# EXPLANATION OF SIGNIFICANT DIFFERENCES
# OPERABLE UNIT 3
# FORT WAINWRIGHT, ALASKA

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**Prepared by**

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**LIST OF ACRONYMS**

| | |
|---|---|
| ADEC | Alaska Department of Environmental Conservation |
| AWQS | Alaska Water Quality Standards |
| ARAR | Applicable or Relevant and Appropriate Requirements |
| AS | air sparge |
| AST | above ground storage tank |
| bgs | below ground surface |
| BTEX | benzene, toluene, ethylbenzene, and xylenes |
| CANOL | Canadian Oil Pipeline |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| COC | contaminants of concern |
| DCA | 1,2-dichloroethane |
| DRO | diesel range organics |
| EBHTF | East Birch Hill Tank Farm |
| EDB | 1,2-dibromoethane |
| EPA | United States Environmental Protection Agency |
| ESD | Explanation of Significant Differences |
| FFT | Fairbanks Fuel Terminal |
| GRO | gasoline range organic |
| µg/L | micrograms per liter |
| mg/L | milligrams per liter |
| MCL | maximum contaminant level |
| MP | Milepost |
| NCP | National Contingency Plan |
| O&M | operation and maintenance |
| ORC | oxygen releasing compound |
| OU3 | Operable Unit 3 |
| RAO | Remedial Action Objective |
| RCRA | Resource Conservation and Recovery Act |
| RI/FS | remedial investigation/feasibility study |
| ROD | Record of Decision |
| ROLF | railcar off-loading facility |
| SVE | soil vapor extraction |
| TCLP | toxicity characteristic leaching procedure |
| TFS | truck fill stand |
| TMB | trimethylbenzene |
| USARAK | United States Army Alaska |
| UST | underground storage tank |
| VOC | volatile organic compound |

# 1.0 INTRODUCTION

## 1.1 Purpose

The April 1996 Record of Decision (ROD) for Operable Unit 3 (OU3) at Fort Wainwright in Fairbanks, Alaska selected a remedy involving a combination of *in-situ* soil vapor extraction and air sparging of groundwater with natural attenuation to remove fuel-related contaminants in groundwater at the following source areas: the Birch Hill Tank Farm, a Railcar Off-Loading Facility (ROLF), and three milepost (MP) sites along the Fairbanks-Eielson Pipeline (Mileposts 2.7, 3.0, and 15.75). Figure 1 presents a site location map showing these areas.

Through implementation of the remedial actions in the ROD and additional historical research, the sources and volumes of contamination, groundwater movements, and geology are now better understood than they were at the time of the Remedial Investigation/Feasibility Study (RI/FS). The RI/FS, conducted in 1993, was limited in many areas and inadequate to determine the full extent of groundwater contamination. Post ROD activities determined that there is more total volume and lateral extent of contamination in OU3 than previously documented. This information required the re-evaluation of the remedial actions in the ROD. This evaluation has resulted in the conclusion that the scope of the remedies selected in the ROD will not fully achieve the remedial action objectives (RAOs) without some significant changes. This Explanation of Significant Differences (ESD) documents the changes in some components of the selected remedy described in the ROD and summarizes the information that led to making the changes. These changes do not fundamentally alter the overall cleanup approach within OU3.

The total cost for implementing remedial actions, in addition to what was already estimated for implementation of the ROD, is presented in Table 1-1 below. The table includes short term remedial action construction and operating and maintenance costs over thirty years. Additional details regarding these implementation costs are included within this document in the remedy description for each remedial area.

**Table 1-1 – OU3 ROD and ESD Cost Comparison**

| Remedial Area | ROD Cost Estimate (present worth) | ESD Cost Estimate[1] (present worth) |
|---|---|---|
| Remedial Area 1B | $2,800,000 | $10,286,137 |
| Remedial Area 2 | $1,000,000 | $9,862,812 |
| Remedial Area 3 | $560,000 | $1,034,144 |
| **Totals** | $4,360,000 | $21,183,093 |

[1] From June 2002 Interim Remedial Action Report

## 1.2 Lead and Support Agencies

The United States Army Alaska (USARAK) is the lead agency for remedial actions at OU3. The United States Environmental Protection Agency (EPA) and the Alaska Department of Environmental Conservation (ADEC) are the support agencies. All three agencies were signatories to the ROD and have agreed to the significant changes included in this ESD.

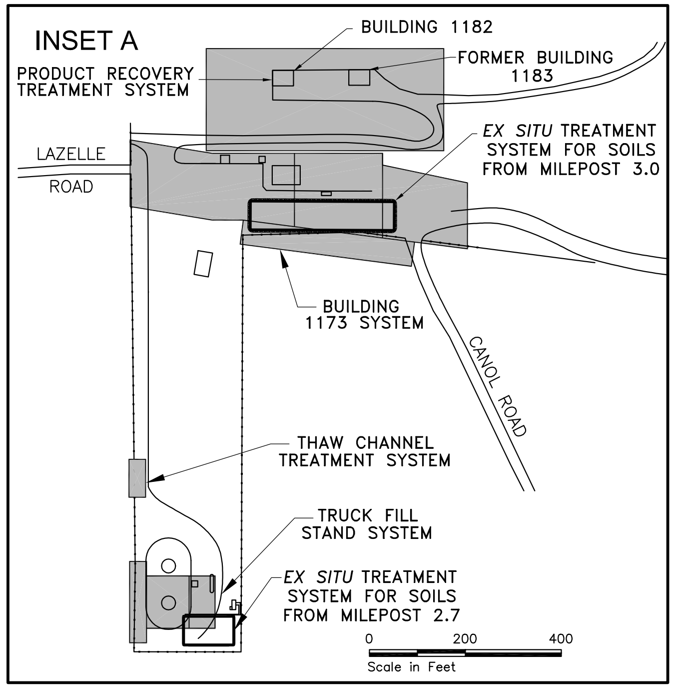
## 1.3 Statutory Authority

This ESD was prepared in accordance with Section 117(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and 40 CFR Section 300.435(c)(2)(i) and 300.825(a)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

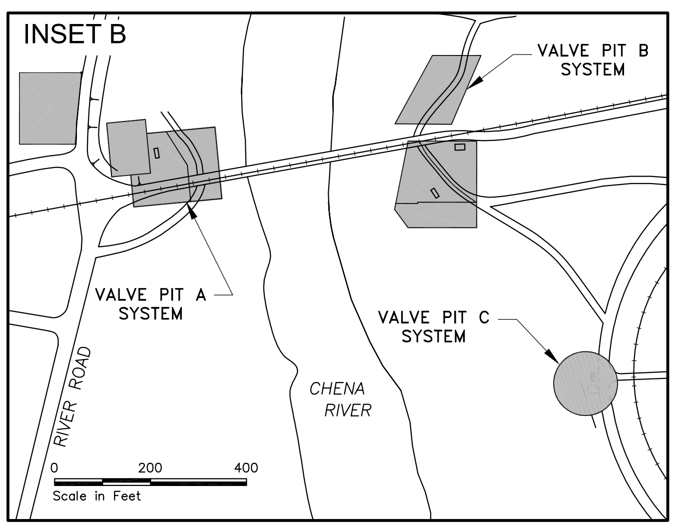
## 1.4 Administrative Record

This ESD will become part of the Administrative Record for Fort Wainwright, as required by Section 300.823(a)(2) of the NCP. The Administrative Record is available for public review at the following locations:

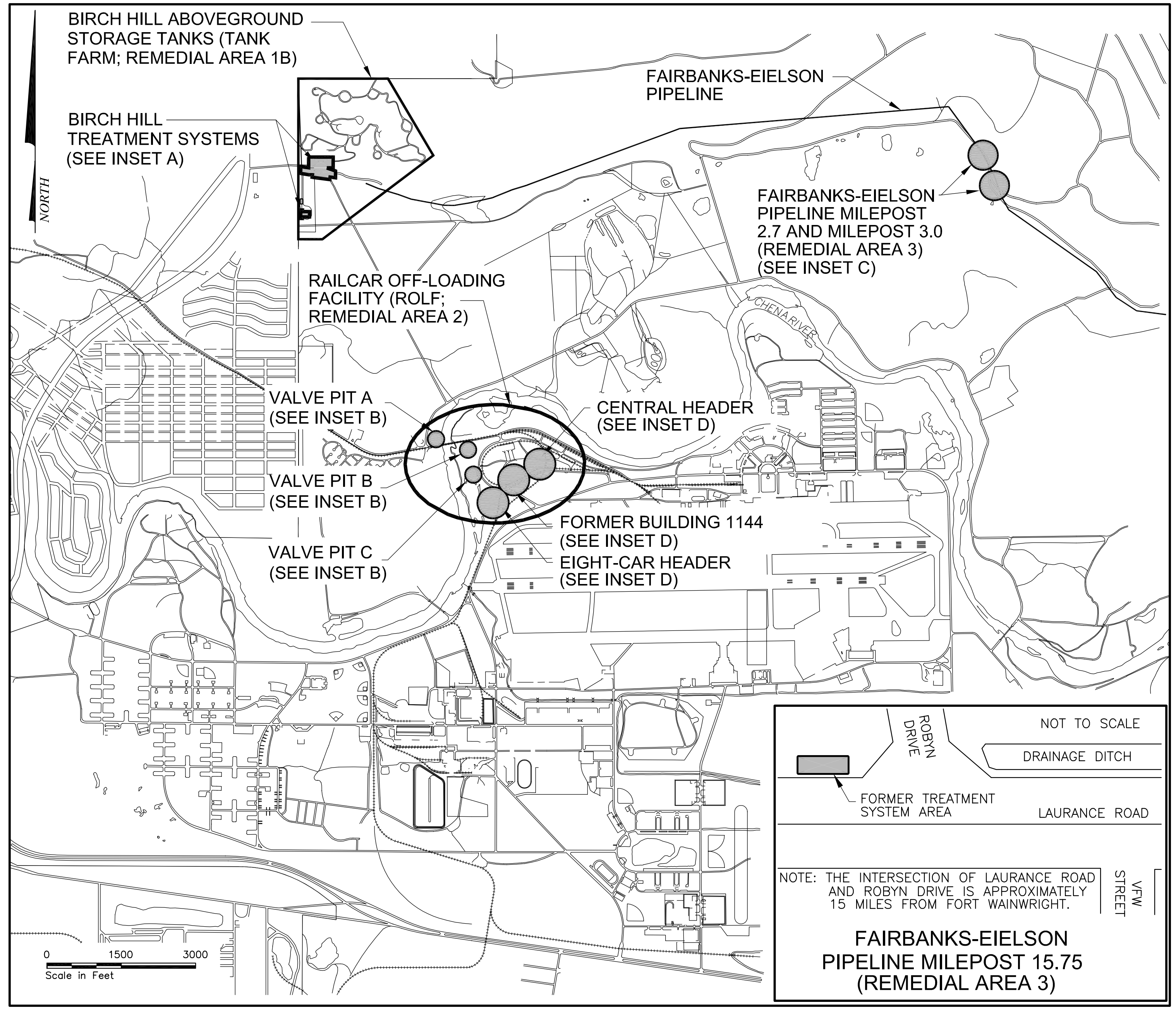
- Building 3023 on Fort Wainwright;
- Fort Wainwright Post Library; and,
- Noel Wien Library, 1215 Cowles Street, Fairbanks, Alaska



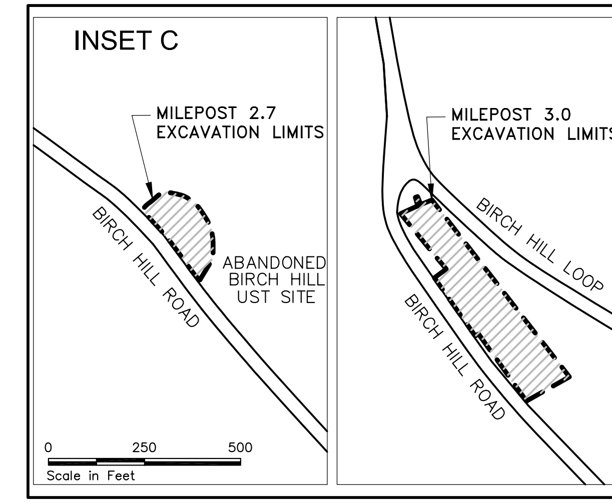

REMEDIAL AREA 1B BIRCH HILL TANK FARM TREATMENT SYSTEMS



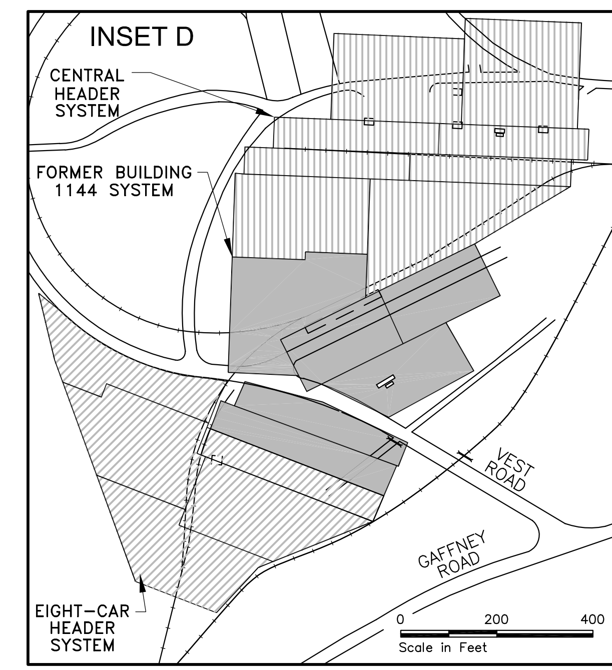

REMEDIAL AREA 2 VALVE PITS A, B, AND C




SITE VICINITY MAP




REMEDIAL AREA 3 FAIRBANKS-EIELSON PIPELINE MILEPOST 2.7 AND 3.0




REMEDIAL AREA 2 CENTRAL ROLF: CENTRAL HEADER, FORMER BUILDING 1144, AND EIGHT-CAR HEADER

| FAIRBANKS ENVIRONMENTAL SERVICES<br>748 GAFFNEY ROAD, SUITE 200<br>FAIRBANKS, ALASKA | ALASKA DISTRICT<br>CORPS OF ENGINEERS<br>ANCHORAGE, ALASKA |
|---|---|

## System Location Map

Explanation of Significant Differences
Operable Unit 3
Fort Wainwright, Alaska

| CONTRACT: | FIGURE: | DATE: |
|---|---|---|
| DACA85-01-C-0018 | 1 | 8/02 |

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# 2.0 OPERABLE UNIT 3 OVERVIEW

## 2.1 OU3 Site, Name, Location, and History

Fort Wainwright is located on the eastern edge of Fairbanks, in the Fairbanks-North Star Borough, in interior Alaska. The 915,000-acre site includes the main Post area, a range complex, and two maneuver areas. Areas at Fort Wainwright where active investigative and remedial activities associated with past releases of hazardous substances have occurred have been divided into five Operable Units (OUs). The OU's have been further subdivided into remedial areas (source areas) that have been grouped together to facilitate proper management and remedial action. Each OU is addressed in a separate ROD.

## 2.2 OU3 Record of Decision

OU3 was the first Fort Wainwright OU to reach a ROD. That ROD was signed on April 9, 1996 and initially addressed four remedial areas (as depicted on Figure 1):

1. Remedial Area 1a: Lead-contaminated soils near ASTs within Birch Hill Tank Farm (Remedial Area 1a was transferred to OU5. The RPMs agreed to defer selection of a final remedy because additional time was required to select an appropriate cleanup level and remediation goal for lead in soil.);

2. Remedial Area 1b: Area below Birch Hill Tank Farm and around the Truck Fill Stand;

3. Remedial Area 2: Valve Pit A, Valve Pit B, Valve Pit C, and the ROLF; and,

4. Remedial Area 3: Milepost 2.7, 3.0, and 15.75 of the Fairbanks-Eielson Pipeline.

The RAOs described in the ROD remain unchanged by this ESD and are as follows:

*Groundwater*

- Restore to drinking water quality within a reasonable time;
- Reduce further migration of contaminated groundwater; and,
- Prevent use when concentrations exceed Safe Drinking Water Act levels.

*Soil*

- For petroleum-contaminated soil, prevent migration of contaminants from soil into groundwater that would result in groundwater contamination and exceedance of Safe Drinking Water Act standards.

The Applicable or Relevant and Appropriate Requirements (ARARs) established in the ROD for OU3 are not changed by this ESD but are clarified.

### 2.3 Summary of OU3 Significant Differences

Since April 1996 numerous investigative and remedial activities have occurred in order to implement the remedial actions in the ROD. This work resulted in new information that has caused the lead and support agencies to re-evaluate the remedial actions in the ROD. This re-evaluation has resulted in the conclusion that the remedy selected in the ROD will not fully achieve the RAOs without some significant changes in the selected remedy. While the changes are significant, they do not fundamentally alter the remedy selected in the ROD. For Remedial Areas 1b, 2, and 3, this ESD documents the following findings:

- Higher contaminant concentrations than previously identified in all source areas;
- Larger extent of soil and groundwater contamination at all source areas;
- Discovery of significant contamination in fractured bedrock aquifer at Remedial Area 1b;
- An increase in the cost of the overall remedial actions resulting from the requirement for additional and more extensive treatment systems;
- Treatability studies at Milepost sites demonstrated that air sparge/soil vapor extraction (AS/SVE) systems were ineffective due to low-permeability soils and permafrost; and,
- A need to conduct additional characterization of source areas

These findings and the subsequent changes in the Remedial Areas resulting from these findings are presented in Sections 3-5 of this ESD. The following changes are common to all three Remedial Areas:

Clarification of Institutional Controls

A facility-wide institutional control policy was established in the OU5 ROD for Fort Wainwright. This policy documents the general requirements the Army will undertake at Fort Wainwright to ensure effective institutional controls for OU3. Further details of the Army/Fort Wainwright IC policy can be found in the OU5 ROD, the U.S. Army Alaska Institutional Controls Standard Operating Procedures [APVR-RPW [200-1]], and February 2002 Memorandum on Institutional Controls [APVR-RPW-EV-[200-1c]] from Major General James J. Lovelace, Fort Richardson, Alaska. These requirements are incorporated by reference in their entirety into this ESD. The facility-wide institutional control requirements establish the procedures and processes the Army will use to develop, implement, and monitor the site-specific institutional control requirements.

Implementation of Exit Strategy

The Operations and Maintenance (O&M) Manuals for OU3 describe the conditions under which various pieces of treatment equipment comprising the remedial actions covered in the ROD and this ESD are managed, maintained, operated, and turned on and off. Modification of the O&M Manuals will be made in accordance with the process described in the following paragraphs.

Operation of the systems will be evaluated annually by the project managers and continue until the RAOs are achieved. The project managers will review the operating characteristics of the remediation systems and determine whether they are performing as intended, continuing to make progress toward achieving the RAOs, and further, whether these systems are operating efficiently and cost-effectively. This information will be used by USARAK to develop an exit strategy that is consistent with the ROD and Federal Facility Agreement. The Army is currently developing an exit strategy evaluation process known as Cleanup Operations and Site Exit Strategy (CLOSES).

Based on the results of the annual evaluation, the project managers will set the operating parameters of the remediation systems for the next year. The Army will then operate the treatment systems as agreed over the coming year, making adjustments as they consider reasonable and in accordance with agreements made during the last annual evaluation. If the project managers can not reach concurrence on the operating parameters of the treatment systems, long term monitoring and/or site closeout, operating parameters previously agreed to will be followed until the issue is resolved in accordance with the dispute resolution procedures incorporated in the Federal Facility Agreement.

Clarification of Trimethylbenzenes (TMB's)

The remedial goals for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene are based on an RBC equivalent to a noncancer hazard quotient of 1 using a residential groundwater exposure assumption. The values established in the ROD were erroneously selected from the wrong column in the Region 3, RBC tables. The values listed in the ROD for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene, 0.014 mg/l and 0.012 mg/l, respectively, correspond to an inhalation pathway. The residential groundwater assumptions in the RI/FS correspond to a remedial goal of 1.85 mg/l for both compounds.

Clarification of ARAR's Identified as Relevant and Appropriate

- **18 AAC 78 - Alaska Underground Storage Tanks Regulations** are derived from the following federal regulations.

