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CAPE ROMANZOF LRRS
ALASKA

ADMINISTRATIVE RECORD
COVER SHEET

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INSTALLATION RESTORATION PROGRAM

FINAL
ENVIRONMENTAL MONITORING REPORT
FOR
LANDFILL 2 (LF03)
AND
SPILL SITES SS13 AND SS15

CAPE ROMANZOF LRRS, ALASKA

JUNE 14, 2005

FINAL
ENVIRONMENTAL MONITORING REPORT
FOR
LANDFILL 2 (LF03)
AND
SPILL SITES SS13 AND SS15

CAPE ROMANZOF LRRS, ALASKA

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Contract No. 1435-04-03-CT-71697
Delivery Order No. 34980

June 14, 2005

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ABBREVIATIONS AND ACRONYMS

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AFCEE	Air Force Center for Environmental Excellence
ARARs	Applicable or Relevant and Appropriate Regulations
AWQS	Alaska Water Quality Standards
bgs	belowground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CES	Civil Engineering Squadron
COPC	Contaminant of Potential Concern
Cy	cubic yards
DQO	data quality objective
DRO	diesel range organics
USEPA	U.S. Environmental Protection Agency
GRO	gasoline range organics
LRRS	Long Range Radar System
LTM	Long-Term Monitoring
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MNA	Monitored Natural Attenuation
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
OVM	organic vapor monitor
PAH	polynuclear aromatic hydrocarbon
Paug-Vik	Paug-Vik Development Corporation
PCBs	polychlorinated biphenyl
PEL	probable effects level
POL	petroleum, oil, and lubricants
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
redox	reduction oxidation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RRO	residual range organics
SQuiRT	Screening Quick Reference Tables
SSHP	Site Safety and Health Plan
SVOC	semivolatile organic compound
TAH	total aromatic hydrocarbons
TAqH	total aqueous hydrocarbons
TEL	threshold effects level
TPH	total petroleum hydrocarbons
U.S.C.	U.S. Code
USAF	U.S. Air Force
VOC	volatile organic compound

1 INTRODUCTION

This report describes the results and findings of the 2004 Monitored Natural Attenuation (MNA) study at SS13 (Diesel Seep Area) and SS15 (Underground Storage Tank [UST] Spill Area), and the 2004 Long-Term Monitoring (LTM) study at LF03 (Landfill No. 2) at the Cape Romanzof Long Range Radar Site (LRRS), Alaska. Site locations are shown in Figure 1-1.

The work described in this report was performed by Paug-Vik Development Corporation (Paug-Vik) as part of the 2004/2005 Environmental Monitoring and Remedial Investigation/Feasibility Study for the 611th Civil Engineer Squadron (611 CES). The work was awarded as Delivery Order No. 34980 under an indefinite delivery/indefinite quantity contract (No. 1435-04-03-CT-71697) with the Department of Interior, Minerals Management Service (GovWorks).

1.1 Description of Current Study

The project scope was described in the *Record of Decision for Interim Remedial Action at Sites: Spill Site SS013, Spill Site SS015, and Landfill Site LF003* (611 CES, 2002); and the *Final Work Plan for Environmental Monitoring and Remedial Investigation/Feasibility Study at the Cape Romanzof Long Range Radar Site (LRRS)* (Paug-Vik, 2004).

The Interim Record of Decision (ROD) (611 CES, 2002) was developed to satisfy the requirements of the Defense Environmental Restoration Program, 10 U.S. Code 2701; Alaska Department of Environmental Conservation (ADEC) Oil and Hazardous Substances Pollution Control Regulations (18 Alaska Administrative Code [AAC] 75); the Comprehensive Environmental Restoration Compensation and Liability Act of 1980 (CERCLA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 Code of Federal Regulations 300).

The Work Plan was consistent with the Interim ROD and current Applicable Regulations and Appropriate Requirements (ARARs) such as ADEC Water Quality Standards (18 AAC 70) and other regulatory guidance for developing preliminary Remedial Action Objectives (RAOs).

1.1.1 2004 Monitored Natural Attenuation and Long-Term Monitoring Activities

Figure 1-2 shows an overview of the installation layout and project study sites noted below. Project activities in 2004 include:

- MNA sampling at SS13 and SS15.
- LTM sampling at LF03 (Landfill No. 2).
- Closed Landfill cap inspection at LF03.
- Soil investigation of polychlorinated biphenyls (PCB) hot spots at LF03 and remedial recommendations. (Note: this aspect of Interim ROD requirements is reported separately.)

1.1.2 Project Purpose

The purpose of the 2004 MNA and LTM activities is to collect multi-media environmental samples at SS13, SS15, and LF03 in accordance with the Interim ROD (611 CES, 2002) and as described in the Final Work Plan (Paug-Vik, 2004).

Specifically, the purpose of the MNA effort at SS13 and SS15 is to:

- Monitor petroleum contaminant concentrations in soil, sediment, groundwater, and surface water.
- Evaluate and identify the rates at which site contaminants may be decreasing over time; and evaluate whether natural attenuation will effectively mitigate site contaminants.

Specifically, the purpose of the LTM effort at LF03 is to:

- Monitor petroleum and PCB contaminant concentrations in groundwater and surface water at the landfill to identify any leachate emanating from buried landfill debris.
- Inspect the landfill's surface cap to assess its effectiveness.

These actions are intended to address risks to human health and the environment at the sites.

1.2 Data Quality Objectives

Data quality objectives (DQOs) for environmental samples were developed in the Work Plan (Paug-Vik, 2004) and based upon preliminary RAOs identified for each media of concern. Development of preliminary RAOs for groundwater, surface water, soil, and sediments is discussed in Section 4.0 of this report.

Contaminants of potential concern (COPCs) previously identified at SS13, SS15, and LF03 include:

- SS13 – Diesel range organics (DRO) in groundwater, soil, and sediment and residual range organics (RRO) in sediment. (Total aromatic hydrocarbon [TAH] and total aqueous hydrocarbon [TAqH] analyses were performed for surface water samples.)
- SS15 – Gasoline range organics (GRO), DRO, RRO, and benzene in groundwater, surface water, and sediment.
- LF03 – DRO; benzene, toluene, ethylbenzene, and total xylenes (BTEX); polynuclear aromatic hydrocarbons (PAHs); and polychlorinated biphenyl s (PCBs) in groundwater, surface water, and sediment.

1.3 Technical Report Organization

This report describes project activities and presents findings, conclusions, recommendations, from field sampling and analyses in 2004 for the MNA and LTM tasks in accordance with the Interim ROD (611 CES, 2002) and the Work Plan (CES 2004). Table 1-1 identifies report organization.

Table 1-1 Technical Report Organization

Report Unit	Contents
Section 1	Introduction
Section 2	Summary of Historical and Existing Information
Section 3	2004 Field Activities
Section 4	Remedial Action Objectives
Section 5	2004 Findings for Hydrocarbon-Related Sample Data and Comparative Evaluation with Similar Historical Results (Organic and Hydrocarbon Related Compounds).
Section 6	2004 Inorganic Results and Intrinsic Remediation Conditions.
Section 7	Conclusions and Recommendations
Section 8	Report References
Appendices	Appendix A – Field Site Photographs Appendix B – Daily Status Reports and Project Field Notes Appendix C – Groundwater Sampling Log Sheets Appendix D – Quality Assurance Report Appendix E – Summary Analytical Data Tables Appendix F – Complete Analytical Data Package (electronic only)

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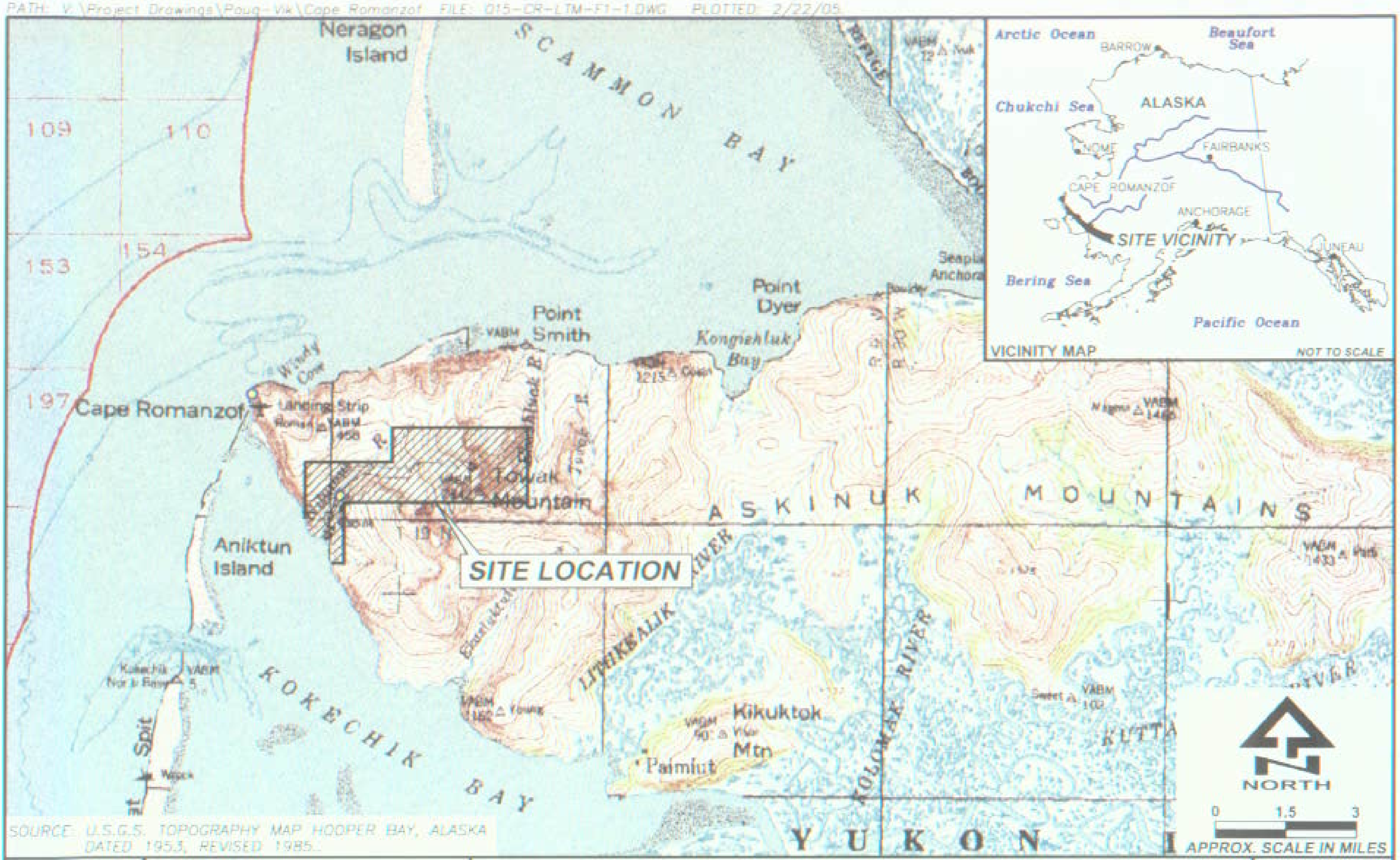

SOURCE: U.S.G.S. TOPOGRAPHY MAP HOOPER BAY, ALASKA DATED 1953, REVISED 1985.

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ELMENDORF AFB, ALASKA

SITE LOCATION MAP

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

FIGURE
1-1

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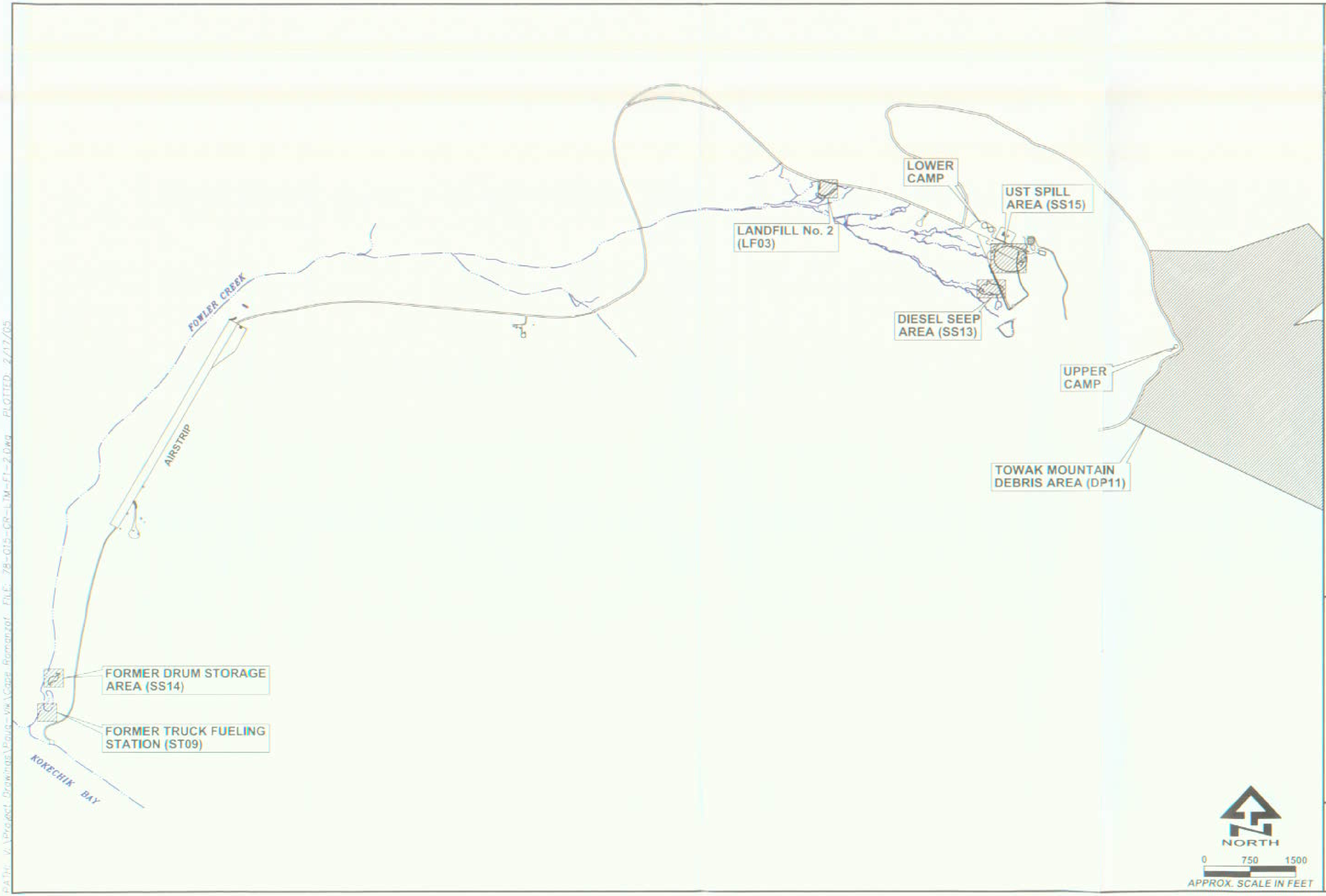

FIGURE 1-2

INSTALLATION LAYOUT AND OVERVIEW

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

611TH AIR SUPPORT GROUP
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2 SUMMARY OF HISTORICAL AND EXISTING INFORMATION

The USAF has conducted numerous environmental studies at the Cape Romanzof LRRS site. Various environmental reports and technical memorandums published as a result of these studies were reviewed and guided in the development of DQOs for this project, including:

- Remedial Investigation/Feasibility Study Technical Report Cape Romanzof LRRS, Alaska (USAF, December 1992).
- Remedial Investigation/Feasibility Study Report for SS13 (USAF, 1998).
- Closure Monitoring Report for Landfill 2 (LF03) (USAF, 1997).
- Long Term Monitoring and Landfill Cap Inspection Report (USAF, 2000).
- Long Term Monitoring Technical Report, Landfill 2 (LF03), SS13 and SS15 (USAF, 2001).
- Long Term Monitoring Technical Report, Landfill 2 (LF03), SS13 and SS15 (USAF, 2003).

In March 2002, the USAF produced an Interim Record of Decision for Spill Site SS13, Spill Site SS15, and Landfill Site LF003 (611 CES, 2002) documenting interim remedial action decisions for each of the three sites. The decisions were based upon findings from the 1992 and 1997 Remedial Investigation/Feasibility Study (RI/FS) and subsequent groundwater sampling events. The Interim ROD identified the following response actions for SS13, SS15, and LF03 to mitigate the actual or threatened release of contaminant hazards characterized for each of the sites:

- SS13 and SS15 – Monitored Natural Attenuation (MNA) for soil, sediment, groundwater, and surface water to reduce risk to human health and the environment by utilizing natural remedial technologies with a five-year review of annual and comprehensive data results.
- LF03 – Landfill Closure combined with PCB hotspot removal. The main elements of the landfill closure portion of the remedy are capping and long-term monitoring (LTM) of groundwater and any effluent generated by the landfill with a five-year review of annual and comprehensive data results.

Section 2.1 is a historical summary of site conditions. Figure 2-1 shows the location and aerial proximity of each site.

2.1 SS13 Diesel Seep Area

Site SS13 is located 800 feet south of the Lower Camp composite facility and is accessible by road (Figure 2-1). Environmental concerns were created at SS13 in 1979 when 14,000 gallons of diesel fuel were spilled there. In 1992, Woodward-Clyde conducted an investigation at this site and included the findings in a subsequent report to the USAF. The main contaminants of concern identified were petroleum hydrocarbons in groundwater and soils. In 1997, another investigation was conducted to delineate the extent and magnitude of petroleum contaminants in site soils, surface water, and groundwater. In 1998, an LTM plan was developed for the site, which included a determination of aquifer characteristics and natural attenuation parameters in groundwater.

2.1.1 SS13 Groundwater

Groundwater samples collected at SS13 monitoring wells in 1999 showed that petroleum contaminants previously detected (1997) had decreased to below cleanup levels, with the exception of DRO. Other groundwater data collected in 1999 indicated that natural attenuation processes were active and that concentrations of hydrocarbon constituents were generally decreasing with time.

DRO levels in groundwater at this site continue to exceed cleanup levels as evidenced by sampling events in 2000 and 2003.

2.1.2 SS13 Surface Water

Analytical results for surface water samples in 1999 and 2000 showed that hydrocarbon constituents were below method detection limits for parameters analyzed. Surface water samples were not collected in 2003 due to frozen conditions.

2.1.3 SS13 Sediments

DRO concentrations have exceeded the cleanup level during each of the four annual sampling events (i.e., 1997, 1999, 2000, and 2003). In 2003, GRO showed an increase to levels above cleanup criteria. BTEX and RRO contaminants were also present in some instances. Almost all semivolatile organic compound (SVOC) results for the various years were below method detection limits.

2.1.4 SS13 Soils

For near-surface soil samples collected at SS13 in 1997, 1999, 2000 and 2003, DRO levels were above cleanup criteria in all but the 2000 and 2003 sample collected from location LB-03. RRO levels exceeded cleanup levels at one sampling location for prior years.

2.2 SS15 Underground Storage Tank Spill Area

Site SS15 is located 200 feet south of the main composite facility and is accessible by road (Figure 2-1). Site SS15 was the result of spills, leaks and seeps from two underground storage tanks (USTs) used to store diesel fuel, one with a 5,000-gallon capacity and one with a 15,000-gallon capacity. In 1991, both USTs and 900 cubic yards of contaminated soil were removed from that location. ENSR Corporation conducted a preliminary assessment of the site in 1991 and followed up with an investigation in 1993. However, findings from the 1993 investigation did not effectively delineate the extent of diesel contamination. The USAF conducted a second investigation of the site in 1995. In 1998, a follow-up effort included a determination of aquifer characteristics and natural attenuation parameters in groundwater.

2.2.1 SS15 Groundwater

Groundwater samples collected from SS15 monitoring wells in 1997, 1999, 2000, and 2003 indicated that most results were below cleanup levels except in WW02 which consistently had elevated concentrations of GRO, DRO, and benzene. Initially, three wells were in the monitoring plan, but one well, WW07, was not sampled in 2003 because it did not produce enough water. In 2004, WW09 was installed but could also not be sampled due to lack of water.

2.3 LF03 Landfill No. 2

LF03 is situated approximately one-half mile northwest of the main composite facility and is accessible by the road that leads to the runway. This landfill was used from the 1950s to the 1970s. During this period, garbage, construction material, shop waste, and incineration ash were deposited into the landfill.

In 1992, Woodward Clyde conducted an RI/FS at LF03. In 1994, the landfill was capped. In 1995, the USAF conducted a Remedial Assessment on SS15 and LF03. In 1996, Harding Lawson conducted a Remedial Assessment at LF03. Total petroleum hydrocarbons (TPH) and PCBs were detected in surface water, and TPH was detected in sediment and soil. PCBs and DRO were detected in sediment samples.

2.3.1 LF03 Groundwater

Groundwater samples were collected from up to seven wells at LF03 in 1996, 1997, 1999, 2000, and 2003. Hydrocarbon constituents detected in the 1999 groundwater results were lower in 1999 than in 1997 samples, and none of the 1999 or subsequent results exceeded cleanup levels for constituents of concern.

2.3.2 LF03 Surface Water

Surface water samples were collected from three locations at LF03 in 1997, 1999, 2000, and 2003 and analyzed for hydrocarbon constituents of concern. None of the sample results from 1999 to 2003 exceeded surface water criteria.

2.3.3 LF03 Sediment

Sediment samples were collected from co-located surface water sampling sites in 1997, 1999, 2000, and 2003. DRO and PCB exceedances were observed in 2000 and PCBs exceedences were observed in 2003 at location SD-2.

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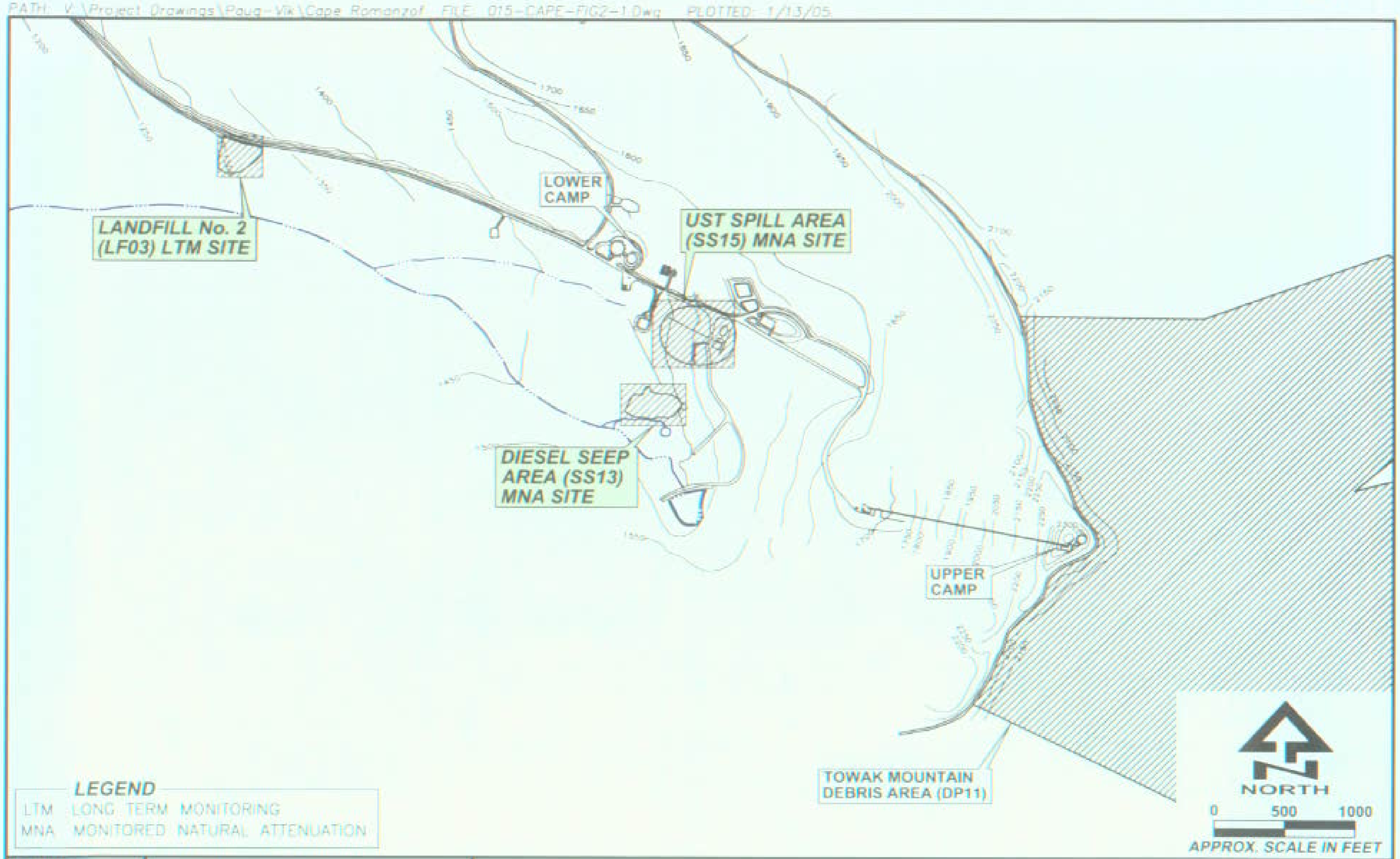

LEGEND

LTM LONG TERM MONITORING
MNA MONITORED NATURAL ATTENUATION

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OVERVIEW OF SITE LOCATIONS

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

FIGURE
2-1

3 PROJECT FIELD TASKS CONDUCTED IN 2004

Field sampling activities at Cape Romanzof sites SS13, SS15, and LF03 were completed in June and August of 2004. The landfill surface cover was inspected, and repair recommendations were reported. Sampling protocols and field tasks were described in the project work plan (Paug-Vik, 2004).

The field team collected environmental samples from groundwater, surface water, sediments, and soil media from specified locations as noted in Table 3-1. Sample locations for each site are shown on Figures 3-1, 3-2, and 3-3. Field site photographs from 2004 are included in Appendix A. Copies of the daily status report and original field notes are included in Appendix B.

Samples were submitted for laboratory analyses of specified chemical parameters of concern (Table 3-1). Groundwater samples were additionally field tested for specific parameters at the time of collection (i.e., temperature, pH, conductivity, dissolved oxygen, reduction oxidation [redox] potential, and turbidity). Groundwater Sampling Log Sheets are included in Appendix C for each well.

Table 3-1 Site/Location-Specific Sample Analytical Parameters

Site	Media/Locations Sampled	Analytical Parameters	Purpose
SS13 (Diesel Spill Area)	Groundwater: MW-01 and MW-02	BTEX, DRO, RRO, PAH, Alkalinity, Dissolved Iron, Sulfate, Nitrate/Nitrite	Monitored Natural Attenuation scope
	Surface Water: SW-01, SW-02, SW-03	BTEX, DRO, RRO, PAH, TAH, TAqH	
	Sediments: SS-01 and SS-06	BTEX, DRO, RRO, PAH	
	Near-surface Soil: LB-03, LB-07, and LB-08	BTEX, DRO, RRO, PAH	
SS15 (UST Seep Area)	Groundwater: WW-02, WW-07 and WW-08	BTEX, GRO, DRO, RRO, PAH, Alkalinity, Dissolved Iron, Sulfate, Nitrate/Nitrite	Monitored Natural Attenuation scope
LF03 (Closed Landfill No. 2)	Groundwater: MW-1, CMW-1, CMW-2, CMW-3, CMW-4, CMW-5, CMW-6, and CMW-7.	BTEX, DRO, PAH, PCBs	Long Term Monitoring and Landfill Cap Inspection scope
	Surface Water: SW-1, SW-2, and SW-3	BTEX, DRO, PAH, PCBs	
	Sediments: SS-1, SS-2, and SS-3	BTEX, DRO, PAH, PCBs	

Definitions:
BTEX = benzene, toluene, ethylbenzene, and total xylenes
DRO = diesel range organics
GRO = gasoline range organics
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
RRO = residual range organics
TAH = total aromatic hydrocarbons = sum of BTEX concentrations
TAqH = total aqueous hydrocarbons = sum of BTEX and PAH concentrations

3.1 Laboratory Analyses

Laboratory analytical parameters and methods for water samples submitted for this project in 2004 are listed in Table 3-2. Analytical parameters and methods for soil and sediment samples are listed in Table 3-3. Organic hydrocarbon results and findings are discussed Section 5. Inorganic and field measurements results are presented in Section 6. Conclusions and recommendations from project findings are presented in Section 7.

Table 3-2 Laboratory Methods for Groundwater/Surface Water Samples

Sample Location	Analyte	Analytical Method	PQL (mg/L)
LF03, SS13, SS15	BTEX	8021B	0.500 µg/L to 2.00 µg/L
SS15	GRO	AK101	0.100 µg/L
LF03, SS13, SS15	DRO	AK102	100 µg/L
SS13, SS15	RRO	AK103	1.00 mg/L
LF03, SS13, SS15	PAH	8270-SIMS	0.100 µg/L to 0.15 µg/L
LF03	PCBs	8082	1.00 µg/L
SS13	TAH	602 or 8021B	0.500 µg/L to 2.00 µg/L
SS13	TAqH	610 or 8270	0.400 µg/L to 1.00 µg/L
SS13, SS15	Alkalinity	310.1	20.0 mg/L
SS13, SS15	Ferrous Iron	6010	1000 µg/L [1]
SS13, SS15	Sulfate	E 300	0.500 mg/L
SS13, SS15	Nitrate/Nitrite	E 300	0.500 mg/L

Note:
[1] This value reflects the actual value reported in the data set. There is no Air Force Center for Environmental Excellence PQL requirement for iron by inductively coupled plasma – mass spectroscopy (ICP-MS).

Definitions:
µg/L = micrograms per liter
BTEX = benzene, toluene, ethylbenzene, total xylenes
DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
PCBs = polychlorinated biphenyls
PQL = practical quantitation limit
RRO = residual range organics
TAH = total aromatic hydrocarbons = sum of BTEX concentrations
TAqH = total aqueous hydrocarbons = sum of BTEX and PAH concentrations

Table 3-3 Laboratory Methods for Soil/Sediment Samples

Sample Location	Analyte	Analytical Method	PQL (mg/L)
LF03, SS13	BTEX	8021B	0.0125 mg/kg to 0.0500 mg/kg
LF03, SS13	DRO	AK102	20.0 mg/kg
SS13	RRO	AK103	6 00 mg/kg
LF03, SS13	PAH	8270-SIMS	0.006 mg/kg
LF03	PCBs	8082	0.033 mg/kg

Definitions:
BTEX = benzene, toluene, ethylbenzene, total xylenes
DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PQL = practical quantitation limit
RRO = residual range organics
TAH = Total aromatic hydrocarbons = sum of BTEX concentrations
TAqH = Total aqueous hydrocarbons = sum of BTEX and PAH concentrations
µg/L = micrograms per liter

3.2 Laboratory Quality Assurance/Quality Control Procedures

Sample collection, handling, and management adhered to strict quality assurance/quality control (QA/QC) criteria. Laboratory analytical QA/QC reporting such as data quality assessment and data validation information is presented in the Quality Assurance Report for this study and is included in Appendix D.

3.3 Groundwater Field Measurements

Before groundwater samples were collected from monitoring wells identified in this scope, total well depths and water levels were measured and recorded in the field and each well was purged by removing approximately three well volumes of water. The purpose of purging is to draw true formation water into the well for sampling so that actual aquifer conditions are measured and analyzed. In a few instances, the well recharge rates were slow, and the total purge volume could not be removed. When this occurred, available water was collected and used for the analytical sample.

Table 3-4 identifies groundwater sample locations where field measurements were obtained, along with the measurement method and unit ranges for each field test. Groundwater samples were typically field tested at the time of sampling for temperature, pH, conductivity, dissolved oxygen, redox potential, and total dissolved solids (TDS). In 2004, field readings were recorded on field data sheets. Specific measurements and results obtained in 2004 are reported in Section 6.

Table 3-4 Field Parameters Measurement Methods

Location (Well ID)	Parameter	Method	Range
LF03 (CMW-1 to CMW-7, MW-1) SS13 (MW-01 and MW-02) SS15 (WW02, WW07, WW08)	Temperature	E170.1	0-50°C
	PH	SW9040C	0-14 units
	Conductivity	E120.1	0-100 mS/cm^2
	Dissolved Oxygen	E360.1	0-19.9 mg/L
	redox Potential	ASTM D1498	+/- 999 mv
	TDS	E180.1	0-1990 ppm

Definitions:
°C = degrees Celsius
mg/L = milligrams per liter
mS/cm^2 = milliseimens per square centimeter
mv = millivolts
ppm = parts per million
TDS = total dissolved solids

3.4 SS13 Field Tasks

Two groundwater, three surface water, two sediment, and three near-surface soil samples were collected at SS13 and submitted for laboratory analyses (Figure 3-1). Requested analytical parameters varied according to sample media (Table 3-1).

3.4.1 Groundwater Sampling

Paug-Vik collected a groundwater sample from MW-01 on June 22, 2004. On August 31, 2004, Paug-Vik also collected a sample from MW-02 because that well was dry during the June attempt to sample. MW-01 and MW-02 groundwater samples were submitted to the project laboratory for the following analytical parameters in 2004: BTEX, DRO, RRO, PAHs, alkalinity, dissolved iron, sulfate, and nitrate/nitrite.

BNCI installed and sampled well MW-03 at SS13 in 2004 under a separate contract and project scope. Sampling and analytical details for this well are provided in *Volume I of the Landfill 2 (LF03), SS13 and SS15 Long Term Monitoring Cape Romanzof LRRS, Alaska* (BNCI, 2004). This sample was submitted for the following laboratory analyses: GRO, DRO, RRO, BTEX, SVOC, alkalinity, total iron, dissolve iron, sulfate, and nitrates.

Table 3-5 provides information about SS13 wells MW-01, MW-02, and MW-03 from 2004. Groundwater field measurements for temperature, pH, conductivity, dissolved oxygen content, redox potential, and TDS are presented and discussed in Section 6.

Waterra® inertial pumps were found in MW-01 and MW-02 and were removed prior to sampling. The pumps consist of half-inch-diameter plastic tubes with foot valves that produce water flow when oscillated up and down in the well. However, the foot valves had silted up because of noncontinuous use and were not operational at the time. The pumps were cut and disposed of with other sampling debris.

The casing and well monument at MW-02 were noted to be in extremely poor condition. Both the casing and monument were loose and not cemented into place. Water had pooled around the well casing (approximately 1 foot in depth). A gurgling sound was noted during sampling, and the integrity of this well is suspect.

Organic hydrocarbon results are presented and discussed in Section 5. Inorganic analytical results are discussed in Section 6 as part of natural attenuation processes.

Table 3-5 Monitoring Well Information at SS13 in 2004

Well ID (units)	Total Well Depth[1] (feet)	Water Level Depth[1] (feet)	Date Sampled	Comments
MW-01	26.3	23.0	June 22, 2004	2-inch (diameter) well.
MW-02	12.04	4.06	Aug 31, 2004	No water in June but sampled successfully in August. Poor condition 2-inch well. Casing Bent at 6 feet below top of casing.
MW-03	23.02	9.36	Aug 31,2004	BNCI installed a 2-inch well in 2004.

Note:
[1] Depths measured from top of casing.

3.4.2 *Surface Water Sampling*

Three surface water samples were collected on June 9, 2004, from the main drainage downgradient of the SS13 spill area (Figure 3-1). Sample locations are identified as SW-01, SW-02, and SW-03. SW-01 was the farthest downgradient location from the small pond from which the drainage appeared to originate. SW-02 was collected several yards upgradient from SW-01, and SW-03 was collected further upgradient at the confluence of a small drainage and the main stream. Surface water samples were submitted to the project laboratory for analyses of the following parameters: BTEX, DRO, RRO, PAHs, TAH, and TAqH.

3.4.3 Sediment Sampling

Two sediment samples were collected on June 9, 2004, from locations identified as SS-01 and SS-06 in an intermittent drainage that joins the larger stream downgradient. Sediment sample locations are upgradient of the surface water sample sites (Figure 3-1). Sediment samples were submitted to the project laboratory for analyses of the following parameters: BTEX, DRO, RRO, and PAHs.

3.4.4 Near-Surface Soil Sampling

Near-surface soil samples were collected from three locations identified as LB-03, LB-07, and LB-08 (Figure 3-1) and submitted to the project laboratory for analyses for the following parameters: BTEX, DRO, RRO, and PAHs.

3.5 SS15 Field Tasks

Only groundwater samples were collected at the SS15 site in 2004. Waterra® inertial pumps were found in wells WW-02, WW-07, and WW-08 at SS15. The pumps were removed from WW-02 and WW-08 prior to sampling. However, the pump in WW-07 could not be removed despite repeated attempts. The pumps consist of half-inch-diameter plastic tubes with foot valves that, when oscillated up and down in the well, produce a flow of water. However, the foot valves had silted up because of noncontinuous use and were no longer operational. The pumps were cut and disposed of with other sampling debris.

Well WW-02 was the only well sampled at this site during the June 2004 sampling event. A fuel odor was noted when the field team opened well WW-02. Using a product interface probe lowered into the well, the field team did not note the presence of any free product in the well. Sheen was noted during purging and sampling of groundwater from the well.

WW-08, which was dry in June, was later sampled in August when groundwater levels had risen. Table 3-6 provides available information for the wells sampled at SS15 in 2004. It should be noted that WW-08 had been incorrectly labeled "WW-09" on previous reports and work plans. The well number was clearly marked on the well as "WW-08" and was reported as such.

An attempt to sample WW-07 in 2004 because the field team could not remove old inertial pump and tubing left in well WW-07. Some water was extracted from the inside of the pump during an initial attempt to purge and sample this well anyway, but the water quickly went dry and no water was available for a sample. As a result, no sample was collected from this well. Attempts to lace peristaltic pump tubing between the existing pump tubing and the casing were unsuccessful due to a slightly bent well casing.

A third monitoring well was installed in June 2004 at SS15 by BNCI under a separate contract (WW-09). Sampling details and data for this well are provided in *Volume I of the Landfill 2 (LF03), SS13 and SS15 Long Term Monitoring Cape Romanzof LRRS, Alaska*, (BNCI, 2004).

Table 3-6 Monitoring Well Information at SS15 in 2004

Well ID (units)	Total Well Depth[1] (feet)	Water Level Depth[1] (feet)	Date Sampled	Comments
WW-02	69.15	63.36	June 8, 2004	Fuel odor and sheen noted. 4-inch well.
WW-07	12.03	7.42	NA	Unable to withdraw pump tubing so could not sample well. 2-inch well.
WW-08	25 62	10.10	Aug 31, 2004	This well was dry in June but was sampled successfully in August. 2-inch well.
WW-09	14.49	Dry	NA	Well installed in 2004 under separate contract for BNCI. Well was inspected in June and August, 2004, and was dry both times. 2-inch well

Note:
[1] Depths measured from top of casing.

3.6 LF03 Field Tasks

Seven groundwater wells were sampled at LF03 in 2004. Three co-located surface water and sediment samples were collected from downgradient seep areas (Seep 1, Seep 2, and Seep 3).

3.6.1 Groundwater Sampling

Seven groundwater wells in the LTM scope for the landfill were sampled in June and August 2004 (Table 3-1). The eighth monitoring well in the scope (CMW-2) was dry during both attempts and could not be sampled in 2004. Table 3-7 provides specific information on the sampled LTM wells at the LF03. Sampled well locations are shown on Figure 3-2.

Groundwater samples were submitted to the project laboratory for BTEX, DRO, PAH, and PCB analyses. Groundwater samples were field tested for temperature, pH, conductivity, dissolved oxygen, redox potential, and total dissolved solids (turbidity) at the time of collection. The information was recorded for each well in the groundwater sampling field data sheets (Appendix C).

3.6.2 Surface Water and Sediment Sampling

Three co-located surface water and sediment samples were collected in June 2004 from downgradient drainages emanating from the landfill area identified as Seep 1, Seep 2, and Seep 3 (Figure 3-2). Surface water samples generally appeared clear when collected with no other noteworthy observations. Both surface water and sediment samples were analyzed at the project laboratory for BTEX, DRO, PAH, and PCB constituents.

Table 3-7 LF03 Monitoring Well Information

Well ID (units)	Total Well Depth [1] (feet)	Water Level Depth (feet)	Date Sampled	Comments
MW-1	20.00	17.20	June 13, 2004	Sampled. Well stand in poor condition.
CMW-1	10.05	5.08	June 24, 2004	Sample collected.
CMW-2	9.80	9.25	June 13, 2004	Not sampled. Well dry at each attempt.
CMW-3	9.12	7.60	June 24, 2004	Sample collected
CMW-4	10.37	7.02	June 13, 2004	Sample collected
CMW-5	10.35	4.95	June 13, 2004	Sample collected
CMW-6	15.00	13.01	June 13, 2004	Sample collected. Good recovery. Duplicate sample collected.
CMW-7	13.85	11.65	June 24, 2004	Sample collected.

Note:
[1] Depths measured from top of casing.

