame ionization detector                                             |
| FS     | feasibility study                                                     |
| GC     | gas chromatograph                                                     |
| GPR    | ground-penetrating radar                                              |
| GZAR   | GZA Remediation, Inc.                                                 |
| HASP   | Health and Safety Plan                                                |
| HEAST  | Health Effects Assessment Summary Tables                              |
| HSA    | hollow stem auger                                                     |
| IAG    | interagency agreement                                                 |

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## **GLOSSARY OF ABBREVIATIONS AND ACRONYMS**

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|        |                                                                |
|--------|----------------------------------------------------------------|
| ID     | inside diameter                                                |
| IR     | infrared                                                       |
| IRDMIS | Installation Restoration Data Management<br>Information System |
| IRIS   | Integrated Risk Information System                             |
| MADEP  | Massachusetts Department of Environmental<br>Protection        |
| MCL    | Maximum Contaminant Level                                      |
| MEP    | Master Environmental Plan                                      |
| mg/L   | milligrams per liter                                           |
| NCP    | National Contingency Plan                                      |
| NDIR   | non-dispersive infrared                                        |
| OU     | operable unit                                                  |
| PAHs   | polynuclear aromatic hydrocarbons                              |
| PAL    | Project Analyte List                                           |
| PID    | photoionization detector                                       |
| POP    | Project Operations Plan                                        |
| POTW   | publicly-owned treatment works                                 |
| ppb    | parts per billion                                              |
| ppm    | parts per million                                              |
| PRE    | preliminary risk evaluation                                    |
| PVC    | polyvinyl chloride                                             |
| QA     | Quality Assurance                                              |
| QC     | Quality Control                                                |
| RAAP   | Risk Assessment Approach Plan                                  |
| RAB    | Restoration Advisory Board                                     |
| RAGS   | Risk Assessment Guidance for Superfund                         |
| RI     | remedial investigation                                         |
| ROD    | Record of Decision                                             |
| SA     | Study Area                                                     |

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## **GLOSSARY OF ABBREVIATIONS AND ACRONYMS**

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|       |                                              |
|-------|----------------------------------------------|
| SARA  | Superfund Amendments and Reauthorization Act |
| SI    | Site Investigation                           |
| SSI   | Supplemental Site Investigation              |
| SVE   | soil vapor extraction                        |
| SVOC  | semivolatile organic compound                |
| TBC   | to be considered                             |
| TCD   | thermal conductivity detector                |
| TEX   | toluene, ethylbenzene, xylene                |
| TOC   | total organic carbon                         |
| TPHC  | total petroleum hydrocarbon Compounds        |
| TRC   | Technical Review Committee                   |
| TSS   | total suspended solids                       |
| USAEC | U.S. Army Environmental Center               |
| USEPA | U.S. Environmental Protection Agency         |
| UST   | underground storage tank                     |
| VOC   | volatile organic compound                    |
| WWTP  | waste water treatment plant                  |

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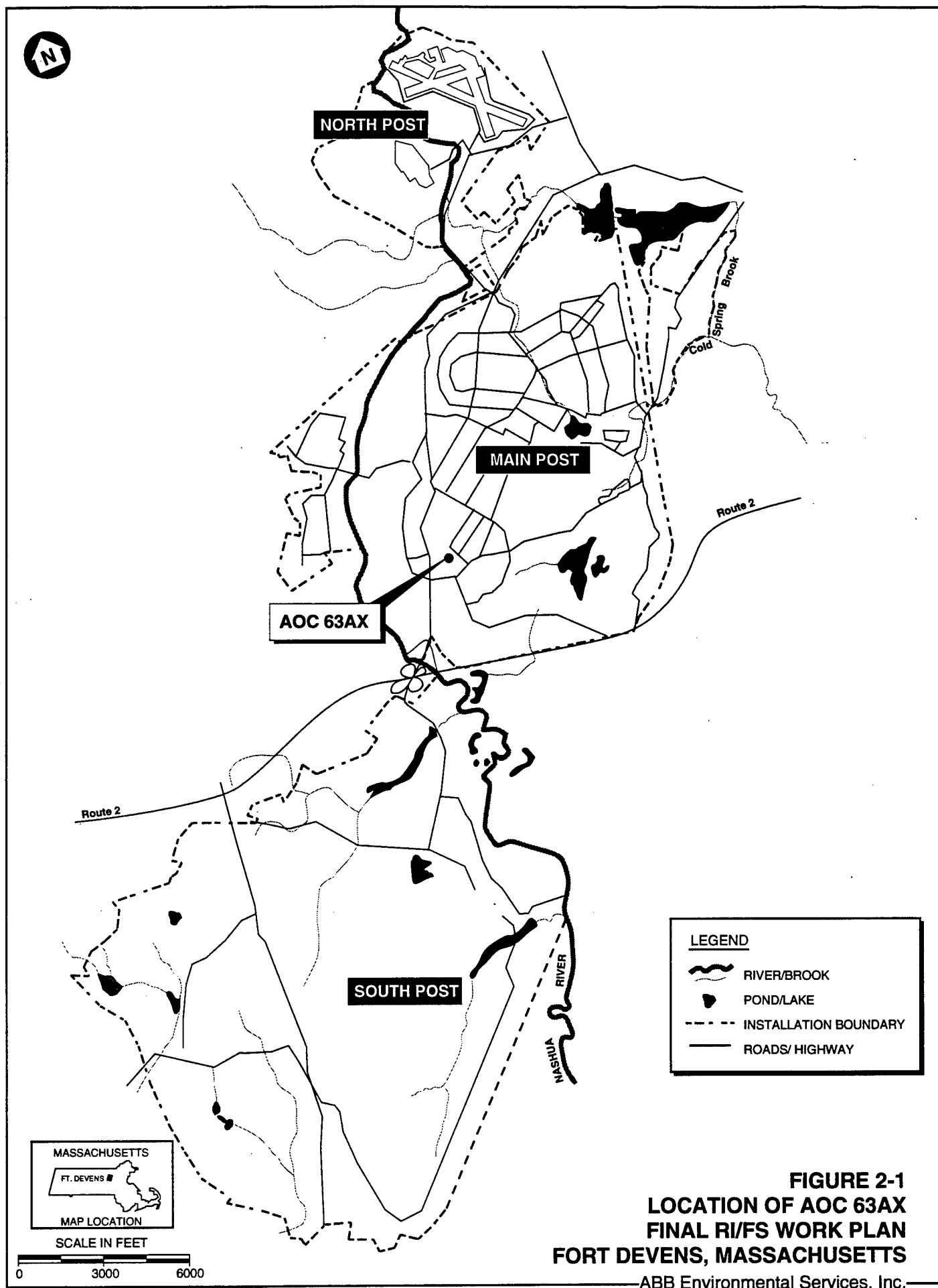
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ABB Environmental Services, Inc.





PARKING LOT

LOCATION OF  
UST EXCAVATION

63AX-94-01

63AX-94-02

63AX-94-03

RV PARKING LOT

T2517

T2506

T2505

T2504

T2527

### LEGEND



MONITORING WELL



CURRENT LOCATION OF  
WASTE OIL AST

### NOTE:

LOCATION OF WELLS ARE APPROXIMATE, BASED ON FIGURE 3-6  
UNDERGROUND STORAGE TANKS (AREE 63) SUPPLEMENTAL  
SITE EVALUATION DATA PACKAGE  
FORT DEVENS, MASSACHUSETTS, ARTHUR D. LITTLE, INC.,  
OCTOBER, 1994

0 40 80 160 FEET

SCALE: 1"=80'

600 KVA  
SUB STATION

2515

FIGURE 2-2  
AOC 63AX

PREVIOUS EXPLORATION LOCATIONS  
FINAL RI/FS WORK PLAN  
FORT DEVENS, MA

ABB Environmental Services, Inc.

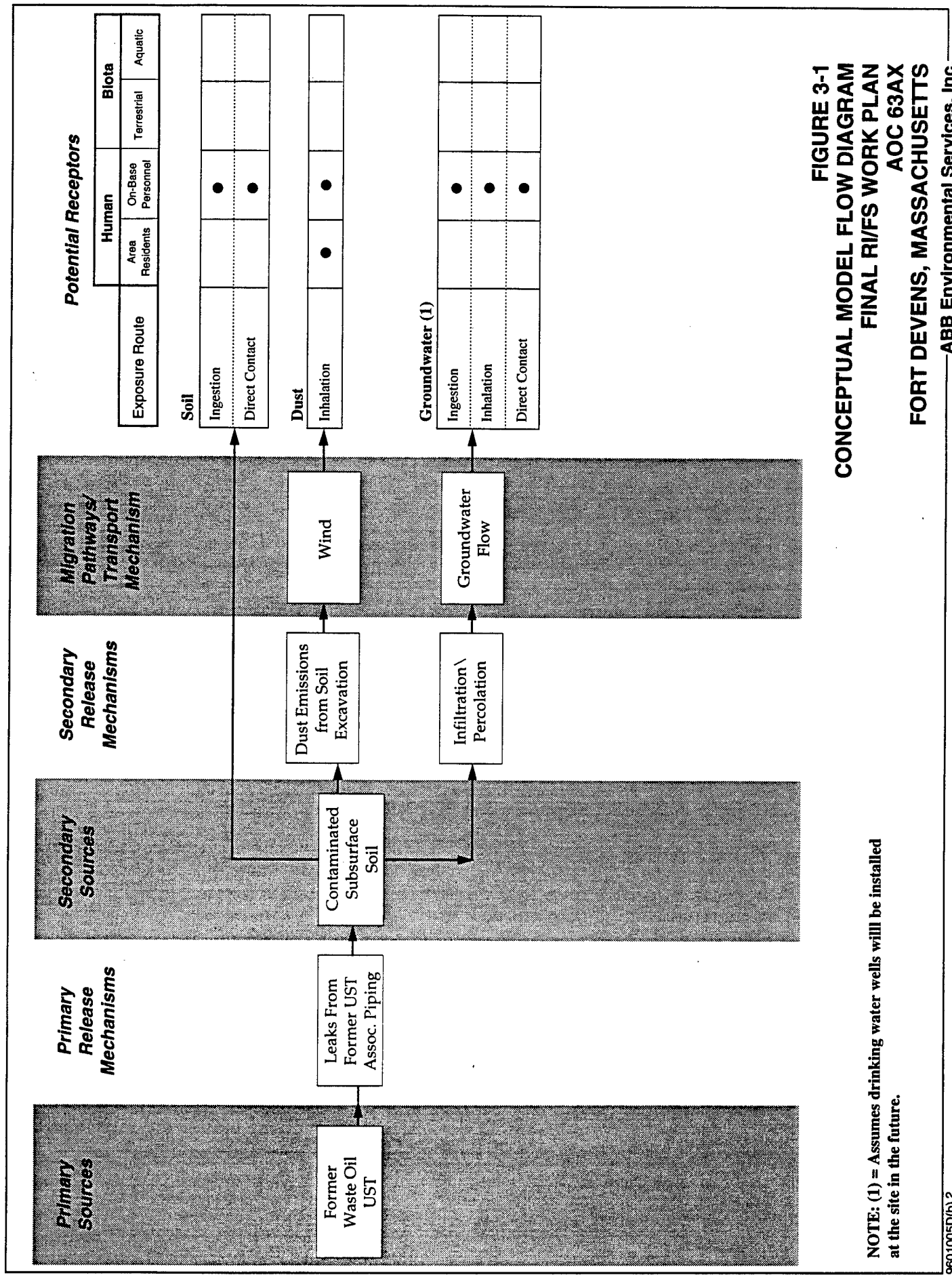


**FIGURE 3-1**  
**CONCEPTUAL MODEL FLOW DIAGRAM**  
**FINAL RI/FS WORK PLAN**  
**AOC 63AX**  
**FORT DEVENS, MASSACHUSETTS**

NOTE: (1) = Assumes drinking water wells will be installed at the site in the future.

## AOC 63AX Groundwater

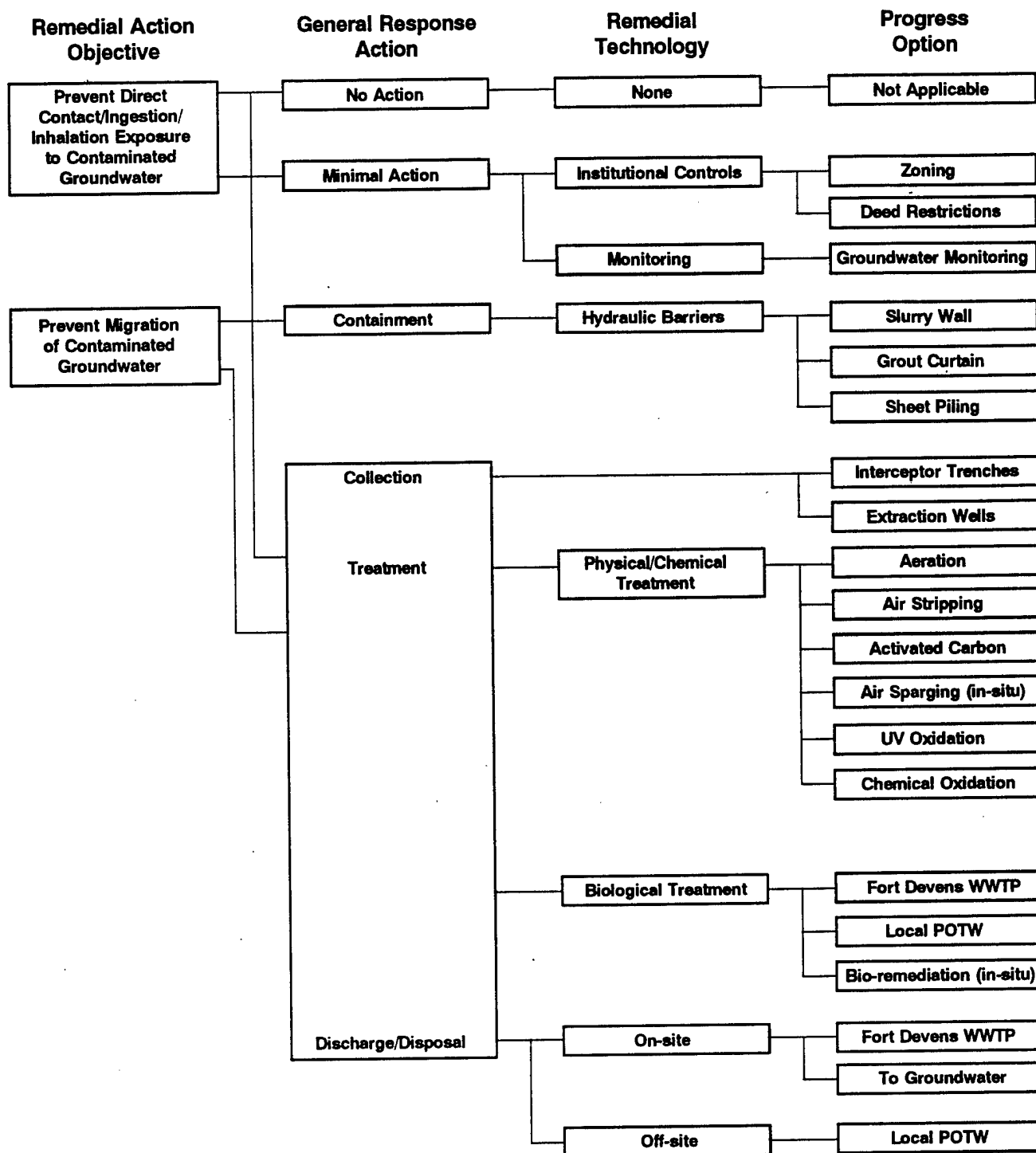


**FIGURE 3-2**  
**IDENTIFICATION OF POTENTIAL REMEDIAL TECHNOLOGIES**  
**FINAL RI/FS WORK PLAN**  
**AOC 63AX**  
**FORT DEVENS, MA**

ABB Environmental Services, Inc.

## AOC 63AX Subsurface Soil

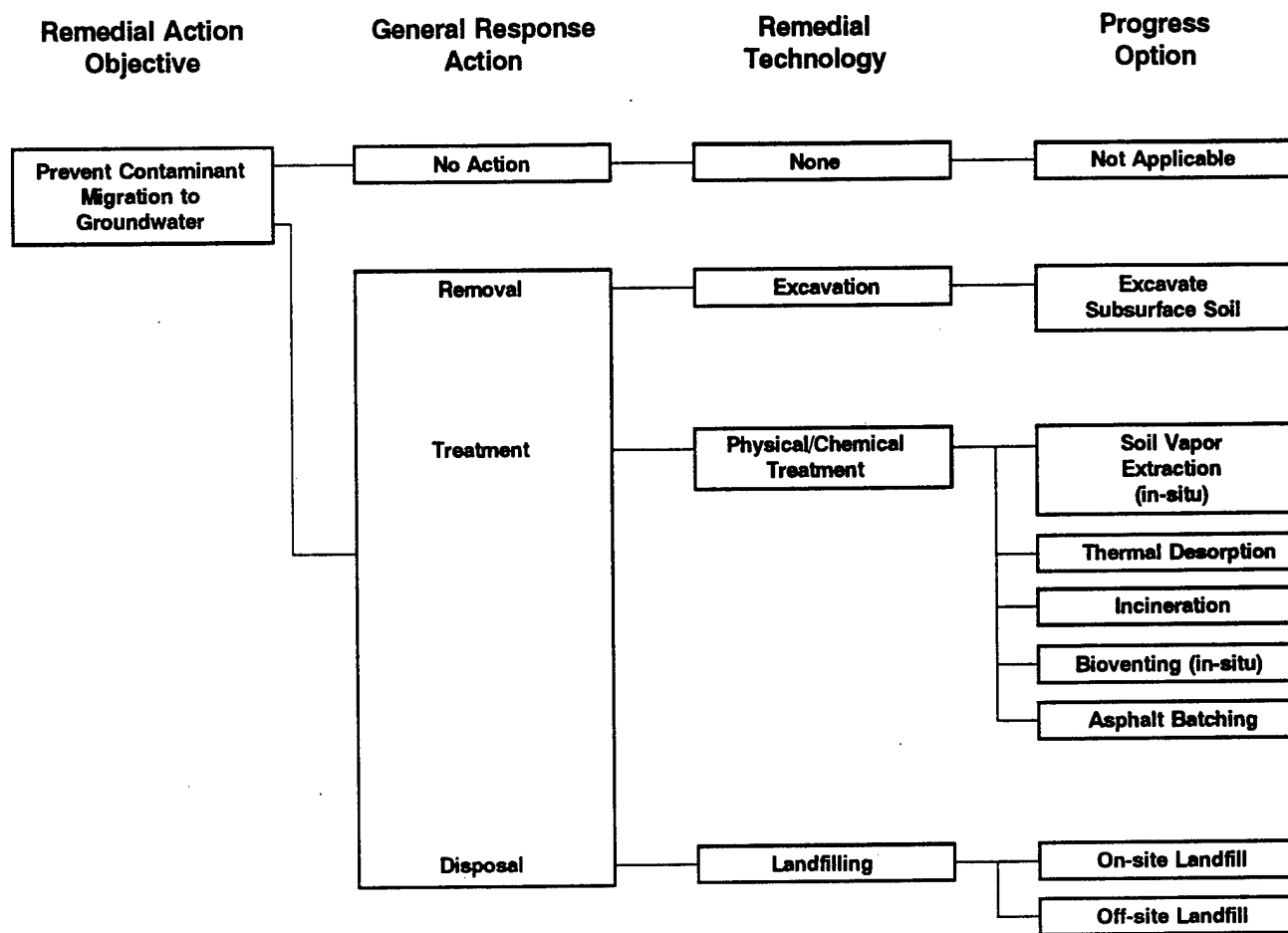


**FIGURE 3-2 (Cont.)**  
**IDENTIFICATION OF POTENTIAL REMEDIAL TECHNOLOGIES**  
**FINAL RI/FS WORK PLAN**  
**AOC 63AX**  
**FORT DEVENS, MA**

ABB Environmental Services, Inc.



## LEGEND

-  PROPOSED MONITORING WELL
- 63AX-94-03  PREVIOUSLY INSTALLED MONITORING WELLS
- CURRENT LOCATION OF WASTE OIL AST
- PROPOSED TERRAPROBE INVESTIGATION POINTS
-  AREA OF PROPOSED GPR INVESTIGATION
-  PROPOSED SOIL BORING

AXB-95-01X

AXB-95-02X

63AX-94-01

PARKING  
LOT

AXB-95-04X

63AX-94-02

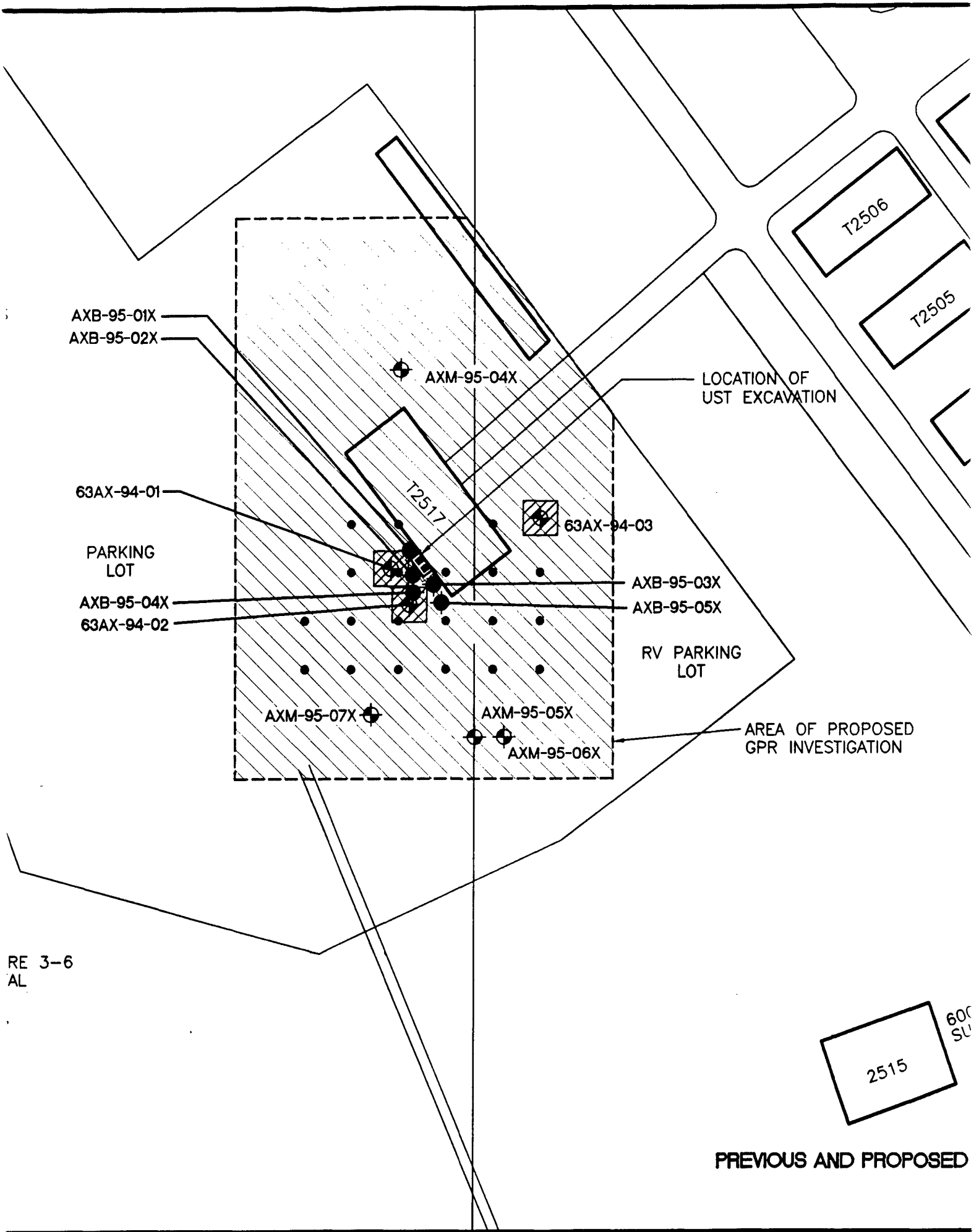
AXM-95-07

### NOTE:

LOCATION OF WELLS ARE APPROXIMATE, BASED ON FIGURE 3-6  
UNDERGROUND STORAGE TANKS (AREE 63) SUPPLEMENTAL  
SITE EVALUATION DATA PACKAGE  
FORT DEVENS, MASSACHUSETTS, ARTHUR D. LITTLE, INC.,  
OCTOBER, 1994

