INSTALLATION RESTORATION PROGRAM

FINAL

REMEDIAL INVESTIGATION REPORT

FOR SITES ST001, SS002, SS003,
SS004, SS011, AND LF005
BIG MOUNTAIN RRS, ALASKA

FEBRUARY 10, 2006

FINAL

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FOR SITES ST001, SS002, SS003, SS004, SS011, AND LF005 BIG MOUNTAIN RRS, ALASKA

FEBRUARY 10, 2006

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ABBREVIATIONS AND ACRONYMS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ARARs	Applicable or Relevant and Appropriate Regulations
AST	Aboveground Storage Tank
bgs	below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Civil Engineering Squadron
CFR	Code of Federal Regulations
DQO	Data Quality Objective
DRO	Diesel-Range Organics
ERA	Environmental Risk Assessment
GRO	Gasoline-Range Organics
IDW	Investigation-Derived Waste
IRP	Installation Restoration Program
MDL	Method Detection Limit
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
msl	Mean Sea Level
µg/L	Micrograms per Liter
NCP	National Contingency Plan NPL
NOAA	National Oceanic and Atmospheric Administration
OSWER	Office of Solid Waste and Emergency Response
PAH	Polynuclear Aromatic Hydrocarbon
Paug-Vik	Paug-Vik Development Corporation
PCBs	Polychlorinated Biphenyls
QA	Quality Assurance
QAR	Quality Assurance Report
QC	Quality Control
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation and Feasibility Study
RL	Reporting Limit
ROD	Record of Decision
RRO	Residual-Range Organics
RRS	Radio Relay Station
SVOC	Semi-volatile organic compound
TAH	Total Aromatic Hydrocarbons
TAqH	Total Aqueous Hydrocarbons
USAF	United State Air Force
USEPA	Environmental Protection Agency
VOC	Volatile Organic Compound

PART 1 BACKGROUND

1 INTRODUCTION

Paug-Vik Development Corporation (Paug-Vik) performed the Installation Restoration Program (IRP) project scope for the United States Air Force (USAF), 611th Civil Engineer Squadron (611 CES), as a firm-fixed-price delivery order under an indefinite delivery, indefinite quantity contract issued by the franchise authority of the Department of Interior, Minerals Management Service (GovWorks) (Contract No. 1435-04-03-CT-71697; Delivery Order No. 34984).

The primary purpose of this remedial investigation (RI) was to evaluate impacts to surface water, groundwater, sediment, and soil at the 42,400-gallon Aboveground Storage Tank (AST) and Pipeline Area (ST001) and the Former Lower Camp Landfill (LF005). Surface soils, subsurface soils, and groundwater were investigated at the 1,000-gallon Fuel Oil AST Area (SS002), the Auto Maintenance Shop and Flight Operations Building (SS003), and the 1,000-gallon MOGAS Tank Area (SS004). In addition, surface and subsurface soils were investigated at the Temporary Upper Camp Auto Storage Shop Area (SS011). Groundwater and subsurface soils were investigated by installing monitoring wells and soil borings. The objectives of this investigation were to:

- Fill in data gaps identified in previous studies.
- Characterize the nature and extent of soil, water, and sediment contamination at each site.
- Develop remedial action objectives (RAOs) for impacted soil, water, and sediment.
- Recommend remedial strategies to address regulatory and environmental concerns at each site.

1.1 REPORT ORGANIZATION

This report contains two main parts. Background information is presented in Part 1. Part 2 includes the RI objectives and findings from sites ST001, LF005, SS002, SS003, SS004, and SS011, as well as a brief discussion of Ecological Risk Assessment and background study findings. Background includes an introduction, site description, installation history, and project purpose. The RI portion presents descriptions of the field effort, field screening and analytical laboratory results, and the nature and extent of contamination. The selected remedial approach and conclusions of the RI are also discussed in Part 2 of this report.

Figures, summary tables, and appended material follow the report text. Appendices are as follows:

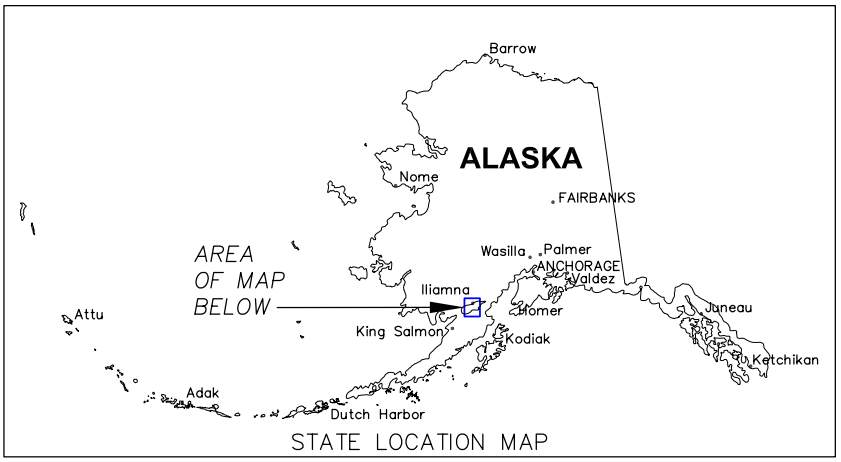
- APPENDIX A: Field Notes.
- APPENDIX B: Daily Activity Reports.
- APPENDIX C: Site Photographs.
- APPENDIX D: Field Sampling Sheets.
- APPENDIX E: Analytical Summary Tables.
- APPENDIX F: Complete Analytical Data Package (On CD-ROM).
- APPENDIX G: Monitoring Well Construction Diagrams and Borehole Logs.
- APPENDIX H: Quality Assurance Reports.
- APPENDIX I: LF005 Landfill Cap Inspection Documentation.
- APPENDIX J: Comments to Draft Report and Response to Comments.

1.2 SITE DESCRIPTION

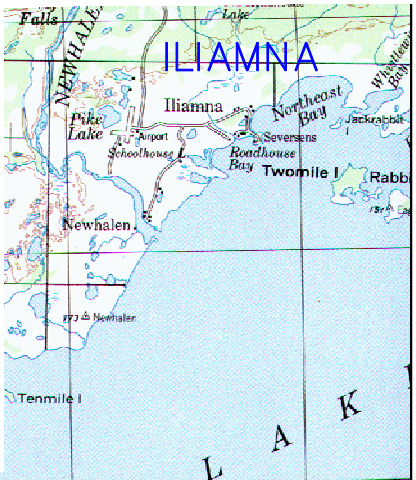
Big Mountain Radio Relay Station (RRS) lies 200 miles southwest of Anchorage on the south shore of Iliamna Lake (Figure 1-1). The installation consists of approximately 440 acres of property owned by the USAF (Figure 1-2). Project activities occurred at both the Lower Camp (elevation 52 feet above mean sea level {msl}) and the Upper Camp areas (elevation 2,160 feet above msl).

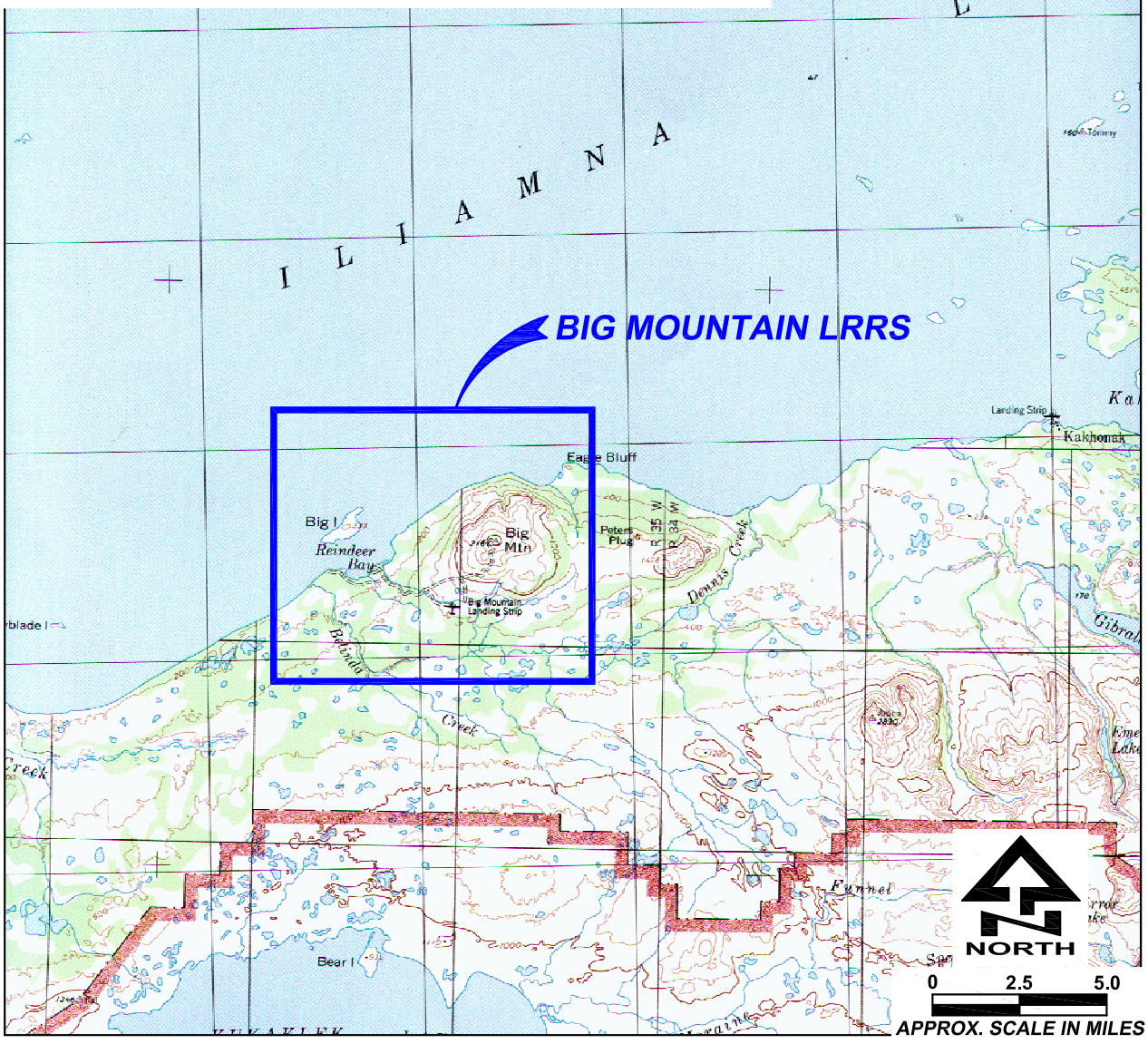
There are no roads connecting the surrounding communities to the Big Mountain installation property. Access to the installation area is by air, by barge landing on the lake during the summer months, by snow machine over the frozen lake during the winter months, or by ATV trails overland during the summer months. The refurbished 4,000-foot long runway at Lower Camp currently serves the installation. A gravel road connects the Barge Landing to Lower Camp and to the Upper Camp area. The Barge Landing site is located along Iliamna Lake at Reindeer Bay, and is on former USAF property that has been transferred to the University of Alaska.

The nearest local community is Kokhanok, approximately 17 miles east of Big Mountain on the southern shore of Iliamna Lake. Igiugig is located about 30 miles west of Big Mountain where the Kvichak River flows out of Iliamna Lake. The three other lake communities in the region include Iliamna, Pedro Bay, and Newhalen.



STATE LOCATION MAP





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ELMENDORF AFB, ALASKA

PROJECT LOCATION AND VICINITY

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
1-1

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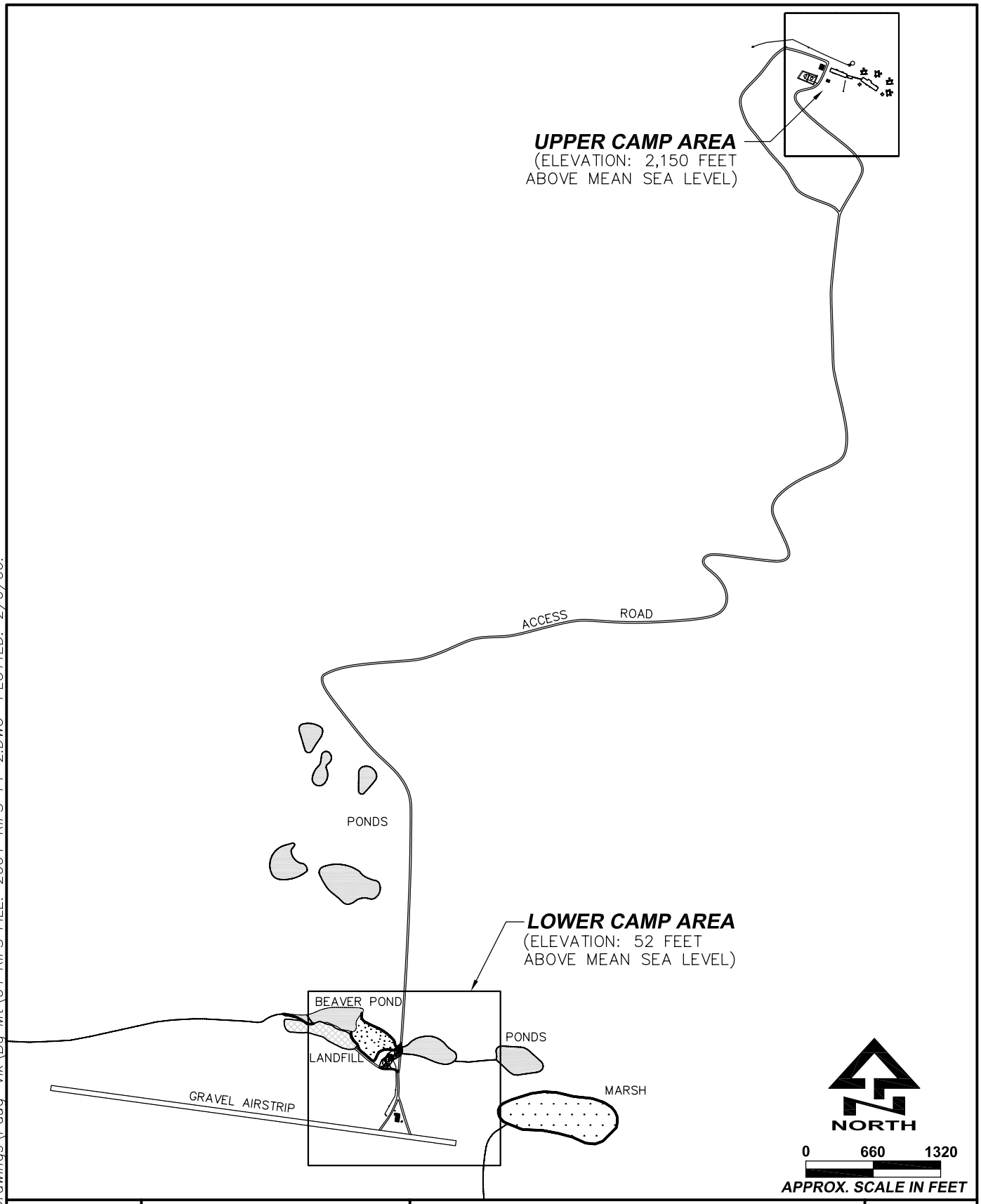

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ELMENDORF AFB, ALASKA

UPPER AND LOWER CAMP AREAS

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE

1-2

1.3 INSTALLATION HISTORY

The Big Mountain RRS was constructed by the USAF as part of a defense communication network and aircraft warning system established across Alaska during the Cold War. The facilities were constructed in 1956 as part of the White Alice Communication System (WACS), which was operational as a tropospheric scatter station from September 1957 to 1979.

Over the years, as communication and defense surveillance technology improved, progressively fewer personnel were needed on site to support the installation's mission. This resulted in the gradual downsizing of the operational facilities. By 1979, the installation was closed. Most of the original equipment, structures, and facility infrastructure were left in place at that time.

During installation activity, hazardous and potentially hazardous substances were used and stored there to support base activities. These substances included diesel fuel and gasoline, oils, antifreeze, solvents (for servicing and cleaning equipment), lead-acid and nickel-cadmium batteries, asbestos (as construction insulation material), and electrical transformers containing Polychlorinated Biphenyls (PCBs).

1.4 PROJECT SCOPE

The scope of the 2004 RI at ST001 and LF005 was to investigate surface water, groundwater, sediment, and soil conditions. At SS002, SS003, and SS004, the scope included investigation of soil and groundwater. Both surface and subsurface soils were investigated at SS011 under the 2004 RI scope of work. Remedial options and cleanup strategies were evaluated for each site. The 2004 scope also included an Ecological Risk Assessment (ERA) and background study to assess potential impacts from contaminants to human interceptors. Results of the ERA are briefly discussed in this report and will be presented in greater detail in a separate ERA report.

The purpose of the 2004 RI was to:

- Delineate the degree and extent of contamination at the sites.
- Determine the likelihood of contaminant migration from the sites.
- Recommend remedial actions.

1.5 DATA QUALITY OBJECTIVES

Project Data Quality Objectives (DQOs) guide decisions and procedures for collecting, analyzing, and evaluating data so that overall project objectives are met. RAOs are the

goals a selected remedy is designed to achieve. Project DQOs established for the 2004 Big Mountain RI verified that work procedures and data collected were of sufficient quality and quantity to meet project objectives and to evaluate attainment of RAOs established for the sites.

Primary objectives for this project are:

- To protect human and ecological receptors from unacceptable exposure to contaminated soils, sediments, and water.
- To comply with Applicable or Relevant and Appropriate Requirements (ARARs).
- To evaluate attainment of RAOs for sites being managed under the Decision Document for Interim Remedial Action (Paug-Vik, 2002).

Specific analytical DQOs can be found in Appendix B of the 2004 Work Plan (Paug-Vik, 2004a)

Soil, groundwater, surface water, and sediment samples were submitted to North Creek Analytical Laboratory. Analytical results from the 2004 sampling effort were compared to the following regulatory cleanup levels and screening criteria:

- 18 Alaska Administrative Code (AAC) 75 Method 2 Soil Cleanup Levels, Tables B1 and B2, (Alaska Department of Environmental Conservation [ADEC, 2004a]).
- 18 AAC 75 Groundwater Cleanup Levels, Table C, (ADEC, 2004a).
- 18 AAC 70 Water Quality Criteria, (ADEC, 2003b).
- National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables, (NOAA, 1999).
- United States Environmental Protection Agency (USEPA), Office of Solid Waste and Emergency Response (OSWER) Ecotox Thresholds, (USEPA, 1996).

Consistent with ADEC's technical memorandum *Sediment Quality Guidelines* (ADEC, 2004b), sediment samples were initially compared to the NOAA Screening Quick Reference Tables (SQuiRTs). However, when screening values were not listed within this reference, sediment sample results were compared to the hierarchy of benchmarks presented in ADEC's *Risk Assessment Procedures Manual* (ADEC, 2000) and listed in Section 6.1.1 of the ERA work plan (Paug-Vik/OASIS, 2004). Sediment sample results were also compared to the USEPA, OSWER Ecotox Thresholds (USEPA, 1996) when necessary.

1.6 SUMMARY OF PAST IRP ACTIVITIES

Currently, the Big Mountain RRS is not listed or proposed for inclusion on the National Priority Listing. Several environmental studies have been conducted at the Big Mountain

RRS site under the USAF IRP. The environmental reports and technical memorandums resulting from these studies were reviewed and utilized to guide the development of DQOs for this project. The following is a brief summary of findings from previous studies performed at the various Lower and Upper Camp sites. Figures 1-3 and 1-4 show the Lower and Upper Camp IRP sites addressed by this report.

1.6.1 42,400-Gallon AST and Pipeline Area (ST001)

The 42,400-gallon AST and fuel oil system was located approximately 600 feet north of the airstrip and 200 feet west of the Lower Camp access road, as detailed in Figure 1-3. In addition to the AST, the system included a truck fill stand, a containment berm with an outflow pipe, and a 600-foot long, four-inch diameter pipeline that extended east from the AST toward the access road. The pipeline was above ground for most of its length, buried only where it crossed the landfill access road. These structures were removed as part of the Clean Sweep program in 2003, except for the underground portion of the pipeline, which was removed during the 2004 Clean Sweep field effort (ILC/Paug-Vik, 2004b). Vegetation in the nearby wetlands is intact and shows no evidence of disturbance from recent tank removal activities.

During the 1998 RI and feasibility study (FS) (DOWL, 2001); surface and subsurface soil, groundwater, surface water, and sediment samples were collected from the pipeline and tank areas. Samples were analyzed for diesel-range organics (DRO), residual-range organics (RRO), polynuclear aromatic hydrocarbons (PAHs), benzene, toluene, ethylbenzene, and xylenes compounds (BTEX), and Resource Conservation and Recovery Act (RCRA) metals.

Surface and subsurface soil samples were collected from seven soil borings and two test pits excavated down to a maximum depth of fifteen feet below ground surface (bgs). DRO were detected at a maximum concentration of 17,000 milligrams per kilogram (mg/Kg), as compared to the cleanup level of 250 mg/Kg. Arsenic was detected at a concentration of 4.7 mg/Kg. The estimated volume of DRO-contaminated soil is about 800 cubic yards. However, the extent of contamination was not well defined to the north and west of the former AST or along the pipeline.

One temporary monitoring well was installed and sampled in 1998. The DRO concentration detected in the groundwater sample was equal to the preliminary cleanup level of 1.5 milligrams per liter (mg/L). The 1998 groundwater data (DOWL, 2001) indicates that the direction of groundwater flow at ST001 is to the northwest.

One surface water sample and one sediment sample were collected from a single location at the site. No contaminants were detected above cleanup levels in the surface

water sample. In the sediment sample, chromium was detected at a concentration above its ecological benchmark screening level, and low levels of DRO and RRO were also detected. The benchmark screening value for chromium represents the level that could cause adverse effects on the plants or wildlife in the area but is not a regulated cleanup level. There are no regulatory cleanup levels or benchmark screening values for diesel or motor oil in sediments.

The 2002 Decision Document for Interim Remedial Action at Four IRP Sites (Paug-Vik, 2002) identifies the selected remedy for ST001 as follows:

- DRO-contaminated soils will be excavated and thermally treated onsite. Approximately 800 cubic yards of DRO-contaminated soil was estimated at this site.
- Three to five groundwater monitoring wells will be installed to evaluate potential groundwater impacts at the site. A final groundwater remedy, if necessary, will be identified after the additional monitoring results have been evaluated.
- Surface water and sediment sampling will be performed to evaluate potential contamination in the wetland area located northwest of the site.

1.6.2 Former Landfill (LF005)

The former landfill (LF005) is located next to the unnamed creek in a relatively flat area north of the runway at Lower Camp (Figure 1-3). A limited landfill cap consisting of gravel from a local borrow source was previously placed on the landfill.

During the 1998 RI/FS (DOWL, 2001), five locations were selected for permanent groundwater monitoring wells. Four wells were installed down gradient from the landfill and one was placed upgradient to serve as a background well. Soil samples were collected during borings and were analyzed for total organic carbon and grain size distribution. One groundwater sample was collected at each monitoring well and analyzed for DRO, RRO, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PAHs, PCBs, pesticides, the total analyte list (TAL) of metals, nitrate/nitrite as nitrogen, sulfate, and chloride. Groundwater contaminants detected in site samples (with maximum values detected in parenthesis) included: 1,3-Dichlorobenzene (91 μg/L), 1,4-Dichlorobenzene (75 μg/L), aluminum (390 mg/L), arsenic (0.13 mg/L), barium (2.7 mg/L), beryllium (0.007 mg/L), chromium (0.31 mg/L), iron (550 mg/L), lead (0.099 mg/L), manganese (15 mg/L), nickel (0.1 mg/L), and vanadium (1.4 mg/L).

Data collected in 1999 indicated that groundwater flow at the former landfill (LF005) was to the southwest. It is possible that the beaver dammed pond in this area is recharging

the groundwater at the landfill area under certain conditions (i.e. heavy rainfall events and high pond levels).

The 2002 Decision Document for Interim Remedial Action (Paug-Vik, 2002) identified a limited landfill cap and additional assessment activities as the interim remedy selected for LF005. The interim remedy includes the following components:

- The landfill cap repair will include removal or covering of debris evident at the surface, placing of additional soil where the cover material is thin, grading the cover to minimize ponding, and revegetation of the cover.
- Three to five additional groundwater monitoring wells will be installed to monitor any potential groundwater impacts from possible leachate from buried debris at the landfill. A final groundwater remedy, if necessary, will be identified after the additional monitoring results have been evaluated.
- An ERA will be performed near the landfill. A minimum of three additional surface water and sediment samples will be collected in conjunction with the ecological risk assessment. A final surface water/sediment remedy, if necessary, will be identified after the ERA results have been evaluated.
- Long-term annual groundwater, surface water, and sediment monitoring with a five-year review (consistent with 42 United States Code [USC] 9621(c)) will be performed.

1.6.3 1,000-Gallon Fuel Oil AST Area (SS002)

The 1,000-gallon AST fuel oil system was located approximately ten feet north of the former Flight Operations Building at Lower Camp, adjacent to the Upper Camp Access road (Figure 1-3). The system was used to store fuel oil for generators and heating systems associated with the Automotive Maintenance Shop and Flight Operations buildings. Some disturbance of surface soils at this site has occurred during demolition activities in 2003 (ILC/Paug-Vik, 2004a). The original grade has not been significantly altered or covered over, but heavy equipment has been moving about the area as it is near a main thoroughfare between the Lower Camp and the runway.

Soil and groundwater samples were collected during the 1998 RI/FS (DOWL, 2001). Samples were analyzed for petroleum hydrocarbon constituents (gasoline-range organics [GRO], DRO, RRO, and PAHs) and VOCs. Selected samples were also analyzed for pesticides, PCBs, and RCRA metals.

Soil samples were collected from two soil borings and two test pit locations. The maximum DRO concentration detected was 18,000 mg/Kg. The maximum GRO concentration detected was 640 mg/Kg. The maximum benzene concentration detected was 0.86 mg/Kg. The maximum toluene concentration detected was 7.5 mg/Kg. The maximum arsenic detected was 3.9 mg/Kg. The detected concentrations exceed

preliminary cleanup levels for these constituents. The total estimated volume of contaminated soil is 300 cubic yards; however, the lateral extent of contamination is undefined to the north and east.

During the 1998 RI/FS effort (DOWL, 2001) one groundwater monitoring well was installed (total boring depth was 30 feet bgs) and sampled. Groundwater was analyzed for GRO, DRO, RRO, VOCs, PAHs, pesticides, PCBs, and RCRA metals. DRO was found in the groundwater sample at a level of 1.8 mg/L. The 1998 RI/FS data (DOWL, 2001) shows that the groundwater flow direction at SS002 is toward the northwest. Further investigation is necessary to determine the extent of DRO contamination at the site.

The 2002 Decision Document for Interim Remedial Action at Four IRP (Paug-Vik, 2002) identifies the selected remedy for SS002 as follows:

- DRO-contaminated soils will be excavated and thermally treated onsite. Approximately 300 cubic yards of DRO-contaminated soil was estimated at this site.
- Three to five groundwater monitoring wells will be installed to evaluate potential groundwater impacts at the site. A final groundwater remedy, if necessary, will be identified after the additional monitoring results have been evaluated.

1.6.4 Auto Maintenance Shop and Flight Operations Building (SS003)

Site SS003 is located to the north of the airstrip at Lower Camp (Figure 1-3). The former Auto Maintenance Shop and Flight Operations building served as a location for auto maintenance activities during the time that the installation was active. Based on historical documents, other facilities at this site include a concrete slab, reported to have been the Fire and Rescue Building, and an area on the west side of the buildings that was once used for 55-gallon drum and vehicle storage.

During the 1998 RI/FS effort (DOWL, 2001), surface and subsurface soils were analyzed for GRO, DRO, RRO, VOCs, PAHs, pesticides, PCBs, and RCRA metals. Soil contaminants noted to exceed applicable cleanup levels (with maximum detection in parenthesis) included: DRO (4,100 mg/Kg), benzene (0.35 mg/Kg), methylene chloride (0.28 mg/Kg), and arsenic (5.8 mg/Kg). In addition, a wooden crib and surrounding gravel-cobble fill layer coated with a malodorous hydrocarbon film were encountered in test pit TP-31 (DOWL, 2001).

It is likely that waste oil was used and stored at this facility; therefore, RRO cannot be ruled out as a contaminant of potential concern. Groundwater flow direction was determined to be generally to the northwest at this site (DOWL, 2001).

1.6.5 1,000-Gallon MOGAS Tank (SS004)

Site SS004 is located at Lower Camp, northeast of the former Auto Maintenance Shop and Flight Operations Building (Figure 1-3). This AST contained motor-vehicle grade gasoline during the time the installation was active. Gasoline was also dispensed from this tank. Historic aerial photographs indicate that drums were once staged in this area. The contents of these drums is unknown, it is possible that the drums were empty. Recent Clean Sweep Demolition activities have not disturbed this site, as evidenced by substantial alder growth.

Eight soil borings were installed at SS004 during the 1998 RI/FS (DOWL, 2001). The soil borings were sampled at surface depth and five feet bgs for GRO, BTEX, and lead. Samples were also collected at four feet, six feet, and ten feet from one of these borings, and were analyzed for SVOCs and pesticides. No cleanup level exceedences were noted for these soil samples.

One groundwater monitoring well was installed to a depth of 25 feet bgs. Following well completion, a groundwater sample was collected and analyzed for GRO, BTEX, and lead. Lead was found in the groundwater sample at a concentration of 0.028 mg/L, which exceeded screening criteria.

1.6.6 Temporary Auto Storage Shop (SS011)

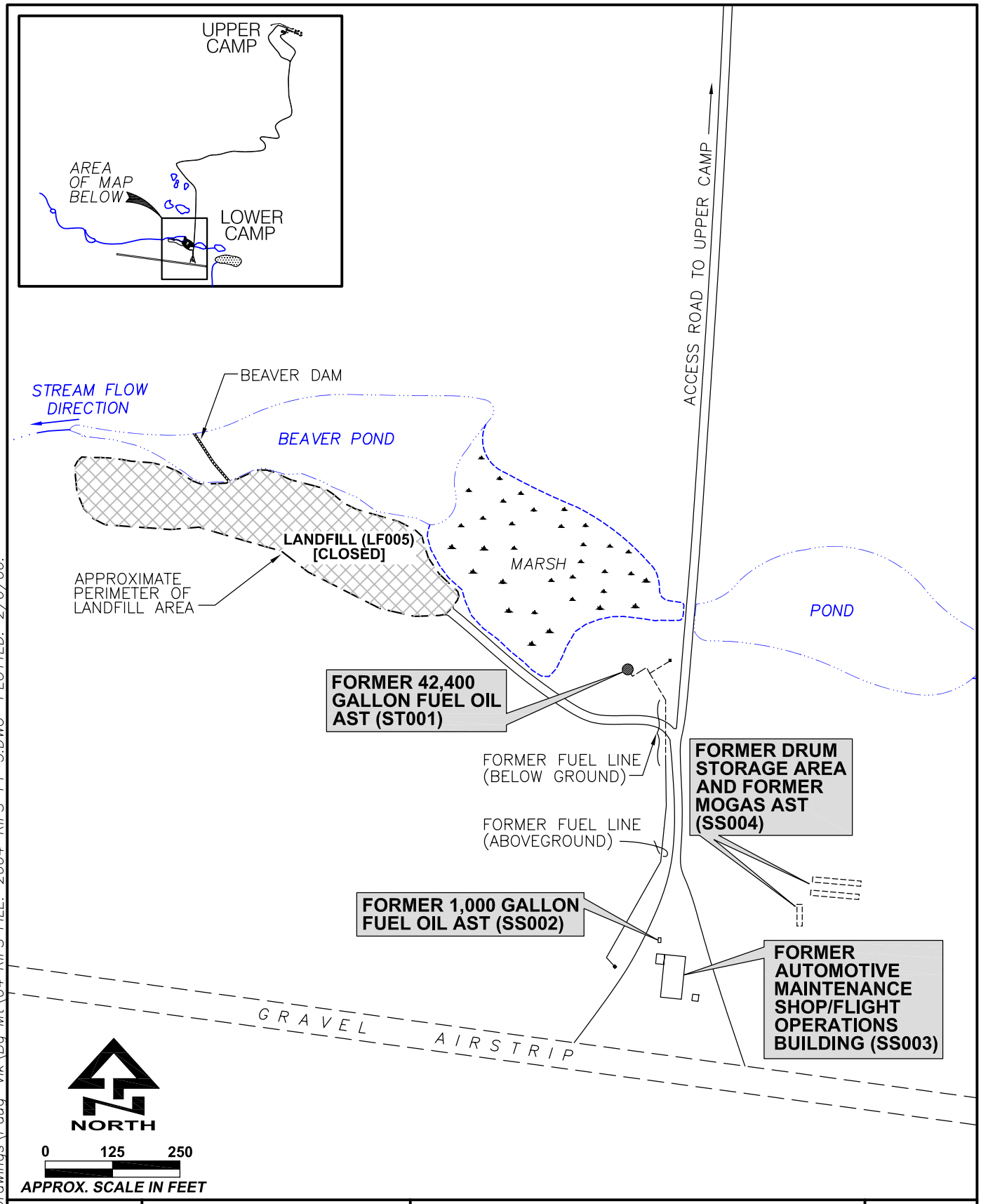
The former Temporary Auto Storage Shop (SS011) was located at Upper Camp (Figure 1-4). This building was demolished in 2003 under Clean Sweep, and the only remaining structure is the concrete pad foundation. This pad was removed during the Clean Sweep field effort this year (ILC/Paug-Vik, 2004b). Vehicles were stored in this building during active installation operations. It is likely that waste oils were also stored and used at this site.

Six locations were selected for soil sampling at SS011 during the 1998 RI/FS (DOWL, 2001). Shallow test pits were excavated at each of these locations using an excavator. Soil samples were collected both at from these test pits and analyzed for DRO, RRO, VOCs, SVOCs, PAHs, pesticides, PCBs, and RCRA metals. No groundwater was encountered at this site. DRO was only detected above the screening level of 250 mg/Kg at one sample location, TP-42, with a maximum concentration of 4,500 mg/Kg in the surface soil sample. Pentachlorophenol (0.34 mg/Kg) and PCBs (1.3 mg/Kg of total arochlors) were detected above screening criteria at location L4, which is located in an earthen pit area located in the center of the concrete pad.

1.6.7 List of Previous Environmental Reports

The following is a list of previous environmental reports and technical memorandums produced in support of environmental restoration efforts at Big Mountain sites ST001, SS002, SS003, SS004, and SS011.

- Hazardous Substance Investigation at Big Mountain White Alice Communications Systems Site (DOWL, 1983).
- Preliminary Assessment of Big Mountain Radio Relay Station (HMTC, 1989).
- Preliminary Assessment of Big Mountain Radio Relay Station (SAIC, 1993).
- Environmental Baseline Study at the Big Mountain Proposed Communications Relay Site (DOWL, 1995).
- Final Environmental Assessment of Big Mountain Radio Relay Station Demolition (ENSR, 1996).
- Site Characterization Technical Memorandum (DOWL/Ogden, 1998a).
- Community Relations Plan (DOWL/Ogden, 1998b).
- Final Clean Sweep Management Action Plan (Montgomery Watson, 1998).
- Final Remedial Investigation/Feasibility Study (DOWL, 2001).
- Decision Document for Interim Remedial Action for Four IRP Sites at the Big Mountain Radio Relay Station, Alaska {Sites: 42,400-Gallon Fuel Oil Above Ground Storage Tank (AST), 1,000-Gallon Fuel Oil AST (SS002), Dual AST System (SS014), and Landfill (LF005)} (Paug-Vik, 2002a).
- Decision Document for Two IRP Sites at the Big Mountain Radio Relay Station, Alaska {Sites: Antennae 2 and 4 (SS013) and Antennae 1 and 3 (SS015)} (Paug-Vik, 2002b).
- Final RI/FS Report for Upper Camp Sites SS009 and SS010, Big Mountain Radio Relay Station, Alaska. (Paug-Vik, 2004b).
- Final Report, Clean Sweep Demolition Volume 1 – Phase 1, Big Mountain RRS, Alaska (ILC/Paug-Vik, 2004a).
- Final Report, Clean Sweep Demolition – Phase 2, Big Mountain RRS, Alaska, (ILC/Paug-Vik, 2004b).



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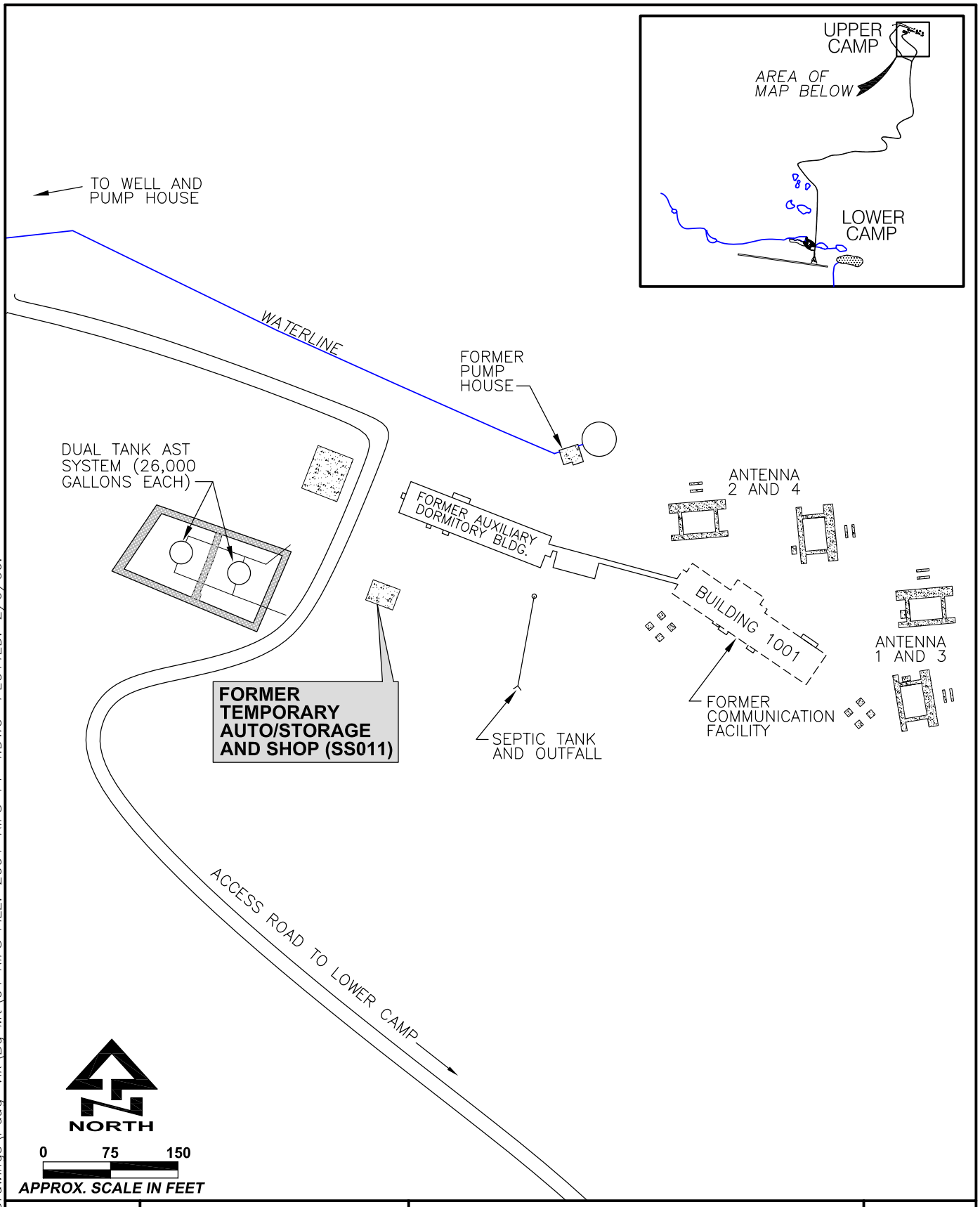
LOWER CAMP SITES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE

1-3



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DATE FEB. 2006 CHKD T.E.O. DRAWN OASIS-PDC PROJ. NO 4119-11	611TH AIR SUPPORT GROUP 611TH CIVIL ENGINEER SQUADRON ELMENDORF AFB, ALASKA	**UPPER CAMP SITES** 2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY BIG MOUNTAIN RADIO RELAY STATION, ALASKA	FIGURE **1-4**

2 ENVIRONMENTAL SETTING

Big Mountain RRS is located in a remote area on the south shore of Iliamna Lake (Figure 1-1) in the Bristol Bay region of the Alaska Peninsula. This area generally consists of gently rolling terrain characterized by glacial outwash features. The peak of Big Mountain is at an elevation of 2,161 feet above msl. Big Mountain is mostly above tree line and the mountain itself is predominantly barren or covered by tundra with scattered clumps of brush, and occasional stands of spruce or deciduous trees.

The surrounding area has low, rounded hills and mountains with alpine tundra. Mosses lichens, low growing shrubs, wild berry bushes, and a few hardy grass species are the dominating vegetation types. Numerous fresh-water lakes, streams, and bogs are also typical.

2.1 GEOLOGY AND SOILS

The majority of bedrock in the Big Mountain area is primarily of volcanic origin, with exposed bedrock formations of basalt, andesite, tuff, and volcanic conglomerate and rubble are common. The surface topography of the region was altered during the last Pleistocene glaciation (10,000 to 30,000 years ago), with unconsolidated, poorly sorted glacial sediments and morainal deposits making up much of the material that thinly overlies bedrock in the highland areas.

In the lowland areas and drainage basins of the region, the glacial sediments have been reworked and distributed in broad alluvial outwash plains, which can cover many square miles. The alluvial stratigraphy consists of inter-stratified sand and gravel interspersed with silt and fine sand layers. Some of the lowland areas are poorly drained, and the surface soils may be dark, loamy, and highly acidic, with a high organic material content.

Soil data gathered at the Big Mountain RRS Lower Camp area indicate that much of the native soils in this area consist of 5% to 50% silt with variable amounts of organic material. The low-lying areas in the Lower Camp vicinity typically have a top layer of about 20 inches of dark brown loamy soils, which are strongly acidic and have been shown to contain naturally occurring arsenic. Much of the surface material at the Lower Camp facility consists of imported fill of local gravelly material.

Surface material at the Upper Camp area, located on top of Big Mountain, has been found to be thin to non-existent, and overlies exposed bedrock layers. Thin layers of unconsolidated volcanic gravel material are typical of the hilly, steep, and mountainous terrain in the area.

2.2 HYDROGEOLOGY

Regional groundwater occurrences are not described here. Most of the regional villages obtain drinking water from local wells. Minimal groundwater data are available for the Big Mountain RRS area.

2.2.1 Groundwater

Groundwater data are limited to information from wells installed at the facility during this and previous environmental investigation efforts. Static water level measurements were recorded at permanent, temporary, and drive-point wells installed at the both the Lower and Upper Camp areas. Boreholes advanced during the 2004 Lower Camp area activities encountered groundwater at depths ranging from 5.6 to 28.5 feet bgs. Figure 2-1 presents a groundwater contour map generated from well data collected in 2004.

It is hypothesized that two aquifer systems exist at Lower Camp. Shallower groundwater encountered during monitoring well and borehole installation activities at Site ST001 and LF005 is thought to be part of a localized perched aquifer, which is fed by the adjacent beaver pond. The groundwater gradient at both LF005 and ST001 is difficult to measure due to this perched aquifer. The general flow direction for the perched aquifer is to the west and northwest, mimicking topography. The localized perched aquifer is not present at sites SS002, SS003, and SS004. A deeper aquifer was encountered at depths of 20 to 28 feet bgs at all Lower Camp sites in 2004, and is assumed to be contiguous beneath the Lower Camp sites. However, this aquifer was not present in the northeastern section of SS004. Groundwater was not encountered in a borehole installed at this location which advanced to bedrock refusal at a depth of 40 feet bgs. A groundwater gradient of 0.03 feet/feet was measured during the 2004 RI activities at sites SS002, SS003, and SS004. The flow direction for this deeper aquifer to the north and northwest.

No groundwater was encountered at the Upper Camp area during 2003 or 2004 RI/FS activities. During installation operations, potable water and fire protection resources at the Upper Camp were reportedly provided by a well located at the western end of the Upper Camp area (at former Building 1004 - Water Supply Facility). This Upper Camp well was reportedly completed in fractured bedrock to a total depth of 232 feet bgs (DOWL, 2001). It should be noted that this well was located at an elevation approximately 50 feet below the top of the mountain. This well had not been used since 1979 and was abandoned during the 2004 Clean Sweep field effort (ILC/Paug-Vik, 2004b).