144 27

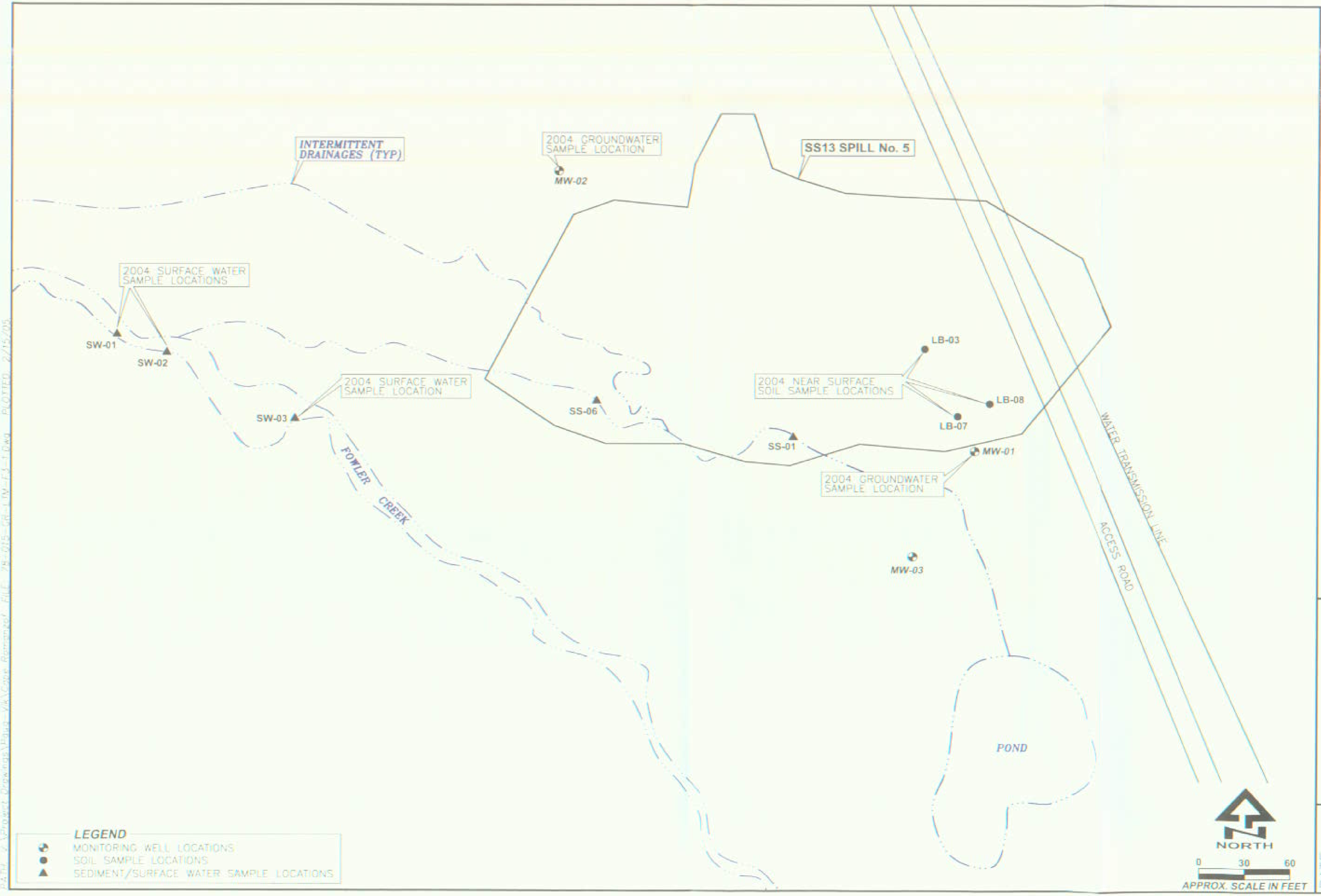

FIGURE
3-1

(SS13)
2004 MNA SAMPLE LOCATIONS

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

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

DATE	FEB 2005
CHKD	HG
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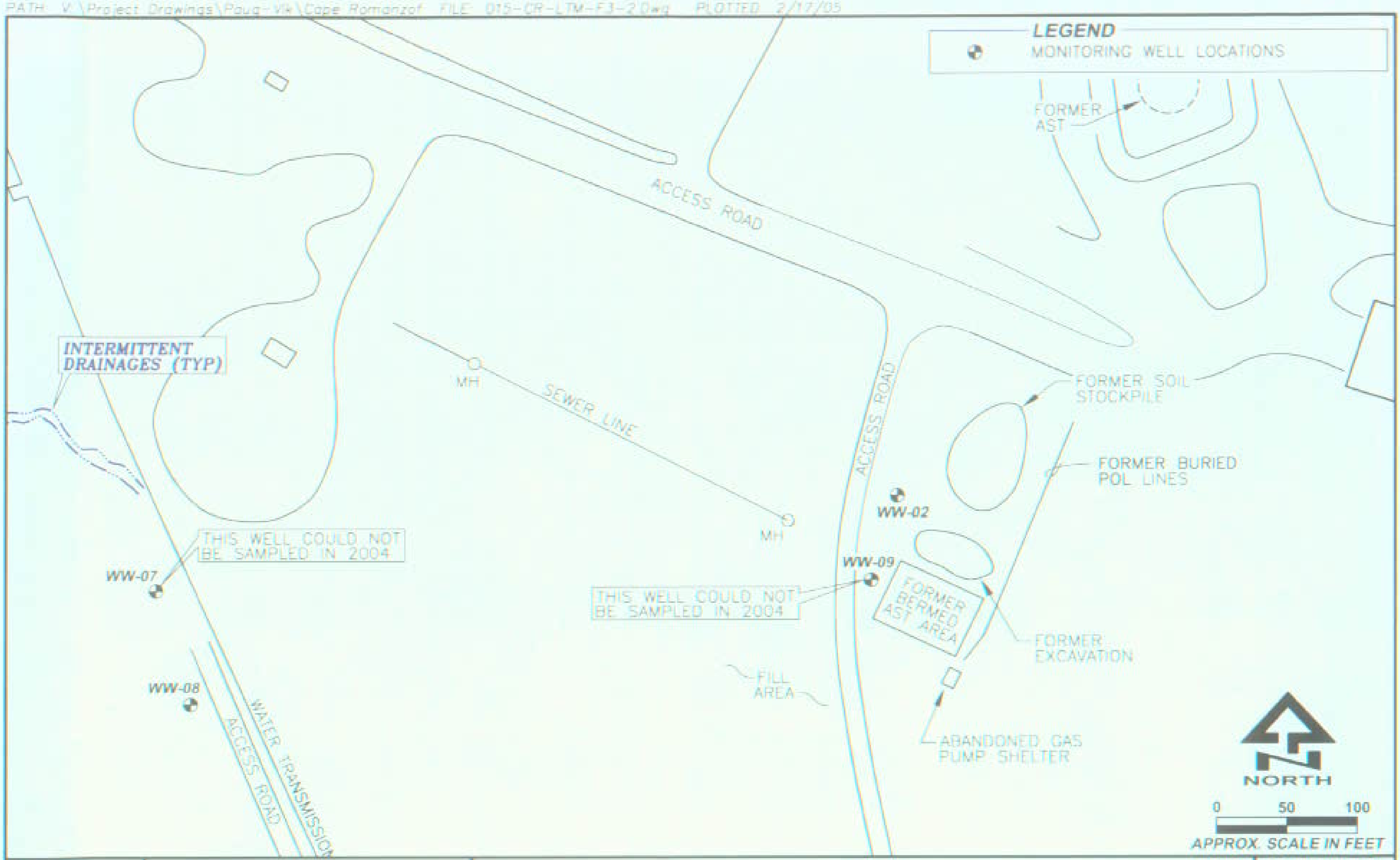

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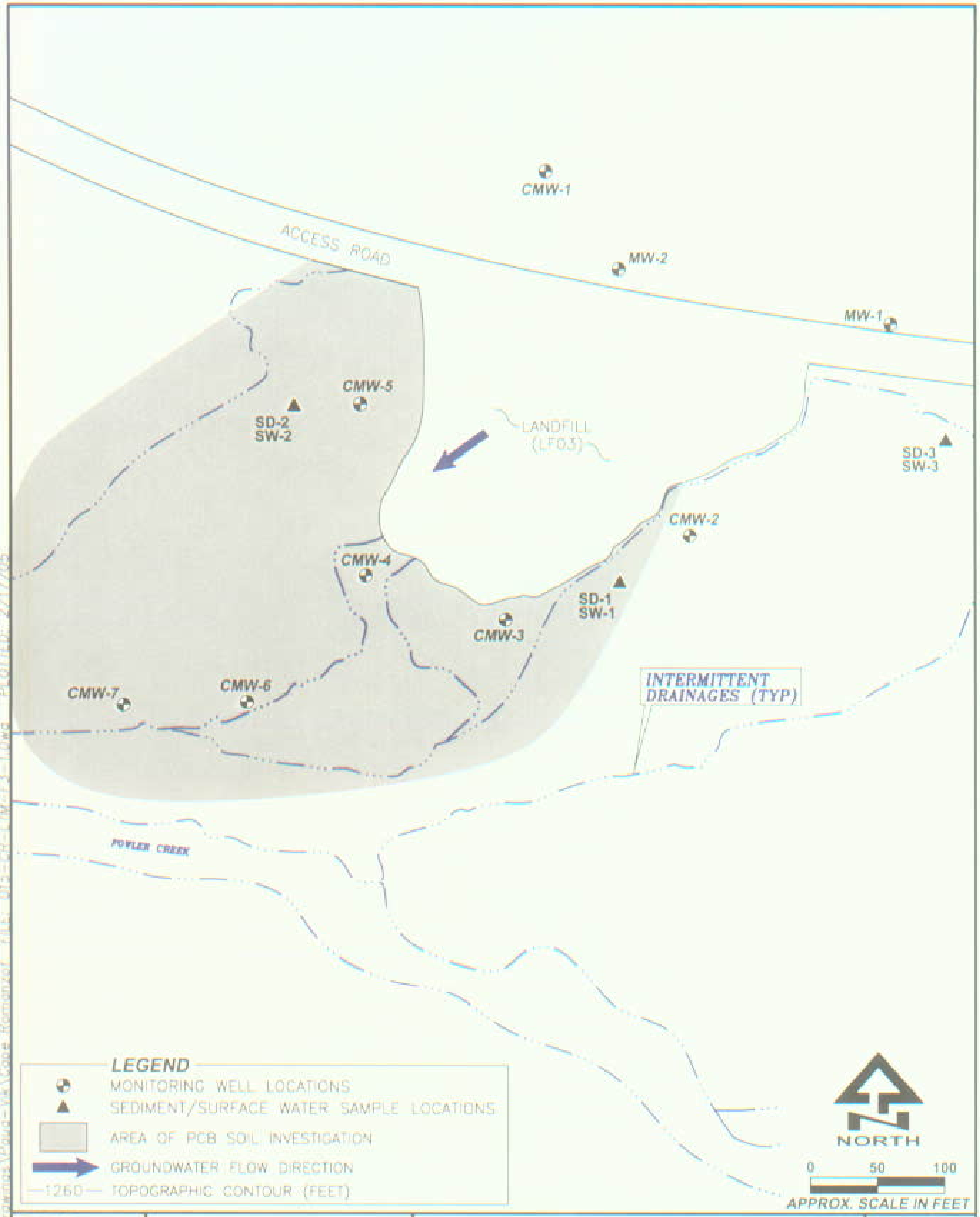
611TH AIR SUPPORT GROUP
611TH CIVIL ENGINEER SQUADRON
ELMENDORF AFB, ALASKA

(SS15)
2004 MNA SAMPLE LOCATIONS

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

FIGURE
3-2

144 29



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

(LF03)
2004 SAMPLE LOCATIONS

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

FIGURE
3-3

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4 PRELIMINARY REMEDIAL ACTION OBJECTIVES

Analytical sample results for groundwater, surface water, soil, and sediment samples are presented in Section 5 and compared against preliminary updated RAOs developed for the sites, based on current ADEC regulations and guidance. In some cases, the updated preliminary RAOs presented in this report are different from the cleanup levels presented in the Interim ROD (611 CES, March 2002). The RAOs presented in this report are based upon up-to-date regulations and guidance.

Development of the preliminary RAOs for specific media of concern (i.e., groundwater, surface water, soil, and sediment) is presented in Sections 4.1 through 4.4, along with a discussion of any deviation from the initial cleanup levels identified in the Interim ROD (611 CES, 2002).

4.1 Groundwater

Preliminary RAOs for groundwater were developed in accordance with the Alaska Oil and Other Hazardous Substances Pollution Control Regulations (18 AAC 75.345[b][a] Method Two [Table C] groundwater cleanup levels). Preliminary RAOs for groundwater contaminants of concern at SS13, SS15, and LF03 are presented in Table 4-1 and include contaminants of concern (COCs) presented in the Interim ROD and COPCs detected in the 2004 analytical data. COPCs presented in Section 5 are compared with groundwater RAOs presented in Table 4-1. Groundwater RAOs identified for GRO, DRO, and RRO are consistent with the projected cleanup levels identified in the Interim ROD (611 CES, 2002).

4.2 Surface Water

Preliminary RAOs for surface water were developed in accordance with the Alaska Water Quality Standards (AWQS), 18 AAC 70. There are no quantitative criteria established for GRO, DRO, and RRO in surface water. Instead, the AWQS provide water quality criteria for specific hydrocarbon constituents (i.e., TAH, and TAqH). TAH is defined as the sum of the BTEX concentrations. TAqH is defined as the sum of TAH and the sum of PAH as analyzed by USEPA-approved methods. Water quality standards for specific COCs identified in the Interim ROD and COPCs detected in 2004 samples are presented in Table 4-2 as preliminary RAOs. Contaminant levels detected in 2004 surface water samples are compared with Table 4-2 cleanup levels in Section 5.

The preliminary RAOs presented in Table 4-2 are *not* consistent with the projected cleanup levels for the surface water COPCs (PCBs) presented in the Interim ROD.

Table 4-1 Groundwater Cleanup Levels for COCs and COPCs

Contaminant of Concern	Cleanup Level (mg/L)	Regulatory Basis
Bulk Hydrocarbons		
GRO	1.3	18 AAC 75.345(b)(1)
DRO	1.5	
RRO	1.1	
VOCs		
Benzene	0.005	18 AAC 75.345(b)(1)
Toluene	1.0	
Ethylbenzene	0.7	
Total Xylenes	10	
PAHs		
Naphthalene	0.7	18 AAC 75 345(b)(1)
Acenaphthene	2.2	
Anthracene	11.0	
Benzo(a)anthracene	0.001	
Benzo(a)pyrene	0.0002	
Benzo(b)fluoranthene	0.001	
Benzo(k)fluoranthene	0.01	
Chrysene	0.1	
Dibenzo(a,h)anthracene	0.0001	
Fluoranthene	1.46	
Fluorene	1.46	
Indeno(1,2,3-c,d)pyrene	0.001	
Pyrene	1.1	
Phenanthrene	11.0	ADEC Tech Memo 01-007
Benzo(g,h,i)perylene	1.1	
PCBs		
PCBs	0.0005	18 AAC 75.345(b)(1)

Notes:
18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.
Calculated cleanup level in accordance with 18 AAC 75.340(g); provided in ADEC Tech Memo 01-007, dated November 24, 2003

Definitions:
DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
RRO = residual range organics
VOCs = volatile organic compounds

Table 4-2 ADEC Surface Water Criteria for COCs and COPCs

Contaminant of Concern	Criteria (mg/L)	Regulatory Basis
Bulk Hydrocarbons [1]		
TAH	0.010	18 AAC 70.020(b)
TAqH	0.015	
DRO, GRO, RRO	No sheen	
VOCs		
Benzene	0.005	18 AAC 70.020(b)
Ethylbenzene	0.7	
Toluene	1.0	
Total Xylenes	10	
PAHs		
Benzo(b)fluoranthene	0.3	NOAA SQuiRT Marine Criteria [2]
Benzo(g,h,I)perylene	0.3	
Naphthalene	0.62	NOAA SQuiRT Freshwater Criteria [2]
Pyrene	0.960	18 AAC 70.020 (b)
PCBs		
PCBs	0.000014	18 AAC 70.020 (b)

Notes:

18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; water quality criteria; Alaska Water Quality Standards tables, as amended through June 26, 2003 (ADEC, 2004b).

NOAA SQuiRT = National Oceanic and Atmospheric Administration Screening Quick Reference Tables, updated September 1999 (Buchman, 1999).

[1] There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[2] There are no standards provided for these analytes in 18AAC70; therefore, ambient water quality criteria values found in the NOAA SQuiRT tables are used as surface water screening criteria. Note that the NOAA SQuiRT values are not regulatory cleanup levels.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
RRO = residual range organics
TAH = Total aromatic hydrocarbons = sum of BTEX concentrations
TAqH = Total aqueous hydrocarbons = sum of BTEX and PAH concentrations
VOCs = volatile organic compounds

4.3 Soil

Preliminary RAOs for soil were developed in accordance with the Alaska Oil and Other Hazardous Substances Pollution Control Regulations (18 AAC 75.341[c] and [d] Method Two, under 40-inch [precipitation] zone [Tables B1 and B2] soil cleanup levels). The more restrictive cleanup level of the "ingestion," "inhalation," and "migration to groundwater" pathways were used to develop preliminary RAOs.

Preliminary RAOs for soil COPCs identified in the Interim ROD and detected in the 2004 sampling data are presented in Table 4-3. Contaminant levels discussed in Section 5 are compared against those preliminary RAOs developed (Table 4-3). Preliminary RAOs for DRO and RRO are consistent with the projected cleanup levels for COCs presented in the Interim

ROD. Preliminary RAOs for other COPCs detected in 2004 are also included (i.e., GRO, BTEX, PAHs, and PCBs).

Table 4-3 Soil Cleanup Levels for 2004 COCs and COPCs

Contaminant of Concern	Soil Cleanup Levels			Regulatory Basis
	Ingestion Pathway (mg/kg)	Inhalation Pathway (mg/kg)	Migration to Groundwater Pathway (mg/kg)	
		Bulk Hydrocarbons*		
GRO	10,250	1,400	**300**	18 AAC 75.341 (d)
DRO	**10,000**	12,500	**250**	
RRO	**10,000**	22,000	11,000	
		VOCs		
Benzene	20,300	9	**0.02**	18 AAC 75.341 (c)
Toluene	10,000	180	**5.4**	
Ethylbenzene	203,000	89	**5.5**	
Xylenes (total)	203,000	81	**78**	
		PAHs and other SVOCs		
Chrysene	2,000	Not available	**620**	18 AAC 75.341 (c)
Napthalene	3,000	120	**21**	
Pyrene	4,100	Not available	**1,500**	
Fluoranthene	10,000	Not available	**2,100**	
Di-n-butylphthalate	4,100	Not available	**1,700**	
Flourene	**11**	Not available	**270**	
Benzo(b)fluoranthene	30,000	Not available	20	
Phenanthrene	3000	Not available	**4,300**	ADEC Tech Memo 01-007
Benzo(g,h,I)perylene	2030	Not available	**1500**	
2-Methylnaphthalene	**590**	Not available	**60.9**	
Bis-2(ethylhexyl) phthalate	**590**	Not available	1200	18 AAC 75.341 (c)
		PCBs		
PCBs	**1***	**1***	10	18 AAC 75.341 (c)

Notes:

*The inhalation/ingestion cleanup level of 1 mg/kg PCBs is protective of residential use. For commercial/industrial use, a cleanup level of 10 mg/kg PCBs is protective.

18 AAC 75.341(c) and (d) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)

Calculated cleanup level in accordance with 18 AAC 75.340(g); provided in ADEC Tech Memo 01-007, dated November 24, 2003.

Bolded cleanup level is the most stringent of the available cleanup levels and is protective of inhalation, ingestion, and migration to groundwater.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
RRO = residual range organics
VOCs = volatile organic compounds

Note: *Unlike surface water or groundwater samples, analytical results for soil (and sediment) matrix samples cannot be rigorously compared from sampling event to sampling event. This is due to the inherent heterogeneity of the soil/sediment matrix and the likely irregular distribution of contaminants within a given spatial area. In addition, the precise sampling location cannot be duplicated from event to event as it can with water, since the process of sample collection of a solid in and of itself is destructive, requiring the removal of material from the site.*

4.4 Sediments

Preliminary RAOs for sediment were developed in accordance with ADEC's Technical Memorandum on Sediment Quality Guidelines (ADEC, 2004) and Risk Assessment Procedures Manual (ADEC, 2000). If available for any given analyte, National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables (SQuiRT) threshold effects level (TEL) or probable effects level (PEL) sediment benchmarks were selected as preliminary RAOs. If there are no NOAA SQuiRT PEL/TEL values published for an analyte, then the most conservative sediment screening value provided by other published sources (e.g., NOAA SQuiRT that are not PEL or TEL values, Oak Ridge National Laboratory sediment quality benchmarks or the USEPA Office of Solid Waste and Emergency Response Ecotox Thresholds) were selected as the preliminary RAO. There are no quantitative sediment quality criteria established for GRO, DRO, or RRO in sediments. Preliminary RAOs for sediment COPCs (identified both in the Interim ROD and from 2004 analytical data) are presented in Table 4-4. Contaminant levels discussed in Section 5 are compared with RAOs (Table 4-4).

It should be noted that preliminary RAOs presented in Table 4-4 are *not* consistent with project cleanup levels for sediment COPCs (DRO and PCBs) presented in the Interim ROD and are consistent with current regulatory guidelines. The Interim ROD presented cleanup levels of 250 milligrams per kilogram (mg/kg) for DRO and 10 mg/kg for PCBs; however, recent ADEC sediment quality guidelines (ADEC, 2004b) does not provide for quantitative sediment quality criterion for DRO in sediments, but does provide a sediment quality criteria of 0.0341 mg/kg for PCBs. Table 4-4 presents preliminary RAOs for COPCs identified in the Interim ROD and in the 2004 sampling data (i.e., BTEX and PAHs).

4.5 Data Evaluation Procedures

This section outlines how the data were evaluated and presented. Table 4-5 summarizes each general sampling activity, sampling objective, and data evaluation standard with recommended actions. Specific evaluation of each sample location is presented in Section 5 for hydrocarbon contaminants and in Section 6 for field parameters and inorganic data use to assess intrinsic remediation activity in groundwater.

Table 4-4 Sediment Screening Benchmarks for COPCs Detected in Sediments in 2004

Contaminants of Concern	Sediment Screening Benchmark (mg/kg)[1]	Reference
	Bulk Hydrocarbons [2]	
	VOCs	
Benzene	0.057	OWSER ET
Toluene	0.05	ORNL SQB
Ethylbenzene	0.089	ORNL SQB
Xylenes (total)	0.025	OSWER ET
	PAHs	
Chrysene	0.0571	NOAA SQuiRT TEL
Napthalene	0.01465	NOAA SQuiRT Lowest ARC TEL
Pyrene	0.053	NOAA SQuiRT TEL
Fluoranthene	0.111	NOAA SQuiRT TEL
Fluorene	0.010	NOAA SQuiRT Lowest ARC TEL
Phenanthrene	0.0419	NOAA SQuiRT TEL
Benzo(b)fluoranthene	1.8	NOAA SQuiRT Marine AET
Benzo(g,h,l)perylene	0.3	NOAA SQuiRT UET
	PCBs	
PCBs	0.0341	NOAA SQuiRT TEL

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum Sediment Quality Guidelines (2004).

[2] There are no screening benchmarks for bulk hydrocarbons in sediment.

Definitions:

AET = apparent effects threshold
mg/kg = milligrams per kilogram
NOAA SQuiRT = National Oceanic and Atmospheric Administration Screening Quick Reference Tables, updated September 1999 (Buchman, 1999).
OSWER ET= Environmental Protection Agency (USEPA) Office of Solid Waste and Emergency Response Ecotox Thresholds (USEPA, 1996)ORNL SQB = Oak Ridge National Laboratory Sediment Quality Benchmark (Jones et al., 1997)
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
PEL = probable effects level
TEL = threshold effects level
UET = upper effects threshold
VOCs = volatile organic compounds

4.6 Evaluation of Intrinsic Remediation

Biodegradation of fuel constituents by microbial processes is directly affected by various inorganic and geochemical factors including dissolved oxygen, iron, pH, nitrate, sulfate, and alkalinity. Additional factors that affect or may be indicators of remediation activity include conductivity, redox potential, and temperature.

Biodegradation of fuels occurs either aerobically or anaerobically. In many subsurface environments, both aerobic and anaerobic biodegradation can occur simultaneously. Both of these processes require an electron acceptor to complete the degradation reaction of fuel contaminants.

Table 4-5 Data Evaluation Procedures

Activity/Objective	Data Evaluation/Action
Groundwater: Collect groundwater data from monitoring wells to assess the nature, degree, and extent of potential contaminant plumes.	• Compare data to ADEC groundwater cleanup levels in 18 AAC 75.345 Groundwater Cleanup Levels (Table C). • Compare data to previous sample data. • Assess status of intrinsic remediation.
Surface Water: Collect surface water data to assess the degree and extent of any potential contaminants, or any adverse effects on water quality from surface water runoff.	• Compare data to ADEC water quality standards in 18 AAC 70.020(b) • Compare data to previous sample data. • Assess status of intrinsic remediation, if applicable.
Soil: Collect soil data to assess the nature, degree, and extent of potential contaminants.	• Compare data to: ADEC soil cleanup levels in 18 AAC 75.341 Tables B-1 and B-2 (<40" zone, Migration to GW) for soil cleanup levels. • Compare data to previous sample data. • Assess current status of soil conditions.
Sediments: Collect sediment data to assess the nature and extent of potential adverse environmental impacts from identified contaminants.	• Compare data to ADEC Technical Memo "Sediment Quality Guidelines" (ADEC, March 2004).. • Compare data to previous sample data.

Aerobic degradation is the dominant process using oxygen as the electron acceptor. Aerobic degradation requires dissolved oxygen to function. If oxygen is limited, the process will proceed under anaerobic conditions using nitrate, iron, and sulfate (in respective order) as electron acceptors.

Table 4-6, developed in accordance with the Air Force Center for Environmental Excellence (AFCEE) publication *Technical Protocol for Implementing Intrinsic Remediation with Long-Term Monitoring for Natural Attenuation of Fuel Contamination Dissolved in Groundwater* (March, 1999), presents a brief description of field parameter measurements and inorganic constituents and how they are used in this report to evaluate intrinsic remediation activity.

Table 4-6 Summary of Evaluation Factors for Intrinsic Remediation

Parameter	Evaluation Factors
pH	• Generally, pH will range from 6 to 8 for optimal biodegradation
Temperature	• Bioremediation is known to occur from 0 to 75° Celsius (° C). Slower rates occur at lower temperatures although numerous studies have shown that bacteria in cold climates are acclimated to and function optimally at cold temperatures. Activity generally slower if <5° C. • Directly affects solubility of dissolved oxygen; dissolved oxygen is more soluble in cold water.
Alkalinity	• Helps buffer pH. Hydrocarbon bioremediation will increase alkalinity relative to background.
Redox Potential	• Measure of electron activity (determination of aerobic or anaerobic environment).
Conductivity	• Can be used to identify similar or different water sources.
Nitrate/Sulfate	• Acts as electron acceptor when oxygen is depleted.
Iron (II)	• Acts as electron acceptor during anaerobic fuel degradation
Dissolved Oxygen (DO)	• Most important factor for aerobic biodegradation. DO > 1.0 mg/L will limit anaerobic activity.

Intrinsic remediation, also commonly referred to as natural attenuation, is the natural chemical, physical, and biological processes that reduce or eliminate contaminant concentrations in soil, surface water, or groundwater. Intrinsic remediation results from several subsurface attenuation mechanisms that are either destructive or nondestructive to the contaminant of concern. Destructive attenuation removes contaminant mass from the soil or water. Biodegradation is the most important destructive attenuation mechanism (Weidemeier et al., 1995). Nondestructive attenuation mechanisms include sorption, dispersion, dilution, and volatilization.

The significance of the various intrinsic remediation parameters (geochemical indicators) important for aerobic biodegradation of fuel hydrocarbons is discussed in Section 6.

4.7 Evidence of Intrinsic Remediation

Field parameter measurements and inorganic data were obtained during the 2004 field effort at Cape Romanzof for the purpose of evaluating the intrinsic remediation activity and potential of affected groundwater. During collection of groundwater samples, temperature, pH, conductivity, dissolved oxygen, redox potential, and turbidity were measured in the field. Groundwater samples were also analyzed at the project laboratory for alkalinity, ferrous iron, sulfate, and nitrite/nitrate. These results are discussed in Section 6, but their significance and how the information is used is discussed below.

In bioremediation, microorganisms obtain energy by oxidation of an electron donor and reduction of an electron acceptor. Electron donors are fuel hydrocarbon or other organic carbon compounds; they act as a microbial substrate or food source during microbial reactions. The electron acceptors are elements or compounds that are required to complete the electron transfer reaction (coupled redox reaction). In natural groundwater systems, these elements and compounds generally consist of oxygen, nitrate, ferric iron (iron [III]), sulfate, and carbon dioxide. Biodegradation of fuel hydrocarbons is usually limited by the electron acceptor availability.

Three lines of evidence can be used to support the occurrence of intrinsic remediation: (1) loss of contaminant mass, (2) changes in geochemical parameters, or (3) direct microbial evidence such as microcosm studies. Intrinsic remediation reduces the total mass of contaminant dissolved in groundwater using naturally occurring biological attenuation mechanisms. These mechanisms can be aerobic or anaerobic, or both, and commonly occur in a sequence that is somewhat dependent on the groundwater geochemical conditions and available geochemical electron acceptors. The attenuating mechanisms bring about measurable changes in the groundwater chemistry in the affected area. By measuring these geochemical changes at the site, intrinsic remediation can be quantitatively evaluated.

In general, the following geochemical indicators for intrinsic remediation can be quantitatively evaluated:

- Indicators of biological activity such as dissolved oxygen, nitrate, ferrous iron, sulfate/sulfide, and methane.
- Indicators—such as alkalinity, temperature, pH, and redox potential—used to evaluate the environmental conditions of an aquifer and used to determine whether they are favorable for biological activity.
- Indicators—such as chloride and conductivity—used to determine whether the sampling locations are all within the same hydrogeologic unit.

5 2004 FINDINGS FOR HYDROCARBON-RELATED SAMPLE DATA AND COMPARATIVE EVALUATION WITH SIMILAR HISTORICAL RESULTS

This section presents analytical results for hydrocarbon compounds detected in environmental samples collected from three study sites as part of the 2004 LTM/MNA effort at the Cape Romanzof LRRS. Other results that are related to evaluating natural attenuation conditions, such as analytical data for inorganic constituents and groundwater field measurements, are discussed in Section 6.

During the field effort in June and August 2004, samples were collected from four types of media (i.e., groundwater, sediments, and near-surface soils) at the three study sites for this project:

1. SS13 – Diesel Seep Area (MNA).
2. SS15 – UST Spill Area (MNA).
3. LF03 – Closed Landfill No. 2 (LTM).

Figure 2-1 shows an overview of the locations of the three study sites. Site details for SS13, SS15, and LF03 are presented on Figures 5-1, 5-2, and 5-3, respectively. The sampling scope for each site is summarized in Table 5-1.

Table 5-1 2004 Sampling Scope for MNA/LTM Study at Cape Romanzof

Site	Media/Locations Sampled	Analytical Parameters	Purpose
SS13 (Diesel Spill Area)	Groundwater: MW-01, MW-02, and MW-03.[1]	BTEX, DRO, RRO, PAH, Alkalinity, Dissolved Iron, Sulfate, and Nitrate/Nitrite.	Monitored Natural Attenuation scope
	Surface Water: SW-01, SW-02, and SW-03.	BTEX, DRO, RRO, PAH, TAH, and TAqH.	
	Sediments: SS-01 and SS-06.	BTEX, DRO, RRO, and PAH.	
	Near-surface Soil: LB-03, LB-07, and LB-08.	BTEX, DRO, RRO, and PAH.	
SS15 (UST Seep Area)	Groundwater: WW-02, WW-07, and WW-08.	BTEX, GRO, DRO, RRO, PAH, Alkalinity, Dissolved Iron, Sulfate, and Nitrate/Nitrite.	Monitored Natural Attenuation scope
LF03 (Closed Landfill No. 2)	Groundwater: MW-1, CMW-1, CMW-2. CMW-3, CMW-4, CMW-5, CMW-6, and CMW-7.	BTEX, DRO, PAH, and PCBs.	Long-term Monitoring and Landfill Cap Inspection scope
	Surface Water: SW-1, SW-2, and SW-3	BTEX, DRO, PAH, and PCBs.	
	Sediments: SS-1, SS-2, and SS-3	BTEX, DRO, PAH, and PCBs.	

Note:
[1] Sample collected under a separate project and contract.

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Data tables in this section include a comparison to preliminary RAOs developed in Section 4 of this report. These preliminary RAOs have been updated from the projected cleanup levels presented in the Interim ROD (611 CES, 2002) based upon current regulations and guidelines.

5.1 Site SS13 Hydrocarbon-Related Compounds

Groundwater, surface water, sediments, and near-surface soils were collected at this site in the summer of 2004 for MNA evaluation. Identified media-specific sample locations are listed below and shown on Figure 5-1:

- Groundwater at MW-01, MW-02, and MW-03[1].
- Surface Water at SW-01, SW-02, SW-03.
- Sediments at SS-01 and SS-06.
- Near-surface Soils at LB-03, LB-07, LB-08.

Groundwater samples were collected from monitoring well MW-01 on June 22, 2004, and from MW-02 and MW-03 on August 31, 2004. Surface water, sediment, and soil samples were collected on June 9, 2004. Samples were submitted to the project laboratory for the analytical parameters listed in Table 5-1.

MW-03 was installed and sampled in 2004 under a separate project and contract, with details and results provided in BNCI's November 2004 report (BNCI, 2004). Soil samples collected from the borehole were collected and analyzed at specific depth intervals. Although initially presented in BNCI's November 2004 report, soil results are also included in this report.

The subsections below discuss only organic hydrocarbon results. Groundwater samples were also analyzed for inorganic parameters such as alkalinity, dissolved iron, sulfate, and nitrate/nitrite to assess the natural attenuation processes currently at work. The natural attenuation results are discussed in Section 6.

5.1.1 SS13 Groundwater Hydrocarbon Data

Groundwater samples collected from MW-01 and MW-02 were analyzed for BTEX, DRO, RRO, and PAHs in 2004. Samples for MW-03 were analyzed for BTEX, DRO, and RRO. Semivolatile organic compounds (SVOCs) were also analyzed in the MW-03 sample. Table 5-2 lists the groundwater sampling results.

As noted in BNCI's 2004 report, MW-03 was installed on June 17, 2004, under a separate project and contract. Immediately after well completion in June 2004, MW-03 was reported to be dry and no sample was collected. The well was re-visited on August 31, 2004, and there was enough water volume to collect an analytical sample. The groundwater data from the August sampling event at MW-03 is included in Table 5-2 of this report.

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[1] Sample collected under a separate project and contract.

5.1.1.1 Summary of 2004 Groundwater Results at SS13

Tables 5-2 and 5-2a include tabulated 2004 analytical results for hydrocarbons at SS13 groundwater wells, along with preliminary RAOs for groundwater.

Low levels of GRO, DRO, RRO, and napthalene (a PAH) were detected in 2004 in one or more of the groundwater samples collected from MW-01, MW-02, and MW-03. None of the constituents detected exceeded preliminary RAOs. GRO, DRO, and RRO values were reported below the Practical Quantitation Limit (PQL) for the analytical methods used, which means that their accuracy is suspect because the reported concentrations are so low.

Table 5-2 2004 Hydrocarbon Results for SS13 Groundwater Samples

SS13 location	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene[1] (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PAHs (mg/L)
RAOs[1]	*(1.3)*	*(1.5)*	*(1.1)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	See Table 5-2a
MW-01	ND	0.175[a]	0.393[a]	ND	ND	ND	ND	See Table 5-2a
MW-02	0.0239[a]	0.142[a]	0.106[a]	ND	ND	ND	ND	ND
MW-03[b]	0.142	ND	NA	ND	ND	ND	ND	ND[c]

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit (PQL) for the analyte but above the Method Detection Limit (MDL).

[b] This well was installed in 2004 by another contractor with data reported originally in the 2003 LTM report for SS13, SS15, and LF03 by BNCI (dated Nov 2004).

[c] SVOCs were analyzed instead of PAHs for this sample only in 2004. All results were reported below method detection limits for all SVOC constituents.

Definitions:

DRO = diesel range organics
GRO = gasoline-range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
RAOs = remedial Action Objectives (preliminary)
RRO = residual range organics
SVOCs = semi-volatile organic compounds

Table 5-2a 2004 PAH Results for SS13 Groundwater Samples

Location	PAH Detected	Level Detected	*Groundwater RAOs[1]*
MW-01	Naphthalene	0.0000706 mg/L	0.7 mg/L

Note:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

Definitions:

mg/L = milligrams per liter PAHs = Polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)

5.1.1.2 Comparative Analyses of Hydrocarbon Trends at MW-01

As shown in Table 5-3, between 1997 and 2003, DRO was the only contaminant detected at MW-01 in excess of preliminary RAOs. DRO levels appear to have been consistent from year to year up until 2004 when DRO levels dropped. In 2004, DRO was reported below preliminary RAOs at MW-01 and was below the PQL for the analytical method used (AK102).

Other constituents initially detected in 1997 were generally not detected in subsequent years, and if they were, their occurrence appears sporadic and the reported concentrations are low (Table 5-3).

Table 5-3 Comparison of MW-01 Hydrocarbon Levels: 1997-2004

SS13 MW-01	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene[1] (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(1.1)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	See Table 5-3a
2004	ND	0.175	0.393	ND	ND	ND	ND	NA
2003	ND	**2.22**	0.245	ND	ND	0.00186	ND	ND
2000	ND	**1.9**	ND	ND	ND	ND	2.9	ND
1999	ND	**2.7**	0.5	ND	ND	ND	ND	NA
1997	0.091	**2.47**	0.628	0.0003	0.003	0.0005	0.004	See Table 5-3a

Note:

[1] 18 AAC 75 345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels

Values in **Bold** exceed preliminary RAOs.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOCs = semivolatile organic compounds

As shown in Table 5-3a, semivolatile organic compounds (SVOCs) were detected at MW-01 in 1997, but were not detected in subsequent sampling years (Table 5-3) with the exception of napthalene, which was detected in 2004 (Table 5-2a). SVOC results have not exceeded current preliminary RAOs (Table 5-3a).

5.1.1.3 Comparative Analyses of Hydrocarbon Trends at MW-02

As shown in Table 5-4, hydrocarbon concentrations detected between 1997 and 2004 did not exceed preliminary RAOs.

5.1.2 SS13 Surface Water Hydrocarbon Data

Surface water samples were collected in 2004 from three locations as shown on Figure 5-1: SW-01, SW-02, and SW-03. Samples were collected on June 9, 2004 and analyzed for BTEX, DRO, RRO, PAHs, TAH and TAqH.

5.1.2.1 Summary of 2004 Surface Water Results at SS13

DRO, RRO, and napthalene (a PAH) were detected at low concentrations in all three surface locations sampled in 2004 (Tables 5-5 and 5-5a). Reported concentrations are below the PQL for all analytes detected. None of the constituents of concern exceeded preliminary RAOs for surface water at any location. (Note: There are no numerical regulatory requirements or guidelines for DRO and RRO in surface water, and thus no RAOs have been identified.)

Table 5-3a Previous Groundwater SVOC Results at MW-01 (1997)

Location (year)	SVOC Detected	Level Detected	Groundwater RAOs[1]
MW-01 (1997)	2-Methylnaphthalene	0.0087 mg/L	0.78 mg/L [2]
MW-01 (1997)	4-Methylphenol	0.0004 mg/L	0.183 mg/L [3]
MW-01 (1997)	Di-n-octyl phthalate	0.0002 mg/L	0.7 mg/L
MW-01 (1997)	Fluorene	0.0002 mg/L	0.7 mg/L
MW-01 (1997)	Naphthalene	0.0073 mg/L	0.7 mg/L
MW-01 (1997)	Phenanthrene	0.0001 mg/L	11.0 mg/L [2]

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[2] Calculated cleanup level in accordance with 18 AAC 75.340 (g); provided in ADEC Tech Memo 01-007, dated November 24, 2003.

[3] Calculated cleanup level in accordance with 18 AAC 75.340 (g)

Definitions:
mg/L = milligrams per liter
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

Table 5-4 Comparison of MW-02 Hydrocarbon Levels 1997-2000

SS13 MW-02	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene[1] (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(1.1)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	
2004	0.0239	0.142	0.106	ND	ND	ND	ND	NA
2003	ND	0.114	0.123	ND	ND	0.000727	ND	ND
2000	ND	ND	ND	ND	ND	ND	ND	ND
1999	ND	0.385	ND	ND	ND	ND	ND	NA
1997	ND	0.213	0.202	0.0002	ND	0.0003	ND	ND

Note:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels

Definitions:
DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOCs = semivolatile organic compounds

Table 5-5 2004 Surface Water Hydrocarbon Results at SS13

SS13 Location	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PAHs (mg/L)	TAH (mg/L)	TAqH (mg/L)
(RAOs)[1]	*No sheen* [2]	*No sheen* [2]	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	Table 5-5a	*(0.010)*	*(0.015)*
SW-01	0.0637[a]	0.0969[a]	ND	ND	ND	ND	ND	ND	ND
SW-01D	ND	0.0678[a]	ND	ND	ND	ND	Table 5-5a	ND	ND
SW-02	0.0653[a]	0.139[a]	ND	ND	ND	ND	Table 5-5a	ND	ND
SW-03	0.0917[a]	0.363[a]	ND	ND	ND	ND	Table 5-5a	ND	ND

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Alaska Water Quality Standards, as amended through June 26, 2003 (ADEC, 2003).

[2] There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[a] = Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)
RRO = Residual range organics
TAH = Total aromatic hydrocarbons = sum of BTEX concentrations
TAqH = Total aqueous hydrocarbons = sum of BTEX and PAH concentrations

Table 5-5a 2004 Surface Water PAH Results at SS13

Location	PAH Detected	Level Detected	*Surface Water RAOs* [1]
SW-01D	Naphthalene [2]	0.0000171 mg/L	*0.62 mg/L* [3]
SW-02	Naphthalene [2]	0.000115 mg/L	*0.62 mg/L* [3]
SW-03	Naphthalene [2]	0.0000312 mg/L [a]	*0.62 mg/L* [3]

Notes:

[1] NOAA SQuiRT = National Oceanic and Atmospheric Administration Screening Quick Reference Tables, updated September 1999 (Buchman, 1999).

[2] There are no standards provided for these analytes in 18 AAC 70; therefore, ambient water quality criteria values found in the NOAA SQuiRT tables are used as surface water screening criteria. Note that the NOAA SQuiRT values are not regulatory cleanup levels

[3] NOAA SQuiRT Freshwater Criteria.

[a] = Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

mg/L = milligrams per liter
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives

5.1.2.2 Comparative Analyses of Hydrocarbon Trends in Surface Water Samples

As noted in Tables 5-6, 5-7, and 5-8, surface water results obtained from the three locations at SS13 between 1997 and 2004 do not show an exceedance of preliminary RAOs.

A comparison of current and historical surface water sample data from SS13 does not indicate the presence of petroleum contaminants above AWQS. Samples at this site were collected from the drainages located on site (Figure 5-1). It should be noted that in 2003, surface water samples could not be collected at SS13 because the drainages were frozen.

Table 5-6 Comparison of SW-01 Hydrocarbon Levels for 1997-2004

SS13 SW-01	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	SVOC (mg/L)
(RAOs)[1]	*No sheen* [2]	*No sheen* [2]	*No sheen* [2]	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	
2004	NA	0.0637[a]	0.0969[a]	ND	ND	ND	ND	NA
2003	Surface water samples were not collected in 2003 (frozen conditions)							
2000	0.15	ND	ND	ND	ND	ND	ND	ND
1999	ND	ND	ND	ND	ND	ND	ND	NA
1997	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; water quality criteria; water quality standards tables, as amended through June 26, 2003 (ADEC, 2003).

[2] There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics

GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOCs = semivolatile organic compounds

Table 5-7 Comparison of SW-02 Hydrocarbon Levels for 1997-2004

SS13 SW-02	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	SVOC (mg/L)
(RAOs)[1]	*No sheen* [2]	*No sheen* [2]	*No sheen* [2]	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	
2004	NA	0.0653[a]	0.139[a]	ND	ND	ND	ND	NA
2003	Surface water samples were not collected due to frozen conditions							
2000	ND	ND	ND	ND	ND	ND	ND	ND
1999	ND	ND	ND	ND	ND	ND	ND	NA
1997	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; as amended through June 26, 2003 (ADEC, 2003).

[2] There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOCs = semivolatile organic compounds

Table 5-8 Comparison of SW-03 Hydrocarbon Levels 1997-2004

SS13 SW-03	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene[1] (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	SVOC (mg/L)
(RAOs)[1]	*No sheen*[2]	*No sheen*[2]	*No sheen*[2]	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	
2004	NA	0.0917[a]	0.363[a]	ND	ND	ND	ND	NA
2003	Surface water samples were not collected in 2003 (frozen conditions)							
2000	ND	ND	0.23	ND	ND	ND	ND	ND
1999	ND	ND	ND	ND	ND	ND	ND	NA
1997	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; as amended through June 26, 2003 (ADEC, 2003).

[2] There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[3] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels

[a] = Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOCs = semivolatile organic compounds

5.1.3 SS13 Sediment Hydrocarbon Data

Sediment samples were collected from two drainage locations at SS13 on June 9, 2004 (Figure 5-1). Samples obtained from locations identified as SS01 and SS06 were analyzed for BTEX, DRO, RRO, and PAHs.

5.1.3.1 Summary of 2004 Sediment Sample Results at SS13

Sediment sample results for the year 2004 are presented in Tables 5-9 and 5-9a, along with preliminary RAOs.

DRO was detected at concentrations between 998 mg/kg and 1,680 mg/kg, and RRO was detected at concentrations between 743 mg/kg and 1,060 mg/kg at both sample locations (Table 5-9). However, there are no preliminary RAOs established for DRO and RRO in sediments.

Xylenes and fluorine were detected in primary and duplicate samples collected at SS01 in excess of preliminary RAOs (Tables 5-9 and 5-9a). (It is notable that the flourene result exceeded the preliminary RAO; however, the concentration reported is below the laboratory PQL for the method used. Results reported below the PQL may be imprecise because the method accuracy is challenged at such low levels.)

Other analytes detected in 2004 at levels below preliminary RAOs include phenanthrene at SS01 and chrysene and pyrene at SS06 (Table 5-9a). Both of these constituents are reported at concentrations below the PQL.

Table 5-9 2004 Sediment Sample Results at SS13

SS13 Location	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene[1] (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	PAHs (mg/kg)
(RAOs)[1]	*None*[2]	*None*[2]	*(0.057)*[3]	*(0.089)*[4]	*(0.05)*[4]	*(0.025)*[3]	Table 5-9a
SS01	998	1060	ND	ND	ND	0.0569[a]	Table 5-9a
SS01D	1290	834	ND	ND	ND	0.0837[a]	Table 5-9a
SS06	1680	743	ND	ND	ND	ND	Table 5-9a

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines (SQG),*" dated March 2004.

[2] There are no screening benchmarks for bulk hydrocarbons in sediment.

[3] USEPA, 1996.

[4] Jones et al., 1997.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics

Table 5-9a 2004 Sediment PAH Results at SS13

Sample Location (2004)	PAH Detected	Level Detected	*Preliminary RAOs*[1,2]
SS01	Fluorene	**0.0323 mg/kg**[a]	*0.010 mg/kg*[3]
SS01D	Fluorene	**0.0306 mg/kg**[a]	*0.010 mg/kg*[3]
SS01D	Phenanthrene	0.0118 mg/kg[a]	*0.01419 mg/kg*[4]
SS06	Chrysene	0.00372 mg/kg[a]	*0.0571 mg/kg*[4]
SS06	Pyrene	0.00442 mg/kg[a]	*0.053 mg/kg*[4]

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines* (2004).

[2] NOAA SQuiRT [National Oceanic and Atmospheric Administration Screening Quick Reference Tables, updated September 1999 (Buchman, 1999)].

[3] NOAA SquiRT Lowest ARC Threshold Effects Level.

[4] NOAA SquiRT Threshold Effects Level.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit .

Values in **Bold** exceed preliminary RAOs.

Definitions:

mg/kg = milligrams per kilogram
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)

5.1.3.2 Comparative Analyses of Hydrocarbon Trends in Sediments at SS01 (1997 – 2004)

As shown in Table 5-10, all four BTEX constituents were detected above preliminary RAOs for sediments in samples collected at SS01 in 2003. Previously, only xylenes (in 1997 only) and bis(2-Ethylhexyl) phthalate (an SVOC and common laboratory contaminant that was only detected in 2000) were detected above preliminary RAOs (Tables 5-10 and 5-10a).

The pattern exhibited in the DRO results between 1997 and 2004 is a curve with a sharp peak in 1999 that is followed by a declining trend. The peak concentration at 55,800 mg/kg is quite high although there are no RAOs for DRO in sediments. The GRO concentration increased sharply from steady levels in 2003, which does not correspond with the timing of peak DRO concentrations at this location. However, benzene and ethylbenzene exceedances in 2003 correspond closely with the GRO concentration peak exhibited. There are no numerical regulatory criteria for GRO, DRO, and RRO in sediments.

Table 5-10 Comparison of SS01 Sediment Hydrocarbon Levels 1997-2004

SS13 Location SS01	GRO (mg/kg)	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	SVOC (mg/kg)
(RAOs)[1]	*None* [2]	*None* [2]	*None* [2]	*(0.057)*[3]	*(0.089)* [4]	*(0.05)* [4]	*(0.025)*[5]	Table 5-10a
2004	NA	998	1060	ND	ND	ND	ND	ND
2003	1,730	1,150	561	**0.409**	**19.7**	**3.40**	**37.8**	ND
2000	13	52,000	3,800	ND	ND	ND	ND	Table 5-10a
1999	16.4	55,800	7,250	ND	ND	ND	ND	ND
1997	9	416	83	ND	0.02	ND	0.08	ND

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines* (2004).

[2] There are no screening benchmarks for bulk hydrocarbons in sediment. Use alternate RAOs established for soil.

[3] USEPA, 1996.

[4] Jones et al., 1997.

Values in Bold exceed preliminary RAOs

Definitions:

DRO = diesel range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics

Table 5-10a 2000 Sediment SVOC Results at SS13

Sediment Sample Location (2000)	SVOC Detected	Level Detected	Sediment RAOs[1]
SS-01	Bis (2-Ethylhexyl) phthalate	1.0 mg/kg	Not available

Note:

[1] = NOAA SquiRT Upper Effects Threshold Effects Level.

Definitions:

mg/kg = milligrams per kilogram
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

5.1.3.3 Comparative Analyses of Hydrocarbon Trends in Sediments at SS06 (1997 – 2004)

As shown in Table 5-11, benzene, toluene, and ethylbenzene were detected above preliminary RAOs in sediments collected in 2003 from location SS06 (Figure 5-1). Prior to 2003, only bis(2-ethylhexyl) phthalate and di-n-butyl phthalate (SVOCs) were detected above preliminary RAOs in the 2000 data (see Table 5-11a). Phthalates are common laboratory contaminants often associated with plastic equipment used to analyze samples at the laboratory. All of the 2000 data do appear to exhibit a pattern of common laboratory contaminants potentially affecting the data in that year.