  **40 CFR Part 280 Subpart F: Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST).** The primary applicable requirements to this ESD are the release response and corrective action for UST Systems Containing Petroleum or Hazardous Substances. The actions outlined in this ESD will meet these requirements through the CERCLA remedy.

  **40 CFR Part 261: Identification and Listing of Hazardous Waste.** Part 261 contains RCRA definitions and criteria for identifying hazardous waste. The primary applicable requirement to this ESD is the exclusion allowed under 261.4(b)(10). Petroleum- contaminated media and debris that fail the test for the Toxicity Characteristic of '261.24 (Hazardous Waste Codes D018 through D043 only) are subject to the corrective action regulations under 40 CFR Part 280.

- **18 AAC 70 - Alaska Water Quality Standards (AWQS)**

The AWQS, 18 AAC 70, describes the water quality criteria for all waters and sediments of the State; however, 18 AAC 70.005 describes the nonapplicability of the groundwater provisions as:

**18 AAC 70.005 - Nonapplicability of Groundwater Provisions**

(a) Except as provided in (b) of this section, the provisions of this chapter that are applicable to groundwater do not apply to a response action, a cleanup, or a corrective action approved by

(1) the department under 18 AAC 60.440, 18 AAC 60.860, 18 AAC 75, or 18 AAC 78, except as this chapter is specifically made applicable by 18 AAC 60, 18 AAC 75, or 18 AAC 78; or

(2) the United States Environmental Protection Agency under 42 U.S.C. 9601-9675 (Comprehensive Environmental Response, Compensation, and Liability Act of 1980) or 42 U.S.C. 69-6992k (Solid Waste Disposal Act, as amended by the Resource Conservation Recovery Act), if the response, cleanup, or corrective action meets, at a minimum, the site cleanup rules at 18 AAC 75.325-18 AAC 75.390.

This section does not affect the application of this chapter to contaminated surface water and sediment. (Eff 1/22/99, Register 149) Therefore, the AWQS do not directly apply to the groundwater at Fort Wainwright; however, they do still apply to the surface water. In 18 AAC 70.040, the procedure for applying the water quality criteria at the boundary between waters of two different use classes (i.e. groundwater and fresh water) is described as follows:

**18 AAC 70.040**

(2) at the boundary between waters protected for different use classes under 18 AAC 70.050 or 18 AAC 70.230 (e), the water quality criteria for the most stringent use class will apply.

Also, the oil and hazardous substances pollution control regulations (18 AAC 75), which regulate cleanup of contaminated sites, indicates in 18 AAC 75.345 (f) that "groundwater that is closely connected hydrologically to nearby surface water may not cause a violation of the water quality standards in 18 AAC 70 for surface water or sediment." Therefore, this ARAR is applicable to portions of Remedial Area 2 where groundwater is hydrologically connected to surface water.

# 3.0 REMEDIAL AREA 1b - BIRCH HILL TANK FARM

## 3.1 Remedial Area 1b – Location and Background

Location

Remedial Area 1b (Birch Hill Tank Farm) extends south from the base of Birch Hill to the Truck Fill Stand (TFS) and extends west toward Lazelle Road and east toward the Canadian Oil Pipeline (CANOL) service road (see Figure 1). The Tank Farm is located north of the main cantonment area.

History

The facility was originally constructed as part of the 1943 CANOL Project. The CANOL project involved the construction of a 3-inch pipeline from Whitehorse to Fairbanks. The Tank Farm originally consisted of fourteen 10,000-barrel-capacity, bolted-steel, above ground fuel tanks on top of Birch Hill which contained JP-4, mogas, and diesel fuels. These fourteen tanks were connected by an 8-inch pipeline to the ROLF (Remedial Area 2) and the East Birch Hill UST Tank Farm (EBHTF) near the Milepost sites (Remedial Area 3).

A post ROD historical search indicated that a pump house with a slop tank was located at the base of Birch Hill. This is believed to be the major source of contamination at the Building 1173 sub-area. The pump house was used until 1955 when the Haines to Fairbanks pipeline was built. In 1955, as part of the new Haines Pipeline, two 25,000 barrel tanks, the Truck Fill Stand, and a new pump house and manifold building were built.

Physical Characteristics

This area is located in the Chena River floodplain and is characterized by flat topography that gently slopes southward. The subsurface is typified by discontinuous permafrost and poorly drained soils covered by thick organic mats. Surface water ponding is common throughout the area from spring breakup until early to mid-summer. Wetlands are scattered throughout the area and shrub and forested wetlands border the southern portion of the Tank Farm. The Tank Farm Source Area has two distinct hydrogeologic areas: 1) the Birch Creek schist bedrock aquifer located at Birch Hill, which includes the area beneath the aboveground storage tanks (ASTs); and 2) the alluvial aquifer located at the base of Birch Hill (with discontinuous permafrost located south and west of the TFS), which includes private property, the Bentley Trust Property and Church property.

Birch Hill consists of loess overlaying Birch Creek schist. Groundwater flow in the bedrock aquifer at the Tank Farm is expected to occur mainly in fractures and to flow to the south southwest. The presence, location, and extent of permafrost from the base of Birch Hill southward to the Chena River significantly affect the groundwater flow direction in this part of the Tank Farm source area. Groundwater occurs in two zones above and below the permafrost in the alluvial aquifer. The suprapermafrost groundwater zone is the saturated zone above permafrost. The subpermafrost groundwater zone is the saturated zone beneath the permafrost. Groundwater occurs at approximately

20 to 22 feet below ground surface (bgs) in the alluvial aquifer at the base of Birch Hill.

Groundwater in the alluvial aquifer generally flows to the west. Shallow discontinuous permafrost south and west of the TFS area may channel groundwater into thawed corridors that occur in meander scars, and a hydraulic connection may exist between the suprapermafrost groundwater zone in the thawed areas and the subpermafrost groundwater zone.

Land and Resource Use

The current land use is considered light industrial in the immediate Remedial Area and light industrial, recreational, and residential in the surrounding areas. The groundwater below Remedial Area 1b is not currently a source of drinking water. The closest drinking water wells to the Tank Farm Source Area (although not currently in use) are located at the Shannon Park Baptist Church and Steese Chapel on Lazelle Road, approximately 1/4 miles west of the Tank Farm.

Historically, 1,2-dichloroethane (DCA) has been detected at concentrations slightly above the maximum contaminant level (MCL) in the Shannon Park Baptist Church well, although it has been below the MCL in every sampling event since 1999. There is no record of DCA concentrations exceeding the MCL in the Steese Chapel well. In response to the presence of DCA in these wells, the Army began supplying bottled water to both churches in February 1995. During the annual project managers' evaluations described in Section 2.3, the project managers will evaluate the need to provide drinking water to the Shannon Park Baptist Church and Steese Chapel. The evaluation will be based on decreasing trends in contaminant concentrations in these off-Post wells (see figure in Section 3.4) and the project managers' best professional judgment, based on both monitoring and modeling results.

### 3.2 Summary of Contamination

The primary sources of contamination at Remedial Area 1b are associated with fuel storage, transfer, and handling activities at the Fairbanks Fuel Terminal (FFT) and the TFS. A majority of the contamination within the bedrock resulted from releases while receiving fuels from Haines Terminal, cleaning and dewatering of ASTs and operational spills. At the Truck Fill Stand, the majority of contamination was due to spills during truck filling activities and operational spills. USTs located at the base of the hill are thought to be a source of petroleum contamination through spills and overfilling or leaking.

The RI for Remedial Area 1b focused mainly on the alluvial aquifer at the base of Birch Hill. This area was characterized by only seven monitoring wells located at the base of Birch Hill and six at the Truck Fill Stand. At the time of the RI, no wells or deep borings were installed on Birch Hill; thus, free product within the bedrock aquifer was missed. Post ROD activities, which identified the free product, have led to the addition of a sub-area known as the Birch Hill Product Recovery System.

Two of the sub-areas investigated during the RI/FS indicated no remedial action was required. The Shannon Park Subdivision sub-area and the CANOL Road sub-area were both recommended for no further action in the OU3 ROD.

Investigations prior to and during the RI characterized petroleum hydrocarbon contamination associated with Remedial Area 1b as follows: benzene, toluene, ethylbenzene, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene were detected in groundwater within the alluvial aquifer at the base of Birch Hill and in the TFS area in concentrations exceeding federal drinking water MCLs and EPA risk based concentrations used for screening potential contaminants of concern. DCA has been detected in off-Post wells at or below MCL.

### 3.3 Remedy Selected in the ROD

The remedial action in the ROD is generic to all source areas with specific design criteria to be incorporated at the time of implementation. The selected remedy for Remedial Area 1b was necessary for the following reasons:

- Benzene was detected above Safe Drinking Act levels in groundwater,
- Proximity to site boundary, residential drinking water wells and Class A public water supply system, and
- The need to reduce contaminant migration of soil to groundwater.

For Remedial Area 1b the selected remedial action is soil vapor extraction of petroleum-contaminated soil and air sparging of petroleum-contaminated groundwater in permafrost-free areas to achieve Safe Drinking Water Act levels and natural attenuation to meet Alaska Water Quality Standards. The OU3 ROD also specified that due to different site conditions, site specific design information would be collected in a pilot study. In addition, during implementation or operations of systems, if the remedy is not effective or contaminant levels cease to decline, the system performance and/or the remedy may be re-evaluated. Modifications may be implemented by the project managers and may include installation of treatment units. The remedy also included institutional controls to restrict access and development of the site and long-term groundwater monitoring.

At Remedial Area 1b, periodic off-Post sampling of two church wells is being conducted while remedial activities at OU3 are on-going. If contaminant levels increase above MCLs in the drinking water wells located at two churches west of the Tank Farm, and if contamination is clearly demonstrated to originate from the Tank Farm, the Army agreed to provide a permanent replacement water supply to the two churches (U.S. Army [page 115], 1996). Although contaminant levels are below MCL's in wells located at the churches, the Army has been providing water to both Churches since 1995 and will continue to do so until a decision is made otherwise during an annual project managers' evaluation.

Cleanup Goals

Based on the results of the baseline risk assessment for current (at the time of the ROD) and projected land use at the site, contaminants of concern were identified for establishing numeric cleanup goals for Remedial Area 1b as follows (U.S. Army [Section 7.3.1], 1996):

*Groundwater*

Federal and State of Alaska drinking water MCLs were adopted as groundwater cleanup goals for benzene, toluene, ethylbenzene, 1,2-dibromoethane (EDB), and DCA. The cleanup goals for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene were based on an RBC equivalent to a noncancer hazard quotient of 1 using residential groundwater exposure assumptions, since there were no MCLs for these contaminants at the time of the ROD.

*Soil*

The remedial action goal for *in-situ* soils contaminated with volatile organic and petroleum compounds is protection of groundwater. The ROD stated that since soils are acting as a continuing source of contamination to the groundwater, active remediation of the soils will continue until Safe Drinking Water Act levels are consistently met. AWQS will be achieved through natural attenuation. The ROD also stated that petroleum-contaminated soils that are treated *ex-situ* will be treated to State of Alaska Matrix Level A standards before they are returned to the source area.

<u>Status of Remediation by Sub-Area</u>

Remedial Area 1b was originally subdivided into sub-areas based on geographic location and differing physical characteristics. The Birch Hill Product Recovery System sub-area is new and was not identified in the OU3 ROD. A summary of contaminant remediation at each sub-area is provided below.

*Lazelle Road Sub-Area*

An air sparging (AS)/soil vapor extraction (SVE) treatment system was installed in 1996 to remove volatile organic compounds (VOCs) and to prevent contaminated soils from acting as an ongoing source of contamination to groundwater. Air sparging wells were placed in areas of highest contamination (hot spots). The Lazelle Road treatment system was removed in 1997 and the treatment area was incorporated into the 1173 sub-area system.

*Building 1173 Sub-Area*

In 1996 at Building 1173 Sub-Area, an AS/SVE treatment system was installed to remove VOCs and to prevent contaminated soils from acting as an ongoing source of contamination to groundwater. In 1997 this system was expanded in size to treat additional contaminated areas. In addition, an oxidizer was installed to reduce atmospheric emissions. As of 2001 the treatment system has removed over 73,289 pounds of VOC.

*Truck Fill Stand Sub-Area*

In 1997 an AS/SVE system was installed in the area of the Truck Fill Stand for the removal of VOCs in groundwater and to prevent contaminated soils from acting as an ongoing source of contamination to groundwater. As of 2001 the treatment system has removed over 5,194 pounds of VOCs.

*Thaw Channel Sub-Area*

In 1999, an AS treatment system was installed as part of a treatability study to reduce contaminants migrating off-Post through a permafrost thaw channel. This system has been effective and was retained as part of the remedy for this remedial area. Groundwater monitoring locations associated with this treatment area include on-Post wells downgradient of Birch Hill, wells on Bentley Trust Property (adjacent to the Post boundary), and two drinking water wells at Shannon Park Baptist Church and Steese Chapel.

*Birch Hill Tank Farm Product Recovery System*

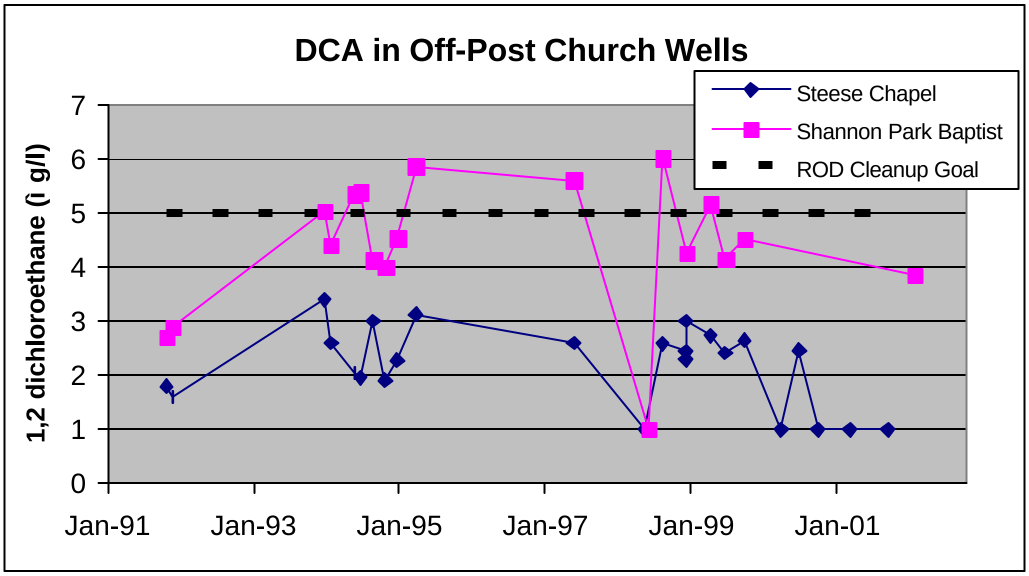
Floating product was discovered in large amounts during the 1998 field season on Birch Hill. In 1998 active and passive skimmers were installed in various wells located on the hill. In 1999 a pilot scale recovery system was installed in new wells. During the summer and fall of 2000 a product recovery system was constructed on Birch Hill. This sub-area was not a part of the OU3 ROD but is established as part of this ESD. The product recovery system continues to operate and approximately 4,000 gallons have been recovered by the combined efforts.

### 3.4 Basis for the Significant Differences

The characterization of soil and groundwater contamination at the Birch Hill Tank Farm has been complicated by permafrost blocks that partially control groundwater flow in the area. The difficulty of characterizing the soil and groundwater contamination during the RI contributed to an underestimation of the nature and extent of contamination in this area. Prior to the ROD, the permafrost distribution was inferred from limited available borehole geological data, preliminary studies of historical aerial photography, and vegetation and terrain analysis. Since the ROD, numerous geophysical surveys, such as ground penetrating radar and direct current (DC) resistivity, have helped refine the interpretation of permafrost distribution between boreholes. As a result, the permafrost configuration and groundwater flow characteristics are better understood. Figure 2 compares inferred deep and shallow permafrost distributions developed in 1995 to the current understanding of permafrost areas throughout the Tank Farm.

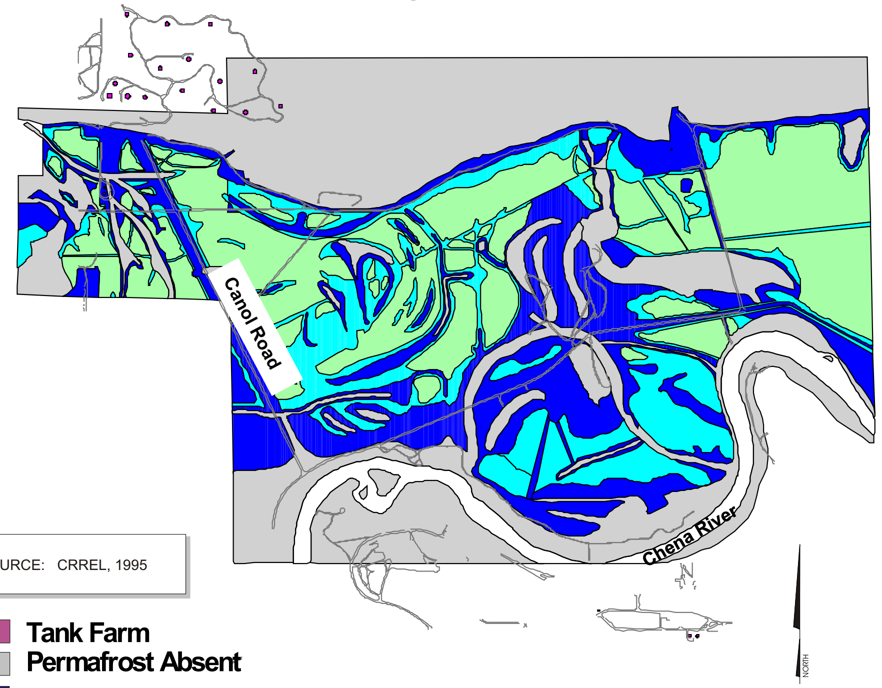
Post ROD studies have shown a three to four times greater aerial extent of contamination in the alluvial aquifer, including areas of free product (weathered AVGAS) and elevated groundwater plume concentrations. Additionally, contamination was found within the Birch Hill bedrock aquifer both as free product and in the dissolved phase in the groundwater. Both DCA and EDB were identified at elevated concentrations in the bedrock aquifer.

Further investigations indicated that dissolved contaminants measured off-Post are likely migrating in groundwater that comes in contact with free product identified in the fractured bedrock on Birch Hill. A product recovery system was installed on Birch Hill in 2000 and modified in 2001 to recover product and reduce the potential for off-Post migration of contaminants. Contamination still remains in off-Post wells, but at levels below the MCL. Concentrations of DCA in the church wells are presented below.

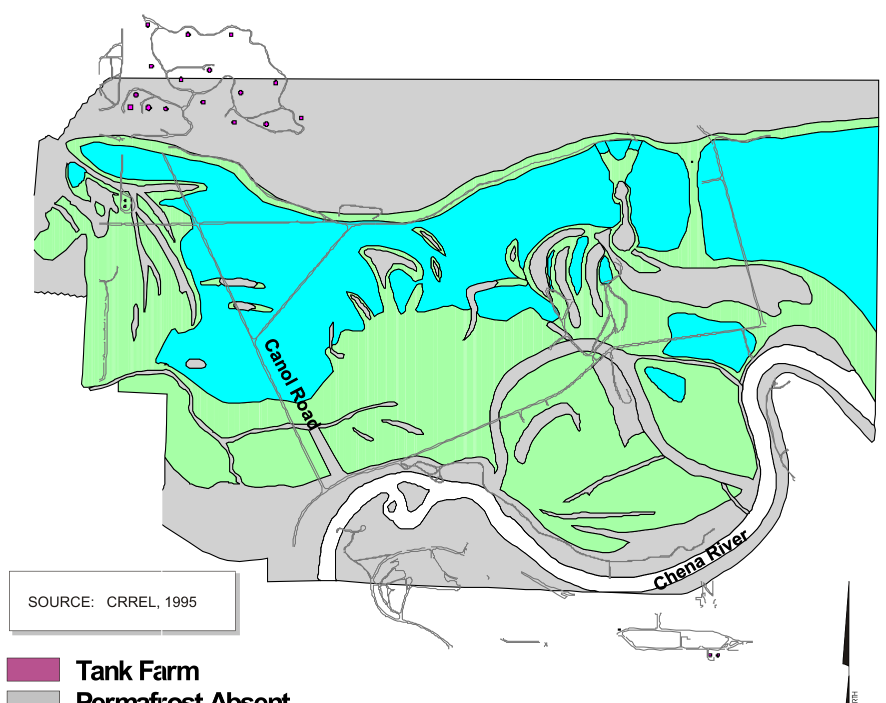



Figures 3, 4, and 5 show the aerial extent of benzene, EDB, and DCA, respectively, identified (post-ROD) throughout both the alluvial and bedrock aquifers and the reduction in contaminant plume areas since treatment began. Table 3-1 identifies contaminants of concern and their respective concentrations that were detected pre-ROD versus post-ROD and compares the pre-ROD estimated treatment system requirements to the actual installed systems.