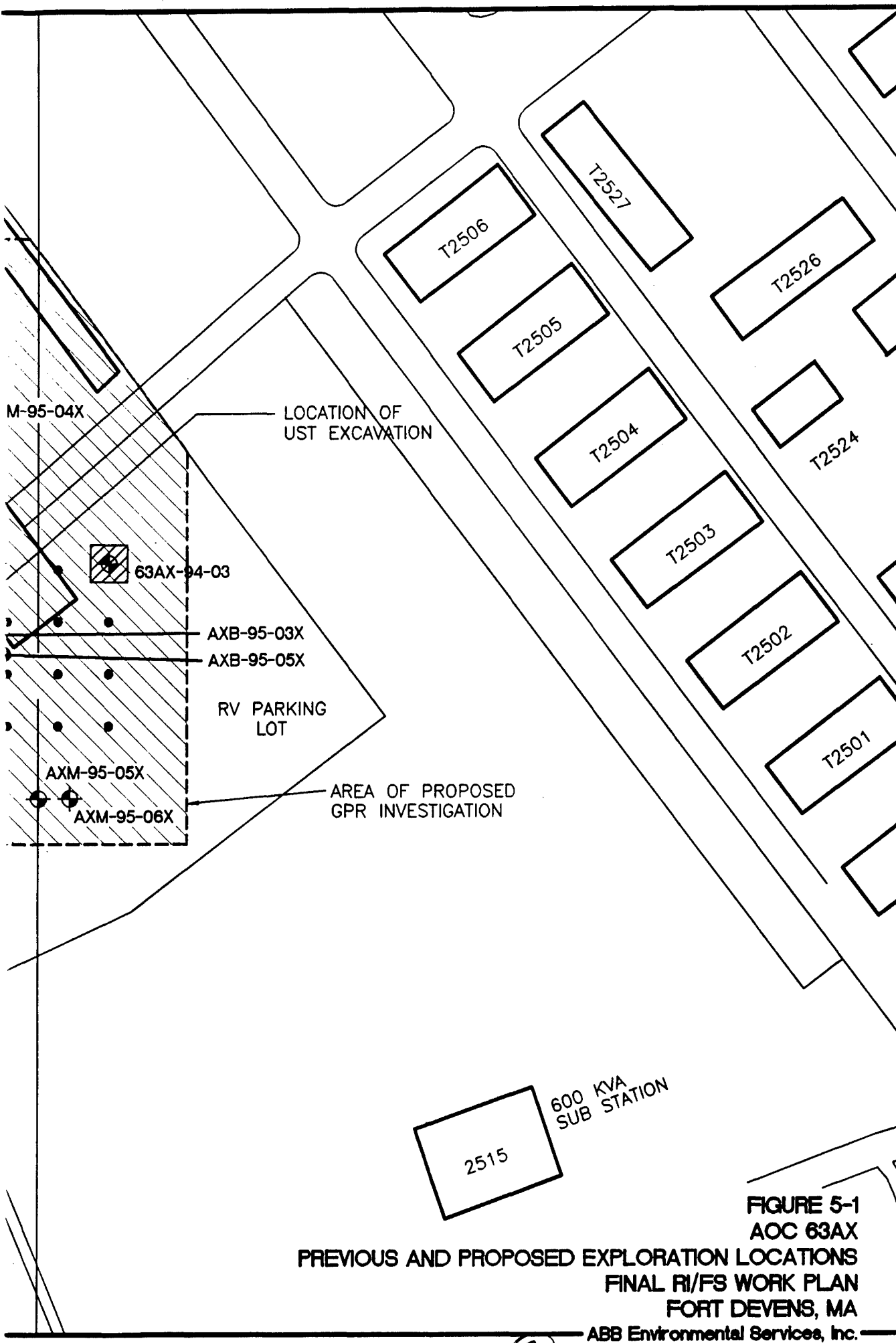
0 40 80 160 FEET

SCALE: 1"=80'



RE 3-6  
AL

PREVIOUS AND PROPOSED



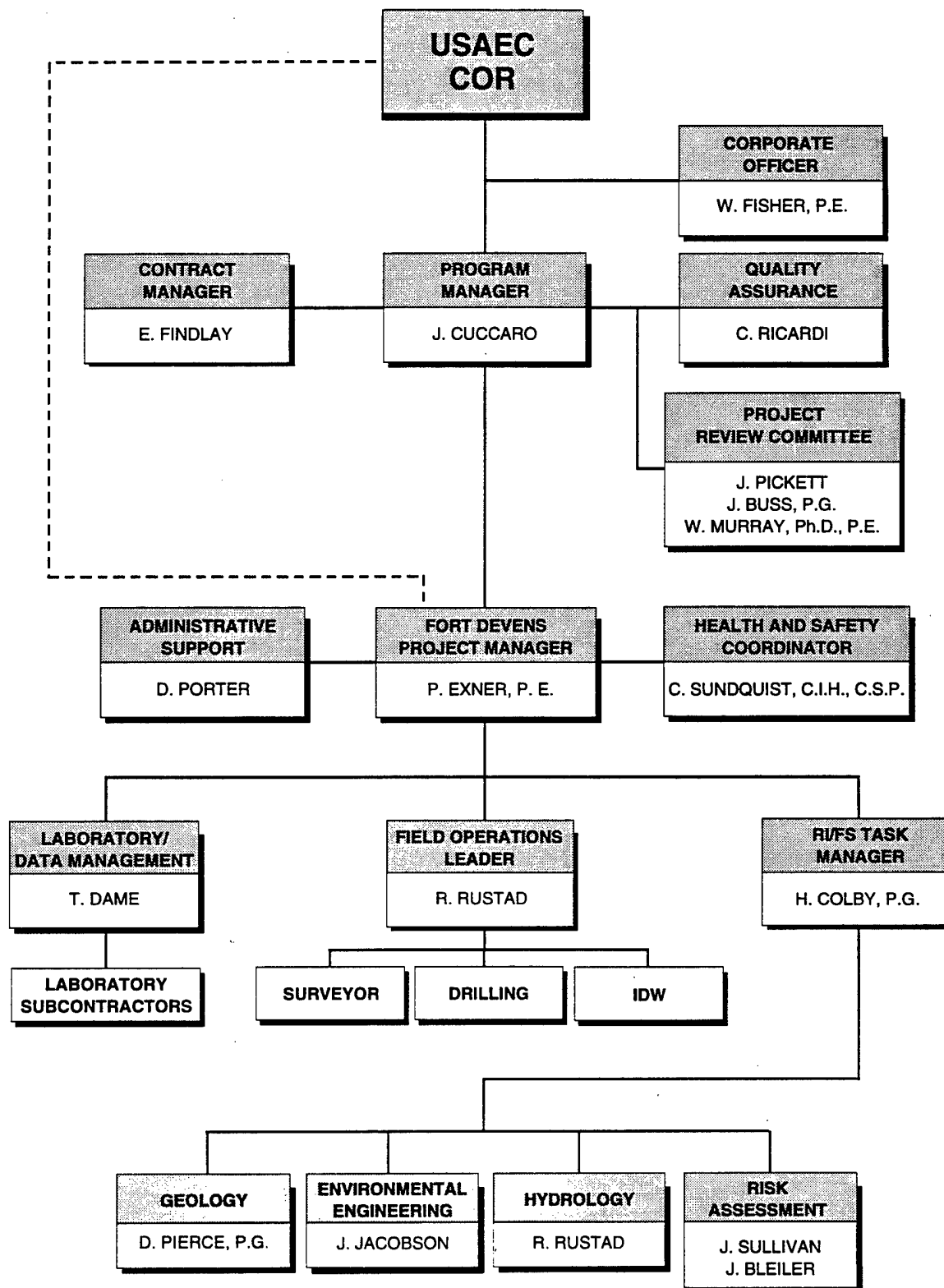


**FIGURE 6-1**  
**PROJECT ORGANIZATION**  
**AOC 63AX BUILDING 2517 PREVIOUSLY REMOVED UST**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MASSACHUSETTS**

ABB Environmental Services, Inc.

TABLE 5 - 1  
FIELD ANALYTICAL SAMPLE RATIONALE  
AOC 63AX  
FINAL RI/FS WORK PLAN  
FORT DEVENS, MA

| SAMPLE TYPE | DEPTH                          | MEDIA | NO. OF SAMPLES | LOCATION AND RATIONALE                                                                                                                                                                            |
|-------------|--------------------------------|-------|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Terra Probe | 3 - 15 ft                      | Soil  | 60             | To assess the lateral and vertical distribution of subsurface soil contamination in the area of the former UST. Three samples per probe, to be analyzed in the field for selected PAL VOCs and TH |
| Terra Probe | Water table<br>(est. 3 - 7 ft) | Water | 20             | To assess the presence and concentration of VOC contamination in groundwater. One water sample per boring will be collected from the water table and analyzed in the field for selected PAL VOCs. |

**TABLE 5-2**  
**SOIL BORING LOCATION AND SAMPLE RATIONALE**  
**AOC 63AX**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID    | DEPTH<br>(FT BGS) | DRILLING<br>METHOD | SAMPLE<br>ID                     | LOCATION AND RATIONALE                                                                                                                                                                                                                                                                                             |
|------------|-------------------|--------------------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AXB-95-01X | 15                | 4.25-inch HSAs     | BXAX0106<br>BXAX0110<br>BXAX0112 | Located at the northern limit of the former UST excavation, to determine if residual contaminants remain at this location following removal of the waste oil UST. Three samples will be collected at approximately 3, 8, and 13 feet bgs, for laboratory analysis of TPHC, PAL VOCs, PAL SVOCs and PAL inorganics. |
| AXB-95-02X | 15                | 4.25-inch HSAs     | BXAX0206<br>BXAX0210<br>BXAX0212 | Located at the western limit of the former UST excavation, to determine if residual contaminants remain at this location following removal of the waste oil UST. Three samples will be collected at approximately 3, 8, and 13 feet bgs, for laboratory analysis of TPHC, PAL VOCs, PAL SVOCs and PAL inorganics.  |
| AXB-95-03X | 15                | 4.25-inch HSAs     | BXAX0306<br>BXAX0310<br>BXAX0312 | Located at the southern limit of the former UST excavation, to determine if residual contaminants remain at this location following removal of the waste oil UST. Three samples will be collected at approximately 3, 8, and 13 feet bgs, for laboratory analysis of TPHC, PAL VOCs, PAL SVOCs and PAL inorganics. |
| AXB-95-04X | 15                | 4.25-inch HSAs     | BXAX0406<br>BXAX0410<br>BXAX0412 | Located further southwest of the former UST excavation, to determine if contaminants from the former UST have impacted subsurface soil at this location. Three samples will be collected at approximately 3, 8, and 13 feet bgs, for laboratory analysis of TPHC, PAL VOCs, PAL SVOCs and PAL inorganics.          |
| AXB-95-05X | 15                | 4.25-inch HSAs     | BXAX0506<br>BXAX0510<br>BXAX0512 | Located further south of the former UST excavation, to determine if contaminants from the former UST have impacted subsurface soil at this location. Three samples will be collected at approximately 3, 8, and 13 feet bgs, for laboratory analysis of TPHC, PAL VOCs, PAL SVOCs and PAL inorganics.              |

**TABLE 5-3**  
**MONITORING WELL INSTALLATION SUMMARY AND RATIONALE**  
**AOC 63AX**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID    | DRILLING METHOD | EXPECTED WATER TABLE DEPTH (FT) | ESTIMATED BOTTOM DEPTH OF SCREEN (FT) | ESTIMATED LENGTH OF SCREEN (FT) | PURPOSE AND RATIONALE                                                              |
|------------|-----------------|---------------------------------|---------------------------------------|---------------------------------|------------------------------------------------------------------------------------|
| AXM-95-04X | 6.25 HSAs       | 3-7                             | 15                                    | 10                              | To evaluate shallow groundwater quality upgradient of the former UST excavation.   |
| AXM-95-05X | 6.25 HSAs       | 3-7                             | 15                                    | 10                              | To evaluate shallow groundwater quality downgradient of the former UST excavation. |
| AXM-95-06X | 6.25 HSAs       | 3-7                             | 40                                    | 10                              | To evaluate deep groundwater quality downgradient of the former UST excavation.    |
| AXM-95-07X | 6.25 HSAs       | 3-7                             | 40                                    | 10                              | To evaluate deep groundwater quality downgradient of the former UST excavation.    |

**TABLE 5-4**  
**MONITORING WELL/GROUNDWATER SAMPLE RATIONALE**  
**AOC 63AX**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID    | LOCATION                                         | RATIONALE AND PURPOSE                                                                                                                                                                                                                                                                   |
|------------|--------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 63AX-94-01 | Existing well to west of former UST excavation.  | Monitor groundwater quality to west of former UST excavation. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, water quality parameters, and TDS.                                              |
| 63AX-94-02 | Existing well to south of former UST excavation. | Monitor groundwater quality to south of former UST excavation. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, water quality parameters, and TDS.                                             |
| 63AX-94-03 | Existing well to east of former UST excavation.  | Monitor groundwater quality to east of former UST excavation. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, water quality parameters, and TDS.                                              |
| AXM-95-04X | Proposed well to north of former UST excavation  | Monitor shallow groundwater quality in the inferred upgradient direction from the former UST excavation. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, water quality parameters, and TDS.   |
| AXM-95-05X | Proposed well to south of former UST excavation  | Monitor shallow groundwater quality in the inferred downgradient direction from the former UST excavation. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, water quality parameters, and TDS. |
| AXM-95-06X | Proposed well to south of former UST excavation  | Monitor deep groundwater quality in the inferred downgradient direction from the former UST excavation. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, water quality parameters, and TDS.    |
| AXM-95-07X | Proposed well to west of former UST excavation.  | Monitor deep groundwater quality in the inferred downgradient direction from the former UST excavation. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (both filtered and unfiltered), TPHC, water quality parameters, and TDS.    |

TABLE 5-5  
 SAMPLING AND LABORATORY ANALYSIS SCHEDULE  
 AOC 63AX  
 DRAFT RI/FS WORK PLAN  
 FORT DEVENS, MA

| SITE<br>TYPE | MEDIA       | SITE<br>ID | SAMPLE<br>ID | LAB<br>SAMPLE<br>NO. | MS/1<br>MSD | DUP | RINS | FINGER | PET | GRAIN<br>SIZE | PAL <sup>2</sup><br>VOCS | PAL <sup>2</sup><br>SVOCs | PAL <sup>1</sup><br>INORG. | PAL <sup>2</sup><br>PEST/<br>PCBs | WTR<br>QUA | PRMTRS | TPHC | TDS | TOC |
|--------------|-------------|------------|--------------|----------------------|-------------|-----|------|--------|-----|---------------|--------------------------|---------------------------|----------------------------|-----------------------------------|------------|--------|------|-----|-----|
|              |             |            |              |                      |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-01X | BXAX0106     | DV4S* 212            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-01X | BXAX0110     | DV4S* 213            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-01X | BXAX0112     | DV4S* 214            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-02X | BXAX0206     | DV4S* 215            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-02X | BXAX0210     | DV4S* 216            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-02X | BXAX0212     | DV4S* 217            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-03X | BXAX0306     | DV4S* 218            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-03X | BXAX0310     | DV4S* 219            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-03X | BXAX0312     | DV4S* 220            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-04X | BXAX0406     | DV4S* 221            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-04X | BXAX0410     | DV4S* 222            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-04X | BXAX0412     | DV4S* 223            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-05X | BXAX0506     | DV4S* 224            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-05X | BXAX0510     | DV4S* 225            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXB-95-05X | BXAX0512     | DV4S* 226            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXM-95-04X | BXAX04--     | DV4S* 227            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXM-95-05X | BXAX05--     | DV4S* 228            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXM-95-06X | BXAX06--     | DV4S* 229            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| BORE         | SOIL        | AXM-95-07X | BXAX07--     | DV4S* 230            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-01 | MXAX01X1     | DV4W* 231            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-01 | MXAX01X1     | DV4F* 231            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-01 | MXAX01X2     | DV4W* 232            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-01 | MXAX01X2     | DV4F* 232            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-02 | MXAX02X1     | DV4W* 233            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-02 | MXAX02X1     | DV4F* 233            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-02 | MXAX02X2     | DV4W* 234            |             |     |      |        |     |               |                          |                           |                            |                                   |            |        |      |     |     |

**TABLE 5-5**  
**SAMPLING AND LABORATORY ANALYSIS SCHEDULE**  
**AOC 63AX**  
**DRAFT RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE<br>TYPE | MEDIA       | SITE<br>ID | LAB          |               | MSD | DUP | RINS | FINGER | GRAIN<br>SIZE | PAL <sup>2</sup><br>VOCs | PAL <sup>2</sup><br>SVOCs | PAL <sup>2</sup><br>INORG. | PAL <sup>2</sup><br>PEST/<br>PCBs | PAL <sup>2</sup><br>PRMTRS | WTR<br>QUA | TPHC | TDS | TOC |
|--------------|-------------|------------|--------------|---------------|-----|-----|------|--------|---------------|--------------------------|---------------------------|----------------------------|-----------------------------------|----------------------------|------------|------|-----|-----|
|              |             |            | SAMPLE<br>ID | SAMPLE<br>NO. |     |     |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-02 | MXAX02X2     | DV4F*         | 234 |     |      |        |               |                          |                           |                            | 1                                 |                            |            |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-03 | MXAX03X1     | DV4W*         | 235 | 1   |      |        |               | 1                        |                           |                            | 1                                 |                            | 1          | 1    | 1   | 1   |
| WELL         | GROUNDWATER | 63AX-94-03 | NXAX03X1     | DV4F*         | 235 | 1   |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | 63AX-94-03 | MXAX03X2     | DV4W*         | 236 |     |      |        |               | 1                        |                           |                            | 1                                 |                            |            | 1    | 1   | 1   |
| WELL         | GROUNDWATER | 63AX-94-03 | MXAX03X2     | DV4F*         | 236 | 1   |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | AXM-95-04X | MXAX04X1     | DV4W*         | 237 |     |      |        |               |                          |                           |                            | 1                                 |                            |            | 1    | 1   | 1   |
| WELL         | GROUNDWATER | AXM-95-04X | MXAX04X1     | DV4F*         | 237 |     |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | AXM-95-04X | MXAX04X2     | DV4W*         | 238 | 1   |      |        |               | 1                        |                           |                            | 1                                 |                            | 1          | 1    | 1   | 1   |
| WELL         | GROUNDWATER | AXM-95-04X | MXAX04X2     | DV4F*         | 238 | 1   |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | AXM-95-05X | MXAX05X1     | DV4W*         | 239 |     |      |        |               | 1                        |                           |                            | 1                                 |                            |            | 1    | 1   | 1   |
| WELL         | GROUNDWATER | AXM-95-05X | MXAX05X1     | DV4F*         | 239 |     |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | AXM-95-05X | MXAX05X2     | DV4W*         | 240 |     |      |        |               | 1                        |                           |                            | 1                                 |                            | 1          | 1    | 1   | 1   |
| WELL         | GROUNDWATER | AXM-95-05X | MXAX05X2     | DV4F*         | 240 |     |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | AXM-95-06X | MXAX06X1     | DV4W*         | 241 |     |      |        |               | 1                        |                           |                            | 1                                 |                            | 1          | 1    | 1   | 1   |
| WELL         | GROUNDWATER | AXM-95-06X | MXAX06X1     | DV4F*         | 241 |     |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | AXM-95-06X | MXAX06X2     | DV4W*         | 242 |     |      |        |               | 1                        |                           |                            | 1                                 |                            | 1          | 1    | 1   | 1   |
| WELL         | GROUNDWATER | AXM-95-06X | MXAX06X2     | DV4F*         | 242 |     |      |        |               |                          |                           |                            |                                   |                            |            |      |     |     |
| WELL         | GROUNDWATER | AXM-95-07X | MXAX07X1     | DV4W*         | 243 |     |      |        |               | 1                        |                           |                            | 1                                 |                            | 1          | 1    | 1   | 1   |

**TABLE S-5**  
**SAMPLING AND LABORATORY ANALYSIS SCHEDULE**  
**AOC 63AX**  
**DRAFT RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE TYPE                        | MEDIA       | SITE ID    | SAMPLE ID | LAB SAMPLE NO. | MSD | DUP | RINS | FINGER | PET GRAIN SIZE | PAL <sup>2</sup> VOCs | PAL <sup>2</sup> SVOCs | PAL <sup>2</sup> INORG. | PAL <sup>2</sup> PEST/PCBs | PAL <sup>2</sup> PRMTRS | PAL <sup>2</sup> WTR QUA | TDS | TPHC | TOC |
|----------------------------------|-------------|------------|-----------|----------------|-----|-----|------|--------|----------------|-----------------------|------------------------|-------------------------|----------------------------|-------------------------|--------------------------|-----|------|-----|
|                                  |             |            |           |                |     |     |      |        |                |                       |                        |                         |                            |                         |                          |     |      |     |
| WELL                             | GROUNDWATER | AXM-95-07X | MXAX07X1  | DV4F* 243      |     |     |      |        | -              | -                     | -                      | 1                       | -                          | -                       | -                        | -   | -    | -   |
| WELL                             | GROUNDWATER | AXM-95-07X | MXAX07X2  | DV4W* 244      |     |     |      |        | -              | 1                     | 1                      | 1                       | 1                          | 1                       | 1                        | 1   | 1    | 1   |
| WELL                             | GROUNDWATER | AXM-95-07X | MXAX07X2  | DV4F* 244      |     |     |      |        | -              | -                     | -                      | 1                       | -                          | -                       | -                        | -   | -    | -   |
| SOIL SAMPLE SUBTOTAL             |             |            |           |                |     |     |      |        | 0              | 15                    | 15                     | 15                      | 0                          | 0                       | 0                        | 15  | 0    | 4   |
| WATER SAMPLE SUBTOTAL            |             |            |           |                |     |     |      |        | 0              | 14                    | 14                     | 28                      | 14                         | 14                      | 14                       | 14  | 14   | 0   |
|                                  |             |            |           |                |     |     |      |        |                |                       |                        |                         |                            |                         |                          |     |      |     |
| MS/MSD SAMPLES (5%)              |             |            |           |                |     |     |      |        | 0              | 0                     | NA                     | NA                      | 1                          | 0                       | 0                        | NA  | 0    | NA  |
| (5% PER EPISODE FOR GROUNDWATER) |             |            |           |                |     |     |      |        | 0              | 0                     | NA                     | NA                      | 2                          | 2                       | NA                       | NA  | NA   | 0   |
| DUPLICATES (5%)                  |             |            |           |                |     |     |      |        | 0              | 0                     | 1                      | 1                       | 1                          | 0                       | 0                        | 1   | 0    | 1   |
| (5% PER EPISODE FOR GROUNDWATER) |             |            |           |                |     |     |      |        | 0              | 0                     | 2                      | 2                       | 2                          | 2                       | 2                        | 2   | 2    | 0   |
| RINSE BLANKS(5%)                 |             |            |           |                |     |     |      |        | 0              | 0                     | 1                      | 1                       | 1                          | 0                       | 0                        | 1   | 0    | 1   |
| TRIP BLANKS                      |             |            |           |                |     |     |      |        |                |                       |                        |                         |                            |                         |                          |     |      |     |
|                                  |             |            |           |                |     |     |      |        |                |                       |                        |                         |                            |                         |                          |     |      |     |
| SOIL SAMPLE TOTAL                |             |            |           |                |     |     |      |        |                |                       |                        |                         |                            |                         |                          |     |      |     |
| WATER SAMPLE TOTAL               |             |            |           |                |     |     |      |        | 0              | 0                     | 16                     | 16                      | 17                         | 0                       | 0                        | 16  | 0    | 5   |
|                                  |             |            |           |                |     |     |      |        | 0              | 0                     | 26                     | 17                      | 33                         | 18                      | 16                       | 17  | 16   | 1   |

NOTE: <sup>1</sup> MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SAMPLES WILL BE COLLECTED FOR INORGANICS AND PESTICIDE/PCBS ONLY AS INDICATED IN THE PROJECT OPERATIONS PLAN.