As with samples collected from SS01, a comparison of the data collected at SS06 indicates that GRO above detection limits occurs for the first time in 2003, along with BTEX constituents. However, a similar pattern is not apparent in reported DRO concentrations between 1997 and 2004. In 2003, the benzene concentration exceeded the current preliminary RAO for sediments, which are based upon guidelines. There are no numerical regulatory criteria for GRO, DRO, and RRO in sediments.

Table 5-11 SS13 Comparison of SS06 Hydrocarbon Levels in Sediments 1997-2004

SS13 SS06	GRO (mg/kg)	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	SVOC (mg/kg)
(RAOs)[1]	*None*[2]	*None*[2]	*None*[2]	*(0.057)*[3]	*(0.089)*[4]	*(0.05)*[4]	*(0.025)*[5]	See Table 5-11a
2004	NA	1,680	743	ND	ND	ND	ND	See Table 5-9a
2003	10.6	75.0	547	**0.0923**[a]	0.127	0.366	ND	ND
2000[b]	ND	4,300	4,300	ND	ND	ND	ND	See Table 5-11a
1999	ND	154	421	ND	ND	ND	ND	ND
1997	ND	1,710	1,230	ND	ND	ND	ND	ND

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines (SQG)*, (2004).

[2] There are no screening benchmarks for bulk hydrocarbons in sediment. Use alternate RAOs established for soil.

[3] USEPA, 1996.

[4] Jones et al., 1997.

[a] Value indicated is below the Practical Quantitation Limit (PQL) for the analyte but above the Method Detection Limit (MDL). In this instance, the PQL is above the RAO established for benzene in this analyses.

[b] SB-04 was alternative sample location in 2000 for SS-06.

Values in Bold exceed preliminary RAOs.

Definitions:

DRO = diesel range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOC = semivolatile organic compounds

Table 5-11a 2000 Sediment SVOC Results for SB-04 at SS13

Sediment Sample Location (2000)	SVOC Detected	Level Detected	Sediment RAOs[1, 2]
SB-04[3]	Bis (2-Ethylhexyl) phthalate	0.22 mg/kg	0.75 mg/kg
SB-04[3]	Di-n-butylphthalate	**0.31 mg/kg**	0.11 mg/kg

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum "Sediment Quality Guidelines (SQG)," dated March 2004.

[2] NOAA SquiRT Upper Effects Threshold Effects Level (UET).

[3] SB-04 was alternative sample location in 2000 for SS-06.

Values in **Bold** exceed preliminary RAOs.

Definitions:

mg/kg = milligrams per kilogram
RAOs = Remedial Action Objectives (preliminary)
SVOC = Semivolatile organic compounds

5.1.4 SS13 Near-surface Soil Hydrocarbon-Related Compounds

Near-surface soil samples were collected from three locations at SS13 in 2004. Shallow samples collected from locations identified as LB-03, LB-07, and LB-08 were analyzed for BTEX, DRO, RRO, and PAHs (Figure 5-1). Tables 5-12 and 5-12a present the hydrocarbon results obtained from these samples in 2004.

Table 5-12 2004 Near-surface Soil Sample Results at SS13

SS13 Sample Location	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	PAHs (mg/kg)
(RAOs)[1]	_(250)_	_(11,000)_	_(0.02)_	_(5.0)_	_(6.0)_	_(78)_	Table 5-12a
LB03	**411**	1140	ND	ND	ND	ND	ND
LB07	**4390**	5160	ND	ND	ND	ND	Table 5-12a
LB08	**48,500**	**51,600**	ND	ND	ND	ND	Table 5-12a

Notes:

[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

Values in **Bold** exceed preliminary RAOs.

Definitions:

DRO = diesel range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics

Table 5-12a 2004 Near-surface Soil Sample PAH Results at SS13

Sediment Sample Location (2004)	PAH Detected	Level Detected	Soil Cleanup Levels [2]
LB07	Chrysene	0.0292 mg/kg	620 mg/kg
LB07	Naphthalene	0.0128 mg/kg	21 mg/kg
LB07	Pyrene	0.0376 mg/kg	1500 mg/kg
LB08	Chrysene	0.532 mg/kg	620 mg/kg
LB08	Fluoranthene	0.457 mg/kg	2,100 mg/kg
LB08	Pyrene	0.584 mg/kg	1,500 mg/kg

Notes:

[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)]

:

Definitions

mg/kg = milligrams per kilogram
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)

DRO was detected in the soil from all three samples in excess of preliminary RAOs. The highest DRO result detected in 2004 was at location LB08, which also exhibited the only RRO hit in excess of the preliminary RAO. RRO was also detected at LB03 and LB07 at levels below the current preliminary RAO in 2004.

The 2004 BTEX results were all reported below method detection limits. Several PAHs were detected at locations LB07 and LB08 in 2004 (see Table 5-12a). Chrysene, pyrene, and napthalene were detected at LB07 below current preliminary RAOs. Chrysene, pyrene, and flouranthene were detected at LB08 below current preliminary RAOs.

5.1.4.1 Comparative Analyses of Hydrocarbon Trends Soil Samples at LB03 (1997 – 2004)

DRO is the only contaminant historically detected in soil at this location at levels in excess of preliminary RAOs (see Table 5-13). DRO levels exceeded preliminary RAOs at LB03 in the 1997 data (the year with the highest reported level), in 1999, and then again in 2004. RRO is consistently detected in data collected for all prior years, but at concentrations below preliminary RAOs.

As with previous 2000 data patterns, di-n-butylphthalate (an SVOC and common laboratory contaminant) was detected in 2000 (see Table 5-13a). There were no other SVOCs detected in other years. PAHs were also not detected at this location in 2004.

Table 5-13 SS13 Comparison of Hydrocarbon Levels in Soil at LB03 (1997-2004)

SS13 LB-03	GRO (mg/kg)	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	SVOC (mg/kg)
(RAOs)[1]	*(300)*	*(250)*	*(11,000)*	*(0.02)*	*(5.0)*	*(6.0)*	*(78)*	See Table 5-13a
2004	NA	**411**	1140	ND	ND	ND	ND	ND
2003	8.75	158	83.2	ND	0.0819	0.0809	ND	ND
2000	ND	48	140	ND	ND	ND	ND	See Table 5-13a
1999	ND	**466**	469	ND	ND	ND	ND	ND
1997	119	**16,800**	1,610	ND	0.46	ND	1.14	ND

Notes:
[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].
Values in Bold exceed preliminary RAOs.

Definitions:
DRO = diesel range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics

Table 5-13a 2000 Near-surface Soil Sample SVOC Results for LB03

Sediment Sample Location (2000)	SVOC Detected	Level Detected	Soil Cleanup Levels [1]
LB03	Di-n-butylphthalate	0.042 mg/kg	1,700 mg/kg

Notes:
[1] = 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

Definitions:
mg/kg = milligrams per kilogram
PAHs = Polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)

5.1.4.2 Comparative Analyses of Hydrocarbon Trends Soil Samples at LB07 (1997 – 2004)

Historically, GRO and BTEX levels have been reported below method detection limits at LB07, with the exception of GRO and ethylbenzene results in 2003, as shown in Table 5-14. All of the DRO detections at LB07 between 1997 and 2004 were above preliminary RAOs, with the peak concentration of 31,000 mg/kg exhibited in the 2003 data.

Table 5-14 SS13 Comparison of Hydrocarbon Levels in Soil at LB07 (1997-2004)

SS13 LB07	GRO (mg/kg)	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene[1] (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	SVOC (mg/kg)
(RAOs)[2]	*(300)*	*(250)*	*(11,000)*	*(0.02)*	*(5.0)*	*(6.0)*	*(78)*	Table 5-14a
2004	NA	**4,390**	5,160	ND	ND	ND	ND	NA
2003	9.02	**31,000**	7,640	ND	0.128	ND	ND	ND
2000	ND	**8,900**	6,800	ND	ND	ND	ND	Table 5-14a
1999	ND	**5,870**	3,440	ND	ND	ND	ND	ND
1997	ND	**7,050**	2,560	ND	0.03	ND	ND	ND

Notes:

[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

Values in **Bold** exceed preliminary RAOs.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics

In 2000, bis (2-Ethylhexyl) phthalate (an SVOC and common laboratory contaminant) was detected at LB07 below RAOs, as shown in Table 5-14a. This is consistent with a potential chronic problem with laboratory data from that year.

Table 5-14a 2000 Near-surface Soil Sample SVOC Results for LB07

Soil Sample Location (2000)	SVOC Detected	Level Detected	Soil RAOs[1]
LB07	Bis (2-Ethylhexyl) phthalate	1.5 mg/kg	620 mg/kg

Notes:

[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

Definitions:

mg/kg = milligrams per kilogram
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

5.1.4.3 Comparative Analyses of Hydrocarbon Trends Near-surface Soil Samples at LB08 (1997 – 2004)

As shown in Table 5-15, all of the DRO results obtained at LB08 between 1997 and 2004 exceed the preliminary RAO for soil. RRO results exceeded the preliminary RAO for all data years except for 1999 and 2000. BTEX results were below method detection limits for all years between 1997 and 2004, except for one low ethylbenzene hit in 1997.

Table 5-15 SS13 Comparison of Hydrocarbon Levels in Soil at LB08 (1997-2004)

SS13 LB08	GRO (mg/kg)	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	SVOC (mg/kg)
(RAOs)[1]	*(300)*	*(250)*	*(11,000)*	*(0.02)*	*(5.0)*	*(6.0)*	*(78)*	Table 5-15a
2004	NA	**48,500**	**51,600**	ND	ND	ND	ND	NA
2003	5.21	**59,400**	**19,400**	ND	ND	ND	ND	ND
2000	ND	**620**	810	ND	ND	ND	ND	Table 5-15a
1999	ND	**2,680**	1,880	ND	ND	ND	ND	ND
1997	13	**110,000**	**35,000**	ND	0.03	ND	ND	ND

Note:
[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)]
Values in Bold exceed current preliminary RAOs.

Definitions:
DRO = diesel range organics
GRO = gasoline range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = Residual range organics
SVOCs = semivolatile organic compounds

Historic SVOC results were at very low to mostly nondetectable levels between 1997 and 2004, as shown in Table 5-15a. Consistent with the 2000 analytical data, two common laboratory contaminants were detected in 2000, di-n-butylphthalate and bis(2-Ethylhexyl) phthalate, at levels below preliminary RAOs (Table 5-15a). These SVOCs did not show up in the analytical data from other years.

Table 5-15a 2000 Near-surface Soil Sample SVOC Results for LB08

Soil Sample Location (2000)	SVOC Detected	Level Detected	Soil Cleanup Levels [1]
LB08	Di-n-butylphthalate	0.12 mg/kg	620 mg/kg
LB08	Bis (2-Ethylhexyl) phthalate	0.087 mg/kg	2,100 mg/kg

Note:
[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

Definitions:
mg/kg = milligrams per kilogram
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

A comparison of the DRO and RRO data at LB08 between 1997 and 2004 show a close correlation between the DRO and RRO concentrations, which exhibit a "U" shaped curve pattern when plotted over time, with the lowest detection for both in the year 2000 data. This pattern at LB08 is also apparent at the other two soil locations sampled (LB03 and LB07), which would support a conclusion of some common fuel contaminant source and timing sequence. Throughout all of the historical data, GRO levels remain consistently low between 1997 and 2004 at LB08.

5.1.5 Site SS13 Soil Boring Hydrocarbon Data for MW-03

In 2004, MW-03 was installed at SS13 by another contractor (BNCI) under a separate contract and project scope. Well construction detail is described in a technical report produced by BNCI (2004). One soil sample was collected from the soil boring and analyzed. Results obtained from the 2004 report are discussed below for comparative purposes.

As shown in Tables 5-16 and 5-16a, there were no preliminary RAO exceedances detected in the soil sample collected at the 2.5- to 4.5-foot depth interval. GRO, DRO, RRO, and bis(2-ethylhexyl)phthalate were detected in the soil sample at concentrations below preliminary RAOs.

Table 5-16 2004 Results for Soil Boring Samples Collected at New Well MW-03

MW-03 Soil Boring Depth	GRO (mg/kg)	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	SVOCs (mg/kg)
(RAOs)[1]	*(300)*	*(250)*	*(11,000)*	*(0.02)*	*(5.0)*	*(6.0)*	*(78)*	Table 5-16a
2.5 to 4.5 feet bgs	1.03[a]	67.3	600	ND	ND	ND	ND	Table 5-16a

Note:
[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels, 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

Definitions:
bgs = belowground surface
DRO = diesel range organics
GRO = gasoline range organics
mg/kg = milligrams per kilogram
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOCs = semivolatile organic compounds

Table 5-16a 2004 SVOC Results for WW-09 Soil Boring Samples

Location	SVOC Detected	Level Detected	Soil RAOs[1]
MW-03 2.5 to 4.5	Bis(2-Ethylhexyl)phthalate	0.104 mg/kg	590 mg/kg

Note:
[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

Definitions:
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

5.2 Site SS15 Hydrocarbon-Related Compounds

SS15 groundwater samples were collected from monitoring wells WW02 and WW08 in 2004 (WW02 was sampled on June 8, 2004, and WW08 was sampled in August 31, 2004). Multiple attempts to collect a groundwater sample from WW07 in 2004 were unsuccessful due to a lack of available water. The two groundwater samples successfully collected were analyzed for GRO, DRO, RRO, BTEX, and PAHs. Well locations and analytical results at this site are shown on Figure 5-2.

In 2004, a new monitoring well was installed (WW09) under a separate project and contract by BNCI. Soil samples were collected from the boring column in 2004, with the results originally reported by BNCI (2004). The soil results presented in the BNCI report are summarized here for comparative purposes. A groundwater sample was not collected from WW09 in 2004 and no groundwater data are available.

5.2.1 Site SS15 Groundwater Hydrocarbon Data

Although groundwater samples were also analyzed for alkalinity, dissolved iron, sulfate, and nitrate/nitrite as inorganic parameters to help indicate natural attenuation processes, the following discussion only addresses results for organic hydrocarbons. Inorganic and field testing results for groundwater are discussed in Section 6.

5.2.1.1 Summary of 2004 Groundwater Results at SS15

GRO, DRO, and benzene were detected above preliminary RAOs in 2004 groundwater samples collected from WW02, as shown in Table 5-17. Benzo(a)pyrene and naphthalene (PAHs) were also detected in WW02 in 2004 above preliminary RAOs, as shown in Table 5-16a. Ethylbenzene, toluene, total xylenes, and 13 other PAH compounds were reported in the 2004 data for WW02, but at levels below RAOs (Tables 5-17 and 5-17a). The RRO concentration was below detection limits at WW02.

Table 5-17 2004 Groundwater Sample Hydrocarbon Results at SS15

SS15 Location	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PAHs (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(1.1)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	Table 5-17a
WW-02	**8.38**	**387**	ND	**0.311**	0.063	0.0392	0.457	Table 5-17a
WW-07	*This well was dry and could not be sampled in 2004*							
WW-08	0.0212[a]	0.315[a]	0.223[a]	ND	ND	ND	ND	Table 5-17a

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit (PQL) for the analyte but above the Method Detection Limit (MDL). In this instance, the PQL for the benzene analysis is above the preliminary RAO established for benzene.

Values in **Bold** exceed preliminary RAOs.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RRO = residual range organics
VOCs = volatile organic compounds

Table 5-17a 2004 Groundwater PAH Results at SS15

Location	PAH Detected	Level Detected	Groundwater RAOs[1]
WW-02	Acenaphthene	0.0246 mg/L	2.2 mg/L
WW-02	Anthracene	0.00117 mg/L	11.0 mg/L
WW-02	Benzo(a)anthracene	0.000631 mg/L	0.001 mg/L
WW-02	**Benzo(a)pyrene**	**0.000434 mg/L**	**0.0002 mg/L**
WW-02	Benzo(b)fluoranthene	0.000438 mg/L	0.01 mg/L
WW-02	Benzo(g,h,l)perylene	0.000278 mg/L	1.1 mg/L [2]
WW-02	Benzo(k)fluoranthene	0.000406 mg/L	0.01 mg/L
WW-02	Chrysene	0.000866 mg/L	0.1 mg/L
WW-02	Dibenzo(a,h)anthracene	0.0000756 mg/L	0.0001 mg/L
WW-02	Fluoranthene	0.00246 mg/L	1.46 mg/L
WW-02	Fluorene	0.0496 mg/L	1.46 mg/L
WW-02	Indeno(1,2,3-c,d)pyrene	0.000213 mg/L	0.001 mg/L
WW-02	**Naphthalene**	**0.967 mg/L**	**0.7 mg/L**
WW-02	Phenanthrene	0.0182 mg/L	11.0 mg/L [2]
WW-02	Pyrene	0.00302 mg/L	1.1 mg/L
WW-08	Naphthalene	0.0000509 mg/L [a]	0.7 mg/L

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[2] Calculated cleanup level in accordance with 18 AAC 75.340 (g); provided in ADEC Tech Memo 01-007, dated November 24, 2003.

[a] Value indicated is below the Practical Quantitation Limit (PQL) for the analyte but above the Method Detection Limit (MDL).

Values in **Bold** exceed current preliminary RAOs

Definitions:

mg/L = milligrams per liter
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

There were no exceedances of preliminary RAOs identified in 2004 groundwater data for WW08 (Tables 5-17 and 5-17a). GRO, DRO, RRO, and naphthalene (a PAH) were detected at concentrations below the PQL at WW08. All other analytes were below method detection limits.

5.2.1.2 Comparative Analyses of Previous Hydrocarbon Trends at WW-02 (1997 – 2004)

Between 1997 and 2004, historical data results for WW02 indicate that GRO, DRO, RRO, benzene, and ethylbenzene exceeded current preliminary RAOs for groundwater multiple times, as shown in Table 5-18. GRO and DRO concentrations represent the most consistent exceedances during this span of time, however trends in the historical data are not readily apparent.

A rather long list of SVOC constituents have been historically detected in samples from well WW-02 over the years, as shown in Table 5-18a. Only one hit of Benzo(a)pyrene, detected in WW-02 in 1997, meets (considered an exceedance) the current preliminary RAO level for this constituent. In 2004, PAH analyses replaced the historical SVOC analyses so that lower detections could be achieved. Many of the same SVOC constituents historically detected were detected in the 2004 PAH results from this well (Table 5-17a).

Table 5-18 SS15 Comparison of WW-02 Hydrocarbon Levels 1997-2004

SS15 WW-02	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(1.1)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	Table 5-18a
2004	**8.38**	**387**	ND	**0.311**	0.063	0.0392	0.4571	NA
2003	**3.16**	**50.4**	0.628	**0.563**	0.304	0.144	0.5212	Table 5-18a
2000	**4.4**	**3.2**	ND	**0.7**	0.14	0.17	0.37	Table 5-18a
1999	NA	**7.23**	ND	NA	NA	NA	NA	Table 5-18a
1997	**7.95**	**400**	**1.38**	**1.11**	0.31	0.15	0.553	Table 5-18a

Note:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels

Values in Bold exceed current preliminary RAOs.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
RRO = residual range organics
SVOCs = semivolatile organic compounds

Table 5-18a Previous Groundwater SVOC Results at WW-02 (1997-2000)

Location (year)	SVOC Detected	Level Detected	*Groundwater RAOs*[1]
WW-02 (1997)	Acenaphthene	0.006 mg/L	*2.2 mg/L*
WW-02 (1997)	Benzo(a)anthracene	0.0002 mg/L	*0.001 mg/L*
WW-02 (1997)	Benzo(a)fluoranthene	0.0003 mg/L	*0.001 mg/L*
WW-02 (1997)	**Benzo(a)pyrene**	**0.0002 mg/L**	***0.0002 mg/L***
WW-02 (1997)	Benzoic Acid	0.020 mg/L	*146.0 mg/L*
WW-02 (1997)	Benzo(k)fluoranthene	0.0001 mg/L	*0.01 mg/L*
WW-02 (1997)	Bis 2(ethylhexyl)phthalate	0.005 mg/L	*0.006 mg/L*
WW-02 (1997)	di-n-octyl phthalate	0.0005 mg/L	*0.7 mg/L*
WW-02 (1997)	Fluoranthene	0.0008 mg/L	*1.46 mg/L*
WW-02 (1997)	Fluorene	0.001 mg/L	*1.46 mg/L*
WW-02 (2000)	2-Methylnaphthalene	0.011 mg/L	*0.78 mg/l*[2]
WW-02 (2003)	2-Methylnaphthalene	0.011 mg/L	*0.78 mg/l*[2]
WW-02 (1999)	2-Methylnaphthalene	0.08 mg/L	*0.78 mg/l*[2]
WW-02 (1997)	2-Methylnaphthalene	0.530 mg/L	*0.78 mg/l*[2]
WW-02 (2000)	Naphthalene	0.04 mg/L	*0.7 mg/L*
WW-02 (2003)	Naphthalene	0.19 mg/L	*0.7 mg/L*
WW-02 (1999)	Naphthalene	0.05 mg/L	*0.7 mg/L*
WW-02 (1997)	Naphthalene	0.450 mg/L	*0.7 mg/L*
WW-02 (1997)	Naphthalene	0 0073 mg/L	*0.7 mg/L*
WW-02 (1997)	Phenanthrene	0.005 mg/L	*11.0 mg/L*[2]
WW-02 (1997)	Phenol	0.014 mg/L	*22.0 mg/L*
WW-02 (1997)	Pyrene	0.0009 mg/L	*1.1 mg/L*

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[2] Calculated cleanup levels in accordance with 18 AAC 75.340 (g), provided in ADEC Tech Memo 01-007, dated November 24, 2003.

Values in **Bold** exceed current preliminary RAOs.

Definitions:

mg/L = milligrams per liter
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

5.2.1.3 Comparative Analyses of Previous Hydrocarbon Trends at WW-07 (1997 – 2000)

Groundwater analytical data for WW07 are not available from 2003 and 2004. Historical results obtained from 1997 to 2000 are shown in Tables 5-19 and 5-19a. In 2000, DRO, RRO, benzene, toluene, and total xylenes were detected below preliminary RAOs developed in this report. All analytical constituents were below detection limits in 1999. DRO, toluene, xylenes, and n-nitrosodi-n-propylamine (an SVOC) were detected in 1997 at levels below preliminary RAOs. A pattern of low results for all constituents is all that is apparent in the historical data.

Table 5-19 SS15 Comparison of WW-07 Hydrocarbon Levels 1997-2000

SS15 WW-07	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	SVOC (mg/L)
(MCLs)[1]	*(1.3)*	*(1.5)*	*(1.1)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	Table 5-19a
2004	Well was not sampled due to lack of water.							
2003	Well was not sampled.							
2000	ND	0.46	0.69	0.0013	ND	0.0011	0.0033	ND
1999	ND	ND	ND	ND	ND	ND	ND	NA
1997	ND	0.063	ND	ND	ND	0.0004	0.0002	Table 5-19a

Note:
[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels
Values in Bold exceed preliminary RAOs.
Definitions:
DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RRO = residual range organics
SVOCs = semivolatile organic compounds

Table 5-19a 1997 Groundwater SVOC Results at WW-07

Location	SVOC Detected	Level Detected	Groundwater RAO [1]
WW-07	N-Nitrosodi-n-propylamine	0.0002 mg/L	1.46 mg/L

Note:
[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels
Definitions:
mg/L = milligrams per liter
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

5.2.1.4 Comparative Analyses of Previous Hydrocarbon Trends at WW-08 (1997 – 2004)

As shown in Tables 5-20 and 5-20a, historical results for analytes of concern are low to nondetect in groundwater samples collected from WW08 between 1997 and 2004. None of the reported historical results exceeded preliminary RAOs and all appear to be consistently low.

Table 5-20 SS15 Comparison of WW-08 Hydrocarbon Levels 1997-2004

SS15 WW-08	GRO (mg/L)	DRO (mg/L)	RRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(1.1)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	Table 5-20a
2004	0.0212[a]	0.315[a]	0.223[a]	ND	ND	ND	ND	NA
2003	ND	0.129	ND	ND	0.00116	0.00131	0.002	ND
2000	ND	0.16	0.23	ND	ND	ND	0.002	ND
1999	ND	0.363	ND	ND	ND	ND	ND	NA
1997	ND	0.165	0.275	ND	ND	ND	ND	Table 5-20a

Notes:

[1] 18 AAC 75 345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit (PQL) for the analyte but above the Method Detection Limit (MDL).

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
RRO = residual range organics
SVOCs = semivolatile organic compounds

Table 5-20a 1997 Groundwater SVOC Results at WW-08

Location	SVOC Detected	Level Detected	*Groundwater RAO*[1]
WW-08	4-Methylphenol	0.0003 mg/L	*0.183 mg/L*

Note:

[1] Calculated cleanup level in accordance with 18 AAC 75.340 (g) Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004

Definitions:

mg/L = milligrams per liter
RAOs = Remedial Action Objectives (preliminary)
SVOCs = semivolatile organic compounds

5.2.2 Site SS15 Soil Boring Hydrocarbon Data for WW09

BNCI installed Well WW09 at SS15 in 2004 under a separate contract and project scope. Well construction detail is described in the following technical report produced by BNCI: *Landfill 2 (LF03), SS 13 and SS15 Long Term Monitoring Cape Romanzof LRRS, Alaska, November 2004.*

Three soil samples (plus a duplicate) were collected from the soil boring for this well. Soil sample results are shown in Tables 5-21 and 5-21a. DRO is the only soil contaminant detected above preliminary RAOs in soil boring samples, with preliminary RAO exceedances reported at every depth interval sampled. GRO, RRO, and BTEX constituents were detected at one or more depth intervals sampled but at levels below preliminary RAOs (Table 5-21).

Table 5-21 2004 Results for Soil Boring Samples Collected at New Well WW09

SS15 Soil Boring Depth Interval bgs	GRO (mg/kg)	DRO (mg/kg)	RRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	SVOC (mg/kg)
(RAOs)[1]	*(300)*	*(250)*	*(11,000)*	*(0.02)*	*(5.0)*	*(6.0)*	*(78)*	Table 5-21a
5.2 to 7.2 feet	73.5	**8,010**	299	0.0119	0.121	0.0437	0.947	ND
5.2 to 7.2 feet	32.4	**5,460**	249	0.00984	0.0556	ND	0.452	ND
7.5 to 9.5 feet	9.7	**740**	76.6	ND	0.0172	ND	0.1312	ND
10 to 12 feet	14.6	**856**	156	ND	0.0387	ND	0.1612	Table 5-21a

Note:

[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

Values in **bold** exceed preliminary RAOs.

Definitions:

bgs = belowground surface
DRO = diesel range organics
GRO = gasoline range organics
mg/kg = milligrams per kilogram
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOCs = semivolatile organic compounds

Two SVOCs (2-Methylnaphthalene and Bis[2-Ethylhexyl]phthalate) were detected at the 10- to 12-foot depth interval at levels below the preliminary RAO in the soil boring (Table 5-21a).

Table 5-21a 2004 SVOC Results for WW-09 Soil Boring Samples

Location	SVOC Detected	Level Detected	*Soil RAOs*[1]
SB/WW-09 10 to 12 feet bgs	2-Methylnaphthalene	0.359 mg/kg	*0.78 mg/kg*[2]
	Bis(2-Ethylhexyl)phthalate	0.104 mg/kg	*590 mg/kg*

Notes:

[1] 18 AAC 75.341(c) and (d) [Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (under 40-inch precipitation) soil cleanup levels; 341(c) refers to chemicals other than petroleum hydrocarbons (Table B1), and 341(d) refers to petroleum hydrocarbons (Table B2)].

[2] Calculated cleanup level in accordance with 18 AAC 75.340 (g); provided in ADEC Tech Memo 01-007, dated November 24, 2003.

Definitions:

bgs = belowground surface
mg/kg = milligrams per kilogram
RAOs = Remedial Action Objectives (preliminary)
SVOC = Semivolatile organic compound

5.3 Site LF03 Hydrocarbon Related Compounds

Groundwater, surface water, and sediments were sampled in 2004 as part of the LTM program at LF03, a now-closed landfill as part of provisions in the Interim ROD (611 CES, 2002). LTM samples were collected at the following media-specific locations:

- Groundwater at MW-1, CMW-1, CMW-2, CMW-3, CMW-4, CMW-5, CMW-6, and CMW-7.
- Surface water at SW-1, SW-2, and SW-3.
- Sediments at SD-1, SD-2, and SD-3 (co-located at surface water sample sites).

Two attempts to sample MW-2 were unsuccessful because the well was dry. Sample locations at LF03 are shown on Figure 5-3. Sections 5.3.1 and 5.3.2 discuss organic hydrocarbon analytical results obtained from sample locations and media identified as part of the LTM program (note that investigative surface soil sampling at LF03 is presented in a separate 2005 report[2]. and is not part of the LTM program)

5.3.1 LF03 Groundwater – Hydrocarbon Data

Groundwater samples were collected from MW-1, CMW-4, CMW-5, and CMW-6 on June 13, 2004. Samples were collected from CMW-1, CMW-3, and CMW-7 on June 24, 2004. A low volume sample was collected from CMW-2 on August 31, 2004, because the well recharge rate was slow. Well MW-2 could not be sampled in 2004 due to a lack of groundwater.

5.3.1.1 Summary of 2004 Groundwater Sample Results at LF03

LTM groundwater samples collected in 2004 from eight monitoring wells at LF03 and were analyzed for BTEX, DRO, PCBs, and PAHs. Inorganic analytical results (for groundwater only) and field measurement data are presented in Section 6 for evaluating intrinsic remediation conditions in groundwater.

Tables 5-22 and 5-22a present the analytical results. Preliminary RAOs were not exceeded for any 2004 groundwater analytes. Low levels of DRO, benzene, toluene, and xylenes were detected in some of the wells, but most of these detections were below the PQL for the analytical methods used (Table 5-22). Ethylbenzene and PCBs were not detected in any of the wells sampled in 2004.

Naphthalene (a PAH) was detected in all the wells sampled in 2004 but at levels below preliminary RAOs and in some cases below the PQL (Table 5-22a). Acenaphthene and fluorene (also PAHs) were detected in well CMW-4 at levels below preliminary RAOs (Table 5-22a).

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[2] Final Report Former Landfill (LF03) Surface Soil Investigation Report, Cape Romanzof LRRS, Alaska, February 8, 2005.

5.3.1.2 Comparative Analyses of Hydrocarbon Trends in Groundwater Data at LF03 (1996 – 2004)

Historical groundwater results for all the wells sampled in 2004 are discussed collectively in this section because there were no historical exceedences of current preliminary RAOs, with the exception of 1996 and 1997 results at CMW-4.

Table 5-22 2004 Groundwater Sample Hydrocarbon Results at LF03

LF03 Location	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	PAHs (mg/L)
(RAOs)[1]	*(1.5)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.0005)*	Table 5-22a
MW-1	0.0713 [a]	ND	ND	ND	ND	ND	Table 5-22a
MW-2	The well was dry in 2004 and could not be sampled.						
CMW-1	ND	ND	ND	ND	ND	ND	Table 5-22a
CMW-2	0.226 [a]	ND	ND	ND	ND	ND	Table 5-22a
CMW-3	ND	0.000156 [a]	ND	ND	ND	ND	Table 5-22a
CMW-4	0.355	0.000393 [a]	ND	ND	0.002055 [a]	ND	Table 5-22a
CMW-5	0.157	0.000195 [a]	ND	0.000543 [a]	0.00056 [a]	ND	Table 5-22a
CMW-6	0.0853	0.00024 [a]	ND	0.000757 [a]	0.00132 [a]	ND	ND
CMW-6D	0.184	0.000532	ND	0.00139 [a]	0.0024 [a]	ND	Table 5-22a
CMW-7	ND	ND	ND	ND	ND	ND	Table 5-22a

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit .

Definitions:

DRO = diesel range organics
mg/L = milligrams per liter
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)

Table 5-22a 2004 Groundwater PAH Results at LF03

Location	PAH Detected	Level Detected	*Groundwater RAOs* [1]
MW-1	Naphthalene	0.00003 mg/L [a]	*0.7 mg/L*
CMW-1	Naphthalene	0.000259 mg/L	*0.7 mg/L*
CMW-2	Naphthalene	0.0000864 mg/L [a]	*0.7 mg/L*
CMW-3	Naphthalene	0.0000833 mg/L	*0.7 mg/L*
CMW-4	Acenaphthene	0.0000882 mg/L	*2.2 mg/L*
CMW-4	Fluorene	0.00042 mg/L [a]	*1.46 mg/L*
CMW-4	Naphthalene	0.00115 mg/L [a]	*0.7 mg/L*
CMW-5	Naphthalene	0.0000163 mg/L	*0.7 mg/L*
CMW-6D	Naphthalene	0.0000162 mg/L	*0.7 mg/L*
CMW-7	Naphthalene	0.000101 mg/L	*0.7 mg/L*

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

mg/L = milligrams per liter
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)

Historical and current data for MW-1 is presented in Table 5-23. Sample data were obtained initially from this well in 2000. Most of the results for analytes of concern are below detectable levels. A low concentration of toluene was detected in MW-1 in 2003, and a low concentration of DRO was detected in 2004. There were no historical exceedences of current preliminary RAOs detected in MW-1.

Table 5-23 Comparison of MW-1 Hydrocarbon Levels 2000-2004

LF03 MW-1	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs) [1]	(1.3)	(1.5)	(0.005)	(0.7)	(1.0)	(10)	(0.0005)	NA	NA
2004	NA	0.0713 [a]	ND	ND	ND	ND	ND	NA	NA
2003	ND	ND	ND	ND	0.000510	ND	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

[1] = 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] = Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Values in Bold exceed current preliminary RAOs

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOCs = Volatile organic compounds

Historical and current data for CMW-1 are presented in Table 5-24. Historical data are available for this well starting in 1996, when low levels of GRO, DRO, and RRO were detected. DRO was detected again in 1997 but not again until 2003. All other results for analytes of concern were below detectable levels. There are no RAO exceedances historically reported in the groundwater data from CMW-1.

Table 5-24 Comparison of CMW-1 Hydrocarbon Levels 1996-2004

LF03 CMW-1	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	(1.3)	(1.5)	(0.005)	(0.7)	(1.0)	(10)	(0.0005)	NA	NA
2004	NA	ND	ND	ND	ND	ND	ND	NA	NA
2003	ND	0.0863	ND	ND	ND	ND	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	ND	ND	ND
1999	ND	ND	ND	ND	ND	ND	ND	ND	ND
1997	ND	0.179	ND	ND	ND	ND	NA	ND	ND
1996	0.113	0.89	0.017	ND	ND	ND	NA	ND	ND

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit .

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
Mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOCs = volatile organic compounds

Historical and current data for CMW-2 are presented in Table 5-25. This well was initially sampled in 1996 but was not sampled again until 2000. In 1996, only DRO was detected at 1.34 mg/L. In 2000, DRO levels were below method detection limits along with all of the other reported levels for analytical constituents of concern. In 2003, CMW-2 could not be sampled because water was not available in the well. In the 2004 data, only GRO and DRO were detected at very low levels below the PQL. Current preliminary RAOs have not been historically exceeded in this well.

Table 5-25 Comparison of CMW-2 Hydrocarbon Levels 1996-2004

LF03 CMW-2	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.0005)*		
2004	0.0216 [a]	0.226 [a]	ND	ND	ND	ND	ND	NA	NA
2003	Could not be sampled due to lack of water								
2000	ND	ND	ND	ND	ND	ND	ND	ND	ND
1996	ND	1.34	ND	ND	ND	ND	NA	ND	ND

Notes:

[1] = 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] "Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOCs = volatile organic compounds

Historical and current data for CMW-3 are presented in Table 5-26. Data are available for this well for the years 1996, 1999, 2000, and 2003. DRO results from this well were very similar in 1996 and 2003. DRO was below detection limits in 2004. Benzene was the only analyte detected in CMW-3 in 2004 and was reported at low levels below the PQL. Current RAOs have not been historically exceeded in this well.

Table 5-26 Comparison of CMW-3 Hydrocarbon Levels 1996-2004

LF03 CMW-3	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.0005)*	NA	NA
2004	NA	ND	0.000156[a]	ND	ND	ND	ND	NA	NA
2003	ND	0.0949	ND	ND	ND	ND	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	NA	ND	ND
1999	ND	ND	ND	ND	ND	ND	NA	ND	ND
1996	ND	0.092	ND	ND	ND	ND	NA	ND	ND

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004, Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
ND = below method detection limits
NA = not analyzed PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOCs = Volatile organic compounds

Historical and current data for CMW-4 are presented in Tables 5-27, 5-27a, and 5-27b. DRO results exceeded current preliminary RAOs in 1996 and 1997, with concentrations of 1.62 mg/L and 2.13 mg/L, respectively (the current preliminary RAO for DRO is 1.5 mg/L). DRO levels declined to 0.079 mg/L in 1999, then to below detection limits in 2000. DRO was again detected in 2003 and 2004 at 0.436 mg/L and 0.355 mg/L, respectively (Table 5-27). GRO was detected at low levels in 1996 and 2003 (0.03 mg/L) but was not detected in the intervening years. GRO was not analyzed in 2004.

In 2003, nine VOCs were detected in samples from CMW-4 (Table 5-27a) although most of these results were below the PQL (BNCI, 2004). No VOCs were detected from 1996 to 2000. Benzoic acid (an SVOC) was detected at a very low concentration in 1996 (Table 5-27b). No other SVOCs were detected during any of the sampling events from 1996 to 2003. Three PAHs were detected at low levels in 2004 (see Table 5-22a).

Table 5-27 Comparison of CMW-4 Hydrocarbon Levels 1996-2004

LF03 CMW-4	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethyl-benzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.0005)*	Table 5-27a	See Table 5-27b
2004	NA	0.355	0.000393 [a]	ND	ND	0.002055 [a]	ND	NA	NA
2003	0.0343	0.436	ND	ND	0.000570	ND	ND	Table 5-27a	ND
2000	ND	ND	ND	ND	ND	ND	NA	ND	ND
1999	ND	0.79	ND	ND	ND	ND	NA	ND	ND
1997	ND	**2.13**	ND	ND	ND	ND	NA	ND	ND
1996	0.033	**1.62**	ND	ND	ND	ND	NA	ND	See Table 5-27b

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Values in **Bold** exceed preliminary RAOs

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOCs = volatile Organic compounds

Table 5-27a 2003 Groundwater VOC Results at CMW-4

Location	Other VOCs Detected	Level Detected	*Groundwater RAOs* [1]
CMW-4 (2003)	Chloroethane	0.000710 mg/L	*0.29 mg/L* [2]
	1,1-Dichloroethane	0.000590 mg/L	*3.65 mg/L*
	1,2-Dichloroethane	0.000510 mg/L	*0.005 mg/L*
	n-Propylbenzene	0.000510 mg/L	*1.46 mg/L* [2]
	tert-Butylbenzene	0.000380 mg/L	*1.46 mg/L* [2]
	sec-Butylbenzene	0.00400 mg/L	*1.46 mg/L* [2]
	4-Isopropyltoluene	0.000500 mg/L	*3.65 mg/L* [2]
	n-Butylbenzene	0.00172 mg/L	*1.46 mg/L* [2]

Notes:

[1] = 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[2] = Calculated cleanup level in accordance with 18 AAC 75.340(g) (Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004).

[a] "Value indicated is below the Practical Quantitation Limit (PQL) for the analyte but above the Method Detection Limit (MDL).

Definitions:

mg/L = milligrams per liter
RAOs = Remedial Action Objectives (preliminary)
VOCs = volatile organic compounds

Table 5-27b 1996 Groundwater SVOC Results at CMW-4

Location	SVOC Detected	Level Detected	*Groundwater RAOs* [1]
CMW-4	Benzoic acid	0.0125 mg/L	*146.0 mg/L*

Notes:
[1] = 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels
[a] = Value indicated is below the Practical Quantitation Limit (PQL) for the analyte but above the Method Detection Limit (MDL).
Values in Bold exceed current RAOs

Definitions:
mg/L = milligrams per liter
RAOs = Remedial Action Objectives (preliminary)
VOCs = volatile organic compounds

Historical and current data for CMW-5 are presented in Table 5-28. DRO was detected at low levels below RAOs in 1996, 1999, 2003, and 2004. DRO levels were below detection limits in 1997 and 2000. GRO was not detected in data collected from 1996 to 2003 and was not analyzed for in 2004. VOCs and SVOCs were not detected in the data collected from 1996 to 2003 (this includes BTEX constituents). Benzene was detected in the 2004 data at low levels below the PQL. Toluene was detected at low levels in 2003 and 2004. Xylenes were detected at low levels below the PQL in 2004. PCBs were added to the analyte list in 2003 and were not detected in the 2003 or 2004 data. RAOs have not been historically exceeded at this well for any of the constituents of concern.

Table 5-28 Comparison of CMW-5 Hydrocarbon Levels 1996-2004

LF03 CMW-5	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.0005)*		
2004	NA	0.157	0.000195 [a]	ND	0.000543 [a]	0.00056 [a]	ND	NA	NA
2003	ND	0.178	ND	ND	0.000400	ND	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	NA	ND	ND
1999	ND	0.41	ND	ND	ND	ND	NA	ND	ND
1997	ND	ND	ND	ND	ND	ND	NA	ND	ND
1996	ND	0.31	ND	ND	ND	ND	NA	ND	ND

Notes:
[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels
[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:
DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOCs = volatile organic compounds

Historical and current data for CMW-6 are presented in Table 5-29. DRO was not detected between 1996 and 2000. DRO was detected in 2003 (0.104 mg/L) and at a much lower level in 2004 (0.0853 mg/L). GRO was not detected in this well between 1996 and 2003. GRO was not analyzed in 2004. Between 1996 and 2003, VOCs and SVOCs were not detected in CMW-06 (including BTEX constituents). Benzene, toluene, and xylenes were detected at very low levels, below the PQL, in 2004. PCBs were not detected in 2003 and 2004 and were not analyzed prior to 2003.

Historical and current data for CMW-7 are presented in Table 5-30. GRO and benzene were detected at very low levels in 1996 but were below detectable levels from 1997 to 2004. DRO was detected in 1996 and 1997 at 1.21 mg/L and 0.25 mg/L, respectively (the preliminary RAO for DRO is 1.5 mg/L). DRO was not detected between 1999 and 2004. Historical DRO concentrations at MW-07 show a declining concentration pattern over time. VOCs (including BTEX constituents) and SVOCs were not detected between 1996 and 2004. PCBs were not detected in 2003 and 2004, and were not analyzed in prior years. Current preliminary RAOs have not historically been exceeded in this well.

5.3.2 LF03 Surface Water – Hydrocarbon Data

Surface water samples were collected from three drainage/seep locations emanating from the toe of the landfill on June 9, 2004 (Figure 5-3). Surface water sample[3] locations are correspondingly identified as SW-1 (Seep 1), SW-2 (Seep 2) and SW-3 (Seep 3). Surface water samples were analyzed for BTEX, DRO, PAHs, and PCBs at the project laboratory.

Table 5-29 Comparison of CMW-6 Hydrocarbon Levels 1996-2004

LF03 CMW-6	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.0005)*	NA	NA
2004	NA	0.0853	0.00024[a]	ND	0.000757[a]	0.00132[a]	ND	NA	NA
2003	ND	0.104	ND	ND	0.00420	ND	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	NA	ND	ND
1999	ND	ND	ND	ND	ND	ND	NA	ND	ND
1997	ND	ND	ND	ND	ND	ND	NA	ND	ND
1996	ND	ND	ND	ND	ND	ND	NA	ND	ND

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit..

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOCs = volatile organic compounds

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[3] Note: At LF03, surface water samples were co-located with sediment samples.

Table 5-30 Comparison of CMW-7 Hydrocarbon Levels 1996-2004

LF03 CMW-7	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*(1.3)*	*(1.5)*	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.0005)*	NA	NA
2004	NA	ND	ND	ND	ND	ND	ND	NA	NA
2003	ND	ND	ND	ND	ND	ND	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	NA	ND	ND
1999	ND	ND	ND	ND	ND	ND	NA	ND	ND
1997	ND	0.25	ND	ND	ND	ND	NA	ND	ND
1996	0.074	1.21	0.007	ND	ND	ND	NA	ND	ND

Notes:

[1] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOCs = volatile organic compounds

5.3.2.1 Summary of 2004 Surface Water Hydrocarbon Results at LF03

Analytical results for 2004 surface water samples are shown in Tables 5-30 and 5-30a. PCBs were detected in a surface water sample collected from SW-2 (Seep 2) at 0.0797 mg/L, a level exceeding the current preliminary RAO for PCBs in surface water (0.000014 mg/L). This was the only preliminary RAO exceedance in 2004 surface water samples collected at the landfill. PCBs were not detected in surface water samples collected from the other two seep locations (SW-1 and SW-3).

Low levels of DRO were detected in 2004 samples collected from all three seep locations (three primary samples and one duplicate). DRO levels ranged in concentration from 0.07 mg/L to 0.21 mg/L. There are no preliminary RAOs for DRO in surface water, as noted in Table 5-31.

Table 5-31 2004 Surface Water Hydrocarbon Levels

LF03 2004	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	TAH (mg/L)	TAqH (mg/L)	PAH (mg/L)
(RAOs)[1]	*No sheen*[2]	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.000014)*	*(0.010)*	*(0.015)*	See Table 5-31a
SW-1 (Seep 1)	0.0708[a]	ND	ND	ND	ND	ND	ND[b]	ND[b]	ND
SW-1D (Seep 1)	0.0882[a]	ND	ND	ND	ND	ND	ND[b]	ND[b]	See Table 5-31a
SW-2 (Seep 2)	0.208[a]	0.000325[a]	ND	0.00824[a]	0.00148[a]	**0.0797**	0.010[b]	0.010[b]	ND
SW-3 (Seep 3)	0.117[a]	ND	ND	ND	ND	ND	ND[b]	ND[b]	See Table 5-31a

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; water quality criteria; water quality standards tables, as amended through June 26, 2003 (ADEC, 2003).

[2] There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[3] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

[b] TAH and TAqH are calculated values based upon definition below.

Values in Bold exceed preliminary RAOs

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
ND = below method detection limits
PAHs = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
TAH = total aromatic hydrocarbons = sum of BTEX concentrations
TAqH = Total aqueous hydrocarbons = sum of BTEX and PAH concentrations

Naphthalene (a PAH) was detected surface water samples collected from SW-1 (Seep 1) and SW-3 (Seep 3) in 2004 at levels below preliminary RAOs, as well as below the method PQL (Table 5-31a). No other analytical constituents were detected in surface water samples from SW-1 and SW-3 in 2004.