LOWER CAMP GROUNDWATER FLOW

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE 2-1

611TH AIR SUPPORT GROUP
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ELMENDORF AFB, ALASKA

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NORTH

STREAM FLOW DIRECTION

BEAVER DAM

BEAVER POND

APPROXIMATE PERIMETER OF LANDFILL AREA

LANDFILL (LF005) [CLOSED]

AP-01 (52.21)
MW06 (55.36)
MW07 (59.62)
AP-03 (63.24)
AP-04 (62.89)
AP-05 (56.42)
AP-02 (48.20)
MW-08 (64.36)
MW-09 (48.32)

MARSH

POND

ACCESS ROAD TO UPPER CAMP

FORMER 42,400 GALLON FUEL OIL AST

MW11 (69.46)
MW10 (51.45)

FORMER 4" FUEL PIPELINE

FORMER DRUM STORAGE AREA AND FORMER MOGAS AST (SS004)

MW12 (70.05)

MW02 (69.32)

FORMER 1,000 GALLON FUEL OIL AST (SS002)

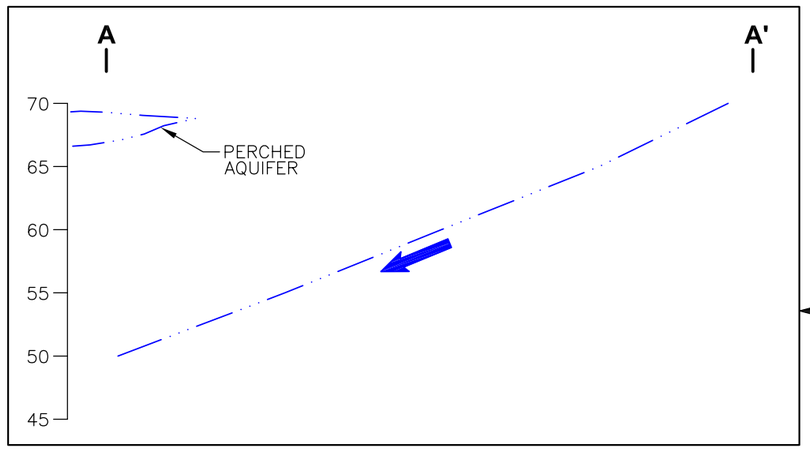
FORMER AUTOMOTIVE MAINTENANCE SHOP/FLIGHT OPERATIONS BUILDING (SS033)

MW13 (72.78)
MW04 (71.0)
MW03 (73.26)

50 55 60 65 70 72.5

A A'

0 60 120
APPROX. SCALE IN FEET



CROSS SECTION A-A'
NOT TO SCALE

LEGEND

- AP-01 — MONITORING WELL LOCATIONS
- (52.21) — RELATIVE GROUNDWATER ELEVATION IN FEET
- 60 — GROUNDWATER CONTOURS (DASHED WHERE INFERRED) (RED = PERCHED – BLUE = REGIONAL)
- DIRECTION OF GROUNDWATER FLOW
- DIRECTION OF PERCHED GROUNDWATER FLOW

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2.2.2 Surface Water

Surface water is abundant in the Big Mountain area. Drainage patterns are heavily influenced by glacial topography, with drainage patterns typically controlled by morainal borders. Discontinuous permafrost underneath low-lying areas creates poorly integrated stream patterns and isolated wetlands in the area, forming numerous fresh-water lakes, streams, and bogs.

Iliamna Lake is adjacent to the Big Mountain installation and is the regional discharge zone for the area's surface water. Belinda Creek is the major surface-water drainage basin for the immediate Big Mountain RRS area, and eventually discharges into Iliamna Lake at Reindeer Bay.

A small, unnamed drainage, located just north of the Lower Camp airstrip at the base of Big Mountain, receives most of the surface water from the Lower Camp area and part of the Upper Camp area. Several beaver dams built along this stream near Former Landfill (LF005) have caused the water to become impounded, leading to the formation of many large ponds and marshy areas.

Surface water drainage at the Upper Camp area is typical of high relief rocky substrates, with intermittent and radial surface water flow into one of several intermittent stream paths. Water draining from the north, northwest, and northeast side of the Big Mountain drains directly into Iliamna Lake at the base of the mountain. Surface water from the west and south side of the Upper Camp area, and from the Lower Camp area tends to flow south and southeast, eventually reaching the Belinda Creek drainage. The lower portion of Belinda Creek is used for subsistence fishing about three miles down gradient from the installation.

2.2.3 Wetlands

The National Wetland Inventory has not mapped the Big Mountain area; however, it is estimated that potentially significant areas of wetlands occur within a four-mile radius of the Big Mountain RRS facility. Discontinuous permafrost underneath low-lying land in the area creates poorly integrated drainages and isolated wetland areas.

Several beaver dams built along the small stream near the airstrip and former landfill at the Lower Camp area have impounded the surface water and created additional wetlands. Isolated pockets of wetland areas may occur on the slopes of Big Mountain but none are present at the rocky summit of the Upper Camp area.

2.3 CLIMATOLOGY

The Iliamna Lake region has a coastal type climate, characterized by high precipitation and moderate seasonal temperatures. Recorded weather observation data obtained at King Salmon (approximately 70 miles to the southwest, in the Bristol Bay area) indicates average summer temperatures range from 40°F (4°C) to 65°F (18°C), and average winter temperatures from 8°F (-13°F) to 30°F (-1°C) (WRCC, 2000). Temperature extremes from the King Salmon area are recorded as 88°F (31°C) for the summer high and -48°F (-44°C) for the winter low. Some variation from this data would be expected for Big Mountain.

The rainy season at Big Mountain generally occurs between July and October, with snowfall and subfreezing temperatures typical between November and March. Annual precipitation levels measured at Iliamna (located 30 miles northwest of Big Mountain) average 26 inches of water equivalent, which includes 60 inches of snow (WRCC, 2000).

Specific wind data for Big Mountain RRS has not been collected, but data from Iliamna is considered representative because of similar exposure and topography. Data from Iliamna shows daily wind speeds from June to September to exceed 30 mph nearly 65 percent of the time (AFCEE, 2001). Fog creates low visibility conditions at the Upper Camp site about fifteen percent of the time, during the months of July and August, and five percent of the time during the rest of the year (AFCEE, 2001).

2.4 ARCHAEOLOGICAL RESOURCES

The former facilities at the installation were identified as eligible for listing on the National Register of Historic Places. A Memorandum of Agreement between the USAF and the State Historic Preservation Officer was completed in 1988, authorizing demolition of the installation. An archaeological survey was conducted in the summer of 1999 and indicated no archeological sites on the installation. The survey recommended that future activities, including ground-disturbing activities, be permitted to proceed without further survey.

2.5 CRITICAL HABITAT

The Big Mountain area is not considered critical habitat for birds, mammals, or fish species due to lack of cover and preferred food sources for most of these animals (ENSR, 1996). Nearby critical habitat areas, include the Katmai National Preserve, located six miles south of the airstrip, and the Kvichak River, located 20 miles west of the facility, which is a major sockeye salmon route back to Iliamna Lake.

2.6 THREATENED AND ENDANGERED SPECIES

The U.S. Fish and Wildlife Service lists five animal species in Alaska as threatened or endangered, and one plant species as endangered. None of these species have been observed in the area of the Big Mountain RRS nor are they known to inhabit the Iliamna Lake region.

PART 2 – REMEDIAL INVESTIGATION

3 42,400-GALLON AST & PIPELINE AREA (ST001)

The 2004 RI scope for site ST001 included investigating the possible presence of soil, groundwater, surface water, and sediment contamination, as well as characterizing and estimating the extent of contamination.

3.1 2004 FIELD ACTIVITIES AND SAMPLE RESULTS AT ST001

Field activities at ST001 occurred from July 7 to August 2, 2004. The buddy system was used while sampling this site. The sampling team carried an emergency whistle and radio, as well as a first aid kit during all sampling activities.

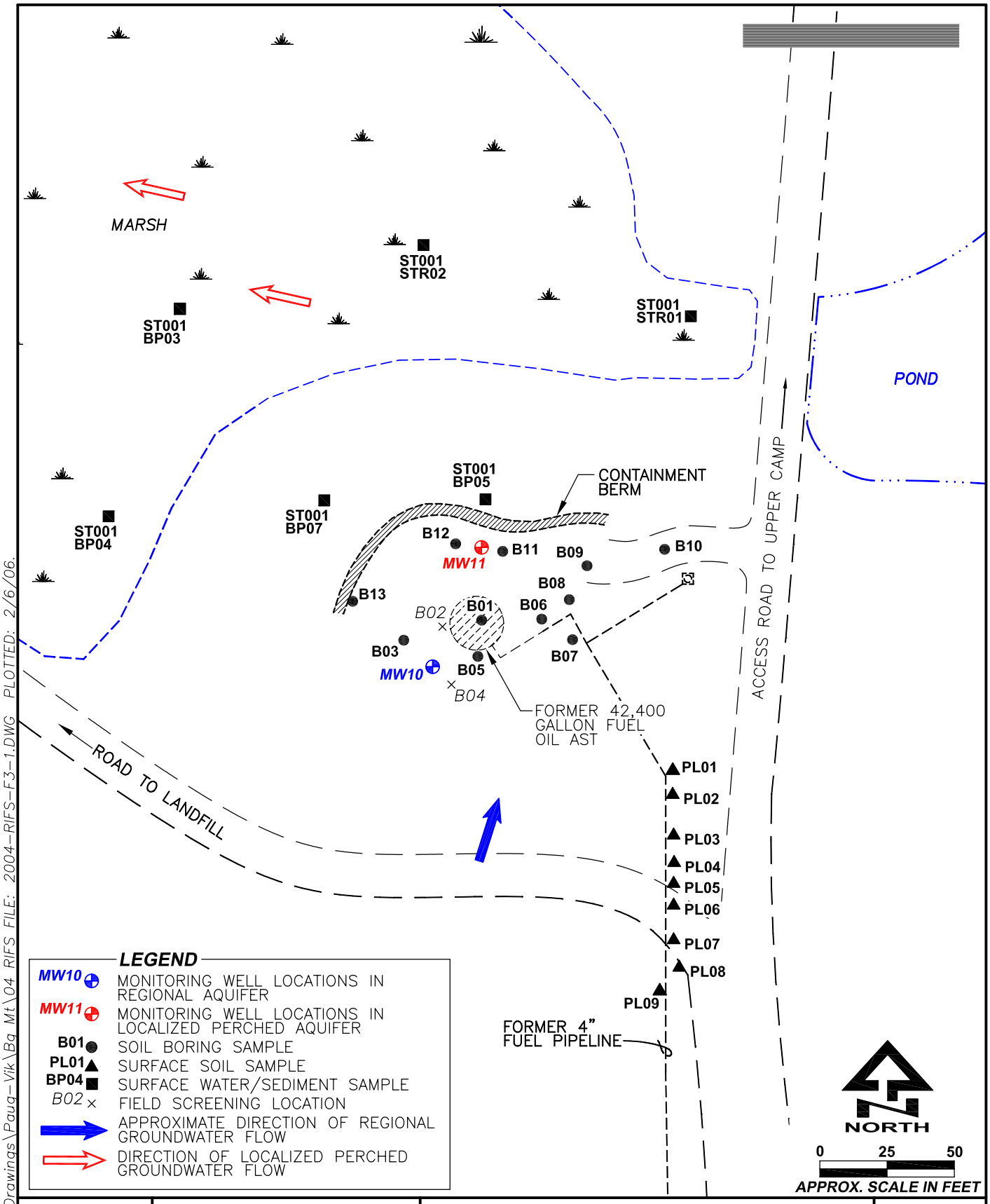
3.1.1 ST001 Site Description

The 42,400-gallon AST and fuel oil system was located approximately 600 feet north of the airstrip and 200 feet west of the Lower Camp access road, as detailed in Figure 1-3. In addition to the AST, the system included a truck fill stand, a containment berm with an outflow pipe, and a 600-foot long, four-inch diameter pipeline that extended east from the AST toward the access road. The pipeline was above ground for most of its length, buried only where it crossed the landfill access road.

The AST and its associated structures were removed in 2003 and 2004 during the Clean Sweep program, under separate projects and contracts. Vegetation in the nearby wetlands is intact and shows no evidence of disturbance from recent tank removal activities.

3.1.2 Investigative Methodologies

Field sampling activities were conducted in accordance with the procedures described in Appendix A of the project Work Plan (Paug-Vik, 2004a), except as noted in Section 3.2 of this report, which describes field deviations to the work plan. A site reconnaissance was performed prior to sampling to identify the best sampling locations. Soil and groundwater sampling locations were chosen by their proximity to the locations of the former AST, the truckfill stand, and the pipeline. Surface water and sediment sampling locations in the adjacent wetlands were chosen in both upgradient and downgradient areas, as well as in areas that are in close proximity to the containment berm.



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42,400-GALLON AST AND PIPELINE AREA (ST001) SAMPLE LOCATIONS

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
3-1

3.1.3 Investigative Approach

Twenty-five soil samples and three duplicate samples were collected at areas of suspect contamination and during monitoring well installation. A total of six surface water and sediment samples pairs and one duplicate surface water and sediment sample were collected. One surface water/sediment sample was collected upgradient of the AST site near the culvert that passes under the road to Upper Camp. Three surface water/sediment samples were taken from the wetlands downgradient of the AST site. Two additional surface water and sediment samples were taken at points along the containment berm. Sample locations are shown on Figure 3-1. Two groundwater monitoring wells were installed and sampled as well. One duplicate groundwater sample was collected as well. Additional groundwater monitoring wells could not be installed due to the limited accessibility and close proximity of the wetlands beyond the containment berm.

3.1.4 Field Documentation

Field documentation was an important part of the field effort. Field documentation was performed in accordance with the project work plan (Paug-Vik, 2004a). Copies of all field notes and Daily Activity Reports are included in Appendices A and B, respectively. Site photographs that document the 2004 RI effort can be found in Appendix C.

3.1.5 Surface Water and Sediment Sampling Locations

Surface water and sediment sample pairs were collected at six areas in the wetlands adjacent to the ST001 site to define contamination to the north and west of the former tank site. Samples collected at BP05 and BP07 were collected in lieu of advancing soil borings or groundwater monitoring wells due to wetland conditions. Sampling locations are displayed on Figure 3-1. GPS coordinates and sample location descriptions are presented in Table 3-1, below.

Table 3-1: Surface Water and Sediment Sampling Location Descriptions

Sampling Location	Latitude	Longitude	Approximate Elev. (ft amsl)	Description
STR01	59.36400	155.25218	680	Unnamed stream west of culvert passing under road to Upper Camp, approximately 75 feet northeast of the containment berm.
STR02	59.36410	155.25239	675	Downgradient of STR01 (west) in unnamed stream that flows into the beaver pond, about 125 feet north of the containment berm.
BP03	59.36409	155.25248	670	Downgradient of STR01 (west) in unnamed stream that flows into the beaver pond, about 100 feet north of the containment berm. At the edge of the beaver pond.
BP04	59.36411	155.25333	664	Approximately 50 feet to the west of the containment berm, along the edge of the beaver pond.
BP05	59.36393	155.25240	656	Ponded water about 5 feet from the northern edge of the containment berm.
BP07	59.36387	155.25294	651	Ponded water approximately 10 feet from the northwestern edge of the containment berm.

Note:
GPS readings were taken on the Universal Transverse Mercator (UTM) coordinate system using the North American Datum of 1927 (NAD27).

3.1.6 Surface Water Results

Water quality parameters were measured at each surface water sampling location. Water quality measurements included temperature, pH, conductivity, and dissolved oxygen. Results are presented in Table 3-2, below. Surface Water Data Sheets are located in Appendix D.

Table 3-2: Surface Water Quality Parameters

Sample Name	Temperature (°C)	pH	Conductivity (µS)	Dissolved Oxygen (mg/L)
STR01WS/STR01SE	24.5	6.9	70	7.49
STR02WS/STR02SE	24.0	7.4	70	5.27
BP03WS/BP03SE	24.3	7.4	70	7.15
BP04WS/BP03SE	21.5	6.6	90	5.0
BP05WS/BP05SE	18.2	NM	70	7.92
BP07WS/BP07SE	13.0	NM	130	0.80

Notes:
(°C) – degrees in Celsius
NM – Not measured due to equipment malfunction
µS - microsiemens

Surface water samples were collected from small streams and ponded areas using new laboratory-supplied sample bottles. Samples were collected under the surface of the water with a minimum of sediment disturbance, as described in the work plan (Paug-Vik, 2004a). A total of six primary surface water samples were collected. One duplicate sample was collected at location STR01. Surface water samples were collected and shipped to Anchorage for laboratory analysis of PAHs, dissolved metals, PCBs, pesticides, BTEX (benzene, toluene, ethylbenzene, and total xylenes), Total Aqueous Hydrocarbons (TAqH) and Total Aromatic Hydrocarbons (TAH). Laboratory analysis summary reports can be found in Appendix E. Complete analytical data packages are provided in Appendix F. A summary of these results is provided below.

Table 3-3: ST001 Surface Water Analytical Results Summary

Sample Location	PAHs (mg/L)	Dissolved Metals (mg/L)	PCBs (mg/L)	Pesticides (µg/L)	BTEX (µg/L)	TAqH (µg/L)	TAH (µg/L)
STR01WS	ND	BC	ND	Methoxychlor – 0.0125 F VJ	Toluene – 0.428 F VB	0.428	0.428
STR01WS (D)	NS	NS	NS	NS	Toluene – 0.521 VB	NS	0.521
STR02WS	ND	Ag – **0.00018 F** All others BC	ND	ND	Toluene – 0.188 F VB	0.188	0.188
BP03WS	ND	Ag – **0.00015 F** All others BC	ND	ND	Toluene – 0.205 F VB	0.205	0.205
BP04WS	ND	BC	ND	ND	Toluene – 0.115 F VB	0.115	0.115
BP05WS	ND	NS	NS	NS	ND	ND	ND
BP07WS	ND	NS	NS	NS	Toluene – 2.08 VB	2.08	2.08
ADEC Criteria	*Varies*	*Ag – 0.00012*	*0.0005*	*Methoxychlor – 40.0*	*Toluene - 1000*	*15.0*	*10.0*

Notes:

Criteria taken from ADEC 18 AAC 70, Water Quality Criteria (ADEC, 2003b).
PAHs - Polynuclear Aromatic Hydrocarbons.
Dissolved Metals - Silver, Arsenic, Barium, Cadmium, Chromium, Mercury, Lead, Selenium.
PCBs - Polychlorinated Biphenyls.
TAH - Total Aromatic Hydrocarbons.
TAqH -Total Aqueous Hydrocarbons.
BTEX – Benzene, Toluene, Ethylbenzene, and Total Xylenes.
ND – Not Detected.
NS – Analyte was not sampled for.
BOLD – Result exceeded water quality criteria for that analyte.
BC – Below Criteria.
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – Data review assigned flag indicating that the analyte was positively identified, but the associated numerical value is below the reporting limit.
B – The analyte was found in the associated blank, as well as in the project sample.
J – The analyte was positively identified, the quantitation is an estimation.

The metals silver, arsenic, barium, and chromium were detected at low levels in several samples. Silver was detected at concentrations ranging from 0.00009 mg/L to 0.00018 mg/L in three samples. Currently there are no criteria for silver in surface water listed in ADEC 18 AAC 70 (ADEC, 2003b) or in the ADEC water Quality Criteria Manual (ADEC, 2003a). These concentrations were compared to reference concentrations listed in the NOAA SQuiRTs (NOAA, 1999). Two of the detections for silver (STR02 at 0.00018 mg/L and BP03 at 0.00015 mg/L) exceeded the reference concentration of 0.00012 mg/L listed in NOAA SQuiRTs (NOAA, 1999). These reference concentration exceedences for silver are shown on Figure 3-2.

Arsenic was detected in four samples at concentrations ranging from 0.00061 mg/L to 0.00202 mg/L. All of these detections are below the water quality criteria of 0.05 mg/L for arsenic (ADEC, 2003a). Barium was detected in four of the surface water samples at concentrations ranging from 0.00344 mg/L to 0.00607 mg/L. All detections were below the water quality criteria of 2.0 mg/L for barium established in the Alaska Water Quality Criteria Manual (ADEC, 2003a). Chromium was detected in four of the samples at concentrations that ranged from 0.0002 mg/L to 0.00046 mg/L. These detections are below the established water quality criteria of 0.1 mg/L for chromium (ADEC, 2003a).

The pesticide methoxychlor was detected in one sample at a concentration of 0.0125 µg/L. This detection is several orders of magnitude below the ADEC water quality criteria of 0.04 mg/L found in the Alaska Water Quality Criteria Manual (ADEC, 2003a). No other pesticides were detected in any of the samples. Surrogate recoveries in two project samples were biased low. Pesticide results for these samples were flagged “VJ” during the data review process to indicate that the reported value is an estimation.

Toluene was detected in four of the samples at low levels, ranging from 0.115 µg/L to 0.428 µg/L. The water quality criteria for toluene is 1.0 mg/L (ADEC, 2003a). No toluene detections exceeded this criteria. Toluene was detected in the method blank and trip blank samples at concentrations below the laboratory Reporting Limit (RL), but greater than the Method Detection Limit (MDL). Project sample results with toluene concentrations less than five times the blank concentration were flagged “VB” to indicate potential blank contamination.

ADEC uses total aromatic hydrocarbons (TAH) and total aqueous hydrocarbons (TAqH) to guide decision making, as there are no cleanup levels established for common fuel analysis (GRO, DRO, or RRO) in surface waters (ADEC, 2003a). TAH is defined as the sum of the various concentrations of BTEX. TAqH is defined as the sum of TAH and the sum of PAHs.

ADEC sets cleanup guidelines for TAH and TAqH as 10 and 15 micrograms per liter (µg/L), respectively (ADEC, 2003b). TAH results for the surface water samples at ST001 ranged from 0.115 µg/L to 2.08 µg/L. TAqH results for site ST001 ranged from 0.115 µg/L to 2.08 µg/L as well. All detections were below the cleanup criteria. Only the sample from BP-05 was non-detect for TAH and TAqH. No PCBs or PAHs were detected in any of the surface water samples.

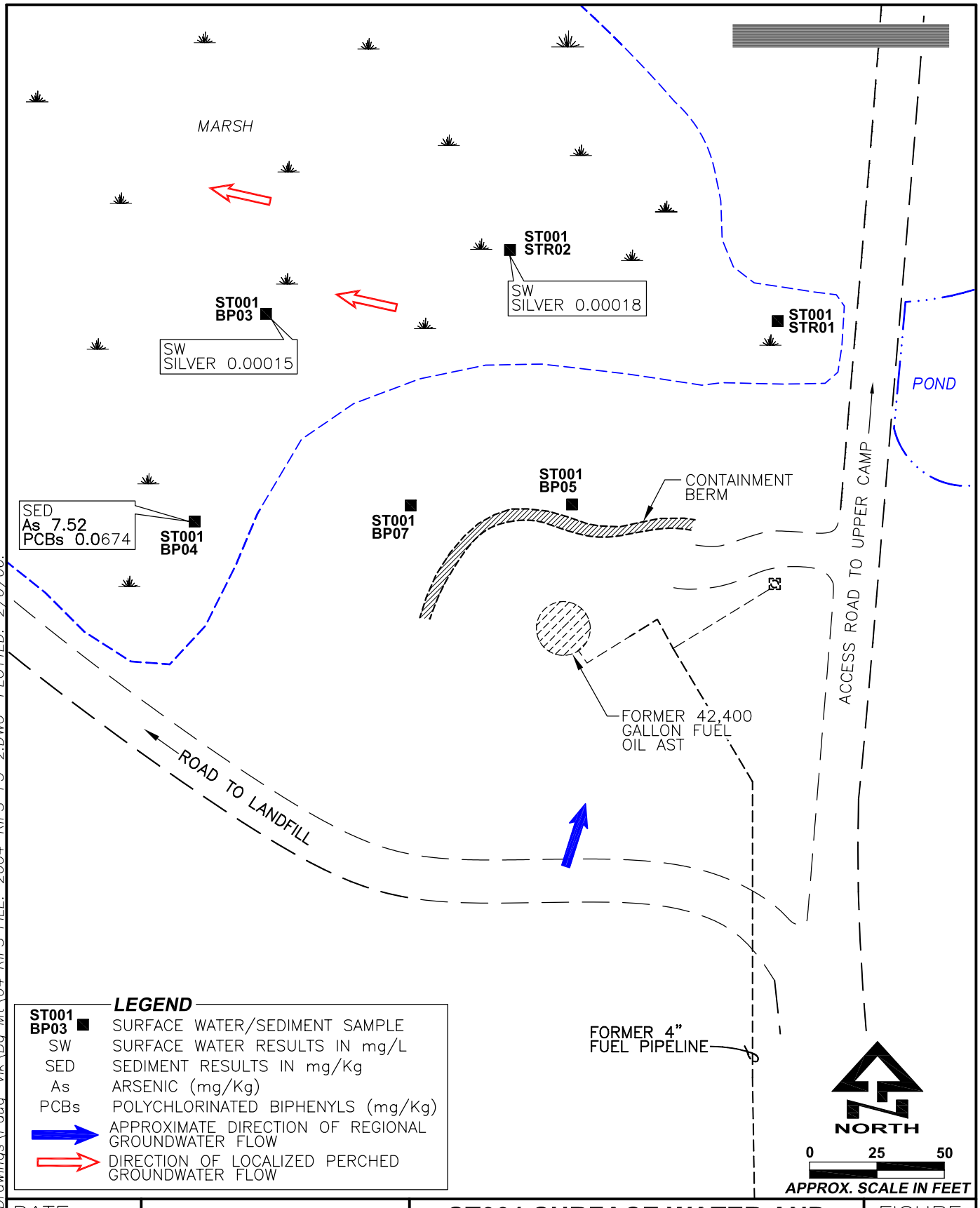
Holding times for all analytical samples were met. All surface water samples were received in coolers that were within the recommended temperature range. The computed completeness percentage for this project is greater than 99 percent.

3.1.7 Sediment Sample Results

Six primary sediment samples were collected from the same locations as the surface water samples (Table 3-1). One duplicate sample was collected at sample location STR01. Sediment samples were collected from the upper three-inches of sediment using a disposable sample scoop. Surface water samples were collected prior to sediment samples. Information including material type, odor, depth, and location was recorded on the Sediment Sample Sheet (Appendix C). Sediment samples were sent to the project laboratory for analysis of PAHs, total metals, PCBs, Pesticides, BTEX, and DRO. Complete results are provided in Appendix E. A summary of the results is presented in Table 3-4.

Concentrations of contaminants in sediment samples were compared to reference concentrations in NOAA SQuiRTs (NOAA, 1999) and benchmarks listed in the USEPA Ecotox Thresholds (USEPA, 1996). Two concentration levels referenced in the SQuiRTs were used for comparison:

- TEL – Threshold effects level; represents the concentration below which adverse effects are expected to occur only rarely.
- PEL – Probable effects level; represents the concentration above which adverse effects are frequently expected.



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ST001 SURFACE WATER AND SEDIMENT SAMPLE CRITERIA EXCEEDENCES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
3-2

Table 3-4: ST001 Sediment Analytical Results Summary

Sample Location	PAHs (mg/Kg)	Total Metals (mg/Kg)	PCBs (mg/Kg)	Pesticides (mg/Kg)	BTEX (mg/Kg)	DRO (mg/Kg)
STR01SE	ND	BTEL	Arochlor 1260 – 0.0233 F	ND	T – 0.00863 F VB E – 0.00225 F VB X – 0.0075 F VB	NS
STR01SE(D)	NS	NS	NS	NS	T – 0.00828 F VB E – 0.00115 F VB	NS
STR02SE	ND	BTEL	Arochlor 1260 – 0.0121 F	4,4'-DDT – 0.00172 F	T – 0.00231 F VB	NS
BP03SE	ND	BTEL	Arochlor 1260 – 0.00935 F	4,4'-DDT – 0.00129 F Endrin – 0.00138 F	T – 0.00416 F VJ, VB E – 0.00138 F VJ, VB X – 0.00615 F VJ, VB	NS
BP04SE	ND	BTEL except: **As – 7.52**	**Arochlor 1260 – 0.0674 VJ**	ND	T – 0.00631 F VB	NS
BP05SE	NS	NS	NS	NS	T – 0.119 E – 0.00429 F VB X – 0.0135 F VB	25.5
BP07SE	NS	NS	NS	NS	T – 0.01 F VJ, VB E – 0.00197 F VJ, VB X – 0.0114 F VJ, VB	28.7
TELs	*Varies*	*As – 5.9*	*0.0341*	*Varies*	*Varies*	*None*

Notes:
TELs taken from NOAA Screening Quick Reference Tables, (NOAA, 1999).
DRO – Diesel Range Organics
PAHs - Polynuclear Aromatic Hydrocarbon
PCB - Polychlorinated Biphenyls
Total Metals – Ag, As, Ba, Cd, Cr, Pb, Hg, and Se
TEL – Threshold Effects Level (NOAA, 1999)
BTEX – Benzene, Toluene, Ethylbenzene, and Total Xylenes
mg/Kg – Milligrams per kilogram
BTEL – Below the Threshold Effects Level.
F – Data review assigned flag indicating that the analyte was positively identified, but the associated numerical value is below the reporting limit.
B – The analyte was found in the associated blank, as well as in the project sample.
J – The analyte was positively identified, the quantitation is an estimation.
BOLD – Result exceeded a reference concentration or ecological benchmark for that analyte.

No PAHs were detected in the sediment samples. There were several detections of the RCRA metals in all of the sediment samples, however only one detection of arsenic, 7.52 mg/Kg at BP04, was above the TEL, but below the PEL. This result was compared to a TEL concentration of 5.9 mg/kg and a PEL concentration of 17 mg/Kg. This concentration is noted to be within the range of levels detected in background samples for arsenic at the Big Mountain site. Further discussion of arsenic background levels in sediments can be found in Section 5.2.3 and Table 5-4 of this report.

The PCB Arochlor-1260 was detected in four samples at concentrations ranging from 0.00935 mg/Kg to 0.0674 mg/Kg. The detection at BP04 was above the TEL concentration of 0.0341 mg/Kg, but below the PEL concentration of 0.277 mg/Kg. This detection is shown on Figure 3-2. All other PCB detections were below both the TEL and the PEL. One project sample (BP04) had a surrogate recovery that was biased low. This PCB result was flagged "VJ" during the data review process.

The pesticide 4,4'-DDT was detected at two sample locations, STR02 and BP03 at concentrations below the TEL of 0.00698 mg/Kg listed in the NOAA SQuiRTs (NOAA, 1999). The pesticide Endrin was also detected at sample location BP03 at a concentration below the NOAA SQuiRTs TEL of 0.00267 mg/Kg (NOAA, 1999).

Toluene was detected in all six samples at concentrations ranging from 0.00231 mg/Kg to 0.119 mg/Kg. Ethylbenzene was detected in four of the six samples, with concentrations ranging from 0.00138 mg/Kg to 0.00429 mg/Kg. Xylenes are reported as total xylenes and consist of the compounds m-xylene, o-xylene, and p-xylene. Xylenes were detected in four of the six samples at concentrations ranging from 0.00615 mg/Kg to 0.0135 mg/Kg. No TEL or PEL concentrations exist for toluene, ethylbenzene, or total xylenes (NOAA, 1999). These results were compared to USEPA benchmark screening values (USEPA, 1996) and found to be several orders of magnitude below the screening criteria in all cases. Toluene, ethylbenzene, and total xylenes were noted in the method blank and trip samples at concentrations greater than the MDL, but below the RL. Project sample results within five times the method blank contamination were flagged "VB."

DRO constituents were detected in two of the sediment samples. At this time, there are no criteria for DRO in sediments.

Cooler temperatures were noted to be within the specified range. No holding time exceedences were noted for ST001 sediment samples. The overall calculated completeness for this project is greater than 99 percent.

3.1.8 Surface and Subsurface Soil Sampling

Surface and subsurface soils were collected at fifteen locations using disposable scoops. Figure 3-1 details the locations of these samples. Surface soil was collected as discreet grab samples. Surface material was obtained from the top six inches of soil and placed into pre-cleaned sample jars, according to procedures described in the work plan (Paug-Vik, 2004a). Subsurface soil samples were collected at varying depths by drilling boreholes with a hollow stem auger drill rig and using a spoon sampler to collect the soil. Copies of Soil Sample Field Data Sheets are included in Appendix C. Surface and subsurface samples were collected to define the nature and extent of contamination at ST001, specifically to the north and west of the former AST area.

Hydrocarbon odor and staining was noted in several of the boreholes installed at ST001. This evidence of contamination was found primarily in boreholes installed along the northern and eastern portions of ST001. Gray soil staining and hydrocarbon odor was noted at depths ranging from one foot bgs to seven feet bgs in boreholes B02, B06, B08, B09, B11, B12, and MW11 (see field notes in Appendix A and soil sample data sheets in Appendix D). PID readings for soils from these boreholes ranged from 34.2 ppmV (MW11, 1.5 ft. bgs) to 603 ppmV (B06, 1 ft. bgs).

Soils were field screened using a PID at all locations, except at depths where groundwater was encountered. The field screening was used to delineate areas of potential contamination in the field and to select soils for laboratory analysis. Analytical sample locations were also chosen in areas of suspected contamination based on previous field studies, or locations of contaminant sources. A total of nine surface soil samples were selected for laboratory analysis at ST001. Thirteen subsurface soil samples were selected for laboratory analysis at eleven different locations at ST001. The location and details of all field screening and analytical samples is described in Table 3-5 below.

Table 3-5: Surface and Subsurface Soil Sample Descriptions

Location	Depth (ft bgs)	PID Reading	Details
B01	1	7.8	Brown, dry, coarse, gravelly, silty SAND.
B01	5-7	7.2	Brown, wet, coarse, gravelly, silty SAND.
B02	1	124.2	Brown, dry silty SAND. Petroleum hydrocarbon odor and staining noted.
B02	5	188	Gray, dry silty SAND. Petroleum hydrocarbon odor and staining noted.
B03	1	0.3	Brown, dry, silty SAND.
B03	5	0.4	Brown, wet, coarse, silty, gravelly SAND.
B04	1	0.4	Brown, dry silty SAND.
B04	5	1.4	Brown, dry silty SAND.
B05	1	1.8	Brown, dry, silty SAND.
B05	5-7	1.3	Brown, dry, gravelly, silty SAND.
B06	1	603	Gray, dry, sandy SILT. Petroleum hydrocarbon odor noted.
B06	5-7	203	Gray, wet, coarse, gravelly, silty SAND. Petroleum hydrocarbon odor and staining noted.
B07	1	7.7	Brown, dry, gravelly, sandy SILT.
B07	5-7	2.2	Gray, wet, coarse, gravelly SAND.
B08	1	435	Gray, dry, sandy SILT. Petroleum hydrocarbon odor and staining noted.
B08	5-7	7.6	Gray, wet, coarse gravelly silty SAND. Strong petroleum hydrocarbon odor noted.
B09	1	1.1	Brown, dry, silty, gravelly SAND.
B09	5	392	Brown/gray, dry silty gravelly SAND. Petroleum hydrocarbon odor and staining noted.
B10	5-7	1.7	Brown to Black, dry, peaty, gravelly SAND. Organic odor noted.
B11	1	38.1	Brown, dry, gravelly, silty SAND. Petroleum hydrocarbon odor noted.
B11	5	25.3	Brown, dry, peaty, gravelly, silty SAND. Petroleum hydrocarbon odor noted.
B12	1	185	Brown/gray, dry, sandy gravelly SILT. Petroleum hydrocarbon odor and staining noted.
B12	5	363	Brown, dry, gravelly, sandy SILT. Petroleum hydrocarbon odor and staining noted.
B13	1	1.0	Brown, dry, gravelly, sandy SILT.
B13	5	0.5	Brown, dry, gravelly, sandy SILT.
MW10	1	0.4	Brown, dry, gravelly, sandy SILT.
MW10	2.5-4.5	0.4	Brown, dry, gravelly, sandy SILT.
MW10	5-6	0	Gray, dry, sandy, gravelly SILT.
MW10	10-10.5	0	Gray, dry, sandy, gravelly SILT.
MW11	1.5	34.2	Gray, dry, sandy, gravelly SILT.
MW11	5-7	NA	Gray, wet, gravelly SAND. Petroleum hydrocarbon odor and staining noted.

Nine surface soil samples were also collected along the remaining buried pipeline after it was excavated and removed. There were no cleanup level exceedences noted in any of the samples collected along the remaining pipeline. A detailed discussion of this sampling and analytical results are presented in the *Final Report for Clean Sweep Demolition Phase 2, Big Mountain RRS, Alaska* (ILC/Paug-Vik, 2004b).

A total of nine surface soil samples and thirteen subsurface soil samples were collected at ST001. Three duplicate subsurface soil samples were collected as well. Soil samples were sent to the laboratory and analyzed for DRO, RRO, and BTEX. Complete laboratory results can be found in Appendix E. Complete analytical data packages are presented in Appendix F. Results are summarized in Table 3-6, below.

Analytical results were compared to 18 AAC 75, Table B1, Method Two Soil Cleanup Levels Table (under 40 inch zone, migration to groundwater) and Table B2, Method Two Petroleum Hydrocarbon Soil Cleanup Levels (ADEC, 2004a).

Table 3-6: ST001 Soil Boring Analytical Results Summary

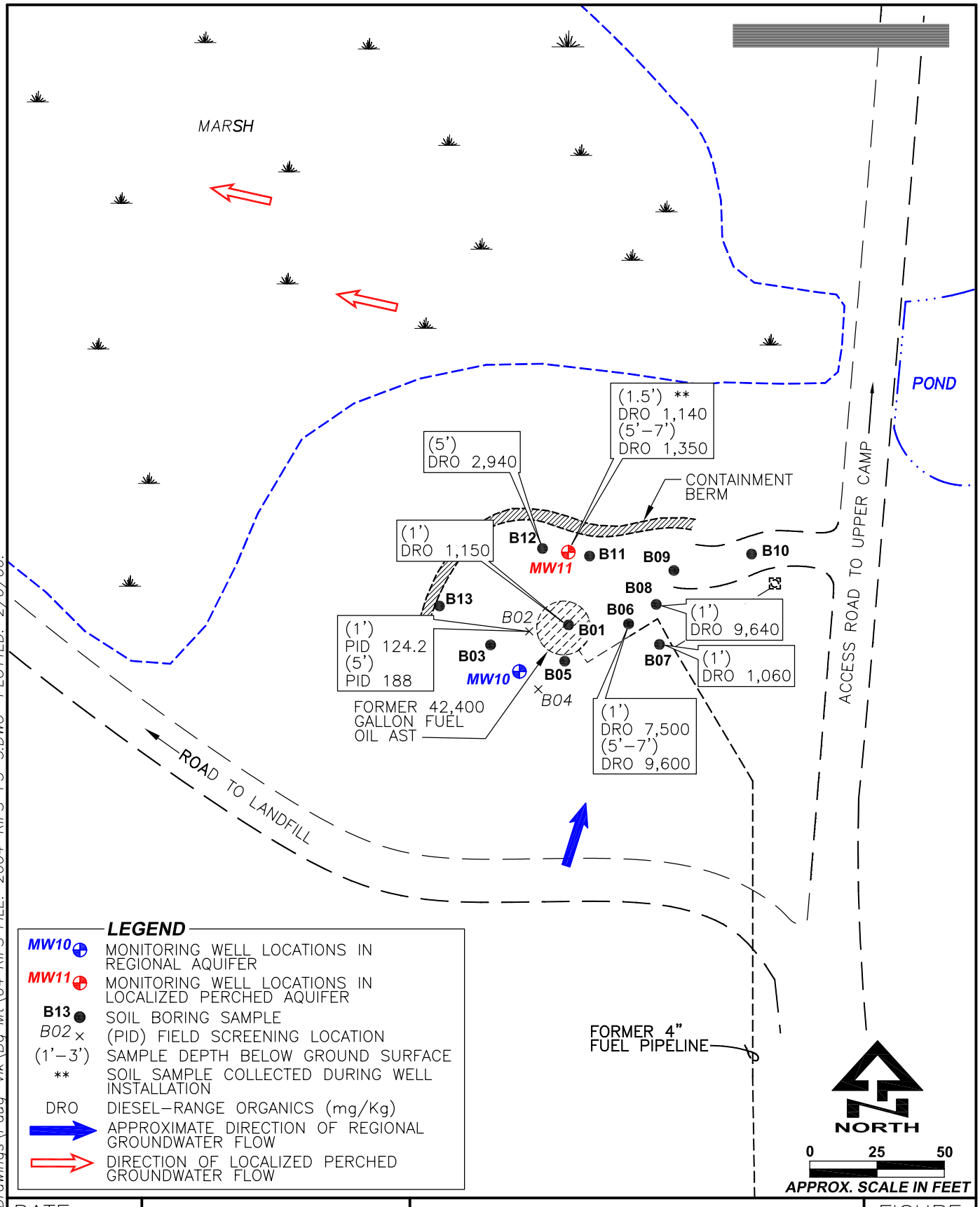
Sample Location	Depth (feet)	DRO (mg/Kg)	RRO (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethylbenzene (mg/Kg)	Total Xylenes (mg/Kg)
B01-01	1	**1150 D, VJ**	NS	ND	0.00759 F D, VB	ND	0.0127 F D, VB
B01-02	5-7	71.7 BJ	NS	ND	0.00216 F VB	ND	ND
B03	5	2.75 F VJ	NS	ND	0.00188 F VB	ND	ND
B05-01	1	24.8 VJ	NS	ND	0.00496 F VB	ND	ND
B05-02	5-7	ND	NS	ND	0.0026 F VB	ND	ND
B06-01	1	**7500 D, VJ, VR**	76.2	ND	0.0137 F D, VB	0.104 F, D, VB	2.19 D VJ
B06-02	5-7	**9600 D, VJ, VR**	105	ND	0.0204 VJ, D, VB	0.0414 VJ, D, VB	0.875 VJ, D
B06-02(D)	5-7	**5000 D, VJ, VR**	39.1	0.00944 F VJ, D	0.0324 VJ, D, VB	0.356 VJ, D	2.74 VJ, D
B07-01	1	**1060 D, VJ**	NS	ND	0.00258 F VB	0.00203 F VB	0.0120 F VB
B07-02	5-7	ND	NS	ND	0.00168 F VB	ND	ND
B08	1	**9640 D, VJ, VR**	NS	ND	ND	0.135 VJ, D	5.14 VJ, D
B09	1	37.9 VJ	NS	ND	0.00380 F VB	ND	0.0144 F VB
B10	5-7	10.5	NS	ND	0.00275 F VB	ND	ND
B11	5	87.7 VJ	98.7 VJ	0.00394 F	0.00276 F VB	0.0128 F VB	0.0571 VJ
B11(D)	5	39.4 VJ	110 VJ	ND	0.00263 F VB	0.0134 F VB	0.0535 VJ
B12	5	**2940 D, VJ, VR**	88.4 VJ	0.0192 F VJ, D	0.743VJ, D	0.807 VJ, D	4.16 VJ, D
B13-01	1	138 VJ	NS	ND	0.00242 F VB	0.00178 F VB	ND
B13-02	5	11.8 VJ	NS	ND	0.0357 F VB	0.0235 F VB	ND
MW10-01	1	8.74	NS	ND	0.00262 F VJ, VB	ND	ND
MW10-02	2.5-4.5	ND	NS	ND	0.00237 F VJ, VB	ND	ND
MW10-02(D)	2.5-4.5	ND	NS	ND	0.00352 F VJ, VB	0.00158 F VJ, VB	0.00560 F, VJ, VB
MW10-03	5-6	ND	NS	ND	0.00176 F VJ, VB	ND	ND
MW10-04	10-10.5	3.44 F VJ	NS	ND	0.00287 F VJ, VB	0.00215 F VJ, VB	ND
MW11-01	1.5	**1140 D, VJ**	NS	ND	0.00257 F VJ, VB	0.00439 F VJ, VB	0.355 VJ, VB
MW11-02	5-7	**1350 D**	NS	ND	0.00619 D, VJ, VB	0.0228 D, VJ, VB	0.240 DVJ
Cleanup Level		*250*	*11,000*	*0.02*	*5.4*	*5.5*	*78*

Notes
Cleanup Level - Alaska Administrative Code 18 AAC 75, Tables B1 and B2, Under 40 inch zone.
ND – Analyte was not detected above the laboratory method detection limit
NS – Analyte was not sampled for
mg/Kg – milligrams per kilogram
DRO – Diesel Range Organics
RRO – Residual Range Organics
Bold – Sample exceeded the ADEC cleanup level
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
B – The analyte was found in the associated blank, as well as in the project sample.
D – Laboratory qualifier indicating that the value is the result of a dilution.
R – The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

RRO and BTEX compounds were not detected above cleanup levels in any of the surface or subsurface soil samples.