<sup>2</sup> PAL = PROJECT ANALYTE LIST.

MS/MSD = MARIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLE

DUP = DUPLICATE SAMPLE

RINS = RINSE SAMPLE

NA = NOT APPLICABLE

SECTION 3

AOC 69W

**FINAL WORK PLAN  
REMEDIAL INVESTIGATION/FEASIBILITY STUDY  
AOC 69W  
FORT DEVENS, MASSACHUSETTS**

**DATA ITEM A002**

**CONTRACT NO. DACA31-94-D-0061**

*Prepared for:*

**United States Army Environmental Center  
Aberdeen Proving Ground, Maryland**

*Prepared by:*

**ABB Environmental Services, Inc.  
Wakefield, Massachusetts**

**JANUARY 1996**

FINAL WORK PLAN - AOC 69W  
FORT DEVENS, MASSACHUSETTS

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**GLOSSARY OF ACRONYMS AND ABBREVIATIONS**

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**EXECUTIVE SUMMARY**

Base Realignment and Closure Environmental Evaluation (BRAC EEs) Reports and Supplemental Site Evaluations were conducted in 1993 and 1994 at five areas requiring environmental evaluation (AREEs) at Fort Devens. These AREEs included collective, site-wide evaluations of facilities within the installation that currently, or historically, known or suspected of being the source of the release of contaminants that may pose a threat to human health or the environment.

Ten AREE 69 (Past Spill Sites) on the North and Main Posts were identified for supplemental investigation in the October, 1993 "Draft Past Spill Sites" report. A work plan entitled "Work Plan - Past Spill Sites (AREE 69)" issued in February, 1994, discussed the objectives and the recommended approach of the supplemental site evaluations. Field investigation efforts were conducted during the spring and summer of 1994.

The presence of contamination in the area around an existing underground storage tank and evidence of its migration in groundwater at AREE 69W (Fort Devens Elementary School Past Spill Site) lead to a recommendation for further investigations.

Based on the preliminary findings at AREE 69W, it was recommended that a Remedial Investigation Feasibility Study (RI/FS) be performed. In the Draft Work Plan (Work Plan) and in all subsequent plans and reports, AREE 69W will be referred to as Area of Contamination (AOC) 69W.

ABB-ES will conduct RI and FS activities at AOC 69W in accordance with the plans and rationale presented in the Work Plan and in conformance to the methods, procedures, and requirements set forth in the Final Project Operations Plan (POP) prepared by ABB-ES for activities conducted at Fort Devens.

As proposed in the Work Plan, activities will be performed to establish the nature and extent of contamination at the site, to evaluate potential risks to humans and the environment presented by the contaminants, and to develop and evaluate remedial alternatives to eliminate or reduce those hazards to acceptable levels.

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The following specific activities will be conducted at AOC 69W as integral parts of the RI/FS:

- **Background Historical Research** - as a means to further understand and better characterize the contaminant release scenarios, former ownership, and past operational history at AOC 69W;
- **A Geophysical Survey** - to rapidly gather AOC-wide, non-intrusive data on subsurface features. The proposed survey will focus on identifying the location of an underground storage tank allegedly located in the school courtyard, and other subsurface utilities. The geophysical survey results will also provide information on subsurface geology to aid in the placement of soil borings and monitoring wells;
- **TerraProbe Investigation** -to rapidly obtain data on the lateral and vertical distribution of subsurface soil contaminants and groundwater quality;
- **Installation of 2 Piezometers and 4 Groundwater Monitoring Wells** - as a means to gather information on the distribution of dissolved phases of contaminants, monitoring possible free-phase product thicknesses, and characterization of aquifer hydraulic properties;
- **Collection and Analysis of Soil, Groundwater, Surface Water, and Sediment Samples** - including both field and laboratory analysis, to provide information necessary to evaluate contaminant distribution, assess potential risks to human health and the environment, and develop and evaluate remedial alternatives. Toxicity tests will also be performed to assess effects contaminants might have on selected aquatic organisms;
- **An Ecological Survey and Wetlands Investigation** - to identify potential ecological receptors and exposure pathways in Willow Brook and its floodplain at AOC 69W;

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- Human Health and Ecological Risk Assessments - to evaluate both actual and potential human health and ecological risks associated with soil, groundwater, surface water, and sediment contamination;
- Treatability Study/Pilot Testing - to provide data to allow treatment alternatives to be more accurately evaluated in the FS, to reduce uncertainties associated with the cost and performance of a treatment technology, and to support the design of the selected remedial alternative;
- Determination of Applicable or Relevant and Appropriate Requirements - to aid in establishing clean-up objectives for media of concern, to determine whether site features such as wetlands or floodplains will restrict activities on site, and to determine if the type and concentration of contaminants will trigger certain regulations, such as those which restrict land disposal or those that apply to a specific type of compound;
- Remedial Alternatives Development/Screening - as a key part of the FS, to develop a range of reasonable remedial alternatives which can be subjected to a detailed evaluation; and
- Detailed Analysis of Alternatives - performed in the FS to provide decision-makers with information that will assist them in selecting the best alternative for remediation of the site.

A comprehensive report presenting the results of these activities will be prepared upon completion.

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ABB Environmental Services, Inc.

## 1.0 INTRODUCTION

Base Realignment and Closure Environmental Evaluation (BRAC EEs) Reports and Supplemental Site Evaluations were conducted in 1993 and 1994 at five areas requiring environmental evaluation (AREEs) at Fort Devens. These AREEs included collective, site-wide evaluations of facilities within the installation that currently, or historically, known or suspected of being the source of the release of contaminants that may pose a threat to human health or the environment.

Ten AREE 69 (Past Spill Sites) on the North and Main Posts were identified for supplemental investigation in the October, 1993 "Draft Past Spill Sites" report. A work plan entitled "Work Plan - Past Spill Sites (AREE 69)" issued in February, 1994, discussed the objectives and the recommended approach of the supplemental site evaluations. Field investigation efforts were conducted during the spring and summer of 1994.

The presence of contamination in the area around an existing underground storage tank and evidence of its migration in groundwater at AREE 69W (Fort Devens Elementary School Past Spill Site) lead to a recommendation for further investigations.

Based on the preliminary findings at AREE 69W, it was recommended that a Remedial Investigation Feasibility Study (RI/FS) be performed. In this Draft Work Plan (Work Plan) and in all subsequent plans and reports, AREE 69W will be referred to as Area of Contamination (AOC) 69W.

ABB Environmental Services, Inc. (ABB-ES) has been tasked to conduct RI/FS activities at AOC 69W in accordance with the plans and rationale presented herein, and in conformance to the methods, procedures, and requirements set forth in the Project Operations Plan (POP) (ABB-ES, 1995) and all applicable U.S. Army Environmental Center (USAEC) guidelines.

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## **2.0 SITE BACKGROUND AND PHYSICAL SETTING**

### **2.1 SITE BACKGROUND**

AOC 69W is comprised of a parking lot and adjacent lawn, located on the northern side of the Fort Devens Elementary School (Building 215), extending approximately 250 feet northwest to Willow Brook (Figures 2-1 and 2-2). AOC 69W was first identified as an AREE due to a release of 400 gallons of No. 4 fuel oil that occurred at the existing underground storage tank (UST) located in the middle portion of the parking lot. The release occurred in April 1978 at the ground surface presumably from a ruptured fuel line and faulty interception system. The spill saturated the surrounding soil with No. 4 fuel oil, and may have migrated as far as Willow Brook.

Initial contaminant remedial actions involved pumping the UST dry, excavation of contaminated soil near the UST, and the product recovery in Willow Brook and adjacent to the UST. Supplemental investigations focused on determining whether residual soil and/or groundwater contamination remains at the AOC, and evaluating the need for additional contaminant removal.

The investigation involved sampling, field screening, and laboratory analysis of surface soil, subsurface soil, groundwater, surface water, and sediment, and a geophysical survey to locate subsurface utilities. The results of screening and laboratory analysis are summarized below. Locations of the exploration points are presented on Figure 2-2.

#### **2.1.1 Surface Soil**

Six surface soil samples were collected from a depth of 0 to 1 foot below ground surface (bgs), from the grassy area north and northwest of the parking lot (Figure 2-2). The samples were analyzed by portable field instruments for benzene, toluene, ethylbenzene and xylenes (BTEX) and total petroleum hydrocarbon compounds (TPHC), using gas chromatography (GC) and non-dispersive infrared spectroscopy (NDIR) techniques, respectively. The sample with the highest observed TPHC concentration was submitted for laboratory analysis of Project

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Analyte List (PAL) volatile organic compounds (VOCs), PAL semivolatile organic compounds (SVOCs), TPHC, PAL inorganics, and total organic carbon (TOC).

TPHC field screening concentrations ranged from 9.5 parts per million (ppm) to a high of 131 ppm (observed at location HA-5, located just off the northwest corner of the paved area). No BTEX was detected in the screening results. Laboratory results from the single surface soil sample submitted for laboratory analysis revealed no compounds at concentrations exceeding Massachusetts Contingency Plan (MCP) Method 1, S-1/GW-1 Standards. Carcinogenic polycyclic aromatic hydrocarbons (cPAHs) detected in the surface soils at the site consisted of benzo(a)anthracene and chrysene at a combined concentration of 0.29  $\mu\text{g/g}$ .

### 2.1.2 Subsurface Soil

Subsurface soil samples were collected during the installation of groundwater monitoring wells and during the Geoprobe investigations. During the first round of Geoprobe sampling, subsurface samples were collected from 0 to 2 and 3 to 5 feet bgs at 16 locations (Figure 2-2) for field analysis of TPHC and BTEX. Of the 32 samples analyzed in the field, three samples exhibiting the highest TPHC concentrations and one sample with the lowest TPHC concentration were submitted for laboratory analysis of PAL VOC, PAL SVOCs, TPHC, PAL inorganics and TOC analysis. During the second Geoprobe sampling round, nine additional locations were investigated (Figure 2-2). Subsurface soil samples were collected from a depth of 3 to 5 feet bgs and field screened for TPHC.

Subsurface soil samples were collected at depth intervals of 0 to 2 feet, 2 to 4 feet, and 11 to 13 feet bgs during the monitoring well installation effort. These samples were screened in the field for TPHC and BTEX. The samples from the 2 to 4 and 4 to 6 foot depth intervals were submitted for laboratory analysis of TPHC, PAL VOCs, PAL SVOCs, PAL inorganics, and TOC analysis.

TPHC concentrations in soils collected with the Geoprobe and from monitoring well soil borings ranged from 7.5 ppm to 15,500 ppm. Concentrations of benzo(b)fluoranthene, benzo(a)anthracene, and chrysene detected in Geoprobe soils were above MCP Method 1, S-1/GW-1 standards. Concentrations of chloroform, 2-methyl naphthalene, benzo(b)fluoranthene, chrysene, and

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naphthalene were detected in the monitoring well soil borings above the MCP Method 1, S-2/GW-1 standards.

Based on the field screening and laboratory analysis results, TPHC and cPAH soil contamination appears to be concentrated in the area of the existing UST (the presumed source area), and may have migrated downgradient towards Willow Brook.

### **2.1.3 Groundwater**

Groundwater samples were collected from each Geoprobe location and of the six newly installed groundwater monitoring wells. Sixteen groundwater samples were collected during the first Geoprobe sampling round and field screened for TPHC and BTEX. Filtered and non-filtered groundwater samples collected during the second Geoprobe sampling round were field screened for TPHC.

Field screening results from the 25 Geoprobe groundwater samples indicated that TPHC was present in groundwater. BTEX was not detected. Five sample locations from the first Geoprobe sampling round exhibiting the highest field screening TPHC concentrations were resampled and submitted to the laboratory for analysis of PAL VOCs, PAL SVOCs, TPHC and water quality parameters. No samples from the second geoprobe sampling round were sent for laboratory analysis. Results indicated that TPHC, inorganic analytes (arsenic, lead, antimony, beryllium, chromium, and nickel), and organic compounds (1,1-dichloroethene, benzene, carbon tetrachloride, chloroform, tetrachloroethene, trichloroethene, 2-methyl naphthalene and naphthalene) were detected at concentrations exceeding MCP Method 1 GW-1 Standards. Most of these exceedances occurred at locations GP-1, GP-2, GP-6 and GP-15, located in the area of the UST and downgradient of this location. No cPAHs were detected in the Geoprobe groundwater samples.

Six monitoring wells installed at the site confirmed the results of the Geoprobe investigation. Groundwater samples were submitted for analysis of TPHC, PAL VOCs, PAL SVOCs, unfiltered inorganics and water quality parameters. Results indicated that TPHC, arsenic, beryllium, cadmium, chromium, lead, nickel, 2-methyl naphthalene, acenaphthene, and naphthalene were detected at concentrations exceeding MCP Method 1 GW-1 Standards. These exceedances

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occurred at monitoring wells 69W-94-10, 69W-94-11, 69W-94-13 and 69W-94-14. No cPAHs were detected in the groundwater samples.

Groundwater sample results indicate that the area around the UST has the greatest number of most compounds exceeding MCP Standards. Groundwater northwest of the UST was also found to have elevated concentrations of inorganics and TPHC, suggesting that contaminants have potentially migrated downgradient of the UST location.

### 2.1.4 Surface Water and Sediment

Surface water samples were collected from two surface water and sediment samples in Willow Brook (Figure 2-2). One sample location (69W-94-16) was placed in line with the inferred plume migration pathway indicated by the Geoprobe survey, and the other (69W-94-15) was placed upstream of this area. Samples were analyzed for TPHC, PAL VOCs, PAL SVOCs, unfiltered inorganics, and water quality parameters.

The results indicated the presence of cPAHs in both sediment samples, and TPHC in sample 69W-94-16. Specifically, the cPAHs benzo(a)anthracene, chrysene, benzo(b)fluoranthene, and benzo(k)fluoranthene were detected in the 69W-94-15 (upstream) sediment sample. In sediment sample 69W-94-16, TPHC, benzo(a)anthracene and chrysene were detected. Total cPAHs in the upstream sample barely exceeded the clean-up goal of 7.0 ppm total cPAHs being used at AOCs 44 & 52. Total cPAHs in the downstream were an order of magnitude less than the clean-up. Other PAHs and metals were detected in both samples.

TPHC and cPAHs were not detected in surface water samples.

## 2.2 PHYSICAL SETTING

The following subsections describe the physical setting of AOC 69W.

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### 2.2.1 Soil

Unconsolidated surficial deposits of glacial and postglacial origin comprise nearly all of the exposed geologic materials at Fort Devens. The glacial units consist of till, deltaic deposits of glacial Lake Nashua, and deposits of glacial meltwater streams. Based on the regional soils map for Fort Devens, the soils at AOC 69W were mapped by the Soil Conservation Service and have been classified as the Hinckley-Merrimack (Freetown)- Windsor (HMW) soil association.

Subsurface soil encountered at AOC 69W during earlier investigations consisted of a dark yellowish-brown fine to coarse sand, with some fine to medium gravel and a little sandy silt with organic material.

### 2.2.2 Bedrock

No rock core samples were collected during the earlier AREE field investigation program. Based on regional bedrock maps, the bedrock in this portion of the installation is likely part of the Oakdale Formation, which consists of metasilstone and phyllite.

### 2.2.3 Hydrogeologic Conditions

Limited information regarding hydrogeologic conditions at AOC 69W was determined during the previous investigation. The previous investigation did determine the following:

- the static water table was measured at 4.8 feet bgs at 69W-94-10, 3.25 feet bgs at 69W-94-11, and 5.28 feet bgs in 69W-94-13, and
- the inferred groundwater flow appears to be to the northwest toward Willow Brook.

Hydraulic conductivity test were not conducted during the previous investigation.

Water in Willow Brook flows generally north, approximately 3,500 feet to Nonacoicus Brook, and thence to the Nashua River. Fort Devens is in the Nashua River drainage basin, and the Nashua River is the eventual discharge

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locus for all surface water and groundwater flow at the installation. The water of the Nashua River has been assigned to Class B. Class B surface water is "designated for the uses of protection and propagation of fish, other aquatic life and wildlife, and for primary and secondary contact recreation" (314 CMR 4.03).

Groundwater in the surficial aquifer at Fort Devens is Class I. Class I consists of groundwaters which are "found in the saturated zone of unconsolidated deposits or consolidated rock and bedrock, and are designated as a source of potable water supply" (314 CMR 6.03). Subsection 2.2.8 of the Group 2, 7 and Historic Gas Station Final SI Report presents a discussion of the regional hydrogeology for Fort Devens (ABB-ES, 1993a).

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### **3.0 INITIAL EVALUATION**

#### **3.1 TYPES AND VOLUMES OF WASTE**

Based on the results of the previous investigations, the primary site-related contaminants at AOC 69W are fuel-related contaminants in soil, groundwater and sediment. TPHC and PAL SVOCs were detected in surface and subsurface soil samples collected during the previous investigation. TPHC, inorganics, PAL VOCs and PAL SVOCs were detected in groundwater at concentrations exceeding MCP Method 1/GW-1 standards. Soil and groundwater contamination appears to be concentrated in the area of the UST. TPHC and cPAHs were detected in sediment samples collected from Willow Brook, across-gradient and downgradient of the UST location.

Figure 3-1 presents a site conceptual model flow chart showing the potential source and transport mechanisms for the contaminants detected at AOC 69W. Based on the results of the previous investigation, it appears that the fuel oil spill, which resulted from ruptured fuel lines and a faulty interception system, was the primary source of soil and groundwater contamination.

The primary release mechanism was the 1978 spill from the fuel oil UST and associated piping. A potential secondary source of groundwater contamination is the contaminated soil at the location of the UST. It appears that contaminants released to the soil have migrated to the groundwater table and possibly to Willow Brook. Secondary release mechanisms appear to be surface water infiltration and/or percolation through the subsurface soil and to the water table, and runoff to Willow Brook. Also, if the contaminated soil was excavated there could be a release of contaminants into the air in the form of dust. The migration pathways/transport mechanisms appear to be groundwater flow of dissolved contaminants, sediment transport with surface water flow in Willow Brook, and wind for contaminants adhering to soil.

AOC 69W is located on the Main Post of Fort Devens, near the former Fort Devens Elementary School. In the Devens Reuse Plan (Vanassee Hangen Brustlin, Inc., 1994), the future uses of the site are designated as "Gateway" and "Open Space and Recreation". Potential uses of the "Gateway" portion include Job

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## SECTION 3

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Corps, Education, and Administration. The "Open Space and Recreation" portion includes the area adjacent to Willow Brook. Potential exposure routes for the fuel-related contaminants to on-post personnel and terrestrial receptors appear to be via ingestion and direct contact. Exposure routes for groundwater, assuming that drinking water wells are installed at the site in the future, would be via ingestion, inhalation, and direct contact. Both area residents and on-post personnel could be exposed to contaminated subsurface soil dust via inhalation, if the site is disturbed (e.g. construction activities). Aquatic receptors in Willow Brook could be exposed to contaminants in sediment via ingestion and direct contact.

### 3.2 PRELIMINARY IDENTIFICATION OF OPERABLE UNITS

The National Contingency Plan (NCP) (U.S. Environmental Protection Agency [USEPA], 1990) and the Federal Facility Agreement (Interagency Agreement [IAG]), (USEPA, 1991a) define an operable unit (OU) as a discrete response action that comprises an incremental step towards comprehensively addressing site contamination. The site may be divided into one or more OUs at any phase of the response action, depending on the type and complexity of contamination associated with the site. Based on the conceptual model detailed in Subsection 3.1, the primary source of contaminants identified at AOC 69W is the historical release of fuel oil to the subsurface soil. This source has contaminated subsurface soil and groundwater, and may have impacted Willow Brook. Both subsurface soil and groundwater contain contaminants at concentrations exceeding applicable MCP Method 1 standards. Alternatives selected for remediation of the site are likely to entail combinations of technologies to address the soil and groundwater contamination. It is currently proposed that AOC 69W be handled as one OU. If the RI field results indicate that widespread or complex soil and groundwater contamination exists, or contamination in Willow Brook can be directly attributable to AOC 69W, multiple OUs may be appropriate.

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### **3.3 PRELIMINARY IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES AND ALTERNATIVES**

As part of the project planning phase and development of the work plan, preliminary remedial action objectives and a preliminary range of remedial action technologies have been developed for AOC 69W. The identification of technologies for development of potential alternatives at this stage is not intended to be a detailed investigation, but is intended to be a more general classification of potential remedial actions based upon the initially identified potential routes of exposure and associated receptors. Identification of potential technologies is made at this time in the process to help ensure that data needed to evaluate them can be collected during the RI or as early as possible from treatability studies. A detailed investigation of alternatives will be performed during the FS (see Sections 5.10 and 5.11) based on data collected during the RI. Figure 3-2 depicts the preliminary remedial action objectives, general response actions and remedial action technologies under consideration for alternative development at AOC 69W.

#### **3.3.1 Remedial Action Objectives**

Preliminary remedial action objectives were identified for each contaminated medium based on existing site information and the conceptual model. Remedial action objectives consist of medium-specific goals to protect public health and the environment based on the Applicable or Relevant and Appropriate Requirements (ARARs), the risk assessment goals, and technology based cleanup goals. The chemical specific standards/guidelines (e.g., Massachusetts Contingency Plan Method 1 soil and groundwater standards) identified for screening purposes in the Supplemental Site Evaluation were used in developing the preliminary remedial action objectives identified in Figure 3-2.

Two of the four objectives identified for AOC 69W are for the contaminated groundwater. In the Supplemental Site Evaluation, TPHC, arsenic, lead, antimony, beryllium, chromium, nickel, 1,1-dichloroethene, benzene, carbon tetrachloride, chloroform, tetrachloroethene, trichloroethene, 2-methyl naphthalene, and naphthalene were detected at concentrations in groundwater exceeding MCP Method 1 GW-1 Standards. The identified objectives are to prevent direct exposure to the groundwater and to prevent migration of the contaminated groundwater from the source.