Benzene, toluene, and xylenes were detected in the 2004 surface water sample collected from SW-2, with concentrations below preliminary RAOs and below the method PQL (Table 5-13). Ethylbenzene was not detected in the 2004 surface water sample from SW-2.

Table 5-31a 2004 Surface Water PAH Results at LF03

Location	PAH Detected	Level Detected	*RAOs* [1, 2, 3]
SW-1D	Naphthalene	0 0000153 mg/L [a]	*0.62 mg/L*
SW-3	Naphthalene	0.0000154 mg/L [a]	*0.62 mg/L*

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; water quality criteria; water quality standards tables, as amended through June 26, 2003 (ADEC, 2003).

[2] There are no standards provided for these analytes in 18 AAC 70; therefore, ambient water quality criteria values found in the NOAA SQuiRT tables are used as surface water screening criteria Note that the NOAA SQuiRT values are not regulatory cleanup levels.

[3] NOAA SQuiRT Freshwater Criteria.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

mg/L = milligrams per liter
PAHs = Polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)

DRO was detected in the sample from SW-2 although a preliminary RAO for DRO concentrations in surface water does not exist. At the time the 2004 surface water sample was collected at SW-2 (Seep 2), the field team noted some staining and surface sheen at the sample site. The presence of sheen does constitute an exceedance of the preliminary RAOs for petroleum hydrocarbons in surface water.

Only DRO was detected in the 2004 sample collected at SW-3 (Seep 3). As mentioned, a preliminary RAO for DRO concentrations in surface water does not exist. At the time this location was sampled in 2004, the field team noted some staining and surface sheen at location SW-3. The presence of sheen constitutes an exceedance of the preliminary RAO for petroleum hydrocarbons in surface water.

5.3.2.2 Comparative Analyses of Historical Surface Water Hydrocarbon Results from LF03 (1997-2004)

Historical results for SW-1 (Seep 1) are presented in Table 5-32. GRO was not detected from 1997 to 2003, and no analysis for GRO was performed in 2004. DRO was detected at low levels below the PQL in 2004, but had not been detected in 1997 through 2003 data. PCBs were not detected from 1997 to 2004. VOCs (including BTEX constituents) and SVOCs were not detected from 1997 to 2004.

Historical results for SW-2 (Seep 2) are presented in Table 5-33. PCBs were detected above preliminary RAOs in 2004 as well as in 1997. No other contaminants were detected above preliminary RAOs in surface water samples collected at SW-2, with the exception of the surface sheen observed when collecting the 2004 surface water sample. GRO was not detected in samples collected in 1997, 1999, or 2003. Surface water samples were not collected at LF03 in 2000, and GRO was not analyzed in samples collected in 2004. DRO was detected at low levels in 1997, 2003, and 2004 but was not detected in 1999. Benzene, toluene, and xylenes were detected at low levels in 2004. BTEX constituents were not detected in samples collected in prior years (Table 5-33). VOCs (including BTEX constituents) and SVOCs were not detected in samples collected from 1997 to 2004.

Table 5-32 Comparison of SW-1 Surface Water Hydrocarbon Levels (1997-2004)

LF03 SW-1	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*No sheen*[2]	*No sheen*[2]	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.00014)*	NA	NA
2004	NA	0.0708[a]	ND	ND	ND	ND	ND	NA	NA
2003	ND	ND	ND	ND	ND	ND	ND	ND	ND
2000	ND	ND	ND	ND	ND	ND	ND	ND	ND
1999	ND	ND	ND	ND	ND	ND	ND	ND	ND
1997	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; water quality criteria; water quality standards tables, as amended through June 26, 2003 (ADEC, 2003).

[2] There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[3] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/L = milligrams per liter
NA = not analyzed
ND = below method detection limits
PAHs = Polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics

Table 5-33 Comparison of SW-2 Surface Water Hydrocarbon Levels (1997-2004)

LF03 SW-2	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*No sheen*[2]	*No sheen*[2]	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.000014)*		
2004	NA	0.208[a]	0.000325	ND	0.00824	0.00148	**0.0797**	NA	NA
2003	ND	0.108	ND	ND	ND	ND	ND	ND	ND
1999	ND	ND	ND	ND	ND	ND	ND	ND	ND
1997	ND	0.205	ND	ND	ND	ND	**0.046**	ND	ND

Notes:

[1] = 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; water quality criteria; water quality standards tables, as amended through June 26, 2003 (ADEC, 2003).

[2] = There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[a] = Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Values in Bold exceed preliminary RAOs

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOC = semivolatile organic compounds
VOC = volatile organic compounds

Historical results for SW-3 (Seep 3) are presented in Tables 5-34 and 5-34a. GRO was not detected at this location from 1997 to 2003, and no analysis for GRO was performed in 2004. DRO was detected at this location in 2003 and 2004 only. Toluene was detected at SW-3 in 2003 at a very low level (0.00031 mg/L) (Tables 5-34 and 5-34a). Three other VOCs were detected at this location in 2000 but not at levels above RAOs (Table 5-34a). No other contaminants were detected, and preliminary RAOs were not exceeded, with the exception of the surface sheen observed when collecting the 2004 surface water sample.

Table 5-34 Comparison of SW-3 Surface Water Hydrocarbon Levels (1997-2004)

LF03 SW-2	GRO (mg/L)	DRO (mg/L)	Benzene (mg/L)	Ethylbenzene (mg/L)	Toluene (mg/L)	Xylenes (mg/L)	PCBs (mg/L)	VOC (mg/L)	SVOC (mg/L)
(RAOs)[1]	*No sheen* [2]	*No sheen* [2]	*(0.005)*	*(0.7)*	*(1.0)*	*(10)*	*(0.000014)*	Table 5-34a	NA
2004	NA	0.117[a]	ND	ND	ND	ND	ND	NA	NA
2003	ND	0.0733	ND	ND	0.00031	ND	ND	Table 5-34a	ND
2000	ND	ND	ND	ND	ND	ND	ND	Table 5-34a	ND
1999	ND	ND	ND	ND	ND	ND	ND	ND	ND
1997	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; water quality criteria; water quality standards tables, as amended through June 26, 2003 (ADEC, 2003).

[2] There are no quantitative surface water criteria for DRO, RRO, or GRO; 18 AAC 70 requires that petroleum hydrocarbons, oils, and grease may not cause a visible sheen upon the surface of the water.

[3] 18 AAC 75.345(b)(1) = Alaska Department of Environmental Conservation Oil and Hazardous Substances Pollution Control Regulations, as amended through May 26, 2004; Method Two (Table C) groundwater cleanup levels

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
RRO = residual range organics
SVOC = semivolatile organic compounds
VOC = volatile organic compounds

Table 5-34a Surface Water VOC Results at SW-3

Location	VOC Detected	Level Detected	*Preliminary RAOs*
SW-3 (2003)	Toluene	0.000310 mg/L	*1.0 mg/L* [1]
SW-3 (2000)	1,2,3-Trichlorobenzene	0.004 mg/L	*None available*
SW-3 (2000)	Naphthalene	0.009 mg/L	*0.62 mg/L* [2,3]
SW-3 (2000)	1,2,4-Trichlorobenzene	0.0072 mg/L	*0.07 mg/L* [1]

Notes:

[1] 18 AAC 70.020 = Alaska Department of Environmental Conservation Water Quality Standards; water quality criteria; water quality standards tables, as amended through June 26, 2003 (ADEC, 2003).

[2] There are no standards provided for these analytes in 18 AAC 70, therefore, ambient water quality criteria values found in the NOAA SQuiRT tables are used as surface water screening criteria. Note that the NOAA SQuiRT values are not regulatory cleanup levels.

[3] NOAA SQuiRT Freshwater Criteria.

Definitions:

mg/L = milligrams per liter
RAOs = Remedial Action Objectives (preliminary)
VOC = volatile organic compounds

5.3.2.3 Summary of 2004 Sediment Results at LF03

Sediment samples were collected on June 9, 2004, from locations SD-1, SD-2, and SD-3 at LF-03 (Figure 5-3). The three sediment samples were collected from seep drainages 1, 2, and 3 emanating from the toe of the landfill and were co-located with the surface water samples collected in 2004. Sediment and surface water samples are correspondingly numbered. Table 5-35 presents the 2004 sediment sample results.

Table 5-35 2004 Sediment Hydrocarbon Results

LF03 2004	DRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	PCBs (mg/kg)	PAH (mg/kg)
(RAOs)[1]	*None* [2]	*(0.057)*[3]	*(0.089)* [4]	*(0.05)*[4]	*(0.025)*[3]	*(0.0341)*[5]	Table 5-35a
SD-1	42.7[a]	ND	ND	ND	0.0918[a]	ND[b]	ND
SD-2	154	ND	ND	ND	0.0389[a]	**153**	Table 5-35a
SD-3	0.0296[a]	ND	ND	ND	0.0469[a]	ND[c]	ND

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines*, dated March 2004.

[2] There are no screening benchmarks for bulk hydrocarbons in sediment.

[3] USEPA, 1996.

[4] Jones et al., 1997.

[5] NOAA SQuiRT Lowest ARC Threshold Effects Level.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

[b] Method detection limit for this analyte is 0.118 mg/kg which is above the RAO for PCBs in sediments.

[c] Method detection limit for this analyte is 0.0815 mg/kg which is above the RAO for PCBs in sediments.

Values in Bold exceed preliminary RAOs

Definitions:

DRO = diesel range organics
mg/kg = milligrams per kilogram
ND = below method detection limits
PAH = polynuclear aromatic hydrocarbons
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives
RRO = residual range organics

At all three sediment sample locations, xylenes were detected above preliminary RAOs for sediments (SD-1, SD-2, and SD-3). PCBs were detected at SD-2 at 153 mg/kg, which is above the preliminary sediment RAO of 0.0341 mg/kg for PCBs (Table 5-35). DRO was detected at SD-1, SD-2, and SD-3, at concentrations of 42.7 mg/kg, 154 mg/kg, and 0.0296 mg/kg, respectively. (Note: There is no preliminary RAO for DRO in sediments.)

Benzo(b)fluoranthene, benzo(g,h,l)perylene, and pyrene (all PAHs) were detected in sediments from SD-2 below preliminary RAOs, as shown in Table 5-35a. No other chemicals were detected in sediment samples.

5.3.2.4 Comparative Analyses of Sediment Hydrocarbon Results at SD-1 1997-2004

DRO has consistently been detected in sediment samples collected between 1997 and 2004 from SD-1, as shown in Table 5-36. Historic DRO results range from about 21 mg/kg to 98 mg/kg, although a preliminary RAO for DRO in sediments does not exist (Table 5-36).

Table 5-35a 2004 Sediment Sample Results

Location	PAH Detected	Level Detected	*Preliminary RAOs*[1,2]
SD-2	Benzo(b)fluoranthene	0.0162 mg/kg	*1.8 mg/kg* [3]
SD-2	Benzo(g,h,i)perylene	0.005 mg/kg [a]	*3.0 mg/kg* [4]
SD-2	Pyrene	0.00319 mg/kg [a]	*0.053 mg/kg* [4]

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines*, dated March 2004.

[2] Values identified in NOAA SquiRT reference table guidelines.

[3] Identified in NOAA SquiRT as Marine Apparent Effects Threshold value.

[4] Identified in NOAA SquiRT Threshold Effects Level.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Definitions:

mg/kg = milligrams per kilogram
PAH = polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives (preliminary)

Table 5-36 Comparison of Sediment Hydrocarbon Levels at SD-1 1997-2004

LF03 SD-1	GRO (mg/kg)	DRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	PCBs (mg/kg)	VOC (mg/kg)	SVOC (mg/kg)
(RAOs)[1]	*None* [2]	*None* [2]	*(0.057)* [3]	*(0.089)* [4]	*(0.05)* [4]	*(0.025)*[3]	*(0.0341)*[5]	NA	NA
2004	NA	42.7	ND	ND	ND	ND	ND [b]	NA	NA
2003	ND	16.4	ND	ND	ND	ND	**0.0867**	ND	ND
2000	ND	21	ND	ND	ND	ND	**0.045**	ND	ND
1999	ND	98.3	ND	ND	ND	ND	ND	ND	ND
1997	ND	34.7	ND	ND	ND	ND	ND	ND	ND

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines*, dated March 2004.

[2] There are no screening benchmarks for bulk hydrocarbons in sediment.

[3] USEPA, 1996.

[4] Jones et al., 1997.

[5] NOAA SquiRT Lowest ARC Threshold Effects Level.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

[b] method detection limit for this analyte is 0.118 mg/kg which is above the RAO for PCBs in sediments.

Values in Bold exceed preliminary RAOs

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOC = volatile organic compounds

The PCB Aroclor-1260 was first detected in 2000 at a concentration of 0.045 mg/kg, and again in 2003 at 0.0867 mg/kg. Both of these results exceed the current preliminary RAO, but did not exceed the projected cleanup level presented in the Interim ROD (611 CES, March 2002). The PCB result for the 2004 sample collected at this location was below the detection limit. Between 2000 and 2004, historic data shows a definite decline in PCB levels at this location.

GRO, VOCs (including BTEX constituents), and SVOCs were not detected in any of the prior sampling years at SD-1, and were not analyzed in 2004. BTEX results for the 2004 sample were below method detection limits.

5.3.2.5 Comparative Analyses Sediment Hydrocarbon Results at SD-2 1997-2004

As shown in Table 5-37, DRO was detected at fairly consistent levels at SD-2 for all sample years between 1997 and 2004. There is no preliminary RAO for DRO in sediments.

PCBs were detected at levels exceeding the preliminary RAO in 1997, 2000, 2003, and 2004 (Table 5-37). PCBs were not detected in 1999. PCB concentrations ranged from 69.1 mg/kg to 341 mg/kg from 1997 to 2003. These levels exceed the current preliminary RAO for PCBs for sediments (0.0341 mg/kg), but did not exceed cleanup levels presented in the 2002 Interim ROD.

Table 5-37 Comparison of Sediment Hydrocarbon Levels at SD-2 1997-2004

LF03 SD-2	GRO (mg/kg)	DRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	PCBs (mg/kg)	VOC (mg/kg)	SVOC (mg/kg)
(RAOs)[1]	*None* [2]	*None* [2]	*(0.057)* [3]	*(0.089)* [4]	*(0.05)* [4]	*(0.025)*[3]	*(0.0341)*[5]	NA	Table 5-36a
2004	NA	154	ND	ND	ND	ND	**153**	NA	NA
2003	1.02	156	ND	ND	ND	ND	**342**	ND	ND
2000	ND	310	ND	ND	ND	ND	**250**	ND	Table 5-36a
1999	ND	112	ND	ND	ND	ND	ND	ND	ND
1997	ND	181	ND	ND	ND	ND	**69.1**	ND	Table 5-37a

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines*, dated March 2004.

[2] There are no screening benchmarks for bulk hydrocarbons in sediment.

[3] USEPA, 1996.

[4] Jones et al., 1997.

[5] NOAA SQuiRT Lowest ARC Threshold Effects Level.

[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.

Values in Bold exceed preliminary RAOs

Definitions:

DRO = diesel range organics
GRO = gasoline range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOC = volatile organic compounds

VOCs (including BTEX constituents) were not detected in sediments collected from SD-2 in 1997, 1999, 2000, or 2003 (Table 5-37).

SVOC results are shown in Table 5-37a. Di-n-Octylphthalate was detected in 1997 above the preliminary RAO (Table 5-37a). Bis(2-Ethylhexyl) phthalate was detected above its preliminary RAO in 2000 (Table 5-37a). Both of these SVOCs are common laboratory contaminants and the detections are suspect, especially for the 2000 data, which exhibits a pattern of similar anomalous detections of this nature. It is unlikely that either SVOC detection represents actual environmental conditions.

Table 5-37a 2000 and 1997 SVOC Sediment Sample Results at SD-2

Location (year)	SVOC Detected	Level Detected	*Preliminary RAOs* [1]
SD-2 (2000)	Bis (2-Ethylhexyl) phthalate	**0.84 mg/kg**	*0.75 mg/kg* [2]
SD-2 (1997)	Di-n-Octylphthalate	0.331 mg/kg	*0.061 mg/kg* [3]

Notes:
[1] = Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum "Sediment Quality Guidelines (SQG)," dated March 2004.
[2] = NOAA SQuiRT Upper Effects Threshold (UET) level for freshwater sediment (Buckman, 1999)
[3] = NOAA SQuiRT Apparent Effects Threshold (AET) for marine sediments (Buckman, 1999).
Values in Bold exceed current preliminary RAOs.
Definitions:
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds

5.3.2.6 Comparative Analyses Sediment Hydrocarbon Results at SD-3 1997-2004

As shown in Table 5-38, DRO was detected in sediment samples at low, but fairly consistent concentrations in results obtained from location SD-3 between 1997 and 2004. PCBs were not detected in sediments from this location between 1997 and 2004. GRO was detected in 2003 at a very low level below the PQL. There is no preliminary RAO for GRO in sediments.

Table 5-38 Comparison of Sediment Hydrocarbon Levels at SD-3 1997-2004

LF03 SD-3	GRO (mg/kg)	DRO (mg/kg)	Benzene (mg/kg)	Ethylbenzene (mg/kg)	Toluene (mg/kg)	Xylenes (mg/kg)	PCBs (mg/kg)	VOC (mg/kg)	SVOC (mg/kg)
(RAOs)[1]	*None* [2]	*None* [2]	*(0.057)* [3]	*(0.089)* [4]	*(0.05)* [4]	*(0.025)*[3]	*(0.0341)* [5]	NA	See Table 5-38a
2004	NA	ND	ND	ND	ND	ND	ND [b]	NA	NA
2003	0.745	10.5	ND	ND	ND	ND	ND	ND	ND
2000	ND	18	ND	ND	ND	ND	ND	ND	See Table 5-38a
1999	ND	109	ND	ND	ND	ND	ND	ND	ND
1997	ND	13.1	ND	ND	ND	ND	ND	ND	ND

Notes:
[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines*, dated March 2004.
[2] There are no screening benchmarks for bulk hydrocarbons in sediment.
[3] USEPA, 1996.
[4] Jones et al., 1997.
[5] NOAA SQuiRT Lowest ARC Threshold Effects Level
[a] Value indicated is below the Practical Quantitation Limit for the analyte but above the Method Detection Limit.
[b] Method detection limit for this analyte is 0.0815 mg/kg which is above the RAO for PCBs in sediments.
Definitions:
DRO = diesel range organics
GRO = gasoline range organics
mg/kg = milligrams per kilogram
NA = not analyzed
ND = below method detection limits
PCBs = polychlorinated biphenyls
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds
VOC = volatile organic compounds

SVOC results are presented in Table 5-38a. Di-n-butylphthalate was detected above its preliminary RAO in 2000. Di-n-butylphthalate is a common laboratory contaminant, and the 2000 data exhibits a consistent pattern of anomalous detections of this nature and is suspect.

Table 5-38a 2000 Sediment Sample Results at Location SD-3

Location (year)	SVOC Detected	Level Detected	*Preliminary RAOs* [1,2]
SD-3 (2000)	Di-n-butylphthalate	0.57 mg/kg	*0.11 mg/kg*
SD-3 (2000)	Di-n-butylphthalate	0.88 mg/kg	*0.11 mg/kg*

Notes:

[1] Sediment screening was performed in accordance with Alaska Department of Environmental Conservation Technical Memorandum *Sediment Quality Guidelines*, dated March 2004.

[2] NOAA SquiRT Upper Effects Threshold (UET) level for freshwater sediments (Buckman, 1999).

Definitions:

mg/kg = milligrams per kilogram
RAOs = Remedial Action Objectives (preliminary)
SVOC = semivolatile organic compounds

144 80

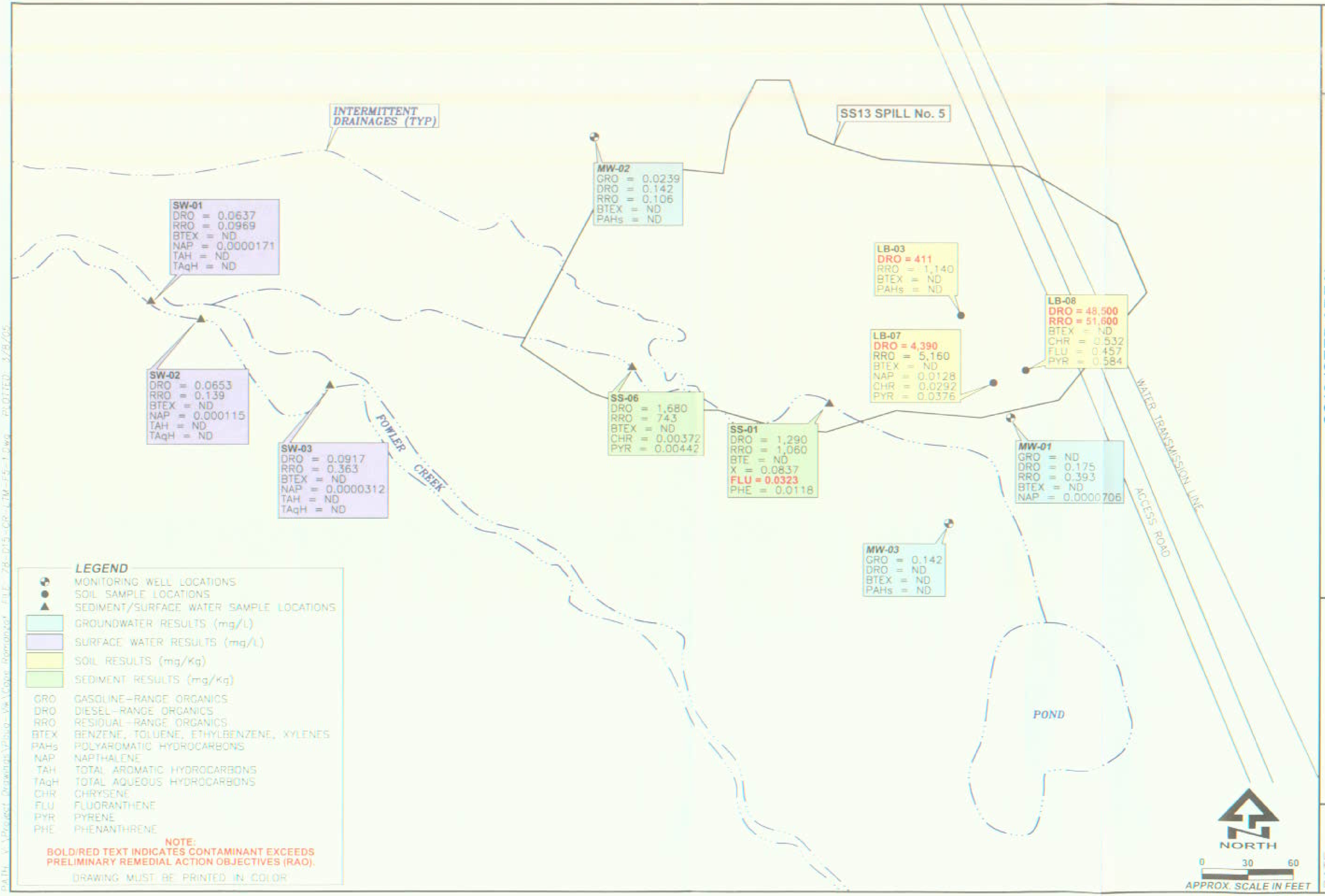

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FIGURE
5-1

SS13 (SEEP AREA)
2004 MNA SAMPLE LOCATIONS AND ANALYTICAL RESULTS

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

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

DATE
MARCH 2005
CHKD
HG
DRAWN
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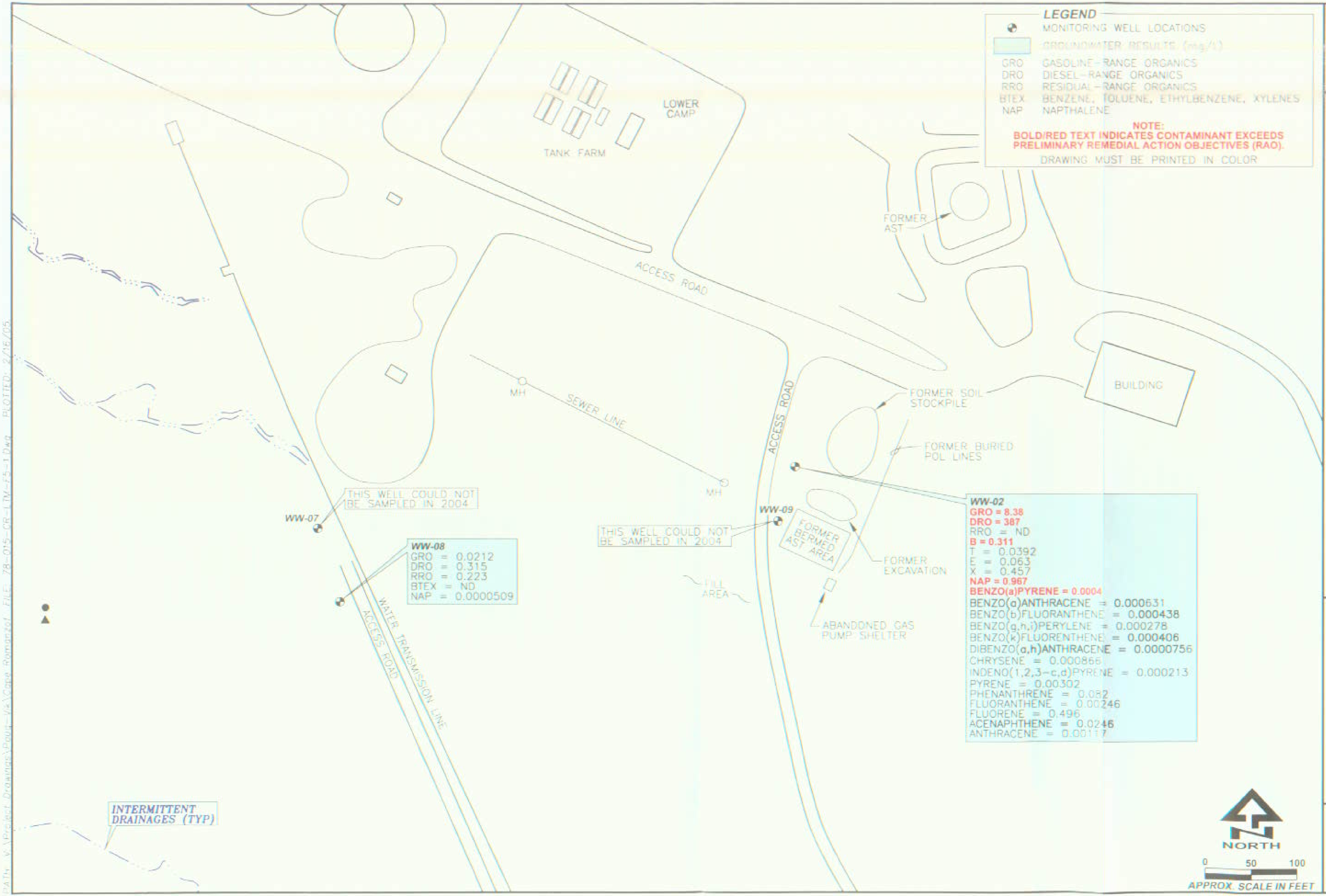
PROJ. NO
4112



THIS WELL COULD NOT BE SAMPLED IN 2004

THIS WELL COULD NOT BE SAMPLED IN 2004

WW-02
GRO = 8.38
DRO = 387
RRO = ND
B = 0.311
T = 0.0392
E = 0.063
X = 0.457
NAP = 0.967
BENZO(a)PYRENE = 0.0004
BENZO(a)ANTHRACENE = 0.000631
BENZO(b)FLUORANTHENE = 0.000438
BENZO(g,h,i)PERYLENE = 0.000278
BENZO(k)FLUORENTHENE = 0.000406
DIBENZO(a,h)ANTHRACENE = 0.0000756
CHRYSENE = 0.000866
INDENO(1,2,3-c,d)PYRENE = 0.000213
PYRENE = 0.00302
PHENANTHRENE = 0.082
FLUORANTHENE = 0.00246
FLUORENE = 0.496
ACENAPHTHENE = 0.0246
ANTHRACENE = 0.00117

WW-08
GRO = 0.0212
DRO = 0.315
RRO = 0.223
BTEX = ND
NAP = 0.0000509

LEGEND

●	MONITORING WELL LOCATIONS
🟦	GROUNDWATER RESULTS (mg/l)
GRO	GASOLINE-RANGE ORGANICS
DRO	DIESEL-RANGE ORGANICS
RRO	RESIDUAL-RANGE ORGANICS
BTEX	BENZENE, TOLUENE, ETHYLBENZENE, XYLENES
NAP	NAPTHALENE

NOTE:
BOLD/RED TEXT INDICATES CONTAMINANT EXCEEDS PRELIMINARY REMEDIAL ACTION OBJECTIVES (RAO).

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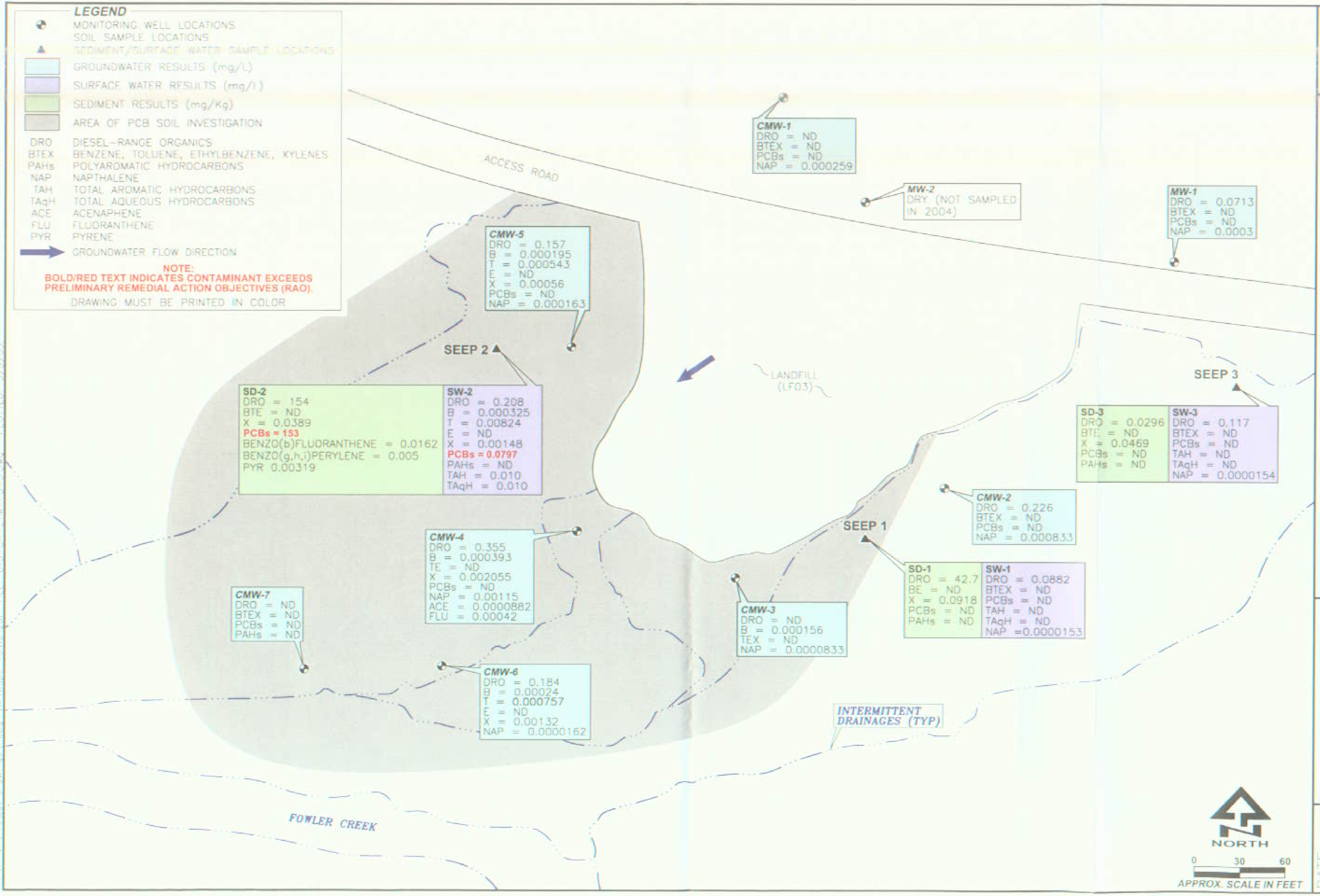
FIGURE
5-2

SS15 (UST AREA)
2004 MNA SAMPLE LOCATIONS AND ANALYTICAL RESULTS

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

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

DATE
FEB 2005
CHKD
H.G.
DRAWN
OASIS-PDC
PROJ. NO
4112



LF03 (LANDFILL No. 2)
2004 SAMPLE LOCATIONS AND ANALYTICAL RESULTS

2004 LONG TERM MONITORING AND
MONITORED NATURAL ATTENUATION STUDY
Cape Romanzof LRRS, Alaska

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

FIGURE
5-3

DATE
MARCH 2005
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PROJ. NO
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6 ASSESSMENT OF GROUNDWATER CONDITIONS THROUGH FIELD MEASUREMENTS AND INORGANIC DATA RESULTS

This section presents findings of groundwater field condition measurements and laboratory analyses of inorganic parameters as an aid to the interpretive assessment of groundwater conditions, plume stability, and intrinsic remediation probability.

6.1 SS13 Groundwater Conditions

Field measurements and inorganic data were obtained from groundwater samples collected from the three monitoring wells at SS13 successfully sampled in 2004: MW-1, MW-2, and MW-3. Similar historic data are available and reported for MW-1 and MW-2.

At the time of collection, groundwater samples were field tested for temperature, pH, conductivity, dissolved oxygen, oxygen-reduction potential (redox), and total dissolved solids (turbidity). Laboratory analyses for inorganic conditions of alkalinity, ferrous iron, sulfate, and nitrate/nitrite were also obtained for groundwater samples collected in 2004 at SS13. Field testing and analytical results obtained from each well in 2004, and prior years if available, are shown below in Tables 6-1, 6-2, and 6-3.

Table 6-1 SS13 (MW-01) Groundwater Field Measurements and Inorganic Data 1997-2004

Parameter/Analyte Collection Date	Units	MW-01 (SS13)				
		Sept-97	*Oct-99*	*Sept-00*	*Oct-03*	*June-04*
Depth to Water	Feet BTOC				14.73	23.0
Temperature	°C	2.25	2.0	1.7	1.1	2.9
PH		5.66	8.7	5.3	5.27	5.52
Conductivity	sM/cM^2	0.085	0.10	16.0	0.109	60
Dissolved Oxygen	mg/L	7.1	6.9	9.70	0	4.0
redox	MV	157	69	87	428	405
Turbidity	NTU	1000	42	132	150	Not measured
TDS	Ppm	No data	No data	No data	No data	30
Alkalinity	mg/L	120	37.6	42	40.0	30
Sulfate	mg/L	28.00	2.73	4.4	2.08	1.49
Nitrate	Ppm	39.1	0.667	ND	< 0.2	Not analyzed
Total Iron	mg/L	7.8	13.6	20	2.33	Not analyzed
Ferrous Iron (Fe^{+2})	mg/L	No data	No data	No data	0.116	Not analyzed
Ferric Iron (Fe^{+3})	mg/L	No data	No data	No data	2.214	Not analyzed

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Table 6-2 SS13 (MW-02) Groundwater Field Measurements and Inorganic Data 1997-2004

Parameter/Analyte Collection Date	Units	MW-02 (SS13) Sampling Results				
		Sept-97	**Oct-99**	**Sept-00**	**Oct-03**	**Aug-04**
Depth to Water	Feet BTOC				6.59	4.06
Temperature	°C	2.4	1.0	0.92	2.1	5.2
PH		5.7	8.5	5.55	5.11	4.8
Conductivity	Sm/cm^2	0.034	0.03	4.6	0.048	40
Dissolved Oxygen	mg/L	10.4	11.9	13.1	1.21	3.5
redox	MV	116	142	190	424	411
Turbidity	NTU	312	NA	561	> 999	Not measured
TDS	Ppm	No data	No data	No data	No data	60
Alkalinity	mg/L	60	12	10	24.0	Not analyzed
Sulfate	mg/L	NA	1.47	1.50	1.69	2.91
Nitrate	Ppm	33.7	0.70	0.18	< 0.2	Not analyzed
Total Iron	mg/L	2.4	116	39	56.5	Not analyzed
Ferrous Iron (Fe^{+2})	mg/L	No data	No data	No data	No data	Not analyzed
Ferric Iron (Fe^{+3})	mg/L	No data	No data	No data	56.5	Not analyzed

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts

NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Table 6-3 SS13 (MW-03) Groundwater Field Measurements and Inorganic Data June 2004

Parameter/Analyte	Units	MW-03 (SS13)
Collection Date	***June 04***	
Depth to Water	Feet BTOC	9.36
Temperature	°C	3.7
pH		4.0
Conductivity	Sm/cm^2	0.030
Dissolved Oxygen	mg/L	4.0 (bailed)
redox	MV	368
Turbidity	NTU	Low
TDS	ppm	Not measured
Alkalinity	mg/L	12.5
Sulfate	mg/L	1.07
Nitrate	ppm	0.360F
Total Iron	mg/L	44.6
Ferrous Iron (Fe^{+2})	mg/L	0.127F
Ferric Iron (Fe^{+3})	mg/L	44.473

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts

NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

6.2 SS15 Groundwater Conditions

Field measurements and inorganic data obtained from the two wells successfully sampled at SS15 in 2004 (WW-02 and WW-08) are shown in Tables 6-4 and 6-5, along with available historical data for each.

Table 6-4 SS15 (WW-02) Groundwater Field Parameter/Inorganic Data = 1997 – 2004

Parameter/Analyte	Units	WW-02 (SS15) Sampling Results				
		Sept-97	Oct-99	Sept-00	Oct-03	June-04
Depth to Water	Feet BTOC				45.82	63.36
Temperature	°C	2.53	2.0	1.93	1.1	6.80
PH		6.37	8.4	5.57	6.01	7.28
Conductivity	Sm/cm^2	0.51	0.20	34.6	0.401	270
Dissolved Oxygen	mg/L	2.36	3.2 (bailed)	9.85	0.00 (bailed)	NA
redox	MV	330	40	235	18	179
Turbidity	NTU	149	42	199	23.8	Not analyzed
TDS	ppm	No data	No data	No data	No data	80
Alkalinity	mg/L	260	104	110	143	141
Sulfate	mg/L	55.0	54.3	42.0	39.6	34.1
Nitrate	ppm	99.8	0.62	No data	1.9	Not analyzed
Total Iron	mg/L	10	8.52	10	16.2	7.61
Ferrous Iron (Fe^{+2})	mg/L	No data	No data	No data	16.7	Not analyzed
Ferric Iron (Fe^{+3})	mg/L	No data	No data	No data	No data	Not analyzed

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Table 6-5 SS15 (WW-08) Groundwater Field Measurements and Inorganic Data 1997 – 2004

Parameter/Analyte	Units	WW-08 (SS15) Sampling Results				
		Sept-97	Oct-99	Sept-00	Oct-03	Aug-04
Depth to Water	Feet BTOC				12.74	10.10
Temperature	°C	2.57	1.0	1.19	1.5	3.4
PH		5.87	7.6	5.63	5.24	5.1
Conductivity	Sm/cm^2	0.057	0.06	7.5	0.081	80
Dissolved Oxygen	mg/L	13.9	11.0	12.13	4.51	4.40
redox	MV	244	108	235	422	434
Turbidity	NTU	490	1000	265	10.9	Not measured
TDS	ppm	No data	No data	No data	No data	116
Alkalinity	mg/L	40	NA	26.0	21.0/22	22.0
Sulfate	mg/L	6.0	NA	1.90	1.93/1.8	4.04
Nitrate	ppm	88.1	NA	1.0	1.8/1.3	Not analyzed
Total Iron	mg/L	2.2	43.9	28	0.144/0.147	Not analyzed
Ferrous Iron (Fe^{+2})	mg/L	No data	No data	No data	ND/0.0782	Not analyzed
Ferric Iron (Fe^{+3})	mg/L	No data	No data	No data	0.144/0.0688	Not analyzed

Definitions:
°C = degrees Celsius
NTU = Nessler turbidity units

BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Tabulated data includes water-level measurements for each well, field sample results for temperature, pH, conductivity, dissolved oxygen, redox, total dissolved solids, and inorganic laboratory analytes (i.e., alkalinity, ferrous iron, sulfate, and nitrate/nitrite).

6.3 LF03 Groundwater Conditions

In 2004, groundwater samples from seven wells[4] were successfully field tested at LF03 (i.e., MW-1, CMW-1, CMW-3, CMW-4, CMW-5, CMW-6, and CMW-7). Field measurements and inorganic data obtained from the LF03 wells in 2004 are shown in Tables 6-6 through 6-12 below, along with available historical data for each.

Tabulated data include water level measurements for each well, field sample results for temperature, pH, conductivity, dissolved oxygen, redox, and total dissolved solids. Data for inorganic laboratory analytes were not obtained.

Table 6-6 LF03 (MW-1) Groundwater Field Measurements 1997-2004

Parameter/Analyte	Units	MW-1 Sampling Results		
		Sept-00	Oct-03	June-04
Depth to Water	Feet BTOC	No data	20.68	17.20
Temperature	°C	2.63	3.6	6.0
pH		5.66	5.18	6.91
Conductivity	Sm/cm^2	3.2	0.03	30
Dissolved Oxygen	mg/L	12.75	9.23	12.81
redox	MV	241	468	311
Turbidity	NTU	999	22.2	Not measured
TDS	ppm	No data	No data	10

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

---

[4] Field testing was not performed on the sample obtained from well CMW-2 because not enough water was available as a result of slow recharge of the well.

Table 6-7 LF03 (CMW-1) Groundwater Field Measurements 1997-2004

Parameter/Analyte	Units	CMW-1 Sampling Results					
		July-96	Sept-97	Oct-99	Sept-00	Oct-03	June-04
Depth to Water	Feet BTOC					5.19	5.08
Temperature	°C	5.0	1.4	3.0	2.74	2.2	7.1
PH		6.3	6.3	10.1	5.69	4.89	6.64
Conductivity	Sm/cm^2	0.024	0.09	0.02	2.6	0.035	30
Dissolved Oxygen	mg/L	4.1	9.65	12.7	12.8	9.1	13.75
redox	MV	-81	85	87	263	487	189
Turbidity	NTU	1000	1000	99	999	54.4	Not measured
TDS	ppm	No data	No data	No data	No data	No data	10

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Table 6-8 LF03 (CMW-3) Groundwater Field Measurements 1997-2004

Parameter/Analyte	Units	CMW-3 Sampling Results				
		July-96	*Oct-99*	*Sept-00*	*Oct-03*	*June-04*
Depth to Water	Feet BTOC				7.07	7.6
Temperature	°C	8.0	3.0	4.93	1.6	6.3
PH		6.1	8.2	5.61	5.26	6.89
Conductivity	Sm/cm^2	0.05	0.04	4.7	0.047	60
Dissolved Oxygen	mg/L	5.8	9.9	10.94	1.73	5.11
redox	MV	165	77	249	278	56
Turbidity	NTU	1000	99	999	25.8	Not measured
TDS	ppm	No data	No data	No data	No data	20

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Table 6-9 LF03 (CMW-4) Groundwater Field Measurements 1997-2004

Parameter/Analyte	Units	CMW-4 Sampling Results					
		July-96	*Sept-97*	*Oct-99*	*Sept-00*	*Oct-03*	*June-04*
Depth to Water	Feet BTOC					4.42	7.02
Temperature	°C	4.0	1.0	3.0	3.55	2.4	6.2
PH		6.1	6.67	7.1	5.9	5.58	7.12
Conductivity	Sm/cm^2	0.18	0.46	0.15	13.6	0.191	120
Dissolved Oxygen	mg/L	5.2	7.99	7.3	9.61	0.0	5.68
redox	MV	-33	132	65	96	178	147
Turbidity	NTU	1000	1000	99	399	31.9	Not measured
TDS	ppm	No data	No data	No data	No data	No data	60

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Table 6-10 LF03 (CMW-5) Groundwater Field Measurements 1997-2004

Parameter/Analyte	Units	CMW-5 Sampling Results					
		July-96	*Sept-97*	*Oct-99*	*Sept-00*	*Oct-03*	*June-04*
Depth to Water	Feet BTOC					4.81	4.95
Temperature	°C	5.0	2.2	3.0	3.2	1.2	3.3
PH		5.7	6.2	8.3	5.66	5.31	6.75
Conductivity	Sm/cm^2	0.08	0.036	0.07	6.2	0.079	40
Dissolved Oxygen	mg/L	3.2	3.24	12.0	8.45	0.0	9.44
redox	MV	106	-177	51	145	413	290
Turbidity	NTU	478	340	15	137	31.0	Not measured
TDS	ppm	No data	No data	No data	No data	No data	20

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Table 6-11 LF03 (CMW-6) Groundwater Field Measurements 1997-2004

Parameter/Analyte	Units	CMW-6 Sampling Results					
		July-96	*Sept-97*	*Oct-99*	*Sept-00*	*Oct-03*	*June-04*
Depth to Water	Feet BTOC					8.34	13.01
Temperature	°C	2.0	0.8	2.0	1.13	2	2.2
PH		6.6	6.40	8.7	5.57	5.86	7.07
Conductivity	Sm/cm^2	0.03	0.027	0.03	4.3	0.045	40
Dissolved Oxygen	mg/L	7.1	11.9	11.9	12.66	5.58	12.5
redox	MV	142	-128	52	279	300	349
Turbidity	NTU	78	1000	99	571	8.8	Not measured
TDS	ppm	No data	No data	No data	No data	No data	20

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

Table 6-12 LF03 (CMW-7) Groundwater Field Measurements 1997-2004

Parameter/Analyte	Units	CMW-7 Sampling Results					
		July-96	*Sept-97*	*Oct-99*	*Sept-00*	*Oct-03*	*June-04*
Depth to Water	Feet BTOC					8.23	11.65
Temperature	°C	3.0	0.3	2.0	1.34	1.9	5.10
PH		6.1	6.15	10.1	5.78	5.56	7.50
Conductivity	Sm/cm^2	0.82	0.125	0.06	5.9	0.067	140
Dissolved Oxygen	mg/L	5.0	7.6	11.4	10.85	5.59	13.29
redox	MV	-49	109	94	272	419	280
Turbidity	NTU	1000	708	99	566	280	Not measured
TDS	ppm	No data	No data	No data	No data	No data	70

Definitions:
°C = degrees Celsius
BTOC = below top of casing
mg/L = milligrams per Liter
mV = millivolts
NTU = Nessler turbidity units
ppm = parts per million
Sm/cm^2 = milliseimens per centimeter squared
TDS = Total Dissolved Solids

7 CONCLUSIONS AND RECOMMENDATIONS

This section provides the conclusions and recommendations of the 2004 Cape Romanzof LRRS Environmental Monitoring study.