Eight soil samples at sites B01-01, B06-01, B06-02, B07-01, B08, B12, MW11-01, and MW11-02 and one duplicate sample at B06-02, had DRO results that exceeded the ADEC cleanup level of 250 mg/kg. These DRO concentrations ranged from 1,060 mg/Kg to 9,640 mg/Kg. DRO concentrations in other samples ranged from below detection limits to 138 mg/kg. Cleanup level exceedences are shown on Figure 3-3. Five project samples, (B06-01, B06-02, B06-03, B08-01, and B12-01) had non-detectable surrogate concentrations due to high concentrations of analyte and/or required sample dilutions. Associated sample results were flagged "VR" during the data review process. These results are likely to exceed the ADEC cleanup level for DRO, however, their exact concentration is estimated.

Overall completeness for this project was calculated to greater than 99 percent. Two coolers of samples were received with temperatures outside of the recommended range. All detectable analyses for samples contained in these coolers were flagged "VJ" during the data review process. Holding times for all ST001 soil samples were met. Toluene, ethylbenzene, and total xylenes were detected in the method blank and trip blank samples at concentrations greater than the MDL, but below the RL. Project sample results within five times the method blank contamination were flagged "VB."



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ST001 SOIL SAMPLE CLEANUP LEVEL EXCEEDENCES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
3-3

3.1.9 Monitoring Well Installation

Two monitoring wells were installed at ST001 on July 21, 2004. The locations of these wells are shown on Figure 3-1. Soil samples were collected during installation and were field screened. Field screening results of these samples are reported in Table 3-5. These wells were installed using a hollow stem auger drill rig. Well construction diagrams are provided in Appendix G. Wells were completed with casings extending above grade approximately three to four feet.

Petroleum hydrocarbon odor and staining was noted in the soils ranging from one to seven feet bgs at MW11 during borehole installation. Descriptions of these soils and PID readings are noted in Table 3-5.

Four soil samples were collected for laboratory analysis during installation of MW10 and two were taken during the installation of MW11. Depth below ground surface of these samples is shown in Table 3-6. Soil samples were submitted to the project laboratory for DRO and BTEX analyses. Analytical results are provided in Table 3-6. Both samples at MW11 exceeded ADEC cleanup levels for DRO. No other cleanup level exceedences were noted. Complete analytical results can be found in Appendix E.

3.1.10 Monitoring Well Development

Following well installation, both ST001 wells were developed using a disposable bailer following procedures outlined in the project work plan (Paug-Vik, 2004a). Both wells were purged three times using the surge/purge technique described in Appendix A of the project Work Plan (Paug-Vik, 2004a). Well development forms are provided in Appendix D of this report.

A strong hydrocarbon odor was noted at MW11 during the purging process (see field notes for July 22, 2004 in Appendix A). A PID reading of 50.5 ppmV was taken from the breathing zone immediately after removing the well cap. A subsequent PID reading taken from inside the well casing at MW11 was 70 ppmV. MW11 was allowed to vent for several minutes prior to purging. All subsequent PID readings of the breathing zone during the purging process were less than 50 ppmV. It was also noted that the water removed from MW11 during purging had a slight hydrocarbon sheen on it. No free product was noted. This water was treated and disposed of according to specifications in the Work Plan.

3.1.11 Groundwater Sampling

Twenty-four hours after development, both monitoring wells were purged and sampled. Three well volumes were removed during purging. Groundwater parameters were measured after each well volume to ensure stabilization before sampling, as described

in the 2004 work plan (Paug-Vik, 2004a). Final readings are presented in Table 3-7, below. Groundwater Sample Data Sheets are located in Appendix D.

PID readings taken at monitoring well MW11 during sampling ranged from 0.1 ppmV to 0.4 ppmV in the breathing zone (see field notes for July 24, 2004 in Appendix A). A slight hydrocarbon odor and sheen were noted during the sampling process as well (see groundwater data sheet in Appendix D). No free product was found in the water at this well.

Table 3-7: Groundwater Quality Parameters

Sample ID	pH	Conductivity (µS)	Temp (^oC)	ORP (mV)	Dissolved O_2 (mg/L)	TDS (ppm)
04RIST001-MW10-01WG	7.5	160	5.1	16	4.65	150
04RIST001-MW11-01WG	6.6	110	7.1	-53	NR	100

Notes
µS - Microsiemens
oC – Degrees Celsius
mV - Milivolts
mg/L – Milligrams per liter
ppm – Parts per million
NR – Data was not collected due to presence of free product in well

Groundwater samples were shipped to the project laboratory for DRO and BTEX analyses. One duplicate groundwater sample was collected from MW11 for BTEX analysis only. RRO analysis was not requested, however the project laboratory completed this analysis and provided results for RRO in hard copy only. Table 3-8 summarizes analytical results for these samples. Complete laboratory results can be found in Appendix E. Complete analytical data reports are provided in Appendix F. Groundwater samples were compared to 18 AAC 75, Table C Groundwater Cleanup Levels (ADEC, 2004a).

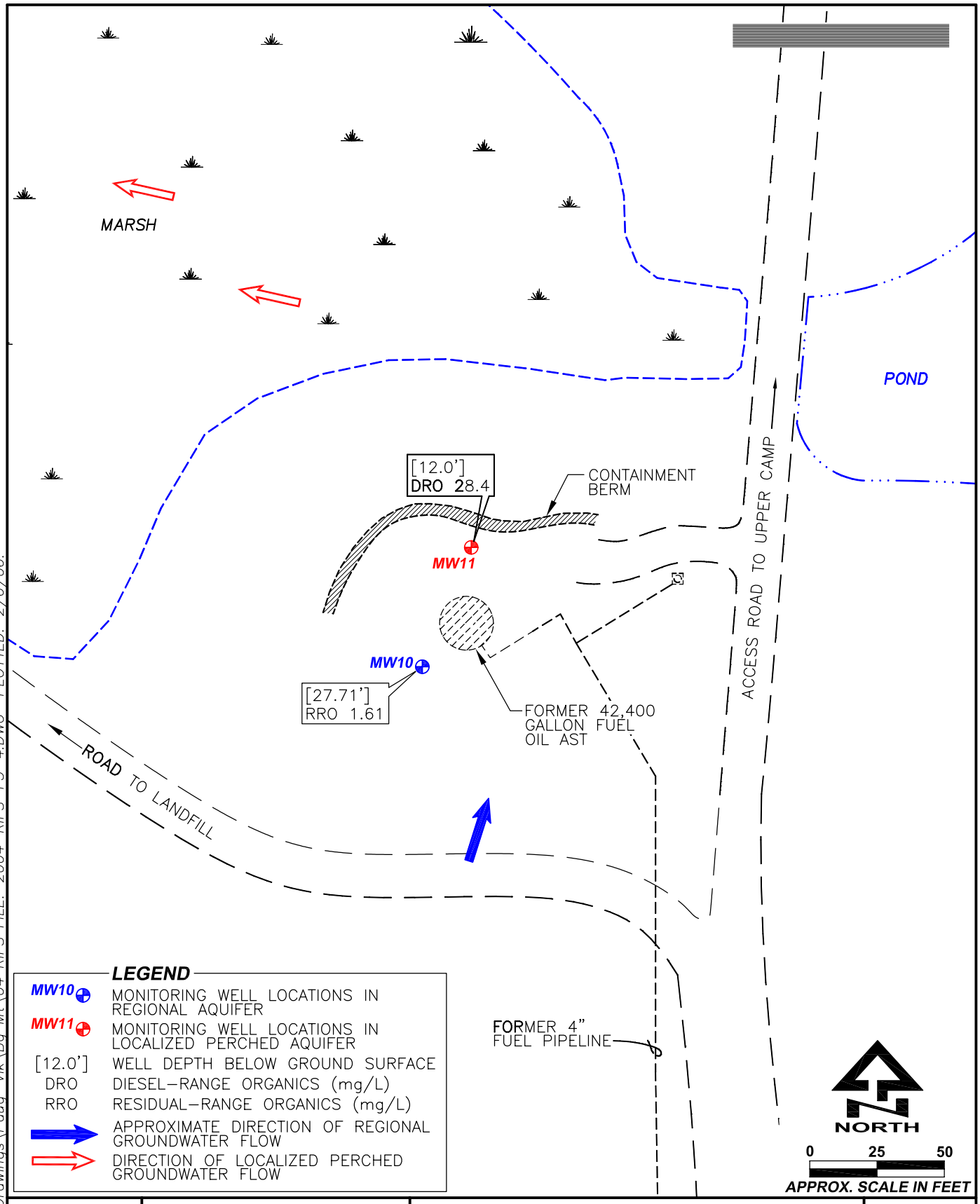
Table 3-8: ST001 Groundwater Sample Analytical Results Summary

Location	DRO (mg/L)	RRO[1] (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)
MW10	0.194 F VB	**1.61**	ND	0.197 F VB	ND	ND
MW11	**28.4**	0.373	0.483 VJ	2.73 VJ	11.9 VJ	32.1 VJ
MW11 (DUP)	NS	NS	0.608 VJ	2.58 VJ	9.73 VJ	22.8 VJ
Cleanup Level	*1.5*	*1.1*	*5*	*1,000*	*700*	*10,000*

Notes
Cleanup Level – ADEC 18 AAC 75 Table C
1. RRO analysis was not requested as part of the analytical suite for groundwater at this site.
DRO – Diesel Range Organics
RRO – Residual Range Organics
mg/L – Milligrams per liter
µg/L – micrograms per liter
ND – Analyte was not detected above laboratory method detection limits
NS – Analyte was not sampled for
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
B – The analyte was found in the associated blank, as well as in the project sample.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
BOLD font indicates cleanup level exceedence.

There were no cleanup level exceedences for BTEX compounds. The DRO result for MW11 exceeded the ADEC cleanup level of 1.5 mg/L. Groundwater cleanup level exceedences are shown on Figure 3-4. DRO was found in the method blank sample at a concentration greater than the MDL, but lower than the RL. Project sample results within five times the method blank contamination were flagged "VB" during the data review process. The RRO concentration for the sample collected from MW10 exceeded the ADEC groundwater cleanup level of 1.1 mg/L.

The overall completeness for this project was calculated to greater than 99 percent. Two coolers containing groundwater samples were received at temperatures below the recommended range. No qualification was necessary. Holding times were met for all groundwater samples from ST001. Both the method blank and the trip blank samples contained concentrations of toluene that exceeded the MDL, but were less than the RL. Associated project samples were flagged "VB."



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ST001 GROUNDWATER SAMPLE CLEANUP LEVEL EXCEEDENCES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
3-4

3.1.12 Groundwater Flow and Gradient at ST001

Well locations, relative elevations of monitoring wells, and depth to water measurements were determined in order to calculate groundwater flow direction and gradient at this site. Well locations were measured using a hand-held tape measure. Distances to wells from identified landmarks were recorded.

Relative elevations were measured with a standard survey rod and level. Monitoring well MW12 at Lower Camp site SS004 was used as a benchmark and was given an elevation of 100.00 feet. Based on the newly established benchmark, top-of-casing (TOC) elevations were determined for all wells. TOC measurement points were marked with a black permanent marker to maintain consistent depth-to-water (DTW) measurements in the future.

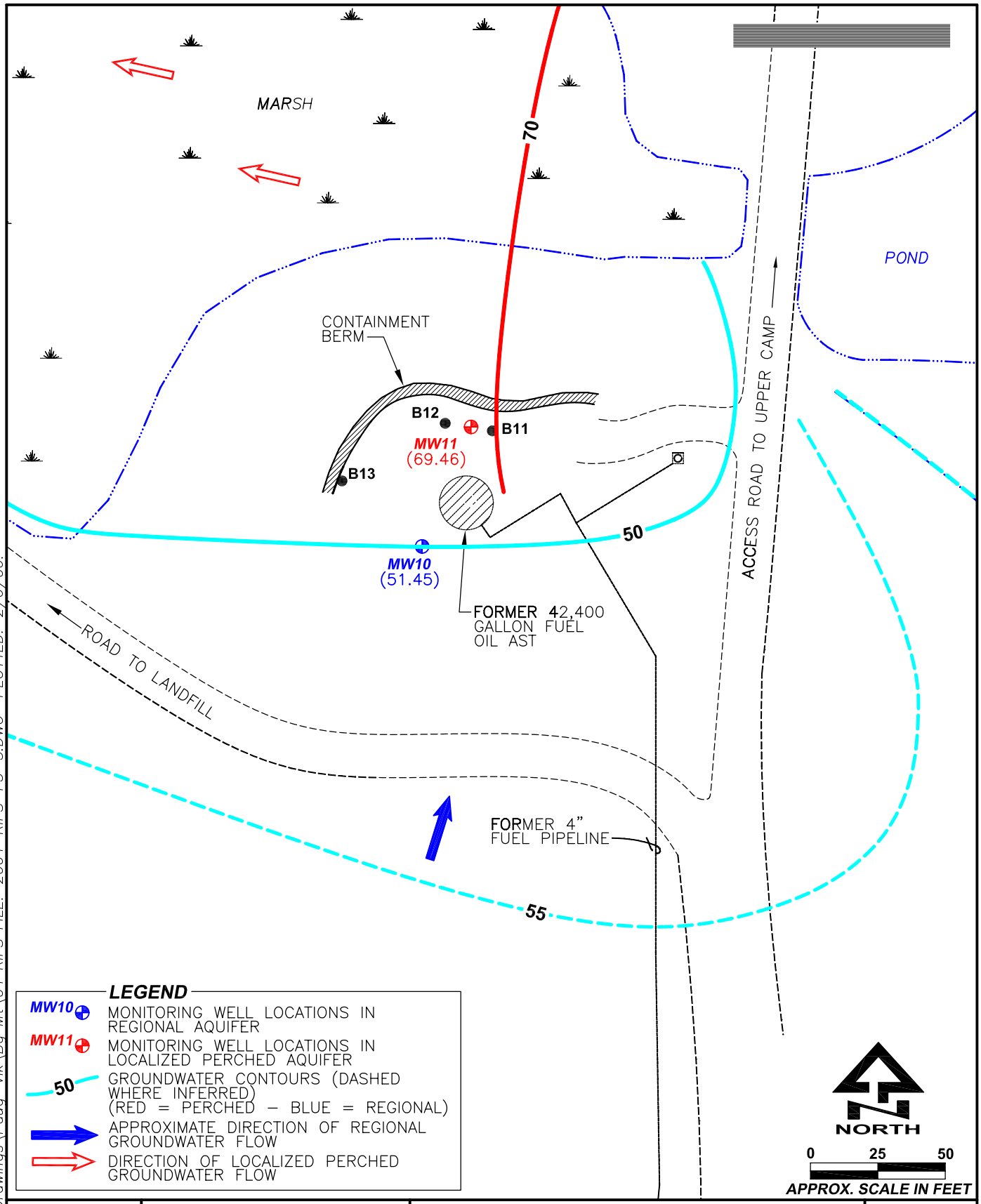
Relative groundwater elevations were calculated by subtracting the DTW from the TOC elevations and are presented in Table 3-9 below.

Table 3-9: Relative Groundwater Elevations at ST001

Monitoring Well	TOC Elevation (feet)	DTW (feet)	Total Depth (feet)	Groundwater Elevation (feet)
MW-10	77.22	25.77	27.71	51.45
MW-11	75.95	6.49	12.00	69.46

Groundwater elevations are plotted on Figure 3-5. Groundwater contour lines were drawn based on these relative elevations.

It is hypothesized that an aquifer exists at a depth of approximately 25 feet bgs at this site and that groundwater encountered at shallower depths is the result of a localized perched aquifer that is in communication with the adjacent beaver pond. Groundwater gradient at ST001 is difficult to measure due to this perched aquifer. Data collected from adjacent sites SS002, SS003, and SS004 indicate a groundwater gradient of 0.03 feet/feet with a north to northwest groundwater flow direction. Given this data and data collected from Site ST001, it is likely that the deeper aquifer encountered at ST001 is part of the aquifer encountered at Sites SS002, SS003, and SS004 and also has a flow direction of north to northwest. Localized perched groundwater flow direction is thought to vary seasonally, generally mimicking topography, but possibly flowing to the south during the wettest times of the year. The general flow direction for perched groundwater is thought to be to the west and northwest.



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42,400-GALLON AST AND PIPELINE AREA (ST001) GROUNDWATER FLOW AND GRADIENT

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
3-5

3.1.13 Investigation-Derived Waste Handling

Minimal investigation-derived waste (IDW) was generated during site sampling activities. Sampling gloves, disposable scoops, and other miscellaneous items were used and disposed of during this sampling event. All IDW was collected for this project. The IDW was disposed of and eventually burned in the on-site SmartAsh® burner.

Soil cuttings generated during borehole installation were used to backfill the boreholes following sampling.

Soil cuttings generated during well installation at ST001 were collected in Supersacks® and stored on-site pending receipt of analytical results. Both Supersacks® were clearly labeled with the well ID, the date of containerization, and contact information, and were placed in a connex and stored on-site for the winter. The soil from MW10 will be removed from its Supersack® and placed back at the well location in the summer of 2005, as analytical results indicate no cleanup level exceedences. The analytical results for the soils from MW11 indicate cleanup level exceedences for DRO. These soils will be included in the POL soil treatment project scheduled to occur in the summer of 2005.

3.2 WORK PLAN DEVIATIONS

Deviations from the work plan that occurred during the sampling effort are as follows:

- Shallow soil borings were not installed in the area north of the former containment berm, as this area is predominantly wetlands and would not support the weight of the drill rig. Instead, two additional surface water and sediment samples were collected from this area.
- Only two monitoring wells were installed at ST001. Rig accessibility was limited due to the steep gradients south of the former tank area and wetland conditions immediately beyond the containment berm to the west and north of the site.
- Field screening with the PID was not conducted at every soil sampling location due to inclement weather and malfunctioning of equipment.

3.3 RI FINDINGS – ST001

This section presents the findings from the field investigations at the 42,400-Gallon AST and Pipeline area, ST001. Field observations, analytical results, and estimated volume and extent of contamination are discussed in the following sections.

3.3.1 Data Evaluation Approach

Field observations and analytical data obtained during the 2004 RI were compared with the DQOs specified in Section 1.5 to identify areas of contamination.

Discussion of analytical results is limited to specific analytes detected. Additional information on analytical method detection limits (sensitivity), quality control (QC) samples (other than field duplicates), precision and accuracy calculations, and evaluation of data quality are described in the analytical data quality assurance report (QAR) included as Appendix H. A complete list of analytical results is presented in Appendix E.

3.3.2 Surface Water

The dissolved metals arsenic, barium, chromium, and silver were detected in surface water at sample sites shown on Figure 3-2 at low levels. These detections were compared to water quality criteria found in the ADEC Water Quality Criteria Manual (ADEC, 2003a) and to reference concentrations in NOAA SQuiRTs (NOAA, 1999). The detections for arsenic, barium, and chromium are below the ADEC criteria of 0.05 mg/L (for arsenic), 2.0 mg/L (for barium), and 0.1 mg/L (for chromium). Two detections for silver at sample locations STR02 and BP03 (0.00018 and 0.00015 mg/L, respectively) only slightly exceeded the NOAA SQuiRTs reference concentration of 0.00012 mg/L.

Methoxychlor and toluene were detected at low levels in the surface water samples. These detections were compared to criteria found in the ADEC Water Quality Criteria Manual. All detections for these compounds are below the ADEC criteria of 0.04 mg/L (for methoxychlor) and 1.0 mg/L (for toluene).

No other PAHs, metals, PCBs, Pesticides, or BTEX compounds were detected in surface water samples.

TAH and TAqH were calculated based on these results. TAH results ranged from 0.115 µg/L to 2.08 µg/L and detectable TAqH ranged from 0.115 µg/L to 2.08 µg/L. No TAH or TAqH detections at site ST001 exceeded applicable ADEC criteria.

Based on these results, surface water does not appear to be impacted by the former AST and pipeline.

3.3.3 Sediment

Concentrations of contaminants in sediment samples were compared to reference NOAA SQuiRT TEL and PEL values, as well as to benchmarks listed in the USEPA Ecotox Thresholds (USEPA, 1996). No concentrations of any analytes detected exceeded the PEL values (values that represent the concentration above which adverse effects are frequently expected). Arsenic was found in one sample at a concentration that was above the TEL, but below the PEL, and is considered within background range for the Big Mountain site.

The PCB Arochlor-1260 was detected in four samples, however only one of these detections at BP04 exceeded the TEL for PCBs. This detection, as well as all other PCB detections, is below the PEL.

The pesticide 4,4'-DDT was detected at two sample locations at concentrations below the NOAA SQuiRTs TEL and PEL. Endrin was also detected at one sample location at a concentration below both the TEL and PEL listed in the NOAA SQuiRTs (NOAA, 1999).

Toluene, ethylbenzene, and total xylenes were detected at low levels in several of the sediment samples at ST001. These concentrations were compared to benchmarks listed in the USEPA Ecotox Thresholds (USEPA, 1996). All detections were several orders of magnitude below benchmark values.

DRO was detected in two of the samples. There are no criteria for DRO in sediments.

Based on these results, sediment does not appear to be adversely impacted by the former AST and pipeline located upgradient of these sampling sites.

3.3.4 Soil

Soil contamination covers much of the site surface, down through the soil horizon, and extending as deep as seven feet bgs in a few locations. DRO exceedences were noted in soils at locations B6, B7, B8, B12, and MW11. B6, B7, and B8 are located to the east of the former AST location and B12 and MW11 are located north of the former AST location (Figure 3-1). DRO exceedences were also noted in soils from thirteen samples collected during the 1998 RI/FS effort (DOWL, 2001). Exceedences range from 290 mg/Kg to 17,000 mg/Kg in the 1998 samples. The majority of soils that exceeded cleanup levels in both 1998 and 2004 had DRO concentrations greater than 1,000 mg/Kg, substantially higher than the 250 mg/Kg cleanup level.

Low levels of RRO and BTEX compounds were noted across the site. No detections of these analytes exceeded soil cleanup levels in 18 AAC 75 (ADEC, 2004a).

DRO-contamination at this site appears to be extensive in surface soils and extends to the localized perched water table aquifer that has been encountered at an approximated depth of five feet bgs. Soil at ST001 can be classified as glacial alluvium, consisting primarily of silty sands and silty gravels.

3.3.5 Groundwater

The contamination is migrating from the soil to the groundwater at ST001. MW-11 showed a DRO concentration of 28.4 mg/L, substantially above the ADEC cleanup level

of 1.5 mg/L. A groundwater sample collected at ST001 in 1998 (DOWL, 2001) showed a DRO concentration of 1.5 mg/L. Well MW-10, installed in 2004, had an RRO concentration of 1.61 mg/L, slightly above the cleanup level of 1.1 mg/L. A hydrocarbon odor and sheen were noted in the groundwater at MW11.

Low levels of BTEX compounds were found in both 2004 samples; however, there were no cleanup level exceedences for these compounds.

3.3.6 Conceptual Site Model

Potential human receptors at ST001 were evaluated as part of this study. The resulting exposure scenarios are listed below:

- Recreational & Subsistence Exposure Scenario (short-term visits by fishermen, hunters, and recreational users).
- Industrial Exposure Scenario (short-term visits by site workers and camp support staff during investigation and cleanup efforts).

These following potential exposure scenarios were considered complete at the site:

- Inhalation of dust-borne COPCs in surface soils.
- Ingestion of and dermal contact with soil-borne COPCs in surface soils.
- Bioaccumulation of COPCs (There is a complete exposure pathway to biota. POLs are present in surface and subsurface soils and may bioaccumulate in local flora and fauna).
- Ingestion of and dermal contact with COPCs present in surface water.
- Ingestion of and dermal contact with COPCs present in groundwater.

Free-phase liquid plume and mobile free-liquid transport have been determined to not be contaminant sources and transport mechanisms at the ST001 site.

Terrestrial animals and humans may be directly exposed to contaminants in surface soil at the facility via incidental ingestion, inhalation, or dermal contact.

3.4 RI SUMMARY AND CONCLUSIONS

The soil boreholes and groundwater samples show extensive DRO and RRO contamination at this site. However, surface water and sediment downgradient of ST001 do not appear to be impacted by the former AST and pipeline.

Contaminated soil volume estimates are based on analytical sampling results. Contaminated soils and groundwater identified by the 1998 RI/FS efforts (DOWL, 2001) were also included in soil volume estimates. A total of 685 cubic yards of soil appears to

be impacted by previous site activities at ST001. Because no field sampling program can completely assess the lateral and vertical extent of contamination at a site, and the actual volume of contaminated soil may vary from the estimated volume. Thus, a more conservative volume of contaminated soil of 800 cubic yards was used in choosing the appropriate remedial action.

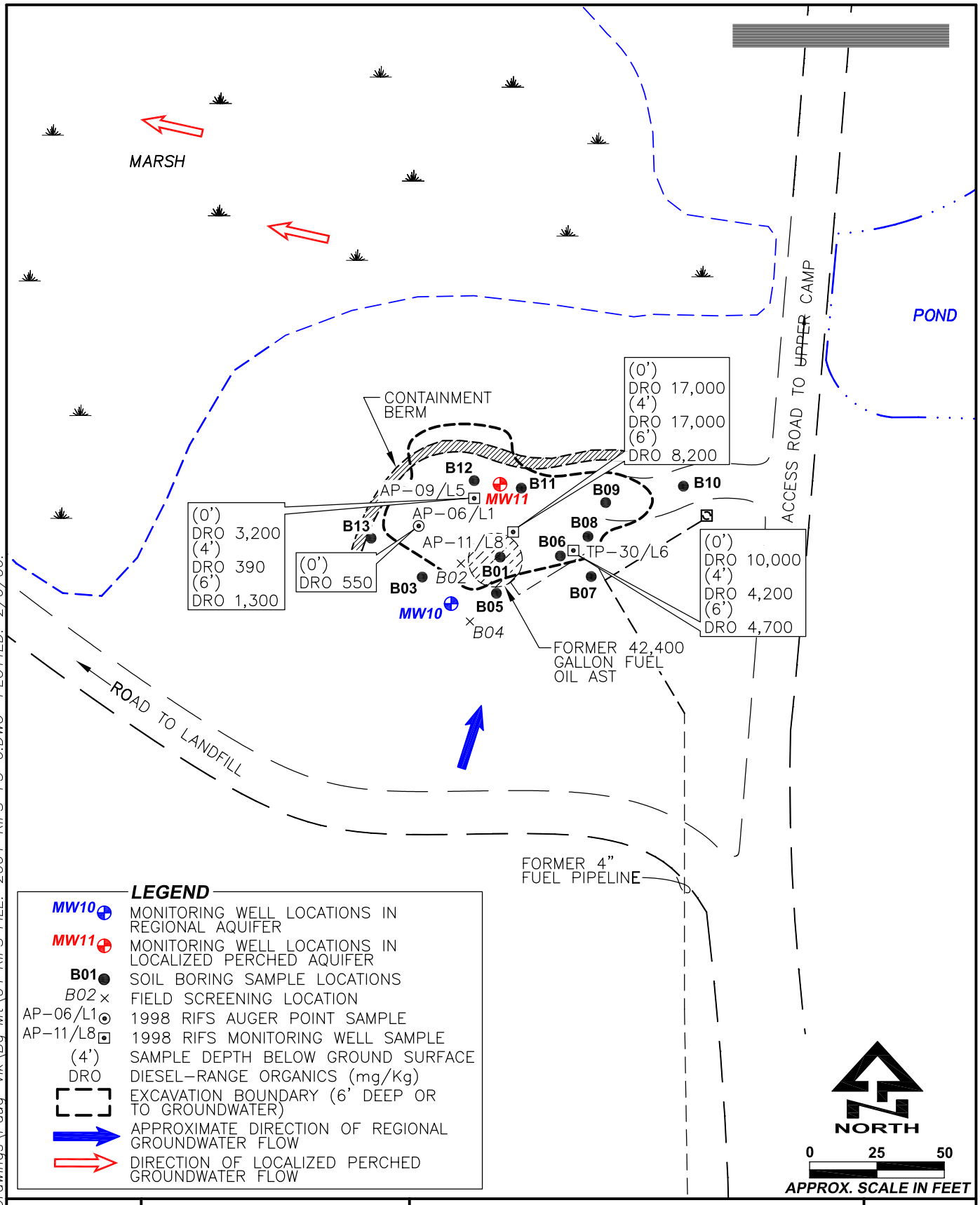
3.5 SELECTED REMEDIAL ACTION FOR ST001

Site ST001 is currently managed under an Interim Record of Decision (ROD) (Paug-Vik, 2002a). In accordance with this Interim ROD, contaminated soils at ST001 will be excavated according to the isopachs shown in Figure 3-6. Soils will be excavated to the isopach depth (predominantly six feet bgs), or to groundwater contact, whichever is encountered first.

Following excavation, contaminated soils will be thermally treated to reduce contaminant concentrations below the ADEC cleanup level for DRO (250 mg/Kg) in soils (ADEC, 2004a). The DRO concentration in these soils will be verified using a field analytical method.

The Interim ROD specifies installation of monitoring wells at this site to evaluate groundwater impacts and to determine final actions for groundwater. These wells were installed in 2004, as part of the RI activities. Because soil removal is expected to remove the contaminant source, Monitored Natural Attenuation (MNA) will be an adequate remedy to address potential groundwater, surface water, and sediment impacts.

Long-term monitoring of groundwater, surface water, and sediment for contamination is recommended. Three well points should be installed at wetland locations downgradient of ST001 for future groundwater monitoring. These well points should be evenly spaced along the northern perimeter of the containment berm in order to gain an accurate depiction of potential contaminant migration from ST001 to the adjacent stream and wetlands. Periodic sampling should be conducted in for a duration of five years, and will include groundwater, surface water, and sediments. A five-year review will be conducted based monitoring data, and the Interim ROD will be revisited at that time.



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ST001 SOIL EXCAVATION BOUNDARIES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
3-6

4 FORMER LANDFILL LF005

4.1 2004 FIELD ACTIVITIES AND SAMPLE RESULTS AT LF005

Field activities at LF005 were performed from July 10 to August 2, 2004. The buddy system was used while sampling this site. The sampling team carried an emergency whistle and radio, as well as a first aid kit during all sampling activities.

4.1.1 Site Description

The former Lower Camp Landfill (LF005) is located approximately 800 feet north of the airstrip, as detailed in Figure 1-3. A limited landfill cap consisting of gravel from a local glacial moraine source has been placed on the landfill.

Four downgradient and one upgradient groundwater monitoring wells were installed at LF005 during the 1998 RI/FS (DOWL, 2001). COPCs for this site identified during the 1998 RI/FS include the VOCs 1,3-Dichlorobenzene, and 1,4-Dichlorobenzene, as well as the metals aluminum, arsenic, barium, beryllium, chromium, iron, lead, manganese, nickel, and vanadium.

4.1.2 Investigative Methodologies

Field sampling activities were conducted in accordance with the procedures described in Appendix A of the project Work Plan (Paug-Vik, 2004a), except as noted in Section 4.2 of this report, which describes field deviations to the work plan. A site reconnaissance was performed prior to sampling to identify the best sampling locations. Surface water and sediment sampling locations in the adjacent wetlands were chosen in both upgradient and downgradient areas. Groundwater monitoring locations were chosen to supplement the existing monitoring wells and provide more detailed information on contamination at this site.

4.1.3 Investigative Approach

Thirteen primary and two duplicate soil samples were collected during monitoring well installation. Five surface water and sediment sample pairs and one duplicate surface water and sediment sample were collected. One surface water/sediment sample was collected upgradient of LF005. Four surface water/sediment samples were taken from the wetlands downgradient of the former landfill. Sample locations are shown on Figure 4-1. Four groundwater monitoring wells were installed and sampled as well. Surface and subsurface soil samples were collected during monitoring well installation.

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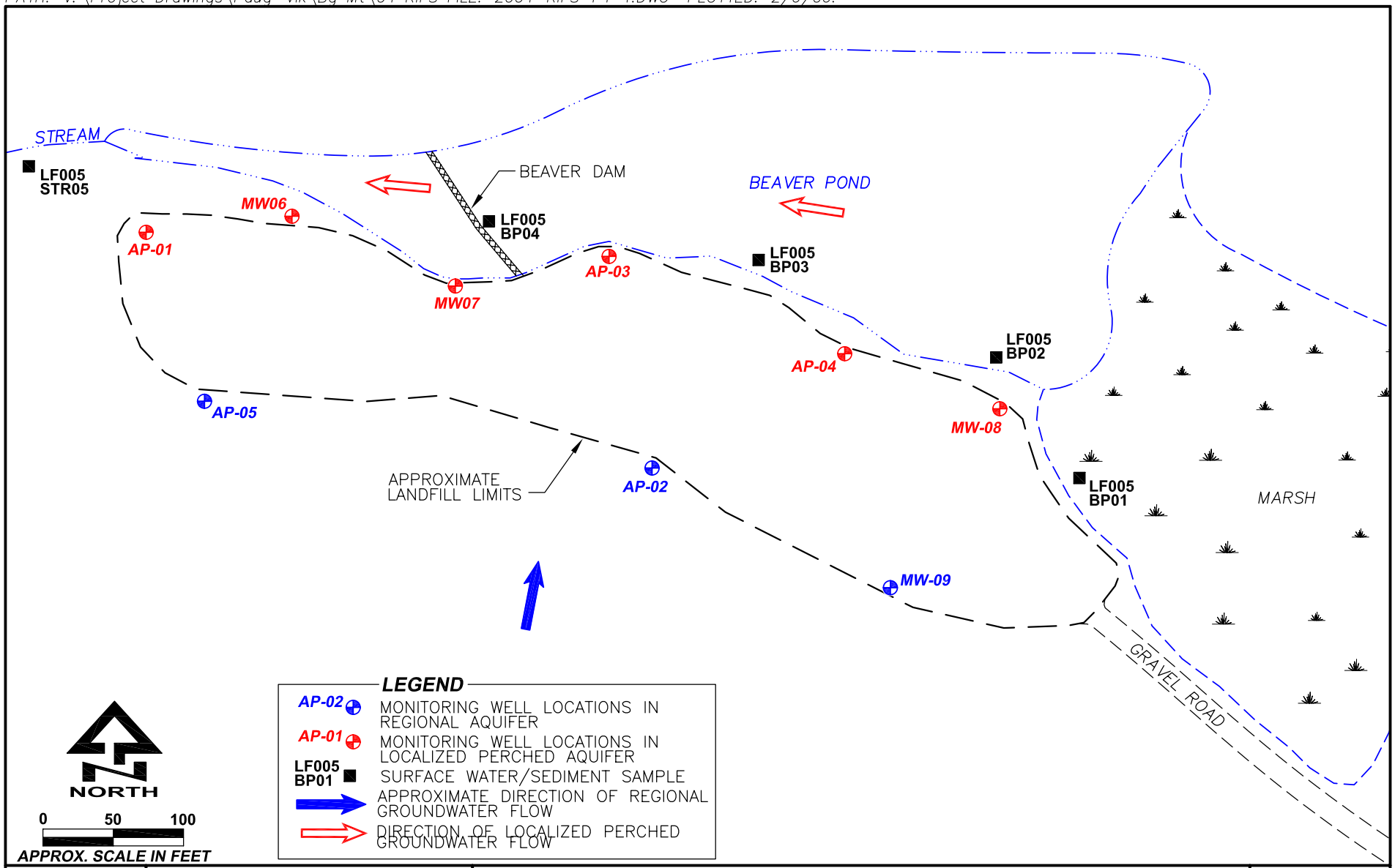

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FORMER LANDFILL AREA (LF005) SAMPLE LOCATIONS

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE

4-1

4.1.4 Field Documentation

Field documentation was an important part of the field effort and was performed in accordance with the work plan (Paug-Vik, 2004a). Copies of all field notes and Daily Activity Reports are included in Appendices A and B. Site photographs that document the 2004 RI effort are provided in Appendix C.

4.1.5 Surface Water and Sediment Sampling Locations

Surface water and sediment sample pairs were collected at five areas in the wetlands adjacent to the LF005 site. Sampling locations are displayed on Figure 4-1. GPS coordinates and sample location descriptions are presented in Table 4-1, below.

Table 4-1: Surface Water and Sediment Sample Locations and Description

Sampling Location	Latitude	Longitude	Approx. Elev. (ft amsl)	Description
BP02	59.36449	155.25454	665	Southeast edge of beaver pond adjacent to LF005.
BP01	59.36451	155.25466	664	Edge of beaver pond located east of LF005, across the dam from BP02.
BP03	59.36472	155.25546	666	Southern edge of beaver pond adjacent to LF005.
BP04	59.36494	155.25669	660	Center of beaver dam on western edge of pond adjacent to LF005.
STR05	59.36499	155.25740	649	Stream down gradient of beaver pond, northwest of LF005.

Note:
GPS readings were taken on the Universal Transverse Mercator (UTM) coordinate system using the North American Datum of 1927 (NAD27).

While sampling location BP04, it was noted that a drum was found in the beaver dam adjacent to the sampling area. There were no visible identifiable markings on the drum, and no residual drum contents were apparent. The drum did not appear to be intact.

4.1.6 Surface Water Results

Water quality parameters were measured at each surface water sampling location prior to sampling. Water quality measurements included temperature, pH, conductivity, and dissolved oxygen. Results are presented in Table 4-2, below. Surface Water Data Sheets are located in Appendix D

Table 4-2: Surface Water Parameters

Sample Name	Temperature (^{o}C)	pH	Conductivity (µS)	Dissolved Oxygen (mg/L)
BP02WS/BP02SE	13.4	7.5	60	4.6
BP01WS/BP01SE	19.7	7.7	90	6.58
BP03WS/BP03SE	21	7.6	80	6.5
BP04WS/BP03SE	22.4	7.6	80	7.25
STR05WS/STR05SE	12.8	7.5	70	6.25

Notes:
(^{o}C) – degrees in Celsius
mg/L – milligrams per liter
µS - microsiemens

Five surface water samples and one duplicate sample were collected from small streams and ponded areas using new laboratory-supplied sample bottles. Samples were collected under the surface of the water with a minimum of sediment disturbance, as described in the work plan (Paug-Vik, 2004a). Surface water samples were collected and shipped to Anchorage for laboratory analysis of PAHs, dissolved metals, PCBs, pesticides, and VOCs. Laboratory analysis summary reports can be found in Appendix E. Complete analytical data packages are provided in Appendix F. A summary of these results is presented in Table 4-3 below.

Surface water results were compared to criteria found in 18 AAC 80, Drinking Water (ADEC, 2003b), as well as to the Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances (ADEC, 2003b). When criteria for a specific analyte did not exist in either 18 AAC 80 or the Alaska Water Quality Criteria Manual, results were compared to criteria found in the NOAA SQuiRTS (NOAA, 1999).

Table 4-3: LF005 Surface Water Analytical Results Summary

Sample Location	PAHs (mg/L)	Dissolved Metals (mg/L)	PCBs (mg/L)	Pesticides (mg/L)	VOCs (mg/L)	TAH (µg/L)	TAqH (µg/L)
BP02WS	All ND	BC	All ND	All ND	All ND	All ND	All ND
BP02WS (DUP)	All ND	BC	All ND	All ND	All ND	All ND	All ND
BP01WS	All ND	BC	All ND	All ND	All ND	All ND	All ND
BP03WS	BC	BC	All ND	All ND	All ND	All ND	0.0962 F
BP04WS	All ND	BC	All ND	BC	All ND	All ND	All ND
STR05WS	All ND	BC	All ND	All ND	All ND	All ND	All ND
ADEC Criteria	*Varies*	*Varies*	*0.0005*	*Varies*	*Varies*	*10*	*15*

Notes:

Criteria taken from ADEC 18 AAC 70, Water Quality Criteria, (ADEC, 2003b).

PAH - Polynuclear Aromatic Hydrocarbon

Dissolved Metals - Silver, Arsenic, Barium, Cadmium, Chromium, Mercury, Lead, Selenium

PCB - Polychlorinated Biphenyls

VOCs – Volatile Organic Compounds

TAH – Total Aromatic Hydrocarbons.

TAqH – Total Aqueous Hydrocarbons.

ND – Not Detected

µg/L – Micrograms per liter.
mg/L – Milligrams per liter.

BC – Below water quality criteria.

BOLD – Criteria exceedence.

F – The analyte was positively identified, but the associated numerical value is below the reporting limit.

There were no PCBs or VOCs detected in the surface water at LF005. The PAH benzo(k)fluoranthene was detected at a low level at one sample location. This detection was several orders of magnitude below water quality criteria for this compound. The pesticide alpha-Hexachlorocyclohexane (alpha-BHC) was detected at a low level in the surface water at BP04. There are no criteria for this compound in either 18 AAC 70 (ADEC, 2003b), or the NOAA SQuiRTs. This result was below the cleanup level in 18 AAC 75 (ADEC, 2004a) of 0.1 µg/L.

TAH was not detected in any surface water samples at LF005. The sample collected at BP03 had a TAqH result of 0.0962 µg/L, which is well below the ADEC criteria for TAqH of 15 µg/L.

The metals arsenic, barium, and chromium were detected at low concentrations at all surface water sample locations. Silver was also detected in the duplicate sample of BP02WS. No detections of metals exceeded water quality criteria.

The overall calculated completeness for this project was greater than 99 percent. Holding times and cooler temperatures for the surface water samples for LF005 were within quality assurance (QA) and QC acceptance criteria. No analytes were detected in the association method blank or trip blank samples. The metals sample from STR05 was submitted as unfiltered for metals analysis, due to field equipment malfunction. Metals results for this sample were flagged “VJ” during the data review process.

4.1.7 Sediment Sample Results

Sediment samples were collected from the same area as the surface water samples (Table 4-1). One duplicate sediment sample was collected at location BP02. Sediment was collected form the upper three-inches of sediment using a disposable sample scoop. Information including material type, odor, depth, and location were recorded on the Sediment Sample Sheet (Appendix C). Sediment samples were sent to the project laboratory for analysis of PAHs, total metals, PCBs, Pesticides, and VOCs. Complete results are presented in Appendix E. A summary of the results is presented in Table 4-4 below. Criteria exceedences are shown on Figure 4-2

Table 4-4: LF005 Sediment Sample Analytical Results Summary

Sample Location	PAHs (mg/Kg)	Total Metals (mg/Kg)	PCBs (mg/Kg)	Pesticides (mg/Kg)	VOCs (mg/Kg)
BP02SE	All ND	**Arsenic – 6.3**	**Arochlor-1260 – 0.135 VJ**	All ND	All ND
BP02SE (DUP)	BUET	**Arsenic – 6.13**	**Arochlor-1260 – 0.0388 F VJ**	All ND	All ND
BP01SE	All ND	**Arsenic – 6.14**	BTEL	All ND	All ND
BP03SE	BUET	BTEL	BTEL	All ND	All ND
BP04SE	All ND	BTEL	**Arochlor-1260 – 0.0486**	All ND	All ND
STR05SE	All ND	**Arsenic – 8.56**	BTEL	All ND	All ND
TELs	*Varies*	*As – 5.9*	*0.0341*	*Varies*	*Varies*

Notes:

TELs taken from NOAA Screening Quick Reference Tables, (NOAA, 1999).

PAH - Polynuclear Aromatic Hydrocarbon

Total Metals - Silver, Arsenic, Barium, Cadmium, Chromium, Mercury, Lead, Selenium

PCB - Polychlorinated Biphenyls

VOCs – Volatile Organic Compounds

ND – Not Detected

mg/Kg – Milligrams per kilogram.

BTEL – Below Threshold Effects Level.

BUET – Below Upper Effects Threshold.

BOLD – Ecological benchmark exceedence.

V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.

J – The analyte was positively identified, the quantitation is an estimation.

There were no pesticides or VOCs detected in any of the sediment samples at LF005. The PCB Arochlor-1260 was detected at all sample locations, with concentrations ranging from 0.0104 mg/Kg to 0.135 mg/Kg). Detections of Arochlor-1260 at two locations, BP02SE and BP04SE, exceeded the TEL of 0.0341 mg/Kg in the NOAA SQuiRTs (NOAA, 1999), but were below the PEL of 0.277 mg/Kg. The duplicate sample from location BP02SE also exceeded the TEL for Arochlor-1260, but did not exceed the PEL.

The PAH benzo(ghi)perylene was detected in two samples, the duplicate sample at BP02SE and BP03SE. Detected concentrations were 0.0225 mg/Kg and 0.0061 mg/Kg respectively. These detections were compared to criteria listed in the NOAA SQuiRTs (0.3 mg/Kg for Upper Effects Threshold [UET]) and found to be at least one order of magnitude below these criteria.

Metals were detected in all of the sediment samples. These detections were compared to criteria listed in the NOAA SQuiRTs (NOAA, 1999). Detections of barium and selenium were compared to cleanup levels in 18 AAC 75 (ADEC, 2004a), as there are no criteria for those metals listed in the NOAA SQuiRTs. Most of the detections of metals were below criteria. However, four detections of arsenic exceeded the TEL of 5.9 mg/Kg for arsenic, but were below the PEL of 17.0 mg/Kg (NOAA, 1999). These arsenic detections are within detected background arsenic levels in sediments for the Big Mountain site, as discussed in Section 5.2.3 and presented in Table 5-4 of this report. Arsenic, barium, lead, and selenium were found in the associated method blank samples at concentrations greater than the MDL, but below the RL. Project sample results within five times the method blank contamination were flagged “VB” during the data review process.