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The two other objectives are for surface and subsurface soils and sediments at the site. In the Supplemental Site Evaluation, TPHC in surface soil may pose a potential risk to human health and the environment. In subsurface soils, TPHC, chloroform, benzo (a) anthracene, benzo (b) fluoranthene, chrysene, 2-methyl naphthalene, naphthalene, and thallium may pose a potential risk to human health. Although not yet attributed to AOC 69W, contaminants present in sediments in Willow Brook may present a hazard to aquatic organisms. Subsurface soils around the existing gasoline tanks warrant investigation as a potential source of contaminants in the groundwater. The identified remedial action objectives for the soil are to prevent direct exposure to subsurface soils and to prevent contaminant migration to groundwater. These preliminary remedial action objectives will be reviewed and refined during the RI/FS process when RI results are obtained and as ARARs are identified.

### 3.3.2 General Response Actions

Following identification of preliminary remedial action objectives, potential general response actions were developed. General response actions are general purpose statements describing probable remediation activities at a given site to meet remedial action objectives. The general response actions identified in this work plan have been based upon current understanding of the site and preliminary remedial action objectives. Groundwater general response actions identified for AOC 69W consist of:

- no action
- limited action
- containment
- collection
- treatment
- discharge/disposal

Soil and sediment general response actions consist of:

- no action
- removal
- treatment
- disposal

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### 3.3.3 Potential Remedial Technologies and Alternatives

The potential technologies which are most likely to satisfy the general response actions were preliminarily identified from review of documented information and data on technologies, including USEPA-published reports and vendor information. Technologies were assessed considering probable effectiveness and implementability with regard to site-specific conditions, known and suspected contaminants, and affected media. Remedial technologies identified for the contaminated groundwater at AOC 69W consist of:

- no action;
- institutional controls such as zoning and implementing deed restrictions, and/or performing groundwater monitoring;
- installing hydraulic barriers (e.g., slurry wall, grout curtain, sheet piling) to contain the groundwater;
- using interceptor trenches or extraction wells to collect contaminated groundwater.

Treatment technologies include physical/chemical or biological treatment in the form of:

- aeration;
- air stripping;
- oil/water separation;
- activated carbon;
- UV oxidation;
- chemical oxidation;
- air sparging;

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- in-situ bioremediation;
- treatment at the Fort Devens Wastewater Treatment Plant (WWTP) (currently consists only of primary treatment) or treatment at a local publicly-owned treatment works (POTW).

Disposal technologies consist of discharging treated water to groundwater, the Fort Devens WWTP, or local POTW.

Alternatives developed from these technologies will depend upon the results of the RI (also see Subsection 3.2, Preliminary Identification of Operable Units). If possible, the alternatives developed for screening will encompass a range or combination of the technologies in which treatment is used to reduce the toxicity, mobility, or volume of the contaminants, but will vary in the degree to which long-term management of residuals or untreated waste is required; one or more alternatives involving containment with little or no treatment; and a no-action alternative. Alternatives that involve limited and discrete efforts to reduce potential exposures (e.g., deed restrictions) will be presented as "limited action" alternatives.

The potential remedial technologies selected for the soils and sediments at AOC 69W include no action and various treatment technologies. Treatment technologies identified for soil include in-situ technologies such as soil vapor extraction and bioventing, and treatment technologies for excavated soil and sediments including thermal desorption, asphalt batching, and incineration. Bioventing is included as an innovative technology for treatment of TPHC which is not as readily treated using only soil vapor extraction. The presence of non-VOC contaminants (e.g., higher molecular weight hydrocarbons) may minimize the potential effectiveness of soil vapor extraction. Asphalt batching is a proven technology and has been successfully used at Fort Devens for petroleum contaminated soils, and may be able to be used as sub-base for road or parking lot construction. Soil and sediment meeting regulatory levels (before or after treatment) may be landfilled at an on-site or off-site, lined landfill.

Potential remedial alternatives for AOC 69W may consist of excavation and treatment technologies for soil and sediment contamination, with groundwater extraction and treatment. If an in-situ treatment technology (e.g., bioventing) is

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considered, the groundwater table may need to be lowered by pumping to allow for air flow through the source area. Based on the results of the RI, a treatability test for soil vapor extraction/bioventing may be recommended to determine the permeability of the soil and treatability of the petroleum source.

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#### 4.0 WORK PLAN RATIONALE

The extent of soil, sediment, and groundwater contamination observed during the previous investigation has necessitated the need for an RI/FS to provide more complete characterization of contamination at AOC 69W. The objectives of this RI/FS focus on expanding the characterization of contaminant distribution in soil, groundwater, and surface water and sediment, along with a more detailed evaluation of past contaminant sources and migration. Coupled with these, the RI/FS will provide a detailed assessment of human health and environmental risk which will be used as a basis for establishing clean-up goals, and ultimately an evaluation of alternatives for site remediation.

A discussion of the individual proposed RI/FS activities and data quality objectives to be used in pursuit of these objectives is presented below.

#### 4.1 RI/FS ACTIVITIES

The following specific activities will be conducted at AOC 69W as integral parts of the RI/FS:

1. background historical research
2. TerraProbe survey
3. evaluate vadose zone soil conditions adjacent to the existing UST
4. further characterize groundwater flow in the area around the existing UST, and in areas of known soil and groundwater contamination
5. better define the lateral and vertical distribution of subsurface soil and groundwater contamination
6. evaluate upgradient/upstream water quality and downgradient receptors

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7. evaluate contaminant impacts to human health and ecological receptors
8. evaluate and recommend alternatives for site remediation
9. produce final decision documents regarding remedial action at this AOC

### **4.1.1 Background Research**

Background research will be conducted to obtain information regarding the history of USTs at AOC 69W, and to better characterize the history of releases in the area of AOC 69W. Details of the background research activities are presented in Subsection 5.3.1. The results of this research effort will guide the selection of sampling locations and laboratory analysis.

### **4.1.2 Geophysical Survey**

After conducting the historical research and prior to exploratory work, a geophysical survey will be conducted at AOC 69W to rapidly gather AOC-wide, non-intrusive data on subsurface features. The proposed survey will focus on identifying the location of potential subsurface utilities, such as the underground storage tank alleged to be situated in the school courtyard, and pipelines. The geophysical survey results will also provide information on subsurface geology to aid in the placement of soil borings and monitoring wells.

### **4.1.3 TerraProbe Survey**

The TerraProbe (same technology as the Geoprobe) investigation will allow a determination of the lateral and vertical distribution of subsurface soil and groundwater contamination at AOC 69W. This will be accomplished through the collection of subsurface soil and groundwater samples for field screening and laboratory analysis, in the area around the UST. The TerraProbe will allow many locations to be investigated in a short period of time, and in a minimally intrusive manner. Results gathered from the TerraProbe survey will also aid in the design of a remedial alternative. The details of the TerraProbe investigation are presented in Subsection 5.3.2.

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#### **4.1.4 Piezometers and Surface Water Measurement Stations**

Piezometers and surface water measurement stations will be installed to determine vertical hydraulic gradients in the area of AOC 69W and Willow Brook. These points will be installed so that the screens intercept the water table, to allow for seasonal fluctuations. Piezometers and surface water elevation measurement stations will be used to establish water table elevations and predict groundwater flow conditions and directions and hydrologic dynamics of Willow Brook. Information from these measurement points will aid in the development and evaluation of remedial alternatives in the FS process.

#### **4.1.5 Monitoring Wells**

Evidence collected during the previous investigation at AOC 69W revealed the presence of contaminants in groundwater near and downgradient of the UST. Characterizing the nature and potential groundwater flow and contamination in the area around 69W is of critical importance to defining potential receptors. The installation of additional groundwater monitoring wells (and piezometers) at AOC 69W will provide information on the distribution of dissolved phases of contaminants, monitoring possible free-phase product thicknesses, and characterization of aquifer hydraulic properties, all of which are important to the development of remedial alternatives in the FS process.

Wells will be installed in locations selected to provide representative samples from upgradient and downgradient groundwater. Piezometers will be located to evaluate the hydraulic dynamics between groundwater and Willow Brook as part of the assessment of potential downgradient receptors.

#### **4.1.6 Sample Analysis**

Petroleum hydrocarbons appear to be the predominant contaminants present in soil, groundwater, and sediment collected at AOC 69W. Elevated concentrations of chlorinated contaminants have also been identified. Soil, groundwater, surface water, and sediment samples collected from selected locations within soil borings, monitoring wells, and Willow Brook will be analyzed for analytes likely to be present. Chemical analyses performed during the RI will include various field screening techniques designed to provide a preliminary evaluation of contaminant

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distribution. Sample analysis will also include laboratory analysis designed to provide a higher level of accuracy in evaluating contaminant distribution, as input to the human health and ecological risk assessments, and remedial alternatives development. The field and laboratory analytical program will enhance and build upon efforts begun under previous investigations at the site.

Toxicity testing will also be conducted on selected whole sediment samples collected from the wetland adjacent to AOC 69W. The test results will be used to evaluate adverse effects associated with exposure of selected freshwater invertebrate species to sediment, sediment elutriate, and surface water. These results will be used to supplement the chemical data used in the ecological risk assessment, ultimately to define clean-up goals for AOC 69W sediment.

### **4.1.7 Ecological Survey and Wetlands Investigation**

A qualitative ecological survey will be conducted to identify potential ecological receptors and exposure pathways in Willow Brook and its floodplain at AOC 69W. Information from the qualitative survey will be incorporated into the baseline ecological risk assessment. The results of the survey will provide information necessary for evaluating and developing cost estimates for remedial alternatives.

### **4.1.8 Baseline Risk Assessment**

A baseline risk assessment, in accordance with EPA risk assessment guidelines, will be conducted at AOC 69W to evaluate both actual and potential human health and ecological risks associated with soil, groundwater, surface water, and sediment contamination. The components of the two risk assessments will include the following: data summarization and selection of chemicals of potential concern (COPCs); hazard assessment; ecological characterization; exposure assessments; ecological effects assessment; toxicity assessment; risk characterizations; comparison of analytical data to health standards and guidelines; and qualitative uncertainty analyses.

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#### **4.1.9 Treatability Study/Pilot Testing**

Treatability studies are typically conducted to provide data to allow treatment alternatives to be more accurately evaluated in the FS, to reduce uncertainties associated with the cost and performance of a treatment technology, and to support the design of the selected remedial alternative (USEPA, 1988). Treatability studies may not be necessary for well-developed technologies that have been proven to be effective at other, similar sites or for similar contaminants.

The need for treatability studies has not been identified for soil and groundwater at AOC 69W at this time. However, as the RI field effort proceeds, certain other physical and chemical data may need to be collected to aid in evaluating remedial technologies. These additional data would be used in evaluating the effectiveness of various treatment technologies; data such as soil gradation, TOC content, and moisture content may be performed on selected soil samples in order to evaluate the potential effectiveness of soil treatment technologies such as soil vapor extraction or thermal desorption. Groundwater pumping tests could, for example, be used to establish the design parameters for groundwater extraction technologies; and specific water quality parameters could be used to evaluate the effectiveness of water treatment technologies.

#### **4.1.10 Applicable or Relevant and Appropriate Requirements**

CERCLA requires that Superfund remedial actions meet any federal and state standards, criteria, or requirements that are determined to be Applicable or Relevant and Appropriate Requirements (ARARs). Chemical-specific and location-specific ARARs can be identified during the RI as the chemical and physical site conditions are characterized. Action-specific ARARs are typically identified during the FS based on the remedial actions being evaluated. ARARs are considered during the RI/FS process to aid in establishing clean-up objectives for media of concern, to determine whether site features such as wetlands or floodplain will restrict activities on site, and to determine if the type and concentration of contaminants will trigger certain regulations, such as those which restrict land disposal or those that apply to a specific type of compound. Compliance with ARARs is a criterion which must be met for an alternative to be selected as the remedial action.

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### **4.1.11 Remedial Alternatives Development/Screening**

A range of remedial alternatives are developed in the FS by assembling combinations of technologies to address the response objectives (see Section 3.0). The range of alternatives should include no action, actions that reduce contaminant migration or minimize exposure, and treatment alternatives that address the principal threats and eliminate or minimize the need for long-term management. These alternatives will then be screened using effectiveness, implementability, and cost criteria to limit the number of alternatives to be evaluated in detail, while still preserving the range of options.

### **4.1.12 Detailed Analysis of Alternatives**

A limited number of alternatives remaining after the screening process will be evaluated based on seven of the nine CERCLA criteria in the FS. The criteria of state and community acceptance will be evaluated upon receipt of state and public comments. Each alternative is evaluated individually, and then the alternatives are compared against each other to provide decision-makers with information that will assist them in selecting the best alternative for remediation of the site.

## **4.2 DATA QUALITY OBJECTIVES**

The procedures of the Quality Assurance (QA) Objectives presented in Section 3.0 of Volume I of the Fort Devens POP will be followed during the RI/FS field program at AOC 69W (ABB-ES, 1995). This subsection describes a general scope of work, data quality objectives (DQOs) and the QA/QC approach.

Analyses will be conducted on samples collected from AOC 69W to evaluate the nature and distribution of the contaminants detected in the previous investigation. On-site field analysis will conform with the guidelines presented in Subsection 4.6 of Volume I of the Fort Devens POP. Off-site laboratory analytical procedures are presented Section 7.0 of Volume I of the POP, and the Laboratory QA Plan and the USAEC Performance Demonstrated Analytical Methods procedures are presented in Appendices B and C, respectively, in Volume II of the Fort Devens POP (ABB-ES, 1995).

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The USEPA has recently identified two general levels of analytical data quality, which replace the former five general levels. One of the levels, Screening with Definitive Confirmation, generally comprises field screening and analysis, and encompasses former USEPA 1987 DQO Levels I and II. Activities conducted under the AOC 69W RI which fall into this category include basic field measurements for pH, conductivity, temperature, dissolved oxygen, turbidity, and photoionization detector (PID) measurements, as well as any on-site analyses. The other general level of data quality, Definitive Data, generally comprises laboratory analysis using CLP RAS or other published USEPA methods, and includes former USEPA 1987 DQO Levels III, IV, and V. Laboratory methods which have been performance-demonstrated under procedures outlined in the USATHAMA QA Plan (USATHAMA, 1990) fall into this level. This level includes off-site water quality parameter and other parameters where USAEC guidelines are not applicable, and off-site laboratory analyses for PAL organics and inorganics. The specific data requirements and analytical parameters for proposed samples at AOC 69W are outlined in Section 5.0 of this Draft Work Plan.

All data collected during the RI/FS process (both chemical and geotechnical data) will be entered and stored in USAEC's Installation Restoration Data Management Information System (IRDMIS). The subcontract analytical laboratory will be responsible for entering all laboratory chemical data as USAEC Level II data, and ABB-ES will be responsible for all geotechnical data. The USAEC will be responsible for reviewing and qualifying the USAEC Level II data submitted by the subcontract laboratory, and elevating the chemical data to USAEC Level III data. At that point the chemical data will be at it's highest data quality and will be available for use in the IRDMIS. USAEC Level III and appropriate data will be used in the RI/FS Report.

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## 5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY TASKS

### 5.1 PROJECT PLANNING

The planning and scoping of the RI/FS program at AOC 69W was conducted in accordance with the USEPA guidance document "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (USEPA, 1988).

### 5.2 COMMUNITY RELATIONS

For this task ABB-ES will assist the U.S. Army in conducting communication activities relating to AOC 69W as outlined in the IAG (USEPA, 1991) and existing Community Relations Plan (CRP) (E&E, 1992, as revised) for Fort Devens.

The IAG stipulates that community relations be compliant with all USEPA public participation requirements specified by CERCLA and the NCP; a Community Relations Plan be developed; a public repository be established; an Administrative Record be established at two locations and the Administrative Record be updated and supplied to the USEPA.

The activities proposed in the CRP are designed to inform interested citizens and local officials about the progress of remedial activities, and to provide opportunities for the public to be involved in planning remedial actions at the AOC. Specific community relation activities ABB-ES will participate in will include:

- attending Restoration Advisory Board (RAB) meetings pertaining to AOC 69W;
- preparing fact sheets to inform the public of the use of USEPA presumptive remedies (if applicable) as potential remedial alternatives, and of the proposed plan and public comment period;
- updating the Administrative Record;

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- attending a public informational meeting at the onset of the public comment period that provides an informal question and answer session about the proposed plan for remediating AOC 69W; and
- attending a formal public hearing during the public comment period that provides opportunity for the public to submit oral or written comments on the proposed plan for remediating AOC 69W. All comments received will be transcribed and responded to in the Responsiveness Summary.

### **5.3 FIELD INVESTIGATION ACTIVITIES**

All field activities will be conducted in accordance with the procedures set forth in the Fort Devens POP and USAEC's Geotechnical Guidelines (USAEC, 1987). The following subsections describe the proposed field activities to be conducted during the RI/FS at AOC 69W, based on the objectives and rationale outlined in Section 4.0.

#### **5.3.1 Background Research**

Background research at AOC 69W will involve an extensive search of historical records and other sources of information to include interviews with pertinent individuals knowledgeable in the past ownership, operatorship, and use of AOC 69W, photograph interpretation and literature searches. The objective of the research will be to discover and define contaminant release mechanisms, dates and locations of releases, and nature and volume of contaminants released.

Background research at AOC 69W will involve the following:

- interviews with pertinent individuals knowledgeable regarding the history of AOC 69W
- review of remedial response documentation
- further research into the history of the alleged underground fuel line break which caused the contaminant release

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- Determination of the individual(s) responsible for the USTs at the elementary school
- Research UST history at the AOC

Coordination for this effort shall be made through USAEC and the Fort Devens BRAC Environmental Coordinator (BEC) Office.

### **5.3.2 Surficial Geophysical Survey**

A surficial geophysical survey will be conducted in an attempt to locate an underground storage tank allegedly located in the elementary school courtyard, and to clear proposed exploration (TerraProbe, soil borings, etc.) locations for underground obstacles. Exploration locations and the courtyard will be investigated with ground penetrating radar (GPR). A magnetometer survey may be conducted in the courtyard if site conditions are appropriate. Information obtained during the courtyard survey may be used to direct subsequent field activities (i.e., TerraProbe locations, borings, monitoring well placement, etc.). The geophysical survey will be conducted in accordance with Subsection 4.4.3 of Volume I of the POP (ABB-ES, 1995).

### **5.3.3 TerraProbe Investigation**

The TerraProbe investigation will be conducted to further define the lateral and vertical distribution of contamination in the area around the UST. A maximum of 20 TerraProbe sampling locations will be completed, to a maximum depth of 12 feet bgs (see Figure 5-1). Subsurface soil samples will be collected from each location at depths of 4, 6, and 10 feet bgs (these depths may vary depending on the observed depth to groundwater at each location), for a total of 60 samples. Groundwater samples will also be collected from each TerraProbe location, for a total of 20 groundwater samples. Each subsurface soil and groundwater sample will be analyzed by portable field instruments for TPHC, BTEX, and selected PAL chlorinated VOCs (Table 5-1). The Terraprobe and field analytical procedures are presented in Subsections 4.4.5 & 4.6, of Volume I of the POP (ABB-ES, 1995).

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A total of 20 samples will be submitted for laboratory analyses of TPHC, PAL VOCs, PAL SVOCs, PAL inorganics, and grain-size. Samples will be selected from both future re-use areas ("Gateway" and "Open Space and Recreation") present at the site, and from both surface (0-1 foot) and sub-surface (1-15 feet) depths. The following table presents the proposed soil sampling plan:

|                      | GATEWAY | OPEN SPACE |
|----------------------|---------|------------|
| SURFACE (1 FT)       | 5       | 5          |
| SUBSURFACE (1-15 FT) | 5       | 5          |

The TerraProbe soil sample with the highest field screening concentration from each of the four area/depth locations will be submitted for laboratory analysis. The remaining samples from each area/depth location will be chosen randomly, in order that sample results used in the risk assessment are representative of site conditions. In conjunction with existing data and RI screening results, the laboratory analytical results to be developed from this program will be adequate to perform a meaningful human health risk assessment for foreseeable reuse scenarios, characterize distribution, identify areas requiring potential remediation, and develop remedial cost estimates during the feasibility study.

Sample volume requirements and/or low sample recovery may preclude the use of the TerraProbe for the collection of laboratory samples. If this occurs, samples will be collected by returning to each location with a drill rig, drilling to the desired depth(s), and collecting samples for confirmatory laboratory analysis using a two-foot long split spoon sampler.

### 5.3.4 Piezometer and Surface Water Measurement Stations

Two piezometers will be installed to a depth of 15 feet at AOC 69W, to determine the vertical hydraulic gradients in and around the wetlands associated with Willow Brook (see Figure 5-1). Piezometers will be installed as outlined in Subsection 4.4.6.7 of Volume I of the POP (ABB-ES, 1995). The only variation is that piezometers will be constructed of 1-inch inside diameter (ID) polyvinyl chloride (PVC) with a 2-foot long screened interval. Table 5-2 and Figure 5-1

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provide the rationale and proposed location for each new piezometer installed during the RI.

Two surface water measurement stations will also be installed coincident with the two piezometer locations. The surface water measurement stations will be installed in Willow Brook. These stations will be surveyed following installation.

### **5.3.5 Monitoring Well Installation and Sampling**

A total of four new monitoring wells will be installed at AOC 69W during the RI. Two wells will be positioned upgradient, and two wells will be positioned downgradient of the UST. Table 5-2 and Figure 5-1 provide the rationale and proposed location for each new monitoring well installed during the RI.

Soil borings in which the wells will be constructed will be advanced using hollow stem augers. Each new monitoring well will be constructed with the screen spanning the water table. During installation of one downgradient monitoring well, continuous split spoon soil samples will be collected to the bottom of the well. Each soil sample collected from this boring will be visually logged, and used as reference samples to classify the soil types and further characterize geologic conditions at AOC 69W.

A soil sample will be collected from each monitoring well boring immediately after penetration into the saturated zone. These soil samples will be submitted for laboratory analysis of TOC. The monitoring wells will be installed in accordance with Subsection 4.4.6 of Volume I of the POP (ABB-ES, 1995).

Each of the newly installed monitoring wells will be developed using the pump and surge method. Well development will be conducted to removed any water added to the boring during drilling and/or well installation, and to remove sediment from the bottom of the well screen. The procedures for well development are presented in Subsection 4.4.6.6 of Volume I of the POP (ABB-ES, 1995).

Two rounds of groundwater samples will be collected from the four new and six existing monitoring wells at AOC 69W. Prior to purging monitoring wells the depth to water will be measured with an oil-water interface probe to check for the

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existence of a free product layer. The groundwater sampling rounds will be collected at least 90 days apart. A total of 20 groundwater samples will be submitted for laboratory analysis of PAL VOCs, PAL SVOCs, PAL pesticides/polychlorinated biphenyls (PCBs), PAL inorganics (filtered and unfiltered), TPHC, total suspended solids (TSS), total dissolved solids (TDS), water quality parameters (alkalinity, hardness, pH, temperature, conductivity and dissolved oxygen) and anions and cations (see Table 5-3). Groundwater sampling procedures are presented in Subsection 4.5.2.2 of Volume I of the POP (ABB-ES, 1995).

After the completion of the first round of groundwater sampling, hydraulic conductivity tests will be performed on each of the newly installed monitoring wells to further define the hydraulic conductivity of the geologic units at AOC 69W. The procedures for conducting the hydraulic conductivity tests in soil and bedrock are presented in Subsection 4.8.2 of Volume I of the POP (ABB-ES, 1995). Hydraulic conductivity test data will be analyzed by the methods of Hvorslev (1951) and Bouwer and Rice (1976). When appropriate, the KGS model (Hyder and Butler, 1995) will be used in conjunction with the Bouwer and Rice method. The Bouwer and Rice method will also be used with respect to limitations outlined by Brown, Narasimhan, and Demir (1995).