7.1 SS13 Diesel Seep Area

7.1.1 Groundwater

7.1.1.1 2004 Exceedances of Preliminary RAOs

As showed in Table 5-2, there were no analytes detected above preliminary RAOs in 2004 groundwater samples from SS13 monitoring wells (MW-01, MW-02, and MW-03).

7.1.1.2 Natural Attenuation Analysis

Tables 5-3 and 5-4 present the historical contaminant chemistry at MW-01 and MW-02. Since there are only data from 1 year (2004) for MW-03, the results from this well were not used to evaluate whether the groundwater plume is stable or shrinking.

The primary line of evidence for natural attenuation in groundwater, a stable to shrinking groundwater plume, can be inferred from the data collected at this site. At MW-01, DRO decreased from around 2.5 mg/L in 1997 and 1999 to about 2 mg/L in 2000 and 2003, and to 0.175 mg/L in 2004. RRO also decreased from 0.628 mg/L in 1997 to 0.393 mg/L in 2004. Other than xylenes, BTEX compounds remain at or below detection limits. The trend in xylenes is complicated by an increase to 2.9 mg/L in 2000 followed by a decrease to nondetect in 2004. At MW-02, GRO remains near or below the detection limit, DRO has decreased from above 0.2 mg/L before 1999 to around 0.1 mg/L since 2003, and BTEX compounds remain at or below detection limits.

A secondary line of evidence for natural attenuation in groundwater is consumption of electron acceptors (oxygen, nitrate, sulfate); production of dissolved ferrous iron; and lower redox potential in areas with more petroleum hydrocarbons (Tables 6-2 to 6-4). It is very difficult to look at these data and conclude that secondary evidence for biological degradation of petroleum hydrocarbons exists. From 1997 to 2000, dissolved oxygen (DO) levels at the more contaminated well (MW-01) were lower than at MW-02. However, in later years, this same correlation does not exist. Comparing MW-01 to MW-02 (or earlier, more contaminated years with later, less contaminated years) does not yield a clear conclusion that ferrous iron is higher or nitrate and sulfate are lower where contamination is higher.

Other measurements were made to determine whether aquifer conditions are generally hospitable to biologic activity in this aquifer. The water at SS13 is cold, generally between 1° C and 3° C. These temperatures will slow, although not prevent, biologic processes. Except for the measurements made in 1997, the water has also been acidic, with pH ranging from 4.8 to 5.7. A pH below 6 is not optimal for biodegradation.

In summary, although the primary line of evidence suggests that natural attenuation is acting to keep hydrocarbon levels in groundwater at this site stable or declining, the secondary evidence for natural attenuation is weak. In addition, aquifer conditions are not optimal for biologic degradation of hydrocarbons.

7.1.2 Near-surface Soils

Figure 5-1 shows the locations of the three near-surface soil samples collected at this site in 2004; Tables 5-12 to 5-15 list the analytical data collected at these sites from 1997 to the present.

7.1.2.1 2004 Exceedances of Preliminary RAOs

As shown in Table 5-12, DRO and RRO were detected above preliminary RAOs in 2004 in SS13 near-surface soil samples collected from locations LB03, LB07, and LB08. DRO was detected at 411 mg/kg (LB03), 4,390 mg/kg (LB07), and 48,500 (LB08), versus the preliminary RAO for 250 mg/kg. RRO was detected at 51,600 mg/kg (LB08), versus the preliminary RAO of 10,000 mg/kg.

7.1.2.2 Summary of SS13 Historical Soil Contamination

DRO levels in surface soil have generally been above, and some times substantially above, preliminary RAOs at SS-13. RRO levels are also elevated and generally, above preliminary RAOs at LB-08, but generally below preliminary RAOs at LB03 and LB07. GRO, BTEX, and PAH levels are below preliminary RAOs.

MW-01 was installed at the south edge of the spill (Figure 5-1) in 1997 (USAF, 1998). The boring log for this well shows increasing DRO with depth: 798 mg/kg at about 2.5 to 4.5 feet belowground surface (bgs) and 2,100 mg/kg at about 5 to 7 feet bgs. Field screening readings, using an Organic Vapor Monitor (OVM) and a Handby test kit (which measures TPH), showed low levels at 0 to 2 feet bgs, slightly higher levels at 2.5 to 4.5 feet bgs, much higher levels at 5 to 7 and 7.5 to 9.5 feet bgs, and then low and decreasing levels with depth below the water table (about 10 feet bgs).

Combining all these data, it appears that the spill ran over ground and left what is still contaminated material near the surface over a wide area. The spill percolated into the water table in some areas and left contamination that has been and may still be above RAOs.

7.1.3 Sediments

Figure 5-1 shows the locations of the three sediment samples collected at this site in 2004; Tables 5-9 to 5-11 list the analytical data collected at these sites from 1997 to the present.

7.1.3.1 2004 Exceedances of Preliminary RAOs

As shown in Tables 5-9 and 5-9a, xylenes and fluorine were detected above preliminary RAOs in the 2004 sediment sample obtained from location SS01 at SS13. Xylenes were detected at 0.0569 mg/kg (0.0837 mg/kg in a duplicate sample), versus the preliminary RAO of 0.025 mg/kg. Fluorene was detected at 0.0323 mg/kg (0.0306 mg/kg in a duplicate sample), versus the preliminary RAO of 0.01 mg/kg.

7.1.3.2 Summary of SS13 Historical Sediment Impact

Petroleum hydrocarbons are present at both sediment sample locations, at levels that exceed preliminary RAOs for some PAH compounds. This is not surprising considering that 2004 DRO levels are also elevated at about 1,000 to 1,600 mg/kg. Indeed, in the past, DRO levels have been as high as 55,800 mg/kg at SS01 and 4,300 mg/kg at SS-06.

7.1.4 Surface water

Figure 5-1 shows the locations of the three surface water samples collected at this site in 2004. Tables 5-5 to 5-8 list the analytical data collected at these sites from 1997 to the present.

7.1.4.1 2004 Exceedances of Preliminary RAOs

As shown in Table 5-2, there were no analytes detected above preliminary RAOs in 2004 surface water samples obtained from SS13.

7.1.4.2 Historical Surface Water Contamination

Petroleum hydrocarbons in surface water at SS13 have been quite low since monitoring began at this site and have never above preliminary RAOs.

7.1.5 SS13 Recommendations

The following is a bulleted list of recommendations:

- Groundwater, soil, sediment, and surface water monitoring should continue. Additional data will allow continued evaluation of MNA processes at this site. However, PAH analyses should be removed from the analytical suite for all sample matrices, and GRO, DRO, and RRO parameters should be removed from the sediment and surface water sample suites.
- The surface water sampling locations should be reconsidered, or additional sample locations should be used. All three of the current samples come from closely spaced locations along Fowler Creek, south of this site (Figure 5-1), and no sample locations assess the ephemeral drainage that runs through SS-01 and SS-06. Water quality should be monitored closer to the spill zone, preferably at one of the sediment sampling locations or, if no water is present at SS-01 or SS-06, at the pond. The least useful of the current sample locations is SW-02, so this sampling location should be the first to be abandoned in favor of a surface water sampling location closer to the spill.
- Sediment samples should be taken along Fowler Creek, at the same locations that surface water samples are collected. Some contaminants are soluble and are therefore more likely to be in surface water, and some contaminants are insoluble and thus are more likely to be in sediments. It is better to collect a surface water/sediment pair at any location where one wants to measure migration through surface water drainages.
- All three wells should be surveyed, and an accurate water table map should be created using data obtained from this site combined with any information obtained from water elevations at nearby sites. The new monitoring well has not been surveyed, and monitoring well elevations do not remain static with time. For these reasons, monitoring well networks should be periodically resurveyed. Monitoring wells that cannot be redeveloped or repaired should be decommissioned and replaced with new wells.

- One upgradient monitoring well should be installed to measure electron acceptor concentrations in an uncontaminated area. Comparing the levels of these analytes to contaminated areas can yield important evidence for natural attenuation.

7.2 SS15 UST Spill Area

This section describes conclusions and recommendations for groundwater at SS15.

7.2.1 Groundwater

7.2.1.1 2004 Exceedances of Preliminary RAOs

As shown in Table 5-17 and 5-17a, GRO, DRO, benzene, and benzo(a)pyrene were detected above preliminary RAOs in the 2004 groundwater sample obtained from well WW-02 at SS15. GRO was detected at 9.38 mg/L, versus the preliminary RAO of 1.3 mg/L. DRO was detected at 387 mg/L, versus the preliminary RAO of 0.005 mg/L. Benzene was detected at 0.311 mg/L, versus the preliminary RAO of 0.005 mg/L. Benzo(a)pyrene was detected at 0.000434 mg/L, versus the preliminary RAO of 0.0002 mg/L.

No analytes were detected above preliminary RAOs in the 2004 groundwater sample collected from well WW-08 at SS15. Due to dry conditions, no sample was collected from WW-07.

7.2.1.2 Natural Attenuation Analysis

Tables 5-17 and 5-20 present the historical contaminant chemistry at SS15 monitoring wells. Note that DRO, GRO, and benzene have been detected above preliminary RAOs at WW-07 and WW-08.

The primary line of evidence for natural attenuation in groundwater, a stable to shrinking groundwater plume, can be inferred from the data collected at this site. At WW-02, DRO and GRO decreased from about 400 and 8 mg/L, respectively, in 1997, to about 3 and 4 mg/L, respectively, in 2000, and then increased back to about 400 and 8 mg/L, respectively, in 2004. The high DRO and GRO numbers are probably more indicative of dissolved concentrations. At WW-02, benzene levels show a consistent decline, and other BTEX compounds show a stable and declining trend in BTEX concentrations. At WW-07, the period of record is so short (1997 to 2000), and the contaminant levels are so low, that no clear pattern can be inferred. At WW-08, the trend in DRO and RRO appears to be stable, and the other analytes have no trend because the concentrations are so low.

A secondary line of evidence for natural attenuation in groundwater is consumption of electron acceptors (oxygen, nitrate, sulfate); production of dissolved ferrous iron; and lower redox potential in areas with more petroleum hydrocarbons (Tables 6-2 to 6-4). It is very difficult to look at these data and conclude that secondary evidence for biological degradation of petroleum hydrocarbons exists. No clear pattern of lower DO, nitrate, and sulfate, or higher ferrous iron, at the more contaminated well (WW-02) exists compared to less-contaminated wells (WW-07 and WW-08).

Other measurements were made to determine whether aquifer conditions are generally hospitable to biologic activity in this aquifer. The water at SS15 is cold, generally between 1° C and 6° C.

These temperatures will slow, although not prevent, biologic processes. Except for the measurements made in 1999 (some of which are suspect), the water at WW-02 has been neutral, and the water at WW-07 and WW-08 has been acidic. The pH value observed at WW-07 and WW-08 are not optimal for biodegradation.

In summary, although the primary line of evidence suggests that natural attenuation is acting to keep hydrocarbon levels at this site stable or declining, the secondary evidence for natural attenuation is weak. In addition, aquifer conditions are not optimal for biologic degradation of hydrocarbons.

7.2.2 Borehole for WW-09

Figure 5-2 shows the location of the borehole drilled for WW-09; Table 5-21 lists the analytical data collected from this borehole soil sample.

7.2.2.1 2004 Exceedances of Preliminary RAOs

As shown in Table 5-21, DRO was detected above the preliminary RAO in all soil samples collected from borehole WW-09. DRO was detected at 8,010 mg/kg between 5.2 and 7.2 feet bgs (5,460 mg/kg in a duplicate sample), at 740 mg/kg between 7.5 and 9.5 feet bgs, and at 856 mg/kg between 10 and 12 feet bgs, versus the preliminary RAO of 250 mg/kg. No other analytes were detected above preliminary RAOs in the WW-09 borehole samples.

7.2.3 SS15 Recommendations

- Groundwater, soil, sediment, and surface water monitoring should continue. Additional data will allow continued evaluation of MNA processes at this site. However, for well WW-02, PAH and RRO analyses should be removed from the sample suite.
- A statistical analysis of groundwater concentration trends should be made with the next data set collected at this site. These tests should be nonparametric (e.g., Mann-Kendall).
- All wells should be surveyed, and an accurate water table map should be created using data from this site combined with any information from water elevations at nearby sites.
- One upgradient monitoring point should be installed to measure electron acceptor concentrations in an uncontaminated area.

7.3 LF03 Landfill No. 2

This sections presents conclusions and recommendations for LF03.

7.3.1 Groundwater

This section discusses conclusions and recommendations for groundwater at LF03.

7.3.1.1 2004 Exceedances of Preliminary RAOs

As shown in Table 5-22 and 5-22a, there were no analytes detected above preliminary RAOs in 2004 groundwater samples from LF03 monitoring wells MW-1, CMW-1, CMW-2, CMW-3, CMW-4, CMW-5, CMW-6, and CMW-7. No sample was collected from MW-2 because it was dry.

7.3.1.2 Natural Attenuation Analysis

Tables 5-22 and 5-30 present the historical contaminant chemistry at LF03 monitoring wells. Note that all analytes have been below RAOs over the entire period of record.

The primary line of evidence for natural attenuation in groundwater, a stable to shrinking groundwater plume, can be inferred from the data collected at this site. An apparently declining DRO concentration trend has been observed at CMW-1, CMW-2, CMW-4, CMW-5, and CMW-7. The DRO concentrations at MW-1, CMW-3, and CMW-6 have been too low to discern any trend. The concentrations of all other analytes have been too low to discern a trend.

A secondary line of evidence for natural attenuation in groundwater is consumption of electron acceptors (oxygen, nitrate, sulfate); production of dissolved ferrous iron; and lower redox potential in areas with more petroleum hydrocarbons (Tables 6-10 to 6-16). The only parameter measured that could provide secondary evidence for natural attenuation is DO, but no clear relationship can be inferred between elevated petroleum hydrocarbon levels and depressed DO from these data. DO was high (near saturation) at MW-1, CMW-1, CMW-6, and CMW-7, and these wells had low DRO levels. DO was somewhat depressed to about 5 mg/L at CMW-3 and CMW-4 and about 9 mg/L at CMW-5. CMW-4 did have the highest DRO levels, but CMW-3 and CMW-5 did not have high DRO levels. The lack of a clear relationship between DO and petroleum hydrocarbon levels is probably due to the lack of significant petroleum hydrocarbon contamination at this site. Naturally occurring carbon compounds are probably a more important oxygen sink at this site.

Other measurements were made to determine whether aquifer conditions are generally hospitable to biologic activity in this aquifer. The water at this site is cold, generally between 2° C and 7° C. These temperatures will slow, although not prevent, biologic processes. Except for the measurements made in 1999 (some of which are suspect), the water at this site has been neutral to slightly acidic, and optimal or nearly optimal for biodegradation.

In summary, although the primary line of evidence suggests that natural attenuation is acting to keep hydrocarbon levels at this site stable or declining, the secondary evidence for natural attenuation does not exist. In addition, aquifer conditions are hospitable for biologic degradation of hydrocarbons.

7.3.2 Surface Water and Sediments at Seeps

Figure 5-3 shows the locations of surface water sampling; Tables 5-31 to 5-34 list the analytical data collected from these locations.

7.3.2.1 2004 Exceedances of Preliminary RAOs

As shown in Table 5-31 and 5-31a, PCBs were detected above preliminary RAOs in the 2004 surface water sample from SW-2. PCBs were detected at 0.0797 mg/L, versus the preliminary RAO of 0.000014 mg/L. No other analytes were detected above preliminary surface water RAOs in SW-1, SW-2, or SW-3. The presence of an observable sheen at SW-2 and SW-3 does constitute an exceedance of preliminary RAOs for petroleum hydrocarbons.

As shown in Table 5-35 and 5-35a, PCBs were also detected in sediments above preliminary RAOs in the 2004 at sample collect at location SD-2. PCBs were detected at 153 mg/L, versus a preliminary RAO of 0.0341 mg/kg. In addition, xylenes were detected above their preliminary RAO of 0.025 mg/kg in the sediment samples collected at SD-1 (0.0918 mg/kg), SD-2 (0.0389 mg/kg), and SD-3 (0.0469 mg/kg). No other analytes were detected in sediments above preliminary RAOs at locations SD-1, SD-2, and SD-3.

7.3.2.2 Historical Surface Water and Sediment Contaminant Analysis

At SW-1 and SW-3, all analyte concentrations have been below preliminary RAOs. At SW-2, PCB levels have exceeded preliminary RAOs, and TAH levels are at the preliminary RAO (calculated concentrations from BTEX and PAH concentrations). No clear concentration trends can be observed.

Figure 5-3 shows the locations of sediment samples, and Tables 5-31 to 5-34 list the analytical data collected from these locations.

Location SD-2 had the highest contaminant levels with PCBs above preliminary RAOs currently and each year measured in the past. SD-2 also had higher petroleum hydrocarbon levels than the other sediment samples, but they were below preliminary RAOs. At SD-1, PCBs have been above preliminary RAOs in the past but were not detected during 2004. SD-3 has consistently had the lowest petroleum hydrocarbon levels and no PCB detections.

Taken together, these data suggest that seeps emanating from this landfill have petroleum hydrocarbon contamination, and some have PCB contamination above preliminary RAOs. Samples collected from Seep No. 2 have the highest contaminant concentrations of the three seep areas at the landfill. The worst seepage site is Seep 2. No clear decreasing trends in PCB levels could be observed at this location.

7.3.3 LF03 Recommendations

- Groundwater, soil, sediment, and surface water monitoring should continue. Additional data will allow continued evaluation of MNA processes at this site.
- A statistical analysis of groundwater concentration trends should be made with the next data set collected at this site. These tests should be nonparametric (e.g., Mann-Kendall).
- All wells should be surveyed, and an accurate water table map should be created using data from this site combined with any information from water elevations at nearby sites.
- Petroleum hydrocarbon levels are so low that no recommendation can be made to monitor for additional electron acceptors. Such monitoring is unlikely to show any clear patterns between contamination and electron acceptor levels.

7.4 LF03 (Landfill No. 2) Cap Inspection and Repair Recommendations

As part of LTM activities at LF03, the field crew visually inspected the entire extent of the landfill cap and documented its condition in field notes, site sketches, and photographs (Appendix A).

7.4.1 Inspection Results

Three seeps appear to be flowing out of the capped landfill area. During the June 2004 field inspection, the landfill liner was exposed in several places around the top of the landfill and at the toe area. Although exposed in several places, there were no rips or tears observed in the liner. During a second inspection of the landfill in August 2004, the field team observed that a layer of soil from a decommissioned biocell had been added to the top of the landfill by the 611 CES. The added soil did cover previously observed exposed liner at the top of the landfill, but the liner was still exposed at areas near the toe of the landfill.

During the inspections, the field team observed various amounts of nonhazardous waste such as metal scrap and assorted household waste in the region downhill of the landfill toe area (Photographs 19 and 20, Appendix A). This area was beyond the intended area of the landfill surface cap.

The landfill cap appears to be intact, and no direct precipitation is likely entering the landfill through the cap. However, the three seeps noted during the investigation indicate that water is still entering (and exiting) the landfill area.

Water is likely entering the landfill via subsurface routes. While the landfill is covered with an impermeable cap, it is possible that there is no liner below or aquitard upgradient of the landfill. The entire area surrounding LF03 is composed of boulders and talus slopes and easily supports migration of water. It is likely that water is flowing through the talus and can enter the landfill by traveling under the road, upgradient of the landfill. In periods of higher groundwater regimes, water could also enter the landfill from below.

7.4.2 Recommendations

As evidenced by the three seeps emerging from the toe of the landfill, water is still entering the landfill, despite the landfill cap. Future efforts to prevent water from entering the landfill is recommended, although they may not involve repair of the surface cap.

It is recommended that, at the least, all exposed areas of the landfill's surface liner be covered with a soil having a minimum thickness of 24 inches, which should then be graded to promote drainage, and revegetated to minimize erosion. This should be done with minimal disturbance of the area beyond the lower boundaries of the landfill cap to avoid spreading PCB impacted soil.

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APPENDICES

A Field Site Photographs

B Daily Status Reports and Project Field Notes

C Groundwater Sampling Log Sheets

D Qualtiy Assurance Report

E Summary Analytical Data Tables

F Complete Analytical Data Package

Appendix A

Field Site Photographs

Above: Lower Camp overview. Photograph taken from road to Upper Camp, looking west.

Above: SS13 sampling site LB-03. Photograph taken facing northwest. Lower Camp in background.

Above: SS13 groundwater well MW-01 and SS13 soil sampling sites LB-08 and LB-07. Photograph taken facing east.

Selected Photographs – Sites SS13, SS15, and LF03
2004 Environmental Monitoring Report
Cape Romanzof LRRS, AK

Figure
A-1

Date
March 2005

Project No
4112.004

Above: SS13 sampling site SS-01. Photograph taken looking northeast. Water transmission line in background.

Above: SS13 sampling site SW-01.

Left: SS13 sampling site SW-02. Photograph taken looking west.

Selected Photographs – Sites SS13, SS15, and LF03
2004 Environmental Monitoring Report
Cape Romanzof LRRS, AK

Figure
A-2

Date:
March 2005

Project No.
4112.004

Left: SS13 sampling site SS-06. Photograph taken looking west.

Below: SS13 sampling site SW-02. Photograph taken looking east.

Below: SS13 samplling site SW-01 (in foreground) and SW-02 (in background). Photograph taken looking east towards reservoir.

Selected Photographs – Sites SS13, SS15, and LF03
2004 Environmental Monitoring Report
Cape Romanzof LRRS, AK

Figure
A-3

Date:
March 2005

Project No.
4112.004

Above: SS15 well WW-08. This well had been mismarked as WW-09 in previous reports, but is clearly labeled WW-08 (see inset). Photograph taken looking southwest.

Above: SS15 well WW-02.

Left: SS15 well WW-07. Photograph taken looking southwest.

Selected Photographs – Sites SS13, SS15, and LF03
2004 Environmental Monitoring Report
Cape Romanzof LRRS, AK

Figure
A-4

Date
March 2005

Project No.
4112.004

Above: LF03 wells CMW-6 and CMW-7. Photograph taken looking northwest.

Above: LF03 well MW-01.

Left: LF03 well CMW-2. Photograph taken looking north. ATV parked on top of landfill for scale.

	Selected Photographs – Sites SS13, SS15, and LF03 2004 Environmental Monitoring Report Cape Romanzof LRRS, AK	Figure **A-5**	Date March 2005 Project No. 4112.004

Appendix B

Daily Status Reports and Project Field Notes

Page 1 of 1

Figure A-7

Daily Activity Summary

Project #: 4112

Date: ~~6/8/04~~ BT 6/7/04 (MON)

Location: Cape Romanzof

Site: SS15/SS13

Daily Activity Summary:

0500 → 1030 Teresa OCaroll (TEO), Matt Carnahan (MJC), and Brandie Theisen (BAT) mob from Anchorage (ANC) to Cape Romanzof (CR)

10^{30} → 12^{30} Orientation @ CR, Lunch (TEO off job 12^{30})

12^{30} → 12^{45} BAT, MJC mob for water level measurements on SS13, SS15

13^{45} → 15^{45} Water levels on SS13/SS15. Most wells found to be dry. Only ~~MW~~ BT WW-02, WW-07 had water. All wells had 3/4" ~~well~~ waterra tubing in them. WW-02 smelly, but no product detected.

16^{00} – 16^{30} Set up computer / office space

19^{00} – 19^{30} Recon DP-11 site visually from road

6/8/04

Field Team Leader Date

6/8/04

Reviewer/Project Manager Date

PLANES IN:
1 CARAVAN (1 SKYVAN + 1 207)
1 207 (Shared w/ ATT)
~20 coolers

PLANES OUT:
CARAVAN
207

COOLERS OUT:
0

144 109

Page 1 of ____

Figure A-7

Daily Activity Summary

Project #: 4112

Date: 6/8/04 (TUES)

Location: Cape Romanzof, AK

Site: SS15/SS13

Daily Activity Summary:

0800-1000 TEO, MJC, BAT hold H&S meeting, discuss field work plans

1000-1200 BAT, MJC mob up for sampling SS13/SS15

1230-1600 MJC begins purging ~~M~~ WW02. - bails dry. BAT, TEO cannot locate WW-9, but find WW-08 instead. Group discovers that interior tubing of wells is a Waterra inertial pump system. Pull out tubing from inside of wells @ WW-02 and MW-01. All other tubing is either below reach or stuck in well.

1600-1700 BAT, MJC mob to sample SW @ SS13

1800-1830 Miscellaneous work

1840 Sample WW-02 (04SS15WW02GW)

1900-2000 Scope out SW sampling locations - not ~~the~~ as depicted on map.

Try to purge more H2O from WW-07. dry.

2100 Done for day.

6/8/04

Field Team Leader

Date

6/8/04

Reviewer/Project Manager

Date

PLANES IN: 0

PLANES OUT: 0

COOLERS OUT: 0

Page 1 of 1

Figure A-7

Daily Activity Summary

Project #: 4112
Date: 6/9/04 (WED)
Location: Cape Romanzof
Site: SS13

Daily Activity Summary:

0800-1000 Pack ~~soil samples~~ water sample (BT) from ~~SS13~~ SS15 (BT) (BT, MC) TEO @ Res. Dave dealing w/paperwork
1000-1200 Take Soil/Sediment Samples from SS13
1029 Sample 04SS13LB08SS
1030 Sample 04SS13SS01SD *
1037 Sample 04SS13LB07SS
1043 Sample 04SS13LB03SS
1050 Sample 04SS13SS06SD (ms/msd) + duplicate 04SS13SS101SD

Note: Tried to pump MW-07 DRY!

1230 Pack soil samples for shipment
1330-1700 ~~Soil Sampling~~ (BT). Surface Water Sampling @ SS13 (BT, MC)
1500 Sample 04SS13SW03SW
1530 Sample 04SS13SW02SW
1545 Sample 04SS13SW01SW (ms/msd) + dup 04SS13SW101SW
1700-1900 Prep SW samples for shipment / paperwork

Field Team Leader: 6/9/04 (Date)
Reviewer/Project Manager: 6/7/04 (Date)

Planes/People/Gear IN
2 Drillers (mail rm)
Lynden Herc
Skyvan (~2000 #)
1 Box + 2 PIDs on mail rm

Planes Out
Lynden Herc
Skyvan

Cooler Out
SS15 GW
SS13 Soil + Sed
} forgot to name coolers

Page 2 of 2

Figure A-7

Daily Activity Summary

Project #: 4112
Date: 6/11/2004

Location: Cape Romanzof
Site: LF03

Field TEAM 2 (MJC, TEO)

Daily Activity Summary:

0730 - 1200 inspected landfill and cap at LF03. Laid out grid for screening samples around SD2 and collected screening samples
1200 - ~~0230~~ 1430 began screening samples collected @ LF03. Mechanical failure of analyzer (RRA-1) prevented actual analysis but extraction of first 21 samples is completed.
~~0230~~ 1430 - ~~0500~~ 1700 - prepared sample kits for sediment and surface water samples to be collected at SS09 and LF03.
1730 - 1845 took water level measurements at LF03 (see field book).

6/13/04
Field Team Leader
Date

6-14-04
Reviewer/Project Manager
Date

6/14/04

Page 2 of 2

Figure A-7

Daily Activity Summary

Project #: 4112 Date: 6-13-2004

Location: Cape Romanzof Site: LF03

team 2: MattC. and TEO

Daily Activity Summary: (

0630-1100 moved supplies to LF03 and finished paperwork.

0130-2030 collect SW, sediment, and groundwater samples at LF03

2030-2200 prepare samples for shipment. The following samples were collected for DRO, BTEX, PCBs, PAHs

1205 04LF03SW03SW

1210 04 LF03 SD 03 SD

1230 04 LF03 MW01 ~~AW~~ GW TEO & extra volume MS/MSD

1445 04 LF03 SW01SW & 04LF03SW101SW

1500 04LF03SD01SD

1630 04LF03CMW6GW & 04LF03CMW106GW

1800 04LF03CMW4GW

1935 04 LF03 SW02SW

1945 04LF03SD02SD

2005 04 LF03 CMW5GW

MC

6-14-04 6-14-04

Field Team Leader Date Reviewer/Project Manager Date

Page 2 of 2

Figure A-7

Daily Activity Summary

Project #: 412 Date: 6/14/04

Location: Cape Romanzof Site: LF03

Field Team 2: Matt C.

Daily Activity Summary:

0630 → ~~X~~ 1430 Pack samples for LF03

1430 → 1930 PCB Screening Samples

for grid established at LF03

6-14-04 6-26-04

Field Team Leader Date Reviewer/Project Manager Date

6/14/04

Page 1 of 1

Figure A-7

Daily Activity Summary

Project #: 4112
Date: 6/22/04
Location: Cape Romanzof
Site: DP11 / SS13

Daily Activity Summary:

0700 → 1700 CW, BT DESCEND TO
DP11, TAKE SW-1 → SW-3 SAMPLES
1700 → 2100 MJC @ TOP - SAFETY
PACK SAMPLES
1700 → 2100 OW, MJC DIP WELLS
SS13 / SS15 - MW-1 HAD WATER
(PREVIOUSLY DRY). SAMPLED WELL
AND PLACED LOCKS ON ALL WELLS.
(BT DOES PAPERWORK, ORGANIZES
GEAR, PACKS SAMPLES)

SAMPLES COLLECTED:

DP-11 {
SW-1 @ 1030
SW-2 @ 1200
SW-3 @ 1130
}
MW-1 (SS13) @ 2000

	6/22/04		6-26-04
Field Team Leader	Date	Reviewer/Project Manager	Date

Page 1 of 1

Figure A-7

Daily Activity Summary

Project #: 4112
Date: 6/23/04
Location: Cape Romanzof
Site: LF03, DP11

Daily Activity Summary:

0700 → 1400 Mob for DP-11 SW Sampling
Send drillers stuff (ATV, trailer
Bentonite, ~~out~~) out, 8 coolers
Break ATV Attempt to repair

(Dipped LF03 "dry" wells)

1400 → 2300 Sample SW in 1st basin of DP11,
prep samples for shipment

Samples taken:

1500	SS-7
1530	SS-5
1600	SW-5, SD-5
1700	SW-6, SD-6
1800	SW-4, SD-4
1845	SS-6
1930	SS-4

10-18-04

Field Team Leader Date Reviewer/Project Manager Date

planes in
1 caravan

planes out
1 caravan
(Drillers ATV, trailer, Bent)

coolers out
8

Page 1 of 1

Figure A-7

Daily Activity Summary

Project #: 4112 Date: 6/23/04

Location: Cape Romanzof Site: DP11, LF03

Daily Activity Summary:

0700-0800 Mob for DP11 sampling

0800-0900 Load gear for Caravan Flight.

0900-1000 supervise/load plane - out drillers ~~to~~ ATV & trailer, bentonite, sample jars

10-1200 Dip Landfill wells (previously dry), pack

1200-1400 ATV woes - try to fix

1400-2200 DP-11 sampling, packing of samples

2230 BT/MC Done for day. 2300 CW Done for day

Samples taken:

SW-4 @ 1800 (also SW-4)

SW-5 @ 1600 (also SD-5)

SW-6 @ 1700 (also SD-6)

SS-4 @ 1930

SS-5 @ 1530

SS-6 @ 1845

SS-7 @ 1500

Field Team Leader	Date	Reviewer/Project Manager	Date
			10-18-04

planes in
1 caravan

planes out
1 caravan
(Drillers ATV, trailer, bentonite.)

coolers out
8

Page 1 of 1

Figure A-7

Daily Activity Summary

Project #: 4112
Date: 6/29/04
Location: Cape Romanzof
Site: LF03, DP11

Daily Activity Summary:

0600 → 1200 Sample LF03 previously dry wells, prep samples for shipment, demob
~~1200 →~~ fix ATV.
1200 → 1700 Sample SS samples @ DP11
1700 → 2300 Prep samples for shipment, pack coolers for demob, pack office areas.

Samples taken:

1300 SS-8
1330 SS-9
1400 SS-10
1420 SS-11
1445 SS-12
1515 SS-13
1530 SS-14
1545 SS-15
1600 SS-16

	6/29/04		10-18-04
Field Team Leader	Date	Reviewer/Project Manager	Date

planes in 0

planes at 0

coolers at 0

Page 1 of 1

Figure A-7

Daily Activity Summary

Project #: 4112
Date: 10/25/04
Location: Cape Romanzof
Site: DP-11, LF03

Daily Activity Summary:

0700 ↓ 10³⁰ Pack personal gear, re-ice sample coolers, tape up st coolers, action packers, leave stuff in cold storage, arange bills.

10³⁰ ↓ 0600 Travel to Anchorage (CW, MC done for day)

0730 BT done for day

10/28/04 — Field Team Leader — Date

Elliott 10-28-04 — Reviewer/Project Manager — Date

planes out
1 caravan

planes in
1 caravan
3 folks + gear

coolers at
5

Page 1 of 2

Figure A-7

Daily Activity Summary

Project #: 4112

Date: 8/30/04

Location: Cape Romanzof, AK

Site: ST09/SS14/LF05/SS13/SS15

Daily Activity Summary:

0430 BT (Brandee Theisen) & MC (Matt Carnahan), both of Paug-Vik
Arrive @ Airport
0600 ANCHORAGE to Bethel
0900 Bethel to Cape Romanzof
1030 Arrive @ Cape Romanzof, check in
1100 Measure water levels in wells that were dry in June
BNCi Well (no name) DTW: DRY
BNCi Well (MW-3) DTW: 9.36' TD: 23.02'
WW-07 DTW: 7.42' TD: 12.03'* — measu[illegible] inside [illegible] tubing
WW-08 DTW: 10.10' TD: 25.62'
MW-02 DTW: 4.06' TD: 12.04'
1145 Get 4-wheeler, equip out of cold storage
1200 Break
1230 BT organizes, does paperwork
1300 Meet with Roger (Arctec) to transport drums of
soil to airstrip, empty supersacks
1530 BT, MC meet w/ Don, station chief - give paperwork

8.30.04 10-18-04
Field Team Leader Date Reviewer/Project Manager Date

planes in:
1 207 w/ 2 people + gear

Page 2 of 2

Figure A-7

Daily Activity Summary

Project #: 4112

Date: 8/30/04

Location: CR

Site:

Daily Activity Summary: (continued)

for purge water, soil disposal

1630 Break

1730 MC purges 10 well volumes (20 gal) from BNCi well

BT tries, repeatedly, to remove inertial pump tubing from inside of MW-07, without success

1845 BT, MC dump purge water from MW-03 down shop drain

1915 Done for the day.

8.30.04

Field Team Leader

Date

10-18-04

Reviewer/Project Manager

Date

Page 1 of 3

Figure A-7

Daily Activity Summary

Project #: 4112 Date: 8/31/04

Location: Cape Romanzof, AK Site: SS13/SS15/LF03

Daily Activity Summary:

0800 BT calls ANC, calculates purge vol's, while
MC calibrates field probes
0845 Mob up for SS13/SS15 sampling
0930 Begin sampling MW-3
1000 Sample MW-3 @ SS13 ~~(04MW03G~~ BT
(04SS13MW03GW) (see sampling sheet)
1100 Try to sample WW-08 w/ bailer
Bailer gets stuck @ ~6' BTOC
When pulled out, bailer end is
full of bentonite, indicating
possible rupture of casing or cracked/
broken casing ~6' btoc.
1130 Move to MW-2
1200 Sample MW-2 ~~(04MW1~~ BT
(04SS13MW02GW)
Sample was EXTREMELY TURBID
and well monument/casing in very poor condition

8-31-04 10-18-04

Field Team Leader Date Reviewer/Project Manager Date

Page 2 of 3

Figure A-7

Daily Activity Summary

Project #: 4112
Date: 8/31/04
Location: CR
Site:

Daily Activity Summary: continued

casing is loose and monument ~~nearly non~~ [illegible]
is also loose. monument is not cemented
into place. no soil exists within 1' radius of
monument - instead, puddle water exists to
a depth of ~1' below normal ground elevation
While purging well, a gurgling sound water
heard inside the well - is this indicative
of a break in casing? Water was
extremely turbid (~10% or more sediment)
VOAs would not seal properly due to
sediment in vial threads

1210 Break for lunch

1300 Pack coolers for wells MW-2, MW-3.
Call TEO (teresa ocarroll) and discuss
progress. tell her mail plane is full of
611th/Arctec people! Call Greg Dubois,
BNCi, to report progress, double check analysis

Field Team Leader Date

10-18-04

Reviewer/Project Manager Date

Figure A-7

Daily Activity Summary

Project #: 4112 Date: 8/31/04

Location: CR Site:

Daily Activity Summary: continued

1330 MC checks well CMW-2
DTW: 8.71 TD: 9.51
1400 Mob to sample MW-07.
Well runs dry after purging ~1 gal
Let recharge ~10 min. Still dry.
Did not sample.
1500 Decon-ed tubing to sample MW-8.
(Didn't have enough tubing to sample two wells)
1530 Start purging MW-8
1600 Sample 04SS15MW08GW
1730 Sample Equipment rinse (04SS15ERGW)
(Rinse thru tubing after Decon procedure)
1800 MC samples 04LF03CMW2GW
1900 Prep for shipping off site
1930 Done for day

8.31.04 10-18-04

Field Team Leader Date Reviewer/Project Manager Date

Page 1 of 1

Figure A-7

Daily Activity Summary

Project #: 4112 Date: 9/1/04

Location: Cape Romanzof Site: —

Daily Activity Summary:

0800 Pack coolers, gear to demob

1000 Caravan lands, load drums gear

1030 207 lands, loads people

1100-1400 travel to Bethel (Delay due to weather)

1400 Ship gear to ANC/King Salmon via Lynden, Everetts, and AK Air

1530-1730 Travel to Anchorage

1800 Done for day.

9/2/04 10-18-04

Field Team Leader Date Reviewer/Project Manager Date

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SS13/SS15/LF03

Cape Romanzof LRRS
Environmental Services
6/7/04 →

4 5/8" x 7" - 48 Numbered Pages

Paug-Vik Development
810 N st, ste 201
Anc AK 99501
(907) 258-1345

2

3

6/7/04

~0500	Teresa O'carroll (TEO), Matt Carnahan (MJC), and Brandie Thesen (BAT) ~~arrive ANC airport~~ (All Paug-Vik Employees) arrive anchorage (ANC) airport
0600	Departure for Bethel
0725	Arrival in Bethel (BET)
0745	Contact Arctic Air – coordinate transfer of goods
0800	Arrive Artic Circle Air – do paperwork
0900	Depart BET for Cape Romanzof (CR)
1000	Arrive Romanzof in 207 and skyvan (cargo). Unload cargo
~10³⁰	Arrive lower camp at CR Watch orientation/safety video. Discuss logistics with site supervisors.
11¹⁵	Get settled into rooms avail. start organizing coolers
1200	Break for lunch.

6/07/04

1230 BAT, MJC organize field equipment. TEO to work on different project

1345 BAT, MJC mob up to do water levels/Recon @ SS13, SS15

1415 Begin water level recording SS15/SS13

~~SSA~~ (BT)

	Well	DTW	TD	Time	Comment
SS13	MW-01	-NONE-	26.5	1415	see note
	MW-02	5.9	casing Bent @ 6.0'	1425	1/2" tubing in 2" well
SS15	MW-08	-NONE-	Bent casing @ 26.5'	1430	1/2" tubing in 2" well
	MW-07	-NONE-	Bent casing @ 26.5'	1435	" "
	WW-02	63.36	69.15	1530	Smells like product — 4" well w/ 1/2 tubing
	DTP None.				

1430 PLANE (207) W/ REST OF GEAR ARRIVES - (SHARED PLANE W/ ATT)

1445 UNLOAD GEAR FROM TRUCK.

1500 SHORT BREAK TO WARM UP!

NOTE: MW-01 IS 2" WELL W/ 1/2" VINYL TUBING INSIDE. BENT CASING @ 26'
(ALL WELL SIMILAR IN DESIGN)

6/7/04

1515 Return to MW-2 w/ water/oil interface probe due to smelly nature of well. -
No product detected

1535 Return to shop area to decon instruments.

1600 Set up computer/printer inside residential dome

1630 Done for ~~day~~ (BT) afternoon.

1900 Recon DP-11 site from road

1930 Done for day.

6/8/04

0800 TEO, BAT, MJC have field meeting discussing work plan, F&S plan. Hold H&S Meeting - Radios, PPE, SS13/SS15 Hazards discussed

Present: BAT

MJC

TEO

0900 continue talking about project

1000 Mob up to sample ~~DP 11~~ SS13/SS15 (BT) (BT, MJC) (TEO off job)

1200 Break for lunch

1230 MJC to begin sampling (BT) ~~44~~ MW-02

BT, TEO walk ~~DP~~ (BT) SS13, SS15 sites to look @ wells.

MW-9 not found. MW-8 found in location where MW-9 is shown on map. Sampling debris (tubing) found next to well. Decided to sample MW-8 instead.

1300 MJC purges MW-02 dry. Sheen noted. TEO pulls out interior tubing ("waterra") from well.

Unsure why tubing is there, but it is easier to access water post-removal

1345 Called Waterra to find out what tubing could be used for (360) 738-3366

turns out tubing is "internal pump tubing" used to draw water into tube by up/down action of tube and check valve @ bottom (see www.waterra.com)

1400 ~~Checked re~~ (BT)

Attempted to sample rest of wells @ SS13, SS15

Only MW-07 had water - all other wells dry.

1500 Removed internal pump tubing from MW-~~02~~ 8 (BT) Still dry. Clay was dried @ end of tubing. Tubing could not be removed from other wells (MW-02, WW-8, WW-7) continued

6/8/04

due to stuck tubing (physically) or tubing too deep in well to Reach, even with pliers

1600 Get Ready to sample surface water/soils @ SS13.

1700 Break for dinner

1800 Store gel ice in freezer

1815 Out to sample SW/GW sample @ SS13/SS15

1840 Sample WW-02 (04SS14WW02GW)
for BTEX/GRO DRO/RRO PAH
Alkalinity, Fe, SO4, NO3, NO2

1900 Walk out to SW sites - cannot locate exact SW sampling sites - does not match map

2000 Try to purge more water from MW-07. Well is dry and has not recharged since 1400 today.

2030 Finish field work for the day. Talk to TEO about field results

2100 Finish for day

40s p-sunny 6/9/04

0800 BT, MJC Pack 1 cooler to ship to Anchorage (1 cooler - ~40 lbs)

1000 Mob to sample soil and sediment @ SS13 - Sample locations are not well marked. Remarked sample locations with PINK flags.

~~1050~~

1029 Sample 04SS13LB08SS (Surf Soil LB 05)
Submit Sample for
DRO/RRO/PAH/BTEX
MeOH Lot LS 0042-50-17

1030 Sample 04SS13SS01SD (Sediment SS01)
duplicate 04SS13SS101SD
Submit sample for
DRO/RRO/PAH/BTEX + 4
MeOH Lot LS 0042-50-17

1037 Sample 04SS13LB07SS (Surf Soil LB-08)
~~Samp~~ Submit samples for
DRO/RRO/PAH/BTEX
MeOH Lot LS 0042-50-17

1043 Sample 04SS13LB03SS (Surf Soil LB 03)
Submit sample for:
DRO/RRO/PAH/BTEX
MeOH Lot LS 0042-50-17

6/9/04 cont.

1050 ~~Sample 04SS130~~ BT
Sample 04SS13SS06SD (Sed SS-06)
Submit sample for
DRO/RRO/PAH/BTEX+4
Micah Lot LS0042-50-H
1120 Try to pump MW-07. Dry
1135 Return to Dome area.
Pack samples/paperwork
1200 Break for Lunch
NOTE: DRILLERS: Jeff and
Richard arrive on site this morning.
HERC also arrived & gear
unloaded.
1230 Pick up cooler full of soil samples
Ship to ANC on mail run
(1 cooler – 37 #)
1330 BT, MJC mob to sample SW
sites (again) at SS13
1500 Sample 04SS13SW03SW (SW-03)
Submit samples for BTEX+4 (TAH), DRO/RRO
and PAH (TAqH)
1530 Sample 04SS13SW02SW (SW-02)
Submit sample for BTEX+4 (TAH)
DRO/RRO & PAH (TAqH)

6/9/04 cont

1545 Sample 04SS13SW01SW (SW-01)
and duplicate 04SS13SW101SW
extra samples for MS/MSD
Sample analysis: DRO/RRO
BTEX+4 (TAH), PAH (TAqH)
1615 Finish sampling – prep
samples for early morning
shipment.
1700 Paperwork
1915 done w/ paperwork
1930 Done for day

6-10-04 Matt C.

0925 - Prepare samples for shipment to laboratory via arctic Circle Air.