## Pre-ROD Understanding of Permafrost Distribution

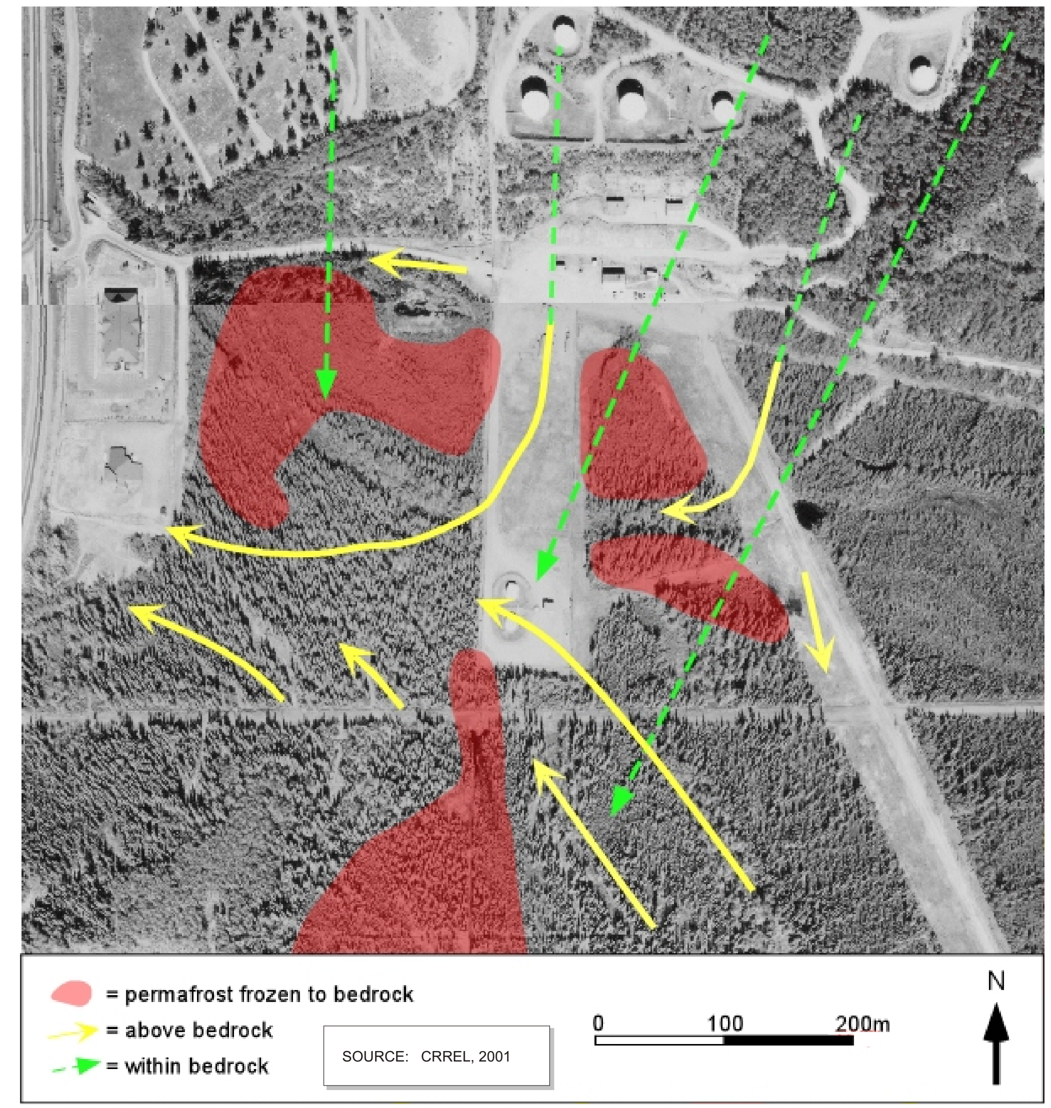



(a.) Distribution of permafrost showing characteristic depths of thaw in the shallow permafrost zones.




(b.) Distribution of deep permafrost and aquifer conditions.

## Current Understanding of Permafrost Distribution

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**Permafrost Drawings**
Birch Hill Tank Farm
Explanation of Significant Differences
Operable Unit 3
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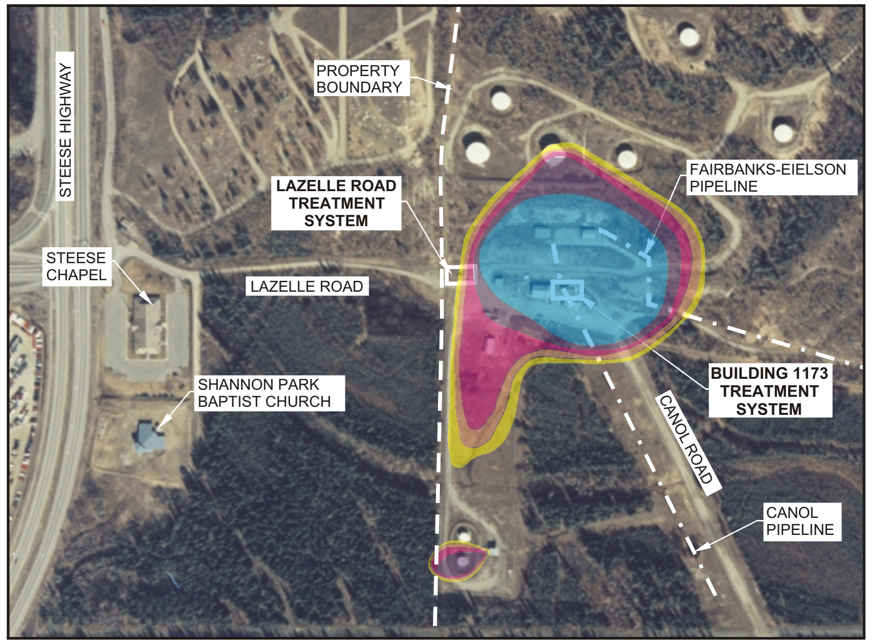
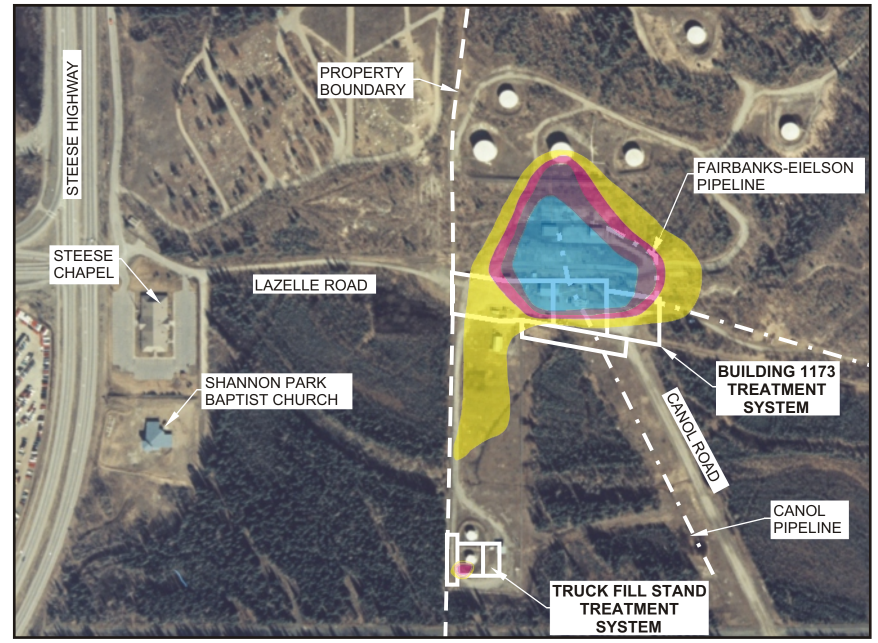
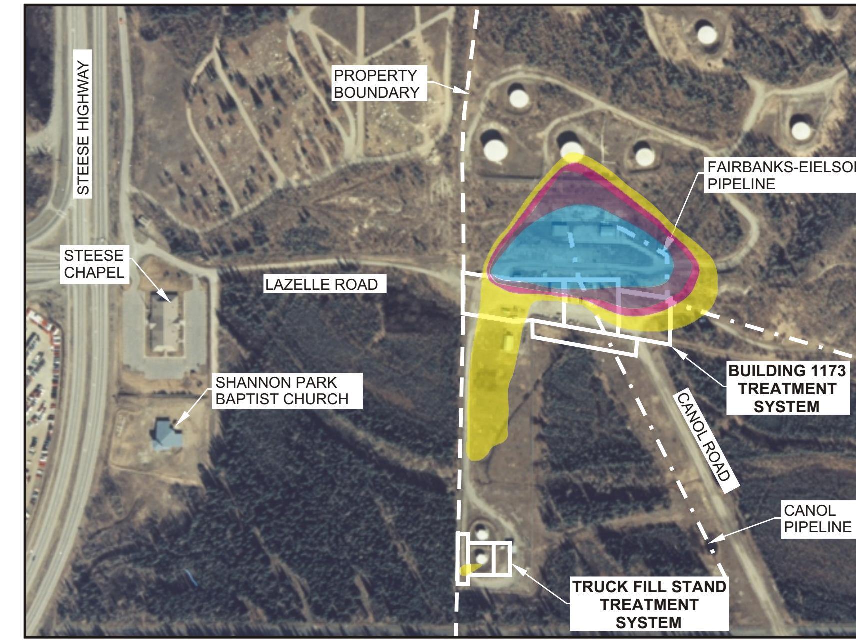


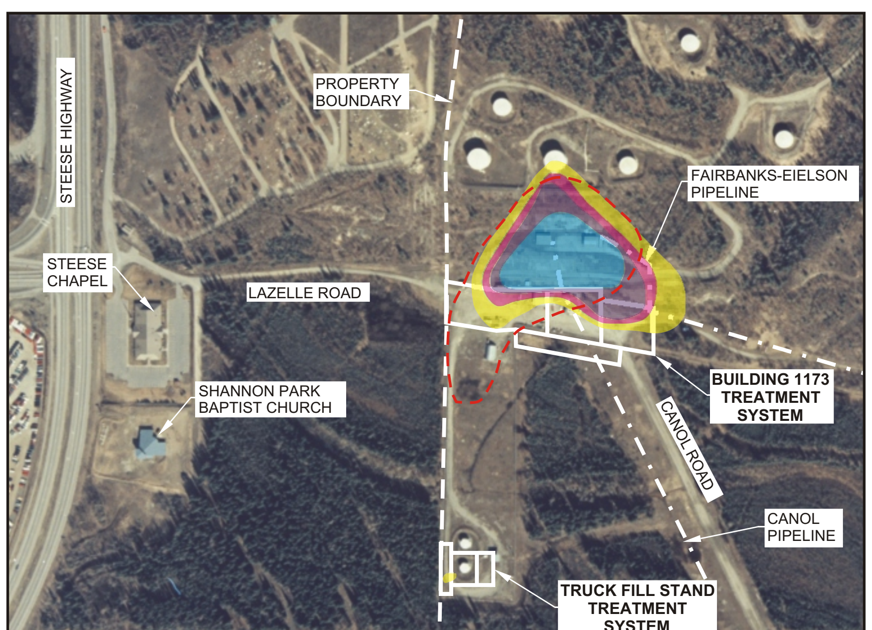

*Prior to Treatment 1996-1997*




*Fall 1998*




*Fall 1999*

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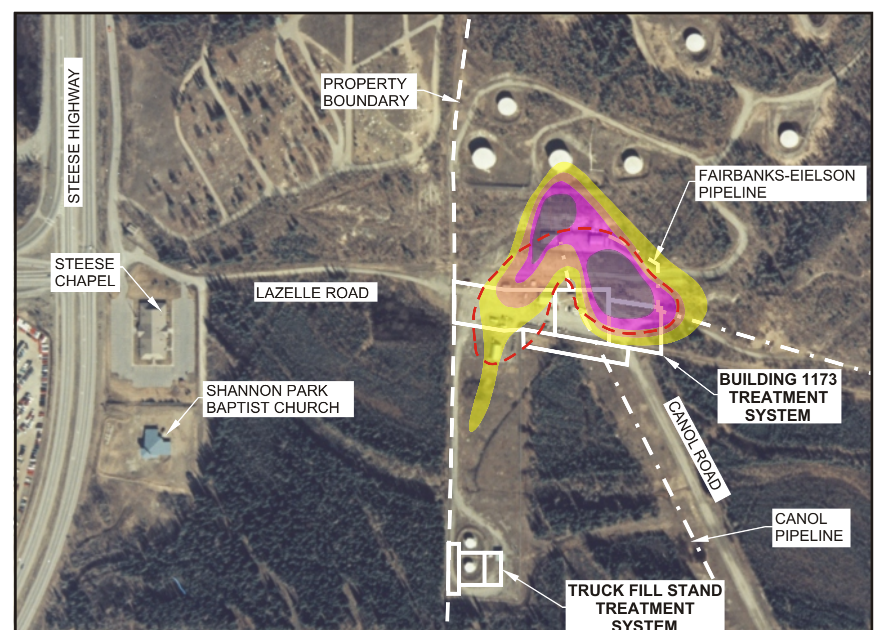


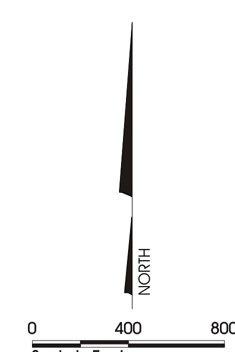

*Fall 2001*

LEGEND

- µg/L MICROGRAMS PER LITER
- APPROXIMATE EXTENT OF 5 µg/L BENZENE PLUME
- APPROXIMATE EXTENT OF 50 µg/L BENZENE PLUME
- APPROXIMATE EXTENT OF 100 µg/L BENZENE PLUME
- APPROXIMATE EXTENT OF 1,000 µg/L BENZENE PLUME
- APPROXIMATE EXTENT OF PRODUCT PLUME
- APPROXIMATE EXTENT OF TRIMETHYLBENZENES

NOTE: EXTENT OF BENZENE ON BIRCH HILL IS ESTIMATED FOR 1996-1997 BASED ON INFORMATION OBTAINED FROM WELLS INSTALLED IN 1998.

SOURCE: AEROMAP U.S., MAY 7, 1997

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**Benzene Plume Reduction from 1996 to 2001**

Birch Hill Tank Farm
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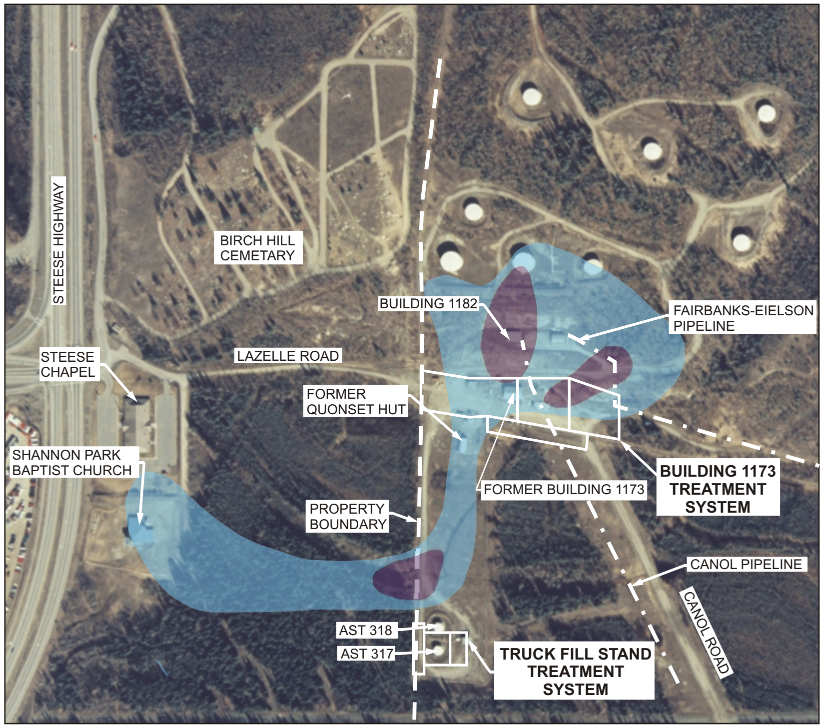
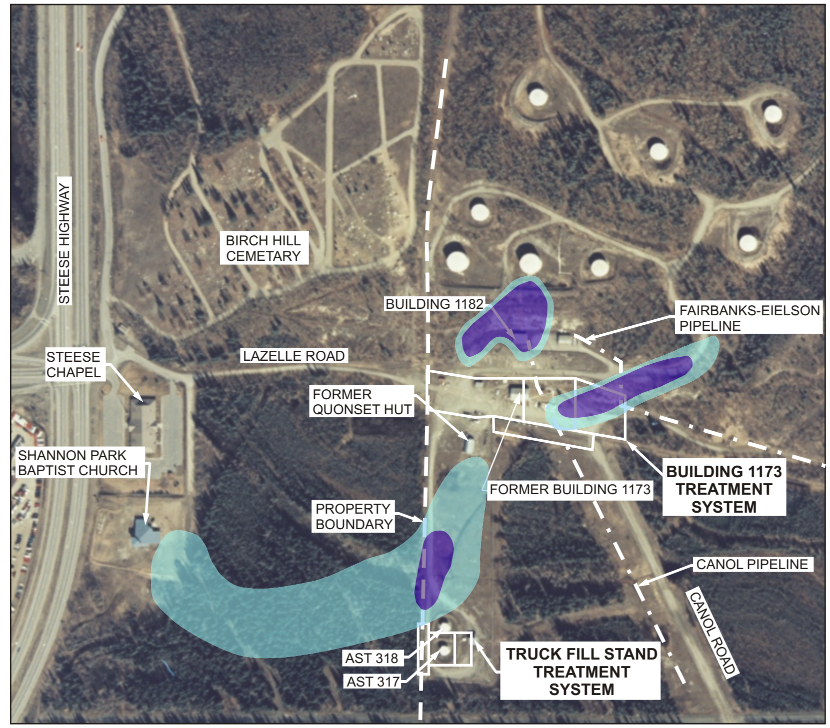



***DCA Plume 2000***




***DCA Plume 2001***

SOURCE: AEROMAP U.S., MAY 7, 1997

NORTH

0 600 1200

Scale in Feet

LEGEND

| | |
|---|---|
| μg/L | MICROGRAMS PER LITER |
| (light blue) | APPROXIMATE EXTENT OF DCA PLUME |
| (purple) | APPROXIMATE EXTENT OF DCA PLUME WITH CONCENTRATIONS ABOVE 5 μg/L |

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# DCA Concentrations at the Birch Hill Tank Farm