All new and existing monitoring wells at AOC 69W will be included in the quarterly basewide synoptic water level measurement rounds as outlined in Section 4.8.1 of the Fort Devens POP (ABB-ES, 1995). The water level data will be used to construct groundwater potentiometric contour maps, determine groundwater flow direction, and calculate vertical and horizontal gradients.

### 5.3.6 Sediment and Surface Water Sampling

In order to characterize the nature of contaminant migration to Willow Brook, sediment and surface water samples will be collected from wetland areas near AOC 69W and from Willow Brook. Sediment samples will be collected from areas of deposition. At three locations, sediment samples will be collected from 0 to 1 foot and 2 to 4 feet, and at three other locations sediment samples will only be collected from 0 to 1 foot. The nine sediment samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics, TPHC, TOC, petroleum finger-printing and grain size.

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A surface water sample will be collected from each of the six sediment sampling locations. Surface water samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics, TPHC, and water quality parameters.

The procedures for conducting the surface water and sediment sampling, are presented in Subsection 4.5.2 of Volume I of the POP (ABB-ES, 1995).

In order to determine effects of contaminated sediments from AOC 69W on aquatic organisms, controlled whole sediment laboratory toxicity tests will also be conducted on sediment samples collected at AOC 69W. Although the results of the proposed sediment toxicity tests will be used to predict the effects that might occur to aquatic ecological receptors *in situ*, it is important to recognize that: (1) exposure to contaminated sediments might be avoided by motile organisms; and, (2) toxicity to organisms *in situ* may be dependent upon sediment physical characteristics and equilibrium partitioning that are not replicable under laboratory conditions (ASTM, 1993).

The objective of the proposed toxicity testing is to obtain laboratory data to evaluate adverse effects associated with exposure of the freshwater invertebrate species *Hyalloa azteca* (the amphipod) and *Chironomus tentans* (the chironomid midge) to whole sediment from AOC 69W.

Four short-term chronic toxicity tests for *Chironomus tentans* and *Hyalloa azteca* shall be conducted (with whole sediment samples and no dilutions) to provide a screening-level spatial distribution of sediment toxicity at AOC 69W. Sediment samples for toxicity testing will be collected from the 0 to 1-foot depth at these locations. The ASTM *Standard Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates* (E 1383; ASTM, 1993) and the draft USEPA *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates* (USEPA, 1994) will be used as the laboratory standard. Specific test protocols outlined in USEPA (1994) for the amphipod (10-day growth and survival) and the midge (10-day growth and survival) will be followed. Sediment samples for toxicity testing will be stored according to protocols established in the ASTM *Standard Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing* (E 1391-90; ASTM, 1993). Sediment samples for analytical chemistry analysis and toxicity testing will be conducted concurrently, allowing for evaluation of chemical and

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physical stressors in the baseline ecological risk assessment. The four toxicity testing sampling locations (3 plus one reference station) are shown in Figure 5-1.

Statistical analyses to assess the significance of any differences in survival and growth between the Willow Brook reference sample and/or negative control sediment sample and the AOC 69W whole sediment samples will be performed

### **5.3.7 Ecological Survey and Wetlands Investigation**

A qualitative ecological survey will be conducted to identify potential ecological receptors and exposure pathways at AOC 69W. Information from the qualitative survey will be incorporated into the baseline ecological risk assessment.

Ecological receptors in the vicinity of the AOC which potentially could be exposed to contaminated environmental media will be identified during the qualitative ecological survey. Possible site-specific exposure pathways through which ecological receptors could be exposed to contaminated media will be evaluated, and any observed gross signs and symptoms of stress on biological receptors at the site will be recorded. The qualitative ecological survey will help further define the proposed surface water and sediment sampling locations, and define sampling requirements for the toxicity testing at AOC 69W. This survey includes a literature review and a field reconnaissance program as described below.

A limited literature review will be conducted to evaluate the major floral and faunal receptors and ecological community types likely to be encountered in the vicinity of AOC 69W. Existing information sources related to flora, fauna, and ecological communities in the area will be reviewed, and standard taxonomic sources and references will be identified. Trustee agencies such as the U.S. Fish and Wildlife Service, the Massachusetts Division of Fish and Wildlife, Fort Devens Forestry Department, and the Massachusetts Natural Heritage Program will be contacted for information regarding state or federally listed endangered or threatened species. Historic information on the biota (e.g., fish) of Willow Brook will be retrieved from the Fort Devens Environmental Management Office.

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Following the information review, a limited field reconnaissance program will be initiated to characterize the aquatic, wetland, and terrestrial habitats at and in the vicinity of AOC 69W. The field program will identify and verify major vegetative cover types and dominant taxa at the site. This field program will involve a site walk-over by a wetland-aquatic specialist and an ecologist. Qualitative belt and/or line transect surveys of vegetative community types will be conducted; each identified cover type will be characterized through the use of a minimum of 2 transects. Observations of wildlife use of the site will be collected during the qualitative vegetative survey.

Ten minnow traps will be set for a 24-hour period in the brook channel and palustrine wetland to obtain baseline information on the forage fish community. In addition, the fish community will be qualitatively sampled with a small man-powered haul seine. No fishing shall occur without a valid Scientific Collection Permit from the Massachusetts Division of Fisheries and Wildlife.

All fish captured in the minnow traps and seines will be keyed to species. A subsample of fish collected will be weighed and measured; sample collection forms will be completed for these samples. Sample collection forms will include: the client; site name; Sample Identification Number; sampling location; species; number of animals per subsample; physical characteristics of the sampling station; length and weight of fish sampled; date and time; names of field personnel; and a checklist to record any observed gross physical abnormalities. Any grossly deformed specimens will be photographed, preserved, and retained in a voucher collection. In addition, voucher specimens of each species collected will be obtained, labeled, preserved, and archived. If necessary, duplicates of the voucher specimens will be sent to recognized experts in the field for taxonomic confirmation.

Limited habitat mapping will be completed at AOC 69W. Observed evidence of ecological stress in plant species, such as yellowing, wilting, or insect infestations, and animal species (disease, parasitism, death, and reduced diversity or abundance) will be noted. Any state or federally listed rare or endangered species identified during the survey will be documented.

The wetlands will be functionally assessed through the use of the Nashua-Hudson Circumferential Highway Method (Nashua-Hudson Circumferential Highway,

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1992). This technique has been recommended for use in New England by the New England Division Corps of Engineers (NEDCOE) as a rapid method to assess wetland functions and values. The Nashua-Hudson Circumferential Highway Method is designed to provide a descriptive wetland functional evaluation that includes hydrologic, cultural, and biological information regarding the wetland and its functions.

If required for the FS, wetland delineation at this study area will be conducted; any required delineations will be made in accordance with state and federal guidance. Wetlands will be identified and delineated pursuant to federal (Section 404 of the Clean Water Act) and state regulations (Massachusetts Wetlands Protection Act (M.G.L. c. 131, s.40) and Regulations (310 CMR 10.00)).

### **5.4 SAMPLE ANALYSIS AND DATA MANAGEMENT**

The analytical program for the RI/FS at AOC 69W is designed to identify the contaminants that are expected to be encountered. Based on the results of the previous investigation, a suite of contaminant types were identified at AOC 69W. The field screening and laboratory analyses selected for the RI are designed to provide useable data on the concentrations and distributions of the contaminants for use in both the risk assessments and feasibility study. The specific analyses proposed for each sample are itemized in the Sampling and Laboratory Analysis Schedule (Table 5-4). The procedures to be followed during the RI/FS for both field screening and laboratory analysis are presented in Section 7.0 of Volume I of the POP. The Laboratory QA Plan and the USAEC Performance Demonstrated Analytical Methods are presented in Appendices B and C of Volume III of the POP (ABB-ES, 1995).

With the volume of data being collected, a critical aspect to developing USAEC chemical and geotechnical data for this RI/FS will be to maintain strict compliance with the data management procedures set forth in Section 8.0 of Volume I of the POP.

Geotechnical and chemical data generated from the RI will be managed in accordance with the procedures set forth in Section 8.0 of Volume I of the POP.

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## 5.5 DATA EVALUATION

The data collected during the RI will be evaluated to determine whether it meets the RI DQOs. The evaluations for AOC 69W will be completed on the basis of verifying the nature and distribution of environmental contamination. The procedures for the data assessment are presented in Section 12.0 of Volume I of the POP.

ABB-ES will assess the presence, sources, and spacial distribution of contamination, as well as potential pathways of contaminant migration in the environment using data collected from the previous investigation and this RI.

## 5.6 RISK ASSESSMENT

A baseline risk assessment will be conducted at AOC 69W to evaluate the potential human health and ecological risks associated with site-related contamination in surface and subsurface soil, surface water, sediment, and groundwater.

### 5.6.1 Human Health Risk Assessment

The human health risk assessment will be performed to conform with the following USEPA guidance manuals and directives:

- *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part A)*, (RAGs) 1989b, Interim Final, December 1989.
- *Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part B), Development of Risk-based Preliminary Remediation Goals*, Interim, December 1991b.
- *Dermal Exposure Assessment Principles and Applications*, Interim, January 1992.

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- *Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions*, 1991c, OSWER Directive 9355.0-30, April 22, 1991.
- *Standard Default Exposure Factors: Human Health Evaluation Manual, Supplemental Guidance*, 1991d, OSWER Directive 9285.6-03, March 25, 1991.
- *Supplemental Risk Assessment Guidance for the Superfund Program*, 1989a Draft Final, USEPA Region I Risk Assessment Work Group, June 1989.
- *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons*, July 1993.

The components of the risk assessment will include the following: Data Summarization and Selection of Chemicals of Potential Concern (COPCs); Exposure Assessment; Toxicity Assessment; Risk Characterization; Comparison of Analytical Data to Health Standards and Guidelines; and Qualitative Uncertainty Analysis. A more detailed discussion of these components follows.

COPCs will be selected for inclusion in the risk assessment based on frequency of detection and, for inorganic analytes, comparison to Fort Devens background concentrations. If the maximum detected concentration is below the basewide background concentration, then it will be eliminated as a COPC. Essential nutrients (i.e., potassium, sodium, magnesium, calcium, and iron) will be considered for elimination if it can be documented that they are present at concentrations not associated with adverse effects. Any analytes attributable to laboratory contamination will not be included as COPCs. The reasons for eliminating any analytes will be documented in the risk assessment report.

In the Exposure Assessment, potential exposures under current land use conditions as well as possible future land use conditions will be evaluated. AOC 69W is currently a parking lot and lawn on the northern side of the now-closed Fort Devens Elementary School (Building 215). The site also extends to Willow Brook (250 feet to the northwest). In the Devens Reuse Plan (Vanassee Hangen Brustlin, Inc., 1994), the future use of the site is designated as "Gateway" and "Open Space and Recreation". Example uses include active and passive

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recreational facilities, conference center, cultural center, conservation land, or open space.

Based on the findings of the field investigation, exposure scenarios will be developed for the following human exposure pathways:

- Contact with subsurface soil during excavation. Soil at AOC 69W could be excavated in the future either for utility repair/installation or building construction. The receptor would be the individual involved in soil excavation. Exposure routes during excavation could include incidental ingestion of soil and inhalation of VOCs and dermal contact with soil. Following USEPA Region I policy, this route will not be evaluated quantitatively. The need to consider shallow groundwater as a potential exposure medium (to which a worker could come in contact) will be determined based on the results of the groundwater sampling program.
- Ingestion of groundwater from future water supply wells. Although not currently used, groundwater at the AOC could be used as a source of potable water. Workers at the site and nearby residents could be exposed to contaminated groundwater if a well was installed within the area of contamination. The Risk Assessment will therefore consider and evaluate a residential exposure for groundwater.
- Contact with surface soil during recreational or site maintenance activities. The fuel release at the site occurred at or near the ground surface. Potential receptors of surface soil contamination include future site occupants (for example, school children or building occupants) or transient site users (for example, recreational users). Exposure routes could include incidental ingestion of soil and inhalation of VOCs. Dermal contact with soil would also occur but, in the risk assessment, this route will not be evaluated quantitatively (following USEPA Region I policy).
- Contact with surface water and sediment in Willow Brook. Future site occupants (for example, school children) or transient site users

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(for example, recreational users) could be exposed to contamination in Willow Brook by wading, incidental ingestion of sediment, and dermal contact with surface water. As with soil, the dermal route for sediment will not be quantitatively evaluated. Because swimming is unlikely in the Brook, the incidental ingestion of surface water would not be expected.

- Depending on the lateral and vertical extent of contamination, another possible exposure pathway could be migration of VOCs in the shallow groundwater and soil gas into a building foundation. A UST reportedly located beneath the elementary school is being investigated as part of the RI. If groundwater and/or soil contamination has occurred due to a historical release from the UST, then this exposure pathway will need to be considered.

While dust could be generated during soil excavation, it is not considered to be as important as the release of VOCs in the subsurface soil. Therefore, the inhalation of soil dust that becomes airborne will be identified as a potential exposure pathway but will not be modeled in the risk assessment.

Under the anticipated site uses discussed above, extraction of groundwater beneath the AOC appears unlikely. However, for the risk assessment, we will assume that a well may be installed at the AOC for drinking water. The baseline risk assessment will identify this potential supply well and discuss future reliance on this well for drinking water.

While fishing in Willow Brook is possible, possible risks from the consumption of Willow Brook fish will not be evaluated in the risk assessment. Neither the VOCs nor PAHs associated with the release at AOC 69W would be expected to bioaccumulate in fish.

Following USEPA Region I guidance, the 95% upper confidence limit (UCL) on the arithmetic mean concentration will be coupled with central tendency and reasonable maximum exposure (RME) exposure parameter values to model the central tendency and RME soil, sediment and surface water exposure scenarios (USEPA, 1994). For groundwater, if evaluated for vapor migration, the average and maximum concentrations will be used to model the two exposure scenarios.

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(USEPA Region I guidance states that the use of the 95% UCL is not appropriate for evaluating groundwater exposures.)

To minimize comments, a Risk Assessment Approach Plan (RAAP) will be developed and a meeting will be held with representatives from the U.S. Army, USEPA, and MADEP to discuss these exposure pathways. The RAAP will be published and the meeting will be scheduled when work on the risk assessment begins.

In the Toxicity Assessment, brief toxicity profiles will be developed for the COPCs. These profiles will identify the toxic effects associated with exposure. Summary tables containing the dose/response data for the COPCs will also be included in the Toxicity Assessment. Dose/response data will be obtained from the USEPA Integrated Risk Information System (IRIS) database, Health Effects Assessment Summary Tables (HEAST), and readily available toxicity values developed by the USEPA Environmental Criteria and Assessment Office (ECAO).

The Risk Characterization will combine the exposure intakes from the Exposure Assessment with the toxicity values identified in the Toxicity Assessment to develop quantitative risk estimates (i.e., cancer risks and noncancer hazard indices) for the COPCs. Risk estimates will be developed for individual COPCs, for exposure pathways, and for receptors potentially exposed through more than one medium. If quantitative risk estimates cannot be generated for particular COPCs, their risks will be discussed in the Risk Characterization.

In addition to the quantitative risk evaluation, exposure point concentrations will be compared to federal and state health-based standards and guidelines. For example, a comparison of soil concentrations to MCP Method 1 soil standards (used only as guidelines) will be included.

An uncertainty analysis will follow the risk characterization discussed to identify important issues that affect the interpretation of the risk assessment findings. Uncertainties and limitations in the Toxicity and Exposure Assessments as well as in current risk assessment methodologies will be discussed.

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### 5.6.2 Baseline Ecological Risk Assessment

The purpose of the baseline ecological risk assessment at AOC 69W is to provide an evaluation of the actual and potential risks to ecological receptors posed by chemicals in environmental media at the site. The results of the AOC 69W Supplemental Site Evaluation (ADL, 1994) suggested that concentrations of TPHCs and several PAHs in AOC 69W surface soil and sediment may be elevated.

The approach used in this ecological evaluation will be consistent with the following guidance:

- Risk Assessment Guidance for Superfund Environmental Evaluation Manual (USEPA, 1989c);
- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference (USEPA, 1989a);
- Ecological Assessment of Superfund Sites: An Overview (USEPA, 1991a); and,
- Framework for Ecological Risk Assessment (USEPA, 1992).

Recent risk assessment guidance including the USEPA "Eco Update" bulletins and recent publications (e.g., Maughan 1993; Suter, 1993) will also be consulted.

The baseline ecological risk assessment will consist of the following elements: hazard assessment, ecological characterization, ecological exposure assessment, ecological effects assessment, ecological risk characterization, and an uncertainty analysis.

The assessment approach will integrate a variety of methodologies to assess risks. The decisions regarding overall risk to ecological receptors will be based on the weight-of-evidence from the results of all components of the assessment methodology (i.e., an approach that integrates results of physical, biological, toxicological, and modeling studies to draw risk-based conclusions). The weight-

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of-evidence components were designed to provide measures of risks for different ecological receptors, exposure pathways, and potential adverse effects.

A Risk Assessment Approach Plan will be completed prior to commencement of the ecological risk assessment. This plan shall be presented to state and federal regulators, as well as natural resource trustees. Comments from regulators and trustees shall be incorporated into the RI ecological risk assessment for AOC 57.

The hazard assessment will present an overview of the type and extent of contamination present at AOC 69W and will identify ecological chemicals of potential concern (COPCs). COPCs will be selected from available site data based on factors such as the applicability of the data for ecological assessment, the data quality objectives, the classification of chemicals (e.g., inorganic, volatile organic), comparison of chemical concentrations with naturally occurring basewide background concentrations for inorganics in surface soils, and upstream concentrations for surface water and sediment in Willow Brook, the physical and chemical properties of chemicals, the frequency of detection, and the inherent toxicity of the chemicals and their potential to bioaccumulate.

The ecological characterization will serve as the basis for identifying potential ecological receptors at AOC 69W. Flora and fauna located at or potentially affected by the site will be qualitatively characterized. Information gathered in the qualitative ecological survey (see Section 5.3.7 of this Work Plan) will be incorporated into a receptor analysis in the ecological characterization section of the risk assessment. The results of the receptor analysis will be used to further develop exposure scenarios for the ecological exposure assessment.

The ecological exposure assessment will evaluate the potential for receptor exposure to COPCs at AOC 69W. This evaluation will involve the identification of potential exposure routes and an evaluation of the magnitude of exposure of identified ecological receptors. Exposure concentrations and/or doses will be estimated for each exposure pathway. If appropriate, indicator species will be selected for ecological exposure modeling.

Exposure pathways describe how ecological receptors can come into contact with contaminated media and are based on identifying (1) the contaminant source, (2) the environmental transport medium, (3) the point of receptor contact, and (4)

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the exposure route (e.g., incidental soil ingestion, drinking of contaminated surface water, or ingestion of contaminated prey items).

A conceptual site model identifying exposure pathways will be developed for AOC 69W. The ecological exposure pathways most likely to be complete include:

- dermal contact and incidental ingestion by wildlife of contaminated surface soils, sediments, and/or surface water,
- wildlife ingestion of food items that are contaminated as a result of accumulation of contamination from the soils and sediments,
- direct contact with and ingestion of surface water and sediment by aquatic life,
- direct contact with and ingestion of surface soils by plants and invertebrates.

Based on COPC concentration data, exposure point concentrations within each medium will be estimated for the selected ecological exposure pathways and receptors. For evaluating exposure to wildlife receptors, these concentrations will be assumed to be equivalent to: (1) the lower of the 95 percent upper confidence limit on the arithmetic mean or the maximum detected concentration; and (2) the arithmetic mean concentration. For evaluating exposure to aquatic receptors, surface water and sediment concentrations will be evaluated on a sampling station by sampling station basis (e.g., summary statistics will not be used).

The process of assessing exposure for wildlife receptors will involve estimating the likely dosage for each relevant exposure route, and summing these estimates to derive an expected total body dosage for each receptor type. The extent of exposure will depend upon various factors such as the type of food consumed, feeding rates, habitat preference, and home range.

In order to evaluate exposure of aquatic organisms to contaminated sediment, two species of benthic macroinvertebrates will be exposed to AOC 69W sediment in controlled laboratory toxicity tests, as outlined in Section 5.3.6 of this Work Plan.

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The ecological effects assessment will contain a description of the ecotoxicological effects associated with the COPCs, and a discussion of the relationship between the exposure concentration and the potential for adverse effects in ecological receptors. Measurements of actual toxicity and adverse effects will be completed when possible to decrease uncertainties associated with evaluating the actual mixture of contamination present in sediments at AOC 69W.

Toxicological effects will be evaluated using concentration- or dose-response data regarding acute and chronic toxicity to the identified potential ecological receptors. Benchmark concentrations or doses will be identified for use in the ecological risk characterization section. Sources which will be considered in identifying benchmark values for aquatic receptors include USEPA ambient water quality criteria, State water quality standards, and sediment quality guidelines. Criteria or standards for protection of terrestrial receptors have not yet been established; therefore terrestrial benchmark values will be obtained from published toxicological studies.

Effects from exposure of aquatic organisms to contaminated sediment will be evaluated using controlled laboratory toxicity tests, as outlined in Section 5.3.6 of this Work Plan.

The purpose of the ecological risk characterization will be to combine the results of the exposure and effects assessments to characterize the ecological risks at AOC 69W. This section will identify ecological receptors that might be at risk from site-related contamination. Risks will be characterized for aquatic and wildlife receptors.

Potential risks to wildlife will be described using the following hazard index approach. The estimated doses or exposure concentrations will be compared to benchmark values identified in the toxicity assessment. Hazard Quotients (HQs) will be calculated for each chemical by dividing the exposure concentration by the benchmark value. These HQs will be summed into a cumulative hazard index (HI). As the HI increases in magnitude, the likelihood for adverse ecological effects increases. When the estimated HQ is less than 1, the contaminant exposure will be assumed to fall below the range considered to be associated with adverse effects for growth, reproduction and survival (of the individual organism) and no risks to the wildlife populations will be assumed. When the HQ or HI is

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greater than 1, a discussion of the ecological significance will be included. When HIs are greater than 1, an evaluation of the HQs comprising the HI will be completed.

This hazard ranking scheme evaluates potential ecological effects to individual organisms and does not evaluate potential population-wide effects. Contaminants may cause population reductions by affecting birth and mortality rates, immigration, and emigration (USEPA, 1989b). In many circumstances, lethal or sub-lethal effects may occur to individual organisms with little population or community level impacts; however, as the number of individual organisms experiencing toxic effects increases, the probability that population effects will occur also increases. The number of affected individuals in a population presumably increase with increasing HQ or HI values; therefore, the likelihood of population level effects occurring is generally expected to increase with higher HQ or HI values.

Risks for aquatic receptors will be characterized for AOC 69W based on a weight-of-evidence evaluation of the following factors:

- presence or absence of analytes in surface water and sediment samples,
- concentrations of analytes measured in surface water and sediment samples,
- responses of *H. azteca* and *C. tentans* in the sediment laboratory toxicity tests,
- concentrations of COPCs in surface water relative to reported toxicity of the COPC in laboratory tests (AQUIRE information), Federal AWQC and State Water Quality Standards, and,
- concentrations of COPCs in sediment relative to available sediment quality guidelines

The samples for sediment toxicity testing and chemical analysis will be collected concurrently and split for the two separate analyses; therefore, the chemical

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analyses results for the sediment samples can be used to help interpret the contaminant exposures for the test species (*H. azteca* and *C. tentans*). If toxicity is observed in any of the sediment toxicity tests, simple linear regressions will be completed to determine if a correlation exists between the concentration of an analyte in sediment samples and the adverse response in the toxicity test.