The overall calculated completeness for this project was greater than 99 percent. One cooler containing LF005 sediment samples arrived at the laboratory at a temperature above the recommended range. The temperature was measured again using a more precise instrument and found to be within acceptance criteria, thus no further qualification was necessary. The VOC methylene chloride was detected in the method blank sample, however there were no detections of this compound in the project samples and data qualification was not required.

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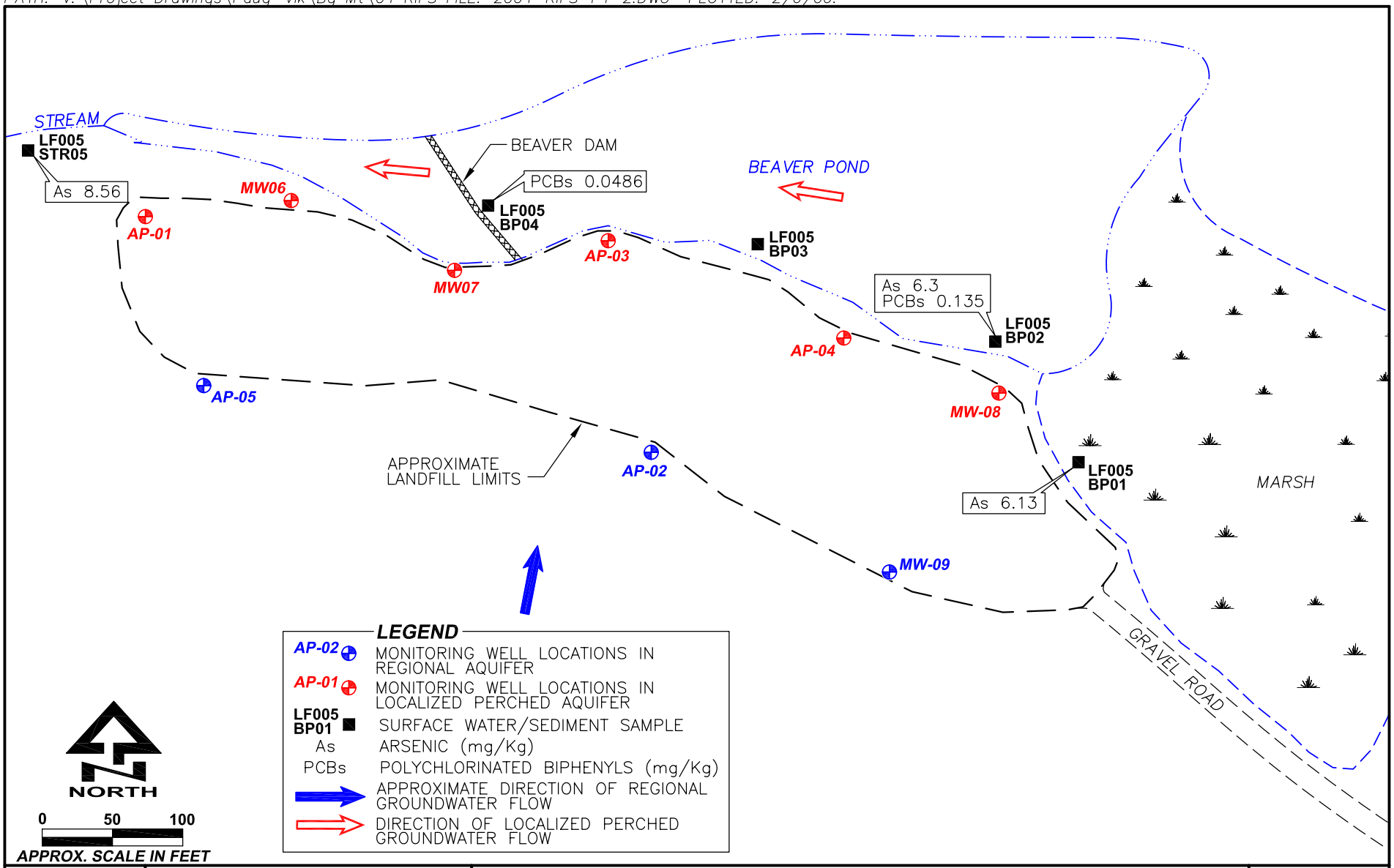

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LF005 SEDIMENT SAMPLE CRITERIA EXCEEDENCES

2004 REMEDIAL INVESTIGATION AND
FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE

4-2

4.1.8 Surface and Subsurface Soil Sampling

Surface and subsurface soils were collected from the borehole installation of four wells. Figure 4-1 details the locations of these samples. Surface soil was collected as discreet grab samples. Surface material was obtained from the top six inches of soil and placed into pre-cleaned sample jars, according to procedures described in the work plan (Paug-Vik, 2004a). Subsurface soil samples were collected at varying depths by drilling boreholes with a hollow stem auger drill rig and using a spoon sampler to collect the soil. Copies of Soil Sample Field Data Sheets are included in Appendix C.

A surface soil sample was collected from each of the four well boreholes installed at LF005. Nine subsurface soil samples were collected from the four well boreholes at roughly 5-foot depth intervals. One duplicate surface soil sample was collected at location MW06-01 and one duplicate subsurface soil sample was collected from MW09-03. All soil samples were field screened using a PID. The location and details of these samples is described in Table 4-5 below.

Table 4-5: Surface and Subsurface Sample Location and Description

Location	Depth (ft bgs)	PID Reading (ppmV)	Details
MW06-01	0-1	0.3	Dry, brown, sandy pebbly SILT.
MW06-02	5-7	0.7	Dry, brown, sandy pebbly SILT.
MW06-03	10-11.5	0.2	Wet, brown, sandy SILT.
MW07-01	0-1	0.0	Dry, brown, sandy gravelly SILT.
MW07-02	5-7	0.2	Moist, brown/gray coarse SAND to sandy SILT.
MW07-03	10-12	0.0	Wet, brown/gray coarse SAND to sandy SILT.
MW08-01	0-1	0.0	Dry, brown, silty pebbly SAND.
MW08-02	5-7	0.0	Dry, brown gravelly coarse SAND.
MW08-03	7.5-9.5	0.0	Wet, red/brown silty SAND. Iron staining noted.
MW09-01	0-1	0.3	Dry, brown, silty gravelly SAND.
MW09-02	5-6	0.3	Dry, light brown, silty gravelly SAND.
MW09-03	7.5-9	0.3	Dry, lt. brown, silty gravelly SAND.
MW09-04	15-16	0.3	Dry, brown, silty gravelly SAND.

Notes:
ft bgs – Feet below ground surface.
ppm/V – Parts per million per volt.

Soil samples were sent to the project laboratory for DRO, RRO, VOCs, PCBs, pesticides, total metals, and PAHs analyses. Complete laboratory results can be found in Appendix E. Complete analytical data packages are provided in Appendix F. Results have been summarized in Table 4-6.

Analytical results were compared to 18 AAC 75, Table B1, Method Two Soil Cleanup Levels Table (under 40 inch zone, migration to groundwater) and Table B2, Method Two Petroleum Hydrocarbon Soil Cleanup Levels (ADEC, 2004a). DRO, RRO, VOCs, pesticides, and PAHs were detected at low levels in several surface and subsurface samples. None of these detections exceeded ADEC cleanup levels.

The PCB Arochlor 1260 was detected above the ADEC cleanup level of 1 mg/Kg at one sample location at LF005 (MW06-01). This detection was confirmed by the duplicate sample at this location.

Arsenic was detected above the ADEC cleanup level of 2 mg/Kg in all surface and subsurface soil samples collected at this site. Detections ranged from 3.71 mg/Kg to 10.3 mg/Kg. The majority of these detections are within detected background for sediment and soil in the Big Mountain area (Section 5.2.4 and Table 5-6 of this report). Barium and silver were detected in the associated method blank samples at concentrations greater than the MDL, but below the RL. The QAR notes that project sample results for barium and silver were either greater than five times the contamination concentration or were non-detectable, thus requiring no further qualification.

Cleanup level exceedences with the exception of those for arsenic are shown on Figure 4-3.

Overall completeness for this project was calculated to 99 percent. Several coolers of soil samples were received above the recommended temperature range. All detectable results for samples contained in these coolers were flagged “VJ” during the data review process. The trip blank for LF005 soil samples contained 2-butanone at a concentration greater than the MDL, but less than the RL. Project samples with levels of 2-butanone within ten times the trip blank concentration were flagged “VB.”

Table 4-6: LF005 Surface and Subsurface Soil Sample Analytical Results Summary

Sample Location	DRO (mg/Kg)	RRO (mg/Kg)	VOCs (mg/Kg)	PCBs (mg/Kg)	Pesticides (mg/Kg)	Metals (mg/Kg)	PAHs (mg/Kg)
MW06-01	43.5 VM, VJ	599 VJ, D	All ND	**Arochlor-1260 – 1.53 VJ, D**	All ND	**As – 4.2**	BCL
MW06-01(D)	64.4 VM, VJ	407 D, VJ	All ND	**Arochlor-1260 – 2.19 VJ, D**	All ND	**As – 4.8**	BCL
MW06-02	26.4 VM	246 VJ	BCL	All ND	All ND	**As – 4.3**	All ND
MW06-03	4.5VB, VJ, VM	64.2 VJ	All ND	All ND	All ND	**As – 3.71**	BCL
MW07-01	13.7 VB, VM	135 VJ	All ND	Arochlor-1260 – 0.0074 F, VJ	BCL	**As – 5.12**	BCL
MW07-02	4.59 VB, VM	50.5 VJ	All ND	All ND	BCL	**As – 4.43**	All ND
MW07-03	18.9 VM	170 VJ	All ND	All ND	BCL	**As – 7.67**	All ND
MW08-01	ND	14.7 F	All ND	All ND	BCL	**As – 5.32**	All ND
MW08-02	ND	ND	All ND	All ND	All ND	**As – 5.1**	All ND
MW08-03	ND	ND	All ND	All ND	All ND	**As – 7.7**	All ND
MW09-01	ND	4.95 F	All ND	Arochlor-1260 – 0.0121 F	BCL	**As – 4.3 VJ**	All ND
MW09-02	6.22 VM, VJ	25.3 VJ	BCL	Arochlor-1260 – 0.0137 F	BCL	**As – 3.8 VJ**	All ND
MW09-03	ND	ND	BCL	All ND	BCL	**As – 3.7 VJ**	All ND
MW09-03(D)	ND	ND	BCL	All ND	BCL	**As – 4.3 VJ**	All ND
MW09-04	ND	ND	BCL	All ND	All ND	**As – 10.3 VJ**	All ND
Cleanup Level	*250*	*11,000*	*Varies*	*1.0*	*Varies*	*As – 2.0*	*Varies*

Notes:
Cleanup Level – ADEC 18 AAC 75, Tables B1 and B2, Under 40 inch Zone, Migration to Groundwater.
DRO – Diesel Range Organics.
RRO – Residual Range Organics.
VOCs – Volatile Organic Compounds.
PCBs – Polychlorinated Biphenyls.
PAHs – Polyaromatic Hydrocarbons.
ND – Analyte was not detected above the laboratory method detection limit.
BCL – Below the applicable cleanup level.
BOLD – The sample result exceeded the applicable cleanup level.
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
B – The analyte was found in the associated blank, as well as in the project sample.
M – A matrix effect was present.
D – A laboratory qualifier that indicates that the value is the result of a dilution.

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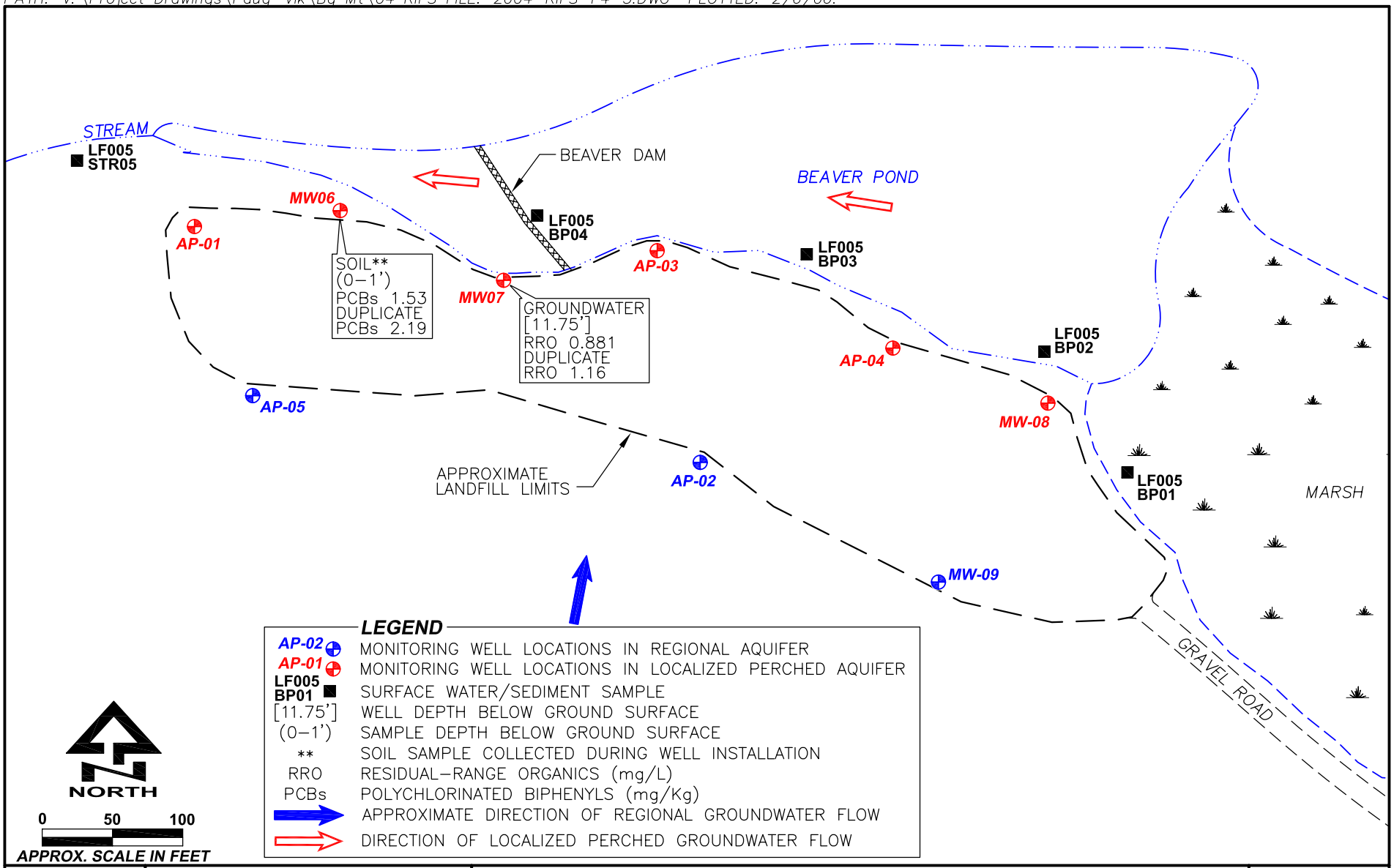

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LF005 SOIL AND GROUNDWATER SAMPLE CLEANUP LEVEL EXCEEDENCES

2004 REMEDIAL INVESTIGATION AND
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FIGURE

4-3

4.1.9 Monitoring Well Installation

Four monitoring wells were installed at LF005 on July 20th and 21st. The locations of these wells are shown on Figure 4-1. Soil samples were collected during installation and were field screened. Field screening results of these samples are reported in Table 4-5. These wells were installed using a hollow stem auger drill rig. Well construction diagrams are provided in Appendix G.

Three analytical samples were taken during installation of MW06; three were also taken during the installation of MW07 and MW08. Four analytical samples were collected during the installation of MW09. Depths below ground surface for these samples are provided in Table 4-6. Soil was submitted to the project laboratory for DRO, RRO, VOCs, PCBs, pesticides, total metals, and PAHs analyses. Analytical results are provided in Table 4-6. The PCB Arochlor 1260 was noted to exceed the ADEC cleanup level in the surface soil sample collected at MW06. Arsenic was detected above the cleanup level in all soil samples, however all detections are within background levels for arsenic in sediment and soil at this site (Section 5.2.4 and Table 5-6 of this report). No other cleanup level exceedences were noted. Complete analytical results can be found in Appendix E.

4.1.10 Monitoring Well Development

Following well installation, all LF005 wells were developed using a disposable bailer following procedures outlined in the project work plan (Paug-Vik, 2004a). Both wells were purged three times using the surge/purge technique described in Appendix A of the project Work Plan (Paug-Vik, 2004a). Well development forms are provided in Appendix D of this report.

4.1.11 Groundwater Sampling

Twenty-four hours after development, the monitoring wells were purged and sampled. Three well volumes were removed during purging. Groundwater parameters were measured after each well volume to ensure stabilization before sampling, as described in the 2004 work plan (Paug-Vik, 2004a). Final readings are presented in Table 4-7, below. Groundwater Sample Data Sheets are located in Appendix D.

Additionally, five previously installed wells (DOWL, 2001) at LF005 were sampled during the 2004 RI field effort. These wells were purged following the procedure described above prior to sampling. Groundwater parameters were measured after each purge volume, and final readings are reported in Table 4-7.

Table 4-7: Groundwater Parameters for LF005

Sample ID	pH	Conductivity (µS)	Temp (^oC)	ORP (mV)	Dissolved O_2 (mg/L)	TDS (ppm)
04RILF005-MW06-01WG	6.2	300	6.2	1	2.84	290
04RILF005-MW07-01WG	6.4	180	11.3	-1	1.88	170
04RILF005-MW08-01WG	6.2	50	17.2	174	3.49	50
04RILF005-MW09-01WG	7.9	120	4.3	213	11.75	110
04RILF005-AP01-01WG	6.7	140	6.8	34	NM	120
04RILF005-AP02-01WG	7.6	420	12.0	285	NM	390
04RILF005-AP03-01WG	6.5	70	12.5	60	NM	60
04RILF005-AP04-01WG	5.9	50	7.7	293	NM	40
04RILF005-AP05-01WG	5.9	140	9.1	270	NM	100

Notes
µS - Microsiemens
oC – Degrees Celsius
mV - Milivolts
mg/L – Milligrams per liter
ppm – Parts per million
NM – Not measured

Groundwater samples from newly installed monitoring wells were shipped to the project laboratory for GRO, DRO, RRO, VOCs, PCBs, pesticides, dissolved metals, and PAHs analyses. One duplicate groundwater sample was collected from the 2004 monitoring well MW07. Samples from the monitoring wells installed in 1998 were submitted for GRO, DRO, RRO, VOCs, and dissolved metals analyses only. Table 4-8 summarizes analytical results for these samples. Complete laboratory results can be found in Appendix E. Complete analytical data packages are provided in Appendix F.

Groundwater samples were compared to 18 AAC 75, Table C Groundwater Cleanup Levels (ADEC, 2004a).

Table 4-8: LF005 Groundwater Analytical Results Summary

Sample Location	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	VOCs (mg/L)	PCBs (mg/L)	Pesticides (mg/L)	Metals (mg/L)	PAHs (mg/L)
MW06	0.0164 F VB, VJ	0.118 VJ	0.924 VJ, VR	BCL	All ND	BCL	BCL	All ND
MW07	0.0102 F VJ, VB	0.136 VJ	0.881 VJ, VR	All ND	All ND	BCL	BCL	All ND
MW07 (DUP)	0.0103 F VB, VJ	0.175 VJ	**1.16 VJ, VR**	All ND	All ND	All ND	BCL	NS
MW08	ND	ND	ND	All ND	All ND	All ND	BCL	NS
MW09	0.013 F VB	0.128 F VB	NS	BCL	All ND	All ND	BCL	All ND
AP01	0.123	0.275F VB	ND	BCL	NS	NS	BCL	NS
AP02	0.0107 F	ND	ND	BCL	NS	NS	BCL	NS
AP03	0.013 F	ND	ND	BCL	NS	NS	BCL	NS
AP04	0.0135 F	ND	ND	All ND	NS	NS	BCL	NS
AP05	0.00988 F	ND	0.244	All ND	NS	NS	BCL	NS
Cleanup Level	*1.3*	*1.5*	*1.1*	*Varies*	*0.0005*	*Varies*	*Varies*	*Varies*

Notes
Cleanup Level – ADEC 18 AAC 75 Table C.
DRO – Diesel Range Organics
RRO – Residual Range Organics
GRO – Gasoline Range Organics
VOCs – Volatile Organic Compounds
PCBs – Polychlorinated Biphenyls
PAHs – Polynuclear Aromatic Hydrocarbons
RCRA Metals –Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver
mg/L – Milligrams per liter
BOLD font indicates cleanup level exceedence.
ND – Analyte was not detected above laboratory method detection limits
NS – Analyte was not sampled for.
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
B – The analyte was found in the associated blank, as well as in the project sample.
R – The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

There were no cleanup level exceedences for GRO, DRO, VOCs, PAHs, PCBs, Pesticides, or the RCRA metals.

The RRO concentration for the duplicate sample collected from MW07 exceeded the ADEC groundwater cleanup level of 1.1 mg/L. This exceedence is shown on Figure 4-3. The surrogate spike compound was not added to any of the blanks, QC samples, or project samples for RRO, thus all project groundwater samples for site LF005 were flagged "VR" for RRO analysis.

The overall calculated completeness for this project was greater than 99 percent. Holding times and cooler temperatures were within QA/QC acceptance criteria. The method blank and trip blank samples contained GRO concentrations greater than the MDL, but less than the RL. Associated project samples were flagged "VB" during the data review process. DRO was found in the method blank samples as well at levels higher than the MDL, but below the RL. Project sample results within five times the method blank contamination were flagged "VB."

4.1.12 Groundwater Flow and Gradient at LF005

Well locations, relative elevations of monitoring wells, and depth to water measurements were determined in order to calculate groundwater flow direction and gradient at this site.

Well locations were measured using a hand-held tape measure. Distances to wells from identified landmarks were recorded.

Relative elevations were measured with a standard survey rod and level. Monitoring well MW12 at Lower Camp site SS004 was used as a benchmark and was given an elevation of 100.00 feet. Based on the newly established benchmark, top-of-casing (TOC) elevations were determined for all wells. TOC measurement points were marked with a black permanent marker to maintain consistent depth-to-water (DTW) measurements in the future.

Relative groundwater elevations were calculated by subtracting the DTW from the TOC elevations and are presented in Table 4-9 below. Groundwater elevations are plotted on Figure 4-4. Groundwater contour lines were drawn based on these relative elevations.

Table 4-9: Relative Groundwater Elevations at LF005

Monitoring Well	TOC Elevation (feet)	DTW (feet)	Total Depth (feet)	Groundwater Elevation (feet)
MW06	65.08	9.72	15.01	55.36
MW07	65.82	6.15	10.9	59.67
MW08	72.86	8.5	11.5	64.36
MW09	74.57	26.25	29.99	48.32
AP01	59.98	7.77	14.70	52.21
AP02	71.72	23.52	27.29	48.20
AP03	70.18	6.94	14.01	63.24
AP04	71.87	8.98	14.52	62.89
AP05	65.00	8.58	22.03	56.42

It is hypothesized that an aquifer is present at approximately 25 feet bgs at LF005, and that groundwater encountered at shallower depths is the result of a localized perched aquifer which is in communication with the adjacent beaver pond. Groundwater gradient at LF005 is difficult to measure due to this perched aquifer. Data collected from adjacent sites SS002, SS003, and SS004 indicate a groundwater gradient of 0.03 feet/feet with a north to northwest groundwater flow direction. Given this data and data collected from Site LF005, it is likely that the deeper aquifer encountered at LF005 is part of the regional groundwater system encountered at Sites SS002, SS003, and SS004 and also has a flow direction of north to northwest. Localized perched groundwater flow direction is thought to generally follow topography, but may be influenced seasonally during the wettest times of the year. The general flow direction for perched groundwater is thought to be to the west and northwest.

4.1.13 Investigation-Derived Waste Handling

Minimal IDW was generated during site sampling activities. Sampling gloves, disposable scoops, and other miscellaneous items were used and disposed of during this sampling event.

All IDW was collected for this project. The IDW was disposed of and eventually burned in the on-site SmartAsh® burner.

Soil cuttings generated during well installation at LF005 were collected in supersacks® and stored on-site pending receipt of analytical results. All of the supersacks were clearly labeled with the well ID, the date of containerization, and contact information. These supersacks® were placed in a connex on-site for winter storage. The soils from MW07, MW08, and MW09 were shown to have no contamination that exceeded ADEC

cleanup levels. These soils will be returned to their original well locations in the summer of 2005. The soil from MW06 exceeded the ADEC cleanup level for PCBs. This soil will be included in the PCB-contaminated soil removal project and will be disposed of off-site.

4.1.14 Landfill Cap Repair

The existing landfill cap was repaired on July 26 through July 29, 2004. Iliamna Lake Contractors was the subcontractor who completed this work. A silt fence was installed along the northern perimeter of the landfill. Debris was collected and placed in the on-site Construction and Demolition (C&D) landfill. Approximately 3,600 cubic yards of gravel from the northwest borrow source was used to repair the cap. The landfill was re-graded and seeded. LF005 was inspected on a weekly basis and after heavy rainfall events for erosional features, per requirements in the SWPPP. Copies of weekly Landfill Inspection forms can be found in Appendix I.

4.2 WORK PLAN DEVIATIONS

Two deviations from the project Work Plan were noted during the field effort for LF005.

- The peristaltic pump was not functioning at surface water/sediment sample location STR05WS/STR05SE and thus we were unable to filter the sample for dissolved metals analysis. The sample was submitted to the project laboratory for total metals analysis instead and the malfunction was noted on the Chain-of-Custody form.
- The groundwater sample from monitoring well MW09 was not submitted for RRO analysis due to an error on the Chain-of-Custody form.

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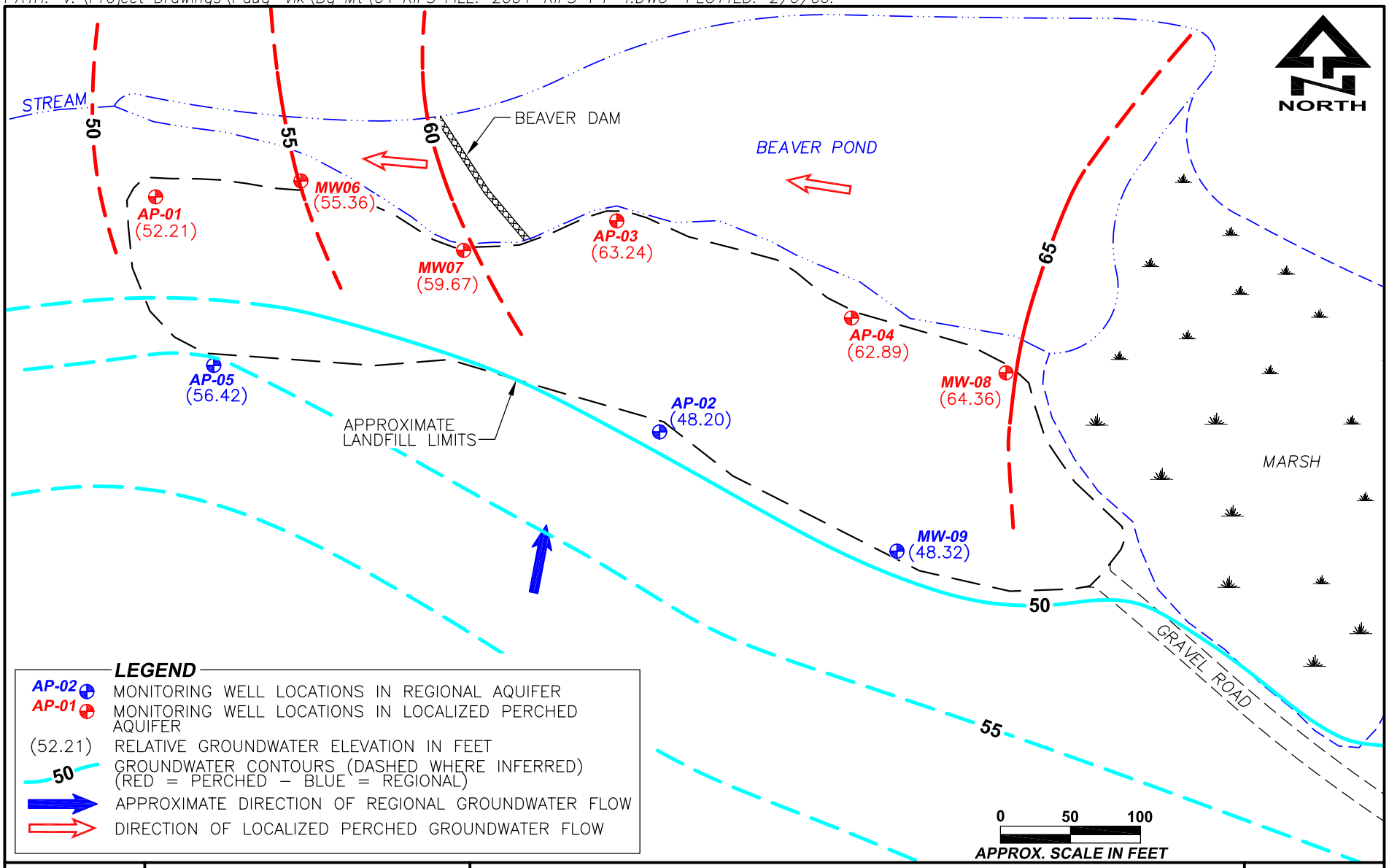

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611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON
ELMENDORF AFB, ALASKA

FORMER LANDFILL AREA (LF005) GROUNDWATER FLOW AND GRADIENT

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
4-4

4.3 RI FINDINGS – LF005

This section presents the findings from the field investigations at the Former Lower Camp Landfill area, LF005. Field observations, analytical results, and estimated volume and extent of contamination are discussed in the following sections.

4.3.1 Data Evaluation Approach

Field observations and analytical data obtained during 2004 were compared with the DQOs specified in Section 1.5 of this report to identify areas of contamination.

Discussion of analytical results is limited to specific analytes detected. Additional information on analytical method detection limits (sensitivity), QC samples (other than field duplicates), precision and accuracy calculations, and evaluation of data quality are described in the analytical data QAR included as Appendix H. A complete list of analytical results is presented in Appendix E.

4.3.2 Surface Water

There were no PCBs or VOCs detected in the surface water at LF005. Low-level detections of dissolved metals, pesticides, and PAHs were compared to ADEC criteria (18 AAC 70, ADEC, 2003b) and found to be below criteria in all cases.

4.3.3 Sediment

Pesticides and VOCs were not detected in any of the sediment samples collected at LF005. The PCB Arochlor-1260 was detected at all sample locations. Two detections at BP02SE and BP04SE exceeded the TEL (NOAA, 1999), but did not exceed the PEL (NOAA, 1999).

The PAH benzo(ghi) perylene was detected in two of the sediment samples at LF005. Both detections were below the UET listed in the NOAA SQuiRTS (NOAA, 1999).

There were several detections of metals in all of the sediment samples collected at LF005. Four detections of the metal arsenic exceeded the TEL, but did not exceed the PEL listed in the NOAA SQuiRTS (NOAA, 1999). These detections were within established background levels for arsenic at the Big Mountain site. There were no other criteria exceedences for metals detections.

Sediment contamination at the LF005 site is limited to PCBs. While PCBs were detected in sediment at all LF005 sampling locations, the TEL exceedences occurred on the southeastern and western edges of the beaver pond located to the north of the former Lower Camp landfill area.

4.3.4 Soil

No detections of DRO, RRO, VOCs, Pesticides, and PAHs in the surface and subsurface soil samples collected at LF005 exceeded ADEC cleanup levels (ADEC, 2004a). The metal arsenic was detected in all surface and subsurface soil samples at levels exceeding the ADEC cleanup level of 2.0 mg/Kg. However, these detections are within background concentrations for arsenic in sediments and soil for the Big Mountain site as shown in the discussion provided in Section 5.2.4 of this report.

The PCB Arochlor-1260 was detected above the ADEC cleanup level of 1.0 mg/Kg in two surface soil samples, MW06-01 and its duplicate sample (1.53 mg/Kg and 2.19 mg/Kg) respectively.

Soil contamination at LF005 appears to be limited to PCB contamination in one area, at surface depth. The soil in this area consists of sandy, gravelly silt with minimal organic matter.

4.3.5 Groundwater

There were no detections of GRO, DRO, VOCs, PCBs, PAHs, or metals in groundwater at LF005 that exceeded cleanup levels provided in 18 AAC 75 (ADEC, 2004a). The duplicate sample collected at MW07 had an RRO concentration that exceeded the ADEC cleanup level of 1.1 mg/Kg. No other exceedences for RRO were noted in any of the groundwater samples collected.

The primary and duplicate samples collected at well AP-02 during the 1998 RI/FS (DOWL, 2001) showed cleanup level exceedences for the VOC compounds 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 1,2,4-Trimethylbenzene, and 1,3,5-Trimethylbenzene.

4.3.6 Conceptual Site Model

Potential human receptors at LF005 were evaluated as part of this study. The resulting exposure scenarios are listed below:

- Recreational & Subsistence Exposure Scenario (short-term visits by fishermen, hunters, and recreational users).
- Industrial Exposure Scenario (short-term visits by site workers and camp support staff during investigation and cleanup efforts).

These following potential exposure scenarios were considered complete at the site:

- Inhalation of dust-borne COPCs in surface soils.

- Ingestion of and dermal contact with soil-borne COPCs in surface soils.
- Bioaccumulation of COPCs (There is a complete exposure pathway to biota. PCBs and metals are present in surface soils and may bioaccumulate in local flora and fauna).
- Ingestion and dermal contact with COPCs in surface water.
- Ingestion and dermal contact with COPCs in groundwater.

Free-phase liquid plume and mobile free-liquid transport were determined to not be potential contaminant sources or transport mechanisms at this site.

Terrestrial animals and humans may be directly exposed to contaminants in surface soils, surface water, sediment, and groundwater at the facility via incidental ingestion, inhalation, or dermal contact.

4.4 RI SUMMARY AND CONCLUSIONS

Surface water adjacent to LF005 does not appear to be impacted by the former landfill activities. Soil contamination is limited to PCBs and was found at surface depth at one location. PCB contamination was also noted in sediments adjacent to LF005, at two sample locations. Groundwater contamination at LF005 was detected during the 2004 RI effort. Cleanup levels for RRO were exceeded in one groundwater sample at this site. However, these results were flagged "VR" during the data review process as discussed in previous sections. Previous RI findings indicate exceedences for several VOCs in groundwater as well. Some low-level concentrations of fuels (GRO, DRO, and RRO), PAHs, VOCs, and pesticides were found at various sampling sites, but did not exceed cleanup levels or screening criteria.

4.5 SELECTED REMEDIAL ACTION FOR LF005

LF005 is currently managed under an Interim ROD (Paug-Vik, 2002a) for monitoring groundwater, surface water, sediment, and evaluation of ecological risks. This ROD specified the installation of additional monitoring wells to evaluate groundwater impacts and to determine final actions for groundwater at LF005. These additional monitoring wells were installed during the 2004 RI.

Since contamination at LF005 was limited to specific locations and is not widespread, contaminated soils will not be removed from this site. Instead, Monitored Natural Attenuation (MNA) is the selected remedial action at this site. Long-term monitoring of groundwater, surface water, and sediment will continue for a duration of five years. A five-year review of the monitoring results from will be conducted at the end of that time frame, and the Interim ROD will be revisited as part of the review.

5 ECOLOGICAL RISK ASSESSMENT AND BACKGROUND STUDY

5.1 SCOPE AND PURPOSE – ERA AND BACKGROUND STUDY

The 2004 scope for an ERA and background study included establishing baseline groundwater, surface water, and soil/sediment quality for the Lower Camp sites, as well as to screen site data to enable further refinement of contaminants of potential concern (COPCs).

The purpose of the 2004 ERA and background study was to:

- Assess baseline risk from contamination in groundwater, surface water, soil, and sediment.
- Establish background groundwater, surface water, and soil/sediment quality.
- Evaluate potential food chain exposure from contaminants to human receptors.

5.1.1 Investigation Area

The two IRP sites under consideration for the ERA are ST001 and LF005. Detailed descriptions of these sites have been provided in Sections 3 and 4 of this report. Figure 1-3 shows the locations of these sites.

Petroleum hydrocarbon contamination above soil cleanup levels is present at ST001. PCB contamination above soil cleanup levels was identified at one location at LF005. Further characterization of contamination in surface water, and sediment at ST001 and LF005 is necessary to assess baseline risk.

Results of previous characterization activities at these sites are summarized below:

- DRO were detected at concentrations equal to or greater than groundwater cleanup levels in samples from ST001.
- Contaminants were detected in groundwater at LF005 at levels above cleanup levels.
- No free product was found at either of the sites.
- A human health risk evaluation concluded that potential carcinogenic and noncarcinogenic risks above threshold levels may be present due to exposure to metals and 1,4-dichlorobenzene in groundwater at LF005.
- In a sediment sample from ST001, chromium was detected at a concentration above its ecological benchmark screening level.
- Contaminants were detected above ecological benchmark values in various Ecological Assessment (EA) surface water and sediment samples.

5.1.2 Investigative Methodologies

Field sampling activities were conducted in accordance with the procedures described in Appendix A of the project Work Plan (Paug-Vik, 2004a) and in the Work Plan for Ecological Risk Assessment (Paug-Vik/OASIS, 2004), except as noted in Section 5.3 of this report, which describes field deviations to the work plan. A site reconnaissance was performed prior to sampling to identify the best sampling locations. Surface water and sediment sampling locations in the adjacent wetlands were chosen in both upgradient and downgradient areas. The groundwater monitoring location was chosen to upgradient of other groundwater monitoring locations at Lower Camp. Background soil sample locations were chosen in areas upgradient of ST001 and LF005. Sample locations are shown on Figure 5-1.

5.1.3 Investigative Approach

Twenty co-located surface water and sediment samples were collected from the adjacent upgradient and downgradient wetland areas and from the down gradient drainage areas as part of the 2004 ERA. The background study involved collecting seven upgradient soil/sediment samples and one upgradient surface water sample. Additionally, a background monitoring well was installed at an upgradient location to establish background metals concentrations in groundwater for the lower Camp Area.

Six surface water/sediment sample pairs were collected at site ST001 as part of the ERA. The results of these samples are presented in Section 3.1 of this report. Five surface water/sediment pairs were collected at LF005 for the ERA. These sample results are presented and discussed in Section 4.1 of this report.

5.1.4 Field Documentation

Field documentation was an important part of the field effort. Field documentation was performed in accordance with the work plan (Paug-Vik, 2004a). Copies of all field notes and Daily Activity Reports are included in Appendices A and B. Site photographs that document the 2004 ERA and background study efforts are provided in Appendix C.

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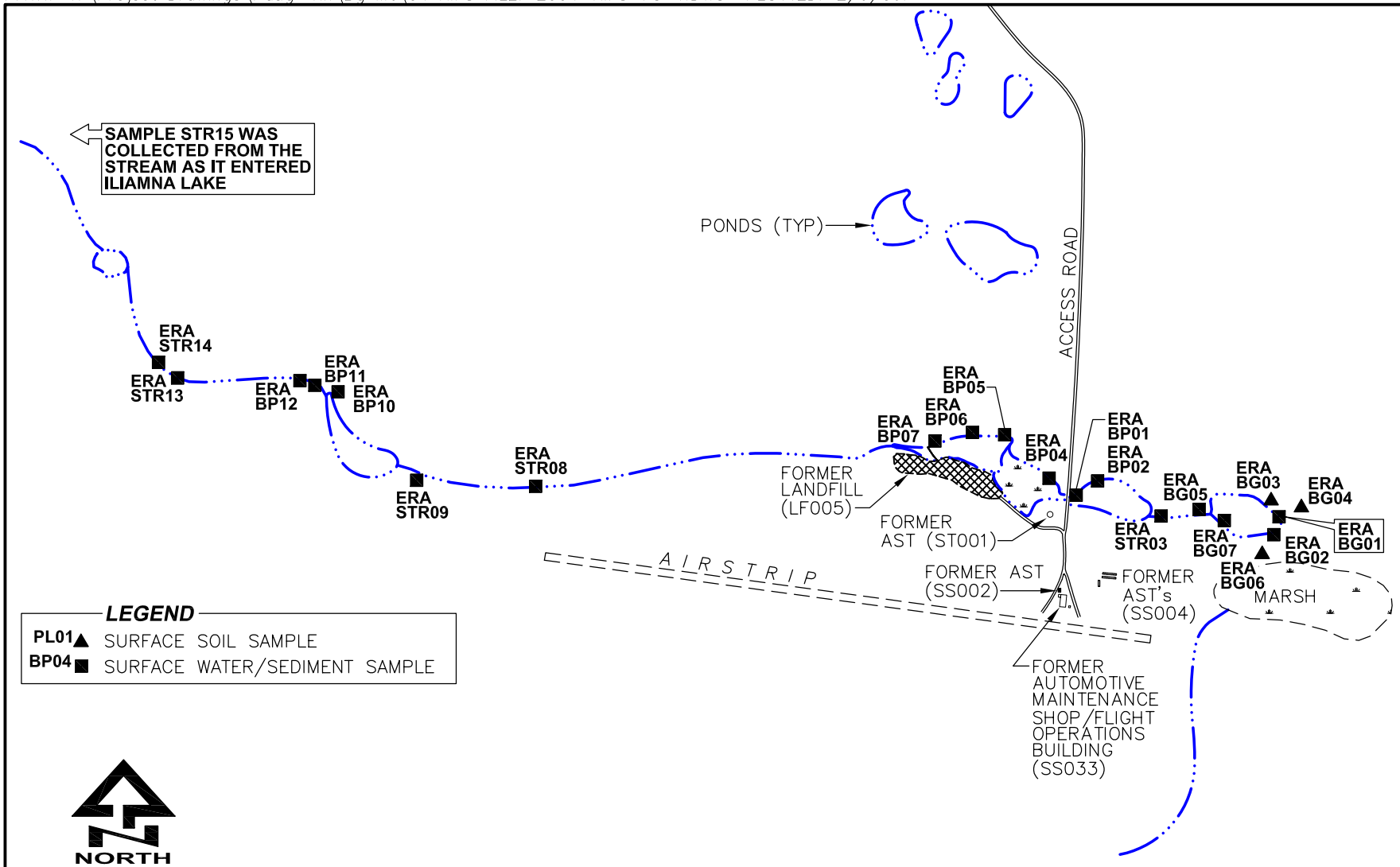

DATE FEB. 2006 CHKD T.E.O. DRAWN OASIS-PDC PROJ. NO 4119-11	611TH AIR SUPPORT GROUP 611TH CIVIL ENGINEER SQUADRON ELMENDORF AFB, ALASKA	**ERA AND BACKGROUND STUDY SAMPLE LOCATIONS** 2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY BIG MOUNTAIN RADIO RELAY STATION, ALASKA	FIGURE **5-1**

5.2 2004 ERA AND BACKGROUND STUDY FIELD ACTIVITIES AND SAMPLE RESULTS

ERA and background study field activities were performed from July 10 to August 2, 2004. The buddy system was used while sampling at all locations. The sampling team carried an emergency whistle and radio, as well as a first aid kit during all sampling activities.

5.2.1 Surface Water and Sediment Sampling Locations

Surface water and sediment sample pairs collected as part of the ERA were taken from fifteen locations in the wetlands adjacent to the ST001 and LF005 sites as well as from downgradient areas. Three sediment samples and one co-located surface water/sediment sample were collected as part of the background study. ERA sampling locations are displayed on Figure 5-1. Figures 3-1 and 4-1 of this report show the additional sample locations for the six surface water/sediment sample pairs collected at ST001 and the five surface water/sediment sample pairs collected at LF005. GPS coordinates and sample location descriptions for the ERA, ST001, LF005, and background study surface water/sediment samples are provided in Table 5-1.