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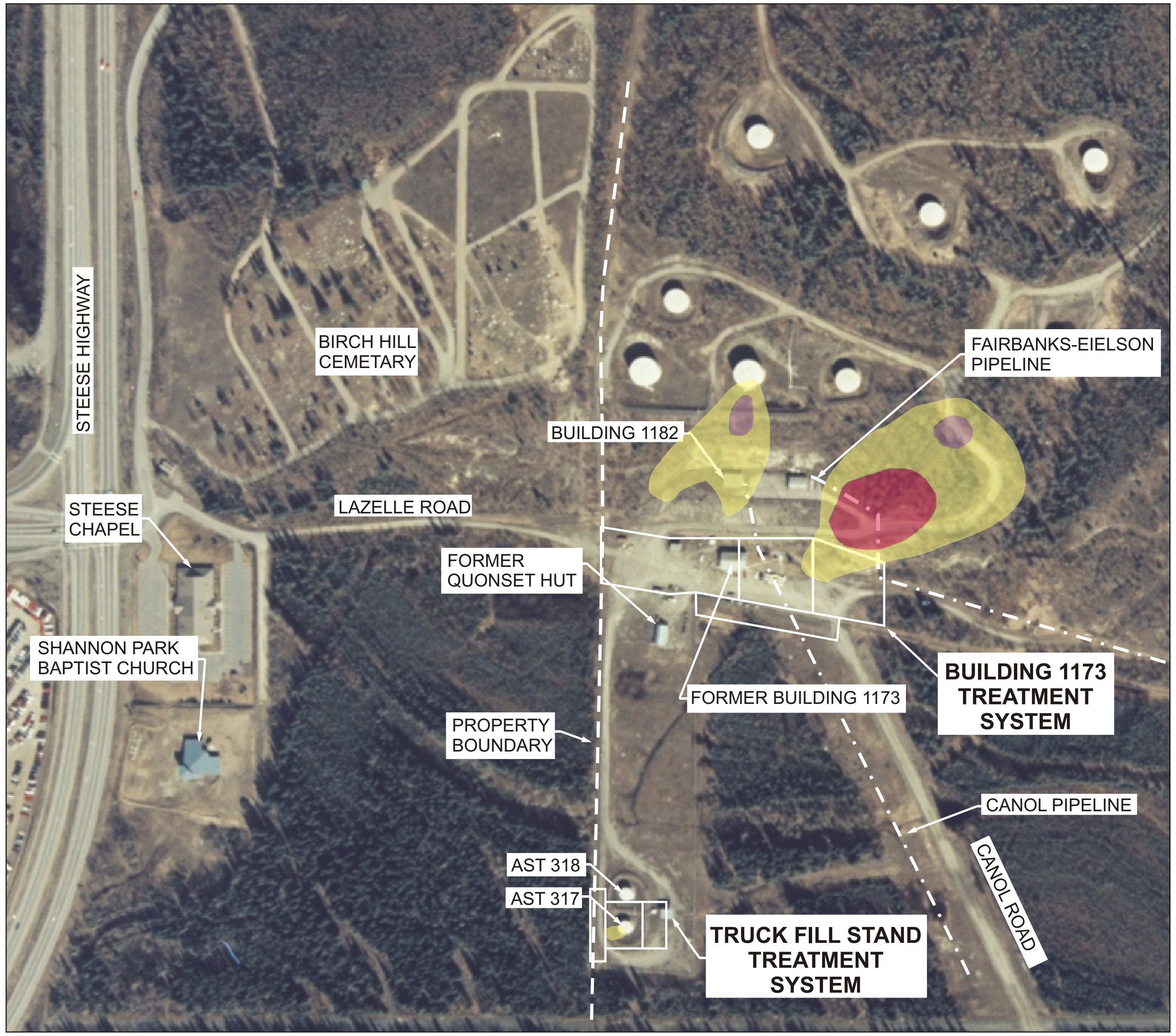
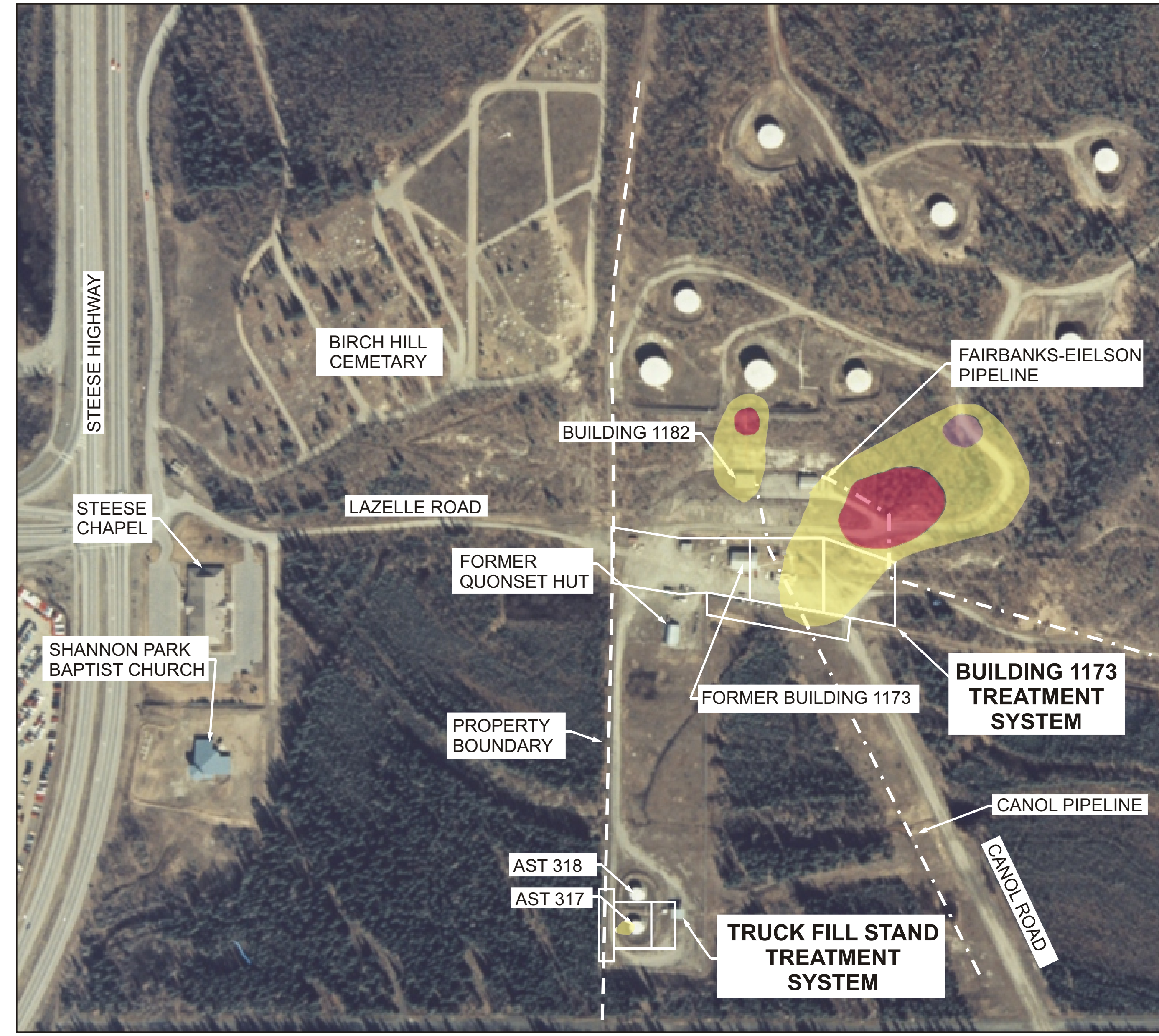



***EDB Plume 2000***




***EDB Plume 2001***

NORTH

0 350 750

Scale in Feet

LEGEND

µg/L MICROGRAMS PER LITER

APPROXIMATE EXTENT OF EDB PLUME ABOVE REMEDIAL ACTION GOALS

APPROXIMATE EXTENT OF EDB PLUME WITH CONCENTRATIONS ABOVE 10 µg/L (HOT SPOT)

APPROXIMATE EXTENT OF EDB PLUME WITH CONCENTRATIONS ABOVE 100 µg/L (HOT SPOT)

SOURCE: AEROMAP U.S., MAY 7, 1997

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**EDB Concentrations at the Birch Hill Tank Farm**

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**Table 3-1 – Pre vs. Post ROD Comparisons for Birch Hill Tank Farm**

| Site | COC | Pre-ROD | | Post-ROD | |
|---|---|---|---|---|---|
| | | Maximum Concentration (µg/L) | Treatment System Proposed | Maximum Concentration (µg/L) | Treatment System Implemented |
| **Birch Hill** | Benzene<br>Toluene<br>Ethylbenzene<br>1,2,4-TMB<br>1,3,5-TMB<br>DCA<br>EDB | NA[1] | No System | 9,300<br>3,200<br>2,520<br>2,330<br>765<br>1,200<br>607 | Dual-phase Product Recovery System |
| **Building 1173 (formerly Lazelle Road)** | Benzene<br>1,2,4-TMB<br>1,3,5-TMB<br>DCA<br>EDB | 150<br>32<br>20<br>ND<br>ND | AS/SVE System | 400<br>405<br>118<br>19.3<br>0.052 | AS/SVE System |
| **Truck Fill Stand** | Benzene<br>Toluene<br>1,2,4-TMB<br>1,3,5-TMB<br>EDB | 11<br>7<br>ND<br>ND<br>ND | AS/SVE System | 5,330<br>1,320<br>70<br>47.3<br>0.537 | AS/SVE System |
| **Thaw Channel** | DCA<br>EDB | 5.4<br>ND | No System | 14.4<br>0.017 | Air Sparge System |

Notes: [1] Investigation of the Birch Hill bedrock aquifer was not conducted prior to the ROD.
ND = Not detected

The detection of free product containing high concentrations of DCA and EDB in the alluvial aquifer at the base of Birch Hill is strongly influenced by groundwater elevations, and as a result free product was not identified in the initial characterization work for the ROD. The complex fractured bedrock in the subsurface below Birch Hill makes it difficult to estimate the volume of free product. Historical records from past operations indicate that millions of gallons of fuel were handled by the Birch Hill Tank Farm. A majority of the contamination within the bedrock aquifer is likely from operational spills during transfer of fuels and dewatering of tanks.

More importantly, free product containing high concentrations of DCA and EDB in the Birch Hill bedrock aquifer is believed to be the major source of groundwater contamination in the alluvial aquifer, including dissolved-phase contamination detected in off-Post wells. Therefore, this ESD requires implementation of remedial activities designed to remove free product from the ground.

### 3.5 Description of Significant Differences for Remedial Area 1b

Specifically, for Remedial Area 1b, this ESD documents the following actions that were not anticipated in the ROD but have been implemented or are planned to be implemented as part of the OU3 ROD and are required pursuant to this ESD. Table 3-1, in Section 3.4, shows the significant differences in the pre-ROD proposed treatment systems compared to the implemented treatment systems.

Enhancement of the AS/SVE Systems

Enhancement and expansion of the AS/SVE treatment systems to cover the larger lateral extent of contamination, including off-gas treatment of the soil vapor extraction exhaust, was implemented. The enhancement and expansion of the AS/SVE systems consists of the following:

- Installation of additional air sparge and vapor extraction probes, groundwater monitoring probes, remote metering enclosures, blower enclosures, and a thermal/catalytic oxidizer (to control off-gas emissions at Building 1173) in order to treat the identified lateral extent of contamination in the alluvial aquifer at the base of Birch Hill;

- Installation of the Thaw Channel treatment system, including an air compressor, air sparge probes, a remote metering enclosure, and associated underground piping, to treat the identified extent of contaminants, enhance biodegradation, and prevent the migration of contaminants off-Post; and

- Operation, maintenance, and monitoring of the expanded treatment systems in accordance with the approved OU3 Operation and Maintenance Manual and subsequent amendments (Hart Crowser, 2001b).

Table 3-2 below presents a comparison of the costs for the original AS/SVE treatment systems proposed in the ROD to the costs of the current expanded systems.

**Table 3-2 – Remedial Area 1b ROD and ESD Cost Comparison (AS/SVE Systems)**

| Cost Category | ROD Cost Estimate (present worth) | ESD Cost Estimate[4] (present worth) |
|---|---|---|
| Capital Cost | $2,600,000 [1] | $1,203,594 |
| Treatment System Operation | 200,000 [2] | 496,801 |
| Monitoring | | 1,216,630 |
| Closure | | 74,729 |
| Administrative (20%) | [3] | 598,351 |
| Contingency (15%) | [3] | 357,025 |
| **Totals** | $2,800,000 | $3,947,128 |

[1] It is assumed capital costs include installation, repair, and closure costs

[2] Operation and monitoring costs were not separated in the ROD

[3] Administrative and contingency costs were not identified in the ROD

[4] From June 2002 Interim Remedial Action Report

A detailed Remedial Area 1b ESD cost estimate is provided as Table A-1 in Appendix A. The ESD estimates that the Remedial Area 1B remedial costs for the enhancement of AS/SVE systems will be approximately forty percent greater than the ROD estimate. This significant difference is attributed to the following:

- Treatment system operation and monitoring costs were significantly underestimated in the ROD;
- Costs associated with the Thaw Channel treatment system were not included in the ROD; and,
- The ROD underestimated the extent and magnitude of contamination in the Building 1173 and Truck Fill Stand sub areas.

Installation of a Product Recovery System

A dual phase product recovery system designed to recover free product and limit the migration of dissolved contaminants into groundwater has been constructed and is operational at Birch Hill. The system adjusts to maximize product recovery under variable groundwater conditions. Operation, maintenance, and monitoring of the product recovery system are conducted in accordance with the approved OU3 Operation and Maintenance Manual and subsequent amendments (Hart Crowser, 2001b). Table 3-3 below presents the costs for the Birch Hill product recovery system; costs for this treatment system were not included in ROD cost estimates.

**Table 3-3 – Remedial Area 1b ROD and ESD Cost Comparison (Product Recovery)**

| Cost Category | ROD Cost Estimate (present worth) | ESD Cost Estimate[1] (present worth) |
|---|---|---|
| Capital Cost | NA | $1,177,262 |
| Treatment System Operation | NA | 1,157,629 |
| Monitoring | | 2,527,074 |
| Closure | NA | 62,799 |
| Administrative (20%) | NA | 984,953 |
| Contingency (15%) | NA | 429,291 |
| **Totals** | | $6,339,009 |

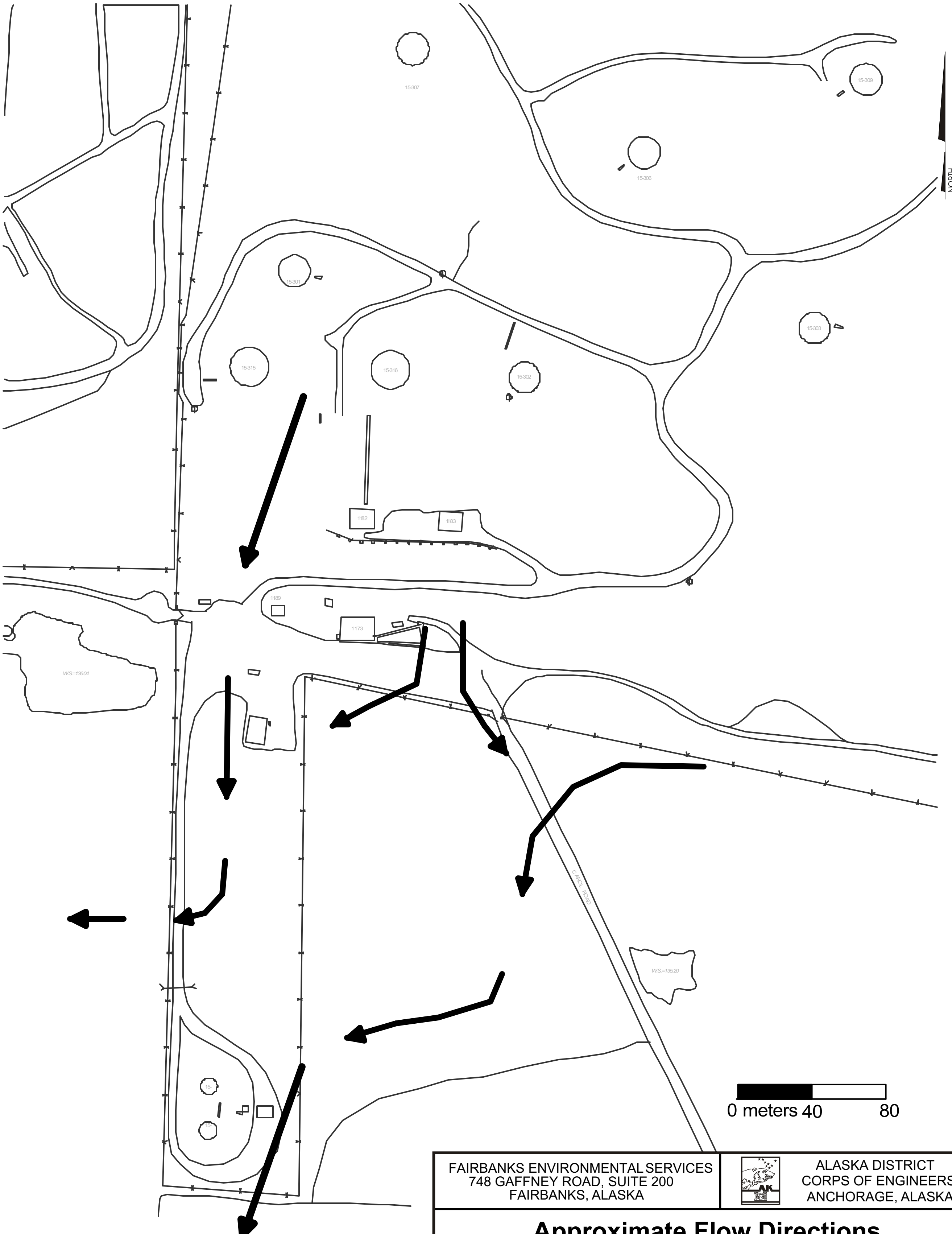
[1] From June 2002 Interim Remedial Action Report

The product recovery system shall consist of the following principal elements:

- Dual-phase free product/groundwater extraction from wells within an area containing the highest concentrations of EDB, DCA, and fuel contaminants;
- Separation of the groundwater/free product mixture;
- Product is to be stored for later disposal in accordance with any applicable ARARs for storage, disposal or reuse, and groundwater shall be treated using an air stripping process, followed by carbon treatment if necessary, with subsequent discharge of groundwater to the shallow alluvial aquifer; and,
- Monitoring of the treated groundwater shall be conducted to make sure it does not exceed the substantive requirements of the State of Alaska general discharge permit for Ft. Wainwright.

Implementation of Groundwater Modeling

Groundwater and permafrost modeling is being conducted to predict groundwater flow around permafrost free areas and establish potential future conditions for the purpose of assessing performance of the remedial action system. Modeling results will not be used to determine whether cleanup standards in groundwater have been achieved in any groundwater monitoring well, but shall instead be used to; 1) evaluate whether the Army's conceptual site model is consistent with groundwater conditions both predicted by the model and found via sampling and analysis efforts, and 2) calculate the expected rate of groundwater movement in order to predict cleanup time frames and whether the implemented remedial actions are achieving the RAOs in accordance with these time frames. Figure 6 shows the current understanding of groundwater flow at the Birch Hill Tank Farm.

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## Approximate Flow Directions

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SOURCE: CH2MHILL, 8/02

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To support the groundwater modeling efforts, monitoring wells have been installed on Birch Hill in fractured bedrock. The modeling results will be used as described above, and shall be used to make decisions related to ongoing operation and maintenance of the selected remedial actions.

Further Characterization of the Birch Hill Area

Additional characterization at Birch Hill is necessary to better understand contaminant transport pathways in the bedrock aquifer, in order to effectively treat the Birch Hill Tank Farm area and eliminate the potential for further off-Post migration. The additional characterization activities include:

- An aquifer pump test to study bedrock aquifer characteristics and identify potential locations for additional extraction wells;
- A tracer study to analyze groundwater flow pathways and transport mechanisms;
- Continued groundwater monitoring and modeling to evaluate trends in contaminant concentrations and contaminant plumes; and
- Seismic work to identify bedrock fractures in the Birch Hill area.

The results of these activities will be used to refine the conceptual site model and more effectively operate the product recovery system.

Contingent Off-Post Investigation

The ROD requires routine monitoring and sampling of off-Post wells. At the time the remedy described in the ROD was selected, the source of contamination in drinking water wells at two churches immediately west of Remedial Area 1b had not been clearly determined. However, information gathered during post-ROD investigations has established that the observed contaminant concentrations, groundwater flow directions, contaminant types and other plume characteristics are consistent with the Birch Hill Tank Farm being the source of contamination observed in the church wells. The exact groundwater pathway is still unknown. It is believed that groundwater flows underneath adjacent private property which lies between the church properties and the Post boundary below permafrost or around permafrost and frozen bedrock (see Figure 6). Continuation of the groundwater model will help to establish this flow.