The ecological risk characterization section will also contain a discussion of visual observations of any ecosystem degradation or other symptoms of environmental stress observed during the qualitative ecological survey.

The estimation of ecological risks involves a number of assumptions. In this section, the uncertainties associated with these risk assessment assumptions will be identified and their potential effects upon the results of the risk assessment will be discussed.

The results of the risk assessment will be discussed in a summary section that will include summary data tables containing quantitative risk estimates.

### 5.7 REMEDIAL INVESTIGATION REPORT

Upon completion of the of the field investigation and laboratory analyses, elevation of the Level III chemical data and completion of the ecological and human health risk assessments, ABB-ES will prepare an RI Report. The RI Report will address the specific issues that resulted in the RI and will present conclusions and recommendations concerning site conditions and status. The RI Report will include the human health risk assessment as one of its sections. A separate FS report will be completed for this AOC.

The data interpretation will conclude with the nature and distribution of site-related contamination, with one of the following recommendations:

- Take no further action or initiate long-term monitoring (Record of Decision [ROD] required).
- Conduct a Feasibility Study.

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The RI Report will follow appropriate USEPA Region I and USAEC guidelines.

### **5.8 TREATABILITY STUDY/PILOT TESTING**

The Supplemental Site Evaluation data indicate that groundwater at AOC 69W is contaminated with TPHC, arsenic, lead, antimony, beryllium, chromium, nickel, 1,1-dichloroethene, benzene, carbon tetrachloride, chloroform, tetrachloroethene, trichloroethene, 2-methyl naphthalene, and naphthalene and soil is contaminated with TPHC, PAHs, chloroform, and thallium. The RI will further evaluate the nature and distribution of soil and groundwater contamination, as well as quantitatively evaluate risks. Treatability studies are not recommended for soil and groundwater at AOC 69W at this time. However, data can be collected at this phase which will aid in evaluating remedial technologies.

#### **5.8.1 Data Requirements for Evaluating Soil Remedial Technologies**

If a significant source of petroleum contamination is located during the subsurface soil investigation, data in addition to chemical analyses will be collected. Potential treatment technologies for soil include soil vapor extraction, thermal desorption, and incineration technologies. To aid in evaluating the effectiveness of these technologies, samples will be collected from the source area analyzed for grain size analysis, TOC content, and moisture content.

#### **5.8.2 Data Requirements for Evaluating Groundwater Remedial Technologies**

Evaluation of the potential effectiveness of groundwater remedial technologies is dependent upon information which will be collected during RI field activities, including contaminant source, direction of groundwater flow, and additional chemical data. Hydraulic conductivity tests will be performed on each of the newly installed wells (Subsection 5.3.5) to further define the hydraulic conductivity of the soils at AOC 69W. Although beneficial for evaluating hydraulic conductivity, these tests are limited for evaluating aquifer characteristics under a pumping scenario. A pumping test may be warranted at a later time depending upon the findings from the RI. Pumping tests would be used to establish well efficiency, specific capacity and short-term yields and to calculate transmissivity, storage coefficients, and long-term pumping rates.

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Groundwater samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL inorganics (filtered and unfiltered), TPHC, TSS, TDS, anions and cations, and water quality parameters, including alkalinity, hardness, pH (measured in the field), temperature (measured in the field), and dissolved oxygen (measured in the field). The data collected during the RI will be used to evaluate the potential effectiveness of groundwater treatment technologies.

### **5.9 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**

ARARs are human health and environmental regulatory requirements used to determine the appropriate extent of site cleanup, develop site-specific remedial response objectives, develop remedial action alternatives, and direct site cleanup. Superfund Amendments and Reauthorization Act (SARA) (Section 121) and the NCP (USEPA, 1990) require that CERCLA remedial actions comply with federal and state ARARs. To be an ARAR, state requirements must be identified in a timely manner and applied consistently statewide. Additional procedures for ARAR identification are specified in Section VII (7.5) of the IAG (USEPA, 1991a) between the USEPA and the U.S. Department of the Army.

Applicable requirements are federal and state requirements that specifically address substances or contaminants and actions at CERCLA sites. Relevant and appropriate requirements are federal and state requirements that, while not legally applicable, are appropriate if the site circumstances are sufficiently similar to those covered by the jurisdiction of the requirement. Applicable requirements and relevant and appropriate requirements are considered to have the same weight with respect to requiring compliance at CERCLA site cleanups. SARA also identifies a "To Be Considered" (TBC) category, which includes federal and state nonregulatory requirements such as criteria, advisories, and guidance documents. TBCs do not have the same status as ARARs; however, if no ARAR exists for a chemical or particular situation, TBCs can be used to ensure that a remedy is protective.

CERCLA remedial actions must be protective of human health and the environment and comply with ARARs. ARARs can be divided into three categories: chemical-, location-, and action-specific. Chemical-specific ARARs for AOC 69W will be identified using RI site characterization data. Potential

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location- and action-specific ARARs will be identified during the development of alternatives. The potential location- and chemical-specific ARARs for the site will be presented in the draft RI Report. The identification of ARARs is an iterative process, and the list of potential ARARs will be refined as alternatives are developed. ABB-ES will also present a synopsis of location-, action- and chemical-specific ARARs in the draft and final FS Reports.

### **5.10 REMEDIAL ALTERNATIVES DEVELOPMENT/SCREENING**

For this task of the FS process, ABB-ES will develop a range of distinct, hazardous waste management alternatives that will reduce the potential human health risks associated with exposure to contaminated soil and groundwater at AOC 69W, as deemed necessary from the results of the RI. This process consists of six general steps:

- Develop remedial action objectives and preliminary remediation goals based on data review, and compilation of ARARs.
- Develop general response actions for each medium of interest defining containment, treatment, excavation, pumping, or other actions, singly or in combination, that may be taken to satisfy the remedial action objectives for the site.
- Determine target cleanup levels and identify volumes or areas of media to which general response actions might be applied.
- Identify and screen the technologies applicable to each general response action to eliminate those that cannot be implemented technically at the site.
- Identify and evaluate technology process options to select a representative process for each technology type retained for consideration.
- Assemble the selected representative technologies into alternatives representing a range of treatment and containment combinations as

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appropriate, and screen these alternatives with respect to the criteria of effectiveness, implementability, and cost.

The first two steps and the potential technology identification in the fourth step have been preliminarily performed as described in Section 3.0, Initial Evaluation, for the benefit of identifying field data and treatability/pilot testing needs early for the RI. The potential remedial action objectives, response actions, and technologies identified in this work plan will be reviewed and refined as the RI/FS process progresses.

The sixth step entails the final assembly and screening of remedial alternatives. As appropriate, a range of remedial alternatives will be developed by combining retained technologies in which treatment is used to reduce the toxicity, mobility, or volume of wastes, but which vary in the degree to which long-term management of residuals or untreated waste is required; one or more alternatives involving containment with little or no treatment; and a no-action alternative. Alternatives that involve discrete or limited efforts to reduce potential exposures (e.g., fencing) will be presented as "limited action" alternatives.

During screening, alternatives are quantitatively defined to allow differentiation with respect to the criteria of effectiveness, implementability, and cost. Quantitative definition of alternatives with respect to spatial requirements, time frames, rates of treatment, and refinement of volumes/areas of contaminated material, as well as transportation distances for disposal technologies, required permits for off-site actions, and imposed limitations will enable differentiation among alternatives with respect to the screening criteria. Innovative technologies may be carried through the screening process if there is reason to believe they offer significant advantages in the form of better treatment performance or implementability, fewer adverse impacts, or lower costs. The three screening criteria conform with remedy selection requirements of CERCLA and the NCP. The screening step eliminates impractical alternatives or higher cost alternatives (i.e., order of magnitude) that provide little or no increase in effectiveness or implementability over their lower-cost counterparts. By eliminating these alternatives early, more time and effort can be devoted to detailed analysis of the more promising alternatives. The no-action alternative will not be evaluated according to screening criteria; it will pass through screening to be evaluated

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during detailed analysis as a baseline for the other retained alternatives (USEPA, 1988).

### 5.11 DETAILED ANALYSIS OF ALTERNATIVES

For this task of the FS process, ABB-ES will conduct a detailed analysis of alternatives which will consist of an individual analysis of each alternative against a set of evaluation criteria, and a comparative analysis of all options against the evaluation criteria with respect to one another.

The detailed analysis presents the relevant information that allows a site remedy selection. The detailed analysis of each remedial alternative includes the following:

- detailed descriptions of each remedial alternative, with emphasis on application of the various technologies as components in the alternative
- detailed analysis of each remedial alternative relative to the evaluation criteria established to address CERCLA requirements

The detailed description of each remedial alternative will emphasize the technologies used and the components of each alternative. Where appropriate, the description will present preliminary design calculations, process flow diagrams, sizing of key components, preliminary site layouts, and a discussion of limitations, assumptions, and uncertainties concerning each alternative.

As part of the criteria analysis, remedial alternatives will be examined with respect to requirements stipulated in CERCLA (Section 121), as amended by SARA. CERCLA emphasizes the evaluation of long-term effectiveness and related considerations for each remedial alternative. USEPA guidance for conducting RI/FSs under CERCLA (USEPA, 1988) and the NCP outline the following nine criteria for evaluating remedial alternatives:

1. overall protection of human health and environment;
2. compliance with ARARs;

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3. long-term effectiveness and performance;
4. reductions in toxicity, mobility, and volume through treatment;
5. short-term effectiveness;
6. implementability;
7. cost;
8. state/support agency acceptance; and
9. community acceptance.

The first seven criteria (threshold and balancing criteria) will be used for detailed analysis of alternatives in the FS Report. The eighth and ninth CERCLA evaluation criteria, state acceptance and community acceptance, are modifying criteria and are addressed following the public information meeting, public hearing and public comment period.

The detailed analysis of alternatives will be presented in the FS Report discussed in Subsection 5.12.

#### **5.12 FEASIBILITY STUDY REPORT**

At the conclusion of the FS process, ABB-ES will produce an FS Report to compile the development/screening of alternatives and detailed analysis of alternatives. Additionally, the FS Report will include a comparative analysis of alternatives. The comparative analysis will identify the advantages and disadvantages of each alternative relative to one another in relation to the evaluation criteria.

The criteria of state and community acceptance will be addressed in the Responsiveness Summary and the Draft ROD, once formal Commonwealth and community comments on the Draft FS Report and the Proposed Plan have been received. Following public comment, the Army, in consultation with USEPA, will modify the FS or Proposed Plan based on the comments received.

The FS Report will be issued in draft and final versions according to the IAG reporting requirements for primary documents. Draft versions for regulatory review and comments will include one issued upon initial screening of alternatives and one upon detailed analysis of alternatives.

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## **SECTION 5**

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### **5.13 POST RI/FS SUPPORT**

For this task ABB-ES will prepare the Proposed Plan, the Fact Sheet, the responsiveness summary, and the ROD for the OU. This task also includes attending public informational meetings and formal meetings regarding the cleanup of this site.

The Proposed Plan will explain the opportunities for the public to comment on the remedial alternatives evaluated in the FS Report. It will provide a brief history of AOC 69W, the principal findings of site investigations, and will provide brief descriptions of the Preferred Alternative and other alternatives evaluated in the FS. It will outline the criteria used by the Army to propose an alternative and present the Army's rationale for its preliminary selection of the Preferred Alternative.

The Fact Sheet will be written to provide the public with a brief explanation of the Army's selected remedy for cleanup of the site. It will contain the information the public needs to understand and participate in the Army's plans for the remediation activities. The Fact Sheet briefly summarizes the information detailed in the Proposed Plan including details regarding the public comment period and public meetings to be held.

The Responsiveness Summary will contain all the comments received during the public comment period and the responses. The Responsiveness Summary will be issued with the ROD document and both will be made available for public review in the Administrative Record located at Fort Devens and the Ayer Town Hall.

The ROD will be issued to document the Army's final choice of a remedy for cleanup of the site, considering all comments received during the public comment period. Once the ROD is signed by the appropriate Army and USEPA personnel, it will become part of the Administrative Record.

Format for the above documents will follow USEPA Region I established models and will be issued in draft and final versions according to the IAG reporting requirements for primary documents.

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## **6.0 PROJECT MANAGEMENT AND SCHEDULE**

### **6.1 TASK ORDER STAFFING**

The project organization structure is illustrated in Figure 6-1. Solid lines on the figure depict direct lines of control while dotted lines indicate channels of communication. Rationale for project organization and resource allocation are discussed in the Fort Devens POP. QA/QC procedures and responsibilities for ABB-ES, USAEC, and Environmental Science & Engineering (ESE) Laboratory personnel are also described in the Fort Devens POP (ABB-ES, 1995).

The duties, functions, and responsibilities associated with each task are detailed in the following paragraphs.

**Program Manager.** The Program Manager for ABB-ES' USAEC efforts is Mr. Joseph T. Cuccaro. He is responsible for providing direction, coordination, and continuous monitoring and review of the program. His responsibilities include initiating program activities; participating in work plan preparation; coordinating staff assignments; assisting in the identification and fulfillment of equipment and special resource needs; monitoring all task activities to confirm compliance with schedule, fiscal, and technical objectives; maintaining communications both internally and with the USAEC Contracting Officer's Representative (COR) through continuous interaction, thereby allowing quick resolution of potential problems; providing final review and approval of work plans, task deliverables, schedules, contract changes, and manpower allocations; and developing coordination among management, field teams, and support personnel to maintain consistency of performance.

**Project Manager.** The Project Manager for ABB-ES' Fort Devens efforts, Mr. Alan Fillip, P.E., has the day-to-day responsibility for conducting the Fort Devens project. The Project Manager is responsible for confirming the appropriateness and adequacy of the technical or engineering services provided for a specific task; developing the technical approach and level of effort required to address each element of a task; supervising day-to-day conduct of the work, including integrating the efforts of all supporting disciplines and subcontractors for all tasks; overseeing the preparation of all reports and plans; providing for QC and quality

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## SECTION 6

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review during performance of the work; confirming technical integrity, clarity, and usefulness of task work products; forming a task group with expertise in disciplines appropriate to accomplish the work; reviewing and approving sampling tests and QA plans, which include monitoring site locations, analysis methods to be used, and hydrologic and geophysical techniques to be used; developing and monitoring task schedules; supervising task fiscal requirements (e.g., funds management for labor and materials), and reviewing and approving all invoicing actions; and providing day-to-day communication, both within the ABB-ES team and with the USAEC COR, on all task matters including task status reporting.

**Corporate Officer.** ABB-ES' Corporate Officer, William R. Fisher, P.E., is responsible for ensuring that a contract for the services to be provided has been executed; necessary corporate resources are committed to conduct the program activities; corporate level input and response is readily available to both the ABB-ES team and the USAEC COR; and assistance is provided to the Program and Project Managers for project implementation.

**Technical Director and Project Review Committee.** The members of the Project Review Committee for this Task Order are Mr. James Buss, P.G., Mr. Jeffrey Pickett, and Mr. Willard Murray, Ph.D., P.E. Mr. Buss will serve as Technical Director and will be responsible for the overall technical quality of the work performed; he also will serve as chairman of the Project Review Committee. The function of this group of senior technical and/or management personnel is to provide guidance and oversight on the technical aspects of the project. This is accomplished through periodic reviews of the services provided to confirm they represent the accumulated experience of the firm, are being produced in accordance with corporate policy, and live up to the objectives of the program as established by ABB-ES and USAEC.

**Quality Assurance Supervisor.** Mr. Christian Ricardi is the QA Supervisor for ABB-ES' USAEC program and this project. The QA function has been established so that appropriate protocols from USAEC, Commonwealth of Massachusetts, and USEPA Region 1 are followed. In addition, the QA Supervisor must confirm that QC plans are in place and implemented for each element of the task. The QA Supervisor reports directly to the Program Manager but is responsible to the Project Manager in matters related to management of the QA/QC work element. The QA Supervisor is independent of the Project

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Manager relative to corrective action. The QA Supervisor has authority to stop work that is not in compliance with the POP, provided he has the concurrence of the USAEC Chemistry Branch, the Program Manager, the COR, and the Contracting Officer.

**Health and Safety Supervisor.** Ms. Cynthia E. Sundquist is the Health and Safety Supervisor for the Fort Devens project, reporting directly to the Project Manager. She has stop work authority to prevent or mitigate any unacceptable health and safety risks to project personnel, the general public, or the environment. Responsibilities of this position include confirming that the project team and, in particular, field personnel, comply with the ABB-ES Health and Safety Plan (HASP); helping the Program Manager and Project Manager develop the site-specific HASP; making certain that the HASP is distributed to appropriate personnel; and informing the Program Manager and the appropriate USAEC personnel in the specified manner when any health- or safety-related incident occurs.

**Contract Manager.** Ms. Elaine H. Findlay is the Contract Manager for the Fort Devens effort. The Contract Manager supports the Program Manager and Project Manager in all contractual matters, providing a liaison between contract representatives for USAEC and all subcontracted services.

**Project Administrator.** Ms. Dana Porter is the Project Administrator for the Fort Devens effort. The Project Administrator supports the Program Manager and Project Manager in the day-to-day monitoring of fiscal, schedule, and documentation requirements. She is responsible for maintaining the necessary systems to support budget monitoring and controls, and schedule monitoring and maintenance; and for controlling the flow and processing of documentation.

**RI/FS Task Manager.** Mr. Herb Colby will serve as Task Manager for the remedial investigation and feasibility study for the AOC. As a Task Leader, he is responsible for planning all ABB-ES' geologic and hydrogeologic investigations at the AOC. He also is responsible for the interpretation of all chemical and hydrogeologic information and data performance of the FS, and preparation of the required reports for the AOC.

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**Field Operations Leader.** Mr. Rod Rustad will serve as the Field Operations Leader for the Fort Devens Field Program. As Field Operations Leader he is responsible for conducting the field program in accordance with procedures outlined in the Work Plan and POP.

**Laboratory/Data Management Leader.** Ms. Elizabeth Dawes, as the coordinator of laboratory services, is responsible for implementing and maintaining the Fort Devens analytical program. Her responsibilities as the Laboratory Management Leader will include coordination with the Project Manager, QA Supervisor, and the analytical subcontractor on overall project and individual site analytical efforts. As the Data Management Leader, Ms. Dawes is responsible for operating and maintaining the database management systems committed to USAEC projects.

### 6.2 SUBCONTRACTORS

The following services and/or activities will be performed by subcontractors during the RI/FS field investigation activities at AOC 69W: field drilling and monitoring well installation, surveying, investigation derived waste disposal, and laboratory chemical analysis.

**Drilling Services.** Maher Environmental has been chosen through a competitive bidding process to provide drilling service for the RI. The drilling subcontractor will be responsible for mobilizing the proper drilling equipment to complete the soil boring and monitoring well installation. The Field Operations Leader will be responsible for coordinating and overseeing the activities of the drilling subcontractor.

**Surveying Services.** Martinage Engineering Associates, a professional land surveying company registered in the Commonwealth of Massachusetts, has been subcontracted to establish map coordinates and elevations for new monitoring wells and sediment sampling locations. Surveying activities will be coordinated and monitored by the Field Operations Leader, who will keep the Project Manager informed on a day-to-day basis.

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**Investigation-derived Waste Disposal.** Jet-Line Services has been selected through a competitive bidding process to remove and dispose of soil and/or water generated during the RI/FS program. The subcontractor will be responsible for disposing of the waste in accordance with all state and federal regulations.

**Laboratory Chemical Analysis.** Analytical services for the AOC 69W RI/FS field investigations will be subcontracted to ESE of Gainesville, Florida. ESE's analytical program is USAEC-approved.

### **6.3 PROJECT SCHEDULE**

ABB-ES' projection of the schedule for the AOC 69W RI/FS at Fort Devens allows for the regulatory review and approval period specified in the Federal Facility Agreement for all deliverables.

The field tasks are scheduled to be completed in five-day work shifts during the 5 weeks following authorization to proceed. The fieldwork is anticipated to commence in August 1995.

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## **GLOSSARY OF ABBREVIATIONS AND ACRONYMS**

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|        |                                                                       |
|--------|-----------------------------------------------------------------------|
| AAFES  | Army Air Force Exchange Service                                       |
| ABB-ES | ABB Environmental Services, Inc.                                      |
| AOC    | Area of Contamination                                                 |
| ARARs  | Applicable or Relevant and Appropriate Requirements                   |
| ATEC   | ATEC Environmental Consultants                                        |
| BTEX   | benzene, toluene, ethylbenzene, and xylenes                           |
| bgs    | below ground surface                                                  |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFU    | colony forming units                                                  |
| cm/sec | centimeters per second                                                |
| COPC   | chemical of potential concern                                         |
| COR    | Contracting Officer's Representative                                  |
| CRP    | Community Relations Plan                                              |
| DQO    | Data Quality Objective                                                |
| EA     | Environmental Applications, Inc.                                      |
| ECAO   | Environmental Criteria and Assessment Office                          |
| EMO    | Environmental Management Office                                       |
| ESE    | Environmental Science & Engineering                                   |
| FID    | flame ionization detector                                             |
| FS     | feasibility study                                                     |
| GC     | gas chromatograph                                                     |
| GPR    | ground-penetrating radar                                              |
| GZAR   | GZA Remediation, Inc.                                                 |
| HASP   | Health and Safety Plan                                                |
| HEAST  | Health Effects Assessment Summary Tables                              |
| HSA    | hollow stem auger                                                     |
| IAG    | interagency agreement                                                 |

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## GLOSSARY OF ABBREVIATIONS AND ACRONYMS

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|        |                                                             |
|--------|-------------------------------------------------------------|
| ID     | inside diameter                                             |
| IR     | infrared                                                    |
| IRDMIS | Installation Restoration Data Management Information System |
| IRIS   | Integrated Risk Information System                          |
| MADEP  | Massachusetts Department of Environmental Protection        |
| MCL    | Maximum Contaminant Level                                   |
| MEP    | Master Environmental Plan                                   |
| mg/L   | milligrams per liter                                        |
| NCP    | National Contingency Plan                                   |
| NDIR   | non-dispersive infrared                                     |
| OU     | operable unit                                               |
| PAHs   | polynuclear aromatic hydrocarbons                           |
| PAL    | Project Analyte List                                        |
| PID    | photoionization detector                                    |
| POP    | Project Operations Plan                                     |
| POTW   | publicly-owned treatment works                              |
| ppb    | parts per billion                                           |
| ppm    | parts per million                                           |
| PRE    | preliminary risk evaluation                                 |
| PVC    | polyvinyl chloride                                          |
| QA     | Quality Assurance                                           |
| QC     | Quality Control                                             |
| RAAP   | Risk Assessment Approach Plan                               |
| RAB    | Restoration Advisory Board                                  |
| RAGS   | Risk Assessment Guidance for Superfund                      |
| RI     | remedial investigation                                      |
| ROD    | Record of Decision                                          |
| SA     | Study Area                                                  |

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## **GLOSSARY OF ABBREVIATIONS AND ACRONYMS**

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|       |                                              |
|-------|----------------------------------------------|
| SARA  | Superfund Amendments and Reauthorization Act |
| SI    | Site Investigation                           |
| SSI   | Supplemental Site Investigation              |
| SVE   | soil vapor extraction                        |
| SVOC  | semivolatile organic compound                |
| TBC   | to be considered                             |
| TCD   | thermal conductivity detector                |
| TEX   | toluene, ethylbenzene, xylene                |
| TOC   | total organic carbon                         |
| TPHC  | total petroleum hydrocarbon Compounds        |
| TRC   | Technical Review Committee                   |
| TSS   | total suspended solids                       |
| USAEC | U.S. Army Environmental Center               |
| USEPA | U.S. Environmental Protection Agency         |
| UST   | underground storage tank                     |
| VOC   | volatile organic compound                    |
| WWTP  | waste water treatment plant                  |