Table 5-1: Surface Water and Sediment Sample Locations and Description

Location	Latitude	Longitude	Elev. (ft amsl)	Description
ST001-STR01	59.36400	155.25218	680	Unnamed stream west of culvert at Upper Camp Rd.
ST001-STR02	59.36410	155.25239	675	Downgradient of STR01, the same unnamed stream.
ST001-BP03	59.36409	155.25248	670	Downgradient of STR01, as stream flows into beaver pond.
ST001-BP04	59.36411	155.25333	664	Approx. 50 feet to the west of the containment berm, edge of beaver pond.
ST001-BP05	59.36393	155.25240	656	Ponded water approx. 5 feet from northern edge of containment berm.
ST001-BP07	59.36387	155.25294	651	Ponded water approx. 10 feet from the northwestern edge of berm.
LF005-BP02	59.36449	155.25454	665	Southeast edge of beaver pond adjacent to LF005.
LF005-BP01	59.36451	155.25466	664	Edge of beaver pond located east of LF005, across the dam from BP02.
LF005-BP03	59.36472	155.25546	666	Southern edge of beaver pond adjacent to LF005.
LF005-BP04	59.36494	155.25669	660	Center of beaver dam on western edge of pond adjacent to LF005.
LF005-STR05	59.36499	155.25740	649	Stream down gradient of beaver pond, northwest of LF005.
ERA-BP01	59.36417	155.25171	597	Beaver pond upgradient of ST001, across road to Upper Camp.
ERA-BP02	59.36422	155.25090	632	Beaver pond upgradient of ST001, northern edge of pond.
ERA-STR03	59.36376	155.24883	638	Stream flowing into beaver pond upgradient of ST001.
ERA-BP04	59.36429	155.25225	620	Stream downgradient of road to Upper Camp, adjacent to ST001.
ERA-BP05	59.36487	155.25378	635	Northeastern edge of beaver pond adjacent to LF005.
ERA-BP06	59.36496	155.25553	634	Northern edge of beaver pond adjacent to LF005.
ERA-BP07	59.36507	155.25674	630	Northwestern edge of beaver pond adjacent to LF005.
ERA-STR08	59.36378	155.26987	NM	Stream downgradient of LF005, adjacent to road to Barge Landing.
ERA-BP10	59.36523	155.27802	NM	Stream downgradient of LF005, at culvert on road to Barge Landing.
ERA-BP11	59.36533	155.27839	NM	Stream downgradient, western side of culvert on road to Barge Landing.
ERA-STR09	59.36467	155.27729	NM	Edge of beaver pond downgradient from LF005.
ERA-STR15	59.37714	155.32787	75	Downgradient stream at it entered Iliamna Lake.
ERA-STR14	59.36823	155.28648	493	Stream upgradient of Iliamna Lake and STR15.
ERA-STR13	59.36817	155.28591	504	Stream at culvert along road to Barge Landing.
ERA-BP12	59.36539	155.27851	NM	Stream downgradient of BP10 and BP11.
BG02	59.36334	155.24539	618	Beaver pond upgradient of Lower Camp, southeastern edge.
BG01	59.36361	155.24483	615	Beaver pond upgradient of Lower Camp, northeastern edge.
BG05	59.36404	155.24483	645	Stream upgradient of Lower Camp, flowing out of beaver pond (west).
BG07	59.36361	155.24622	659	Beaver pond upgradient of Lower Camp, western edge.

Notes:
GPS readings were taken on the Universal Transverse Mercator (UTM) coordinate system using the North American Datum of 1927 (NAD27).
ST001 – Sample was collected as part of the sampling activities at ST001.
LF005 – Sample was collected as part of the sampling activities at LF005.
ERA – Sample was collected as part of the ERA sampling activities.
BG – Sample was collected as part of the background study activities.

5.2.2 Surface Water Results

Water quality parameters were measured at each surface water sampling location. Water quality measurements included temperature, pH, conductivity, and dissolved oxygen. Results for ERA and background surface water samples are presented in Table 5-2, below. Water quality data for samples ST001-STR01, ST001-STR02, ST001-BP03, ST001-BP04, ST001-BP05, and ST001-BP07 is reported in Section 3.1.6 and in Table 3-2 of this report. Data for samples LF005-BP02, LF005-BP01, LF005-BP03, LF005-BP04, and LF005-STR05 is reported in Section 4.1.6 and in Table 4-2 of this report. Surface Water Data Sheets are located in Appendix D

Table 5-2: Surface Water Quality Parameters

Sample Name	Temperature (^{o}C)	pH	Conductivity (µS)	Dissolved Oxygen (mg/L)
ERA-BP01	20.2	7.5	80	8.65
ERA-BP02	20.6	7.6	80	8.60
ERA-STR03	16.9	7.7	80	8.17
ERA-BP04	17.3	7.1	80	7.40
ERA-BP05	16.8	8.0	70	9.07
ERA-BP06	19.6	7.7	80	8.45
ERA-BP07	19.1	7.7	80	8.45
ERA-STR08	13.9	7.3	70	8.16
ERA-BP10	13.8	7.5	70	10.44
ERA-BP11	15.0	7.7	80	9.98
ERA-STR09	14.4	7.5	70	9.80
ERA-STR15	9.1	7.7	70	11.5
ERA-STR14	15.1	7.8	70	9.65
ERA-STR13	15.2	7.8	70	9.75
ERA-BP12	16.4	7.9	70	9.86
BG01	17.2	7.5	70	9.16

Notes:
(^{o}C) – degrees in Celsius
mg/L – milligrams per liter
µS - microsiemens

Sixteen primary samples and one duplicate sample were collected from surface water at small streams and ponded areas using new laboratory-supplied sample bottles. Samples were collected under the surface of the water with a minimum of sediment disturbance, as described in the work plan (Paug-Vik, 2004a). ERA and background

study surface water samples were collected and shipped to Anchorage for laboratory analysis of the dissolved metals arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Surface water samples from Site ST001, (ST001-STR01, ST001-STR02, ST001-BP03, ST001-BP04, ST001-BP05, and ST001-BP07), were also evaluated as part of the ERA. These results are presented in Section 3.1.6 and Table 3-3 of this report. LF005 surface water samples (LF005-BP02, LF005-BP01, LF005-BP03, LF005-BP04, and LF005-STR05) have been evaluated in the ERA as well. A discussion of these results is provided in Section 4.1.6 and in Table 4-3 of this report.

Laboratory analysis summary reports can be found in Appendix E. Complete analytical data packages are found in Appendix F. Results of ERA and background study surface water samples, minus those from ST001 and LF005, are summarized in Table 5-3 below

Table 5-3: ERA and Background Study Surface Water Analytical Results Summary

	Dissolved Metals (mg/L)							
Sample Location	**Arsenic**	**Barium**	**Cadmium**	**Chromium**	**Lead**	**Mercury**	**Selenium**	**Silver**
ERA-BP01	0.000720 F	0.00374 F	ND	0.000110 F	ND	ND	0.000320 F	ND
ERA-BP01 (DUP)	0.000770 F	0.00348 F	ND	ND	ND	ND	ND	ND
ERA-BP02	0.000690 F	0.00334 F	ND	0.000150 F	ND	ND	ND	ND
ERA-STR03	0.000610 F	0.00298 F	ND	0.000140 F	ND	ND	ND	ND
ERA-BP04	0.00106	0.00360 F	ND	0.000330 F	ND	ND	0.0006 F	**0.00018 F**
ERA-BP04 (DUP)	0.000730 F	0.00362 F	ND	0.000140 F	ND	ND	ND	ND
ERA-BP05	0.000850 F	0.00359 F	ND	0.000120 F	ND	ND	ND	ND
ERA-BP06	0.000780 F	0.00331 F	ND	0.000130 F	ND	ND	ND	ND
ERA-BP07	0.000740 F	0.00442 F	ND	0.000130 F	ND	ND	ND	ND
ERA-STR08	0.000430 F	0.00287 F	ND	0.000100 F	0.0000800 F	ND	ND	ND
ERA-BP10	0.000430 F	0.00303 F	ND	0.0000900 F	0.000170 F	ND	ND	ND
ERA-BP11	0.000370 F	0.00295 F	ND	0.000100 F	0.000100 F	ND	ND	ND
ERA-STR09	0.000450 F	0.00302 F	ND	0.0000900 F	0.000170 F	ND	ND	ND
ERA-STR15	0.00158	0.00124 F	ND	0.000180 F	0.0000900 F	ND	ND	ND
ERA-STR14	0.000400 F	0.00217 F	ND	0.000100 F	ND	ND	ND	ND
ERA-STR13	0.000310 F	0.00224 F	ND	0.000100 F	0.0000900 F	ND	ND	ND
ERA-BP12	0.000310 F	0.00283 F	ND	0.000100 F	0.000110 F	ND	ND	ND
BG01	0.000520 F	0.00253 F	ND	0.000120 F	ND	ND	ND	ND
Criteria	*0.05*	*2.0*	*0.005*	*0.1*	*0.015*[1]	*0.002*	*0.05*	*0.00012*[2]

Notes:

Criteria taken from ADEC 18 AAC 70, Water Quality Criteria, unless otherwise noted (ADEC, 2003b).

1. Criteria taken from ADEC18 AAC 75, Table C, Groundwater Cleanup Levels (ADEC, 2004a).

2. Criteria taken from NOAA Screening Quick Reference Tables, (NOAA, 1999)

Mg/L – Milligrams per Liter

ND – Analyte was not detected

BOLD – Indicates criteria exceedence

F – The analyte was positively identified but the associated numerical value is below the reporting limit.

Metals detections in surface water were compared to criteria found in 18 AAC 70 (ADEC, 2003b) or to criteria found in the NOAA SQuiRTs (NOAA, 1999). There were no cadmium or mercury detections in any of the surface water samples collected for the ERA and the background study. Lead detections were compared to cleanup levels found in 18 AAC 75 (ADEC, 2004a), as there are no criteria for lead in surface water. Arsenic and lead were detected in the method blank above the MDL, but below the RL on some work orders. Positive sample results for these analytes were greater than five times the blank concentration and did not require qualification.

Silver was detected at ERA-BP04 at a concentration of 0.00018 mg/L. There are criteria for silver in 18 AAC 70 and this detection was compared to criteria in NOAA SQuiRTs. The detection at ERA-BP04 exceeded the chronic effect criteria of 0.00012 mg/L, yet did not exceed the acute effect criteria of 0.0017 mg/L. No other detections of metals in surface water exceeded water quality criteria.

The computed completeness for this project was 99 percent. All surface water samples for the ERA and background study were received at the project laboratory within the recommended temperature range with the exception of samples for work order B4G0665 in which the average cooler temperature was 7.7 degrees Celsius. The analyses for metals are not significantly affected by the slight temperature difference, and thus further qualification was unnecessary. Holding times for all surface water samples were met.

5.2.3 Sediment Sample Results

Nineteen primary samples and two duplicate samples were collected from sediments (16 from co-located surface water sample locations and three additional sediment sample locations) (see Table 5-1). All sediment was collected form the upper three-inches of sediment using a disposable sample scoop. Information including material type, odor, depth, and location were recorded on the Sediment Sample Sheet (Appendix C).

Sediment samples collected as part of the ERA were sent to the project laboratory for analysis of total metals, PCBs, and Pesticides. One sediment sample, collected at location ERA-STR08, was submitted for VOC analysis as well to assess potential VOC contamination in that area. The sediment samples for the background study were submitted for PAHs, PCBs, Pesticides, and total metals. Complete results are provided in Appendix E. A summary of the results for the ERA and background study sediment samples can be found in Table 5-4 below. Sediment samples collected at Site ST001 and LF005 were also evaluated in the ERA. Results from the ST001 sediment samples are presented in Section 3.1.7 and in Table 3-4 of this report. Results for the LF005 sediment samples are reported in Section 4.1.7 and in Table 4-4 of this report.

Table 5-4: ERA and Background Sediment Sample Analytical Results Summary

Sampling Location	PAHs (mg/Kg)	Metals (mg/Kg)	PCBs (mg/Kg)	Pesticides (mg/Kg)	VOCs (mg/Kg)
ERA-BP01	NS	BTEL	BTEL	BTEL	NS
ERA-BP01 (DUP)	NS	**As – 8.24**	BTEL	BTEL	NS
ERA-BP02	NS	BTEL	BTEL	BTEL	NS
ERA-STR03	NS	BTEL	ND	BTEL	NS
ERA-BP04	NS	BTEL	BTEL	BTEL	NS
ERA-BP04 (DUP)	NS	BTEL	BTEL	**4,4'-DDE – 0.00366**	NS
ERA-BP05	NS	BTEL	**Arochlor-1260 – 0.0713 F**	**4,4'-DDE – 0.00858 F**	NS
ERA-BP06	NS	BTEL	BTEL	BTEL	NS
ERA-BP07	NS	**As – 7.52**	BTEL	BTEL	NS
ERA-STR08	NS	**As – 17.10**	BTEL	BTEL	**Acetone – 2.02 VR** **Methylene Chloride – 2.23 VR**
ERA-BP10	NS	BTEL	ND	BTEL	NS
ERA-BP11	NS	BTEL	BTEL	BTEL	NS
ERA-STR09	NS	**As – 11.50**	BTEL	**4,4'-DDD – 0.00560** **4,4'-DDE – 0.00319**	NS
ERA-STR15	NS	**As – 12.60**	ND	BTEL	NS
ERA-STR14	NS	BTEL	BTEL	BTEL	NS
ERA-STR13	NS	**As – 7.18**	BTEL	BTEL	NS
ERA-BP12	NS	**As – 6.10**	**Arochlor-1260 – 0.0867**	**4,4'-DDD – 0.00505** **4,4'-DDE – 0.00167 F** **4,4'-DDT – 0.00546**	NS
BG02	BTEL	**Hg – 0.641**	BTEL	BTEL	NS
BG01	BTEL	BTEL	ND	BTEL	NS
BG05	BTEL	**As – 18.20**	BTEL	BTEL	NS
BG07	ND	BTEL	BTEL	BTEL	NS
Criteria[1]	*Varies*	*Varies*	*0.0341*	*Varies*	*Acetone – 0.0099*[2] *Methylene Chloride – 0.37*[3]

Notes:
1. Screening criteria taken from NOAA Screening Quick Reference Tables, (NOAA, 1999).
2. Screening criteria taken from USEPA Region 5, RCRA Ecological Screening Levels, (USEPA, 2003).
3. Screening Criteria taken from USEPA Toxicological Benchmarks for Screening COPCs for Effects on Sediment Associated Biota: 1997 Revision, (ORNL, 1997).

PAHs – Polynuclear Aromatic Hydrocarbons
Metals – Ag, As, Ba, Cd, Cr, Hg, Pb, and Se
PCBs – Polychlorinated Biphenyls
VOCs – Volatile Organic Compounds
mg/Kg – Milligrams per kilogram
NS – Analyte was not sampled for.
ND – Analyte was not detected.
BTEL – Below Threshold Effects Level.
BOLD – Indicates criteria exceedence.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.

PAHs were detected in three of the samples. All detections of PAHs were below screening criteria listed in the NOAA SQuiRTs (NOAA, 1999). PAH compounds were not detected in any of the method blank samples.

The PCB Arochlor-1260 was detected at several sample locations at low levels. Results at two sample locations (ERA-BP05 – 0.0713 mg/Kg and ERA-BP12 – 0.0867 mg/Kg) exceeded the TEL of 0.0341 mg/Kg in the NOAA SQuiRTs (NOAA, 1999), but were below the PEL of 0.277 mg/Kg. Arochlor 1016 and 1260 were detected in the method blank sample above the MDL but below the RL on one work order. Positive sample results within five times the blank contamination were assigned the qualifier "VB."

The VOCs acetone and methylene chloride were detected in the sample collected at ERA-STR08 at levels above ecological screening criteria. The result for acetone was compared to criteria in the USEPA Region 5 RCRA Ecological Screening Levels (USEPA, 2003). Criteria for methylene chloride was found in the ORNL Toxicological Benchmarks for Screening COPCs for Effects on Sediment Associated Biota: 1997 Revision, (ORNL, 1997). These results were flagged "VR" during the data review process to indicate that the sample was extracted past the USEPA recommended holding time for VOCs.

Metals were detected in all of the sediment samples. These detections were compared to criteria listed in the NOAA SQuiRTs (NOAA, 1999). Detections of barium and selenium were compared to cleanup levels in 18 AAC 75 (ADEC, 2004a), as there are no criteria for those metals listed in the NOAA SQuiRTs. Most of the detections of metals were below criteria. However, six detections of arsenic exceeded the TEL of 5.9 mg/Kg for arsenic, but were below the PEL of 17.0 mg/Kg (NOAA, 1999). Two detections of arsenic at sample locations ERASTR08 and BG05 (17.10 mg/Kg and 18.20 mg/Kg respectively) exceeded the PEL of 17.0 mg/Kg (NOAA, 1999). Arsenic in the sediment background samples ranged from 3.88 to 18.2 mg/Kg. These detections of arsenic in background study sediments are indicative of arsenic levels in Alaskan soils and served to further define the background levels for arsenic in the Big Mountain area.

One detection of mercury at background study location BG-02 (0.641 mg/Kg) exceeded the TEL of 0.174 mg/Kg and the PEL of 0.486 mg/Kg (NOAA, 1999). This result exceeded the UET of 0.560 mg/Kg (NOAA, 1999) as well. Arsenic, barium, lead, and selenium were detected in the method blank sample below the RL on work order B4G0439. The "VB" qualifier was assigned to associated project samples with results within five times the blank contamination.

Pesticides were detected in many of the sediment samples collected for the ERA and background study. 4,4'-DDD was detected at two sample locations (ERA-STR09 and

ERA-BP12) at levels above the TEL of 0.00354 mg/Kg, but below the PEL of 0.00851 mg/Kg (NOAA, 1999). The pesticide 4,4'-DDE was detected in four locations (ERA-BP05, ERA-BP07DUP, ERA-STR09, and ERA-BP12) at concentrations that exceeded the TEL of 0.00142 mg/Kg (NOAA, 1999). One of these detections (ERA-BP05 – 0.00858) exceeded the PEL of 0.00675 mg/Kg (NOAA, 1999) as well. This detection did not exceed the UET (0.06 mg/Kg) in the NOAA SQuiRTs (NOAA, 1999). 4,4'-DDT was detected at ERA-BP12 at a concentration of 0.00546, which exceeds the screening value of 0.0033 mg/Kg listed in USEPA Region IV guidance (USEPA, 2001), but did not exceed the UET in the NOAA SQuiRTs of 0.05 mg/Kg (NOAA, 1999). CCV recoveries for 4,4'-DDT, 4,4'-DDD, and methoxychlor were below acceptance limits in some work orders. Associated project sample results were qualified "VJ" in the data review process.

Overall, the calculated completeness for this project was 99 percent. Samples for work orders B4G0439 and B4G0530 were received at the project laboratory within the recommended temperature range. Sediment samples for work order B4G0708 were received above the recommended temperature range and all project sample results above the MDL were qualified "VJ." Holding times for all ERA and background study sediment samples met QA/QC criteria with the following exceptions.

Samples from BG01-02, BG07-02, and BP05-02 required extraction past holding times for pesticides and PCBs due to low surrogate recoveries. Pesticide and PCB results for these samples were qualified "VH" to indicate holding time exceedence.

5.2.4 Background Study Surface Soil Sampling

Surface soils were collected at three locations using disposable scoops. One duplicate surface soil sample was collected at location BG04. Figure 5-1 details the locations of these samples. Surface soil was collected as composite grab samples. Surface material was obtained from the top six inches of soil at three locations within the sample area, composited, and placed into pre-cleaned sample jars, according to procedures described in the work plan (Paug-Vik, 2004a). Copies of Soil Sample Field Data Sheets are included in Appendix C.

Table 5-5 describes the location and details for these sample locations.

Table 5-5: Background Study Surface Soil Sample Location and Description

Location	Latitude	Longitude	Approx. Elev. (ft. amsl)	Details
BG03	59.36387	155.24473	612	North of beaver pond, upgradient of Lower Camp.
BG04	59.36380	155.24430	641	Northeast of beaver pond, upgradient of Lower Camp.
BG06	59.36324	155.24578	668	South of beaver pond, upgradient of Lower Camp.

Note:
GPS readings were taken on the Universal Transverse Mercator (UTM) coordinate system using the North American Datum of 1927 (NAD27).

Soil samples were sent to the laboratory and analyzed for PCBs, pesticides, total metals, and PAHs. The duplicate sample collected at location BG04 was submitted for PAH analysis only. Complete laboratory results can be found in Appendix E. Complete analytical data packages are presented in Appendix F. Results are summarized in Table 5-6, below.

Table 5-6: Background Soil Sample Analytical Results Summary

Sample Location	PCBs (mg/Kg)	Pesticides (mg/Kg)	Metals (mg/Kg)	PAHs (mg/Kg)
BG03	ND	BCL	**Arsenic – 4.57**	ND
BG04	ND	BCL	**Arsenic– 5.49**	ND
BG04 (DUP)	NS	NS	NS	ND
BG06	BCL	BCL	**Arsenic – 3.81**	ND
Cleanup Level	*1.0*	*Varies*	*Varies*	*Varies*

Notes:
Cleanup Level - Alaska Administrative Code 18 AAC 75, Table B1 and B2, Under 40 inch zone, Migration to groundwater

PAHs - Polynuclear Aromatic Hydrocarbons

RCRA Metals – Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver

ND - Not detected above the laboratory reporting limit

mg/kg - Milligrams per kilogram

BCL – Below cleanup level

BOLD font indicates exceedence of applicable ADEC cleanup level

Analytical results were compared to 18 AAC 75, Table B1, Method Two Soil Cleanup Levels Table, under 40 inch zone, migration to groundwater (ADEC, 2004a). There were no PAHs detected in any of the background study surface soil samples collected.

The PCB Arochlor 1260 was detected in the sample at location BG-06 at a low level (0.00159 mg/Kg). This detection was three orders of magnitude below the ADEC cleanup level of 1.0 mg/Kg (ADEC, 2004a).

All pesticide detections were below cleanup levels. CCV recoveries for 4,4'-DDT, 4,4'-DDD, and methoxychlor were below acceptance limits in some work orders. Associated project sample results were qualified "VJ" in the data review process.

Arsenic was detected above the ADEC cleanup level of 2 mg/Kg in all surface soil samples collected for the background study. Detections ranged from 3.81 mg/Kg to 5.49 mg/Kg. These concentrations further refined background levels for arsenic and other metals for the Big Mountain area. All other detections of metals were below established cleanup levels.

Overall, the calculated completeness for this project was 99 percent. Samples for work orders B4G0439 and B4G0530 were received at the project laboratory within the recommended temperature range. Holding times for all ERA and background study sediment samples met QA/QC criteria.

5.2.5 Monitoring Well Installation

One monitoring well was installed at the east end of the airstrip to evaluate background metals concentrations in groundwater on July 20, 2004. The location of this well is shown on Figure 5-2. Soil samples were collected during installation for lithologic description purposes only, and were field screened. PID field screening results ranged from 0.0 to 0.2. This well was installed using a hollow stem auger drill rig. The well construction diagram is provided in Appendix G.

A discussion of groundwater flow and gradient for MW05 is included in Section 8.1.9 of this report.

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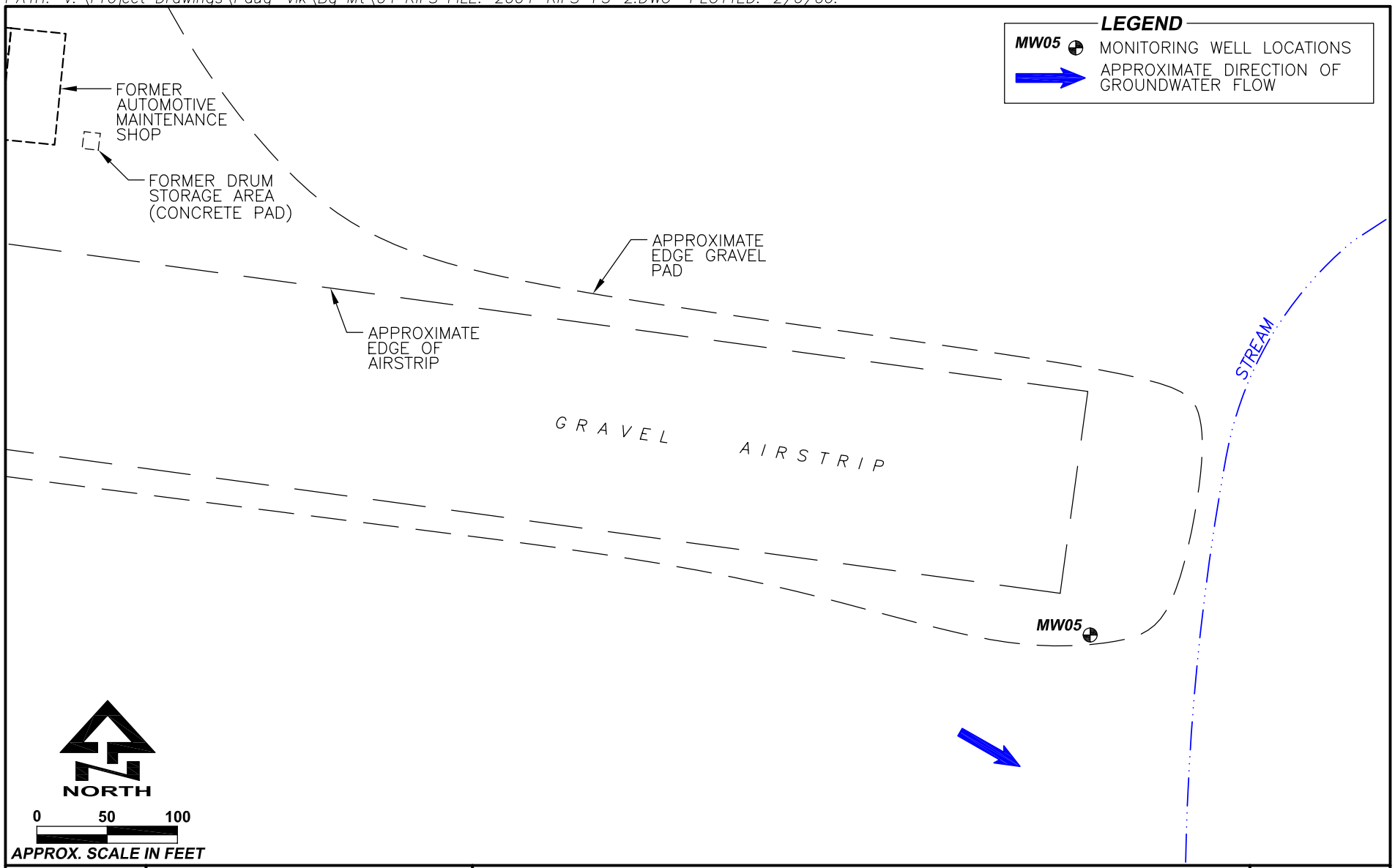

DATE FEB. 2006 CHKD T.E.O. DRAWN OASIS-PDC PROJ. NO 4119-11	611TH AIR SUPPORT GROUP 611TH CIVIL ENGINEER SQUADRON ELMENDORF AFB, ALASKA	**BACKGROUND MONITORING WELL LOCATION AT LOWER CAMP** 2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY BIG MOUNTAIN RADIO RELAY STATION, ALASKA	FIGURE **5-2**

5.2.6 Monitoring Well Development

Following well installation, MW05 was developed using a disposable bailer following procedures outlined in the project work plan (Paug-Vik, 2004a). This well was purged three times using the surge/purge technique described in Appendix A of the project Work Plan (Paug-Vik, 2004a). The well development form is provided in Appendix D of this report.

5.2.7 Groundwater Sampling

Twenty-four hours after development, the monitoring well was purged and sampled. Three well volumes were removed during purging. Groundwater parameters were measured after each well volume to ensure stabilization before sampling, as described in the 2004 work plan (Paug-Vik, 2004a). Final readings are presented in Table 5-7, below. The groundwater Sample Data Sheet is located in Appendix D.

Table 5-7: Background Well Water Quality Parameters

Sample ID	pH	Conductivity (µS)	Temp (^{o}C)	ORP (mV)	Dissolved O_2 (mg/L)	TDS (ppm)
04RIBCK-MW05-01WG	7.1	240	7.2	211	11.0	230

Notes
µS - Microsiemens
oC – Degrees Celsius
mV - Milivolts
mg/L – Milligrams per liter
ppm – Parts per million

The groundwater sample collected at MW05 was submitted to the project laboratory for dissolved metals analysis. Table 5-8 summarizes analytical results for this sample. Complete laboratory results can be found in Appendix E. Complete analytical data packages are provided in Appendix F.

Table 5-8: Background Groundwater Analytical Results Summary

Sample Location	Dissolved Metals (mg/L)							
	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
MW05	0.00016 F	0.0113	0.00014 F	0.00027 F	0.00058 F VB	ND	ND	ND
Cleanup Level	*0.05*	*2.0*	*0.005*	*0.1*	*0.015*	*0.002*	*0.05*	*0.18*

Notes:
Cleanup levels taken from ADEC 18 AAC 75, Table C, Groundwater Cleanup Levels.
mg/L – Milligrams per Liter
ND – Analyte was not detected

This groundwater sample was compared to 18 AAC 75, Table C Groundwater Cleanup Levels (ADEC, 2004a). There were no cleanup level exceedences for the RCRA metals. Barium and lead were found in the method blank sample above the MDL, but below the RL. Positive sample results were assigned the qualifier "VB" to indicate potential blank contamination.

The computed completeness for this project was 99 percent. Holding times for the groundwater sample from MW05 were met. The sample was received outside of the recommended temperature range, however data qualification was unnecessary as this did not significantly affect the analyses for metals.

5.2.8 Investigation-Derived Waste Handling

Minimal IDW was generated during site sampling activities. Sampling gloves, disposable scoops, and other miscellaneous items were used and disposed of during this sampling event.

All IDW was collected for this project. The IDW was disposed of and eventually burned in the on-site SmartAsh® burner.

Soil cuttings generated during well installation at MW05 were initially collected in a supersack. These soils were dispersed back to the ground around MW05 on July 27, 2004.

5.3 WORK PLAN DEVIATIONS

Deviations from the work plan that occurred during the sampling effort are as follows:

- The approximate elevation was not recorded at all sample locations due to mechanical error.
- PID readings of background surface soil samples were not collected as the PID was being used for field screening on a separate task for this project.

5.4 ECOLOGICAL RISK ASSESSMENT AND BACKGROUND STUDY FINDINGS

This section summarizes the findings from the 2004 ERA and background study at Lower Camp. A complete discussion of findings is provided in the separate ERA report (Paug-Vik/OASIS, 2006).

5.4.1 Data Evaluation Approach

Field observations and analytical data obtained during the 2004 ERA and background study were compared with the DQOs specified in Section 1.5 to identify potential risk and further refine background contaminant levels for the Big Mountain area.

Discussion of analytical results is limited to specific analytes detected. Additional information on analytical method detection limits (sensitivity), QC samples (other than field duplicates), precision and accuracy calculations, and evaluation of data quality are described in the analytical data QAR included as Appendix H. A complete list of analytical results is presented in Appendix E.

5.4.2 Surface Water

The majority of the dissolved metals detections in surface water samples collected as part of the ERA and of the background study were below relevant screening criteria. One detection of silver in an ERA surface water sample exceeded the chronic effect level listed in the SQuiRTs (NOAA, 1999), but did not exceed the acute effect level. There are no criteria for silver in 18 AAC 70 (ADEC, 2003b).

5.4.3 Sediment

PAHs were detected in three of the samples. All detections of PAHs were below screening criteria listed in the NOAA SQuiRTs (NOAA, 1999).

The PCB Arochlor-1260 was detected at several sample locations at low levels. Results at two sample locations (ERA-BP05 – 0.0713 mg/Kg and ERA-BP12 – 0.0867 mg/Kg) exceeded the TEL of 0.0341 mg/Kg in the NOAA SQuiRTs (NOAA, 1999), but were below the PEL of 0.277 mg/Kg.

The VOCs acetone and methylene chloride were detected in the sample collected at ERA-STR08 at levels above ecological screening criteria. The result for acetone was compared to criteria in the USEPA Region 5 RCRA Ecological Screening Levels (USEPA, 2003). Criteria for methylene chloride was found in the USEPA Toxicological Benchmarks for Screening COPCs for Effects on Sediment Associated Biota: 1997 Revision, (USEPA, 1997). Methylene chloride is a common laboratory contaminant.

Metals were detected in all of the sediment samples. Most of the detections of metals were below criteria. However, six detections of arsenic exceeded the TEL for arsenic, but were below the PEL (NOAA, 1999). Two arsenic detections exceeded the PEL (NOAA, 1999). One detection of mercury at background study location BG-02 exceeded the TEL and the PEL for mercury (NOAA, 1999). This result exceeded the UET (NOAA, 1999) as well.

Pesticides were detected in many of the sediment samples collected for the ERA and background study. No pesticide detections exceeded the UET for the various compounds listed in the NOAA SQuiRTs (NOAA, 1999).

5.4.4 Soil

There were no PAHs detected in any of the background study surface soil samples collected. The PCB Arochlor-1260 was detected in the sample at location BG-06 at three orders of magnitude below the ADEC cleanup level (ADEC, 2004a).

Arsenic was detected above the ADEC cleanup level in all surface soil samples collected for the background study with a maximum detected concentration of 5.49 mg/Kg. All other detections of metals were below established cleanup levels.

5.4.5 Groundwater

While several metals were detected in the groundwater at MW05, none of these detections exceeded established cleanup levels (ADEC, 2004a).

5.5 CONCLUSIONS AND RECOMMENDATIONS

The purpose of the ERA was to ascertain if COPCs remaining at the Big Mountain RRS are negatively impacting, or have the potential to impact, ecological receptors at the site. Conclusions and recommendations of the ERA report (Paug-Vik/OASIS, 2006) are summarized below.

- Sediment and surface water data collected during 1998 and 2004 from adjacent and downstream habitat associated with the landfill (LF005) and AST site (ST001) do not indicate significant fate and transport of contaminants from the AST and landfill to the surrounding environment.
- The toxicity assessment indicated that estimated risks to ecological receptors were largely attributable to metals and occasionally detected low concentrations of 4,4-DDD, 4,4-DDE, benzo(a)pyrene, benzo(k)fluoranthene, and 4-methylphenol; however, based on the uncertainties of the assessment as described in Section 6 of the ERA report and the species-specific discussions in Section 5 of the ERA report, particularly those pertaining to the use of very conservative exposure and toxicity assumptions, these calculated risks are likely significantly overestimated.
- There is adequate information to conclude that the ecological risks at the Big Mountain RRS are negligible. A comprehensive baseline ERA is not necessary and no further action for ecological risk is recommended.

6 1,000-GALLON AST AREA (SS002)

6.1 2004 FIELD ACTIVITIES AND SAMPLE RESULTS FOR SS002

Field activities at SS002 were performed from July 16 to August 2, 2004. Investigative soil borings were drilled on July 16, 2004. Groundwater monitoring well MW02 was installed on July 18, 2004. This well was developed and sampled on July 20, 2004 and July 21, 2004, respectively. Field activities were conducted in accordance with the 2004 Work Plan (Paug-Vik, 2004a).

6.1.1 Site Description

The 1,000-gallon AST area is a former fuel oil system located approximately 10 feet north of the former Flight Operations Building at Lower Camp, adjacent to the Upper Camp Access road (Figure 1-3). The system was used to store fuel oil for generators and heating systems associated with the Automotive Maintenance Shop and Flight Operations buildings.

Soil and groundwater samples were collected during the 1998 RI/FS (DOWL, 2001). This was accomplished through the installation of two soil borings, two test pits, and one temporary monitoring well. DRO, GRO, benzene, toluene, and arsenic contamination were identified by this study.

6.1.2 Investigative Methodologies

Field sampling activities were conducted in accordance with the procedures described in Appendix A of the project Work Plan (Paug-Vik, 2004a), except as noted in Section 6.2 of this report, which describes field deviations to the work plan. A site reconnaissance and literature review were performed prior to sampling to identify the best investigative sampling locations. Investigative efforts focused mainly on the area to the north and to the east of the former AST location to define the extent of contamination at the site.

6.1.3 Investigation Approach

Five soil borings were drilled at SS002 during the 2004 field investigation. The locations of these borings were recorded using a hand-held GPS unit. GPS coordinates and approximate elevation obtained from the GPS readings are provided in Table 6-1.

Soil from borings was field screened using a PID and sampled to investigate this former AST area. Samples were collected from varying depths in the boreholes, depending on field screening results. Based on field screening results, one monitoring well was

installed, developed, and sampled at this site. Analytical soil samples were collected during monitoring well installation.

Soil samples were analyzed for GRO, BTEX, DRO, RRO, and lead. The groundwater sample was analyzed for GRO, BTEX, DRO, and lead. Sample locations are shown on Figure 6-1.

6.1.4 Field Documentation

Field documentation was performed in accordance with the project work plan (Paug-Vik, 2004). Copies of all field notes and daily activity reports are included in Appendix A and Appendix B, respectively.

6.1.5 Soil Borings

Five soil borings were drilled and field screened at SS002. Field screening and analytical samples were collected from various depths at these locations. Field screening results were used to determine the location of analytical samples. Analytical samples were taken from most locations. Field screening results and soil descriptions are reported in Table 6-1, below. GPS readings for the soil borings are also recorded in Table 6-1.

The majority of the field screening readings were between 0.0 ppmV and 0.7 ppmV. One PID reading at location SB14, at surface depth, was 682 ppmV. An analytical sample was collected from this location and depth based on this reading. A second analytical sample was collected at this location at a depth of five to seven feet bgs to evaluate the extent of contamination.

Additional analytical samples were collected from areas of likely contamination and from areas where contamination had previously been identified by the 1998 RI/FS (DOWL, 2001). Ten surface and subsurface soil samples were collected at SS002. Two duplicate samples were collected as well. Selected soil samples were submitted for laboratory analysis of GRO, BTEX, DRO, RRO, and lead. A summary of analytical results is presented in Table 6.2, below. Complete analytical results are located in Appendix E.

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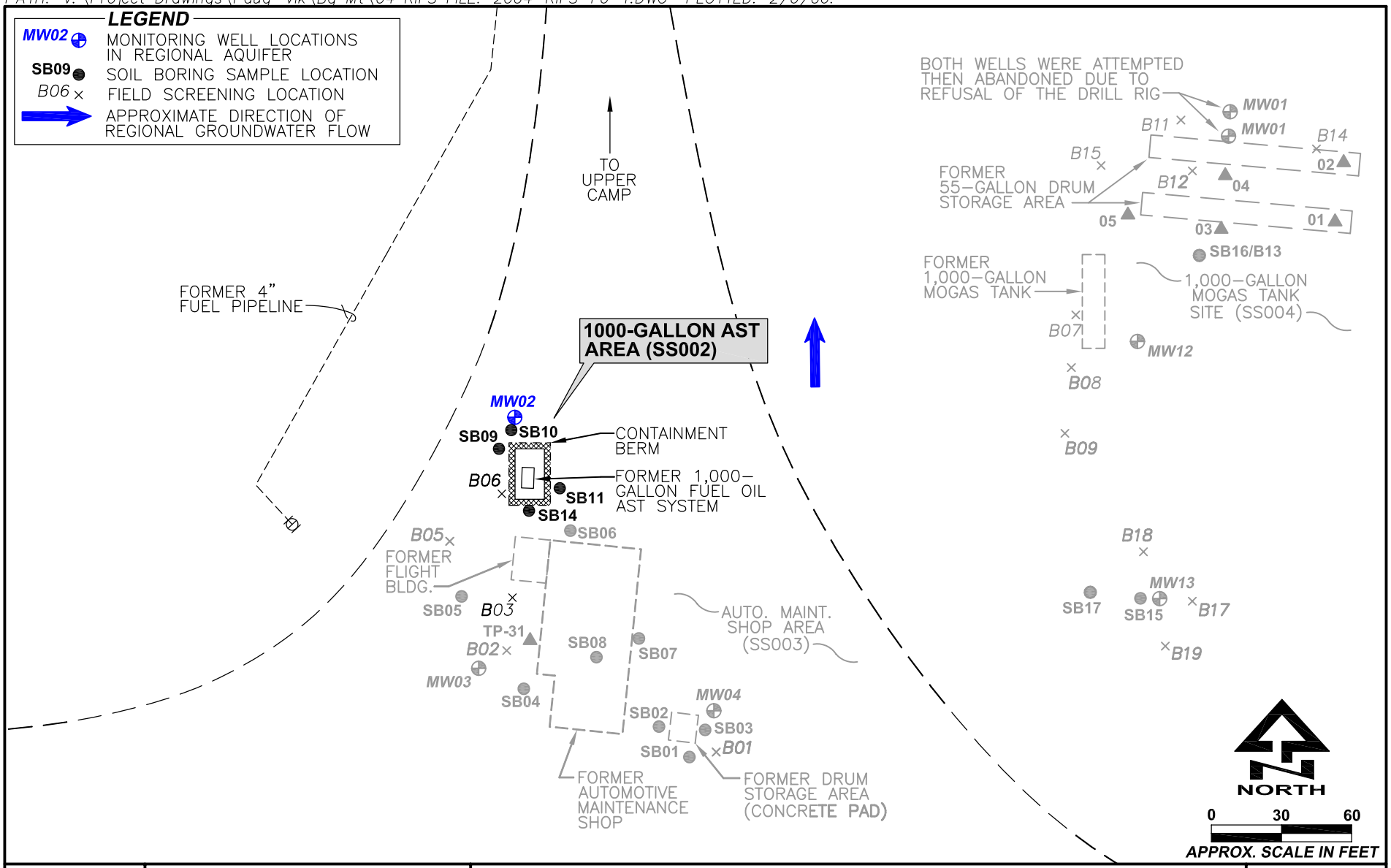

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1,000-GALLON AST AREA (SS002) SAMPLE LOCATIONS

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
6-1

Table 6-1: Soil Boring Field Screening Results and Description

Boring Number	Depth (feet)	Latitude	Longitude	Approx. Elev. (ft. amsl)	PID Results (ppmV)	Soil Description
B06	5-7	59.36235	155.25220	674	0.0	Dry, light brown, sandy gravelly SILT.
B06	10-11	59.36235	155.25220	674	0.2	Dry, light brown, sandy gravelly SILT.
SB09	1-2	59.36237	155.25222	676	NA	Dry, brown silty gravelly SAND.
SB09	5-7	59.36237	155.25222	676	0.4	Dry, brown silty gravelly SAND.
SB10-01	1-3	59.36243	155.25216	675	0.0	Dry, brown silty gravelly SAND.
SB10-02	6-7	59.36243	155.25216	675	NA	Dry, brown silty gravelly SAND, with some pebble and cobble size clasts.
SB11	1-3	59.36232	155.25199	677	0.4	Dry, brown silty gravelly SAND, with some pebble and cobble size clasts.
SB11	5	59.36232	155.25199	677	0.7	Dry, brown silty gravelly SAND, with some pebble and cobble size clasts.
SB14-01	1-3	59.36232	155.25215	673	682	Dry gray/brown silty gravelly SAND. Strong hydrocarbon odor and staining noted.
SB14-02	5-7	59.36232	155.25215	673	6.8	Moist, gray silty SAND. Hydrocarbon odor and staining noted.
MW02	10-12	NA	NA	NA	0.2	Dry, brown, silty gravelly SAND.
MW02	15-17	NA	NA	NA	0.5	Dry, brown/gray silty SAND.
MW02	20-22	NA	NA	NA	0.4	Dry, brown/gray clayey gravelly SILT.
MW02	25-27	NA	NA	NA	0.2	Wet, brown/gray silty pebbly SAND.

Notes:

GPS readings were taken on the Universal Transverse Mercator (UTM) coordinate system using the North American Datum of 1927 (NAD27).
NA – Not available.

ft amsl – Feet above mean sea level.

ppmV – Parts per million volts.

Table 6-2: SS002 Soil Boring Analytical Results Summary

Soil Boring	GRO (mg/kg)	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylenes (mg/kg)	Lead (mg/kg)
SB09	0.422 F VB, VJ	3.59 F VJ	17.8 F VJ	ND	0.00162 F VB, VJ	ND	ND	4.87 VJ
SB09(D)	0.646 F VB, VJ	2.41 F VJ	10.2 F VB, VJ	ND	0.00227 F VB, VJ	ND	ND	1.54 VJ
SB10-01	0.527 F VB, VJ	8.44 VJ	54.6 VJ	ND	0.00229 F VB, VJ	ND	ND	2.58 VJ
SB10(D)	0.380 F VB, VJ	4.55 VJ	27.3 VJ	ND	0.00218 F VB, VJ	ND	ND	2.43 VJ
SB10-02	0.500 F VB, VJ	2.90 F VJ	10.5 F VB, VJ	ND	0.00313 F VB, VJ	0.00167 F VB, VJ	ND	2.67 VJ
SB11	0.540 F VB, VJ	93.1 VJ	89.2 VJ	ND	0.00292 F VB, VJ	0.00149 F VB, VJ	ND	2.71 VJ
SB14-01	**756 D VJ**	**17,700 D VJ, VR**	693 D VJ	**1.08 D VJ**	**12.9 D VJ**	**9.25 D VJ**	42.2 D VJ	3.07 VJ
SB14-02	6.94VB, VJ	150 VJ	20.4 F VB, VJ	0.0105 VJ	0.00539 F VB, VJ	0.0146 F VB, VJ	0.0589 VB, VJ	4.33 VJ
MW02-01	0.708 F VB, VJ	3.07 F VJ	6.62 F VB, VJ	ND	0.00469 F VB, VJ	ND	ND	2.05 VJ
MW02-02	0.504 F VB, VJ	2.81 F VJ	3.81 F VB, VJ	ND	0.00508F VB, VJ	0.00326 F VB, VJ	0.0103 F VB, VJ	2.53 VJ
MW02-03	0.720 F VB, VJ	5.51 F VJ	10.6 F VB, VJ	ND	0.00406 F VB, VJ	ND	ND	3.65 VJ
MW02-04	0.612 F VB, VJ	**2,230 D VJ**	53.4 VJ	ND	0.00315 F VB, VJ	0.00130 F VB, VJ	0.00449 F VB, VJ	0.892 VJ
Cleanup Level	*300*	*250*	*11,000*	*0.02*	*5.4*	*5.5*	*78*	*400*

Notes:
Cleanup Level from ADEC 18 AAC 75, Tables B1 and B2, Under 40 inch Zone, Migration to Groundwater.
GRO – Gasoline Range Organics
DRO – Diesel Range Organics
RRO – Residual Range Organics
Mg/Kg – Milligrams per Kilogram
ND – Analyte was not detected above the MDL.
BOLD – Sample results exceeded the applicable cleanup level.
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
B – The analyte was found in the associated blank, as well as in the sample.
D – The is a laboratory qualifier indicating that the value is the result of a dilution.
R – The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

All RRO, total xylenes, and lead detections were below ADEC cleanup levels (ADEC, 2004a). One GRO result at a depth of one to three feet bgs at location SB14 (756 mg/Kg) exceeded the ADEC cleanup level (300 mg/Kg). All other GRO detections were below cleanup levels. Figure 6-2 shows cleanup level exceedences for soils at SS002. GRO was detected in both the method blank and the trip blank samples at concentrations greater than the MDL, but less than the RL. Project sample results within five times the blank concentration were qualified "VB." Surrogate recovery difficulties in the GRO samples also resulted in the assignment of the "VJ" qualifier to some project sample results.