The significant remedy changes included in this ESD focus on source reduction and control strategies that are, over time, reducing ongoing contamination to groundwater and, hence, reducing off-Post contaminant concentrations, particularly in the church wells. Under the ROD, Fort Wainwright has implemented an air sparging system on the western Fort Wainwright boundary, immediately adjacent to private property, which is designed to control off-Post groundwater migration of dissolved phase contaminants, particularly DCA. If off-Post concentrations of DCA increase above MCLs over several sampling events, then additional off-Post investigation may be required.

During the annual project manager evaluations described earlier in this ESD for Remedial Area 1b, the project managers will determine the period of time over which the performance of the remedial actions on off-Post groundwater contaminant concentrations will be evaluated. The time period will be based on the ongoing modeling efforts conducted by the Army and on the project manager's best professional judgment based on the factors described above, such as off-Post concentrations not decreasing from existing levels in a reasonable period of time (which may be as many as four to six years based on current modeling efforts), or based on off-Post concentrations consistently increasing over several sampling events.

# 4.0 REMEDIAL AREA 2 - RAILCAR OFF-LOADING FACILITY

## 4.1 Remedial Area 2 – Location and Background

Remedial Area 2 is located south of the Tank Farm Facility across the Chena River and north of Gaffney Road. The ROLF was built in 1939 to receive fuel from tanks on railcars and to distribute the fuels to the airfield refueling points, quartermaster fuel system, and the Birch Hill AST Tank Farm. As part of this distribution system, there were three valve pits; Valve Pit A is on the west side of the Chena River, and Valve Pits B and C are located on the east side of the Chena River. Fuel pipelines connect the ROLF to the Birch Hill AST Tank Farm (Remedial Area 1b). Fuel was also stored in USTs within Remedial Area 2 until the tanks were removed in 1990. Remedial Area 2 was subdivided into sub-areas based on geographic location and differing physical characteristics. Figure 1 shows the six sub-areas, Valve Pit A, Valve Pit B, Valve Pit C, Central Header, Former Building 1144, and Eight-Car Header. The facility covers an area of approximately 40 acres.

<u>Physical Characteristics</u>

Valve Pit A, Valve Pit B, and Valve Pit C are located directly on the banks of the Chena River. Valve Pit A is approximately 1/4 mile east of 801 Housing Subdivision on the north bank of the Chena River. The main area of the ROLF is within the Chena River floodplain. The ROLF is located immediately north of the Fort Wainwright airstrip and is bound on its north and west sides by the Chena River and Gaffney Road to the south. A scrub-shrub wetland borders the northeast edge of the ROLF. No endangered or threatened species reside in the area.

Groundwater in the shallow aquifer zone is consistent with the regional groundwater flow to the northwest. Flow direction and gradient is subject to seasonal variations. Depth to groundwater in the vicinity of the ROLF is approximately 10 to 20 feet.

<u>Land and Resource Use</u>

The area around Remedial Area 2 is used heavily by residents and nonresidents involved in recreational sport fishing, boating and hiking. Numerous private residential wells are located on the north bank of the Chena River, less than 1/2 miles downstream. The Golden Heart Utilities and College Utilities wells are located approximately three and five and one half miles from the source area, respectively. Four Fort Wainwright drinking water supply wells are located approximately one mile south, and the Pioneer Class A drinking water wells for the Hamilton Subdivision are located approximately one mile west of the ROLF. Future land use is considered to be residential and recreational.

## 4.2 Summary of Contamination

The primary sources of contamination at Remedial Area 2 are associated with fuel and fuel additives from storage, transfer, and handling activities at Valve Pit A, Valve Pit B, Valve Pit C, Central Header, Former Building 1144, and Eight-Car Header at the ROLF. Available records indicate that one 20-gallon fuel spill occurred at the ROLF between 1970 and 1987. It is also known that the tank car headers were prone to minor leaks, and at least one major spill of JP-4 occurred at one of the headers.

Additionally, the USTs formerly at the central ROLF reportedly were overfilled on numerous occasions.

In 1988 a soil-gas survey was conducted at the ROLF and associated valve pits. Samples collected revealed a contaminant plume centered on the railroad spur containing the 16-tank-car unloading headers and the former USTs. A monitoring well was installed at Valve Pit C in 1989 and contained free-floating product in most of the sampling events until commencement of remedial activities. In 1991, a pipeline from Valve Pit C to the airfield failed a hydrostatic pressure test and was taken out of service. Valve pits on both sides of the Chena River and at the ROLF had leaks. During the summer of 1996 up to 1 ½ feet of floating product was measured in monitoring wells. The findings indicated subsurface contamination in hot spots throughout the area, especially in the vicinity of valve pits located along the pipeline system, which consisted of three 8-inch pipelines and four 3-inch pipelines. Petroleum contamination was found in subsurface soils and groundwater surrounding Valve Pits A, B, and C, along Front Street, and in surface and subsurface soils and groundwater in the center of the site during the RI.

Investigations prior to and during the RI characterized contamination associated with Remedial Area 2 as follows:

*Groundwater*

Benzene, toluene, ethylbenzene, DCA, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene were detected in groundwater exceeding federal drinking water MCLs and EPA risk based concentrations used for screening potential contaminants of concern.

*Soil*

Petroleum hydrocarbons were identified and quantified as diesel in surface soil and Jet-A in subsurface soil at the ROLF.

## 4.3 Remedy Selected in the ROD

The selected remedy in the ROD was soil vapor extraction of petroleum-contaminated soil and air sparging of petroleum-contaminated groundwater at known contaminant sources and at locations where MCLs are exceeded (i.e., hot spots) to achieve Safe Drinking Water Act levels and natural attenuation to meet Alaska Water Quality Standards. The pilot scale AS/SVE systems were installed during the summer of 1996 (with the exception of Eight-Car Header). Institutional controls, restricting access to and development at the site as long as hazardous substances remain, and groundwater monitoring were also part of the selected remedy. The OU3 ROD specified that due to different site conditions, site specific design information would be collected in a pilot study. In addition, during implementation or operations of systems, if the remedy was not effective in achieving the performance standards, the system would be expanded and/or the remedy would be re-evaluated.

Cleanup Goals

Based on the results of the baseline risk assessment for current (at the time of the ROD) and projected land use at the site, contaminants of concern were identified for establishing numeric cleanup goals for OU3 as described in the following paragraphs (U.S. Army [Section 7.3.1], 1996):

*Groundwater*

Federal and State of Alaska drinking water MCLs were adopted as groundwater cleanup goals for benzene, toluene, ethylbenzene, EDB, and DCA. The concentrations corresponding to the EPA excess cancer risk ($10^{-4}$) based cleanup levels were adopted as the cleanup goals for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene, since there were no MCLs for these contaminants.

*Soil*

The remedial action goal for *in-situ* soil contaminated with volatile organic and petroleum compounds is protection of groundwater. The ROD stated that since soils are acting as a continuing source of contamination to the groundwater, active remediation of the soils will continue until Safe Drinking Water Act levels are consistently met. AWQS will be achieved through natural attenuation. Petroleum-contaminated soils that are treated *ex-situ* will be treated to State of Alaska Matrix Level A standards before they are returned to the source area.

Status of Remediation

The ROLF remedial systems have been effective in the removal of free product and the reduction of both the magnitude and extent of groundwater contamination. The reduction in the size of the benzene plume throughout Remedial Area 2, since treatment began in 1996, is presented as Figure 7.

*Valve Pit A*

The AS/SVE system was initially installed in 1996, expanded in 1997 and further expanded to its current size in 2000. The treatment system operates seasonally. As of 2001 the treatment system has removed 22,383 pounds of VOC. Contaminant concentrations within the treatment area have decreased by two orders of magnitude, and the extent of the benzene plume exceeding the ROD cleanup goal has decreased by approximately 60 percent (Figure 7). However, benzene remains above the cleanup goal in this treatment area.

*Valve Pit B*

The AS/SVE system was initially installed in 1996 and expanded to its current size in 1997. The treatment system operates seasonally. As of 2001 the treatment system has removed 30,703 pounds of VOCs. The benzene plume exceeding the ROD cleanup goal was eliminated in this treatment area by 2001 (Figure 7).

*Valve Pit C*

The AS/SVE system was initially installed in 1996 and expanded to its current size in 1997. The treatment system operates seasonally, but is currently shutdown for a rebound evaluation. As of 2001 the treatment system has removed 10,449 pounds of VOC. Benzene concentrations within the treatment area have decreased by two orders of magnitude, and benzene was only detected at one downgradient location during 2001 (Figure 7).

*Central Header*

The AS/SVE system was initially installed in 1996, expanded in 1997 and further expanded to its current size in 2000. The treatment system operates year round and is equipped with a thermal oxidizer for off-gas emissions control. The oxidizer was taken off-line in February 2002 when emissions control became no longer necessary at this system. As of 2001 the treatment system has removed 247,403 pounds of VOCs. Contaminant concentrations within the treatment area have decreased by two orders of magnitude, and the extent of the benzene plume exceeding the ROD cleanup goal has decreased by over 50 percent (Figure 7). Upgradient contaminant concentrations, east of the Alaska Railroad, remain persistent. The treatment system can not be easily expanded to this area due to the railroad and underground utilities.

*Eight Car Header*

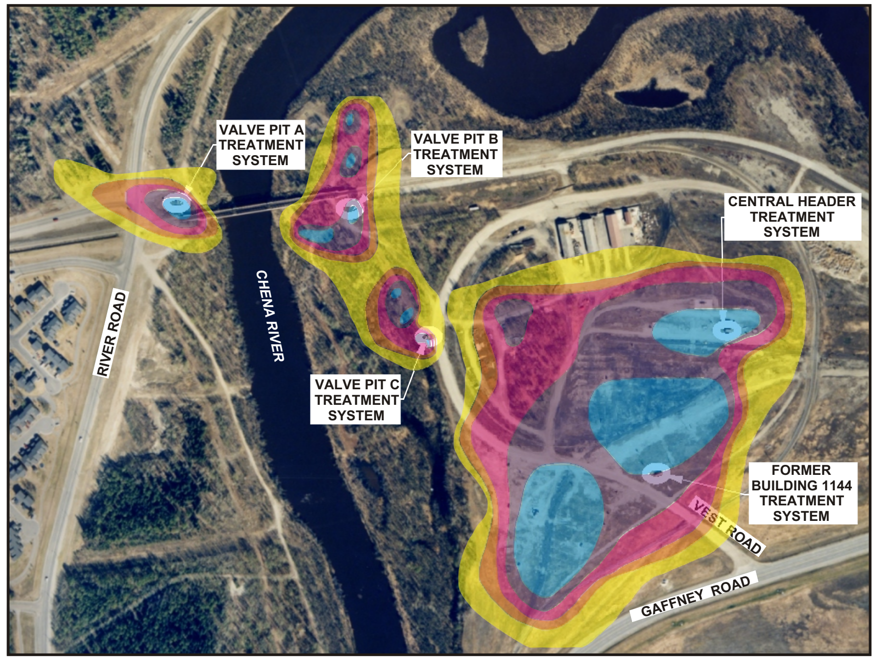
The AS/SVE system was initially installed in 1997 and expanded to its current size in 1998. The treatment system operates year round. Off-gas emissions are controlled by the use of an electric oxidizer. As of 2001 the treatment system has removed 122,954 pounds of VOCs. Contaminant concentrations within the treatment area have decreased by two orders of magnitude, and the extent of the benzene plume exceeding the ROD cleanup goal has decreased by approximately 70 percent (Figure 7). Upgradient contaminant concentrations, south of the Alaska Railroad, remain consistently above cleanup goals. The treatment system can not be easily expanded to this area due to the railroad and significant utilities.

*Former Building 1144*

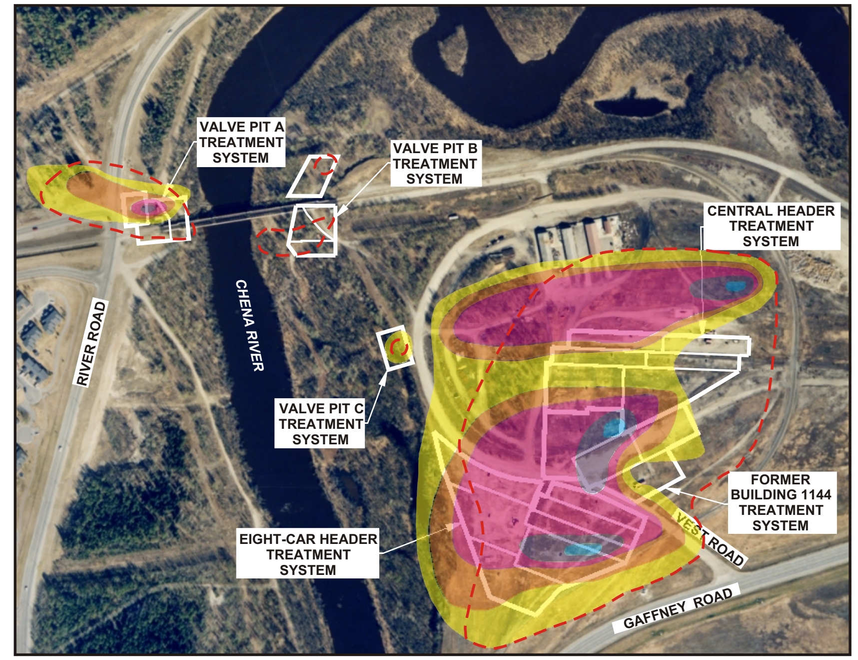
The AS/SVE system was initially installed in 1996 and expanded to its current size in 1997. The treatment system operates year round and is equipped with a thermal oxidizer for off-gas emission control. The oxidizer was taken off-line in May 2001 when emissions control became no longer necessary at this system. As of 2001 the treatment system has removed 220,642 pounds of VOC. Benzene concentrations within the treatment area have decreased by an order of magnitude, and the extent of the benzene plume exceeding the ROD cleanup goal has decreased by approximately 60 percent (Figure 7).

### 4.4 Basis for the Significant Differences

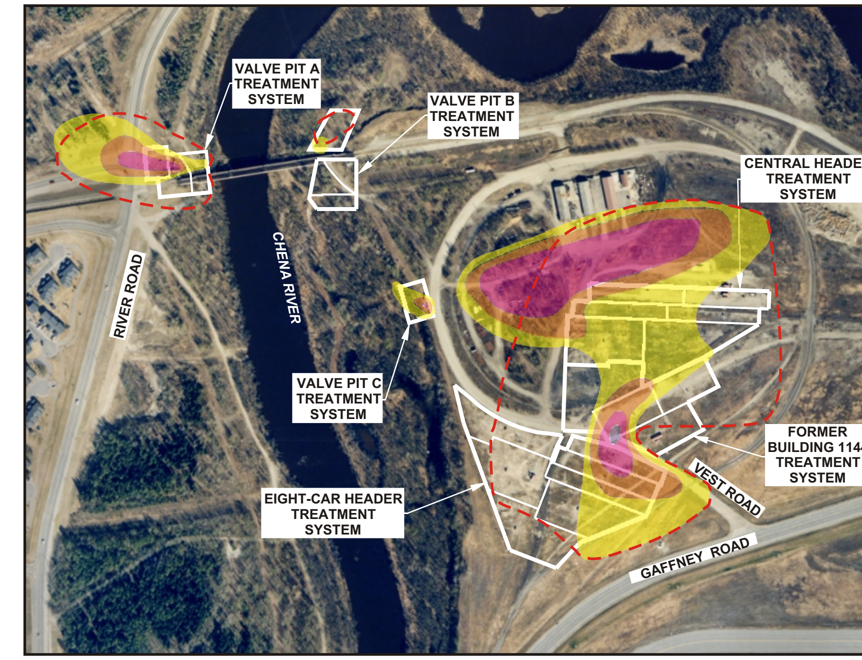
After the AS/SVE systems were initially installed in 1996, sampling results indicated a larger area of contamination existed than originally identified. Expansion of the systems was determined to be



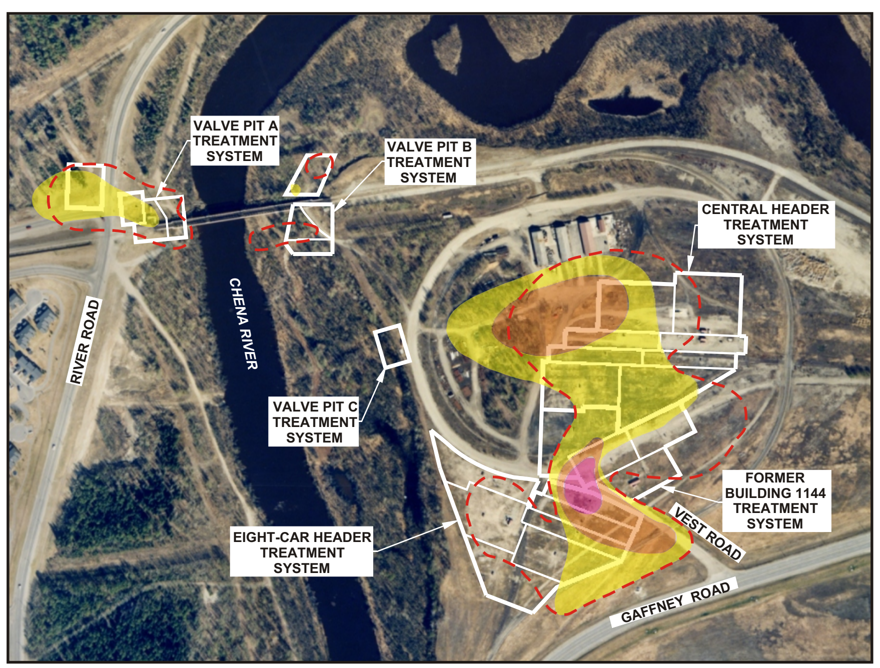

**Prior to Treatment 1996-1997**



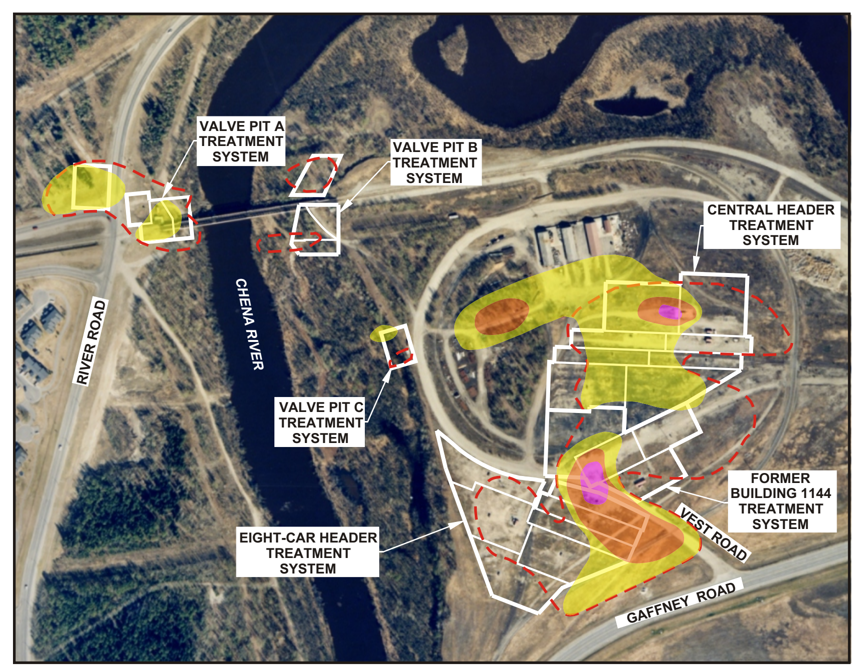

**Fall 1998**




**Fall 1999**




**Fall 2000**




**Fall 2001**

LEGEND

| | |
|---|---|
| $\mu$g/L | MICROGRAMS PER LITER |
| (yellow) | APPROXIMATE EXTENT OF 5 $\mu$g/L BENZENE PLUME |
| (orange) | APPROXIMATE EXTENT OF 50 $\mu$g/L BENZENE PLUME |
| (pink) | APPROXIMATE EXTENT OF 100 $\mu$g/L BENZENE PLUME |
| (purple) | APPROXIMATE EXTENT OF 1,000 $\mu$g/L BENZENE PLUME |
| (blue) | APPROXIMATE EXTENT OF PRODUCT PLUME |
| | APPROXIMATE EXTENT OF TRIMETHYLBENZENES |

SOURCE: AEROMAP U.S., MAY 18, 1999

NORTH

0 350 700
SCALE IN FEET

FAIRBANKS ENVIRONMENTAL SERVICES
748 GAFFNEY ROAD, SUITE 200
FAIRBANKS, ALASKA

ALASKA DISTRICT
CORPS OF ENGINEERS
ANCHORAGE, ALASKA

# Benzene Plume Reduction from 1996 to 2001

Central ROLF
Explanation of Significant Differences
Operable Unit 3
Fort Wainwright, Alaska

| CONTRACT: | FIGURE: | DATE: |
|---|---|---|
| DACA85-01-C-0018 | 7 | 8/02 |

118C

necessary to treat the larger area. Table 4-1 compares contaminant concentrations detected both pre-ROD and post-ROD and compares the sizes of the treatment systems proposed in the ROD to the sizes of the current expanded treatment systems.