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**NORTH POST**

**AOC 69W**

**MAIN POST**

Cold Spring Brook

Route 2

Route 2

**SOUTH POST**

NASHUA RIVER

**LEGEND**



RIVER/BROOK



POND/LAKE



INSTALLATION BOUNDARY



ROADS/HIGHWAY

MASSACHUSETTS

FT. DEVENS

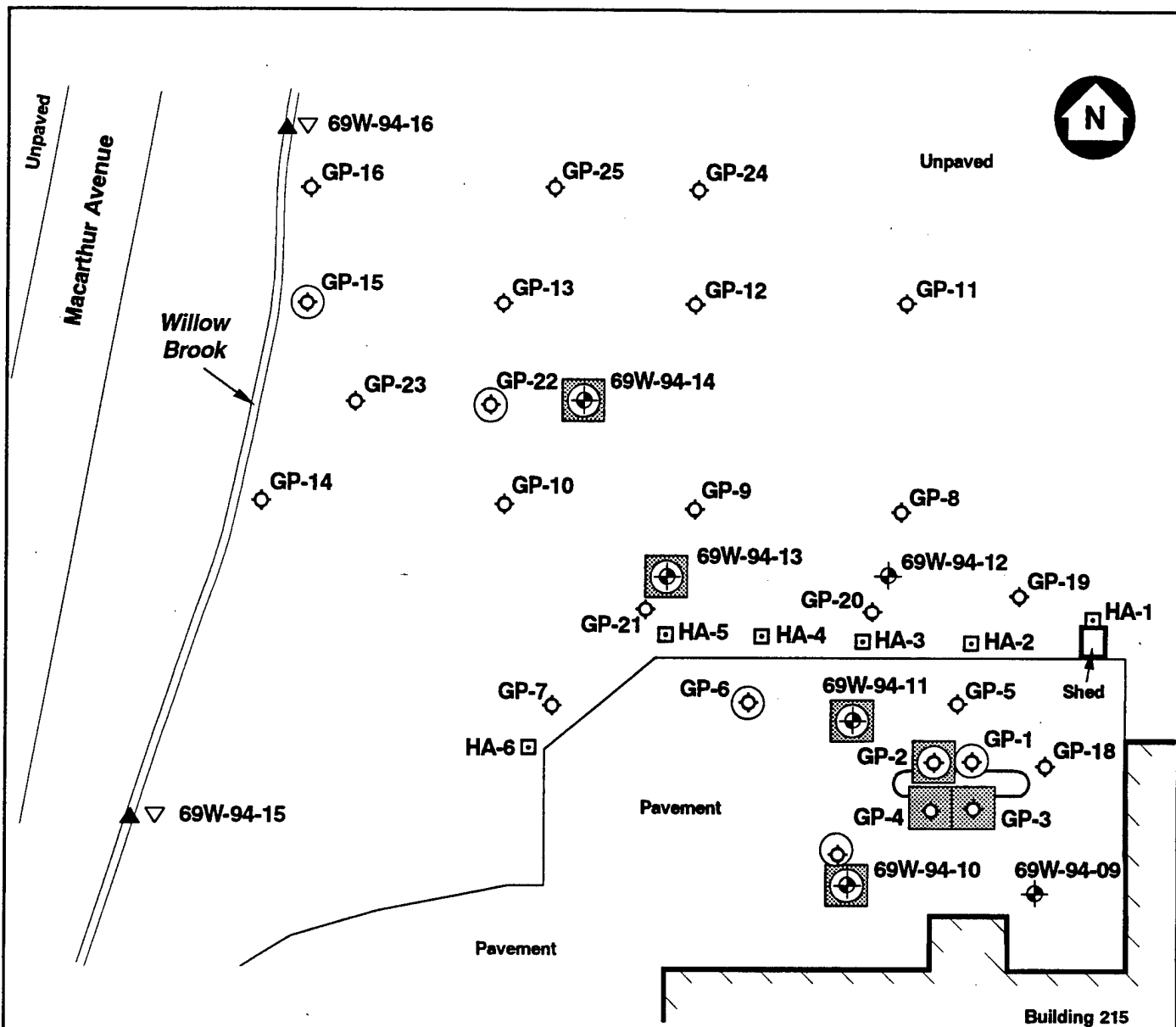
MAP LOCATION

SCALE IN FEET

0 3000 6000

**FIGURE 2-1  
LOCATION OF AOC 69W  
FINAL RI/FS WORK PLAN  
FORT DEVENS, MASSACHUSETTS**

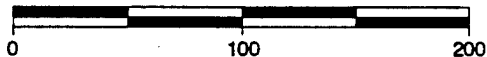
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# **LEGEND**

- ◊ GEOPROBE LOCATION
- ◻ HAND AUGER LOCATION
- ⊕ MONITORING WELL
- ▲ SEDIMENT SAMPLE LOCATION
- ▽ SURFACE WATER SAMPLE LOCATION
- ◻ LOCATIONS WHERE SOIL SAMPLES EXCEEDED MCP STANDARDS
- LOCATIONS WHERE GROUNDWATER SAMPLES EXCEEDED MCP STANDARDS

Scale in Feet



Source: Arthur D. Little, October 1994.

**FIGURE 2-2  
PREVIOUS EXPLORATION LOCATIONS  
FINAL RI/FS WORK PLAN  
FORT DEVENS, MA**

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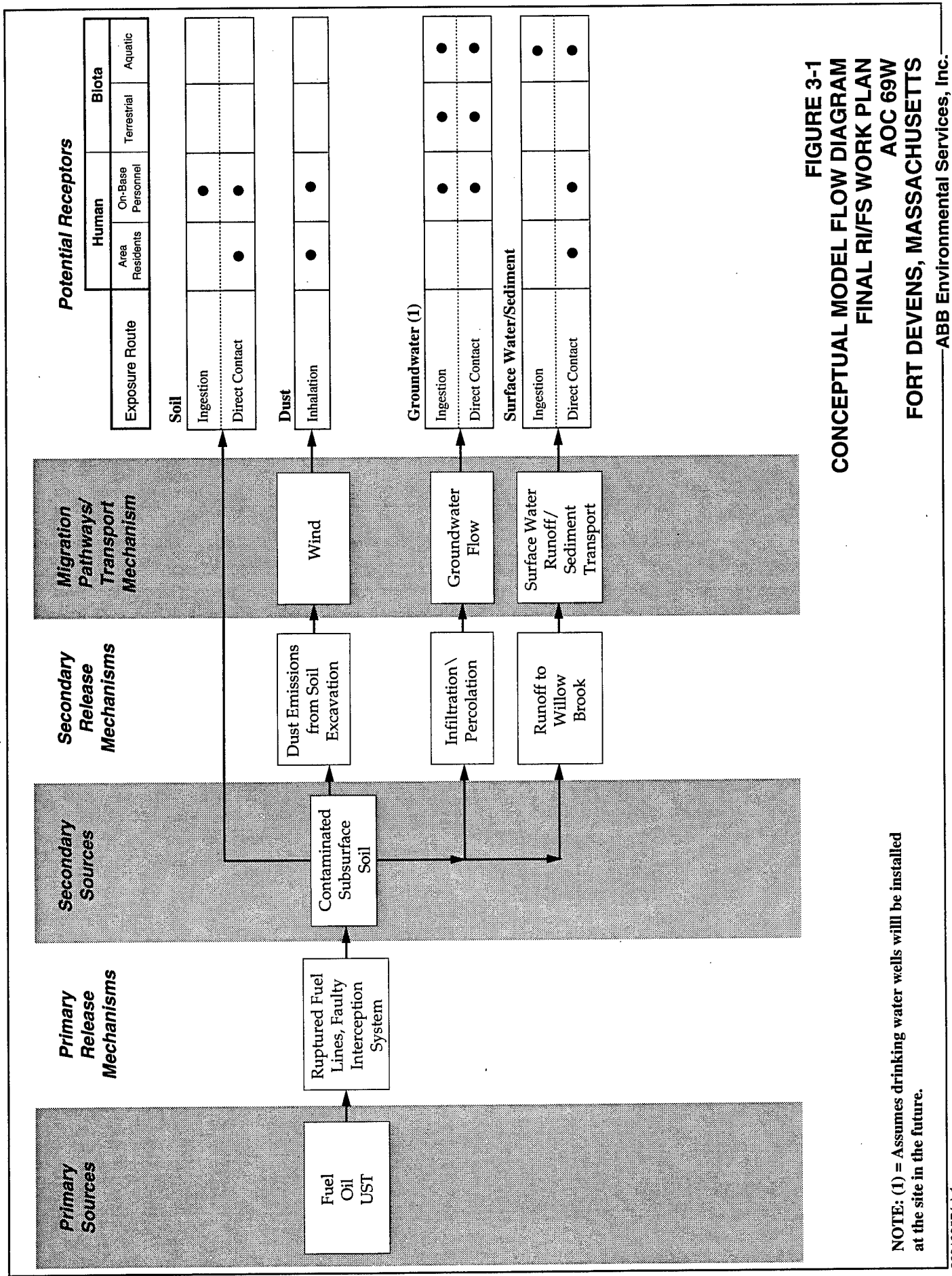


**FIGURE 3-1**  
**CONCEPTUAL MODEL FLOW DIAGRAM**  
**FINAL RI/FS WORK PLAN**  
**AOC 69W**  
**FORT DEVENS, MASSACHUSETTS**  
 ABB Environmental Services, Inc.

NOTE: (1) = Assumes drinking water wells will be installed at the site in the future.

## AOC 69W Groundwater

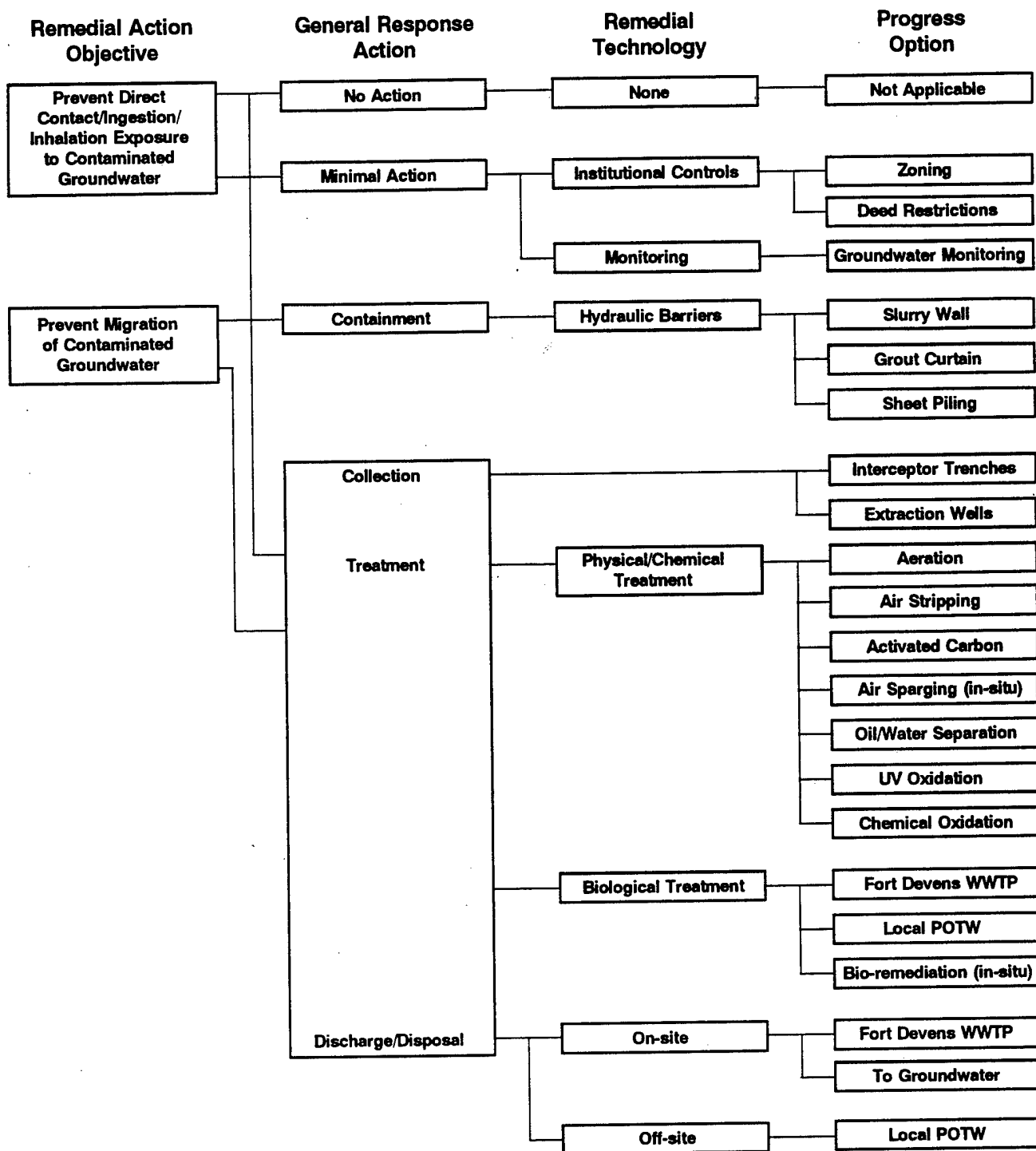


FIGURE 3-2  
IDENTIFICATION OF POTENTIAL REMEDIAL TECHNOLOGIES  
FINAL RI/FS WORK PLAN  
AOC 69W  
FORT DEVENS, MA

ABB Environmental Services, Inc.

## AOC 69W Soil

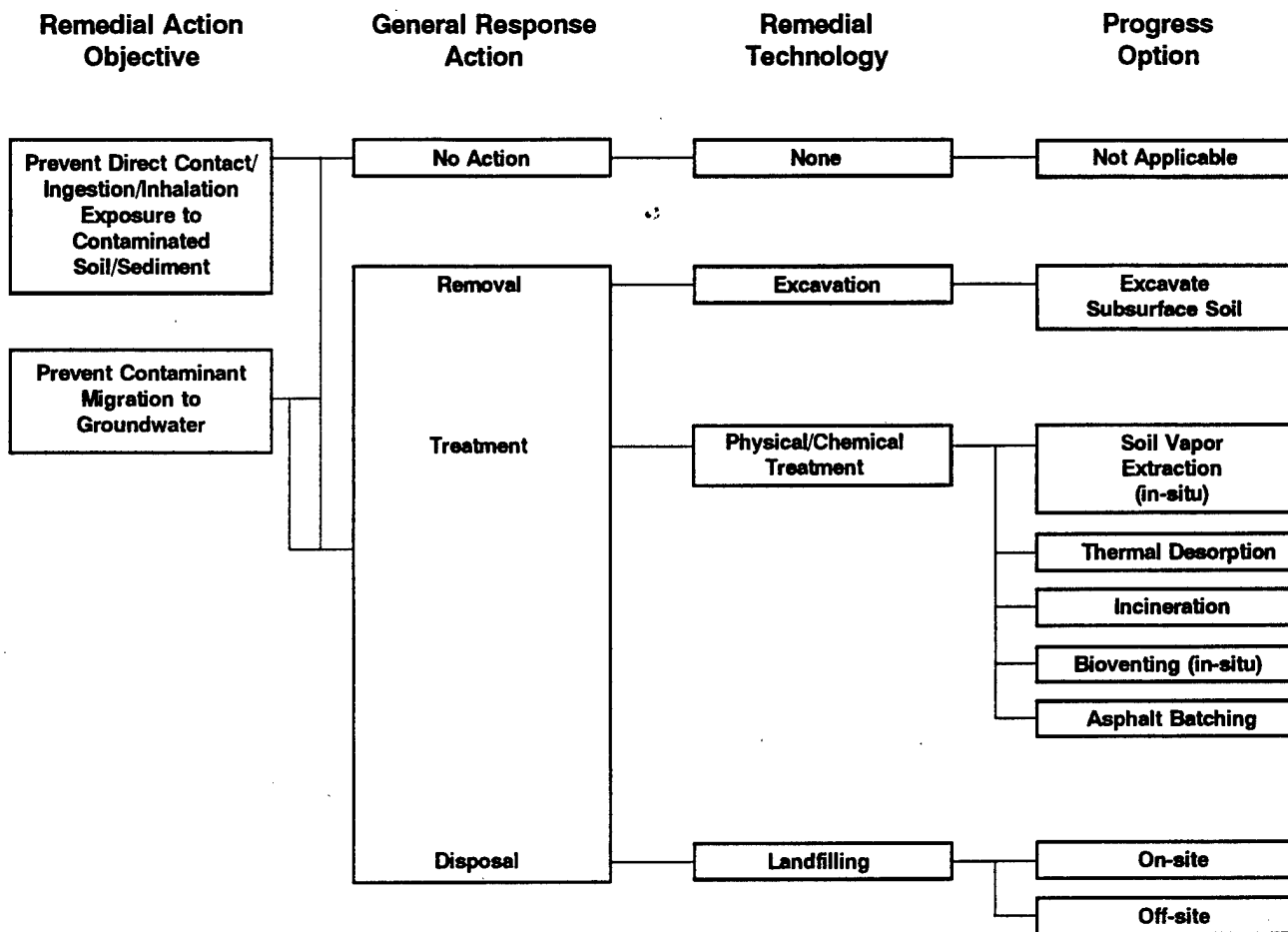


**FIGURE 3-2 (Cont.)**  
**IDENTIFICATION OF POTENTIAL REMEDIAL TECHNOLOGIES**  
**FINAL RI/FS WORK PLAN**  
**AOC 69W**  
**FORT DEVENS, MA**

ABB Environmental Services, Inc.



NO  
LC  
AF  
SE  
EX  
M/  
OI

MACARTHUR AVENUE

GATEWAY

WILLOW BROOK

OPEN SPACE

GATEWAY

ANTIETAM ST

69W--94-16

GP-16

GP-25

GP-24

GP-15

GP-22

69W--94-14

UNPAV

GP-23

GP-14

GP-10

GP-9

69W--94-13

69W--94-12

GP-21

HA-4

HA-5

GP-7

GP-6

69W--94-11

GP-2

69W--94-15

HA-6

PAVED

69W 94 10 69

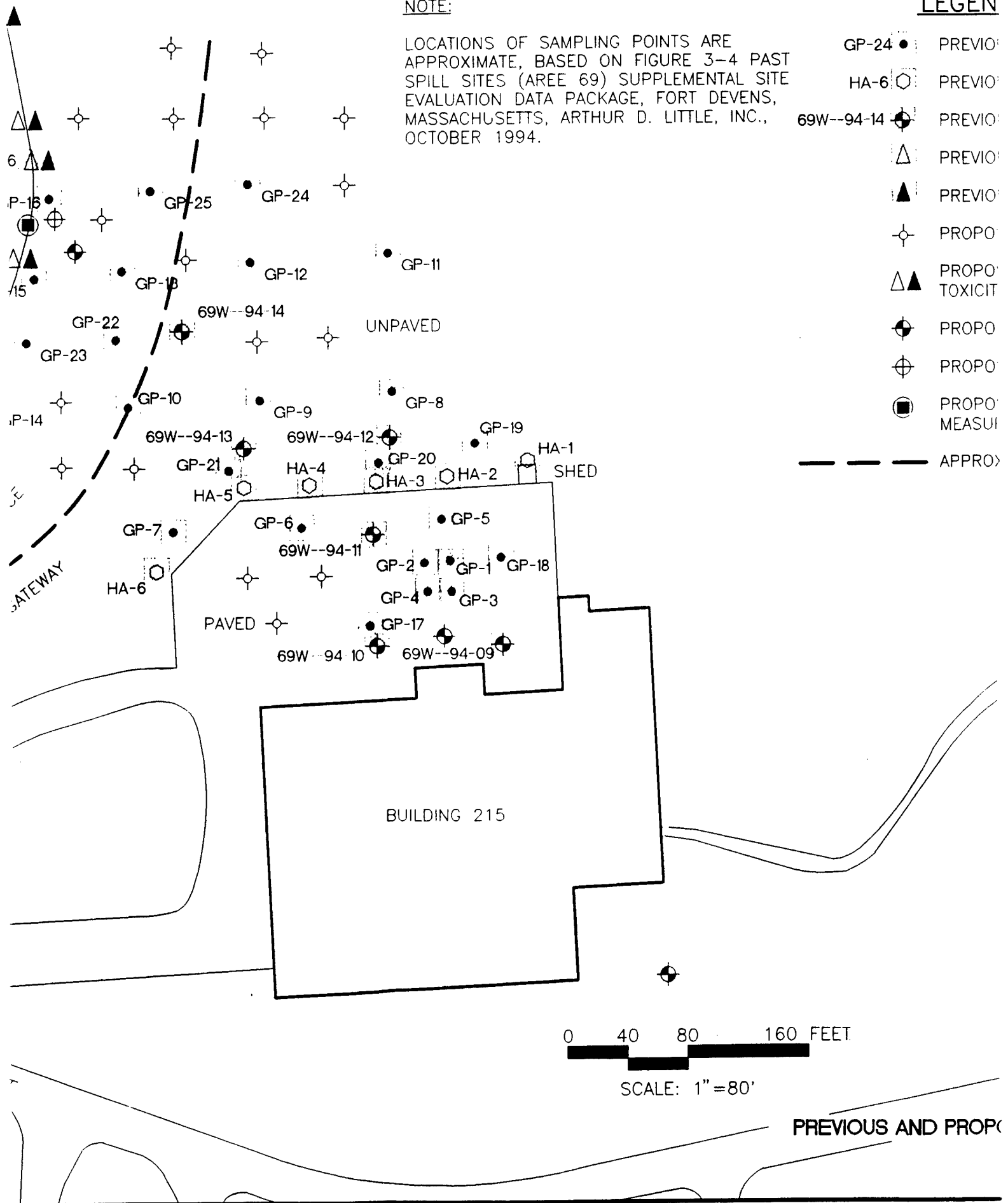
BUII

# NOTE:

LOCATIONS OF SAMPLING POINTS ARE APPROXIMATE, BASED ON FIGURE 3-4 PAST SPILL SITES (AREE 69) SUPPLEMENTAL SITE EVALUATION DATA PACKAGE, FORT DEVENS, MASSACHUSETTS, ARTHUR D. LITTLE, INC., OCTOBER 1994.