0950 - Ship out samples

1100 - Reconoiter LF03. All wells located as well as surface water sites. Several pictures taken for inclusion in report. MC

6-11-04 LF03 Matt Carnahan

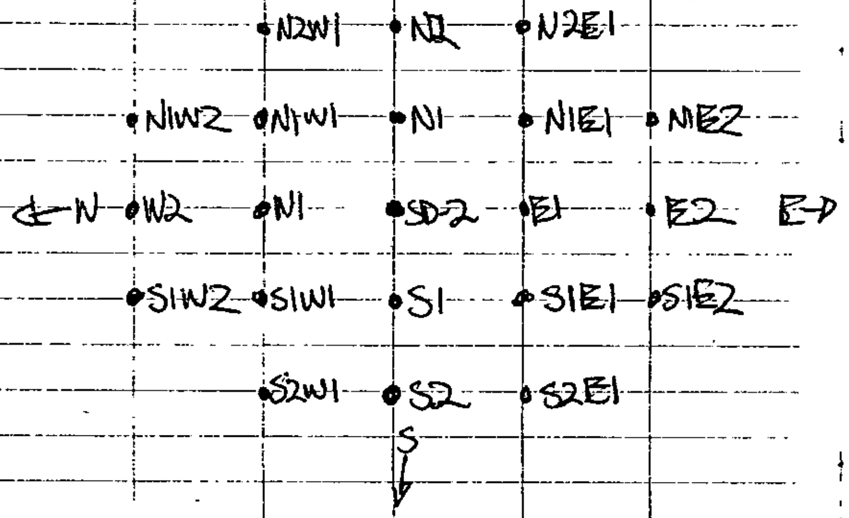
~~[illegible]~~ 0806 Begin Landfil inspection obvious staining east end of land fill. First area of staining at stream emminating from landfill. Stain is orange with an organic sheen. Second area between CMW-2 and CMW-3. Stain is orange without sheen. Pictures taken of both Areas

0825 - No Further Obvious stains on west or south end of landfill. Move to inspect hotspot for PCBs at SD-2

0858 - Grid established for screening samples at SD-2. All screening samples are along a N to S grid pattern at 10' intervals. Naming nomenclature is relative to SD-2 and is shown on the following pages. Water flow in the area is approximately North to South.

MC

6-11-04 LF03 Matt Carnahan



1220 - All screening samples collected according to above notation. RPA Analyser Power Cord broke where it connects to the instrument. Will contact SDI for technical scheme and attempt to repair on site. New power cord being routed through Anchorage IPC, MC

1459 Proceeding w/ sample extractions. Have diagram of plug from SDI and will repair this eve. MC

6-11-04 LF03 Matt Carnahan

1313 - Have finished extractions will proceed w/ TEO to LF03 to take water level measurements and make sure wells aren't dry.

1433 - Taken depth meas @ LF03. No progress yet w/ plug. Depths as follows

Well	DTW	TD	WC
MW-1	17.20'	20.00'	
CMW-1	9.51'	10.31'	
CMW-2	9.25	9.80	
CMW-3	8.85	9.37	
CMW-4	7.02	10.37	
CMW-5	4.95	10.35	
CMW-6	13.01	15.00	
CMW-7	13.69	14.10	

MC
6-11-04

6/12/2004 LF03 Matt Cavalan

0840 - searched for seep to Nulamut Creek from stream Feeding SD2. Seems to originate from NW crotch of landfill and proceed ≈100 m downslope under a boulder field (followed by sound of running water) before reaching a bench and going deep underground. Several seeps located allong Nulamut Creek as well as subsequent sediment deposits.

1000 Packing sample containers to return to LF03 and take Surface soil and screening samples simultaneously per TBD

1216 Have returned to LF03. Found site of obvious sedimentation at Nulamut Creek Downstream from LF03. GPS Coord. =
Elev: 384 m
N 61° 47' 27.4"
W 165° 59' 0.78"

6/12/2004 LF03 Matt Cavalan

Will begin w/ sample SS01 here waypoint 001

1236 Have Found stained sediment at the base of plane of LF03 and conjunction w Nulamut Ck. GPS Coord = Elev 355 m
N 61° 47' 27.9"
W 165° 59' ~~0.23~~02.3"
Will be SS02 and waypoint 002
me

1247 - piece of barrier located at SS02 while sample is taken. see photo

---

1252 - Have located seep from lanfil bluff to Nulamut Creek. Will collect Sample and Duplicate at this location in area of sediment concentration GPS coord. are:
Elev = 364 m
N 61° 47' 28.3"
W 165° 59' 00.6"
} SS03

1318 Have located another seep approximately 100m upstream from First. Will take SS04 here.

18

6-12-2004 LF03 Matt Carnahan

GPS Coordinates are:

Elev = 370m
N 61° 47' 28.3"
W 165° 58' 57.8"

Creek turns east from here towards lower camp. Will proceed onto bluff and towards SD-2.

1443 Have traced stream at SD-2 to underground to a spring that again returns below ground and emerges in Nulunet Cr. just South (app 5 m) of SS02. Will take samples on return trip MC

1454 Have collected SS05 where spring goes underground again. app. 40m N of N.L. Cr. GPS =

Elev. = 384m
N 61° 47' 28.4"
W 165° 58' 54.3"

1511 Have collected SS06 where spring emerges from the hillside
GPS is:

Elev = 377
N 61° 47' 29"
W 165° 59' 0.2"

19

6-12-2004 LF03 Matt Carnahan

1524 Have collected SS07. GPS coord are

Elev = 381m
N 61° 47' 29.3"
W 165° 58' 57.1"

1555 Have returned to lower camp

1700 Prepared sample kits for Surface water and wells at LF03. Will sample like mad tomorrow am MC

MC

2 order 4 tomorrow

Flextube
AA batteries
9V batteries
Locks
Gloves
ankle wraps

6/13/2004 LF03 MattCarahan

0630 Begin moving coolers to sample LF03

1205 - Collect sample 04LF03SW038W
1230 - collect sample 04LF03 MW01MW
1300 - CMW-1 purges dry instantly
1345 - CMW-2 purges dry No Sample
1430 - CMW-3 purges dry No Sample
1445 - Collect SW01 and duplicate
1500 - Collect SD01
1630 - collect CMW 6
1645 - CMW-7 purges dry, No Sample
1800 - collect GW CMW-4
1935 - collect SW02

6/13/2004 LF03 MattCarahan

1945 - collect SD02
2005 - collect CMW-5
2030 - return to camp prepare samples for shipment

22

6/14/2004 LF03 Matt Carnahan

0630 Finishing previous days paperwork

0930 - repack samples for shipment

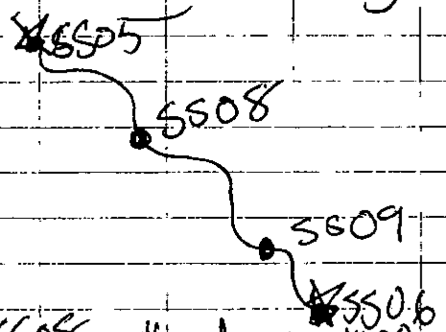
@1320 Samples set for shipment via arctic circle air to SGS, COC's faxed to shore Poston. Have received new power cord for RPA-1. will allow to warm for ½ hr and reagents

23

6/18/04 LF03 Matt Carnahan

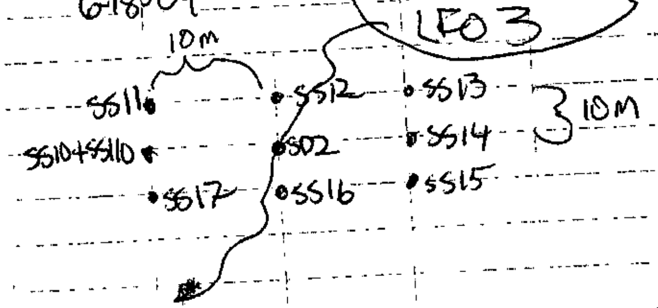
1230 prepare to return to LF03 and use screening results to collect surface soils (~~at LF03~~).

1400 Have placed locks on all monuments at LF03. Now at spring Between which SS05 and SS06 were collected, per TEO 2 more samples to be collected here in the following fashion.



SS08 collected at 1400 and SS09 at 1415.

1430 return to SD2 to establish perimeter. Following samples collected at the following Locations, 6-18-04 LF03 Matt Carnahan



Also have collected SS18 app 1/2 distance between SS07 and SD2 to further establish gradient. Sample times as follow,

SS-10	1430
SS-110	"
SS-11	1422
SS12	1431
SS-13	1427
SS14	1437
SS-15	1432
SS-16	1435
SS-17	1438
SS-18	1444
~~SS150~~	
SS115	1432

MC

8/22/04 Matt Carnahan

MW02 Dry @ 15.12ft
MW08 Dry @ 6.28ft
MW07 Dry @ 10.85ft
(tubing dry @ 5.21ft

MW01 DTW 23.08
Total Depth = 26.3

2000 Sample MW01
2100 Done for day

MC

6/23/05

0700 → 1000 Different Project

1000 → 1200 Measure Water Levels in "Dry" Wells (BT, MC, CW)

Water Levels (previously dry wells)

	DTW	TD
CMW-1	5.08	10.05
CMW-2	—	9.55
CMW-3	7.60	9.12
CMW-7	11.65	13.85

8/30/04
[illegible]

0930 BRANDIE THEISEN (BT), MATT CARNAHAN (MC), PAUG-VIK DEPART FOR AIRPORT

0600 DEPART FOR BETHEL

0700 ARRIVE BETHEL - WAIT FOR AK AIR CARGO TO OPEN,

0800 GET GEAR, CALL ARCTIC CIRCLE AIR

0900 DEPART BETHEL

1030 ARRIVE CAPE ROMANZOF CHAT W/ DON, RALPH

1100 MEASURE WATER LEVELS IN WELLS:

	DTW	~~TD~~ TD
BNCi WELL ( )		DRY @ 14.49
BNCi WELL (MW3)	9.36	23.02
WW-07	7.42	12.03*
WW-08	10.10	25.62
MW-02	4.06	12.04

* INSIDE INTERNAL TUBING

1145 Get 4wheeler and* gear for afternoon

1200 Break for lunch

1230 BT does paperwork, organizes

Purge water cal for MW-3

23.02
− 9.36
13.66

Depth of water: 13.66
× .16
8196
1366
2.1856

2 gal/well volume

Purge ~6 gal

8/30
continued

1300 Meet w/ Roger to get drums / empty supersacks from ST19/SSA, transport drums to airport (BT, MC)

1530 BT, MC give station chief paperwork and ~~purge~~ dump purge water from LF03 down shop drain.

1630 Break

1700 Dinner

1730 MC purges 10 well volumes (20± gal) from BNCI well MW-3

BT MCS to remove inertial pump tubing from well MW-07

1845 BT, MC dump purge water from BNCI well and clean up for day

1915 Done for day (whew!)

0800 BT calls ANC, calc's purge vols. MC calibrates field probes

0845 Mob up for sampling SS13/SS15 wells.

0930 Begin sampling MW-3

1000 Sample MW-3 @ SS15
04SS13MW03GW

1100 Try to sample WW-08 w/ bailer. Bailer gets stuck @ ~6' BTOC. When pulled out, the end is full of bentonite. There must be a crack in the casing or the casing is broken @ 6' BTOC. Sample should not be considered representative as surface water can infiltrate into well. Will try to sample w/ peristaltic pump later.

1130 Move to MW-2

1200 Sample MW-2
04SS13MW02GW extremely turbid
Note: well monument/casing is in very poor condition - casing is

8/[illegible]/04

loose and monument is loose – not cemented into place no soil exists within 1' radius of monument – puddled water to ~1' below normal ground elevation. ~~Afto or~~ while purging well, a gurgling sound was heard in The well – may be indicative of casing break somewhere? Water was extremely turbid (~10% sediment). VOAs would not seal w/o bubbles, as sediment got lodged in Threads

1210 Break for lunch.

1300 Pack coolers for wells MW-2, MW-3. Call TED and discuss situation. Tell her that we had to charter plane ~~out~~ as mail run plane is full of 611th/ARCTEC people.
Call Greg Dubois, BNLI, to inform him of wells (MW-3, other well). Double check if 8270C is correct

8/[illegible]/04

analysis for well. (not 8270SIMS)

1330 MC checks water volume @ CMW-2.
DTW: 8.71
TD: 9.51

1400 Mob to sample WW-07 well runs dry after purging ~1 gallon. Let recharge 10 minutes. still dry – did not sample.
May be result of inertial pump tubing ~~stilted~~ lodged into well. Tried repeatedly to remove inertial tubing w/o success.

1500 Deconed tubing – don't have enough for two wells – will do equipment [illegible].

1530 Start purging MW-8

1600 Sample ~~MW~~-8
04SGISMWO8GW
~~Note: TR~~ (BT)

1700 BREAK

1730 BT SAMPLES EQUIPMENT RINSE →

8/31/04

1730 04SS15EB01 (equipment blank)
EQUIPMENT RINSE IS RINSE
THROUGH HOSING FOR PERISTALTIC
HOSING WAS RE-USED DUE TO
SHORTAGE. BETWEEN USES HOSING
WAS WASHED W/ H2O & ALKANOX
RINSED 2X W/ TAP WATER
RINSED 1X W/ D.I. WATER
EB is DI water run thru
hosing after decon.
1800 MC samples ~~04SST~~
04LF03CMW2GW
1900 Prep for shipping off stuff
1930 Done for day.

9.1.04

0800 Pack samples / field gear for
Demob, arrange flight info
1000 ~~G~~ Caravan lands, load
drums, 4 wheeler
1030 207 lands
1100 207, caravan depart w/ people
gear
1400 Arrive in BET, late due
to weather delay
ATV shipped via Everetts
Gear, Drums shipped via Lynden
3 coolers goldstreaked
1530 Depart Bet (Load)
1730 Arrive ANC
1800 Done for day

Appendix C

Groundwater Sampling Log Sheets

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler: Matt C. + Teresa O
Sample Location (ie. MW1): MW-1
Sample ID (ie. 95BIA WG003): 04LF03MW01GW
Date Sample Collected: 6-13-04
Time sampled: 1230

Well Information

Groundwater: Yes, Shallow
Casing Diameter (in): 4"
Other:
a) Well Depth (ft): 20.00
b) Water Depth (ft). 17.20
c) Water Column (ft): 2.80
d) Calc. Purge Vol. (gal): ~~1.82~~ 4.62

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

6-13-04 TE

1047 Time	Volume (gallons)	pH	Conductivity (mS)	Temperature ~~(F)~~ C	Color	ppm Turbidity	Redox	Dissolved O_2	Other
~~0917~~	1 gal	6.77	30	2.5	dk br	10	271	17.72	
1024	1 gal	6.71	40	3.6	dk br	30	282	—	
1145	.5 gal	6.86	30	2.9	cl	10	306	16.71	
1230	.5 gal	6.91	30	6.0	cl	10	311	12.81	

Total Volume Purged:
Free Product (y/[✓ n]):
Odor: None
Sheen (y/[✓ n]):
Purge Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)
& peristaltic pump
Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump.
Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Poor, broken well casing, bent protective casing, missing cap
Remarks (well recovery, unusual conditions/observations):
slow well recovery
collected extra volume for MS/MSD DRO, BTEX, PCBs PAHs
Duplicate Sample ID:
Split Sample ID:

Signed:
Date: 6-13-04
Signed/reviewer: S. O'Carroll
Date: 6-14-04

Arrive @ well @ 10:00
purged dry after 2 gallons, allow to recharge
Arrive back @ well 11:40

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler: Matt C. + Teresa O
Sample Location (ie. MW1): CMW-1
Sample ID (ie. 95BIA WG003): ~~04LF03~~ No Sample
Date Sample Collected: 6/12/04
Time sampled: No Sample

Well Information

Groundwater: Yes, Shallow
Casing Diameter (in): 2
Other:
a) Well Depth (ft): 10.31
b) Water Depth (ft): ~~10.31~~ 9.51
c) Water Column (ft): 0.8
d) Calc. Purge Vol. (gal): ~~0.128~~ ~~[illegible]~~

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
[✓ 2]	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
[✓ 8]	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (~~F~~ C)	Color	ppm Turbidity	Redox	Dissolved O_2	Other
1320		6.64	30	7.1	dk gray	10	189	13.75	

Total Volume Purged:
Free Product (y/[✓ n]):
Odor: No
Sheen (y/[✓ n])

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
Peristaltic Pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
N/A

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Good

Remarks (well recovery, unusual conditions/observations):
Dry Well

Duplicate Sample ID:
Split Sample ID:

Signed: Date: 6-13-04
Signed/reviewer: Teresa E. O'Carroll Date: 6-14-04

arrive @ well @ 1315
purged dry after 150 ml.
No sample / Dry Well

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler:
Sample Location (ie. MW1): CMW-2
Sample ID (ie. 95BIA WG003): No Sample
Date Sample Collected: 6-13-04
Time sampled: No Sampl

Well Information

Groundwater: Shallow
Casing Diameter (in): 2
Other:
a) Well Depth (ft): 9.80
b) Water Depth (ft): 9.25
c) Water Column (ft): 0.55
d) Calc. Purge Vol. (gal): ~~[illegible]~~ ~~[illegible]~~ 0.46

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature C (~~F~~)	Color	Turbidity	Redox	Dissolved O_2	Other
1346	0.1				Clear				

Total Volume Purged: 0.1 gallon
Odor: No
Free Product (y/[✓ n])
Sheen (y/[✓ n])

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
NA

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Good

Remarks (well recovery, unusual conditions/observations):
Dry Well

Duplicate Sample ID:
Split Sample ID:

Signed: Date: 6-13-04
Signed/reviewer: O'Carroll Date: 6-14-04

Arrive 1345
well purged dry after 0.1 gallon.
No Sample / Dry Well

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Sample Location (ie. MW1): CMW-3
Project Name: Cape Romanzof 2003
Sample ID (ie. 95BIA WG003): No Sample
Client: AFCEE
Date Sample Collected: 6-13-04
Sampler: Matt C + Teresa O
Time sampled: No Sample

Well Information

Groundwater: Shallow
Casing Diameter (in): 2
Other:

a) Well Depth (ft): 9.37
b) Water Depth (ft): 8.85
c) Water Column (ft): 0.52
d) Calc. Purge Vol. (gal): ~~0.27~~ 0.45

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
[✓ 2]	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
[✓ 8]	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (~~F~~ C)	Color	ppm Turbidity	Redox	Dissolved O_2.	Other
1405	0.1	6.89	60	6.3	lt. gray	20	56	5.11	

Total Volume Purged: 0.1 gallon
Free Product (y/[✓ n])
Odor: None
Sheen (y/[✓ n])

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
N/A

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Good

Remarks (well recovery, unusual conditions/observations):
Well Dry, No Sample

Duplicate Sample ID:
Split Sample ID:

Signed:
Date: 6-13-04
Signed/reviewer: Teresa E. O'Carroll
Date: 6-14-04

Arrived @ well @ 1400

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Sample Location (ie. MW1): CMW-6
Project Name: Cape Romanzof 2003
Sample ID (ie. 95BIA WG003): 04LF03CMW6GW
Client: AFCEE
Date Sample Collected: 6-13-04
Sampler: Matt C. + Teresa O
Time sampled: 1630

Well Information

Groundwater:
Casing Diameter (in): 2
Other:

a) Well Depth (ft): 15.00
b) Water Depth (ft): 13.01
c) Water Column (ft): 1.99
d) Calc. Purge Vol. (gal): ~~[illegible]~~ ME 1.73

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (~~F~~ C)	Color	ppm Turbidity	Redox	Dissolved O_2	Other
1550	0	7.52	60	3.9	dk br.	30	333	11.51	
1555	1.75	7.62	40	3.0	lt. br	20	336	11.72	
1605	1.75	7.27	40	2.5	clear	20	348	11.79	
1625	1.75	7.07	40	2.2	clear	20	349	12.50	

Total Volume Purged: 5.25 gallons
Free Product (y/[✓ n]):
Odor: No
Sheen (y/[✓ n]):

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Good

Remarks (well recovery, unusual conditions/observations):
Good recovery
collected Dup 04LF03CMW106GW
DRO, BTEX, PCBs, PAHs

Duplicate Sample ID: NA
Split Sample ID:

Signed:
Date: 6-13-04
Signed/reviewer:
Date: 6-14-04

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Sample Location (ie. MW1): CMW-7
Project Name: Cape Romanzof 2003
Sample ID (ie. 95BIA WG003): No Sample
Client: AFCEE
Date Sample Collected: 6-13-2004
Sampler: Matt C + Teresa O
Time sampled: No Sample

Well Information

Groundwater: Shallow
Casing Diameter (in): 2
Other:

a) Well Depth (ft): 14.10
b) Water Depth (ft): 13.69
c) Water Column (ft): 0.41
d) Calc. Purge Vol. (gal): 0.38

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
	0.2	7.5	140	5.1	br/grey	70	280	13.29	

Total Volume Purged:
Free Product (y/[✓ n])
Sheen (y/[✓ n])
Odor:

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
N/A

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Good

Remarks (well recovery, unusual conditions/observations):
purged dry after 0.2 gallons

Duplicate Sample ID:
Split Sample ID:

Signed:
Date: 6-13-04
Signed/reviewer:
Date: 6-14-04

arr. at well 1530
purge Dry NO Sample

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Sample Location (ie. MW1): CMW-4
Project Name: Cape Romanzof 2003
Sample ID (ie. 95BIA WG003): 04LF03CMW4GW
Client: AFCEE
Date Sample Collected: 6-13-04
Sampler: MattC +Teresa D
Time sampled: 1800

Well Information

Groundwater: Shallow
Casing Diameter (in): 2
Other:
a) Well Depth (ft): 10.37
b) Water Depth (ft): 7.02
c) Water Column (ft): 3.35
d) Calc. Purge Vol. (gal): ~~[illegible]~~ 2.91

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
[✓ 2]	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
[✓ 8]	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature ~~(F)~~ C	Color	ppm Turbidity	Redox	Dissolved O_2	Other
1420	0	6.86	140	8.0	lt br	70	101	5.13	
1430	1.6	7.07	120	5.1	lt br	70	148	6.15	
1515	1.25	7.12	120	6.2	Clear	50	147	5.68	

Total Volume Purged: 2.85 gallons
Free Product (y/[✓ n]):
Odor: ~~None~~ TE 6-13-04 slight hydrocarbon
Sheen (y/[✓ n])

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Good

Remarks (well recovery, unusual conditions/observations):
Moderate well recovery, DRO, BTEX, PCBs, PAHs

Duplicate Sample ID:
Split Sample ID:

Signed:
Date: 6-13-04
Signed/reviewer:
Date: 6-14-04

Arrived @ well @ 1415
purged dry after 1.6 gallons, purged dry after 1.25 gallons

144 150

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number:	4112	Sample Location (ie. MW1):	CMW-5
Project Name:	Cape Romanzof 2003	Sample ID (ie. 95BIA WG003):	04LF03CMW5GW
Client:	AFCEE	Date Sample Collected:	6-13-2004
Sampler:	MattC and FBD	Time sampled:	2005

Well Information

Groundwater:	Shallow	Casing Diameter (in):	2	a) Well Depth (ft):	10.35
				b) Water Depth (ft):	4.95
Other:				c) Water Column (ft):	5.40
				d) Calc. Purge Vol. (gal):	4.70

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
[✓ 2]	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0 16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
[✓ 8]	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
1825	0	6.37	50	5.5	Lt Br	20	266	4.56	
1855	5	6.47	40	3.2	Clear	40	380	5.33	
1920	4.5	6.75	40	3.3	clear	20	210	9.44	

Total Volume Purged: 9.5 gal
Free Product (y/[✓ n])
Odor:
Sheen (y/[✓ n])

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
Peristaltic Pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic Pump

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Good

Remarks (well recovery, unusual conditions/observations): DRO, BTEX, PCBs, PAHs
Purged Dry after 2 well Volumes = 9.5 gallons

Duplicate Sample ID:
Split Sample ID:

Signed: Date: 6-13-04
Signed/reviewer: Date: 6-14-04

dir. @ well 1820

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number 4112 Sample Location (ie. MW1) CMW-7
Project Name Cape Romanzof 2003 Sample ID (ie. 95BIA WG003): 04LF03CMW07GW
Client: AFCEE Date Sample Collected. 6/24/04
Sampler: Time sampled. 0730

Well Information

Groundwater ______ Casing Diameter (in). 2"
a) Well Depth (ft). 13.85
b) Water Depth (ft): 11.65
Other: ______
c) Water Column (ft). 2.2
d) Calc. Purge Vol. (gal): 0.35

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.25

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column:
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column:
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (C)	Color	Turbidity	Redox	Dissolved O_2	Other
	0.4	7.3	60	2.1	BRN	20	402	10.14	
	0.8	7.0	60	2.1	↓	20	410	10.10	
	1.2	7.0	60	2.2	↓	20	414	9.99	

Total Volume Purged. <1.5 Free Product (y/n): N
Odor: Sheen (y/n): N

Purge Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
GOOD

Remarks (well recovery, unusual conditions/observations)
NEW LOCK

Duplicate Sample ID: ______
Split Sample ID: ______

Signed: Date: 6/24/04
Signed/reviewer: Date:

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler:
Sample Location (ie. MW1): CMW-3
Sample ID (ie. 95BIA WG003): 04LF03CMW03GW
Date Sample Collected: 6/24/04
Time sampled: 0715

Well Information

Groundwater:
Other:
Casing Diameter (in): 2"
a) Well Depth (ft): 9.12
b) Water Depth (ft): 7.60
c) Water Column (ft): 1.52
d) Calc. Purge Vol. (gal): 0.24

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (µS)	Temperature (~~F~~)	Color	Turbidity	Redox	Dissolved O_2	Other
	0.25	7.4	40	6.1	BRN	20	300	9.7	
	0.50	6.5	40	5.2	"	10	300	8.69	
	0.75	6.2	40	5.1	"	10	335	8.07	

Total Volume Purged: <1 gal
Free Product (y/n): N
Sheen (y/n): N
Odor:
Purge Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)
Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)
Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
GOOD
Remarks (well recovery, unusual conditions/observations):
NEW LOCK
Duplicate Sample ID:
Split Sample ID:
Signed:
Date: 6/24/04
Signed/reviewer:
Date:

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number:	4112	Sample Location (ie. MW1):	CMW-1
Project Name:	Cape Romanzof 2003	Sample ID (ie. 95BIA WG003):	04LF03CMW01GW
Client:	AFCEE	Date Sample Collected:	6/24/04
Sampler:	BT, CW, MC	Time sampled:	0700

Well Information

Groundwater:	X	Casing Diameter (in):	2"	a) Well Depth (ft):	10.05
				b) Water Depth (ft):	5.08
Other:				c) Water Column (ft):	4.92
				d) Calc. Purge Vol. (gal):	0.79

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (µS)	Temperature (C)	Color	Turbidity	Redox	Dissolved O_2	Other
	0.9	6.08	10	2.6	BRN	20	288	9.46	
	1.6	6.13	30	2.0	BRN	10	330	9.44	
	2.4	6.15	30	1.8	BRN	10	363	9.55	

Total Volume Purged: 3.0 GAL
Free Product (y/n):
Odor:
Sheen (y/n):

Purge Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)

GOOD

Remarks (well recovery, unusual conditions/observations):

NEW LOCK

Duplicate Sample ID:
Split Sample ID:

Signed:
Date: 6/24/04

Signed/reviewer:
Date:

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler:

Sample Location (ie. MW1): CMW-2
Sample ID (ie. 95BIA WG003): ~~0ASS~~ 04LF03CMW2GW
Date Sample Collected: 8/31/04
Time sampled: 1800

Well Information

Groundwater:
Other:
Casing Diameter (in):

a) Well Depth (ft):
b) Water Depth (ft):
c) Water Column (ft):
d) Calc. Purge Vol. (gal):

Calculating Purge Volume

Well Casing Diameter	Multiply c) by
2	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other

Total Volume Purged:
Free Product (y/n):
Sheen (y/n):
Odor:

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
Did not purge

Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.)

Remarks (well recovery, unusual conditions/observations):

Duplicate Sample ID: NONE
Split Sample ID:

Signed:
Date: 9/1/04
Signed/reviewer:
Date:

Figure A-5

Sediment Sample Sheet

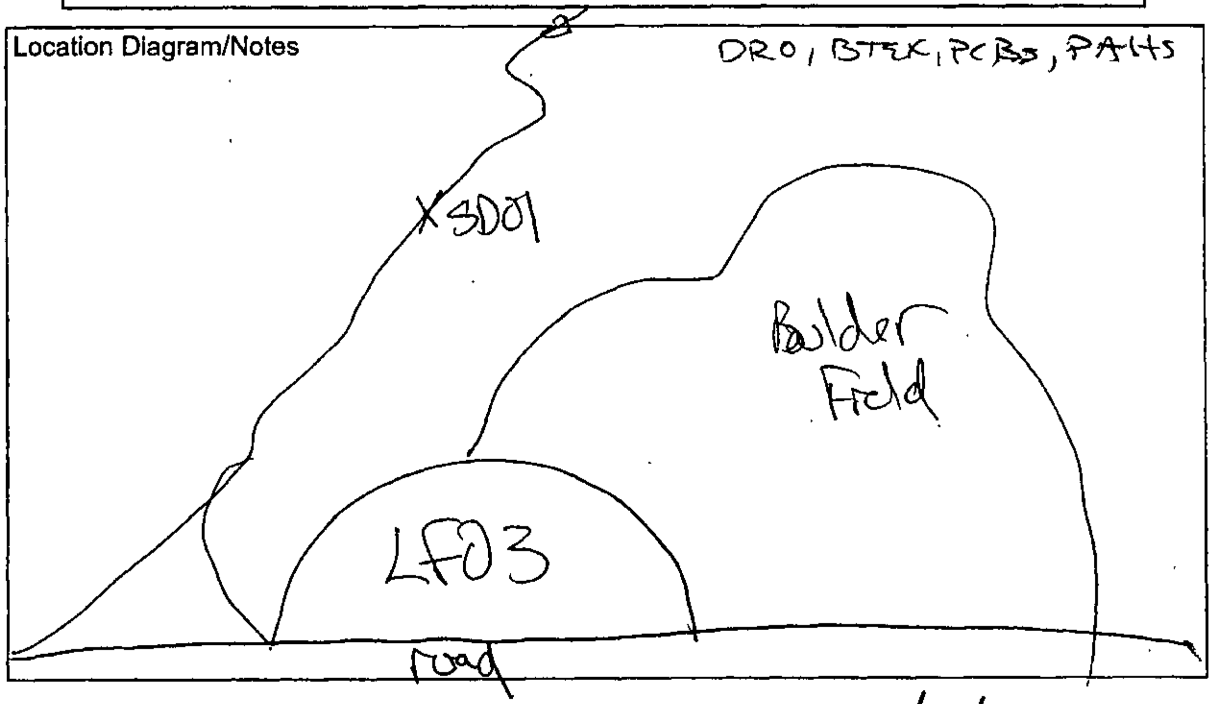
Sample ID 04LF03SD01SD
Date 6-13-04 Time 1500
Site LF03
Sampler MC
Location SD01
☐ QA/QC Sample
☒ Associated QA/QC Sample No TEO 6-13-04
Split
Duplicate

☐ Marine
☐ Brackish
☐ Freshwater
☐ Lake/Pond (LK)
☐ River (RV)
☒ Stream/Creek (SP)
☐ Seep/Spring (SE)
☐ Other
Sample Depth 4"
Total Depth 4"

☐ Clay
☒ Silt
☐ Sand
☐ Gravel
☐ Organic
☐ Color greenish gray, brown staining
☐ Odor None
☐ Sheen None
☐ Debris rust
☐ Other

Location Diagram/Notes

DRO, BTEX, PCBs, PAHs



6/14/04

A5 Sediment Sample Sheet

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Figure A-5

Sediment Sample Sheet

Sample ID 04LF03SD02SD
Site LF03
Location SD2

Date 6-13-04 Time 1945
Sampler MC
☐ QA/QC Sample
☐ Associated QA/QC Sample
Split
Duplicate

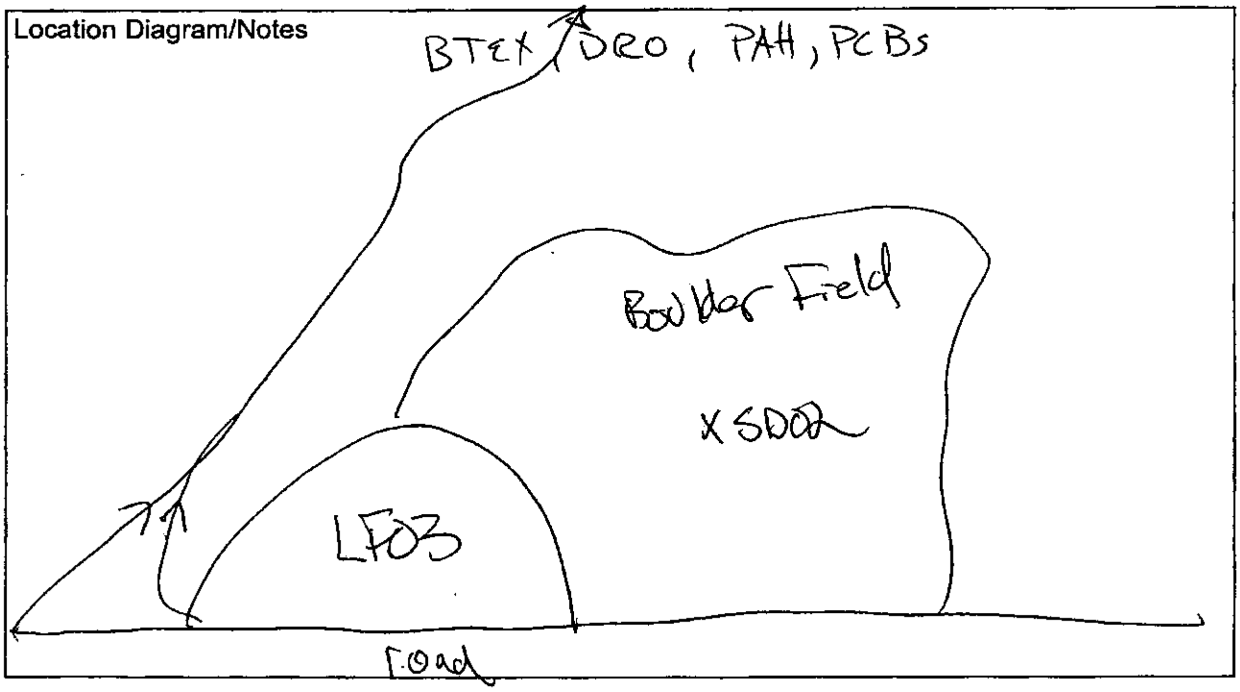
☐ Marine ☐ Lake/Pond (LK) Sample Depth 1"
☐ Brackish ☐ River (RV) Total Depth 1"
☐ Freshwater ☐ Stream/Creek (SP) ☒ Seep/Spring (SE) ☐ Other

☐ Clay
☒ Silt
☐ Sand
☐ Gravel
☐ Organic

☐ Color greenish gray
☐ Odor None
☐ Sheen None
☐ Debris None
☐ Other

Location Diagram/Notes

BTEX / DRO, PAH, PCBs



6/14/04

Figure A-5

Sediment Sample Sheet

Sample ID 04LF03SD03SD
Site LF03
Location SW3/SD3

Date 6-13-04 Time 1210
Sampler TEO/MC
☐ QA/QC Sample
☐ Associated QA/QC Sample
Split
Duplicate

☐ Marine ☐ Lake/Pond (LK) Sample Depth 6"
☐ Brackish ☐ River (RV) Total Depth 6"
☐ Freshwater ☐ Stream/Creek (SP) ☒ Seep/Spring (SE) ☐ Other

☐ Clay
☒ Silt
☐ Sand
☐ Gravel
☒ Organic very low

☒ Color greenish gray
☐ Odor No
☐ Sheen No
☐ Debris No
☐ Other

Location Diagram/Notes

BTEX, DRO, PCBs, PAHs

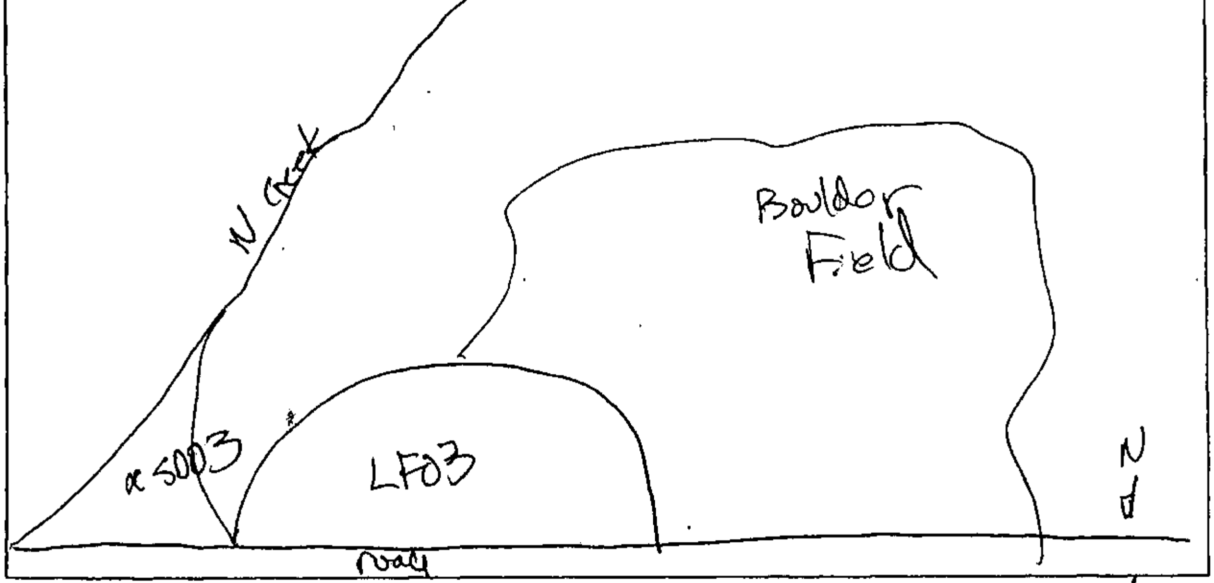


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Figure A-4

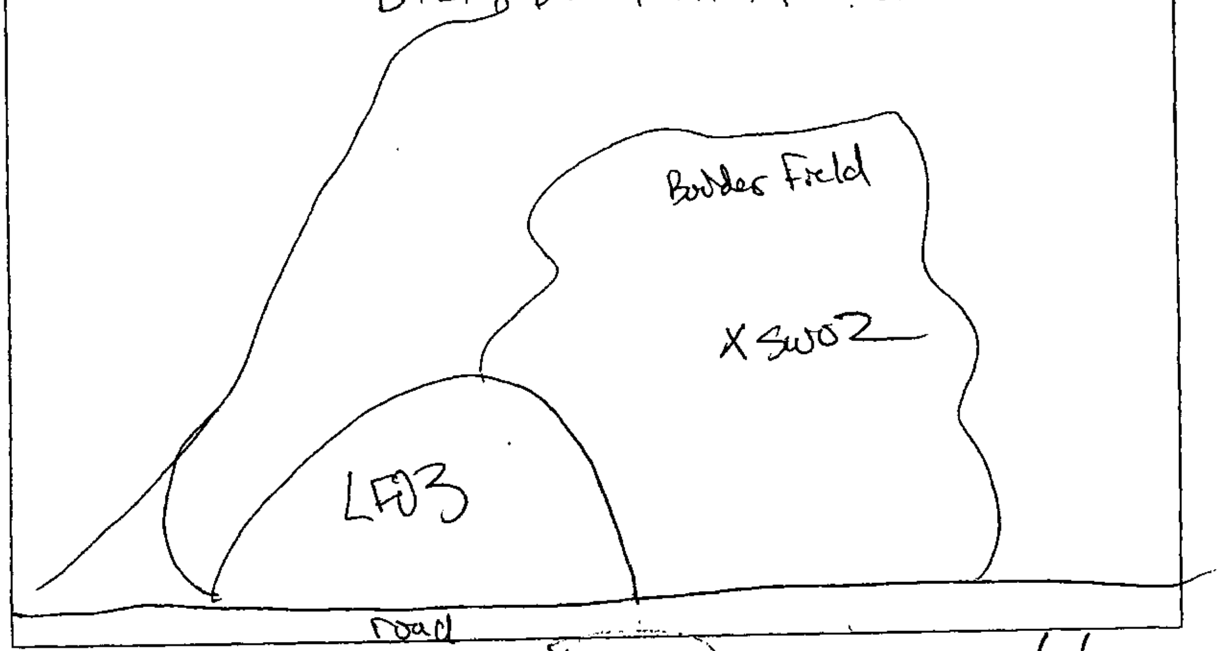
Surface Water Sample Sheet

Sample ID 04LF03SW02SW	Date 6-13-04 Time 1935
Site LF03	Sampler MC
Location SW2/SD2	☐ QA/QC Sample
	☐ Associated QA/QC Sample
	Split
	Duplicate

☐ Marine	☐ Lake/Pond (LK)	Sample Depth 1"
☐ Brackish	☐ River (RV)	Total Depth 1"
☐ Freshwater	☐ Stream/Creek (SP)	Velocity (ft./Sec.)
☒ Seep/Spring (SE)	☐ Other	Flow Direction
☐ Emergent Vegetation		

Temperature °C 3.5	☐ Color clear
pH 7.39	☐ Odor none
Conductance (mS) 20	☐ Sheen none
	☐ Debris none
Dissolved O_2 13.93	☐ Turbidity none

Location Diagram/Notes BTEX, DRO, PAH, PCBs



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A4 Surface Water Sample Sheet

Figure A-4

Surface Water Sample Sheet

Sample ID 04LF03SW01SW
Site LF03
Location SW01

Date 6-13-04 Time 1445
Sampler ML
☐ QA/QC Sample
☒ Associated QA/QC Sample
Split
Duplicate 04LF03SW103SW

☐ Marine
☐ Brackish
☐ Freshwater
☐ Seep/Spring (SE)
☐ Emergent Vegetation

☐ Lake/Pond (LK)
☐ River (RV)
☒ Stream/Creek (SP)
☐ Other

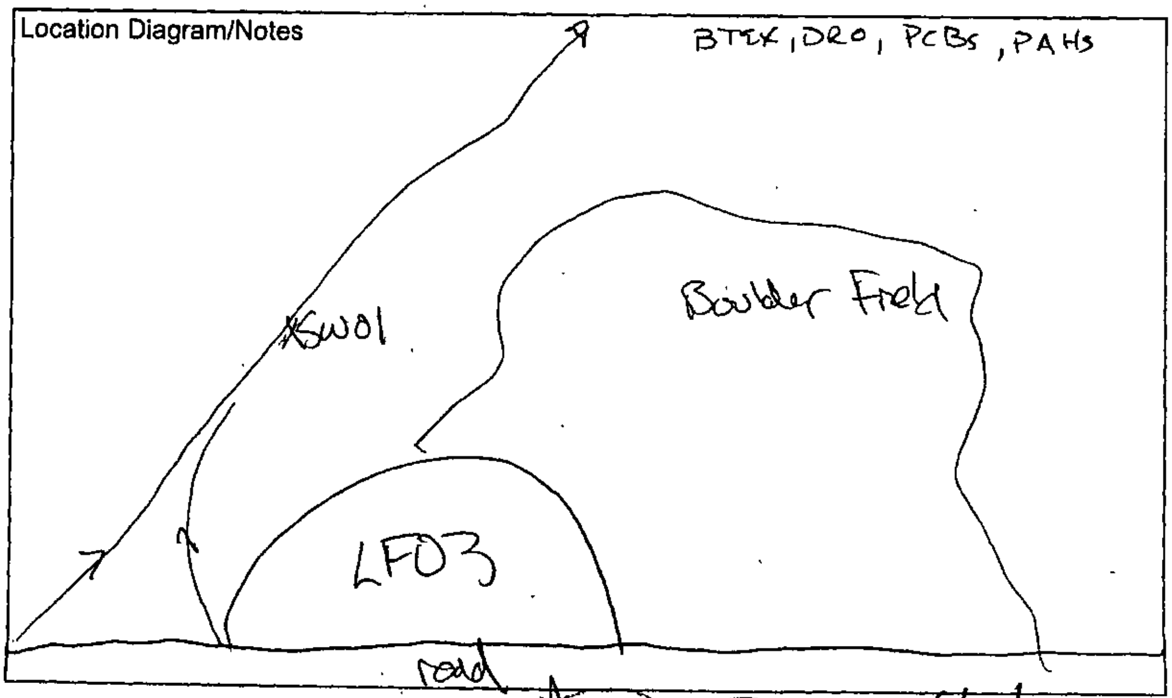
Sample Depth Surface
Total Depth 3"
Velocity (ft./Sec.) 1.5
Flow Direction South

Temperature °C 10.6
pH 8.18
Conductance (mS) 30
Dissolved O_2 9.04 ppm

☐ Color Clear
☐ Odor None
☐ Sheen None
☐ Debris rust
☐ Turbidity low

Location Diagram/Notes

BTEX, DRO, PCBs, PAHs



6/14/04

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Figure A-4

Surface Water Sample Sheet

Sample ID 04LF03SW03SW
Site LF03
Location SW3/SD3

Date 6-13-04 Time 1205
Sampler TEO / MC
☐ QA/QC Sample
☐ Associated QA/QC Sample
Split
Duplicate

☐ Marine
☐ Brackish
☐ Freshwater
☒ Seep/Spring (SE)
☐ Emergent Vegetation

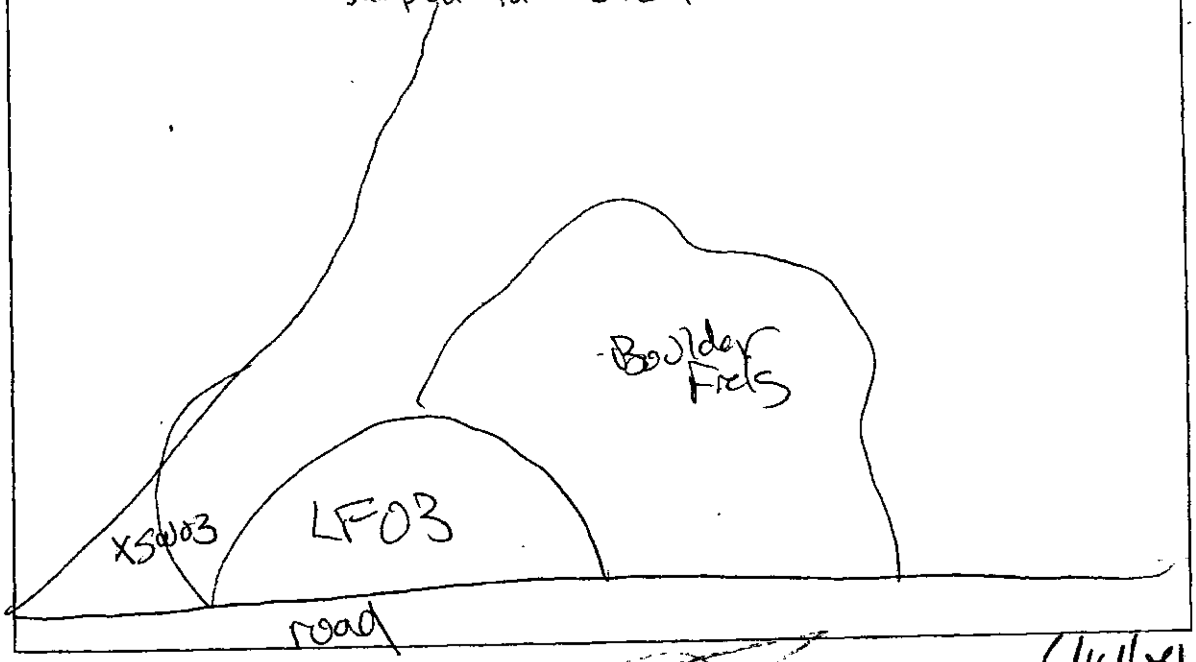
☐ Lake/Pond (LK)
☐ River (RV)
☐ Stream/Creek (SP)
☐ Other