DRO was detected above the ADEC cleanup level (250 mg/Kg) at two sample locations. DRO was detected in SB14 at one to three feet bgs at a concentration of 17,700 mg/Kg, and in MW02-04 at 25-27 feet bgs at a concentration of 2,230 mg/Kg). The sample collected at SB14-01 had a non-detectable concentration of surrogate due to high concentrations of analyte and/or required sample dilutions. This result was qualified "VR" during the data review process.

Benzene was detected above the ADEC cleanup level at SB14 at a depth of one to three feet bgs with a concentration of 1.08 mg/Kg. Toluene and ethylbenzene were also detected above ADEC cleanup levels at this location and depth (12.9 mg/Kg and 9.25 mg/Kg respectively). There were no other cleanup level exceedences for these compounds at this site. The method blanks and the trip blanks contained concentrations of toluene, ethylbenzene, and total xylenes greater than the MDL, but less than the RL. Associated project sample results were flagged "VB" to indicate potential blank contamination.

The computed completeness percentage for this project is 95 percent. Holding times for all SS002 soil samples were met. Soil samples for some work orders were received outside of the recommended temperature range. All detectable results for analyses conducted on these samples were flagged "VJ" during the data review process.

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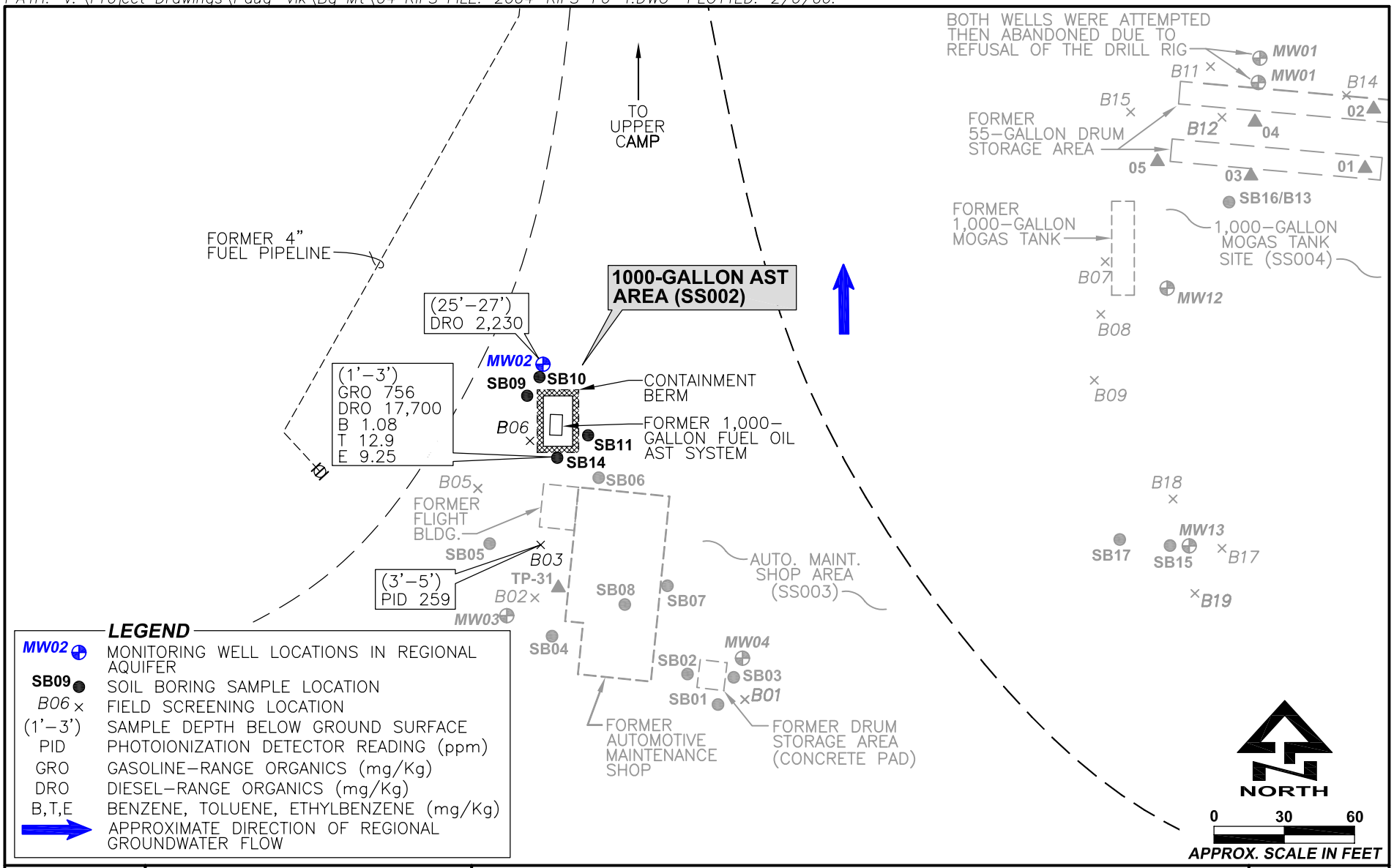

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(SS002) SOIL SAMPLE CLEANUP LEVEL EXCEEDENCES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE

6-2

6.1.6 Monitoring Well Installation

One monitoring well was installed at SS002 on July 18, 2004. Soil samples were collected during installation and were field screened. Field screening results are reported in Table 6-1. The monitoring well installation log has been included in Appendix G.

Four analytical soil samples were taken during the installation of the well borehole. Sample collection depths are reported in Table 6-1. Soil was submitted for laboratory analysis of GRO, BTEX, DRO, RRO, and lead. Analytical results are provided in Table 6-2. DRO was detected in one soil sample collected at MW02 above the ADEC cleanup level. Complete results can be found in Appendix E.

Groundwater flow and gradient for MW02 are discussed in Section 8.1.9 of this report.

6.1.7 Monitoring Well Development

Twenty-four hours after installation, MW02 was developed using a disposable bailer. A surge/purge technique was utilized to fully develop the well and three casing volumes were removed. The well development data sheet is provided in Appendix D.

6.1.8 Groundwater Sampling

Twenty-four hours after development, the monitoring well was purged and sampled. Three well volumes were removed during purging. Groundwater parameters were measured after each well volume to ensure stabilization before sampling, as described in the 2004 work plan (Paug-Vik, 2004a). Final groundwater parameter readings are shown in Table 6-3 below.

Table 6-3: Groundwater Parameters at SS002

Sample Name	Temperature (^{o}C)	PH	Conductivity (µS)	Dissolved Oxygen (mg/L)	TDS (ppm)	ORP (mV)
MW02	7.5	6.7	220	8.84	220	220

Notes:
mV - milivolts
NM - not measured
ORP - Oxidation Reduction Potential
ppm - parts per million
TDS - Total Dissolved Solids
µS - microsiemens

After purging, MW02 was sampled and submitted for laboratory analysis of GRO, DRO, RRO, VOCs, and lead. A duplicate sample was collected from MW02 for lead analysis. A summary of groundwater analytical results is presented in Table 6-4, below. Complete analytical results can be found in Appendix E.

Table 6-4: SS002 Groundwater Analytical Results Summary

Well	Lead (mg/L)	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	VOCs (µg/L)
MW02	ND	ND	0.359 VJ	ND	ND
MW02 (DUP)	0.0002 F VB, VJ	NS	NS	NS	NS
Cleanup Levels	*0.015*	*1.3*	*1.5*	*1.6*	*varies*

Notes
Cleanup Levels – ADEC 18 AAC 75 Table C, (ADEC, 2004a).
BOLD font indicates cleanup level exceedence.
DRO – Diesel Range Organics
RRO – Residual Range Organics
GRO – Gasoline Range Organics
VOCs – Volatile Organic Compounds
mg/L – Milligrams per liter
µg/L – micrograms per liter
ND – Analyte was not detected above laboratory method detection limits
NS – Analyte was not sampled for
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the RL.
J – The analyte was positively identified, but the quantitation is an estimation.
B – The analyte was found in the associated blank and in the project sample.

Analytical results were compared to cleanup levels in 18 AAC 75, Table C, Groundwater Cleanup Levels (ADEC, 2004a). No cleanup level exceedences were noted for the groundwater sample collected at MW02.

The overall calculated completeness for this project is 95 percent. Holding times for all SS002 groundwater samples were met. Cooler temperatures for SS002 groundwater samples were outside of the recommended range. All detectable results for analyses conducted on these samples were flagged "VJ." The method blank and trip blank samples contained concentrations of GRO greater than the MDL, but below the RL. All project sample results were non-detect, so further qualification was unnecessary. Lead was noted in the method blank sample at a concentration below the RL. Associated project sample results were qualified "VB" to indicate blank contamination.

6.1.9 Investigation-Derived Waste Handling

Minimal IDW was generated during site sampling activities. Sampling gloves, disposable scoops, and other miscellaneous items were used and disposed of during this sampling event. All IDW was collected for this project. The IDW was disposed of and eventually burned in the on-site SmartAsh® burner.

Soil cuttings produced during monitoring well installation were collected in a Supersack® and stored on-site pending analytical results. The Supersack® was clearly labeled with the well ID, the date of containerization, and contact information. It was then placed in a connex on-site for winter storage. Analytical results show cleanup level exceedences for DRO in the MW02 soils. These soils will be included in the POL soil treatment project scheduled for the summer of 2005. Soil cuttings generated during borehole installation were used as backfill for the boreholes. DRO-contaminated soil identified at specific boreholes, such as SB14 at Site SS002, will be thermally treated with soils that are excavation under the Interim ROD.

6.2 WORK PLAN DEVIATIONS

Deviations from the work plan that occurred during the sampling effort are as follows:

- Only one monitoring well was installed at SS002. While the work plan called for the installation of two monitoring wells, it was decided that one monitoring well would be sufficient to characterize the groundwater at this site when combined with two additional wells installed at the adjoining site, SS003. As a result, only one groundwater sample was collected.
- Field screening with the PID was not conducted at every soil sampling location due to inclement weather and malfunctioning of equipment.
- An additional surface soil sample (1-3 feet bgs) was collected at SS002 to better characterize the location and extent of surface contamination at this site.
- Fewer subsurface soil samples (>3 feet bgs) were collected at this site than the work plan called for due to the installation of only one monitoring well.

6.3 RI FINDINGS – SS002

This section presents the findings from the field investigations at the 1,000-Gallon AST Area, SS002. The following sections discuss field observations, analytical results, and estimated volume and extent of contamination.

6.3.1 Data Evaluation Approach

Field observations and analytical data obtained during the 2004 RI were compared with the DQOs identified in Section 1.5 to identify areas of contamination.

Discussion of analytical results is limited to specific analytes detected. Additional information on analytical method detection limits (sensitivity), QC samples (other than field duplicates), precision and accuracy calculations, and evaluation of data quality are described in the analytical data QAR included as Appendix H.

6.3.2 Soil Sampling

One GRO result at surface depth at location SB14 (756 mg/Kg) exceeded the ADEC cleanup level. DRO was detected above the ADEC cleanup level at two sample locations (SB14 at surface and MW02-04 at 27 feet bgs). Those DRO results are 17,700 mg/Kg and 2,230 mg/Kg respectively. The contamination at MW02 is located within the "smear zone," or the horizontal layer of subsurface soils through which the fluctuating water table has "smeared" contamination.

Benzene was detected above the ADEC cleanup level at SB14 at surface depth with a concentration of 1.08 mg/Kg. Toluene and ethylbenzene were also detected above ADEC cleanup levels at this location and depth (12.9 mg/Kg and 9.25 mg/Kg respectively).

Six samples collected during the 1998 RI/FS (DOWL, 2001) exceeded the ADEC cleanup level for DRO. Three of these samples exceeded the GRO cleanup level as well. The cleanup levels for benzene and toluene were exceeded at one sample location.

POL contamination is concentrated around the former tank location, and primarily exists to the south of this area. Contamination is noted primarily at depths ranging from surface level to ten feet bgs. Soils at MW02 have DRO contamination at 25 to 27 feet bgs.

Soils at this site are consistent with that of glacial alluvium, and are mainly silty, gravelly sand.

6.3.3 Groundwater Sampling

While DRO constituents were found in the groundwater sample collected at MW02, the concentration did not exceed the ADEC cleanup level for DRO in groundwater (ADEC, 2004a). MW02 is located downgradient of the tank area.

The 1998 RI/FS temporary monitoring well L3, AP-17, located upgradient (approximately 30 feet to the south) from MW02, showed a DRO cleanup level exceedence of 1.8 mg/L (DOWL, 2001), thus indicating that some soil contamination has migrated to the groundwater at site SS002. However, well L3, AP-17 was a temporary well and consisted of a pre-packed screen placed down the auger. An attempt was made to develop and purge this temporary well (DOWL, 2001), however because of the well construction, cross-contamination cannot be ruled out as a possibility.

6.3.4 Conceptual Site Model

Potential human receptors at SS002 were identified during the 2004 RI. The resulting exposure scenarios are listed below:

- Recreational & Subsistence Exposure Scenario (short-term visits by fishermen, hunters, and recreational users).
- Industrial Exposure Scenario (short-term visits by site workers and camp support staff during investigation and cleanup efforts).

These following potential exposure scenarios were considered complete at the site:

- Inhalation of dust-borne COPCs in surface soils.
- Ingestion of and dermal contact with soil-borne COPCs in surface soils.
- Bioaccumulation of COPCs (There is a complete exposure pathway to biota. POLs are present in surface soils and may bioaccumulate in local flora and fauna).
- Ingestion and dermal contact with COPCs in groundwater.

There are no completed exposure pathways to surface water (no surface water is present on the site).

Free-phase liquid plume and mobile free-liquid transport were ruled out as potential contaminant sources and transport mechanisms at SS002.

Terrestrial animals and humans may be directly exposed to contaminants in surface soil at the facility via incidental ingestion, inhalation, or dermal contact.

6.4 RI SUMMARY AND CONCLUSIONS

The data collected in both 1998 and in 2004 indicate that contamination at SS002 is limited to POLs. Contaminated soils at SS002 exist in the former tank location and to the south sides of the former tank saddle. Groundwater at SS002 does appear to be affected by localized soil contamination. Some low-level concentrations of RRO, VOCs, and lead were found at various sampling sites, but did not exceed cleanup levels.

Soil volume estimates are based on analytical sampling results. Contaminated soils and groundwater identified by the 1998 RI/FS efforts (DOWL, 2001) were also included in soil volume estimates. Assuming an average depth of 10 feet bgs, approximately 85 cubic yards of soil appear to be impacted at SS002, with about 75 cubic yards of contaminated soil being located at zero to ten feet bgs. Given the depth of some of

these contaminated soils, approximately 300 cubic yards of soil will be excavated to completely remove the contamination source.

6.5 SELECTED REMEDIAL ACTION FOR SSOO2

Site SS002 is currently managed under an Interim ROD (Paug-Vik, 2002a). Based on the findings of both the 1998 RI/FS and the 2004 RI, the chosen remedial action for contaminated soils at SS002 is removal of the contamination at the source. The horizontal extent of contamination will be delineated, and those soils will be excavated and thermally treated in accordance with the Interim ROD. Contamination appears to extend south to the location of borehole B03 (Figure 6-1) into Site SS003. The results of the RI indicate that this contamination is resultant and contiguous from SS002, and will be addressed by the remedial action chosen for SS002.

Following removal of surface soil contamination, the vertical extent of contamination will be addressed to the degree possible. Soils will be removed to within the reach of the excavator, or approximately 20 feet bgs if some benching is performed. Contamination beyond that depth will be left in place. Excavated soils will be thermally treated to below ADEC soil cleanup levels. Treatment will be confirmed in the field through field analysis. Figure 6-3 shows the estimated excavation boundaries for SS002.

The Interim ROD specified installation of monitoring wells to evaluate groundwater impacts, and to determine final actions to groundwater. This was accomplished in 2004 during the RI field effort. MW02 and the monitoring wells at SS003 showed minimal impacts to groundwater. Contaminated soils left in place in the smear zone are not expected to result in future groundwater contamination. The removal of the surface source of contamination will remove the major potential source for future groundwater contamination at this site. Groundwater concentrations will be monitored for five years. After which time, a five-year review will be conducted to re-evaluate monitoring requirements.

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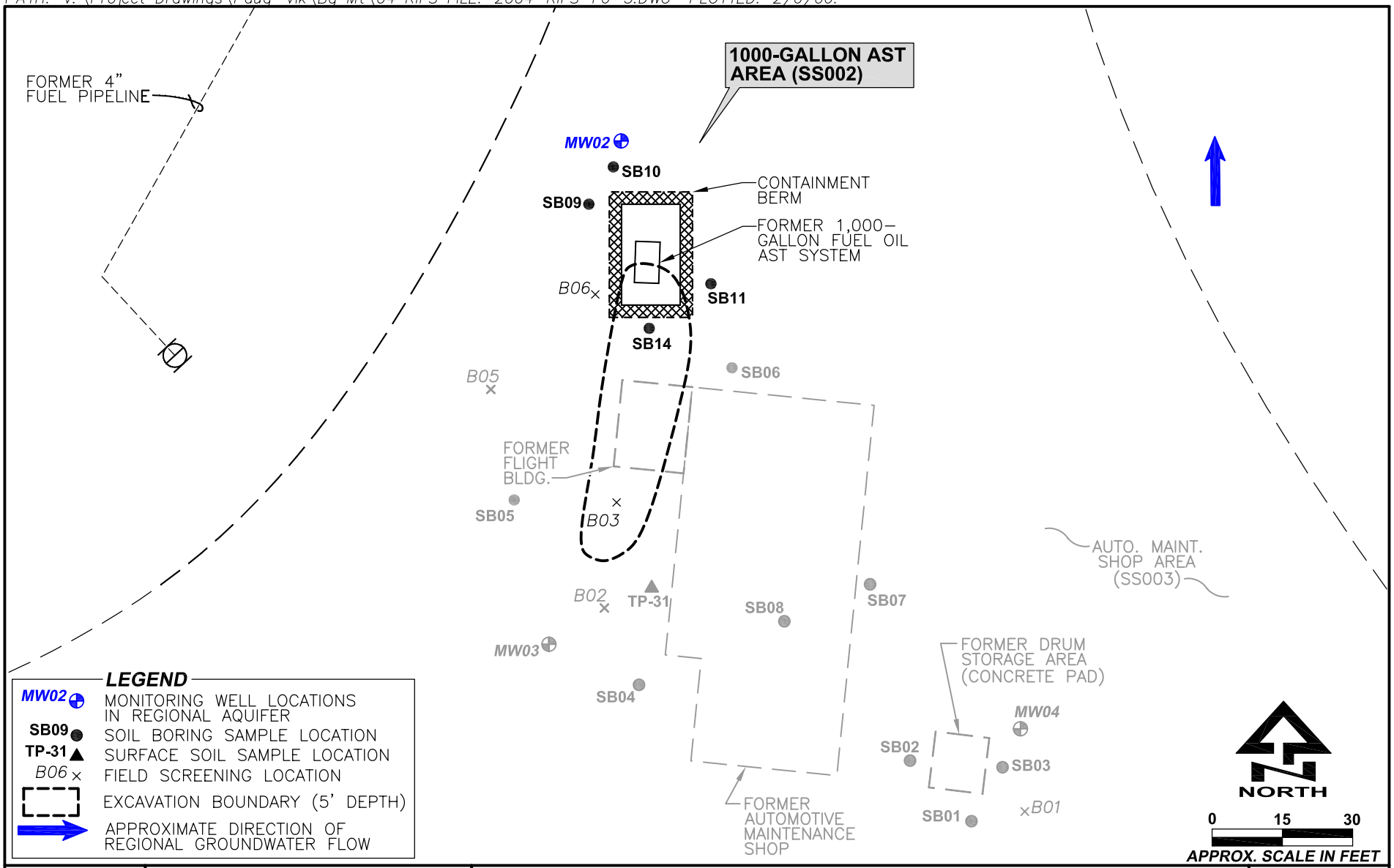

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SS002 SOIL EXCAVATION BOUNDARIES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
6-3

7 AUTO MAINTENANCE SHOP AREA (SS003)

7.1 2004 FIELD ACTIVITIES AND SAMPLE RESULTS FOR SS003

Field activities at SS003 were performed from July 15 to August 2, 2004. Investigative soil borings were drilled on July 15, 2004. Groundwater monitoring wells MW03 and MW04 were installed on July 19 and 20, 2004. These wells were developed on July 20, 2004 and sampled on July 21, 2004. Field activities were conducted in accordance with the 2004 Work Plan (Paug-Vik, 2004a).

7.1.1 Site Description

The Auto Maintenance Shop area served as the location for auto maintenance activities at Lower Camp and was located adjacent to the former Flight Operations Building at Lower Camp, and to the Upper Camp Access road (Figure 1-3). Facilities at this site include a concrete slab reported to have been the Fire and Rescue Building and an area on the west side of the buildings that was once used for 55-gallon drum and vehicle storage. Additionally, a wooden crib was encountered at a depth of approximately three feet bgs in test pit TP-31 during the 1998 RI/FS (DOWL, 2001). A hydrocarbon film was noted in the surrounding gravel-cobble fill layer near this test pit.

Soil and groundwater samples were collected during the 1998 RI/FS (DOWL, 2001). This was accomplished through the installation of soil borings, test pits, and one temporary monitoring well. DRO, benzene, methylene chloride, and arsenic contamination were identified by this study.

7.1.2 Investigative Methodologies

Field sampling activities were conducted in accordance with the procedures described in Appendix A of the project Work Plan (Paug-Vik, 2004), Section 7.2 of this report, which describes field deviations to the work plan. A site reconnaissance and literature review was performed prior to sampling to identify the best investigative sampling locations in order to fill data gaps for this site.

7.1.3 Investigation Approach

Twelve soil borings were drilled at locations on all perimeters of SS003 during the 2004 field investigation. One surface soil sample was also collected in the vicinity of 1998 RI/FS sample location TP-31 (DOWL, 2001). Soils from the borings and the surface soil sample were field screened using a PID and sampled. Field screening results were used to determine analytical soil sample collection, as well as monitoring well locations.

The two monitoring wells were installed, developed, and sampled as part of the 2004 RI activities. Sample locations are shown on Figure 7-1.

Soil samples were analyzed for GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and total metals. The two groundwater samples were analyzed for GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and dissolved metals.

7.1.4 Field Documentation

Field documentation was performed in accordance with the project work plan (Paug-Vik, 2004a). Copies of all field notes and daily activity reports are included in Appendix A and Appendix B, respectively.

7.1.5 Soil Borings

Twelve soil borings were drilled and field screened during site investigation activities. The locations of these borings were recorded using a hand-held GPS unit. Soil cuttings generated during borehole installation were used to backfill the boreholes once sampling and field screening was complete. Additionally, soil samples were collected at 5-foot depth intervals from the boreholes of two monitoring wells that were installed at SS003.

Field screening results were used to delineate areas of potential contamination. Results from the 1998 RI/FS (DOWL, 2001) were also used to identify areas of potential contamination for analytical sampling purposes. Analytical samples were taken from most locations, at varying depths. Field screening results and soil descriptions are reported in Table 7-1, below. GPS readings are provided in Table 7-1 as well.

Boundaries between SS003 and SS002 are not distinct, and thus soil boreholes were installed at both sites over the same period of time. Samples were collected from around the concrete pad of the former Auto Maintenance Shop Location. One boring was installed in the center of the concrete pad, in an area that appeared to be a drain location.

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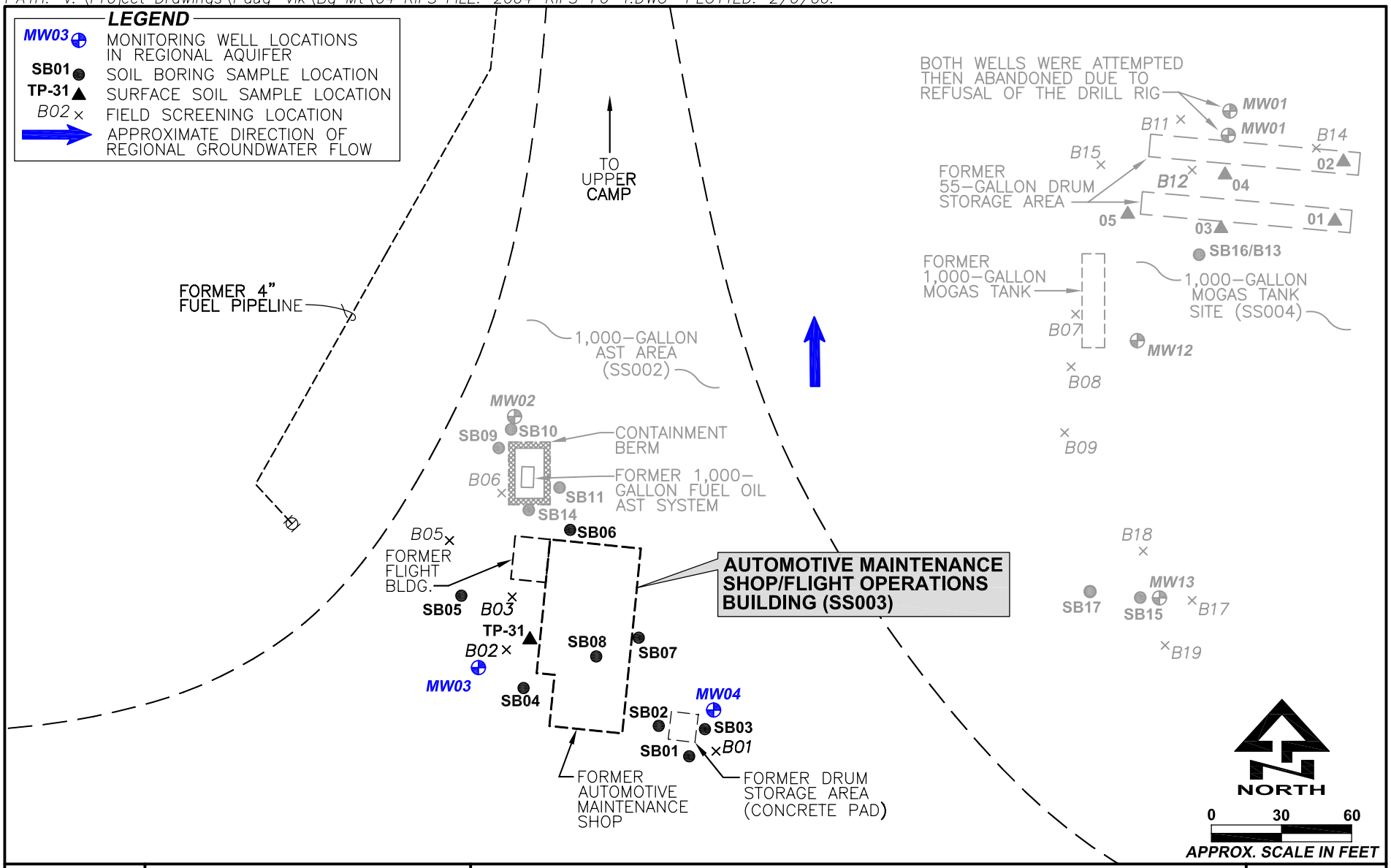

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AUTOMOTIVE MAINTENANCE SHOP AREA (SS003) SAMPLE LOCATIONS

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
7-1

Table 7-1: SS003 Soil Boring Field Screening Results and Description

Boring Number	Depth (feet)	Latitude	Longitude	Approx. Elev. (ft. amsl)	PID Results (ppmV)	Soil Description
B01	2-3	59.36208	155.25174	717	0.5	Dry, brown, silty gravelly SAND.
B01	5-7	59.36208	155.25174	717	0.6	Dry, brown, silty gravelly SAND.
SB01-01	1-3	59.36209	155.25180	680	0.0	Dry, brown silty gravelly SAND.
SB02-01	1-3	59.36213	155.25184	677	0.0	Dry, brown silty gravelly SAND.
SB03-01	1-3	59.36213	155.25170	674	0.0	Dry, brown silty gravelly SAND.
SB04-01	1-3	59.36216	155.25218	678	0.0	Dry, brown silty pebbly SAND, w/dark brown peat.
SB04-02	10-12	59.36216	155.25218	678	NA	Dry, brown silty gravelly SAND.
B02	5-7	59.36221	155.25222	675	1.4	Dry, brown silty gravelly SAND.
B02	10-12	59.36221	155.25222	675	0.3	Dry, brown silty gravelly SAND.
B03	3-5	59.36222	155.25221	675	259	Dry, dark brown, silty gravelly SAND. Hydrocarbon odor noted.
SB05 (B04)-01	5-7	59.36224	155.25223	676	0.3	Dry, brown silty gravelly SAND.
SB05 (B04)-02	10-12	59.36224	155.25223	676	0.5	Dry, brown silty gravelly SAND.
B05	5-7	59.36228	155.25226	670	1.2	Dry, brown silty gravelly SAND.
B05	10-12	59.36228	155.25226	670	0.5	Dry, brown silty gravelly SAND.
SB06-01	1-3	59.36229	155.25197	672	1.2	Dry, brown silty pebbly SAND.
SB06-02	5-7	59.36229	155.25197	672	0.7	Dry, brown silty gravelly SAND.
SB07-01	1-3	NA	NA	NA	1.0	Dry, brown silty gravelly SAND.
SB07-02	5-7	NA	NA	NA	0.2	Dry, brown silty gravelly SAND.
SB08-01	1-3	59.36219	155.25204	676	1.2	Dry, brown silty gravelly SAND.
SB08-02	5-7	59.36219	155.25204	676	0.2	Dry, brown silty gravelly SAND.
MW03-01	1-2	NA	NA	NA	0.0	Dry, brown silty gravelly SAND.
MW03-02	5-7	NA	NA	NA	0.0	Dry, brown silty gravelly SAND w/some cobbles.
MW03-03	10-12	NA	NA	NA	0.0	Dry, brown silty gravelly SAND.
MW03-04	20-22	NA	NA	NA	0.0	Dry, brown silty gravelly SAND.
MW03-05	23-24	NA	NA	NA	0.0	Moist, gray clayey SILT to moist brown gravelly coarse SAND.
MW04-01	1-2	NA	NA	NA	0.0	Dry, brown silty pebbly SAND.
MW04-02	5-6.5	NA	NA	NA	0.1	Dry, reddish brown sandy gravelly SILT.
MW04-03	10-11.5	NA	NA	NA	0.0	Dry, brown gravelly SAND.
MW04-04	15-17	NA	NA	NA	0.0	Dry, brown sandy pebbly SILT to silty gravelly SAND.
TP31	3-4	NA	NA	NA	0.2	Dry, brown silty gravelly SAND, w/organic matter at top 1”.

Note:
GPS readings were taken on the Universal Transverse Mercator (UTM) coordinate system using the North American Datum of 1927 (NAD27).

Additionally, one surface soil sample was collected in the area of Test Pit TP31 to confirm 1998 RI/FS results (DOWL, 2001) as shown on Figure 7-1. A borehole was not installed in this area due to concerns for stability of the soil in the vicinity of the wooden crib described in the 1998 RI/FS. The sample was collected using hand tools from the bottom of a depression that had a depth of two to three feet bgs. Approximately one foot of surface material was removed prior to sampling, giving an approximate sample depth of three to four feet bgs. No olfactory or visual observations of contamination were noted during sampling at TP-31. This sample was field screened using a PID and submitted to the project laboratory for BTEX, VOCs, GRO, DRO, RRO, PCBs, Pesticides, PAHs, and total metals analyses.

The majority of the field screening results for soils at SS003 were in the range of 0.0 ppmV to 1.4 ppmV, and thus did not prove to be useful indicators for analytical sample selection. Analytical samples were instead chosen at areas of likely contamination and at areas where contamination had been previously identified in the 1998 RI/FS (DOWL, 2001). Samples were also chosen in locations so that previously identified contamination could be further delineated. Selected soil samples were submitted for laboratory analysis of GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and total metals.

Sample location names beginning with a “B” were not submitted for lab analysis. If it was determined to take an analytical sample mid-hole, the location name was changed to “SB” and that number series, such as B-04 changing to SB-05. Sample location names were continued from Site SS003 to Site SS002 in order to minimize confusion.

A PID reading of 259 ppmV was noted at soil boring location B03 at a depth of three to five feet bgs. While this location is within Site SS003, it is believed that contamination from SS002 is the source for this high field screening result. The excavation boundaries for SS002 were extended to this location and this contamination will be removed under the selected remedial action for SS002, previously discussed in Section 6.5 of this report.

A summary of analytical results is presented in Table 7.2, below. Complete analytical results are located in Appendix E.

Table 7-2: SS003 Soil Boring Analytical Results Summary

Boring Number	GRO (mg/Kg)	DRO (mg/Kg)	RRO (mg/Kg)	VOCs (mg/Kg)	PAHs (mg/Kg)	PCBs (mg/Kg)	Pesticides (mg/Kg)	RCRA Metals (mg/Kg)
SB01-01	1.22 F VB, VJ	8.74 VJ	52.6 VJ	**Methylene Chloride – 0.0756 F VB, VJ**	BCL	ND	ND	**As – 4.84 VJ**
SB02-01	0.623 F VB, VJ	3.66 F VJ	11.8 F VB, VJ	ND	ND	ND	ND	**As – 3.19 VJ**
SB03-01	1.56 F VB, VJ	8.94 VJ	61.4 VJ	ND	ND	Arochlor-1260 – 0.003 F VJ	ND	**As – 6.96 VJ**
SB04-01	1.32 F VB, VJ	3.10 F VJ	4.75 F VJ	ND	ND	Arochlor-1260 – 0.0088 F VJ	ND	**As – 3.64 VJ**
SB04-02	0.884 F VB, VJ	2.34 F VJ	9.19 F VB, VJ	ND	ND	ND	ND	**As – 5.49 VJ**
SB05-01	1.79 F VB, VJ	5.43 VJ	15.7 F VB, VJ	ND	ND	Arochlor-1260 – 0.0205 F VJ	BCL	**As – 4.66 VJ**
SB06-01	0.75 F VB, VJ	10.3 VJ	82.4 VJ	ND	ND	Arochlor-1260 – 0.00439 F VJ	ND	**As – 3.57 VJ**
SB07-01	0.566 F VB, VJ	8.02 VJ	38.4 VJ	ND	ND	ND	ND	**As – 3.94 VJ**
SB08-01	0.916 F VB, VJ	9.35 VJ	108 VJ	ND	ND	ND	ND	**As – 3.43 VJ**
SB08-02	0.628 F VB, VJ	10.4 VJ	70.8 VJ	ND	NS	Arochlor-1260 – 0.0148 F VJ	ND	**As – 3.61 VJ**
MW03-01	0.378F VB	6.20 VJ	42.0 VJ	BCL	ND	Arochlor-1260 – 0.0446 VJ	BCL	**As – 5.51 VJ**
MW03-02	0.308F VB	13.7 VJ	90.4 VJ	BCL	ND	Arochlor-1260 – 0.0662 VJ	BCL	**As – 4.19 VJ**
MW03-03	0.316 F VB	ND	ND	BCL	ND	ND	ND	**As – 4.81 VJ**
MW03-04	0.299 F VB	ND	ND	BCL	ND	ND	ND	**As – 3.15 VJ**
MW03-04(D)	0.431 F VB	ND	ND	BCL	ND	ND	BCL	**As – 3.25 VJ**
MW03-05	0.237 F VB	ND	ND	BCL	BCL	ND	ND	**As – 3.52 VJ**
MW04-01	0.924 F VB	34.1 VJ	133 VJ	BCL	ND	Arochlor-1260 – 0.602 VJ	ND	**As – 3.74 VJ**
MW04-02	0.412 F VB	3.71 F VJ	46.2 VJ	BCL	ND	ND	ND	**As – 2.34 VJ**
MW04-03	0.314 F VB	ND	2.16 F VJ	BCL	ND	ND	ND	**As – 5.36 VJ**
MW04-04	0.476 F VB	ND	2.22	BCL	ND	ND	ND	**As – 3.42 VJ**
MW04-04(D)	0.392 F VB	2.22 F VJ	ND F VJ	BCL	ND	ND	ND	**As – 3.24 VJ**
TP31 [2]	0.774 F	130	356 D	All ND	BCL	Arochlor-1260 – 0.116 VM	BCL	**As – 4.29**
Cleanup Levels[1]	*300*	*250*	*11,000*	*Varies*	*Varies*	*1*	*Varies*	*Varies*

Notes:
1. Cleanup Level from ADEC 18 AAC 75, Tables B1 and B2, Under 40 inch Zone, Migration to Groundwater.
2. A surface soil sample was collected from 3-4 ft. bgs at TP31 to confirm results of the 1998 RI/FS (DOWL, 2001).
GRO – Gasoline Range Organics
DRO – Diesel Range Organics
RRO – Residual Range Organics
Mg/Kg – Milligrams per Kilogram
ND – Analyte was not detected above the MDL.
BOLD – Sample results exceeded the applicable cleanup level.
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
B – The analyte was found in the associated blank, as well as in the sample.
D – The is a laboratory qualifier indicating that the value is the result of a dilution.
R – The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

There were no detections of GRO, DRO, RRO, PAHs, PCBs, or pesticides that exceeded applicable ADEC cleanup levels (ADEC, 2004a). The VOC methylene chloride was detected at one sample location (SB01-01) at a concentration of 0.0756 mg/Kg. This VOC and the VOC 2-butanone were detected in the method blank and trip blank samples at levels higher than the MDL, but lower than the RL. Project samples with detections of these common laboratory contaminants were flagged "VB" during the data review process. Methylene chloride is a common laboratory contaminant.

Arsenic was detected above the ADEC cleanup level of 2.0 mg/Kg in all soil samples. Arsenic concentrations ranged from 2.34 mg/Kg to 6.96 mg/Kg. These concentrations are generally within reported background arsenic levels for Big Mountain. Further discussion of background metals sample results can be found in Section 5.2.4 and in Table 5-6 of this report. Barium and selenium were found in the method blank samples at concentrations greater than the MDL, but less than the RL. Associated project samples were flagged "VB."

The computed completeness for this project is 95 percent. Holding times for all analytical sample results were found to be in accordance with USEPA methods, with the following exception. PCB and pesticide samples for work order B4G0665 were reanalyzed past the USEPA recommended holding time for conformational purposes. Results for these analyses were flagged VH and were not included in the final results. Six of the eight coolers of soil samples for Site SS003 were outside of the recommended temperature range. Sample results for analyses conducted on the samples in these coolers were flagged "VJ" during the data review process.

7.1.6 Monitoring Well Installation

Two monitoring wells were installed on July 19 and 20, 2004. Soil samples were collected during installation and were field screened. Field screening results have been reported in Table 7-1. Monitoring well installation logs are provided in Appendix G. Groundwater flow and gradient for SS003 is discussed in Section 8.1.9 of this report.

Five analytical soil samples were taken during the installation of MW03 and four samples were collected during the installation of MW04. Sample depths are reported in Table 7-1. Soils were submitted for laboratory analysis of GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and total metals. Analytical results are provided in Table 7-2. Arsenic was detected in all soil samples collected at MW03 and MW04 above the ADEC cleanup level; however, these concentrations are within established background levels for arsenic at the Big Mountain site.

7.1.7 Monitoring Well Development

MW03 and MW04 were developed on July 20, 2004 using a disposable bailer. A surge/purge technique was utilized to fully develop the wells and three casing volumes were removed from each monitoring well. Well development data sheets are provided in Appendix D.

7.1.8 Groundwater Sampling

Twenty-four hours after development, the monitoring wells were purged and sampled on July 21, 2004. Four well volumes were removed from each well during purging. Groundwater parameters were measured after each well volume to ensure stabilization before sampling, as described in the 2004 work plan (Paug-Vik, 2004a). Final groundwater parameter readings are shown in Table 7-3 below.

Table 7-3: Groundwater Parameters for SS003

Sample Name	Temp (^{o}C)	PH	Conductivity (µS)	DO (mg/L)	TDS (ppm)	ORP (mV)
04RISS003-MW03-01GW	5.5	6.9	160	10.6	150	295
04RISS003-MW04-01GW	5.4	7.2	490	8.46	480	40

Notes:
mV - milivolts
DO – Dissolved Oxygen
ORP - Oxidation Reduction Potential
ppm - parts per million
TDS - Total Dissolved Solids
µS - microsiemens

After purging, MW03 and MW04 were sampled and submitted for laboratory analysis of GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and dissolved metals. A summary of groundwater analytical results is presented in Table 7-4, below. Complete analytical results can be found in Appendix E.

Table 7-4: SS003 Groundwater Analytical Results Summary

Well	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	RCRA Metals (mg/L)	PCBs (mg/L)	Pesticides (µg/L)	PAHs (µg/L)	VOCs (µg/L)
MW03	ND	0.0897 F VJ	ND	BCL	BCL	ND	BCL	ND
MW04	0.0091 F VB, VJ	0.24 VJ	ND	BCL	ND	ND	ND	BCL
Cleanup Level	*1.3*	*1.5*	*1.1*	*Varies*	*0.0005*	*Varies*	*Varies*	*Varies*

Notes
Cleanup Level – ADEC 18 AAC 75 Table C, Groundwater Cleanup Levels, (ADEC, 2004a).
BOLD font indicates cleanup level exceedence.
DRO – Diesel Range Organics
GRO – Gasoline Range Organics
RRO – Residual Range Organics
PCBs – Polychlorinated Biphenyls
PAHs – Polynuclear Aromatic Hydrocarbons
RCRA Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver
VOCs – Volatile Organic Compounds
mg/L – Milligrams per liter
µg/L – micrograms per liter
ND – Analyte was not detected above laboratory method detection limits
BCL – Cleanup Level
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the RL.
J – The analyte was positively identified, but the quantitation is an estimation.
B – The analyte was found in the associated blank and in the project sample.

Analytical results were compared to cleanup levels in 18 AAC 75, Table C, Groundwater Cleanup Levels (ADEC, 2004a). No cleanup level exceedences were noted for the groundwater samples collected at SS003. GRO was noted in the trip blank and in the method blank samples above the MDL, but below the RL. Project sample results within five times the blank contamination were flagged "VB."

The overall calculated completeness for this project is 95 percent. Holding times for all sample analyses were consistent with USEPA guidelines. Groundwater samples for SS003 were received at the laboratory in coolers outside of the recommended temperature range. All detectable results for analyses in these coolers were flagged "VJ" during the data review process.

7.1.9 Investigation-Derived Waste Handling

Minimal IDW was generated during site sampling activities. Sampling gloves, disposable scoops, and other miscellaneous items were used and disposed of during this sampling event. All IDW was collected for this project. The IDW was disposed of and eventually burned in the on-site SmartAsh® burner.

Soil cuttings produced during monitoring well installation were collected in Supersacks® and stored on-site pending analytical results. Both Supersacks® were clearly labeled with the well ID, the date of containerization, and contact information. At the end of the 2004 field season, they were placed in a connex and stored on-site for the winter. Analytical results show no cleanup level exceedences for the soil at SS003. These soil cuttings may be dispersed to their respective well. Soil cuttings generated during borehole installation were used to backfill the boreholes following the completion of sampling.