# LEGEND

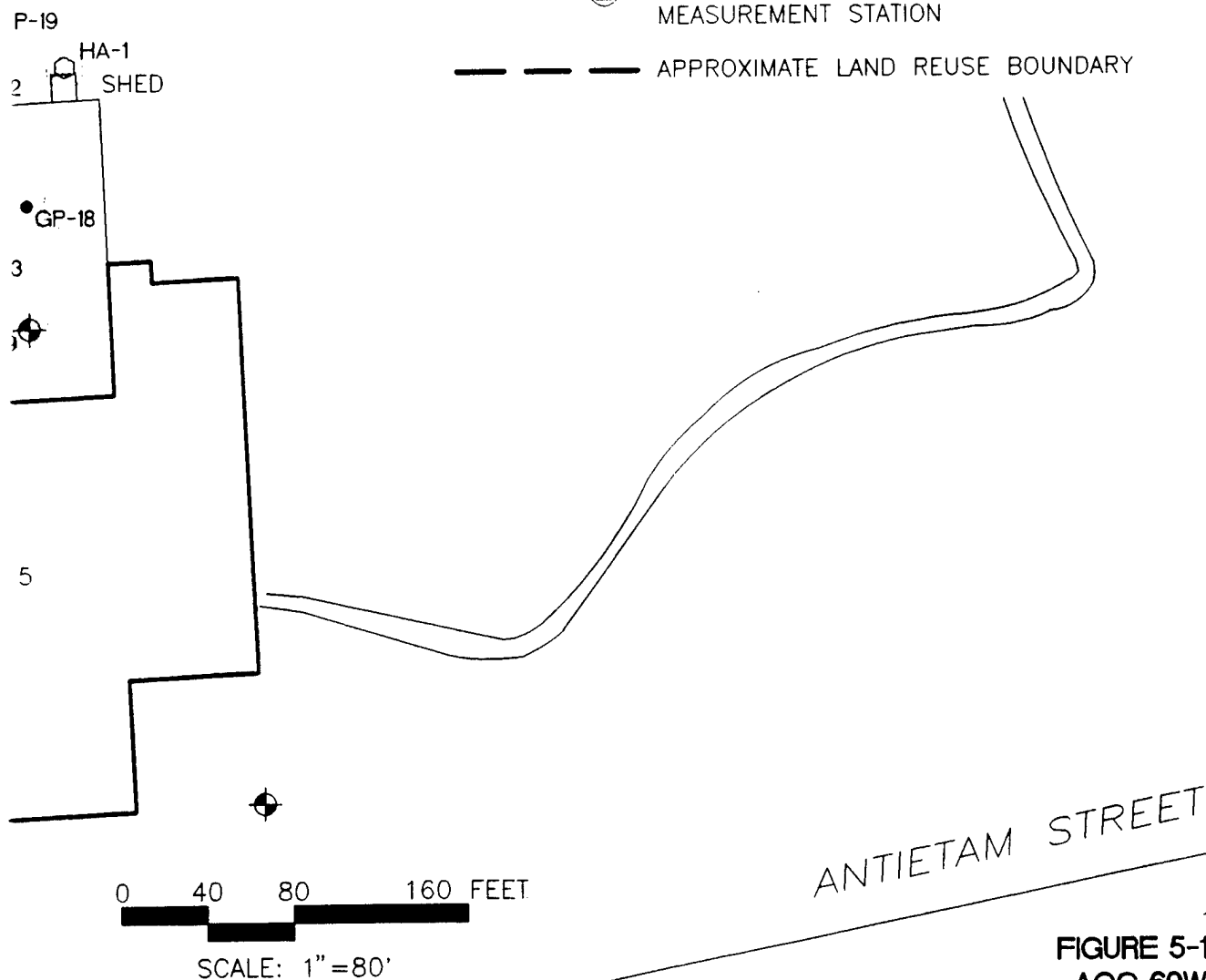
- GP-24 ● PREVIOUS
- HA-6 ○ PREVIOUS
- 69W--94-14 ● PREVIOUS
- △ PREVIOUS
- ▲ PREVIOUS
- ⊕ PROPOSED
- △▲ PROPOSED TOXICITY
- ⊕ PROPOSED
- ⊕ PROPOSED
- ⊕ PROPOSED MEASUREMENT
- APPROXIMATE



## LEGEND

3 OF SAMPLING POINTS ARE  
ATE, BASED ON FIGURE 3-4 PAST  
ES (AREE 69) SUPPLEMENTAL SITE  
N DATA PACKAGE, FORT DEVENS,  
ISETTS, ARTHUR D. LITTLE, INC.,  
1994.

- |              |                                                              |
|--------------|--------------------------------------------------------------|
| GP-24 ●      | PREVIOUS GEOPROBE LOCATION                                   |
| HA-6 ○       | PREVIOUS HAND AUGER LOCATION                                 |
| 69W--94-14 ● | PREVIOUS MONITORING WELL LOCATION                            |
| △            | PREVIOUS SEDIMENT SAMPLE LOCATION                            |
| ▲            | PREVIOUS SURFACE WATER SAMPLE LOCATION                       |
| ⊕            | PROPOSED TERRAPROBE LOCATION                                 |
| △▲           | PROPOSED SURFACE WATER/SEDIMENT/<br>TOXICITY SAMPLE LOCATION |
| ⊕            | PROPOSED MONITORING WELL LOCATION                            |
| ⊕            | PROPOSED PIEZOMETER LOCATION                                 |
| ■            | PROPOSED SURFACE WATER<br>MEASUREMENT STATION                |
| ---          | APPROXIMATE LAND REUSE BOUNDARY                              |



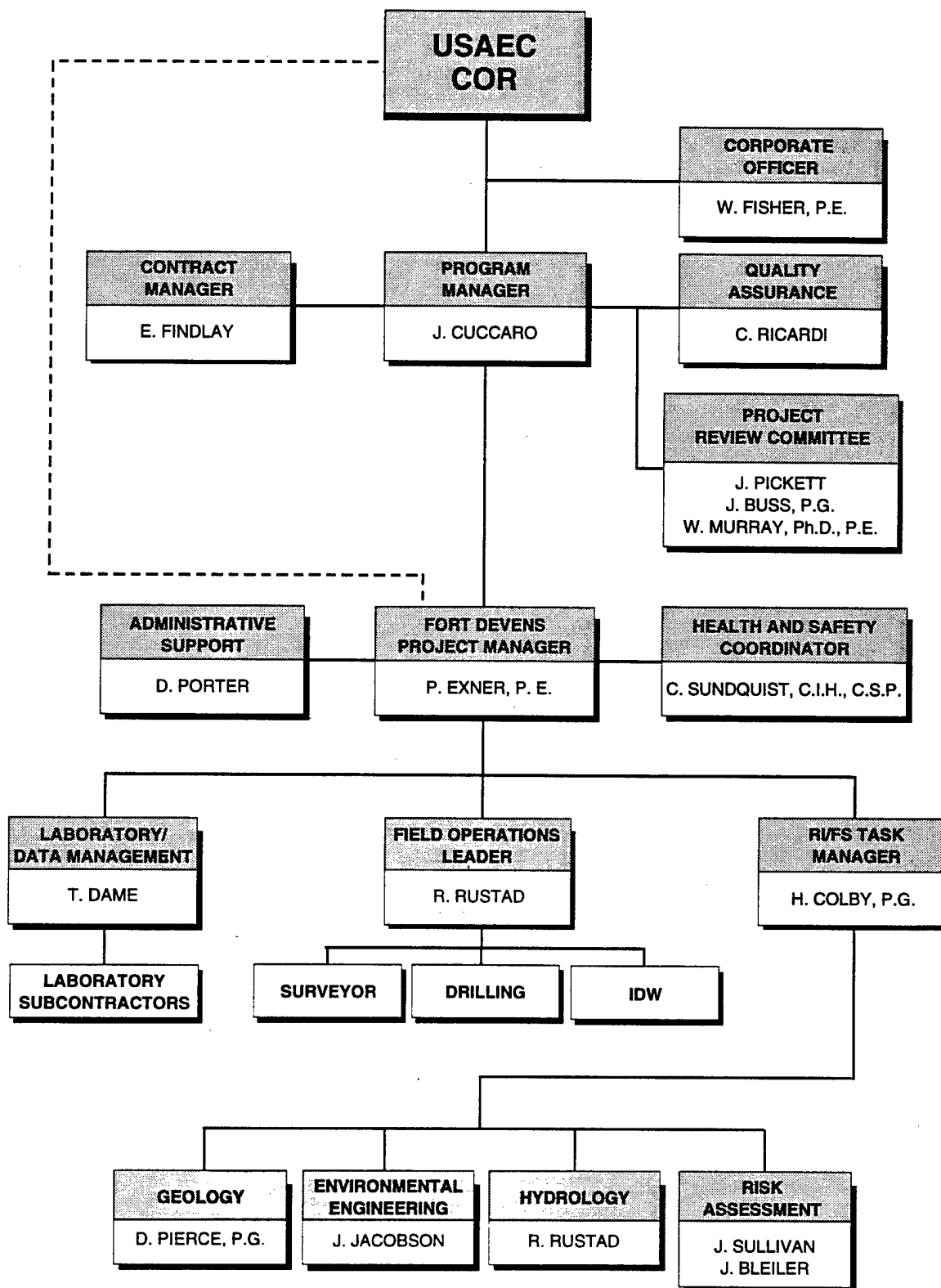


**FIGURE 6-1**  
**PROJECT ORGANIZATION**  
**AOC 69W**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MASSACHUSETTS**

ABB Environmental Services, Inc.

**TABLE 5-1**  
**FIELD ANALYTICAL SAMPLE RATIONALE**  
**AOC 69W**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SAMPLE TYPE | DEPTH                   | MEDIA | NO. OF SAMPLES | LOCATION AND RATIONALE                                                                                                                                                                                                     |
|-------------|-------------------------|-------|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Terra Probe | 12 ft                   | Soil  | 60             | To assess the distribution of petroleum contamination in soil. Three samples per probe, to be analyzed in the field for TPHC, BTEX, and selected PAL chlorinated VOCs.                                                     |
| Terra Probe | Water table (est. 5 ft) | Water | 20             | To assess the presence and concentration of fuel-related contamination in the groundwater. One water sample per boring will be collected from the water table and analyzed in the field for BTEX and PAL chlorinated VOCs. |

TABLE 5-2  
MONITORING WELL/PIEZOMETER INSTALLATION SUMMARY AND RATIONALE  
AOC69W  
FINAL RI/FS WORK PLAN  
FORT DEVENS, MA

| SITE ID    | DRILLING METHOD | EXPECTED WATER TABLE DEPTH (FT) | ESTIMATED BOTTOM DEPTH OF SCREEN (FT) | ESTIMATED LENGTH OF SCREEN (FT) | PURPOSE AND RATIONALE                                                  |
|------------|-----------------|---------------------------------|---------------------------------------|---------------------------------|------------------------------------------------------------------------|
| ZWM-95-15X | 6.25 HSAs       | 5                               | 20                                    | 10                              | To evaluate groundwater quality upgradient of UST excavation.          |
| ZWM-95-16X | 6.25 HSAs       | 5                               | 20                                    | 10                              | To evaluate groundwater quality upgradient of UST excavation.          |
| ZWM-95-17X | 6.25 HSAs       | 5                               | 20                                    | 10                              | To evaluate groundwater quality downgradient of UST excavation.        |
| ZWM-95-18X | 6.25 HSAs       | 5                               | 20                                    | 10                              | To evaluate groundwater quality downgradient of UST excavation.        |
| ZWP-95-01X | 4.25 HSAs       | 5                               | 15                                    | 2                               | To further evaluate hydrologic conditions in the area of Willow Brook. |
| ZWP-95-02X | 4.25 HSAs       | 5                               | 15                                    | 2                               | To further evaluate hydrologic conditions in the area of Willow Brook. |

**TABLE 5-3**  
**MONITORING WELL/GROUNDWATER SAMPLE RATIONALE**  
**AOC 69W**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID   | LOCATION                           | RATIONALE AND PURPOSE                                                                                                                                                                                                             |
|-----------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 69W-94-09 | Existing well upgradient of UST.   | Monitor groundwater quality upgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters.   |
| 69W-94-10 | Existing well upgradient of UST.   | Monitor groundwater quality upgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters.   |
| 69W-94-11 | Existing well downgradient of UST. | Monitor groundwater quality downgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 69W-94-12 | Existing well downgradient of UST. | Monitor groundwater quality downgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 69W-94-13 | Existing well downgradient of UST. | Monitor groundwater quality downgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| 69W-94-14 | Existing well downgradient of UST. | Monitor groundwater quality downgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| ZWM-95-15 | Proposed well, upgradient of UST.  | Monitor groundwater quality upgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters.   |
| ZWM-95-16 | Proposed well, upgradient of UST.  | Monitor groundwater quality upgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters.   |

**TABLE 5-3**  
**MONITORING WELL/GROUNDWATER SAMPLE RATIONALE**  
**AOC 69W**  
**FINAL RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE ID   | LOCATION                           | RATIONALE AND PURPOSE                                                                                                                                                                                                             |
|-----------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ZWM-95-17 | Proposed well downgradient of UST. | Monitor groundwater quality downgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |
| ZWM-95-18 | Proposed well downgradient of UST. | Monitor groundwater quality downgradient of the UST. Two rounds of samples will be analyzed for PAL VOCs, PAL SVOCs, PAL Pesticides/PCBs, PAL Inorganics (both filtered and unfiltered), TPHC, TDS, and water quality parameters. |

TABLE 5-4  
SAMPLING AND LABORATORY ANALYSIS SCHEDULE  
AOC 69W  
DRAFT RI/FS WORK PLAN  
FORT DEVENS, MA

| SITE<br>TYPE | MEDIA       | SITE<br>ID | SAMPLE<br>ID# | LAB<br>SAMPLE<br>NO. | MS/<br>MSD | DUP | RINS | FINGER | PET<br>SIZE | PAL/<br>VOCS | PAL/<br>SVOCs | PAL/<br>INORG. | PAL/<br>PEST/<br>PCBs | PAL/<br>PRMTS | WTR/QUA | TPHC | TDS | TOC |
|--------------|-------------|------------|---------------|----------------------|------------|-----|------|--------|-------------|--------------|---------------|----------------|-----------------------|---------------|---------|------|-----|-----|
|              |             |            |               |                      |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-26X | RXZW26--      | DV4S* 245            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-27X | RXZW27--      | DV4S* 246            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-28X | RXZW28--      | DV4S* 247            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-29X | RXZW29--      | DV4S* 248            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-30X | RXZW30--      | DV4S* 249            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-31X | RXZW31--      | DV4S* 250            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-32X | RXZW32--      | DV4S* 251            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-33X | RXZW33--      | DV4S* 252            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-34X | RXZW34--      | DV4S* 253            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-35X | RXZW35--      | DV4S* 254            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-36X | RXZW36--      | DV4S* 255            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-37X | RXZW37--      | DV4S* 256            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-38X | RXZW38--      | DV4S* 257            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-39X | RXZW39--      | DV4S* 258            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-40X | RXZW40--      | DV4S* 259            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-41X | RXZW41--      | DV4S* 260            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-42X | RXZW42--      | DV4S* 261            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-43X | RXZW43--      | DV4S* 262            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-44X | RXZW44--      | DV4S* 263            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWR-95-45X | RXZW45--      | DV4S* 264            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWM-95-15X | BXZW15--      | DV4S* 265            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWM-95-16X | BXZW16--      | DV4S* 266            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWM-95-17X | BXZW17--      | DV4S* 267            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| BORE         | SOIL        | ZWM-95-18X | BXZW18--      | DV4S* 268            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| WELL         | GROUNDWATER | 69W-94-09  | MXZW09X3      | DV4W* 269            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |
| WELL         | GROUNDWATER | 69W-94-09  | MXZW09X3      | DV4F* 269            |            |     |      |        |             |              |               |                |                       |               |         |      |     |     |

TABLE 5-4  
 SAMPLING AND LABORATORY ANALYSIS SCHEDULE  
 AOC 69W  
 DRAFT RI/FS WORK PLAN  
 FORT DEVENS, MA

| SITE<br>TYPE | MEDIA       | SITE<br>ID | LAB            |               | MSD | DUP | RINS | FINGER | SIZE | GRAIN | PAL <sup>2</sup><br>VOCs | PAL <sup>2</sup><br>SVOCs | PAL <sup>2</sup><br>INORG. | PAL <sup>2</sup><br>PEST/<br>PCBs | PAL <sup>2</sup><br>WTR/QUA<br>PRMTRS | TPHC | TDS | TOC |
|--------------|-------------|------------|----------------|---------------|-----|-----|------|--------|------|-------|--------------------------|---------------------------|----------------------------|-----------------------------------|---------------------------------------|------|-----|-----|
|              |             |            | SAMPLE<br>ID** | SAMPLE<br>NO. |     |     |      |        |      |       |                          |                           |                            |                                   |                                       |      |     |     |
| WELL         | GROUNDWATER | 69W-94-09  | MXZW09X4       | DV4W*         | 270 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-09  | MXZW09X4       | DV4F*         | 270 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-10  | MXZW10X3       | DV4W*         | 271 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-10  | MXZW10X3       | DV4F*         | 271 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-10  | MXZW10X4       | DV4W*         | 272 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-10  | MXZW10X4       | DV4F*         | 272 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-11  | MXZW11X3       | DV4W*         | 273 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-11  | MXZW11X3       | DV4F*         | 273 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-11  | MXZW11X4       | DV4W*         | 274 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-11  | MXZW11X4       | DV4F*         | 274 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-12  | MXZW12X3       | DV4W*         | 275 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-12  | MXZW12X3       | DV4F*         | 275 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-12  | MXZW12X4       | DV4W*         | 276 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-12  | MXZW12X4       | DV4F*         | 276 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-13  | MXZW13X3       | DV4W*         | 277 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-13  | MXZW13X3       | DV4F*         | 277 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-13  | MXZW13X4       | DV4W*         | 278 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-13  | MXZW13X4       | DV4F*         | 278 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-14  | MXZW14X3       | DV4W*         | 279 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-14  | MXZW14X3       | DV4F*         | 279 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-14  | MXZW14X4       | DV4W*         | 280 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | 69W-94-14  | MXZW14X4       | DV4F*         | 280 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | ZWM-95-15X | MXZW15X1       | DV4W*         | 281 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | ZWM-95-15X | MXZW15X1       | DV4F*         | 281 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | ZWM-95-15X | MXZW15X2       | DV4W*         | 282 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |
| WELL         | GROUNDWATER | ZWM-95-15X | MXZW15X2       | DV4F*         | 282 |     |      |        | -    | -     | -                        | -                         | -                          | -                                 | -                                     | -    | -   | -   |

TABLE 5-4  
 SAMPLING AND LABORATORY ANALYSIS SCHEDULE  
 AOC 69W  
 DRAFT RI/FS WORK PLAN  
 FORT DEVENS, MA

| LAB  |               |            |          |       |     |      |        |     |       | PAL <sup>1</sup> |                  |                  |                  |                  |                  |        |       |     |     | PAL <sup>2</sup> |      |     |     |  |  |  |  |  |  |
|------|---------------|------------|----------|-------|-----|------|--------|-----|-------|------------------|------------------|------------------|------------------|------------------|------------------|--------|-------|-----|-----|------------------|------|-----|-----|--|--|--|--|--|--|
| SITE | SITE          | SAMPLE     | SAMPLE   | MS/1  | DUP | RINS | FINGER | PET | GRAIN | PAL <sup>1</sup> | PAL <sup>1</sup> | PAL <sup>1</sup> | PAL <sup>1</sup> | PAL <sup>1</sup> | PAL <sup>1</sup> | INORG. | PEST/ | WTR | QUA | FRMTRS           | TPHC | TDS | TOC |  |  |  |  |  |  |
| TYPE | MEDIA         | ID         | ID**     | NO.   |     |      |        |     | SIZE  | VOCS             | SVOCs            |                  |                  |                  |                  |        |       |     |     |                  |      |     |     |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-16X | MXZW16X1 | DV4W* | 283 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-16X | MXZW16X1 | DV4F* | 283 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-16X | MXZW16X2 | DV4W* | 284 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-16X | MXZW16X2 | DV4F* | 284 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-17X | MXZW17X1 | DV4W* | 285 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-17X | MXZW17X1 | DV4F* | 285 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-17X | MXZW17X2 | DV4W* | 286 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-17X | MXZW17X2 | DV4F* | 286 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-18X | MXZW18X1 | DV4W* | 287 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-18X | MXZW18X1 | DV4F* | 287 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-18X | MXZW18X2 | DV4W* | 288 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| WELL | GROUNDWATER   | ZWM-95-18X | MXZW18X2 | DV4F* | 288 |      |        |     | -     | -                | -                | -                | -                | -                | -                | -      | -     | -   | -   | -                | -    | -   | -   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-01X | DXZW0101 | DV4S* | 289 | 1    |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-01X | DXZW0102 | DV4S* | 290 |      |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-02X | DXZW0101 | DV4S* | 291 | 1    |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-02X | DXZW0102 | DV4S* | 292 |      |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-03X | DXZW0101 | DV4S* | 293 |      |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-03X | DXZW0102 | DV4S* | 294 |      |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-04X | DXZW0101 | DV4S* | 295 | 1    |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-05X | DXZW0101 | DV4S* | 296 |      |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SEDIMENT      | ZWD-95-06X | DXZW0101 | DV4S* | 297 |      |        |     | 1     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SURFACE WATER | ZWD-95-01X | WXZW01XX | DV4W* | 298 | 1    |        |     | -     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SURFACE WATER | ZWD-95-02X | WXZW02XX | DV4W* | 299 |      |        |     | -     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SURFACE WATER | ZWD-95-03X | WXZW03XX | DV4W* | 300 |      |        |     | -     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SURFACE WATER | ZWD-95-04X | WXZW04XX | DV4W* | 301 | 1    |        |     | -     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |
| STRM | SURFACE WATER | ZWD-95-05X | WXZW05XX | DV4W* | 302 |      |        |     | -     | 1                | 1                | 1                | 1                | 1                | 1                | 1      | 1     | 1   | 1   | 1                | 1    | 1   | 1   |  |  |  |  |  |  |

**TABLE 5-4**  
**SAMPLING AND LABORATORY ANALYSIS SCHEDULE**  
**AOC 69W**  
**DRAFT RI/FS WORK PLAN**  
**FORT DEVENS, MA**

| SITE TYPE                        | MEDIA         | SITE ID    | LAB SAMPLE ID** | MSD NO. | MSD DUP | RINS | FINGER | PET GRAIN SIZE | PAL <sup>1</sup> VOCs | PAL <sup>2</sup> SVOCs | PAL <sup>2</sup> INORG. | PAL <sup>2</sup> PEST/PCBs | PAL <sup>2</sup> WTR/QUA | TPHC | TDS | TOC |
|----------------------------------|---------------|------------|-----------------|---------|---------|------|--------|----------------|-----------------------|------------------------|-------------------------|----------------------------|--------------------------|------|-----|-----|
|                                  |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| STRM                             | SURFACE WATER | ZWD-95-06X | WXZW06XX        | DV4W*   | 303     |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| SOIL SAMPLE SUBTOTAL             |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| WATER SAMPLE SUBTOTAL            |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| MS/MSD SAMPLES (5%)              |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| (5% PER EPISODE FOR GROUNDWATER) |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| DUPLICATES (5%)                  |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| (5% PER EPISODE FOR GROUNDWATER) |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| RINSATE BLANKS (5%)              |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| TRIP BLANKS                      |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| SOIL SAMPLE TOTAL                |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |
| WATER SAMPLE TOTAL               |               |            |                 |         |         |      |        |                |                       |                        |                         |                            |                          |      |     |     |

NOTE: <sup>1</sup> MATRIX SPIKE AND MATRIX SPIKE DUPLICATE SAMPLES WILL BE COLLECTED FOR INORGANICS AND PESTICIDE/PCBS ONLY AS INDICATED IN THE PROJECT OPERATIONS PLAN.

\*\* = THREE SAMPLES WILL BE COLLECTED FROM EACH TERRAPROBE EXPLORATIONS. ONE OF THE THREE SAMPLES WILL BE SHIPPED TO AN OFF-SITE LABORATORY BASED ON FIELD SCREENING RESULTS. THE COMPLETE SAMPLE ID WILL BE DETERMINED IN THE FIELD BASED ON DEPTH OF THE SAMPLE SELECTED FOR OFF-SITE ANALYSIS.

PAL = PROJECT ANALYTE LIST.

[ ] = INDICATES QA/QC PARAMETERS TO BE COLLECTED

MS/MSD = MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLE

DUP = DUPLICATE SAMPLE

RINS = RINSATE SAMPLE

NA = NOT APPLICABLE