Sample Depth 0'
Total Depth 6"
Velocity (ft./Sec.)
Flow Direction

Temperature °C 8.8
pH 7.80
Conductance (mS) 30
Dissolved O_2 15.55

☐ Color clear
☐ Odor no
☐ Sheen no
☐ Debris no
☐ Turbidity low

Location Diagram/Notes Sampled for BTEX, DRO, PCBs, PAHs



6/14/04

Figure A-8

QUALITY ASSURANCE SAMPLES

Project: 4112 Cape Romanzof
Date: 6/12/04 → 6/20/04
Sampling Leader / Team: BT (Team 1)
Quality Assurance Objective of the Investigtion:
See QAPP

Sample Numbers	Lab Sent to	Date Made/Sent	Matrix	Sample Type/ Concentration	Notes
04SS14SB112SB 15'	SGS	6/12/04 / 6/14/04	Soil	Soil sample from auger cuttings	Dup of 04SS14SB12SB 15'
04SS14SB115SB 1.5'	SGS	"	"	"	Dup of 04SS15SB15SB 1.5'
04ST09SB26SB 8'	SGS	6/14/04 / 6/16/04	"	SOIL BORING SAMPLE	MS/MSD extra volume collectd
04ST09SB127SB3'	SGS	"	"	"	Dup of 04ST09SB27SB 3'
04ST09MW05GW	SGS	6/21/04 / 6/23/04	water	Groundwater	MS/MSD extra volume collecto
04SS14SW02SW	"	6/20/04 / 6/21/04	"	surface water	MS/MSD extra volume collected

Figure A-8

QUALITY ASSURANCE SAMPLES

Project: 4112 Cape Romanzof Date: 6/9/04
Sampling Leader / Team: Brandie Theisen
Quality Assurance Objective of the Investigtion:
See QAPP

Sample Numbers	Lab Sent to	Date Made/Sent	Matrix	Sample Type/ Concentration	Notes
04SS15TBGW	SGS	6/9/04 / 6/9/04	water	trip blank	Trip Blank for cooler AK 6676-2684
04SS13SS06SD	SGS	6/9/04	soil	sediment	ms/msd - extra volume
04SS13SS101SD	SGS	6/9/04	soil	Sediment	~~Trip blank~~ (BS) Duplicate of 04SS13SSD1SD BTEX /DRO/RRO/PAH
04SS13TBSS	SGS	6/9/04	soil	trip blank	trip blank for cooler AK 6300330l
04SS13SW9SW 04SS13SW101SW	SGS	6/9/04 / 6/10/04	water	water	ms/msd -extravolume duplicate taken (~~AA~~ 04SS13SW101SW) TAH/DRO/RRO/TAqH
04SS13TBSW	SGS	6/9/04 / 6/10/04	water	trip blank	Trip Blank for cooler 609A

Figure A-8

QUALITY ASSURANCE SAMPLES

Project: 4112 Cape Romanzof Date: 6/11/04 - 6/12/04
Sampling Leader / Team: Brandie Theisen - Team 1
Quality Assurance Objective of the Investigtion:
See QAPP

Sample Numbers	Lab Sent to	Date Made/Sent	Matrix	Sample Type/ Concentration	Notes
04ST09MW107SB 5'	SGS	6/11/04 6/14/04	SoiL	soil from SS @ 5'	Duplicate of 04ST09MW07SB 5'
04SS14SB02SB 3'	SGS	6/12/04 6/14/04	SoiL	soil from SS@ 3-5'	Extra volume collected for MS/MSD
04SS14SB112SB 1.5'	SGS	6/12/04 6/14/04	"	soil from auger cuttings	Duplicate of 04SS14SB12SB 1.5'
04SS14SB115Sb1.5'	SGS	"	"	"	Duplicate of 04SS14SB15SB 1.5
04ST09SB23SB 5'	SGS	"	"	soil from SS 3-7'	Extra volume provided for MS/MSD
04SS14SB02SB 3'	SGS	"	"	Soil from SS 3-5'	" " MS/MSD

Figure A-8

QUALITY ASSURANCE SAMPLES

Project: 4112 Gope Romanzof Date: 6/12/04

Sampling Leader / Team: Team 2, Matt Carnahan

Quality Assurance Objective of the Investigtion: See QAPP

Sample Numbers	Lab Sent to	Date Made/Sent	Matrix	Sample Type/ Concentration	Notes
04LF03SS103SS	SGS	6/12/04 6/14/04	Soil	Surface soil Grab	Duplicate of 04LF03SS03 SS PCBs

Figure A-8

QUALITY ASSURANCE SAMPLES

Project: 4/12 Cape Romanzof Date: 6/13/04
Sampling Leader / Team: Team 2 Matt Carnahan, Teresa O'Carroll
Quality Assurance Objective of the Investigtion: See QAPP

Sample Numbers	Lab Sent to	Date Made/Sent	Matrix	Sample Type/ Concentration	Notes
04LF03MW01GW	SGS	6/13/04 6/14/04	W	well Grab MS/MSD	extra volumes collected for MS/MSD DRO, BTEX, PCBs, PAHs
04LF03CMW106GW	SGS	6/13/04 6/14/04	W	Dup	Duplicate of 04LF03CMW6GW DRO, BTEX, PCBs, PAHs

Figure A-8

QUALITY ASSURANCE SAMPLES

Project: 4112 Cape Romanzof
Date: 6/20/04 –
Sampling Leader / Team: BJ
Quality Assurance Objective of the Investigtion: see QAPP

Sample Numbers	Lab Sent to	Date Made/Sent	Matrix	Sample Type/ Concentration	Notes
04SS14SW103	SGS	6/20/04 6/21/04	H20	surface water	Dup of 04SS14SW03SW
04ST09MW108GW	SGS	6/21/09 6/23/09	〃	ground water	Dup of 04ST09MW08GW

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number:	4112	Sample Location (ie. MW1):	~~AF~~ WW-08
Project Name:	Cape Romanzof 2003	Sample ID (ie. 95BIA WG003):	04SS15WW08GW
Client:	AFCEE	Date Sample Collected:	8/31/04
Sampler:	BT / MC	Time sampled:	1600

Well Information

Groundwater: 10.10

Casing Diameter (in): 2 4

Other:

a) Well Depth (ft): 2562

b) Water Depth (ft): 10.10

c) Water Column (ft): 15.52

d) Calc. Purge Vol. (gal): 2.5

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by
8	0.71
10	1
12	1.28

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity ~~(mS)~~ µS	Temperature ~~(F)~~ °C	Color	Turbidity	mV Redox	Dissolved O_2	Other	TDS ppm
1540	2.5	5.8	60	3.9	clear	none	421	4 mg/L	—	90
1549	5.0	9.6	70	3.7	yellow	none	408	4.5 mg/L	—	110
1650	6.5	5.2	80	3.6	clear	none	428	4.4 mg/L	—	110
1610	7.5	5.1	80	3.4	clear	none	434	4.4	—	110

Total Volume Purged:

Free Product (y/n): NO

Odor: NO

Sheen (y/n): NO

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)

peristaltic pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)

peristaltic pump

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)

Casing appears to be broken @ ~6' btoc as bailer would not go further past this point and was covered in bentonite when pulled up.

Remarks (well recovery, unusual conditions/observations):

Well/monument in good condition – casing bent/broken/ruptured – see above.

Duplicate Sample ID:

Split Sample ID: NONE

Signed:

Date: 8/31/04

Signed/reviewer:

Date: 10-18-04

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Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler: BT/MC
Sample Location (ie. MW1): WW-07
Sample ID (ie. 95BIA WG003): CASS15WW07GW
Date Sample Collected: 8/31/04
Time sampled: ~~1230~~

Well Information

Groundwater: 7.42*
Casing Diameter (in): 2"
Other:
a) Well Depth (ft): 12.03
b) Water Depth (ft): 7.42
c) Water Column (ft): 4.61
d) Calc. Purge Vol. (gal): 2.25

*sampled water in inner tube (

Calculating Purge Volume

Well Casing Diameter	Multiply c) by.
2	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O$_2$	Other
	.75								
	1.5								
	2.25								

Total Volume Purged:
Odor: N
Free Product (y/n): N
Sheen (y/n): N

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
Peristaltic pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Well has inertial pump tubing inside - could not remove

Remarks (well recovery, unusual conditions/observations):
DID NOT SAMPLE

Duplicate Sample ID:
Split Sample ID:

Signed:
Date: 8/31/04
Signed/reviewer:
Date: 10-18-04

A3 GW Sample Data Sheet

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler: BT, MC
Sample Location (ie. MW1): MW-02, SS-13
Sample ID (ie. 95BIA WG003): 04SS13MW02GW
Date Sample Collected: 8/31/04
Time sampled: 1200

Well Information

Groundwater: 4.06
Casing Diameter (in): 2"
Other:
a) Well Depth (ft): 12.04
b) Water Depth (ft): 4.06
c) Water Column (ft): 7.98
d) Calc. Purge Vol. (gal): 3.8

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity ~~(mS~~ [illegible]	Temperature (~~F~~ C)	Color	Turbidity	Redox	Dissolved O_2	Other	TDS ppm
[illegible]	1.5	4.7	50	5.8	BRN	Med to Hi	393	3.5	–	70
[illegible]	3.0	4.7	40	5.3	BRN	Hi	405	3.5	–	60
[illegible]	4.5	4.8	40	5.2	BRN	Hi	411		–	60

Total Volume Purged: NA
Odor:
Free Product (y/n): NO
Sheen (y/n): NO

Purge Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.)
ABVG [illegible]MOUNT IS LOOSE - STANDING WATER ~10" DEEP NEXT TO MONUMENT

WATER WAS EXTREMELY TURBID

Remarks (well recovery, unusual conditions/observations):
BAILS DRY BUT FAST RECHARGE
WELL MADE BUBBLING NOISE AS SAMPLED - PERHAPS CASING NOT A TIGHT CONNECTION?

Duplicate Sample ID: NONE
Split Sample ID:

Signed: Date: 8.31.04
Signed/reviewer: Date: 10-18-04

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Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Sample Location (ie. MW1): CMW-2
Project Name: Cape Romanzof 2003
Sample ID (ie. 95BIA WG003): ~~0455~~ 04LF03CMW2GW
Client: AFCEE
Date Sample Collected: 8/31/04
Sampler: BT / MC
Time sampled: 1800

Well Information

Groundwater:
Casing Diameter (in):
a) Well Depth (ft):
b) Water Depth (ft):
c) Water Column (ft):
Other:
d) Calc. Purge Vol. (gal):

Calculating Purge Volume

Well Casing Diameter	Multiply c) by
2	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other

Total Volume Purged:
Free Product (y/n):
Odor:
Sheen (y/n):

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
Did not purge

Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.)

Remarks (well recovery, unusual conditions/observations):

Duplicate Sample ID: NONE
Split Sample ID:

Signed:
Date: 9/1/04
Signed/reviewer:
Date: 10-18-04

Figure A-6

Surface Soil Sample Sheet

Sample ID ~~SS~~ 04SS13LB03SS
Site SS13
Location Cape Romanzof

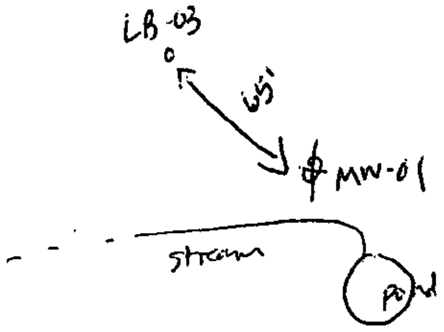
Date 6/9/04 Time 1043
Sampler MJC
☐ QA/QC Sample
☐ Associated QA/QC Sample
Split
Duplicate

Sample Depth surface
Total Depth 2"

☒ Clay
☒ Silt
☐ Sand
☐ Gravel
☒ Organic

☒ Color Dark Brown
☐ Odor No
☐ Sheen No
☐ Debris organics
☐ Other

Location Diagram/Notes



DRO/RRO/PAH/BTEX

Matr Lt : LS0042-50-17

Figure A-6

Surface Soil Sample Sheet

Sample ID ~~SS~~ 04SS13CB07SS

Site SS13

Location Cape Rampart

Date 6/9/07 Time 1037

Sampler MJC

☐ QA/QC Sample

☐ Associated QA/QC Sample

Split

Duplicate

Sample Depth Surface

Total Depth 2"

☒ Clay

☒ Silt

☐ Sand

☐ Gravel

☒ Organic

☒ Color Dark Brown

☐ Odor No

☐ Sheen No

☐ Debris Organic

☐ Other

Location Diagram/Notes

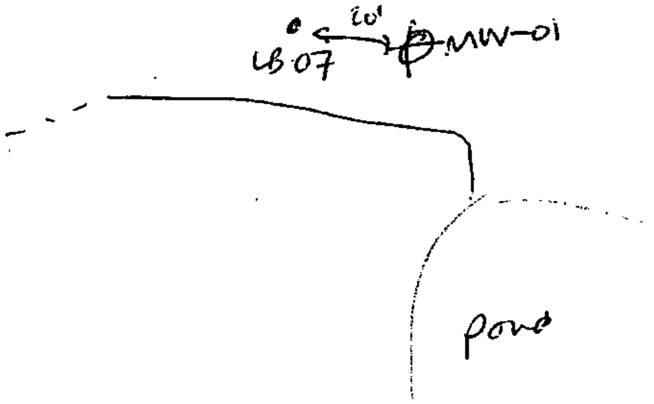


Figure A-6

Surface Soil Sample Sheet

Sample ID 04SS13LB08SS

Site SS13 - LB-08

Location Cape Romanzof

Date 6/9/04 Time 1029

Sampler MJC

☐ QA/QC Sample

☐ Associated QA/QC Sample
Split
Duplicate

Sample Depth surface

Total Depth 2"

☒ Clay
☒ Silt
☐ Sand
☐ Gravel
☒ Organic

☒ Color Dark Brown
☐ Odor No
☐ Sheen No
☐ Debris
☐ Other

Location Diagram/Notes

Rotten board discovered ~~[illegible]~~ BT 2" below surface

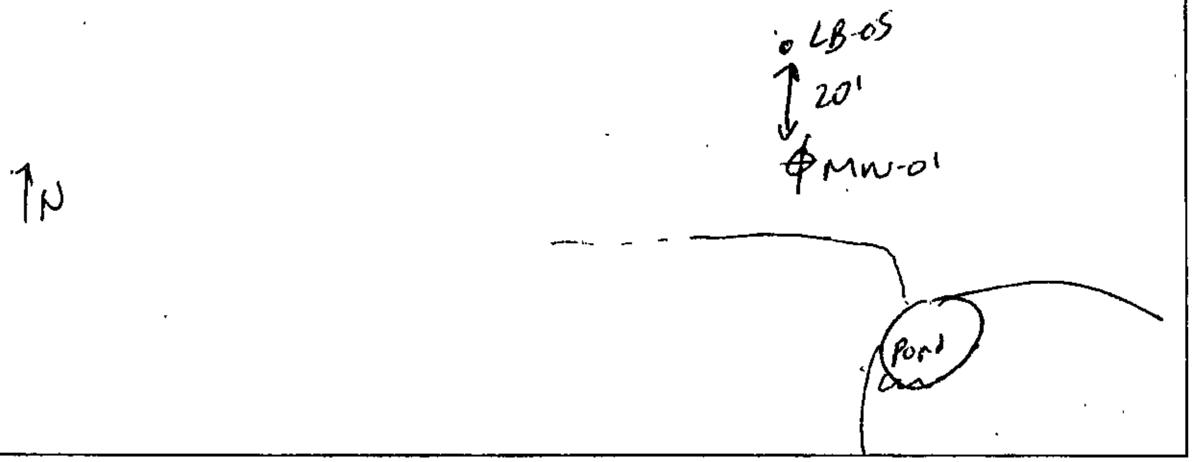


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Figure A-5

Sediment Sample Sheet

Sample ID ~~SS13~~ BT 04SS13SS01SD

Site SS13 SS01

Location Cape Romanzof

Date 6/9/04 Time ~~1050~~ BT 1030

Sampler BT

☒ QA/QC Sample ~~MS/MSD~~ BT ~~extra sample provided~~

☒ Associated QA/QC Sample

Split

Duplicate 04SS1310ISD

☐ Marine
☐ Brackish
☐ Freshwater

☐ Lake/Pond (LK)
☐ River (RV)
☒ Stream/Creek (SP)

Sample Depth ~6" under water

Total Depth ~8"

☐ Seep/Spring (SE)
☐ Other

☒ Clay
☒ Silt
☐ Sand
☐ Gravel
☒ Organic ~3%

☐ Color light brown to reddish tan
☐ Odor No
☐ Sheen No
☐ Debris
☐ Other

Location Diagram/Notes

Figure A-5

Sediment Sample Sheet

Sample ID 04SS13SS06SD
Site SS13, SS-06
Location Cape Romanzof

Date 6/9/04 Time 1050
Sampler BT
☒ QA/QC Sample MS/MSD
extra sample volume provided
☐ Associated QA/QC Sample
Split
Duplicate

☐ Marine	☐ Lake/Pond (LK)	Sample Depth ~ 1" under water
☐ Brackish	☐ River (RV)	Total Depth ~ 4" total
☐ Freshwater	☒ Stream/Creek (SP)	☐ Seep/Spring (SE) ☐ Other

☒ Clay	☒ Color Dark to Light Brown
☐ Silt	☐ Odor No
☐ Sand	☐ Sheen No
☐ Gravel	☐ Debris
☒ Organic 20%	☐ Other

Location Diagram/Notes

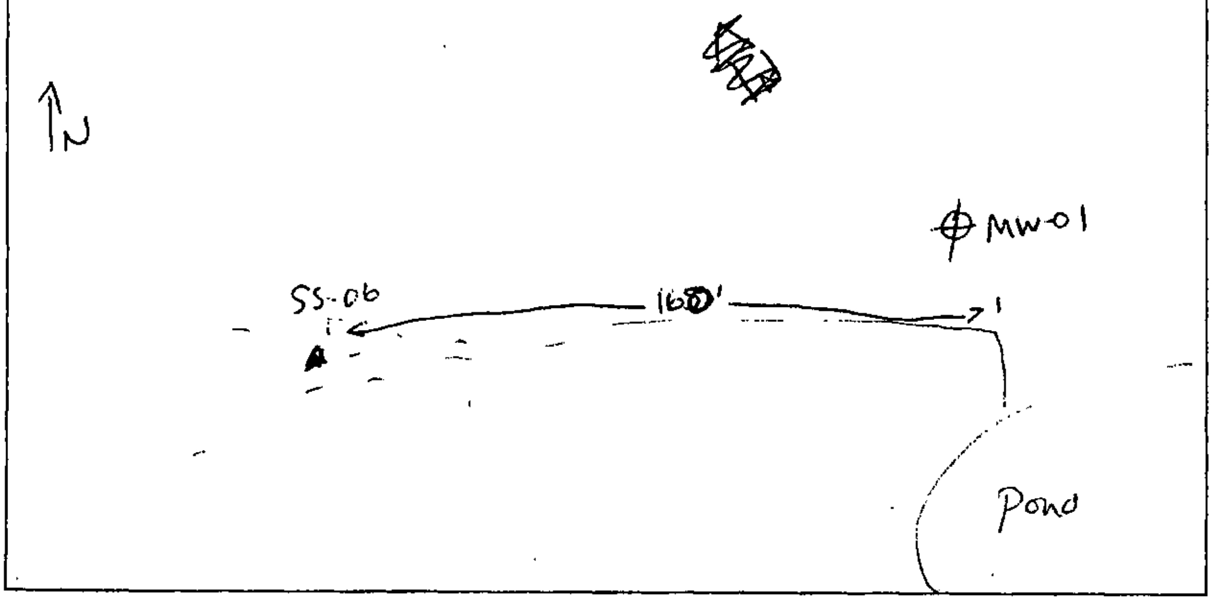

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Figure A-4

Surface Water Sample Sheet

Sample ID 04SS13SW01SW

Site SS13, SW01

Location Cape Romanzof

Date 6/9/04 Time 1545

Sampler BT/MC

☒ QA/QC Sample additional sample provided

☒ Associated QA/QC Sample

Split

Duplicate 04SS13SW101SW

☐ Marine	☐ Lake/Pond (LK)	Sample Depth 2"
☐ Brackish	☐ River (RV)	Total Depth —
☒ Freshwater	☒ Stream/Creek (SP)	Velocity (ft./Sec.) —
☐ Seep/Spring (SE)	☐ Other	Flow Direction W
☐ Emergent Vegetation		

Temperature °C ~~10~~ 7.7	☑ Color Clear
pH 7.51	☐ Odor NO
Conductance (mS) 10.0 mS	☐ Sheen NO
	☐ Debris NO
Dissolved O_2 11.09	☐ Turbidity CLEAR

Location Diagram/Notes

See figure SW-03

A4 Surface Water Sample Sheet

Figure A-4

Surface Water Sample Sheet

Sample ID 04SS13SW02SW
Site SS13 SW02
Location Romanzof

Date 6/9/04 Time 1530
Sampler BT/MC
☐ QA/QC Sample

☐ Associated QA/QC Sample
Split
Duplicate

☐ Marine
☐ Brackish
☒ Freshwater
☐ Seep/Spring (SE)
☐ Emergent Vegetation

☐ Lake/Pond (LK)
☐ River (RV)
☒ Stream/Creek (SP)
☐ Other

Sample Depth ~2'
Total Depth —
Velocity (ft./Sec.) —
Flow Direction West

Temperature °C 7.9
pH 7.07
Conductance (mS) 10
Dissolved O_2 11.35

☒ Color clear
☐ Odor None
☐ Sheen None
☐ Debris None
☐ Turbidity Clear

Location Diagram/Notes

see figure SW-03

Figure A-4

Surface Water Sample Sheet

Sample ID 04SS13SW03SW
Site SS13, SW-03
Location Romanzof

Date 6/9/09 Time 1500
Sampler BT
☐ QA/QC Sample
☐ Associated QA/QC Sample
Split
Duplicate

☐ Marine
☐ Brackish
☒ Freshwater
☐ Seep/Spring (SE)
☐ Emergent Vegetation

☐ Lake/Pond (LK)
☐ River (RV)
☒ Stream/Creek (SP)
☐ Other

Sample Depth 2"
Total Depth 2"
Velocity (ft./Sec.) —
Flow Direction WNW

Temperature °C ~~1K~~ 6.8°C
pH 7.97
Conductance (mS) 10.0
Dissolved O_2 11.31 mg/L

☒ Color Clear
☐ Odor No
☐ Sheen No
☐ Debris None
☐ Turbidity Very little.

Location Diagram/Notes

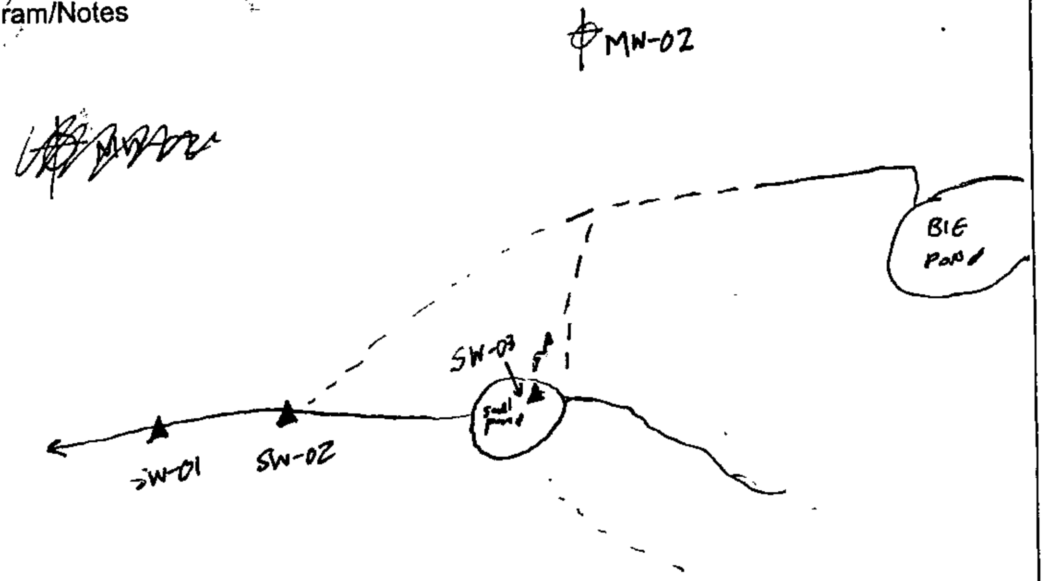

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler: C.Wang, M.Carnahan
Sample Location (ie. MW1): MW-01
Sample ID (ie. 95BIA WG003): 04SS13MW01GW
Date Sample Collected: 6/22/04
Time sampled: 2000

Well Information

Groundwater: X
Other:
Casing Diameter (in): 2"
a) Well Depth (ft): 26.3
b) Water Depth (ft): 23
c) Water Column (ft): 3.3
d) Calc. Purge Vol. (gal): 0.5

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature ~~(F)~~ C	Color	Turbidity	Redox	Dissolved O_2	TDS Other
1945	0.5	5.81	60	2.8	rust	NONE	356	3.56	40
1950	0.5	5.70	60	2.6	rust	NONE	405	4.0	30
1955	0.5	5.52	60	2.9	rust	NONE	405	4.0	30

Total Volume Purged:
Free Product (y/n): N
Odor: FUEL ODOR
Sheen (y/n): VERY LITTLE

Purge Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
GOOD, MONUMENT SIGNIFICANTLY HIGH THAN WELL CASING

Remarks (well recovery, unusual conditions/observations):
ADDED A LOCK

Duplicate Sample ID:
Split Sample ID:

Signed:
Date: 6/22/04
Signed/reviewer:
Date:

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Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler: BAT, MTC

Sample Location (ie. MW1): SS15, WW-02
Sample ID (ie. 95BIA WG003): 04SS15WW02GW
Date Sample Collected: 6/8/09
Time sampled: 1840

Well Information

Groundwater: 63.36
Casing Diameter (in): 4"
Other: smells like product
use product/water interface - no product detected

a) Well Depth (ft): 69.15
b) Water Depth (ft): 63.36
c) Water Column (ft): 5.79
d) Calc. Purge Vol. (gal): 3.76 / well casing
~11 gal purge

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
[✓ 4]	[✓ 0.65]
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	~~Other~~ TDS
1300	1.5	Bailed	Dry	- Had sheen	so	did not	take	field meas	urement
1539	-	7.28	2700	6.80	Brown	V. High	179 MV	-	80

Total Volume Purged: ~~2.5~~ 3.0 gallons
Odor: yes
Free Product (y/n): No
Sheen (y/n): yes

Purge Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
MISSING LOCK

Remarks (well recovery, unusual conditions/observations):
Removed 1/2" tubing from interior of well
well purged dry #3. ~~[illegible]~~ still present. parameters final. Me

Duplicate Sample ID: sheen
Split Sample ID:

Signed:
Date: 6/8/04
Signed/reviewer:
Date: 6/8/04

Did not measure D.O. @ this well
as sheen could interfere w/ instrument
behavior

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler: BT, MC
Sample Location (ie. MW1): MW-02, SS-13
Sample ID (ie. 95BIA WG003): 04SS13MW02GW
Date Sample Collected: 8/31/04
Time sampled: 1200

Well Information

Groundwater: 4.06
Casing Diameter (in): 2"
Other:
a) Well Depth (ft): 12.04
b) Water Depth (ft): 4.06
c) Water Column (ft): 7.98
d) Calc. Purge Vol. (gal): 3.8

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity ~~(mS)~~ mS/cm	Temperature °C ~~(F)~~	Color	Turbidity	Redox	Dissolved O_2	Other
[illegible]	1.5	4.7	50	5.8	BRN	Med to Hi	393	3.5	–
[illegible]	3.0	4.7	40	5.3	BRN	Hi	405	3.5	–
[illegible]	4.5	4.8	40	5.2	BRN	Hi	411		–

Total Volume Purged: NO
Odor:
Free Product (y/n): NO
Sheen (y/n): NO

Purge Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Sample Method ([✓ disposable bailer], teflon bailer, submersible pump, etc.)

Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.)
ABOVE GROUND MOUNT IS LOOSE - STANDING WATER ~18" DEEP NEXT TO MONUMENT
WATER WAS EXTREMELY TURBID

Remarks (well recovery, unusual conditions/observations):
BAILS DRY BUT FAST RECHARGE
WELL MADE BUBBLING NOISE AS SAMPLED - PERHAPS CASING NOT A TIGHT CONNECTION?

Duplicate Sample ID: NONE
Split Sample ID:

Signed:
Date: 8.31.04
Signed/reviewer:
Date:

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Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler:
Sample Location (ie. MW1): WW-07
Sample ID (ie. 95BIA WG003): 04SS15WW07GW
Date Sample Collected: 8/31/04
Time sampled: ~~1230~~

Well Information

Groundwater: 7.42*
Casing Diameter (in): 2"
Other:
*sampled water in inner tube (

a) Well Depth (ft): 12.03
b) Water Depth (ft): 7.42
c) Water Column (ft): 4.61
d) Calc. Purge Vol. (gal): 2.25

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 8-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity (mS)	Temperature (F)	Color	Turbidity	Redox	Dissolved O_2	Other
	.75								
	1.5								
	2.25								

Total Volume Purged:
Odor: N
Free Product (y/n): N
Sheen (y/n): N

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
Perstaltic Pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
perstaltic pump

Well Integrity (condition of casing, flush mount sealing properly, cement seal intact, etc.)
Well has inertial pump tubing inside - could not remove

Remarks (well recovery, unusual conditions/observations):
DID NOT SAMPLE

Duplicate Sample ID:
Split Sample ID:

Signed:
Date: 8/31/04
Signed/reviewer:
Date:

Figure A-3

GROUNDWATER SAMPLE DATA SHEET

Project Number: 4112
Project Name: Cape Romanzof 2003
Client: AFCEE
Sampler:

Sample Location (ie. MW1): ~~#~~ WW-08
Sample ID (ie. 95BIA WG003): 04SS15WW08GW
Date Sample Collected: 8/31/04
Time sampled: 1600

Well Information

Groundwater: 10.10
Casing Diameter (in): 2"
Other:

a) Well Depth (ft): 25.62
b) Water Depth (ft): 10.10
c) Water Column (ft): 15.52
d) Calc. Purge Vol. (gal): 2.5

Calculating Purge Volume

Well Casing Diameter	Multiply c) by:
2	0.16
4	0.65
6	1.47

Example 1- purging only well casing volume
You have 2-inch casing and 6-foot water column.
One Purge Volume= 0.16 X 6 = 0.96 gallons water

Sand Pack Diameter	Multiply c) by:
8	0.71
10	1
12	1.28

Note: assuming sand pack has 29% porosity
Example 2- purging well casing and sand pack volume
You have 2-inch casing, 6-inch sand pack, and 6-foot water column.
One Purge Volume= (0.16 X 6) + (0.71 X 6) = 5.22 gallons water

FIELD MEASUREMENTS

Time	Volume (gallons)	pH	Conductivity ~~(mS)~~ µS	Temperature ~~(°F)~~ °C	Color	Turbidity	mV Redox	Dissolved O_2	Other	TDS ppm
1540	2.5	5.8	60	3.9	clear	none	421	4 mg/L	—	90
1605	5.0	5.6	70	3.7	yellow	none	408	4.5 mg/L	—	110
1650	6.5	5.2	80	3.6	clear	none	429	4.4 mg/L	—	112
1620	7.5	5.1	80	3.4	clear	none	434	4.4	—	116

Total Volume Purged:
Free Product (y/n): NO
Odor: NO
Sheen (y/n): NO

Purge Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Sample Method (disposable bailer, teflon bailer, submersible pump, etc.)
peristaltic pump

Well Integrity (condition of casing, flush mount sealing property, cement seal intact, etc.)
Casing appears to be broken @ ~6' btoc as bailer would not go further past this point and was covered in bentonite when pulled up.

Remarks (well recovery, unusual conditions/observations):
Well in good condition — casing bent/broken/ruptured - see above.
movement

Duplicate Sample ID: NONE
Split Sample ID: NONE

Signed:
Date: 8/31/04
Signed/reviewer:
Date:

Appendix D

Quality Assurance Report

APPENDIX D: QUALITY ASSURANCE REPORT (QAR)

1 QUALITY ASSURANCE REPORT (QAR)

In general, the overall quality of the data for the Monitored Natural Attenuation (MNA) sampling event at the Cape Romanzof sites SS13, SS15, and LF03 is acceptable and is considered usable for the purposes of this project. The QA/QC data indicate that the quality control mechanisms were effective in ensuring measurement data reliability within the expected limits of sampling and analytical error. Where applicable, the appropriate data qualifiers have been assigned to the analytical results as discussed herein. The computed completeness percentage for this project is 100 percent.

The data review procedures, calculations, and qualifications used for this project are based on the Air Force Center for Environmental Excellence (AFCEE) and U.S. Environmental Protection Agency (USEPA) procedural guidance documents. The reference documents used include the AFCEE *Guidance for Contract Deliverables, Quality Assurance Project Plan, Version 3.1* dated August 2001, USEPA *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA 540/R-99/008), October 1999; and the USEPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 540/R-01/008), July 2002. Specific procedures, calculations, and qualifications for this sampling program have been completed in conformance with the June 1, 2004 final *Quality Assurance Project Plan* (Paug-Vik, 2004) for this project.

1.1 Project Summary

SGS Environmental Services (SGS) provided project laboratory services for the field sampling event at SS13 and SS15. The five analytical data packages (SGS work order numbers 1043252, 1043258, 1043273, 1043659, and 1045677) provided by the project laboratory were reviewed to evaluate the integrity of the associated results. Sampling at these sites was conducted on June 8, 9, and 22, and August 31, 2004. SGS Environmental Services also provided laboratory services for samples collected at LF03. The six analytical data packages (SGS work order numbers 1043353, 1043358, 1043361. 1043724, 1043725, and 1045677) provided by the project laboratory were reviewed to evaluate the integrity of the associated results. Sampling at site LF03 was conducted on June 12, 13, and 24, and August 31, 2004.

1.2 Data Quality Objectives

The *Final Work Plan for 2004 Environmental Monitoring and Remedial Investigation/Feasibility Study at Cape Romanzof LRRS* (dated June 1, 2004) provides the list of analytes to be included during the site investigation activities. The analytical reporting limits required for this project include the most stringent of the following requirements:

- 18 AAC 75 Method Soil Cleanup Levels (Tables B1 and B2)
- Alaska Water Quality Standards 18 AAC 70 (Ground and Surface Water)
- NOAA Screening Quick Reference Tables (Sediment)

2 Summary of QA/QC Procedures

Problems with analytical data usually occur in spite of all precautions taken in the planning and execution of the sampling and analysis task. This Quality Assurance Report (QAR) specifies any data problems in terms of the data that are affected and how these data may be limited for use in their intended applications. The data assessment is conducted in a two-step process. The first step is performed by the analytical laboratory and is based on their standard operating and quality control procedures. After the laboratory analyses have been completed and the laboratory has reported the data, the architect-engineer (AE) firm performs the second step of the data assessment. This QAR discusses the second step of the data review process. The data review procedures that were performed for this project include:

- Initial review of analytical and field data for complete and accurate documentation, holding time compliance, and required frequency of quality control (QC) samples.
- Evaluation of blank samples to identify systematic contamination.
- Statistical calculations for accuracy and precision using the appropriate quality control sample results.
- Assigning of data qualifier flags to the data as necessary to reflect limitations identified by the data assessment process.
- Estimate of completeness, in terms of the percent of valid data.

Quality control data provide information for identifying and defining qualitative limitations associated with measurement data. The following key types of QC procedures provide the primary basis for quantitatively evaluating data quality:

- Sample handling procedures.
- Field and laboratory blank samples.
- Laboratory control samples.
- Matrix spiked samples.
- Surrogate spikes.
- Field duplicate and split samples.

2.1 Sample Handling Procedures

Proper sample handling techniques are required to ensure sample integrity. The following items are included in the sample handling criteria:

- Sample collection (i.e., container type) and preservation method.
- Maintaining proper sample temperature during storage and transport.
- Chain-of-custody procedures to prevent sample tampering.
- Holding time limits for sample extraction and analysis.
- Proper sample labeling and documentation to ensure correct sample identification.

The analytical data reports received from the laboratories were reviewed to determine compliance with the sample handling and holding time criteria.

2.2 Blank Samples

2.2.1 Laboratory Blank Samples

Laboratory blank samples (method blanks) are laboratory-prepared, analyte-free matrices designed to detect the introduction of contamination or other artifacts into the laboratory sample handling and analytical process. These blanks play an especially important role in sampling programs involving trace-level analyses or analytes that are solvents commonly found in a laboratory.

2.2.2 Trip Blanks

A trip blank is a sample of analyte-free media taken from the laboratory to the sampling site, and returned to the laboratory unopened for analysis. A trip blank simulates a sample container and sample traveling to/from the field. It is used to document contamination attributable to shipping and field handling procedures. This type of blank is particularly useful in documenting contamination of volatile organic samples.

2.3 Laboratory Control Samples

Laboratory control samples are used to assess analytical performance under a given set of standard conditions. These are synthetic samples containing some or all of the analytes of interest at known concentrations and prepared independently from calibration standards. The samples consist of laboratory control samples (LCS) and laboratory control sample duplicates (LCSD). Typically analyzed with each analytical batch, laboratory control samples may be used to estimate analytical accuracy and precision by comparing measured results to theoretical concentrations.

Laboratory control samples are also duplicated in the laboratory and then analyzed in an identical manner by the laboratory to assess the laboratory's internal precision. The analytical precision is expressed by the relative percent difference (RPD) between the measurement results of the two duplicate samples.

2.4 Matrix Spikes and Matrix Spike Duplicates

Matrix spiked samples are field samples to which known amounts of a spike compound (one of the analytes of interest) has been added. Both a spiked and an unspiked aliquot are analyzed. The difference between the concentration of the spike compound in the spiked and unspiked aliquots is compared to the amount of spike added before the extraction process. Since actual samples are used for the recovery determination, any matrix effects are taken into consideration. Usually expressed as a percentage of the mass of the spiked amount, spike recovery can be considered a measure of the method accuracy in the field sample matrix.

Matrix spikes samples are also duplicated in the laboratory and then analyzed in an identical manner by the laboratory to assess laboratory's internal precision. The analytical precision is expressed by the RPD between the measurement results of the two duplicate samples.

2.5 Surrogate Compounds

Surrogates are generally added to all analytical samples being analyzed for organic compounds. All samples are spiked with one or more of the surrogate compounds, which are chemically similar to the analytes of interest but are not expected to be present in the original sample. Recovery of these surrogate compounds gives an estimate of the effectiveness of the extraction and analysis for each individual sample.

2.6 Field Duplicate and Split Samples

Field duplicate samples are collected simultaneously with or in immediate succession to a primary project sample. Duplicates are designed to replicate their primary samples. Duplicates are treated in the same manner as the primary sample during all phases of sample collection, handling, and analysis. Duplicate sample results are used to assess precision, including variability associated with both the laboratory analysis and the sample collection process. Split samples are collected in an identical manner to duplicate samples; however, they are submitted to an independent laboratory for analysis. Duplicate field samples were collected and submitted blind to the project laboratory at a frequency of ten percent for this program. Split samples were not collected under this sampling program.

The analytical results are reviewed for agreement with each other or their respective reporting limits and evaluated for comparability. The primary, field duplicate, and QA laboratory results must be within the RPD established by each of the analytical methods as established in the QAPP to be considered comparable. Estimated data (results that have been quantified below the reporting limit and results qualified with an "F" flag) will not be considered significant for the purpose of data agreement.

2.7 Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. Completeness is calculated and reported for each method, matrix and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an "R" flag. The requirement for completeness is 95 percent for aqueous samples and 90 percent for soil samples. For any instances of samples that could not be analyzed for any reason (holding time violations in which re-sampling or re-analysis was not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of results possible minus the number of non-reportable results.

The formula for calculation of completeness is presented below:

$$\%\ \text{completeness} = \frac{\text{number of valid (i.e., non-R flagged) results}}{\text{number of possible results}}$$

2.8 Data Qualification

Based on the data assessment the analytical data results are flagged with qualifiers to indicate potential problems with the qualified results. The following is a list of data qualifiers that were used in this report. A definition of the data qualifier meaning is also provided.

Table E-1 Data Qualifiers

Qualifier	Description
J	The analyte was positively identified, but the quantitation is an estimation.
ND/U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the method reporting limit. The method reporting limit is shown in brackets.
F	The analyte was positively identified but the associated numerical value is below the laboratory's reporting limit.
R	The data are unusable due to deficiencies in the ability to analyze the sample and meet QC criteria.
B	The analyte was found in an associated blank, as well as in the sample.
M	A matrix effect was present.
S	To be applied to all field screening data.
T	Tentatively identified compound (using GC/MS).
V	Indicates that the data qualifier was assigned during the data review process, as opposed to being assigned by the laboratory.

3 DATA QUALITY REVIEW OF SS13 AND SS15 SAMPLE DATA

Samples collected at SS13 and SS15, consisting of surface soil, ground water, sediment, and surface water, were analyzed in accordance with EPA methods found in SW846. QC procedures associated with these samples included the evaluation of sample holding times, sample containers and preservation, blank samples, laboratory control samples, field duplicates, matrix spikes, and surrogate spikes. Results of these analyses are discussed in this section.

3.1 Holding Times

Holding times for all analytical sample requests were reviewed and found to be consistent with the USEPA recommended holding times.

3.2 Containers and Preservation

Samples were received in containers with preservation consistent with requested analyses to be performed at the laboratory.

SGS Environmental Services Alaska Division received the samples for this project in six coolers. All six coolers had cooler temperatures within the recommended temperature range of 4 ± 2 degrees Celsius. One temperature blank was below the recommended temperature range, these results are not qualified as no effect on the results was apparent.

3.3 Ground Water Samples

Five groundwater samples were collected at SS13 and SS15 for gasoline range organics (GRO), diesel range organics (DRO), residual range organics (RRO), benzene, toluene, ethylbenzene, and xylenes

(BTEX), alkalinity, nitrogen and sulfate, iron, and polynuclear aromatic hydrocarbon (PAH) analyses. Results for these five samples are included in three different work orders. Three samples (locations MW-02, EB, and WW-08) are part of work order number 1045677, one sample (location MW-01) is part of work order 1043659, and the remaining sample (location WW-02) is part of work order 1043252.

3.3.1 Gasoline Range Organics (GRO)

Four groundwater samples and two trip blanks were collected and analyzed for gasoline-range organics (GRO) using Alaska Method AK101. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. GRO compounds were detected in a method blank and a trip blank sample associated with work order number 1043252 at concentrations below the laboratory-reporting limit (RL), but greater than the method detection limit (MDL). GRO compounds were also detected in method blanks associated with work order number 1045677. Sample results less than five times the highest blank concentration have been flagged VB to indicate potential blank contamination.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for GRO analysis were within acceptance criteria in all of the LCS samples.

- A single surrogate spike compound (4-bromofluorobenzene) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits

3.3.2 Diesel Range Organics (DRO)

Five groundwater samples were collected and analyzed for diesel-range organics (DRO) using Alaska Method AK102. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. DRO compounds were detected in the method blank samples associated with work orders 1043252 and 1045677 at concentrations below the laboratory reporting limit, but greater than the method detection limit. Sample results that are less than five times the method blank concentration in these work orders have been flagged VB to indicate potential blank contamination.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for DRO analysis were within acceptance criteria in all of the LCS samples.

- A single surrogate spike compound ($C_{19}H_{32}$) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. The surrogate recovery associated with the sample 04SS15WW02GW was above control limits and the sample result is flagged VJ. All other surrogate recoveries were within acceptable control limits.

3.3.3 Residual Range Organics (RRO)

Five groundwater samples were collected and analyzed for residual-range organics (RRO) using Alaska Method AK103. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. The analytical results are acceptable with the following qualifications.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential RRO contamination. RRO compounds were detected in a method blank associated with SGS work order number 1043252, sample results associated with this work order are non-detect and qualifiers have not been assigned. All other method blank results and recoveries met acceptance criteria.
- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for RRO analysis were within acceptance criteria in all of the LCS samples.
- A laboratory MS/MSD sample pairs was analyzed to determine matrix effects on accuracy and precision. One MS/MSD pair associated with work order number 1043659 and site SS13 had relative percent difference (RPD) values above control limits. Qualifiers were not assigned because associated results were not above reporting limits.
- A single surrogate spike compound (n-triacontane) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within control limits.

3.3.4 Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)

Five groundwater samples and three trip blanks were collected and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) using EPA Method SW8021B. This analytical method involves purge-and-trap gas chromatography using a flame ionization detector. All analytical results are acceptable for use on this project without exception.

- Method blanks and trip blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. Method and trip blank results and recoveries met acceptance criteria.
- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for BTEX analysis were within acceptance criteria in all of the LCS samples.
- Two surrogate spike compounds (1,4-difluorobenzene and 4-bromofluorobenzene) were added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

3.3.5 Total Alkalinity

Five groundwater samples were analyzed for total alkalinity by EPA Method A2320. All analytical results are acceptable for use on this project without exception.

- Method blanks were analyzed at the appropriate frequency to assess for potential alkalinity contamination. All method blank results and recoveries met acceptance criteria.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recoveries for alkalinity analysis were within acceptance criteria in all of the LCS samples.