**Table 4-1 – Pre vs. Post ROD Comparisons for Remedial Area 2**

| Site | COC | Pre-ROD | | Post-ROD | |
|---|---|---|---|---|---|
| | | Maximum Concentration (µg/L) | Treatment System Proposed | Maximum Concentration (µg/L) | Treatment System Implemented |
| **Valve Pit A** | Benzene | 1,700 | 7 Injection wells 7 Extraction wells | 6,200 | 45 AS probes 16 VE probes Horizontal Well |
| | Toluene | 12,000 | | 25,800 | |
| | Ethylbenzene | 1,600 | | 1,250 | |
| | 1,2,4-TMB | 1,400 | | 13,200 | |
| | 1,3,5-TMB | 1,700 | | 520 | |
| **Valve Pit B** | Benzene | 1,400 | 7 Injection wells 7 Extraction wells | 1,800 | 43 AS probes 12 VE probes |
| | Toluene | 3,900 | | 9,400 | |
| | Ethylbenzene | 650 | | 1,300 | |
| | 1,2,4-TMB | 800 | | 1,000 | |
| | 1,3,5-TMB | 50 | | 680 | |
| **Valve Pit C** | Benzene | 730 | 5 Injection wells 5 Extraction wells | 850 | 10 AS probes 4 VE probes |
| | Toluene | 5,800 | | 10,000 | |
| | Ethylbenzene | 880 | | 1,100 | |
| | 1,2,4-TMB | 290 | | 730 | |
| | 1,3,5-TMB | 100 | | 300 | |
| **Central Header** | Benzene | 3,500 | 13 Injection wells[2] 13 Extraction wells[2] | 4,500 | 274 AS probes 81 VE probes |
| | Toluene | 15,000 | | 23,000 | |
| | Ethylbenzene | 700[1] | | 1,600 | |
| | 1,2,4-TMB | 18 | | 700 | |
| | 1,3,5-TMB | 21 | | 360 | |
| | DCA | 6 | | 6.81 | |
| | EDB | ND | | 360 | |
| **Building 1144** | Benzene | 5,800 | 13 Injection wells[2] 13 Extraction wells[2] | 3,270 | 215 AS probes 56 VE probes |
| | Toluene | 11,000 | | 3,370 | |
| | Ethylbenzene | 1,100 | | 610 | |
| | 1,2,4-TMB | 710 | | 1,010 | |
| | 1,3,5-TMB | ND | | 580 | |
| | DCA | ND | | 19.3 | |
| **Eight-Car Header** | Benzene | 2,900 | 7 Injection wells 7 Extraction wells | 1,500 | 199 AS probes 58 VE probes |
| | Toluene | 3,400 | | 12,000 | |
| | Ethylbenzene | 590 | | 990 | |
| | 1,2,4-TMB | 630 | | 1,100 | |
| | 1,3,5-TMB | 190 | | 346 | |

Notes: [1]Ethylbenzene concentration for Central Header is an average from the central ROLF.
[2]The ROD estimated a total of 13 injection and 13 extraction wells for Central Header and Building 1144.

The significant differences in the size of the treatment systems proposed in the ROD to the size of the current treatment systems can be attributed to the following:

- The ROD underestimated the extent and magnitude of contamination within Remedial Area 2; and
- The radius of influence for both extraction and injection wells was overestimated in the ROD.

### 4.5 Description of the Significant Differences for Remedial Area 2

Table 4-1, presented in Section 4.4, shows the significant differences in the pre-ROD proposed treatment systems compared to the implemented treatment systems. Specifically, for Remedial Area 2, this ESD documents the following actions that were not anticipated in the ROD, but are required pursuant to this ESD:

- Expansion of the AS/SVE treatment areas, including installation of additional air sparge and vapor extraction probes, groundwater monitoring probes, remote metering enclosures, and blower enclosures, to cover the identified lateral extent of contamination detected at Remedial Area 2;
- Installation of thermal/catalytic oxidizers for off-gas treatment of the soil vapor extraction systems where necessary; and,
- Operation, maintenance, and monitoring of the expanded treatment systems in accordance with the approved OU3 Operation and Maintenance Manual and subsequent amendments (Hart Crowser, 2001b).

Table 4-2 below compares estimated costs at the time of the ROD to the current estimated costs of the expanded treatment systems.

**Table 4-2 – Remedial Area 2 ROD and ESD Cost Comparison**

| Cost Category | ROD Cost Estimate (present worth) | ESD Cost Estimate[4] (present worth) |
|---|---|---|
| Capital Cost | $900,000 [1] | $3,503,473 |
| Treatment System Operation | 100,000 [2] | 1,461,339 |
| Monitoring | | 2,855,636 |
| Closure | | 163,638 |
| Administrative (20%) | [3] | 1,596,817 |
| Contingency (15%) | [3] | 281,908 |
| **Totals** | $1,000,000 | $9,862,812 |

[1] It is assumed capital costs include installation, repair, and closure costs
[2] Operation and monitoring costs were not separated in the ROD
[3] Administrative and contingency costs were not identified in the ROD
[4] From June 2002 Interim Remedial Action Report

The detailed Remedial Area 2 ESD cost estimate is provided as Table A-2 in Appendix A. The ESD estimates that the Remedial Area 2 remedial costs will be approximately ten times greater than estimated in the ROD. This significant difference is attributed to the following:

- The ROD significantly underestimated the extent of contamination at the ROLF and, therefore, undersized the treatment systems; and
- Treatment system operation and monitoring costs were significantly underestimated in the ROD, due to the smaller treatment areas and shorter treatment periods.

# 5.0 REMEDIAL AREA 3 - MILEPOSTS 2.7, 3.0, and 15.75

## 5.1 Remedial Area 3 – Location and Background

Remedial Area 3 consists of three locations along the Fairbanks-Eielson Pipeline: Milepost 2.7, Milepost 3.0, and Milepost 15.75. There have been no changes in the selected remedy for Milepost 15.75, which will not be discussed further in this ESD. The Milepost 2.7 and 3.0 sites are located in the EBHTF area, as shown on Figure 1. The Milepost designations represent miles from the FFT; thus, MP 3.0 is approximately 3.0 miles east of the FFT.

Fort Wainwright historically had two distinct pipelines that provided fuel to Ladd Army Airfield. The first pipeline was the CANOL line. The CANOL line supplied fuel to the EBHTF, FFT and fuel facilities on Fort Wainwright from approximately 1940 to 1955. The second pipeline, the Haines to Fairbanks Pipeline, was built in 1955 and operated until 1971, when the Haines-Eielson portion of the pipeline was closed and it became the Fairbanks-Eielson Pipeline until 1990. The Fairbanks-Eielson pipeline route was from the Mapco refinery in the city of North Pole directly to the FFT where fuel was distributed. The section of the pipeline between Fort Wainwright and the Mapco refinery was decommissioned in 1992.

The EBHTF was constructed in 1940 to store three types of fuel for cold weather testing of aircraft and for supporting the lend-lease program. The facility consisted of 34 50,000-gallon USTs, underground piping, valve pits, and truck fill stands. High-octane gasoline, jet fuels, and diesel fuel were stored in the 12-foot-diameter, 66-foot-long steel USTs. The EBHTF consisted of three truck fill stands, three truck unloading ramps, nine main valve pits, several water separator pits, and over 30 concrete valve pits, one at each UST. Use of the facility was terminated upon construction of the Haines-Fairbanks Pipeline in 1955.

Physical Characteristics

Milepost 2.7 and Milepost 3.0 Source Areas are similar in physical characteristics. Both have a moderate to steep south-facing slope to the north and a shallow, south-facing slope to the south. They are located downgradient of the EBHTF. Soils are poorly drained and ponded surface water is common from spring breakup until mid-summer. Discontinuous permafrost is typical in the areas' subsurface soil. A black spruce-scrub-shrub wetland borders the south side of the source areas while the rest of the surrounding area is densely vegetated. Groundwater is encountered at depths from 3 to 12 feet bgs and groundwater flows to the southwest.

Land and Resource Use

The Milepost 2.7 and 3.0 source areas are located within a military training area across the Chena River and approximately one mile from the nearest residential development. Both areas are used for recreational uses. The nearest well to both source areas is located approximately one mile to the east, at the Birch Hill Ski area. Since it is completed in bedrock, this well is not hydraulically connected to the alluvial aquifer at the source areas.

## 5.2 Summary of Contamination

The source areas at Milepost 2.7 and 3.0 were discovered as part of a 1989 soil gas survey along the active section of the Fairbanks-Eielson Pipeline. Sampling locations were spaced one mile apart, and the investigation spanned 27 miles from the Fairbanks Terminal to Eielson Air Force Base. Elevated levels of benzene, toluene, ethylbenzene, and xylenes (BTEX) were noted at MP 2.6. This investigation concluded that the contamination at MP 2.6 was downgradient of a truck fill stand associated with the abandoned Birch Hill USTs. Subsequent investigations of the East Birch Hill USTs encountered contamination along the base of Birch Hill near MP 2.7 and 3.0. The source of contamination is attributed to the EBHTF. This tank farm was built as part of the CANOL pipeline and stored high-octane aviation gasoline, jet fuel, and diesel fuel. There were three truck fill stands associated with this tank farm, two adjacent to the contamination at Milepost 2.7 and 3.0. Numerous investigations were conducted to close out the USTs under the State of Alaska UST regulations. The State of Alaska closed the USTs, but due to severe groundwater contamination associated with this operation, the groundwater was added to OU3.

During the RI, surface and subsurface petroleum hydrocarbon soil contamination was identified at MP 2.7. Surface soil contamination was estimated to extend 120 feet south of the pipeline into adjacent wetlands and subsurface soil contamination was estimated to extend underneath Birch Hill Road adjacent to two truck fill stands. Petroleum hydrocarbons (quantified as gasoline) were detected in groundwater during the RI, and benzene was detected above the MCL.

During the RI, petroleum contamination in subsurface soils at MP 3.0 was found to be concentrated along Birch Hill Road. The subsurface contamination was estimated to extend northwest toward MP 2.7, approximately 250 feet southeast of the source area, and approximately 200 feet south of the source area under adjacent wetlands. Petroleum hydrocarbons (quantified as gasoline) were also detected in groundwater during the RI, and benzene, ethylbenzene, toluene, and EDB were each detected above the MCL.

## 5.3 Remedy Selected in the ROD

The selected remedy in the ROD was soil vapor extraction and air sparging of groundwater in permafrost-free areas. This alternative was chosen because it had been proven effective with similar petroleum contamination on Fort Wainwright. The ROD also specified that long-term groundwater monitoring would be conducted to ensure that contaminant concentrations are reduced in groundwater in nearby wetlands.

### Cleanup Levels

Based on the results of the baseline risk assessment for current (at the time of the ROD) and projected land use at the site, contaminants of concern were identified for establishing numeric cleanup goals for MP 2.7 and 3.0 as follows (U.S. Army [Section 7.3.1], 1996):

*Groundwater*

Federal and State of Alaska drinking water MCLs were adopted as groundwater cleanup goals for benzene, toluene, ethylbenzene, EDB, and DCA. The cleanup goals for 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene were based on an RBC equivalent to a noncancer hazard quotient of 1 using residential groundwater exposure assumptions, since there were no MCLs for these contaminants at the time of the ROD.

*Soil*

The remedial action goal for *in-situ* soils contaminated with volatile organic and petroleum compounds is protection of groundwater. The ROD stated that since soils are acting as a continuing source of contamination to the groundwater, active remediation of the soils will continue until Safe Drinking Water Act levels are consistently met. AWQS will be achieved through natural attenuation. The ROD also stated that petroleum-contaminated soils that are treated *ex-situ* will be treated to State of Alaska Matrix Level A standards before they are returned to the source area.

<u>Status of Remediation</u>

An air sparging treatability study was conducted at MP 2.7 in 1996. The same year, a study involving oxygen-releasing compounds (ORC) injected into the groundwater was evaluated. These *in-situ* technologies were not considered viable for the site due to low soil permeability. A treatability study was performed during 1998 to evaluate the feasibility of excavation and *ex-situ* soil treatment. This involved the excavation of approximately 1,500 cubic yards of contaminated soil. These soils were placed in a treatment cell constructed adjacent to the Truck Fill Stand. The Truck Fill Stand AS/SVE blowers were utilized to treat the petroleum-contaminated soil *ex-situ*. This system is still operational; however, soil contaminant concentrations have decreased significantly.

A pilot study was conducted at MP 3.0 in 1996 involving the use of ORC injected as a slurry below the water table. As with MP 2.7, site analytical results of groundwater samples did not indicate that injection of the ORC slurry was effective. Based upon the results of the MP 2.7 treatability study for excavation and *ex-situ* treatment of soils, it was not clear if the same technology would be effective for MP 3.0 due to potential differences in soil or contaminant concentrations between the two sites. Therefore, in April 2000 a pilot study excavation and subsequent *ex-situ* soil treatment were performed at MP 3.0. This involved the excavation of approximately 6,000 cubic yards of petroleum-contaminated soil. These soils were mixed with gravel and placed in an 8,000 cubic yard treatment cell constructed at the base of Birch Hill. The Building 1173 AS/SVE blowers were utilized to treat the petroleum-contaminated soil *ex-situ*. This treatment cell operated for two field seasons, with the main contaminants being gasoline range organics (GRO) and benzene. Contaminant concentrations in the treatment cell have decreased rapidly and ADEC Level A cleanup goals are anticipated to be achieved during 2002.

Groundwater monitoring has been conducted semi-annually at Milepost 2.7 and 3.0 to evaluate the progress towards achieving RAOs. At Milepost 2.7, benzene concentrations remained above the ROD cleanup levels in each of the six monitoring wells during at least one of the 2001 sampling events. In general, a decreasing trend in groundwater concentrations is not yet evident. Figure 8 presents a summary of groundwater contaminant concentrations in Milepost 2.7 monitoring wells. At Milepost 3.0, the ROD cleanup goal for benzene was also exceeded in samples collected from all monitoring wells during both of the 2001 sampling events. However, significant decreases in benzene concentrations were evident in two downgradient wells, AP-7821 and AP-5850. The decreasing benzene trend in these downgradient wells may be a result of the source removal that was conducted as part of the 2000 pilot study. Figure 9 presents a summary of groundwater contaminant concentrations in Milepost 3.0 monitoring wells.

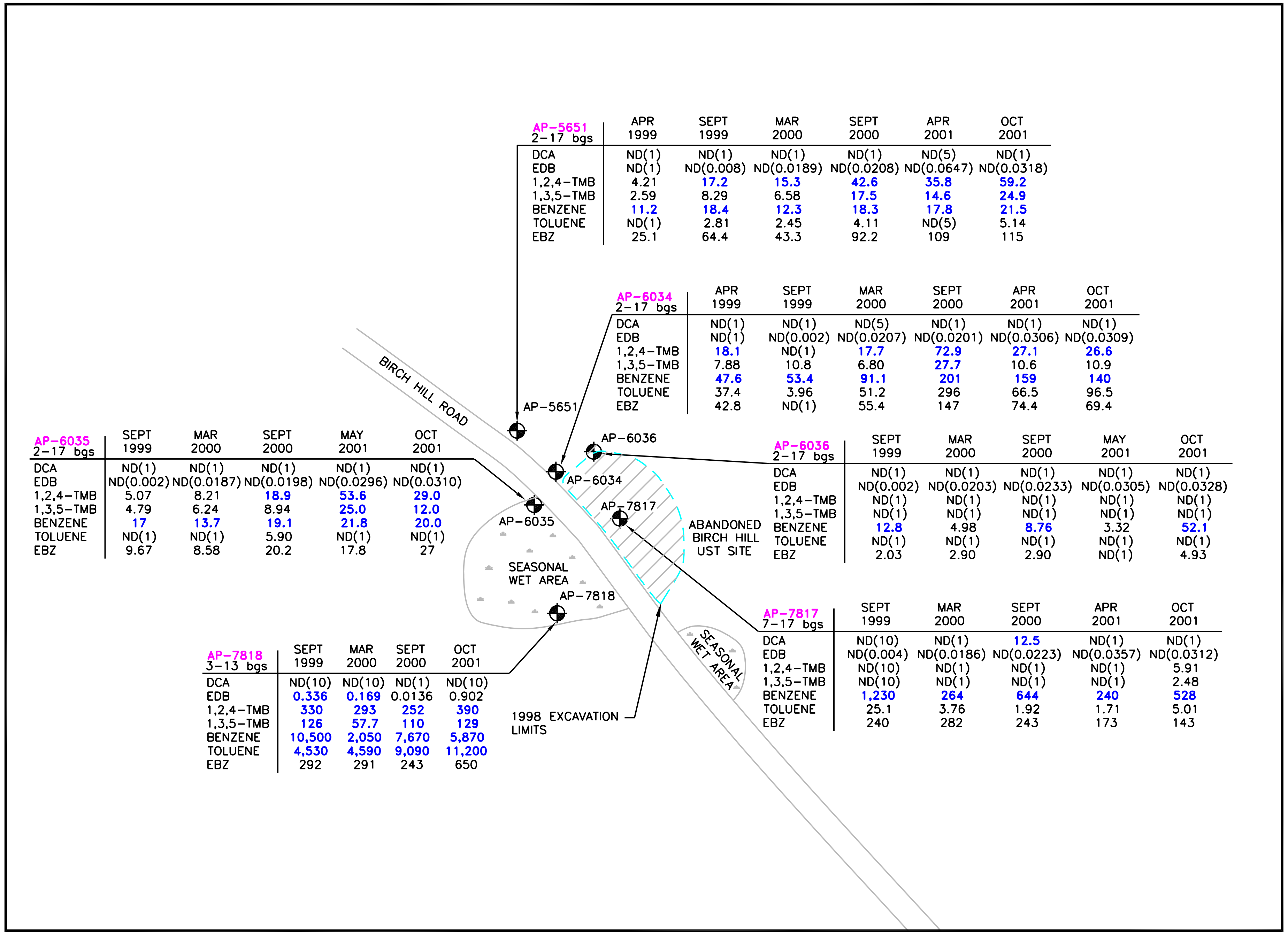
### 5.4 Basis for the Significant Differences

At the time of the ROD it was thought that the soil conditions at Remedial Area 3 would be conducive to soil vapor extraction, based on the limited information provided in the RI concerning grain size and soil moisture. However, the ROD indicated that site-specific design information would be collected in a pilot study. Based on additional sampling conducted post-ROD, it was found that the soils in both locations contained high fractions of silt and clay and were tightly bonded, thus limiting the movement of air within the vadose zone, which is necessary for effective contaminant reduction. Therefore, the selected remedial action in the ROD for this area, AS/SVE *in-situ* treatment, could not be implemented. However, pilot studies conducted after the ROD have shown *ex-situ* treatment of soil to be effective in meeting soil cleanup goals.

An additional finding that became apparent based on evaluations of post-ROD investigations related to the sources of contamination at the Milepost sites. The OU3 RI and ROD did not specifically identify the source of petroleum contamination. During post ROD excavation at Milepost 3.0, two out of seven samples collected from excavated soil were above the toxicity characteristic leaching procedure (TCLP) action level for benzene. These results could be interpreted such that a release of a hazardous waste had occurred which would be subject to regulation under RCRA. Recently, the Army evaluated existing data and conducted additional historical research for this area and came to the conclusion that the majority of the contamination at the Milepost 2.7 and 3.0 sites is most likely upgradient of the Fairbanks-Eielson Pipeline and thus is associated with the former East Birch Hill UST Tank Farm (FES, 2002a). Therefore, these soils fall under the exclusion allowed under 40 CFR 261.4(b)(10) and the handling of these soils is subject to the corrective action requirements of 40 CFR Part 280 for underground storage tanks. These requirements are being met through implementation of the CERCLA remedy and this ESD.