7.2 DEVIATIONS FROM WORK PLAN

Deviations from the work plan that occurred during the sampling effort are as follows:

- Field screening with the PID was not conducted at every soil sampling location due to inclement weather and malfunctioning of equipment.
- A surface soil sample (3-4 feet bgs) was collected at TP31 (see Figure 8-5 of the 1998 RI/FS report, DOWL, 2001) at SS003 to determine the nature of contamination at this location.

7.3 RI FINDINGS – SS003

This section presents the findings from the field investigations at the Auto Maintenance Shop Area, SS003. The following sections impart field observations, analytical results, and estimated volume and extent of contamination.

7.3.1 Data Evaluation Approach

Field observations and analytical data obtained during the 2004 RI were compared with the DQOs identified in Section 1.5 to identify areas of contamination.

Discussion of analytical results is limited to specific analytes detected. Additional information on analytical method detection limits (sensitivity), QC samples (other than field duplicates), precision and accuracy calculations, and evaluation of data quality are described in the analytical data QAR included as Appendix H.

7.3.2 Soil Sampling

The VOC methylene chloride was detected above the ADEC cleanup level of 0.015 mg/Kg at one sample location (SB01-01). This compound was also detected in the trip blank for this sample event. Arsenic was detected above the ADEC cleanup level in all soil samples. These concentrations are in the range of established background arsenic levels for the Big Mountain area. No other analytical detections exceeded applicable cleanup levels at SS003.

No contaminated soils at SS003 were identified by the 2004 RI activities. However, contaminated soils identified at Site SS002 may border soils in Site SS003.

7.3.3 Groundwater Sampling

While low levels of DRO, GRO, VOCs, PCBs, Pesticides, and the RCRA Metals were found in the groundwater samples collected at SS003, none of these detections exceeded applicable ADEC cleanup levels.

7.3.4 Conceptual Site Model

Potential human receptors at SS003 were identified during the 2004 RI. The resulting exposure scenarios are listed below:

- Recreational & Subsistence Exposure Scenario (short-term visits by fishermen, hunters, and recreational users).
- Industrial Exposure Scenario (short-term visits by site workers and camp support staff during investigation and cleanup efforts).

These following potential exposure scenarios were considered complete at the site:

- Inhalation of dust-borne COPCs in surface soils.
- Ingestion of and dermal contact with soil-borne COPCs in surface soils.
- Bioaccumulation of COPCs in local flora and fauna.
- Ingestion and dermal contact with COPCs present in groundwater.

There are no completed exposure pathways to surface water (no surface water is present on the site).

Free-phase liquid plume and mobile free-liquid transport are not potential contaminant sources or transport mechanisms at SS003.

Terrestrial animals and humans may be directly exposed to contaminants in surface soil at the facility via incidental ingestion, inhalation, or dermal contact.

7.4 RI SUMMARY AND CONCLUSIONS

Soil and groundwater at SS003 do not appear to be impacted by activities at the Former Auto Maintenance Shop at Lower Camp. Low levels of various analytes were found in several of the samples collected, however none of these detections exceeded ADEC cleanup levels. Contamination observed within Site SS002, as previously discussed in Section 6 of this document, does appear to extend southward into SS003. Soil borings installed within SS002 and SS003 indicate SS002 as the source of contamination in this area. Evidence of a contamination source at Site SS003 was not found in 2004.

7.5 SELECTED REMEDIAL ACTION FOR SSOO3

Given that neither soils nor groundwater at SS003 appear to have been impacted by former site activities, NFRAP status will be sought for this site. A NFRAP document will be prepared based on the 1998 and 2004 RI results.

8 1,000-GALLON MOGAS TANK AREA (SS004)

8.1 2004 FIELD ACTIVITIES AND SAMPLE RESULTS FOR SS004

Field activities at SS004 were performed from July 16 to August 2, 2004. Investigative soil borings were drilled on July 16 and July 17, 2004. Groundwater monitoring wells MW12 and MW13 were installed on July 22, 2004. These wells were developed on July 23, 2004 and sampled on July 24 and 25, 2004. Field activities were conducted in accordance with the 2004 Work Plan (Paug-Vik, 2004a).

8.1.1 Site Description

The 1,000-gallon MOGAS tank area is located approximately 250 feet to the northeast of the former Flight Operations Building at Lower Camp, (Figure 1-3). This tank contained motor-vehicle grade gasoline during the time the installation was active. Gasoline was also dispensed from the tank at this site. A drum storage area was also present at Site SS004.

Soil and groundwater samples were collected during the 1998 RI/FS (DOWL, 2001). This was accomplished through the installation of soil borings and one temporary monitoring well. Lead contamination was identified in the groundwater by this study.

8.1.2 Investigative Methodologies

Field sampling activities were conducted in accordance with the procedures described in Appendix A of the project Work Plan (Paug-Vik, 2004a). Section 8.2 describes field deviations to the work plan. Site reconnaissance and literature reviews were performed prior to sampling to identify the best investigative sampling locations.

8.1.3 Investigation Approach

Thirteen soil borings were drilled at SS004 during the 2004 field investigation. Five surface soil samples were also collected at this site using hand tools. Soil samples were field screened using a PID and sampled to investigate this area. Field screening results were used to determine the locations of analytical samples, as well as those of the monitoring wells installed at SS004. The two monitoring wells were installed, developed, and sampled. Sample locations are shown on Figure 8-1.

Soil samples were analyzed for GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and total metals. The groundwater samples were analyzed for GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and dissolved metals.

8.1.4 Field Documentation

Field documentation was performed in accordance with the project work plan (Paug-Vik, 2004a). Copies of all field notes and daily activity reports are included in Appendix A and Appendix B, respectively.

8.1.5 Soil Borings

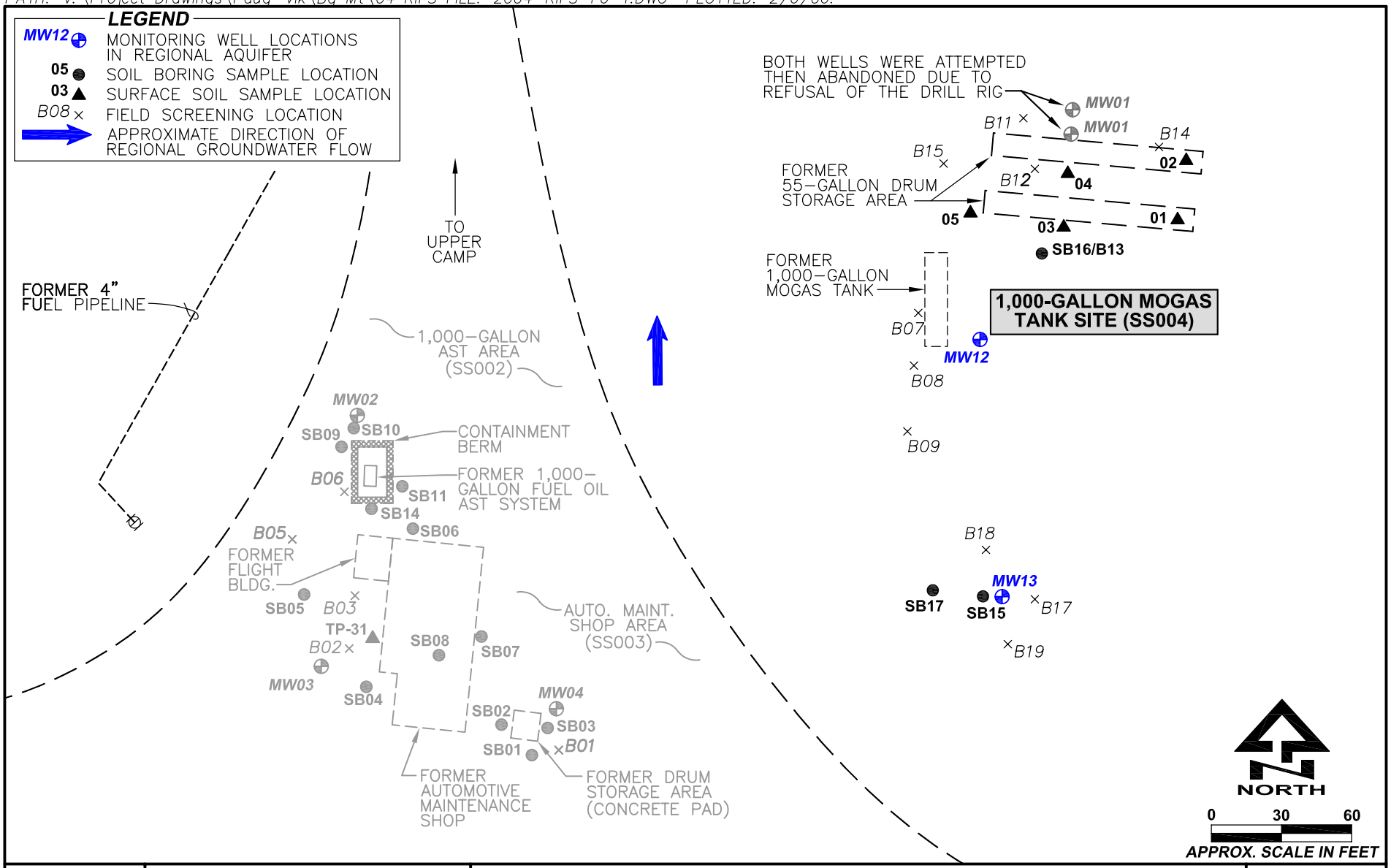
Thirteen soil borings were drilled and field screened. Soil cuttings generated during borehole installation were used to backfill the boreholes after sampling was complete. Field screening results were used to guide the locations and depths of analytical samples. Analytical samples were taken from most locations. GPS readings of soil boring and surface soil sample locations were also collected. Field screening results, GPS readings, and soil descriptions are reported in Table 8-1, below. Additionally, soil samples were collected at five-foot intervals from three well boreholes.

In addition, several surface samples were collected using hand tools from soils near the former 55-gallon drum storage area. These samples were field screened using the PID and sent to the project laboratory for GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and total metals analyses.

Twenty-three soil samples and one duplicate sample were submitted for laboratory analysis of GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and total metals. If it was determined to take an analytical sample mid-hole, the location name was changed to "SB" and that number series, such as B-10 changing to SB-15.

A summary of analytical results is presented in Table 8-2, below. Complete analytical results are located in Appendix E. Figure 8-2 shows sample locations and cleanup level exceedences with the exception of arsenic for Site SS004.

PATH: V:\Project Drawings\Paug-Vik\Bg Mt\04 RIFS FILE: 2004-RIFS-F6-1.DWG PLOTTED: 2/6/06.



DATE	FEB. 2006
CHKD	T.E.O.
DRAWN	OASIS-PDC
PROJ. NO	4119-11

611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON
ELMENDORF AFB, ALASKA

1,000-GALLON MOGAS TANK AREA (SS004) SAMPLE LOCATIONS

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
8-1

Table 8-1: SS004 Soil Sample Field Screening Results and Description

Sample Location	Depth (feet)	Latitude	Longitude	Approx. Elev. (ft. amsl)	PID Results (ppmV)	Soil Description
01	0-1	59.36263	155.25010	NA	0.0	Dry, brown sandy pebbly SILT.
02	0-1	59.36270	155.25014	NA	0.0	Dry, brown sandy pebbly SILT, w/traces of iron oxidation.
03	0-1	59.36265	155.25044	NA	0.0	Dry, brown sandy gravelly SILT.
04	0-1	59.36269	155.25045	NA	217	Dry, brown sandy SILT. Petroleum hydrocarbon odor noted.
05	0-1	59.36269	155.25063	687	0.0	Dry, brown sandy pebbly SILT.
B07	5-7	59.36260	155.25080	NA	0.6	Dry, brown sandy pebbly SILT.
B08	5-7	59.36254	155.25083	NA	0.5	Dry, brown sandy pebbly SILT.
B09	5-7	59.36245	155.25083	NA	0.3	Dry, brown sandy pebbly SILT.
SB15-01 (B10)	5-7	59.36228	155.25070	NA	603	Dry, brown silty gravelly SAND. Strong “sweet” odor noted.
SB15-02 (B10)	7-8.5	59.36228	155.25070	NA	20	Dry, brown silty gravelly SAND.
SB15-03 (B10)	1-1.5	59.36228	155.25070	NA	NA	Dry, brown silty gravelly SAND. Strong “sweet” odor noted.
SB15-04 (B10)	10-12	59.36228	155.25070	NA	3.6	Dry, brown silty gravelly SAND.
B11	5-7	NA	NA	NA	0.2	Dry, brown sandy gravelly SILT.
B12	5-7	NA	NA	NA	0.2	Dry, brown sandy gravelly SILT.
B14	5-7	NA	NA	NA	0.0	Dry, brown sandy gravelly SILT.
B15	5-7	NA	NA	NA	0.5	Dry, brown sandy gravelly SILT.
SB16 (B13)	5-7	NA	NA	NA	0.4	Dry, brown sandy gravelly SILT.
SB17 (B16)	0-1	59.36227	155.25077	NA	0.2	Dry, brown silty gravelly SAND.
SB17 (B16)	5-7	59.36227	155.25077	NA	0.1	Dry, brown sandy gravelly SILT.
B17	1-3	59.36236	155.25072	NA	1.2	Dry, brown sandy gravelly SILT.
B17	5	59.36236	155.25072	NA	0.3	Dry, brown sandy gravelly SILT.
B18	1-3	59.36228	155.25059	NA	0.4	Dry, brown sandy gravelly SILT.
B18	5	59.36228	155.25059	NA	0.4	Dry, brown sandy gravelly SILT.
B19	3	59.36224	155.25067	NA	0.4	Dry, brown sandy gravelly SILT.
B19	5	59.36224	155.25067	NA	0.3	Dry, brown sandy gravelly SILT.
MW01-01	1-2	59.36270	155.25038	NA	0.3	Dry brown sandy pebbly gravelly SILT.
MW01-02	5-7	59.36270	155.25038	NA	1.2	Dry, brown sandy gravelly SILT.
MW01-03	10-12	59.36270	155.25038	NA	6.7	Dry, brown sandy gravelly SILT w/occasional cobbles.
MW01-04	15-17	59.36270	155.25038	NA	0.2	Dry, brown sandy gravelly SILT w/occasional cobbles.
MW01-05	20-22	59.36270	155.25038	NA	0.3	Dry, brown sandy gravelly SILT.
MW01-06	30-32	59.36270	155.25038	NA	0.2	Dry, brown sandy gravelly SILT w/occasional cobbles.
MW01-07	38-40	59.36270	155.25038	NA	0.3	Moist, brown sandy gravelly SILT w/occasional cobbles.
MW12-01	0-1	NA	NA	NA	0.4	Dry, red/brown sandy SILT w/some organic matter.
MW12-02	7-8.5	NA	NA	NA	0.2	Dry, brown sandy gravelly SILT.
MW12-03	15-16.5	NA	NA	NA	0.3	Dry, brown silty gravelly SAND.
MW13-01	15-17	NA	NA	NA	0.6	Dry, brown silty gravelly SAND.
MW13-02	25-25.5	NA	NA	NA	1.2	Wet, gray/brown sandy SILT.

Note:
GPS readings were taken on the Universal Transverse Mercator (UTM) coordinate system using the North American Datum of 1927 (NAD27).

Table 8-2: SS004 Soil Sample Analytical Results Summary

Sample Location		GRO (mg/Kg)	DRO (mg/Kg)	RRO (mg/Kg)	Total Metals (mg/Kg)	PCBs (mg/Kg)	Pesticides (mg/Kg)	PAHs (mg/Kg)	VOCs (mg/Kg)
01	0-1	0.384 F VB, VJ	2.26F VJ	13.1 F VJ	**As – 4.22 VJ**	ND	ND	BCL	**MC – 0.318 F VB, VJ**
01(D)	0-1	0.459F VB, VJ	ND	13.9 F VJ	**As – 3.11 VJ**	BCL	BCL	ND	**MC – 3.78 F VB, VJ**
02	0-1	0.533 F VB, VJ	6.62 VJ	56.3 VJ	**As – 48.50 VJ**	ND	BCL	ND	**MC – 0.177 F VB, VJ**
03	0-1	0.443 F VB, VJ	**678 D VJ, VR**	6,800 D VJ, VR	**As – 4.22 VJ**	ND	BCL	BCL	**MC – 0.301 F VB, VJ**
04	0-1	32.2 VJ	**2,170 D VJ, VR**	92.2 F D VJ	**As – 2.82 VJ**	ND	BCL	BCL	**MC – 0.345 F VB, VJ**
05	0-1	0.841 F VB, VJ	ND	8.21 F VJ	**As – 3.77 VJ**	ND	BCL	ND	**MC – 0.471 F VB, VJ**
SB15-01	5-7	1.99 F VB, VJ	ND	4.32 F VB, VJ	**As – 4.51 VJ**	ND	ND	ND	**MC – 0.340 F VB, VJ**
SB15-02	7-8.5	0.559 F VB, VJ	ND	2.71 F VB, VJ	**As – 3.27 VJ**	ND	ND	ND	**MC – 0.265 F VB, VJ**
SB15-03	1-1.5	24.3 F VB, VJ	**292 D VJ**	23.8 F VB, VJ	**As – 4.77 VJ**	ND	BCL	BCL	**MC – 0.557 F VB, VJ**
SB15-04	10-12	0.882 F VB, VJ	ND	2.22 F VB, VJ	**As – 3.30 VJ**	ND	ND	BCL	**MC – 0.352 F VB, VJ**
SB16-01	5-7	0.624 F VB, J	3.87 F VJ	NS	**As – 4.10 VJ**	BCL	ND	ND	**MC – 0.414 F VB, VJ**
SB17-01	0-1	0.666 F VB, VJ	3.10 F VJ	NS	**As – 3.74 VJ**	ND	ND	ND	ND
MW01-01	1-2	30.4 VJ	4.71 VJ	NS	**As – 3.75 VJ**	ND	ND	BCL	ND
MW01-02	5-7	33.6 VJ	ND	NS	**As – 3.81 VJ**	ND	ND	ND	ND
MW01-03	10-12	0.425 F VB, VJ	2.92 F VJ	NS	**As – 3.97 VJ**	ND	ND	BCL	ND
MW01-04	15-17	0.435 F VB, VJ	ND	NS	**As – 2.33 VJ**	ND	ND	BCL	ND
MW01-05	20-22	0.606 F VB, VJ	3.24 F VJ	NS	**As – 2.63 VJ**	ND	ND	BCL	ND
MW01-06	30-32	0.332 F VB, VJ	ND	NS	**As – 5.17 VJ**	ND	ND	ND	ND
MW01-07	38-40	0.447 F VB, J	4.96 VJ	NS	**As – 3.70 VJ**	ND	BCL	ND	ND
MW12-01	0-1	1.32 F VB	10.8	83.5	**As – 3.66**	**Arochlor 1260 – 4.32 D**	ND	ND	**MC – 0.104 F VB**
MW12-02	7-8.5	0.802 F VB	ND	ND	**As – 3.18**	ND	ND	ND	**MC – 0.0737 F VB**
MW12-03	15-16.5	1.14 F VB	ND	ND	**As – 3.53**	ND	ND	ND	**MC – 0.101 F VB**
MW13-01	15-17	0.502 F VB	ND	ND	**As – 2.91**	ND	ND	ND	**MC – 0.0368 F VB**
MW13-02	25-25.5	0.647 F VB	ND	ND	**As – 2.24**	ND	ND	ND	**MC – 0.0479 F VB**
Cleanup Level		*300*	*250*	*11,000*	*As – 2.0*	*1.0*	*Varies*	*Varies*	*MC – 0.015*

Notes:
Cleanup Level from ADEC 18 AAC 75, Tables B1 and B2, Under 40 inch Zone, Migration to Groundwater.
GRO – Gasoline Range Organics
DRO – Diesel Range Organics
RRO – Residual Range Organics
mg/Kg – Milligrams per Kilogram
ND – Analyte was not detected above the MDL.
NS – Not Sampled.
BCL – Below the cleanup level.
MC – Methylene Chloride
BOLD – Sample results exceeded the applicable cleanup level.
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
B – The analyte was found in the associated blank, as well as in the sample.
D – The is a laboratory qualifier indicating that the value is the result of a dilution.
R – The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.

There were no GRO, RRO, pesticides, or PAHs detected in soils at SS004 above applicable ADEC cleanup levels. The method blank samples and trip blank samples contained GRO at concentrations higher than the MDL, but lower than the RL. Project samples within five times the blank contamination were flagged "VB." RRO was found in the method blank sample below the RL and associated project samples were flagged "VB" during the data review process.

DRO concentrations exceeded the ADEC cleanup level (ADEC, 2004a) in three samples at SS004, (SS03 – 678 mg/Kg, SS04 – 2,170 mg/Kg, and SB15-03 – 292 mg/Kg). Cleanup level exceedences are shown on Figure 8-2. DRO surrogate recovery on work order B4G0528 was low and all associated sample results were flagged "VJ." Samples from locations 03 and 04 had non-detectable concentrations of surrogate due to high concentrations of analyte and/or required sample dilutions. These DRO results were flagged "VR," however it is likely that the sample results are above the cleanup level for DRO.

The PCB Arochlor-1260 was detected at a concentration exceeding the ADEC cleanup level of 1 mg/Kg at sample location MW12-01 (4.32 mg/Kg). Some surrogate recovery difficulties were noted during sample analysis for PCBs. Associated project sample results have been flagged "VJ."

The VOC methylene chloride was detected above the ADEC cleanup level of 0.015 mg/Kg in several samples. Detections of methylene chloride ranged from 0.0368 mg/Kg to 3.78 mg/Kg. There were no other VOC detections in the soil samples at SS004 that exceeded cleanup levels. Methylene chloride was detected in the method blank and the trip blank samples at concentrations greater than the MDL, but less than the RL. Associated project sample results were flagged "VB" to indicate potential blank contamination. Methylene chloride is a common laboratory contaminant.

Arsenic was detected above the ADEC cleanup level of 2.0 mg/Kg in all soil samples. Arsenic concentrations predominantly ranged from 2.24 mg/Kg to 5.17 mg/Kg. These concentrations are within reported background arsenic levels for this site. Further discussion of background arsenic levels in soils at the Big Mountain site can be found in Section 5.2.4 and in Table 5-6 of this report.

The sample collected at SS02 had an arsenic concentration of 48.5 mg/Kg, which is significantly higher than reported background arsenic levels for Big Mountain. The 95% Upper Confidence Limit (95% UCL) of the mean was calculated for arsenic in soil at Site SS004 using the USEPA statistical program ProUCL (Singh, et al, 2004). Data set outliers were identified using WinSTAT for Microsoft Excel (version 2001.1). WinSTAT

calculates outliers by assuming a normal distribution and by using one of the following methods:

- Data points more than a 4-sigma multiple of the standard deviation (any point farther than four standard deviations away from the mean) are considered outliers.
- A 0.05 probability (any point at a distance such that at least 95% of all of the other points are closer).

The arsenic detection of 48.5 mg/Kg at sample location SS02 (Site SS004) was identified as an outlier by this process. The 95% UCL with the result from SS02 included is 13.6 mg/Kg and the 95% UCL without the result from SS02 is 3.9 mg/Kg.

Overall completeness for this project was calculated to 95 percent. Holding times for all analytical sample requests were met with two exceptions, noted in the QAR in Appendix H. SS004 soil samples were received at the project laboratory with cooler temperatures outside of the recommended range. All detectable results for analyses included in these coolers were flagged "VJ" during the data review process.

8.1.6 Monitoring Well Installation

Two monitoring wells (MW12 and MW13) were installed on July 22, 2004. Soil samples were collected during installation and were field screened. Field screening results are reported in Table 8-1. Monitoring well installation logs are provided in Appendix G. Figure 8-1 shows the locations of these wells.

An attempt was made to install a monitoring well (MW01) near the former drum storage area at SS004 (Figure 8-1), however the drill rig hit refusal at approximately 40 feet bgs in two separate locations before groundwater contact was made. Groundwater was encountered at MW12, located approximately 100 feet to the southwest of MW01 borehole locations, at a depth of 28.61 feet bgs. Both boreholes were abandoned according to ADEC guidelines. Soil samples were collected during advancement of both boreholes. These samples were field screened and results are provided in Table 8-1.

Seven analytical samples were taken while attempting to install MW01. Three samples were collected during the installation of MW12 and two were taken while installing MW13. Samples depths are reported in Table 8-1. Soil was submitted for laboratory analysis of GRO, VOCs, DRO, PCBs, Pesticides, PAHs, and total metals. Analytical results are provided in Table 8-2.

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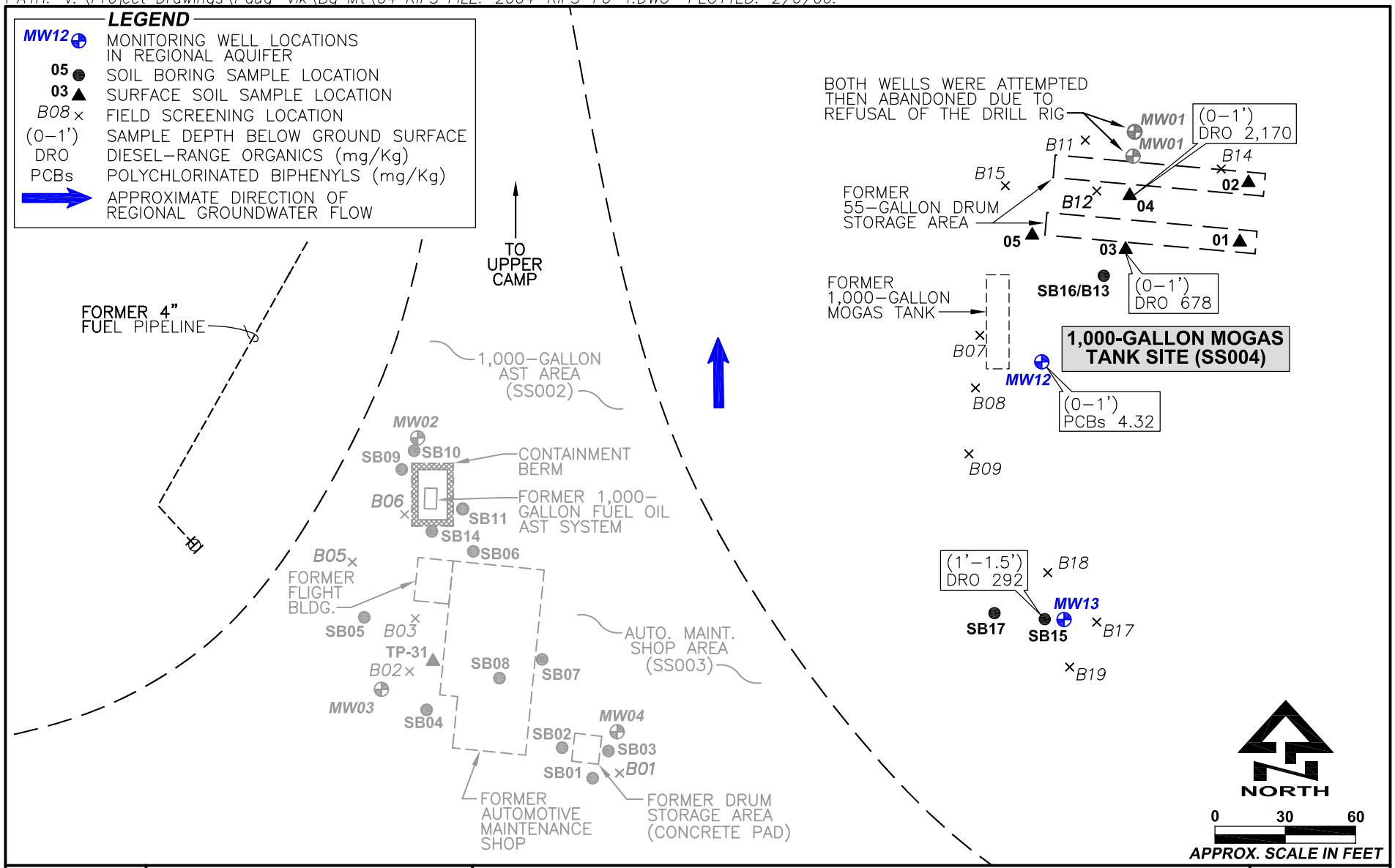

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611TH AIR SUPPORT GROUP
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ELMENDORF AFB, ALASKA

(SS004) SOIL SAMPLE CLEANUP LEVEL EXCEEDENCES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE
8-2

The PCB Arochlor-1260 was detected above the ADEC cleanup level in one of the samples collected at MW12. Arsenic was detected in all soil samples collected at MW01, MW12, and MW13 above the ADEC cleanup level (ADEC, 2004a), but within background levels for this area. The VOC methylene chloride was detected above the ADEC cleanup level of 0.015 mg/Kg (ADEC, 2004a) in all soil samples collected during the installation of MW12 and MW13. It is likely that these detections are the result of laboratory contamination. Complete results can be found in Appendix E.

8.1.7 Monitoring Well Development

MW12 and MW13 were developed on July 23, 2004 using a disposable bailer. A surge/purge technique was utilized to fully develop the wells and three casing volumes were removed from each monitoring well. Well development data sheets are provided in Appendix D.

8.1.8 Groundwater Sampling

Twenty-four hours after development, the monitoring wells were purged and sampled on July 24, 2004. A duplicate sample was collected at monitoring well MW13. A minimum of three well volumes were removed from each well during purging. Groundwater parameters were measured after each well volume to ensure stabilization before sampling, as described in the 2004 work plan (Paug-Vik, 2004a). Final groundwater parameter readings are shown in Table 8-3 below.

Table 8-3: Groundwater Parameters for SS004

Sample Name	Temp (^{o}C)	PH	Conductivity (µS)	DO (mg/L)	TDS (ppm)	ORP (mV)
04RISS004-MW12-01GW	6.3	8.2	190	9.25	170	-56
04RISS004-MW13-01GW	5.7	7.6	120	10.81	110	51

Notes:
mV - milivolts
DO – Dissolved oxygen
ORP - Oxidation Reduction Potential
ppm - parts per million
TDS - Total Dissolved Solids
µS - microsiemens

After purging, MW12 and MW13 were sampled and submitted for laboratory analysis of GRO, VOCs, DRO, RRO, PCBs, Pesticides, PAHs, and dissolved metals. A summary of groundwater analytical results is presented in Table 8-4, below. Complete analytical results can be found in Appendix E.

Table 8-4: SS004 Groundwater Analytical Results Summary

Well	GRO (µg/L)	DRO (mg/L)	RRO (mg/L)	RCRA8 Metals (mg/L)	PCBs (mg/L)	Pesticides (µg/L)	PAHs (µg/L)	VOCs (µg/L)
MW12	35.1 F, VB, VJ	0.208 F VB	0.351 F VB	BCL	All ND	BCL	All ND	BCL
MW13	16.6 F VB, VJ	0.231 F VB	0.348 F VB	BCL	All ND	BCL	All ND	All ND
MW13(D)	15.9 F VB, VJ	0.113 F VB	0.394 F VB	BCL	All ND	BCL	All ND	All ND
Cleanup Level	*1,300*	*1.5*	*1.1*	*Varies*	*0.0005*	*Varies*	*Varies*	*Varies*

Notes
Cleanup Level – ADEC 18 AAC 75 Table C, Groundwater Cleanup Levels, (ADEC, 2004a).
BOLD indicates cleanup level exceedence.
DRO – Diesel Range Organics
GRO – Gasoline Range Organics
RRO – Residual Range Organics
PCBs – Polychlorinated Biphenyls
PAHs – Polynuclear Aromatic Hydrocarbons
RCRA Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver
VOCs – Volatile Organic Compounds
mg/L – Milligrams per liter
µg/L – micrograms per liter
ND – Analyte was not detected above laboratory method detection limits
BCL – Below the Cleanup Level.
V – The "V" flag indicates that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the RL.
J – The analyte was positively identified, but the quantitation is an estimation.
B – The analyte was found in the associated blank and in the project sample.

Analytical results were compared to cleanup levels in 18 AAC 75, Table C, Groundwater Cleanup Levels (ADEC, 2004a). No cleanup level exceedences were noted for the groundwater samples collected at SS004. GRO was detected in the method blank and in the trip blank at concentrations greater than the MDL, but below the RL. Associated project results for GRO have been flagged "VB." The method blank contained DRO below the RL and project sample results were flagged "VB" to indicate potential blank contamination. RRO was detected in the method blank as well at concentrations above the MDL, but below the RL. Positive project sample results were flagged "VB."

The calculated completeness for this project is 95 percent. Holding times were met for groundwater samples. One cooler arrived at the laboratory above the recommended temperature. DRO and RRO analyses would not be affected by this slight temperature difference, and thus qualification was not necessary. All of the VOC vials contained headspace and sediment. All sample results for GRO and VOCs were flagged "VJ" during the data review process.

8.1.9 Groundwater Flow and Gradient at SS002, SS003, and SS004

Well locations, relative elevations of monitoring wells, and depth to water measurements were determined in order to calculate groundwater flow direction and gradient at site SS002, SS003, and SS004.

Well locations were measured using a GPS and a hand-held tape measurer. Distances to wells from identified landmarks were recorded.

Relative elevations were measured with a standard survey rod and level. Monitoring well MW12 at Lower Camp site SS004 was used as a benchmark and was given an elevation of 100.00 feet. Based on the newly established benchmark, top-of-casing (TOC) elevations were determined for all wells. TOC measurement points were marked with a black permanent marker to maintain consistent depth-to-water (DTW) measurements in the future.

Relative groundwater elevations were calculated by subtracting the DTW from the TOC elevations and are presented in Table 8-5 below.

Table 8-5: Relative Groundwater Elevations for SS002, SS003, and SS004

Monitoring Well	TOC Elevation (feet)	DTW (feet)	Total Depth (feet)	Groundwater Elevation (feet)
MW-12	100.00	29.95	33.1	70.05
MW-13	93.43	20.65	27.85	72.78
MW-02	95.39	26.07	31.29	69.32
MW-03	94.16	20.90	31.05	73.26
MW-04	94.68	23.68	28.55	71.00
MW-05	88.43	22.49	26.70	65.94

Note:
DTW – Depth to Water
TOC – Top of Casing

Groundwater elevations are plotted on Figure 8-3. Groundwater contour lines were drawn based on these relative elevations. The estimated direction of groundwater flow for MW05 is shown on Figure 5-2. Based on the contour lines drawn using data from MW02, MW03, MW04, MW12, and MW13, groundwater flow is to the north/northwest and has a gradient of approximately 0.03 feet per foot.

Groundwater flow in the vicinity of MW05 is thought to be toward the southeast, following topography. The exact direction of groundwater flow for this particular area of Lower Camp is unknown due to the lack of groundwater data.

8.1.10 Investigation-Derived Waste Handling

Minimal IDW was generated during site sampling activities. Sampling gloves, disposable scoops, and other miscellaneous items were used and disposed of during this sampling event. All IDW was collected for this project. The IDW was disposed of and eventually burned in the on-site SmartAsh® burner.

Soil cuttings produced during monitoring well installation were collected in Supersacks® and stored on-site pending analytical results. All Supersacks® were clearly labeled with the well ID, the date of containerization, and contact information. They were then placed in a connex for winter storage. The soils from MW01 showed no contamination that exceeded ADEC cleanup levels and they will be dispersed to the ground near the abandoned boreholes in the summer of 2005. The soils from MW12 exceeded the cleanup level for PCBs and will be included in the PCB-contaminated soils removal project. Soils from MW13 exceeded the cleanup level for DRO and will be included in the POL soil treatment project. Soil cuttings generated during borehole installation and during the attempted installation of monitoring well MW01 were used to backfill the borehole once sampling was complete.

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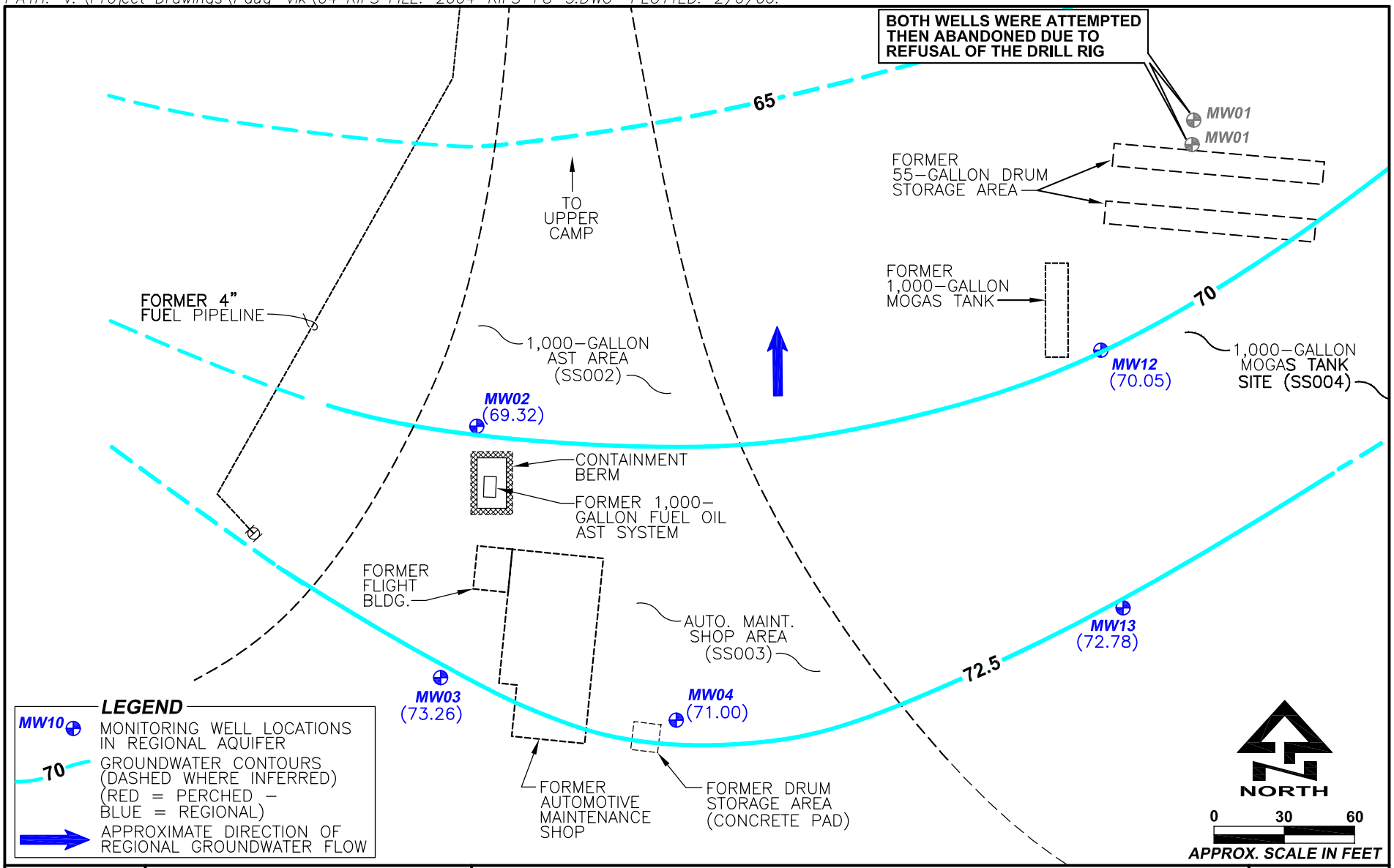


DATE FEB. 2006 CHKD T.E.O. DRAWN OASIS-PDC PROJ. NO 4119-11	611TH AIR SUPPORT GROUP 611TH CIVIL ENGINEER SQUADRON ELMENDORF AFB, ALASKA	**1,000-GALLON AST AREA (SS002), AUTOMOTIVE MAINTENANCE SHOP AREA (SS003), AND 1,000-GALLON MOGAS TANK (SS004) GROUNDWATER FLOW AND GRADIENT** 2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY BIG MOUNTAIN RADIO RELAY STATION, ALASKA	FIGURE **8-3**

8.2 DEVIATIONS FROM WORK PLAN

Deviations from the work plan that occurred during the sampling effort are as follows:

- A well was not installed near the location of the former drum storage area as called for in the project work plan due to the lack of occurrence of groundwater in two well boreholes advanced at the site. Instead, a monitoring well was installed approximately 180 feet to the south of that area in a location where contamination was identified in field screening samples.
- Field screening with the PID was not conducted at every soil sampling location due to inclement weather and malfunctioning of equipment.
- One additional surface soil sample and eight additional subsurface soil samples were collected at this site to delineate the nature and extent of any contamination.

8.3 RI FINDINGS – SS004

This section presents the findings from the field investigations at the former 1,000-Gallon MOGAS Tank Area, SS004. The following sections discuss field observations, analytical results, and estimated volume and extent of contamination.

8.3.1 Data Evaluation Approach

Field observations and analytical data obtained during the 2004 RI were compared with the DQOs identified in Section 1.5 to identify areas of contamination.

Discussion of analytical results is limited to specific analytes detected. Additional information on analytical method detection limits (sensitivity), QC samples (other than field duplicates), precision and accuracy calculations, and evaluation of data quality are described in the analytical data QAR included as Appendix H.

8.3.2 Soil Sampling

There were no GRO, RRO, pesticides, or PAHs detected in soils at SS004 above applicable ADEC cleanup levels. DRO concentrations exceeded the ADEC cleanup level in three soil samples at SS004, all at surface depth. Two of these samples (Locations 03 and 04) were collected from soils in the vicinity of the Former 55-Gallon Drum Storage area. The sample collected at Location SB15-03 was collected approximately 150 feet to the south of the Former 1,000-Gallon MOGAS Tank location.

The PCB Arochlor-1260 was detected at a concentration exceeding the ADEC cleanup level at sample location MW12-01. MW12 is approximately fifteen feet to the east of the Former 1,000-Gallon MOGAS Tank location. PCB contamination is noted at surface depth only. However the next soil sample in this borehole was collected at a depth of

seven to eight feet bgs, and while this sample was non-detect for PCBs, PCB contamination could possibly exist in soils above this depth.

The VOC methylene chloride was detected above the ADEC cleanup level in several samples. There were no other VOC detections in the soil samples at SS004 that exceeded cleanup levels. Methylene chloride was detected in both the method blank and the trip blank samples above the MDL, but below the RL. All project samples with positive results for methylene chloride have been flagged "VB."

Arsenic was detected above the ADEC cleanup level of 2.0 mg/Kg in all soil samples. Reported concentrations are generally within background arsenic levels for this site. One result from location SS02 (48.5 mg/Kg) was above reported background arsenic levels for Big Mountain. The 95% UCL of the mean was calculated for this result using the USEPA program ProUCL (Singh, et al, 2004). This result was identified as an outlier by this process.

The 1998 RI/FS did not find any cleanup level exceedences in soils (DOWL, 2001).

Soil contamination at SS004 appears to be limited to DRO constituents and PCBs. DRO contamination was found in surface soils in three areas. PCB contamination is present in surface soils at one location. Soil at SS004 is predominantly glacial alluvium, silty gravelly sands and sandy gravelly silts.

8.3.3 Groundwater Sampling

Low levels of GRO, DRO, RRO, Pesticides, VOCs, and the RCRA Metals were found in the groundwater samples collected at SS004. None of these detections exceeded ADEC cleanup levels for groundwater (ADEC, 2004a).

8.3.4 Conceptual Site Model

Potential human receptors at SS004 were identified during the 2004 RI. The resulting exposure scenarios are listed below:

- Recreational & Subsistence Exposure Scenario (short-term visits by fishermen, hunters, and recreational users).
- Industrial Exposure Scenario (short-term visits by site workers and camp support staff during investigation and cleanup efforts).

These following potential exposure scenarios were considered complete at the site:

- Inhalation of dust-borne COPCs in surface soils.
- Ingestion of and dermal contact with soil-borne COPCs in surface soils.

- Bioaccumulation of COPCs in local flora and fauna.
- Ingestion and dermal contact with COPCs in groundwater.

There are no completed exposure pathways to surface water (no surface water is present on the site).

Free-phase liquid plume and mobile free-liquid transport are not potential contaminant sources or transport mechanisms at SS004.

Terrestrial animals and humans may be directly exposed to contaminants in surface soil at the facility via incidental ingestion, inhalation, or dermal contact.

8.4 SS004 RI SUMMARY AND CONCLUSIONS

Contamination at SS004 is limited to DRO and PCBs in soil. DRO contamination is present in surface soils at the Former 55-Gallon Drum Storage Area and in surface soils approximately 150 feet to the south of the Former 1,000-Gallon MOGAS Tank site. PCB contamination was found in surface soils to the east of the former tank location, at MW12.

The majority of arsenic detections in soils at SS004 are within background arsenic levels for the Big Mountain site. One arsenic detection at sample location SS02 had a concentration significantly higher than arsenic background levels. This detection has been identified as an outlier by calculating the 95% UCL of the mean for arsenic in soil as Site SS004. No evidence of a release from a waste oil drum or another source of arsenic (i.e. no appreciable concentrations of other metals, POLs, VOCs, PCBs, or pesticides) have been identified for this sample location.