3.3.6 Total Nitrogen and Sulfate

Five groundwater samples were analyzed for total nitrogen and sulfate using EPA Method E300. Analytical results are acceptable for project use with the following exceptions noted below.

- Method blanks were analyzed at the appropriate frequency to assess for potential sulfate contamination. No method blanks were analyzed to assess potential nitrogen contamination. Sulfate was detected in the method blank sample associated with work order 1043252 at concentrations greater than the method detection limit, but less than the reporting limit. Results were not qualified because sample results were greater than five times the blank contamination.

- LCS samples were analyzed with the appropriate frequencies to assess method accuracy and precision. The LCS sample associated with SGS work order number 1045677 had recoveries above the control limits and associated positive sample results are flagged VJ. All other LCS recoveries were within control limits.

3.3.7 Iron

Four groundwater samples were analyzed for iron. Two samples (locations MW-01 and WW-02) were analyzed using EPA Method SW6010B, and the two others (locations MW-02 and WW-08) were analyzed using EPA Method SW6020. Because the analysis of dissolved metals involves the aspiration of the sample directly onto the instrumentation, no extraction quality control were analyzed by this method

3.3.8 Polynuclear Aromatic Hydrocarbons (PAHs)

Five groundwater samples were analyzed for Polynuclear Aromatic Hydrocarbons (PAHs) using EPA Method SW8270-SIMS. This method uses a gas chromatograph/mass spectrometry (GC/MS) technique for sample analysis, with selective ion monitoring. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequency to assess for potential PAH contamination. All method blank results and recoveries met acceptance criteria.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. All LCS recoveries for PAH analysis were within control limits.

- Laboratory MS/MSD sample pairs were analyzed at the appropriate frequency to deteremine matrix effects on accuracy and precision. Recoveries for the analyte benzo(a)pyrene were above the control limits. No qualifies are assigned because all associated results are non-detect.

- Three surrogate spike compounds (acenaphthene-d10, chrysene-d12, and naphthalene-d8) were added to each blank, QA/QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

3.4 Surface Soil and Sediment Samples

Three surface soil, and two sediment samples, one MS/MSD sediment sample pair, one sediment field duplicate, and one trip blank were collected at SS13 for DRO, RRO, BTEX, and PAH analysis. All surface soil and sediment samples were part of work order number 1043258.

3.4.1 Diesel Range Organics (DRO)

Three soil samples, three sediment samples, one MS/MSD sediment sample pair were collected and analyzed for diesel-range organics (DRO) using Alaska Method AK102. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. All method blank results and recoveries met QA/QC acceptance criteria.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for DRO analysis were within acceptance criteria in all of the LCS samples.

- One sediment MS/MSD sample pair was analyzed to assess matrix effects on method accuracy and precision. DRO recoveries in the MS/MSD were within control limits.

- A single surrogate spike compound (C19H32) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. The project samples 04SS13LB07SS, 04SS13LB08SS, and 04SS13SS01SD had surrogate recoveries above acceptance criteria. Reportable concentrations of DRO in these samples are flagged VJ.

- One field duplicate sample pair was collected and analyzed for DRO. The RPD for the field duplicate sample was within acceptance criteria.

3.4.2 Residual Range Organics (RRO)

Three soil samples, three sediment samples, one MS/MSD sediment sample pair were collected and analyzed for residual-range organics (RRO) using Alaska Method AK103. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. The analytical results are acceptable with the following qualifications.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential RRO contamination. All method blank results and recoveries met QA/QC acceptance criteria.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for RRO analysis were within acceptance criteria in all of the LCS samples.

- One sediment MS/MSD sample pair was analyzed to assess matrix effects on method accuracy and precision. RRO recovery in the MS/MSD was below acceptance criteria. All RRO results in the related matrix have been flagged VM to indicate a potential matrix bias.

- A single surrogate spike compound (n-triacontane) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. The project samples 04SS13LB07SS, 04SS13LB08SS, 04SS13SS01SD, and 04SS13SS101SD had surrogate recoveries above acceptance criteria. Reportable concentrations of RRO in these samples have been flagged VJ.
- One field duplicate sample pair was collected and analyzed for RRO. The RPD for the field duplicate sample was within acceptance criteria.

3.4.3 Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)

Three soil samples, three sediment samples, one MS/MSD sediment sample pair, and one trip blank were collected and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) using EPA Method SW8021B. This analytical method involves purge-and-trap gas chromatography using a flame ionization detector. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. The analytes m&p-xylene were detected in a method blank at concentrations greater than the method detection limit, but less than the reporting limit. As a result all sample concentrations in the related sample data set within five times the method blank contamination have been flagged VB.
- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for BTEX analysis were within acceptance criteria in all of the LCS samples.
- One sediment MS/MSD sample pair was analyzed to assess matrix effects on method accuracy and precision. BTEX recovery in the MS/MSD pair did not exceed percent recovery or RPD acceptance criteria.
- Two surrogate spike compounds (1,4-difluorobenzene and 4-bromofluorobenzene) were added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable QC control limits.
- One field duplicate sample pair was collected and analyzed for BTEX. A comparison of the field duplicate and the original sample concentrations was not possible because at least one result was below the reporting limit in all instances.

3.4.4 Polynuclear Aromatic Hydrocarbons (PAHs)

Six samples and one sediment MS/MSD sample pair were analyzed for polynuclear aromatic hydrocarbons (PAHs) using EPA Method SW8270-SIMS. This method uses a gas chromatograph/mass spectrometry (GC/MS) technique for sample analysis, with selective ion monitoring. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequency to assess for potential PAH contamination. The PAH-SIM compounds naphthalene and phenanthrene were detected in the method blank sample at concentrations greater than the method detection limit, but less than the reporting limit. As all sample results are greater than five times the method blank contamination, no qualification was required.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for PAH-SIM analysis were within acceptance criteria in all of the LCS samples.

- One sediment MS/MSD sample pair was analyzed to assess matrix effects on method accuracy and precision. PAH-SIM recovery in the MS/MSD was above acceptance criteria for the analyte compounds acenaphthene, acenaphthylene, fluorene, and naphthalene. Results above the reporting limit are flagged VM indicating potential matrix bias.

- Three surrogate spike compounds (acenaphthene-d10, chrysene-d12, and naphthalene-d8) were added to each blank, sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable QA/QC control limits.

- One field duplicate sample pair was collected and analyzed for PAH-SIMs. A comparison of the field duplicate and the original sample concentrations was not possible because at least one result was below the reporting limit in all instances.

3.5 Surface Water Samples

Three surface water samples, one field duplicate, one MS/MSD sample pair, and one trip blank were collected at SS13 for DRO, RRO, limited VOC, and PAH analysis. All results are included in work order 1043273.

3.5.1 Diesel Range Organics (DRO)

Three surface water samples, a field duplicate, and one MS/MSD sample pair were collected and analyzed for diesel-range organics (DRO) using Alaska Method AK102. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. DRO compounds were detected in the method blank sample at concentrations below the laboratory reporting limit, but greater than the method detection limit. Sample results that are less than five times the method blank concentration in these work orders have been flagged VB to indicate potential blank contamination.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for DRO analysis were below acceptance criteria in the LCS sample, all results are flagged VJ.

- One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. DRO recovery in the MS/MSD pair did not exceed percent recovery or RPD acceptance criteria.

- A single surrogate spike compound (C19H32) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

- One field duplicate sample pair was collected and analyzed for DRO compounds. A comparison of the field duplicate and original sample concentrations was not possible because both sample results were below the reporting limit.

3.5.2 Residual Range Organics (RRO)

Three surface water samples, a field duplicate, and one MS/MSD sample pair were collected and analyzed for residual-range organics (RRO) using Alaska Method AK103. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. The analytical results are acceptable with the following qualifications.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential RRO contamination. RRO compounds were not detected in the method blank.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for RRO analysis were below acceptance criteria in the LCS sample. All results are flagged VM.

- One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. RRO recovery in the MS/MSD pair did not exceed percent recovery or RPD acceptance criteria.

- A single surrogate spike compound (n-triacontane) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All recoveries are within acceptance criteria.

- One field duplicate sample pair was collected and analyzed for RRO compounds. A comparison of the field duplicate and original sample concentrations was not possible because both sample results were below the reporting limit.

3.5.3 Polynuclear Aromatic Hydrocarbons (PAHs)

Three surface water samples, a field duplicate, and one MS/MSD sample pair were collected and analyzed for Polynuclear Aromatic Hydrocarbons (PAHs) using EPA Method SW8270-SIMS. All analytical results are acceptable for use on this project with the following exceptions.

- Method blanks were analyzed at the appropriate frequency to assess for potential PAH contamination. No PAH compounds were detected in the method blank.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. The analyte acenaphthylene was above acceptance criteria. No qualifiers were assigned because all sample results are below reporting limits.

- One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. RRO recovery in the MS/MSD pair did not exceed percent recovery or RPD acceptance criteria.

- Three surrogate spike compounds (acenaphthene-d10, chrysene-d12, and naphthalene-d8) were added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

- One field duplicate sample pair was collected and analyzed for PAH compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

3.5.4 Volatile Organic Compounds (VOCs)

A limited number (benzene, toluene, ethylbenzene, xylenes, and chlorobenzenes) of volatile, or purgeable, organic compounds (VOCs) were analyzed by EPA Method E624. Three surface water samples, a field duplicate, one MS/MSD sample pair, and a trip blank were collected and analyzed by this method. All analytical results are acceptable for use on this project without exception.

- Method and trip blanks were analyzed at the appropriate frequency to assess potential VOC contamination. All method and trip blank results and recoveries met acceptance criteria.
- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recoveries for VOC analysis were within acceptance criteria in the LCS samples.
- One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. VOC recoveries in the MS/MSD pair did not exceed percent recovery or RPD acceptance criteria.
- Three surrogate spike compounds (4-bormofluorobenzene, 1,2-dichloroethane-d4, and toluene-d8) were added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.
- One field duplicate sample pair was collected and analyzed for PAH compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

4 DATA QUALITY REVIEW OF LF03 SAMPLE DATA

Samples collected at LF03, consisting of ground water, sediment, and surface water samples, were analyzed in accordance with EPA methods found in SW846. QC procedures associated with these samples included the evaluation of sample holding times, sample containers and preservation, blank samples, laboratory control samples, field duplicates, matrix spikes, and surrogate spikes. Results of these analyses are discussed in this section.

4.1 Holding Times

Holding times for all analytical sample requests were reviewed and found to be consistent with the USEPA recommended holding times.

4.2 Containers and Preservation

Samples were received in containers with preservation consistent with requested analyses to be performed at the laboratory.

SGS Environmental Services Alaska Division received the samples for this project in seventeen coolers. All coolers had temperature blank and cooler temperatures within the recommended temperature range of 4 ± 2 degrees Celsius.

4.3 Ground Water Samples

Eight groundwater samples, one MS/MSD sample pair, one field duplicate, and two trip blanks were collected at LF03. These samples were analyzed for DRO, BTEX, PCBs, and PAHs. Sample results from sites CMW-01, CMW-03, and CMW-07 are included in work order number 1043725; the associated trip blank for this work order is included in work order 1043724. Sample results from site CMW-02 are included in work order number 1045677, and results for site MW-01 are included in work order number 1043358. Sample results for sites CMW-04, CMW-05, CMW-06, and the field duplicate (for site CMW-06) are included in work order 1043353, the associated trip blank for these sites is included in work order 1043358.

4.3.1 Diesel Range Organics (DRO)

Eight groundwater samples, one MS/MSD sample pair, and one field duplicate sample were collected and analyzed for diesel-range organics (DRO) using Alaska Method AK102. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. All analytical results are acceptable for use on the project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. DRO compounds were detected in the method blank samples associated with work orders 1043353 and 1045677, at concentrations below the laboratory reporting limit, but greater than the method detection limit. Sample results that are less than five times the method blank concentration in these work orders have been flagged VB to indicate potential blank contamination. All other method blank results and recoveries met acceptance criteria.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for DRO analysis were below acceptance criteria for samples associated with work orders 1043353, and 1043358. All associated results are flagged VJ.

- One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. Percent recovery values for DRO analysis were below acceptance criteria, and all sample results are flagged VM indicating potential matrix bias.

- A single surrogate spike compound ($C_{19}H_{32}$) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

- One field duplicate sample was collected and analyzed for DRO compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

4.3.2 Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)

Eight groundwater samples, one MS/MSD sample pair, one field duplicate sample, and one trip blank were collected and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) were analyzed for using EPA Method SW8021B. The analytical method involves purge-and-trap gas chromatography using and flame ionization detector. All analytical results are acceptable for use on this project with the following exceptions.

- Method blanks and trip blanks were analyzed at the appropriate frequency to assess for potential BTEX contamination. The analytes m&p-xylene were detected in the trip blank (associated with work order 1043358) below the method reporting limit, but above the method detection limit. Associated positive results are flagged VB indicating potential blank contamination.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recoveries for BTEX analysis were within acceptance criteria in all of the LCS samples.

- One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. Percent recovery values for BTEX analysis were within acceptance criteria.

- A single surrogate spike compound (1,4-diflourobenzene) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

- One field duplicate sample was collected and analyzed for BTEX compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

4.3.3 Polychlorinated Biphenyls (PCB)

Polychlorinated biphenyls (PCBs) were analyzed using EPA Method SW8082. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using an electron capture detector. Eight groundwater samples, one MS/MSD sample pair, and one field duplicate sample were analyzed to assess for potential PCB contamination. All analytical results are acceptable for use on this project without exception.

- Method blanks were analyzed at the appropriate frequency to assess for potential pesticide and PCB contamination. All method blank results and recoveries met acceptance criteria.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recoveries for PCB analysis were within acceptance criteria in all of the LCS samples.

- One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. Percent recovery values for PCB analysis were within acceptance criteria.

- One surrogate spike compound (decachlorobiphenyl) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

- One field duplicate sample was collected and analyzed for PCB compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

4.3.4 Polynuclear Aromatic Hydrocarbons (PAHs)

Eight groundwater samples, one MS/MSD sample pair, and one field duplicate sample were analyzed for polynuclear aromatic hydrocarbons (PAHs) using EPA Method SW8270-SIMS. This method uses a gas chromatograph/mass spectrometry (GC/MS) technique for sample analysis, with selective ion monitoring. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequency to assess for potential PAH contamination. The PAH compound naphthalene was detected in the method blank samples associated with work orders 1043353, 1043358, and 1043725 at concentrations greater than the method detection limit, but less than the reporting limit. Samples within five times the concentration in the related method blank have been flagged VB to indicate potential blank contamination.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recoveries for PAH analysis were with acceptance criteria.

- One MS/MSD sample pair was analyzed to assess matrix effects on accuracy and precision. Percent recovery values for PAH analysis were within acceptance criteria.

- Three surrogate spike compounds (acenaphthene-d10, chrysene-d12, and naphthalene-d8) were added to each blank, QA/QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

- One field duplicate sample was collected and analyzed for PAH compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

4.4 Sediment Samples

Three sediment samples and one trip blank were collected at site LF03. These samples were analyzed for DRO, BTEX, PCBs, and PAHs. A single MS/MSD sample pair was collected for DRO analysis. All sample results are included in work order 1043616.

4.4.1 Diesel Range Organics (DRO)

Three sediment samples and one MS/MSD sample pair were collected and analyzed for diesel-range organics (DRO) using Alaska Method AK102. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. All method blank results and recoveries met acceptance criteria.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for DRO analysis were within acceptance criteria in all of the LCS samples.

- One MS/MSD sample pair was analyzed to asses matrix effects on accuracy and precision. Percent recovery values for DRO analysis were within acceptance criteria.

- A single surrogate spike compound ($C_{19}H_{32}$) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable QC control limits.

4.4.2 Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)

Three sediment samples and one trip blank were collected and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) were analyzed for using EPA Method SW8021B. The analytical method involves purge-and-trap gas chromatography using and flame ionization detector. All analytical results are acceptable for use on this project with the following exceptions.

- Method and trip blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. The analytes m&p-xylene were detected in the trip blank sample at a concentration below the laboratory reporting limit, but greater than the method detection limit. Sample results were non-detects and are not qualified.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for BTEX analysis were within acceptance criteria in all of the LCS samples.

- A single surrogate spike compound (1,4-difluorobenzene) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

4.4.3 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) were analyzed using EPA Method SW8082. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using an electron capture detector. Three sediment samples were collected for analysis, all analytical results are acceptable for use on this project without exception.

- Method blanks were analyzed at the appropriate frequency to assess for potential pesticide and PCB contamination. All method blank results and recoveries met acceptance criteria.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recoveries for PCB analysis were within acceptance criteria in all of the LCS samples.

- One surrogate spike compound (decachlorobiphenyl) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

4.4.4 Polynuclear Aromatic Hydrocarbons (PAHs)

Three sediment samples were analyzed for polynuclear aromatic hydrocarbons (PAHs) using EPA Method SW8270-SIMS. This method uses a gas chromatograph/mass spectrometry (GC/MS) technique for sample analysis, with selective ion monitoring. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequency to assess for potential PAH contamination. Two PAH compounds, naphthalene and phenanthrene, were detected, however sample results are non-detect and are not qualified.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recoveries for PAH analysis were within acceptance criteria in all of the LCS samples.

- One MS/MSD sample pair was analyzed to assess matrix intereference. The RPD values for chrysene were below acceptance criteria and all results are flagged VM to indicate potential matrix intereference.

- Three surrogate spike compounds (acenaphthene-d10, chrysene-d12, and naphthalene-d8) were added to each blank, QA/QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.

4.5 Surface Water Samples

Three surface water samples were collected at LF03, and analyzed for DRO, BTEX, PCBs, and PAHs. Sample results from site SW-01 (including the field duplicate) and SW-03 are included in work order 1043358, and sample results from site SW-02 are included in work order 1043353.

4.5.1 Diesel Range Organics (DRO)

Three surface water samples and one field duplicate sample were collected and analyzed for diesel-range organics (DRO) using Alaska Method AK102. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using a flame ionization detector. All analytical results are acceptable for use on this project with the exceptions noted below.

- Method blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. DRO compounds were detected in the method blank samples associated with work orders 1043353 and 1043358 at concentrations below the laboratory reporting limit, but greater than the method detection limit. Sample results that are less than five times the method blank concentration in these work orders have been flagged VB to indicate potential blank contamination.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for DRO analysis were below acceptance criteria in all of the LCS samples and all results are flagged VJ.

- A single surrogate spike compound (C19H32) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable QC control limits.

- One field duplicate sample pair was collected and analyzed for DRO compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

4.5.2 Benzene, Toluene, Ethylbenzene, and Xylenes (BTEX)

Three surface water samples and one field duplicate sample were collected and analyzed for benzene, toluene, ethylbenzene, and xylenes (BTEX) were analyzed for using EPA Method SW8021B. The analytical method involves purge-and-trap gas chromatography using and flame ionization detector. All analytical results are acceptable for use on this project with the following exceptions.

- Method and trip blanks were analyzed at the appropriate frequencies, with the above referenced samples to assess potential sample contamination. The analytes m&p-xylene were detected in the trip blank at a concentration below the laboratory reporting limit, but greater than the method detection limit. Sample results are flagged VB indicating potential blank contamination.

- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for BTEX analysis were within acceptance criteria in all of the LCS samples.
- A single surrogate spike compound (1,4-difluorobenzene) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable QC control limits.
- One field duplicate sample pair was collected and analyzed for BTEX compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

4.5.3 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) were analyzed using EPA Method SW8082. This analytical method involves extraction of the sample with methylene chloride and quantification by gas chromatography using an electron capture detector. Three surface water samples and one field duplicate sample were collected for analysis, all analytical results are acceptable for use on this project without exception.

- Method blanks were analyzed at the appropriate frequency to assess for potential pesticide and PCB contamination. All method blank results and recoveries met acceptance criteria.
- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recoveries for PCB analysis were within acceptance criteria in all of the LCS samples.
- One surrogate spike compound (decachlorobiphenyl) was added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable control limits.
- One field duplicate sample pair was collected and analyzed for BTEX compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

4.5.4 Polynuclear Aromatic Hydrocarbons (PAHs)

Three surface water samples and one field duplicate were analyzed for polynuclear aromatic hydrocarbons (PAHs) using EPA Method SW8270-SIMS. All analytical results are acceptable for use on this project with the following exceptions.

- Method blanks were analyzed at the appropriate frequency to assess for potential PAH contamination. The PAH compound naphthalene was detected in the method blank at a concentration greater than the method detection limit, but less than the reporting limit. As a result sample concentrations within five times the concentration in the method blank have been flagged VB to indicate potential blank contamination.
- LCS samples were analyzed at the appropriate frequencies to assess method accuracy and precision. Percent recovery values for PAH analysis were within acceptance criteria in all of the LCS samples.

- Three surrogate spike compounds (acenaphthene-d10, chrysene-d12, and naphthalene-d8) were added to each blank, QC sample, and project sample to assess the sample extraction recovery. All surrogate recoveries were within acceptable QC control limits.

- One field duplicate sample pair was collected and analyzed for BTEX compounds. A comparison of the field duplicate and original sample concentrations was not possible because all sample results were below the reporting limit.

Appendix E

Summary Analytical Data Tables

Cape Romanzof
LF03
Ground Water

		Location	MW-01		CMW-01		CMW-02		CMW-03		CMW-04	
		Sample Type	N		N		N		N		N	
		Client Sample ID	04LF03MW01GW		04LF03CMW1GW		04LF03CMW02GW		04LF03CMW3GW		04LF03CMW04GW	
		Matrix	WG		WG		WG		WG		WG	
		Laboratory Report #	1043358		1043725		1045677		1043725		1043353	
Analyte	**Method**	**Units**										
Diesel Range Organics	AK102	MG/L	0.0713	F VJ,VM	ND	[0.3] VM	0.226	F VM,VJ	ND	0.323] VM	0.355	VB,VJ,VM
Benzene	SW8021B	UG/L	ND	[0.5]	ND	[0.5]	ND	[0.5]	0.156	F	0.393	F
Ethylbenzene	SW8021B	UG/L	ND	[2]	ND	[2]	ND	[2]	ND	[2]	ND	[2]
Toluene	SW8021B	UG/L	ND	[2]	ND	[2]	ND	[2]	ND	[2]	ND	[2]
m,p-Xylene (Sum of Isomers)	SW8021B	UG/L	ND	[2]	ND	[2]	ND	[2]	ND	[2]	0.935	F VB
o-Xylene	SW8021B	UG/L	ND	[2]	ND	[2]	ND	[2]	ND	[2]	1.12	F
PCB-1016 (Aroclor 1016)	SW8082	UG/L	ND	[0.102]	ND	[0.1]	ND	[0.111]	ND	[0.108]	ND	[0.102]
PCB-1221 (Aroclor 1221)	SW8082	UG/L	ND	[0.102]	ND	[0.1]	ND	[0.111]	ND	[0.108]	ND	[0.102]
PCB-1232 (Aroclor 1232)	SW8082	UG/L	ND	[0.102]	ND	[0.1]	ND	[0.111]	ND	[0.108]	ND	[0.102]
PCB-1242 (Aroclor 1242)	SW8082	UG/L	ND	[0.102]	ND	[0.1]	ND	[0.111]	ND	[0.108]	ND	[0.102]
PCB-1248 (Aroclor 1248)	SW8082	UG/L	ND	[0.102]	ND	[0.1]	ND	[0.111]	ND	[0.108]	ND	[0.102]
PCB-1254 (Aroclor 1254)	SW8082	UG/L	ND	[0.102]	ND	[0.1]	ND	[0.111]	ND	[0.108]	ND	[0.102]
PCB-1260 (Aroclor 1260)	SW8082	UG/L	ND	[0.102]	ND	[0.1]	ND	[0.111]	ND	[0.108]	ND	[0.102]
Acenaphthene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	0.0882	
Acenaphthylene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Benzo(a)anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Benzo(a)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Benzo(b)fluoranthene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Benzo(g,h,i)perylene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Benzo(k)fluoranthene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Chrysene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Dibenzo(a,h)anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Fluoranthene	BNASIM	UG/L	ND	[0.1]	ND	[0.102]	ND	[0.4]	ND	[0.105]	ND	[0.1]
Fluorene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	0.42	
Indeno(1,2,3-cd)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]
Naphthalene	BNASIM	UG/L	0.03	F VB	0.259		0.0864	F VM	0.0833	VB	1.15	
Phenanthrene	BNASIM	UG/L	ND	[0.1]	ND	[0.102]	ND	[0.4]	ND	[0.105]	ND	[0.1]
Pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.051]	ND	[0.2]	ND	[0.0526]	ND	[0.05]

Cape Romanzof
LF03
Ground Water

		Location	CMW-05		CMW-06		CMW-06D		CMW-07		FIELDQC		FIELDQC	
		Sample Type	N		N		FD		N		TB		TB	
		Client Sample ID	04LF03CMW05GW		04LF03CMW06GW		04LF03CMW106GW		04LF03CMW7GW		04LF03TBSW		04SS13TB01GW	
		Matrix	WG		WG		WG		WG		WQ		WQ	
		Laboratory Report #	1043353		1043353		1043353		1043725		1043358		1045677	
Analyte	**Method**	**Units**												
Diesel Range Organics	AK102	MG/L	0.157	VB,VJ,VM	0.0853	VJ,VB,VM	0.184	VJ,VB,VM	ND	0.319] VM	-	-	-	-
Benzene	SW8021B	UG/L	0.195	F	0.24	F	0.532		ND	[0.5]	ND	[0.5]	ND	[0.5]
Ethylbenzene	SW8021B	UG/L	ND	[2]	ND	[2]	ND	[2]	ND	[2]	ND	[2]	ND	[2]
Toluene	SW8021B	UG/L	0.543	F	0.757	F	1.39	F	ND	[2]	ND	[2]	ND	[2]
m,p-Xylene (Sum of Isomers)	SW8021B	UG/L	0.56	F VB	0.669	F VB	1.47	F VB	ND	[2]	0.826	F	ND	[2]
o-Xylene	SW8021B	UG/L	ND	[2]	0.651	F	0.93	F	ND	[2]	ND	[2]	ND	[2]
PCB-1016 (Aroclor 1016)	SW8082	UG/L	ND	[0.1]	ND	[0.101]	ND	[0.1]	ND	[0.111]	-	-	-	-
PCB-1221 (Aroclor 1221)	SW8082	UG/L	ND	[0.1]	ND	[0.101]	ND	[0.1]	ND	[0.111]	-	-	-	-
PCB-1232 (Aroclor 1232)	SW8082	UG/L	ND	[0.1]	ND	[0.101]	ND	[0.1]	ND	[0.111]	-	-	-	-
PCB-1242 (Aroclor 1242)	SW8082	UG/L	ND	[0.1]	ND	[0.101]	ND	[0.1]	ND	[0.111]	-	-	-	-
PCB-1248 (Aroclor 1248)	SW8082	UG/L	ND	[0.1]	ND	[0.101]	ND	[0.1]	ND	[0.111]	-	-	-	-
PCB-1254 (Aroclor 1254)	SW8082	UG/L	ND	[0.1]	ND	[0.101]	ND	[0.1]	ND	[0.111]	-	-	-	-
PCB-1260 (Aroclor 1260)	SW8082	UG/L	ND	[0.1]	ND	[0.101]	ND	[0.1]	ND	[0.111]	-	-	-	-
Acenaphthene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Acenaphthylene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Benzo(a)anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Benzo(a)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Benzo(b)fluoranthene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Benzo(g,h,i)perylene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Benzo(k)fluoranthene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Chrysene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Dibenzo(a,h)anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Fluoranthene	BNASIM	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.1]	ND	[0.109]	-	-	-	-
Fluorene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Indeno(1,2,3-cd)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-
Naphthalene	BNASIM	UG/L	0.0163	F VB	ND	[0.05]	0.0162	F VB	0.101	VB	-	-	-	-
Phenanthrene	BNASIM	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.1]	ND	[0.109]	-	-	-	-
Pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.0543]	-	-	-	-

Cape Romanzof
LF03
Surface Water

		Location	SW-01		SW-01D		SW-02		SW-03		FIELDQC		FIELDQC	
		Sample Type	N		FD		N		N		TB		TB	
		Client Sample ID	04LF03SW01SW		04LF03SW101SW		04LF03SW02SW		04LF03SW03SW		04LF03TBSW		04SS13TB01GW	
		Matrix	WS		WS		WS		WS		WQ		WQ	
		Laboratory Report #	1043358		1043358		1043353		1043358		1043358		1045677	
Analyte	**Method**	**Units**												
Diesel Range Organics	AK102	MG/L	0.0708	F VJ,VB	0.0882	F VJ,VB	0.208	F VJ,VB	0.117	F VJ,VB	-	-	-	-
Benzene	SW8021B	UG/L	ND	[0.5]	ND	[0.5]	0.325	F	ND	[0.5]	ND	[0.5]	ND	[0.5]
Ethylbenzene	SW8021B	UG/L	ND	[2]	ND	[2]	ND	[2]	ND	[2]	ND	[2]	ND	[2]
Toluene	SW8021B	UG/L	ND	[2]	ND	[2]	0.824	F	ND	[2]	ND	[2]	ND	[2]
m,p-Xylene (Sum of Isomers)	SW8021B	UG/L	ND	[2]	ND	[2]	0.891	F	ND	[2]	0.826	F	ND	[2]
o-Xylene	SW8021B	UG/L	ND	[2]	ND	[2]	0.59	F	ND	[2]	ND	[2]	ND	[2]
PCB-1016 (Aroclor 1016)	SW8082	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.103]	ND	[0.11]	-	-	-	-
PCB-1221 (Aroclor 1221)	SW8082	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.103]	ND	[0.11]	-	-	-	-
PCB-1232 (Aroclor 1232)	SW8082	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.103]	ND	[0.11]	-	-	-	-
PCB-1242 (Aroclor 1242)	SW8082	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.103]	ND	[0.11]	-	-	-	-
PCB-1248 (Aroclor 1248)	SW8082	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.103]	ND	[0.11]	-	-	-	-
PCB-1254 (Aroclor 1254)	SW8082	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.103]	ND	[0.11]	-	-	-	-
PCB-1260 (Aroclor 1260)	SW8082	UG/L	ND	[0.1]	ND	[0.1]	79.7		ND	[0.11]	-	-	-	-
Acenaphthene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Acenaphthylene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Benzo(a)anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Benzo(a)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Benzo(b)fluoranthene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Benzo(g,h,i)perylene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Benzo(k)fluoranthene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Chrysene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Dibenzo(a,h)anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Fluoranthene	BNASIM	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.1]	ND	[0.1]	-	-	-	-
Fluorene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Indeno(1,2,3-cd)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-
Naphthalene	BNASIM	UG/L	ND	[0.05]	0.0153	F VB	ND	[0.05]	0.0154	F VB	-	-	-	-
Phenanthrene	BNASIM	UG/L	ND	[0.1]	ND	[0.1]	ND	[0.1]	ND	[0.1]	-	-	-	-
Pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0.05]	ND	[0.05]	-	-	-	-

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Cape Romanzof
LF03
Sediment

Analyte	Method	Units								
		Location	SD-01		SD-02		SD-03		FIELDQC	
		Sample Type	N		N		N		TB	
		Client Sample ID	04LF03SD01SD		04LF03SD02SD		04LF03SD03SD		04LF03TB01SD	
		Matrix	SE		SE		SE		SQ	
		Laboratory Report #	1043361		1043361		1043361		1043361	
Diesel Range Organics	AK102	MG/KG	42.7	F	154		29.6	F	-	-
Benzene	SW8021B	UG/KG	ND	[33.7]	ND	[12.6]	ND	[24]	ND	[12.1]
Ethylbenzene	SW8021B	UG/KG	ND	[135]	ND	[50.4]	ND	[96.1]	ND	[48.4]
Toluene	SW8021B	UG/KG	ND	[135]	ND	[50.4]	ND	[96.1]	ND	[48.4]
Isomers)	SW8021B	UG/KG	ND	[135]	ND	[50.4]	ND	[96.1]	22.4	F
o-Xylene	SW8021B	UG/KG	91.8	F	38.9	F	46.9	F	ND	[48.4]
PCB-1016 (Aroclor 1016)	SW8082	MG/KG	ND	[0.118]	ND	[0.067]	ND	[0.0815]	-	-
PCB-1221 (Aroclor 1221)	SW8082	MG/KG	ND	[0.118]	ND	[0.067]	ND	[0.0815]	-	-
PCB-1232 (Aroclor 1232)	SW8082	MG/KG	ND	[0.118]	ND	[0.067]	ND	[0.0815]	-	-
PCB-1242 (Aroclor 1242)	SW8082	MG/KG	ND	[0.118]	ND	[0.067]	ND	[0.0815]	-	-
PCB-1248 (Aroclor 1248)	SW8082	MG/KG	ND	[0.118]	ND	[0.067]	ND	[0.0815]	-	-
PCB-1254 (Aroclor 1254)	SW8082	MG/KG	ND	[0.118]	ND	[0.067]	ND	[0.0815]	-	-
PCB-1260 (Aroclor 1260)	SW8082	MG/KG	ND	[0.118]	153		ND	[0.0815]	-	-
Acenaphthene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Acenaphthylene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Anthracene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Benzo(a)anthracene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Benzo(a)pyrene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Benzo(b)fluoranthene	BNASIM	UG/KG	ND	[11.8]	16.2		ND	[8.14]	-	-
Benzo(g,h,i)perylene	BNASIM	UG/KG	ND	[11.8]	5	F	ND	[8.14]	-	-
Benzo(k)fluoranthene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Chrysene	BNASIM	UG/KG	ND	[11.8] VM	ND	[6.76] VM	ND	[8.14] VM	-	-
Dibenzo(a,h)anthracene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Fluoranthene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Fluorene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Indeno(1,2,3-cd)pyrene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Naphthalene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Phenanthrene	BNASIM	UG/KG	ND	[11.8]	ND	[6.76]	ND	[8.14]	-	-
Pyrene	BNASIM	UG/KG	ND	[11.8]	3.19	F	ND	[8.14]	-	-

Cape Romanzof
SS13 and SS15
Groundwater

Analyte	Method	Units								
		Client Sample ID	04SS13MW01GW		04SS13MW02GW		04SS15WW02GW		04SS15WW08GW	04SS15EBGW
		Location	MW-01		MW02		WW-02		WW08	EB
		Sample Type	N		N		N		N	N
		Matrix	WG		WG		WG		WG	WG
		Laboratory Report #	1043659		1045677		1043252		1045677	1045677
Gasoline Range Organics	AK101	UG/L	-	-	23.9	F VB	8380		21.2	F VB	102
Diesel Range Organics	AK102	MG/L	0.175	F	0.142	F VB	387	VJ	0.315	F VB	0 187
Residual Range Organics	AK103	MG/L	0.393	F	0.106	F	ND	[26.3]	0 223	F	0 0771
Benzene	SW8021B	UG/L	ND	[0 5]	ND	[0 5]	311		ND	[0 5]	7 42
Toluene	SW8021B	UG/L	ND	[2]	ND	[2]	39.2		ND	[2]	27 2
Ethylbenzene	SW8021B	UG/L	ND	[2]	ND	[2]	63		ND	[2]	1 96
m,p-Xylene (Sum of Isomers	SW8021B	UG/L	ND	[2]	ND	[2]	406		ND	[2]	7 12
o-Xylene	SW8021B	UG/L	ND	[2]	ND	[2]	51.1		ND	[2]	2 55
Alkalinity, Tota	A2320	MG/L	30		40		141		22		-
Sulfate	E300	MG/L	1 49		2 91	VJ	34.1		4 04	VJ	-
Nitrogen, Nitrate-Nitrite	E300	MG/L	ND	[1]	ND	[1]	ND	[0 1]	0 9	F	-
Iron	SW6010B	MG/L	ND	[0 2]	-	-	7 61		-	-	-
Iron	SW6020	UG/L	-	-	ND	[1000]	-	-	ND	[1000]	-
Acenaphthene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	24 6		ND	[0 0562]	ND
Acenaphthylene	BNASIM	UG/L	ND	[0.05]	ND	[0 05]	ND	[5]	ND	[0 0562]	ND
Anthracene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	1 17		ND	[0 0562]	ND
Benzo(a)anthracene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	0 631		ND	[0 0562]	ND
Benzo(a)pyrene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	0 434		ND	[0 0562]	ND
Benzo(b)fluoranthene	BNASIM	UG/L	ND	[0.05]	ND	[0 05]	0 438		ND	[0 0562]	ND
Benzo(g,h,i)perylene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	0 278		ND	[0 0562]	ND
Benzo(k)fluoranthene	BNASIM	UG/L	ND	[0 05]	ND	[0.05]	0 406		ND	[0.0562]	ND
Chrysene	BNASIM	UG/L	ND	[0 05]	ND	[0.05]	0 866		ND	[0 0562]	ND
Dibenzo(a,h)anthracene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	0.0756		ND	[0 0562]	ND
Fluoranthene	BNASIM	UG/L	ND	[0.1]	ND	[0.1]	2 46		ND	[0 112]	ND
Fluorene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	49 6		ND	[0 0562]	ND
Indeno(1,2,3-cd)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	0 213		ND	[0.0562]	ND
Naphthalene	BNASIM	UG/L	0 0706		ND	[0.05]	967		0.0509	F	0 384
Phenanthrene	BNASIM	UG/L	ND	[0.1]	ND	[0.1]	18 2		ND	[0 112]	ND
Pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	3.02		ND	[0 0562]	ND

Cape Romanzof
SS13 and SS15
Groundwater

		Client Sample ID		04SS13TB01GW		04SS13TBGW		04SS15TBGW	
		Location		FIELDQC		FIELDQC		FIELDQC	
		Sample Type		TB		TB		TB	
		Matrix		WQ		WQ		WQ	
		Laboratory Report #		1045677		1043659		1043252	
Analyte	**Method**	**Units**							
Gasoline Range Organics	AK101	UG/L		ND	[90]	-	-	13 9	F
Diesel Range Organics	AK102	MG/L	F VB	-	-	-	-	-	-
Residual Range Organics	AK103	MG/L	F	-	-	-	-	-	-
Benzene	SW8021B	UG/L		ND	[0 5]	ND	[0.5]	ND	[0 5]
Toluene	SW8021B	UG/L		ND	[2]	ND	[2]	ND	[2]
Ethylbenzene	SW8021B	UG/L	F	ND	[2]	ND	[2]	ND	[2]
m,p-Xylene (Sum of Isomers	SW8021B	UG/L		ND	[2]	ND	[2]	ND	[2]
o-Xylene	SW8021B	UG/L		ND	[2]	ND	[2]	ND	[2]
Alkalinity, Tota	A2320	MG/L	-	-	-	-	-	-	-
Sulfate	E300	MG/L	-	-	-	-	-	-	-
Nitrogen, Nitrate-Nitrite	E300	MG/L	-	-	-	-	-	-	-
Iron	SW6010B	MG/L	-	-	-	-	-	-	-
Iron	SW6020	UG/L	-	-	-	-	-	-	-
Acenaphthene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-
Acenaphthylene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-
Anthracene	BNASIM	UG/L	[0.0568]	-	-	-	-	-	-
Benzo(a)anthracene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-
Benzo(a)pyrene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-
Benzo(b)fluoranthene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-
Benzo(g,h,i)perylene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-
Benzo(k)fluoranthene	BNASIM	UG/L	[0.0568]	-	-	-	-	-	-
Chrysene	BNASIM	UG/L	[0.0568]	-	-	-	-	-	-
Dibenzo(a,h)anthracene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-
Fluoranthene	BNASIM	UG/L	[0 114]	-	-	-	-	-	-
Fluorene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-
Indeno(1,2,3-cd)pyrene	BNASIM	UG/L	[0.0568]	-	-	-	-	-	-
Naphthalene	BNASIM	UG/L		-	-	-	-	-	-
Phenanthrene	BNASIM	UG/L	[0.114]	-	-	-	-	-	-
Pyrene	BNASIM	UG/L	[0 0568]	-	-	-	-	-	-

Cape Romanzof
SS13 and SS15
Surface Soil and Sediment

		Client Sample ID	04SS13LB03SS		04SS13LB07SS		04SS13LB08SS		04SS13SS01SD		04SS13SS06SD		04SS13SS101SD		04SS13TBSS	
		Sample Type	N		N		N		N		N		FD		TB	
		Laboratory Report #	1043258		1043258		1043258		1043258		1043258		1043258		1043258	
		Matrix	SO		SO		SO		SE		SE		SE		SQ	
Analyte	**Method**	**Units**														
Diesel Range Organics	AK102	MG/KG	411		4390	VJ	48500	VJ	998	VJ	1680		1290		-	-
Residual Range Organics	AK103	MG/KG	1140		5160	VJ	51600	VJ	1060	VJ,VM	743	VM	834	VM,VJ	-	-
Benzene	B	UG/KG	ND	[57.4]	ND	[37.1]	ND	[45.7]	ND	[16.5]	ND	[13.6]	ND	[19.5]	ND	[12.5]
Toluene	B	UG/KG	ND	[230]	ND	[149]	ND	[183]	ND	[65.9]	ND	[54.5]	ND	[77.8]	ND	[50.2]
Ethylbenzene	B	UG/KG	ND	[230]	ND	[149]	ND	[183]	ND	[65.9]	ND	[54.5]	ND	[77.8]	ND	[50.2]
o-Xylene	B	UG/KG	ND	[230]	ND	[149]	ND	[183]	21.4	F	ND	[54.5]	83.7		ND	[50.2]
Isomers)	B	UG/KG	ND	[230]	ND	[149]	ND	[183]	35.5	F VB	ND	[54.5]	61.5	F VB	ND	[50.2]
Acenaphthene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Acenaphthylene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Anthracene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Benzo(a)anthracene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	149	F	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Benzo(a)pyrene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Benzo(b)fluoranthene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Benzo(g,h,i)perylene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Benzo(k)fluoranthene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Chrysene	BNASIM	UG/KG	ND	[56.7]	29.2	F	532		ND	[35.9]	3.72	F	ND	[37.2]	-	-
Dibenzo(a,h)anthracene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Fluoranthene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	457		ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Fluorene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	32.3	F	ND	[7.62]	30.6	F	-	-
Indeno(1,2,3-cd)pyrene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Naphthalene	BNASIM	UG/KG	ND	[56.7]	12.8	F	ND	[434]	ND	[35.9]	ND	[7.62]	ND	[37.2]	-	-
Phenanthrene	BNASIM	UG/KG	ND	[56.7]	ND	[38.6]	ND	[434]	ND	[35.9]	ND	[7.62]	11.8	F	-	-
Pyrene	BNASIM	UG/KG	ND	[56.7]	37.6	F	584		ND	[35.9]	4.42	F	ND	[37.2]	-	-

Cape Romanzof
SS13 and SS15
Surface Water

		Client Sample ID	04SS13SW01SW		04SS13SW02SW		04SS13SW03SW		04SS13SW101SW		04SS13TBSW	
		Sample Type	N		N		N		FD		TB	
		Laboratory Report #	1043273		1043273		1043273		1043273		1043273	
		Matrix	WS		WS		WS		WS		WQ	
		Location	SW-01		SW-02		SW-03		SW-01D		FIELDQC	
Analyte	**Method**	**Units**										
Diesel Range Organics	AK102	MG/L	0.0637	F VB,VM	0.0653	F VB,VM	0 0917	F VB,VM	ND	0 326] VM	-	-
Residual Range Organics	AK103	MG/L	0 0969	F VM	0.139	F VM	0 363	F VM	0.0678	F VM	-	-
Benzene	E624	UG/L	ND	[0 4]	ND	[0 4]	ND	[0.4]	ND	[0 4]	ND	[0.4]
Toluene	E624	UG/L	ND	[1]	ND	[1]	ND	[1]	ND	[1]	ND	[1]
Ethylbenzene	E624	UG/L	ND	[1]	ND	[1]	ND	[1]	ND	[1]	ND	[1]
o-Xylene	E624	UG/L	ND	[1]	ND	[1]	ND	[1]	ND	[1]	ND	[1]
m,p-Xylene (Sum of Isomers	E624	UG/L	ND	[2]	ND	[2]	ND	[2]	ND	[2]	ND	[2]
1,2-Dichlorobenzene	E624	UG/L	ND	[1]	ND	[1]	ND	[1]	ND	[1]	ND	[1]
1,3-Dichlorobenzene	E624	UG/L	ND	[1]	ND	[1]	ND	[1]	ND	[1]	ND	[1]
1,4-Dichlorobenzene	E624	UG/L	ND	[0 5]	ND	[0 5]	ND	[0.5]	ND	[0 5]	ND	[0 5]
Chlorobenzene	E624	UG/L	ND	[0.5]	ND	[0 5]	ND	[0 5]	ND	[0 5]	ND	[0 5]
Acenaphthene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
Acenaphthylene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0 0549]	ND	[0.0556]	-	-
Anthracene	BNASIM	UG/L	ND	[0 05]	ND	[0.05]	ND	[0.0549]	ND	[0 0556]	-	-
Benzo(a)anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
Benzo(a)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
Benzo(b)fluoranthene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
Benzo(g,h,i)perylene	BNASIM	UG/L	ND	[0.05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
Benzo(k)fluoranthene	BNASIM	UG/L	ND	[0.05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
Chrysene	BNASIM	UG/L	ND	[0.05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
Dibenzo(a,h)anthracene	BNASIM	UG/L	ND	[0.05]	ND	[0.05]	ND	[0 0549]	ND	[0 0556]	-	-
Fluoranthene	BNASIM	UG/L	ND	[0 1]	ND	[0.1]	ND	[0.11]	ND	[0 111]	-	-
Fluorene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	ND	[0.0549]	ND	[0.0556]	-	-
Indeno(1,2,3-cd)pyrene	BNASIM	UG/L	ND	[0.05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
Naphthalene	BNASIM	UG/L	ND	[0.05]	0 115		0 0312	F	0.0171	F	-	-
Phenanthrene	BNASIM	UG/L	ND	[0.1]	ND	[0 1]	ND	[0.11]	ND	[0 111]	-	-
Pyrene	BNASIM	UG/L	ND	[0 05]	ND	[0 05]	ND	[0 0549]	ND	[0 0556]	-	-
TAH	NA	UG/L	ND		ND		ND		ND		ND	
TAqH	NA	UG/L	ND		0 115		ND		ND			

Appendix F

Complete Analytical Data Package

(Electronic Copy Only)

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FINAL PAGE

ADMINISTRATIVE RECORD

FINAL PAGE