### 5.5 Description of Significant Differences for Remedial Area 3

Specifically, for Remedial Area 3, this ESD documents the following actions/changes that were not anticipated at the time of the ROD, but are required pursuant to this ESD. Many of these actions have been completed prior to development of this ESD:




| AP-5651 2-17 bgs | APR 1999 | SEPT 1999 | MAR 2000 | SEPT 2000 | APR 2001 | OCT 2001 |
|---|---|---|---|---|---|---|
| DCA | ND(1) | ND(1) | ND(1) | ND(1) | ND(5) | ND(1) |
| EDB | ND(1) | ND(0.008) | ND(0.0189) | ND(0.0208) | ND(0.0647) | ND(0.0318) |
| 1,2,4-TMB | 4.21 | **17.2** | **15.3** | **42.6** | **35.8** | **59.2** |
| 1,3,5-TMB | 2.59 | 8.29 | 6.58 | **17.5** | **14.6** | **24.9** |
| BENZENE | **11.2** | **18.4** | **12.3** | **18.3** | **17.8** | **21.5** |
| TOLUENE | ND(1) | 2.81 | 2.45 | 4.11 | ND(5) | 5.14 |
| EBZ | 25.1 | 64.4 | 43.3 | 92.2 | 109 | 115 |

| AP-6034 2-17 bgs | APR 1999 | SEPT 1999 | MAR 2000 | SEPT 2000 | APR 2001 | OCT 2001 |
|---|---|---|---|---|---|---|
| DCA | ND(1) | ND(1) | ND(5) | ND(1) | ND(1) | ND(1) |
| EDB | ND(1) | ND(0.002) | ND(0.0207) | ND(0.0201) | ND(0.0306) | ND(0.0309) |
| 1,2,4-TMB | **18.1** | ND(1) | **17.7** | **72.9** | **27.1** | **26.6** |
| 1,3,5-TMB | 7.88 | 10.8 | 6.80 | **27.7** | 10.6 | 10.9 |
| BENZENE | **47.6** | **53.4** | **91.1** | **201** | **159** | **140** |
| TOLUENE | 37.4 | 3.96 | 51.2 | 296 | 66.5 | 96.5 |
| EBZ | 42.8 | ND(1) | 55.4 | 147 | 74.4 | 69.4 |

| AP-6035 2-17 bgs | SEPT 1999 | MAR 2000 | SEPT 2000 | MAY 2001 | OCT 2001 |
|---|---|---|---|---|---|
| DCA | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| EDB | ND(0.002) | ND(0.0187) | ND(0.0198) | ND(0.0296) | ND(0.0310) |
| 1,2,4-TMB | 5.07 | 8.21 | **18.9** | **53.6** | **29.0** |
| 1,3,5-TMB | 4.79 | 6.24 | 8.94 | **25.0** | **12.0** |
| BENZENE | **17** | **13.7** | **19.1** | **21.8** | **20.0** |
| TOLUENE | ND(1) | ND(1) | 5.90 | ND(1) | ND(1) |
| EBZ | 9.67 | 8.58 | 20.2 | 17.8 | 27 |

| AP-6036 2-17 bgs | SEPT 1999 | MAR 2000 | SEPT 2000 | MAY 2001 | OCT 2001 |
|---|---|---|---|---|---|
| DCA | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| EDB | ND(0.002) | ND(0.0203) | ND(0.0233) | ND(0.0305) | ND(0.0328) |
| 1,2,4-TMB | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| 1,3,5-TMB | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| BENZENE | **12.8** | 4.98 | **8.76** | 3.32 | **52.1** |
| TOLUENE | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| EBZ | 2.03 | 2.90 | 2.90 | ND(1) | 4.93 |

| AP-7817 7-17 bgs | SEPT 1999 | MAR 2000 | SEPT 2000 | APR 2001 | OCT 2001 |
|---|---|---|---|---|---|
| DCA | ND(10) | ND(1) | **12.5** | ND(1) | ND(1) |
| EDB | ND(0.004) | ND(0.0186) | ND(0.0223) | ND(0.0357) | ND(0.0312) |
| 1,2,4-TMB | ND(10) | ND(1) | ND(1) | ND(1) | 5.91 |
| 1,3,5-TMB | ND(10) | ND(1) | ND(1) | ND(1) | 2.48 |
| BENZENE | **1,230** | **264** | **644** | **240** | **528** |
| TOLUENE | 25.1 | 3.76 | 1.92 | 1.71 | 5.01 |
| EBZ | 240 | 282 | 243 | 173 | 143 |

| AP-7818 3-13 bgs | SEPT 1999 | MAR 2000 | SEPT 2000 | OCT 2001 |
|---|---|---|---|---|
| DCA | ND(10) | ND(10) | ND(1) | ND(10) |
| EDB | **0.336** | **0.169** | 0.0136 | 0.902 |
| 1,2,4-TMB | **330** | **293** | **252** | **390** |
| 1,3,5-TMB | **126** | **57.7** | **110** | **129** |
| BENZENE | **10,500** | **2,050** | **7,670** | **5,870** |
| TOLUENE | **4,530** | **4,590** | **9,090** | **11,200** |
| EBZ | 292 | 291 | 243 | 650 |

LEGEND

| | |
|---|---|
| AP-6034 | MONITORING WELL |
| 1,2,4-TMB | 1,2,4-TRIMETHYLBENZENE |
| 1,3,5-TMB | 1,3,5-TRIMETHYLBENZENE |
| bgs | BELOW GROUND SURFACE |
| DCA | 1,2-DICHLOROETHANE |
| EDB | 1,2-DIBROMOETHANE |
| EBZ | ETHYLBENZENE |
| NA | ANALYSIS NOT PERFORMED |
| ND | NOT DETECTED (DETECTION LIMIT) |
| UST | UNDERGROUND STORAGE TANK |

KEY:

MONITORING WELL → AP-7818

SCREENED INTERVAL DEPTH IN FEET bgs → 3-13 bgs

SEE LEGEND FOR ABBREVIATIONS.

| AP-7818 3-13 bgs | SEPT 1999 | MAR 2000 | SEPT 2000 |
|---|---|---|---|
| DCA | ND(10) | ND(10) | ND(1) |
| EDB | **0.336** | **0.169** | 0.0136 |
| 1,2,4-TMB | **330** | **293** | **252** |
| 1,3,5-TMB | **126** | **57.7** | **110** |
| BENZENE | **10,500** | **2,050** | **7,670** |
| TOLUENE | **4,530** | **4,590** | **9,090** |
| EBZ | 292 | 291 | 243 |

CONCENTRATIONS

CONCENTRATIONS EXCEEDING REMEDIAL ACTION GOALS

REMEDIAL ACTION GOALS IN $\mu g/L$

| | | | |
|---|---|---|---|
| 5 | DCA | 5 | BENZENE |
| 0.05 | EDB | 1,000 | TOLUENE |
| 14 | 1,2,4-TMB | 700 | EBZ |
| 12 | 1,3,5-TMB | | |

NOTES:
1. CONCENTRATIONS IN MICROGRAMS PER LITER ($\mu g/L$)
2. CONCENTRATIONS EXCEEDING REMEDIAL ACTION GOALS SHOWN IN **BOLD**

0 100 200

Scale in Feet

FAIRBANKS ENVIRONMENTAL SERVICES
748 GAFFNEY ROAD, SUITE 200
FAIRBANKS, ALASKA

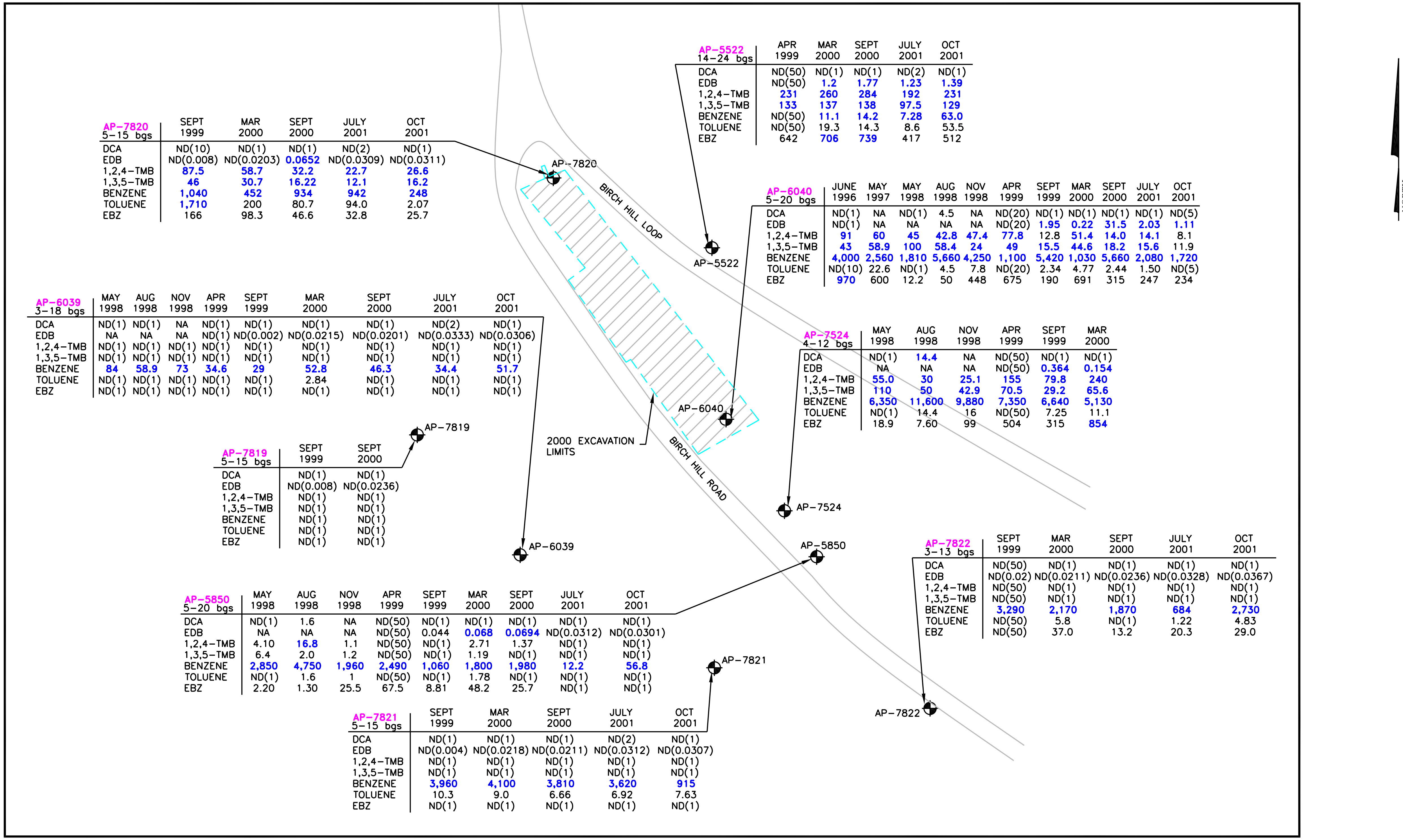
ALASKA DISTRICT
CORPS OF ENGINEERS
ANCHORAGE, ALASKA

# Concentrations of Analytes in Groundwater - Milepost 2.7

Explanation of Significant Differences
Operable Unit 3
Fort Wainwright, Alaska

CONTRACT: DACA85-01-C-0018 | FIGURE: 8 | DATE: 8/02

201AF




| AP-7820 5-15 bgs | SEPT 1999 | MAR 2000 | SEPT 2000 | JULY 2001 | OCT 2001 |
|---|---|---|---|---|---|
| DCA | ND(10) | ND(1) | ND(1) | ND(2) | ND(1) |
| EDB | ND(0.008) | ND(0.0203) | **0.0652** | ND(0.0309) | ND(0.0311) |
| 1,2,4-TMB | **87.5** | **58.7** | **32.2** | **22.7** | **26.6** |
| 1,3,5-TMB | **46** | **30.7** | **16.22** | **12.1** | **16.2** |
| BENZENE | **1,040** | **452** | **934** | **942** | **248** |
| TOLUENE | **1,710** | 200 | 80.7 | 94.0 | 2.07 |
| EBZ | 166 | 98.3 | 46.6 | 32.8 | 25.7 |

| AP-5522 14-24 bgs | APR 1999 | MAR 2000 | SEPT 2000 | JULY 2001 | OCT 2001 |
|---|---|---|---|---|---|
| DCA | ND(50) | ND(1) | ND(1) | ND(2) | ND(1) |
| EDB | ND(50) | **1.2** | **1.77** | **1.23** | **1.39** |
| 1,2,4-TMB | **231** | **260** | **284** | **192** | **231** |
| 1,3,5-TMB | **133** | **137** | **138** | **97.5** | **129** |
| BENZENE | ND(50) | **11.1** | **14.2** | **7.28** | **63.0** |
| TOLUENE | ND(50) | 19.3 | 14.3 | 8.6 | 53.5 |
| EBZ | 642 | **706** | **739** | 417 | 512 |

| AP-6040 5-20 bgs | JUNE 1996 | MAY 1997 | MAY 1998 | AUG 1998 | NOV 1998 | APR 1999 | SEPT 1999 | MAR 2000 | SEPT 2000 | JULY 2001 | OCT 2001 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| DCA | ND(1) | NA | ND(1) | 4.5 | NA | ND(20) | ND(1) | ND(1) | ND(1) | ND(1) | ND(5) |
| EDB | ND(1) | NA | NA | NA | NA | ND(20) | **1.95** | **0.22** | **31.5** | **2.03** | **1.11** |
| 1,2,4-TMB | **91** | **60** | **45** | **42.8** | **47.4** | **77.8** | 12.8 | **51.4** | **14.0** | **14.1** | 8.1 |
| 1,3,5-TMB | **43** | **58.9** | **100** | **58.4** | **24** | **49** | **15.5** | **44.6** | **18.2** | **15.6** | 11.9 |
| BENZENE | **4,000** | **2,560** | **1,810** | **5,660** | **4,250** | **1,100** | **5,420** | **1,030** | **5,660** | **2,080** | **1,720** |
| TOLUENE | ND(10) | 22.6 | ND(1) | 4.5 | 7.8 | ND(20) | 2.34 | 4.77 | 2.44 | 1.50 | ND(5) |
| EBZ | **970** | 600 | 12.2 | 50 | 448 | 675 | 190 | 691 | 315 | 247 | 234 |

| AP-6039 3-18 bgs | MAY 1998 | AUG 1998 | NOV 1998 | APR 1999 | SEPT 1999 | MAR 2000 | SEPT 2000 | JULY 2001 | OCT 2001 |
|---|---|---|---|---|---|---|---|---|---|
| DCA | ND(1) | ND(1) | NA | ND(1) | ND(1) | ND(1) | ND(1) | ND(2) | ND(1) |
| EDB | NA | NA | NA | ND(1) | ND(0.002) | ND(0.0215) | ND(0.0201) | ND(0.0333) | ND(0.0306) |
| 1,2,4-TMB | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| 1,3,5-TMB | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| BENZENE | **84** | **58.9** | **73** | **34.6** | **29** | **52.8** | **46.3** | **34.4** | **51.7** |
| TOLUENE | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | 2.84 | ND(1) | ND(1) | ND(1) |
| EBZ | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |

| AP-7524 4-12 bgs | MAY 1998 | AUG 1998 | NOV 1998 | APR 1999 | SEPT 1999 | MAR 2000 |
|---|---|---|---|---|---|---|
| DCA | ND(1) | **14.4** | NA | ND(50) | ND(1) | ND(1) |
| EDB | NA | NA | NA | ND(50) | **0.364** | **0.154** |
| 1,2,4-TMB | **55.0** | **30** | **25.1** | **155** | **79.8** | **240** |
| 1,3,5-TMB | **110** | **50** | **42.9** | **70.5** | **29.2** | **65.6** |
| BENZENE | **6,350** | **11,600** | **9,880** | **7,350** | **6,640** | **5,130** |
| TOLUENE | ND(1) | 14.4 | 16 | ND(50) | 7.25 | 11.1 |
| EBZ | 18.9 | 7.60 | 99 | 504 | 315 | **854** |

| AP-7819 5-15 bgs | SEPT 1999 | SEPT 2000 |
|---|---|---|
| DCA | ND(1) | ND(1) |
| EDB | ND(0.008) | ND(0.0236) |
| 1,2,4-TMB | ND(1) | ND(1) |
| 1,3,5-TMB | ND(1) | ND(1) |
| BENZENE | ND(1) | ND(1) |
| TOLUENE | ND(1) | ND(1) |
| EBZ | ND(1) | ND(1) |

| AP-7822 3-13 bgs | SEPT 1999 | MAR 2000 | SEPT 2000 | JULY 2001 | OCT 2001 |
|---|---|---|---|---|---|
| DCA | ND(50) | ND(1) | ND(1) | ND(1) | ND(1) |
| EDB | ND(0.02) | ND(0.0211) | ND(0.0236) | ND(0.0328) | ND(0.0367) |
| 1,2,4-TMB | ND(50) | ND(1) | ND(1) | ND(1) | ND(1) |
| 1,3,5-TMB | ND(50) | ND(1) | ND(1) | ND(1) | ND(1) |
| BENZENE | **3,290** | **2,170** | **1,870** | **684** | **2,730** |
| TOLUENE | ND(50) | 5.8 | ND(1) | 1.22 | 4.83 |
| EBZ | ND(50) | 37.0 | 13.2 | 20.3 | 29.0 |

| AP-5850 5-20 bgs | MAY 1998 | AUG 1998 | NOV 1998 | APR 1999 | SEPT 1999 | MAR 2000 | SEPT 2000 | JULY 2001 | OCT 2001 |
|---|---|---|---|---|---|---|---|---|---|
| DCA | ND(1) | 1.6 | NA | ND(50) | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| EDB | NA | NA | NA | ND(50) | 0.044 | **0.068** | **0.0694** | ND(0.0312) | ND(0.0301) |
| 1,2,4-TMB | 4.10 | **16.8** | 1.1 | ND(50) | ND(1) | 2.71 | 1.37 | ND(1) | ND(1) |
| 1,3,5-TMB | 6.4 | 2.0 | 1.2 | ND(50) | ND(1) | 1.19 | ND(1) | ND(1) | ND(1) |
| BENZENE | **2,850** | **4,750** | **1,960** | **2,490** | **1,060** | **1,800** | **1,980** | **12.2** | **56.8** |
| TOLUENE | ND(1) | 1.6 | 1 | ND(50) | ND(1) | 1.78 | ND(1) | ND(1) | ND(1) |
| EBZ | 2.20 | 1.30 | 25.5 | 67.5 | 8.81 | 48.2 | 25.7 | ND(1) | ND(1) |

| AP-7821 5-15 bgs | SEPT 1999 | MAR 2000 | SEPT 2000 | JULY 2001 | OCT 2001 |
|---|---|---|---|---|---|
| DCA | ND(1) | ND(1) | ND(1) | ND(2) | ND(1) |
| EDB | ND(0.004) | ND(0.0218) | ND(0.0211) | ND(0.0312) | ND(0.0307) |
| 1,2,4-TMB | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| 1,3,5-TMB | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |
| BENZENE | **3,960** | **4,100** | **3,810** | **3,620** | **915** |
| TOLUENE | 10.3 | 9.0 | 6.66 | 6.92 | 7.63 |
| EBZ | ND(1) | ND(1) | ND(1) | ND(1) | ND(1) |

LEGEND

| | |
|---|---|
| AP-6039 | MONITORING WELL |
| 1,2,4-TMB | 1,2,4-TRIMETHYLBENZENE |
| 1,3,5-TMB | 1,3,5-TRIMETHYLBENZENE |
| bgs | BELOW GROUND SURFACE |
| DCA | 1,2-DICHLOROETHANE |
| EDB | 1,2-DIBROMOETHANE |
| EBZ | ETHYLBENZENE |
| NA | ANALYSIS NOT PERFORMED |
| ND | NOT DETECTED (DETECTION LIMIT) |
| UST | UNDERGROUND STORAGE TANK |

KEY:

MONITORING WELL — AP-5522

SCREENED INTERVAL DEPTH IN FEET bgs — 14-24 bgs

SEE LEGEND FOR ABBREVIATIONS.

| AP-5522 14-24 bgs | APR 1999 | MAR 2000 | SEPT 2000 | JULY 2001 |
|---|---|---|---|---|
| DCA | ND(50) | ND(1) | ND(1) | ND(2) |
| EDB | ND(50) | **1.2** | **1.77** | **1.23** |
| 1,2,4-TMB | **231** | **260** | **284** | **192** |
| 1,3,5-TMB | **133** | **137** | **138** | **97.5** |
| BENZENE | ND(50) | **11.1** | **14.2** | **7.28** |
| TOLUENE | ND(50) | 19.3 | 14.3 | 8.6 |
| EBZ | 642 | **706** | **739** | 417 |

CONCENTRATIONS — **CONCENTRATIONS EXCEEDING REMEDIAL ACTION GOALS**

REMEDIAL ACTION GOALS IN $\mu g/L$

| | | | |
|---|---|---|---|
| 5 | DCA | 5 | BENZENE |
| 0.05 | EDB | 1,000 | TOLUENE |
| 14 | 1,2,4-TMB | 700 | EBZ |
| 12 | 1,3,5-TMB | | |

0 100 200

Scale in Feet

NOTES: 1. CONCENTRATIONS IN MICROGRAMS PER LITER ($\mu g/L$)

2. CONCENTRATIONS EXCEEDING REMEDIAL ACTION GOALS SHOWN IN **BOLD**


FAIRBANKS ENVIRONMENTAL SERVICES
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FAIRBANKS, ALASKA

ALASKA DISTRICT
CORPS OF ENGINEERS
ANCHORAGE, ALASKA


# Concentrations of Analytes in Groundwater - Milepost 3.0

Explanation of Significant Differences
Operable Unit 3
Fort Wainwright, Alaska

CONTRACT: DACA85-01-C-0018 | FIGURE: 9 | DATE: 8/02

201AF

- Excavation of contaminated soils from Milepost 2.7 (1,500 cubic yards) and Milepost 3.0 (6,000 cubic yards) and treatment in the vicinity of the Truck Fill Stand and Building 1173 treatment systems;

- Treatment of contaminated soil from Milepost sites 2.7 and 3.0 in the treatment cells to achieve ADEC Level A cleanup levels and soil disposal criteria required for placement in Fort Wainwright's on-Post solid waste landfill or to achieve applicable off-Post soil disposal criteria, as determined appropriate by the Army;

- Monitoring of soil and groundwater contamination remaining in the vicinity of Remedial Area 3, for as long as required until RAOs have been achieved, as determined by concurrence of the project managers; and

- Installation of additional monitoring wells and site characterization at Milepost 2.7 and 3.0 to gain a better understanding of local hydrology, impacts of permafrost, and contaminant migration.