Groundwater at SS004 does not appear to be affected by localized soil contamination. Some low-level concentrations of GRO, DRO, RRO, VOCs, Pesticides, and the RCRA Metals were found at various sampling sites, but did not exceed cleanup levels.

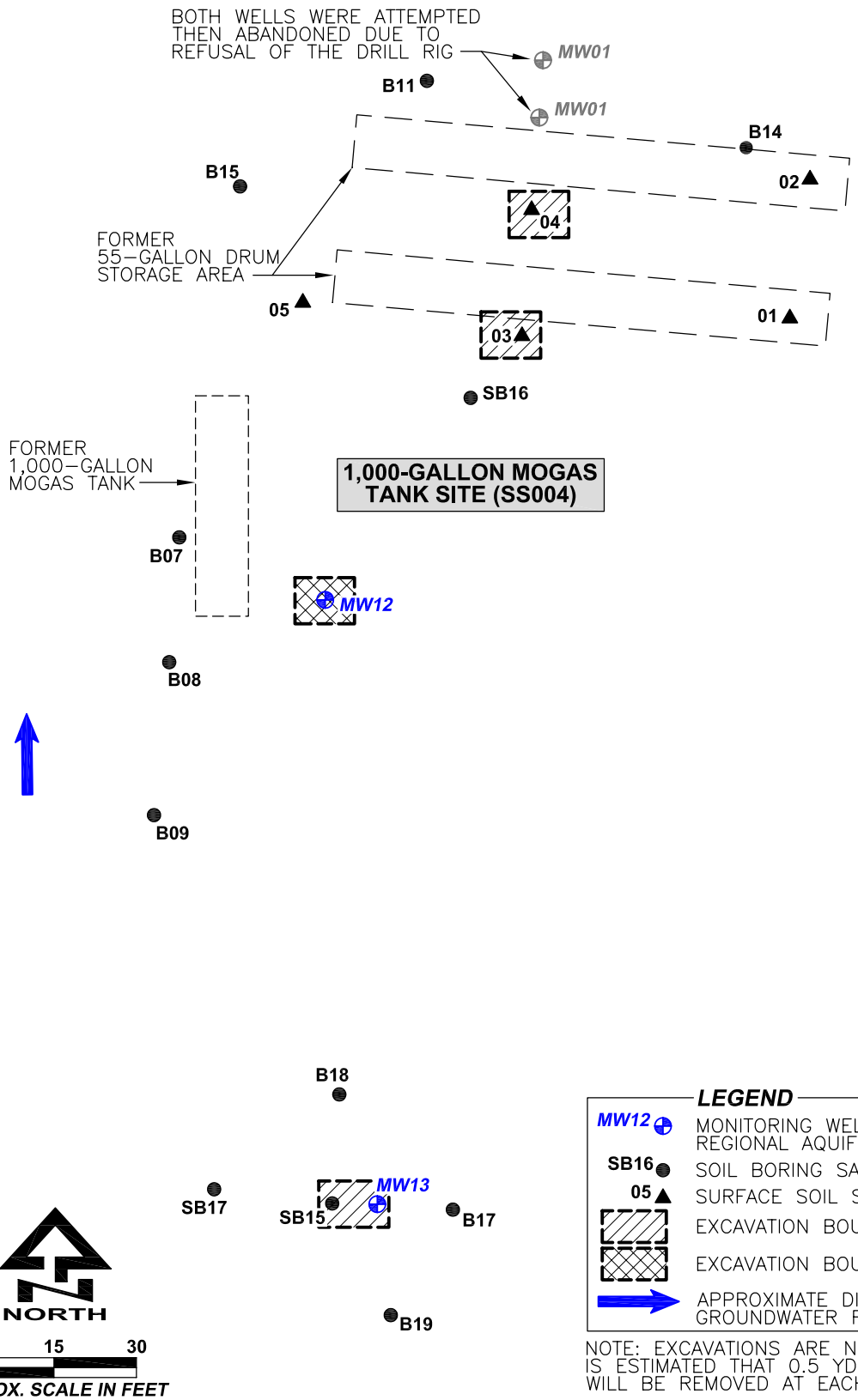
Soil volume estimates are based on analytical sampling results. It is estimated that approximately 1.5 to 3 total cubic yards of soils at the three locations are contaminated by DRO. A minimal amount of soil appears to be impacted by DRO contamination at SS004. DRO contamination is limited to surface soils (zero to two feet bgs) with the horizontal extent of contamination being less than three feet in diameter. PCB contamination was noted in a minimal amount of soil at SS004 at surface depth as well. Again the horizontal extent of contamination is less than three feet in diameter. PCB contamination is estimated to impact approximately one cubic yard of soil at MW12.

8.5 SELECTED REMEDIAL ACTION FOR SS004

Given that contamination at this site appears to be limited in volume and extent, the recommended remedial action is limited soil removal and treatment. DRO contaminated soils will be removed using hand tools to a depth of approximately two and a half feet bgs. These DRO-contaminated soils will be thermally treated on-site to below the applicable cleanup level. Removal and treatment may take place concurrently with remedial actions at ST001 and SS002. The areas and boundaries for excavation of contaminated soils are shown in Figure 8-4. MW13 will be left in place for future groundwater monitoring purposes.

PCB contaminated soils may also take place concurrently with the planned removal action at two Upper Camp sites, SS009 and SS010. PCB-contaminated soil will be removed using hand tools to the extent possible. MW12 will be left in place for future groundwater monitoring. Analytical samples will be collected during the removal process to verify that all contaminated soils have been removed from the site. Contaminated soils will be placed in new 55-gallon plastic drums or a similar DOT-approved container and shipped off-site for treatment and disposal following 49 Code of Federal Regulations (CFR) procedures and guidelines, as well as guidelines found in the 611th Waste Handling Handbook (USAF, 2004).

Once removal of contaminated soils has been confirmed, NFRAP status will be sought for SS004. A NFRAP document will be prepared based on the findings of the 2004 RI and the actions taken in 2005 to address the contaminated soils noted above.



NOTE: EXCAVATIONS ARE NOT DRAWN TO SCALE. IT IS ESTIMATED THAT 0.5 YD3 TO 1.0 YD.3 OF SOIL WILL BE REMOVED AT EACH EXCAVATION SITE.

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SS004 SOIL EXCAVATION BOUNDARIES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE

8-4

9 TEMPORARY AUTO STORAGE SHOP AREA (SS011)

9.1 2004 FIELD ACTIVITIES AND SAMPLE RESULTS FOR SS011

Field activities at SS004 were performed from July 9 to August 2, 2004. Surface soil samples were collected on July 9, 2004, and subsurface soil samples were collected on July 10, with the exception of one subsurface soil sample, which was collected on July 15.

9.1.1 Site Description

The Temporary Auto Storage Shop area is located approximately 75 feet to the southwest of the former Auxiliary Dormitory Building at Upper Camp (Figure 1-4). This building was used as a storage facility for vehicles during active installation operations. It is likely that waste oils were also stored and used at this site. The Temporary Auto Storage Shop was demolished in 2003 under the Clean Sweep Phase 1 project (ILC/Paug-Vik, 2004a). The concrete foundation at this site was removed during 2004 Clean Sweep activities (ILC/Paug-Vik, 2004b).

Soil samples were collected during the 1998 RI/FS (DOWL, 2001). Shallow test pits were excavated at six different locations at SS011 in 1998. DRO, pentachlorophenol, PCBs, arsenic, and chromium were detected at concentrations exceeding ADEC cleanup levels. No groundwater was encountered during this study.

9.1.2 Investigative Methodologies

Field sampling activities were conducted in accordance with the procedures described in Appendix A of the project Work Plan (Paug-Vik, 2004a), Section 9.2 of this report, which describes field deviations to the work plan. A site reconnaissance and literature review was performed prior to sampling to identify the best investigative sampling locations to define the extent of contamination.

9.1.3 Investigation Approach

Ten surface soil samples and five subsurface soil samples were collected at SS011 during the 2004 field investigation. Surface soil samples were collected using hand tools, and subsurface samples were collected by digging test pits with an excavator. One subsurface sample was collected using hand tools because the excavator was unavailable at the time the sample was collected.

Soil samples were field screened using a PID and sampled to investigate this area. Locations of subsurface samples were determined by field screening results. However,

most PID field screening results were relatively low, so subsurface soil sample locations were also determined by historical sample results.

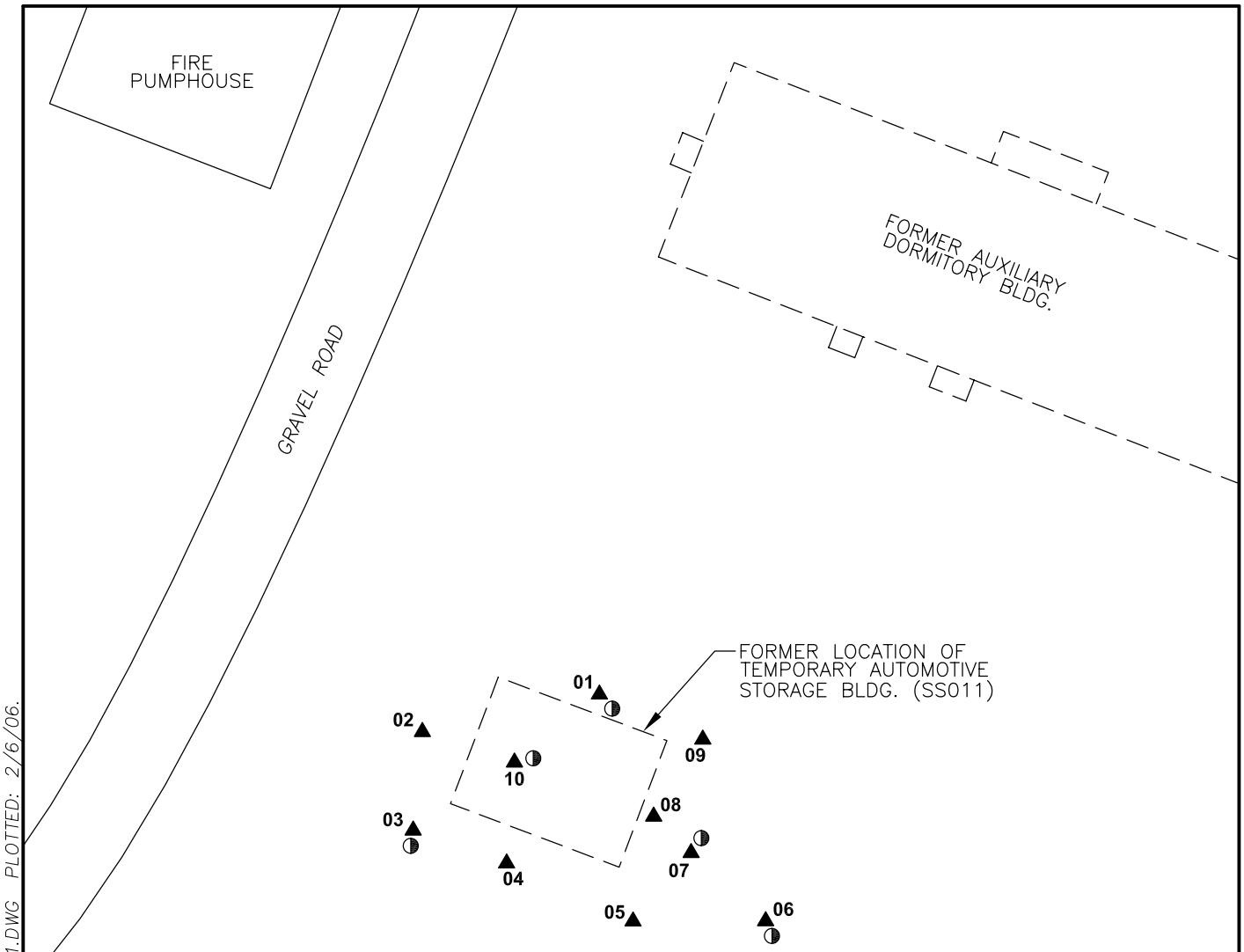
Soil samples were analyzed for GRO, VOCs, DRO, PCBs, SVOCs, and RCRA metals. Sample locations are shown on Figure 9-1.

9.1.4 Field Documentation

Field documentation was performed in accordance with the project work plan (Paug-Vik, 2004a). Copies of all field notes and daily activity reports are included in Appendix A and Appendix B, respectively.

9.1.5 Surface Soil Samples

Ten surface soil samples were collected using hand tools and field screened with a PID on July 9, 2005. One duplicate surface soil sample was collected at sample location 10. Analytical samples were taken from all locations. Field screening results and soil descriptions are reported in Table 9-1, below. All analytical samples were submitted to the project laboratory for GRO, VOCs, DRO, PCBs, SVOCs, and total metals analyses. PAH analysis by USEPA Method 8270SIM was completed on all surface soil samples as well.



NORTH

0 15 30

APPROX. SCALE IN FEET

LEGEND

05 ▲ SURFACE SOIL SAMPLE

◑ TEST PIT/SUBSURFACE SAMPLE

PATH: V:\Project Drawings\Paug-Vik\Bg Mt\04 RIFS FILE: 2004-RIFS-F9-1.DWG PLOTTED: 2/6/06.

DATE	FEB. 2006
CHKD	T.E.O.
DRAWN	OASIS-PDC
PROJ. NO	4119-11

611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON
ELMENDORF AFB, ALASKA

AUTOMOTIVE STORAGE BUILDING (SS011) SAMPLE LOCATIONS

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE

9-1

Table 9-1: Surface Soil Sample Field Screening Results and Description

Sample Location	Depth (in feet)	PID Results (in ppmV)	Soil Description
01	0-1	10.7	Dry, brown sandy GRAVEL.
02	0-1	0.0	Dry, brown sandy GRAVEL.
03	0-1	0.9	Dry, brown sandy GRAVEL.
04	0-1	0.7	Dry, brown sandy GRAVEL.
05	0-1	0.3	Dry, brown sandy GRAVEL.
06	0-1	0.4	Dry, brown sandy GRAVEL.
07	0-1	4.2	Dry, brown sandy GRAVEL.
08	0-1	2.4	Dry, brown sandy GRAVEL.
09	0-1	0.3	Dry, brown sandy GRAVEL.
10	0-1	0.9	Dry, brown sandy GRAVEL. Taken from “drain” area.

A summary of analytical results is presented in Table 9.2, below. Complete analytical results are located in Appendix E. Figure 9-2 shows cleanup level exceedences, with the exception of results for metals. Analytical results were compared to cleanup levels found in 18 AAC 75, Tables B1 and B2, Method Two Soil Cleanup Levels, Inhalation and Ingestion (ADEC, 2004a). Cleanup levels for specific analytes were also found in the ADEC Technical Memorandum 01-007, Additional Cleanup Values (ADEC, 2003c).

Table 9-2: SS011 Surface Soil Sample Analytical Results Summary

Sample Location	GRO (mg/Kg)	DRO (mg/Kg)	PCBs (mg/Kg)	VOCs (mg/Kg)	SVOCs (mg/Kg)	PAHs (mg/Kg)	Metals (mg/Kg)
01	6.69 D, VJ	25 VM, VJ	BCL	All ND	All ND	All ND	BCL
02	0.918 D, VB	27.5 VM, VJ	BCL	All ND	All ND	BCL	BCL
03	0.976 F D, VB	ND	ND	All ND	All ND	All ND	BCL
04	1.59 F D, VB	7.41 VM, VJ	BCL	All ND	All ND	All ND	**Arsenic – 5.76 VJ**
05	0.662 F D, VB	10.7 VM, VJ	ND	All ND	BCL	BCL	BCL
06	0.779 F D, VB	16.6 VM, VJ	BCL	All ND	BCL	BCL	BCL
07	0.658F D, VB	492 D VM, VJ	BCL	All ND	BCL	All ND	BCL
08	2.35 F D, VB	174 VM, VJ	BCL	All ND	BCL	All ND	**Arsenic – 6.41 VJ**
09	0.647 F D, VB	37.4 VM, VJ	BCL	All ND	BCL	BCL	**Arsenic – 5.6 VJ**
10	0.749F D, VB	170 D, VM, VJ	BCL	All ND	**Benzo(a)pyrene – 1.0 F D**	**Benzo(a)pyrene – 1.34 D, VJ**	**Arsenic – 11.1 VJ**
10 (DUP)	0.622 F D, VB	23.7 D, VM, VJ	BCL	All ND	BCL	BCL	BCL
Cleanup Levels	*1,400*	*10,250*	*1.0*	*Varies*	*Benzo(a)pyrene – 1.0*	*Benzo(a)pyrene – 1.0*	*Varies*

Notes
Cleanup Levels – ADEC 18 AAC 75 Method Two, Tables B1 and B2 Soil Cleanup Levels, Under 40" Zone, Inhalation/Ingestion.
BOLD font indicates cleanup level exceedence.
DRO – Diesel Range Organics
GRO – Gasoline Range Organics
PCBs – Polychlorinated Biphenyls
PAHs – Polynuclear Aromatic Hydrocarbons
RCRA Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver
VOCs – Volatile Organic Compounds
SVOCs – Semi-Volatile Organic Compounds
mg/Kg – Milligrams per kilogram
ND – Analyte was not detected above laboratory method detection limits
BCL – Below Cleanup Levels
V – The "V" flag signifies that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
M – A matrix effect was present.
B – The analyte was found in the associated blank, as well as in the project sample.
D – A laboratory assigned qualifier indicating that the value is the result of a dilution.

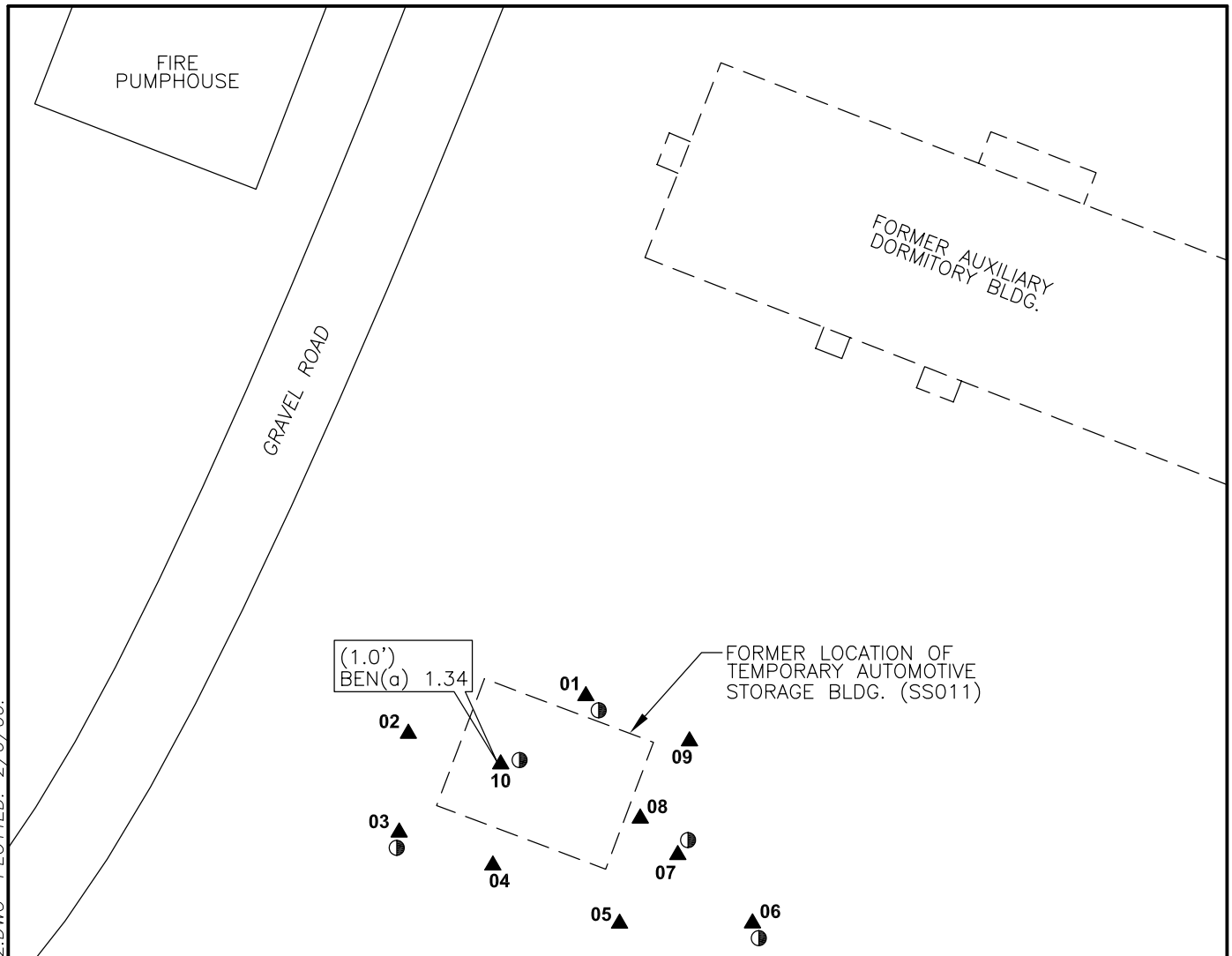
There were no VOC detections in any of the surface soil samples. GRO, DRO, and PCBs were detected at low levels in several of the surface soil samples at Site SS011; however, none of these detections exceeded ADEC cleanup levels (ADEC, 2004a).

Several SVOC compounds were detected at low levels in the samples collected at SS011. Benzo(a)pyrene was detected at a concentration of 1.0 mg/Kg at location 10 using the SW8270C analytical method, which equals the ADEC cleanup level of 1.0 mg/Kg (ADEC, 2004a). This compound was detected in a duplicate sample from this location at a concentration below the ADEC cleanup level. This sample was also analyzed for PAHs using the SW8270SIMS and benzo(a)pyrene was detected at a concentration of 1.34 mg/Kg which exceeded the ADEC cleanup level of 1.0 mg/Kg. The duplicate SW8270SIMS sample analyzed from this location and depth did not exceed the ADEC cleanup level. Benzo(a)pyrene is a byproduct of burning. Given the burned debris found at sample location 10 (see Appendix A Field Notes and Appendix D Sample Data Sheets), it is likely that this activity is the source of this contamination.

USEPA Region 5 RCRA Ecological Screening Levels for soil (USEPA, 2003), were used for comparison for several of the SVOC compounds that did not have ADEC cleanup levels. No other exceedences for SVOCs or PAHs were noted.

Arsenic was detected above the ADEC cleanup level of 5.5 mg/Kg in several samples. Arsenic concentrations ranged from 5.61 mg/Kg to 11.1 mg/Kg. These concentrations are within the background arsenic levels for soil for the Big Mountain site, as discussed in Section 5.2.4 and Table 5-6 of this report. No other detections of metals at SS011 exceeded ADEC cleanup levels.

The computed completeness for this project is 100 percent. Holding times were met for all surface soil samples at SS011. Cooler temperatures were within the specified range. The PCB Arochlor-1260 was detected in the method blank at a concentration greater than the MDL but less than the RL. Associated project samples were flagged “VB.”



NORTH

0 15 30

APPROX. SCALE IN FEET

LEGEND

05 ▲	SURFACE SOIL SAMPLE
◑	TEST PIT/SUBSURFACE SAMPLE
(1.0')	SAMPLE DEPTH BELOW GROUND SURFACE
BEN(a)	BENZO(a)PYRENE (mg/Kg)

DATE FEB. 2006
CHKD T.E.O.
DRAWN OASIS-PDC
PROJ. NO 4119-11

611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON
ELMENDORF AFB, ALASKA

AUTOMOTIVE STORAGE BUILDING (SS011) SOIL SAMPLE CLEANUP LEVEL EXCEEDENCES

2004 REMEDIAL INVESTIGATION AND FEASIBILITY STUDY
BIG MOUNTAIN RADIO RELAY STATION, ALASKA

FIGURE 9-2

PATH: V:\Project Drawings\Paug-Vik\Bg Mt\04 RIFS FILE: 2004-RIFS-F9-2.DWG PLOTTED: 2/6/06.

9.1.6 Subsurface Soil Samples

Subsurface soil sample locations were determined based on the highest field screening results obtained during surface soil sampling. Four subsurface soil samples were collected on July 10, 2004 through the installation of test pits. One duplicate subsurface soil sample was collected at sample location 07-02. Test pits were excavated to bedrock using a backhoe. Bedrock was encountered at a maximum depth of four feet bgs. Soil samples were collected using disposable sample scoops.

Additionally, a fifth subsurface soil sample was collected on July 15, 2004, after the removal of the concrete slab foundation at SS001 (ILC/Paug-Vik, 2004b). This sample was collected from a test pit using hand tools and submitted to the laboratory. Table 9-3 provides a location and description of all subsurface soil samples.

No groundwater was encountered during any subsurface sampling activities at SS011. No areas of obvious contamination were observed during subsurface sampling activities.

Table 9-3: Subsurface Soil Sample Field Screening Results and Description

Sample Location	Depth (feet)	PID Results (ppmV)	Soil Description
03-02	4	0.8	Dry, brown sandy GRAVEL.
01-02	4	1.0	Dry, brown sandy GRAVEL.
06-02	4	0.9	Dry, brown sandy GRAVEL.
07-02	3-4	1.2	Dry, gray coarse SAND.
10-02	1.5	NA	Dry, brown gravelly SAND. Found insulation, burned wood, & caribou bones in test pit.

Notes:
NA – Not available.
ppmV – Parts per million volts.

All samples were field screening using a PID and submitted to the project laboratory for GRO, VOCs, DRO, PCBs, SVOCs, and total metals analyses. PAH analysis by USEPA Method 8270SIM was completed for the subsurface samples as well. The subsurface soil sample collected at location 10-02 was analyzed for PAHs using 8270SIMS, but was not analyzed for the complete SVOC suite using SW8270C. Table 9-4 presents a summary of analytical results for the subsurface soil samples collected at SS011. Complete analytical results are located in Appendix E and the complete analytical data package can be found in Appendix F.

Table 9-4: SS011 Subsurface Soil Sample Analytical Results Summary

Sample Location	GRO (mg/Kg)	DRO (mg/Kg)	PCBs (mg/Kg)	VOCs (mg/Kg)	SVOCs (mg/Kg)	PAHs (mg/Kg)	Metals (mg/Kg)
03-02	0.506 F D, VB	2.53 F VM, VJ	All ND	All ND	All ND	All ND	BCL
01-02	0.791 F D, VB	9.03 VM, VJ	All ND	All ND	All ND	All ND	BCL
06-02	0.334 F D, VB	2.27 F VM, VJ	All ND	All ND	All ND	All ND	BCL
07-02	0.403 F D, VB	ND	All ND	All ND	All ND	All ND	BCL
07-02 (DUP)	0.362 F D, VB	2.37 F VM, VJ	All ND	All ND	All ND	All ND	BCL
10-02	1.79 F VJ, VB	211 D, VM, VJ	BCL	BCL	NS	BCL	**Arsenic – 11.4 VJ**
Cleanup Levels	*1,400*	*10,250*	*1.0*	*Varies*	*Varies*	*Varies*	*Varies*

Notes
Cleanup Levels – ADEC 18 AAC 75 Method Two, Tables B1 and B2 Soil Cleanup Levels, Under 40" Zone, Inhalation/Ingestion, (ADEC, 2004a).
DRO – Diesel Range Organics
GRO – Gasoline Range Organics
PCBs – Polychlorinated Biphenyls
PAHs – Polynuclear Aromatic Hydrocarbons
RCRA Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, and Silver
VOCs – Volatile Organic Compounds
SVOCs – Semi-Volatile Organic Compounds
mg/Kg – Milligrams per kilogram
ND – Analyte was not detected above laboratory method detection limits
NS – Analyte was not sampled for
BCL – Below Cleanup Levels
BOLD font indicates cleanup level exceedence.
V – The "V" flag signifies that the associated flag (i.e. VJ) was assigned during the Architect/Engineer's data review process.
F – The analyte was positively identified, but the associated numerical value is below the reporting limit.
J – The analyte was positively identified, the quantitation is an estimation.
M – A matrix effect was present.
B – The analyte was found in the associated blank, as well as in the project sample.
D – A laboratory assigned qualifier indicating that the value is the result of a dilution.

There were no SVOC detections in any of the subsurface soil samples. GRO, DRO, PCBs, VOCs, and PAHs were detected at low levels in several of the samples; however, none of these detections exceeded ADEC cleanup levels (ADEC, 2004a). It should be noted that the subsurface sample collected from a depth of 1.5 feet at location 10 did not contain a detectable concentration of benzo(a)pyrene, indicating that the slightly elevated detection in the surface sample from this location is an isolated occurrence.

Arsenic was detected above the ADEC cleanup level of 5.5 mg/Kg in one subsurface soil sample at a concentration of 11.4 mg/Kg. This concentration is within the background arsenic levels for the Big Mountain area.

The calculated completeness for this project was 100 percent. Holding times for PCB analysis for the subsurface sample collected at location 03 were not met due to re-analysis by the laboratory for conformational purposes. These results were flagged "VH" during the data review process. VOC analysis for the subsurface sample at location 10 were not met as well and project sample results were flagged "VH." DRO recovery in some project samples was biased low, thus necessitating the qualification "VM" in some project sample results for DRO.

9.1.7 Investigation-Derived Waste Handling

Minimal IDW was generated during site sampling activities. Sampling gloves, disposable scoops, and other miscellaneous items were used and disposed of during this sampling event. All IDW was collected for this project. The IDW was disposed of and eventually burned in the on-site SmartAsh® burner.

9.2 DEVIATIONS FROM WORK PLAN

Deviations from the work plan that occurred during the sampling effort are as follows:

- Subsurface soil samples were not collected at two-foot intervals down to bedrock; instead only one subsurface soil sample was collected from the maximum depth of excavation at each subsurface sample location. Samples were collected from just above bedrock at all of the excavated areas. No evidence of surface or subsurface contamination was noted at any depth at SS011.
- The subsurface soil sample at Location 10 was collected using hand tools rather than by excavation due to the unavailability of the excavator.
- Field screening with the PID was not conducted at one subsurface soil sampling location as the PID was being used at another site.

9.3 RI FINDINGS – SS011

This section presents the findings from the field investigations at the former Temporary Auto Storage Shop Area, SS011. Field observations, analytical results, and estimated volume and extent of contamination are discussed in the following sections.

9.3.1 Data Evaluation Approach

Field observations and analytical data obtained during the 2004 RI were compared with the DQOs identified in Section 1.5 to identify areas of contamination. Discussion of analytical results is limited to specific analytes detected. Additional information on analytical method detection limits (sensitivity), QC samples (other than field duplicates), precision and accuracy calculations, and evaluation of data quality are described in the analytical data QAR included as Appendix H.

9.3.2 Surface Soils

Arsenic was detected above the ADEC cleanup level in four surface soil samples. These concentrations are slightly higher than established background arsenic levels for the Big Mountain area, however these levels are generally indicative of arsenic in soil in Alaska.

The sample collected at location 10 had a concentration of 1.0 mg/Kg for the SVOC benzo(a)pyrene that equaled the ADEC cleanup level for this compound. The duplicate sample collected at this location for SVOCs did not exceed the ADEC cleanup level. This sample also had a reported concentration of 1.34 mg/Kg for the PAH benzo(a)pyrene, which also exceeded the ADEC cleanup level of 1.0 mg/Kg. Benzo(a)pyrene was detected in the duplicate PAH sample at this location at a concentration below the cleanup level. The PAH subsurface sample collected from this location did not have a detectable concentration of benzo(a)pyrene.

Minimal contamination was found at surface depth in the soils at SS011. Surface soils at SS011 are gravelly sand in composition and can be classified as fill. There was no surface water at SS011.

9.3.3 Subsurface Soils

No contaminated soils were found below grade surface at SS011. Subsurface soils at SS011 consisted primarily of gravelly sand (fill); however, a six to eight inch thick lens of gray coarse sand was noted at approximately three feet below ground surface at Location 07. Bedrock was encountered at depths ranging from four to five feet bgs.

Groundwater was not encountered at this site. The Upper Camp drinking water well, located approximately 900 feet to the northwest of Site SS011and at a lower elevation than SS011, was installed to a depth of 232 feet (DOWL, 2001).

9.3.4 Conceptual Site Model

Potential human receptors at SS011 were identified during the 2004 RI. The resulting exposure scenarios are listed below:

- Recreational & Subsistence Exposure Scenario (short-term visits by fishermen, hunters, and recreational users).
- Industrial Exposure Scenario (short-term visits by site workers and camp support staff during investigation and cleanup efforts).

These following potential exposure scenarios were considered complete at the site:

- Inhalation of dust-borne COPCs in surface soils.
- Ingestion of and dermal contact with soil-borne COPCs in surface soils.
- Bioaccumulation of COPCs in local flora and fauna.

There are no completed exposure pathways to surface water or groundwater (no surface water or groundwater are present on the site). Free-phase liquid plume and mobile free-liquid transport are not potential sources of contamination or transport mechanisms for identified COPCs at SS011.

Terrestrial animals and humans may be directly exposed to contaminants in surface soil at the facility via incidental ingestion, inhalation, or dermal contact.

9.4 RI SUMMARY AND CONCLUSIONS

Soil at SS011 does not appear to be impacted by activities at the Temporary Auto Storage Shop Area at Upper Camp. Low levels of various analytes were found in several of the samples collected, however most detections did not exceed applicable cleanup levels. Two detections of the compound benzo(a)pyrene (one using USEPA Method 8270C and the other using USEPA Method 8270SIM) slightly exceeded the ADEC cleanup level. The duplicate samples collected at this location did not exceed the cleanup level for benzo(a)pyrene, and the subsurface sample collected at this location at a depth of 1.5 feet bgs was non-detect for this compound. This contamination is thought to be the result of using this location as a burn pit.

9.5 SELECTED REMEDIAL ACTION FOR SS011

NFRAP status will be sought for SS011. A NFRAP document will be prepared based on the findings of both the 1998 RI/FS and the 2004 RI results.

10 REMEDIAL ACTION OBJECTIVES (RAOS)

RAOs are the goals that the selected remedial actions are designed to achieve (USEPA, 1988). RAOs include objectives that are applicable to all sites, in addition to objectives specific to the Big Mountain RRS sites (ST001, LF005, SS002, SS003, SS004, and SS011). Specific RAOs must ensure compliance with 18 AAC 75 and other applicable state and federal regulations, ARARs, and protection of human health and the environment. Applicable regulations strictly apply to a site. Relevant and appropriate requirements may not strictly apply but need to be followed. In general, ARARs are the regulatory requirements the site must meet. Protection of human health and the environment is determined by comparing contamination levels to clean up levels specified in 18 AAC 75 or performing a site-specific risk assessment.

10.1 GENERAL RAOS

Overall goals for remedial action are defined by both state and federal regulations. The main applicable state regulations are contained in the State of Alaska Oil and Hazardous Substances Pollution Control Regulations (18 AAC 75).

The federal regulations that apply to this site are the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 USC §§ 9601-9675) and the National Contingency Plan (NCP), which is a part of CERCLA, RCRA (42 USC §§ 6901-6992k), and the Toxic Substance Control Act (TSCA) (40 CFR 761). The overall goals listed below apply to CERCLA sites in general, are consistent with state law, and are appropriate for the Big Mountain RRS sites.

- Protect human health by reducing the risk from the potential exposures, including cumulative risk posed by exposure to multiple contaminants. Cleanup levels for individual contaminants may not be protective when multiple contaminants are present.
- Protect environmental receptors.
- Restore contaminated media for present and future land use where practicable and within a reasonable period given the particular circumstances of the site.
- Protect uncontaminated media by preventing releases from sources.
- Use permanent solutions and alternative treatment technologies to the maximum extent practicable.
- Comply with state and federal ARARs.

Specific RAOs derived from these goals are identified in Table 10-1. These RAOs were developed considering state requirements, site-specific conditions, and the goals listed above.

Table 10-1: Specific RAOs

- Meet potential contaminant, location, and action specific ARARs.
- Reduce the site's human health carcinogenic risk to less than 10^{-5} and non-carcinogenic risk to less than a hazard index of one. This objective includes the requirement to reduce the site's cumulative risk to less than 10^{-5} and non-carcinogenic hazard index to one or less across all exposure pathways as stipulated in 18 AAC 75.325(g).
- Reduce, to acceptable levels, the risk posed by contaminants that present an unacceptable level of risk to the existing ecology.
- Prevent contaminants from reaching potential drinking water sources or important aquatic habitats.
- Select actions that include treatment, where applicable and practicable, as opposed to actions that are limited to simply moving contamination to disposal sites.
- Select cost-effective remedial actions.
- Maintain the physical integrity of natural topographical features where possible.
- Meet all federal facility agreement requirements (if any).
- Consider the impact of remedial actions on future land use.

10.2 POTENTIAL CONTAMINANT-SPECIFIC ARARS

Potential chemical-specific ARARs are typically health-based or risk-based numerical values, or methodologies that result in numerical values when applied to a specific site. These values establish the acceptable amount or concentration of a chemical that may be found in or discharged to an environmental medium (soil, sediment, groundwater, surface water, or air).

The potential contaminant-specific ARARs for sites ST001, LF005, SS002, SS003, SS004, and SS011 include:

- State of Alaska Method Two Soil Cleanup Levels (18 AAC 75, Tables B1 and B2; as amended through May 21, 2004).
- State of Alaska Groundwater Cleanup Levels (18 AAC 75, Table C, as amended through May 21, 2004).
- State of Alaska Water Quality Criteria (18 AAC 70, as amended through June 26, 2003).
- NOAA Screening Quick Reference Tables for Sediment and Surface Water (NOAA, 1999).
- USEPA, OSWER Ecotox Thresholds (USEPA, 1996).
- RCRA (40 CFR 261 and 18 AAC 62; Listed and Characteristic Wastes).
- Toxic Substance Control Act (TSCA) (40 CFR 761).

10.3 POTENTIAL LOCATION-SPECIFIC ARARS

Potential location-specific ARARs are requirements that affect the management of hazardous constituents, or the units in which they are managed, due to the location of the unit(s). Examples of sensitive locations for such units include wetlands, floodplains, historic areas, and wildlife refuges.

10.4 POTENTIAL ACTION-SPECIFIC ARARS

Potential action-specific ARARs are technology-based or activity-based requirements that may be triggered by the particular remedial action chosen for a site. Potential action-specific ARARs do not affect the selection of a remedial action but instead may pose restrictions on the methods by which a selected action may be achieved. Examples of potential action-specific ARARs include landfilling or transport of wastes off site subject to the Solid Waste Disposal Act and discharge of pollutants into surface waters subject to the Clean Water Act.

10.5 SITE-SPECIFIC RAOS

In general, contaminated sites in Alaska are subject to soil cleanup levels provided by ADEC's Oil and Hazardous Substance Control Regulations (18 AAC 75 Articles 3 and 9; ADEC, 2004a). Soil cleanup levels provided in 18 AAC 75 were established at levels considered protective of human health and the environment. The 18 AAC 75 Method Two Soil Cleanup Levels (based on protection of the migration to groundwater pathway) are applicable for all sites except SS011. Because groundwater is not present at the Upper Camp sites, including SS011, the 18 AAC 75 Method Two Soil Cleanup Levels based on protection of the ingestion and inhalation pathways are applicable for site SS011.

Cleanup of PCB spills also is regulated by the federal government through the (TSCA, 40 CFR 761). Like 18 AAC 75, TSCA [40 CFR 761.61(a)(4)] requires cleanup of surface soil PCBs to 1 mg/Kg (ppm) in *high occupancy areas* (which includes a residential scenario) for no further restrictions on the site.

Contaminated sites are also subject to groundwater cleanup levels provided by ADEC's Oil and Hazardous Substance Control Regulations (18 AAC 75, Articles 3 and 9; ADEC 2004a). Groundwater cleanup levels provided in 18 AAC 75 were established at levels considered protective of human health and the environment. The 18 AAC 75 Table C Groundwater Cleanup Levels are applicable for all sites except SS011, where groundwater is not present.

The specific cleanup levels and related requirements to be met at the Big Mountain RRS ST001, LF005, SS002, SS003, SS004, and SS011 sites are the site-specific RAOs. These RAOs are consistent with the RAOs established for sites ST001 and SS002 in the Interim ROD (Paug-Vik, 2002b). Detected concentrations of potential contaminants in all media sampled at SS003 were below the applicable cleanup levels. All detected concentrations of potential contaminants in soil at SS011 were below applicable cleanup levels with the exception of one slightly elevated detection of benzo(a)pyrene. The presence of benzo(a)pyrene at this site is limited based on duplicate and subsurface samples from the same sample location. Given the absence of contamination at SS003, and the isolated occurrence of benzo(a)pyrene at SS011, remedial actions are not warranted at these two sites.

Based on the results of the 1998 and 2004 RIs, cleanup levels or preliminary remedial goals (RGs) have been developed ST001, LF005, SS002, and SS004 for DRO, GRO, Benzene, Toluene, Ethylbenzene, and PCBs in soil, as well as for DRO, RRO, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 1,2,4-Trimethylbenzene, and 1,3,5-Trimethylbenzene in groundwater. Preliminary RGs for soil are summarized in Table 10-2 and preliminary RGs for groundwater are summarized in Table 10-3. Draft RGs will be developed by the USAF with regulatory agency concurrence.

Table 10-2: Preliminary Remedial Goals for Soils for the 2004 RI Sites

Media	Contaminant of Concern	Maximum 2004 Concentration (mg/Kg)	2004 Sample Location ID	Maximum 1998 Concentration (Location) (mg/Kg)	ARARs RG[1] (mg/Kg)	Cleanup Level (mg/Kg)
42,400-Gallon AST and Pipeline ST001						
Soil	DRO	9,640	B06, 5-7'bgs	17,000 (L8, AP-11 – 0' & 4' bgs)	250	250
Former Lower Camp Landfill LF005						
Soil	Total PCBs	2.19	MW06, 0-1' bgs	NA	1	1
1,000-Gallon Fuel Oil AST SS002						
Soil	DRO	17,700	SB14, 1-3' bgs	18,000 (TP-15, L2)	250	250
	GRO	756	SB14, 1-3' bgs	640 (TP-15, L2)	300	300
	Benzene	1.08	SB14, 1-3' bgs	0.86 (TP-15, L2)	0.02	0.02
	Toluene	12.9	SB14, 1-3' bgs	7.5 (TP-15, L2)	5.4	5.4
	Ethylbenzene	9.25	SB14, 1-3' bgs	NA	5.5	5.5
1,000-Gallon MOGAS Tank SS004						
Soil	DRO	2,170	SS04, 0-1'bgs	NA	250	250
	Total PCBs	4.32	MW12, 0-1'bgs	NA	1	1

1. ADEC 18 AAC 75 Method Two Soil Cleanup Levels (Tables B1 and B2), based on the migration to groundwater pathway for the Under 40" Zone (as amended through May 2004).

2. The Toxic Substance Control Act (TSCA) requires cleanup of surface soil PCBs to 1 mg/Kg (ppm) in high occupancy areas (which includes a residential scenario) for no further restrictions on the site.

NA – Not analyzed.

Table 10-3: Preliminary Remedial Goals for Groundwater for the 2004 RI Sites

Media	Contaminant of Concern	Maximum 2004 Concentration (mg/L)	2004 Sample Location ID	Maximum 1998 Concentration (Location, mg/L)	ARARs RG[1] (mg/L)	Cleanup Level (mg/L)
42,400-Gallon AST and Pipeline ST001						
Groundwater	DRO	28.4	MW11	1.5 (AP-06, L1)	1.5	1.5
	RRO	1.61	MW10	NA	1.1	1.1
Former Lower Camp Landfill LF005						
Groundwater	RRO	1.16	MW07	NA	1.1	1.1
	1,3-Dichloro-benzene	ND	NA	0.091 (AP-02, L2)	1.1	1.1
	1,4-Dichloro-benzene	ND	NA	0.075 (AP-02, L2)	0.075	0.075
	1,2,4-Trimethyl-benzene	ND	NA	0.007 (AP-02, L2)	1.85	1.85
	1,3,5-Trimethyl-benzene	ND	NA	0.003 (AP-02, L2)	1.85	1.85
1,000-Gallon Fuel Oil AST SS002						
Groundwater	DRO	0.359	MW02	1.8 (AP-17, L3)	1.5	1.5

1. ADEC 18 AAC 75 Groundwater Cleanup Levels, Table C (as amended through May 2004).

NA – Not analyzed.

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Appendix A

Field Notes

Appendix B

Daily Activity Reports

Appendix C

Site Photographs

Appendix D

Field Sampling Data Sheets

Appendix E

Analytical Summary Tables

Appendix F

Complete Analytical Data Laboratory Reports
(On CD-ROM)

Appendix G

Monitoring Well Construction Diagrams
And Borehole Logs

Appendix H

Quality Assurance Reports (QARs)

Appendix I

LF005 Landfill Cap Inspection Documentation

Appendix J

Comments to Draft Report
And
Response to Comments