Table 5-1 below compares estimated costs at the time of the ROD to the current estimated costs for Remedial Area 3.

**Table 5-1 – Remedial Area 3 ROD and ESD Cost Comparison**

| **Cost Category** | **ROD Cost Estimate (present worth)** | **ESD Cost Estimate[4] (present worth)** |
|---|---|---|
| Capital Cost | $480,000 [1] | $263,074 |
| Treatment System Operation | 80,000 [2] | 86,628 |
| Monitoring | | 437,262 |
| Closure | | 29,050 |
| Administrative (20%) | [3] | 163,203 |
| Contingency (15%) | [3] | 54,927 |
| **Totals** | $560,000 | $1,034,144 |

[1] It is assumed capital costs include installation, repair, and closure costs

[2] Operation and monitoring costs were not separated in the ROD

[3] Administrative and contingency costs were not identified in the ROD

[4] From June 2002 Interim Remedial Action Report

A detailed Remedial Area 3 ESD cost estimate is provided as Table A-3 in Appendix A. The ESD estimates that the Remedial Area 3 remedial costs will be approximately double the costs estimated in the ROD. This difference can predominantly be attributed to the fact that the ROD underestimated the costs associated with long-term groundwater monitoring.

## 6.0 STATE AGENCY COMMENTS

ADEC has reviewed this ESD and supports these changes to the selected remedy.

## 7.0 AFFIRMATION OF THE STATUTORY DETERMINATION

Considering the new information that has been developed and the changes that have been made to the selected remedies, the lead and support agencies believe that the remedies remain protective of human health and the environment, comply with federal and state requirements that were identified in the ROD as applicable or relevant and appropriate to these remedial actions at the time of the ROD, and are cost-effective. In addition, the revised remedies continue to utilize permanent solutions and alternative treatment technologies to the maximum extent practicable for these source areas.

# 8.0 PUBLIC PARTICIPATION ACTIVITIES

In accordance with 40 CFR 300.435(c)(2)(i), the Army will conduct the following public participation activities:

- The ESD and supporting information will be made available to the public in the administrative record established under 40 CFR 300.815 and the information repository (administrative record locations are listed in Section 1.4);

- A notice of availability and a brief description of this ESD will be published in the *Fairbanks Daily News Miner*; and

- The public was made aware of the preparation of this ESD through a publication in the May 2002 edition of the Fort Wainwright *Environmental Restoration News.*

**Signed:**

Fredrick J. Lehman
Colonel, U.S. Army
Garrison Commander

Date

**Signed:**

Michael F. Gearheard, Director
Office of Environmental Cleanup
EPA, Region 10

9/27/02
Date

**Signed:**

Jennifer Roberts
Section Manager, DOD Section
Division of Spill Prevention and Response
Alaska Department of Environmental Conservation

Sept 20 2002
Date

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# APPENDIX A

**TABLE A-1 Summary of Remedial Area 1B Remedial Costs**

| | Cost Category (present worth) | | | | | | |
|---|---|---|---|---|---|---|---|
| Remedial System | Capital | Operation | Monitoring | Closure | Administrative | Contingency | TOTAL |
| Birch Hill Product Recovery | 1,177,262 | 1,157,629 | 2,527,074 | 62,799 | 984,953 | 429,291 | **6,339,009** |
| Thaw Channel | 166,425 | 67,959 | 435,051 | 24,087 | 138,704 | 291,569 | **1,123,795** |
| Building 1173 | 676,978 | 264,164 | 511,565 | 24,087 | 295,359 | 46,907 | **1,819,059** |
| Truck Fill Stand | 360,191 | 164,678 | 270,014 | 26,555 | 164,288 | 18,549 | **1,004,275** |
| **TOTAL REMEDIAL AREA 1B COST** | **$ 2,380,856** | **$ 1,654,430** | **$ 3,743,704** | **$ 137,528** | **$1,583,304** | **$786,316** | **$ 10,286,137** |

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| **Birch Hill Product Recovery** | | | | | Installation & Active Treatment | | Active Treatment | | | | | | | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | |
| **Thaw Channel** | | | Installation & Active Treatment | | | Active Treatment | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | | | |
| **Building 1173** | Installation & Active Treatment | | Active Treatment | | | | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | | | |
| **Truck Fill Stand** | | Installation & Treatment | Active Treatment | | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | | | | | |
| **Capital Costs** | $102,651 | $927,895 | $109,396 | $3,473 | $998,161 | $87,150 | $30,000 | $66,667 | $0 | $31,098 | $0 | $0 | $0 | $0 | $24,366 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $2,380,856 |
| **Operation Costs** | $30,056 | $153,558 | $135,588 | $27,668 | $103,725 | $150,247 | $100,990 | $121,061 | $112,010 | $109,876 | $91,224 | $89,486 | $85,083 | $83,462 | $81,873 | $80,313 | $78,783 | $9,806 | $9,619 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $1,654,430 |
| **Monitoring Costs** | $2,010 | $6,381 | $27,957 | $143,657 | $306,564 | $457,909 | $243,840 | $237,695 | $233,373 | $228,928 | $254,684 | $249,833 | $180,471 | $177,033 | $173,661 | $170,353 | $165,827 | $108,922 | $106,847 | $45,816 | $40,627 | $39,853 | $21,394 | $20,986 | $20,586 | $20,194 | $19,810 | $19,432 | $19,062 | $0 | $3,743,704 |
| **Closure Costs** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $16,454 | $0 | $29,849 | $0 | $0 | $0 | $0 | $0 | $0 | $53,032 | $10,101 | $0 | $18,324 | $0 | $0 | $0 | $0 | $0 | $0 | $9,767 | $137,528 |
| **Total Contract Costs** | $134,718 | $1,087,834 | $272,940 | $174,798 | $1,408,449 | $695,305 | $374,830 | $425,423 | $345,383 | $369,902 | $362,362 | $339,319 | $295,402 | $260,495 | $279,900 | $250,666 | $244,610 | $118,728 | $116,467 | $98,848 | $50,728 | $39,853 | $39,718 | $20,986 | $20,586 | $20,194 | $19,810 | $19,432 | $19,062 | $9,767 | $7,916,518 |
| **Administrative Costs** | $26,944 | $217,567 | $54,588 | $34,960 | $281,690 | $139,061 | $74,966 | $85,085 | $69,077 | $73,980 | $72,472 | $67,864 | $59,080 | $52,099 | $55,980 | $50,133 | $48,922 | $23,746 | $23,293 | $19,770 | $10,146 | $7,971 | $7,944 | $4,197 | $4,117 | $4,039 | $3,962 | $3,886 | $3,812 | $1,953 | $1,583,304 |
| **Contingency Costs** | $0 | $0 | $186,702 | $52,788 | $0 | $0 | $0 | $53,813 | $51,807 | $50,821 | $54,354 | $50,898 | $44,310 | $39,074 | $38,330 | $37,600 | $36,691 | $17,809 | $17,470 | $14,827 | $7,609 | $5,978 | $5,958 | $3,148 | $3,088 | $3,029 | $2,971 | $2,915 | $2,859 | $1,465 | 786,316 |
| **Total Costs** | $161,661 | $1,305,401 | $514,230 | $262,546 | $1,690,139 | $834,366 | $449,796 | $564,321 | $466,267 | $494,704 | $489,188 | $458,081 | $398,793 | $351,669 | $374,210 | $338,399 | $330,223 | $160,283 | $157,230 | $133,445 | $68,483 | $53,801 | $53,619 | $28,331 | $27,791 | $27,262 | $26,743 | $26,233 | $25,734 | $13,186 | $10,286,137 |

Notes:

1) All values are in present worth.

2) Administrative costs are calculated as 20% of the the total contract cost.

3) Contingency costs are calculated as 15% of future operation, monitoring, and closure costs.

**TABLE A-2 Summary of Remedial Area 2 Remedial Costs**

| | Cost Category (present worth) | | | | | | |
|---|---|---|---|---|---|---|---|
| Remedial System | Capital | Operation | Monitoring | Closure | Administrative | Contingency | TOTAL |
| Valve Pit A | 379,823 | 193,739 | 430,871 | 24,087 | 205,704 | 37,964 | **1,272,187** |
| Valve Pit B | 255,805 | 190,961 | 444,002 | 25,026 | 183,159 | 38,418 | **1,137,371** |
| Valve Pit C | 128,177 | 147,709 | 273,635 | 14,639 | 112,832 | 16,846 | **693,838** |
| Central Header | 1,277,727 | 357,284 | 655,530 | 53,953 | 468,899 | 76,659 | **2,890,052** |
| Buildiing 1144 | 700,316 | 350,133 | 572,910 | 21,847 | 329,041 | 60,977 | **2,035,225** |
| 8 Car Header | 761,626 | 221,512 | 478,687 | 24,087 | 297,182 | 51,046 | **1,834,139** |
| **TOTAL REMEDIAL AREA 2 COSTS** | **$ 3,503,473** | **$ 1,461,339** | **$ 2,855,636** | **$163,638** | **$1,596,817** | **$281,908** | **$9,862,812** |

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| **Valve Pit A** | Installation & Active Treatment | | Active Treatment | | Expansion & Treatment | Active Treatment | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | | | |
| **Valve Pit B** | Installation & Active Treatment | | Active Treatment | | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | | | | | |
| **Valve Pit C** | Installation & Active Treatment | | Rebound Evaluation | | Active Treatment | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | | | | | | | |
| **Central Header** | Installation & Active Treatment | | Active Treatment | | Expansion & Treatment | Active Treatment | | | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | |
| **Building 1144** | Installation & Active Treatment | | Active Treatment | | | | | | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | |
| **8 Car Header** | | | Install & Treatment | Active Treatment | | | | | | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | Well Decom-missioning | | | | | | | | |
| **Capital Costs** | $513,257 | $1,203,534 | $1,196,058 | $0 | $584,325 | $6,300 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $3,503,473 |
| **Operation Costs** | $150,282 | $269,292 | $421,650 | $75,544 | $76,031 | $88,662 | $80,641 | $74,940 | $72,011 | $70,640 | $38,477 | $37,744 | $2,739 | $2,687 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $1,461,339 |
| **Monitoring Costs** | $10,051 | $31,907 | $36,465 | $402,882 | $437,913 | $318,203 | $201,703 | $191,444 | $155,148 | $152,193 | $141,953 | $139,249 | $96,453 | $94,616 | $75,069 | $53,273 | $52,258 | $48,337 | $40,989 | $39,897 | $31,384 | $30,503 | $15,864 | $15,306 | $8,136 | $7,748 | $7,379 | $7,028 | $6,201 | $6,083 | $2,855,636 |
| **Closure Costs** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $9,070 | $0 | $0 | $0 | $44,773 | $0 | $13,537 | $0 | $0 | $46,774 | $5,568 | $0 | $10,101 | $0 | $18,324 | $0 | $8,310 | $0 | $0 | $7,179 | $0 | $0 | $163,638 |
| **Total Contract Costs** | $673,590 | $1,504,733 | $1,654,173 | $478,425 | $1,098,269 | $413,164 | $282,344 | $266,384 | $236,230 | $222,833 | $180,430 | $176,993 | $143,966 | $97,303 | $88,606 | $53,273 | $52,258 | $95,112 | $46,558 | $39,897 | $41,485 | $30,503 | $34,189 | $15,306 | $16,446 | $7,748 | $7,379 | $14,207 | $6,201 | $6,083 | $7,984,087 |
| **Administrative Costs** | $134,718 | $300,947 | $330,835 | $95,685 | $219,654 | $82,633 | $56,469 | $53,277 | $47,246 | $44,567 | $36,086 | $35,399 | $28,793 | $19,461 | $17,721 | $10,655 | $10,452 | $19,022 | $9,312 | $7,979 | $8,297 | $6,101 | $6,838 | $3,061 | $3,289 | $1,550 | $1,476 | $2,841 | $1,240 | $1,217 | $1,596,817 |
| **Contingency Costs** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $39,958 | $35,434 | $33,425 | $27,065 | $26,549 | $21,595 | $14,596 | $13,291 | $7,991 | $7,839 | $14,267 | $6,984 | $5,985 | $6,223 | $4,576 | $5,128 | $2,296 | $2,467 | $1,162 | $1,107 | $2,131 | $930 | $912 | $281,908 |
| **Total Costs** | $808,307 | $1,805,679 | $1,985,008 | $574,110 | $1,317,922 | $495,797 | $338,813 | $359,618 | $318,910 | $300,824 | $243,581 | $238,941 | $194,354 | $131,360 | $119,617 | $71,918 | $70,548 | $128,401 | $62,853 | $53,861 | $56,005 | $41,180 | $46,155 | $20,663 | $22,202 | $10,460 | $9,962 | $19,179 | $8,372 | $8,212 | $9,862,812 |

Notes:

1) All values are in present worth.

2) Administrative costs are calculated as 20% of the the total contract cost.

3) Contingency costs are calculated as 15% of future operation, monitoring, and closure costs.

**TABLE A-3  Summary of Remedial Area 3 Remedial Costs**

| Site | Capital | Operation | Monitoring | Closure | Administrative | Contingency | TOTAL |
|---|---|---|---|---|---|---|---|
| | Cost Category (present worth) | | | | | | |
| Milepost 2.7 | 0 | 0 | 128,922 | 3,256 | 26,436 | 19,827 | **178,440** |
| Milepost 3.0 | 0 | 0 | 186,483 | 3,256 | 37,948 | 28,461 | **256,148** |
| Milepost 15.75 | 263,074 | 86,628 | 121,857 | 22,539 | 98,819 | 6,640 | **599,557** |
| **TOTAL REMEDIAL AREA 3 COSTS** | **$263,074** | **$86,628** | **$437,262** | **$29,050** | **$163,203** | **$54,927** | **$1,034,144** |

| | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| Milepost 2.7 | | | | | | | | Long-Term Monitoring (Groundwater Sampling) | | | | | | | |
| Milepost 3.0 | | | | | | | | Long-Term Monitoring (Groundwater Sampling) | | | | | | | |
| Milepost 15.75 | Installation & Active Treatment | | Rebound Evaluation | | System Removal | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | |
| **Capital Costs** | $263,074 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Operation Costs** | $30,056 | $56,571 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Monitoring Costs** | $0 | $0 | $6,078 | $18,903 | $23,587 | $17,786 | $14,460 | $36,000 | $32,512 | $34,642 | $18,963 | $20,036 | $17,060 | $19,280 | $16,416 |
| **Closure Costs** | $0 | $0 | $0 | $0 | $19,316 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| **Total Contract Costs** | $293,131 | $56,571 | $6,078 | $18,903 | $42,903 | $17,786 | $14,460 | $36,000 | $32,512 | $34,642 | $18,963 | $20,036 | $17,060 | $19,280 | $16,416 |
| **Administrative Costs** | $58,626 | $11,314 | $1,216 | $3,781 | $8,581 | $3,557 | $2,892 | $7,200 | $6,502 | $6,928 | $3,793 | $4,007 | $3,412 | $3,856 | $3,283 |
| **Contingency Costs** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $5,400 | $4,877 | $5,196 | $2,844 | $3,005 | $2,559 | $2,892 | $2,462 |
| **Total Costs** | $351,757 | $67,885 | $7,293 | $22,684 | $51,483 | $21,344 | $17,352 | $48,600 | $43,891 | $46,766 | $25,599 | $27,049 | $23,030 | $26,029 | $22,161 |

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| Milepost 2.7 | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | | | | | | Well Decom-missioning | |
| Milepost 3.0 | Long-Term Monitoring (Groundwater Sampling) | | | | | | | | | | | | | | Well Decom-missioning | |
| Milepost 15.75 | Well Decom-missioning | | | | | | | | | | | | | | | |
| **Capital Costs** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $263,074 |
| **Operation Costs** | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $86,628 |
| **Monitoring Costs** | $15,450 | $11,471 | $13,610 | $11,038 | $13,096 | $10,622 | $12,602 | $10,221 | $12,127 | $9,835 | $11,669 | $9,464 | $11,229 | $9,107 | $0 | $437,262 |
| **Closure Costs** | $3,223 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $6,511 | $29,050 |
| **Total Contract Costs** | $18,673 | $11,471 | $13,610 | $11,038 | $13,096 | $10,622 | $12,602 | $10,221 | $12,127 | $9,835 | $11,669 | $9,464 | $11,229 | $9,107 | $6,511 | $816,014 |
| **Administrative Costs** | $3,735 | $2,294 | $2,722 | $2,208 | $2,619 | $2,124 | $2,520 | $2,044 | $2,425 | $1,967 | $2,334 | $1,893 | $2,246 | $1,821 | $1,302 | $163,203 |
| **Contingency Costs** | $2,801 | $1,721 | $2,041 | $1,656 | $1,964 | $1,593 | $1,890 | $1,533 | $1,819 | $1,475 | $1,750 | $1,420 | $1,684 | $1,366 | $977 | $54,927 |
| **Total Costs** | $25,208 | $15,486 | $18,373 | $14,901 | $17,680 | $14,339 | $17,013 | $13,798 | $16,371 | $13,278 | $15,753 | $12,777 | $15,159 | $12,294 | $8,790 | $1,034,144 |

Notes:

1) All values are in present worth.

2) Administrative costs are calculated as 20% of the the total contract cost.

3) Contingency costs are calculated as 15% of future operation, monitoring, and closure costs.